HANDBOOK
of
CHEMISTRY
and
PHYSICS

FORTIETH
EDITION

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HANDBOOK

OF

CHEMISTRY AND PHYSICS

A READY-REFERENCE BOOK OF CHEMICAL AND PHYSICAL DATA

FORTIETH EDITION

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PREFACE

The Handbook of Chemistry and Physics, continuing the policy of the past, is being revised at frequent intervals.

The general features and scheme of arrangement, which have received extensive endorsement in former editions have been retained. The aim throughout has been to present in condensed form as large an amount of accurate, reliable and up-to-date information in the fields of chemistry and physics as was consistent with convenience in form and the possibility of wide utility and distribution. A very large proportion of the tables have been compiled especially for the Handbook from various authoritative collections of data and from the current journals.

Since the beginning special consideration has been given to the requests and suggestions of those who have used former editions. In this way it has been hoped to develop the book along lines most acceptable to those interested in a volume of this type. Suggestions and contributions are received each year from many eminent chemists and physicists including members of the teaching profession and those engaged in industrial work. We believe this coöperation to have been of very great value in the growth and development of the work.

An attempt has been made to include material on all branches of chemistry and physics and the closely allied sciences, which would be likely to find any extended use. On the other hand, in order to retain the convenience of moderate dimensions and at the same time allow for natural growth due to the extension of knowledge in these sciences, and logical additions along lines already developed, it has seemed necessary to exclude types of material of use only in certain highly specialized lines of work.

Chemistry and physics, always closely related sciences, have been brought into much more intimate relations by the more recent developments of research. To an increasing extent the student of either science should have a knowledge of the other. It would seem that there should be a large field for a single volume containing the constants and formulæ of the two sciences together with mathematical and conversion tables adequate for accurate computation. The generous response which the previous editions have met indicates that the volumes have been found useful and it is with the hope of even more completely meeting the needs of the chemists and physicists of the English speaking world that succeeding editions are offered.

CHARLES D. HODGMAN

PREFACE TO THE FORTIETH EDITION

The question of the information to be included in any book which is revised annually is a difficult one. All editors attempt to strike a balance between information useful to the areas that the book is most likely to serve. This policy serves the purpose of keeping the book up-to-date and in providing students and research personnel with data and information in one book rather than in widely separated books, reference works, industrial libraries, and government publications.

In continuing the practice of collecting information of use to physicists and chemists there have been added to our book for the Fortieth Edition the following tables:

Electron Physics Tables
Physical Constants of the Rare Earth Compounds
Physical Constants of Inorganic Hydrides
Thermal Conductivity of Oven-dry Wood Across the Grain
Thermal Conductivity of Wood Across the Grain at Various Moisture Content Values
Thermodynamic Properties of the Elements
Thermodynamic Properties of the Oxides
Langevin Functions
Superconducting Transition Temperatures, Magnetic Threshold Fields at Absolute Zero, Electronic Constants and DeBye Temperatures for Superconducting Elements
Chelating Agents
Ion Exchange Resins.

There has, in addition, been a revision of certain areas of the book. In particular the following information and tables have been revised:

The section of Definitions and Formulas
Physical Constants of Ozone and Oxygen
Viscosity of Aqueous Glycerol Solutions
Trade Names of Commercial Resins and Plastics
Properties of Plastics
Inclusion of new element No. 102—Nobelium—in the section Description of the Elements, in the Atomic Weights, and the Table of Isotopes.

Obviously it is not possible to add an unlimited amount of information each year. Nevertheless, the editors continue to welcome suggestions for new material to be placed in the Handbook of Chemistry and Physics. Such suggestions are not only helpful but are necessary if the book is to continue to serve the specialists who are working in significant fields but who are outside of the generalized knowledge of most scientists.

As in the past the editors are grateful to those who have assisted us with the present revision.

Cleveland, Ohio,
July 15, 1958.

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ANTIDOTES OF POISONS

Acetic Acid.—Emetics, magnesia, chalk, soap, oil.

Acetylene.—Same as for carbon monoxide.

Arsenic, Rat Poison, Paris Green.—Milk, raw egg, sweet oil, lime water, flour and water.

Carbolic Acid.—Any soluble non-toxic sulphate, after provoking vomiting with zinc sulphate; uncooked white of egg in abundance, milk of lime, saccharate of calcium, olive or castor oil with magnesia in suspension, ice, washing the stomach with equal parts water and vinegar; give alcohol or whiskey or about four fluid ounces camphorated oil at one dose.

Carbon Monoxide.—Remove to fresh air immediately and call for pulmotor; apply artificial respiration for at least one hour or until the pulmotor arrives. Administration of oxygen containing 5% of carbon dioxide is beneficial; inhalation of ammonia or amyl nitrite is often of value.

Chloroform, Chloral, Ether.—Dash cold water on head and chest, artificial respiration.

Ethylene.—Same as for carbon monoxide.

Gas (illuminating).—Same as for carbon monoxide.

Hydrochloric Acid.—Magnesia, alkali carbonates, albumen, ice.

Hydrocyanic or Prussic Acid.—Hydrogen peroxide internally, and artificial respiration, breathing ammonia or chlorine from chlorinated lime, ferrous sulphate followed by potassium carbonate, emetics, warmth.

Iodine.—Emetics, stomach siphon, starchy foods in abundance, sodium thiosulphate.

Lead Acetate.—Emetics, stomach siphon, sodium, potassium or magnesium sulphates, milk, albumen.

Mercuric Chloride or Corrosive Sublimate.—Zinc sulphate, emetics, stomach siphon, white of egg, milk, chalk, castor oil, table salt, reduced iron.

Nitrate of Silver.—Salt and water.

Nitric Acid.—Same as for hydrochloric acid.

Opium, Morphine, Laudanum, Paregoric, etc.—Strong coffee, hot bath. Keep awake and moving at any cost.

Phosphoric Acid.—Same as for hydrochloric.

ANTIDOTES OF POISONS (Continued)

Sodium Hydroxide or Potassium Hydroxide.—Vinegar, lemon juice, orange juice, oil, milk.

Sulfuric Acid.—Same as for hydrochloric acid with the addition of soap or oil.

Sulfurous Acid or Sulfur Dioxide.—Mustard plaster on chest; narcotics, expectorants.

Wood Alcohol (Methyl Alcohol or Methanol).—Emetic or wash out stomach (stomach tube) with a solution of 10 grains sodium citrate per ounce of water. Give milk, white of egg or flour in water; purgative of magnesium sulfate (15 grams); stimulate and combat collapse. In case of cardiac or pulmonary failure use artificial respiration. Physicians may administer atropine, digitalin or strychnine as stimulants; to cause perspiration and elimination of the poison use 0.1 grain of pilocarpine hydrochloride.

BURNS AND SCALDS

Exclude air by thin paste of starch, flour, or baking soda. Ordinary oils such as Vaseline petroleum jelly, olive or castor oil, lard or cream may also be used except for phosphorus burns. Lime water mixed with an equal part of raw linseed oil makes an excellent dressing. An especially valuable material for all burns is picric acid gauze which may be applied in the form of a compress.

After treatment with any of the above materials, cover with a cloth or with cotton and hold in place with a light bandage.

Apply a freshly prepared 5% tannic acid solution. Place several layers of sterile gauze over the burned area, saturate with the tannic acid solution and bandage loosely.

CHEMICAL BURNS

With either, wash off as quickly as possible with a large quantity of water. Water from a tap may be allowed to flow over burns.

Acids

While the injury is being washed, have procured lime water or lime water and raw linseed oil mixed together in equal proportions or a mixture of baking soda and water or soap suds and apply freely. For acid in the eye wash as quickly as possible with water and then with lime water.

Alkalis

Wash with a large quantity of water as for acid burns. Neutralize with weak vinegar, hard cider or lemon juice. For lime or other strong alkali burns in the eye wash with weak solution of vinegar or with olive oil or a saturated solution of boric acid.

Bromine.—Sponge immediately with a strong solution of sodium thiosulfate until all the bromine color is gone, then wash off the mildly poisonous sodium thiosulfate with plenty of water.

FIRE PRECAUTIONS AND CHEMICAL HAZARDS

Acetone.—Dilute with a spray of water to avoid spread of burning liquid. Use suitable gas mask.

Alcohol.—See under acetone.

Ammonia.—Use water and dilute acid. Use suitable gas mask.

Benzol or Benzene.—Use water to cool containers which are endangered; extinguish flame with sand, earth, fire-foam or carbon tetrachloride fire extinguishers. Use suitable gas mask.

Calcium Carbide.—Do not use water as this generates acetylene, an inflammable and explosive gas; cut off electric current to avoid ignition of gas. Remove containers to a dry place. Use gas mask.

Carbon Disulfide.—Use water to cool containers which are endangered; extinguish blaze with sand, earth, fire-foam or carbon tetrachloride fire extinguishers. Use suitable gas mask.

Carbon Tetrachloride.—When a carbon tetrachloride type extinguisher is used on a fire in a confined space, the fire should be attacked from outside the enclosure, if possible, or the area should be vacated immediately after the fire is out. No one should return to the enclosure until the air is cleared of smoke and fumes. These precautions should be observed regardless of the means by which the fire is extinguished, however, since fire in a confined space rapidly produces a toxic atmosphere.

Do not put carbon tetrachloride on a sodium fire, violent explosions may be caused.

Celluloid.—Use large volumes of water and sand. The smoke contains oxides of nitrogen which are injurious. Use suitable gas mask.

Chlorine.—Spray with water. The pungent nature of the gas makes the use of a gas mask imperative.

Collodion.—See under carbon disulfide.

Ether.—See under carbon disulfide.

Gasoline.—See under carbon disulfide.

Hydrochloric Acid.—Use large volumes of water also chalk or soda. Use gas mask.

Hydrocyanic or Prussic Acid.—Suitable gas mask is essential because of the extremely poisonous nature of the vapors. Provide ventilation.

Lacquer Solvents.—See under carbon disulfide.

Magnesium.—Do not use water. Use sand or earth to extinguish flames. Remove containers to a dry place.

Nitric Acid and Oxides of Nitrogen.—Use large volumes of water. Do not use sand or earth. Use gas mask.

Potassium.—Do not use water. Remove containers to a dry place. Extinguish flames with sand or earth. For storage, potassium is kept immersed in petroleum.

Potassium Hydroxide.—Use large volumes of water or dilute acids.

Phosphorus.—Use water and wet sand. Use gas mask. For storage, white phosphorus must be kept immersed in water. Red phosphorus is less dangerous.

Sodium.—See under potassium.

Sodium Hydroxide.—See under potassium hydroxide.

Sulfur.—Extinguish with water or sand. Use gas mask.

Sulfuric Acid.—See under hydrochloric acid.

Turpentine.—See under acetone.

MATHEMATICAL TABLES

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USE OF MATHEMATICAL TABLES

For a complete discussion of the principles and use of mathematical tables, textbooks on the subject should be consulted. The following brief statements are intended to give only sufficient information to make possible the intelligent use of the tables, omitting for the most part any attempt at treating the theory and principles.

Exponential Method of Expressing Numbers—For convenience in writing and manipulation, numbers are often expressed as factors of appropriate powers of 10. The following examples will illustrate:

2,380,000,000. may be written 2.38×10^9
238. may be written 2.38×10^2
.238 may be written 2.38×10^{-1}
.000000238 may be written 2.38×10^{-7}

Logarithms—The logarithm of a number is the exponent of that power to which another number, the base, must be raised to give the number first named. Any positive number greater than 1 might serve as a base. Two have been selected, yielding two systems of logarithms. One base, 2.718 . . . . usually indicated by the letter e, gives rise to a system of logarithms convenient in higher mathematics. These are called natural, Napierian, or hyperbolic logarithms. Reference will be made to their use in a subsequent paragraph.

The other base used is 10, giving logarithms particularly adapted to use in computation, called common or Briggian logarithms. Tables of logarithms given without designation are invariably of this latter type.

Since most numbers are incommensurable powers of ten, a common logarithm, in general, consists of an integer which is called the characteristic and an endless decimal, the mantissa.

It is to be observed that the common logarithms of all numbers expressed by the same figures in the same order with the decimal point in different positions have different characteristics but the same mantissa. To illustrate:—if the decimal point stand after the first figure of a number, counting from the left, the characteristic is 0; if after two figures, it is 1; if after three figures, it is 2, and so forth. If the decimal point stand before the first significant figure the characteristic is -1, usually written $\bar{1}$; if there is one zero between the decimal point and the first significant figure it is 2 and so on. For example: $\log 256 = 2.40824$, $\log 2.56 = 0.40824$, $\log 0.256 = \bar{1}.40824$, $\log 0.00256 = \bar{3}.40824$. The two latter are often written $\log 0.256 = 9.40824 - 10$, $\log 0.00256 = 7.40824 - 10$.

A method of determining characteristics of logarithms is to write the number with one figure to the left of the decimal point multiplied by the appropriate power of 10. The characteristic is then the exponent used. For example:

$$256{,}000{,}000 = 2.56 \times 10^8 \quad \log = 8.40824$$
$$0.000000256 = 2.56 \times 10^{-7} \quad \log = \overline{7}.40824 \text{ or } 3.40824-10$$

Inasmuch as the characteristic may be determined by inspection the mantissas only are given in tables of common logarithms.

To find the logarithm of a number:

For a number of four figures, take out the tabular mantissa on a line with the first three figures of the number and under its fourth figure. The characteristic is determined as previously explained.

For a number of less than four figures, supply zeros to make a four figure number and take the value of the mantissa from the tables as before. For example: $\log 2 = \log 2.000 = 0.30103$.

For a number of more than four figures, take the tabular value of the mantissa for the first four figures; find the difference between this mantissa and the next greater tabular mantissa and multiply the difference so found by the remaining figures of the number as a decimal and add the product to the mantissa of the first four figures. For example: to find log 46.762.

$$\log 46.76 = 1.66987$$

Tabular difference between this mantissa and that for 4677 is .00010.

$$\begin{aligned} \therefore \log 46.762 &= 1.66987 + .2 \times .00010 \\ &= 1.66987 + .00002 \\ &= 1.66989 \end{aligned}$$

To find the number corresponding to a given logarithm:

If the mantissa is found exactly in the table, join the figure at the top which is directly above the given mantissa to the three figures on the line at the left and place the decimal point according to the characteristic of the logarithm. For example, $\log^{-1}$ (antilogarithm) $3.39967 = 2510$.

If the mantissa is not found exactly in the table it is necessary to interpolate. For example, $\log^{-1} 3.40028 = 2513. + {}^{9}/_{18} = 2513.5$.

The column of proportional parts at the right of each page of the table shows, under the heading of the various tabular differences, the parts of these differences which correspond to the digits from 1 to 9 in the fifth place. This makes it possible to take out a logarithm for a five figure number or to find an antilogarithm of the same number of significant figures with increased facility, usually by inspection.

USE OF MATHEMATICAL TABLES (Continued)

The following formulae express the relations on which the use of logarithms is based:

$$\begin{aligned} \log ab &= \log a + \log b \\ \log \frac{a}{b} &= \log a - \log b \\ \log a^n &= n \times \log a \\ \log \sqrt[n]{a} &= \frac{\log a}{n}. \end{aligned}$$

The following examples will serve as illustrations:

1. $52600 \times 0.00381 \times 2.74 = 549.1$

$$\begin{aligned} \log 52600 &= 4.72099 \\ \log 0.00381 &= \bar{3}.58092 \\ \log 2.74 &= 0.43775 \\ \hline \text{Sum:} \quad &= 2.73966 \\ \text{Antilogarithm} &= 549.1 \end{aligned}$$

The sum is the logarithm of the product, the mantissa of which is 73966. On looking up this mantissa in the logarithm tables we see that it corresponds to the digits 5491. The characteristic is 2, hence there are three figures before the decimal point. The number corresponding to the logarithm, called the antilogarithm, is 549.1.

2. $0.00123 \div 52.7 = 0.00002334$

$$\begin{aligned} \log 0.00123 &= \bar{3}.08991 \\ \log \quad 52.7 &= 1.72181 \\ \hline \text{Subtracting} \quad & \bar{5}.36810 \\ \text{Antilog} \quad & 0.00002334 \end{aligned}$$

An Alternative method:

$$\begin{aligned} \log 0.00123 &= 7.08991 - 10 \\ \log \quad 52.7 &= 1.72181 \\ \hline & 5.36810 - 10 \end{aligned}$$

The characteristic $\bar{5}$ (5. -10) shows four zeros after the decimal point before the first significant figure.

3. $\dfrac{273 \times 780}{292 \times 760} \times 15 \times 0.09 = 1.295$

$$\begin{aligned} \log \ 273 &= 2.43616 \\ \log \ 780 &= 2.89209 \\ \log \ \ 15 &= 1.17609 \\ \log 0.09 &= \bar{2}.95424 \\ \hline \log \text{sum} &= 5.45858 \end{aligned}$$

$$\begin{aligned} \log 292 &= 2.46538 \\ \log 760 &= 2.88081 \\ \hline \log \text{denominator} &= 5.34619 \end{aligned}$$

$$\begin{aligned} \log \text{numerator} &= 5.45858 \\ \log \text{denominator} &= 5.34619 \\ \hline \text{subtracting} &= 0.11239 \\ \text{antilogarithm} &= 1.295 \end{aligned}$$

USE OF MATHEMATICAL TABLES (Continued)

As division may be accomplished by multiplying by the reciprocal of a number, the above may be considerably simplified. The logarithm of the reciprocal of a number, called the cologarithm, is readily obtained from the table by subtracting the logarithm of the number from zero. This may readily be read off from the table of mantissas. Change the sign of the characteristic algebraically adding to it −1, then mentally subtract each figure of the mantissa from 9 proceeding from left to right, the last figure being subtracted from 10. The example then is:

$$\begin{array}{lcl}
\log\ 273 & = & 2.43616 \\
\log\ 780 & = & 2.89209 \\
\log\ 15 & = & 1.17609 \\
\log\ 0.09 & = & \bar{2}.95424 \\
\text{colog}\ 292 & = & \bar{3}.53462 \\
\text{colog}\ 760 & = & \bar{3}.11919 \\
\hline
 & & 0.11239
\end{array}$$

4. $(0.00098)^4 = 9.224 \times 10^{-13}$

$$\begin{array}{lcl}
\log 0.00098 & = & \bar{4}.99123 \\
 & & 4 \\
\hline
 & & 3.96492\text{(a)} \\
\bar{4} \times 4 & & \overline{16}.\quad\text{(b)} \\
\hline
\log (0.00098)^4 & = & \overline{13}.96492\text{(c)} \\
\text{antilog} = 9.224 \times 10^{-13} & &
\end{array}$$

An alternative method:

$$\begin{array}{lcr}
\log 0.00098 & = & 6.99123-10 \\
 & & 4 \\
\hline
 & & 27.96492-40 \\
 & & \text{or } 7.96492-20 \\
 & & \text{or } \overline{13}.96492 \\
\text{antilog} & = & 9.224 \times 10^{-13}
\end{array}$$

In the above it will be noted that the mantissa is always positive hence the multiplication of the mantissa shown at (a) while (b) shows the multiplication of the characteristic. (c) is the algebraic sum.

5. $\sqrt[5]{492} = 3.455$
$\log 492 = 2.69197$

Dividing the logarithm by 5 gives as the logarithm of the root 0.53839 the antilogarithm of which is 3.455 both characteristic and mantissa being positive. When the characteristic is negative and not evenly divisible by the root to be taken a modification of the logarithm is necessary.

6. $\sqrt[3]{0.000372} =$

$$\begin{array}{lcll}
\log 3.72 \times 10^{-4} & = & \bar{4}.57054 & \text{(a)} \\
 & = & 26.57054-30 & \text{(b)}
\end{array}$$

dividing (b) by 3 gives 8.85685−10 which may be written

$\bar{2}.85685$ and is the logarithm of the root sought, the antilogarithm of which is 0.07192.

7. $0.000372^{1.2} = 0.000076674$

log 0.000372 $= \bar{4}.57054$

or $6.57054 - 10$

1.2

$7.88465 - 12$

antilogarithm 0.000076674

8. $(0.000372)^{-1.32} = 33642$

colog 0.000372 $= 3.42946$

1.32

4.52689

antilogarithm 33642

Four-Place Logarithms—This short table on two facing pages makes possible logarithmic computation precise to four significant figures, (three without interpolation). The mantissa is given complete and the proportional parts indicated for each line.

Four-Place Antilogarithms—Some computers prefer to use separate tables for determining antilogarithms; the table being entered from the margins with the logarithm and the number being found in the body of the table. Such a table is given to accompany the four-place logarithms.

Five-Place Logarithms—For computation involving five significant figures, (four without interpolation) the five-place table will be adequate. Since the first two figures will be the same for several lines of the table they are given in the first line only. The point at which these first two figures change is indicated by an asterisk. While space does not permit the proportional parts for each line, tables will be found for each tabular difference.

The supplementary table following the five-place logarithms, giving seven-place logarithms for numbers of five significant figures from 10,000 to 12,000 will be found convenient to increase precision and avoid the inconvenience of interpolation where the differences are large.

Logarithms of the Trigonometric Functions—Logarithms of the functions are given for each minute from 0-360°.

The quantity − 10 is to be appended to all logarithms of the sine and cosine, to logarithms of the tangent from 0-45° and of the cotangent from 45-90°.

With degrees indicated at either side of the top of the page use the column headings at the top. With degrees stated at the bottom of the page use the column designations at the bottom.

With degrees at the left (top or bottom) use the minute column at the left, and with degrees on the right side of the page use the minute column at the right.

USE OF MATHEMATICAL TABLES (Continued)

To illustrate the proper employment of headings for angles in the four quadrants—

$\log\sin 6^\circ 24' = 9.04715-10$ $\log\sin 186^\circ 24' = 9.04715-10$
$\log\sin 83^\circ 15' = 9.99698-10$ $\log\sin 263^\circ 15' = 9.99698-10$
$\log\cos 96^\circ 41' = 9.06589-10$ $\log\cos 276^\circ 41' = 9.06589-10$
$\log\cos 173^\circ 49' = 9.99747-10$ $\log\cos 353^\circ 49' = 9.99747-10$

For the accurate determination of values where the tabular differences are large, the values of CS and CT are given. The following equations indicate their use.

To find the logarithm of the functions of an angle:

For angles 0–3°
$\log\sin\theta = \log\theta'' - CS$
$\log\tan\theta = \log\theta'' - CT$
$\log\cot\theta = \operatorname{colog}\tan\theta$

For angles 87–90°
$\log\cos\theta = \log(90^\circ-\theta)'' - CS$
$\log\cot\theta = \log(90^\circ-\theta)'' - CT$
$\log\tan\theta = \operatorname{colog}\cot\theta$

To find the angle:

For angles 0–3°
$\log\theta'' = \log\sin\theta + CS$
$\log\theta'' = \log\tan\theta + CT$

For angles 87–90°
$\log(90^\circ-\theta)'' = \log\cos\theta + CS$
$\log(90^\circ-\theta)'' = \log\cot\theta + CT$

In the above expressions, θ'' and $(90^\circ-\theta)''$ are used to indicate the value of the angles expressed in seconds. The values in the body of the table are the cologarithms and should be used as indicated above.

The values of the logarithms S and T are also given in a separate table. For these the following relations hold:

To find the functions of an angle.

$\log\sin\theta = \log\theta'' + S$ $\log\cos\theta = \log(90^\circ-\theta)'' + S$
$\log\tan\theta = \log\theta'' + T$ $\log\cot\theta = \log(90^\circ-\theta)'' + T$

To find the angle.

$\log\theta'' = \log\sin\theta - S$ $\log(90^\circ-\theta)'' = \log\cos\theta - S$
$\log\theta'' = \log\tan\theta - T$ $\log(90^\circ-\theta)'' = \log\cot\theta - T$

Where the values of CS and CT are given, the angles expressed in seconds are given in the supplementary column at the left.

The tabular differences are given under the headings "d" and "c.d.", the latter referring to the common difference for the tangent and cotangent. Tables of proportional parts ("P.P.") facilitate interpolation. At the bottom of each column will be found special proportional parts between the tabular differences for the tangent or cotangent and those for the sine or cosine. These are useful when one function is to be obtained directly from the other without determining the angle.

For example, suppose log tan θ is given as 9.67644 and log cos θ is required. The difference between the given logarithm and that given in the table, 9.67622 (opposite 25° 23′), is 22.

USE OF MATHEMATICAL TABLES (Continued)

The tabular differences of the two logarithmic functions at this place are 32 and 6. In the proportional table for $\frac{6}{32}$, 22 corresponds to 4; this, subtracted from the tabular logarithmic cosine 9.95591, gives the required log cos $\theta = 9.95587$.

The symbols $\bar{5}$ and $\dot{5}$ are used to indicate how the terminal 5 has been derived. For example, the logarithm 8.83075 is more fully given as 8.8307495 while the value $9.4082\dot{5}$ is derived from 9.4082539. Thus, in rounding off to four places, a number ending in $\bar{5}$ should be decreased but a number ending in $\dot{5}$ should be increased.

Natural Trigonometric Functions—Values of the natural trigonometric functions of angles are given for each minute from 0–360°.

For degrees indicated at the top of the page use the column headings at the top. For degrees indicated at the bottom use the column indications at the bottom.

With degrees at the left of each block (top or bottom), use the minute column at the left and with degrees at the right of each block use the minute column at the right.

Natural Functions and their Logarithms are given for angles in degrees and tenths from 0 to 90 degrees.

Natural Functions and their Logarithms are given for angles in radians and hundredths, from 0 to 2 radians.

Haversines—Values of $(1 - \cos\theta)/2$ for angles between 0 and 180° are given to four significant figures. The four-place mantissas of the logarithms of the haversines are also given. The correct characteristic must be provided in each case.

The listed values of the haversines were derived from values which were computed to seven significant figures. The logarithms were independently derived from the more exact values of the haversines and are, therefore, in many cases not the exact value of the logarithm of the haversine as listed. This is notably true at the beginning of the table where the logarithm can be given with more exactness than the function.

Natural Logarithms—The natural logarithms of numbers from 0.000 to 999. are given in a group of four tables. The method of finding logarithms of numbers not included in the tables is indicated at the beginning of the third page. A convenient table of constants occurs at the top of the fourth page.

The first page gives the natural logarithms of numbers from 0.000 to 0.499. Since the characteristics change rapidly for the smaller numbers, they are indicated *above* the mantissa in the first line. In the second and following lines the characteristics are given at the left only. For example, $\log_e 0.004 = -5.52146$; $\log_e 0.014 = -4.26870$.

The succeeding pages give the natural logarithms of numbers up to 999.

USE OF MATHEMATICAL TABLES (Continued)

Exponential Functions—Values of e^x, log e^x and e^{-x} where e is the base of the natural system of logarithms 2.71828 . . . and x has values from 0 to 10. Facilitating the solution of exponential equations, these tables also serve as a table of natural or Naperian antilogarithms. For instance if the logarithm or exponent $x = 3.26$ the corresponding number or value of e^x is 26.050. Its reciprocal e^{-x} is .038388.

Hyperbolic Functions—The table gives the values and logarithms of the hyperbolic sine x, cosine x, tangent x and cotangent x for values of x from 0 to 10.

Degrees-Radians—This table gives the value in radians to five significant figures; for each 10 minutes from $0° \, 0'$ to $90° \, 0'$; for each degree from 90 to 180; for each 10 degrees from 180 to 480. Values are also given for each minute from 0–60′ and for each second from 0–60″.

Tables are also provided to facilitate changing from degrees and decimal fractions to radians, from decimal fractions of a degree to minutes and seconds and the reverse operations.

Numerical Tables—The first section gives the reciprocals of numbers from 0 to 1000 and circumferences and areas of circles with diameters having these values. Reciprocals and circumferences for values not listed can be obtained by an appropriate shift of the decimal point.

The second section is devoted to squares, cubes and roots. The squares and cubes from 1 to 1000 are given exactly. The roots are given to seven significant figures. Since the square roots of $10n$ are given, values of the square roots from 1 to 10,000 may be found directly. For the square roots of numbers below and above this range, use may be made of the following relations: $\sqrt{100n} = 10\sqrt{n}$; $\sqrt{1000n} = 10\sqrt{10n}$; $\sqrt{\tfrac{1}{10}n} = \tfrac{1}{10}\sqrt{10n}$; $\sqrt{\tfrac{1}{100}n} = \tfrac{1}{10}\sqrt{n}$; $\sqrt{\tfrac{1}{1000}n} = \tfrac{1}{100}\sqrt{10n}$. For example, the square root of 0.268 may be found by using the form, $\sqrt{0.268} = \tfrac{1}{100}\sqrt{10 \times 268}$. The tabular value for the square root of $10n$ for 268 is 51.76872. Hence, the desired root is 0.5176872.

Values of cube roots for all numbers from 1 to 100,000 will be found directly in the table. Cube roots for numbers above or below this range will be found from the following relations: $\sqrt[3]{1000n} = 10\sqrt[3]{n}$; $\sqrt[3]{10{,}000n} = 10\sqrt[3]{10n}$; $\sqrt[3]{100{,}000n} = 10\sqrt[3]{100n}$; $\sqrt[3]{\tfrac{1}{10}n} = \tfrac{1}{10}\sqrt[3]{100n}$; $\sqrt[3]{\tfrac{1}{100}n} = \tfrac{1}{10}\sqrt[3]{10n}$; $\sqrt[3]{\tfrac{1}{1000}n} = \tfrac{1}{10}\sqrt[3]{n}$. For example, the cube root of 731,000 may be found by using the form, $\sqrt[3]{731{,}000} = 10\sqrt[3]{731}$. The tabular value of the root for 731 is 9.008223. The desired root is, therefore, 90.08223.

Powers of Numbers—This table is given to supplement the values of squares and cubes of numbers found in the preceding numerical table. The larger numbers are expressed exponentially to at least seven significant figures. The approximate value written as a whole number may be obtained by shifting the decimal point to the right by the number of places indicated in the exponent of 10 shown at the head of each group of values. For example: the approximate value of 33^8 is found in the table as 14.064086×10^{11}. Written as a whole number it is 1,406,408,600,000.

Factorials and their Logarithms—The product $n \times (n-1) \times (n-2) \times \cdots \times 1$ is called factorial n, expressed as $n!$ or $\underline{|n}$. For example: factorial $5 = 5 \times 4 \times 3 \times 2 \times 1 = 120$. Factorials are very often met with in series. For purposes of computation in such cases the table giving the values of the factorials and of their logarithms for numbers from 1 to 100 is provided. The values of the factorials are expressed exponentially to 5 significant figures.

A brief table of exact values and reciprocals of factorials is to be found on page 165.

Factors for Computing Probable Errors—The probable error of a series of n measures $a_1, a_2, a_3 \ldots a_n$, the mean of which is m, is given by the expression,

$$e = \frac{0.6745}{\sqrt{n-1}}\sqrt{(m-a_1)^2 + (m-a_2)^2 + \cdots (m-a_n)^2}$$

The probable error of the mean is,

$$E = \frac{0.6745}{\sqrt{n(n-1)}}\sqrt{(m-a_1)^2 + (m-a_2)^2 + \cdots (m-a_n)^2}$$

The following approximate equations are convenient forms for computation,

$$e = 0.8453\frac{\Sigma d}{\sqrt{n(n-1)}}$$

$$E = 0.8453\frac{\Sigma d}{n\sqrt{n-1}}$$

The symbol Σd represents the arithmetical sum of the deviations.

For convenience in computing the probable error the value of several of the factors involved is given for values of n from 2 to 100.

USE OF MATHEMATICAL TABLES (Continued)

Probability of Occurrence of Deviations—The significance of deviations is indicated by this table. The probability of occurrence of deviations as great as or greater than any specific value is given for various ratios of deviation to probable error and also with respect to the standard deviation σ. The probability of occurrence is stated in per cent or chances in 100. The odds against occurrence are also stated. The probable error is $0.6745 \times (\sigma)$.

Normal Curve of Error—If, for a large number of observations, the frequency y, of the occurrence of an error of magnitude t be plotted, a curve results whose equation may be written,

$$y = \frac{1}{\sqrt{2\pi}} e^{-t^2/2}$$

The area, ordinates and derivatives for this curve given in the table are useful in the treatment of observational data. A text on statistical methods should be consulted for a complete explanation.

Factors and Primes—The table presents the prime factors of *all* factorable numbers and the logarithms of all prime numbers from 1 to 2000.

Conversion Tables

Inches		Centimeters	Centimeters		Inches
1	=	2.54001	1	=	0.39370
2	=	5.08001	2	=	0.78740
3	=	7.62002	3	=	1.1811
4	=	10.16002	4	=	1.5748
5	=	12.70003	5	=	1.9685
6	=	15.24003	6	=	2.3622
7	=	17.78004	7	=	2.7559
8	=	20.32004	8	=	3.1496
9	=	22.86005	9	=	3.5433

Feet		Meters	Meters		Feet
1	=	0.304801	1	=	3.28083
2	=	0.609601	2	=	6.56167
3	=	0.914402	3	=	9.84250
4	=	1.219202	4	=	13.12333
5	=	1.524003	5	=	16.40417
6	=	1.828804	6	=	19.68500
7	=	2.133604	7	=	22.96583
8	=	2.438405	8	=	26.24666
9	=	2.743205	9	=	29.52750

Yards		Meters	Meters		Yards
1	=	0.914402	1	=	1 093611
2	=	1.828804	2	=	2.187222
3	=	2.743205	3	=	3.280833
4	=	3.657607	4	=	4.374444
5	=	4.572009	5	=	5.468056
6	=	5.486411	6	=	6.561667
7	=	6.400813	7	=	7.655278
8	=	7.315215	8	=	8 748889
9	=	8.229616	9	=	9.842500

Conversion Tables (Continued)

Miles	Kilometers	Kilometers	Miles
1	1.60935	1	0.62137
2	3.21869	2	1.24274
3	4.82804	3	1.86411
4	6.43739	4	2.48548
5	8.04674	5	3.10685
6	9.65608	6	3.72822
7	11.26543	7	4.34959
8	12.87478	8	4.97096
9	14.48412	9	5.59233

Pounds Av.	Kilograms	Kilograms	Pounds Av.
1	0.45359	1	2.20462
2	0.90718	2	4.40924
3	1.36078	3	6.61387
4	1.81437	4	8.81849
5	2.26796	5	11.02311
6	2.72155	6	13.22773
7	3.17514	7	15.43236
8	3.62874	8	17.63698
9	4.08233	9	19.84160

Conversion Factors

U. S. AND METRIC UNITS

Each unit in bold face type is followed by its equivalent in other units of the same quantity.

Acre—0.0015625 square mile; 4.3560 $\times 10^4$ square feet; 0.4046873 hectare

Bushel—1.2444 cubic feet; 2150.42 cubic inches; 0.035239 cubic meter; 35.238 liters

Centimeter—0.032808 foot; 0.39370 inch.

Circular Mil.—7.854 $\times 10^{-7}$ square inch; 5.0671 $\times 10^{-6}$ square centimeter

Cubic Centimeter—0.061023 cubic inch; 0.27051 dram; 16.231 minims; 0.99997 milliliter

Cubic Foot—0.80357 bushel; 7.481 gallon; 0.02831701 cubic meter; 28.316 liters

Cubic Inch—16.387162 cubic centimeters

Cubic Meter—35.314445 cubic feet; 264.173 gallons

Foot—0.3048006 meter

Gallon—0.13368 cubic foot; 0.83268 gallons (British); 231.00 cubic inches; 0.0037854 cubic meter; 3.7853 liters

Grain—0.064798918 gram

Gram—0.00220462 pound (avoirdupois); .0352740 ounce (avoirdupois); 15.4324 grains

Hectare—2.471044 acres; 1.0764 $\times 10^5$ square feet

Inch—2.540005 centimeter

Kilogram—2.2046223 pounds (avoirdupois)

Kilometer—0.62137 mile

Liter—0.26417762 gallon; 0.035316 cubic foot; 1.056710 quarts

Meter—1.093611 yards; 3.280833 feet; 39.3700 inches

Mile—1.60935 kilometers

Ounce (fluid)—1.80469 cubic inches; 29.5737 cubic centimeters

Ounce (avoirdupois)—28.349527 grams

Ounce (apothecary or troy)—31.103481 grams

Pint (liquid)—0.473167 liter; 473.167 cubic centimeters

Pound (avoirdupois)—0.453592 kilogram; 453.5924 grams

Pound (apothecary or troy)—0.3732418 kilogram; 373.2418 grams

Quart—1.10120 liters

Quart (liquid)—.946333 liter

Radian—57.29578 degrees

Rod—5.029210 meters

Square Centimeter—0.15500 square inches

Square Foot—0.09290341 square meter

Square Inch—645.16258 square millimeters

Square Meter—10.76387 square feet

Square Yard—0.83613 square meter

Ton (short)—907.185 kilograms

Yard—0.91440183 meter

NUMERICAL CONSTANTS

Numbers Containing π

$\pi = 3.14159\ 26536 \quad \log_{10}\pi = 0.49714\ 98727 \quad \log_e \pi = 1.14472\ 98858$

	Number	Logarithm		Number	Logarithm
π	3.1415 927	0.4971 499	π^2	9.8696 044	0.9942 997
2π	6.2831 853	0.7981 799	$2\pi^2$	19.7392 088	1.2953 297
3π	9.4247 780	0.9742 711	$4\pi^2$	39.4784 176	1.5963 597
4π	12.5663 706	1.0992 099	$1/\pi^2$	0.1013 212	9.0057 003 − 10
8π	25.1327 412	1.4002 399	$1/(2\pi^2)$	0.0506 606	8.7046 703 − 10
$\pi/2$	1.5707 963	0.1961 199	$1/(4\pi^2)$	0.0253 303	8.4036 403 − 10
$\pi/3$	1.0471 976	0.0200 286	$\sqrt{\pi}$	1.7724 539	0.2485 749
$\pi/4$	0.7853 982	9.8950 899 − 10	$\sqrt{\pi/4}$ or	0.8862 269	9.9475 449 − 10
$\pi/6$	0.5235 988	9.7189 986 − 10	$\sqrt{\pi}/2$		
$\pi/8$	0.3926 991	9.5940 599 − 10	$\sqrt{\pi}/4$	0.4431 135	9.6465 149 − 10
$2\pi/3$	2.0943 951	0.3210 586	$\sqrt{\pi/2}$	1.2533 141	0.0980 599
$4\pi/3$	4.1887 902	0.6220 886	$\sqrt{2/\pi}$	0.7978 846	9.9019 401 − 10
$1/\pi$	0.3183 099	9.5028 501 − 10	π^3	31.0062 767	1.4914 496
$2/\pi$	0.6366 198	9.8038 801 − 10	$\sqrt[3]{\pi}$	1.4645 919	0.1657 166
$4/\pi$	1.2732 395	0.1049 101	$1/\sqrt[3]{\pi}$	0.6827 841	9.8342 834 − 10
$1/(2\pi)$	0.1591 549	9.2018 201 − 10	$\sqrt[3]{\pi^2}$	2.1450 294	0.3314 332
$1/(4\pi)$	0.0795 775	8.9007 901 − 10	$1/\sqrt{\pi}$	0.5641 896	9.7514 251 − 10
$1/(6\pi)$	0.0530 516	8.7246 989 − 10	$1/\sqrt{2\pi}$	0.3989 423	9.6009 101 − 10
$1/(8\pi)$	0.0397 887	8.5997 601 − 10	$2/\sqrt{\pi}$	1.1283 792	0.0524 551
$\pi/180$	0.0174 533	8.2418 774 − 10			
$180/\pi$	57.2957 795	1.7581 226			

Logarithmic Constants

$e = 2.71828\ 18284\ 59045$

$1/e = 0.36787\ 94412$

$\log_e 2 = 0.69314\ 71806$

$\log_e 3 = 1.09861\ 22887$

$M = \log_{10} e = 0.43429\ 44819\ 03251\ 82765$

$1/M = \log_e 10 = 2.30258\ 50929\ 94045\ 68402$

$\log_{10} M = \log_{10}\log_{10} e = 9.63778\ 43113 - 10$

$\log_{10} 2 = 0.30102\ 99957$

$\log_{10} 3 = 0.47712\ 12547$

Change of Base

$$\log_a x = \log_b x/\log_b a$$

$$\log_{10} x = \log_e x/\log_e 10 \qquad \log_e x = \log_{10} x/\log_{10} e$$

$$\log_e x = 1/M \log_{10} x = 2.30258\ 50930 \log_{10} x$$

$$\log_{10} x = M \log_e x = 0.43429\ 44819 \log_e x$$

Euler's Constant $\gamma = 0.57721\ 56649\ 01533$

DECIMAL EQUIVALENTS OF COMMON FRACTIONS

	1/32	2/64	= 0.03125		17/32	34/64	= 0.53125
1/16	2/32	4/64	= .0625	9/16	18/32	36/64	= .5625
	3/32	6/64	= .09375		19/32	38/64	= .59375
1/8	4/32	8/64	= .125	5/8	20/32	40/64	= .625
	5/32	10/64	= .15625		21/32	42/64	= .65625
3/16	6/32	12/64	= .1875	11/16	22/32	44/64	= .6875
	7/32	14/64	= .21875		23/32	46/64	= .71875
1/4	8/32	16/64	= .25	3/4	24/32	48/64	= .75
	9/32	18/64	= .28125		25/32	50/64	= .78125
5/16	10/32	20/64	= .3125	13/16	26/32	52/64	= .8125
	11/32	22/64	= .34375		27/32	54/64	= .84375
3/8	12/32	24/64	= .375	7/8	28/32	56/64	= .875
	13/32	26/64	= .40625		29/32	58/64	= .90625
7/16	14/32	28/64	= .4375	15/16	30/32	60/64	= .9375
	15/32	30/64	= .46875		31/32	62/64	= .96875
1/2	16/32	32/64	= .50				

MISCELLANEOUS CONSTANTS

Mean radius of the earth, 3959 miles = 6371 kilometers.

1 degree of latitude at 40° = 69 miles.

International nautical mile = 1.151 statute miles = 1,852 meters = 6,076.10333 feet.

Mean density of the earth, 5.522 grams per cm^3.

Constant of gravitation, $K = 6.670 \times 10^{-8}$ = the attraction in dynes between two gram masses one centimeter apart.

Acceleration due to gravity at sea level, lat. 45° = 980.665 cm. per sec. per sec. = 32.172 feet per sec. per sec.

Length of seconds pendulum at sea level, lat. 45° = 99.358 cm. = 39.117 in.

1 knot = 101.3 ft/min = 1.689 ft/sec = 1.152 mi/hr.

1 micron = 10^{-4} cm. 1 ångström unit = 10^{-8} cm.

Mass of hydrogen atom = $1.67339_3 \pm 0.00031 \times 10^{-24}$ gram.

Avogadro's number = $6.0247 \pm .0002 \times 10^{23}$ $mole^{-1}$ (Physical scale).

Planck's constant = $6.6254 \pm .0002 \times 10^{-27}$ erg sec.

Density of mercury at 0° C. = 13.59509 g. per cm^3.

Density of water, maximum at 3.98° C. = 0.999973 g. per cm^3.

Density of dry air at 0° C. and 760 mm. = .001293 g. per cm^3.

Velocity of sound in dry air at 0° C., 33,136 cm. per sec. = 1087.1 feet per sec.

Velocity of light in a vacuum = 2.99776×10^{10} cm. per sec. = 9.83514×10^{8} feet per sec. = 186,272 mi./sec. (Birge, 1941).

Heat equivalent of fusion of water 79.63 cal. (15° C.) per gram.

Heat equivalent of vaporization of water, 539.55 cal. (15° C.) per gram.

Coefficient of expansion of gases, .003665.

Specific heat of air, at constant pressure, 0.238.

Electrochemical equivalent of silver, 0.001118 g. per sec. per int. ampere.

Mean wave length of sodium light, .00005893 cm. or 5893 ångström units.

Absolute wave length of red cadmium line in air, 760 mm. pressure, 15° C.; 6438.4696 ångström units.

GREEK ALPHABET

Greek letter	Greek name	English equivalent	Greek letter	Greek name	English equivalent
Α α	Alpha	a	Ν ν	Nu	n
Β β	Beta	b	Ξ ξ	Xi	x
Γ γ	Gamma	g	Ο ο	Omicron	ŏ
Δ δ	Delta	d	Π π	Pi	p
Ε ε	Epsilon	ĕ	Ρ ρ	Rho	r
Ζ ζ	Zeta	z	Σ σ ς	Sigma	s
Η η	Eta	ē	Τ τ	Tau	t
Θ θ ϑ	Theta	th	Υ υ	Upsilon	u
Ι ι	Iota	i	Φ φ	Phi	ph
Κ κ	Kappa	k	Χ χ	Chi	ch
Λ λ	Lambda	l	Ψ ψ	Psi	ps
Μ μ	Mu	m	Ω ω	Omega	ō

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts								
											1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	*4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	*3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	5	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

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*Interpolation in this section of the table is inaccurate.

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts								
											1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	6
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

*FOUR-PLACE COMMON LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9
.10	−1.000	−.9957	−.9914	−.9872	−.9830	−.9788	−.9747	−.9706	−.9666	−.9626
.11	−.9586	−.9547	−.9508	−.9469	−.9431	−.9393	−.9355	−.9318	−.9281	−.9245
.12	−.9208	−.9172	−.9136	−.9101	−.9066	−.9031	−.8996	−.8962	−.8928	−.8894
.13	−.8861	−.8827	−.8794	−.8761	−.8729	−.8697	−.8665	−.8633	−.8601	−.8570
.14	−.8539	−.8508	−.8477	−.8447	−.8416	−.8386	−.8356	−.8327	−.8297	−.8268
.15	−.8239	−.8210	−.8182	−.8153	−.8125	−.8097	−.8069	−.8041	−.8013	−.7986
.16	−.7959	−.7932	−.7905	−.7878	−.7852	−.7825	−.7799	−.7773	−.7747	−.7721
.17	−.7696	.−7670	−.7645	−.7620	−.7595	−.7570	−.7545	−.7520	−.7496	−.7471
.18	−.7447	−.7423	−.7399	−.7375	−.7352	−.7328	−.7305	−.7282	−.7258	−.7235
.19	−.7212	−.7190	−.7167	−.7144	−.7122	−.7100	−.7077	−.7055	−.7033	−.7011
.20	−.6990	−.6968	−.6946	−.6925	−.6904	−.6882	−.6861	−.6840	−.6819	−.6799
.21	−.6778	−.6757	−.6737	−.6716	−.6696	−.6676	−.6655	−.6635	−.6615	−.6596
.22	−.6576	−.6556	−.6536	−.6517	−.6498	−.6478	−.6459	−.6440	−.6421	−.6402
.23	−.6383	−.6364	−.6345	−.6326	−.6308	−.6289	−.6271	−.6253	−.6234	−.6216
.24	−.6198	−.6180	−.6162	−.6144	−.6126	−.6108	−.6091	−.6073	−.6055	−.6038
.25	−.6021	−.6003	−.5986	−.5969	−.5952	−.5935	−.5918	−.5901	−.5884	−.5867
.26	−.5850	−.5834	−.5817	−.5800	−.5784	−.5768	−.5751	−.5735	−.5719	−.5702
.27	−.5686	−.5670	−.5654	−.5638	−.5622	−.5607	−.5591	−.5575	−.5560	−.5544
.28	−.5528	−.5513	−.5498	−.5482	−.5467	−.5452	−.5436	−.5421	−.5406	−.5391
.29	−.5376	−.5361	−.5346	−.5331	−.5317	−.5302	−.5287	−.5272	−.5258	−.5243
.30	−.5229	−.5214	−.5200	−.5186	−.5171	−.5157	−.5143	−.5129	−.5114	−.5100
.31	−.5086	−.5072	−.5058	−.5045	−.5031	−.5017	−.5003	−.4989	−.4976	−.4962
.32	−.4949	−.4935	−.4921	−.4908	−.4895	−.4881	−.4868	−.4855	−.4841	−.4828
.33	−.4815	−.4802	−.4789	−.4776	−.4763	−.4750	−.4737	−.4724	−.4711	−.4698
.34	−.4685	−.4672	−.4660	−.4647	−.4634	−.4622	−.4609	−.4597	−.4584	−.4572
.35	−.4559	−.4547	−.4535	−.4522	−.4510	−.4498	−.4486	−.4473	−.4461	−.4449
.36	−.4437	−.4425	−.4413	−.4401	−.4389	−.4377	−.4365	−.4353	−.4342	−.4330
.37	−.4318	−.4306	−.4295	−.4283	−.4271	−.4260	−.4248	−.4237	−.4225	−.4214
.38	−.4202	−.4191	−.4179	−.4168	−.4157	−.4145	−.4134	−.4123	−.4112	−.4101
.39	−.4089	−.4078	−.4067	−.4056	−.4045	−.4034	−.4023	−.4012	−.4001	−.3990
.40	−.3979	−.3969	−.3958	−.3947	−.3936	−.3925	−.3915	−.3904	−.3893	−.3883
.41	−.3872	−.3862	−.3851	−.3840	−.3830	−.3820	−.3809	−.3799	−.3788	−.3778
.42	−.3768	−.3757	−.3747	−.3737	−.3726	−.3716	−.3706	−.3696	−.3686	−.3675
.43	−.3665	−.3655	−.3645	−.3635	−.3625	−.3615	−.3605	−.3595	−.3585	−.3575
.44	−.3565	−.3556	−.3546	−.3536	−.3526	−.3516	−.3507	−.3497	−.3487	−.3478
.45	−.3468	−.3458	−.3449	−.3439	−.3429	−.3420	−.3410	−.3401	−.3391	−.3382
.46	−.3372	−.3363	−.3354	−.3344	−.3335	−.3325	−.3316	−.3307	−.3298	−.3288
.47	−.3279	−.3270	−.3261	−.3251	−.3242	−.3233	−.3224	−.3215	−.3206	−.3197
.48	−.3188	−.3179	−.3170	−.3161	−.3152	−.3143	−.3134	−.3125	−.3116	−.3107
.49	−.3098	−.3089	−.3080	−.3072	−.3063	−.3054	−.3045	−.3036	−.3028	−.3019
.50	−.3010	−.3002	−.2993	−.2984	−.2976	−.2967	−.2958	−.2950	−.2941	−.2933
.51	−.2924	−.2916	−.2907	−.2899	−.2890	−.2882	−.2874	−.2865	−.2857	−.2848
.52	−.2840	−.2832	−.2823	−.2815	−.2807	−.2798	−.2790	−.2782	−.2774	−.2765
.53	−.2757	−.2749	−.2741	−.2733	−.2725	−.2716	−.2708	−.2700	−.2692	−.2684
.54	−.2676	−.2668	−.2660	−.2652	−.2644	−.2636	−.2628	−.2620	−.2612	−.2604

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* This table gives the logarithms of the decimal fractions which are negative numbers. For example $\log 0.61 = -0.2147 = 9.7853 - 10$. It should be noted that the entries as given can be used conveniently to find cologarithms of positive numbers. Every positive number $N = P \cdot (10)^k$, where $0 < P \leqq 1$. Since $\text{colog } N = -\log N$, it follows that $\text{colog } N = -\log P - k$.

For example $\text{colog } 0.61 = -\log 0.61 = 0.2147$; $\text{colog } 61 = 0.2147 - 2$; and $\text{colog } 0.00061 = 3.2147$.

N	0	1	2	3	4	5	6	7	8	9
.55	—.2596	—.2588	—.2581	—.2573	—.2565	—.2557	—.2549	—.2541	—.2534	—.2526
.56	—.2518	—.2510	—.2503	—.2495	—.2487	—.2480	—.2472	—.2464	—.2457	—.2449
.57	—.2441	—.2434	—.2426	—.2418	—.2411	—.2403	—.2396	—.2388	—.2381	—.2373
.58	—.2366	—.2358	—.2351	—.2343	—.2336	—.2328	—.2321	—.2314	—.2306	—.2299
.59	—.2291	—.2284	—.2277	—.2269	—.2262	—.2255	—.2248	—.2240	—.2233	—.2226
.60	—.2218	—.2211	—.2204	—.2197	—.2190	—.2182	—.2175	—.2168	—.2161	—.2154
.61	—.2147	—.2140	—.2132	—.2125	—.2118	—.2111	—.2104	—.2097	—.2090	—.2083
.62	—.2076	—.2069	—.2062	—.2055	—.2048	—.2041	—.2034	—.2027	—.2020	—.2013
.63	—.2007	—.2000	—.1993	—.1986	—.1979	—.1972	—.1965	—.1959	—.1952	—.1945
.64	—.1938	—.1931	—.1925	—.1918	—.1911	—.1904	—.1898	—.1891	—.1884	—.1878
.65	—.1871	—.1864	—.1858	—.1851	—.1844	—.1838	—.1831	—.1824	—.1818	—.1811
.66	—.1805	—.1798	—.1791	—.1785	—.1778	—.1772	—.1765	—.1759	—.1752	—.1746
.67	—.1739	—.1733	—.1726	—.1720	—.1713	—.1707	—.1701	—.1694	—.1688	—.1681
.68	—.1675	—.1669	—.1662	—.1656	—.1649	—.1643	—.1637	—.1630	—.1624	—.1618
.69	—.1612	—.1605	—.1599	—.1593	—.1586	—.1580	—.1574	—.1568	—.1561	—.1555
.70	—.1549	—.1543	—.1537	—.1530	—.1524	—.1518	—.1512	—.1506	—.1500	—.1494
.71	—.1487	—.1481	—.1475	—.1469	—.1463	—.1457	—.1451	—.1445	—.1439	—.1433
.72	—.1427	—.1421	—.1415	—.1409	—.1403	—.1397	—.1391	—.1385	—.1379	—.1373
.73	—.1367	—.1361	—.1355	—.1349	—.1343	—.1337	—.1331	—.1325	—.1319	—.1314
.74	—.1308	—.1302	—.1296	—.1290	—.1284	—.1278	—.1273	—.1267	—.1261	—.1255
.75	—.1249	—.1244	—.1238	—.1232	—.1226	—.1221	—.1215	—.1209	—.1203	—.1198
.76	—.1192	—.1186	—.1180	—.1175	—.1169	—.1163	—.1158	—.1152	—.1146	—.1141
.77	—.1135	—.1129	—.1124	—.1118	—.1113	—.1107	—.1101	—.1096	—.1090	—.1085
.78	—.1079	—.1073	—.1068	—.1062	—.1057	—.1051	—.1046	—.1040	—.1035	—.1029
.79	—.1024	—.1018	—.1013	—.1007	—.1002	—.0996	—.0991	—.0985	—.0980	—.0975
.80	—.0969	—.0964	—.0958	—.0953	—.0947	—.0942	—.0937	—.0931	—.0926	—.0921
.81	—.0915	—.0910	—.0904	—.0899	—.0894	—.0888	—.0883	—.0878	—.0872	—.0867
.82	—.0862	—.0857	—.0851	—.0846	—.0841	—.0835	—.0830	—.0825	—.0820	—.0814
.83	—.0809	—.0804	—.0799	—.0794	—.0788	—.0783	—.0778	—.0773	—.0768	—.0762
.84	—.0757	—.0752	—.0747	—.0742	—.0737	—.0731	—.0726	—.0721	—.0716	—.0711
.85	—.0706	—.0701	—.0696	—.0691	—.0685	—.0680	—.0675	—.0670	—.0665	—.0660
.86	—.0655	—.0650	—.0645	—.0640	—.0635	—.0630	—.0625	—.0620	—.0615	—.0610
.87	—.0605	—.0600	—.0595	—.0590	—.0585	—.0580	—.0575	—.0570	—.0565	—.0560
.88	—.0555	—.0550	—.0545	—.0540	—.0535	—.0531	—.0526	—.0521	—.0516	—.0511
.89	—.0506	—.0501	—.0496	—.0491	—.0487	—.0482	—.0477	—.0472	—.0467	—.0462
.90	—.0458	—.0453	—.0448	—.0443	—.0438	—.0434	—.0429	—.0424	—.0419	—.0414
.91	—.0410	—.0405	—.0400	—.0395	—.0391	—.0386	—.0381	—.0376	—.0372	—.0367
.92	—.0362	—.0357	—.0353	—.0348	—.0343	—.0339	—.0334	—.0329	—.0325	—.0320
.93	—.0315	—.0311	—.0306	—.0301	—.0297	—.0292	—.0287	—.0283	—.0278	—.0273
.94	—.0269	—.0264	—.0259	—.0255	—.0250	—.0246	—.0241	—.0237	—.0232	—.0227
.95	—.0223	—.0218	—.0214	—.0209	—.0205	—.0200	—.0195	—.0191	—.0186	—.0182
.96	—.0177	—.0173	—.0168	—.0164	—.0159	—.0155	—.0150	—.0146	—.0141	—.0137
.97	—.0132	—.0128	—.0123	—.0119	—.0114	—.0110	—.0106	—.0101	—.0097	—.0092
.98	—.0088	—.0083	—.0079	—.0074	—.0070	—.0066	—.0061	—.0057	—.0052	—.0048
.99	—.0044	—.0039	—.0035	—.0031	—.0026	—.0022	—.0017	—.0013	—.0009	—.0004

ANTILOGARITHMS

	0	1	2	3	4	5	6	7	8	9	Proportional Parts								
											1	2	3	4	5	6	7	8	9
.00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	1	2	2	2
.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2
.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	2	2	2
.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1	1	2	2	2
.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1	2	2	2	2
.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1	2	2	2	2
.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1	2	2	2	2
.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1	2	2	2	2
.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	2	2	2	3
.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	2	2	2	3
.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	2	2	2	3
.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	2	2	2	3	3
.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	2	2	2	2	3
.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	2	2	2	3	3
.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	2	2	2	3	3
.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	2	2	2	3	3
.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	2	2	2	3	3
.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	2	2	2	3	3
.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	2	2	2	3	3
.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	2	2	3	3	3
.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	2	2	3	3	3
.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	2	2	2	3	3	3
.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	2	2	2	3	3	3
.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	2	2	2	3	3	4
.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	2	2	2	3	3	4
.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	2	2	2	3	3	4
.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	2	2	3	3	3	4
.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	2	2	3	3	3	4
.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	2	2	3	3	4	4
.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	2	2	3	3	4	4
.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2	3	3	4	4
.31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2	3	3	4	4
.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2	3	3	4	4
.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2	3	3	4	4
.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3	3	4	4	5
.35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
.36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3	3	4	4	5
.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3	3	4	4	5
.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	5	5
.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	5
.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	5
.42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	6
.43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	6
.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	6
.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3	4	5	5	6
.46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3	4	5	5	6
.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3	4	5	5	6
.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	4	4	5	6	6
.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4	4	5	6	6
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

ANTILOGARITHMS

	0	1	2	3	4	5	6	7	8	9	Proportional Parts								
											1	2	3	4	5	6	7	8	9
.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	6	7
.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	2	2	3	4	5	5	6	7
.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	2	2	3	4	5	5	6	7
.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4	5	6	6	7
.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4	5	6	6	7
.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4	5	6	7	7
.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	3	3	4	5	6	7	8
.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4	5	6	7	8
.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	4	4	5	6	7	8
.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5	5	6	7	8
.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5	6	6	7	8
.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5	6	7	8	9
.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	2	3	4	5	6	7	8	9
.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5	6	7	8	9
.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	2	3	4	5	6	7	8	9
.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5	6	7	8	9
.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5	6	7	9	10
.67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	2	3	4	5	7	8	9	10
.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	2	3	4	6	7	8	9	10
.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6	7	8	9	10
.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	4	5	6	7	8	9	11
.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6	7	8	10	11
.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6	7	9	10	11
.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6	8	9	10	11
.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6	8	9	10	12
.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7	8	9	10	12
.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7	8	9	11	12
.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7	8	10	11	12
.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7	8	10	11	13
.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7	9	10	11	13
.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7	9	10	12	13
.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8	9	11	12	14
.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8	9	11	12	14
.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8	9	11	13	14
.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	6	8	10	11	13	15
.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8	10	12	13	15
.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8	10	12	13	15
.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	3	5	7	9	10	12	14	16
.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9	11	12	14	16
.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	5	7	9	11	13	14	16
.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	13	15	17
.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	8	11	13	15	17	19
.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11	14	16	18	20
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

N.		0	1	2	3	4	5	6	7	8	9	Proportional parts			
100	00	000	043	087	130	173	217	260	303	346	389		**44**	**43**	**42**
101		432	475	518	561	604	647	689	732	775	817	1	4,4	4,3	4,2
102		860	903	945	988	*030	*072	*115	*157	*199	*242	2	8,8	8,6	8,4
103	01	284	326	368	410	452	494	536	578	620	662	3	13,2	12,9	12,6
104		703	745	787	828	870	912	953	995	*036	*078	4	17,6	17,2	16,8
105	02	119	160	202	243	284	325	366	407	449	490	5	22,0	21,5	21,0
106		531	572	612	653	694	735	776	816	857	898	6	26,4	25,8	25,2
107		938	979	*019	*060	*100	*141	*181	*222	*262	*302	7	30,8	30,1	29,4
108	03	342	383	423	463	503	543	583	623	663	703	8	35,2	34,4	33,6
109		743	782	822	862	902	941	981	*021	*060	*100	9	39,6	38,7	37,8
110	04	139	179	218	258	297	336	376	415	454	493		**41**	**40**	**39**
111		532	571	610	650	689	727	766	805	844	883	1	4,1	4,0	3,9
112		922	961	999	*038	*077	*115	*154	*192	*231	*269	2	8,2	8,0	7,8
113	05	308	346	385	423	461	500	538	576	614	652	3	12,3	12,0	11,7
114		690	729	767	805	843	881	918	956	994	*032	4	16,4	16,0	15,6
115	06	070	108	145	183	221	258	296	333	371	408	5	20,5	20,0	19,5
116		446	483	521	558	595	633	670	707	744	781	6	24,6	24,0	23,4
117		819	856	893	930	967	*004	*041	*078	*115	*151	7	28,7	28,0	27,3
118	07	188	225	262	298	335	372	408	445	482	518	8	32,8	32,0	31,2
119		555	591	628	664	700	737	773	809	846	882	9	36,9	36,0	35,1
120		918	954	990	*027	*063	*099	*135	*171	*207	*243		**38**	**37**	**36**
121	08	279	314	350	386	422	458	493	529	565	600	1	3,8	3,7	3,6
122		636	672	707	743	778	814	849	884	920	955	2	7,6	7,4	7,2
123		991	*026	*061	*096	*132	*167	*202	*237	*272	*307	3	11,4	11,1	10,8
124	09	342	377	412	447	482	517	552	587	621	656	4	15,2	14,8	14,4
125		691	726	760	795	830	864	899	934	968	*003	5	19,0	18,5	18,0
126	10	037	072	106	140	175	209	243	278	312	346	6	22,8	22,2	21,6
127		380	415	449	483	517	551	585	619	653	687	7	26,6	25,9	25,2
128		721	755	789	823	857	890	924	958	992	*025	8	30,4	29,6	28,8
129	11	059	093	126	160	193	227	261	294	327	361	9	34,2	33,3	32,4
130		394	428	461	494	528	561	594	628	661	694		**35**	**34**	**33**
131		727	760	793	826	860	893	926	959	992	*024	1	3,5	3,4	3,3
132	12	057	090	123	156	189	222	254	287	320	352	2	7,0	6,8	6,6
133		385	418	450	483	516	548	581	613	646	678	3	10,5	10,2	9,9
134		710	743	775	808	840	872	905	937	969	*001	4	14,0	13,6	13,2
135	13	033	066	098	130	162	194	226	258	290	322	5	17,5	17,0	16,5
136		354	386	418	450	481	513	545	577	609	640	6	21,0	20,4	19,8
137		672	704	735	767	799	830	862	893	925	956	7	24,5	23,8	23,1
138		988	*019	*051	*082	*114	*145	*176	*208	*239	*270	8	28,0	27,2	26,4
139	14	301	333	364	395	426	457	489	520	551	582	9	31,5	30,6	29,7
140		613	644	675	706	737	768	799	829	860	891		**32**	**31**	**30**
141		922	953	983	*014	*045	*076	*106	*137	*168	*198	1	3,2	3,1	3,0
142	15	229	259	290	320	351	381	412	442	473	503	2	6,4	6,2	6,0
143		534	564	594	625	655	685	715	746	776	806	3	9,6	9,3	9,0
144		836	866	897	927	957	987	*017	*047	*077	*107	4	12,8	12,4	12,0
145	16	137	167	197	227	256	286	316	346	376	406	5	16,0	15,5	15,0
146		435	465	495	524	554	584	613	643	673	702	6	19,2	18,6	18,0
147		732	761	791	820	850	879	909	938	967	997	7	22,4	21,7	21,0
148	17	026	056	085	114	143	173	202	231	260	289	8	25,6	24,8	24,0
149		319	348	377	406	435	464	493	522	551	580	9	28,8	27,9	27,0
150		609	638	667	696	725	754	782	811	840	869				
N.		0	1	2	3	4	5	6	7	8	9	Proportional parts			

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9	Proportional parts		
150	17	609	638	667	696	725	754	782	811	840	869		**29**	**28**
151		898	926	955	984	*013	*041	*070	*099	*127	*156	1	2,9	2,8
152	18	184	213	241	270	298	327	355	384	412	441	2	5,8	5,6
153		469	498	526	554	583	611	639	667	696	724	3	8,7	8,4
154		752	780	808	837	865	893	921	949	977	*005	4	11,6	11,2
155	19	033	061	089	117	145	173	201	229	257	285	5	14,5	14,0
156		312	340	368	396	424	451	479	507	535	562	6	17,4	16,8
157		590	618	645	673	700	728	756	783	811	838	7	20,3	19,6
158		866	893	921	948	976	*003	*030	*058	*085	*112	8	23,2	22,4
159	20	140	167	194	222	249	276	303	330	358	385	9	26,1	25,2
160		412	439	466	493	520	548	575	602	629	656		**27**	**26**
161		683	710	737	763	790	817	844	871	898	925	1	2,7	2,6
162		952	978	*005	*032	*059	*085	*112	*139	*165	*192	2	5,4	5,2
163	21	219	245	272	299	325	352	378	405	431	458	3	8,1	7,8
164		484	511	537	564	590	617	643	669	696	722	4	10,8	10,4
165		748	775	801	827	854	880	906	932	958	985	5	13,5	13,0
166	22	011	037	063	089	115	141	167	194	220	246	6	16,2	15,6
167		272	298	324	350	376	401	427	453	479	505	7	18,9	18,2
168		531	557	583	608	634	660	686	712	737	763	8	21,6	20,8
169		789	814	840	866	891	917	943	968	994	*019	9	24,3	23,4
170	23	045	070	096	121	147	172	198	223	249	274		**25**	
171		300	325	350	376	401	426	452	477	502	528	1	2,5	
172		553	578	603	629	654	679	704	729	754	779	2	5,0	
173		805	830	855	880	905	930	955	980	*005	*030	3	7,5	
174	24	055	080	105	130	155	180	204	229	254	279	4	10,0	
175		304	329	353	378	403	428	452	477	502	527	5	12,5	
176		551	576	601	625	650	674	699	724	748	773	6	15,0	
177		797	822	846	871	895	920	944	969	993	*018	7	17,5	
178	25	042	066	091	115	139	164	188	212	237	261	8	20,0	
179		285	310	334	358	382	406	431	455	479	503	9	22,5	
180		527	551	575	600	624	648	672	696	720	744		**24**	**23**
181		768	792	816	840	864	888	912	935	959	983	1	2,4	2,3
182	26	007	031	055	079	102	126	150	174	198	221	2	4,8	4,6
183		245	269	293	316	340	364	387	411	435	458	3	7,2	6,9
184		482	505	529	553	576	600	623	647	670	694	4	9,6	9,2
185		717	741	764	788	811	834	858	881	905	928	5	12,0	11,5
186		951	975	998	*021	*045	*068	*091	*114	*138	*161	6	14,4	13,8
187	27	184	207	231	254	277	300	323	346	370	393	7	16,8	16,1
188		416	439	462	485	508	531	554	577	600	623	8	19,2	18,4
189		646	669	692	715	738	761	784	807	830	852	9	21,6	20,7
190		875	898	921	944	967	989	*012	*035	*058	*081		**22**	**21**
191	28	103	126	149	171	194	217	240	262	285	307	1	2,2	2,1
192		330	353	375	398	421	443	466	488	511	533	2	4,4	4,2
193		556	578	601	623	646	668	691	713	735	758	3	6,6	6,3
194		780	803	825	847	870	892	914	937	959	981	4	8,8	8,4
195	29	003	026	048	070	092	115	137	159	181	203	5	11,0	10,5
196		226	248	270	292	314	336	358	380	403	425	6	13,2	12,6
197		447	469	491	513	535	557	579	601	623	645	7	15,4	14,7
198		667	688	710	732	754	776	798	820	842	863	8	17,6	16,8
199		885	907	929	951	973	994	*016	*038	*060	*081	9	19,8	18,9
200	30	103	125	146	168	190	211	233	255	276	298			
N.		0	1	2	3	4	5	6	7	8	9	Proportional parts		

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts		
200	30 103	125	146	168	190	211	233	255	276	298		**22**	**21**
201	320	341	363	384	406	428	449	471	492	514	1	2,2	2,1
202	535	557	578	600	621	643	664	685	707	728	2	4,4	4,2
203	750	771	792	814	835	856	878	899	920	942	3	6,6	6,3
204	963	984	*006	*027	*048	*069	*091	*112	*133	*154	4	8,8	8,4
205	31 175	197	218	239	260	281	302	323	345	366	5	11,0	10,5
206	387	408	429	450	471	492	513	534	555	576	6	13,2	12,6
207	597	618	639	660	681	702	723	744	765	785	7	15,4	14,7
208	806	827	848	869	890	911	931	952	973	994	8	17,6	16,8
209	32 015	035	056	077	098	118	139	160	181	201	9	19,8	18,9
210	222	243	263	284	305	325	346	366	387	408		**20**	
211	428	449	469	490	510	531	552	572	593	613	1	2,0	
212	634	654	675	695	715	736	756	777	797	818	2	4,0	
213	838	858	879	899	919	940	960	980	*001	*021	3	6,0	
214	33 041	062	082	102	122	143	163	183	203	224	4	8,0	
215	244	264	284	304	325	345	365	385	405	425	5	10,0	
216	445	465	486	506	526	546	566	586	606	626	6	12,0	
217	646	666	686	706	726	746	766	786	806	826	7	14,0	
218	846	866	885	905	925	945	965	985	*005	*025	8	16,0	
219	34 044	064	084	104	124	143	163	183	203	223	9	18,0	
220	242	262	282	301	321	341	361	380	400	420		**19**	
221	439	459	479	498	518	537	557	577	596	616	1	1,9	
222	635	655	674	694	713	733	753	772	792	811	2	3,8	
223	830	850	869	889	908	928	947	967	986	*005	3	5,7	
224	35 025	044	064	083	102	122	141	160	180	199	4	7,6	
225	218	238	257	276	295	315	334	353	372	392	5	9,5	
226	411	430	449	468	488	507	526	545	564	583	6	11,4	
227	603	622	641	660	679	698	717	736	755	774	7	13,3	
228	793	813	832	851	870	889	908	927	946	965	8	15,2	
229	984	*003	*021	*040	*059	*078	*097	*116	*135	*154	9	17,1	
230	36 173	192	211	229	248	267	286	305	324	342		**18**	
231	361	380	399	418	436	455	474	493	511	530	1	1,8	
232	549	568	586	605	624	642	661	680	698	717	2	3,6	
233	736	754	773	791	810	829	847	866	884	903	3	5,4	
234	922	940	959	977	996	*014	*033	*051	*070	*088	4	7,2	
235	37 107	125	144	162	181	199	218	236	254	273	5	9,0	
236	291	310	328	346	365	383	401	420	438	457	6	10,8	
237	475	493	511	530	548	566	585	603	621	639	7	12,6	
238	658	676	694	712	731	749	767	785	803	822	8	14,4	
239	840	858	876	894	912	931	949	967	985	*003	9	16,2	
240	38 021	039	057	075	093	112	130	148	166	184		**17**	
241	202	220	238	256	274	292	310	328	346	364	1	1,7	
242	382	399	417	435	453	471	489	507	525	543	2	3,4	
243	561	578	596	614	632	650	668	686	703	721	3	5,1	
244	739	757	775	792	810	828	846	863	881	899	4	6,8	
245	917	934	952	970	987	*005	*023	*041	*058	*076	5	8,5	
246	39 094	111	129	146	164	182	199	217	235	252	6	10,2	
247	270	287	305	322	340	358	375	393	410	428	7	11,9	
248	445	463	480	498	515	533	550	568	585	602	8	13,6	
249	620	637	655	672	690	707	724	742	759	777	9	15,3	
250	794	811	829	846	863	881	898	915	933	950			
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts		

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9	Proportional parts	
250	39	794	811	829	846	863	881	898	915	933	950		**18**
251		967	985	*002	*019	*037	*054	*071	*088	*106	*123	1	1,8
252	40	140	157	175	192	209	226	243	261	278	295	2	3,6
253		312	329	346	364	381	398	415	432	449	466	3	5,4
254		483	500	518	535	552	569	586	603	620	637	4	7,2
255		654	671	688	705	722	739	756	773	790	807	5	9,0
256		824	841	858	875	892	909	926	943	960	976	6	10,8
257		993	*010	*027	*044	*061	*078	*095	*111	*128	*145	7	12,6
258	41	162	179	196	212	229	246	263	280	296	313	8	14,4
259		330	347	363	380	397	414	430	447	464	481	9	16,2
260		497	514	531	547	564	581	597	614	631	647		**17**
261		664	681	697	714	731	747	764	780	797	814	1	1,7
262		830	847	863	880	896	913	929	946	963	979	2	3,4
263		996	*012	*029	*045	*062	*078	*095	*111	*127	*144	3	5,1
264	42	160	177	193	210	226	243	259	275	292	308	4	6,8
265		325	341	357	374	390	406	423	439	455	472	5	8,5
266		488	504	521	537	553	570	586	602	619	635	6	10,2
267		651	667	684	700	716	732	749	765	781	797	7	11,9
268		813	830	846	862	878	894	911	927	943	959	8	13,6
269		975	991	*008	*024	*040	*056	*072	*088	*104	*120	9	15,3
270	43	136	152	169	185	201	217	233	249	265	281		**16**
271		297	313	329	345	361	377	393	409	425	441	1	1,6
272		457	473	489	505	521	537	553	569	584	600	2	3,2
273		616	632	648	664	680	696	712	727	743	759	3	4,8
274		775	791	807	823	838	854	870	886	902	917	4	6.4
275		933	949	965	981	996	*012	*028	*044	*059	*075	5	8,0
276	44	091	107	122	138	154	170	185	201	217	232	6	9,6
277		248	264	279	295	311	326	342	358	373	389	7	11,2
278		404	420	436	451	467	483	498	514	529	545	8	12,8
279		560	576	592	607	623	638	654	669	685	700	9	14,4
280		716	731	747	762	778	793	809	824	840	855		**15**
281		871	886	902	917	932	948	963	979	994	*010	1	1,5
282	45	025	040	056	071	086	102	117	133	148	163	2	3,0
283		179	194	209	225	240	255	271	286	301	317	3	4,5
284		332	347	362	378	393	408	423	439	454	469	4	6,0
285		484	500	515	530	545	561	576	591	606	621	5	7,5
286		637	652	667	682	697	712	728	743	758	773	6	9,0
287		788	803	818	834	849	864	879	894	909	924	7	10,5
288		939	954	969	984	*000	*015	*030	*045	*060	*075	8	12,0
289	46	090	105	120	135	150	165	180	195	210	225	9	13,5
290		240	255	270	285	300	315	330	345	359	374		**14**
291		389	404	419	434	449	464	479	494	509	523	1	1,4
292		538	553	568	583	598	613	627	642	657	672	2	2,8
293		687	702	716	731	746	761	776	790	805	820	3	4,2
294		835	850	864	879	894	909	923	938	953	967	4	5,6
295		982	997	*012	*026	*041	*056	*070	*085	*100	*114	5	7,0
296	47	129	144	159	173	188	202	217	232	246	261	6	8,4
297		276	290	305	319	334	349	363	378	392	407	7	9,8
298		422	436	451	465	480	494	509	524	538	553	8	11,2
299		567	582	596	611	625	640	654	669	683	698	9	12,6
300		712	727	741	756	770	784	799	813	828	842		
N.		0	1	2	3	4	5	6	7	8	9	Proportional parts	

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9	Proportional parts	
300	47	712	727	741	756	770	784	799	813	828	842		
301		857	871	885	900	914	929	943	958	972	986		
302	48	001	015	029	044	058	073	087	101	116	130		
303		144	159	173	187	202	216	230	244	259	273		**15**
304		287	302	316	330	344	359	373	387	401	416	1	1,5
305		430	444	458	473	487	501	515	530	544	558	2	3,0
306		572	586	601	615	629	643	657	671	686	700	3	4,5
307		714	728	742	756	770	785	799	813	827	841	4	6,0
308		855	869	883	897	911	926	940	954	968	982	5	7,5
309		996	*010	*024	*038	*052	*066	*080	*094	*108	*122	6	9,0
												7	10,5
310	49	136	150	164	178	192	206	220	234	248	262	8	12,0
311		276	290	304	318	332	346	360	374	388	402	9	13,5
312		415	429	443	457	471	485	499	513	527	541		
313		554	568	582	596	610	624	638	651	665	679		
314		693	707	721	734	748	762	776	790	803	817		
315		831	845	859	872	886	900	914	927	941	955		**14**
316		969	982	996	*010	*024	*037	*051	*065	*079	*092	1	1,4
317	50	106	120	133	147	161	174	188	202	215	229	2	2,8
318		243	256	270	284	297	311	325	338	352	365	3	4,2
319		379	393	406	420	433	447	461	474	488	501	4	5,6
												5	7,0
320		515	529	542	556	569	583	596	610	623	637	6	8,4
321		651	664	678	691	705	718	732	745	759	772	7	9,8
322		786	799	813	826	840	853	866	880	893	907	8	11,2
323		920	934	947	961	974	987	*001	*014	*028	*041	9	12,6
324	51	055	068	081	095	108	121	135	148	162	175		
325		188	202	215	228	242	255	268	282	295	308		
326		322	335	348	362	375	388	402	415	428	441		
327		455	468	481	495	508	521	534	548	561	574		**13**
328		587	601	614	627	640	654	667	680	693	706	1	1,3
329		720	733	746	759	772	786	799	812	825	838	2	2,6
												3	3,9
330		851	865	878	891	904	917	930	943	957	970	4	5,2
331		983	996	*009	*022	*035	*048	*061	*075	*088	*101	5	6,5
332	52	114	127	140	153	166	179	192	205	218	231	6	7,8
333		244	257	270	284	297	310	323	336	349	362	7	9,1
334		375	388	401	414	427	440	453	466	479	492	8	10,4
335		504	517	530	543	556	569	582	595	608	621	9	11,7
336		634	647	660	673	686	699	711	724	737	750		
337		763	776	789	802	815	827	840	853	866	879		
338		892	905	917	930	943	956	969	982	994	*007		
339	53	020	033	046	058	071	084	097	110	122	135		**12**
												1	1,2
340		148	161	173	186	199	212	224	237	250	263	2	2,4
341		275	288	301	314	326	339	352	364	377	390	3	3,6
342		403	415	428	441	453	466	479	491	504	517	4	4,8
343		529	542	555	567	580	593	605	618	631	643	5	6,0
344		656	668	681	694	706	719	732	744	757	769	6	7,2
345		782	794	807	820	832	845	857	870	882	895	7	8,4
346		908	920	933	945	958	970	983	995	*008	*020	8	9,6
347	54	033	045	058	070	083	095	108	120	133	145	9	10,8
348		158	170	183	195	208	220	233	245	258	270		
349		283	295	307	320	332	345	357	370	382	394		
350		407	419	432	444	456	469	481	494	506	518		
N.		0	1	2	3	4	5	6	7	8	9	Proportional parts	

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
350	54 407	419	432	444	456	469	481	494	506	518
351	531	543	555	568	580	593	605	617	630	642
352	654	667	679	691	704	716	728	741	753	765
353	777	790	802	814	827	839	851	864	876	888
354	900	913	925	937	949	962	974	986	998	*011
355	55 023	035	047	060	072	084	096	108	121	133
356	145	157	169	182	194	206	218	230	242	255
357	267	279	291	303	315	328	340	352	364	376
358	388	400	413	425	437	449	461	473	485	497
359	509	522	534	546	558	570	582	594	606	618
360	630	642	654	666	678	691	703	715	727	739
361	751	763	775	787	799	811	823	835	847	859
362	871	883	895	907	919	931	943	955	967	979
363	991	*003	*015	*027	*038	*050	*062	*074	*086	*098
364	56 110	122	134	146	158	170	182	194	205	217
365	229	241	253	265	277	289	301	312	324	336
366	348	360	372	384	396	407	419	431	443	455
367	467	478	490	502	514	526	538	549	561	573
368	585	597	608	620	632	644	656	667	679	691
369	703	714	726	738	750	761	773	785	797	808
370	820	832	844	855	867	879	891	902	914	926
371	937	949	961	972	984	996	*008	*019	*031	*043
372	57 054	066	078	089	101	113	124	136	148	159
373	171	183	194	206	217	229	241	252	264	276
374	287	299	310	322	334	345	357	368	380	392
375	403	415	426	438	449	461	473	484	496	507
376	519	530	542	553	565	576	588	600	611	623
377	634	646	657	669	680	692	703	715	726	738
378	749	761	772	784	795	807	818	830	841	852
379	864	875	887	898	910	921	933	944	955	967
380	978	990	*001	*013	*024	*035	*047	*058	*070	*081
381	58 092	104	115	127	138	149	161	172	184	195
382	206	218	229	240	252	263	274	286	297	309
383	320	331	343	354	365	377	388	399	410	422
384	433	444	456	467	478	490	501	512	524	535
385	546	557	569	580	591	602	614	625	636	647
386	659	670	681	692	704	715	726	737	749	760
387	771	782	794	805	816	827	838	850	861	872
388	883	894	906	917	928	939	950	961	973	984
389	995	*006	*017	*028	*040	*051	*062	*073	*084	*095
390	59 106	118	129	140	151	162	173	184	195	207
391	218	229	240	251	262	273	284	295	306	318
392	329	340	351	362	373	384	395	406	417	428
393	439	450	461	472	483	494	506	517	528	539
394	550	561	572	583	594	605	616	627	638	649
395	660	671	682	693	704	715	726	737	748	759
396	770	780	791	802	813	824	835	846	857	868
397	879	890	901	912	923	934	945	956	966	977
398	988	999	*010	*021	*032	*043	*054	*065	*076	*086
399	60 097	108	119	130	141	152	163	173	184	195
400	206	217	228	239	249	260	271	282	293	304
N.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	13
1	1,3
2	2,6
3	3,9
4	5,2
5	6,5
6	7,8
7	9,1
8	10,4
9	11,7

	12
1	1,2
2	2,4
3	3,6
4	4,8
5	6,0
6	7,2
7	8,4
8	9,6
9	10,8

	11
1	1,1
2	2,2
3	3,3
4	4,4
5	5,5
6	6,6
7	7,7
8	8,8
9	9,9

	10
1	1,0
2	2,0
3	3,0
4	4,0
5	5,0
6	6,0
7	7,0
8	8,0
9	9,0

Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
400	60 206	217	228	239	249	260	271	282	293	304	
401	314	325	336	347	358	369	379	390	401	412	
402	423	433	444	455	466	477	487	498	509	520	
403	531	541	552	563	574	584	595	606	617	627	
404	638	649	660	670	681	692	703	713	724	735	
405	746	756	767	778	788	799	810	821	831	842	
406	853	863	874	885	895	906	917	927	938	949	
407	959	970	981	991	*002	*013	*023	*034	*045	*055	**11**
408	61 066	077	087	098	109	119	130	140	151	162	1 | 1,1
409	172	183	194	204	215	225	236	247	257	268	2 | 2,2
410	278	289	300	310	321	331	342	352	363	374	3 | 3,3
411	384	395	405	416	426	437	448	458	469	479	4 | 4,4
412	490	500	511	521	532	542	553	563	574	584	5 | 5,5
413	595	606	616	627	637	648	658	669	679	690	6 | 6,6
414	700	711	721	731	742	752	763	773	784	794	7 | 7,7
415	805	815	826	836	847	857	868	878	888	899	8 | 8,8
416	909	920	930	941	951	962	972	982	993	*003	9 | 9,9
417	62 014	024	034	045	055	066	076	086	097	107	
418	118	128	138	149	159	170	180	190	201	211	
419	221	232	242	252	263	273	284	294	304	315	
420	325	335	346	356	366	377	387	397	408	418	**10**
421	428	439	449	459	469	480	490	500	511	521	1 | 1,0
422	531	542	552	562	572	583	593	603	613	624	2 | 2,0
423	634	644	655	665	675	685	696	706	716	726	3 | 3,0
424	737	747	757	767	778	788	798	808	818	829	4 | 4,0
425	839	849	859	870	880	890	900	910	921	931	5 | 5,0
426	941	951	961	972	982	992	*002	*012	*022	*033	6 | 6,0
427	63 043	053	063	073	083	094	104	114	124	134	7 | 7,0
428	144	155	165	175	185	195	205	215	225	236	8 | 8,0
429	246	256	266	276	286	296	306	317	327	337	9 | 9,0
430	347	357	367	377	387	397	407	417	428	438	
431	448	458	468	478	488	498	508	518	528	538	
432	548	558	568	579	589	599	609	619	629	639	
433	649	659	669	679	689	699	709	719	729	739	
434	749	759	769	779	789	799	809	819	829	839	
435	849	859	869	879	889	899	909	919	929	939	
436	949	959	969	979	988	998	*008	*018	*028	*038	**9**
437	64 048	058	068	078	088	098	108	118	128	137	1 | 0,9
438	147	157	167	177	187	197	207	217	227	237	2 | 1,8
439	246	256	266	276	286	296	306	316	326	335	3 | 2,7
440	345	355	365	375	385	395	404	414	424	434	4 | 3,6
441	444	454	464	473	483	493	503	513	523	532	5 | 4,5
442	542	552	562	572	582	591	601	611	621	631	6 | 5,4
443	640	650	660	670	680	689	699	709	719	729	7 | 6,3
444	738	748	758	768	777	787	797	807	816	826	8 | 7,2
445	836	846	856	865	875	885	895	904	914	924	9 | 8,1
446	933	943	953	963	972	982	992	*002	*011	*021	
447	65 031	040	050	060	070	079	089	099	108	118	
448	128	137	147	157	167	176	186	196	205	215	
449	225	234	244	254	263	273	283	292	302	312	
450	321	331	341	350	360	369	379	389	398	408	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9
450	65	321	331	341	350	360	369	379	389	398	408
451		418	427	437	447	456	466	475	485	495	504
452		514	523	533	543	552	562	571	581	591	600
453		610	619	629	639	648	658	667	677	686	696
454		706	715	725	734	744	753	763	772	782	792
455		801	811	820	830	839	849	858	868	877	887
456		896	906	916	925	935	944	954	963	973	982
457		992	*001	*011	*020	*030	*039	*049	*058	*068	*077
458	66	087	096	106	115	124	134	143	153	162	172
459		181	191	200	210	219	229	238	247	257	266
460		276	285	295	304	314	323	332	342	351	361
461		370	380	389	398	408	417	427	436	445	455
462		464	474	483	492	502	511	521	530	539	549
463		558	567	577	586	596	605	614	624	633	642
464		652	661	671	680	689	699	708	717	727	736
465		745	755	764	773	783	792	801	811	820	829
466		839	848	857	867	876	885	894	904	913	922
467		932	941	950	960	969	978	987	997	*006	*015
468	67	025	034	043	052	062	071	080	089	099	108
469		117	127	136	145	154	164	173	182	191	201
470		210	219	228	237	247	256	265	274	284	293
471		302	311	321	330	339	348	357	367	376	385
472		394	403	413	422	431	440	449	459	468	477
473		486	495	504	514	523	532	541	550	560	569
474		578	587	596	605	614	624	633	642	651	660
475		669	679	688	697	706	715	724	733	742	752
476		761	770	779	788	797	806	815	825	834	843
477		852	861	870	879	888	897	906	916	925	934
478		943	952	961	970	979	988	997	*006	*015	*024
479	68	034	043	052	061	070	079	088	097	106	115
480		124	133	142	151	160	169	178	187	196	205
481		215	224	233	242	251	260	269	278	287	296
482		305	314	323	332	341	350	359	368	377	386
483		395	404	413	422	431	440	449	458	467	476
484		485	494	502	511	520	529	538	547	556	565
485		574	583	592	601	610	619	628	637	646	655
486		664	673	681	690	699	708	717	726	735	744
487		753	762	771	780	789	797	806	815	824	833
488		842	851	860	869	878	886	895	904	913	922
489		931	940	949	958	966	975	984	993	*002	*011
490	69	020	028	037	046	055	064	073	082	090	099
491		108	117	126	135	144	152	161	170	179	188
492		197	205	214	223	232	241	249	258	267	276
493		285	294	302	311	320	329	338	346	355	364
494		373	381	390	399	408	417	425	434	443	452
495		461	469	478	487	496	504	513	522	531	539
496		548	557	566	574	583	592	601	609	618	627
497		636	644	653	662	671	679	688	697	705	714
498		723	732	740	749	758	767	775	784	793	801
499		810	819	827	836	845	854	862	871	880	888
500		897	906	914	923	932	940	949	958	966	975
N.		0	1	2	3	4	5	6	7	8	9

Proportional parts

	10
1	1·0
2	2·0
3	3·0
4	4·0
5	5·0
6	6·0
7	7·0
8	8·0
9	9·0

	9
1	0·9
2	1·8
3	2·7
4	3·6
5	4·5
6	5·4
7	6·3
8	7·2
9	8·1

	8
1	0·8
2	1·6
3	2·4
4	3·2
5	4·0
6	4·8
7	5·6
8	6·4
9	7·2

Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
500	69 897	906	914	923	932	940	949	958	966	975
501	984	992	*001	*010	*018	*027	*036	*044	*053	*062
502	70 070	079	088	096	105	114	122	131	140	148
503	157	165	174	183	191	200	209	217	226	234
504	243	252	260	269	278	286	295	303	312	321
505	329	338	346	355	364	372	381	389	398	406
506	415	424	432	441	449	458	467	475	484	492
507	501	509	518	526	535	544	552	561	569	578
508	586	595	603	612	621	629	638	646	655	663
509	672	680	689	697	706	714	723	731	740	749
510	757	766	774	783	791	800	808	817	825	834
511	842	851	859	868	876	885	893	902	910	919
512	927	935	944	952	961	969	978	986	995	*003
513	71 012	020	029	037	046	054	063	071	079	088
514	096	105	113	122	130	139	147	155	164	172
515	181	189	198	206	214	223	231	240	248	257
516	265	273	282	290	299	307	315	324	332	341
517	349	357	366	374	383	391	399	408	416	425
518	433	441	450	458	466	475	483	492	500	508
519	517	525	533	542	550	559	567	575	584	592
520	600	609	617	625	634	642	650	659	667	675
521	684	692	700	709	717	725	734	742	750	759
522	767	775	784	792	800	809	817	825	834	842
523	850	858	867	875	883	892	900	908	917	925
524	933	941	950	958	966	975	983	991	999	*008
525	72 016	024	032	041	049	057	066	074	082	090
526	099	107	115	123	132	140	148	156	165	173
527	181	189	198	206	214	222	230	239	247	255
528	263	272	280	288	296	304	313	321	329	337
529	346	354	362	370	378	387	395	403	411	419
530	428	436	444	452	460	469	477	485	493	501
531	509	518	526	534	542	550	558	567	575	583
532	591	599	607	616	624	632	640	648	656	665
533	673	681	689	697	705	713	722	730	738	746
534	754	762	770	779	787	795	803	811	819	827
535	835	843	852	860	868	876	884	892	900	908
536	916	925	933	941	949	957	965	973	981	989
537	997	*006	*014	*022	*030	*038	*046	*054	*062	*070
538	73 078	086	094	102	111	119	127	135	143	151
539	159	167	175	183	191	199	207	215	223	231
540	239	247	255	263	272	280	288	296	304	312
541	320	328	336	344	352	360	368	376	384	392
542	400	408	416	424	432	440	448	456	464	472
543	480	488	496	504	512	520	528	536	544	552
544	560	568	576	584	592	600	608	616	624	632
545	640	648	656	664	672	679	687	695	703	711
546	719	727	735	743	751	759	767	775	783	791
547	799	807	815	823	830	838	846	854	862	870
548	878	886	894	902	910	918	926	933	941	949
549	957	965	973	981	989	997	*005	*013	*020	*028
550	74 036	044	052	060	068	076	084	092	099	107
N.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	9
1	0·9
2	1·8
3	2·7
4	3·6
5	4·5
6	5·4
7	6·3
8	7·2
9	8·1

	8
1	0·8
2	1·6
3	2·4
4	3·2
5	4·0
6	4·8
7	5·6
8	6·4
9	7·2

	7
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3

Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9	Proportional parts	
550	74	036	044	052	060	068	076	084	092	099	107		
551		115	123	131	139	147	155	162	170	178	186		
552		194	202	210	218	225	233	241	249	257	265		
553		273	280	288	296	304	312	320	327	335	343		
554		351	359	367	374	382	390	398	406	414	421		
555		429	437	445	453	461	468	476	484	492	500		
556		507	515	523	531	539	547	554	562	570	578		
557		586	593	601	609	617	624	632	640	648	656		
558		663	671	679	687	695	702	710	718	726	733		
559		741	749	757	764	772	780	788	796	803	811		
560		819	827	834	842	850	858	865	873	881	889		**8**
561		896	904	912	920	927	935	943	950	958	966	1	0·8
562		974	981	989	997	*005	*012	*020	*028	*035	*043	2	1·6
563	75	051	059	066	074	082	089	097	105	113	120	3	2·4
564		128	136	143	151	159	166	174	182	189	197	4	3·2
565		205	213	220	228	236	243	251	259	266	274	5	4·0
566		282	289	297	305	312	320	328	335	343	351	6	4·8
567		358	366	374	381	389	397	404	412	420	427	7	5·6
568		435	442	450	458	465	473	481	488	496	504	8	6·4
569		511	519	526	534	542	549	557	565	572	580	9	7·2
570		587	595	603	610	618	626	633	641	648	656		
571		664	671	679	686	694	702	709	717	724	732		
572		740	747	755	762	770	778	785	793	800	808		
573		815	823	831	838	846	853	861	868	876	884		
574		891	899	906	914	921	929	937	944	952	959		
575		967	974	982	989	997	*005	*012	*020	*027	*035		
576	76	042	050	057	065	072	080	087	095	103	110		
577		118	125	133	140	148	155	163	170	178	185		
578		193	200	208	215	223	230	238	245	253	260		
579		268	275	283	290	298	305	313	320	328	335		
580		343	350	358	365	373	380	388	395	403	410		**7**
581		418	425	433	440	448	455	462	470	477	485	1	0·7
582		492	500	507	515	522	530	537	545	552	559	2	1·4
583		567	574	582	589	597	604	612	619	626	634	3	2·1
584		641	649	656	664	671	678	686	693	701	708	4	2·8
585		716	723	730	738	745	753	760	768	775	782	5	3·5
586		790	797	805	812	819	827	834	842	849	856	6	4·2
587		864	871	879	886	893	901	908	916	923	930	7	4·9
588		938	945	953	960	967	975	982	989	997	*004	8	5·6
589	77	012	019	026	034	041	048	056	063	070	078	9	6·3
590		085	093	100	107	115	122	129	137	144	151		
591		159	166	173	181	188	195	203	210	217	225		
592		232	240	247	254	262	269	276	283	291	298		
593		305	313	320	327	335	342	349	357	364	371		
594		379	386	393	401	408	415	422	430	437	444		
595		452	459	466	474	481	488	495	503	510	517		
596		525	532	539	546	554	561	568	576	583	590		
597		597	605	612	619	627	634	641	648	656	663		
598		670	677	685	692	699	706	714	721	728	735		
599		743	750	757	764	772	779	786	793	801	808		
600		815	822	830	837	844	851	859	866	873	880		
N.		0	1	2	3	4	5	6	7	8	9	Proportional parts	

FIVE-PLACE LOGARITHMS (Continued)

N.		0	1	2	3	4	5	6	7	8	9
600	77	815	822	830	837	844	851	859	866	873	880
601		887	895	902	909	916	924	931	938	945	952
602		960	967	974	981	988	996	*003	*010	*017	*025
603	78	032	039	046	053	061	068	075	082	089	097
604		104	111	118	125	132	140	147	154	161	168
605		176	183	190	197	204	211	219	226	233	240
606		247	254	262	269	276	283	290	297	305	312
607		319	326	333	340	347	355	362	369	376	383
608		390	398	405	412	419	426	433	440	447	455
609		462	469	476	483	490	497	504	512	519	526
610		533	540	547	554	561	569	576	583	590	597
611		604	611	618	625	633	640	647	654	661	668
612		675	682	689	696	704	711	718	725	732	739
613		746	753	760	767	774	781	789	796	803	810
614		817	824	831	838	845	852	859	866	873	880
615		888	895	902	909	916	923	930	937	944	951
616		958	965	972	979	986	993	*000	*007	*014	*021
617	79	029	036	043	050	057	064	071	078	085	092
618		099	106	113	120	127	134	141	148	155	162
619		169	176	183	190	197	204	211	218	225	232
620		239	246	253	260	267	274	281	288	295	302
621		309	316	323	330	337	344	351	358	365	372
622		379	386	393	400	407	414	421	428	435	442
623		449	456	463	470	477	484	491	498	505	511
624		518	525	532	539	546	553	560	567	574	581
625		588	595	602	609	616	623	630	637	644	650
626		657	664	671	678	685	692	699	706	713	720
627		727	734	741	748	754	761	768	775	782	789
628		796	803	810	817	824	831	837	844	851	858
629		865	872	879	886	893	900	906	913	920	927
630		934	941	948	955	962	969	975	982	989	996
631	80	003	010	017	024	030	037	044	051	058	065
632		072	079	085	092	099	106	113	120	127	134
633		140	147	154	161	168	175	182	188	195	202
634		209	216	223	229	236	243	250	257	264	271
635		277	284	291	298	305	312	318	325	332	339
636		346	353	359	366	373	380	387	393	400	407
637		414	421	428	434	441	448	455	462	468	475
638		482	489	496	502	509	516	523	530	536	543
639		550	557	564	570	577	584	591	598	604	611
640		618	625	632	638	645	652	659	665	672	679
641		686	693	699	706	713	720	726	733	740	747
642		754	760	767	774	781	787	794	801	808	814
643		821	828	835	841	848	855	862	868	875	882
644		889	895	902	909	916	922	929	936	943	949
645		956	963	969	976	983	990	996	*003	*010	*017
646	81	023	030	037	043	050	057	064	070	077	084
647		090	097	104	111	117	124	131	137	144	151
648		158	164	171	178	184	191	198	204	211	218
649		224	231	238	245	251	258	265	271	278	285
650		291	298	305	311	318	325	331	338	345	351
N.		0	1	2	3	4	5	6	7	8	9

Proportional parts

	8
1	0.8
2	1.6
3	2.4
4	3.2
5	4.0
6	4.8
7	5.6
8	6.4
9	7.2

	7
1	0.7
2	1.4
3	2.1
4	2.8
5	3.5
6	4.2
7	4.9
8	5.6
9	6.3

	6
1	0.6
2	1.2
3	1.8
4	2.4
5	3.0
6	3.6
7	4.2
8	4.8
9	5.4

Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
650	81 291	298	305	311	318	325	331	338	345	351	
651	358	365	371	378	385	391	398	405	411	418	
652	425	431	438	445	451	458	465	471	478	485	
653	491	498	505	511	518	525	531	538	544	551	
654	558	564	571	578	584	591	598	604	611	617	
655	624	631	637	644	651	657	664	671	677	684	
656	690	697	704	710	717	723	730	737	743	750	
657	757	763	770	776	783	790	796	803	809	816	
658	823	829	836	842	849	856	862	869	875	882	
659	889	895	902	908	915	921	928	935	941	948	
660	954	961	968	974	981	987	994	*000	*007	*014	**7**
661	82 020	027	033	040	046	053	060	066	073	079	1 | 0.7
662	086	092	099	105	112	119	125	132	138	145	2 | 1.4
663	151	158	164	171	178	184	191	197	204	210	3 | 2.1
664	217	223	230	236	243	249	256	263	269	276	4 | 2.8
665	282	289	295	302	308	315	321	328	334	341	5 | 3.5
666	347	354	360	367	373	380	387	393	400	406	6 | 4.2
667	413	419	426	432	439	445	452	458	465	471	7 | 4.9
668	478	484	491	497	504	510	517	523	530	536	8 | 5.6
669	543	549	556	562	569	575	582	588	595	601	9 | 6.3
670	607	614	620	627	633	640	646	653	659	666	
671	672	679	685	692	698	705	711	718	724	730	
672	737	743	750	756	763	769	776	782	789	795	
673	802	808	814	821	827	834	840	847	853	860	
674	866	872	879	885	892	898	905	911	918	924	
675	930	937	943	950	956	963	969	975	982	988	
676	995	*001	*008	*014	*020	*027	*033	*040	*046	*052	
677	83 059	065	072	078	085	091	097	104	110	117	
678	123	129	136	142	149	155	161	168	174	181	
679	187	193	200	206	213	219	225	232	238	245	
680	251	257	264	270	276	283	289	296	302	308	**6**
681	315	321	327	334	340	347	353	359	366	372	1 | 0.6
682	378	385	391	398	404	410	417	423	429	436	2 | 1.2
683	442	448	455	461	467	474	480	487	493	499	3 | 1.8
684	506	512	518	525	531	537	544	550	556	563	4 | 2.4
685	569	575	582	588	594	601	607	613	620	626	5 | 3.0
686	632	639	645	651	658	664	670	677	683	689	6 | 3.6
687	696	702	708	715	721	727	734	740	746	753	7 | 4.2
688	759	765	771	778	784	790	797	803	809	816	8 | 4.8
689	822	828	835	841	847	853	860	866	872	879	9 | 5.4
690	885	891	897	904	910	916	923	929	935	942	
691	948	954	960	967	973	979	985	992	998	*004	
692	84 011	017	023	029	036	042	048	055	061	067	
693	073	080	086	092	098	105	111	117	123	130	
694	136	142	148	155	161	167	173	180	186	192	
695	198	205	211	217	223	230	236	242	248	255	
696	261	267	273	280	286	292	298	305	311	317	
697	323	330	336	342	348	354	361	367	373	379	
698	386	392	398	404	410	417	423	429	435	442	
699	448	454	460	466	473	479	485	491	497	504	
700	510	516	522	528	535	541	547	553	559	566	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

N.		0	1	2	3	4	5	6	7	8	9
700	84	510	516	522	528	535	541	547	553	559	566
701		572	578	584	590	597	603	609	615	621	628
702		634	640	646	652	658	665	671	677	683	689
703		696	702	708	714	720	726	733	739	745	751
704		757	763	770	776	782	788	794	800	807	813
705		819	825	831	837	844	850	856	862	868	874
706		880	887	893	899	905	911	917	924	930	936
707		942	948	954	960	967	973	979	985	991	997
708	85	003	009	016	022	028	034	040	046	052	058
709		065	071	077	083	089	095	101	107	114	120
710		126	132	138	144	150	156	163	169	175	181
711		187	193	199	205	211	217	224	230	236	242
712		248	254	260	266	272	278	285	291	297	303
713		309	315	321	327	333	339	345	352	358	364
714		370	376	382	388	394	400	406	412	418	425
715		431	437	443	449	455	461	467	473	479	485
716		491	497	503	509	516	522	528	534	540	546
717		552	558	564	570	576	582	588	594	600	606
718		612	618	625	631	637	643	649	655	661	667
719		673	679	685	691	697	703	709	715	721	727
720		733	739	745	751	757	763	769	775	781	788
721		794	800	806	812	818	824	830	836	842	848
722		854	860	866	872	878	884	890	896	902	908
723		914	920	926	932	938	944	950	956	962	968
724		974	980	986	992	998	*004	*010	*016	*022	*028
725	86	034	040	046	052	058	064	070	076	082	088
726		094	100	106	112	118	124	130	136	141	147
727		153	159	165	171	177	183	189	195	201	207
728		213	219	225	231	237	243	249	255	261	267
729		273	279	285	291	297	303	308	314	320	326
730		332	338	344	350	356	362	368	374	380	386
731		392	398	404	410	415	421	427	433	439	445
732		451	457	463	469	475	481	487	493	499	504
733		510	516	522	528	534	540	546	552	558	564
734		570	576	581	587	593	599	605	611	617	623
735		629	635	641	646	652	658	664	670	676	682
736		688	694	700	705	711	717	723	729	735	741
737		747	753	759	764	770	776	782	788	794	800
738		806	812	817	823	829	835	841	847	853	859
739		864	870	876	882	888	894	900	906	911	917
740		923	929	935	941	947	953	958	964	970	976
741		982	988	994	999	*005	*011	*017	*023	*029	*035
742	87	040	046	052	058	064	070	075	081	087	093
743		099	105	111	116	122	128	134	140	146	151
744		157	163	169	175	181	186	192	198	204	210
745		216	221	227	233	239	245	251	256	262	268
746		274	280	286	291	297	303	309	315	320	326
747		332	338	344	349	355	361	367	373	379	384
748		390	396	402	408	413	419	425	431	437	442
749		448	454	460	466	471	477	483	489	495	500
750		506	512	518	523	529	535	541	547	552	558
N.		0	1	2	3	4	5	6	7	8	9

Proportional parts

	7
1	0,7
2	1,4
3	2·1
4	2,8
5	3,5
6	4,2
7	4,9
8	5,6
9	6,3

	6
1	0,6
2	1,2
3	1,8
4	2,4
5	3,0
6	3,6
7	4,2
8	4,8
9	5,4

	5
1	0,5
2	1,0
3	1,5
4	2,0
5	2,5
6	3,0
7	3,5
8	4,0
9	4,5

Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
750	87 506	512	518	523	529	535	541	547	552	558	
751	564	570	576	581	587	593	599	604	610	616	
752	622	628	633	639	645	651	656	662	668	674	
753	679	685	691	697	703	708	714	720	726	731	
754	737	743	749	754	760	766	772	777	783	789	
755	795	800	806	812	818	823	829	835	841	846	
756	852	858	864	869	875	881	887	892	898	904	
757	910	915	921	927	933	938	944	950	955	961	
758	967	973	978	984	990	996	*001	*007	*013	*018	
759	88 024	030	036	041	047	053	058	064	070	076	
760	081	087	093	098	104	110	116	121	127	133	6
761	138	144	150	156	161	167	173	178	184	190	1 | 0.6
762	195	201	207	213	218	224	230	235	241	247	2 | 1.2
763	252	258	264	270	275	281	287	292	298	304	3 | 1.8
764	309	315	321	326	332	338	343	349	355	360	4 | 2.4
765	366	372	377	383	389	395	400	406	412	417	5 | 3.0
766	423	429	434	440	446	451	457	463	468	474	6 | 3.6
767	480	485	491	497	502	508	513	519	525	530	7 | 4.2
768	536	542	547	553	559	564	570	576	581	587	8 | 4.8
769	593	598	604	610	615	621	627	632	638	643	9 | 5.4
770	649	655	660	666	672	677	683	689	694	700	
771	705	711	717	722	728	734	739	745	750	756	
772	762	767	773	779	784	790	795	801	807	812	
773	818	824	829	835	840	846	852	857	863	868	
774	874	880	885	891	897	902	908	913	919	925	
775	930	936	941	947	953	958	964	969	975	981	
776	986	992	997	*003	*009	*014	*020	*025	*031	*037	
777	89 042	048	053	059	064	070	076	081	087	092	
778	098	104	109	115	120	126	131	137	143	148	
779	154	159	165	170	176	182	187	193	198	204	
780	209	215	221	226	232	237	243	248	254	260	5
781	265	271	276	282	287	293	298	304	310	315	1 | 0.5
782	321	326	332	337	343	348	354	360	365	371	2 | 1.0
783	376	382	387	393	398	404	409	415	421	426	3 | 1.5
784	432	437	443	448	454	459	465	470	476	481	4 | 2.0
785	487	492	498	504	509	515	520	526	531	537	5 | 2.5
786	542	548	553	559	564	570	575	581	586	592	6 | 3.0
787	597	603	609	614	620	625	631	636	642	647	7 | 3.5
788	653	658	664	669	675	680	686	691	697	702	8 | 4.0
789	708	713	719	724	730	735	741	746	752	757	9 | 4.5
790	763	768	774	779	785	790	796	801	807	812	
791	818	823	829	834	840	845	851	856	862	867	
792	873	878	883	889	894	900	905	911	916	922	
793	927	933	938	944	949	955	960	966	971	977	
794	982	988	993	998	*004	*009	*015	*020	*026	*031	
795	90 037	042	048	053	059	064	069	075	080	086	
796	091	097	102	108	113	119	124	129	135	140	
797	146	151	157	162	168	173	179	184	189	195	
798	200	206	211	217	222	227	233	238	244	249	
799	255	260	266	271	276	282	287	293	298	304	
300	309	314	320	325	331	336	342	347	352	358	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
800	90 309	314	320	325	331	336	342	347	352	358	
801	363	369	374	380	385	390	396	401	407	412	
802	417	423	428	434	439	445	450	455	461	466	
803	472	477	482	488	493	499	504	509	515	520	
804	526	531	536	542	547	553	558	563	569	574	
805	580	585	590	596	601	607	612	617	623	628	
806	634	639	644	650	655	660	666	671	677	682	
807	687	693	698	703	709	714	720	725	730	736	
808	741	747	752	757	763	768	773	779	784	789	
809	795	800	806	811	816	822	827	832	838	843	
810	849	854	859	865	870	875	881	886	891	897	6
811	902	907	913	918	924	929	934	940	945	950	1 0.6
812	956	961	966	972	977	982	988	993	998	*004	2 1.2
813	91 009	014	020	025	030	036	041	046	052	057	3 1.8
814	062	068	073	078	084	089	094	100	105	110	4 2.4
815	116	121	126	132	137	142	148	153	158	164	5 3.0
816	169	174	180	185	190	196	201	206	212	217	6 3.6
817	222	228	233	238	243	249	254	259	265	270	7 4.2
818	275	281	286	291	297	302	307	312	318	323	8 4.8
819	328	334	339	344	350	355	360	365	371	376	9 5.4
820	381	387	392	397	403	408	413	418	424	429	
821	434	440	445	450	455	461	466	471	477	482	
822	487	492	498	503	508	514	519	524	529	535	
823	540	545	551	556	561	566	572	577	582	587	
824	593	598	603	609	614	619	624	630	635	640	
825	645	651	656	661	666	672	677	682	687	693	
826	698	703	709	714	719	724	730	735	740	745	
827	751	756	761	766	772	777	782	787	793	798	
828	803	808	814	819	824	829	834	840	845	850	
829	855	861	866	871	876	882	887	892	897	903	
830	908	913	918	924	929	934	939	944	950	955	5
831	960	965	971	976	981	986	991	997	*002	*007	1 0.5
832	92 012	018	023	028	033	038	044	049	054	059	2 1.0
833	065	070	075	080	085	091	096	101	106	111	3 1.5
834	117	122	127	132	137	143	148	153	158	163	4 2.0
835	169	174	179	184	189	195	200	205	210	215	5 2.5
836	221	226	231	236	241	247	252	257	262	267	6 3.0
837	273	278	283	288	293	298	304	309	314	319	7 3.5
838	324	330	335	340	345	350	355	361	366	371	8 4.0
839	376	381	387	392	397	402	407	412	418	423	9 4.5
840	428	433	438	443	449	454	459	464	469	474	
841	480	485	490	495	500	505	511	516	521	526	
842	531	536	542	547	552	557	562	567	572	578	
843	583	588	593	598	603	609	614	619	624	629	
844	634	639	645	650	655	660	665	670	675	681	
845	686	691	696	701	706	711	716	722	727	732	
846	737	742	747	752	758	763	768	773	778	783	
847	788	793	799	804	809	814	819	824	829	834	
848	840	845	850	855	860	865	870	875	881	886	
849	891	896	901	906	911	916	921	927	932	937	
850	942	947	952	957	962	967	973	978	983	988	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts	
850	92 942	947	952	957	962	967	973	978	983	988		
851	993	998	*003	*008	*013	*018	*024	*029	*034	*039		
852	93 044	049	054	059	064	069	075	080	085	090		
853	095	100	105	110	115	120	125	131	136	141		
854	146	151	156	161	166	171	176	181	186	192		
855	197	202	207	212	217	222	227	232	237	242		
856	247	252	258	263	268	273	278	283	288	293		**6**
857	298	303	308	313	318	323	328	334	339	344	1	0.6
858	349	354	359	364	369	374	379	384	389	394	2	1.2
859	399	404	409	414	420	425	430	435	440	445	3	1.8
											4	2.4
860	450	455	460	465	470	475	480	485	490	495	5	3.0
861	500	505	510	515	520	526	531	536	541	546	6	3.6
862	551	556	561	566	571	576	581	586	591	596	7	4.2
863	601	606	611	616	621	626	631	636	641	646	8	4.8
864	651	656	661	666	671	676	682	687	692	697	9	5.4
865	702	707	712	717	722	727	732	737	742	747		
866	752	757	762	767	772	777	782	787	792	797		
867	802	807	812	817	822	827	832	837	842	847		
868	852	857	862	867	872	877	882	887	892	897		
869	902	907	912	917	922	927	932	937	942	947		
870	952	957	962	967	972	977	982	987	992	997		**5**
871	94 002	007	012	017	022	027	032	037	042	047	1	0.5
872	052	057	062	067	072	077	082	086	091	096	2	1.0
873	101	106	111	116	121	126	131	136	141	146	3	1.5
874	151	156	161	166	171	176	181	186	191	196	4	2.0
875	201	206	211	216	221	226	231	236	240	245	5	2.5
876	250	255	260	265	270	275	280	285	290	295	6	3.0
877	300	305	310	315	320	325	330	335	340	345	7	3.5
878	349	354	359	364	369	374	379	384	389	394	8	4.0
879	399	404	409	414	419	424	429	433	438	443	9	4.5
880	448	453	458	463	468	473	478	483	488	493		
881	498	503	507	512	517	522	527	532	537	542		
882	547	552	557	562	567	571	576	581	586	591		
883	596	601	606	611	616	621	626	630	635	640		
884	645	650	655	660	665	670	675	680	685	689		**4**
885	694	699	704	709	714	719	724	729	734	738	1	0.4
886	743	748	753	758	763	768	773	778	783	787	2	0.8
887	792	797	802	807	812	817	822	827	832	836	3	1.2
888	841	846	851	856	861	866	871	876	880	885	4	1.6
889	890	895	900	905	910	915	919	924	929	934	5	2.0
											6	2.4
890	939	944	949	954	959	963	968	973	978	983	7	2.8
891	988	993	998	*002	*007	*012	*017	*022	*027	*032	8	3.2
892	95 036	041	046	051	056	061	066	071	075	080	9	3.6
893	085	090	095	100	105	109	114	119	124	129		
894	134	139	143	148	153	158	163	168	173	177		
895	182	187	192	197	202	207	211	216	221	226		
896	231	236	240	245	250	255	260	265	270	274		
897	279	284	289	294	299	303	308	313	318	323		
898	328	332	337	342	347	352	357	361	366	371		
899	376	381	386	390	395	400	405	410	415	419		
900	424	429	434	439	444	448	453	458	463	468		
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts	

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
900	95 424	429	434	439	444	448	453	458	463	468	
901	472	477	482	487	492	497	501	506	511	516	
902	521	525	530	535	540	545	550	554	559	564	
903	569	574	578	583	588	593	598	602	607	612	
904	617	622	626	631	636	641	646	650	655	660	
905	665	670	674	679	684	689	694	698	703	708	
906	713	718	722	727	732	737	742	746	751	756	
907	761	766	770	775	780	785	789	794	799	804	
908	809	813	818	823	828	832	837	842	847	852	
909	856	861	866	871	875	880	885	890	895	899	
910	904	909	914	918	923	928	933	938	942	947	**5**
911	952	957	961	966	971	976	980	985	990	995	1 0·5
912	999	*004	*009	*014	*019	*023	*028	*033	*038	*042	2 1·0
913	96 047	052	057	061	066	071	076	080	085	090	3 1·5
914	095	099	104	109	114	118	123	128	133	137	4 2·0
915	142	147	152	156	161	166	171	175	180	185	5 2·5
916	190	194	199	204	209	213	218	223	227	232	6 3·0
917	237	242	246	251	256	261	265	270	275	280	7 3·5
918	284	289	294	298	303	308	313	317	322	327	8 4·0
919	332	336	341	346	350	355	360	365	369	374	9 4·5
920	379	384	388	393	398	402	407	412	417	421	
921	426	431	435	440	445	450	454	459	464	468	
922	473	478	483	487	492	497	501	506	511	515	
923	520	525	530	534	539	544	548	553	558	562	
924	567	572	577	581	586	591	595	600	605	609	
925	614	619	624	628	633	638	642	647	652	656	
926	661	666	670	675	680	685	689	694	699	703	
927	708	713	717	722	727	731	736	741	745	750	
928	755	759	764	769	774	778	783	788	792	797	
929	802	806	811	816	820	825	830	834	839	844	
930	848	853	858	862	867	872	876	881	886	890	**4**
931	895	900	904	909	914	918	923	928	932	937	1 0·4
932	942	946	951	956	960	965	970	974	979	984	2 0·8
933	988	993	997	*002	*007	*011	*016	*021	*025	*030	3 1·2
934	97 035	039	044	049	053	058	063	067	072	077	4 1·6
935	081	086	090	095	100	104	109	114	118	123	5 2·0
936	128	132	137	142	146	151	155	160	165	169	6 2·4
937	174	179	183	188	192	197	202	206	211	216	7 2·8
938	220	225	230	234	239	243	248	253	257	262	8 3·2
939	267	271	276	280	285	290	294	299	304	308	9 3·6
940	313	317	322	327	331	336	340	345	350	354	
941	359	364	368	373	377	382	387	391	396	400	
942	405	410	414	419	424	428	433	437	442	447	
943	451	456	460	465	470	474	479	483	488	493	
944	497	502	506	511	516	520	525	529	534	539	
945	543	548	552	557	562	566	571	575	580	585	
946	589	594	598	603	607	612	617	621	626	630	
947	635	640	644	649	653	658	663	667	672	676	
948	681	685	690	695	699	704	708	713	717	722	
949	727	731	736	740	745	749	754	759	763	768	
950	772	777	782	786	791	795	800	804	809	813	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
950	97 772	777	782	786	791	795	800	804	809	813	
951	818	823	827	832	836	841	845	850	855	859	
952	864	868	873	877	882	886	891	896	900	905	
953	909	914	918	923	928	932	937	941	946	950	
954	955	959	964	968	973	978	982	987	991	996	
955	98 000	005	009	014	019	023	028	032	037	041	
956	046	050	055	059	064	068	073	078	082	087	
957	091	096	100	105	109	114	118	123	127	132	
958	137	141	146	150	155	159	164	168	173	177	
959	182	186	191	195	200	204	209	214	218	223	
960	227	232	236	241	245	250	254	259	263	268	**5**
961	272	277	281	286	290	295	299	304	308	313	1 | 0,5
962	318	322	327	331	336	340	345	349	354	358	2 | 1,0
963	363	367	372	376	381	385	390	394	399	403	3 | 1,5
964	408	412	417	421	426	430	435	439	444	448	4 | 2,0
965	453	457	462	466	471	475	480	484	489	493	5 | 2,5
966	498	502	507	511	516	520	525	529	534	538	6 | 3,0
967	543	547	552	556	561	565	570	574	579	583	7 | 3,5
968	588	592	597	601	605	610	614	619	623	628	8 | 4,0
969	632	637	641	646	650	655	659	664	668	673	9 | 4,5
970	677	682	686	691	695	700	704	709	713	717	
971	722	726	731	735	740	744	749	753	758	762	
972	767	771	776	780	784	789	793	798	802	807	
973	811	816	820	825	829	834	838	843	847	851	
974	856	860	865	869	874	878	883	887	892	896	
975	900	905	909	914	918	923	927	932	936	941	
976	945	949	954	958	963	967	972	976	981	985	
977	989	994	998	*003	*007	*012	*016	*021	*025	*029	
978	99 034	038	043	047	052	056	061	065	069	074	
979	078	083	087	092	096	100	105	109	114	118	
980	123	127	131	136	140	145	149	154	158	162	**4**
981	167	171	176	180	185	189	193	198	202	207	1 | 0,4
982	211	216	220	224	229	233	238	242	247	251	2 | 0,8
983	255	260	264	269	273	277	282	286	291	295	3 | 1,2
984	300	304	308	313	317	322	326	330	335	339	4 | 1,6
985	344	348	352	357	361	366	370	374	379	383	5 | 2,0
986	388	392	396	401	405	410	414	419	423	427	6 | 2,4
987	432	436	441	445	449	454	458	463	467	471	7 | 2,8
988	476	480	484	489	493	498	502	506	511	515	8 | 3,2
989	520	524	528	533	537	542	546	550	555	559	9 | 3,6
990	564	568	572	577	581	585	590	594	599	603	
991	607	612	616	621	625	629	634	638	642	647	
992	651	656	660	664	669	673	677	682	686	691	
993	695	699	704	708	712	717	721	726	730	734	
994	739	743	747	752	756	760	765	769	774	778	
995	782	787	791	795	800	804	808	813	817	822	
996	826	830	835	839	843	848	852	856	861	865	
997	870	874	878	883	887	891	896	900	904	909	
998	913	917	922	926	930	935	939	944	948	952	
999	957	961	965	970	974	978	983	987	991	996	
1000	00 000	004	009	013	017	022	026	030	035	039	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	d.
1000	000 0000	0434	0869	1303	1737	2171	2605	3039	3473	3907	434
1001	4341	4775	5208	5642	6076	6510	6943	7377	7810	8244	434
1002	8677	9111	9544	9977	*0411	*0844	*1277	*1710	*2143	*2576	433
1003	001 3009	3442	3875	4308	4741	5174	5607	6039	6472	6905	433
1004	7337	7770	8202	8635	9067	9499	9932	*0364	*0796	*1228	432
1005	002 1661	2093	2525	2957	3389	3821	4253	4685	5116	5548	432
1006	5980	6411	6843	7275	7706	8138	8569	9001	9432	9863	431
1007	003 0295	0726	1157	1588	2019	2451	2882	3313	3744	4174	431
1008	4605	5036	5467	5898	6328	6759	7190	7620	8051	8481	431
1009	8912	9342	9772	*0203	*0633	*1063	*1493	*1924	*2354	*2784	430
1010	004 3214	3644	4074	4504	4933	5363	5793	6223	6652	7082	430
1011	7512	7941	8371	8800	9229	9659	*0088	*0517	*0947	*1376	429
1012	005 1805	2234	2663	3092	3521	3950	4379	4808	5237	5666	429
1013	6094	6523	6952	7380	7809	8238	8666	9094	9523	9951	429
1014	006 0380	0808	1236	1664	2092	2521	2949	3377	3805	4233	428
1015	4660	5088	5516	5944	6372	6799	7227	7655	8082	8510	428
1016	8937	9365	9792	*0219	*0647	*1074	*1501	*1928	*2355	*2782	427
1017	007 3210	3637	4064	4490	4917	5344	5771	6198	6624	7051	427
1018	7478	7904	8331	8757	9184	9610	*0037	*0463	*0889	*1316	426
1019	008 1742	2168	2594	3020	3446	3872	4298	4724	5150	5576	426
1020	6002	6427	6853	7279	7704	8130	8556	8981	9407	9832	426
1021	009 0257	0683	1108	1533	1959	2384	2809	3234	3659	4084	425
1022	4509	4934	5359	5784	6208	6633	7058	7483	7907	8332	425
1023	8756	9181	9605	*0030	*0454	*0878	*1303	*1727	*2151	*2575	424
1024	010 3000	3424	3848	4272	4696	5120	5544	5967	6391	6815	424
1025	7239	7662	8086	8510	8933	9357	9780	*0204	*0627	*1050	424
1026	011 1474	1897	2320	2743	3166	3590	4013	4436	4859	5282	423
1027	5704	6127	6550	6973	7396	7818	8241	8664	9086	9509	423
1028	9931	*0354	*0776	*1198	*1621	*2043	*2465	*2887	*3310	*3732	422
1029	012 4154	4576	4998	5420	5842	6264	6685	7107	7529	7951	422
1030	8372	8794	9215	9637	*0059	*0480	*0901	*1323	*1744	*2165	422
1031	013 2587	3008	3429	3850	4271	4692	5113	5534	5955	6376	421
1032	6797	7218	7639	8059	8480	8901	9321	9742	*0162	*0583	421
1033	014 1003	1424	1844	2264	2685	3105	3525	3945	4365	4785	420
1034	5205	5625	6045	6465	6885	7305	7725	8144	8564	8984	420
1035	9403	9823	*0243	*0662	*1082	*1501	*1920	*2340	*2759	*3178	420
1036	015 3598	4017	4436	4855	5274	5693	6112	6531	6950	7369	419
1037	7788	8206	8625	9044	9462	9881	*0300	*0718	*1137	*1555	419
1038	016 1974	2392	2810	3229	3647	4065	4483	4901	5319	5737	418
1039	6155	6573	6991	7409	7827	8245	8663	9080	9498	9916	418
1040	017 0333	0751	1168	1586	2003	2421	2838	3256	3673	4090	417
1041	4507	4924	5342	5759	6176	6593	7010	7427	7844	8260	417
1042	8677	9094	9511	9927	*0344	*0761	*1177	*1594	*2010	*2427	417
1043	018 2843	3259	3676	4092	4508	4925	5341	5757	6173	6589	416
1044	7005	7421	7837	8253	8669	9084	9500	9916	*0332	*0747	416
1045	019 1163	1578	1994	2410	2825	3240	3656	4071	4486	4902	415
1046	5317	5732	6147	6562	6977	7392	7807	8222	8637	9052	415
1047	9467	9882	*0296	*0711	*1126	*1540	*1955	*2369	*2784	*3198	415
1048	020 3613	4027	4442	4856	5270	5684	6099	6513	6927	7341	414
1049	7755	8169	8583	8997	9411	9824	*0238	*0652	*1066	*1479	414
1050	021 1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
N.	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	d.
1050	021 1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
1051	6027	6440	6854	7267	7680	8093	8506	8919	9332	9745	413
1052	022 0157	0570	0983	1396	1808	2221	2634	3046	3459	3871	413
1053	4284	4696	5109	5521	5933	6345	6758	7170	7582	7994	412
1054	8406	8818	9230	9642	*0054	*0466	*0878	*1289	*1701	*2113	412
1055	023 2525	2936	3348	3759	4171	4582	4994	5405	5817	6228	411
1056	6639	7050	7462	7873	8284	8695	9106	9517	9928	*0339	411
1057	024 0750	1161	1572	1982	2393	2804	3214	3625	4036	4446	411
1058	4857	5267	5678	6088	6498	6909	7319	7729	8139	8549	410
1059	8960	9370	9780	*0190	*0600	*1010	*1419	*1829	*2239	*2649	410
1060	025 3059	3468	3878	4288	4697	5107	5516	5926	6335	6744	410
1061	7154	7563	7972	8382	8791	9200	9609	*0018	*0427	*0836	409
1062	026 1245	1654	2063	2472	2881	3289	3698	4107	4515	4924	409
1063	5333	5741	6150	6558	6967	7375	7783	8192	8600	9008	408
1064	9416	9824	*0233	*0641	*1049	*1457	*1865	*2273	*2680	*3088	408
1065	027 3496	3904	4312	4719	5127	5535	5942	6350	6757	7165	408
1066	7572	7979	8387	8794	9201	9609	*0016	*0423	*0830	*1237	407
1067	028 1644	2051	2458	2865	3272	3679	4086	4492	4899	5306	407
1068	5713	6119	6526	6932	7339	7745	8152	8558	8964	9371	406
1069	9777	*0183	*0590	*0996	*1402	*1808	*2214	*2620	*3026	*3432	406
1070	029 3838	4244	4649	5055	5461	5867	6272	6678	7084	7489	406
1071	7895	8300	8706	9111	9516	9922	*0327	*0732	*1138	*1543	405
1072	030 1948	2353	2758	3163	3568	3973	4378	4783	5188	5592	405
1073	5997	6402	6807	7211	7616	8020	8425	8830	9234	9638	405
1074	031 0043	0447	0851	1256	1660	2064	2468	2872	3277	3681	404
1075	4085	4489	4893	5296	5700	6104	6508	6912	7315	7719	404
1076	8123	8526	8930	9333	9737	*0140	*0544	*0947	*1350	*1754	403
1077	032 2157	2560	2963	3367	3770	4173	4576	4979	5382	5785	403
1078	6188	6590	6993	7396	7799	8201	8604	9007	9409	9812	403
1079	033 0214	0617	1019	1422	1824	2226	2629	3031	3433	3835	402
1080	4238	4640	5042	5444	5846	6248	6650	7052	7453	7855	402
1081	8257	8659	9060	9462	9864	*0265	*0667	*1068	*1470	*1871	402
1082	034 2273	2674	3075	3477	3878	4279	4680	5081	5482	5884	401
1083	6285	6686	7087	7487	7888	8289	8690	9091	9491	9892	401
1084	035 0293	0693	1094	1495	1895	2296	2696	3096	3497	3897	400
1085	4297	4698	5098	5498	5898	6298	6698	7098	7498	7898	400
1086	8298	8698	9098	9498	9898	*0297	*0697	*1097	*1496	*1896	400
1087	036 2295	2695	3094	3494	3893	4293	4692	5091	5491	5890	399
1088	6289	6688	7087	7486	7885	8284	8683	9082	9481	9880	399
1089	037 0279	0678	1076	1475	1874	2272	2671	3070	3468	3867	399
1090	4265	4663	5062	5460	5858	6257	6655	7053	7451	7849	398
1091	8248	8646	9044	9442	9839	*0237	*0635	*1033	*1431	*1829	398
1092	038 2226	2624	3022	3419	3817	4214	4612	5009	5407	5804	398
1093	6202	6599	6996	7393	7791	8188	8585	8982	9379	9776	397
1094	039 0173	0570	0967	1364	1761	2158	2554	2951	3348	3745	397
1095	4141	4538	4934	5331	5727	6124	6520	6917	7313	7709	397
1096	8106	8502	8898	9294	9690	*0086	*0482	*0878	*1274	*1670	396
1097	040 2066	2462	2858	3254	3650	4045	4441	4837	5232	5628	396
1098	6023	6419	6814	7210	7605	8001	8396	8791	9187	9582	395
1099	9977	*0372	*0767	*1162	*1557	*1952	*2347	*2742	*3137	*3532	395
1100	041 3927	4322	4716	5111	5506	5900	6295	6690	7084	7479	395
N.	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS—(Continued)

N	0	1	2	3	4	5	6	7	8	9	d.
1100	041 3927	4322	4716	5111	5506	5900	6295	6690	7084	7479	395
1101	7873	8268	8662	9056	9451	9845	*0239	*0633	*1028	*1422	394
1102	042 1816	2210	2604	2998	3392	3786	4180	4574	4968	5361	394
1103	5755	6149	6543	6936	7330	7723	8117	8510	8904	9297	394
1104	9691	*0084	*0477	*0871	*1264	*1657	*2050	*2444	*2837	*3230	393
1105	043 3623	4016	4409	4802	5195	5587	5980	6373	6766	7159	393
1106	7551	7944	8337	8729	9122	9514	9907	*0299	*0692	*1084	393
1107	044 1476	1869	2261	2653	3045	3437	3829	4222	4614	5006	392
1108	5398	5790	6181	6573	6965	7357	7749	8140	8532	8924	392
1109	9315	9707	*0099	*0490	*0882	*1273	*1664	*2056	*2447	*2839	392
1110	045 3230	3621	4012	4403	4795	5186	5577	5968	6359	6750	391
1111	7141	7531	7922	8313	8704	9095	9485	9876	*0267	*0657	391
1112	046 1048	1438	1829	2219	2610	3000	3391	3781	4171	4561	390
1113	4952	5342	5732	6122	6512	6902	7292	7682	8072	8462	390
1114	8852	9242	9632	*0021	*0411	*0801	*1190	*1580	*1970	*2359	390
1115	047 2749	3138	3528	3917	4306	4696	5085	5474	5864	6253	389
1116	6642	7031	7420	7809	8198	8587	8976	9365	9754	*0143	389
1117	048 0532	0921	1309	1698	2087	2475	2864	3253	3641	4030	389
1118	4418	4806	5195	5583	5972	6360	6748	7136	7525	7913	388
1119	8301	8689	9077	9465	9853	*0241	*0629	*1017	*1405	*1792	388
1120	049 2180	2568	2956	3343	3731	4119	4506	4894	5281	5669	388
1121	6056	6444	6831	7218	7606	7993	8380	8767	9154	9541	387
1122	9929	*0316	*0703	*1090	*1477	*1863	*2250	*2637	*3024	*3411	387
1123	050 3798	4184	4571	4958	5344	5731	6117	6504	6890	7277	387
1124	7663	8049	8436	8822	9208	9595	9981	*0367	*0753	*1139	386
1125	051 1525	1911	2297	2683	3069	3455	3841	4227	4612	4998	386
1126	5384	5770	6155	6541	6926	7312	7697	8083	8468	8854	386
1127	9239	9624	*0010	*0395	*0780	*1166	*1551	*1936	*2321	*2706	385
1128	052 3091	3476	3861	4246	4631	5016	5400	5785	6170	6555	385
1129	6939	7324	7709	8093	8478	8862	9247	9631	*0016	*0400	385
1130	053 0784	1169	1553	1937	2321	2706	3090	3474	3858	4242	384
1131	4626	5010	5394	5778	6162	6546	6929	7313	7697	8081	384
1132	8464	8848	9232	9615	9999	*0382	*0766	*1149	*1532	*1916	384
1133	054 2299	2682	3066	3449	3832	4215	4598	4981	5365	5748	383
1134	6131	6514	6896	7279	7662	8045	8428	8811	9193	9576	383
1135	9959	*0341	*0724	*1106	*1489	*1871	*2254	*2636	*3019	*3401	382
1136	055 3783	4166	4548	4930	5312	5694	6077	6459	6841	7223	382
1137	7605	7987	8369	8750	9132	9514	9896	*0278	*0659	*1041	382
1138	056 1423	1804	2186	2567	2949	3330	3712	4093	4475	4856	381
1139	5237	5619	6000	6381	6762	7143	7524	7905	8287	8668	381
1140	9049	9429	9810	*0191	*0572	*0953	*1334	*1714	*2095	*2476	381
1141	057 2856	3237	3618	3998	4379	4759	5140	5520	5900	6281	381
1142	6661	7041	7422	7802	8182	8562	8942	9322	9702	*0082	380
1143	058 0462	0842	1222	1602	1982	2362	2741	3121	3501	3881	380
1144	4260	4640	5019	5399	5778	6158	6537	6917	7296	7676	380
1145	8055	8434	8813	9193	9572	9951	*0330	*0709	*1088	*1467	379
1146	059 1846	2225	2604	2983	3362	3741	4119	4498	4877	5256	379
1147	5634	6013	6391	6770	7148	7527	7905	8284	8662	9041	379
1148	9419	9797	*0175	*0554	*0932	*1310	*1688	*2066	*2444	*2822	378
1149	060 3200	3578	3956	4334	4712	5090	5468	5845	6223	6601	378
1150	6978	7356	7734	8111	8489	8866	9244	9621	9999	*0376	378
N	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS—(Continued)

N	0	1	2	3	4	5	6	7	8	9	d.
1150	060 6978	7356	7734	8111	8489	8866	9244	9621	9999	*0376	378
1151	061 0753	1131	1508	1885	2262	2639	3017	3394	3771	4148	377
1152	4525	4902	5279	5656	6032	6409	6786	7163	7540	7916	377
1153	8293	8670	9046	9423	9799	*0176	*0552	*0929	*1305	*1682	377
1154	062 2058	2434	2811	3187	3563	3939	4316	4692	5068	5444	376
1155	5820	6196	6572	6948	7324	7699	8075	8451	8827	9203	376
1156	9578	9954	*0330	*0705	*1081	*1456	*1832	*2207	*2583	*2958	376
1157	063 3334	3709	4084	4460	4835	5210	5585	5960	6335	6711	375
1158	7086	7461	7836	8211	8585	8960	9335	9710	*0085	*0460	375
1159	064 0834	1209	1584	1958	2333	2708	3082	3457	3831	4205	375
1160	4580	4954	5329	5703	6077	6451	6826	7200	7574	7948	374
1161	8322	8696	9070	9444	9818	*0192	*0566	*0940	*1314	*1688	374
1162	065 2061	2435	2809	3182	3556	3930	4303	4677	5050	5424	374
1163	5797	6171	6544	6917	7291	7664	8037	8410	8784	9157	373
1164	9530	9903	*0276	*0649	*1022	*1395	*1768	*2141	*2514	*2886	373
1165	066 3259	3632	4005	4377	4750	5123	5495	5868	6241	6613	373
1166	6986	7358	7730	8103	8475	8847	9220	9592	9964	*0336	372
1167	067 0709	1081	1453	1825	2197	2569	2941	3313	3685	4057	372
1168	4428	4800	5172	5544	5915	6287	6659	7030	7402	7774	372
1169	8145	8517	8888	9259	9631	*0002	*0374	*0745	*1116	*1487	371
1170	068 1859	2230	2601	2972	3343	3714	4085	4456	4827	5198	371
1171	5569	5940	6311	6681	7052	7423	7794	8164	8535	8906	371
1172	9276	9647	*0017	*0388	*0758	*1129	*1499	*1869	*2240	*2610	370
1173	069 2980	3350	3721	4091	4461	4831	5201	5571	5941	6311	370
1174	6681	7051	7421	7791	8160	8530	8900	9270	9639	*0009	370
1175	070 0379	0748	1118	1487	1857	2226	2596	2965	3335	3704	369
1176	4073	4442	4812	5181	5550	5919	6288	6658	7027	7396	369
1177	7765	8134	8503	8871	9240	9609	9978	*0347	*0715	*1084	369
1178	071 1453	1822	2190	2559	2927	3296	3664	4033	4401	4770	369
1179	5138	5506	5875	6243	6611	6979	7348	7716	8084	8452	368
1180	8820	9188	9556	9924	*0292	*0660	*1028	*1396	*1763	*2131	368
1181	072 2499	2867	3234	3602	3970	4337	4705	5072	5440	5807	368
1182	6175	6542	6910	7277	7644	8011	8379	8746	9113	9480	367
1183	9847	*0215	*0582	*0949	*1316	*1683	*2050	*2416	*2783	*3150	367
1184	073 3517	3884	4251	4617	4984	5351	5717	6084	6450	6817	367
1185	7184	7550	7916	8283	8649	9016	9382	9748	*0114	*0481	366
1186	074 0847	1213	1579	1945	2311	2677	3043	3409	3775	4141	366
1187	4507	4873	5239	5605	5970	6336	6702	7068	7433	7799	366
1188	8164	8530	8895	9261	9626	9992	*0357	*0723	*1088	*1453	365
1189	075 1819	2184	2549	2914	3279	3644	4010	4375	4740	5105	365
1190	5470	5835	6199	6564	6929	7294	7659	8024	8388	8753	365
1191	9118	9482	9847	*0211	*0576	*0940	*1305	*1669	*2034	*2398	364
1192	076 2763	3127	3491	3855	4220	4584	4948	5312	5676	6040	364
1193	6404	6768	7132	7496	7860	8224	8588	8952	9316	9680	364
1194	077 0043	0407	0771	1134	1498	1862	2225	2589	2952	3316	364
1195	3679	4042	4406	4769	5133	5496	5859	6222	6585	6949	363
1196	7312	7675	8038	8401	8764	9127	9490	9853	*0216	*0579	363
1197	078 0942	1304	1667	2030	2393	2755	3118	3480	3843	4206	363
1198	4568	4931	5293	5656	6018	6380	6743	7105	7467	7830	362
1199	8192	8554	8916	9278	9640	*0003	*0365	*0727	*1089	*1451	362
1200	079 1812	2174	2536	2898	3260	3622	3983	4345	4707	5068	362
N	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS OF THE TRIGONOMETRIC FUNCTIONS

Logarithms of the functions are given for each minute from 0-360°.

The quantity −10 is to be appended to all logarithms of the sine and cosine, to logarithms of the tangent from 0-45° and of the cotangent from 45-90°.

With degrees indicated at either side of the top of the page use the column headings at the top. With degrees stated at the bottom of the page use the column designations at the bottom.

With degrees at the left (top or bottom) use the minute column at the left, and with degrees on the right side of the page use the minute column at the right.

The method of determining the functions of small angles by the auxiliary quantities S and T is given in the section explaining the use of the mathematical tables at the front of the volume.

LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

Min.	Values of S, − 10 to be appended					Values of T, − 10 to be appended					Sec.
	0°	1°	2°	3°	4°	0°	1°	2°	3°	4°	
0	4.68 557	555	549	538	522	4.68 557	562	575	597	628	0
1	557	555	549	537	522	557	562	575	598	629	60
2	557	555	548	537	522	557	562	576	598	629	120
3	557	555	548	537	521	557	562	576	599	630	180
4	557	555	548	537	521	558	563	576	599	631	240
5	557	555	548	537	521	558	563	577	599	631	300
6	557	555	548	536	520	558	563	577	600	632	360
7	557	555	548	536	520	558	563	577	600	632	420
8	557	555	548	536	520	558	563	578	601	633	480
9	557	555	547	536	520	558	563	578	601	634	540
10	4.68 557	555	547	535	519	4.68 558	564	578	602	634	600
11	557	554	547	535	519	558	564	579	602	635	660
12	557	554	547	535	519	558	564	579	603	635	720
13	557	554	547	535	518	558	564	579	603	636	780
14	557	554	547	534	518	558	564	580	604	637	840
15	557	554	546	534	518	558	564	580	604	637	900
16	557	554	546	534	517	558	565	580	605	638	960
17	557	554	546	534	517	558	565	581	605	639	1020
18	557	554	546	534	517	558	565	581	606	639	1080
19	557	554	546	533	516	558	565	581	606	640	1140
20	4.68 557	554	546	533	516	4.68 558	565	582	607	640	1200
21	557	554	545	533	516	558	566	582	607	641	1260
22	557	553	545	533	515	558	566	582	608	642	1320
23	557	553	545	532	515	558	566	583	608	642	1380
24	557	553	545	532	515	558	566	583	609	643	1440
25	557	553	545	532	515	558	566	583	609	644	1500
26	557	553	544	532	514	558	567	584	610	644	1560
27	557	553	544	531	514	558	567	584	610	645	1620
28	557	553	544	531	514	558	567	584	611	646	1680
29	557	553	544	531	513	559	567	585	611	646	1740
30	4.68 557	553	544	531	513	4.68 559	567	585	612	647	1800
31	557	552	544	530	513	559	568	585	612	648	1860
32	557	552	543	530	512	559	568	586	613	648	1920
33	557	552	543	530	512	559	568	586	613	649	1980
34	557	552	543	529	512	559	568	587	614	650	2040
35	557	552	543	529	511	559	569	587	614	650	2100
36	557	552	543	529	511	559	569	587	615	651	2160
37	557	552	542	529	511	559	569	588	615	652	2220
38	557	552	542	528	510	559	569	588	616	652	2280
39	557	552	542	528	510	559	570	589	616	653	2340
40	4.68 557	551	542	528	510	4.68 559	570	589	617	654	2400
41	556	551	542	528	509	560	570	589	617	654	2460
42	556	551	541	527	509	560	570	590	618	655	2520
43	556	551	541	527	508	560	571	590	619	656	2580
44	556	551	541	527	508	560	571	591	619	656	2640
45	556	551	541	527	508	560	571	591	620	657	2700
46	556	551	541	526	507	560	571	591	620	658	2760
47	556	551	540	526	507	560	572	592	621	659	2820
48	556	550	540	526	507	560	572	592	621	659	2880
49	556	550	540	525	506	560	572	593	622	660	2940
50	4.68 556	550	540	525	506	4.68 561	572	593	622	661	3000
51	556	550	540	525	506	561	573	593	623	661	3060
52	556	550	539	525	505	561	573	594	624	662	3120
53	556	550	539	524	505	561	573	594	624	663	3180
54	556	550	539	524	505	561	573	595	625	664	3240
55	556	549	539	524	504	561	574	595	625	664	3300
56	556	549	539	523	504	561	574	596	626	665	3360
57	556	549	538	523	503	562	574	596	626	666	3420
58	555	549	538	523	503	562	575	596	627	667	3480
59	555	549	538	523	503	562	575	597	628	667	3540
60	4.68 555	549	538	522	502	4.68 562	575	597	628	668	3600

LOGARITHMS OF THE FUNCTIONS (Continued)

0° (180°) (359°) **179°**

″	′	L. Sin.	*d.	C. S.	C. T.	L. Tan.	*c.d.	L. Cot.	L. Cos.	′
0	**0**	—		—	—	—		—	0.00 000	**60**
60	1	6.46 373	30103	5.31 443	5.31 443	6.46 373	30103	3.53 627	0.00 000	59
120	2	6.76 476	17609	5.31 443	5.31 443	6.76 476	17609	3.23 524	0.00 000	58
180	3	6.94 085̄	12494	5.31 443	5.31 443	6.94 085̄	12494	3.05 915̇	0.00 000	57
240	4	7.06 579	9691	5.31 443	5.31 442	7.06 579	9691	2.93 421	0.00 000	56
300	5	7.16 270	7918	5.31 443	5.31 442	7.16 270	7918	2.83 730	0.00 000	55
360	6	7.24 188	6694	5.31 443	5.31 442	7.24 188	6694	2.75 812	0.00 000	54
420	7	7.30 882	5800	5.31 443	5.31 442	7.30 882	5800	2.69 118	0.00 000	53
480	8	7.36 682	5115	5.31 443	5.31 442	7.36 682	5115	2.63 318	0.00 000	52
540	9	7.41 797	4576	5.31 443	5.31 442	7.41 797	4576	2.58 203	0.00 000	51
600	**10**	7.46 373	4139	5.31 443	5.31 442	7.46 373	4139	2.53 627	0.00 000	**50**
660	11	7.50 512	3779	5.31 443	5.31 442	7.50 512	3779	2.49 488	0.00 000	49
720	12	7.54 291	3476	5.31 443	5.31 442	7.54 291	3476	2.45 709	0.00 000	48
780	13	7.57 767	3218	5.31 443	5.31 442	7.57 767	3219	2.42 233	0.00 000	47
840	14	7.60 985̇	2997	5.31 443	5.31 442	7.60 986	2996	2.39 014	0.00 000	46
900	15	7.63 982	2802	5.31 443	5.31 442	7.63 982	2803	2.36 018	0.00 000	45
960	16	7.66 784	2633	5.31 443	5.31 442	7.66 785̄	2633	2.33 215	0.00 000	44
1020	17	7.69 417	2483	5.31 443	5.31 442	7.69 418	2482	2.30 582	9.99 999	43
1080	18	7.71 900	2348	5.31 443	5.31 442	7.71 900	2348	2.28 100	9.99 999	42
1140	19	7.74 248	2227	5.31 443	5.31 442	7.74 248	2228	2.25 752	9.99 999	41
1200	**20**	7.76 475̇	2119	5.31 443	5.31 442	7.76 476	2119	2.23 524	9.99 999	**40**
1260	21	7.78 594	2021	5.31 443	5.31 442	7.78 595̇	2020	2.21 405̄	9.99 999	39
1320	22	7.80 615̄	1930	5.31 443	5.31 442	7.80 615̇	1931	2.19 385̄	9.99 999	38
1380	23	7.82 545	1848	5.31 443	5.31 442	7.82 546	1848	2.17 454	9.99 999	37
1440	24	7.84 393	1773	5.31 443	5.31 442	7.84 394	1773	2.15 606	9.99 999	36
1500	25	7.86 166	1704	5.31 443	5.31 442	7.86 167	1704	2.13 833	9.99 999	35
1560	26	7.87 870	1639	5.31 443	5.31 442	7.87 871	1639	2.12 129	9.99 999	34
1620	27	7.89 509	1579	5.31 443	5.31 442	7.89 510	1579	2.10 490	9.99 999	33
1680	28	7.91 088	1524	5.31 443	5.31 442	7.91 089	1524	2.08 911	9.99 999	32
1740	29	7.92 612	1472	5.31 443	5.31 441	7.92 613	1473	2.07 387	9.99 998	31
1800	**30**	7.94 084	1424	5.31 443	5.31 441	7.94 086	1424	2.05 914	9.99 998	**30**
1860	31	7.95 508	1379	5.31 443	5.31 441	7.95 510	1379	2.04 490	9.99 998	29
1920	32	7.96 887	1336	5.31 443	5.31 441	7.96 889	1336	2.03 111	9.99 998	28
1980	33	7.98 223	1297	5.31 443	5.31 441	7.98 225̇	1297	2.01 775̄	9.99 998	27
2040	34	7.99 520	1269	5.31 443	5.31 441	7.99 522	1259	2.00 478	9.99 998	26
2100	35	8.00 779	1223	5.31 443	5.31 441	8.00 781	1223	1.99 219	9.99 998	25
2160	36	8.02 002	1190	5.31 443	5.31 441	8.02 004	1190	1.97 996	9.99 998	24
2220	37	8.03 192	1158	5.31 443	5.31 441	8.03 194	1159	1.96 806	9.99 997	23
2280	38	8.04 350	1128	5.31 443	5.31 441	8.04 353	1128	1.95 647	9.99 997	22
2340	39	8.05 478	1100	5.31 443	5.31 441	8.05 481	1100	1.94 519	9.99 997	21
2400	**40**	8.06 578	1072	5.31 443	5.31 441	8.06 581	1072	1.93 419	9.99 997	**20**
2460	41	8.07 65̄0	1046	5.31 444	5.31 440	8.07 653	1047	1.92 347	9.99 997	19
2520	42	8.08 696	1022	5.31 444	5.31 440	8.08 700	1022	1.91 300	9.99 997	18
2580	43	8.09 718	999	5.31 444	5.31 440	8.09 722	998	1.90 278	9.99 997	17
2640	44	8.10 717	976	5.31 444	5.31 440	8.10 720	976	1.89 280	9.99 996	16
2700	45	8.11 693	954	5.31 444	5.31 440	8.11 696	955	1.88 304	9.99 996	15
2760	46	8.12 647	934	5.31 444	5.31 440	8.12 651	934	1.87 349	9.99 996	14
2820	47	8.13 581	914	5.31 444	5.31 440	8.13 585̇	915	1.86 415̄	9 99 996	13
2880	48	8.14 495̇	896	5.31 444	5.31 440	8.14 5̄00	895	1.85 500	9.99 996	12
2940	49	8.15 391	877	5.31 444	5.31 440	8.15 395̇	878	1.84 605̄	9.99 996	11
3000	**50**	8.16 268	860	5.31 444	5.31 439	8.16 273	860	1.83 727	9.99 995̇	**10**
3060	51	8.17 128	843	5.31 444	5.31 439	8.17 133	843	1.82 867	9.99 995	9
3120	52	8.17 971	827	5.31 444	5.31 439	8.17 976	828	1.82 024	9.99 995	8
3180	53	8.18 798	812	5.31 444	5.31 439	8.18 804	812	1.81 196	9.99 995̄	7
3240	54	8.19 610	797	5.31 444	5.31 439	8.19 616	797	1.80 384	9.99 995̄	6
3300	55	8.20 407	782	5.31 444	5.31 439	8.20 413	782	1.79 587	9.99 994	5
3360	56	8.21 189	769	5.31 444	5.31 439	8.21 195̇	769	1.78 805̄	9.99 994	4
3420	57	8.21 958	755	5.31 445̄	5.31 439	8.21 964	756	1.78 036	9.99 994	3
3480	58	8.22 713	743	5.31 445̄	5.31 438	8.22 720	742	1.77 280	9.99 994	2
3540	59	8.23 456	730	5.31 445̄	5 31 438	8.23 462	730	1.76 538	9.99 994	1
3600	**60**	8.24 186		5.31 445̄	5.31 438	8.24 192		1.75 808	9.99 993	**0**
	′	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	′

90° (270°) (269°) **89°**

* Interpolation in this section of the table is not accurate.

LOGARITHMS OF THE FUNCTIONS (Continued)

1° (181°) (358°) **178°**

″	′	L. Sin.	*d.	C. S.	C. T.	L. Tan.	*c.d.	L. Cot.	L. Cos.	′
3600	**0**	8.24 186	717	5.31 445	5.31 438	8.24 192	718	1.75 808	9.99 993	**60**
3660	1	8.24 903	706	5.31 445	5.31 438	8.24 910	706	1.75 090	9.99 993	59
3720	2	8.25 609	695	5.31 445	5.31 438	8.25 616	696	1.74 384	9.99 993	58
3780	3	8.26 304	684	5.31 445	5.31 438	8.26 312	684	1.73 688	9.99 993	57
3840	4	8.26 988	673	5.31 445	5.31 437	8.26 996	673	1.73 004	9.99 992	56
3900	5	8.27 661	663	5.31 445	5.31 437	8.27 669	663	1.72 331	9.99 992	55
3960	6	8.28 324	653	5.31 445	5.31 437	8.28 332	654	1.71 668	9.99 992	54
4020	7	8.28 977	644	5.31 445	5.31 437	8.28 986	643	1.71 014	9.99 992	53
4080	8	8.29 621	634	5.31 445	5.31 437	8.29 629	634	1.70 371	9.99 992	52
4140	9	8.30 255	624	5.31 445	5.31 437	8.30 263	625	1.69 737	9.99 991	51
4200	**10**	8.30 879	616	5.31 446	5.31 437	8.30 888	617	1.69 112	9.99 991	**50**
4260	11	8.31 495	608	5.31 446	5.31 436	8.31 505	607	1.68 495	9.99 991	49
4320	12	8.32 103	599	5.31 446	5.31 436	8.32 112	599	1.67 888	9.99 990	48
4380	13	8.32 702	590	5.31 446	5.31 436	8.32 711	591	1.67 289	9.99 990	47
4440	14	8.33 292	583	5.31 446	5.31 436	8.33 302	584	1.66 698	9.99 990	46
4500	15	8.33 875	575	5.31 446	5.31 436	8.33 886	575	1.66 114	9.99 990	45
4560	16	8.34 450	568	5.31 446	5.31 435	8.34 461	568	1.65 539	9.99 989	44
4620	17	8.35 018	560	5.31 446	5.31 435	8.35 029	561	1.64 971	9.99 989	43
4680	18	8.35 578	553	5.31 446	5.31 435	8.35 590	553	1.64 410	9.99 989	42
4740	19	8.36 131	547	5.31 446	5.31 435	8.36 143	546	1.63 857	9.99 989	41
4800	**20**	8.36 678	539	5.31 446	5.31 435	8.36 689	540	1.63 311	9.99 988	**40**
4860	21	8.37 217	533	5.31 447	5.31 434	8.37 229	533	1.62 771	9.99 988	39
4920	22	8.37 750	526	5.31 447	5.31 434	8.37 762	527	1.62 238	9.99 988	38
4980	23	8.38 276	520	5.31 447	5.31 434	8.38 289	520	1.61 711	9.99 987	37
5040	24	8.38 796	514	5.31 447	5.31 434	8.38 809	514	1.61 191	9.99 987	36
5100	25	8.39 310	508	5.31 447	5.31 434	8.39 323	509	1.60 677	9.99 987	35
5160	26	8.39 818	502	5.31 447	5.31 433	8.39 832	502	1.60 168	9.99 986	34
5220	27	8.40 320	496	5.31 447	5.31 433	8.40 334	496	1.59 666	9.99 986	33
5280	28	8.40 816	491	5.31 447	5.31 433	8.40 830	491	1.59 170	9.99 986	32
5340	29	8.41 307	485	5.31 447	5.31 433	8.41 321	486	1.58 679	9.99 985	31
5400	**30**	8.41 792	480	5.31 447	5.31 433	8.41 807	480	1.58 193	9.99 985	**30**
5460	31	8.42 272	474	5.31 448	5.31 432	8.42 287	475	1.57 713	9.99 985	29
5520	32	8.42 746	470	5.31 448	5.31 432	8.42 762	470	1.57 238	9.99 984	28
5580	33	8.43 216	464	5.31 448	5.31 432	8.43 232	464	1.56 768	9.99 984	27
5640	34	8.43 680	459	5.31 448	5.31 432	8.43 696	460	1.56 304	9.99 984	26
5700	35	8.44 139	455	5.31 448	5.31 431	8.44 156	455	1.55 844	9.99 983	25
5760	36	8.44 594	450	5.31 448	5.31 431	8.44 611	450	1.55 389	9.99 983	24
5820	37	8.45 044	445	5.31 448	5.31 431	8.45 061	446	1.54 939	9.99 983	23
5880	38	8.45 489	441	5.31 448	5.31 431	8.45 507	441	1.54 493	9.99 982	22
5940	39	8.45 930	436	5.31 449	5.31 431	8.45 948	437	1.54 052	9.99 982	21
6000	**40**	8.46 366	433	5.31 449	5.31 430	8.46 385	432	1.53 615	9.99 982	**20**
6060	41	8.46 799	427	5.31 449	5.31 430	8.46 817	428	1.53 183	9.99 981	19
6120	42	8.47 226	424	5.31 449	5.31 430	8.47 245	424	1.52 755	9.99 981	18
6180	43	8.47 650	419	5.31 449	5.31 430	8.47 669	420	1.52 331	9.99 981	17
6240	44	8.48 069	416	5.31 449	5.31 429	8.48 089	416	1.51 911	9.99 980	16
6300	45	8.48 485	411	5.31 449	5.31 429	8.48 505	412	1.51 495	9.99 980	15
6360	46	8.48 896	408	5.31 449	5.31 429	8.48 917	408	1.51 083	9.99 979	14
6420	47	8.49 304	404	5.31 450	5.31 428	8.49 325	404	1.50 675	9.99 979	13
6480	48	8.49 708	400	5.31 450	5.31 428	8.49 729	401	1.50 271	9.99 979	12
6540	49	8.50 108	396	5.31 450	5.31 428	8.50 130	397	1.49 870	9.99 978	11
6600	**50**	8.50 504	393	5.31 450	5.31 428	8.50 527	393	1.49 473	9.99 978	**10**
6660	51	8.50 897	390	5.31 450	5.31 427	8.50 920	390	1.49 080	9.99 977	9
6720	52	8.51 287	386	5.31 450	5.31 427	8.51 310	386	1.48 690	9.99 977	8
6780	53	8.51 673	382	5.31 450	5.31 427	8.51 696	383	1.48 304	9.99 977	7
6840	54	8.52 055	379	5.31 450	5.31 427	8.52 079	380	1.47 921	9.99 976	6
6900	55	8.52 434	376	5.31 451	5.31 426	8.52 459	376	1.47 541	9.99 976	5
6960	56	8.52 810	373	5.31 451	5.31 426	8.52 835	373	1.47 165	9.99 975	4
7020	57	8.53 183	369	5.31 451	5.31 426	8.53 208	370	1.46 792	9.99 975	3
7080	58	8.53 552	367	5.31 451	5.31 425	8.53 578	367	1.46 422	9.99 974	2
7140	59	8.53 919	363	5.31 451	5.31 425	8.53 945	363	1.46 055	9.99 974	1
7200	**60**	8.54 282		5.31 451	5.31 425	8.54 308		1.45 692	9.99 974	**0**
	′	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	′

91° (271°) (268°) **88°**

* Interpolation in this section of the table is not accurate.

LOGARITHMS OF THE FUNCTIONS (Continued)

2° (182°) (357°) **177°**

″	′	L. Sin.	*d.	C. S.	C. T.	L. Tan.	*c.d.	L. Cot.	L. Cos.	′
7200	**0**	8.54 282	360	5.31 451	5.31 425̄	8.54 308	361	1.45 692	9.99 974	**60**
7260	1	8.54 642	357	5.31 451	5.31 425̄	8.54 669	358	1.45 331	9.99 973	59
7320	2	8.54 999	355	5.31 452	5.31 424	8.55 027	355	1.44 973	9.99 973	58
7380	3	8.55 354	351	5.31 452	5.31 424	8.55 382	352	1.44 618	9.99 972	57
7440	4	8.55 705	349	5.31 452	5.31 424	8.55 734	349	1.44 266	9.99 972	56
7500	5	8.56 054	346	5.31 452	5.31 423	8.56 083	346	1.43 917	9.99 971	55
7560	6	8.56 400	343	5.31 452	5.31 423	8.56 429	344	1.43 571	9.99 971	54
7620	7	8.56 743	341	5.31 452	5.31 423	8.56 773	341	1.43 227	9.99 970	53
7680	8	8.57 084	337	5.31 453	5.31 422	8.57 114	338	1.42 886	9.99 970	52
7740	9	8.57 421	336	5.31 453	5.31 422	8.57 452	336	1.42 548	9.99 969	51
7800	**10**	8.57 757	332	5.31 453	5.31 422	8.57 788	333	1.42 212	9.99 969	**50**
7860	11	8.58 089	330	5.31 453	5.31 421	8.58 121	330	1.41 879	9.99 968	49
7920	12	8.58 419	328	5.31 453	5.31 421	8.58 451	328	1.41 549	9.99 968	48
7980	13	8.58 747	325	5.31 453	5.31 421	8.58 779	326	1.41 221	9.99 967	47
8040	14	8.59 072	323	5.31 454	5.31 421	8.59 105	323	1.40 895̄	9.99 967	46
8100	15	8.59 395̄	320	5.31 454	5.31 420	8.59 428	321	1.40 572	9.99 967	45
8160	16	8.59 715	318	5.31 454	5.31 420	8.59 749	319	1.40 251	9.99 966	44
8220	17	8.60 033	316	5.31 454	5.31 420	8.60 068	316	1.39 932	9.99 966	43
8280	18	8.60 349	313	5.31 454	5.31 419	8.60 384	314	1.39 616	9.99 965̄	42
8340	19	8.60 662	311	5.31 454	5.31 419	8.60 698	311	1.39 302	9.99 964	41
8400	**20**	8.60 973	309	5.31 455̄	5.31 418	8.61 009	310	1.38 991	9.99 964	**40**
8460	21	8.61 282	307	5.31 455̄	5.31 418	8.61 319	307	1.38 681	9.99 963	39
8520	22	8.61 589	305	5.31 455̄	5.31 418	8.61 626	305	1.38 374	9.99 963	38
8580	23	8 61 894	302	5.31 455	5.31 417	8.61 931	303	1.38 069	9.99 962	37
8640	24	8.62 196	301	5.31 455	5.31 417	8.62 234	301	1.37 766	9.99 962	36
8700	25	8.62 497	298	5.31 455	5.31 417	8.62 535	299	1.37 465̄	9.99 961	35
8760	26	8.62 795̄	296	5.31 456	5.31 416	8.62 834	297	1.37 166	9.99 961	34
8820	27	8.63 091	294	5.31 456	5.31 416	8.63 131	295	1.36 869	9.99 960	33
8880	28	8.63 385	293	5.31 456	5.31 416	8.63 426	292	1.36 574	9.99 960	32
8940	29	8.63 678	290	5.31 456	5.31 415	8.63 718	291	1.36 282	9.99 959	31
9000	**30**	8.63 968	288	5.31 456	5.31 415̄	8.64 009	289	1.35 991	9.99 959	**30**
9060	31	8.64 256	287	5.31 456	5.31 415̄	8.64 298	287	1.35 702	9.99 958	29
9120	32	8.64 543	284	5.31 457	5.31 414	8.64 585	285	1.35 415̄	9.99 958	28
9180	33	8.64 827	283	5.31 457	5.31 414	8.64 870	284	1.35 130	9.99 957	27
9240	34	8.65 110	281	5.31 457	5.31 413	8.65 154	281	1.34 846	9.99 956	26
9300	35	8.65 391	279	5.31 457	5.31 413	8.65 435	280	1.34 565̄	9.99 956	25
9360	36	8.65 670	277	5.31 457	5.31 413	8.65 715̄	278	1.34 285	9.99 955	24
9420	37	8.65 947	276	5.31 458	5.31 412	8.65 993	276	1.34 007	9.99 955̄	23
9480	38	8.66 223	274	5.31 458	5.31 412	8.66 269	274	1.33 731	9.99 954	22
9540	39	8.66 497	272	5.31 458	5.31 412	8.66 543	273	1.33 457	9.99 954	21
9600	**40**	8.66 769	270	5.31 458	5.31 411	8.66 816	271	1.33 184	9.99 953	**20**
9660	41	8.67 039	269	5.31 458	5.31 411	8.67 087	269	1.32 913	9.99 952	19
9720	42	8.67 308	267	5.31 459	5.31 410	8.67 356	268	1.32 644	9.99 952	18
9780	43	8.67 575	266	5.31 459	5.31 410	8.67 624	266	1.32 376	9.99 951	17
9840	44	8.67 841	263	5.31 459	5.31 410	8.67 890	264	1.32 110	9.99 951	16
9900	45	8.68 104	263	5.31 459	5.31 409	8.68 154	263	1.31 846	9.99 950̄	15
9960	46	8.68 367	260	5.31 459	5.31 409	8.68 417	261	1.31 583	9.99 949	14
10020	47	8.68 627	259	5.31 460	5.31 408	8.68 678	260	1.31 322	9.99 949	13
10080	48	8.68 886	258	5.31 460	5.31 408	8.68 938	258	1.31 062	9.99 948	12
10140	49	8.69 144	256	5.31 460	5.31 408	8.69 196	257	1.30 804	9.99 948	11
10200	**50**	8.69 400	254	5.31 460	5.31 407	8.69 453	255	1.30 547	9.99 947	**10**
10260	51	8.69 654	253	5.31 460	5.31 407	8.69 708	254	1.30 292	9.99 946	9
10320	52	8.69 907	252	5.31 461	5.31 406	8.69 962	252	1.30 038	9.99 946	8
10380	53	8.70 159	250	5.31 461	5.31 406	8.70 214	251	1.29 786	9.99 945̄	7
10440	54	8.70 409	249	5.31 461	5.31 405	8.70 465̄	249	1.29 535	9.99 944	6
10500	55	8.70 658	247	5.31 461	5.31 405̄	8.70 714	248	1.29 286	9.99 944	5
10560	56	8.70 905̄	246	5.31 461	5.31 405̄	8.70 962	246	1.29 038	9.99 943	4
10620	57	8.71 151	244	5.31 462	5.31 404	8.71 208	245	1.28 792	9.99 942	3
10680	58	8.71 395	243	5.31 462	5.31 404	8.71 453	244	1.28 547	9.99 942	2
10740	59	8.71 638	242	5.31 462	5.31 403	8.71 697	243	1.28 303	9.99 941	1
10800	**60**	8.71 880		5.31 462	5.31 403	8.71 940		1.28 060	9.99 940	**0**
	′	L. Cos.	d.			L. Cot.	c.d.	L. Tan.	L. Sin.	′

92° (272°) (267°) **87°**

* Interpolation in this section of the table is not accurate.

LOGARITHMS OF THE FUNCTIONS (Continued)

3° (183°) (356°) **176°**

′	L. Sin.	*d.	L Tan.	*c.d.	L. Cot.	L. Cos.	′		P P.				
0	8.71 880	240	8.71 940	241	1.28 060	9.99 940	**60**	″	**241**	**239**	**237**	**235**	**234**
1	8.72 120	239	8.72 181	239	1.27 819	9.99 940	59	1	4.0	4.0	4.0	3.9	3.9
2	8.72 359	238	8.72 420	239	1.27 580	9.99 939	58	2	8.0	8.0	7.9	7.8	7.8
3	8.72 597	237	8.72 659	237	1.27 341	9.99 938	57	3	12.0	12.0	11.8	11.8	11.7
4	8.72 834	235	8.72 896	236	1.27 104	9.99 938	56	4	16.1	15.9	15.8	15.7	15.6
5	8.73 069	234	8.73 132	234	1.26 868	9.99 937	55	5	20.1	19.9	19.8	19.6	19.5
6	8.73 303	232	8.73 366	234	1.26 634	9.99 936	54	6	24.1	23.9	23.7	23.5	23.4
7	8.73 535	232	8.73 600	232	1.26 400	9.99 936	53	7	28.1	27.9	27.6	27.4	27.3
8	8.73 767	230	8.73 832	231	1.26 168	9.99 935	52	8	32.1	31.9	31.6	31.3	31.2
9	8.73 997	229	8.74 063	229	1.25 937	9.99 934	51	9	36.2	35.8	35.6	35.2	35.1
10	8.74 226	228	8.74 292	229	1.25 708	9.99 934	**50**	″	**232**	**229**	**227**	**225**	**223**
11	8.74 454	226	8.74 521	227	1.25 479	9.99 933	49	1	3.9	3.8	3.8	3.8	3.7
12	8.74 680	226	8.74 748	226	1.25 252	9.99 932	48	2	7.7	7.6	7.6	7.5	7.4
13	8.74 906	224	8.74 974	225	1.25 026	9.99 932	47	3	11.6	11.4	11.4	11.2	11.2
14	8.75 130	223	8.75 199	224	1.24 801	9.99 931	46	4	15.5̄	15.3	15.1	15.0	14.9
15	8.75 353	222	8.75 423	222	1.24 577	9.99 930	45	5	19.3	19.1	18.9	18.8	18.6
16	8.75 575̄	220	8.75 645	222	1.24 355̄	9.99 929	44	6	23.2	22.9	22.7	22.5	22.3
17	8.75 795	220	8.75 867	220	1.24 133	9.99 929	43	7	27.1	26.7	26.5̄	26.2	26.0
18	8.76 015	219	8.76 087	219	1.23 913	9.99 928	42	8	30.9	30.5	30.3	30.0	29.7
19	8.76 234	217	8.76 306	219	1.23 694	9.99 927	41	9	34.8	34.4	34.0	33.8	33.4
20	8.76 451	216	8.76 525̄	217	1.23 475̄	9.99 926	**40**	″	**222**	**220**	**217**	**215**	**213**
21	8.76 667	216	8.76 742	216	1.23 258	9.99 926	39	1	3.7	3.7	3.6	3.6	3.6
22	8.76 883	214	8.76 958	215	1.23 042	9.99 925̄	38	2	7.4	7.3	7.2	7.2	7.1
23	8.77 097	213	8.77 173	214	1.22 827	9.99 924	37	3	11.1	11.0	10.8	10.8	10.6
24	8.77 310	212	8.77 387	213	1.22 613	9.99 923	36	4	14.8	14.7	14.5̄	14.3	14.2
25	8.77 522	211	8.77 600	211	1.22 400	9.99 923	35	5	18.5	18.3	18.1	17.9	17.8
26	8.77 733	210	8.77 811	211	1.22 189	9.99 922	34	6	22.2	22.0	21.7	21.5	21.3
27	8.77 943	209	8.78 022	210	1.21 978	9.99 921	33	7	25.9	25.7	25.3	25.1	24.8
28	8.78 152	208	8.78 232	209	1.21 768	9.99 920	32	8	29.6	29.3	28.9	28.7	28.4
29	8.78 360	208	8.78 441	208	1.21 559	9.99 920	31	9	33.3	33.0	32.6	32.2	32.0
30	8.78 568	206	8.78 649	206	1.21 351	9.99 919	**30**	″	**211**	**208**	**206**	**203**	**201**
31	8.78 774	205	8.78 855	206	1.21 145̄	9.99 918	29	1	3.5	3.5̄	3.4	3.4	3.4
32	8.78 979	204	8.79 061	205	1.20 939	9.99 917	28	2	7.0	6.9	6.9	6.8	6.7
33	8.79 183	203	8.79 266	204	1.20 734	9.99 917	27	3	10.6	10.4	10.3	10.2	10.0
34	8.79 386	202	8.79 470	203	1.20 530	9.99 916	26	4	14.1	13.9	13.7	13.5	13.4
35	8.79 588	201	8.79 673	202	1.20 327	9.99 915	25	5	17.6	17.3	17.2	16.9	16.8
36	8.79 789	201	8.79 875	201	1.20 125̄	9.99 914	24	6	21.1	20.8	20.6	20.3	20.1
37	8.79 990	199	8.80 076	201	1.19 924	9.99 913	23	7	24.6	24.3	24.0	23.7	23.4
38	8.80 189	199	8.80 277	199	1.19 723	9.99 913	22	8	28.1	27.7	27.5̄	27.1	26.8
39	8.80 388	197	8.80 476	198	1.19 524	9.99 912	21	9	31.6	31.2	30.9	30.4	30.2
40	8.80 585	197	8.80 674	198	1.19 326	9.99 911	**20**	″	**199**	**197**	**195**	**193**	**192**
41	8.80 782	196	8.80 872	196	1.19 128	9.99 910	19	1	3.3	3.3	3.2	3.2	3.2
42	8.80 978	195	8.81 068	196	1.18 932	9.99 909	18	2	6.6	6.6	6.5	6.4	6.4
43	8.81 173	194	8.81 264	195	1.18 736	9.99 909	17	3	10.0	9.8	9.8	9.6	9.6
44	8.81 367	193	8.81 459	194	1.18 541	9.99 908	16	4	13.3	13.1	13.0	12.9	12.8
45	8.81 560	192	8.81 653	193	1.18 347	9.99 907	15	5	16.6	16.4	16.2	16.1	16.0
46	8.81 752	192	8.81 846	192	1.18 154	9.99 906	14	6	19.9	19.7	19.5	19.3	19.2
47	8.81 944	190	8.82 038	192	1.17 962	9.99 905	13	7	23.2	23.0	22.8	22.5	22.4
48	8.82 134	190	8.82 230	190	1.17 770	9.99 904	12	8	26.5	26.3	26.0	25.7	25.6
49	8.82 324	189	8.82 420	190	1.17 580	9.99 904	11	9	29.8	29.6	29.2	29.0	28.8
50	8.82 513	188	8.82 610	189	1.17 390	9.99 903	**10**	″	**189**	**187**	**185**	**183**	**181**
51	8.82 701	187	8.82 799	188	1.17 201	9.99 902	9	1	3.2	3.1	3.1	3.0	3.0
52	8.82 888	187	8.82 987	188	1.17 013	9.99 901	8	2	6.3	6.2	6.2	6.1	6.0
53	8.83 075̄	186	8.83 175̄	186	1.16 825	9.99 900	7	3	9.4	9.4	9.2	9.2	9.0
54	8.83 261	185	8.83 361	186	1.16 639	9.99 899	6	4	12.6	12.5̄	12.3	12.2	12.1
55	8.83 446	184	8.83 547	185	1.16 453	9.99 898	5	5	15.8	15.6	15.4	15.2	15.1
56	8.83 630	183	8.83 732	184	1.16 268	9.99 898	4	6	18.9	18.7	18.5	13.3	18.1
57	8.83 813	183	8.83 916	184	1.16 084	9.99 897	3	7	22.0	21.8	21.6	21.4	21.1
58	8.83 996	181	8.84 100	182	1.15 900	9.99 896	2	8	25.2	24.9	24.7	24.4	24.1
59	8.84 177	181	8.84 282	182	1.15 718	9.99 895̄	1	9	28.4	28.0	27.8	27.4	27.2
60	8.84 358		8.84 464		1.15 536	9.99 894	**0**	10	31.5	31.2	30.8	30.5	30.2
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′		P. P.				

93° (273°) (266°) **86°**

* Interpolation in this section of the table is not accurate.

LOGARITHMS OF THE FUNCTIONS (Continued)

4° (184°) (355°) 175°

′	L. Sin.	*d.	L. Tan.	*c.d.	L. Cot.	L. Cos.	′
0	8.84 358	181	8.84 464	182	1.15 536	9.99 894	**60**
1	8.84 539	179	8.84 646	180	1.15 354	9.99 893	59
2	8.84 718	179	8.84 826	180	1.15 174	9.99 892	58
3	8.84 897	178	8.85 006	179	1.14 994	9.99 891	57
4	8.85 075̇	177	8.85 185̄	178	1.14 815	9.99 891	56
5	8.85 252	177	8.85 363	177	1.14 637	9.99 890	55
6	8.85 429	176	8.85 540	177	1.14 460	9.99 889	54
7	8.85 605̄	175	8.85 717	176	1.14 283	9.99 888	53
8	8.85 780	175	8.85 893	176	1.14 107	9.99 887	52
9	8.85 955̄	173	8.86 069	174	1.13 931	9.99 886	51
10	8.86 128	173	8.86 243	174	1.13 757	9.99 885̇	**50**
11	8.86 301	173	8.86 417	174	1.13 583	9.99 884	49
12	8.86 474	171	8.86 591	172	1.13 409	9.99 883	48
13	8.86 645̇	171	8.86 763	172	1.13 237	9.99 882	47
14	8.86 816	171	8.86 935̇	171	1.13 065̄	9.99 881	46
15	8.86 987	169	8.87 106	171	1.12 894	9.99 880	45
16	8.87 156	169	8.87 277	170	1.12 723	9.99 879	44
17	8.87 325̇	169	8.87 447	169	1.12 553	9.99 879	43
18	8.87 494	167	8.87 616	169	1.12 384	9.99 878	42
19	8.87 661	168	8.87 785̄	168	1.12 215̇	9.99 877	41
20	8.87 829	166	8.87 953	167	1.12 047	9.99 876	**40**
21	8.87 995̄	166	8.88 120	167	1.11 880	9.99 875̄	39
22	8.88 161	165	8.88 287	166	1.11 713	9.99 874	38
23	8.88 326	164	8.88 453	165	1.11 547	9.99 873	37
24	8.88 490	164	8.88 618	165	1.11 382	9.99 872	36
25	8.88 654	163	8.88 783	165	1.11 217	9.99 871	35
26	8.88 817	163	8.88 948	163	1.11 052	9.99 870	34
27	8.88 980	162	8.89 111	163	1.10 889	9.99 869	33
28	8.89 142	162	8.89 274	163	1.10 726	9.99 868	32
29	8.89 304	160	8.89 437	161	1.10 563	9.99 867	31
30	8.89 464	161	8.89 598	162	1.10 402	9.99 866	**30**
31	8.89 625̄	159	8.89 760	160	1.10 240	9.99 865̄	29
32	8.89 784	159	8.89 920	160	1.10 080	9.99 864	28
33	8.89 943	159	8.90 080	160	1.09 920	9.99 863	27
34	8.90 102	158	8.90 240	159	1.09 760	9.99 862	26
35	8.90 260	157	8.90 399	158	1.09 601	9.99 861	25
36	8.90 417	157	8.90 557	158	1.09 443	9.99 860	24
37	8.90 574	156	8.90 715̄	157	1.09 285̇	9.99 859	23
38	8.90 730	155	8.90 872	157	1.09 128	9.99 858	22
39	8.90 885̇	155	8.91 029	156	1.08 971	9.99 857	21
40	8.91 040	155	8.91 185̄	155	1.08 815̇	9.99 856	**20**
41	8.91 195̄	154	8.91 340	155	1.08 660	9.99 855̄	19
42	8.91 349	153	8.91 495̇	155	1.08 505̄	9.99 854	18
43	8.91 502	153	8.91 65̄0	153	1.08 35̇0	9.99 853	17
44	8.91 655̇	152	8.91 803	154	1.08 197	9.99 852	16
45	8.91 807	152	8.91 957	153	1.08 043	9.99 851	15
46	8.91 959	151	8.92 110	152	1.07 890	9.99 85̄0	14
47	8.92 110	151	8.92 262	152	1.07 738	9.99 848	13
48	8.92 261	150	8.92 414	151	1.07 586	9.99 847	12
49	8.92 411	150	8.92 565̄	151	1.07 435̇	9.99 846	11
50	8.92 561	149	8.92 716	150	1.07 284	9.99 845̇	**10**
51	8.92 710	149	8.92 866	150	1.07 134	9.99 844	9
52	8.92 859	148	8.93 016	149	1.06 984	9.99 843	8
53	8.93 007	147	8.93 165̄	148	1.06 835̇	9.99 842	7
54	8.93 154	147	8.93 313	149	1.06 687	9.99 841	6
55	8.93 301	147	8.93 462	147	1.06 538	9.99 840	5
56	8.93 448	146	8.93 609	147	1.06 391	9.99 839	4
57	8.93 594	146	8.93 756	147	1.06 244	9.99 838	3
58	8.93 740	145	8.93 903	146	1.06 097	9.99 837	2
59	8.93 885̄	145	8.94 049	146	1.05 951	9.99 836	1
60	8.94 030		8.94 195̇		1.05 805̄	9.99 834	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

94° (274°) (265°) 85°

″	P. P.				
″	**182**	**181**	**179**	**178**	**177**
1	3.0	3.0	3.0	3.0	3.0
2	6.1	6.0	6.0	5.9	5.9
3	9.1	9.0	9.0	8.9	8.8
4	12.1	12.1	11.9	11.9	11.8
5	15.2	15.1	14.9	14.8	14.8
6	18.2	18.1	17.9	17.8	17.7
7	21.2	21.1	20.9	20.8	20.6
8	24.3	24.1	23.9	23.7	23.6
9	27.3	27.2	26.8	26.7	26.6
″	**176**	**175**	**174**	**173**	**172**
1	2.9	2.9	2.9	2.9	2.9
2	5.9	5.8	5.8	5.8	5.7
3	8.8	8.8	8.7	8.6	8.6
4	11.7	11.7	11.6	11.5̇	11.5̄
5	14.7	14.6	14.5	14.4	14.3
6	17.6	17.5	17.4	17.3	17.2
7	20.5̇	20.4	20.3	20.2	20.1
8	23.5̄	23.3	23.2	23.1	22.9
9	26.4	26.2	26.1	26.0	25.8
″	**171**	**170**	**169**	**168**	**167**
1	2.8	2.8	2.8	2.8	2.8
2	5.7	5.7	5.6	5.6	5.6
3	8.6	8.5	8.4	8.4	8.4
4	11.4	11.3	11.3	11.2	11.1
5	14.2	14.2	14.1	14.0	13.9
6	17.1	17.0	16.9	16.8	16.7
7	20.0	19.8	19.7	19.6	19.5̄
8	22.8	22.7	22.5̇	22.4	22.3
9	25.6	25.5	25.4	25.2	25̇.0
″	**166**	**165**	**164**	**163**	**162**
1	2.8	2.8	2.7	2.7	2.7
2	5.5̇	5.5	5.5̄	5.4	5.4
3	8.3	8.2	8.2	8.2	8.1
4	11.1	11.0	10.9	10.9	10.8
5	13.8	13.8	13.7	13.6	13.5
6	16.6	16.5	16.4	16.3	16.2
7	19.4	19.2	19.1	19.0	18.9
8	22.1	22.0	21.9	21.7	21.6
9	24.9	24.8	24.6	24.4	24.3
″	**161**	**160**	**159**	**158**	**157**
1	2.7	2.7	2.6	2.6	2.6
2	5.4	5.3	5.3	5.3	5.2
3	8.0	8.0	8.0	7.9	7.8
4	10.7	10.7	10.6	10.5̇	10.5̄
5	13.4	13.3	13.2	13.2	13.1
6	16.1	16.0	15.9	15.8	15.7
7	18.8	18.7	18.6	18.4	18.3
8	21.5̄	21.3	21.2	21.1	20.9
9	24.2	24.0	23.8	23.7	23.6
″	**156**	**155**	**154**	**153**	**152**
1	2.6	2.6	2.6	2.6	2.5
2	5.2	5.2	5.1	5.1	5.1
3	7.8	7.8	7.7	7.6	7.6
4	10.4	10.3	10.3	10.2	10.1
5	13.0	12.9	12.8	12.8	12.7
6	15.6	15.5	15.4	15.3	15.2
7	18.2	18.1	18.0	17.8	17.7
8	20.8	20.7	20.5̇	20.4	20.3
9	23.4	23.2	23.1	23.0	22.8
10	26.0	25.8	25.7	25.5	25.3
	P. P.				

* Interpolation in this section of the table is not accurate.

LOGARITHMS OF THE FUNCTIONS (Continued)

5° (185°) **(354°) 174°**

′	L. Sin.	d.	L.Tan.	c.d.	L. Cot.	L. Cos.	′
0	8.94 030	144	8.94 195̇	145	1.05 805̄	9.99 834	**60**
1	8.94 174	143	8.94 340	145	1.05 660	9.99 833	59
2	8.94 317	144	8 94 485̇	145	1.05 515̄	9.99 832	58
3	8.94 461	142	8.94 630	143	1.05 370	9 99 831	57
4	8.94 603	143	8.94 773	144	1.05 227	9.99 830	56
5	8.94 746	141	8.94 917	143	1.05 083	9.99 829	55
6	8.94 887	142	8.95 060	142	1.04 940	9.99 828	54
7	8.95 029	141	8.95 202	142	1.04 798	9.99 827	53
8	8.95 170	140	8.95 344	142	1.04 656	9.99 825̇	52
9	8.95 310	140	8.95 486	141	1.04 514	9.99 824	51
10	8.95 450̄	139	8.95 627	140	1.04 373	9.99 823	**50**
11	8.95 589	139	8.95 767	141	1.04 233	9.99 822	49
12	8.95 728	139	8.95 908	139	1.04 092	9.99 821	48
13	8.95 867	138	8.96 047	140	1.03 953	9.99 820	47
14	8.96 005̇	138	8.96 187	138	1.03 813	9.99 819	46
15	8.96 143	137	8.96 325̇	139	1.03 675̄	9.99 817	45
16	8.96 280	137	8.96 464	138	1.03 536	9.99 816	44
17	8.96 417	136	8.96 602	137	1.03 398	9.99 815̇	43
18	8.96 553	136	8.96 739	138	1.03 261	9.99 814	42
19	8.96 689	136	8.96 877	136	1.03 123	9.99 813	41
20	8.96 825̄	135	8.97 013	137	1.02 987	9.99 812	**40**
21	8.96 960	135	8.97 150̄	135	1.02 850̇	9.99 810	39
22	8.97 095̄	134	8.97 285̇	136	1.02 715̄	9.99 809	38
23	8.97 229	134	8.97 421	135	1.02 579	9.99 808	37
24	8.97 363	133	8.97 556	135	1.02 444	9.99 807	36
25	8.97 496	133	8.97 691	134	1.02 309	9.99 806	35
26	8.97 629	133	8.97 825̄	134	1.02 175̇	9.99 804	34
27	8.97 762	132	8.97 959	133	1.02 041	9.99 803	33
28	8.97 894	132	8.98 092	133	1.01 908	9.99 802	32
29	8.98 026	131	8.98 225̇	133	1.01 775̄	9.99 801	31
30	8.98 157	131	8.98 358	132	1.01 642	9.99 800	**30**
31	8.98 288	131	8.98 490	132	1.01 510	9.99 798	29
32	8.98 419	130	8.98 622	131	1.01 378	9.99 797	28
33	8.98 549	130	8.98 753	131	1.01 247	9.99 796	27
34	8.98 679	129	8.98 884	131	1.01 116	9.99 795̄	26
35	8.98 808	129	8.99 015̄	130	1.00 985̇	9.99 793	25
36	8.98 937	129	8.99 145̇	130	1.00 855̄	9.99 792	24
37	8.99 066	128	8.99 275̇	130	1.00 725̄	9.99 791	23
38	8.99 194	128	8.99 405̄	129	1.00 595̇	9.99 790	22
39	8.99 322	128	8.99 534	128	1.00 466	9.99 788	21
40	8.99 450̄	127	8.99 662	129	1.00 338	9.99 787	**20**
41	8.99 577	127	8.99 791	128	1.00 209	9.99 786	19
42	8.99 704	126	8.99 919	127	1.00 081	9.99 785̄	18
43	8.99 830	126	9.00 046	128	0.99 954	9.99 783	17
44	8.99 956	126	9.00 174	127	0.99 826	9.99 782	16
45	9.00 082	125	9.00 301	126	0.99 699	9.99 781	15
46	9.00 207	125	9.00 427	126	0.99 573	9.99 780	14
47	9.00 332	124	9.00 553	126	0 99 447	9.99 778	13
48	9.00 456	125	9.00 679	126	0.99 321	9.99 777	12
49	9.00 581	123	9.00 805̄	125	0.99 195̇	9.99 776	11
50	9.00 704	124	9.00 930	125	0.99 070	9.99 775̄	**10**
51	9.00 828	123	9.01 055̄	124	0.98 945̇	9.99 773	9
52	9.00 951	123	9.01 179	124	0.98 821	9.99 772	8
53	9.01 074	122	9.01 303	124	0.98 697	9.99 771	7
54	9.01 196	122	9.01 427	123	0.98 573	9.99 769	6
55	9.01 318	122	9.01 550̇	123	0.98 450̄	9.99 768	5
56	9.01 440	121	9.01 673	123	0.98 327	9.99 767	4
57	9.01 561	121	9.01 796	122	0.98 204	9.99 765̇	3
58	9.01 682	121	9.01 918	122	0.98 082	9.99 764	2
59	9.01 803	120	9.02 040	122	0.97 960	9.99 763	1
60	9.01 923		9.02 162		0.97 838	9.99 761	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P.P.					
″	**151**	**149**	**148**	**147**	**146**
1	2.5̇	2.5̄	2.5̄	2.4	2.4
2	5̇.0	5̄.0	4.9	4.9	4.9
3	7.6	7.4	7.4	7.4	7.3
4	10.1	9.9	9.9	9.8	9.7
5	12.6	12.4	12.3	12.2	12.2
6	15.1	14.9	14.8	14.7	14.6
7	17.6	17.4	17.3	17.2	17.0
8	20.1	19.9	19.7	19.6	19.5̄
9	22.6	22.4	22.2	22.0	21.9
″	**145**	**144**	**143**	**142**	**141**
1	2.4	2.4	2.4	2.4	2.4
2	4.8	4.8	4.8	4.7	4.7
3	7.2	7.2	7.2	7.1	7.0
4	9.7	9.6	9.5̇	9.5̄	9.4
5	12.1	12.0	11.9	11.8	11.8
6	14.5	14.4	14.3	14.2	14.1
7	16.9	16.8	16.7	16.6	16.4
8	19.3	19.2	19.1	18.9	18.8
9	21.8	21.6	21.4	21.3	21.2
″	**140**	**139**	**138**	**137**	**136**
1	2.3	2.3	2.3	2.3	2.3
2	4.7	4.6	4.6	4.6	4.5̇
3	7.0	7.0	6.9	6.8	6.8
4	9.3	9.3	9.2	9.1	9.1
5	11.7	11.6	11.5	11.4	11.3
6	14.0	13.9	13.8	13.7	13.6
7	16.3	16.2	16.1	16.0	15.9
8	18.7	18.5̇	18.4	18.3	18.1
9	21.0	20.8	20.7	20.6	20.4
″	**135**	**134**	**133**	**132**	**131**
1	2.2	2.2	2.2	2.2	2.2
2	4.5	4.5̄	4.4	4.4	4.4
3	6.8	6.7	6.6	6.6	6.6
4	9.0	8.9	8.9	8.8	8.7
5	11.2	11.2	11.1	11.0	10.9
6	13.5	13.4	13.3	13.2	13.1
7	15.8	15.6	15.5̇	15.4	15.3
8	18.0	17.9	17.7	17.6	17.5̄
9	20.2	20.1	20.0	19.8	19.6
″	**130**	**129**	**128**	**127**	**126**
1	2.2	2.2	2.1	2.1	2.1
2	4.3	4.3	4.3	4.2	4.2
3	6.5	6.4	6.4	6.4	6.3
4	8.7	8.6	8.5̇	8.5̄	8.4
5	10.8	10.8	10.7	10.6	10.5
6	13.0	12.9	12.8	12.7	12.6
7	15.2	15̇.0	14.9	14.8	14.7
8	17.3	17.2	17.1	16.9	16.8
9	19.5	19.4	19.2	19.0	18.9
″	**125**	**124**	**123**	**122**	**121**
1	2.1	2.1	2.0	2.0	2.0
2	4.2	4.1	4.1	4.1	4.0
3	6.2	6.2	6.2	6.1	6.0
4	8.3	8.3	8.2	8.1	8.1
5	10.4	10.3	10.2	10.2	10.1
6	12.5	12.4	12.3	12.2	12.1
7	14.6	14.5̄	14.4	14.2	14.1
8	16.7	16.5̇	16.4	16.3	16.1
9	18.8	18.6	18.4	18.3	18.2
10	20.8	20.7	20.5	20.3	20.2
P.P.					

95° (275°) **(264°) 84°**

LOGARITHMS OF THE FUNCTIONS (Continued)

6° (186°) (353°) 173°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′	P. P.				
0	9.01 923		9.02 162		0.97 838	9.99 761	60	″	**121**	**120**	**119**	**118**
1	9.02 043	120	9.02 283	121	0.97 717	9.99 760	59	1	2.0	2.0	2.0	2.0
2	9.02 163	120	9.02 404	121	0.97 596	9.99 759	58	2	4.0	4.0	4.0	3.9
3	9.02 283	120	9.02 525	121	0.97 475	9.99 757	57	3	6.0	6.0	6.0	5.9
4	9.02 402	119	9.02 645	120	0.97 355	9.99 756	56	4	8.1	8.0	7.9	7.9
5	9.02 520	118	9.02 766	121	0.97 234	9.99 755	55	5	10.1	10.0	9.9	9.8
6	9.02 639	119	9.02 885	119	0.97 115	9.99 753	54	6	12.1	12.0	11.9	11.8
7	9.02 757	118	9.03 005	120	0.96 995	9.99 752	53	7	14.1	14.0	13.9	13.8
8	9.02 874	117	9.03 124	119	0.96 876	9.99 751	52	8	16.1	16.0	15.9	15.7
9	9.02 992	118	9.03 242	118	0.96 758	9.99 749	51	9	18.2	18.0	17.8	17.7
10	9.03 109	117	9.03 361	119	0.96 639	9.99 748	50	10	20.2	20.0	19.8	19.7
11	9.03 226	117	9.03 479	118	0.96 521	9.99 747	49	20	40.3	40.0	39.7	39.3
12	9.03 342	116	9.03 597	118	0.96 403	9.99 745	48	30	60.5	60.0	59.5	59.0
13	9.03 458	116	9.03 714	117	0.96 286	9.99 744	47	40	80.7	80.0	79.3	78.7
14	9.03 574	116	9.03 832	118	0.96 168	9.99 742	46	50	100.8	100.0	99.2	98.3
15	9.03 690	116	9.03 948	116	0.96 052	9.99 741	45	″	**117**	**116**	**115**	**114**
16	9.03 805	115	9.04 065	117	0.95 935	9.99 740	44	1	2.0	1.9	1.9	1.9
17	9.03 920	115	9.04 181	116	0.95 819	9.99 738	43	2	3.9	3.9	3.8	3.8
18	9.04 034	114	9.04 297	116	0.95 703	9.99 737	42	3	5.8	5.8	5.8	5.7
19	9.04 149	115	9.04 413	116	0.95 587	9.99 736	41	4	7.8	7.7	7.7	7.6
20	9.04 262	113	9.04 528	115	0.95 472	9.99 734	40	5	9.8	9.7	9.6	9.5
21	9.04 376	114	9.04 643	115	0.95 357	9.99 733	39	6	11.7	11.6	11.5	11.4
22	9.04 490	114	9.04 758	115	0.95 242	9.99 731	38	7	13.6	13.5	13.4	13.3
23	9.04 603	113	9.04 873	115	0.95 127	9.99 730	37	8	15.6	15.5	15.3	15.2
24	9.04 715	112	9.04 987	114	0.95 013	9.99 728	36	9	17.6	17.4	17.2	17.1
25	9.04 828	113	9.05 101	114	0.94 899	9.99 727	35	10	19.5	19.3	19.2	19.0
26	9.04 940	112	9.05 214	113	0.94 786	9.99 726	34	20	39.0	38.7	38.3	38.0
27	9.05 052	112	9.05 328	114	0.94 672	9.99 724	33	30	58.5	58.0	57.5	57.0
28	9.05 164	112	9.05 441	113	0.94 559	9.99 723	32	40	78.0	77.3	76.7	76.0
29	9.05 275	111	9.05 553	112	0.94 447	9.99 721	31	50	97.5	96.7	95.8	95.0
30	9.05 386	111	9.05 666	113	0.94 334	9.99 720	30	″	**113**	**112**	**111**	**110**
31	9.05 497	111	9.05 778	112	0.94 222	9.99 718	29	1	1.9	1.9	1.8	1.8
32	9.05 607	110	9.05 890	112	0.94 110	9.99 717	28	2	3.8	3.7	3.7	3.7
33	9.05 717	110	9.06 002	112	0.93 998	9.99 716	27	3	5.6	5.6	5.6	5.5
34	9.05 827	110	9.06 113	111	0.93 887	9.99 714	26	4	7.5	7.5	7.4	7.3
35	9.05 937	110	9.06 224	111	0.93 776	9.99 713	25	5	9.4	9.3	9.2	9.2
36	9.06 046	109	9.06 335	111	0.93 665	9.99 711	24	6	11.3	11.2	11.1	11.0
37	9.06 155	109	9.06 445	110	0.93 555	9.99 710	23	7	13.2	13.1	13.0	12.8
38	9.06 264	109	9.06 556	111	0.93 444	9.99 708	22	8	15.1	14.9	14.8	14.7
39	9.06 372	108	9.06 666	110	0.93 334	9.99 707	21	9	17.0	16.8	16.6	16.5
40	9.06 481	109	9.06 775	109	0.93 225	9.99 705	20	10	18.8	18.7	18.5	18.3
41	9.06 589	108	9.06 885	110	0.93 115	9.99 704	19	20	37.7	37.3	37.0	36.7
42	9.06 696	107	9.06 994	109	0.93 006	9.99 702	18	30	56.5	56.0	55.5	55.0
43	9.06 804	108	9.07 103	109	0.92 897	9.99 701	17	40	75.3	74.7	74.0	73.3
44	9.06 911	107	9.07 211	108	0.92 789	9.99 699	16	50	94.2	93.3	92.5	91.7
45	9.07 018	107	9.07 320	109	0.92 680	9.99 698	15	″	**109**	**108**	**107**	**106**
46	9.07 124	106	9.07 428	108	0.92 572	9.99 696	14	1	1.8	1.8	1.8	1.8
47	9.07 231	107	9.07 536	108	0.92 464	9.99 695	13	2	3.6	3.6	3.6	3.5
48	9.07 337	106	9.07 643	107	0.92 357	9.99 693	12	3	5.4	5.4	5.4	5.3
49	9.07 442	105	9.07 751	108	0.92 249	9.99 692	11	4	7.3	7.2	7.1	7.1
50	9.07 548	106	9.07 858	107	0.92 142	9.99 690	10	5	9.1	9.0	8.9	8.8
51	9.07 653	105	9.07 964	106	0.92 036	9.99 689	9	6	10.9	10.8	10.7	10.6
52	9.07 758	105	9.08 071	107	0.91 929	9.99 687	8	7	12.7	12.6	12.5	12.4
53	9.07 863	105	9.08 177	106	0.91 823	9.99 686	7	8	14.5	14.4	14.3	14.1
54	9.07 968	105	9.08 283	106	0.91 717	9.99 684	6	9	16.4	16.2	16.0	15.9
55	9.08 072	104	9.08 389	106	0.91 611	9.99 683	5	10	18.2	18.0	17.8	17.7
56	9.08 176	104	9.08 495	106	0.91 505	9.99 681	4	20	36.3	36.0	35.7	35.3
57	9.08 280	104	9.08 600	105	0.91 400	9.99 680	3	30	54.5	54.0	53.5	53.0
58	9.08 383	103	9.08 705	105	0.91 295	9.99 678	2	40	72.7	72.0	71.3	70.7
59	9.08 486	103	9.08 810	105	0.91 190	9.99 677	1	50	90.8	90.0	89.2	88.3
60	9.08 589	103	9.08 914	104	0.91 086	9.99 675	0					
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′	P. P.				

96° (276°) (263°) 83°

LOGARITHMS OF THE FUNCTIONS (Continued)

7° (187°) (352°) 172°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	9.08 589	103	9.08 914	105	0.91 086	9.99 675	60
1	9.08 692	103	9.09 019	104	0.90 981	9.99 674	59
2	9.08 795	102	9.09 123	104	0.90 877	9.99 672	58
3	9.08 897	102	9.09 227	103	0.90 773	9.99 670	57
4	9.08 999	102	9.09 330	104	0.90 670	9.99 669	56
5	9.09 101	101	9.09 434	103	0.90 566	9.99 667	55
6	9.09 202	102	9.09 537	103	0.90 463	9.99 666	54
7	9.09 304	101	9.09 640	102	0.90 360	9.99 664	53
8	9.09 405	101	9.09 742	103	0.90 258	9.99 663	52
9	9.09 506	100	9.09 845	102	0.90 155	9.99 661	51
10	9.09 606	101	9.09 947	102	0.90 053	9.99 659	50
11	9.09 707	100	9.10 049	101	0.89 951	9.99 658	49
12	9.09 807	100	9.10 150	102	0.89 850	9.99 656	48
13	9.09 907	99	9.10 252	101	0.89 748	9.99 655	47
14	9.10 006	100	9.10 353	101	0.89 647	9.99 653	46
15	9.10 106	99	9.10 454	101	0.89 546	9.99 651	45
16	9.10 205	99	9.10 555	101	0.89 445	9.99 650	44
17	9.10 304	98	9.10 656	100	0.89 344	9.99 648	43
18	9.10 402	99	9.10 756	100	0.89 244	9.99 647	42
19	9.10 501	98	9.10 856	100	0.89 144	9.99 645	41
20	9.10 599	98	9.10 956	100	0.89 044	9.99 643	40
21	9.10 697	98	9.11 056	99	0.88 944	9.99 642	39
22	9.10 795	98	9.11 155	99	0.88 845	9.99 640	38
23	9.10 893	97	9.11 254	99	0.88 746	9.99 638	37
24	9.10 990	97	9.11 353	99	0.88 647	9.99 637	36
25	9.11 087	97	9.11 452	99	0.88 548	9.99 635	35
26	9.11 184	97	9.11 551	98	0.88 449	9.99 633	34
27	9.11 281	96	9.11 649	98	0.88 351	9.99 632	33
28	9.11 377	97	9.11 747	98	0.88 253	9.99 630	32
29	9.11 474	96	9.11 845	98	0.88 155	9.99 629	31
30	9.11 570	96	9.11 943	97	0.88 057	9.99 627	30
31	9.11 666	95	9.12 040	98	0.87 960	9.99 625	29
32	9.11 761	96	9.12 138	97	0.87 862	9.99 624	28
33	9.11 857	95	9.12 235	97	0.87 765	9.99 622	27
34	9.11 952	95	9.12 332	96	0.87 668	9.99 620	26
35	9.12 047	95	9.12 428	97	0.87 572	9.99 618	25
36	9.12 142	94	9.12 525	96	0.87 475	9.99 617	24
37	9.12 236	95	9.12 621	96	0.87 379	9.99 615	23
38	9.12 331	94	9.12 717	96	0.87 283	9.99 613	22
39	9.12 425	94	9.12 813	96	0.87 187	9.99 612	21
40	9.12 519	93	9.12 909	95	0.87 091	9.99 610	20
41	9.12 612	94	9.13 004	95	0.86 996	9.99 608	19
42	9.12 706	93	9.13 099	95	0.86 901	9.99 607	18
43	9.12 799	93	9.13 194	95	0.86 806	9.99 605	17
44	9.12 892	93	9.13 289	95	0.86 711	9.99 603	16
45	9.12 985	93	9.13 384	94	0.86 616	9.99 601	15
46	9.13 078	93	9.13 478	95	0.86 522	9.99 600	14
47	9.13 171	92	9.13 573	94	0.86 427	9.99 598	13
48	9.13 263	92	9.13 667	94	0.86 333	9.99 596	12
49	9.13 355	92	9.13 761	93	0.86 239	9.99 595	11
50	9.13 447	92	9.13 854	94	0.86 146	9.99 593	10
51	9.13 539	91	9.13 948	93	0.86 052	9.99 591	9
52	9.13 630	92	9.14 041	93	0.85 959	9.99 589	8
53	9.13 722	91	9.14 134	93	0.85 866	9.99 588	7
54	9.13 813	91	9.14 227	93	0.85 773	9.99 586	6
55	9.13 904	90	9.14 320	92	0.85 680	9.99 584	5
56	9.13 994	91	9.14 412	92	0.85 588	9.99 582	4
57	9.14 085	90	9.14 504	93	0.85 496	9.99 581	3
58	9.14 175	91	9.14 597	91	0.85 403	9.99 579	2
59	9.14 266	90	9.14 688	92	0.85 312	9.99 577	1
60	9.14 356		9.14 780		0.85 220	9.99 575	0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P. P.				
″	**105**	**104**	**103**	**102**
1	1.8	1.7	1.7	1.7
2	3.5	3.5	3.4	3.4
3	5.2	5.2	5.2	5.1
4	7.0	6.9	6.9	6.8
5	8.8	8.7	8.6	8.5
6	10.5	10.4	10.3	10.2
7	12.2	12.1	12.0	11.9
8	14.0	13.9	13.7	13.6
9	15.8	15.6	15.4	15.3
10	17.5	17.3	17.2	17.0
20	35.0	34.7	34.3	34.0
30	52.5	52.0	51.5	51.0
40	70.0	69.3	68.7	68.0
50	87.5	86.7	85.8	85.0
″	**101**	**100**	**99**	**98**
1	1.7	1.7	1.6	1.6
2	3.4	3.3	3.3	3.3
3	5.0	5.0	5.0	4.9
4	6.7	6.7	6.6	6.5
5	8.4	8.3	8.2	8.2
6	10.1	10.0	9.9	9.8
7	11.8	11.7	11.6	11.4
8	13.5	13.3	13.2	13.1
9	15.2	15.0	14.8	14.7
10	16.8	16.7	16.5	16.3
20	33.7	33.3	33.0	32.7
30	50.5	50.0	49.5	49.0
40	67.3	66.7	66.0	65.3
50	84.2	83.3	82.5	81.7
″	**97**	**96**	**95**	**94**
1	1.6	1.6	1.6	1.6
2	3.2	3.2	3.2	3.1
3	4.8	4.8	4.8	4.7
4	6.5	6.4	6.3	6.3
5	8.1	8.0	7.9	7.8
6	9.7	9.6	9.5	9.4
7	11.3	11.2	11.1	11.0
8	12.9	12.8	12.7	12.5
9	14.6	14.4	14.2	14.1
10	16.2	16.0	15.8	15.7
20	32.3	32.0	31.7	31.3
30	48.5	48.0	47.5	47.0
40	64.7	64.0	63.3	62.7
50	80.8	80.0	79.2	78.3
″	**93**	**92**	**91**	**90**
1	1.6	1.5	1.5	1.5
2	3.1	3.1	3.0	3.0
3	4.6	4.6	4.6	4.5
4	6.2	6.1	6.1	6.0
5	7.8	7.7	7.6	7.5
6	9.3	9.2	9.1	9.0
7	10.8	10.7	10.6	10.5
8	12.4	12.3	12.1	12.0
9	14.0	13.8	13.6	13.5
10	15.5	15.3	15.2	15.0
20	31.0	30.7	30.3	30.0
30	46.5	46.0	45.5	45.0
40	62.0	61.3	60.7	60.0
50	77.5	76.7	75.8	75.0
P. P.				

97° (277°) (262°) 82°

LOGARITHMS OF THE FUNCTIONS (Continued)

8° (188°) (351°) **171°**

′	L. Sin	d.	L. Tan.	c. d.	L. Cot.	L. Cos.	′
0	9.14 356	89	9.14 780	92	0.85 220	9.99 575	**60**
1	9.14 445	90	9.14 872	91	0.85 128	9.99 574	59
2	9.14 535	89	9.14 963	91	0.85 037	9.99 572	58
3	9.14 624	90	9.15 054	91	0.84 946	9.99 570	57
4	9.14 714	89	9.15 145	91	0.84 855	9.99 568	56
5	9.14 803	88	9.15 236	91	0.84 764	9.99 566	55
6	9.14 891	89	9.15 327	90	0.84 673	9.99 565	54
7	9.14 980	89	9.15 417	91	0.84 583	9.99 563	53
8	9.15 069	88	9.15 508	90	0.84 492	9.99 561	52
9	9.15 157	88	9.15 598	90	0.84 402	9.99 559	51
10	9.15 245	88	9.15 688	89	0.84 312	9.99 557	**50**
11	9.15 333	88	9.15 777	90	0.84 223	9.99 556	49
12	9.15 421	87	9.15 867	89	0.84 133	9.99 554	48
13	9.15 508	88	9.15 956	90	0.84 044	9.99 552	47
14	9.15 596	87	9.16 046	89	0.83 954	9.99 550	46
15	9.15 683	87	9.16 135	89	0.83 865	9.99 548	45
16	9.15 770	87	9.16 224	88	0.83 776	9.99 546	44
17	9.15 857	87	9.16 312	89	0.83 688	9.99 545	43
18	9.15 944	86	9.16 401	88	0.83 599	9.99 543	42
19	9.16 030	86	9.16 489	88	0.83 511	9.99 541	41
20	9.16 116	87	9.16 577	88	0.83 423	9.99 539	**40**
21	9.16 203	86	9.16 665	88	0.83 335	9.99 537	39
22	9.16 289	85	9.16 753	88	0.83 247	9.99 535	38
23	9.16 374	86	9.16 841	87	0.83 159	9.99 533	37
24	9.16 460	85	9.16 928	88	0.83 072	9.99 532	36
25	9.16 545	86	9.17 016	87	0.82 984	9.99 530	35
26	9.16 631	85	9.17 103	87	0.82 897	9.99 528	34
27	9.16 716	85	9.17 190	87	0.82 810	9.99 526	33
28	9.16 801	85	9.17 277	86	0.82 723	9.99 524	32
29	9.16 886	84	9.17 363	87	0.82 637	9.99 522	31
30	9.16 970	85	9.17 450	86	0.82 550	9.99 520	**30**
31	9.17 055	84	9.17 536	86	0.82 464	9.99 518	29
32	9.17 139	84	9.17 622	86	0.82 378	9.99 517	28
33	9.17 223	84	9.17 708	86	0.82 292	9.99 515	27
34	9.17 307	84	9.17 794	86	0.82 206	9.99 513	26
35	9.17 391	83	9.17 880	85	0.82 120	9.99 511	25
36	9.17 474	84	9.17 965	86	0.82 035	9.99 509	24
37	9.17 558	83	9.18 051	85	0.81 949	9.99 507	23
38	9.17 641	83	9.18 136	85	0.81 864	9.99 505	22
39	9.17 724	83	9.18 221	85	0.81 779	9.99 503	21
40	9.17 807	83	9.18 306	85	0.81 694	9.99 501	**20**
41	9.17 890	83	9.18 391	84	0.81 609	9.99 499	19
42	9.17 973	82	9.18 475	85	0.81 525	9.99 497	18
43	9.18 055	82	9.18 560	84	0.81 440	9.99 495	17
44	9.18 137	83	9.18 644	84	0.81 356	9.99 494	16
45	9.18 220	82	9.18 728	84	0.81 272	9.99 492	15
46	9.18 302	81	9.18 812	84	0.81 188	9.99 490	14
47	9.18 383	82	9.18 896	83	0.81 104	9.99 488	13
48	9.18 465	82	9.18 979	84	0.81 021	9.99 486	12
49	9.18 547	81	9.19 063	83	0.80 937	9.99 484	11
50	9.18 628	81	9.19 146	83	0.80 854	9.99 482	**10**
51	9.18 709	81	9.19 229	83	0.80 771	9.99 480	9
52	9.18 790	81	9.19 312	83	0.80 688	9.99 478	8
53	9.18 871	81	9.19 395	83	0.80 605	9.99 476	7
54	9.18 952	81	9.19 478	83	0.80 522	9.99 474	6
55	9.19 033	80	9.19 561	82	0.80 439	9.99 472	5
56	9.19 113	80	9.19 643	82	0.80 357	9.99 470	4
57	9.19 193	80	9.19 725	82	0.80 275	9.99 468	3
58	9.19 273	80	9.19 807	82	0.80 193	9.99 466	2
59	9.19 353	80	9.19 889	82	0.80 111	9.99 464	1
60	9.19 433		9.19 971		0.80 029	9.99 462	**0**
′	L. Cos.	d.	L. Cot.	c. d.	L. Tan.	L. Sin.	′

P. P.			
″	**92**	**91**	**90**
1	1.5	1.5	1.5
2	3.1	3.0	3.0
3	4.6	4.6	4.5
4	6.1	6.1	6.0
5	7.7	7.6	7.5
6	9.2	9.1	9.0
7	10.7	10.6	10.5
8	12.3	12.1	12.0
9	13.8	13.6	13.5
10	15.3	15.2	15.0
20	30.7	30.3	30.0
30	46.0	45.5	45.0
40	61.3	60.7	60.0
50	76.7	75.8	75.0
″	**89**	**88**	**87**
1	1.5	1.5	1.4
2	3.0	2.9	2.9
3	4.4	4.4	4.4
4	5.9	5.9	5.8
5	7.4	7.3	7.2
6	8.9	8.8	8.7
7	10.4	10.3	10.2
8	11.9	11.7	11.6
9	13.4	13.2	13.0
10	14.8	14.7	14.5
20	29.7	29.3	29.0
30	44.5	44.0	43.5
40	59.3	58.7	58.0
50	74.2	73.3	72.5
″	**86**	**85**	**84**
1	1.4	1.4	1.4
2	2.9	2.8	2.8
3	4.3	4.2	4.2
4	5.7	5.7	5.6
5	7.2	7.1	7.0
6	8.6	8.5	8.4
7	10.0	9.9	9.8
8	11.5	11.3	11.2
9	12.9	12.8	12.6
10	14.3	14.2	14.0
20	28.7	28.3	28.0
30	43.0	42.5	42.0
40	57.3	56.7	56.0
50	71.7	70.8	70.0
″	**83**	**82**	**81**
1	1.4	1.4	1.4
2	2.8	2.7	2.7
3	4.2	4.1	4.0
4	5.5	5.5	5.4
5	6.9	6.8	6.8
6	8.3	8.2	8.1
7	9.7	9.6	9.4
8	11.1	10.9	10.8
9	12.4	12.3	12.2
10	13.8	13.7	13.5
20	27.7	27.3	27.0
30	41.5	41.0	40.5
40	55.3	54.7	54.0
50	69.2	68.3	67.5
P. P.			

98° (278°) (261°) **81°**

9° (189°) (350°) **170°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	′
0	9.19 433	80	9.19 971	82	0.80 029	9.99 462	**60**
1	9.19 513	79	9.20 053	81	0.79 947	9.99 460	59
2	9.19 592	80	9.20 134	82	0.79 866	9.99 458	58
3	9.19 672	79	9.20 216	81	0.79 784	9.99 456	57
4	9.19 751	79	9.20 297	81	0.79 703	9.99 454	56
5	9.19 830	79	9.20 378	81	0.79 622	9.99 452	55
6	9.19 909	79	9.20 459	81	0.79 541	9.99 450	54
7	9.19 988	79	9.20 540	81	0.79 460	9.99 448	53
8	9.20 067	78	9.20 621	80	0.79 379	9.99 446	52
9	9.20 145	78	9.20 701	81	0.79 299	9.99 444	51
10	9.20 223	79	9.20 782	80	0.79 218	9.99 442	**50**
11	9.20 302	78	9.20 862	80	0.79 138	9.99 440	49
12	9.20 380	78	9.20 942	80	0.79 058	9.99 438	48
13	9.20 458	77	9.21 022	80	0.78 978	9.99 436	47
14	9.20 535	78	9.21 102	80	0.78 898	9.99 434	46
15	9.20 613	78	9.21 182	79	0.78 818	9.99 432	45
16	9.20 691	77	9.21 261	80	0.78 739	9.99 429	44
17	9.20 768	77	9.21 341	79	0.78 659	9.99 427	43
18	9.20 845	77	9.21 420	79	0.78 580	9.99 425	42
19	9.20 922	77	9.21 499	79	0.78 501	9.99 423	41
20	9.20 999	77	9.21 578	79	0.78 422	9.99 421	**40**
21	9.21 076	77	9.21 657	79	0.78 343	9.99 419	39
22	9.21 153	76	9.21 736	78	0.78 264	9.99 417	38
23	9.21 229	77	9.21 814	79	0.78 186	9.99 415	37
24	9.21 306	76	9.21 893	78	0.78 107	9.99 413	36
25	9.21 382	76	9.21 971	78	0.78 029	9.99 411	35
26	9.21 458	76	9.22 049	78	0.77 951	9.99 409	34
27	9.21 534	76	9.22 127	78	0.77 873	9.99 407	33
28	9.21 610	75	9.22 205	78	0.77 795	9.99 404	32
29	9.21 685	76	9.22 283	78	0.77 717	9.99 402	31
30	9.21 761	75	9.22 361	77	0.77 639	9.99 400	**30**
31	9.21 836	76	9.22 438	78	0.77 562	9.99 398	29
32	9.21 912	75	9.22 516	77	0.77 484	9.99 396	28
33	9.21 987	75	9.22 593	77	0.77 407	9.99 394	27
34	9.22 062	75	9.22 670	77	0.77 330	9.99 392	26
35	9.22 137	74	9.22 747	77	0.77 253	9.99 390	25
36	9.22 211	75	9.22 824	77	0.77 176	9.99 388	24
37	9.22 286	75	9.22 901	76	0.77 099	9.99 385	23
38	9.22 361	74	9.22 977	77	0.77 023	9.99 383	22
39	9.22 435	74	9.23 054	76	0.76 946	9.99 381	21
40	9.22 509	74	9.23 130	76	0.76 870	9.99 379	**20**
41	9.22 583	74	9.23 206	77	0.76 794	9.99 377	19
42	9.22 657	74	9.23 283	76	0.76 717	9.99 375	18
43	9.22 731	74	9.23 359	76	0.76 641	9.99 372	17
44	9.22 805	73	9.23 435	75	0.76 565	9.99 370	16
45	9.22 878	74	9.23 510	76	0.76 490	9.99 368	15
46	9.22 952	73	9.23 586	75	0.76 414	9.99 366	14
47	9.23 025	73	9.23 661	76	0.76 339	9.99 364	13
48	9.23 098	73	9.23 737	75	0.76 263	9.99 362	12
49	9.23 171	73	9.23 812	75	0.76 188	9.99 359	11
50	9.23 244	73	9.23 887	75	0.76 113	9.99 357	**10**
51	9.23 317	73	9.23 962	75	0.76 038	9.99 355	9
52	9.23 390	72	9.24 037	75	0.75 963	9.99 353	8
53	9.23 462	73	9.24 112	74	0.75 888	9.99 351	7
54	9.23 535	72	9.24 186	75	0.75 814	9.99 348	6
55	9.23 607	72	9.24 261	74	0.75 739	9.99 346	5
56	9.23 679	73	9.24 335	75	0.75 665	9.99 344	4
57	9.23 752	71	9.24 410	74	0.75 590	9.99 342	3
58	9.23 823	72	9.24 484	74	0.75 516	9.99 340	2
59	9.23 895	72	9.24 558	74	0.75 442	9.99 337	1
60	9.23 967		9.24 632		0.75 368	9.99 335	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	′

P. P.

″	**80**	**79**	**78**	**77**
1	1.3	1.3	1.3	1.3
2	2.7	2.6	2.6	2.6
3	4.0	4.0	3.9	3.8
4	5.3	5.3	5.2	5.1
5	6.7	6.6	6.5	6.4
6	8.0	7.9	7.8	7.7
7	9.3	9.2	9.1	9.0
8	10.7	10.5	10.4	10.3
9	12.0	11.8	11.7	11.6
10	13.3	13.2	13.0	12.8
20	26.7	26.3	26.0	25.7
30	40.0	39.5	39.0	38.5
40	53.3	52.7	52.0	51.3
50	66.7	65.8	65.0	64.2

″	**76**	**75**	**74**	**73**
1	1.3	1.2	1.2	1.2
2	2.5	2.5	2.5	2.4
3	3.8	3.8	3.7	3.6
4	5.1	5.0	4.9	4.9
5	6.3	6.2	6.2	6.1
6	7.6	7.5	7.4	7.3
7	8.9	8.8	8.6	8.5
8	10.1	10.0	9.9	9.7
9	11.4	11.2	11.1	11.0
10	12.7	12.5	12.3	12.2
20	25.3	25.0	24.7	24.3
30	38.0	37.5	37.0	36.5
40	50.7	50.0	49.3	48.7
50	63.3	62.5	61.7	60.8

″	**72**	**71**	**3**	**2**
1	1.2	1.2	0.0	0.0
2	2.4	2.4	0.1	0.1
3	3.6	3.6	0.2	0.1
4	4.8	4.7	0.2	0.1
5	6.0	5.9	0.2	0.2
6	7.2	7.1	0.3	0.2
7	8.4	8.3	0.4	0.2
8	9.6	9.5	0.4	0.3
9	10.8	10.6	0.4	0.3
10	12.0	11.8	0.5	0.3
20	24.0	23.7	1.0	0.7
30	36.0	35.5	1.5	1.0
40	48.0	47.3	2.0	1.3
50	60.0	59.2	2.5	1.7

	3/79	**3/78**	**3/77**
0	13.2	13.0	12.8
1	39.5	39.0	38.5
2	65.8	65.0	64.2
3			

	3/76	**3/75**	**3/74**
0	12.7	12.5	12.3
1	38.0	37.5	37.0
2	63.3	62.5	61.7
3			

P. P.

99° (279°) (260°) **80°**

LOGARITHMS OF THE FUNCTIONS (Continued)

10° (190°) (349°) **169°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.23 967	72	9.24 632	74	0.75 368	9.99 335̇	2	**60**
1	9.24 039	71	9.24 706	73	0.75 294	9.99 333	2	59
2	9.24 110	71	9.24 779	74	0.75 221	9.99 331	3	58
3	9.24 181	72	9.24 853	73	0.75 147	9.99 328	2	57
4	9.24 253	71	9.24 926	74	0.75 074	9.99 326	2	56
5	9.24 324	71	9.25̄ 000	73	0.75̇ 000	9.99 324	2	55
6	9.24 395̄	71	9.25 073	73	0.74 927	9.99 322	3	54
7	9.24 466	70	9.25 146	73	0.74 854	9.99 319	2	53
8	9.24 536	71	9.25 219	73	0.74 781	9.99 317	2	52
9	9.24 607	70	9.25 292	73	0.74 708	9.99 315̄	2	51
10	9.24 677	71	9.25 365̄	72	0.74 635̇	9.99 313	3	**50**
11	9.24 748	70	9.25 437	73	0.74 563	9.99 310	2	49
12	9.24 818	70	9.25 510	72	0.74 490	9.99 308	2	48
13	9.24 888	70	9.25 582	73	0.74 418	9.99 306	2	47
14	9.24 958	70	9.25 655̄	72	0.74 345̇	9.99 304	3	46
15	9.25 028	70	9.25 727	72	0.74 273	9.99 301	2	45
16	9.25 098	70	9.25 799	72	0.74 201	9.99 299	2	44
17	9.25 168	69	9.25 871	72	0.74 129	9.99 297	3	43
18	9.25 237	70	9.25 943	72	0.74 057	9.99 294	2	42
19	9.25 307	69	9.26 015̄	71	0.73 985̇	9.99 292	2	41
20	9.25 376	69	9.26 086	72	0.73 914	9.99 290	2	**40**
21	9.25 445	69	9.26 158	71	0.73 842	9.99 288	3	39
22	9.25 514	69	9.26 229	72	0.73 771	9.99 285̇	2	38
23	9.25 583	69	9.26 301	71	0.73 699	9.99 283	2	37
24	9.25 652	69	9.26 372	71	0.73 628	9.99 281	3	36
25	9.25 721	69	9.26 443	71	0.73 557	9.99 278	2	35
26	9.25 790	68	9.26 514	71	0.73 486	9.99 276	2	34
27	9.25 858	69	9.26 585̄	70	0.73 415̇	9.99 274	3	33
28	9.25 927	68	9.26 655̇	71	0.73 345̄	9.99 271	2	32
29	9.25 995̇	68	9.26 726	71	0.73 274	9.99 269	2	31
30	9.26 063	68	9.26 797	70	0.73 203	9.99 267	3	**30**
31	9.26 131	68	9.26 867	70	0.73 133	9.99 264	2	29
32	9.26 199	68	9.26 937	71	0.73 063	9.99 262	2	28
33	9.26 267	68	9.27 008	70	0.72 992	9.99 260	3	27
34	9.26 335̇	68	9.27 078	70	0.72 922	9.99 257	2	26
35	9.26 403	67	9.27 148	70	0.72 852	9.99 255̄	3	25
36	9.26 470	68	9.27 218	70	0.72 782	9.99 252	2	24
37	9.26 538	67	9.27 288	69	0.72 712	9.99 250	2	23
38	9.26 605̇	67	9.27 357	70	0.72 643	9.99 248	3	22
39	9.26 672	67	9.27 427	69	0.72 573	9.99 245	2	21
40	9.26 739	67	9.27 496	70	0.72 504	9.99 243	2	**20**
41	9.26 806	67	9.27 566	69	0.72 434	9.99 241	3	19
42	9.26 873	67	9.27 635̇	69	0.72 365̄	9.99 238	2	18
43	9.26 940	67	9.27 704	69	0.72 296	9.99 236	3	17
44	9.27 007	66	9.27 773	69	0.72 227	9.99 233	2	16
45	9.27 073	67	9.27 842	69	0.72 158	9.99 231	2	15
46	9.27 140	66	9.27 911	69	0.72 089	9.99 229	3	14
47	9.27 206	67	9.27 980	69	0.72 020	9.99 226	2	13
48	9.27 273	66	9.28 049	68	0.71 951	9.99 224	3	12
49	9.27 339	66	9.28 117	69	0.71 883	9.99 221	2	11
50	9.27 405̄	66	9.28 186	68	0.71 814	9.99 219	2	**10**
51	9.27 471	66	9.28 254	69	0.71 746	9.99 217	3	9
52	9.27 537	65	9.28 323	68	0.71 677	9.99 214	2	8
53	9.27 602	66	9.28 391	68	0.71 609	9.99 212	3	7
54	9.27 668	66	9.28 459	68	0.71 541	9.99 209	2	6
55	9.27 734	65	9.28 527	68	0.71 473	9.99 207	3	5
56	9.27 799	65	9.28 595̄	67	0.71 405̇	9.99 204	2	4
57	9.27 864	66	9.28 662	68	0.71 338	9.99 202	2	3
58	9.27 930	65	9.28 730	68	0.71 270	9.99 200	3	2
59	9.27 995̄	65	9.28 798	67	0.71 202	9.99 197	2	1
60	9.28 060		9.28 865̇		0.71 135̄	9.99 195̄		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**74**	**73**	**72**
1	1.2	1.2	1.2
2	2.5	2.4	2.4
3	3.7	3.6	3.6
4	4.9	4.9	4.8
5	6.2	6.1	6.0
6	7.4	7.3	7.2
7	8.6	8.5	8.4
8	9.9	9.7	9.6
9	11.1	11.0	10.8
10	12.3	12.2	12.0
20	24.7	24.3	24.0
30	37.0	36.5	36.0
40	49.3	48.7	48.0
50	61.7	60.8	60.0
″	**71**	**70**	**69**
1	1.2	1.2	1.2
2	2.4	2.3	2.3
3	3.6	3.5	3.4
4	4.7	4.7	4.6
5	5.9	5.8	5.8
6	7.1	7.0	6.9
7	8.3	8.2	8.0
8	9.5̄	9.3	9.2
9	10.6	10.5	10.4
10	11.8	11.7	11.5
20	23.7	23.3	23.0
30	35.5	35.0	34.5
40	47.3	46.7	46.0
50	59.2	58.3	57.5
″	**68**	**67**	**66**
1	1.1	1.1	1.1
2	2.3	2.2	2.2
3	3.4	3.4	3.3
4	4.5̇	4.5̄	4.4
5	5.7	5.6	5.5
6	6.8	6.7	6.6
7	7.9	7.8	7.7
8	9.1	8.9	8.8
9	10.2	10.0	9.9
10	11.3	11.2	11.0
20	22.7	22.3	22.0
30	34.0	33.5	33.0
40	45.3	44.7	44.0
50	56.7	55.8	55.0

	$\frac{3}{74}$	$\frac{3}{73}$	$\frac{3}{72}$
0	12.3	12.2	12.0
1	37.0	36.5	36.0
2	61.7	60.8	60.0
3			

	$\frac{3}{71}$	$\frac{3}{70}$	$\frac{3}{69}$	$\frac{3}{68}$
0	11.8	11.7	11.5	11.3
1	35.5	35.0	34.5	34.0
2	59.2	58.3	57.5	56.7
3				

P. P.

100° (280°) (259°) **79°**

LOGARITHMS OF THE FUNCTIONS (Continued)

11° (191°) (348°) **168°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.28 060	65	9.28 865	68	0.71 135	9.99 195	3	**60**
1	9.28 125	65	9.28 933	67	0.71 067	9.99 192	2	59
2	9.28 190	64	9.29 000	67	0.71 000	9.99 190	3	58
3	9.28 254	65	9.29 067	67	0.70 933	9.99 187	2	57
4	9.28 319	65	9.29 134	67	0.70 866	9.99 185	3	56
5	9.28 384	64	9.29 201	67	0.70 799	9.99 182	2	55
6	9.28 448	64	9.29 268	67	0.70 732	9.99 180	3	54
7	9.28 512	65	9.29 335	67	0.70 665	9.99 177	2	53
8	9.28 577	64	9 29 402	66	0.70 598	9.99 175	3	52
9	9.28 641	64	9.29 468	67	0.70 532	9.99 172	2	51
10	9.28 705	64	9.29 535	66	0.70 465	9.99 170	3	**50**
11	9.28 769	64	9.29 601	67	0.70 399	9.99 167	2	49
12	9.28 833	63	9.29 668	66	0.70 332	9.99 165	3	48
13	9.28 896	64	9.29 734	66	0.70 266	9.99 162	2	47
14	9.28 960	64	9.29 800	66	0.70 200	9.99 160	3	46
15	9.29 024	63	9.29 866	66	0.70 134	9.99 157	2	45
16	9.29 087	63	9.29 932	66	0.70 068	9.99 155	3	44
17	9.29 150	64	9.29 998	66	0.70 002	9.99 152	2	43
18	9.29 214	63	9.30 064	66	0.69 936	9.99 150	3	42
19	9.29 277	63	9.30 130	65	0.69 870	9.99 147	2	41
20	9.29 340	63	9.30 195	66	0.69 805	9.99 145	3	**40**
21	9.29 403	63	9.30 261	65	0.69 739	9.99 142	2	39
22	9.29 466	63	9.30 326	65	0.69 674	9.99 140	3	38
23	9.29 529	62	9.30 391	66	0.69 609	9.99 137	2	37
24	9.29 591	63	9.30 457	65	0.69 543	9.99 135	3	36
25	9.29 654	62	9.30 522	65	0.69 478	9.99 132	2	35
26	9.29 716	63	9.30 587	65	0.69 413	9.99 130	3	34
27	9.29 779	62	9.30 652	65	0.69 348	9.99 127	3	33
28	9.29 841	62	9.30 717	65	0.69 283	9.99 124	2	32
29	9.29 903	63	9.30 782	64	0.69 218	9.99 122	3	31
30	9.29 966	62	9.30 846	65	0.69 154	9.99 119	2	**30**
31	9.30 028	62	9.30 911	64	0.69 089	9.99 117	3	29
32	9.30 090	61	9.30 975	65	0.69 025	9.99 114	2	28
33	9.30 151	62	9.31 040	64	0.68 960	9.99 112	3	27
34	9.30 213	62	9.31 104	64	0.68 896	9.99 109	3	26
35	9.30 275	61	9.31 168	65	0.68 832	9.99 106	2	25
36	9.30 336	62	9.31 233	64	0.68 767	9.99 104	3	24
37	9.30 398	61	9.31 297	64	0.68 703	9.99 101	2	23
38	9.30 459	62	9.31 361	64	0.68 639	9.99 099	3	22
39	9.30 521	61	9.31 425	64	0.68 575	9.99 096	3	21
40	9.30 582	61	9.31 489	63	0.68 511	9.99 093	2	**20**
41	9.30 643	61	9.31 552	64	0.68 448	9.99 091	3	19
42	9.30 704	61	9.31 616	63	0.68 384	9.99 088	2	18
43	9.30 765	61	9.31 679	64	0.68 321	9.99 086	3	17
44	9.30 826	61	9.31 743	63	0.68 257	9.99 083	3	16
45	9.30 887	60	9.31 806	64	0.68 194	9.99 080	2	15
46	9.30 947	61	9.31 870	63	0.68 130	9.99 078	3	14
47	9.31 008	60	9.31 933	63	0.68 067	9.99 075	3	13
48	9.31 068	61	9.31 996	63	0.68 004	9.99 072	2	12
49	9.31 129	60	9.32 059	63	0.67 941	9.99 070	3	11
50	9.31 189	61	9.32 122	63	0.67 878	9.99 067	3	**10**
51	9.31 250	60	9.32 185	63	0.67 815	9.99 064	2	9
52	9.31 310	60	9.32 248	63	0.67 752	9.99 062	3	8
53	9.31 370	60	9.32 311	62	0.67 689	9.99 059	3	7
54	9.31 430	60	9.32 373	63	0.67 627	9.99 056	2	6
55	9.31 490	59	9.32 436	62	0.67 564	9.99 054	3	5
56	9.31 549	60	9.32 498	63	0.67 502	9.99 051	3	4
57	9.31 609	60	9.32 561	62	0.67 439	9.99 048	2	3
58	9.31 669	59	9.32 623	62	0.67 377	9.99 046	3	2
59	9.31 728	60	9.32 685	62	0.67 315	9.99 043	3	1
60	9.31 788		9.32 747		0.67 253	9.99 040		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
″	**65**	**64**	**63**
1	1.1	1.1	1.0
2	2.2	2.1	2.1
3	3.2	3.2	3.2
4	4.3	4.3	4.2
5	5.4	5.3	5.2
6	6.5	6.4	6.3
7	7.6	7.5	7.4
8	8.7	8.5	8.4
9	9.8	9.6	9.4
10	10.8	10.7	10.5
20	21.7	21.3	21.0
30	32.5	32.0	31.5
40	43.3	42.7	42.0
50	54.2	53.3	52.5
″	**62**	**61**	**60**
1	1.0	1.0	1.0
2	2.1	2.0	2.0
3	3.1	3.0	3.0
4	4.1	4.1	4.0
5	5.2	5.1	5.0
6	6.2	6.1	6.0
7	7.2	7.1	7.0
8	8.3	8.1	8.0
9	9.3	9.2	9.0
10	10.3	10.2	10.0
20	20.7	20.3	20.0
30	31.0	30.5	30.0
40	41.3	40.7	40.0
50	51.7	50.8	50.0
″	**59**	**3**	**2**
1	1.0	0.0	0.0
2	2.0	0.1	0.1
3	3.0	0.2	0.1
4	3.9	0.2	0.1
5	4.9	0.2	0.2
6	5.9	0.3	0.2
7	6.9	0.4	0.2
8	7.9	0.4	0.3
9	8.8	0.4	0.3
10	9.8	0.5	0.3
20	19.7	1.0	0.7
30	29.5	1.5	1.0
40	39.3	2.0	1.3
50	49.2	2.5	1.7

	$\frac{3}{67}$	$\frac{3}{66}$	$\frac{3}{65}$
0	11.2	11.0	10.8
1	33.5	33.0	32.5
2	55.8	55.0	54.2
3			
	$\frac{3}{64}$	$\frac{3}{63}$	$\frac{3}{62}$
0	10.7	10.5	10.3
1	32.0	31.5	31.0
2	53.3	52.5	51.7
3			

P. P.

101° (281°) (258°) **78°**

LOGARITHMS OF THE FUNCTIONS (Continued)

12° (192°) (347°) **167°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.31 788	59	9.32 747	63	0.67 253	9.99 040	2	**60**
1	9.31 847	60	9.32 810	62	0.67 190	9.99 038	3	59
2	9.31 907	59	9.32 872	61	0.67 128	9.99 035̇	3	58
3	9.31 966	59	9.32 933	62	0.67 067	9.99 032	2	57
4	9.32 025̄	59	9.32 995̇	62	0.67 005̄	9.99 030	3	56
5	9.32 084	59	9.33 057	62	0.66 943	9.99 027	3	55
6	9.32 143	59	9.33 119	61	0.66 881	9.99 024	2	54
7	9.32 202	59	9.33 180	62	0.66 820	9.99 022	3	53
8	9.32 261	58	9.33 242	61	0.66 758	9.99 019	3	52
9	9.32 319	59	9.33 303	62	0.66 697	9.99 016	3	51
10	9.32 378	59	9.33 365̄	61	0.66 635̇	9.99 013	2	**50**
11	9.32 437	58	9.33 426	61	0.66 574	9.99 011	3	49
12	9.32 495̇	58	9.33 487	61	0.66 513	9.99 008	3	48
13	9.32 553	59	9.33 548	61	0.66 452	9.99 005̇	3	47
14	9.32 612	58	9.33 609	61	0.66 391	9.99 002	2	46
15	9.32 670	58	9.33 670	61	0.66 330	9.99 000	3	45
16	9.32 728	58	9.33 731	61	0.66 269	9.98 997	3	44
17	9.32 786	58	9.33 792	61	0.66 208	9.98 994	3	43
18	9.32 844	58	9.33 853	60	0.66 147	9.98 991	2	42
19	9.32 902	58	9.33 913	61	0.66 087	9.98 989	3	41
20	9.32 960	58	9.33 974	60	0.66 026	9.98 986	3	**40**
21	9.33 018	57	9.34 034	61	0.65 966	9.98 983	3	39
22	9.33 075̇	58	9.34 095̄	60	0.65 905̇	9.98 980	2	38
23	9.33 133	57	9.34 155̇	60	0.65 845̄	9.98 978	3	37
24	9.33 190	58	9.34 215̇	61	0.65 785̄	9.98 975̄	3	36
25	9.33 248	57	9.34 276	60	0.65 724	9.98 972	3	35
26	9.33 305̇	57	9.34 336	60	0.65 664	9.98 969	2	34
27	9.33 362	58	9.34 396	60	0.65 604	9.98 967	3	33
28	9.33 420	57	9.34 456	60	0.65 544	9.98 964	3	32
29	9.33 477	57	9.34 516	60	0.65 484	9.98 961	3	31
30	9.33 534	57	9.34 576	59	0.65 424	9.98 958	3	**30**
31	9.33 591	56	9.34 635̇	60	0.65 365̄	9.98 955̇	2	29
32	9.33 647	57	9.34 695̄	60	0.65 305̇	9.98 953	3	28
33	9.33 704	57	9.34 755̄	59	0.65 245̇	9.98 95̄0	3	27
34	9.33 761	57	9.34 814	60	0.65 186	9.98 947	3	26
35	9.33 818	56	9.34 874	59	0.65 126	9.98 944	3	25
36	9.33 874	57	9.34 933	59	0.65 067	9.98 941	3	24
37	9.33 931	56	9.34 992	59	0.65 008	9.98 938	2	23
38	9.33 987	56	9.35 051	60	0.64 949	9.98 936	3	22
39	9.34 043	57	9.35 111	59	0.64 889	9.98 933	3	21
40	9.34 100	56	9.35 170	59	0.64 830	9.98 930	3	**20**
41	9.34 156	56	9.35 229	59	0.64 771	9.98 927	3	19
42	9.34 212	56	9.35 288	59	0.64 712	9.98 924	3	18
43	9.34 268	56	9.35 347	58	0.64 653	9.98 921	2	17
44	9.34 324	56	9.35 405̇	59	0.64 595̄	9.98 919	3	16
45	9.34 380	56	9.35 464	59	0.64 536	9.98 916	3	15
46	9.34 436	55	9.35 523	58	0.64 477	9.98 913	3	14
47	9.34 491	56	9.35 581	59	0.64 419	9.98 910	3	13
48	9.34 547	55	9.35 640	58	0.64 360	9.98 907	3	12
49	9.34 602	56	9.35 698	59	0.64 302	9.98 904	3	11
50	9.34 658	55	9.35 757	58	0.64 243	9.98 901	3	**10**
51	9.34 713	56	9.35 815̄	58	0.64 185̇	9.98 898	2	9
52	9.34 769	55	9.35 873	58	0.64 127	9.98 896	3	8
53	9.34 824	55	9.35 931	58	0.64 069	9.98 893	3	7
54	9.34 879	55	9.35 989	58	0.64 011	9.98 890	3	6
55	9.34 934	55	9.36 047	58	0.63 953	9.98 887	3	5
56	9.34 989	55	9.36 105̇	58	0.63 895̄	9.98 884	3	4
57	9.35 044	55	9.36 163	58	0.63 837	9.98 881	3	3
58	9.35 099	55	9.36 221	58	0.63 779	9.98 878	3	2
59	9.35 154	55	9.36 279	57	0.63 721	9.98 875̇	3	1
60	9.35 209		9.36 336		0.63 664	9.98 872		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**63**	**62**	**61**
1	1.0	1.0	1.0
2	2.1	2.1	2.0
3	3.2	3.1	3.0
4	4.2	4.1	4.1
5	5.2	5.2	5.1
6	6.3	6.2	6.1
7	7.4	7.2	7.1
8	8.4	8.3	8.1
9	9.4	9.3	9.2
10	10.5	10.3	10.2
20	21.0	20.7	20.3
30	31.5	31.0	30.5
40	42.0	41.3	40.7
50	52.5	51.7	50.8

″	**60**	**59**	**58**
1	1.0	1.0	1.0
2	2.0	2.0	1.9
3	3.0	3.0	2.9
4	4.0	3.9	3.9
5	5.0	4.9	4.8
6	6.0	5.9	5.8
7	7.0	6.9	6.8
8	8.0	7.9	7.7
9	9.0	8.8	8.7
10	10.0	9.8	9.7
20	20.0	19.7	19.3
30	30.0	29.5	29.0
40	40.0	39.3	38.7
50	50.0	49.2	48.3

″	**57**	**56**	**55**
1	1.0	0.9	0.9
2	1.9	1.9	1.8
3	2.8	2.8	2.8
4	3.8	3.7	3.7
5	4.8	4.7	4.6
6	5.7	5.6	5.5
7	6.6	6.5̇	6.4
8	7.6	7.5̄	7.3
9	8.6	8.4	8.2
10	9.5	9.3	9.2
20	19.0	18.7	18.3
30	28.5	28.0	27.5
40	38.0	37.3	36.7
50	47.5	46.7	45.8

	$\frac{3}{62}$	$\frac{3}{61}$	$\frac{3}{60}$
0			
1	10.3	10.2	10.0
2	31.0	30.5	30.0
3	51.7	50.8	50.0

	$\frac{3}{59}$	$\frac{3}{58}$	$\frac{3}{57}$
0			
1	9.8	9.7	9.5
2	29.5	29.0	28.5
3	49.2	48.3	47.5

P. P.

102° (282°) (257°) **77°**

LOGARITHMS OF THE FUNCTIONS (Continued)

13° (193°) (346°) **166°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.35 209	54	9.36 336	58	0.63 664	9.98 872	3	**60**
1	9.35 263	55	9.36 394	58	0.63 606	9.98 869	2	59
2	9.35 318	55	9.36 452	57	0.63 548	9.98 867	3	58
3	9.35 373	54	9.36 509	57	0.63 491	9.98 864	3	57
4	9.35 427	54	9.36 566	58	0.63 434	9.98 861	3	56
5	9.35 481	55	9.36 624	57	0.63 376	9.98 858	3	55
6	9.35 536	54	9.36 681	57	0.63 319	9.98 855̄	3	54
7	9.35 590	54	9.36 738	57	0.63 262	9.98 952	3	53
8	9.35 644	54	9.36 795̇	57	0.63 205̄	9.98 849	3	52
9	9.35 698	54	9.36 852	57	0.63 148	9.98 846	3	51
10	9.35 752	54	9.36 909	57	0.63 091	9.98 843	3	**50**
11	9.35 806	54	9.36 966	57	0.63 034	9.98 840	3	49
12	9.35 860	54	9.37 023	57	0.62 977	9.98 837	3	48
13	9.35 914	54	9.37 080	57	0.62 920	9.98 834	3	47
14	9.35 968	54	9.37 137	56	0.62 863	9.98 831	3	46
15	9.36 022	53	9.37 193	57	0.62 807	9.98 828	3	45
16	9.36 075̇	54	9.37 25̄0	56	0.62 75̇0	9.98 825̇	3	44
17	9.36 129	53	9.37 306	57	0.62 694	9.98 822	3	43
18	9.36 182	54	9.37 363	56	0.62 637	9.98 819	3	42
19	9.36 236	53	9.37 419	57	0.62 581	9.98 816	3	41
20	9.36 289	53	9.37 476	56	0.62 524	9.98 813	3	**40**
21	9.36 342	53	9.37 532	56	0.62 468	9.98 810	3	39
22	9.36 395̇	54	9.37 588	56	0.62 412	9.98 807	3	38
23	9.36 449	53	9.37 644	56	0.62 356	9.98 804	3	37
24	9.36 502	53	9.37 700	56	0.62 300	9.98 801	3	36
25	9.36 555̄	53	9.37 756	56	0.62 244	9.98 798	3	35
26	9.36 608	52	9.37 812	56	0.62 188	9.98 795̇	3	34
27	9.36 660	53	9.37 868	56	0.62 132	9.98 792	3	33
28	9.36 713	53	9.37 924	56	0.62 076	9.98 789	3	32
29	9.36 766	53	9.37 980	55	0.62 020	9.98 786	3	31
30	9.36 819	52	9.38 035̇	56	0.61 965̄	9.98 783	3	**30**
31	9.36 871	53	9.38 091	56	0.61 909	9.98 780	3	29
32	9.36 924	52	9.38 147	55	0.61 853	9.98 777	3	28
33	9.36 976	52	9.38 202	55	0.61 798	9.98 774	3	27
34	9.37 028	53	9.38 257	56	0.61 743	9.98 771	3	26
35	9.37 081	52	9.38 313	55	0.61 687	9.98 768	3	25
36	9.37 133	52	9.38 368	55	0.61 632	9.98 765̄	3	24
37	9.37 185̇	52	9.38 423	56	0.61 577	9.98 762	3	23
38	9.37 237	52	9.38 479	55	0.61 521	9.98 759	3	22
39	9.37 289	52	9.38 534	55	0.61 466	9.98 756	3	21
40	9.37 341	52	9.38 589	55	0.61 411	9.98 753	3	**20**
41	9.37 393	52	9.38 644	55	0.61 356	9.98 75̄0	4	19
42	9.37 445̇	52	9.38 699	55	0.61 301	9.98 746	3	18
43	9.37 497	52	9.38 754	54	0.61 246	9.98 743	3	17
44	9.37 549	51	9.38 808	55	0.61 192	9.98 740	3	16
45	9.37 600	52	9.38 863	55	0.61 137	9.98 737	3	15
46	9.37 652	51	9.38 918	54	0.61 082	9.98 734	3	14
47	9.37 703	52	9.38 972	55	0.61 028	9.98 731	3	13
48	9.37 755̄	51	9.39 027	55	0.60 973	9.98 728	3	12
49	9.37 806	52	9.39 082	54	0.60 918	9.98 725̄	3	11
50	9.37 858	51	9.39 136	54	0.60 864	9.98 722	3	**10**
51	9.37 909	51	9.39 190	55	0.60 810	9.98 719	4	9
52	9.37 960	51	9.39 245̄	54	0.60 755̇	9.98 715̇	3	8
53	9.38 011	51	9.39 299	54	0.60 701	9.98 712	3	7
54	9.38 062	51	9.39 353	54	0.60 647	9.98 709	3	6
55	9.38 113	51	9.39 407	54	0.60 593	9.98 706	3	5
56	9.38 164	51	9.39 461	54	0.60 539	9.98 703	3	4
57	9.38 215̇	51	9.39 515̇	54	0.60 485̄	9.98 700	3	3
58	9.38 266	51	9.39 569	54	0.60 431	9.98 697	3	2
59	9.38 317	51	9.39 623	54	0.60 377	9.98 694	4	1
60	9.38 368		9.39 677		0.60 323	9.98 690		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**57**	**56**	**55**
1	1.0	0.9	0.9
2	1.9	1.9	1.8
3	2.8	2.8	2.8
4	3.8	3.7	3.7
5	4.8	4.7	4.6
6	5.7	5.6	5.5
7	6.6	6.5̇	6.4
8	7.6	7.5	7.3
9	8.6	8.4	8.2
10	9.5	9.3	9.2
20	19.0	18.7	18.3
30	28.5	28.0	27.5
40	38.0	37.3	36.7
50	47.5	46.7	45.8

″	**54**	**53**	**52**
1	0.9	0.9	0.9
2	1.8	1.8	1.7
3	2.7	2.6	2.6
4	3.6	3.5̇	3.5̄
5	4.5	4.4	4.3
6	5.4	5.3	5.2
7	6.3	6.2	6.1
8	7.2	7.1	6.9
9	8.1	8.0	7.8
10	9.0	8.8	8.7
20	18.0	17.7	17.3
30	27.0	26.5	26.0
40	36.0	35.3	34.7
50	45.0	44.2	43.3

″	**51**	**4**	**3**	**2**
1	0.8	0.1	0.0	0.0
2	1.7	0.1	0.1	0.1
3	2.6	0.2	0.2	0.1
4	3.4	0.3	0.2	0.1
5	4.2	0.3	0.2	0.2
6	5.1	0.4	0.3	0.2
7	6.0	0.5̄	0.4	0.2
8	6.8	0.5̇	0.4	0.3
9	7.6	0.6	0.4	0.3
10	8.5	0.7	0.5	0.3
20	17.0	1.3	1.0	0.7
30	25.5	2.0	1.5	1.0
40	34.0	2.7	2.0	1.3
50	42.5	3.3	2.5	1.7

	$\frac{4}{55}$	$\frac{4}{54}$	$\frac{3}{58}$	$\frac{3}{57}$
0	6.9	6.8	9.7	9.5
1	20.6	20.2	29.0	28.5
2	34.4	33.8	48.3	47.5
3	48.1	47.2	—	—
4				

	$\frac{3}{56}$	$\frac{3}{55}$	$\frac{3}{54}$
0	9.3	9.2	9.0
1	28.0	27.5	27.0
2	46.7	45.8	45.0
3			

P. P.

103° (283°) (256°) **76°**

LOGARITHMS OF THE FUNCTIONS (Continued)

14° (194°) (345°) **165°**

'	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	'
0	9.38 368	50	9.39 677	54	0.60 323	9.98 690	3	**60**
1	9.38 418	51	9.39 731	54	0.60 269	9.98 687	3	59
2	9.38 469	50	9.39 785̄	53	0.60 215̇	9.98 684	3	58
3	9.38 519	51	9.39 838	54	0.60 162	9.98 681	3	57
4	9.38 570	50	9.39 892	53	0.60 108	9.98 678	3	56
5	9.38 620	50	9.39 945̇	54	0.60 055̄	9.98 675̄	4	55
6	9.38 670	51	9.39 999	53	0.60 001	9.98 671	3	54
7	9.38 721	50	9.40 052	54	0.59 948	9.98 668	3	53
8	9.38 771	50	9.40 106	53	0.59 894	9.98 665̇	3	52
9	9.38 821	50	9.40 159	53	0.59 841	9.98 662	3	51
10	9.38 871	50	9.40 212	54	0.59 788	9.98 659	3	**50**
11	9.38 921	50	9.40 266	53	0.59 734	9.98 656	4	49
12	9.38 971	50	9.40 319	53	0.59 681	9.98 652	3	48
13	9.39 021	50	9.40 372	53	0.59 628	9.98 649	3	47
14	9.39 071	50	9.40 425̄	53	0.59 575̇	9.98 646	3	46
15	9.39 121	49	9.40 478	53	0.59 522	9.98 643	3	45
16	9.39 170	50	9.40 531	53	0.59 469	9.98 640	4	44
17	9.39 220	50	9.40 584	52	0.59 416	9.98 636	3	43
18	9.39 270	49	9.40 636	53	0.59 364	9.98 633	3	42
19	9.39 319	50	9.40 689	53	0.59 311	9.98 630	3	41
20	9.39 369	49	9.40 742	53	0.59 258	9.98 627	4	**40**
21	9.39 418	49	9.40 795̄	52	0.59 205̇	9.98 623	3	39
22	9.39 467	50	9.40 847	53	0.59 153	9.98 620	3	38
23	9.39 517	49	9.40 900	52	0.59 100	9.98 617	3	37
24	9.39 566	49	9.40 952	53	0.59 048	9.98 614	4	36
25	9.39 615̄	49	9.41 005̄	52	0.58 995̇	9.98 610	3	35
26	9.39 664	49	9.41 057	52	0.58 943	9.98 607	3	34
27	9.39 713	49	9.41 109	52	0.58 891	9.98 604	3	33
28	9.39 762	49	9.41 161	53	0.58 839	9.98 601	4	32
29	9.39 811	49	9.41 214	52	0.58 786	9.98 597	3	31
30	9.39 860	49	9.41 266	52	0.58 734	9.98 594	3	**30**
31	9.39 909	49	9.41 318	52	0.58 682	9.98 591	3	29
32	9.39 958	48	9.41 370	52	0.58 630	9.98 588	4	28
33	9.40 006	49	9.41 422	52	0.58 578	9.98 584	3	27
34	9.40 055̄	48	9.41 474	52	0.58 526	9.98 581	3	26
35	9.40 103	49	9.41 526	52	0.58 474	9.98 578	4	25
36	9.40 152	48	9.41 578	51	0.58 422	9.98 574	3	24
37	9.40 200	49	9.41 629	52	0.58 371	9.98 571	3	23
38	9.40 249	48	9.41 681	52	0.58 319	9.98 568	3	22
39	9.40 297	49	9.41 733	51	0.58 267	9.98 565̄	4	21
40	9.40 346	48	9.41 784	52	0.58 216	9.98 561	3	**20**
41	9.40 394	48	9.41 836	51	0.58 164	9.98 558	3	19
42	9.40 442	48	9.41 887	52	0.58 113	9.98 555̄	4	18
43	9.40 490	48	9.41 939	51	0.58 061	9.98 551	3	17
44	9.40 538	48	9.41 990	51	0.58 010	9.98 548	3	16
45	9.40 586	48	9.42 041	52	0.57 959	9.98 545̄	4	15
46	9.40 634	48	9.42 093	51	0.57 907	9.98 541	3	14
47	9.40 682	48	9.42 144	51	0.57 856	9.98 538	3	13
48	9.40 730	48	9.42 195̇	51	0.57 805̄	9.98 535̄	4	12
49	9.40 778	47	9.42 246	51	0.57 754	9.98 531	3	11
50	9.40 825̇	48	9.42 297	51	0.57 703	9.98 528	3	**10**
51	9.40 873	48	9.42 348	51	0.57 652	9.98 525̄	4	9
52	9.40 921	47	9.42 399	51	0.57 601	9.98 521	3	8
53	9.40 968	48	9.42 450	51	0.57 55̄0	9.98 518	3	7
54	9.41 016	47	9.42 501	51	0.57 499	9.98 515̄	4	6
55	9.41 063	48	9.42 552	51	0.57 448	9.98 511	3	5
56	9.41 111	47	9.42 603	50	0.57 397	9.98 508	3	4
57	9.41 158	47	9.42 653	51	0.57 347	9.98 505̄	4	3
58	9.41 205̇	47	9.42 704	51	0.57 296	9.98 501	3	2
59	9.41 252	48	9.42 755̄	50	0.57 245̇	9.98 498	4	1
60	9.41 300		9.42 805̇		0.57 195̄	9.98 494		0
'	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	'

P. P.

″	**54**	**53**	**52**
1	0.9	0.9	0.9
2	1.8	1.8	1.7
3	2.7	2.6	2.6
4	3.6	3.5̇	3.5̄
5	4.5	4.4	4.3
6	5.4	5.3	5.2
7	6.3	6.2	6.1
8	7.2	7.1	6.9
9	8.1	8.0	7.8
10	9.0	8.8	8.7
20	18.0	17.7	17.3
30	27.0	26.5	26.0
40	36.0	35.3	34.7
50	45.0	44.2	43.3

″	**51**	**50**	**49**
1	0.8	0.8	0.8
2	1.7	1.7	1.6
3	2.6	2.5	2.4
4	3.4	3.3	3.3
5	4.2	4.2	4.1
6	5.1	5.0	4.9
7	6.0	5.8	5.7
8	6.8	6.7	6.5̇
9	7.6	7.5	7.4
10	8.5	8.3	8.2
20	17.0	16.7	16.3
30	25.5	25.0	24.5
40	34.0	33.3	32.7
50	42.5	41.7	40.8

″	**48**	**47**	**4**	**3**
1	0.8	0.8	0.1	0.0
2	1.6	1.6	0.1	0.1
3	2.4	2.4	0.2	0.2
4	3.2	3.1	0.3	0.2
5	4.0	3.9	0.3	0.2
6	4.8	4.7	0.4	0.3
7	5.6	5.5̄	0.5̄	0.4
8	6.4	6.3	0.5̇	0.4
9	7.2	7.0	0.6	0.4
10	8.0	7.8	0.7	0.5
20	16.0	15.7	1.3	1.0
30	24.0	23.5	2.0	1.5
40	32.0	31.3	2.7	2.0
50	40.0	39.2	3.3	2.5

	$\frac{4}{54}$	$\frac{4}{53}$	$\frac{4}{52}$	$\frac{4}{51}$
0	6.8	6.6	6.5	6.4
1	20.2	19.9	19.5	19.1
2	33.8	33.1	32.5	31.9
3	47.2	46.4	45.5	44.6
4				

	$\frac{3}{54}$	$\frac{3}{53}$	$\frac{3}{52}$	$\frac{3}{51}$
0	9.0	8.8	8.7	8.5
1	27.0	26.5	26.0	25.5
2	45.0	44.2	43.3	42.5
3				

P. P.

104° (284°) (255°) **75°**

15° (195°) (344°) **164°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.41 300	47	9.42 805̇	51	0.57 195̄	9.98 494	3	**60**
1	9.41 347	47	9.42 856	50	0.57 144	9.98 491	3	59
2	9.41 394	47	9.42 906	51	0.57 094	9.98 488	4	58
3	9.41 441	47	9.42 957	50	0.57 043	9.98 484	3	57
4	9.41 488	47	9.43 007	50	0.56 993	9.98 481	4	56
5	9.41 535̄	47	9.43 057	51	0.56 943	9.98 477	3	55
6	9.41 582	46	9.43 108	50	0.56 892	9.98 474	3	54
7	9.41 628	47	9.43 158	50	0.56 842	9.98 471	4	53
8	9.41 675	47	9.43 208	50	0.56 792	9.98 467	3	52
9	9.41 722	46	9.43 258	50	0.56 742	9.98 464	4	51
10	9.41 768	47	9.43 308	50	0.56 692	9.98 460	3	**50**
11	9.41 815̄	46	9.43 358	50	0.56 642	9.98 457	4	49
12	9.41 861	47	9.43 408	50	0.56 592	9.98 453	3	48
13	9.41 908	46	9.43 458	50	0.56 542	9.98 45̇0	3	47
14	9.41 954	47	9.43 508	50	0.56 492	9.98 447	4	46
15	9.42 001	46	9.43 558	49	0.56 442	9.98 443	3	45
16	9.42 047	46	9.43 607	50	0.56 393	9.98 440	4	44
17	9.42 093	47	9.43 657	50	0.56 343	9.98 436	3	43
18	9.42 140	46	9.43 707	49	0.56 293	9.98 433	4	42
19	9.42 186	46	9.43 756	50	0.56 244	9.98 429	3	41
20	9.42 232	46	9.43 806	49	0.56 194	9.98 426	4	**40**
21	9.42 278	46	9.43 855̇	50	0.56 145̄	9.98 422	3	39
22	9.42 324	46	9.43 905̄	49	0.56 095̇	9.98 419	4	38
23	9.42 370	46	9.43 954	50	0.56 046	9.98 415̇	3	37
24	9.42 416	45	9.44 004	49	0.55 996	9.98 412	3	36
25	9.42 461	46	9.44 053	49	0.55 947	9.98 409	4	35
26	9.42 507	46	9.44 102	49	0.55 898	9.98 405̇	3	34
27	9.42 553	46	9.44 151	50	0.55 849	9.98 402	4	33
28	9.42 599	45	9.44 201	49	0.55 799	9.98 398	3	32
29	9.42 644	46	9.44 25̄0	49	0.55 75̇0	9.98 395̄	4	31
30	9.42 690	45	9.44 299	49	0.55 701	9.98 391	3	**30**
31	9.42 735	46	9.44 348	49	0.55 652	9.98 388	4	29
32	9.42 781	45	9.44 397	49	0.55 603	9.98 384	3	28
33	9.42 826	46	9.44 446	49	0.55 554	9.98 381	4	27
34	9.42 872	45	9.44 495̄	49	0.55 505̇	9.98 377	4	26
35	9.42 917	45	9.44 544	48	0.55 456	9.98 373	3	25
36	9.42 962	46	9.44 592	49	0.55 408	9.98 370	4	24
37	9.43 008	45	9.44 641	49	0.55 359	9.98 366	3	23
38	9.43 053	45	9.44 690	48	0.55 310	9.98 363	4	22
39	9.43 098	45	9.44 738	49	0.55 262	9.98 359	3	21
40	9.43 143	45	9.44 787	49	0.55 213	9.98 356	4	**20**
41	9.43 188	45	9.44 836	48	0.55 164	9.98 352	3	19
42	9.43 233	45	9.44 884	49	0.55 116	9.98 349	4	18
43	9.43 278	45	9.44 933	48	0.55 067	9.98 345̇	3	17
44	9.43 323	44	9.44 981	48	0.55 019	9.98 342	4	16
45	9.43 367	45	9.45 029	49	0.54 971	9.98 338	4	15
46	9.43 412	45	9.45 078	48	0.54 922	9.98 334	3	14
47	9.43 457	45	9.45 126	48	0.54 874	9.98 331	4	13
48	9.43 502	44	9.45 174	48	0.54 826	9.98 327	3	12
49	9.43 546	45	9.45 222	49	0.54 778	9.98 324	4	11
50	9.43 591	44	9.45 271	48	0.54 729	9.98 320	3	**10**
51	9.43 635	45	9.45 319	48	0.54 681	9.98 317	4	9
52	9.43 680	44	9.45 367	48	0.54 633	9.98 313	4	8
53	9.43 724	45	9.45 415̄	48	0.54 585̇	9.98 309	3	7
54	9.43 769	44	9.45 463	48	0.54 537	9.98 306	4	6
55	9.43 813	44	9.45 511	48	0.54 489	9.98 302	3	5
56	9.43 857	44	9.45 559	47	0.54 441	9.98 299	4	4
57	9.43 901	45	9.45 606	48	0.54 394	9.98 295̇	4	3
58	9.43 946	44	9.45 654	48	0.54 346	9.98 291	3	2
59	9.43 990	44	9.45 702	48	0.54 298	9.98 288	4	1
60	9.44 034		9.45 75̄0		0.54 25̇0	9.98 284		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**51**	**50**	**49**
1	0.8	0.8	0.8
2	1.7	1.7	1.6
3	2.6	2.5	2.4
4	3.4	3.3	3.3
5	4.2	4.2	4.1
6	5.1	5.0	4.9
7	6.0	5.8	5.7
8	6.8	6.7	6.5̇
9	7.6	7.5	7.4
10	8.5	8.3	8.2
20	17.0	16.7	16.3
30	25.5	25.0	24.5
40	34.0	33.3	32.7
50	42.5	41.7	40.8

″	**48**	**47**	**46**
1	0.8	0.8	0.8
2	1.6	1.6	1.5̇
3	2.4	2.4	2.3
4	3.2	3.1	3.1
5	4.0	3.9	3.8
6	4.8	4.7	4.6
7	5.6	5.5̄	5.4
8	6.4	6.3	6.1
9	7.2	7.0	6.9
10	8.0	7.8	7.7
20	16.0	15.7	15.3
30	24.0	23.5	23.0
40	32.0	31.3	30.7
50	40.0	39.2	38.3

″	**45**	**44**	**4**	**3**
1	0.8	0.7	0.1	0.0
2	1.5	1.5̄	0.1	0.1
3	2.2	2.2	0.2	0.2
4	3.0	2.9	0.3	0.2
5	3.8	3.7	0.3	0.2
6	4.5	4.4	0.4	0.3
7	5.2	5.1	0.5̄	0.4
8	6.0	5.9	0.5̇	0.4
9	6.8	6.6	0.6	0.4
10	7.5	7.3	0.7	0.5
20	15.0	14.7	1.3	1.0
30	22.5	22.0	2.0	1.5
40	30.0	29.3	2.7	2.0
50	37.5	36.7	3.3	2.5

	$\frac{\mathbf{4}}{\mathbf{50}}$	$\frac{\mathbf{4}}{\mathbf{49}}$	$\frac{\mathbf{4}}{\mathbf{48}}$	$\frac{\mathbf{4}}{\mathbf{47}}$
0	6.2	6.1	6.0	5.9
1	18.8	18.4	18.0	17.6
2	31.2	30.6	30.0	29.4
3	43.8	42.9	42.0	41.1
4				

	$\frac{\mathbf{3}}{\mathbf{51}}$	$\frac{\mathbf{3}}{\mathbf{50}}$	$\frac{\mathbf{3}}{\mathbf{49}}$	$\frac{\mathbf{3}}{\mathbf{48}}$
0	8.5	8.3	8.2	8.0
1	25.5	25.0	24.5	24.0
2	42.5	41.7	40.8	40.0
3				

P. P.

105° (285°) (254°) **74°**

16° (196°) (343°) 163°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.44 034	44	9.45 750	47	0.54 250	9.98 284	3	60
1	9.44 078	44	9.45 797	48	0.54 203	9.98 281	4	59
2	9.44 122	44	9.45 845̇	47	0.54 155̇	9.98 277	4	58
3	9.44 166	44	9.45 892	48	0.54 108	9.98 273	3	57
4	9.44 210	43	9.45 940	47	0.54 060	9.98 270	4	56
5	9.44 253	44	9.45 987	48	0.54 013	9.98 266	4	55
6	9.44 297	44	9.46 035̄	47	0.53 965̇	9.98 262	3	54
7	9.44 341	44	9.46 082	48	0.53 918	9.98 259	4	53
8	9.44 385̄	43	9.46 130	47	0.53 870	9.98 255̇	4	52
9	9.44 428	44	9.46 177	47	0.53 823	9.98 251	3	51
10	9.44 472	44	9.46 224	47	0.53 776	9.98 248	4	50
11	9.44 516	43	9.46 271	48	0.53 729	9.98 244	4	49
12	9.44 559	43	9.46 319	47	0.53 681	9.98 240	3	48
13	9.44 602	44	9.46 366	47	0.53 634	9.98 237	4	47
14	9.44 646	43	9.46 413	47	0.53 587	9.98 233	4	46
15	9.44 689	44	9.46 460	47	0.53 540	9.98 229	3	45
16	9.44 733	43	9.46 507	47	0.53 493	9.98 226	4	44
17	9.44 776	43	9.46 554	47	0.53 446	9.98 222	4	43
18	9.44 819	43	9.46 601	47	0.53 399	9.98 218	3	42
19	9.44 862	43	9.46 648	46	0.53 352	9.98 215̄	4	41
20	9.44 905̇	43	9.46 694	47	0.53 306	9.98 211	4	40
21	9.44 948	44	9.46 741	47	0.53 259	9.98 207	3	39
22	9.44 992	43	9.46 788	47	0.53 212	9.98 204	4	38
23	9.45 035̄	42	9.46 835̄	46	0.53 165̇	9.98 200	4	37
24	9.45 077	43	9.46 881	47	0.53 119	9.98 196	4	36
25	9.45 120	43	9.46 928	47	0.53 072	9.98 192	3	35
26	9.45 163	43	9.46 975̄	46	0.53 025̇	9.98 189	4	34
27	9.45 206	43	9.47 021	47	0.52 979	9.98 185̄	4	33
28	9.45 249	43	9.47 068	46	0.52 932	9.98 181	4	32
29	9.45 292	42	9.47 114	46	0.52 886	9.98 177	3	31
30	9.45 334	43	9.47 160	47	0.52 840	9.98 174	4	30
31	9.45 377	42	9.47 207	46	0.52 793	9.98 170	4	29
32	9.45 419	43	9.47 253	46	0.52 747	9.98 166	4	28
33	9.45 462	42	9.47 299	47	0.52 701	9.98 162	3	27
34	9.45 504	43	9.47 346	46	0.52 654	9.98 159	4	26
35	9.45 547	42	9.47 392	46	0.52 608	9.98 155̄	4	25
36	9.45 589	43	9.47 438	46	0.52 562	9.98 151	4	24
37	9.45 632	42	9.47 484	46	0.52 516	9.98 147	3	23
38	9.45 674	42	9.47 530	46	0.52 470	9.98 144	4	22
39	9.45 716	42	9.47 576	46	0.52 424	9.98 140	4	21
40	9.45 758	43	9.47 622	46	0.52 378	9.98 136	4	20
41	9.45 801	42	9.47 668	46	0.52 332	9.98 132	3	19
42	9.45 843	42	9.47 714	46	0.52 286	9.98 129	4	18
43	9.45 885̄	42	9.47 760	46	0.52 240	9.98 125̄	4	17
44	9.45 927	42	9.47 806	46	0.52 194	9.98 121	4	16
45	9.45 969	42	9.47 852	45	0.52 148	9.98 117	4	15
46	9.46 011	42	9.47 897	46	0.52 103	9.98 113	3	14
47	9.46 053	42	9.47 943	46	0.52 057	9.98 110	4	13
48	9.46 095̄	41	9.47 989	46	0.52 011	9.98 106	4	12
49	9.46 136	42	9.48 035̄	45	0.51 965̇	9.98 102	4	11
50	9.46 178	42	9.48 080	46	0.51 920	9.98 098	4	10
51	9.46 220	42	9.48 126	45	0.51 874	9.98 094	4	9
52	9.46 262	41	9.48 171	46	0.51 829	9.98 090	3	8
53	9.46 303	42	9.48 217	45	0.51 783	9.98 087	4	7
54	9.46 345̄	41	9.48 262	45	0.51 738	9.98 083	4	6
55	9.46 386	42	9.48 307	46	0.51 693	9.98 079	4	5
56	9.46 428	41	9.48 353	45	0.51 647	9.98 075̇	4	4
57	9.46 469	42	9.48 398	45	0.51 602	9.98 071	4	3
58	9.46 511	41	9.48 443	46	0.51 557	9.98 067	4	2
59	9.46 552	42	9.48 489	45	0.51 511	9.98 063	3	1
60	9.46 594		9.48 534		0.51 466	9.98 060		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

106° (286°) (253°) 73°

P.P.

″	**48**	**47**	**46**
1	0.8	0.8	0.8
2	1.6	1.6	1.5̇
3	2.4	2.4	2.3
4	3.2	3.1	3.1
5	4.0	3.9	3.8
6	4.8	4.7	4.6
7	5.6	5.5̄	5.4
8	6.4	6.3	6.1
9	7.2	7.0	6.9
10	8.0	7.8	7.7
20	16.0	15.7	15.3
30	24.0	23.5	23.0
40	32.0	31.3	30.7
50	40.0	39.2	38.3

″	**45**	**44**	**43**
1	0.8	0.7	0.7
2	1.5	1.5̄	1.4
3	2.2	2.2	2.2
4	3.0	2.9	2.9
5	3.8	3.7	3.6
6	4.5	4.4	4.3
7	5.2	5.1	5.0
8	6.0	5.9	5.7
9	6.8	6.6	6.4
10	7.5	7.3	7.2
20	15.0	14.7	14.3
30	22.5	22.0	21.5
40	30.0	29.3	28.7
50	37.5	36.7	35.8

″	**42**	**41**	**4**	**3**
1	0.7	0.7	0.1	0.0
2	1.4	1.4	0.1	0.1
3	2.1	2.0	0.2	0.2
4	2.8	2.7	0.3	0.2
5	3.5	3.4	0.3	0.2
6	4.2	4.1	0.4	0.3
7	4.9	4.8	0.5̄	0.4
8	5.6	5.5̄	0.5̇	0.4
9	6.3	6.2	0.6	0.4
10	7.0	6.8	0.7	0.5
20	14.0	13.7	1.3	1.0
30	21.0	20.5	2.0	1.5
40	28.0	27.3	2.7	2.0
50	35.0	34.2	3.3	2.5

	$\frac{4}{48}$	$\frac{4}{47}$	$\frac{4}{46}$	$\frac{4}{45}$
0	6.0	5.9	5.8	5.6
1	18.0	17.6	17.2	16.9
2	30.0	29.4	28.8	28.1
3	42.0	41.1	40.2	39.4
4				

	$\frac{3}{48}$	$\frac{3}{47}$	$\frac{3}{46}$	$\frac{3}{45}$
0	8.0	7.8	7.7	7.5
1	24.0	23.5	23.0	22.5
2	40.0	39.2	38.3	37.5
3				

P.P.

17° (197°) (342°) **162°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.46 594	41	9.48 534	45	0.51 466	9.98 060	4	**60**
1	9.46 635̄	41	9.48 579	45	0.51 421	9.98 056	4	59
2	9.46 676	41	9.48 624	45	0.51 376	9.98 052	4	58
3	9.46 717	41	9.48 669	45	0.51 331	9.98 048	4	57
4	9.46 758	42	9.48 714	45	0.51 286	9.98 044	4	56
5	9.46 800	41	9.48 759	45	0.51 241	9.98 040	4	55
6	9.46 841	41	9.48 804	45	0.51 196	9.98 036	4	54
7	9.46 882	41	9.48 849	45	0.51 151	9.98 032	3	53
8	9.46 923	41	9.48 894	45	0.51 106	9.98 029	4	52
9	9.46 964	41	9.48 939	45	0.51 061	9.98 025̄	4	51
10	9.47 005̄	40	9.48 984	45	0.51 016	9.98 021	4	**50**
11	9.47 045̇	41	9.49 029	44	0.50 971	9.98 017	4	49
12	9.47 086	41	9.49 073	45	0.50 927	9.98 013	4	48
13	9.47 127	41	9.49 118	45	0.50 882	9.98 009	4	47
14	9.47 168	41	9.49 163	44	0.50 837	9.98 005̇	4	46
15	9.47 209	40	9.49 207	45	0.50 793	9.98 001	4	45
16	9.47 249	41	9.49 252	44	0.50 748	9.97 997	4	44
17	9.47 290	40	9.49 296	45	0.50 704	9.97 993	4	43
18	9.47 330	41	9.49 341	44	0.50 659	9.97 989	3	42
19	9.47 371	40	9.49 385̇	45	0.50 615̄	9.97 986	4	41
20	9.47 411	41	9.49 430	44	0.50 570	9.97 982	4	**40**
21	9.47 452	40	9.49 474	45	0.50 526	9.97 978	4	39
22	9.47 492	41	9.49 519	44	0.50 481	9.97 974	4	38
23	9.47 533	40	9.49 563	44	0.50 437	9.97 970	4	37
24	9.47 573	40	9.49 607	45	0.50 393	9.97 966	4	36
25	9.47 613	41	9.49 652	44	0.50 348	9.97 962	4	35
26	9.47 654	40	9.49 696	44	0.50 304	9.97 958	4	34
27	9.47 694	40	9.49 740	44	0.50 260	9.97 954	4	33
28	9.47 734	40	9.49 784	44	0.50 216	9.97 950	4	32
29	9.47 774	40	9.49 828	44	0.50 172	9.97 946	4	31
30	9.47 814	40	9.49 872	44	0.50 128	9.97 942	4	**30**
31	9.47 854	40	9.49 916	44	0.50 084	9.97 938	4	29
32	9.47 894	40	9.49 960	44	0.50 040	9.97 934	4	28
33	9.47 934	40	9.50 004	44	0.49 996	9.97 930	4	27
34	9.47 974	40	9.50 048	44	0.49 952	9.97 926	4	26
35	9.48 014	40	9.50 092	44	0.49 908	9.97 922	4	25
36	9.48 054	40	9.50 136	44	0.49 864	9.97 918	4	24
37	9.48 094	39	9.50 180	43	0.49 820	9.97 914	4	23
38	9.48 133	40	9.50 223	44	0.49 777	9.97 910	4	22
39	9.48 173	40	9.50 267	44	0.49 733	9.97 906	4	21
40	9.48 213	39	9.50 311	44	0.49 689	9.97 902	4	**20**
41	9.48 252	40	9.50 355̄	43	0.49 645̇	9.97 898	4	19
42	9.48 292	40	9.50 398	44	0.49 602	9.97 894	4	18
43	9.48 332	39	9.50 442	43	0.49 558	9.97 890	4	17
44	9.48 371	40	9.50 485̇	44	0.49 515̄	9.97 886	4	16
45	9.48 411	39	9.50 529	43	0.49 471	9.97 882	4	15
46	9.48 450	40	9.50 572	44	0.49 428	9.97 878	4	14
47	9.48 490	39	9.50 616	43	0.49 384	9.97 874	4	13
48	9.48 529	39	9.50 659	44	0.49 341	9.97 870	4	12
49	9.48 568	39	9.50 703	43	0.49 297	9.97 866	5	11
50	9.48 607	40	9.50 746	43	0.49 254	9.97 861	4	**10**
51	9.48 647	39	9.50 789	44	0.49 211	9.97 857	4	9
52	9.48 686	39	9.50 833	43	0.49 167	9.97 853	4	8
53	9.48 725̇	39	9.50 876	43	0.49 124	9.97 849	4	7
54	9.48 764	39	9.50 919	43	0.49 081	9.97 845̇	4	6
55	9.48 803	39	9.50 962	43	0.49 038	9.97 841	4	5
56	9.48 842	39	9.51 005̇	43	0.48 995̄	9.97 837	4	4
57	9.48 881	39	9.51 048	44	0.48 952	9.97 833	4	3
58	9.48 920	39	9.51 092	43	0.48 908	9.97 829	4	2
59	9.48 959	39	9.51 135̄	43	0.48 865̇	9.97 825̄	4	1
60	9.48 998		9.51 178		0.48 822	9.97 821		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

″	**45**	**44**	**43**
1	0.8	0.7	0.7
2	1.5	1.5	1.4
3	2.2	2.2	2.2
4	3.0	2.9	2.9
5	3.8	3.7	3.6
6	4.5	4.4	4.3
7	5.2	5.1	5.0
8	6.0	5.9	5.7
9	6.8	6.6	6.4
10	7.5	7.3	7.2
20	15.0	14.7.	14.3
30	22.5	22.0	21.5
40	30.0	29.3	28.7
50	37.5	36.7	35.8

″	**42**	**41**	**40**
1	0.7	0.7	0.7
2	1.4	1.4	1.3
3	2.1	2.0	2.0
4	2.8	2.7	2.7
5	3.5	3.4	3.3
6	4.2	4.1	4.0
7	4.9	4.8	4.7
8	5.6	5.5	5.3
9	6.3	6.2	6.0
10	7.0	6.8	6.7
20	14.0	13.7	13.3
30	21.0	20.5	20.0
40	28.0	27.3	26.7
50	35.0	34.2	33.3

″	**39**	**5**	**4**	**3**
1	0.6	0.1	0.1	0.0
2	1.3	0.2	0.1	0.1
3	2.0	0.2	0.2	0.2
4	2.6	0.3	0.3	0.2
5	3.2	0.4	0.3	0.2
6	3.9	0.5	0.4	0.3
7	4.6	0.6	0.5	0.4
8	5.2	0.7	0.5	0.4
9	5.8	0.8	0.6	0.4
10	6.5	0.8	0.7	0.5
20	13.0	1.7	1.3	1.0
30	19.5	2.5	2.0	1.5
40	26.0	3.3	2.7	2.0
50	32.5	4.2	3.3	2.5

	$\frac{5}{43}$	$\frac{4}{45}$	$\frac{4}{44}$
0	4.3	5.6	5.5
1	12.9	16.9	16.5
2	21.5	28.1	27.5
3	30.1	39.4	38.5
4	38.7	—	—
5			

	$\frac{4}{43}$	$\frac{3}{45}$	$\frac{3}{44}$
0	5.4	7.5	7.3
1	16.1	22.5	22.0
2	26.9	37.5	36.7
3	37.6	—	—
4			

P.P.

107° (287°) (252°) **72°**

LOGARITHMS OF THE FUNCTIONS (Continued)

18° (198°) (341°) **161°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d	′
0	9.48 998	39	9.51 178	43	0.48 822	9.97 821	4	**60**
1	9.49 037	39	9.51 221	43	0.48 779	9.97 817	5	59
2	9.49 076	39	9.51 264	42	0.48 736	9.97 812	4	58
3	9.49 115	38	9.51 306	43	0.48 694	9.97 808	4	57
4	9.49 153	39	9.51 349	43	0.48 651	9.97 804	4	56
5	9.49 192	39	9.51 392	43	0.48 608	9.97 800	4	55
6	9.49 231	38	9.51 435	43	0.48 565	9.97 796	4	54
7	9.49 269	39	9 51 478	42	0.48 522	9.97 792	4	53
8	9.49 308	39	9.51 520	43	0.48 480	9.97 788	4	52
9	9.49 347	38	9.51 563	43	0.48 437	9.97 784	5	51
10	9.49 385	39	9.51 606	42	0.48 394	9.97 779	4	**50**
11	9.49 424	38	9.51 648	43	0.48 352	9.97 775	4	49
12	9.49 462	38	9.51 691	43	0.48 309	9.97 771	4	48
13	9.49 500	39	9.51 734	42	0.48 266	9.97 767	4	47
14	9.49 539	38	9.51 776	43	0.48 224	9.97 763	4	46
15	9.49 577	38	9.51 819	42	0.48 181	9.97 759	5	45
16	9.49 615	39	9.51 861	42	0.48 139	9.97 754	4	44
17	9.49 654	38	9.51 903	43	0.48 097	9.97 750	4	43
18	9.49 692	38	9.51 946	42	0.48 054	9.97 746	4	42
19	9.49 730	38	9.51 988	43	0.48 012	9.97 742	4	41
20	9.49 768	38	9.52 031	42	0.47 969	9.97 738	4	**40**
21	9.49 806	38	9.52 073	42	0.47 927	9.97 734	5	39
22	9.49 844	38	9.52 115	42	0.47 885	9.97 729	4	38
23	9.49 882	38	9.52 157	43	0.47 843	9 97 725	4	37
24	9.49 920	38	9.52 200	42	0.47 800	9.97 721	4	36
25	9.49 958	38	9.52 242	42	0.47 758	9.97 717	4	35
26	9.49 996	38	9.52 284	42	0.47 716	9.97 713	5	34
27	9.50 034	38	9.52 326	42	0.47 674	9.97 708	4	33
28	9.50 072	38	9.52 368	42	0.47 632	9.97 704	4	32
29	9.50 110	38	9.52 410	42	0.47 590	9.97 700	4	31
30	9.50 148	37	9.52 452	42	0.47 548	9.97 696	5	**30**
31	9.50 185	38	9.52 494	42	0.47 506	9.97 691	4	29
32	9.50 223	38	9.52 536	42	0.47 464	9.97 687	4	28
33	9.50 261	37	9.52 578	42	0.47 422	9.97 683	4	27
34	9.50 298	38	9.52 620	41	0.47 380	9.97 679	5	26
35	9.50 336	38	9.52 661	42	0.47 339	9.97 674	4	25
36	9.50 374	37	9.52 703	42	0.47 297	9.97 670	4	24
37	9.50 411	38	9.52 745	42	0.47 255	9.97 666	4	23
38	9.50 449	37	9.52 787	42	0.47 213	9.97 662	5	22
39	9.50 486	37	9.52 829	41	0.47 171	9.97 657	4	21
40	9.50 523	38	9.52 870	42	0.47 130	9.97 653	4	**20**
41	9.50 561	37	9.52 912	41	0.47 088	9.97 649	4	19
42	9.50 598	37	9.52 953	42	0.47 047	9.97 645	5	18
43	9.50 635	38	9.52 995	42	0.47 005	9.97 640	4	17
44	9.50 673	37	9.53 037	41	0.46 963	9.97 636	4	16
45	9.50 710	37	9.53 078	42	0.46 922	9.97 632	4	15
46	9.50 747	37	9.53 120	41	0.46 880	9.97 628	5	14
47	9.50 784	37	9 53 161	41	0.46 839	9.97 623	4	13
48	9.50 821	37	9.53 202	42	0.46 798	9.97 619	4	12
49	9.50 858	38	9.53 244	41	0.46 756	9.97 615	5	11
50	9.50 896	37	9.53 285	42	0.46 715	9.97 610	4	**10**
51	9.50 933	37	9.53 327	41	0.46 673	9.97 606	4	9
52	9.50 970	37	9.53 368	41	0.46 632	9.97 602	5	8
53	9.51 007	36	9.53 409	41	0.46 591	9.97 597	4	7
54	9.51 043	37	9.53 450	42	0.46 550	9.97 593	4	6
55	9.51 080	37	9.53 492	41	0.46 508	9.97 589	5	5
56	9.51 117	37	9.53 533	41	0.46 467	9.97 584	4	4
57	9.51 154	37	9.53 574	41	0.46 426	9.97 580	4	3
58	9.51 191	36	9.53 615	41	0.46 385	9.97 576	5	2
59	9.51 227	37	9.53 656	41	0.46 344	9.97 571	4	1
60	9.51 264		9.53 697		0.46 303	9.97 567		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d	′

P. P.

″	**43**	**42**	**41**
1	0.7	0.7	0.7
2	1.4	1.4	1.4
3	2.2	2.1	2.0
4	2.9	2.8	2.7
5	3.6	3.5	3.4
6	4.3	4.2	4.1
7	5.0	4.9	4.8
8	5.7	5.6	5.5
9	6.4	6.3	6.2
10	7.2	7.0	6.8
20	14.3	14.0	13.7
30	21.5	21.0	20.5
40	28.7	28.0	27.3
50	35.8	35.0	34.2
″	**39**	**38**	**37**
1	0.6	0.6	0.6
2	1.3	1.3	1.2
3	2.0	1.9	1.8
4	2.6	2.5	2.5
5	3.2	3.2	3.1
6	3.9	3.8	3.7
7	4.6	4.4	4.3
8	5.2	5.1	4.9
9	5.8	5.7	5.6
10	6.5	6.3	6.2
20	13.0	12.7	12.3
30	19.5	19.0	18.5
40	26.0	25.3	24.7
50	32.5	31.7	30.8
″	**36**	**5**	**4**
1	0.6	0.1	0.1
2	1.2	0.2	0.1
3	1 8	0.2	0.2
4	2.4	0.3	0.3
5	3.0	0.4	0.3
6	3.6	0.5	0.4
7	4.2	0.6	0.5
8	4.8	0.7	0.5
9	5.4	0.8	0.6
10	6.0	0.8	0.7
20	12.0	1.7	1.3
30	18.0	2.5	2.0
40	24.0	3.3	2.7
50	30.0	4.2	3.3

	$\frac{5}{43}$	$\frac{5}{42}$	$\frac{5}{41}$
0	4.3	4.2	4.1
1	12.9	12.6	12.3
2	21.5	21.0	20.5
3	30.1	29.4	28.7
4	38.7	37.8	36.9
5			

	$\frac{4}{43}$	$\frac{4}{42}$	$\frac{4}{41}$
0	5.4	5.2	5.1
1	16.1	15.8	15.4
2	26.9	26.2	25.6
3	37.6	36.8	35.9
4			

P. P.

108° (288°) (251°) **71°**

19° (199°) (340°) 160°

′	L. Sin.	d.	L. Tan	c.d.	L. Cot.	L. Cos.	d.	′
0	9.51 264	37	9.53 697	41	0.46 303	9.97 567	4	60
1	9.51 301	37	9.53 738	41	0.46 262	9.97 563	5	59
2	9.51 338	36	9.53 779	41	0.46 221	9.97 558	4	58
3	9.51 374	37	9.53 820	41	0.46 180	9.97 554	4	57
4	9.51 411	36	9.53 861	41	0.46 139	9.97 550	5	56
5	9.51 447	37	9.53 902	41	0.46 098	9.97 545	4	55
6	9.51 484	36	9.53 943	41	0.46 057	9.97 541	5	54
7	9.51 520	37	9.53 984	41	0.46 016	9.97 536	4	53
8	9.51 557	36	9.54 025	40	0.45 975	9.97 532	4	52
9	9.51 593	36	9.54 065	41	0.45 935	9.97 528	5	51
10	9.51 629	37	9.54 106	41	0.45 894	9.97 523	4	50
11	9.51 666	36	9.54 147	40	0.45 853	9.97 519	4	49
12	9.51 702	36	9.54 187	41	0.45 813	9.97 515	5	48
13	9.51 738	36	9.54 228	41	0.45 772	9.97 510	4	47
14	9.51 774	37	9.54 269	40	0.45 731	9.97 506	5	46
15	9.51 811	36	9.54 309	41	0.45 691	9.97 501	4	45
16	9.51 847	36	9.54 350	40	0.45 650	9.97 497	5	44
17	9.51 883	36	9.54 390	41	0.45 610	9.97 492	4	43
18	9.51 919	36	9.54 431	40	0.45 569	9.97 488	4	42
19	9.51 955	36	9.54 471	41	0.45 529	9.97 484	5	41
20	9.51 991	36	9.54 512	40	0.45 488	9.97 479	4	40
21	9.52 027	36	9.54 552	41	0.45 448	9.97 475	5	39
22	9.52 063	36	9.54 593	40	0.45 407	9.97 470	4	38
23	9.52 099	36	9.54 633	40	0.45 367	9.97 466	5	37
24	9.52 135	36	9.54 673	41	0.45 327	9.97 461	4	36
25	9.52 171	36	9.54 714	40	0.45 286	9.97 457	4	35
26	9.52 207	35	9.54 754	40	0.45 246	9.97 453	5	34
27	9.52 242	36	9.54 794	41	0.45 206	9.97 448	4	33
28	9.52 278	36	9.54 835	40	0.45 165	9.97 444	5	32
29	9.52 314	36	9.54 875	40	0.45 125	9.97 439	4	31
30	9.52 350	35	9.54 915	40	0.45 085	9.97 435	5	30
31	9.52 385	36	9.54 955	40	0.45 045	9.97 430	4	29
32	9.52 421	35	9.54 995	40	0.45 005	9.97 426	5	28
33	9.52 456	36	9.55 035	40	0.44 965	9.97 421	4	27
34	9.52 492	35	9.55 075	40	0.44 925	9.97 417	5	26
35	9.52 527	36	9.55 115	40	0.44 885	9.97 412	4	25
36	9.52 563	35	9.55 155	40	0.44 845	9.97 408	5	24
37	9.52 598	36	9.55 195	40	0.44 805	9.97 403	4	23
38	9.52 634	35	9.55 235	40	0.44 765	9.97 399	5	22
39	9.52 669	36	9.55 275	40	0.44 725	9.97 394	4	21
40	9.52 705	35	9.55 315	40	0.44 685	9.97 390	5	20
41	9.52 740	35	9.55 355	40	0.44 645	9.97 385	4	19
42	9.52 775	36	9.55 395	39	0.44 605	9.97 381	5	18
43	9.52 811	35	9.55 434	40	0.44 566	9.97 376	4	17
44	9.52 846	35	9.55 474	40	0.44 526	9.97 372	5	16
45	9.52 881	35	9.55 514	40	0.44 486	9.97 367	4	15
46	9.52 916	35	9.55 554	39	0.44 446	9.97 363	5	14
47	9.52 951	35	9.55 593	40	0.44 407	9.97 358	5	13
48	9.52 986	35	9.55 633	40	0.44 367	9.97 353	4	12
49	9.53 021	35	9.55 673	39	0.44 327	9.97 349	5	11
50	9.53 056	36	9.55 712	40	0.44 288	9.97 344	4	10
51	9.53 092	34	9.55 752	39	0.44 248	9.97 340	5	9
52	9.53 126	35	9.55 791	40	0.44 209	9.97 335	4	8
53	9.53 161	35	9.55 831	39	0.44 169	9.97 331	5	7
54	9.53 196	35	9.55 870	40	0.44 130	9.97 326	4	6
55	9.53 231	35	9.55 910	39	0.44 090	9.97 322	5	5
56	9.53 266	35	9.55 949	40	0.44 051	9.97 317	5	4
57	9.53 301	35	9.55 989	39	0.44 011	9.97 312	4	3
58	9.53 336	34	9.56 028	39	0.43 972	9.97 308	5	2
59	9.53 370	35	9.56 067	40	0.43 933	9.97 303	4	1
60	9.53 405		9.56 107		0.43 893	9.97 299		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	41	40	39
1	0.7	0.7	0.6
2	1.4	1.3	1.3
3	2.0	2.0	2.0
4	2.7	2.7	2.6
5	3.4	3.3	3.2
6	4.1	4.0	3.9
7	4.8	4.7	4.6
8	5.5	5.3	5.2
9	6.2	6.0	5.8
10	6.8	6.7	6.5
20	13.7	13.3	13.0
30	20.5	20.0	19.5
40	27.3	26.7	26.0
50	34.2	33.3	32.5

″	37	36	35
1	0.6	0.6	0.6
2	1.2	1.2	1.2
3	1.8	1.8	1.8
4	2.5	2.4	2.3
5	3.1	3.0	2.9
6	3.7	3.6	3.5
7	4.3	4.2	4.1
8	4.9	4.8	4.7
9	5.6	5.4	5.2
10	6.2	6.0	5.8
20	12.3	12.0	11.7
30	18.5	18.0	17.5
40	24.7	24.0	23.3
50	30.8	30.0	29.2

″	34	5	4
1	0.6	0.1	0.1
2	1.1	0.2	0.1
3	1.7	0.2	0.2
4	2.3	0.3	0.3
5	2.8	0.4	0.3
6	3.4	0.5	0.4
7	4.0	0.6	0.5
8	4.5	0.7	0.5
9	5.1	0.8	0.6
10	5.7	0.8	0.7
20	11.3	1.7	1.3
30	17.0	2.5	2.0
40	22.7	3.3	2.7
50	28.3	4.2	3.3

	$\frac{5}{41}$	$\frac{5}{40}$	$\frac{5}{39}$
0	4.1	4.0	3.9
1	12.3	12.0	11.7
2	20.5	20.0	19.5
3	28.7	28.0	27.3
4	36.9	36.0	35.1
5			

	$\frac{4}{41}$	$\frac{4}{40}$	$\frac{4}{39}$
0	5.1	5.0	4.9
1	15.4	15.0	14.6
2	25.6	25.0	24.4
3	35.9	35.0	34.1
4			

P. P.

109° (289°) (250°) 70°

20° (200°) (339°) 159°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.53 405̇	35	9.56 107	39	0.43 893	9.97 299	5	60
1	9.53 440	35	9.56 146	39	0.43 854	9.97 294	5	59
2	9.53 475̄	34	9.56 185̇	39	0.43 815̄	9.97 289	4	58
3	9.53 509	35	9.56 224	40	0.43 776	9.97 285̄	5	57
4	9.53 544	34	9.56 264	39	0.43 736	9.97 280	4	56
5	9.53 578	35	9.56 303	39	0.43 697	9.97 276	5	55
6	9.53 613	34	9.56 342	39	0.43 658	9.97 271	5	54
7	9.53 647	35	9.56 381	39	0.43 619	9.97 266	4	53
8	9.53 682	34	9.56 420	39	0.43 580	9.97 262	5	52
9	9.53 716	35	9.56 459	39	0.43 541	9.97 257	5	51
10	9.53 751	34	9.56 498	39	0.43 502	9.97 252	4	50
11	9.53 785̇	34	9.56 537	39	0.43 463	9.97 248	5	49
12	9.53 819	35	9.56 576	39	0.43 424	9.97 243	5	48
13	9.53 854	34	9.56 615̇	39	0.43 385̄	9.97 238	4	47
14	9.53 888	34	9.56 654	39	0.43 346	9.97 234	5	46
15	9.53 922	35	9.56 693	39	0.43 307	9.97 229	5	45
16	9.53 957	34	9.56 732	39	0.43 268	9.97 224	4	44
17	9.53 991	34	9.56 771	39	0.43 229	9.97 220	5	43
18	9.54 025̄	34	9.56 810	39	0.43 190	9.97 215̇	5	42
19	9.54 059	34	9.56 849	38	0.43 151	9.97 210	4	41
20	9.54 093	34	9.56 887	39	0.43 113	9.97 206	5	40
21	9.54 127	34	9.56 926	39	0.43 074	9.97 201	5	39
22	9.54 161	34	9.56 965̄	39	0.43 035̇	9.97 196	4	38
23	9.54 195̇	34	9.57 004	38	0.42 996	9.97 192	5	37
24	9.54 229	34	9.57 042	39	0.42 958	9.97 187	5	36
25	9.54 263	34	9.57 081	39	0.42 919	9.97 182	4	35
26	9.54 297	34	9.57 120	38	0.42 880	9.97 178	5	34
27	9.54 331	34	9.57 158	39	0.42 842	9.97 173	5	33
28	9.54 365̄	34	9.57 197	38	0.42 803	9.97 168	5	32
29	9.54 399	34	9.57 235̇	39	0.42 765̄	9.97 163	4	31
30	9.54 433	33	9.57 274	38	0.42 726	9.97 159	5	30
31	9.54 466	34	9.57 312	39	0.42 688	9.97 154	5	29
32	9.54 500	34	9.57 351	38	0.42 649	9.97 149	4	28
33	9.54 534	33	9.57 389	39	0.42 611	9.97 145̄	5	27
34	9.54 567	34	9.57 428	38	0.42 572	9.97 140	5	26
35	9.54 601	34	9.57 466	38	0.42 534	9.97 135̇	5	25
36	9.54 635̄	33	9.57 504	39	0.42 496	9.97 130	4	24
37	9.54 668	34	9.57 543	38	0.42 457	9.97 126	5	23
38	9.54 702	33	9.57 581	38	0.42 419	9.97 121	5	22
39	9.54 735̇	34	9.57 619	39	0.42 381	9.97 116	5	21
40	9.54 769	33	9.57 658	38	0.42 342	9.97 111	4	20
41	9.54 802	34	9.57 696	38	0.42 304	9.97 107	5	19
42	9.54 836	33	9.57 734	38	0.42 266	9.97 102	5	18
43	9.54 869	34	9.57 772	38	0.42 228	9.97 097	5	17
44	9.54 903	33	9.57 810	39	0.42 190	9.97 092	5	16
45	9.54 936	33	9.57 849	38	0.42 151	9.97 087	4	15
46	9.54 969	34	9.57 887	38	0.42 113	9.97 083	5	14
47	9.55 003	33	9.57 925̄	38	0.42 075̇	9.97 078	5	13
48	9.55 036	33	9.57 963	38	0.42 037	9.97 073	5	12
49	9.55 069	33	9.58 001	38	0.41 999	9.97 068	5	11
50	9.55 102	34	9.58 039	38	0.41 961	9.97 063	4	10
51	9.55 136	33	9.58 077	38	0.41 923	9.97 059	5	9
52	9.55 169	33	9.58 115̄	38	0.41 885̇	9.97 054	5	8
53	9.55 202	33	9.58 153	38	0.41 847	9.97 049	5	7
54	9.55 235̄	33	9 58 191	38	0.41 809	9.97 044	5	6
55	9.55 268	33	9.58 229	38	0.41 771	9.97 039	4	5
56	9.55 301	33	9.58 267	37	0.41 733	9.97 035̄	5	4
57	9.55 334	33	9.58 304	38	0.41 696	9.97 030	5	3
58	9.55 367	33	9.58 342	38	0.41 658	9.97 025̄	5	2
59	9.55 400	33	9.58 380	38	0.41 620	9.97 020	5	1
60	9.55 433		9.58 418		0.41 582	9.97 015̇		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.			
″	40	39	38
1	0.7	0.6	0.6
2	1.3	1.3	1.3
3	2.0	2.0	1.9
4	2.7	2.6	2.5
5	3.3	3.2	3.2
6	4.0	3.9	3.8
7	4.7	4.6	4.4
8	5.3	5.2	5.1
9	6.0	5.8	5.7
10	6.7	6.5	6.3
20	13.3	13.0	12.7
30	20.0	19.5	19.0
40	26.7	26.0	25.3
50	33.3	32.5	31.7
″	37	35	34
1	0.6	0.6	0.6
2	1.2	1.2	1.1
3	1.8	1.8	1.7
4	2.5̄	2.3	2.3
5	3.1	2.9	2.8
6	3.7	3.5	3.4
7	4.3	4.1	4.0
8	4.9	4.7	4.5
9	5.6	5.2	5.1
10	6.2	5.8	5.7
20	12.3	11.7	11.3
30	18.5	17.5	17.0
40	24.7	23.3	22.7
50	30.8	29.2	28.3
″	33	5	4
1	0.6	0.1	0.1
2	1.1	0.2	0.1
3	1.6	0.2	0.2
4	2.2	0.3	0.3
5	2.8	0.4	0.3
6	3.3	0.5	0.4
7	3.8	0.6	0.5
8	4.4	0.7	0.5
9	5.0	0.8	0.6
10	5.5	0.8	0.7
20	11.0	1.7	1.3
30	16.5	2.5	2.0
40	22.0	3.3	2.7
50	27.5	4.2	3.3

	$\frac{5}{40}$	$\frac{5}{39}$	$\frac{5}{38}$
0	4.0	3.9	3.8
1	12.0	11.7	11.4
2	20.0	19.5	19.0
3	28.0	27.3	26.6
4	36.0	35.1	34.2
5			
	$\frac{5}{37}$	$\frac{4}{39}$	$\frac{4}{38}$
0	3.7	4.9	4.8
1	11.1	14.6	14.2
2	18.5	24.4	23.8
3	25.9	34.1	33.2
4	33.3	—	—
5			

P.P.

110° (290°) (249°) 69°

LOGARITHMS OF THE FUNCTIONS (Continued)

21° (201°) (338°) **158°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.55 433	33	9.58 418	37	0.41 582	9.97 015̇	5	**60**
1	9.55 466	33	9.58 455̇	38	0.41 545̄	9.97 010	5	59
2	9.55 499	33	9.58 493	38	0.41 507	9.97 005̇	4	58
3	9.55 532	32	9.58 531	38	0.41 469	9.97 001	5	57
4	9.55 564	33	9.58 569	37	0.41 431	9.96 996	5	56
5	9.55 597	33	9.58 606	38	0.41 394	9.96 991	5	55
6	9.55 630	33	9.58 644	37	0.41 356	9.96 986	5	54
7	9.55 663	32	9.58 681	38	0.41 319	9.96 981	5	53
8	9.55 695̇	33	9.58 719	38	0.41 281	9.96 976	5	52
9	9.55 728	33	9.58 757	37	0.41 243	9.96 971	5	51
10	9.55 761	32	9.58 794	38	0.41 206	9.96 966	4	**50**
11	9.55 793	33	9.58 832	37	0.41 168	9.96 962	5	49
12	9.55 826	32	9.58 869	38	0.41 131	9.96 957	5	48
13	9.55 858	33	9.58 907	37	0.41 093	9.96 952	5	47
14	9.55 891	32	9.58 944	37	0.41 056	9.96 947	5	46
15	9.55 923	33	9.58 981	38	0.41 019	9.96 942	5	45
16	9.55 956	32	9.59 019	37	0.40 981	9.96 937	5	44
17	9.55 988	33	9.59 056	38	0.40 944	9.96 932	5	43
18	9.56 021	32	9.59 094	37	0.40 906	9.96 927	5	42
19	9.56 053	32	9.59 131	37	0.40 869	9.96 922	5	41
20	9.56 085̇	33	9.59 168	37	0.40 832	9.96 917	5	**40**
21	9.56 118	32	9.59 205̇	38	0.40 795̄	9.96 912	5	39
22	9.56 150	32	9.59 243	37	0.40 757	9.96 907	4	38
23	9.56 182	33	9.59 280	37	0.40 720	9.96 903	5	37
24	9.56 215̄	32	9.59 317	37	0.49 683	9.96 898	5	36
25	9.56 247	32	9.59 354	37	0.40 646	9.96 893	5	35
26	9.56 279	32	9.59 391	38	0.40 609	9.96 888	5	34
27	9.56 311	32	9.59 429	37	0.40 571	9.96 883	5	33
28	9.56 343	32	9.59 466	37	0.40 534	9.96 878	5	32
29	9.56 375̇	33	9.59 503	37	0.40 497	9 96 873	5	31
30	9.56 408	32	9.59 540	37	0.40 460	9.96 868	5	**30**
31	9.56 440	32	9.59 577	37	0.40 423	9.96 863	5	29
32	9.56 472	32	9.59 614	37	0.40 386	9.96 858	5	28
33	9.56 504	32	9.59 651	37	0.40 349	9.96 853	5	27
34	9.56 536	32	9.59 688	37	0.40 312	9.96 848	5	26
35	9.56 568	31	9.59 725̄	37	0.40 275̇	9.96 843	5	25
36	9.56 599	32	9.59 762	37	0.40 238	9.96 838	5	24
37	9 56 631	32	9.59 799	36	0.40 201	9.96 833	5	23
38	9.56 663	32	9.59 835̇	37	0.40 165̄	9.96 828	5	22
39	9.56 695̇	32	9.59 872	37	0.40 128	9.96 823	5	21
40	9.56 727	32	9.59 909	37	0.40 091	9.96 818	5	**20**
41	9.56 759	31	9.59 946	37	0.40 054	9.96 813	5	19
42	9.56 790	32	9.59 983	36	0.40 017	9.96 808	5	18
43	9.56 822	32	9.60 019	37	0.39 981	9.96 803	5	17
44	9.56 854	32	9.60 056	37	0.39 944	9.96 798	5	16
45	9.56 886	31	9.60 093	37	0.39 907	9.96 793	5	15
46	9.56 917	32	9.60 130	36	0.39 870	9.96 788	5	14
47	9.56 949	31	9.60 166	37	0.39 834	9.96 783	5	13
48	9.56 980	32	9.60 203	37	0.39 797	9.96 778	6	12
49	9.57 012	32	9.60 240	36	0.39 760	9.96 772	5	11
50	9.57 044	31	9.60 276	37	0.39 724	9.96 767	5	**10**
51	9.57 075̇	32	9.60 313	36	0.39 687	9.96 762	5	9
52	9.57 107	31	9.60 349	37	0.39 651	9.96 757	5	8
53	9.57 138	31	9.60 386	36	0.39 614	9.96 752	5	7
54	9.57 169	32	9.60 422	37	0.39 578	9.96 747	5	6
55	9.57 201	31	9.60 459	36	0.39 541	9.96 742	5	5
56	9.57 232	32	9.60 495̇	37	0.39 505̄	9.96 737	5	4
57	9.57 264	31	9.60 532	36	0.39 468	9.96 732	5	3
58	9.57 295̄	31	9.60 568	37	0.39 432	9.96 727	5	2
59	9.57 326	32	9.60 605̄	36	0.39 395̇	9.96 722	5	1
60	9.57 358		9.60 641		0.39 359	9.96 717		**0**
′	L. Cos.	d.	L. Cot.	c d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**38**	**37**	**36**
1	0.6	0.6	0.6
2	1.3	1.2	1.2
3	1.9	1.8	1.8
4	2.5	2.5̄	2.4
5	3.2	3.1	3.0
6	3.8	3.7	3.6
7	4.4	4.3	4.2
8	5.1	4.9	4.8
9	5.7	5.6	5.4
10	6.3	6.2	6.0
20	12.7	12.3	12.0
30	19.0	18.5	18.0
50	25.3	24.7	24.0
50	31.7	30.8	30.0

″	**33**	**32**	**31**
1	0.6	0.5̇	0.5̇
2	1.1	1.1	1.0
3	1.6	1.6	1.6
4	2.2	2.1	2.1
5	2.8	2.7	2.6
6	3.3	3.2	3.1
7	3.8	3.7	3.6
8	4.4	4.3	4.1
9	5̄.0	4.8	4.6
10	5.5	5.3	5.2
20	11.0	10.7	10.3
30	16.5	16.0	15.5
40	22.0	21.3	20.7
50	27.5	26.7	25.8

″	**6**	**5**	**4**
1	0.1	0.1	0.1
2	0.2	0.2	0.1
3	0.3	0.2	0.2
4	0.4	0.3	0.3
5	0.5̇	0.4	0.3
6	0.6	0.5	0.4
7	0.7	0.6	0.5̄
8	0.8	0.7	0.5̇
9	0.9	0.8	0.6
10	1.0	0.8	0.7
20	2.0	1.7	1.3
30	3.0	2.5	2.0
40	4.0	3.3	2.7
50	5.0	4.2	3.3

	$\frac{\mathbf{6}}{\mathbf{37}}$	$\frac{\mathbf{5}}{\mathbf{38}}$	$\frac{\mathbf{5}}{\mathbf{37}}$
0	3.1	3.8	3.7
1	9.2	11.4	11.1
2	15.4	19.0	18.5
3	21.6	26.6	25.9
4	27.8	34.2	33.3
5	33.9	—	—
6			

	$\frac{\mathbf{5}}{\mathbf{36}}$	$\frac{\mathbf{4}}{\mathbf{38}}$	$\frac{\mathbf{4}}{\mathbf{37}}$
0	3.6	4.8	4.6
1	10.8	14.2	13.9
3	18.0	23.8	23.1
3	25.2	33.2	32.4
4	32.4	—	—
5			

P .P.

111° (291°) (248°) **68°**

22° (202)° (337°) **157°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.57 358		9.60 641		0.39 359	9.96 717		**60**
1	9.57 389	31	9.60 677	36	0.39 323	9.96 711	6	59
2	9.57 420	31	9.60 714	37	0.39 286	9.96 706	5	58
3	9.57 451	31	9.60 750	36	0.39 250	9.96 701	5	57
4	9.57 482	31	9.60 786	36	0.39 214	9.96 696	5	56
5	9.57 514	32	9.60 823	37	0.39 177	9.96 691	5	55
6	9.57 545	31	9.60 859	36	0.39 141	9.96 686	5	54
7	9.57 576	31	9.60 895	36	0.39 105	9.96 681	5	53
8	9.57 607	31	9.60 931	36	0.39 069	9.96 676	5	52
9	9.57 638	31	9.60 967	36	0.39 033	9.96 670	6	51
10	9.57 669	31	9.61 004	37	0.38 996	9.96 665	5	**50**
11	9.57 700	31	9.61 040	36	0.38 960	9.96 660	5	49
12	9.57 731	31	9.61 076	36	0.38 924	9.96 655	5	48
13	9.57 762	31	9.61 112	36	0.38 888	9.96 650	5	47
14	9.57 793	31	9.61 148	36	0.38 852	9.96 645	5	46
15	9.57 824	31	9.61 184	36	0.38 816	9.96 640	5	45
16	9.57 855	31	9.61 220	36	0.38 780	9.96 634	6	44
17	9.57 885	30	9.61 256	36	0.38 744	9.96 629	5	43
18	9.57 916	31	9.61 292	36	0.38 708	9.96 624	5	42
19	9.57 947	31	9.61 328	36	0.38 672	9.96 619	5	41
20	9.57 978	31	9.61 364	36	0.38 636	9.96 614	5	**40**
21	9.58 008	30	9.61 400	36	0.38 600	9.96 608	6	39
22	9.58 039	31	9.61 436	36	0.38 564	9.96 603	5	38
23	9.58 070	31	9.61 472	36	0.38 528	9.96 598	5	37
24	9.58 101	31	9.61 508	36	0.38 492	9.96 593	5	36
25	9.58 131	30	9.61 544	36	0.38 456	9.96 588	5	35
26	9.58 162	31	9.61 579	35	0.38 421	9.96 582	6	34
27	9.58 192	30	9.61 615	36	0.38 385	9.96 577	5	33
28	9.58 223	31	9.61 651	36	0.38 349	9.96 572	5	32
29	9.58 253	30	9.61 687	36	0.38 313	9.96 567	5	31
30	9.58 284	31	9.61 722	35	0.38 278	9.96 562	5	**30**
31	9.58 314	30	9.61 758	36	0.38 242	9.96 556	6	29
32	9.58 345	31	9.61 794	36	0.38 206	9.96 551	5	28
33	9.58 375	30	9.61 830	36	0.38 170	9.96 546	5	27
34	9.58 406	31	9.61 865	35	0.38 135	9.96 541	5	26
35	9.58 436	30	9.61 901	36	0.38 099	9.96 535	6	25
36	9.58 467	31	9.61 936	35	0.38 064	9.96 530	5	24
37	9.58 497	30	9.61 972	36	0.38 028	9.96 525	5	23
38	9.58 527	30	9.62 008	36	0.37 992	9.96 520	5	22
39	9.58 557	30	9.62 043	35	0.37 957	9.96 514	6	21
40	9.58 588	31	9.62 079	36	0.37 921	9.96 509	5	**20**
41	9.58 618	30	9.62 114	35	0.37 886	9.96 504	5	19
42	9.58 648	30	9.62 150	36	0.37 850	9.96 498	6	18
43	9.58 678	30	9.62 185	35	0.37 815	9.96 493	5	17
44	9.58 709	31	9.62 221	36	0.37 779	9.96 488	5	16
45	9.58 739	30	9.62 256	35	0.37 744	9.96 483	5	15
46	9.58 769	30	9.62 292	36	0.37 708	9.96 477	6	14
47	9.58 799	30	9.62 327	35	0.37 673	9.96 472	5	13
48	9.58 829	30	9.62 362	35	0.37 638	9.96 467	5	12
49	9.58 859	30	9.62 398	36	0.37 602	9.96 461	6	11
50	9.58 889	30	9.62 433	35	0.37 567	9.96 456	5	**10**
51	9.58 919	30	9.62 468	35	0.37 532	9.96 451	5	9
52	9.58 949	30	9.62 504	36	0.37 496	9.96 445	6	8
53	9.58 979	30	9.62 539	35	0.37 461	9.96 440	5	7
54	9.59 009	30	9.62 574	35	0.37 426	9.96 435	5	6
55	9.59 039	30	9.62 609	35	0.37 391	9.96 429	6	5
56	9.59 069	30	9.62 645	36	0.37 355	9.96 424	5	4
57	9.59 098	29	9.62 680	35	0.37 320	9.96 419	5	3
58	9.59 128	30	9.62 715	35	0.37 285	9.96 413	6	2
59	9.59 158	30	9.62 750	35	0.37 250	9.96 408	5	1
60	9.59 188	30	9.62 785	35	0.37 215	9.96 403	5	**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
″	**37**	**36**	**35**
1	0.6	0.6	0.6
2	1.2	1.2	1.2
3	1.8	1.8	1.8
4	2.5	2.4	2.3
5	3.1	3.0	2.9
6	3.7	3.6	3.5
7	4.3	4.2	4.1
8	4.9	4.8	4.7
9	5.6	5.4	5.2
10	6.2	6.0	5.8
20	12.3	12.0	11.7
30	18.5	18.0	17.5
40	24.7	24.0	23.3
50	30.8	30.0	29.2
″	**32**	**31**	**30**
1	0.5	0.5	0.5
2	1.1	1.0	1.0
3	1.6	1.6	1.5
4	2.1	2.1	2.0
5	2.7	2.6	2.5
6	3.2	3.1	3.0
7	3.7	3.6	3.5
8	4.3	4.1	4.0
9	4.8	4.6	4.5
10	5.3	5.2	5.0
20	10.7	10.3	10.0
30	16.0	15.5	15.0
40	21.3	20.7	20.0
50	26.7	25.8	25.0
″	**29**	**6**	**5**
1	0.5	0.1	0.1
2	1.0	0.2	0.2
3	1.4	0.3	0.2
4	1.9	0.4	0.3
5	2.4	0.5	0.4
6	2.9	0.6	0.5
7	3.4	0.7	0.6
8	3.9	0.8	0.7
9	4.4	0.9	0.8
10	4.8	1.0	0.8
20	9.7	2.0	1.7
30	14.5	3.0	2.5
40	19.3	4.0	3.3
50	24.2	5.0	4.2

	$\frac{6}{36}$	$\frac{6}{35}$
0	3.0	2.9
1	9.0	8.8
2	15.0	14.6
3	21.0	20.4
4	27.0	26.2
5	33.0	32.1
6		

	$\frac{5}{37}$	$\frac{5}{36}$	$\frac{5}{35}$
0	3.7	3.6	3.5
1	11.1	10.8	10.5
2	18.5	18.0	17.5
3	25.9	25.2	24.5
4	33.3	32.4	31.5
5			

P. P.

112° (292°) (247°) **67°**

LOGARITHMS OF THE FUNCTIONS (Continued)

23° (203°) (336°) **156°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.59 188	30	9.62 785̇	35	0.37 215̄	9.96 403	6	**60**
1	9.59 218	29	9.62 820	35	0.37 180	9.96 397	5	59
2	9.59 247	30	9.62 855̇	35	0.37 145̄	9.96 392	5	58
3	9.59 277	30	9.62 890	36	0.37 110	9.96 387	6	57
4	9.59 307	29	9.62 926	35	0.37 074	9.96 381	5	56
5	9.59 336	30	9.62 961	35	0.37 039	9.96 376	6	55
6	9.59 366	30	9.62 996	35	0.37 004	9.96 370	5	54
7	9.59 396	29	9.63 031	35	0.36 969	9.96 365̄	5	53
8	9.59 425̇	30	9.63 066	35	0.36 934	9.96 360	6	52
9	9.59 455̄	29	9.63 101	34	0.36 899	9.96 354	5	51
10	9.59 484	30	9.63 135̇	35	0.36 865̄	9.96 349	6	**50**
11	9.59 514	29	9.63 170	35	0.36 830	9.96 343	5	49
12	9.59 543	30	9.63 205̇	35	0.36 795̄	9.96 338	5	48
13	9.59 573	29	9.63 240	35	0.36 760	9.96 333	6	47
14	9.59 602	30	9.63 275̇	35	0.36 725̄	9.96 327	5	46
15	9.59 632	29	9.63 310	35	0.36 690	9.96 322	6	45
16	9.59 661	29	9.63 345̄	34	0.36 655̇	9.96 316	5	44
17	9.59 690	30	9.63 379	35	0.36 621	9.96 311	6	43
18	9.59 720	29	9.63 414	35	0.36 586	9.96 305̇	5	42
19	9.59 749	29	9.63 449	35	0.36 551	9.96 300	6	41
20	9.59 778	30	9.63 484	35	0.36 516	9.96 294	5	**40**
21	9.59 808	29	9.63 519	34	0.36 481	9.96 289	5	39
22	9.59 837	29	9.63 553	35	0.36 447	9.96 284	6	38
23	9.59 866	29	9.63 588	35	0.36 412	9.96 278	5	37
24	9.59 895̇	29	9.63 623	34	0.36 377	9.96 273	6	36
25	9.59 924	30	9.63 657	35	0.36 343	9.96 267	5	35
26	9.59 954	29	9.63 692	34	0.36 308	9.96 262	6	34
27	9.59 983	29	9.63 726	35	0.36 274	9.96 256	5	33
28	9.60 012	29	9.63 761	35	0.36 239	9.96 251	6	32
29	9.60 041	29	9.63 796	34	0.36 204	9.96 245̇	5	31
30	9.60 070	29	9.63 830	35	0.36 170	9.96 240	6	**30**
31	9.60 099	29	9.63 865̄	34	0.36 135̇	9.96 234	5	29
32	9.60 128	29	9.63 899	35	0.36 101	9.96 229	6	28
33	9.60 157	29	9.63 934	34	0.36 066	9.96 223	5	27
34	9.60 186	29	9.63 968	35	0.36 032	9.96 218	6	26
35	9.60 215̄	29	9.64 003	34	0.35 997	9.96 212	5	25
36	9.60 244	29	9.64 037	35	0.35 963	9.96 207	6	24
37	9.60 273	29	9.64 072	34	0.35 928	9.96 201	5	23
38	9.60 302	29	9.64 106	34	0.35 894	9.96 196	6	22
39	9.60 331	28	9.64 140	35	0.35 860	9.96 190	5	21
40	9.60 359	29	9.64 175̄	34	0.35 825̇	9.96 185̄	6	**20**
41	9.60 388	29	9.64 209	34	0.35 791	9.96 179	5	19
42	9.60 417	29	9.64 243	35	0.35 757	9.96 174	6	18
43	9.60 446	28	9.64 278	34	0.35 722	9.96 168	6	17
44	9.60 474	29	9.64 312	34	0.35 688	9.96 162	5	16
45	9.60 503	29	9.64 346	35	0.35 654	9.96 157	6	15
46	9.60 532	29	9.64 381	34	0.35 619	9.96 151	5	14
47	9.60 561	28	9.64 415̄	34	0.35 585̇	9.96 146	6	13
48	9.60 589	29	9.64 449	34	0.35 551	9.96 140	5	12
49	9.60 618	28	9.64 483	34	0.35 517	9.96 135̄	6	11
50	9.60 646	29	9.64 517	35	0.35 483	9.96 129	6	**10**
51	9.60 675̇	29	9.64 552	34	0.35 448	9.96 123	5	9
52	9.60 704	28	9.64 586	34	0.35 414	9.96 118	6	8
53	9.60 732	29	9.64 620	34	0.35 380	9.96 112	5	7
54	9.60 761	28	9.64 654	34	0.35 346	9.96 107	6	6
55	9.60 789	29	9.64 688	34	0.35 312	9.96 101	6	5
56	9.60 818	28	9.64 722	34	0.35 278	9.96 095̇	5	4
57	9.60 846	29	9.64 756	34	0.35 244	9.96 090	6	3
58	9.60 875̄	28	9.64 790	34	0.35 210	9.96 084	5	2
59	9.60 903	28	9.64 824	34	0.35 176	9.96 079	6	1
60	9.60 931		9.64 858		0.35 142	9.96 073		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**36**	**35**	**34**
1	0.6	0.6	0.6
2	1.2	1.2	1.1
3	1.8	1.8	1.7
4	2.4	2.3	2.3
5	3.0	2.9	2.8
6	3.6	3.5	3.4
7	4.2	4.1	4.0
8	4.8	4.7	4.5
9	5.4	5.2	5.1
10	6.0	5.8	5.7
20	12.0	11.7	11.3
30	18.0	17.5	17.0
40	24.0	23.3	22.7
50	30.0	29.2	28.3

″	**30**	**29**	**28**
1	0.5	0.5	0.5
2	1.0	1.0	0.9
3	1.5	1.4	1.4
4	2.0	1.9	1.9
5	2.5	2.4	2.3
6	3.0	2.9	2.8
7	3.5	3.4	3.3
8	4.0	3.9	3.7
9	4.5	4.4	4.2
10	5.0	4.8	4.7
20	10.0	9.7	9.3
30	15.0	14.5	14.0
40	20.0	19.3	18.7
50	25.0	24.2	23.3

″	**6**	**5**
1	0.1	0.1
2	0.2	0.2
3	0.3	0.2
4	0.4	0.3
5	0.5	0.4
6	0.6	0.5
7	0.7	0.6
8	0.8	0.7
9	0.9	0.8
10	1.0	0.8
20	2.0	1.7
30	3.0	2.5
40	4.0	3.3
50	5.0	4.2

	$\frac{6}{36}$	$\frac{6}{35}$	$\frac{6}{34}$
0	3.0	2.9	2.8
1	9.0	8.8	8.5
2	15.0	14.6	14.2
3	21.0	20.4	19.8
4	27.0	26.2	25.5
5	33.0	32.1	31.2
6			

	$\frac{5}{35}$	$\frac{5}{34}$
0	3.5	3.4
1	10.5	10.2
2	17.5	17.0
3	24.5	23.8
4	31.5	30.6
5		

P. P.

113° (293°) (246°) **66°**

LOGARITHMS OF THE FUNCTIONS (Continued)

24° (204°) (335°) **155°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.60 931	29	9.64 858	34	0.35 142	9.96 073	6	**60**
1	9.60 960	28	9.64 892	34	0.35 108	9.96 067	5	59
2	9.60 988	28	9.64 926	34	0.35 074	9.96 062	6	58
3	9.61 016	29	9.64 960	34	0.35 040	9.96 056	6	57
4	9.61 045̄	28	9.64 994	34	0.35 006	9.96 05̇0	5	56
5	9.61 073	28	9.65 028	34	0.34 972	9.96 045̄	6	55
6	9.61 101	28	9.65 062	34	0.34 938	9.96 039	5	54
7	9.61 129	29	9.65 096	34	0.34 904	9.96 034	6	53
8	9.61 158	28	9.65 130	34	0.34 870	9.96 028	6	52
9	9.61 186	28	9.65 164	33	0.34 836	9.96 022	5	51
10	9.61 214	28	9.65 197	34	0.34 803	9.96 017	6	**50**
11	9.61 242	28	9.65 231	34	0.34 769	9.96 011	6	49
12	9.61 270	28	9.65 265̇	34	0.34 735̄	9.96 005̇	5	48
13	9.61 298	28	9.65 299	34	0.34 701	9.96 000	6	47
14	9.61 326	28	9.65 333	33	0.34 667	9.95 994	6	46
15	9.61 354	28	9.65 366	34	0.34 634	9.95 988	6	45
16	9.61 382	29	9.65 400	34	0.34 600	9.95 982	5	44
17	9.61 411	27	9.65 434	33	0.34 566	9.95 977	6	43
18	9.61 438	28	9.65 467	34	0.34 533	9.95 971	6	42
19	9.61 466	28	9.65 501	34	0.34 499	9.95 965̇	5	41
20	9.61 494	28	9.65 535̄	33	0.34 465̇	9.95 960	6	**40**
21	9.61 522	28	9.65 568	34	0.34 432	9.95 954	6	39
22	9.61 55̇0	28	9.65 602	34	0.34 398	9.95 948	6	38
23	9.61 578	28	9.65 636	33	0.34 364	9.95 942	5	37
24	9.61 606	28	9.65 669	34	0.34 331	9.95 937	6	36
25	9.61 634	28	9.65 703	33	0.34 297	9.95 931	6	35
26	9.61 662	27	9.65 736	34	0.34 264	9.95 925̇	5	34
27	9.61 689	28	9.65 770	33	0.34 230	9.95 920	6	33
28	9.61 717	28	9.65 803	34	0.34 197	9.95 914	6	32
29	9.61 745̄	28	9.65 837	33	0.34 163	9.95 908	6	31
30	9.61 773	27	9.65 870	34	0.34 130	9.95 902	5	**30**
31	9.61 800	28	9.65 904	33	0.34 096	9.95 897	6	29
32	9.61 828	28	9.65 937	34	0.34 063	9.95 891	6	28
33	9.61 856	27	9.65 971	33	0.34 029	9.95 885̄	6	27
34	9.61 883	28	9.66 004	34	0.33 996	9.95 879	6	26
35	9.61 911	28	9.66 038	33	0.33 962	9.95 873	5	25
36	9.61 939	27	9.66 071	33	0.33 929	9.95 868	6	24
37	9.61 966	28	9.66 104	34	0.33 896	9.95 862	6	23
38	9.61 994	27	9.66 138	33	0.33 862	9.95 856	6	22
39	9.62 021	28	9.66 171	33	0.33 829	9.95 85̇0	6	21
40	9.62 049	27	9.66 204	34	0.33 796	9.95 844	5	**20**
41	9.62 076	28	9.66 238	33	0.33 762	9.95 839	6	19
42	9.62 104	27	9.66 271	33	0.33 729	9.95 833	6	18
43	9.62 131	28	9.66 304	33	0.33 696	9.95 827	6	17
44	9.62 159	27	9.66 337	34	0.33 663	9.95 821	6	16
45	9.62 186	28	9.66 371	33	0.33 629	9.95 815̇	5	15
46	9.62 214	27	9.66 404	33	0.33 596	9.95 810	6	14
47	9.62 241	27	9.66 437	33	0.33 563	9.95 804	6	13
48	9.62 268	28	9.66 470	33	0.33 530	9.95 798	6	12
49	9.62 296	27	9.66 503	34	0.33 497	9.95 792	6	11
50	9.62 323	27	9.66 537	33	0.33 463	9.95 786	6	**10**
51	9.62 35̇0	27	9.66 570	33	0.33 430	9.95 780	5	9
52	9.62 377	28	9.66 603	33	0.33 397	9.95 775̄	6	8
53	9.62 405̄	27	9.66 636	33	0.33 364	9.95 769	6	7
54	9.62 432	27	9.66 669	33	0.33 331	9.95 763	6	6
55	9.62 459	27	9.66 702	33	0.33 298	9.95 757	6	5
56	9.62 486	27	9.66 735̇	33	0.33 265̄	9.95 751	6	4
57	9.62 513	28	9.66 768	33	0.33 232	9.95 745̇	6	3
58	9.62 541	27	9.66 801	33	0.33 199	9.95 739	6	2
59	9.62 568	27	9.66 834	33	0.33 166	9.95 733	5	1
60	9.62 595̄		9.66 867		0.33 133	9.95 728		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

114° (294°) (245°) **65°**

P. P.

″	**34**	**33**
1	0.6	0.6
2	1.1	1.1
3	1.7	1.6
4	2.3	2.2
5	2.8	2.8
6	3.4	3.3
7	4.0	3.8
8	4.5̇	4.4
9	5.1	5̄.0
10	5.7	5.5
20	11.3	11.0
30	17.0	16.5
40	22.7	22.0
50	28.3	27.5

″	**29**	**28**	**27**
1	0.5̄	0.5̄	0.4
2	1.0	0.9	0.9
3	1.4	1.4	1.4
4	1.9	1.9	1.8
5	2.4	2.3	2.2
6	2.9	2.8	2.7
7	3.4	3.3	3.2
8	3.9	3.7	3.6
9	4.4	4.2	4.0
10	4.8	4.7	4.5
20	9.7	9.3	9.0
30	14.5	14.0	13.5
40	19.3	18.7	18.0
50	24.2	23.3	22.5

″	**6**	**5**
1	0.1	0.1
2	0.2	0.2
3	0.3	0.2
4	0.4	0.3
5	0.5	0.4
6	0.6	0.5
7	0.7	0.6
8	0.8	0.7
9	0.9	0.8
10	1.0	0.8
20	2.0	1.7
30	3.0	2.5
40	4.0	3.3
50	5.0	4.2

	$\frac{6}{34}$	$\frac{6}{33}$	$\frac{5}{34}$
0	2.8	2.8	3.4
1	8.5	8.2	10.2
2	14.2	13.8	17.0
3	19.8	19.2	23.8
4	25.5	24.8	30.6
5	31.2	30.2	—
6			

P. P.

LOGARITHMS OF THE FUNCTIONS (Continued)

25° (205°) (334°) **154°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.62 595	27	9.66 867	33	0.33 133	9.95 728	6	**60**
1	9.62 622	27	9.66 900	33	0.33 100	9.95 722	6	59
2	9.62 649	27	9.66 933	33	0.33 067	9.95 716	6	58
3	9.62 676	27	9.66 966	33	0.33 034	9.95 710	6	57
4	9.62 703	27	9.66 999	33	0.33 001	9.95 704	6	56
5	9.62 730	27	9.67 032	33	0.32 968	9.95 698	6	55
6	9.62 757	27	9.67 065	33	0.32 935	9.95 692	6	54
7	9.62 784	27	9.67 098	33	0.32 902	9.95 686	6	53
8	9.62 811	27	9.67 131	32	0.32 869	9.95 680	6	52
9	9.62 838	27	9.67 163	33	0.32 837	9.95 674	6	51
10	9.62 865	27	9.67 196	33	0.32 804	9.95 668	5	**50**
11	9.62 892	26	9.67 229	33	0.32 771	9.95 663	6	49
12	9.62 918	27	9.67 262	33	0.32 738	9.95 657	6	48
13	9.62 945	27	9.67 295	32	0.32 705	9.95 651	6	47
14	9.62 972	27	9.67 327	33	0.32 673	9.95 645	6	46
15	9.62 999	27	9.67 360	33	0.32 640	9.95 639	6	45
16	9.63 026	26	9.67 393	33	0.32 607	9.95 633	6	44
17	9.63 052	27	9.67 426	32	0.32 574	9.95 627	6	43
18	9.63 079	27	9.67 458	33	0.32 542	9.95 621	6	42
19	9.63 106	27	9.67 491	33	0.32 509	9.95 615	6	41
20	9.63 133	26	9.67 524	32	0.32 476	9.95 609	6	**40**
21	9.63 159	27	9.67 556	33	0.32 444	9.95 603	6	39
22	9.63 186	27	9.67 589	33	0.32 411	9.95 597	6	38
23	9 63 213	26	9.67 622	32	0.32 378	9.95 591	6	37
24	9.63 239	27	9.67 654	33	0.32 346	9.95 585	6	36
25	9.63 266	26	9.67 687	32	0.32 313	9.95 579	6	35
26	9.63 292	27	9.67 719	33	0.32 281	9.95 573	6	34
27	9.63 319	26	9.67 752	33	0.32 248	9.95 567	6	33
28	9.63 345	27	9.67 785	32	0.32 215	9.95 561	6	32
29	9.63 372	26	9.67 817	33	0.32 183	9.95 555	6	31
30	9.63 398	27	9.67 850	32	0.32 150	9.95 549	6	**30**
31	9.63 425	26	9.67 882	33	0.32 118	9.95 543	6	29
32	9.63 451	27	9.67 915	32	0.32 085	9.95 537	6	28
33	9.63 478	26	9.67 947	33	0.32 053	9.95 531	6	27
34	9.63 504	27	9.67 980	32	0.32 020	9.95 525	6	26
35	9.63 531	26	9.68 012	32	0.31 988	9.95 519	6	25
36	9.63 557	26	9.68 044	33	0.31 956	9.95 513	6	24
37	9.63 583	27	9.68 077	32	0.31 923	9.95 507	7	23
38	9.63 610	26	9.68 109	33	0 31 891	9.95 500	6	22
39	9.63 636	26	9.68 142	32	0.31 858	9.95 494	6	21
40	9.63 662	27	9.68 174	32	0.31 826	9.95 488	6	**20**
41	9.63 689	26	9.68 206	33	0.31 794	9.95 482	6	19
42	9.63 715	26	9.68 239	32	0.31 761	9.95 476	6	18
43	9.63 741	26	9.68 271	32	0.31 729	9.95 470	6	17
44	9.63 767	27	9.68 303	33	0.31 697	9.95 464	6	16
45	9.63 794	26	9.68 336	32	0.31 664	9.95 458	6	15
46	9.63 820	26	9.68 368	32	0.31 632	9.95 452	6	14
47	9.63 846	26	9.68 400	32	0.31 600	9.95 446	6	13
48	9.63 872	26	9.68 432	33	0.31 568	9.95 440	6	12
49	9.63 898	26	9.68 465	32	0.31 535	9.95 434	7	11
50	9.63 924	26	9.68 497	32	0.31 503	9.95 427	6	**10**
51	9.63 950	26	9.68 529	32	0.31 471	9.95 421	6	9
52	9.63 976	26	9.68 561	32	0.31 439	9.95 415	6	8
53	9.64 002	26	9.68 593	33	0.31 407	9.95 409	6	7
54	9.64 028	26	9.68 626	32	0.31 374	9.95 403	6	6
55	9.64 054	26	9.68 658	32	0.31 342	9.95 397	6	5
56	9.64 080	26	9.68 690	32	0.31 310	9.95 391	7	4
57	9.64 106	26	9.68 722	32	0.31 278	9.95 384	6	3
58	9.64 132	26	9.68 754	32	0.31 246	9.95 378	6	2
59	9.64 158	26	9.68 786	32	0.31 214	9.95 372	6	1
60	9.64 184		9.68 818		0.31 182	9.95 366		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**33**	**32**
1	0.6	0.5
2	1.1	1.1
3	1.6	1.6
4	2.2	2.1
5	2.8	2.7
6	3.3	3.2
7	3.8	3.7
8	4.4	4.3
9	5.0	4.8
10	5.5	5.3
20	11.0	10.7
30	16.5	16.0
40	22.0	21.3
50	27.5	26.7

″	**27**	**26**
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	**7**	**6**	**5**
1	0.1	0.1	0.1
2	0.2	0.2	0.2
3	0.4	0.3	0.2
4	0.5	0.4	0.3
5	0.6	0.5	0.4
6	0.7	0.6	0.5
7	0.8	0.7	0.6
8	0.9	0.8	0.7
9	1.0	0.9	0.8
10	1.2	1.0	0.8
20	2.3	2.0	1.7
30	3.5	3.0	2.5
40	4.7	4.0	3.3
50	5.8	5.0	4.2

	7 **32**	**6** **32**	**5** **33**
0	2.3	2.7	3.3
1	6.9	8.0	9.9
2	11.4	13.3	16.5
3	16.0	18.7	23.1
4	20.6	24.0	29.7
5	25.1	29.3	—
6	29.7	—	—
7			

P.P.

115° (295°) (244°) **64°**

26° (206°) (333°) 153°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.64 184	26	9.68 818	32	0.31 182	9.95 366	6	60
1	9.64 210	26	9.68 850	32	0.31 150	9.95 360	6	59
2	9.64 236	26	9.68 882	32	0.31 118	9.95 354	6	58
3	9.64 262	26	9.68 914	32	0.31 086	9.95 348	7	57
4	9.64 288	25	9.68 946	32	0.31 054	9.95 341	6	56
5	9.64 313	26	9.68 978	32	0.31 022	9.95 335	6	55
6	9.64 339	26	9.69 010	32	0.30 990	9.95 329	6	54
7	9.64 365	26	9.69 042	32	0.30 958	9.95 323	6	53
8	9.64 391	26	9.69 074	32	0.30 926	9.95 317	7	52
9	9.64 417	25	9.69 106	32	0.30 894	9.95 310	6	51
10	9.64 442	26	9.69 138	32	0.30 862	9.95 304	6	50
11	9.64 468	26	9.69 170	32	0.30 830	9.95 298	6	49
12	9.64 494	25	9.69 202	32	0.30 798	9.95 292	6	48
13	9.64 519	26	9.69 234	32	0.30 766	9.95 286	7	47
14	9.64 545	26	9.69 266	32	0.30 734	9.95 279	6	46
15	9.64 571	25	9.69 298	31	0.30 702	9.95 273	6	45
16	9.64 596	26	9.69 329	32	0.30 671	9.95 267	6	44
17	9.64 622	25	9.69 361	32	0.30 639	9.95 261	7	43
18	9.64 647	26	9.69 393	32	0.30 607	9.95 254	6	42
19	9.64 673	25	9.69 425	32	0.30 575	9.95 248	6	41
20	9.64 698	26	9.69 457	31	0.30 543	9.95 242	6	40
21	9.64 724	25	9.69 488	32	0.30 512	9.95 236	7	39
22	9.64 749	26	9.69 520	32	0.30 480	9.95 229	6	38
23	9.64 775	25	9.69 552	32	0.30 448	9.95 223	6	37
24	9.64 800	26	9.69 584	31	0.30 416	9.95 217	6	36
25	9.64 826	25	9.69 615	32	0.30 385	9.95 211	7	35
26	9.64 851	26	9.69 647	32	0.30 353	9.95 204	6	34
27	9.64 877	25	9.69 679	31	0.30 321	9.95 198	6	33
28	9.64 902	25	9.69 710	32	0.30 290	9.95 192	7	32
29	9.64 927	26	9.69 742	32	0.30 258	9.95 185	6	31
30	9.64 953	25	9.69 774	31	0.30 226	9.95 179	6	30
31	9.64 978	25	9.69 805	32	0.30 195	9.95 173	6	29
32	9.65 003	26	9.69 837	31	0.30 163	9 95 167	7	28
33	9.65 029	25	9.69 868	32	0.30 132	9.95 160	6	27
34	9 65 054	25	9.69 900	32	0.30 100	9.95 154	6	26
35	9.65 079	25	9.69 932	31	0.30 068	9.95 148	7	25
36	9.65 104	26	9.69 963	32	0.30 037	9.95 141	6	24
37	9.65 130	25	9.69 995	31	0.30 005	9.95 135	6	23
38	9.65 155	25	9.70 026	32	0.29 974	9.95 129	7	22
39	9.65 180	25	9.70 058	31	0.29 942	9.95 122	6	21
40	9.65 205	25	9.70 089	32	0.29 911	9.95 116	6	20
41	9.65 230	25	9.70 121	31	0.29 879	9.95 110	7	19
42	9.65 255	26	9.70 152	32	0.29 848	9.95 103	6	18
43	9.65 281	25	9.70 184	31	0.29 816	9.95 097	7	17
44	9 65 306	25	9.70 215	32	0.29 785	9.95 090	6	16
45	9.65 331	25	9.70 247	31	0.29 753	9.95 084	6	15
46	9.65 356	25	9.70 278	31	0.29 722	9.95 078	7	14
47	9.65 381	25	9.70 309	32	0.29 691	9.95 071	6	13
48	9.65 406	25	9.70 341	31	0.29 659	9.95 065	6	12
49	9.65 431	25	9.70 372	32	0.29 628	9.95 059	7	11
50	9.65 456	25	9.70 404	31	0.29 596	9.95 052	6	10
51	9.65 481	25	9.70 435	31	0.29 565	9.95 046	7	9
52	9.65 506	25	9.70 466	32	0.29 534	9.95 039	6	8
53	9.65 531	25	9.70 498	31	0.29 502	9.95 033	6	7
54	9.65 556	24	9.70 529	31	0.29 471	9.95 027	7	6
55	9.65 580	25	9.70 560	32	0.29 440	9.95 020	6	5
56	9.65 605	25	9.70 592	31	0.29 408	9.95 014	7	4
57	9.65 630	25	9.70 623	31	0.29 377	9.95 007	6	3
58	9.65 655	25	9.70 654	31	0.29 346	9.95 001	6	2
59	9.65 680	25	9.70 685	32	0.29 315	9.94 995	7	1
60	9.65 705		9.70 717		0.29 283	9.94 988		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	32	31
1	0.5	0.5
2	1.1	1.0
3	1.6	1.6
4	2.1	2.1
5	2.7	2.6
6	3.2	3.1
7	3.7	3 6
8	4.3	4.1
9	4.8	4.6
10	5.3	5.2
20	10.7	10.3
30	16.0	15.5
40	21.3	20.7
50	26.7	25.8

″	26	25	24
1	0.4	0.4	0.4
2	0.9	0.8	0.8
3	1.3	1.2	1.2
4	1.7	1.7	1.6
5	2.2	2.1	2.0
6	2.6	2.5	2.4
7	3.0	2.9	2.8
8	3.5	3.3	3.2
9	3.9	3.8	3.6
10	4.3	4.2	4.0
20	8.7	8.3	8.0
30	13.0	12.5	12.0
40	17.3	16.7	16.0
50	21.7	20.8	20.0

″	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

	$\frac{7}{32}$	$\frac{7}{31}$	$\frac{6}{32}$
0	2.3	2.2	2.7
1	6.9	6.6	8.0
2	11.4	11.1	13.3
3	16.0	15.5	18.7
4	20.6	19.9	24.0
5	25.1	24.4	29.3
6	29.7	28.8	—
7			

P.P.

116° (296°) (243°) 63°

LOGARITHMS OF THE FUNCTIONS (Continued)

27° (207°) (332°) 152°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.65 705	24	9.70 717	31	0.29 283	9.94 988	6	**60**
1	9.65 729	25	9.70 748	31	0.29 252	9.94 982	7	59
2	9.65 754	25	9.70 779	31	0.29 221	9.94 975	6	58
3	9.65 779	25	9.70 810	31	0.29 190	9.94 969	7	57
4	9.65 804	24	9.70 841	32	0.29 159	9.94 962	6	56
5	9.65 828	25	9.70 873	31	0.29 127	9.94 956	7	55
6	9.65 853	25	9.70 904	31	0.29 096	9.94 949	6	54
7	9.65 878	24	9.70 935	31	0.29 065	9.94 943	7	53
8	9.65 902	25	9.70 966	31	0.29 034	9.94 936	6	52
9	9.65 927	25	9.70 997	31	0.29 003	9.94 930	7	51
10	9.65 952	24	9.71 028	31	0.28 972	9.94 923	6	**50**
11	9.65 976	25	9.71 059	31	0.28 941	9.94 917	6	49
12	9.66 001	24	9.71 090	31	0.28 910	9.94 911	7	48
13	9.66 025	25	9.71 121	32	0.28 879	9.94 904	6	47
14	9.66 050	25	9.71 153	31	0.28 847	9.94 898	7	46
15	9.66 075	24	9.71 184	31	0.28 816	9.94 891	6	45
16	9.66 099	25	9.71 215	31	0.28 785	9.94 885	7	44
17	9.66 124	24	9.71 246	31	0.28 754	9.94 878	7	43
18	9.66 148	25	9.71 277	31	0.28 723	9.94 871	6	42
19	9.66 173	24	9.71 308	31	0.28 692	9.94 865	7	41
20	9.66 197	24	9.71 339	31	0.28 661	9.94 858	6	**40**
21	9.66 221	25	9.71 370	31	0.28 630	9.94 852	7	39
22	9.66 246	24	9.71 401	30	0.28 599	9.94 845	6	38
23	9.66 270	25	9.71 431	31	0.28 569	9.94 839	7	37
24	9.66 295	24	9.71 462	31	0.28 538	9.94 832	6	36
25	9.66 319	24	9.71 493	31	0.28 507	9.94 826	7	35
26	9.66 343	25	9.71 524	31	0.28 476	9.94 819	6	34
27	9.66 368	24	9.71 555	31	0.28 445	9.94 813	7	33
28	9.66 392	24	9.71 586	31	0.28 414	9.94 806	7	32
29	9.66 416	25	9.71 617	31	0.28 383	9.94 799	6	31
30	9.66 441	24	9.71 648	31	0.28 352	9.94 793	7	**30**
31	9.66 465	24	9.71 679	30	0.28 321	9.94 786	6	29
32	9.66 489	24	9.71 709	31	0.28 291	9.94 780	7	28
33	9.66 513	24	9.71 740	31	0.28 260	9.94 773	6	27
34	9.66 537	25	9.71 771	31	0.28 229	9.94 767	7	26
35	9.66 562	24	9.71 802	31	0.28 198	9.94 760	7	25
36	9.66 586	24	9.71 833	30	0.28 167	9.94 753	6	24
37	9.66 610	24	9.71 863	31	0.28 137	9.94 747	7	23
38	9.66 634	24	9.71 894	31	0.28 106	9.94 740	6	22
39	9.66 658	24	9.71 925	30	0.28 075	9.94 734	7	21
40	9.66 682	24	9.71 955	31	0.28 045	9.94 727	7	**20**
41	9.66 706	25	9.71 986	31	0.28 014	9.94 720	6	19
42	9.66 731	24	9.72 017	31	0.27 983	9.94 714	7	18
43	9.66 755	24	9.72 048	30	0.27 952	9.94 707	7	17
44	9.66 779	24	9.72 078	31	0.27 922	9.94 700	6	16
45	9.66 803	24	9.72 109	31	0.27 891	9.94 694	7	15
46	9.66 827	24	9.72 140	30	0.27 860	9.94 687	7	14
47	9.66 851	24	9.72 170	31	0.27 830	9.94 680	6	13
48	9.66 875	24	9.72 201	30	0.27 799	9.94 674	7	12
49	9.66 899	23	9.72 231	31	0.27 769	9.94 667	7	11
50	9.66 922	24	9.72 262	31	0.27 738	9.94 660	6	**10**
51	9.66 946	24	9.72 293	30	0.27 707	9.94 654	7	9
52	9.66 970	24	9.72 323	31	0.27 677	9.94 647	7	8
53	9.66 994	24	9.72 354	30	0.27 646	9.94 640	6	7
54	9.67 018	24	9.72 384	31	0.27 616	9.94 634	7	6
55	9.67 042	24	9.72 415	30	0.27 585	9.94 627	7	5
56	9.67 066	24	9.72 445	31	0.27 555	9.94 620	6	4
57	9.67 090	23	9.72 476	30	0.27 524	9.94 614	7	3
58	9.67 113	24	9.72 506	31	0.27 494	9.94 607	7	2
59	9.67 137	24	9.72 537	30	0.27 463	9.94 600	7	1
60	9.67 161		9.72 567		0.27 433	9.94 593		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**32**	**31**	**30**
1	0.5	0.5	0.5
2	1.1	1.0	1.0
3	1.6	1.6	1.5
4	2.1	2.1	2.0
5	2.7	2.6	2.5
6	3.2	3.1	3.0
7	3.7	3.6	3.5
8	4.3	4.1	4.0
9	4.8	4.6	4.5
10	5.3	5.2	5.0
20	10.7	10.3	10.0
30	16.0	15.5	15.0
40	21.3	20.7	20.0
50	26.7	25.8	25.0

″	**25**	**24**	**23**
1	0.4	0.4	0.4
2	0.8	0.8	0.8
3	1.2	1.2	1.2
4	1.7	1.6	1.5
5	2.1	2.0	1.9
6	2.5	2.4	2.3
7	2.9	2.8	2.7
8	3.3	3.2	3.1
9	3.8	3.6	3.4
10	4.2	4.0	3.8
20	8.3	8.0	7.7
30	12.5	12.0	11.5
40	16.7	16.0	15.3
50	20.8	20.0	19.2

″	**7**	**6**
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

	$\frac{\mathbf{7}}{\mathbf{30}}$	$\frac{\mathbf{6}}{\mathbf{31}}$	$\frac{\mathbf{6}}{\mathbf{30}}$
0	2.1	2.6	2.5
1	6.4	7.8	7.5
2	10.7	12.9	12.5
3	15.0	18.1	17.5
4	19.3	23.2	22.5
5	23.6	28.4	27.5
6	27.9	—	—
7			

P. P.

117° (297°) (242°) 62°

LOGARITHMS OF THE FUNCTIONS (Continued)

28° (208°) (331°) 151°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.67 161	24	9.72 567	31	0.27 433	9.94 593	6	60
1	9.67 185	23	9.72 598	30	0.27 402	9.94 587	7	59
2	9.67 208	24	9.72 628	31	0.27 372	9.94 580	7	58
3	9.67 232	24	9.72 659	30	0.27 341	9.94 573	6	57
4	9.67 256	24	9.72 689	31	0.27 311	9.94 567	7	56
5	9.67 280	23	9.72 720	30	0.27 280	9.94 560	7	55
6	9.67 303	24	9.72 750	30	0.27 250	9.94 553	7	54
7	9.67 327	23	9.72 780	31	0.27 220	9.94 546	6	53
8	9.67 350	24	9.72 811	30	0.27 189	9.94 540	7	52
9	9.67 374	24	9.72 841	31	0.27 159	9.94 533	7	51
10	9.67 398	23	9.72 872	30	0.27 128	9.94 526	7	50
11	9.67 421	24	9.72 902	30	0.27 098	9.94 519	6	49
12	9.67 445	23	9.72 932	31	0.27 068	9.94 513	7	48
13	9.67 468	24	9.72 963	30	0.27 037	9.94 506	7	47
14	9.67 492	23	9.72 993	30	0.27 007	9.94 499	7	46
15	9.67 515	24	9.73 023	31	0.26 977	9.94 492	7	45
16	9.67 539	23	9.73 054	30	0.26 946	9.94 485	6	44
17	9.67 562	24	9.73 084	30	0.26 916	9.94 479	7	43
18	9.67 586	23	9.73 114	30	0.26 886	9.94 472	7	42
19	9.67 609	24	9.73 144	31	0.26 856	9.94 465	7	41
20	9.67 633	23	9.73 175	30	0 26 825	9.94 458	7	40
21	9.67 656	24	9.73 205	30	0.26 795	9.94 451	6	39
22	9.67 680	23	9.73 235	30	0.26 765	9.94 445	7	38
23	9.67 703	23	9.73 265	30	0.26 735	9.94 438	7	37
24	9.67 726	24	9.73 295	31	0.26 705	9.94 431	7	36
25	9.67 750	23	9.73 326	30	0.26 674	9.94 424	7	35
26	9.67 773	23	9.73 356	30	0.26 644	9.94 417	7	34
27	9.67 796	24	9.73 386	30	0.26 614	9.94 410	6	33
28	9.67 820	23	9.73 416	30	0.26 584	9.94 404	7	32
29	9.67 843	23	9.73 446	30	0.26 554	9.94 397	7	31
30	9.67 866	24	9.73 476	31	0.26 524	9.94 390	7	30
31	9.67 890	23	9.73 507	30	0.26 493	9.94 383	7	29
32	9.67 913	23	9.73 537	30	0.26 463	9.94 376	7	28
33	9.67 936	23	9.73 567	30	0.26 433	9.94 369	7	27
34	9.67 959	23	9.73 597	30	0.26 403	9.94 362	7	26
35	9.67 982	24	9.73 627	30	0.26 373	9.94 355	6	25
36	9.68 006	23	9.73 657	30	0.26 343	9.94 349	7	24
37	9.68 029	23	9.73 687	30	0.26 313	9.94 342	7	23
38	9.68 052	23	9.73 717	30	0.26 283	9.94 335	7	22
39	9.68 075	23	9.73 747	30	0.26 253	9.94 328	7	21
40	9.68 098	23	9.73 777	30	0.26 223	9.94 321	7	20
41	9.68 121	23	9.73 807	30	0.26 193	9.94 314	7	19
42	9.68 144	23	9.73 837	30	0.26 163	9.94 307	7	18
43	9.68 167	23	9.73 867	30	0.26 133	9.94 300	7	17
44	9.68 190	23	9.73 897	30	0.26 103	9.94 293	7	16
45	9.68 213	24	9.73 927	30	0.26 073	9.94 286	7	15
46	9.68 237	23	9.73 957	30	0.26 043	9.94 279	6	14
47	9.68 260	23	9.73 987	30	0.26 013	9.94 273	7	13
48	9.68 283	22	9.74 017	30	0.25 983	9.94 266	7	12
49	9.68 305	23	9.74 047	30	0.25 953	9.94 259	7	11
50	9.68 328	23	9.74 077	30	0.25 923	9.94 252	7	10
51	9.68 351	23	9.74 107	30	0.25 893	9.94 245	7	9
52	9.68 374	23	9.74 137	29	0.25 863	9.94 238	7	8
53	9.68 397	23	9.74 166	30	0.25 834	9.94 231	7	7
54	9.68 420	23	9.74 196	30	0.25 804	9.94 224	7	6
55	9.68 443	23	9.74 226	30	0.25 774	9.94 217	7	5
56	9.68 466	23	9.74 256	30	0.25 744	9.94 210	7	4
57	9.68 489	23	9.74 286	30	0.25 714	9.94 203	7	3
58	9.68 512	22	9.74 316	29	0.25 684	9.94 196	7	2
59	9.68 534	23	9.74 345	30	0.25 655	9.94 189	7	1
60	9.68 557		9.74 375		0.25 625	9.94 182		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	31	30	29
1	0.5	0.5	0.5
2	1.0	1.0	1.0
3	1.6	1.5	1.4
4	2.1	2.0	1.9
5	2.6	2.5	2.4
6	3.1	3.0	2.9
7	3.6	3.5	3.4
8	4.1	4.0	3.9
9	4.6	4.5	4.4
10	5.2	5.0	4.8
20	10.3	10.0	9.7
30	15.5	15.0	14.5
40	20.7	20.0	19.3
50	25.8	25.0	24.2

″	24	23	22
1	0.4	0.4	0.4
2	0.8	0.8	0.7
3	1.2	1.2	1.1
4	1.6	1.5	1.5
5	2.0	1.9	1.8
6	2.4	2.3	2.2
7	2.8	2.7	2.6
8	3.2	3.1	2.9
9	3.6	3.4	3.3
10	4.0	3.8	3.7
20	8.0	7.7	7.3
30	12.0	11.5	11.0
40	16.0	15.3	14.7
50	20.0	19.2	18.3

″	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

	$\frac{7}{31}$	$\frac{6}{31}$	$\frac{6}{30}$
0	2.2	2.6	2.5
1	6.6	7.8	7.5
2	11.1	12.9	12.5
3	15.5	18.1	17.5
4	19.9	23.2	22.5
5	24.4	28.4	27.5
6	28.8	—	—
7			

P. P.

118° (298°) (241°) 61°

LOGARITHMS OF THE FUNCTIONS (Continued)

29° (209°) (330°) **150°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.68 557	23	9.74 375̇	30	0.25 625̄	9.94 182	7	**60**
1	9.68 580	23	9.74 405̄	30	0.25 595̇	9.94 175̄	7	59
2	9.68 603	22	9.74 435̄	30	0.25 565̇	9.94 168	7	58
3	9.68 625̇	23	9.74 465̄	29	0.25 535̇	9.94 161	7	57
4	9.68 648	23	9.74 494	30	0.25 506	9.94 154	7	56
5	9.68 671	23	9.74 524	30	0.25 476	9.94 147	7	55
6	9.68 694	22	9.74 554	29	0.25 446	9.94 140	7	54
7	9.68 716	23	9.74 583	30	0.25 417	9.94 133	7	53
8	9.68 739	23	9.74 613	30	0.25 387	9.94 126	7	52
9	9.68 762	22	9.74 643	30	0.25 357	9.94 119	7	51
10	9.68 784	23	9.74 673	29	0.25 327	9.94 112	7	**50**
11	9.68 807	22	9.74 702	30	0.25 298	9.94 105̄	7	49
12	9.68 829	23	9.74 732	30	0.25 268	9.94 098	8	48
13	9.68 852	23	9.74 762	29	0.25 238	9.94 090	7	47
14	9.68 875̄	22	9.74 791	30	0.25 209	9.94 083	7	46
15	9.68 897	23	9.74 821	30	0.25 179	9.94 076	7	45
16	9.68 920	22	9.74 851	29	0.25 149	9.94 069	7	44
17	9.68 942	23	9.74 880	30	0.25 120	9.94 062	7	43
18	9.68 965̄	22	9.74 910	29	0.25 090	9.94 055̇	7	42
19	9.68 987	23	9.74 939	30	0.25 061	9.94 048	7	41
20	9.69 010	22	9.74 969	29	0.25 031	9 94 041	7	**40**
21	9.69 032	23	9.74 998	30	0.25 002	9.94 034	7	39
22	9.69 055̄	22	9.75 028	30	0.24 972	9.94 027	7	38
23	9.69 077	23	9.75 058	29	0.24 942	9.94 020	8	37
24	9.69 100	22	9.75 087	30	0.24 913	9.94 012	7	36
25	9.69 122	22	9.75 117	29	0.24 883	9.94 005̇	7	35
26	9.69 144	23	9.75 146	30	0.24 854	9.93 998	7	34
27	9.69 167	22	9.75 176	29	0.24 824	9.93 991	7	33
28	9.69 189	23	9.75 205̇	30	0.24 795̄	9.93 984	7	32
29	9.69 212	22	9.75 235̄	29	0.24 765̇	9.93 977	7	31
30	9.69 234	22	9.75 264	30	0.24 736	9.93 970	7	**30**
31	9.69 256	23	9.75 294	29	0.24 706	9 93 963	8	29
32	9.69 279	22	9.75 323	30	0.24 677	9.93 955̇	7	28
33	9.69 301	22	9.75 353	29	0.24 647	9.93 948	7	27
34	9.69 323	22	9.75 382	29	0.24 618	9.93 941	7	26
35	9.69 345̇	23	9.75 411	30	0.24 589	9.93 934	7	25
36	9.69 368	22	9.75 441	29	0.24 559	9.93 927	7	24
37	9.69 390	22	9.75 470	30	0.24 530	9.93 920	8	23
38	9.69 412	22	9.75 5̄00	29	0.24 5̇00	9.93 912	7	22
39	9.69 434	22	9.75 529	29	0.24 471	9.93 905̇	7	21
40	9.69 456	23	9.75 558	30	0.24 442	9.93 898	7	**20**
41	9.69 479	22	9.75 588	29	0.24 412	9.93 891	7	19
42	9.69 501	22	9.75 617	30	0.24 383	9.93 884	8	18
43	9.69 523	22	9.75 647	29	0.24 353	9.93 876	7	17
44	9.69 545̇	22	9.75 676	29	0.24 324	9.93 869	7	16
45	9.69 567	22	9.75 705̇	30	0.24 295̄	9.93 862	7	15
46	9.69 589	22	9.75 735̄	29	0.24 265̇	9.93 855̄	8	14
47	9.69 611	22	9.75 764	29	0.24 236	9.93 847	7	13
48	9.69 633	22	9.75 793	29	0.24 207	9.93 840	7	12
49	9.69 655̇	22	9.75 822	30	0.24 178	9.93 833	7	11
50	9.69 677	22	9.75 852	29	0.24 148	9.93 826	7	**10**
51	9.69 699	22	9.75 881	29	0.24 119	9.93 819	8	9
52	9.69 721	22	9.75 910	29	0.24 090	9.93 811	7	8
53	9.69 743	22	9.75 939	30	0.24 061	9.93 804	7	7
54	9.69 765̇	22	9.75 969	29	0.24 031	9.93 797	8	6
55	9.69 787	22	9.75 998	29	0.24 002	9.93 789	7	5
56	9.69 809	22	9.76 027	29	0.23 973	9.93 782	7	4
57	9.69 831	22	9.76 056	30	0.23 944	9.93 775̄	7	3
58	9.69 853	22	9.76 086	29	0.23 914	9.93 768	8	2
59	9.69 875̇	22	9.76 115̄	29	0.23 885̇	9.93 760	7	1
60	9.69 897		9.76 144		0.23 856	9.93 753		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**30**	**29**	**23**
1	0.5	0.5	0.4
2	1.0	1.0	0.8
3	1.5	1.4	1.2
4	2.0	1.9	1.5
5	2.5	2.4	1.9
6	3.0	2.9	2.3
7	3.5	3.4	2.7
8	4.0	3.9	3.1
9	4.5	4.4	3.4
10	5.0	4.8	3.8
20	10.0	9.7	7.7
30	15.0	14.5	11.5
40	20.0	19.3	15.3
50	25.0	24.2	19.2

″	**22**	**8**	**7**
1	0.4	0.1	0.1
2	0.7	0.3	0.2
3	1.1	0.4	0.4
4	1.5	0.5	0.5
5	1.8	0.7	0.6
6	2.2	0.8	0.7
7	2.6	0.9	0.8
8	2.9	1.1	0.9
9	3.3	1.2	1.0
10	3.7	1.3	1.2
20	7.3	2.7	2.3
30	11.0	4.0	3.5
40	14.7	5.3	4.7
50	18.3	6.7	5.8

	8/30	**8/29**
0	1.9	1.8
1	5.6	5.4
2	9.4	9.1
3	13.1	12.7
4	16.9	16.3
5	20.6	19.9
6	24.4	23.6
7	28.1	27.2
8		

	7/30	**7/29**
0	2.1	2.1
1	6.4	6.2
2	10.7	10.4
3	15.0	14.5
4	19.3	18.6
5	23.6	22.8
6	27.9	26.9
7		

P. P.

119° (299°) (240°) **60°**

30° (210°) (329°) 149°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.69 897	22	9.76 144	29	0.23 856	9.93 753	7	60
1	9.69 919	22	9.76 173	29	0.23 827	9.93 746	8	59
2	9.69 941	22	9.76 202	29	0.23 798	9.93 738	7	58
3	9.69 963	21	9.76 231	30	0.23 769	9.93 731	7	57
4	9.69 984	22	9.76 261	29	0.23 739	9.93 724	7	56
5	9.70 006	22	9.76 290	29	0.23 710	9.93 717	8	55
6	9.70 028	22	9.76 319	29	0.23 681	9.93 709	7	54
7	9.70 050	22	9.76 348	29	0.23 652	9.93 702	7	53
8	9.70 072	21	9.76 377	29	0.23 623	9.93 695	8	52
9	9.70 093	22	9.76 406	29	0.23 594	9.93 687	7	51
10	9.70 115	22	9.76 435	29	0.23 565	9.93 680	7	50
11	9.70 137	22	9.76 464	29	0.23 536	9.93 673	8	49
12	9.70 159	21	9.76 493	29	0.23 507	9.93 665	7	48
13	9.70 180	22	9.76 522	29	0.23 478	9.93 658	8	47
14	9.70 202	22	9.76 551	29	0.23 449	9.93 650	7	46
15	9.70 224	21	9.76 580	29	0.23 420	9.93 643	7	45
16	9.70 245	22	9.76 609	30	0.23 391	9.93 636	8	44
17	9.70 267	21	9.76 639	29	0.23 361	9.93 628	7	43
18	9.70 288	22	9.76 668	29	0.23 332	9.93 621	7	42
19	9.70 310	22	9.76 697	28	0.23 303	9.93 614	8	41
20	9.70 332	21	9.76 725	29	0.23 275	9.93 606	7	40
21	9.70 353	22	9.76 754	29	0.23 246	9.93 599	8	39
22	9.70 375	21	9.76 783	29	0.23 217	9.93 591	7	38
23	9.70 396	22	9.76 812	29	0.23 188	9.93 584	7	37
24	9.70 418	21	9.76 841	29	0.23 159	9.93 577	8	36
25	9.70 439	22	9.76 870	29	0.23 130	9.93 569	7	35
26	9.70 461	21	9.76 899	29	0.23 101	9.93 562	8	34
27	9.70 482	22	9.76 928	29	0.23 072	9.93 554	7	33
28	9.70 504	21	9.76 957	29	0.23 043	9.93 547	8	32
29	9.70 525	22	9.76 986	29	0.23 014	9.93 539	7	31
30	9.70 547	21	9.77 015	29	0.22 985	9.93 532	7	30
31	9.70 568	22	9.77 044	29	0.22 956	9.93 525	8	29
32	9.70 590	21	9.77 073	28	0.22 927	9.93 517	7	28
33	9.70 611	22	9.77 101	29	0.22 899	9.93 510	8	27
34	9.70 633	21	9.77 130	29	0.22 870	9.93 502	7	26
35	9.70 654	21	9.77 159	29	0.22 841	9.93 495	8	25
36	9.70 675	22	9.77 188	29	0.22 812	9.93 487	7	24
37	9.70 697	21	9.77 217	29	0.22 783	9.93 480	8	23
38	9 70 718	21	9.77 246	28	0.22 754	9.93 472	7	22
39	9.70 739	22	9.77 274	29	0.22 726	9.93 465	8	21
40	9.70 761	21	9.77 303	29	0.22 697	9.93 457	7	20
41	9.70 782	21	9.77 332	29	0.22 668	9.93 450	8	19
42	9.70 803	21	9.77 361	29	0.22 639	9.93 442	7	18
43	9.70 824	22	9.77 390	28	0.22 610	9.93 435	8	17
44	9.70 846	21	9.77 418	29	0.22 582	9.93 427	7	16
45	9.70 867	21	9.77 447	29	0.22 553	9.93 420	8	15
46	9.70 888	21	9.77 476	29	0.22 524	9.93 412	7	14
47	9.70 909	22	9.77 505	28	0.22 495	9.93 405	8	13
48	9.70 931	21	9.77 533	29	0.22 467	9.93 397	7	12
49	9.70 952	21	9.77 562	29	0.22 438	9.93 390	8	11
50	9.70 973	21	9.77 591	28	0.22 409	9.93 382	7	10
51	9.70 994	21	9.77 619	29	0.22 381	9.93 375	8	9
52	9.71 015	21	9.77 648	29	0.22 352	9.93 367	7	8
53	9.71 036	22	9.77 677	29	0.22 323	9.93 360	8	7
54	9.71 058	21	9.77 706	28	0.22 294	9.93 352	8	6
55	9.71 079	21	9.77 734	29	0.22 266	9.93 344	7	5
56	9.71 100	21	9.77 763	28	0.22 237	9.93 337	8	4
57	9.71 121	21	9.77 791	29	0.22 209	9.93 329	7	3
58	9.71 142	21	9.77 820	29	0.22 180	9.93 322	8	2
59	9.71 163	21	9 77 849	28	0.22 151	9.93 314	7	1
60	9.71 184		9.77 877		0.22 123	9.93 307		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

120° (300°) (239°) 59°

P.P.

″	30	29	28
1	0.5	0.5	0.5
2	1.0	1.0	0.9
3	1.5	1.4	1.4
4	2.0	1.9	1.9
5	2.5	2.4	2.3
6	3.0	2.9	2.8
7	3.5	3.4	3.3
8	4.0	3.9	3.7
9	4.5	4.4	4.2
10	5.0	4.8	4.7
20	10.0	9.7	9.3
30	15.0	14.5	14.0
40	20.0	19.3	18.7
50	25.0	24.2	23.3

″	22	21
1	0.4	0.4
2	0.7	0.7
3	1.1	1.0
4	1.5	1.4
5	1.8	1.8
6	2.2	2.1
7	2.6	2.4
8	2.9	2.8
9	3.3	3.2
10	3.7	3.5
20	7.3	7.0
30	11.0	10.5
40	14.7	14.0
50	18.3	17.5

″	8	7
1	0.1	0.1
2	0.3	0.2
3	0.4	0 4
4	0.5	0.5
5	0.7	0.6
6	0.8	0.7
7	0.9	0.8
8	1.1	0.9
9	1.2	1.0
10	1.3	1.2
20	2.7	2.3
30	4.0	3.5
40	5.3	4.7
50	6.7	5.8

	$\frac{7}{30}$	$\frac{7}{29}$	$\frac{7}{28}$
0	2.1	2.1	2.0
1	6.4	6.2	6.0
2	10.7	10.4	10.0
3	15.0	14.5	14.0
4	19.3	18.6	18.0
5	23.6	22.8	22.0
6	27.9	26.9	26.0
7			

P.P.

LOGARITHMS OF THE FUNCTIONS (Continued)

31° (211°) (328°) **148°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.71 184	21	9.77 877	29	0.22 123	9.93 307	8	**60**
1	9.71 205̄	21	9.77 906	29	0.22 094	9.93 299	8	59
2	9.71 226	21	9.77 935̄	28	0.22 065̇	9.93 291	7	58
3	9.71 247	21	9.77 963	29	0.22 037	9.93 284	8	57
4	9.71 268	21	9.77 992	28	0.22 008	9.93 276	7	56
5	9.71 289	21	9.78 020	29	0.21 980	9.93 269	8	55
6	9.71 310	21	9.78 049	28	0.21 951	9.93 261	8	54
7	9.71 331	21	9.78 077	29	0.21 923	9.93 253	7	53
8	9.71 352	21	9.78 106	29	0.21 894	9.93 246	8	52
9	9.71 373	20	9.78 135̄	28	0.21 865̇	9.93 238	8	51
10	9.71 393	21	9.78 163	29	0.21 837	9.93 230	7	**50**
11	9.71 414	21	9.78 192	28	0.21 808	9.93 223	8	49
12	9.71 435̇	21	9.78 220	29	0.21 780	9.93 215̇	8	48
13	9.71 456	21	9.78 249	28	0.21 751	9.93 207	7	47
14	9.71 477	21	9.78 277	29	0.21 723	9.93 200	8	46
15	9.71 498	21	9.78 306	28	0.21 694	9.93 192	8	45
16	9.71 519	20	9.78 334	29	0.21 666	9.93 184	7	44
17	9.71 539	21	9.78 363	28	0.21 637	9.93 177	8	43
18	9.71 560	21	9.78 391	28	0.21 609	9.93 169	8	42
19	9.71 581	21	9.78 419	29	0.21 581	9.93 161	7	41
20	9.71 602	20	9.78 448	28	0.21 552	9.93 154	8	**40**
21	9.71 622	21	9.78 476	29	0.21 524	9.93 146	8	39
22	9.71 643	21	9.78 505̄	28	0.21 495̇	9.93 138	7	38
23	9.71 664	21	9.78 533	29	0.21 467	9.93 131	8	37
24	9.71 685̄	20	9.78 562	28	0.21 438	9.93 123	8	36
25	9.71 705̇	21	9.78 590	28	0.21 410	9.93 115̇	7	35
26	9.71 726	21	9.78 618	29	0.21 382	9.93 108	8	34
27	9.71 747	20	9.78 647	28	0.21 353	9.93 100	8	33
28	9.71 767	21	9.78 675̇	29	0.21 325̄	9.93 092	8	32
29	9.71 788	21	9.78 704	28	0.21 296	9.93 084	7	31
30	9.71 809	20	9.78 732	28	0.21 268	9.93 077	8	**30**
31	9.71 829	21	9.78 760	29	0.21 240	9.93 069	8	29
32	9.71 85̄0	20	9.78 789	28	0.21 211	9.93 061	8	28
33	9.71 870	21	9.78 817	28	0.21 183	9.93 053	7	27
34	9.71 891	20	9.78 845̇	29	0.21 155̄	9.93 046	8	26
35	9.71 911	21	9.78 874	28	0.21 126	9.93 038	8	25
36	9.71 932	20	9.78 902	28	0.21 098	9.93 030	8	24
37	9.71 952	21	9.78 930	29	0.21 070	9.93 022	8	23
38	9.71 973	21	9.78 959	28	0.21 041	9.93 014	7	22
39	9.71 994	20	9.78 987	28	0.21 013	9.93 007	8	21
40	9.72 014	20	9.79 015̇	28	0.20 985̄	9.92 999	8	**20**
41	9.72 034	21	9.79 043	29	0.20 957	9.92 991	8	19
42	9.72 055̄	20	9.79 072	28	0.20 928	9.92 983	7	18
43	9.72 075̇	21	9.79 100	28	0.20 900	9.92 976	8	17
44	9.72 096	20	9.79 128	28	0.20 872	9.92 968	8	16
45	9.72 116	21	9.79 156	29	0.20 844	9.92 960	8	15
46	9.72 137	20	9.79 185̄	28	0.20 815̇	9.92 952	8	14
47	9.72 157	20	9.79 213	28	0.20 787	9.92 944	8	13
48	9.72 177	21	9.79 241	28	0.20 759	9.92 936	7	12
49	9.72 198	20	9.79 269	28	0.20 731	9.92 929	8	11
50	9.72 218	20	9.79 297	29	0.20 703	9.92 921	8	**10**
51	9.72 238	21	9.79 326	28	0.20 674	9.92 913	8	9
52	9.72 259	20	9.79 354	28	0.20 646	9.92 905̇	8	8
53	9.72 279	20	9.79 382	28	0.20 618	9.92 897	8	7
54	9.72 299	21	9.79 410	28	0.20 590	9.92 889	8	6
55	9.72 320	20	9.79 438	28	0.20 562	9.92 881	7	5
56	9.72 340	20	9.79 466	29	0.20 534	9.92 874	8	4
57	9.72 360	21	9.79 495̄	28	0.20 505̇	9.92 866	8	3
58	9.72 381	20	9.79 523	28	0.20 477	9.92 858	8	2
59	9.72 401	20	9.79 551	28	0.20 449	9.92 85̄0	8	1
60	9.72 421		9.79 579		0.20 421	9.92 842		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	**29**	**28**	**21**	**20**	**8**	**7**
1	0.5	0.5	0.4	0.3	0.1	0.1
2	1.0	0.9	0.7	0.7	0.3	0.2
3	1.4	1.4	1.0	1.0	0.4	0.4
4	1.9	1.9	1.4	1.3	0.5	0.5
5	2.4	2.3	1.8	1.7	0.7	0.6
6	2.9	2.8	2.1	2.0	0.8	0.7
7	3.4	3.3	2.4	2.3	0.9	0.8
8	3.9	3.7	2.8	2.7	1.1	0.9
9	4.4	4.2	3.2	3.0	1.2	1.0
10	4.8	4.7	3.5	3.3	1.3	1.2
20	9.7	9.3	7.0	6.7	2.7	2.3
30	14.5	14.0	10.5	10.0	4.0	3.5
40	19.3	18.7	14.0	13.3	5.3	4.7
50	24.2	23.3	17.5	16.7	6.7	5.8

	8/30	**8/29**	**8/28**
0	1.9	1.8	1.8
1	5.6	5.4	5.2
2	9.4	9.1	8.8
3	13.1	12.7	12.2
4	16.9	16.3	15.8
5	20.6	19.9	19.2
6	24.4	23.6	22.8
7	28.1	27.2	26.2
8			

P.P.

121° (301°) (238°) **58°**

LOGARITHMS OF THE FUNCTIONS (Continued)

32° (212°) (327°) **147°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.72 421	20	9.79 579	28	0.20 421	9.92 842	8	**60**
1	9.72 441	20	9.79 607	28	0.20 393	9.92 834	8	59
2	9.72 461	21	9.79 635̇	28	0.20 365̄	9.92 826	8	58
3	9.72 482	20	9.79 663	28	0.20 337	9.92 818	8	57
4	9.72 502	20	9.79 691	28	0.20 309	9.92 810	7	56
5	9.72 522	20	9.79 719	28	0.20 281	9.92 803	8	55
6	9.72 542	20	9.79 747	29	0.20 253	9.92 795̄	8	54
7	9.72 562	20	9.79 776	28	0.20 224	9.92 787	8	53
8	9.72 582	20	9.79 804	28	0.20 196	9.92 779	8	52
9	9.72 602	20	9.79 832	28	0.20 168	9.92 771	8	51
10	9.72 622	21	9.79 860	28	0.20 140	9.92 763	8	**50**
11	9.72 643	20	9.79 888	28	0.20 112	9.92 755̄	8	49
12	9.72 663	20	9.79 916	28	0.20 084	9.92 747	8	48
13	9.72 683	20	9.79 944	28	0.20 056	9.92 739	8	47
14	9.72 703	20	9.79 972	28	0.20 028	9.92 731	8	46
15	9.72 723	20	9.80 000	28	0.20 000	9.92 723	8	45
16	9.72 743	20	9.80 028	28	0.19 972	9.92 715̇	8	44
17	9.72 763	20	9.80 056	28	0.19 944	9.92 707	8	43
18	9.72 783	20	9.80 084	28	0.19 916	9.92 699	8	42
19	9.72 803	20	9.80 112	28	0.19 888	9.92 691	8	41
20	9.72 823	20	9.80 140	28	0.19 860	9.92 683	8	**40**
21	9.72 843	20	9.80 168	27	0.19 832	9.92 675̇	8	39
22	9.72 863	20	9.80 195̇	28	0.19 805̄	9.92 667	8	38
23	9.72 883	19	9.80 223	28	0.19 777	9.92 659	8	37
24	9.72 902	20	9.80 251	28	0.19 749	9.92 651	8	36
25	9.72 922	20	9.80 279	28	0.19 721	9.92 643	8	35
26	9.72 942	20	9.80 307	28	0.19 693	9.92 635̇	8	34
27	9.72 962	20	9.80 335̇	28	0.19 665̄	9.92 627	8	33
28	9.72 982	20	9.80 363	28	0.19 637	9.92 619	8	32
29	9.73 002	20	9.80 391	28	0.19 609	9.92 611	8	31
30	9.73 022	19	9.80 419	28	0.19 581	9.92 603	8	**30**
31	9.73 041	20	9.80 447	27	0.19 553	9.92 595	8	29
32	9.73 061	20	9.80 474	28	0.19 526	9.92 587	8	28
33	9.73 081	20	9.80 502	28	0.19 498	9.92 579	8	27
34	9.73 101	20	9.80 530	28	0.19 470	9.92 571	8	26
35	9.73 121	19	9.80 558	28	0.19 442	9.92 563	8	25
36	9.73 140	20	9.80 586	28	0.19 414	9.92 555̄	9	24
37	9.73 160	20	9.80 614	28	0.19 386	9.92 546	8	23
38	9.73 180	20	9.80 642	27	0.19 358	9.92 538	8	22
39	9.73 200	19	9.80 669	28	0.19 331	9.92 530	8	21
40	9.73 219	20	9.80 697	28	0.19 303	9.92 522	8	**20**
41	9.73 239	20	9.80 725̄	28	0.19 275̇	9.92 514	8	19
42	9.73 259	19	9.80 753	28	0.19 247	9.92 506	8	18
43	9.73 278	20	9.80 781	27	0.19 219	9.92 498	8	17
44	9.73 298	20	9.80 808	28	0.19 192	9.92 490	8	16
45	9.73 318	19	9.80 836	28	0.19 164	9.92 482	9	15
46	9.73 337	20	9.80 864	28	0.19 136	9.92 473	8	14
47	9.73 357	20	9.80 892	27	0.19 108	9.92 465̇	8	13
48	9.73 377	19	9.80 919	28	0.19 081	9.92 457	8	12
49	9.73 396	20	9.80 947	28	0.19 053	9.92 449	8	11
50	9.73 416	19	9.80 975̄	28	0.19 025̇	9.92 441	8	**10**
51	9.73 435	20	9.81 003	27	0.18 997	9.92 433	8	9
52	9.73 455̄	19	9.81 030	28	0.18 970	9.92 425̄	9	8
53	9.73 474	20	9.81 058	28	0.18 942	9.92 416	8	7
54	9.73 494	19	9.81 086	27	0.18 914	9.92 408	8	6
55	9.73 513	20	9.81 113	28	0.18 887	9.92 400	8	5
56	9.73 533	19	9.81 141	28	0.18 859	9.92 392	8	4
57	9.73 552	20	9.81 169	27	0.18 831	9.92 384	8	3
58	9.73 572	19	9.81 196	28	0.18 804	9.92 376	9	2
59	9.73 591	20	9.81 224	28	0.18 776	9.92 367	8	1
60	9.73 611		9.81 252		0.18 748	9.92 359		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.			
″	**29**	**28**	**27**
1	0.5̄	0.5̄	0.4
2	1.0	0.9	0.9
3	1.4	1.4	1.4
4	1.9	1.9	1.8
5	2.4	2.3	2.2
6	2.9	2.8	2.7
7	3.4	3.3	3.2
8	3.9	3.7	3.6
9	4.4	4.2	4.0
10	4.8	4.7	4.5
20	9.7	9.3	9.0
30	14.5	14.0	13.5
40	19.3	18.7	18.0
50	24.2	23.3	22.5
″	**21**	**20**	**19**
1	0.4	0.3	0.3
2	0.7	0.7	0.6
3	1.0	1.0	1.0
4	1.4	1.3	1.3
5	1.8	1.7	1.6
6	2.1	2.0	1.9
7	2.4	2.3	2.2
8	2.8	2.7	2.5̇
9	3.2	3.0	2.8
10	3.5	3.3	3.2
20	7.0	6.7	6.3
30	10.5	10.0	9.5
40	14.0	13.3	12.7
50	17.5	16.7	15.8
″	**9**	**8**	**7**
1	0.2	0.1	0.1
2	0.3	0.3	0.2
3	0.4	0.4	0.4
4	0.6	0.5̄	0.5̄
5	0.8	0.7	0.6
6	0.9	0.8	0.7
7	1.0	0.9	0.8
8	1.2	1.1	0.9
9	1.4	1.2	1.0
10	1.5	1.3	1.2
20	3.0	2.7	2.3
30	4.5	4.0	3.5
40	6.0	5.3	4.7
50	7.5	6.7	5.8

	8/**29**	**8**/**28**	**7**/**28**
0			
1	1.8	1.8	2.0
2	5.4	5.2	6.0
3	9.1	8.8	10.0
4	12.7	12.2	14.0
5	16.3	15.8	18.0
6	19.9	19.2	22.0
7	23.6	22.8	26.0
8	27.2	26.2	—

P. P.

122° (302°) (237°) **57°**

LOGARITHMS OF THE FUNCTIONS (Continued)

33° (213°) (326°) **146°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.73 611	19	9.81 252	27	0.18 748	9.92 359	8	**60**
1	9.73 630	20	9.81 279	28	0.18 721	9.92 351	8	59
2	9.73 65̄0	19	9.81 307	28	0.18 693	9.92 343	8	58
3	9.73 669	20	9.81 335̄	27	0.18 665̇	9.92 335̄	9	57
4	9.73 689	19	9.81 362	28	0.18 638	9.92 326	8	56
5	9.73 708	19	9.81 390	28	0.18 610	9.92 318	8	55
6	9.73 727	20	9.81 418	27	0.18 582	9.92 310	8	54
7	9.73 747	19	9.81 445̇	28	0.18 555̄	9.92 302	9	53
8	9.73 766	19	9.81 473	27	0.18 527	9.92 293	8	52
9	9.73 785̇	20	9.81 5̇00	28	0.18 5̄00	9.92 285̇	8	51
10	9.73 805̄	19	9.81 528	28	0.18 472	9.92 277	8	**50**
11	9.73 824	19	9.81 556	27	0.18 444	9.92 269	9	49
12	9.73 843	20	9.81 583	28	0.18 417	9.92 260	8	48
13	9.73 863	19	9.81 611	27	0.18 389	9.92 252	8	47
14	9.73 882	19	9.81 638	28	0.18 362	9.92 244	9	46
15	9.73 901	20	9.81 666	27	0.18 334	9.92 235̇	8	45
16	9.73 921	19	9.81 693	28	0.18 307	9.92 227	8	44
17	9.73 940	19	9.81 721	27	0.18 279	9.92 219	8	43
18	9.73 959	19	9.81 748	28	0.18 252	9.92 211	9	42
19	9.73 978	19	9.81 776	27	0.18 224	9.92 202	8	41
20	9.73 997	20	9.81 803	28	0.18 197	9.92 194	8	**40**
21	9.74 017	19	9.81 831	27	0.18 169	9.92 186	9	39
22	9.74 036	19	9.81 858	28	0.18 142	9.92 177	8	38
23	9.74 055̇	19	9.81 886	27	0.18 114	9.92 169	8	37
24	9.74 074	19	9.81 913	28	0.18 087	9.92 161	9	36
25	9.74 093	20	9.81 941	27	0.18 059	9.92 152	8	35
26	9.74 113	19	9.81 968	28	0.18 032	9.92 144	8	34
27	9.74 132	19	9.81 996	27	0.18 004	9.92 136	9	33
28	9.74 151	19	9.82 023	28	0.17 977	9.92 127	8	32
29	9.74 170	19	9.82 051	27	0.17 949	9.92 119	8	31
30	9.74 189	19	9.82 078	28	0.17 922	9.92 111	9	**30**
31	9.74 208	19	9.82 106	27	0.17 894	9.92 102	8	29
32	9.74 227	19	9.82 133	28	0.17 867	9.92 094	8	28
33	9.74 246	19	9.82 161	27	0.17 839	9.92 086	9	27
34	9.74 265̇	19	9.82 188	27	0.17 812	9.92 077	8	26
35	9.74 284	19	9.82 215̇	28	0.17 785̄	9.92 069	9	25
36	9.74 303	19	9.82 243	27	0.17 757	9.92 060	8	24
37	9.74 322	19	9.82 270	28	0.17 730	9.92 052	8	23
38	9.74 341	19	9.82 298	27	0.17 702	9.92 044	9	22
39	9.74 360	19	9.82 325̇	27	0.17 675̄	9.92 035̇	8	21
40	9.74 379	19	9.82 352	28	0.17 648	9.92 027	9	**20**
41	9.74 398	19	9.82 380	27	0.17 620	9.92 018	8	19
42	9.74 417	19	9.82 407	28	0.17 593	9.92 010	8	18
43	9.74 436	19	9.82 435̄	27	0.17 565̇	9.92 002	9	17
44	9.74 455̄	19	9.82 462	27	0.17 538	9.91 993	8	16
45	9.74 474	19	9.82 489	28	0.17 511	9.91 985̄	9	15
46	9.74 493	19	9.82 517	27	0.17 483	9.91 976	8	14
47	9.74 512	19	9.82 544	27	0.17 456	9.91 968	9	13
48	9.74 531	18	9.82 571	28	0.17 429	9.91 959	8	12
49	9.74 549	19	9.82 599	27	0.17 401	9.91 951	9	11
50	9.74 568	19	9.82 626	27	0.17 374	9.91 942	8	**10**
51	9.74 587	19	9.82 653	28	0.17 347	9.91 934	9	9
52	9.74 606	19	9.82 681	27	0.17 319	9.91 925̇	8	8
53	9.74 625̄	19	9.82 708	27	0.17 292	9.91 917	9	7
54	9.74 644	18	9.82 735̇	27	0.17 265̄	9.91 908	8	6
55	9.74 662	19	9.82 762	28	0.17 238	9.91 900	9	5
56	9.74 681	19	9.82 790	27	0.17 210	9.91 891	8	4
57	9.74 700	19	9.82 817	27	0.17 183	9.91 883	9	3
58	9.74 719	18	9.82 844	27	0.17 156	9.91 874	8	2
59	9.74 737	19	9.82 871	28	0.17 129	9.91 866	9	1
60	9.74 756		9.82 899		0.17 101	9.91 857		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan	L. Sin.	d.	′

P. P.

″	**28**	**27**
1	0.5̄	0.4
2	0.9	0.9
3	1.4	1.4
4	1.9	1.8
5	2.3	2.2
6	2.8	2.7
7	3.3	3.2
8	3.7	3.6
9	4.2	4.0
10	4.7	4.5
20	9.3	9.0
30	14.0	13.5
40	18.7	18.0
50	23.3	22.5

″	**20**	**19**	**18**
1	0.3	0.3	0.3
2	0.7	0.6	0.6
3	1.0	1.0	0.9
4	1.3	1.3	1.2
5	1.7	1.6	1.5
6	2.0	1.9	1.8
7	2.3	2.2	2.1
8	2.7	2.5̇	2.4
9	3.0	2.8	2.7
10	3.3	3.2	3.0
20	6.7	6.3	6.0
30	10.0	9.5	9.0
40	13.3	12.7	12.0
50	16.7	15.8	15.0

″	**9**	**8**
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5̇
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

	$\frac{9}{28}$	$\frac{9}{27}$	$\frac{8}{27}$
0	1.6	1.5	1.7
1	4.7	4.5	5.1
2	7.8	7.5	8.4
3	10.9	10.5	11.8
4	14.0	13.5	15.2
5	17.1	16.5	18.6
6	20.2	19.5	21.9
7	23.3	22.5	25.3
8	26.4	25.5	—
9			

P. P.

123° (303°) (236°) **56°**

LOGARITHMS OF THE FUNCTIONS (Continued)

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.74 756	19	9.82 899	27	0.17 101	9.91 857	8	60
1	9.74 775	19	9.82 926	27	0.17 074	9.91 849	9	59
2	9.74 794	18	9.82 953	27	0.17 047	9.91 840	8	58
3	9.74 812	19	9.82 980	28	0.17 020	9.91 832	9	57
4	9.74 831	19	9.83 008	27	0.16 992	9.91 823	8	56
5	9.74 850	18	9.83 035	27	0.16 965	9.91 815	9	55
6	9.74 868	19	9.83 062	27	0.16 938	9.91 806	8	54
7	9.74 887	19	9.83 089	28	0.16 911	9.91 798	9	53
8	9.74 906	18	9.83 117	27	0.16 883	9.91 789	8	52
9	9.74 924	19	9.83 144	27	0.16 856	9.91 781	9	51
10	9.74 943	18	9.83 171	27	0.16 829	9.91 772	9	50
11	9.74 961	19	9.83 198	27	0.16 802	9.91 763	8	49
12	9.74 980	19	9.83 225	27	0.16 775	9.91 755	9	48
13	9.74 999	18	9.83 252	28	0.16 748	9.91 746	8	47
14	9.75 017	19	9.83 280	27	0.16 720	9.91 738	9	46
15	9.75 036	18	9.83 307	27	0.16 693	9.91 729	9	45
16	9.75 054	19	9.83 334	27	0.16 666	9.91 720	8	44
17	9.75 073	18	9.83 361	27	0.16 639	9.91 712	9	43
18	9.75 091	19	9.83 388	27	0.16 612	9.91 703	8	42
19	9.75 110	18	9.83 415	27	0.16 585	9.91 695	9	41
20	9.75 128	19	9.83 442	28	0.16 558	9.91 686	9	40
21	9.75 147	18	9.83 470	27	0.16 530	9.91 677	8	39
22	9.75 165	19	9.83 497	27	0.16 503	9.91 669	9	38
23	9.75 184	18	9.83 524	27	0.16 476	9.91 660	9	37
24	9.75 202	19	9.83 551	27	0.16 449	9.91 651	8	36
25	9.75 221	18	9.83 578	27	0.16 422	9.91 643	9	35
26	9.75 239	19	9.83 605	27	0.16 395	9.91 634	9	34
27	9.75 258	18	9.83 632	27	0.16 368	9.91 625	8	33
28	9.75 276	18	9.83 659	27	0.16 341	9.91 617	9	32
29	9.75 294	19	9.83 686	27	0.16 314	9.91 608	9	31
30	9.75 313	18	9.83 713	27	0.16 287	9.91 599	8	30
31	9.75 331	19	9.83 740	28	0.16 260	9.91 591	9	29
32	9.75 350	18	9.83 768	27	0.16 232	9.91 582	9	28
33	9.75 368	18	9.83 795	27	0.16 205	9.91 573	8	27
34	9.75 386	19	9.83 822	27	0.16 178	9.91 565	9	26
35	9.75 405	18	9.83 849	27	0.16 151	9.91 556	9	25
36	9.75 423	18	9.83 876	27	0.16 124	9.91 547	9	24
37	9.75 441	18	9.83 903	27	0.16 097	9.91 538	8	23
38	9.75 459	19	9.83 930	27	0.16 070	9.91 530	9	22
39	9.75 478	18	9.83 957	27	0.16 043	9.91 521	9	21
40	9.75 496	18	9.83 984	27	0.16 016	9.91 512	8	20
41	9.75 514	19	9.84 011	27	0.15 989	9.91 504	9	19
42	9.75 533	18	9.84 038	27	0.15 962	9.91 495	9	18
43	9.75 551	18	9.84 065	27	0.15 935	9.91 486	9	17
44	9.75 569	18	9.84 092	27	0.15 908	9.91 477	8	16
45	9.75 587	18	9.84 119	27	0.15 881	9.91 469	9	15
46	9.75 605	19	9.84 146	27	0.15 854	9.91 460	9	14
47	9.75 624	18	9.84 173	27	0.15 827	9.91 451	9	13
48	9.75 642	18	9.84 200	27	0.15 800	9.91 442	9	12
49	9.75 660	18	9.84 227	27	0.15 773	9.91 433	8	11
50	9.75 678	18	9.84 254	26	0.15 746	9.91 425	9	10
51	9.75 696	18	9.84 280	27	0.15 720	9.91 416	9	9
52	9.75 714	19	9.84 307	27	0.15 693	9.91 407	9	8
53	9.75 733	18	9.84 334	27	0.15 666	9.91 398	9	7
54	9.75 751	18	9.84 361	27	0.15 639	9.91 389	8	6
55	9.75 769	18	9.84 388	27	0.15 612	9.91 381	9	5
56	9.75 787	18	9.84 415	27	0.15 585	9.91 372	9	4
57	9.75 805	18	9.84 442	27	0.15 558	9.91 363	9	3
58	9.75 823	18	9.84 469	27	0.15 531	9.91 354	9	2
59	9.75 841	18	9.84 496	27	0.15 504	9.91 345	9	1
60	9.75 859		9.84 523		0.15 477	9.91 336		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	28	27	26
1	0.5	0.4	0.4
2	0.9	0.9	0.9
3	1.4	1.4	1.3
4	1.9	1.8	1.7
5	2.3	2.2	2.2
6	2.8	2.7	2.6
7	3.3	3.2	3.0
8	3.7	3.6	3.5
9	4.2	4.0	3.9
10	4.7	4.5	4.3
20	9.3	9.0	8.7
30	14.0	13.5	13.0
40	18.7	18.0	17.3
50	23.3	22.5	21.7

″	19	18
1	0.3	0.3
2	0.6	0.6
3	1.0	0.9
4	1.3	1.2
5	1.6	1.5
6	1.9	1.8
7	2.2	2.1
8	2.5	2.4
9	2.8	2.7
10	3.2	3.0
20	6.3	6.0
30	9.5	9.0
40	12.7	12.0
50	15.8	15.0

″	9	8
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

	9/28	8/28	8/27
0	1.6	1.8	1.7
1	4.7	5.2	5.1
2	7.8	8.8	8.4
3	10.9	12.2	11.8
4	14.0	15.8	15.2
5	17.1	19.2	18.6
6	20.2	22.8	21.9
7	23.3	26.2	25.3
8	26.4	—	—
9			

P.P.

35° (215°) (324°) 144°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.75 859	18	9.84 523	27	0.15 477	9.91 336	8	60
1	9.75 877	18	9.84 550	26	0.15 450	9.91 328	9	59
2	9.75 895	18	9.84 576	27	0.15 424	9.91 319	9	58
3	9.75 913	18	9.84 603	27	0.15 397	9.91 310	9	57
4	9.75 931	18	9.84 630	27	0.15 370	9.91 301	9	56
5	9.75 949	18	9.84 657	27	0.15 343	9.91 292	9	55
6	9.75 967	18	9.84 684	27	0.15 316	9.91 283	9	54
7	9.75 985	18	9.84 711	27	0.15 289	9.91 274	8	53
8	9.76 003	18	9.84 738	26	0.15 262	9.91 266	9	52
9	9.76 021	18	9.84 764	27	0.15 236	9.91 257	9	51
10	9.76 039	18	9.84 791	27	0.15 209	9.91 248	9	50
11	9.76 057	18	9.84 818	27	0.15 182	9.91 239	9	49
12	9.76 075	18	9.84 845	27	0.15 155	9.91 230	9	48
13	9.76 093	18	9.84 872	27	0.15 128	9.91 221	9	47
14	9.76 111	18	9.84 899	26	0.15 101	9.91 212	9	46
15	9.76 129	17	9.84 925	27	0.15 075	9.91 203	9	45
16	9.76 146	18	9.84 952	27	0.15 048	9.91 194	9	44
17	9.76 164	18	9.84 979	27	0.15 021	9.91 185	9	43
18	9.76 182	18	9.85 006	27	0.14 994	9.91 176	9	42
19	9.76 200	18	9.85 033	26	0.14 967	9.91 167	9	41
20	9.76 218	18	9.85 059	27	0.14 941	9.91 158	9	40
21	9.76 236	17	9.85 086	27	0.14 914	9.91 149	8	39
22	9.76 253	18	9.85 113	27	0.14 887	9.91 141	9	38
23	9.76 271	18	9.85 140	26	0.14 860	9.91 132	9	37
24	9.76 289	18	9.85 166	27	0.14 834	9.91 123	9	36
25	9.76 307	17	9.85 193	27	0.14 807	9.91 114	9	35
26	9.76 324	18	9.85 220	27	0.14 780	9.91 105	9	34
27	9.76 342	18	9.85 247	26	0.14 753	9.91 096	9	33
28	9.76 360	18	9.85 273	27	0.14 727	9.91 087	9	32
29	9.76 378	17	9.85 300	27	0.14 700	9.91 078	9	31
30	9.76 395	18	9.85 327	27	0.14 673	9.91 069	9	30
31	9.76 413	18	9.85 354	26	0.14 646	9.91 060	9	29
32	9.76 431	17	9.85 380	27	0.14 620	9.91 051	9	28
33	9.76 448	18	9.85 407	27	0.14 593	9.91 042	9	27
34	9.76 466	18	9.85 434	26	0.14 566	9.91 033	10	26
35	9.76 484	17	9.85 460	27	0.14 540	9.91 023	9	25
36	9.76 501	18	9.85 487	27	0.14 513	9.91 014	9	24
37	9.76 519	18	9.85 514	26	0.14 486	9.91 005	9	23
38	9.76 537	17	9.85 540	27	0.14 460	9.90 996	9	22
39	9.76 554	18	9.85 567	27	0.14 433	9.90 987	9	21
40	9.76 572	18	9.85 594	26	0.14 406	9.90 978	9	20
41	9.76 590	17	9.85 620	27	0.14 380	9.90 969	9	19
42	9.76 607	18	9.85 647	27	0.14 353	9.90 960	9	18
43	9.76 625	17	9.85 674	26	0.14 326	9.90 951	9	17
44	9.76 642	18	9.85 700	27	0.14 300	9.90 942	9	16
45	9.76 660	17	9.85 727	27	0.14 273	9.90 933	9	15
46	9.76 677	18	9.85 754	26	0.14 246	9.90 924	9	14
47	9.76 695	17	9.85 780	27	0.14 220	9.90 915	9	13
48	9.76 712	18	9.85 807	27	0.14 193	9.90 906	10	12
49	9.76 730	17	9.85 834	26	0.14 166	9.90 896	9	11
50	9.76 747	18	9.85 860	27	0.14 140	9.90 887	9	10
51	9.76 765	17	9.85 887	26	0.14 113	9.90 878	9	9
52	9.76 782	18	9.85 913	27	0.14 087	9.90 869	9	8
53	9.76 800	17	9.85 940	27	0.14 060	9.90 860	9	7
54	9.76 817	18	9.85 967	26	0.14 033	9.90 851	9	6
55	9.76 835	17	9.85 993	27	0.14 007	9.90 842	10	5
56	9.76 852	18	9.86 020	26	0.13 980	9.90 832	9	4
57	9.76 870	17	9.86 046	27	0.13 954	9.90 823	9	3
58	9.76 887	17	9.86 073	27	0.13 927	9.90 814	9	2
59	9.76 904	18	9.86 100	26	0.13 900	9.90 805	9	1
60	9.76 922		9.86 126		0.13 874	9.90 796		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P.P.

″	27	26	18
1	0.4	0.4	0.3
2	0.9	0.9	0.6
3	1.4	1.3	0.9
4	1.8	1.7	1.2
5	2.2	2.2	1.5
6	2.7	2.6	1.8
7	3.2	3.0	2.1
8	3.6	3.5	2.4
9	4.0	3.9	2.7
10	4.5	4.3	3.0
20	9.0	8.7	6.0
30	13.5	13.0	9.0
40	18.0	17.3	12.0
50	22.5	21.7	15.0

″	17	10	9	8
1	0.3	0.2	0.2	0.1
2	0.6	0.3	0.3	0.3
3	0.8	0.5	0.4	0.4
4	1.1	0.7	0.6	0.5
5	1.4	0.8	0.8	0.7
6	1.7	1.0	0.9	0.8
7	2.0	1.2	1.0	0.9
8	2.3	1.3	1.2	1.1
9	2.6	1.5	1.4	1.2
10	2.8	1.7	1.5	1.3
20	5.7	3.3	3.0	2.7
30	8.5	5.0	4.5	4.0
40	11.3	6.7	6.0	5.3
50	14.2	8.3	7.5	6.7

	$\frac{10}{27}$	$\frac{10}{26}$
0	1.4	1.3
1	4.1	3.9
2	6.8	6.5
3	9.4	9.1
4	12.2	11.7
5	14.8	14.3
6	17.6	16.9
7	20.2	19.5
8	22.9	22.1
9	25.6	24.7
10		

	$\frac{9}{27}$	$\frac{9}{26}$
0	1.5	1.4
1	4.5	4.3
2	7.5	7.2
3	10.5	10.1
4	13.5	13.0
5	16.5	15.9
6	19.5	18.8
7	22.5	21.7
8	25.5	24.6
9		

P.P.

125° (305°) (234°) 54°

LOGARITHMS OF THE FUNCTIONS (Continued)

36° (216°) (323°) 143°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.76 922	17	9.86 126	27	0.13 874	9.90 796	9	60
1	9.76 939	18	9.86 153	26	0.13 847	9.90 787	10	59
2	9.76 957	17	9.86 179	27	0.13 821	9.90 777	9	58
3	9.76 974	17	9.86 206	26	0.13 794	9.90 768	9	57
4	9.76 991	18	9.86 232	27	0.13 768	9.90 759	9	56
5	9.77 009	17	9.86 259	26	0.13 741	9.90 750	9	55
6	9.77 026	17	9.86 285	27	0.13 715	9.90 741	10	54
7	9.77 043	18	9.86 312	26	0.13 688	9.90 731	9	53
8	9.77 061	17	9.86 338	27	0.13 662	9.90 722	9	52
9	9.77 078	17	9.86 365	27	0.13 635	9.90 713	9	51
10	9.77 095	17	9.86 392	26	0.13 608	9.90 704	10	50
11	9.77 112	18	9.86 418	27	0.13 582	9.90 694	9	49
12	9.77 130	17	9.86 445	26	0.13 555	9.90 685	9	48
13	9.77 147	17	9.86 471	27	0.13 529	9.90 676	9	47
14	9.77 164	17	9.86 498	26	0.13 502	9.90 667	10	46
15	9.77 181	18	9.86 524	27	0.13 476	9.90 657	9	45
16	9.77 199	17	9.86 551	26	0.13 449	9.90 648	9	44
17	9.77 216	17	9.86 577	26	0.13 423	9.90 639	9	43
18	9.77 233	17	9.86 603	27	0.13 397	9.90 630	10	42
19	9.77 250	18	9.86 630	26	0.13 370	9.90 620	9	41
20	9.77 268	17	9.86 656	27	0.13 344	9.90 611	9	40
21	9.77 285	17	9.86 683	26	0.13 317	9.90 602	10	39
22	9.77 302	17	9.86 709	27	0.13 291	9.90 592	9	38
23	9.77 319	17	9.86 736	26	0.13 264	9.90 583	9	37
24	9.77 336	17	9.86 762	27	0.13 238	9.90 574	9	36
25	9.77 353	17	9.86 789	26	0.13 211	9.90 565	10	35
26	9.77 370	17	9.86 815	27	0.13 185	9.90 555	9	34
27	9.77 387	18	9.86 842	26	0.13 158	9.90 546	9	33
28	9.77 405	17	9.86 868	26	0.13 132	9.90 537	10	32
29	9.77 422	17	9.86 894	27	0.13 106	9.90 527	9	31
30	9.77 439	17	9.86 921	26	0.13 079	9.90 518	9	30
31	9.77 456	17	9.86 947	27	0.13 053	9.90 509	10	29
32	9.77 473	17	9.86 974	26	0.13 026	9.90 499	9	28
33	9.77 490	17	9.87 000	27	0.13 000	9.90 490	10	27
34	9.77 507	17	9.87 027	26	0.12 973	9.90 480	9	26
35	9.77 524	17	9.87 053	26	0.12 947	9 90 471	9	25
36	9.77 541	17	9.87 079	27	0.12 921	9.90 462	10	24
37	9.77 558	17	9.87 106	26	0.12 894	9.90 452	9	23
38	9.77 575	17	9.87 132	26	0.12 868	9.90 443	9	22
39	9.77 592	17	9.87 158	27	0.12 842	9.90 434	10	21
40	9.77 609	17	9.87 185	26	0.12 815	9.90 424	9	20
41	9.77 626	17	9.87 211	27	0.12 789	9.90 415	10	19
42	9.77 643	17	9.87 238	26	0.12 762	9.90 405	9	18
43	9.77 660	17	9.87 264	26	0.12 736	9.90 396	10	17
44	9.77 677	17	9.87 290	27	0.12 710	9.90 386	9	16
45	9.77 694	17	9.87 317	26	0.12 683	9.90 377	9	15
46	9.77 711	17	9.87 343	26	0.12 657	9.90 368	10	14
47	9.77 728	16	9.87 369	27	0.12 631	9.90 358	9	13
48	9.77 744	17	9.87 396	26	0.12 604	9.90 349	10	12
49	9.77 761	17	9.87 422	26	0.12 578	9.90 339	9	11
50	9.77 778	17	9.87 448	27	0.12 552	9.90 330	10	10
51	9.77 795	17	9.87 475	26	0.12 525	9.90 320	9	9
52	9.77 812	17	9.87 501	26	0.12 499	9.90 311	10	8
53	9.77 829	17	9.87 527	27	0.12 473	9.90 301	9	7
54	9.77 846	16	9.87 554	26	0.12 446	9.90 292	10	6
55	9.77 862	17	9.87 580	26	0.12 420	9.90 282	9	5
56	9.77 879	17	9.87 606	27	0.12 394	9.90 273	10	4
57	9.77 896	17	9.87 633	26	0.12 367	9.90 263	9	3
58	9.77 913	17	9.87 659	26	0.12 341	9.90 254	10	2
59	9.77 930	16	9.87 685	26	0.12 315	9.90 244	9	1
60	9.77 946		9.87 711		0.12 289	9.90 235		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	18	17	16
1	0.3	0.3	0.3
2	0.6	0.6	0.5
3	0.9	0.8	0.8
4	1.2	1.1	1.1
5	1.5	1.4	1.3
6	1.8	1.7	1.6
7	2.1	2.0	1.9
8	2.4	2.3	2.1
9	2.7	2.6	2.4
10	3.0	2.8	2.7
20	6.0	5.7	5.3
30	9.0	8.5	8.0
40	12.0	11.3	10.7
50	15.0	14.2	13.3

″	10	9
1	0.2	0.2
2	0.3	0.3
3	0.5	0.4
4	0.7	0.6
5	0.8	0.8
6	1.0	0.9
7	1.2	1.0
8	1.3	1.2
9	1.5	1.4
10	1.7	1.5
20	3.3	3.0
30	5.0	4.5
40	6.7	6.0
50	8.3	7.5

	$\frac{9}{27}$	$\frac{9}{26}$
0	1.5	1.4
1	4.5	4.3
2	7.5	7.2
3	10.5	10.1
4	13.5	13.0
5	16.5	15.9
6	19.5	18.8
7	22.5	21.7
8	25.5	24.6
9		

P. P.

126° (306°) (233°) 53°

37° (217°) (322°) 142°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.77 946	17	9.87 711	27	0.12 289	9.90 235	10	60
1	9.77 963	17	9.87 738	26	0.12 262	9.90 225	9	59
2	9.77 980	17	9.87 764	26	0.12 236	9.90 216	10	58
3	9.77 997	16	9.87 790	27	0.12 210	9.90 206	9	57
4	9.78 013	17	9.87 817	26	0.12 183	9.90 197	10	56
5	9.78 030	17	9.87 843	26	0.12 157	9.90 187	9	55
6	9.78 047	16	9.87 869	26	0.12 131	9.90 178	10	54
7	9.78 063	17	9.87 895	27	0.12 105	9.90 168	9	53
8	9.78 080	17	9.87 922	26	0.12 078	9.90 159	10	52
9	9.78 097	16	9.87 948	26	0.12 052	9.90 149	10	51
10	9.78 113	17	9.87 974	26	0.12 026	9.90 139	9	50
11	9.78 130	17	9.88 000	27	0.12 000	9.90 130	10	49
12	9.78 147	16	9.88 027	26	0.11 973	9.90 120	9	48
13	9.78 163	17	9.88 053	26	0.11 947	9.90 111	10	47
14	9.78 180	17	9.88 079	26	0.11 921	9.90 101	10	46
15	9.78 197	16	9.88 105	26	0.11 895	9.90 091	9	45
16	9.78 213	17	9.88 131	27	0.11 869	9.90 082	10	44
17	9.78 230	16	9.88 158	26	0.11 842	9.90 072	9	43
18	9.78 246	17	9.88 184	26	0.11 816	9.90 063	10	42
19	9.78 263	17	9.88 210	26	0.11 790	9.90 053	10	41
20	9.78 280	16	9.88 236	26	0.11 764	9.90 043	9	40
21	9.78 296	17	9.88 262	27	0.11 738	9.90 034	10	39
22	9.78 313	16	9.88 289	26	0.11 711	9.90 024	10	38
23	9.78 329	17	9.88 315	26	0.11 685	9.90 014	9	37
24	9.78 346	16	9.88 341	26	0.11 659	9.90 005	10	36
25	9.78 362	17	9.88 367	26	0.11 633	9.89 995	10	35
26	9.78 379	16	9.88 393	27	0.11 607	9.89 985	9	34
27	9.78 395	17	9.88 420	26	0.11 580	9.89 976	10	33
28	9.78 412	16	9.88 446	26	0.11 554	9.89 966	10	32
29	9.78 428	17	9.88 472	26	0.11 528	9.89 956	9	31
30	9.78 445	16	9.88 498	26	0.11 502	9.89 947	10	30
31	9.78 461	17	9.88 524	26	0.11 476	9.89 937	10	29
32	9.78 478	16	9.88 550	27	0.11 450	9.89 927	9	28
33	9.78 494	16	9.88 577	26	0.11 423	9.89 918	10	27
34	9.78 510	17	9.88 603	26	0.11 397	9.89 908	10	26
35	9.78 527	16	9.88 629	26	0.11 371	9.89 898	10	25
36	9.78 543	17	9.88 655	26	0.11 345	9.89 888	9	24
37	9.78 560	16	9.88 681	26	0.11 319	9.89 879	10	23
38	9.78 576	16	9.88 707	26	0.11 293	9.89 869	10	22
39	9.78 592	17	9.88 733	26	0.11 267	9.89 859	10	21
40	9.78 609	16	9.88 759	27	0.11 241	9.89 849	9	20
41	9.78 625	17	9.88 786	26	0.11 214	9.39 840	10	19
42	9.78 642	16	9.88 812	26	0.11 188	9.89 830	10	18
43	9.78 658	16	9.88 838	26	0.11 162	9.89 820	10	17
44	9.78 674	17	9.88 864	26	0.11 136	9.89 810	9	16
45	9.78 691	16	9.88 890	26	0.11 110	9.89 801	10	15
46	9.78 707	16	9.88 916	26	0.11 084	9.89 791	10	14
47	9.78 723	16	9.88 942	26	0.11 058	9.89 781	10	13
48	9.78 739	17	9.88 968	26	0.11 032	9.89 771	10	12
49	9.78 756	16	9.88 994	26	0.11 006	9.89 761	9	11
50	9.78 772	16	9.89 020	26	0.10 980	9.89 752	10	10
51	9.78 788	17	9.89 046	27	0.10 954	9.89 742	10	9
52	9.78 805	16	9.89 073	26	0.10 927	9.89 732	10	8
53	9.78 821	16	9.89 099	26	0.10 901	9.89 722	10	7
54	9.78 837	16	9.89 125	26	0.10 875	9.89 712	10	6
55	9.78 853	16	9.89 151	26	0.10 849	9.89 702	9	5
56	9.78 869	17	9.89 177	26	0.10 823	9.89 693	10	4
57	9.78 886	16	9.89 203	26	0.10 797	9.89 683	10	3
58	9.78 902	16	9.89 229	26	0.10 771	9.89 673	10	2
59	9.78 918	16	9.89 255	26	0.10 745	9.89 663	10	1
60	9.78 934		9.89 281		0.10 719	9.89 653		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	17	16
1	0.3	0.3
2	0.6	0.5
3	0.8	0.8
4	1.1	1.1
5	1.4	1.3
6	1.7	1.6
7	2.0	1.9
8	2.3	2.1
9	2.6	2.4
10	2.8	2.7
20	5.7	5.3
30	8.5	8.0
40	11.3	10.7
50	14.2	13.3

″	10	9
1	0.2	0.2
2	0.3	0.3
3	0.5	0.4
4	0.7	0.6
5	0.8	0.8
6	1.0	0.9
7	1.2	1.0
8	1.3	1.2
9	1.5	1.4
10	1.7	1.5
20	3.3	3.0
30	5.0	4.5
40	6.7	6.0
50	8.3	7.5

	$\frac{10}{27}$	$\frac{10}{26}$
0	1.4	1.3
1	4.1	3.9
2	6.8	6.5
3	9.4	9.1
4	12.2	11.7
5	14.8	14.3
6	17.6	16.9
7	20.2	19.5
8	22.9	22.1
9	25.6	24.7
10		

P. P.

127° (307°) (232°) 52°

LOGARITHMS OF THE FUNCTIONS (Continued)

38° (218°) (321°) 141°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.78 934	16	9.89 281	26	0.10 719	9.89 653	10	60
1	9.78 950	17	9.89 307	26	0.10 693	9.89 643	10	59
2	9.78 967	16	9.89 333	26	0.10 667	9.89 633	9	58
3	9.78 983	16	9.89 359	26	0.10 641	9.89 624	10	57
4	9.78 999	16	9.89 385	26	0.10 615	9.89 614	10	56
5	9.79 015	16	9.89 411	26	0.10 589	9.89 604	10	55
6	9.79 031	16	9.89 437	26	0.10 563	9.89 594	10	54
7	9.79 047	16	9.89 463	26	0.10 537	9.89 584	10	53
8	9.79 063	16	9.89 489	26	0.10 511	9.89 574	10	52
9	9.79 079	16	9.89 515	26	0.10 485	9.89 564	10	51
10	9.79 095	16	9.89 541	26	0.10 459	9.89 554	10	50
11	9.79 111	17	9.89 567	26	0.10 433	9.89 544	10	49
12	9.79 128	16	9.89 593	26	0.10 407	9.89 534	10	48
13	9.79 144	16	9.89 619	26	0.10 381	9.89 524	10	47
14	9.79 160	16	9.89 645	26	0.10 355	9.89 514	10	46
15	9.79 176	16	9.89 671	26	0.10 329	9.89 504	9	45
16	9.79 192	16	9.89 697	26	0.10 303	9.89 495	10	44
17	9.79 208	16	9.89 723	26	0.10 277	9.89 485	10	43
18	9.79 224	16	9.89 749	26	0.10 251	9.89 475	10	42
19	9.79 240	16	9.89 775	26	0.10 225	9.89 465	10	41
20	9.79 256	16	9.89 801	26	0.10 199	9.89 455	10	40
21	9.79 272	16	9.89 827	26	0.10 173	9.89 445	10	39
22	9.79 288	16	9.89 853	26	0.10 147	9.89 435	10	38
23	9.79 304	15	9.89 879	26	0.10 121	9.89 425	10	37
24	9.79 319	16	9.89 905	26	0.10 095	9.89 415	10	36
25	9.79 335	16	9.89 931	26	0.10 069	9.89 405	10	35
26	9.79 351	16	9.89 957	26	0.10 043	9.89 395	10	34
27	9.79 367	16	9.89 983	26	0.10 017	9.89 385	10	33
28	9.79 383	16	9.90 009	26	0.09 991	9.89 375	11	32
29	9.79 399	16	9.90 035	26	0.09 965	9.89 364	10	31
30	9.79 415	16	9.90 061	25	0.09 939	9.89 354	10	30
31	9.79 431	16	9.90 086	26	0.09 914	9.89 344	10	29
32	9.79 447	16	9.90 112	26	0.09 888	9.89 334	10	28
33	9.79 463	15	9.90 138	26	0.09 862	9.89 324	10	27
34	9.79 478	16	9.90 164	26	0.09 836	9.89 314	10	26
35	9.79 494	16	9.90 190	26	0.09 810	9.89 304	10	25
36	9.79 510	16	9.90 216	26	0.09 784	9.89 294	10	24
37	9.79 526	16	9.90 242	26	0.09 758	9.89 284	10	23
38	9.79 542	16	9.90 268	26	0.09 732	9.89 274	10	22
39	9.79 558	15	9.90 294	26	0.09 706	9.89 264	10	21
40	9.79 573	16	9.90 320	26	0.09 680	9.89 254	10	20
41	9.79 589	16	9.90 346	25	0.09 654	9.89 244	11	19
42	9.79 605	16	9.90 371	26	0.09 629	9.89 233	10	18
43	9.79 621	15	9.90 397	26	0.09 603	9.89 223	10	17
44	9.79 636	16	9.90 423	26	0.09 577	9.89 213	10	16
45	9.79 652	16	9.90 449	26	0.09 551	9.89 203	10	15
46	9.79 668	16	9.90 475	26	0.09 525	9.89 193	10	14
47	9.79 684	15	9.90 501	26	0.09 499	9.89 183	10	13
48	9.79 699	16	9.90 527	26	0.09 473	9.89 173	11	12
49	9.79 715	16	9.90 553	25	0.09 447	9.89 162	10	11
50	9.79 731	15	9.90 578	26	0.09 422	9.89 152	10	10
51	9.79 746	16	9.90 604	26	0.09 396	9.89 142	10	9
52	9.79 762	16	9.90 630	26	0.09 370	9.89 132	10	8
53	9.79 778	15	9.90 656	26	0.09 344	9.89 122	10	7
54	9.79 793	16	9.90 682	26	0.09 318	9.89 112	11	6
55	9.79 809	16	9.90 708	26	0.09 292	9.89 101	10	5
56	9.79 825	15	9.90 734	25	0.09 266	9.89 091	10	4
57	9.79 840	16	9.90 759	26	0.09 241	9.89 081	10	3
58	9.79 856	16	9.90 785	26	0.09 215	9.89 071	11	2
59	9.79 872	15	9.90 811	26	0.09 189	9.89 060	10	1
60	9.79 887		9.90 837		0.09 163	9.89 050		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	17	16	15
1	0.3	0.3	0.2
2	0.6	0.5	0.5
3	0.8	0.8	0.8
4	1.1	1.1	1.0
5	1.4	1.3	1.2
6	1.7	1.6	1.5
7	2.0	1.9	1.8
8	2.3	2.1	2.0
9	2.6	2.4	2.2
10	2.8	2.7	2.5
20	5.7	5.3	5.0
30	8.5	8.0	7.5
40	11.3	10.7	10.0
50	14.2	13.3	12.5

″	11	10	9
1	0.2	0.2	0.2
2	0.4	0.3	0.3
3	0.6	0.5	0.4
4	0.7	0.7	0.6
5	0.9	0.8	0.8
6	1.1	1.0	0.9
7	1.3	1.2	1.0
8	1.5	1.3	1.2
9	1.6	1.5	1.4
10	1.8	1.7	1.5
20	3.7	3.3	3.0
30	5.5	5.0	4.5
40	7.3	6.7	6.0
50	9.2	8.3	7.5

	$\frac{10}{26}$	$\frac{10}{25}$	$\frac{9}{26}$
0	1.3	1.2	1.4
1	3.9	3.8	4.3
2	6.5	6.2	7.2
3	9.1	8.8	10.1
4	11.7	11.2	13.0
5	14.3	13.8	15.9
6	16.9	16.2	18.8
7	19.5	18.8	21.7
8	22.1	21.2	24.6
9	24.7	23.8	—
10			

P. P.

128° (308°) (231°) 51°

LOGARITHMS OF THE FUNCTIONS (Continued)

39° (219°) (320°) **140°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.79 887	16	9.90 837	26	0.09 163	9.89 050	10	60
1	9.79 903	15	9.90 863	26	0.09 137	9.89 040	10	59
2	9.79 918	16	9.90 889	25	0.09 111	9.89 030	10	58
3	9.79 934	16	9.90 914	26	0.09 086	9.89 020	11	57
4	9.79 950	15	9.90 940	26	0.09 060	9.89 009	10	56
5	9.79 965	16	9.90 966	26	0.09 034	9.88 999	10	55
6	9.79 981	15	9.90 992	26	0.09 008	9.88 989	11	54
7	9.79 996	16	9.91 018	25	0.08 982	9.88 978	10	53
8	9.80 012	15	9.91 043	26	0.08 957	9.88 968	10	52
9	9.80 027	16	9.91 069	26	0.08 931	9.88 958	10	51
10	9.80 043	15	9.91 095	26	0.08 905	9.88 948	11	50
11	9.80 058	16	9.91 121	26	0.08 879	9.88 937	10	49
12	9.80 074	15	9.91 147	25	0.08 853	9.88 927	10	48
13	9.80 089	16	9.91 172	26	0.08 828	9.88 917	11	47
14	9.80 105	15	9.91 198	26	0.08 802	9.88 906	10	46
15	9.80 120	16	9.91 224	26	0.08 776	9.88 896	10	45
16	9.80 136	15	9.91 250	26	0.08 750	9.88 886	11	44
17	9.80 151	15	9.91 276	25	0.08 724	9.88 875	10	43
18	9.80 166	16	9.91 301	26	0.08 699	9.88 865	10	42
19	9.80 182	15	9.91 327	26	0.08 673	9.88 855	11	41
20	9.80 197	16	9.91 353	26	0.08 647	9.88 844	10	40
21	9.80 213	15	9.91 379	25	0.08 621	9.88 834	10	39
22	9.80 228	16	9.91 404	26	0.08 596	9.88 824	11	38
23	9.80 244	15	9.91 430	26	0.08 570	9.88 813	10	37
24	9.80 259	15	9.91 456	26	0.08 544	9.88 803	10	36
25	9.80 274	16	9.91 482	25	0.08 518	9.88 793	11	35
26	9.80 290	15	9.91 507	26	0.08 493	9.88 782	10	34
27	9.80 305	15	9.91 533	26	0.08 467	9.88 772	11	33
28	9.80 320	16	9.91 559	26	0.08 441	9.88 761	10	32
29	9.80 336	15	9.91 585	25	0.08 415	9.88 751	10	31
30	9.80 351	15	9.91 610	26	0.08 390	9.88 741	11	30
31	9.80 366	16	9.91 636	26	0.08 364	9.88 730	10	29
32	9.80 382	15	9.91 662	26	0.08 338	9.88 720	11	28
33	9.80 397	15	9.91 688	25	0.08 312	9.88 709	10	27
34	9.80 412	16	9.91 713	26	0.08 287	9.88 699	11	26
35	9.80 428	15	9.91 739	26	0.08 261	9.88 688	10	25
36	9.80 443	15	9.91 765	26	0.08 235	9.88 678	10	24
37	9.80 458	15	9.91 791	25	0.08 209	9.88 668	11	23
38	9.80 473	16	9.91 816	26	0.08 184	9.88 657	10	22
39	9.80 489	15	9.91 842	26	0.08 158	9.88 647	11	21
40	9.80 504	15	9.91 868	25	0.08 132	9.88 636	10	20
41	9.80 519	15	9.91 893	26	0.08 107	9.88 626	11	19
42	9.80 534	16	9.91 919	26	0.08 081	9.88 615	10	18
43	9.80 550	15	9.91 945	26	0.08 055	9.88 605	11	17
44	9.80 565	15	9.91 971	25	0.08 029	9.88 594	10	16
45	9.80 580	15	9.91 996	26	0.08 004	9.88 584	11	15
46	9.80 595	15	9.92 022	26	0.07 978	9.88 573	10	14
47	9.80 610	15	9.92 048	25	0.07 952	9.88 563	11	13
48	9.80 625	16	9.92 073	26	0.07 927	9.88 552	10	12
49	9.80 641	15	9.92 099	26	0.07 901	9.88 542	11	11
50	9.80 656	15	9.92 125	25	0.07 875	9.88 531	10	10
51	9.80 671	15	9.92 150	26	0.07 850	9.88 521	11	9
52	9.80 686	15	9.92 176	26	0.07 824	9.88 510	11	8
53	9.80 701	15	9.92 202	25	0.07 798	9.88 499	10	7
54	9.80 716	15	9.92 227	26	0.07 773	9.88 489	11	6
55	9.80 731	15	9.92 253	26	0.07 747	9.88 478	10	5
56	9.80 746	16	9.92 279	25	0.07 721	9.88 468	11	4
57	9.80 762	15	9.92 304	26	0.07 696	9.88 457	10	3
58	9.80 777	15	9.92 330	26	0.07 670	9.88 447	11	2
59	9.80 792	15	9.92 356	25	0.07 644	9.88 436	11	1
60	9.80 807		9.92 381		0.07 619	9.88 425		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	**16**	**15**
1	0.3	0.2
2	0.5	0.5
3	0.8	0.8
4	1.1	1.0
5	1.3	1.2
6	1.6	1.5
7	1.9	1.8
8	2.1	2.0
9	2.4	2.2
10	2.7	2.5
20	5.3	5.0
30	8.0	7.5
40	10.7	10.0
50	13.3	12.5

″	**11**	**10**
1	0.2	0.2
2	0.4	0.3
3	0.6	0.5
4	0.7	0.7
5	0.9	0.8
6	1.1	1.0
7	1.3	1.2
8	1.5	1.3
9	1.6	1.5
10	1.8	1.7
20	3.7	3.3
30	5.5	5.0
40	7.3	6.7
50	9.2	8.3

	$\frac{11}{26}$	$\frac{11}{25}$
0	1.2	1.1
1	3.5	3.4
2	5.9	5.7
3	8.3	7.9
4	10.6	10.2
5	13.0	12.5
6	15.4	14.8
7	17.7	17.1
8	20.1	19.3
9	22.5	21.6
10	24.8	23.9
11		

P. P.

129° (309°) (230°) **50°**

LOGARITHMS OF THE FUNCTIONS (Continued)

40° (220°) (319°) **139°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.80 807	15	9.92 381	26	0.07 619	9.88 425̇	10	**60**
1	9.80 822	15	9.92 407	26	0.07 593	9.88 415̄	11	59
2	9.80 837	15	9.92 433	25	0.07 567	9.88 404	10	58
3	9.80 852	15	9.92 458	26	0.07 542	9.88 394	11	57
4	9.80 867	15	9.92 484	26	0.07 516	9.88 383	11	56
5	9.80 882	15	9.92 510	25	0.07 490	9.88 372	10	55
6	9.80 897	15	9.92 535̇	26	0.07 465̄	9.88 362	11	54
7	9.80 912	15	9.92 561	26	0.07 439	9.88 351	11	53
8	9.80 927	15	9.92 587	25	0.07 413	9.88 340	10	52
9	9.80 942	15	9.92 612	26	0.07 388	9.88 330	11	51
10	9.80 957	15	9.92 638	25	0.07 362	9.88 319	11	**50**
11	9.80 972	15	9.92 663	26	0.07 337	9.88 308	10	49
12	9.80 987	15	9.92 689	26	0.07 311	9.88 298	11	48
13	9.81 002	15	9.92 715̄	25	0.07 285̇	9.88 287	11	47
14	9.81 017	15	9.92 740	26	0.07 260	9.88 276	10	46
15	9.81 032	15	9.92 766	26	0.07 234	9.88 266	11	45
16	9.81 047	14	9.92 792	25	0.07 208	9.88 255̄	11	44
17	9.81 061	15	9.92 817	26	0.07 183	9.88 244	10	43
18	9.81 076	15	9.92 843	25	0.07 157	9.88 234	11	42
19	9.81 091	15	9.92 868	26	0.07 132	9.88 223	11	41
20	9.81 106	15	9.92 894	26	0.07 106	9.88 212	11	**40**
21	9.81 121	15	9.92 920	25	0.07 080	9.88 201	10	39
22	9.81 136	15	9.92 945̇	26	0.07 055̄	9.88 191	11	38
23	9.81 151	15	9.92 971	25	0.07 029	9.88 180	11	37
24	9.81 166	14	9.92 996	26	0.07 004	9.88 169	11	36
25	9.81 180	15	9.93 022	26	0.06 978	9.88 158	10	35
26	9.81 195	15	9.93 048	25	0.06 952	9.88 148	11	34
27	9.81 210	15	9.93 073	26	0.06 927	9.88 137	11	33
28	9.81 225̄	15	9.93 099	25	0.06 901	9.88 126	11	32
29	9.81 240	14	9.93 124	26	0.06 876	9.88 115̇	10	31
30	9.81 254	15	9.93 15̄0	25	0.06 85̇0	9.88 105̄	11	**30**
31	9.81 269	15	9.93 175̇	26	0.06 825̄	9.88 094	11	29
32	9.81 284	15	9.93 201	26	0.06 799	9.88 083	11	28
33	9.81 299	15	9.93 227	25	0.06 773	9.88 072	11	27
34	9.81 314	14	9.93 252	26	0.06 748	9.88 061	10	26
35	9.81 328	15	9.93 278	25	0.06 722	9.88 051	11	25
36	9.81 343	15	9.93 303	26	0.06 697	9.88 040	11	24
37	9.81 358	14	9.93 329	25	0.06 671	9.88 029	11	23
38	9.81 372	15	9.93 354	26	0.06 646	9.88 018	11	22
39	9.81 387	15	9.93 380	26	0.06 620	9.88 007	11	21
40	9.81 402	15	9.93 406	25	0.06 594	9.87 996	11	**20**
41	9.81 417	14	9.93 431	26	0.06 569	9.87 985̇	10	19
42	9.81 431	15	9.93 457	25	0.06 543	9.87 975̄	11	18
43	9.81 446	15	9.93 482	26	0.06 518	9.87 964	11	17
44	9.81 461	14	9.93 508	25	0.06 492	9.87 953	11	16
45	9.81 475̇	15	9.93 533	26	0.06 467	9.87 942	11	15
46	9.81 490	15	9.93 559	25	0.06 441	9.87 931	11	14
47	9.81 505̄	14	9.93 584	26	0.06 416	9.87 920	11	13
48	9.81 519	15	9.93 610	26	0.06 390	9.87 909	11	12
49	9.81 534	15	9.93 636	25	0.06 364	9.87 898	11	11
50	9.81 549	14	9.93 661	26	0.06 339	9.87 887	10	**10**
51	9.81 563	15	9.93 687	25	0.06 313	9.87 877	11	9
52	9.81 578	14	9.93 712	26	0.06 288	9.87 866	11	8
53	9.81 592	15	9.93 738	25	0.06 262	9.87 855̄	11	7
54	9.81 607	15	9.93 763	26	0.06 237	9.87 844	11	6
55	9.81 622	14	9.93 789	25	0.06 211	9.87 833	11	5
56	9.81 636	15	9.93 814	26	0.06 186	9.87 822	11	4
57	9.81 651	14	9.93 840	25	0.06 160	9.87 811	11	3
58	9.81 665̇	15	9.93 865̇	26	0.06 135̄	9.87 800	11	2
59	9.81 680	14	9.93 891	25	0.06 109	9.87 789	11	1
60	9.81 694		9.93 916		0.06 084	9.87 778		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5̄	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	**15**	**14**
1	0.2	0.2
2	0.5	0.5̄
3	0.8	0.7
4	1.0	0.9
5	1.2	1.2
6	1.5	1.4
7	1.8	1.6
8	2.0	1.9
9	2.2	2.1
10	2.5	2.3
20	5.0	4.7
30	7.5	7.0
40	10.0	9.3
50	12.5	11.7

″	**11**	**10**
1	0.2	0.2
2	0.4	0.3
3	0.6	0.5
4	0.7	0.7
5	0.9	0.8
6	1.1	1.0
7	1.3	1.2
8	1.5̄	1.3
9	1.6	1.5
10	1.8	1.7
20	3.7	3.3
30	5.5	5.0
40	7.3	6.7
50	9.2	8.3

	11 **26**	**10** **26**	**10** **25**
0	1.2	1.3	1.2
1	3.5̇	3.9	3.8
2	5.9	6.5	6.2
3	8.3	9.1	8.8
4	10.6	11.7	11.2
5	13.0	14.3	13.8
6	15.4	16.9	16.2
7	17.7	19.5	18.8
8	20.1	22.1	21.2
9	22.5̄	24.7	23.8
10	24.8	—	—
11			

P. P.

130° (310°) (229°) **49°**

LOGARITHMS OF THE FUNCTIONS (Continued)

41° (221°) (318°) **138°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.81 694	15	9.93 916	26	0.06 084	9.87 778	11	**60**
1	9.81 709	14	9.93 942	25	0.06 058	9.87 767	11	59
2	9.81 723	15	9.93 967	26	0.06 033	9.87 756	11	58
3	9.81 738	14	9.93 993	25	0.06 007	9.87 745̇	11	57
4	9.81 752	15	9.94 018	26	0.05 982	9.87 734	11	56
5	9.81 767	14	9.94 044	25	0.05 956	9.87 723	11	55
6	9.81 781	15	9.94 069	26	0.05 931	9.87 712	11	54
7	9.81 796	14	9.94 095̄	25	0.05 905̇	9.87 701	11	53
8	9.81 810	15	9.94 120	26	0.05 880	9.87 690	11	52
9	9.81 825̄	14	9.94 146	25	0.05 854	9.87 679	11	51
10	9.81 839	15	9.94 171	26	0.05 829	9.87 668	11	**50**
11	9.81 854	14	9.94 197	25	0.05 803	9.87 657	11	49
12	9.81 868	14	9.94 222	26	0.05 778	9.87 646	11	48
13	9.81 882	15	9.94 248	25	0.05 752	9.87 635̄	11	47
14	9.81 897	14	9.94 273	26	0.05 727	9.87 624	11	46
15	9.81 911	15	9.94 299	25	0.05 701	9.87 613	12	45
16	9.81 926	14	9.94 324	26	0.05 676	9.87 601	11	44
17	9.81 940	15	9.94 35̄0	25	0.05 65̇0	9.87 590	11	43
18	9.81 955̄	14	9.94 375̇	26	0.05 625̄	9.87 579	11	42
19	9.81 969	14	9.94 401	25	0.05 599	9.87 568	11	41
20	9.81 983	15	9.94 426	26	0.05 574	9.87 557	11	**40**
21	9.81 998	14	9.94 452	25	0.05 548	9.87 546	11	39
22	9.82 012	14	9.94 477	26	0.05 523	9.87 535̄	11	38
23	9.82 026	15	9.94 503	25	0.05 497	9.87 524	11	37
24	9.82 041	14	9.94 528	26	0.05 472	9.87 513	12	36
25	9.82 055̄	14	9.94 554	25	0.05 446	9.87 501	11	35
26	9.82 069	15	9.94 579	25	0.05 421	9.87 490	11	34
27	9.82 084	14	9.94 604	26	0.05 396	9.87 479	11	33
28	9.82 098	14	9.94 630	25	0.05 370	9.87 468	11	32
29	9.82 112	14	9.94 655̇	26	0.05 345̄	9.87 457	11	31
30	9.82 126	15	9.94 681	25	0.05 319	9.87 446	12	**30**
31	9.82 141	14	9.94 706	26	0.05 294	9.87 434	11	29
32	9.82 155̄	14	9.94 732	25	0.05 268	9.87 423	11	28
33	9.82 169	15	9.94 757	26	0.05 243	9.87 412	11	27
34	9.82 184	14	9.94 783	25	0.05 217	9.87 401	11	26
35	9.82 198	14	9.94 808	26	0.05 192	9.87 390	12	25
36	9.82 212	14	9.94 834	25	0.05 166	9.87 378	11	24
37	9.82 226	14	9.94 859	25	0.05 141	9.87 367	11	23
38	9.82 240	15	9.94 884	26	0.05 116	9.87 356	11	22
39	9.82 255̄	14	9.94 910	25	0.05 090	9.87 345̄	11	21
40	9.82 269	14	9.94 935̇	26	0.05 065̄	9.87 334	12	**20**
41	9.82 283	14	9.94 961	25	0.05 039	9.87 322	11	19
42	9.82 297	14	9.94 986	26	0.05 014	9.87 311	11	18
43	9.82 311	15	9.95 012	25	0.04 988	9.87 300	12	17
44	9.82 326	14	9.95 037	25	0.04 963	9.87 288	11	16
45	9.82 340	14	9.95 062	26	0.04 938	9.87 277	11	15
46	9.82 354	14	9.95 088	25	0.04 912	9.87 266	11	14
47	9.82 368	14	9.95 113	26	0.04 887	9.87 255̄	12	13
48	9.82 382	14	9.95 139	25	0.04 861	9.87 243	11	12
49	9.82 396	14	9.95 164	26	0.04 836	9.87 232	11	11
50	9.82 410	14	9.95 190	25	0.04 810	9.87 221	12	**10**
51	9.82 424	15	9.95 215̇	25	0.04 785̄	9.87 209	11	9
52	9.82 439	14	9.95 240	26	0.04 760	9.87 198	11	8
53	9.82 453	14	9.95 266	25	0.04 734	9.87 187	12	7
54	9.82 467	14	9.95 291	26	0.04 709	9.87 175̇	11	6
55	9.82 481	14	9.95 317	25	0.04 683	9.87 164	11	5
56	9.82 495̄	14	9.95 342	26	0.04 658	9.87 153	12	4
57	9.82 509	14	9.95 368	25	0.04 632	9.87 141	11	3
58	9.82 523	14	9.95 393	25	0.04 607	9.87 130	11	2
59	9.82 537	14	9.95 418	26	0.04 582	9.87 119	12	1
60	9.82 551		9.95 444		0.04 556	9.87 107		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	**26**	**25**
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5̄	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	**15**	**14**
1	0.2	0.2
2	0.5	0.5̄
3	0.8	0.7
4	1.0	0.9
5	1.2	1.2
6	1.5	1.4
7	1.8	1.6
8	2.0	1.9
9	2.2	2.1
10	2.5	2.3
20	5.0	4.7
30	7.5	7.0
40	10.0	9.3
50	12.5	11.7

″	**12**	**11**
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5̄
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

	12/26	**12/25**	**11/25**
0	1.1	1.1	1.1
1	3.2	3.1	3.4
2	5.4	5.2	5.7
3	7.6	7.3	7.9
4	9.8	9.4	10.2
5	11.9	11.5̄	12.5
6	14.1	13.5̇	14.8
7	16.2	15.6	17.1
8	18.4	17.7	19.3
9	20.6	19.8	21.6
10	22.8	21.9	23.9
11	24.9	23.9	—
12			

P. P.

131° (311°) (228°) **48°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.82 551	14	9.95 444	25	0.04 556	9.87 107	11	60
1	9.82 565	14	9.95 469	26	0.04 531	9.87 096	11	59
2	9.82 579	14	9.95 495	25	0.04 505	9.87 085	12	58
3	9.82 593	14	9.95 520	25	0.04 480	9.87 073	11	57
4	9.82 607	14	9.95 545	26	0.04 455	9.87 062	12	56
5	9.82 621	14	9.95 571	25	0.04 429	9.87 050	11	55
6	9.82 635	14	9.95 596	26	0.04 404	9.87 039	11	54
7	9.82 649	14	9.95 622	25	0.04 378	9.87 028	12	53
8	9.82 663	14	9.95 647	25	0.04 353	9.87 016	11	52
9	9.82 677	14	9.95 672	26	0.04 328	9.87 005	12	51
10	9.82 691	14	9.95 698	25	0.04 302	9.86 993	11	50
11	9.82 705	14	9.95 723	25	0.04 277	9.86 982	12	49
12	9.82 719	14	9.95 748	26	0.04 252	9.86 970	11	48
13	9.82 733	14	9.95 774	25	0.04 226	9.86 959	12	47
14	9.82 747	14	9.95 799	26	0.04 201	9.86 947	11	46
15	9.82 761	14	9.95 825	25	0.04 175	9.86 936	12	45
16	9.82 775	13	9.95 850	25	0.04 150	9.86 924	11	44
17	9.82 788	14	9.95 875	26	0.04 125	9.86 913	11	43
18	9.82 802	14	9.95 901	25	0.04 099	9.86 902	12	42
19	9.82 816	14	9.95 926	26	0.04 074	9.86 890	11	41
20	9.82 830	14	9.95 952	25	0.04 048	9.86 879	12	40
21	9.82 844	14	9.95 977	25	0.04 023	9.86 867	12	39
22	9.82 858	14	9.96 002	26	0.03 998	9.86 855	11	38
23	9.82 872	13	9.96 028	25	0.03 972	9.86 844	12	37
24	9.82 885	14	9.96 053	25	0.03 947	9.86 832	11	36
25	9.82 899	14	9.96 078	26	0.03 922	9.86 821	12	35
26	9.82 913	14	9.96 104	25	0.03 896	9.86 809	11	34
27	9.82 927	14	9.96 129	26	0.03 871	9.86 798	12	33
28	9.82 941	14	9.96 155	25	0.03 845	9.86 786	11	32
29	9.82 955	13	9.96 180	25	0.03 820	9.86 775	12	31
30	9.82 968	14	9.96 205	26	0.03 795	9.86 763	11	30
31	9.82 982	14	9.96 231	25	0.03 769	9.86 752	12	29
32	9.82 996	14	9.96 256	25	0.03 744	9.86 740	12	28
33	9.83 010	13	9.96 281	26	0.03 719	9.86 728	11	27
34	9.83 023	14	9.96 307	25	0.03 693	9.86 717	12	26
35	9.83 037	14	9.96 332	25	0.03 668	9.86 705	11	25
36	9.83 051	14	9.96 357	26	0.03 643	9.86 694	12	24
37	9.83 065	13	9.96 383	25	0.03 617	9.86 682	12	23
38	9.83 078	14	9.96 408	25	0.03 592	9.86 670	11	22
39	9.83 092	14	9.96 433	26	0.03 567	9.86 659	12	21
40	9.83 106	14	9.96 459	25	0.03 541	9.86 647	12	20
41	9.83 120	13	9.96 484	26	0.03 516	9.86 635	11	19
42	9.83 133	14	9.96 510	25	0.03 490	9.86 624	12	18
43	9.83 147	14	9.96 535	25	0.03 465	9.86 612	12	17
44	9.83 161	13	9.96 560	26	0.03 440	9.86 600	11	16
45	9.83 174	14	9.96 586	25	0.03 414	9.86 589	12	15
46	9.83 188	14	9.96 611	25	0.03 389	9.86 577	12	14
47	9.83 202	13	9.96 636	26	0.03 364	9.86 565	11	13
48	9.83 215	14	9.96 662	25	0.03 338	9.86 554	12	12
49	9.83 229	13	9.96 687	25	0.03 313	9.86 542	12	11
50	9.83 242	14	9.96 712	26	0.03 288	9.86 530	12	10
51	9.83 256	14	9.96 738	25	0.03 262	9.86 518	11	9
52	9.83 270	13	9.96 763	25	0.03 237	9.86 507	12	8
53	9.83 283	14	9.96 788	26	0.03 212	9.86 495	12	7
54	9.83 297	13	9.96 814	25	0.03 186	9.86 483	11	6
55	9.83 310	14	9.96 839	25	0.03 161	9.86 472	12	5
56	9.83 324	14	9.96 864	26	0.03 136	9.86 460	12	4
57	9.83 338	13	9.96 890	25	0.03 110	9.86 448	12	3
58	9.83 351	14	9.96 915	25	0.03 085	9.86 436	11	2
59	9.83 365	13	9.96 940	26	0.03 060	9.86 425	12	1
60	9.83 378		9.96 966		0.03 034	9.86 413		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	14	13
1	0.2	0.2
2	0.5	0.4
3	0.7	0.6
4	0.9	0.9
5	1.2	1.1
6	1.4	1.3
7	1.6	1.5
8	1.9	1.7
9	2.1	2.0
10	2.3	2.2
20	4.7	4.3
30	7.0	6.5
40	9.3	8.7
50	11.7	10.8

″	12	11
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

	12 26	11 26	11 25
0	1.1	1.2	1.1
1	3.2	3.5	3.4
2	5.4	5.9	5.7
3	7.6	8.3	7.9
4	9.8	10.6	10.2
5	11.9	13.0	12.5
6	14.1	15.4	14.8
7	16.2	17.7	17.1
8	18.4	20.1	19.3
9	20.6	22.5	21.6
10	22.8	24.8	23.9
11	24.9	—	—
12			

P. P.

LOGARITHMS OF THE FUNCTIONS (Continued)

43° (223°) (316°) 136°

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.83 378	14	9.96 966	25	0.03 034	9.86 413	12	60
1	9.83 392	13	9.96 991	25	0.03 009	9.86 401	12	59
2	9.83 405	14	9.97 016	26	0.02 984	9.86 389	12	58
3	9.83 419	13	9.97 042	25	0.02 958	9.86 377	11	57
4	9.83 432	14	9.97 067	25	0.02 933	9.86 366	12	56
5	9.83 446	13	9.97 092	26	0.02 908	9.86 354	12	55
6	9.83 459	14	9.97 118	25	0.02 882	9.86 342	12	54
7	9.83 473	13	9.97 143	25	0.02 857	9.86 330	12	53
8	9.83 486	14	9.97 168	25	0.02 832	9.86 318	12	52
9	9.83 500	13	9.97 193	26	0.02 807	9.86 306	11	51
10	9.83 513	14	9.97 219	25	0.02 781	9.86 295	12	50
11	9.83 527	13	9.97 244	25	0.02 756	9.86 283	12	49
12	9.83 540	14	9.97 269	26	0.02 731	9.86 271	12	48
13	9.83 554	13	9.97 295	25	0.02 705	9.86 259	12	47
14	9.83 567	14	9.97 320	25	0.02 680	9.86 247	12	46
15	9.83 581	13	9.97 345	26	0.02 655	9.86 235	12	45
16	9.83 594	14	9.97 371	25	0.02 629	9.86 223	12	44
17	9.83 608	13	9.97 396	25	0.02 604	9.86 211	11	43
18	9.83 621	13	9.97 421	26	0.02 579	9.86 200	12	42
19	9.83 634	14	9.97 447	25	0.02 553	9.86 188	12	41
20	9.83 648	13	9.97 472	25	0.02 528	9.86 176	12	40
21	9.83 661	13	9.97 497	26	0.02 503	9.86 164	12	39
22	9.83 674	14	9.97 523	25	0.02 477	9.86 152	12	38
23	9.83 688	13	9.97 548	25	0.02 452	9.86 140	12	37
24	9.83 701	14	9.97 573	25	0.02 427	9.86 128	12	36
25	9.83 715	13	9.97 598	26	0.02 402	9.86 116	12	35
26	9.83 728	13	9.97 624	25	0.02 376	9.86 104	12	34
27	9.83 741	14	9.97 649	25	0.02 351	9.86 092	12	33
28	9.83 755	13	9.97 674	26	0.02 326	9.86 080	12	32
29	9.83 768	13	9.97 700	25	0.02 300	9.86 068	12	31
30	9.83 781	14	9.97 725	25	0.02 275	9.86 056	12	30
31	9.83 795	13	9.97 750	26	0.02 250	9.86 044	12	29
32	9.83 808	13	9.97 776	25	0.02 224	9.86 032	12	28
33	9.83 821	13	9.97 801	25	0.02 199	9.86 020	12	27
34	9.83 834	14	9.97 826	25	0.02 174	9.86 008	12	26
35	9.83 848	13	9.97 851	26	0.02 149	9.85 996	12	25
36	9.83 861	13	9.97 877	25	0.02 123	9.85 984	12	24
37	9.83 874	13	9.97 902	25	0.02 098	9.85 972	12	23
38	9.83 887	14	9.97 927	26	0.02 073	9.85 960	12	22
39	9.83 901	13	9.97 953	25	0.02 047	9.85 948	12	21
40	9.83 914	13	9.97 978	25	0.02 022	9.85 936	12	20
41	9.83 927	13	9.98 003	26	0.01 997	9.85 924	12	19
42	9.83 940	14	9.98 029	25	0.01 971	9.85 912	12	18
43	9.83 954	13	9.98 054	25	0.01 946	9.85 900	12	17
44	9.83 967	13	9.98 079	25	0.01 921	9.85 888	12	16
45	9.83 980	13	9.98 104	26	0.01 896	9.85 876	12	15
46	9.83 993	13	9.98 130	25	0.01 870	9.85 864	13	14
47	9.84 006	14	9.98 155	25	0.01 845	9.85 851	12	13
48	9.84 020	13	9.98 180	26	0.01 820	9.85 839	12	12
49	9.84 033	13	9.98 206	25	0.01 794	9.85 827	12	11
50	9.84 046	13	9.98 231	25	0.01 769	9.85 815	12	10
51	9.84 059	13	9.98 256	25	0.01 744	9.85 803	12	9
52	9.84 072	13	9.98 281	26	0.01 719	9.85 791	12	8
53	9.84 085	13	9.98 307	25	0.01 693	9.85 779	13	7
54	9.84 098	14	9.98 332	25	0.01 668	9.85 766	12	6
55	9.84 112	13	9.98 357	26	0.01 643	9.85 754	12	5
56	9.84 125	13	9.98 383	25	0.01 617	9.85 742	12	4
57	9.84 138	13	9.98 408	25	0.01 592	9.85 730	12	3
58	9.84 151	13	9.98 433	25	0.01 567	9.85 718	12	2
59	9.84 164	13	9.98 458	26	0.01 542	9.85 706	13	1
60	9.84 177		9.98 484		0.01 516	9.85 693		0
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	14	13
1	0.2	0.2
2	0.5	0.4
3	0.7	0.6
4	0.9	0.9
5	1.2	1.1
6	1.4	1.3
7	1.6	1.5
8	1.9	1.7
9	2.1	2.0
10	2.3	2.2
20	4.7	4.3
30	7.0	6.5
40	9.3	8.7
50	11.7	10.8

″	12	11
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

	$\frac{13}{26}$	$\frac{13}{25}$	$\frac{12}{25}$
0	1.0	0.9	1.1
1	3.0	2.9	3.1
2	5.0	4.8	5.2
3	7.0	6.7	7.3
4	9.0	8.7	9.4
5	11.0	10.6	11.5
6	13.0	12.5	13.5
7	15.0	14.4	15.6
8	17.0	16.3	17.7
9	19.0	18.3	19.8
10	21.0	20.2	21.9
11	23.0	22.1	23.9
12	25.0	24.1	—
13			

P. P.

133° (313°) (226°) 46°

LOGARITHMS OF THE FUNCTIONS (Continued)

44° (224°) (315°) **135°**

′	L. Sin.	d.	L. Tan.	c.d.	L. Cot.	L. Cos.	d.	′
0	9.84 177	13	9.98 484	25	0.01 516	9.85 693	12	**60**
1	9.84 190	13	9.98 509	25	0.01 491	9.85 681	12	59
2	9.84 203	13	9.98 534	26	0.01 466	9.85 669	12	58
3	9.84 216	13	9.98 560	25	0.01 440	9.85 657	12	57
4	9.84 229	13	9.98 585	25	0.01 415	9.85 645	13	56
5	9.84 242	13	9.98 610	25	0.01 390	9.85 632	12	55
6	9.84 255	14	9.98 635	26	0.01 365	9.85 620	12	54
7	9.84 269	13	9.98 661	25	0.01 339	9.85 608	12	53
8	9.84 282	13	9.98 686	25	0.01 314	9.85 596	13	52
9	9.84 295	13	9.98 711	26	0.01 289	9.85 583	12	51
10	9.84 308	13	9.98 737	25	0.01 263	9.85 571	12	**50**
11	9.84 321	13	9.98 762	25	0.01 238	9.85 559	12	49
12	9.84 334	13	9.98 787	25	0.01 213	9.85 547	13	48
13	9.84 347	13	9.98 812	26	0.01 188	9.85 534	12	47
14	9.84 360	13	9.98 838	25	0.01 162	9.85 522	12	46
15	9.84 373	12	9.98 863	25	0.01 137	9.85 510	13	45
16	9.84 385	13	9.98 888	25	0.01 112	9.85 497	12	44
17	9.84 398	13	9.98 913	26	0.01 087	9.85 485	12	43
18	9.84 411	13	9.98 939	25	0.01 061	9.85 473	13	42
19	9.84 424	13	9.98 964	25	0.01 036	9.85 460	12	41
20	9.84 437	13	9.98 989	26	0.01 011	9.85 448	12	**40**
21	9.84 450	13	9.99 015	25	0.00 985	9.85 436	13	39
22	9.84 463	13	9.99 040	25	0.00 960	9.85 423	12	38
23	9.84 476	13	9.99 065	25	0.00 935	9.85 411	12	37
24	9.84 489	13	9.99 090	26	0.00 910	9.85 399	13	36
25	9.84 502	13	9.99 116	25	0.00 884	9.85 386	12	35
26	9.84 515	13	9.99 141	25	0.00 859	9.85 374	13	34
27	9.84 528	12	9.99 166	25	0.00 834	9.85 361	12	33
28	9.84 540	13	9.99 191	26	0.00 809	9.85 349	12	32
29	9.84 553	13	9.99 217	25	0.00 783	9.85 337	13	31
30	9.84 566	13	9.99 242	25	0.00 758	9.85 324	12	**30**
31	9.84 579	13	9.99 267	26	0.00 733	9.85 312	13	29
32	9.84 592	13	9.99 293	25	0.00 707	9.85 299	12	28
33	9.84 605	13	9.99 318	25	0.00 682	9.85 287	13	27
34	9.84 618	12	9.99 343	25	0.00 657	9.85 274	12	26
35	9.84 630	13	9.99 368	26	0.00 632	9.85 262	12	25
36	9.84 643	13	9.99 394	25	0.00 606	9.85 250	13	24
37	9.84 656	13	9.99 419	25	0.00 581	9.85 237	12	23
38	9.84 669	13	9.99 444	25	0.00 556	9.85 225	13	22
39	9.84 682	12	9.99 469	26	0.00 531	9.85 212	12	21
40	9.84 694	13	9.99 495	25	0.00 505	9.85 200	13	**20**
41	9.84 707	13	9.99 520	25	0.00 480	9.85 187	12	19
42	9·84 720	13	9.99 545	25	0.00 455	9.85 175	13	18
43	9.84 733	12	9.99 570	26	0.00 430	9.85 162	12	17
44	9.84 745	13	9.99 596	25	0.00 404	9.85 150	13	16
45	9.84 758	13	9.99 621	25	0.00 379	9.85 137	12	15
46	9.84 771	13	9.99 646	26	0.00 354	9.85 125	13	14
47	9.84 784	12	9.99 672	25	0.00 328	9.85 112	12	13
48	9.84 796	13	9.99 697	25	0.00 303	9.85 100	13	12
49	9.84 809	13	9.99 722	25	0.00 278	9.85 087	13	11
50	9.84 822	13	9.99 747	26	0.00 253	9.85 074	12	**10**
51	9.84 835	12	9.99 773	25	0.00 227	9.85 062	13	9
52	9.84 847	13	9.99 798	25	0.00 202	9.85 049	12	8
53	9.84 860	13	9.99 823	25	0.00 177	9.85 037	13	7
54	9.84 873	12	9.99 848	26	0.00 152	9.85 024	12	6
55	9.84 885	13	9.99 874	25	0.00 126	9.85 012	13	5
56	9.84 898	13	9.99 899	25	0.00 101	9.84 999	13	4
57	9.84 911	12	9.99 924	25	0.00 076	9.84 986	12	3
58	9.84 923	13	9.99 949	26	0.00 051	9.84 974	13	2
59	9.84 936	13	9.99 975	25	0.00 025	9.84 961	12	1
60	9.84 949		0.00 000		0.00 000	9.84 949		**0**
′	L. Cos.	d.	L. Cot.	c.d.	L. Tan.	L. Sin.	d.	′

134° (314°) (225°) **45°**

P. P.

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	14	13	12
1	0.2	0.2	0.2
2	0.5	0.4	0.4
3	0.7	0.6	0.6
4	0.9	0.9	0.8
5	1.2	1.1	1.0
6	1.4	1.3	1.2
7	1.6	1.5	1.4
8	1.9	1.7	1.6
9	2.1	2.0	1.8
10	2.3	2.2	2.0
20	4.7	4.3	4.0
30	7.0	6.5	6.0
40	9.3	8.7	8.0
50	11.7	10.8	10.0

	13 26	13 25
0	1.0	0.9
1	3.0	2.9
2	5 0	4.8
3	7.0	6.7
4	9.0	8.7
5	11.0	10.6
6	13.0	12.5
7	15.0	14.4
8	17.0	16.3
9	19.0	18.3
10	21.0	20.2
11	23.0	22.1
12	25.0	24.1
13		

	12 26	12 25
0	1.1	1.1
1	3.2	3.1
2	5.4	5.2
3	7.6	7.3
4	9.8	9.4
5	11.9	11.5
6	14.1	13.5
7	16.2	15.6
8	18.4	17.7
9	20.6	19.8
10	22.8	21.9
11	24.9	23.9
12		

P. P.

NATURAL TRIGONOMETRIC FUNCTIONS

Values of the trigonometric functions of angles for each minute from 0–360°.

For degrees indicated at the top of the page use the column headings at the top. For degrees indicated at the bottom use the column indications at the bottom.

With degrees at the left of each block (top or bottom), use the minute column at the left and with degrees at the right of each block use the minute column at the right.

If natural trigonometric function tables are used for angle measures greater than 90° and less than 360°, appropriate signs for the functions must be supplied in accordance with the quadrant in which the angle measure belongs.

NATURAL FUNCTIONS

0° (180°) (359°) **179°**

′	Sin	Tan	Cot	Cos	′
0	.00000	.00000	———	1.0000	**60**
1	.00029	.00029	3437.7	1.0000	59
2	.00058	.00058	1718.9	1.0000	58
3	.00087	.00087	1145.9	1.0000	57
4	.00116	.00116	859.44	1.0000	56
5	.00145	.00145	687.55	1.0000	**55**
6	.00175	.00175	572.96	1.0000	54
7	.00204	.00204	491.11	1.0000	53
8	.00233	.00233	429.72	1.0000	52
9	.00262	.00262	381.97	1.0000	51
10	.00291	.00291	343.77	1.0000	**50**
11	.00320	.00320	312.52	.99999	49
12	.00349	.00349	286.48	.99999	48
13	.00378	.00378	264.44	.99999	47
14	.00407	.00407	245.55	.99999	46
15	.00436	.00436	229.18	.99999	**45**
16	.00465	.00465	214.86	.99999	44
17	.00495	.00495	202.22	.99999	43
18	.00524	.00524	190.98	.99999	42
19	.00553	.00553	180.93	.99998	41
20	.00582	.00582	171.89	.99998	**40**
21	.00611	.00611	163.70	.99998	39
22	.00640	.00640	156.26	.99998	38
23	.00669	.00669	149.47	.99998	37
24	.00698	.00698	143.24	.99998	36
25	.00727	.00727	137.51	.99997	**35**
26	.00756	.00756	132.22	.99997	34
27	.00785	.00785	127.32	.99997	33
28	.00814	.00815	122.77	.99997	32
29	.00844	.00844	118.54	.99996	31
30	.00873	.00873	114.59	.99996	**30**
31	.00902	.00902	110.89	.99996	29
32	.00931	.00931	107.43	.99996	28
33	.00960	.00960	104.17	.99995	27
34	.00989	.00989	101.11	.99995	26
35	.01018	.01018	98.218	.99995	**25**
36	.01047	.01047	95.489	.99995	24
37	.01076	.01076	92.908	.99994	23
38	.01105	.01105	90.463	.99994	22
39	.01134	.01135	88.144	.99994	21
40	.01164	.01164	85.940	.99993	**20**
41	.01193	.01193	83.844	.99993	19
42	.01222	.01222	81.847	.99993	18
43	.01251	.01251	79.943	.99992	17
44	.01280	.01280	78.126	.99992	16
45	.01309	.01309	76.390	.99991	**15**
46	.01338	.01338	74.729	.99991	14
47	.01367	.01367	73.139	.99991	13
48	.01396	.01396	71.615	.99990	12
49	.01425	.01425	70.153	.99990	11
50	.01454	.01455	68.750	.99989	**10**
51	.01483	.01484	67.402	.99989	9
52	.01513	.01513	66.105	.99989	8
53	.01542	.01542	64.858	.99988	7
54	.01571	.01571	63.657	.99988	6
55	.01600	.01600	62.499	.99987	**5**
56	.01629	.01629	61.383	.99987	4
57	.01658	.01658	60.306	.99986	3
58	.01687	.01687	59.266	.99986	2
59	.01716	.01716	58.261	.99985	1
60	.01745	.01746	57.290	.99985	**0**
′	Cos	Cot	Tan	Sin	′

90° (270°) (269°) **89°**

1° (181°) (358°) **178°**

′	Sin	Tan	Cot	Cos	′
0	.01745	.01746	57.290	.99985	**60**
1	.01774	.01775	56.351	.99984	59
2	.01803	.01804	55.442	.99984	58
3	.01832	.01833	54.561	.99983	57
4	.01862	.01862	53.709	.99983	56
5	.01891	.01891	52.882	.99982	**55**
6	.01920	.01920	52.081	.99982	54
7	.01949	.01949	51.303	.99981	53
8	.01978	.01978	50.549	.99980	52
9	.02007	.02007	49.816	.99980	51
10	.02036	.02036	49.104	.99979	**50**
11	.02065	.02066	48.312	.99979	49
12	.02094	.02095	47.740	.99978	48
13	.02123	.02124	47.085	.99977	47
14	.02152	.02153	46.449	.99977	46
15	.02181	.02182	45.829	.99976	**45**
16	.02211	.02211	45.226	.99976	44
17	.02240	.02240	44.639	.99975	43
18	.02269	.02269	44.066	.99974	42
19	.02298	.02298	43.508	.99974	41
20	.02327	.02328	42.964	.99973	**40**
21	.02356	.02357	42.433	.99972	39
22	.02385	.02386	41.916	.99972	38
23	.02414	.02415	41.411	.99971	37
24	.02443	.02444	40.917	.99970	36
25	.02472	.02473	40.436	.99969	**35**
26	.02501	.02502	39.965	.99969	34
27	.02530	.02531	39.506	.99968	33
28	.02560	.02560	39.057	.99967	32
29	.02589	.02589	38.618	.99966	31
30	.02618	.02619	38.188	.99966	**30**
31	.02647	.02648	37.769	.99965	29
32	.02676	.02677	37.358	.99964	28
33	.02705	.02706	36.956	.99963	27
34	.02734	.02735	36.563	.99963	26
35	.02763	.02764	36.178	.99962	**25**
36	.02792	.02793	35.801	.99961	24
37	.02821	.02822	35.431	.99960	23
38	.02850	.02851	35.070	.99959	22
39	.02879	.02881	34.715	.99959	21
40	.02908	.02910	34.368	.99958	**20**
41	.02938	.02939	34.027	.99957	19
42	.02967	.02968	33.694	.99956	18
43	.02996	.02997	33.366	.99955	17
44	.03025	.03026	33.045	.99954	16
45	.03054	.03055	32.730	.99953	**15**
46	.03083	.03084	32.421	.99952	14
47	.03112	.03114	32.118	.99952	13
48	.03141	.03143	31.821	.99951	12
49	.03170	.03172	31.528	.99950	11
50	.03199	.03201	31.242	.99949	**10**
51	.03228	.03230	30.960	.99948	9
52	.03257	.03259	30.683	.99947	8
53	.03286	.03288	30.412	.99946	7
54	.03316	.03317	30.145	.99945	6
55	.03345	.03346	29.882	.99944	**5**
56	.03374	.03376	29.624	.99943	4
57	.03403	.03405	29.371	.99942	3
58	.03432	.03434	29.122	.99941	2
59	.03461	.03463	28.877	.99940	1
60	.03490	.03492	28.636	.99939	**0**
′	Cos	Cot	Tan	Sin	′

91° (271°) (268°) **88°**

NATURAL FUNCTIONS (Continued)

2° (182°) (357°) **177°**

′	Sin	Tan	Cot	Cos	′
0	.03490	.03492	28.636	.99939	**60**
1	.03519	.03521	28.399	.99938	59
2	.03548	.03550	28.166	.99937	58
3	.03577	.03579	27.937	.99936	57
4	.03606	.03609	27.712	.99935	56
5	.03635	.03638	27.490	.99934	**55**
6	.03664	.03667	27.271	.99933	54
7	.03693	.03696	27.057	.99932	53
8	.03723	.03725	26.845	.99931	52
9	.03752	.03754	26.637	.99930	51
10	.03781	.03783	26.432	.99929	**50**
11	.03810	.03812	26.230	.99927	49
12	.03839	.03842	26.031	.99926	48
13	.03868	.03871	25.835	.99925	47
14	.03897	.03900	25.642	.99924	46
15	.03926	.03929	25.452	.99923	**45**
16	.03955	.03958	25.264	.99922	44
17	.03984	.03987	25.080	.99921	43
18	.04013	.04016	24.898	.99919	42
19	.04042	.04046	24.719	.99918	41
20	.04071	.04075	24.542	.99917	**40**
21	.04100	.04104	24.368	.99916	39
22	.04129	.04133	24.196	.99915	38
23	.04159	.04162	24.026	.99913	37
24	.04188	.04191	23.859	.99912	36
25	.04217	.04220	23.695	.99911	**35**
26	.04246	.04250	23.532	.99910	34
27	.04275	.04279	23.372	.99909	33
28	.04304	.04308	23.214	.99907	32
29	.04333	.04337	23.058	.99906	31
30	.04362	.04366	22.904	.99905	**30**
31	.04391	.04395	22.752	.99904	29
32	.04420	.04424	22.602	.99902	28
33	.04449	.04454	22.454	.99901	27
34	.04478	.04483	22.308	.99900	26
35	.04507	.04512	22.164	.99898	**25**
36	.04536	.04541	22.022	.99897	24
37	.04565	.04570	21.881	.99896	23
38	.04594	.04599	21.743	.99894	22
39	.04623	.04628	21.606	.99893	21
40	.04653	.04658	21.470	.99892	**20**
41	.04682	.04687	21.337	.99890	19
42	.04711	.04716	21.205	.99889	18
43	.04740	.04745	21.075	.99888	17
44	.04769	.04774	20.946	.99886	16
45	.04798	.04803	20.819	.99885	**15**
46	.04827	.04833	20.693	.99883	14
47	.04856	.04862	20.569	.99882	13
48	.04885	.04891	20.446	.99881	12
49	.04914	.04920	20.325	.99879	11
50	.04943	.04949	20.206	.99876	**10**
51	.04972	.04978	20.087	.99876	9
52	.05001	.05007	19.970	.99875	8
53	.05030	.05037	19.885	.99873	7
54	.05059	.05066	19.740	.99872	6
55	.05088	.05095	19.627	.99870	**5**
56	.05117	.05124	19.516	.99869	4
57	.05146	.05153	19.405	.99867	3
58	.05175	.05182	19.296	.99866	2
59	.05205	.05212	19.188	.99864	1
60	.05234	.05241	19.081	.99863	**0**
′	Cos	Cot	Tan	Sin	′

92° (272°) (267°) **87°**

3° (183°) (356°)**176°**

′	Sin	Tan	Cot	Cos	′
0	.05234	.05241	19.081	.99863	**60**
1	.05263	.05270	18.976	.99861	59
2	.05292	.05299	18.871	.99860	58
3	.05321	.05328	18.768	.99858	57
4	.05350	.05357	18.666	.99857	56
5	.05379	.05387	18.564	.99855	**55**
6	.05408	.05416	18.464	.99854	54
7	.05437	.05445	18.366	.99852	53
8	.05466	.05474	18.268	.99851	52
9	.05495	.05503	18.171	.99849	51
10	.05524	.05533	18.075	.99847	**50**
11	.05553	.05562	17.980	.99846	49
12	.05582	.05591	17.886	.99844	48
13	.05611	.05620	17.793	.99842	47
14	.05640	.05649	17.702	.99841	46
15	.05669	.05678	17.611	.99839	**45**
16	.05698	.05708	17.521	.99838	44
17	.05727	.05737	17.431	.99836	43
18	.05756	.05766	17.343	.99834	42
19	.05785	.05795	17.256	.99833	41
20	.05814	.05824	17.169	.99831	**40**
21	.05844	.05854	17.084	.99829	39
22	.05873	.05883	16.999	.99827	38
23	.05902	.05912	16.915	.99826	37
24	.05931	.05941	16.832	.99824	36
25	.05960	.05970	16.750	.99822	**35**
26	.05989	.05999	16.668	.99821	34
27	.06018	.06029	16.587	.99819	33
28	.06047	.06058	16.507	.99817	32
29	.06076	.06087	16.428	.99815	31
30	.06105	.06116	16.350	.99813	**30**
31	.06134	.06145	16.272	.99812	29
32	.06163	.06175	16.195	.99810	28
33	.06192	.06204	16.119	.99808	27
34	.06221	.06233	16.043	.99806	26
35	.06250	.06262	15.969	.99804	**25**
36	.06279	.06291	15.895	.99803	24
37	.06308	.06321	15.821	.99801	23
38	.06337	.06350	15.748	.99799	22
39	.06366	.06379	15.676	.99797	21
40	.06395	.06408	15.605	.99795	**20**
41	.06424	.06438	15.534	.99793	19
42	.06453	.06467	15.464	.99792	18
43	.06482	.06496	15.394	.99790	17
44	.06511	.06525	15.325	.99788	16
45	.06540	.06554	15.257	.99786	**15**
46	.06569	.06584	15.189	.99784	14
47	.06598	.06613	15.122	.99782	13
48	.06627	.06642	15.056	.99780	12
49	.06656	.06671	14.990	.99778	11
50	.06685	.06700	14.924	.99776	**10**
51	.06714	.06730	14.860	.99774	9
52	.06743	.06759	14.795	.99772	8
53	.06773	.06788	14.732	.99770	7
54	.06802	.06817	14.669	.99768	6
55	.06831	.06847	14.606	.99766	**5**
56	.06860	.06876	14.544	.99764	4
57	.06889	.06905	14.482	.99762	3
58	.06918	.06934	14.421	.99760	2
59	.06947	.06963	14.361	.99758	1
60	.06976	.06993	14.301	.99756	**0**
′	Cos	Cot	Tan	Sin	′

93° (273°) (266°) **86°**

NATURAL FUNCTIONS (Continued)

4° (184°) (355°) **175°**

′	Sin	Tan	Cot	Cos	′
0	.06976	.06993	14.301	.99756	**60**
1	.07005	.07022	14.241	.99754	59
2	.07034	.07051	14.182	.99752	58
3	.07063	.07080	14.124	.99750	57
4	.07092	.07110	14.065	.99748	56
5	.07121	.07139	14.008	.99746	**55**
6	.07150	.07168	13.951	.99744	54
7	.07179	.07197	13.894	.99742	53
8	.07208	.07227	13.838	.99740	52
9	.07237	.07256	13.782	.99738	51
10	.07266	.07285	13.727	.99736	**50**
11	.07295	.07314	13.672	.99734	49
12	.07324	.07344	13.617	.99731	48
13	.07353	.07373	13.563	.99729	47
14	.07382	.07402	13.510	.99727	46
15	.07411	.07431	13.457	.99725	**45**
16	.07440	.07461	13.404	.99723	44
17	.07469	.07490	13.352	.99721	43
18	.07498	.07519	13.300	.99719	42
19	.07527	.07548	13.248	.99716	41
20	.07556	.07578	13.197	.99714	**40**
21	.07585	.07607	13.146	.99712	39
22	.07614	.07636	13.096	.99710	38
23	.07643	.07665	13.046	.99708	37
24	.07672	.07695	12.996	.99705	36
25	.07701	.07724	12.947	.99703	**35**
26	.07730	.07753	12.898	.99701	34
27	.07759	.07782	12.850	.99699	33
28	.07788	.07812	12.801	.99696	32
29	.07817	.07841	12.754	.99694	31
30	.07846	.07870	12.706	.99692	**30**
31	.07875	.07899	12.659	.99689	29
32	.07904	.07929	12.612	.99687	28
33	.07933	.07958	12.566	.99685	27
34	.07962	.07987	12.520	.99683	26
35	.07991	.08017	12.474	.99680	**25**
36	.08020	.08046	12.429	.99678	24
37	.08049	.08075	12.384	.99676	23
38	.08078	.08104	12.339	.99673	22
39	.08107	.08134	12.295	.99671	21
40	.08136	.08163	12.251	.99668	**20**
41	.08165	.08192	12.207	.99666	19
42	.08194	.08221	12.163	.99664	18
43	.08223	.08251	12.120	.99661	17
44	.08252	.08280	12.077	.99659	16
45	.08281	.08309	12.035	.99657	**15**
46	.08310	.08339	11.992	.99654	14
47	.08339	.08368	11.950	.99652	13
48	.08368	.08397	11.909	.99649	12
49	.08397	.08427	11.867	.99647	11
50	.08426	.08456	11.826	.99644	**10**
51	.08455	.08485	11.785	.99642	9
52	.08484	.08514	11.745	.99639	8
53	.08513	.08544	11.705	.99637	7
54	.08542	.08573	11.664	.99635	6
55	.08571	.08602	11.625	.99632	**5**
56	.08600	.08632	11.585	.99630	4
57	.08629	.08661	11.546	.99627	3
58	.08658	.08690	11.507	.99625	2
59	.08687	.08720	11.468	.99622	1
60	.08716	.08749	11.430	.99619	**0**
′	Cos	Cot	Tan	Sin	′

94° (274°) (265°) **85°**

5° (185°) (354°) **174°**

′	Sin	Tan	Cot	Cos	′
0	.08716	.08749	11.430	.99619	**60**
1	.08745	.08778	11.392	.99617	59
2	.08774	.08807	11.354	.99614	58
3	.08803	.08837	11.316	.99612	57
4	.08831	.08866	11.279	.99609	56
5	.08860	.08895	11.242	.99607	**55**
6	.08889	.08925	11.205	.99604	54
7	.08918	.08954	11.168	.99602	53
8	.08947	.08983	11.132	.99599	52
9	.08976	.09013	11.095	.99596	51
10	.09005	.09042	11.059	.99594	**50**
11	.09034	.09071	11.024	.99591	49
12	.09063	.09101	10.988	.99588	48
13	.09092	.09130	10.953	.99586	47
14	.09121	.09159	10.918	.99583	46
15	.09150	.09189	10.883	.99580	**45**
16	.09179	.09218	10.848	.99578	44
17	.09208	.09247	10.814	.99575	43
18	.09237	.09277	10.780	.99572	42
19	.09266	.09306	10.746	.99570	41
20	.09295	.09335	10.712	.99567	**40**
21	.09324	.09365	10.678	.99564	39
22	.09353	.09394	10.645	.99562	38
23	.09382	.09423	10.612	.99559	37
24	.09411	.09453	10.579	.99556	36
25	.09440	.09482	10.546	.99553	**35**
26	.09469	.09511	10.514	.99551	34
27	.09498	.09541	10.481	.99548	33
28	.09527	.09570	10.449	.99545	32
29	.09556	.09600	10.417	.99542	31
30	.09585	.09629	10.385	.99540	**30**
31	.09614	.09658	10.354	.99537	29
32	.09642	.09688	10.322	.99534	28
33	.09671	.09717	10.291	.99531	27
34	.09700	.09746	10.260	.99528	26
35	.09729	.09776	10.229	.99526	**25**
36	.09758	.09805	10.199	.99523	24
37	.09787	.09834	10.168	.99520	23
38	.09816	.09864	10.138	.99517	22
39	.09845	.09893	10.108	.99514	21
40	.09874	.09923	10.078	.99511	**20**
41	.09903	.09952	10.048	.99508	19
42	.09932	.09981	10.019	.99506	18
43	.09961	.10011	9.9893	.99503	17
44	.09990	.10040	9.9601	.99500	16
45	.10019	.10069	9.9310	.99497	**15**
46	.10048	.10099	9.9021	.99494	14
47	.10077	.10128	9.8734	.99491	13
48	.10106	.10158	9.8448	.99488	12
49	.10135	.10187	9.8164	.99485	11
50	.10164	.10216	9.7882	.99482	**10**
51	.10192	.10246	9.7601	.99479	9
52	.10221	.10275	9.7322	.99476	8
53	.10250	.10305	9.7044	.99473	7
54	.10279	.10334	9.6768	.99470	6
55	.10308	.10363	9.6943	.99467	**5**
56	.10337	.10393	9.6220	.99464	4
57	.10366	.10422	9.5949	.99461	3
58	.10395	.10452	9.5679	.99458	2
59	.10424	.10481	9.5411	.99455	1
60	.10453	.10510	9.5144	.99452	**0**
′	Cos	Cot	Tan	Sin	′

95° (275°) (264°) **84°**

NATURAL FUNCTIONS (Continued)

6° (186°) (353°) **173°**

′	Sin	Tan	Cot	Cos	′
0	.10453	.10510	9.5144	.99452	**60**
1	.10482	.10540	9.4878	.99449	59
2	.10511	.10569	9.4614	.99446	58
3	.10540	.10599	9.4352	.99443	57
4	.10569	.10628	9.4090	.99440	56
5	.10597	.10657	9.3831	.99437	**55**
6	.10626	.10687	9.3572	.99434	54
7	.10655	.10716	9.3315	.99431	53
8	.10684	.10746	9.3060	.99428	52
9	.10713	.10775	9.2806	.99424	51
10	.10742	.10805	9.2553	.99421	**50**
11	.10771	.10834	9.2302	.99418	49
12	.10800	.10863	9.2052	.99415	48
13	.10829	.10893	9.1803	.99412	47
14	.10858	.10922	9.1555	.99409	56
15	.10887	.10952	9.1309	.99406	**45**
16	.10916	.10981	9.1065	.99402	44
17	.10945	.11011	9.0821	.99399	43
18	.10973	.11040	9.0579	.99396	42
19	.11002	.11070	9.0338	.99393	41
20	.11031	.11099	9.0098	.99390	**40**
21	.11060	.11128	8.9860	.99386	39
22	.11089	.11158	8.9623	.99383	38
23	.11118	.11187	8.9387	.99380	37
24	.11147	.11217	8.9152	.99377	36
25	.11176	.11246	8.8919	.99374	**35**
26	.11205	.11276	8.8686	.99370	34
27	.11234	.11305	8.8455	.99367	33
28	.11263	.11335	8.8225	.99364	32
29	.11291	.11364	8.7996	.99360	31
30	.11320	.11394	8.7769	.99357	**30**
31	.11349	.11423	8.7542	.99354	29
32	.11378	.11452	8.7317	.99351	28
33	.11407	.11482	8.7093	.99347	27
34	.11436	.11511	8.6870	.99344	26
35	.11465	.11541	8.6648	.99341	**25**
36	.11494	.11570	8.6427	.99337	24
37	.11523	.11600	8.6208	.99334	23
38	.11552	.11629	8.5989	.99331	22
39	.11580	.11659	8.5772	.99327	21
40	.11609	.11688	8.5555	.99324	**20**
41	.11638	.11718	8.5340	.99320	19
42	.11667	.11747	8.5126	.99317	18
43	.11696	.11777	8.4913	.99314	17
44	.11725	.11806	8.4701	.99310	16
45	.11754	.11836	8.4490	.99307	**15**
46	.11783	.11865	8.4280	.99303	14
47	.11812	.11895	8.4071	.99300	13
48	.11840	.11924	8.3863	.99297	12
49	.11869	.11954	8.3656	.99293	11
50	.11898	.11983	8.3450	.99290	**10**
51	.11927	.12013	8.3245	.99286	9
52	.11956	.12042	8.3041	.99283	8
53	.11985	.12072	8.2838	.99279	7
54	.12014	.12101	8.2636	.99276	6
55	.12043	.12131	8.2434	.99272	**5**
56	.12071	.12160	8.2234	.99269	4
57	.12100	.12190	8.2035	.99265	3
58	.12129	.12219	8.1837	.99262	2
59	.12158	.12249	8.1640	.99258	1
60	.12187	.12278	8.1443	.99255	**0**
′	Cos	Cot	Tan	Sin	′

96° (276°) (263°) **83°**

7° (187°) (352°) **172°**

′	Sin	Tan	Cot	Cos	′
0	.12187	.12278	8.1443	.99255	**60**
1	.12216	.12308	8.1248	.99251	59
2	.12245	.12338	8.1054	.99248	58
3	.12274	.12367	8.0860	.99244	57
4	.12302	.12397	8.0667	.99240	56
5	.12331	.12426	8.0476	.99237	**55**
6	.12360	.12456	8.0285	.99233	54
7	.12389	.12485	8.0095	.99230	53
8	.12418	.12515	7.9906	.99226	52
9	.12447	.12544	7.9718	.99222	51
10	.12476	.12574	7.9530	.99219	**50**
11	.12504	.12603	7.9344	.99215	49
12	.12533	.12633	7.9158	.99211	48
13	.12562	.12662	7.8973	.99208	47
14	.12591	.12692	7.8789	.99204	46
15	.12620	.12722	7.8606	.99200	**45**
16	.12649	.12751	7.8424	.99197	44
17	.12678	.12781	7.8243	.99193	43
18	.12706	.12810	7.8062	.99189	42
19	.12735	.12840	7.7882	.99186	41
20	.12764	.12869	7.7704	.99182	**40**
21	.12793	.12899	7.7525	.99178	39
22	.12822	.12929	7.7348	.99175	38
23	.12851	.12958	7.7171	.99171	37
24	.12880	.12988	7.6996	.99167	36
25	.12908	.13017	7.6821	.99163	**35**
26	.12937	.13047	7.6647	.99160	34
27	.12966	.13076	7.6473	.99156	33
28	.12995	.13106	7.6301	.99152	32
29	.13024	.13136	7.6129	.99148	31
30	.13053	.13165	7.5958	.99144	**30**
31	.13081	.13195	7.5787	.99141	29
32	.13110	.13224	7.5618	.99137	28
33	.13139	.13254	7.5449	.99133	27
34	.13168	.13284	7.5281	.99129	26
35	.13197	.13313	7.5113	.99125	**25**
36	.13226	.13343	7.4947	.99122	24
37	.13254	.13372	7.4781	.99118	23
38	.13283	.13402	7.4615	.99114	22
39	.13312	.13432	7.4451	.99110	21
40	.13341	.13461	7.4287	.99106	**20**
41	.13370	.13491	7.4124	.99102	19
42	.13399	.13521	7.3962	.99098	18
43	.13427	.13550	7.3800	.99094	17
44	.13456	.13580	7.3639	.99091	16
45	.13485	.13609	7.3479	.99087	**15**
46	.13514	.13639	7.3319	.99083	14
47	.13543	.13669	7.3160	.99079	13
48	.13572	.13698	7.3002	.99075	12
49	.13600	.13728	7.2844	.99071	11
50	.13629	.13758	7.2687	.99067	**10**
51	.13658	.13787	7.2531	.99063	9
52	.13687	.13817	7.2375	.99059	8
53	.13716	.13846	7.2220	.99055	7
54	.13744	.13876	7.2066	.99051	6
55	.13773	.13906	7.1912	.99047	**5**
56	.13802	.13935	7.1759	.99043	4
57	.13831	.13965	7.1607	.99039	3
58	.13860	.13995	7.1455	.99035	2
59	.13889	.14024	7.1304	.99031	1
60	.13917	.14054	7.1154	.99027	**0**
′	Cos	Cot	Tan	Sin	′

97° (277°) (262°) **82°**

8° (188°) (351°) **171°**

′	Sin	Tan	Cot	Cos	′
0	.13917	.14054	7.1154	.99027	**60**
1	.13946	.14084	7.1004	.99023	59
2	.13975	.14113	7.0855	.99019	58
3	.14004	.14143	7.0706	.99015	57
4	.14033	.14173	7.0558	.99011	56
5	.14061	.14202	7.0410	.99006	**55**
6	.14090	.14232	7.0264	.99002	54
7	.14119	.14262	7.0117	.98998	53
8	.14148	.14291	6.9972	.98994	52
9	.14177	.14321	6.9827	.98990	51
10	.14205	.14351	6.9682	.98986	**50**
11	.14234	.14381	6.9538	.98982	49
12	.14263	.14410	6.9395	.98978	48
13	.14292	.14440	6.9252	.98973	47
14	.14320	.14470	6.9110	.98969	46
15	.14349	.14499	6.8969	.98965	**45**
16	.14378	.14529	6.8828	.98961	44
17	.14407	.14559	6.8687	.98957	43
18	.14436	.14588	6.8548	.98953	42
19	.14464	.14618	6.8408	.98948	41
20	.14493	.14648	6.8269	.98944	**40**
21	.14522	.14678	6.8131	.98940	39
22	.14551	.14707	6.7994	.98936	38
23	.14580	.14737	6.7856	.98931	37
24	.14608	.14767	6.7720	.98927	36
25	.14637	.14796	6.7584	.98923	**35**
26	.14666	.14826	6.7448	.98919	34
27	.14695	.14856	6.7313	.98914	33
28	.14723	.14886	6.7179	.98910	32
29	.14752	.14915	6.7045	.98906	31
30	.14781	.14945	6.6912	.98902	**30**
31	.14810	.14975	6.6779	.98897	29
3	.14838	.15005	6.6646	.98893	28
33	.14867	.15034	6.6514	.98889	27
34	.14896	.15064	6.6383	.98884	26
35	.14925	.15094	6.6252	.98880	**25**
36	.14954	.15124	6.6122	.98876	24
37	.14982	.15153	6.5992	.98871	23
38	.15011	.15183	6.5863	.98867	22
39	.15040	.15213	6.5734	.98863	21
40	.15069	.15243	6.5606	.98858	**20**
41	.15097	.15272	6.5478	.98854	19
42	.15126	.15302	6.5350	.98849	18
43	.15155	.15332	6.5223	.98845	17
44	.15184	.15362	6.5097	.98841	16
45	.15212	.15391	6.4971	.98836	**15**
46	.15241	.15421	6.4846	.98832	14
47	.15270	.15451	6.4721	.98827	13
48	.15299	.15481	6.4596	.98823	12
49	.15327	.15511	6.4472	.98818	11
50	.15356	.15540	6.4348	.98814	**10**
51	.15385	.15570	6.4225	.98809	9
52	.15414	.15600	6.4103	.98805	8
53	.15442	.15630	6.3980	.98800	7
54	.15471	.15660	6.3859	.98796	6
55	.15500	.15689	6.3737	.98791	**5**
56	.15529	.15719	6.3617	.98787	4
57	.15557	.15749	6.3496	.98782	3
58	.15586	.15779	6.3376	.98778	2
59	.15615	.15809	6.3257	.98773	1
60	.15643	.15838	6.3138	.98769	**0**
′	Cos	Cot	Tan	Sin	′

98° (278°) (261°) **81°**

9° (189°) (350°) **170°**

′	Sin	Tan	Cot	Cos	′
0	.15643	.15838	6.3138	.98769	**60**
1	.15672	.15868	6.3019	.98764	59
2	.15701	.15898	6.2901	.98760	58
3	.15730	.15928	6.2783	.98755	57
4	.15758	.15958	6.2666	.98751	56
5	.15787	.15988	6.2549	.98746	**55**
6	.15816	.16017	6.2432	.98741	54
7	.15845	.16047	6.2316	.98737	53
8	.15873	.16077	6.2200	.98732	52
9	.15902	.16107	6.2085	.98728	51
10	.15931	.16137	6.1970	.98723	**50**
11	.15959	.16167	6.1856	.98718	49
12	.15988	.16196	6.1742	.98714	48
13	.16017	.16226	6.1628	.98709	47
14	.16046	.16256	6.1515	.98704	46
15	.16074	.16286	6.1402	.98700	**45**
16	.16103	.16316	6.1290	.98695	44
17	.16132	.16346	6.1178	.98690	43
18	.16160	.16376	6.1066	.98686	42
19	.16189	.16405	6.0955	.98681	41
20	.16218	.16435	6.0844	.98676	**40**
21	.16246	.16465	6.0734	.98671	39
22	.16275	.16495	6.0624	.98667	38
23	.16304	.16525	6.0514	.98662	37
24	.16333	.16555	6.0405	.98657	36
25	.16361	.16585	6.0296	.98652	**35**
26	.16390	.16615	6.0188	.98648	34
27	.16419	.16645	6.0080	.98643	33
28	.16447	.16674	5.9972	.98638	32
29	.16476	.16704	5.9865	.98633	31
30	.16505	.16734	5.9758	.98629	**30**
31	.16533	.16764	5.9651	.98624	29
32	.16562	.16794	5.9545	.98619	28
33	.16591	.16824	5.9439	.98614	27
34	.16620	.16854	5.9333	.98609	26
35	.16648	.16884	5.9228	.98604	**25**
36	.16677	.16914	5.9124	.98600	24
37	.16706	.16944	5.9019	.98595	23
38	.16734	.16974	5.8915	.98590	22
39	.16763	.17004	5.8811	.98585	21
40	.16792	.17033	5.8708	.98580	**20**
4	.16820	.17063	5.8605	.98575	19
42	.16849	.17093	5.8502	.98570	18
43	.16878	.17123	5.8400	.98565	17
44	.16906	.17153	5.8298	.98561	16
45	.16935	.17183	5.8197	.98556	**15**
46	.16964	.17213	5.8095	.98551	14
47	.16992	.17243	5.7994	.98546	13
48	.17021	.17273	5.7894	.98541	12
49	.17050	.17303	5.7794	.98536	11
50	.17078	.17333	5.7694	.98531	**10**
51	.17107	.17363	5.7594	.98526	9
52	.17136	.17393	5.7495	.98521	8
53	.17164	.17423	5.7396	.98516	7
54	.17193	.17453	5.7297	.98511	6
55	.17222	.17483	5.7199	.98506	**5**
56	.17250	.17513	5.7101	.98501	4
57	.17279	.17543	5.7004	.98496	3
58	.17308	.17573	5.6906	.98491	2
59	.17336	.17603	5.6809	.98486	1
60	.17365	.17633	5.6713	.98481	**0**
′	Cos	Cot	Tan	Sin	′

99° (279°) (260°) **80°**

NATURAL FUNCTIONS (Continued)

10° (190°) (349°) **169°**

′	Sin	Tan	Cot	Cos	′
0	.17365	.17633	5.6713	.98481	**60**
1	.17393	.17663	5.6617	.98476	59
2	.17422	.17693	5.6521	.98471	58
3	.17451	.17723	5.6425	.98466	57
4	.17479	.17753	5.6329	.98461	56
5	.17508	.17783	5.6234	.98455	**55**
6	.17537	.17813	5.6140	.98450	54
7	.17565	.17843	5.6045	.98445	53
8	.17594	.17873	5.5951	.98440	52
9	.17623	.17903	5.5857	.98435	51
10	.17651	.17933	5.5764	.98430	**50**
11	.17680	.17963	5.5671	.98425	49
12	.17708	.17993	5.5578	.98420	48
13	.17737	.18023	5.5485	.98414	47
14	.17766	.18053	5.5393	.98409	46
15	.17794	.18083	5.5301	.98404	**45**
16	.17823	.18113	5.5209	.98399	44
17	.17852	.18143	5.5118	.98394	43
18	.17880	.18173	5.5026	.98389	42
19	.17909	.18203	5.4936	.98383	41
20	.17937	.18233	5.4845	.98378	**40**
21	.17966	.18263	5.4755	.98373	39
22	.17995	.18293	5.4665	.98368	38
23	.18023	.18323	5.4575	.98362	37
24	.18052	.18353	5.4486	.98357	36
25	.18081	.18384	5.4397	.98352	**35**
26	.18109	.18414	5.4308	.98347	34
27	.18138	.18444	5.4219	.98341	33
28	.18166	.18474	5.4131	.98336	32
29	.18195	.18504	5.4043	.98331	31
30	.18224	.18534	5.3955	.98325	**30**
31	.18252	.18564	5.3868	.98320	29
32	.18281	.18594	5.3781	.98315	28
33	.18309	.18624	5.3694	.98310	27
34	.18338	.18654	5.3607	.98304	26
35	.18367	.18684	5.3521	.98299	**25**
36	.18395	.18714	5.3435	.98294	24
37	.18424	.18745	5.3349	.98288	23
38	.18452	.18775	5.3263	.98283	22
39	.18481	.18805	5.3178	.98277	21
40	.18509	.18835	5.3093	.98272	**20**
41	.18538	.18865	5.3008	.98267	19
42	.18567	.18895	5.2924	.98261	18
43	.18595	.18925	5.2839	.98256	17
44	.18624	.18955	5.2755	.98250	16
45	.18652	.18986	5.2672	.98245	**15**
46	.18681	.19016	5.2588	.98240	14
47	.18710	.19046	5.2505	.98234	13
48	.18738	.19076	5.2422	.98229	12
49	.18767	.19106	5.2339	.98223	11
50	.18795	.19136	5.2257	.98218	**10**
51	.18824	.19166	5.2174	.98212	9
52	.18852	.19197	5.2092	.98207	8
53	.18881	.19227	5.2011	.98201	7
54	.18910	.19257	5.1929	.98196	6
55	.18938	.19287	5.1848	.98190	**5**
56	.18967	.19317	5.1767	.98185	4
57	.18995	.19347	5.1686	.98179	3
58	.19024	.19378	5.1606	.98174	2
59	.19052	.19408	5.1526	.98168	1
60	.19081	.19438	5.1446	.98163	**0**
′	Cos	Cot	Tan	Sin	′

100° (280°) (259°) **79°**

11° (191°) (348°) **168°**

′	Sin	Tan	Cot	Cos	
0	.19081	.19438	5.1446	.98163	[illegible]
1	.19109	.19468	5.1366	.98157	[illegible]
2	.19138	.19498	5.1286	.98152	58
3	.19167	.19529	5.1207	.98146	57
4	.19195	.19559	5.1128	.98140	56
5	.19224	.19589	5.1049	.98135	**55**
6	.19252	.19619	5.0970	.98129	54
7	.19281	.19649	5.0892	.98124	53
8	.19309	.19680	5.0814	.98118	52
9	.19338	.19710	5.0736	.98112	51
10	.19366	.19740	5.0658	.98107	**50**
11	.19395	.19770	5.0581	.98101	49
12	.19423	.19801	5.0504	.98096	48
13	.19452	.19831	5.0427	.98090	47
14	.19481	.19861	5.0350	.98084	46
15	.19509	.19891	5.0273	.98079	**45**
16	.19538	.19921	5.0197	.98073	44
17	.19566	.19952	5.0121	.98067	43
18	.19595	.19982	5.0045	.98061	42
19	.19623	.20012	4.9969	.98056	41
20	.19652	.20042	4.9894	.98050	**40**
21	.19680	.20073	4.9819	.98044	39
22	.19709	.20103	4.9744	.98039	38
23	.19737	.20133	4.9669	.98033	37
24	.19766	.20164	4.9594	.98027	36
25	.19794	.20194	4.9520	.98021	**35**
26	.19823	.20224	4.9446	.98016	34
27	.19851	.20254	4.9372	.98010	33
28	.19880	.20285	4.9298	.98004	32
29	.19908	.20315	4.9225	.97998	31
30	.19937	.20345	4.9152	.97992	**30**
31	.19965	.20376	4.9078	.97987	29
32	.19994	.20406	4.9006	.97981	28
33	.20022	.20436	4.8933	.97975	27
34	.20051	.20466	4.8860	.97969	26
35	.20079	.20497	4.8788	.97963	**25**
36	.20108	.20527	4.8716	.97958	24
37	.20136	.20557	4.8644	.97952	23
38	.20165	.20588	4.8573	.97946	22
39	.20193	.20618	4.8501	.97940	21
40	.20222	.20648	4.8430	.97934	**20**
41	.20250	.20679	4.8359	.97938	19
42	.20279	.20709	4.8288	.97922	18
43	.20307	.20739	4.8218	.97916	17
44	.20336	.20770	4.8147	.97910	16
45	.20364	.20800	4.8077	.97905	**15**
46	.20393	.20830	4.8007	.97899	4
47	.20421	.20861	4.7937	.97893	3
48	.20450	.20891	4.7867	.97887	2
49	.20478	.20921	4.7798	.97881	11
50	.20507	.20952	4.7729	.97875	**10**
51	.20535	.20982	4.7659	.97869	9
52	.20563	.21013	4.7591	.97863	8
53	.20592	.21043	4.7522	.97857	7
54	.20620	.21073	4.7453	.97851	6
55	.20649	.21104	4.7385	.97845	**5**
56	.20677	.21134	4.7317	.97839	4
57	.20706	.21164	4.7249	.97833	3
58	.20734	.21195	4.7181	.97827	2
59	.20763	.21225	4.7114	.97821	1
60	.20791	.21256	4.7046	.97815	**0**
′	Cos	Cot	Tan	Sin	′

101° (281°) (258°) **78°**

NATURAL FUNCTIONS (Continued)

12° (192°) (347°) **167°**

′	Sin	Tan	Cot	Cos	′
0	.20791	.21256	4.7046	.97815	**60**
1	.20820	.21286	4.6979	.97809	59
2	.20848	.21316	4.6912	.97803	58
3	.20877	.21347	4.6845	.97797	57
4	.20905	.21377	4.6779	.97791	56
5	.20933	.21408	4.6712	.97784	**55**
6	.20962	.21438	4.6646	.97778	54
7	.20990	.21469	4.6580	.97772	53
8	.21019	.21499	4.6514	.97766	52
9	.21047	.21529	4.6448	.97760	51
10	.21076	.21560	4.6382	.97754	**50**
11	.21104	.21590	4.6317	.97748	49
12	.21132	.21621	4.6252	.97742	48
13	.21161	.21651	4.6187	.97735	47
14	.21189	.21682	4.6122	.97729	46
15	.21218	.21712	4.6057	.97723	**45**
16	.21246	.21743	4.5993	.97717	44
17	.21275	.21773	4.5928	.97711	43
18	.21303	.21804	4.5864	.97705	42
19	.21331	.21834	4.5800	.97698	41
20	.21360	.21864	4.5736	.97692	**40**
21	.21388	.21895	4.5673	.97686	39
22	.21417	.21925	4.5609	.97680	38
23	.21445	.21956	4.5546	.97673	37
24	.21474	.21986	4.5483	.97667	36
25	.21502	.22017	4.5420	.97661	**35**
26	.21530	.22047	4.5357	.97655	34
27	.21559	.22078	4.5294	.97648	33
28	.21587	.22108	4.5232	.97642	32
29	.21616	.22139	4.5169	.97636	31
30	.21644	.22169	4.5107	.97630	**30**
31	.21672	.22200	4.5045	.97623	29
32	.21701	.22231	4.4983	.97617	28
33	.21729	.22261	4.4922	.97611	27
34	.21758	.22292	4.4860	.97604	26
35	.21786	.22322	4.4799	.97598	**25**
36	.21814	.22353	4.4737	.97592	24
37	.21843	.22383	4.4676	.97585	23
38	.21871	.22414	4.4615	.97579	22
39	.21899	.22444	4.4555	.97573	21
40	.21928	.22475	4.4494	.97566	**20**
41	.21956	.22505	4.4434	.97560	19
42	.21985	.22536	4.4373	.97553	18
43	.22013	.22567	4.4313	.97547	17
44	.22041	.22597	4.4253	.97541	16
45	.22070	.22628	4.4194	.97534	**15**
46	.22098	.22658	4.4134	.97528	14
47	.22126	.22689	4.4075	.97521	13
48	.22155	.22719	4.4015	.97515	12
49	.22183	.22750	4.3956	.97508	11
50	.22212	.22781	4.3897	.97502	**10**
51	.22240	.22811	4.3838	.97496	9
52	.22268	.22842	4.3779	.97489	8
53	.22297	.22872	4.3721	.97483	7
54	.22325	.22903	4.3662	.97476	6
55	.22353	.22934	4.3604	.97470	**5**
56	.22382	.22964	4.3546	.97463	4
57	.22410	.22995	4.3488	.97457	3
58	.22438	.23026	4.3430	.97450	2
59	.22467	.23056	4.3372	.97444	1
60	.22495	.23087	4.3315	.97437	**0**
′	Cos	Cot	Tan	Sin	′

102° (282°) (257°) **77°**

13° (193°) (346°) **166°**

′	Sin	Tan	Cot	Cos	′
0	.22495	.23087	4.3315	.97437	**60**
1	.22523	.23117	4.3257	.97430	59
2	.22552	.23148	4.3200	.97424	58
3	.22580	.23179	4.3143	.97417	57
4	.22608	.23209	4.3086	.97411	56
5	.22637	.23240	4.3029	.97404	**55**
6	.22665	.23271	4.2972	.97398	54
7	.22693	.23301	4.2916	.97391	53
8	.22722	.23332	4.2859	.97384	52
9	.22750	.23363	4.2803	.97378	51
10	.22778	.23393	4.2747	.97371	**50**
11	.22807	.23424	4.2691	.97365	49
12	.22835	.23455	4.2635	.97358	48
13	.22863	.23485	4.2580	.97351	47
14	.22892	.23516	4.2524	.97345	46
15	.22920	.23547	4.2468	.97338	**45**
16	.22948	.23578	4.2413	.97331	44
17	.22977	.23608	4.2358	.97325	43
18	.23005	.23639	4.2303	.97318	42
19	.23033	.23670	4.2248	.97311	41
20	.23062	.23700	4.2193	.97304	**40**
21	.23090	.23731	4.2139	.97298	39
22	.23118	.23762	4.2084	.97291	38
23	.23146	.23793	4.2030	.97284	37
24	.23175	.23823	4.1976	.97278	36
25	.23203	.23854	4.1922	.97271	**35**
26	.23231	.23885	4.1868	.97264	34
27	.23260	.23916	4.1814	.97257	33
28	.23288	.23946	4.1760	.97251	32
29	.23316	.23977	4.1706	.97244	31
30	.23345	.24008	4.1653	.97237	**30**
31	.23373	.24039	4.1600	.97230	29
32	.23401	.24069	4.1547	.97223	28
33	.23429	.24100	4.1493	.97217	27
34	.23458	.24131	4.1441	.97210	26
35	.23486	.24162	4.1388	.97203	**25**
36	.23514	.24193	4.1335	.97196	24
37	.23542	.24223	4.1282	.97189	23
38	.23571	.24254	4.1230	.97182	22
39	.23599	.24285	4.1178	.97176	21
40	.23627	.24316	4.1126	.97169	**20**
41	.23656	.24347	4.1074	.97162	19
42	.23684	.24377	4.1022	.97155	18
43	.23712	.24408	4.0970	.97148	17
44	.23740	.24439	4.0918	.97141	16
45	.23769	.24470	4.0867	.97134	**15**
46	.23797	.24501	4.0815	.97127	14
47	.23825	.24532	4.0764	.97120	13
48	.23853	.24562	4.0713	.97113	12
49	.23882	.24593	4.0662	.97106	11
50	.23910	.24624	4.0611	.97100	**10**
51	.23938	.24655	4.0560	.97093	9
52	.23966	.24686	4.0509	.97086	8
53	.23995	.24717	4.0459	.97079	7
54	.24023	.24747	4.0408	.97072	6
55	.24051	.24778	4.0358	.97065	**5**
56	.24079	.24809	4.0308	.97058	4
57	.24108	.24840	4.0257	.97051	3
58	.24136	.24871	4.0207	.97044	2
59	.24164	.24902	4.0158	.97037	1
60	.24192	.24933	4.0108	.97030	**0**
′	Cos	Cot	Tan	Sin	′

103° (283°) (256°) **76°**

NATURAL FUNCTIONS (Continued)

14° (194°) (345°) **165°**

′	Sin	Tan	Cot	Cos	′
0	.24192	.24933	4.0108	.97030	**60**
1	.24220	.24964	4.0058	.97023	59
2	.24249	.24995	4.0009	.97015	58
3	.24277	.25026	3.9959	.97008	57
4	.24305	.25056	3.9910	.97001	56
5	.24333	.25087	3.9861	.96994	**55**
6	.24362	.25118	3.9812	.96987	54
7	.24390	.25149	3.9763	.96980	53
8	.24418	.25180	3.9714	.96973	52
9	.24446	.25211	3.9665	.96966	51
10	.24474	.25242	3.9617	.96959	**50**
11	.24503	.25273	3.9568	.96952	49
12	.24531	.25304	3.9520	.96945	48
13	.24559	.25335	3.9471	.96937	47
14	.24587	.25366	3.9423	.96930	46
15	.24615	.25397	3.9375	.96923	**45**
16	.24644	.25428	3.9327	.96916	44
17	.24672	.25459	3.9279	.96909	43
18	.24700	.25490	3.9232	.96902	42
19	.24728	.25521	3.9184	.96894	41
20	.24756	.25552	3.9136	.96887	**40**
21	.24784	.25583	3.9089	.96880	39
22	.24813	.25614	3.9042	.96873	38
23	.24841	.25645	3.8995	.96866	37
24	.24869	.25676	3.8947	.96858	36
25	.24897	.25707	3.8900	.96851	**35**
26	.24925	.25738	3.8854	.96844	34
27	.24954	.25769	3.8807	.96837	33
28	.24982	.25800	3.8760	.96829	32
29	.25010	.25831	3.8714	.96822	31
30	.25038	.25862	3.8667	.96815	**30**
31	.25066	.25893	3.8621	.96807	29
32	.25094	.25924	3.8575	.96800	28
33	.25122	.25955	3.8528	.96793	27
34	.25151	.25986	3.8482	.96786	26
35	.25179	.26017	3.8436	.96778	**25**
36	.25207	.26048	3.8391	.96771	24
37	.25235	.26079	3.8345	.96764	23
38	.25263	.26110	3.8299	.96756	22
39	.25291	.26141	3.8254	.96749	21
40	.25320	.26172	3.8208	.96742	**20**
41	.25348	.26203	3.8163	.96734	19
42	.25376	.26235	3.8118	.96727	18
43	.25404	.26266	3.8073	.96719	17
44	.25432	.26297	3.8028	.96712	16
45	.25460	.26328	3.7983	.96705	**15**
46	.25488	.26359	3.7938	.96697	14
47	.25516	.26390	3.7893	.96690	13
48	.25545	.26421	3.7848	.96682	12
49	.25573	.26452	3.7804	.96675	11
50	.25601	.26483	3.7760	.96667	**10**
51	.25629	.26515	3.7715	.96660	9
52	.25657	.26546	3.7671	.96653	8
53	.25685	.26577	3.7627	.96645	7
54	.25713	.26608	3.7583	.96638	6
55	.25741	.26639	3.7539	.96630	**5**
56	.25769	.26670	3.7495	.96623	4
57	.25798	.26701	3.7451	.96615	3
58	.25826	.26733	3.7408	.96608	2
59	.25854	.26764	3.7364	.96600	1
60	.25882	.26795	3.7321	.96593	**0**
′	Cos	Cot	Tan	Sin	′

104° (284°) (255°) **75°**

15° (195°) (344°) **164°**

′	Sin	Tan	Cot	Cos	′
0	.25882	.26795	3.7321	.96593	**60**
1	.25910	.26826	3.7277	.96585	59
2	.25938	.26857	3.7234	.96578	58
3	.25966	.26888	3.7191	.96570	57
4	.25994	.26920	3.7148	.96562	56
5	.26022	.26951	3.7105	.96555	**55**
6	.26050	.26982	3.7062	.96547	54
7	.26079	.27013	3.7019	.96540	53
8	.26107	.27044	3.6976	.96532	52
9	.26135	.27076	3.6933	.96524	51
10	.26163	.27107	3.6891	.96517	**50**
11	.26191	.27138	3.6848	.96509	49
12	.26219	.27169	3.6806	.96502	48
13	.26247	.27201	3.6764	.96494	47
14	.26275	.27232	3.6722	.96486	46
15	.26303	.27263	3.6680	.96479	**45**
16	.26331	.27294	3.6638	.96471	44
17	.26359	.27326	3.6596	.96463	43
18	.26387	.27357	3.6554	.96456	42
19	.26415	.27388	3.6512	.96448	41
20	.26443	.27419	3.6470	.96440	**40**
21	.26471	.27451	3.6429	.96433	39
22	.26500	.27482	3.6387	.96425	38
23	.26528	.27513	3.6346	.96417	37
24	.26556	.27545	3.6305	.96410	36
25	.26584	.27576	3.6264	.96402	**35**
26	.26612	.27607	3.6222	.96394	34
27	.26640	.27638	3.6181	.96386	33
28	.26668	.27670	3.6140	.96379	32
29	.26696	.27701	3.6100	.96371	31
30	.26724	.27732	3.6059	.96363	**30**
31	.26752	.27764	3.6018	.96355	29
32	.26780	.27795	3.5978	.96347	28
33	.26808	.27826	3.5937	.96340	27
34	.26836	.27858	3.5897	.96332	26
35	.26864	.27889	3.5856	.96324	**25**
36	.26892	.27921	3.5816	.96316	24
37	.26920	.27952	3.5776	.96308	23
38	.26948	.27983	3.5736	.96301	22
39	.26976	.28015	3.5696	.96293	21
40	.27004	.28046	3.5656	.96285	**20**
41	.27032	.28077	3.5616	.96277	19
42	.27060	.28109	3.5576	.96269	18
43	.27088	.28140	3.5536	.96261	17
44	.27116	.28172	3.5497	.96253	16
45	.27144	.28203	3.5457	.96246	**15**
46	.27172	.28234	3.5418	.96238	14
47	.27200	.28266	3.5379	.96230	13
48	.27228	.28297	3.5339	.96222	12
49	.27256	.28329	3.5300	.96214	11
50	.27284	.28360	3.5261	.96206	**10**
51	.27312	.28391	3.5222	.96198	9
52	.27340	.28423	3.5183	.96190	8
53	.27368	.28454	3.5144	.96182	7
54	.27396	.28486	3.5105	.96174	6
55	.27424	.28517	3.5067	.96166	**5**
56	.27452	.28549	3.5028	.96158	4
57	.27480	.28580	3.4989	.96150	3
58	.27508	.28612	3.4951	.96142	2
59	.27536	.28643	3.4912	.96134	1
60	.27564	.28675	3.4874	.96126	**0**
′	Cos	Cot	Tan	Sin	′

105° (285°) (254°) **74°**

NATURAL FUNCTIONS (Continued)

16° (196°) (343°) **163°**

′	Sin	Tan	Cot	Cos	′
0	.27564	.28675	3.4874	.96126	**60**
1	.27592	.28706	3.4836	.96118	59
2	.27620	.28738	3.4798	.96110	58
3	.27648	.28769	3.4760	.96102	57
4	.27676	.28801	3.4722	.96094	56
5	.27704	.28832	3.4684	.96086	**55**
6	.27731	.28864	3.4646	.96078	54
7	.27759	.28895	3.4608	.96070	53
8	.27787	.28927	3.4570	.96062	52
9	.27815	.28958	3.4533	.96054	51
10	.27843	.28990	3.4495	.96046	**50**
11	.27871	.29021	3.4458	.96037	49
12	.27899	.29053	3.4420	.96029	48
13	.27927	.29084	3.4383	.96021	47
14	.27955	.29116	3.4346	.96013	46
15	.27983	.29147	3.4308	.96005	**45**
16	.28011	.29179	3.4271	.95997	44
17	.28039	.29210	3.4234	.95989	43
18	.28067	.29242	3.4197	.95981	42
19	.28095	.29274	3.4160	.95972	41
20	.28123	.29305	3.4124	.95964	**40**
21	.28150	.29337	3.4087	.95956	39
22	.28178	.29368	3.4050	.95948	38
23	.28206	.29400	3.4014	.95940	37
24	.28234	.29432	3.3977	.95931	36
25	.28262	.29463	3.3941	.95923	**35**
26	.28290	.29495	3.3904	.95915	34
27	.28318	.29526	3.3868	.95907	33
28	.28346	.29558	3.3832	.95898	32
29	.28374	.29590	3.3796	.95890	31
30	.28402	.29621	3.3759	.95882	**30**
31	.28429	.29653	3.3723	.95874	29
32	.28457	.29685	3.3687	.95865	28
33	.28485	.29716	3.3652	.95857	27
34	.28513	.29748	3.3616	.95849	26
35	.28541	.29780	3.3580	.95841	**25**
36	.28569	.29811	3.3544	.95832	24
37	.28597	.29843	3.3509	.95824	23
38	.28625	.29875	3.3473	.95816	22
39	.28652	.29906	3.3438	.95807	21
40	.28680	.29938	3.3402	.95799	**20**
41	.28708	.29970	3.3367	.95791	19
42	.28736	.30001	3.3332	.95782	18
43	.28764	.30033	3.3297	.95774	17
44	.28792	.30065	3.3261	.95766	16
45	.28820	.30097	3.3226	.95757	**15**
46	.28847	.30128	3.3191	.95749	14
47	.28875	.30160	3.3156	.95740	13
48	.28903	.30192	3.3122	.95732	12
49	.28931	.30224	3.3087	.95724	11
50	.28959	.30255	3.3052	.95715	**10**
51	.28987	.30287	3.3017	.95707	9
52	.29015	.30319	3.2983	.95698	8
53	.29042	.30351	3.2948	.95690	7
54	.29070	.30382	3.2914	.95681	6
55	.29098	.30414	3.2879	.95673	**5**
56	.29126	.30446	3.2845	.95664	4
57	.29154	.30478	3.2811	.95656	3
58	.29182	.30509	3.2777	.95647	2
59	.29209	.30541	3.2743	.95639	1
60	.29237	.30573	3.2709	.95630	**0**
′	Cos	Cot	Tan	Sin	′

106° (286°) (253°) **73°**

17° (197°) (342°) **162°**

′	Sin	Tan	Cot	Cos	′
0	.29237	.30573	3.2709	.95630	**60**
1	.29265	.30605	3.2675	.95622	59
2	.29293	.30637	3.2641	.95613	58
3	.29321	.30669	3.2607	.95605	57
4	.29348	.30700	3.2573	.95596	56
5	.29376	.30732	3.2539	.95588	**55**
6	.29404	.30764	3.2506	.95579	54
7	.29432	.30796	3.2472	.95571	53
8	.29460	.30828	3.2438	.95562	52
9	.29487	.30860	3.2405	.95554	51
10	.29515	.30891	3.2371	.95545	**50**
11	.29543	.30923	3.2338	.95536	49
12	.29571	.30955	3.2305	.95528	48
13	.29599	.30987	3.2272	.95519	47
14	.29626	.31019	3.2238	.95511	46
15	.29654	.31051	3.2205	.95502	**45**
16	.29682	.31083	3.2172	.95493	44
17	.29710	.31115	3.2139	.95485	43
18	.29737	.31147	3.2106	.95476	42
19	.29765	.31178	3.2073	.95467	41
20	.29793	.31210	3.2041	.95459	**40**
21	.29821	.31242	3.2008	.95450	39
22	.29849	.31274	3.1975	.95441	38
23	.29876	.31306	3.1943	.95433	37
24	.29904	.31338	3.1910	.95424	36
25	.29932	.31370	3.1878	.95415	**35**
26	.29960	.31402	3.1845	.95407	34
27	.29987	.31434	3.1813	.95398	33
28	.30015	.31466	3.1780	.95389	32
29	.30043	.31498	3.1748	.95380	31
30	.30071	.31530	3.1716	.95372	**30**
31	.30098	.31562	3.1684	.95363	29
32	.30126	.31594	3.1652	.95354	28
33	.30154	.31626	3.1620	.95345	27
34	.30182	.31658	3.1588	.95337	26
35	.30209	.31690	3.1556	.95328	**25**
36	.30237	.31722	3.1524	.95319	24
37	.30265	.31754	3.1492	.95310	23
38	.30292	.31786	3.1460	.95301	22
39	.30320	.31818	3.1429	.95293	21
40	.30348	.31850	3.1397	.95284	**20**
41	.30376	.31882	3.1366	.95275	19
42	.30403	.31914	3.1334	.95266	18
43	.30431	.31946	3.1303	.95257	17
44	.30459	.31978	3.1271	.95248	16
45	.30486	.32010	3.1240	.95240	**15**
46	.30514	.32042	3.1209	.95231	14
47	.30542	.32074	3.1178	.95222	13
48	.30570	.32106	3.1146	.95213	12
49	.30597	.32139	3.1115	.95204	11
50	.30625	.32171	3.1084	.95195	**10**
51	.30653	.32203	3.1053	.95186	9
52	.30680	.32235	3.1022	.95177	8
53	.30708	.32267	3.0991	.95168	7
54	.30736	.32299	3.0961	.95159	6
55	.30763	.32331	3.0930	.95150	**5**
56	.30791	.32363	3.0899	.95142	4
57	.30819	.32396	3.0868	.95133	3
58	.30846	.32428	3.0838	.95124	2
59	.30874	.32460	3.0807	.95115	1
60	.30902	.32492	3.0777	.95106	**0**
′	Cos	Cot	Tan	Sin	′

107° (287°) (252°) **72°**

NATURAL FUNCTIONS (Continued)

18° (198°) (341°) **161°**

′	Sin	Tan	Cot	Cos	′
0	.30902	.32492	3.0777	.95106	**60**
1	.30929	.32524	3.0746	.95097	59
2	.30957	.32556	3.0716	.95088	58
3	.30985	.32588	3.0686	.95079	57
4	.31012	.32621	3.0655	.95070	56
5	.31040	.32653	3.0625	.95061	**55**
6	.31068	.32685	3.0595	.95052	54
7	.31095	.32717	3.0565	.95043	53
8	.31123	.32749	3.0535	.95033	52
9	.31151	.32782	3.0505	.95024	51
10	.31178	.32814	3.0475	.95015	**50**
11	.31206	.32846	3.0445	.95006	49
12	.31233	.32878	3.0415	.94997	48
13	.31261	.32911	3.0385	.94988	47
14	.31289	.32943	3.0356	.94979	46
15	.31316	.32975	3.0326	.94970	**45**
16	.31344	.33007	3.0296	.94961	44
17	.31372	.33040	3.0267	.94952	43
18	.31399	.33072	3.0237	.94943	42
19	.31427	.33104	3.0208	.94933	41
20	.31454	.33136	3.0178	.94924	**40**
21	.31482	.33169	3.0149	.94915	39
22	.31510	.33201	3.0120	.94906	38
23	.31537	.33233	3.0090	.94897	37
24	.31565	.33266	3.0061	.94888	36
25	.31593	.33298	3.0032	.94878	**35**
26	.31620	.33330	3.0003	.94869	34
27	.31648	.33363	2.9974	.94860	33
28	.31675	.33395	2.9945	.94851	32
29	.31703	.33427	2.9916	.94842	31
30	.31730	.33460	2.9887	.94832	**30**
31	.31758	.33492	2.9858	.94823	29
32	.31786	.33524	2.9829	.94814	28
33	.31813	.33557	2.9800	.94805	27
34	.31841	.33589	2.9772	.94795	26
35	.31868	.33621	2.9743	.94786	**25**
36	.31896	.33654	2.9714	.94777	24
37	.31923	.33686	2.9686	.94768	23
38	.31951	.33718	2.9657	.94758	22
39	.31979	.33751	2.9629	.94749	21
40	.32006	.33783	2.9600	.94740	**20**
41	.32034	.33816	2.9572	.94730	19
42	.32061	.33848	2.9544	.94721	18
43	.32089	.33881	2.9515	.94712	17
44	.32116	.33913	2.9487	.94702	16
45	.32144	.33945	2.9459	.94693	**15**
46	.32171	.33978	2.9431	.94684	14
47	.32199	.34010	2.9403	.94674	13
48	.32227	.34043	2.9375	.94665	12
49	.32254	.34075	2.9347	.94656	11
50	.32282	.34108	2.9319	.94646	**10**
51	.32309	.34140	2.9291	.94637	9
52	.32337	.34173	2.9263	.94627	8
53	.32364	.34205	2.9235	.94618	7
54	.32392	.34238	2.9208	.94609	6
55	.32419	.34270	2.9180	.94599	**5**
56	.32447	.34303	2.9152	.94590	4
57	.32474	.34335	2.9125	.94580	3
58	.32502	.34368	2.9097	.94571	2
59	.32529	.34400	2.9070	.94561	1
60	.32557	.34433	2.9042	.94552	**0**
′	Cos	Cot	Tan	Sin	′

108° (288°) (251°) **71°**

19° (199°) (340°) **160°**

′	Sin	Tan	Cot	Cos	′
0	.32557	.34433	2.9042	.94552	**60**
1	.32584	.34465	2.9015	.94542	59
2	.32612	.34498	2.8987	.94533	58
3	.32639	.34530	2.8960	.94523	57
4	.32667	.34563	2.8933	.94514	56
5	.32694	.34596	2.8905	.94504	**55**
6	.32722	.34628	2.8878	.94495	54
7	.32749	.34661	2.8851	.94485	53
8	.32777	.34693	2.8824	.94476	52
9	.32804	.34726	2.8797	.94466	51
10	.32832	.34758	2.8770	.94457	**50**
11	.32859	.34791	2.8743	.94447	49
12	.32887	.34824	2.8716	.94438	48
13	.32914	.34856	2.8689	.94428	47
14	.32942	.34889	2.8662	.94418	46
15	.32969	.34922	2.8636	.94409	**45**
16	.32997	.34954	2.8609	.94399	44
17	.33024	.34987	2.8582	.94390	43
18	.33051	.35020	2.8556	.94380	42
19	.33079	.35052	2.8529	.94370	41
20	.33106	.35085	2.8502	.94361	**40**
21	.33134	.35118	2.8476	.94351	39
22	.33161	.35150	2.8449	.94342	38
23	.33189	.35183	2.8423	.94332	37
24	.33216	.35216	2.8397	.94322	36
25	.33244	.35248	2.8370	.94313	**35**
26	.33271	.35281	2.8344	.94303	34
27	.33298	.35314	2.8318	.94293	33
28	.33326	.35346	2.8291	.94284	32
29	.33353	.35379	2.8265	.94274	31
30	.33381	.35412	2.8239	.94264	**30**
31	.33408	.35445	2.8213	.94254	29
32	.33436	.35477	2.8187	.94245	28
33	.33463	.35510	2.8161	.94235	27
34	.33490	.35543	2.8135	.94225	26
35	.33518	.35576	2.8109	.94215	**25**
36	.33545	.35608	2.8083	.94206	24
37	.33573	.35641	2.8057	.94196	23
38	.33600	.35674	2.8032	.94186	22
39	.33627	.35707	2.8006	.94176	21
40	.33655	.35740	2.7980	.94167	**20**
41	.33682	.35772	2.7955	.94157	19
42	.33710	.35805	2.7929	.94147	18
43	.33737	.35838	2.7903	.94137	17
44	.33764	.35871	2.7878	.94127	16
45	.33792	.35904	2.7852	.94118	**15**
46	.33819	.35937	2.7827	.94108	14
47	.33846	.35969	2.7801	.94098	13
48	.33874	.36002	2.7776	.94088	12
49	.33901	.36035	2.7751	.94078	11
50	.33929	.36068	2.7725	.94068	**10**
51	.33956	.36101	2.7700	.94058	9
52	.33983	.36134	2.7675	.94049	8
53	.34011	.36167	2.7650	.94039	7
54	.34038	.36199	2.7625	.94029	6
55	.34065	.36232	2.7600	.94019	**5**
56	.34093	.36265	2.7575	.94009	4
57	.34120	.36298	2.7550	.93999	3
58	.34147	.36331	2.7525	.93989	2
59	.34175	.36364	2.7500	.93979	1
60	.34202	.36397	2.7475	.93969	**0**
′	Cos	Cot	Tan	Sin	′

109° (289°) (250°) **70°**

NATURAL FUNCTIONS (Continued)

20° (200°) (339°) **159°**

′	Sin	Tan	Cot	Cos	′
0	.34202	.36397	2.7475	.93969	**60**
1	.34229	.36430	2.7450	.93959	59
2	.34257	.36463	2.7425	.93949	58
3	.34284	.36496	2.7400	.93939	57
4	.34311	.36529	2.7376	.93929	56
5	.34339	.36562	2.7351	.93919	**55**
6	.34366	.36595	2.7326	.93909	54
7	.34393	.36628	2.7302	.93899	53
8	.34421	.36661	2.7277	.93889	52
9	.34448	.36694	2.7253	.93879	51
10	.34475	.36727	2.7228	.93869	**50**
11	.34503	.36760	2.7204	.93859	49
12	.34530	.36793	2.7179	.93849	48
13	.34557	.36826	2.7155	.93839	47
14	.34584	.36859	2.7130	.93829	46
15	.34612	.36892	2.7106	.93819	**45**
16	.34639	.36925	2.7082	.93809	44
17	.34666	.36958	2.7058	.93799	43
18	.34694	.36991	2.7034	.93789	42
19	.34721	.37024	2.7009	.93779	41
20	.34748	.37057	2.6985	.93769	**40**
21	.34775	.37090	2.6961	.93759	39
22	.34803	.37123	2.6937	.93748	38
23	.34830	.37157	2.6913	.93738	37
24	.34857	.37190	2.6889	.93728	36
25	.34884	.37223	2.6865	.93718	**35**
26	.34912	.37256	2.6841	.93708	34
27	.34939	.37289	2.6818	.93698	33
28	.34966	.37322	2.6794	.93688	32
29	.34993	.37355	2.6770	.93677	31
30	.35021	.37388	2.6746	.93667	**30**
31	.35048	.37422	2.6723	.93657	29
32	.35075	.37455	2.6699	.93647	28
33	.35102	.37488	2.6675	.93637	27
34	.35130	.37521	2.6652	.93626	26
35	.35157	.37554	2.6628	.93616	**25**
36	.35184	.37588	2.6605	.93606	24
37	.35211	.37621	2.6581	.93596	23
38	.35239	.37654	2.6558	.93585	22
39	.35266	.37687	2.6534	.93575	21
40	.35293	.37720	2.6511	.93565	**20**
41	.35320	.37754	2.6488	.93555	19
42	.35347	.37787	2.6464	.93544	18
43	.35375	.37820	2.6441	.93534	17
44	.35402	.37853	2.6418	.93524	16
45	.35429	.37887	2.6395	.93514	**15**
46	.35456	.37920	2.6371	.93503	14
47	.35484	.37953	2.6348	.93493	13
48	.35511	.37986	2.6325	.93483	12
49	.35538	.38020	2.6302	.93472	11
50	.35565	.38053	2.6279	.93462	**10**
51	.35592	.38086	2.6256	.93452	9
52	.35619	.38120	2.6233	.93441	8
53	.35647	.38153	2.6210	.93431	7
54	.35674	.38186	2.6187	.93420	6
55	.35701	.38220	2.6165	.93410	**5**
56	.35728	.38253	2.6142	.93400	4
57	.35755	.38286	2.6119	.93389	3
58	.35782	.38320	2.6096	.93379	2
59	.35810	.38353	2.6074	.93368	1
60	.35837	.38386	2.6051	.93358	**0**
′	Cos	Cot	Tan	Sin	′

110° (290°) (249°) **69°**

21° (201°) (338°) **158°**

′	Sin	Tan	Cot	Cos	′
0	.35837	.38386	2.6051	.93358	**60**
1	.35864	.38420	2.6028	.93348	59
2	.35891	.38453	2.6006	.93337	58
3	.35918	.38487	2.5983	.93327	57
4	.35945	.38520	2.5961	.93316	56
5	.35973	.38553	2.5938	.93306	**55**
6	.36000	.38587	2.5916	.93295	54
7	.36027	.38620	2.5893	.93285	53
8	.36054	.38654	2.5871	.93274	52
9	.36081	.38687	2.5848	.93264	51
10	.36108	.38721	2.5826	.93253	**50**
11	.36135	.38754	2.5804	.93243	49
12	.36162	.38787	2.5782	.93232	48
13	.36190	.38821	2.5759	.93222	47
14	.36217	.38854	2.5737	.93211	46
15	.36244	.38888	2.5715	.93201	**45**
16	.36271	.38921	2.5693	.93190	44
17	.36298	.38955	2.5671	.93180	43
18	.36325	.38988	2.5649	.93169	42
19	.36352	.39022	2.5627	.93159	41
20	.36379	.39055	2.5605	.93148	**40**
21	.36406	.39089	2.5583	.93137	39
22	.36434	.39122	2.5561	.93127	38
23	.36461	.39156	2.5539	.93116	37
24	.36488	.39190	2.5517	.93106	36
25	.36515	.39223	2.5495	.93095	**35**
26	.36542	.39257	2.5473	.93084	34
27	.36569	.39290	2.5452	.93074	33
28	.36596	.39324	2.5430	.93063	32
29	.36623	.39357	2.5408	.93052	31
30	.36650	.39391	2.5386	.93042	**30**
31	.36677	.39425	2.5365	.93031	29
32	.36704	.39458	2.5343	.93020	28
33	.36731	.39492	2.5322	.93010	27
34	.36758	.39526	2.5300	.92999	26
35	.36785	.39559	2.5279	.92988	**25**
36	.36812	.39593	2.5257	.92978	24
37	.36839	.39626	2.5236	.92967	23
38	.36867	.39660	2.5214	.92956	22
39	.36894	.39694	2.5193	.92945	21
40	.36921	.39727	2.5172	.92935	**20**
41	.36948	.39761	2.5150	.92924	19
42	.36975	.39795	2.5129	.92913	18
43	.37002	.39829	2.5108	.92902	17
44	.37029	.39862	2.5086	.92892	16
45	.37056	.39896	2.5065	.92881	**15**
46	.37083	.39930	2.5044	.92870	14
47	.37110	.39963	2.5023	.92859	13
48	.37137	.39997	2.5002	.92849	12
49	.37164	.40031	2.4981	.92838	11
50	.37191	.40065	2.4960	.92827	**10**
51	.37218	.40098	2.4939	.92816	9
52	.37245	.40132	2.4918	.92805	8
53	.37272	.40166	2.4897	.92794	7
54	.37299	.40200	2.4876	.92784	6
55	.37326	.40234	2.4855	.92773	**5**
56	.37353	.40267	2.4834	.92762	4
57	.37380	.40301	2.4813	.92751	3
58	.37407	.40335	2.4792	.92740	2
59	.37434	.40369	2.4772	.92729	1
60	.37461	.40403	2.4751	.92718	**0**
′	Cos	Cot	Tan	Sin	′

111° (291°) (248°) **68°**

NATURAL FUNCTIONS (Continued)

22° (202°) (337°) **157°**

′	Sin	Tan	Cot	Cos	′
0	.37461	.40403	2.4751	.92718	**60**
1	.37488	.40436	2.4730	.92707	59
2	.37515	.40470	2.4709	.92697	58
3	.37542	.40504	2.4689	.92686	57
4	.37569	.40538	2.4668	.92675	56
5	.37595	.40572	2.4648	.92664	**55**
6	.37622	.40606	2.4627	.92653	54
7	.37649	.40640	2.4606	.92642	53
8	.37676	.40674	2.4586	.92631	52
9	.37703	.40707	2.4566	.92620	51
10	.37730	.40741	2.4545	.92609	**50**
11	.37757	.40775	2.4525	.92598	49
12	.37784	.40809	2.4504	.92587	48
13	.37811	.40843	2.4484	.92576	47
14	.37838	.40877	2.4464	.92565	46
15	.37865	.40911	2.4443	.92554	**45**
16	.37892	.40945	2.4423	.92543	44
17	.37919	.40979	2.4403	.92532	43
18	.37946	.41013	2.4383	.92521	42
19	.37973	.41047	2.4362	.92510	41
20	.37999	.41081	2.4342	.92499	**40**
21	.38026	.41115	2.4322	.92488	39
22	.38053	.41149	2.4302	.92477	38
23	.38080	.41183	2.4282	.92466	37
24	.38107	.41217	2.4262	.92455	36
25	.38134	.41251	2.4242	.92444	**35**
26	.38161	.41285	2.4222	.92432	34
27	.38188	.41319	2.4202	.92421	33
28	.38215	.41353	2.4182	.92410	32
29	.38241	.41387	2.4162	.92399	31
30	.38268	.41421	2.4142	.92388	**30**
31	.38295	.41455	2.4122	.92377	29
32	.38322	.41490	2.4102	.92366	28
33	.38349	.41524	2.4083	.92355	27
34	.38376	.41558	2.4063	.92343	26
35	.38403	.41592	2.4043	.92332	**25**
36	.38430	.41626	2.4023	.92321	24
37	.38456	.41660	2.4004	.92310	23
38	.38483	.41694	2.3984	.92299	22
39	.38510	.41728	2.3964	.92287	21
40	.38537	.41763	2.3945	.92276	**20**
41	.38564	.41797	2.3925	.92265	19
42	.38591	.41831	2.3906	.92254	18
43	.38617	.41865	2.3886	.92243	17
44	.38644	.41899	2.3867	.92231	16
45	.38671	.41933	2.3847	.92220	**15**
46	.38698	.41968	2.3828	.92209	14
47	.38725	.42002	2.3808	.92198	13
48	.38752	.42036	2.3789	.92186	12
49	.38778	.42070	2.3770	.92175	11
50	.38805	.42105	2.3750	.92164	**10**
51	.38832	.42139	2.3731	.92152	9
52	.38859	.42173	2.3712	.92141	8
53	.38886	.42207	2.3693	.92130	7
54	.38912	.42242	2.3673	.92119	6
55	.38939	.42276	2.3654	.92107	**5**
56	.38966	.42310	2.3635	.92096	4
57	.38993	.42345	2.3616	.92085	3
58	.39020	.42379	2.3597	.92073	2
59	.39046	.42413	2.3578	.92062	1
60	.39073	.42447	2.3559	.92050	**0**
′	Cos	Cot	Tan	Sin	′

112° (292°) (247°) **67°**

23° (203°) (336°) **156°**

′	Sin	Tan	Cot	Cos	′
0	.39073	.42447	2.3559	.92050	**60**
1	.39100	.42482	2.3539	.92039	59
2	.39127	.42516	2.3520	.92028	58
3	.39153	.42551	2.3501	.92016	57
4	.39180	.42585	2.3483	.92005	56
5	.39207	.42619	2.3464	.91994	**55**
6	.39234	.42654	2.3445	.91982	54
7	.39260	.42688	2.3426	.91971	53
8	.39287	.42722	2.3407	.91959	52
9	.39314	.42757	2.3388	.91948	51
10	.39341	.42791	2.3369	.91936	**50**
11	.39367	.42826	2.3351	.91925	49
12	.39394	.42860	2.3332	.91914	48
13	.39421	.42894	2.3313	.91902	47
14	.39448	.42929	2.3294	.91891	46
15	.39474	.42963	2.3276	.91879	**45**
16	.39501	.42998	2.3257	.91868	44
17	.39528	.43032	2.3238	.91856	43
18	.39555	.43067	2.3220	.91845	42
19	.39581	.43101	2.3201	.91833	41
20	.39608	.43136	2.3183	.91822	**40**
21	.39635	.43170	2.3164	.91810	39
22	.39661	.43205	2.3146	.91799	38
23	.39688	.43239	2.3127	.91787	37
24	.39715	.43274	2.3109	.91775	36
25	.39741	.43308	2.3090	.91764	**35**
26	.39768	.43343	2.3072	.91752	34
27	.39795	.43378	2.3053	.91741	33
28	.39822	.43412	2.3035	.91729	32
29	.39848	.43447	2.3017	.91718	31
30	.39875	.43481	2.2998	.91706	**30**
31	.39902	.43516	2.2980	.91694	29
32	.39928	.43550	2.2962	.91683	28
33	.39955	.43585	2.2944	.91671	27
34	.39982	.43620	2.2925	.91660	26
35	.40008	.43654	2.2907	.91648	**25**
36	.40035	.43689	2.2889	.91636	24
37	.40062	.43724	2.2871	.91625	23
38	.40088	.43758	2.2853	.91613	22
39	.40115	.43793	2.2835	.91601	21
40	.40141	.43828	2.2817	.91590	**20**
41	.40168	.43862	2.2799	.91578	19
42	.40195	.43897	2.2781	.91566	18
43	.40221	.43932	2.2763	.91555	17
44	.40248	.43966	2.2745	.91543	16
45	.40275	.44001	2.2727	.91531	**15**
46	.40301	.44036	2.2709	.91519	14
47	.40328	.44071	2.2691	.91508	13
48	.40355	.44105	2.2673	.91496	12
49	.40381	.44140	2.2655	.91484	11
50	.40408	.44175	2.2637	.91472	**10**
51	.40434	.44210	2.2620	.91461	9
52	.40461	.44244	2.2602	.91449	8
53	.40488	.44279	2.2584	.91437	7
54	.40514	.44314	2.2566	.91425	6
55	.40541	.44349	2.2549	.91414	**5**
56	.40567	.44384	2.2531	.91402	4
57	.40594	.44418	2.2513	.91390	3
58	.40621	.44453	2.2496	.91378	2
59	.40647	.44488	2.2478	.91366	1
60	.40674	.44523	2.2460	.91355	**0**
′	Cos	Cot	Tan	Sin	′

113° (293°) (246°) **66°**

NATURAL FUNCTIONS (Continued)

24° (204°) (335°) **155°**

′	Sin	Tan	Cot	Cos	′
0	.40674	.44523	2.2460	.91355	**60**
1	.40700	.44558	2.2443	.91343	59
2	.40727	.44593	2.2425	.91331	58
3	.40753	.44627	2.2408	.91319	57
4	.40780	.44662	2.2390	.91307	56
5	.40806	.44697	2.2373	.91295	**55**
6	.40833	.44732	2.2355	.91283	54
7	.40860	.44767	2.2338	.91272	53
8	.40886	.44802	2.2320	.91260	52
9	.40913	.44837	2.2303	.91248	51
10	.40939	.44872	2.2286	.91236	**50**
11	.40966	.44907	2.2268	.91224	49
12	.40992	.44942	2.2251	.91212	48
13	.41019	.44977	2.2234	.91200	47
14	.41045	.45012	2.2216	.91188	46
15	41072	.45047	2.2199	.91176	**45**
16	.41098	.45082	2.2182	.91164	44
17	.41125	.45117	2.2165	.91152	43
18	.41151	.45152	2.2148	.91140	42
19	.41178	.45187	2.2130	.91128	41
20	.41204	.45222	2.2113	.91116	**40**
21	.41231	.45 57	2.2096	.91104	39
22	.41257	.45292	2.2079	.91092	38
23	.41284	.45327	2.2062	.91080	37
24	.41310	.45362	2.2045	.91068	36
25	.41337	.45397	2.2028	.91056	**35**
26	.41363	.45432	2.2011	.91044	34
27	.41390	.45467	2.1994	.91032	33
28	.41416	.45502	2.1977	.91020	32
29	.41443	.45538	2.1960	.91008	31
30	.41469	.45573	2.1943	.90996	**30**
31	.41496	.45608	2.1926	.90984	29
32	.41522	.45643	2.1909	.90972	28
33	.41549	.45678	2.1892	.90960	27
34	.41575	.45713	2.1876	.90948	26
35	.41602	.45748	2.1859	.90936	**25**
36	.41628	.45784	2.1842	.90924	24
37	.41655	.45819	2.1825	.90911	23
38	.41681	.45854	2.1808	.90899	22
39	.41707	.45889	2.1792	.90887	21
40	.41734	.45924	2.1775	.90875	**20**
41	.41760	.45960	2.1758	.90863	19
42	.41787	.45995	2.1742	.90851	18
43	.41813	.46030	2.1725	.90839	17
44	.41840	.46065	2.1708	.90826	16
45	.41866	.46101	2.1692	.90814	**15**
46	.41892	.46136	2.1675	.90802	14
47	.41919	.46171	2.1659	.90790	13
48	.41945	.46206	2.1642	.90778	12
49	.41972	.46242	2.1625	.90766	11
50	.41998	.46277	2.1609	.90753	**10**
51	.42024	.46312	2.1592	.90741	9
52	.42051	.46348	2.1576	.90729	8
53	.42077	.46383	2.1560	.90717	7
54	.42104	.46418	2.1543	.90704	6
55	.42130	.46454	2.1527	.90692	**5**
56	.42156	.46489	2.1510	.90680	4
57	.42183	.46525	2.1494	.90668	3
58	.42209	.46560	2.1478	.90655	2
59	.42235	.46595	2.1461	.90643	1
60	.42262	.46631	2.1445	.90631	**0**
′	Cos	Cot	Tan	Sin	′

114° (294°) (245°) **65°**

25° (205°) (334°) **154°**

′	Sin	Tan	Cot	Cos	′
0	.42262	.46631	2.1445	.90631	**60**
1	.42288	.46666	2.1429	.90618	59
2	.42315	.46702	2.1413	.90606	58
3	.42341	.46737	2.1396	.90594	57
4	.42367	.46772	2.1380	.90582	56
5	.42394	.46808	2.1364	.90569	**55**
6	.42420	.46843	2.1348	.90557	54
7	.42446	.46879	2.1332	.90545	53
8	.42473	.46914	2.1315	.90532	52
9	.42499	.46950	2.1299	.90520	51
10	.42525	.46985	2.1283	.90507	**50**
11	.42552	.47021	2.1267	.90495	49
12	.42578	.47056	2.1251	.90483	48
13	.42604	.47092	2.1235	.90470	47
14	.42631	.47128	2.1219	.90458	46
15	.42657	.47163	2.1203	.90446	**45**
16	.42683	.47199	2.1187	.90433	44
17	.42709	.47234	2.1171	.90421	43
18	.42736	.47270	2.1155	.90408	42
19	.42762	.47305	2.1139	.90396	41
20	.42788	.47341	2.1123	.90383	**40**
21	.42815	.47377	2.1107	.90371	39
22	.42841	.47412	2.1092	.90358	38
23	.42867	.47448	2.1076	.90346	37
24	.42894	.47483	2.1060	.90334	36
25	.42920	.47519	2.1044	.90321	**35**
26	42946	.47555	2.1028	.90309	34
27	.42972	.47590	2.1013	.90296	33
28	.42999	.47626	2.0997	.90284	32
29	.43025	.47662	2.0981	.90271	31
30	.43051	.47698	2.0965	.90259	**30**
31	.43077	.47733	2.0950	.90246	29
32	.43104	.47769	2.0934	.90233	28
33	.43130	.47805	2.0918	.90221	27
34	.43156	.46840	2.0903	.90208	26
35	.43182	.47876	2.0887	.90196	**25**
36	.43209	.47912	2.0872	.90183	24
37	.43235	.47948	2.0856	.90171	23
38	.43261	.47984	2.0840	.90158	22
39	.43287	.48019	2.0825	.90146	21
40	.43313	.48055	2.0809	.90133	**20**
41	.43340	.48091	2.0794	.90120	19
42	.43366	.48127	2.0778	.90108	18
43	.43392	.48163	2.0763	.90095	17
44	.43418	.48198	2.0748	.90082	16
45	.43445	.48234	2.0732	.90070	**15**
46	.43471	.48270	2.0717	.90057	14
47	.43497	.48306	2.0701	.90045	13
48	.43523	.48342	2.0686	.90032	12
49	.43549	.48378	2.0671	.90019	11
50	.43575	.48414	2.0655	.90007	**10**
51	.43602	.48450	2.0640	.89994	9
52	.43628	.48486	2.0625	.89981	8
53	.43654	.48521	2.0609	.89968	7
54	.43680	.48557	2.0594	.89956	6
55	.43706	.48593	2.0579	.89943	**5**
56	.43733	.48629	2.0564	.89930	4
57	.43759	.48665	2.0549	.89918	3
58	.43785	.48701	2.0533	.89905	2
59	.43811	.48737	2.0518	.89892	1
60	.43837	.48773	2.0503	.89879	**0**
′	Cos	Cot	Tan	Sin	′

115° (295°) (244°) **64°**

26° (206°) (333°) **153°**

′	Sin	Tan	Cot	Cos	′
0	.43837	.48773	2.0503	.89879	**60**
1	.43863	.48809	2.0488	.89867	59
2	.43889	.48845	2.0473	.89854	58
3	.43916	.48881	2.0458	.89841	57
4	.43942	.48917	2.0443	.89828	56
5	.43968	.48953	2.0428	.89816	**55**
6	.43994	.48989	2.0413	.89803	54
7	.44020	.49026	2.0398	.89790	53
8	.44046	.49062	2.0383	.89777	52
9	.44072	.49098	2.0368	.89764	51
10	.44098	.49134	2.0353	.89752	**50**
11	.44124	.49170	2.0338	.89739	49
12	.44151	.49206	2.0323	.89726	48
13	.44177	.49242	2.0308	.89713	47
14	.44203	.49278	2.0293	.89700	46
15	.44229	.49315	2.0278	.89687	**45**
16	.44255	.49351	2.0263	.89674	44
17	.44281	.49387	2.0248	.89662	43
18	.44307	.49423	2.0233	.89649	42
19	.44333	.49459	2.0219	.89636	41
20	.44359	.49495	2.0204	.89623	**40**
21	.44385	.49532	2.0189	.89610	39
22	.44411	.49568	2.0174	.89597	38
23	.44437	.49604	2.0160	.89584	37
24	.44464	.49640	2.0145	.89571	36
25	.44490	.49677	2.0130	.89558	**35**
26	.44516	.49713	2.0115	.89545	34
27	.44542	.49749	2.0101	.89532	33
28	.44568	.49786	2.0086	.89519	32
29	.44594	.49822	2.0072	.89506	31
30	.44620	.49858	2.0057	.89493	**30**
31	.44646	.49894	2.0042	.89480	29
32	.44672	.49931	2.0028	.89467	28
33	.44698	.49967	2.0013	.89454	27
34	.44724	.50004	1.9999	.89441	26
35	.44750	.50040	1.9984	.89428	**25**
36	.44776	.50076	1.9970	.89415	24
37	.44802	.50113	1.9955	.89402	23
38	.44828	.50149	1.9941	.89389	22
39	.44854	.50185	1.9926	.89376	21
40	.44880	.50222	1.9912	.89363	**20**
41	.44906	.50258	1.9897	.89350	19
42	.44932	.50295	1.9883	.89337	18
43	.44958	.50331	1.9868	.89324	17
44	.44984	.50368	1.9854	.89311	16
45	.45010	.50404	1.9840	.89298	**15**
46	.45036	.50441	1.9825	.89285	14
47	.45062	.50477	1.9811	.89272	13
48	.45088	.50514	1.9797	.89259	12
49	.45114	.50550	1.9782	.89245	11
50	.45140	.50587	1.9768	.89232	**10**
51	.45166	.50623	1.9754	.89219	9
52	.45192	.50660	1.9740	.89206	8
53	.45218	.50696	1.9725	.89193	7
54	.45243	.50733	1.9711	.89180	6
55	.45269	.50769	1.9697	.89167	**5**
56	.45295	.50806	1.9683	.89153	4
57	.45321	.50843	1.9669	.89140	3
58	.45347	.50879	1.9654	.89127	2
59	.45373	.50916	1.9640	.89114	1
60	.45399	.50953	1.9626	.89101	**0**
′	Cos	Cot	Tan	Sin	′

116° (296°) (243°) **63°**

27° (207°) (332°) **152°**

′	Sin	Tan	Cot	Cos	′
0	.45399	.50953	1.9626	.89101	**60**
1	.45425	.50989	1.9612	.89087	59
2	.45451	.51026	1.9598	.89074	58
3	.45477	.51063	1.9584	.89061	57
4	.45503	.51099	1.9570	.89048	56
5	.45529	.51136	1.9556	.89035	**55**
6	.45554	.51173	1.9542	.89021	54
7	.45580	.51209	1.9528	.89008	53
8	.45606	.51246	1.9514	.88995	52
9	.45632	.51283	1.9500	.88981	51
10	.45658	.51319	1.9486	.88968	**50**
11	.45684	.51356	1.9472	.88955	49
12	.45710	.51393	1.9458	.88942	48
13	.45736	.51430	1.9444	.88928	47
14	.45762	.51467	1.9430	.88915	46
15	.45787	.51503	1.9416	.88902	**45**
16	.45813	.51540	1.9402	.88888	44
17	.45839	.51577	1.9388	.88875	43
18	.45865	.51614	1.9375	.88862	42
19	.45891	.51651	1.9361	.88848	41
20	.45917	.51688	1.9347	.88835	**40**
21	.45942	.51724	1.9333	.88822	39
22	.45968	.51761	1.9319	.88808	38
23	.45994	.51798	1.9306	.88795	37
24	.46020	.51835	1.9292	.88782	36
25	.46046	.51872	1.9278	.88768	**35**
26	.46072	.51909	1.9265	.88755	34
27	.46097	.51946	1.9251	.88741	33
28	.46123	.51983	1.9237	.88728	32
29	.46149	.52020	1.9223	.88715	31
30	.46175	.52057	1.9210	.88701	**30**
31	.46201	.52094	1.9196	.88688	29
32	.46226	.52131	1.9183	.88674	28
33	.46252	.52168	1.9169	.88661	27
34	.46278	.52205	1.9155	.88647	26
35	.46304	.52242	1.9142	.88634	**25**
36	.46330	.52279	1.9128	.88620	24
37	.46355	.52316	1.9115	.88607	23
38	.46381	.52353	1.9101	.88593	22
39	.46407	.52390	1.9088	.88580	21
40	.46433	.52427	1.9074	.88566	**20**
41	.46458	.52464	1.9061	.88553	19
42	.46484	.52501	1.9047	.88539	18
43	.46510	.52538	1.9034	.88526	17
44	.46536	.52575	1.9020	.88512	16
45	.46561	.52613	1.9007	.88499	**15**
46	.46587	.52650	1.8993	.88485	14
47	.46613	.52687	1.8980	.88472	13
48	.46639	.52724	1.8967	.88458	12
49	.46664	.52761	1.8953	.88445	11
50	.46690	.52798	1.8940	.88431	**10**
51	.46716	.52836	1.8927	.88417	9
52	.46742	.52873	1.8913	.88404	8
53	.46767	.52910	1.8900	.88390	7
54	.46793	.52947	1.8887	.88377	6
55	.46819	.52985	1.8873	.88363	**5**
56	.46844	.53022	1.8860	.88349	4
57	.46870	.53059	1.8847	.88336	3
58	.46896	.53096	1.8834	.88322	2
59	.46921	.53134	1.8820	.88308	1
60	.46947	.53171	1.8807	.88295	**0**
′	Cos	Cot	Tan	Sin	′

117° (297°) (242°) **62°**

NATURAL FUNCTIONS (Continued)

28° (208°) (331°) **151°**

′	Sin	Tan	Cot	Cos	′
0	.46947	.53171	1.8807	.88295	**60**
1	.46973	.53208	1.8794	.88281	59
2	.46999	.53246	1.8781	.88267	58
3	.47024	.53283	1.8768	.88254	57
4	.47050	.53320	1.8755	.88240	56
5	.47076	.53358	1.8741	.88226	**55**
6	.47101	.53395	1.8728	.88213	54
7	.47127	.53432	1.8715	.88199	53
8	.47153	.53470	1.8702	.88185	52
9	.47178	.53507	1.8689	.88172	51
10	.47204	.53545	1.8676	.88158	**50**
11	.47229	.53582	1.8663	.88144	49
12	.47255	.53620	1.8650	.88130	48
13	.47281	.53657	1.8637	.88117	47
14	.47306	.53694	1.8624	.88103	46
15	.47332	.53732	1.8611	.88089	**45**
16	.47358	.53769	1.8598	.88075	44
17	.47383	.53807	1.8585	.88062	43
18	.47409	.53844	1.8572	.88048	42
19	.47434	.53882	1.8559	.88034	41
20	.47460	.53920	1.8546	.88020	**40**
21	.47486	.53957	1.8533	.88006	39
22	.47511	.53995	1.8520	.87993	38
23	.47537	.54032	1.8507	.87979	37
24	.47562	.54070	1.8495	.87965	36
25	.47588	.54107	1.8482	.87951	**35**
26	.47614	.54145	1.8469	.87937	34
27	.47639	.54183	1.8456	.87923	33
28	.47665	.54220	1.8443	.87909	32
29	.47690	.54258	1.8430	.87896	31
30	.47716	.54296	1.8418	.87882	**30**
31	.47741	.54333	1.8405	.87868	29
32	.47767	.54371	1.8392	.87854	28
33	.47793	.54409	1.8379	.87840	27
34	.47818	.54446	1.8367	.87826	26
35	.47844	.54484	1.8354	.87812	**25**
36	.47869	.54522	1.8341	.87798	24
37	.47895	.54560	1.8329	.87784	23
38	.47920	.54597	1.8316	.87770	22
39	.47946	.54635	1.8303	.87756	21
40	.47971	.54673	1.8291	.87743	**20**
41	.47997	.54711	1.8278	.87729	19
42	.48022	.54748	1.8265	.87715	18
43	.48048	.54786	1.8253	.87701	17
44	.48073	.54824	1.8240	.87687	16
45	.48099	.54862	1.8228	.87673	**15**
46	.48124	.54900	1.8215	.87659	14
47	.48150	.54938	1.8202	.87645	13
48	.48175	.54975	1.8190	.87631	12
49	.48201	.55013	1.8177	.87617	11
50	.48226	.55051	1.8165	.87603	**10**
51	.48252	.55089	1.8152	.87589	9
52	.48277	.55127	1.8140	.87575	8
53	.48303	.55165	1.8127	.87561	7
54	.48328	.55203	1.8115	.87546	6
55	.48354	.55241	1.8103	.87532	**5**
56	.48379	.55279	1.8090	.87518	4
57	.48405	.55317	1.8078	.87504	3
58	.48430	.55355	1.8065	.87490	2
59	.48456	.55393	1.8053	.87476	1
60	.48481	.55431	1.8040	.87462	**0**
′	Cos	Cot	Tan	Sin	′

118° (298°) (241°) **61°**

29° (209°) (330°) **150°**

′	Sin	Tan	Cot	Cos	′
0	.48481	.55431	1.8040	.87462	**60**
1	.48506	.55469	1.8028	.87448	59
2	.48532	.55507	1.8016	.87434	58
3	.48557	.55545	1.8003	.87420	57
4	.48583	.55583	1.7991	.87406	56
5	.48608	.55621	1.7979	.87391	**55**
6	.48634	.55659	1.7966	.87377	54
7	.48659	.55697	1.7954	.87363	53
8	.48684	.55736	1.7942	.87349	52
9	.48710	.55774	1.7930	.87335	51
10	.48735	.55812	1.7917	.87321	**50**
11	.48761	.55850	1.7905	.87306	49
12	.48786	.55888	1.7893	.87292	48
13	.48811	.55926	1.7881	.87278	47
14	.48837	.55964	1.7868	.87264	46
15	.48862	.56003	1.7856	.87250	**45**
16	.48888	.56041	1.7844	.87235	44
17	.48913	.56079	1.7832	.87221	43
18	.48938	.56117	1.7820	.87207	42
19	.48964	.56156	1.7808	.87193	41
20	.48989	.56194	1.7796	.87178	**40**
21	.49014	.56232	1.7783	.87164	39
22	.49040	.56270	1.7771	.87150	38
23	.49065	.56309	1.7759	.87136	37
24	.49090	.56347	1.7747	.87121	36
25	.49116	.56385	1.7735	.87107	**35**
26	.49141	.56424	1.7723	.87093	34
27	.49166	.56462	1.7711	.87079	33
28	.49192	.56501	1.7699	.87064	32
29	.49217	.56539	1.7687	.87050	31
30	.49242	.56577	1.7675	.87036	**30**
31	.49268	.56616	1.7663	.87021	29
32	.49293	.56654	1.7651	.87007	28
33	.49318	.56693	1.7639	.86993	27
34	.49344	.56731	1.7627	.86978	26
35	.49369	.56769	1.7615	.86964	**25**
36	.49394	.56808	1.7603	.86949	24
37	.49419	.56846	1.7591	.86935	23
38	.49445	.56885	1.7579	.86921	22
39	.49470	.56923	1.7567	.86906	21
40	.49495	.56962	1.7556	.86892	**20**
41	.49521	.57000	1.7544	.86878	19
42	.49546	.57039	1.7532	.86863	18
43	.49571	.57078	1.7520	.86849	17
44	.49596	.57116	1.7508	.86834	16
45	.49622	.57155	1.7496	.86820	**15**
46	.49647	.57193	1.7485	.86805	14
47	.49672	.57232	1.7473	.86791	13
48	.49697	.57271	1.7461	.86777	12
49	.49723	.57309	1.7449	.86762	11
50	.49748	.57348	1.7437	.86748	**10**
51	.49773	.57386	1.7426	.86733	9
52	.49798	.57425	1.7414	.86719	8
53	.49824	.57464	1.7402	.86704	7
54	.49849	.57503	1.7391	.86690	6
55	.49874	.57541	1.7379	.86675	**5**
56	.49899	.57580	1.7367	.86661	4
57	.49924	.57619	1.7355	.86646	3
58	.49950	.57657	1.7344	.86632	2
59	.49975	.57696	1.7332	.86617	1
60	.50000	.57735	1.7321	.86603	**0**
′	Cos	Cot	Tan	Sin	′

119° (299°) (240°) **60°**

NATURAL FUNCTIONS (Continued)

30° (210°) (329°) **149°**

′	Sin	Tan	Cot	Cos	′
0	.50000	.57735	1.7321	.86603	**60**
1	.50025	.57774	1.7309	.86588	59
2	.50050	.57813	1.7297	.86573	58
3	.50076	.57851	1.7286	.86559	57
4	.50101	.57890	1.7274	.86544	56
5	.50126	.57929	1.7262	.86530	**55**
6	.50151	.57968	1.7251	.86515	54
7	.50176	.58007	1.7239	.86501	53
8	.50201	.58046	1.7228	.86486	52
9	.50227	.58085	1.7216	.86471	51
10	.50252	.58124	1.7205	.86457	**50**
11	.50277	.58162	1.7193	.86442	49
12	.50302	.58201	1.7182	.86427	48
13	.50327	.58240	1.7170	.86413	47
14	.50352	.58279	1.7159	.86398	46
15	.50377	.58318	1.7147	.86384	**45**
16	.50403	.58357	1.7136	.86369	44
17	.50428	.58396	1.7124	.86354	43
18	.50453	.58435	1.7113	.86340	42
19	.50478	.58474	1.7102	.86325	41
20	.50503	.58513	1.7090	.86310	**40**
21	.50528	.58552	1.7079	.86295	39
22	.50553	.58591	1.7067	.86281	38
23	.50578	.58631	1.7056	.86266	37
24	.50603	.58670	1.7045	.86251	36
25	.50628	.58709	1.7033	.86237	**35**
26	.50654	.58748	1.7022	.86222	34
27	.50679	.58787	1.7011	.86207	33
28	.50704	.58826	1.6999	.86192	32
29	.50729	.58865	1.6988	.86178	31
30	.50754	.58905	1.6977	.86163	**30**
31	.50779	.58944	1.6965	.86148	29
32	.50804	.58983	1.6954	.86133	28
33	.50829	.59022	1.6943	.86119	27
34	.50854	.59061	1.6932	.86104	26
35	.50879	.59101	1.6920	.86089	**25**
36	.50904	.59140	1.6909	.86074	24
37	.50929	.59179	1.6898	.86059	23
38	.50954	.59218	1.6887	.86045	22
39	.50979	.59258	1.6875	.86030	21
40	.51004	.59297	1.6864	.86015	**20**
41	.51029	.59336	1.6853	.86000	19
42	.51054	.59376	1.6842	.85985	18
43	.51079	.59415	1.6831	.85970	17
44	.51104	.59454	1.6820	.85956	16
45	.51129	.59494	1.6808	.85941	**15**
46	.51154	.59533	1.6797	.85926	14
47	.51179	.59573	1.6786	.85911	13
48	.51204	.59612	1.6775	.85896	12
49	.51229	.59651	1.6764	.85881	11
50	.51254	.59691	1.6753	.85866	**10**
51	.51279	.59730	1.6742	.85851	9
52	.51304	.59770	1.6731	.85836	8
53	.51329	.59809	1.6720	.85821	7
54	.51354	.59849	1.6709	.85806	6
55	.51379	.59888	1.6698	.85792	**5**
56	.51404	.59928	1.6687	.85777	4
57	.51429	.59967	1.6676	.85762	3
58	.51454	.60007	1.6665	.85747	2
59	.51479	.60046	1.6654	.85732	1
60	.51504	.60086	1.6643	.85717	**0**
′	Cos	Cot	Tan	Sin	′

120° (300°) (239°) **59°**

31° (211°) (328°) **148°**

′	Sin	Tan	Cot	Cos	′
0	.51504	.60086	1.6643	.85717	**60**
1	.51529	.60126	1.6632	.85702	59
2	.51554	.60165	1.6621	.85687	58
3	.51579	.60205	1.6610	.85672	57
4	.51604	.60245	1.6599	.85657	56
5	.51628	.60284	1.6588	.85642	**55**
6	.51653	.60324	1.6577	.85627	54
7	.51678	.60364	1.6566	.85612	53
8	.51703	.60403	1.6555	.85597	52
9	.51728	.60443	1.6545	.85582	51
10	.51753	.60483	1.6534	.85567	**50**
11	.51778	.60522	1.6523	.85551	49
12	.51803	.60562	1.6512	.85536	48
13	.51828	.60602	1.6501	.85521	47
14	.51852	.60642	1.6490	.85506	46
15	.51877	.60681	1.6479	.85491	**45**
16	.51902	.60721	1.6469	.85476	44
17	.51927	.60761	1.6458	.85461	43
18	.51952	.60801	1.6447	.85446	42
19	.51977	.60841	1.6436	.85431	41
20	.52002	.60881	1.6426	.85416	**40**
21	.52026	.60921	1.6415	.85401	39
22	.52051	.60960	1.6404	.85385	38
23	.52076	.61000	1.6393	.85370	37
24	.52101	.61040	1.6383	.85355	36
25	.52126	.61080	1.6372	.85340	**35**
26	.52151	.61120	1.6361	.85325	34
27	.52175	.61160	1.6351	.85310	33
28	.52200	.61200	1.6340	.85294	32
29	.52225	.61240	1.6329	.85279	31
30	.52250	.61280	1.6319	.85264	**30**
31	.52275	.61320	1.6308	.85249	29
32	.52299	.61360	1.6297	.85234	28
33	.52324	.61400	1.6287	.85218	27
34	.52349	.61440	1.6276	.85203	26
35	.52374	.61480	1.6265	.85188	**25**
36	.52399	.61520	1.6255	.85173	24
37	.52423	.61561	1.6244	.85157	23
38	.52448	.61601	1.6234	.85142	22
39	.52473	.61641	1.6223	.85127	21
40	.52498	.61681	1.6212	.85112	**20**
41	.52522	.61721	1.6202	.85096	19
42	.52547	.61761	1.6191	.85081	18
43	.52572	.61801	1.6181	.85066	17
44	.52597	.61842	1.6170	.85051	16
45	.52621	.61882	1.6160	.85035	**15**
46	.52646	.61922	1.6149	.85020	14
47	.52671	.61962	1.6139	.85005	13
48	.52696	.62003	1.6128	.84989	12
49	.52720	.62043	1.6118	.84974	11
50	.52745	.62083	1.6107	.84959	**10**
51	.52770	.62124	1.6097	.84943	9
52	.52794	.62164	1.6087	.84928	8
53	.52819	.62204	1.6076	.84913	7
54	.52844	.62245	1.6066	.84897	6
55	.52869	.62285	1.6055	.84882	**5**
56	.52893	.62325	1.6045	.84866	4
57	.52918	.62366	1.6034	.84851	3
58	.52943	.62406	1.6024	.84836	2
59	.52967	.62446	1.6014	.84820	1
60	.52992	.62487	1.6003	.84805	**0**
′	Cos	Cot	Tan	Sin	′

121° (301°) (238°) **58°**

NATURAL FUNCTIONS (Continued)

32° (212°) (327°) **147°**

′	Sin	Tan	Cot	Cos	′
0	.52992	.62487	1.6003	.84805	**60**
1	.53017	.62527	1.5993	.84789	59
2	.53041	.62568	1.5983	.84774	58
3	.53066	.62608	1.5972	.84759	57
4	.53091	.62649	1.5962	.84743	56
5	.53115	.62689	1.5952	.84728	**55**
6	.53140	.62730	1.5941	.84712	54
7	.53164	.62770	1.5931	.84697	53
8	.53189	.62811	1.5921	.84681	52
9	.53214	.62852	1.5911	.84666	51
10	.53238	.62892	1.5900	.84650	**50**
11	.53263	.62933	1.5890	.84635	49
12	.53288	.62973	1.5880	.84619	48
13	.53312	.63014	1.5869	.84604	47
14	.53337	.63055	1.5859	.84588	46
15	.53361	.63095	1.5849	.84573	**45**
16	.53386	.63136	1.5839	.84557	44
17	.53411	.63177	1.5829	.84542	43
18	.53435	.63217	1.5818	.84526	42
19	.53460	.63258	1.5808	.84511	41
20	.53484	.63299	1.5798	.84495	**40**
21	.53509	.63340	1.5788	.84480	39
22	.53534	.63380	1.5778	.84464	38
23	.53558	.63421	1.5768	.84448	37
24	.53583	.63462	1.5757	.84433	36
25	.53607	.63503	1.5747	.84417	**35**
26	.53632	.63544	1.5737	.84402	34
27	.53656	.63584	1.5727	.84386	33
28	.53681	.63625	1.5717	.84370	32
29	.53705	.63666	1.5707	.84355	31
30	.53730	.63707	1.5697	.84339	**30**
31	.53754	.63748	1.5687	.84324	29
32	.53779	.63789	1.5677	.84308	28
33	.53804	.63830	1.5667	.84292	27
34	.53828	.63871	1.5657	.84277	26
35	.53853	.63912	1.5647	.84261	**25**
36	.53877	.63953	1.5637	.84245	24
37	.53902	.63994	1.5627	.84230	23
38	.53926	.64035	1.5617	.84214	22
39	.53951	.64076	1.5607	.84198	21
40	.53975	.64117	1.5597	.84182	**20**
41	.54000	.64158	1.5587	.84167	19
42	.54024	.64199	1.5577	.84151	18
43	.54049	.64240	1.5567	.84135	17
44	.54073	.64281	1.5557	.84120	16
45	.54097	.64322	1.5547	.84104	**15**
46	.54122	.64363	1.5537	.84088	14
47	.54146	.64404	1.5527	.84072	13
48	.54171	.64446	1.5517	.84057	12
49	.54195	.64487	1.5507	.84041	11
50	.54220	.64528	1.5497	.84025	**10**
51	.54244	.64569	1.5487	.84009	9
52	.54269	.64610	1.5477	.83994	8
53	.54293	.64652	1.5468	.83978	7
54	.54317	.64693	1.5458	.83962	6
55	.54342	.64734	1.5448	.83946	**5**
56	.54366	.64775	1.5438	.83930	4
57	.54391	.64817	1.5428	.83915	3
58	.54415	.64858	1.5418	.83899	2
59	.54440	.64899	1.5408	.83883	1
60	.54464	.64941	1.5399	.83867	**0**
′	Cos	Cot	Tan	Sin	′

122° (302°) (237°) **57°**

33° (213°) (326°) **146°**

′	Sin	Tan	Cot	Cos	′
0	.54464	.64941	1.5399	.83867	**60**
1	.54488	.64982	1.5389	.83851	59
2	.54513	.65024	1.5379	.83835	58
3	.54537	.65065	1.5369	.83819	57
4	.54561	.65106	1.5359	.83804	56
5	.54586	.65148	1.5350	.83788	**55**
6	.54610	.65189	1.5340	.83772	54
7	.54635	.65231	1.5330	.83756	53
8	.54659	.65272	1.5320	.83740	52
9	.54683	.65314	1.5311	.83724	51
10	.54708	.65355	1.5301	.83708	**50**
11	.54732	.65397	1.5291	.83692	49
12	.54756	.65438	1.5282	.83676	48
13	.54781	.65480	1.5272	.83660	47
14	.54805	.65521	1.5262	.83645	46
15	.54829	.65563	1.5253	.83629	**45**
16	.54854	.65604	1.5243	.83613	44
17	.54878	.65646	1.5233	.83597	43
18	.54902	.65688	1.5224	.83581	42
19	.54927	.65729	1.5214	.83565	41
20	.54951	.65771	1.5204	.83549	**40**
21	.54975	.65813	1.5195	.83533	39
22	.54999	.65854	1.5185	.83517	38
23	.55024	.65896	1.5175	.83501	37
24	.55048	.65938	1.5166	.83485	36
25	.55072	.65980	1.5156	.83469	**35**
26	.55097	.66021	1.5147	.83453	34
27	.55121	.66063	1.5137	.83437	33
28	.55145	.66105	1.5127	.83421	32
29	.55169	.66147	1.5118	.83405	31
30	.55194	.66189	1.5108	.83389	**30**
31	.55218	.66230	1.5099	.83373	29
32	.55242	.66272	1.5089	.83356	28
33	.55266	.66314	1.5080	.83340	27
34	.55291	.66356	1.5070	.83324	26
35	.55315	.66398	1.5061	.83308	**25**
36	.55339	.66440	1.5051	.83292	24
37	.55363	.66482	1.5042	.83276	23
38	.55383	.66524	1.5032	.83260	22
39	.55412	.66566	1.5023	.83244	21
40	.55436	.66608	1.5013	.83228	**20**
41	.55460	.66650	1.5004	.83212	19
42	.55484	.66692	1.4994	.83195	18
43	.55509	.66734	1.4985	.83179	17
44	.55533	.66776	1.4975	.83163	16
45	.55557	.66818	1.4966	.83147	**15**
46	.55581	.66830	1.4957	.83131	14
47	.55605	.66902	1.4947	.83115	13
48	.55630	.66944	1.4938	.83098	12
49	.55654	.66986	1.4928	.83082	11
50	.55678	.67028	1.4919	.83066	**10**
51	.55702	.67071	1.4910	.83050	9
52	.55726	.67113	1.4900	.83034	8
53	.55750	.67155	1.4891	.83017	7
54	.55775	.67197	1.4882	.83001	6
55	.55799	.67239	1.4872	.82985	**5**
56	.55823	.67282	1.4863	.82969	4
57	.55847	.67324	1.4854	.82953	3
58	.55871	.67366	1.4844	.82936	2
59	.55895	.67409	1.4835	.82920	1
60	.55919	.67451	1.4826	.82904	**0**
′	Cos	Cot	Tan	Sin	′

123° (303°) (236°) **56°**

34° (214°) (325°) **145°**

′	Sin	Tan	Cot	Cos	′
0	.55919	.67451	1.4826	.82904	**60**
1	.55943	.67493	1.4816	.82887	59
2	.55968	.67536	1.4807	.82871	58
3	.55992	.67578	1.4798	.82855	57
4	.56016	.67620	1.4788	.82839	56
5	.56040	.67663	1.4779	.82822	**55**
6	.56064	.67705	1.4770	.82806	54
7	.56088	.67748	1.4761	.82790	53
8	.56112	.67790	1.4751	.82773	52
9	.56136	.67832	1.4742	.82757	51
10	.56160	.67875	1.4733	.82741	**50**
11	.56184	.67917	1.4724	.82724	49
12	.56208	.67960	1.4715	.82708	48
13	.56232	.68002	1.4705	.82692	47
14	.56256	.68045	1.4696	.82675	46
15	.56280	.68088	1.4687	.82659	**45**
16	.56305	.68130	1.4678	.82643	44
17	.56329	.68173	1.4669	.82626	43
18	.56353	.68215	1.4659	.82610	42
19	.56377	.68258	1.4650	.82593	41
20	.56401	.68301	1.4641	.82577	**40**
21	.56425	.68343	1.4632	.82561	39
22	.56449	.68386	1.4623	.82544	38
23	.56473	.68429	1.4614	.82528	37
24	.56497	.68471	1.4605	.82511	36
25	.56521	.68514	1.4596	.82495	**35**
26	.56545	.68557	1.4586	.82478	34
27	.56569	.68600	1.4577	.82462	33
28	.56593	.68642	1.4568	.82446	32
29	.56617	.68685	1.4559	.82429	31
30	.56641	.68728	1.4550	.82413	**30**
31	.56665	.68771	1.4541	.82396	29
32	.56689	.68814	1.4532	.82380	28
33	.56713	.68857	1.4523	.82363	27
34	.56736	.68900	1.4514	.82347	26
35	.56760	.68942	1.4505	.82330	**25**
36	.56784	.68985	1.4496	.82314	24
37	.56808	.69028	1.4487	.82297	23
38	.56832	.69071	1.4478	.82281	22
39	.56856	.69114	1.4469	.82264	21
40	.56880	.69157	1.4460	.82248	**20**
41	.56904	.69200	1.4451	.82231	19
42	.56928	.69243	1.4442	.82214	18
43	.56952	.69286	1.4433	.82198	17
44	.56976	.69329	1.4424	.82181	16
45	.57000	.69372	1.4415	.82165	**15**
46	.57024	.69416	1.4406	.82148	14
47	.57047	.69459	1.4397	.82132	13
48	.57071	.69502	1.4388	.82115	12
49	.57095	.69545	1.4379	.82098	11
50	.57119	.69588	1.4370	.82082	**10**
51	.57143	.69631	1.4361	.82065	9
52	.57167	.69675	1.4352	.82048	8
53	.57191	.69718	1.4344	.82032	7
54	.57215	.69761	1.4335	.82015	6
55	.57238	.69804	1.4326	.81999	**5**
56	.57262	.69847	1.4317	.81982	4
57	.57286	.69891	1.4308	.81965	3
58	.57310	.69934	1.4299	.81949	2
59	.57334	.69977	1.4290	.81932	1
60	.57358	.70021	1.4281	.81915	**0**
′	Cos	Cot	Tan	Sin	′

124° (304°) (235°) **55°**

35° (215°) (324°) **144°**

′	Sin	Tan	Cot	Cos	′
0	.57358	.70021	1.4281	.81915	**60**
1	.57381	.70064	1.4273	.81899	59
2	.57405	.70107	1.4264	.81882	58
3	.57429	.70151	1.4255	.81865	57
4	.57453	.70194	1.4246	.81848	56
5	.57477	.70238	1.4237	.81832	**55**
6	.57501	.70281	1.4229	.81815	54
7	.57524	.70325	1.4220	.81798	53
8	.57548	.70368	1.4211	.81782	52
9	.57572	.70412	1.4202	.81765	51
10	.57596	.70455	1.4193	.81748	**50**
11	.57619	.70499	1.4185	.81731	49
12	.57643	.70542	1.4176	.81714	48
13	.57667	.70586	1.4167	.81698	47
14	.57691	.70629	1.4158	.81681	46
15	.57715	.70673	1.4150	.81664	**45**
16	.57738	.70717	1.4141	.81647	44
17	.57762	.70760	1.4132	.81631	43
18	.57786	.70804	1.4124	.81614	42
19	.57810	.70848	1.4115	.81597	41
20	.57833	.70891	1.4106	.81580	**40**
21	.57857	.70935	1.4097	.81563	39
22	.57881	.70979	1.4089	.81546	38
23	.57904	.71023	1.4080	.81530	37
24	.57928	.71066	1.4071	.81513	36
25	.57952	.71110	1.4063	.81496	**35**
26	.57976	.71154	1.4054	.81479	34
27	.57999	.71198	1.4045	.81462	33
28	.58023	.71242	1.4037	.81445	32
29	.58047	.71285	1.4028	.81428	31
30	.58070	.71329	1.4019	.81412	**30**
31	.58094	.71373	1.4011	.81395	29
32	.58118	.71417	1.4002	.81378	28
33	.58141	.71461	1.3994	.81361	27
34	.58165	.71505	1.3985	.81344	26
35	.58189	.71549	1.3976	.81327	**25**
36	.58212	.71593	1.3968	.81310	24
37	.58236	.71637	1.3959	.81293	23
38	.58260	.71681	1.3951	.81276	22
39	.58283	.71725	1.3942	.81259	21
40	.58307	.71769	1.3934	.81242	**20**
41	.58330	.71813	1.3925	.81225	19
42	.58354	.71857	1.3916	.81208	18
43	.58378	.71901	1.3908	.81191	17
44	.58401	.71946	1.3899	.81174	16
45	.58425	.71990	1.3891	.81157	**15**
46	.58449	.72034	1.3882	.81140	14
47	.58472	.72078	1.3874	.81123	13
48	.58496	.72122	1.3865	.81106	12
49	.58519	.72167	1.3857	.81089	11
50	.58543	.72211	1.3848	.81072	**10**
51	.58567	.72255	1.3840	.81055	9
52	.58590	.72299	1.3831	.81038	8
53	.58614	.72344	1.3823	.81021	7
54	.58637	.72388	1.3814	.81004	6
55	.58661	.72432	1.3806	.80987	**5**
56	.58684	.72477	1.3798	.80970	4
57	.58708	.72521	1.3789	.80953	3
58	.58731	.72565	1.3781	.80936	2
59	.58755	.72610	1.3772	.80919	1
60	.58779	.72654	1.3764	.80902	**0**
′	Cos	Cot	Tan	Sin	′

125° (305°) (234°) **54°**

NATURAL FUNCTIONS (Continued)

36° (216°) (323°) **143°**

′	Sin	Tan	Cot	Cos	′
0	.58779	.72654	1.3764	.80902	**60**
1	.58802	.72699	1.3755	.80885	59
2	.58826	.72743	1.3747	.80867	58
3	.58849	.72788	1.3739	.80850	57
4	.58873	.72832	1.3730	.80833	56
5	.58896	.72877	1.3722	.80816	**55**
6	.58920	.72921	1.3713	.80799	54
7	.58943	.72966	1.3705	.80782	53
8	.58967	.73010	1.3697	.80765	52
9	.58990	.73055	1.3688	.80748	51
10	.59014	.73100	1.3680	.80730	**50**
11	.59037	.73144	1.3672	.80713	49
12	.59061	.73189	1.3663	.80696	48
13	.59084	.73234	1.3655	.80679	47
14	.59108	.73278	1.3647	.80662	46
15	.59131	.73323	1.3638	.80644	**45**
16	.59154	.73368	1.3630	.80627	44
17	.59178	.73413	1.3622	.80610	43
18	.59201	.73457	1.3613	.80593	42
19	.59225	.73502	1.3605	.80576	41
20	.59248	.73547	1.3597	.80558	**40**
21	.59272	.73592	1.3588	.80541	39
22	.59295	.73637	1.3580	.80524	38
23	.59318	.73681	1.3572	.80507	37
24	.59342	.73726	1.3564	.80489	36
25	.59365	.73771	1.3555	.80472	**35**
26	.59389	.73816	1.3547	.80455	34
27	.59412	.73861	1.3539	.80438	33
28	.59436	.73906	1.3531	.80420	32
29	.59459	.73951	1.3522	.80403	31
30	.59482	.73996	1.3514	.80386	**30**
31	.59506	.74041	1.3506	.80368	29
32	.59529	.74086	1.3498	.80351	28
33	.59552	.74131	1.3490	.80334	27
34	.59576	.74176	1.3481	.80316	26
35	.59599	.74221	1.3473	.80299	**25**
36	.59622	.74267	1.3465	.80282	24
37	.59646	.74312	1.3457	.80264	23
38	.59669	.74357	1.3449	.80247	22
39	.59693	.74402	1.3440	.80230	21
40	.59716	.74447	1.3432	.80212	**20**
41	.59739	.74492	1.3424	.80195	19
42	.59763	.74538	1.3416	.80178	18
43	.59786	.74583	1.3408	.80160	17
44	.59809	.74628	1.3400	.80143	16
45	.59832	.74674	1.3392	.80125	**15**
46	.59856	.74719	1.3384	.80108	14
47	.59879	.74764	1.3375	.80091	13
48	.59902	.74810	1.3367	.80073	12
49	.59926	.74855	1.3359	.80056	11
50	.59949	.74900	1.3351	.80038	**10**
51	.59972	.74946	1.3343	.80021	9
52	.59995	.74991	1.3335	.80003	8
53	.60019	.75037	1.3327	.79986	7
54	.60042	.75082	1.3319	.79968	6
55	.60065	.75128	1.3311	.79951	**5**
56	.60089	.75173	1.3303	.79934	4
57	.60112	.75219	1.3295	.79916	3
58	.60135	.75264	1.3287	.79899	2
59	.60158	.75310	1.3278	.79881	1
60	.60182	.75355	1.3270	.79864	**0**
′	Cos	Cot	Tan	Sin	′

126° (306°) (233°) **53°**

37° (217°) (322°) **142°**

′	Sin	Tan	Cot	Cos	′
0	.60182	.75355	1.3270	.79864	**60**
1	.60205	.75401	1.3262	.79846	59
2	.60228	.75447	1.3254	.79829	58
3	.60251	.75492	1.3246	.79811	57
4	.60274	.75538	1.3238	.79793	56
5	.60298	.75584	1.3230	.79776	**55**
6	.60321	.75629	1.3222	.79758	54
7	.60344	.75675	1.3214	.79741	53
8	.60367	.75721	1.3206	.79723	52
9	.60390	.75767	1.3198	.79706	51
10	.60414	.75812	1.3190	.79688	**50**
11	.60437	.75858	1.3182	.79671	49
12	.60460	.75904	1.3175	.79653	48
13	.60483	.75950	1.3167	.79635	47
14	.60506	.75996	1.3159	.79618	46
15	.60529	.76042	1.3151	.79600	**45**
16	.60553	.76088	1.3143	.79583	44
17	.60576	.76134	1.3135	.79565	43
18	.60599	.76180	1.3127	.79547	42
19	.60622	.76226	1.3119	.79530	41
20	.60645	.76272	1.3111	.79512	**40**
21	.60668	.76318	1.3103	.79494	39
22	.60691	.76364	1.3095	.79477	38
23	.60714	.76410	1.3087	.79459	37
24	.60738	.76456	1.3079	.79441	36
25	.60761	.76502	1.3072	.79424	**35**
26	.60784	.76548	1.3064	.79406	34
27	.60807	.76594	1.3056	.79388	33
28	.60830	.76640	1.3048	.79371	32
29	.60853	.76686	1.3040	.79353	31
30	.60876	.76733	1.3032	.79335	**30**
31	.60899	.76779	1.3024	.79318	29
32	.60922	.76825	1.3017	.79300	28
33	.60945	.76871	1.3009	.79282	27
34	.60968	.76918	1.3001	.79264	26
35	.60991	.76964	1.2993	.79247	**25**
36	.61015	.77010	1.2985	.79229	24
37	.61038	.77057	1.2977	.79211	23
38	.61061	.77103	1.2970	.79193	22
39	.61084	.77149	1.2962	.79176	21
40	.61107	.77196	1.2954	.79158	**20**
41	.61130	.77242	1.2946	.79140	19
42	.61153	.77289	1.2938	.79122	18
43	.61176	.77335	1.2931	.79105	17
44	.61199	.77382	1.2923	.79087	16
45	.61222	.77428	1.2915	.79069	**15**
46	.61245	.77475	1.2907	.79051	14
47	.61268	.77521	1.2900	.79033	13
48	.61291	.77568	1.2892	.79016	12
49	.61314	.77615	1.2884	.78998	11
50	.61337	.77661	1.2876	.78980	**10**
51	.61360	.77708	1.2869	.78962	9
52	.61383	.77754	1.2861	.78944	8
53	.61406	.77801	1.2853	.78926	7
54	.61429	.77848	1.2846	.78908	6
55	.61451	.77895	1.2838	.78891	**5**
56	.61474	.77941	1.2830	.78873	4
57	.61497	.77988	1.2822	.78855	3
58	.61520	.78035	1.2815	.78837	2
59	.61543	.78082	1.2807	.78819	1
60	.61566	.78129	1.2799	.78801	**0**
′	Cos	Cot	Tan	Sin	′

127° (307°) (232°) **52°**

NATURAL FUNCTIONS (Continued)

38° (218°) (321°) **141°**

′	Sin	Tan	Cot	Cos	′
0	.61566	.78129	1.2799	.78801	**60**
1	.61589	.78175	1.2792	.78783	59
2	.61612	.78222	1.2784	.78765	58
3	.61635	.78269	1.2776	.78747	57
4	.61658	.78316	1.2769	.78729	56
5	.61681	.78363	1.2761	.78711	**55**
6	.61704	.78410	1.2753	.78694	54
7	.61726	.78457	1.2746	.78676	53
8	.61749	.78504	1.2738	.78658	52
9	.61772	.78551	1.2731	.78640	51
10	.61795	.78598	1.2723	.78622	**50**
11	.61818	.78645	1.2715	.78604	49
12	.61841	.78692	1.2708	.78586	48
13	.61864	.78739	1.2700	.78568	47
14	.61887	.78786	1.2693	.78550	46
15	.61909	.78834	1.2685	.78532	**45**
16	.61932	.78881	1.2677	.78514	44
17	.61955	.78928	1.2670	.78496	43
18	.61978	.78975	1.2662	.78478	42
19	.62001	.79022	1.2655	.78460	41
20	.62024	.79070	1.2647	.78442	**40**
21	.62046	.79117	1.2640	.78424	39
22	.62069	.79164	1.2632	.78405	38
23	.62092	.79212	1.2624	.78387	37
24	.62115	.79259	1.2617	.78369	36
25	.62138	.79306	1.2609	.78351	**35**
26	.62160	.79354	1.2602	.78333	34
27	.62183	.79401	1.2594	.78315	33
28	.62206	.79449	1.2587	.78297	32
29	.62229	.79496	1.2579	.78279	31
30	.62251	.79544	1.2572	.78261	**30**
31	.62274	.79591	1.2564	.78243	29
32	.62297	.79639	1.2557	.78225	28
33	.62320	.79686	1.2549	.78206	27
34	.62342	.79734	1.2542	.78188	26
35	.62365	.79781	1.2534	.78170	**25**
36	.62388	.79829	1.2527	.78152	24
37	.62411	.79877	1.2519	.78134	23
38	.62433	.79924	1.2512	.78116	22
39	.62456	.79972	1.2504	.78098	21
40	.62479	.80020	1.2497	.78079	**20**
41	.62502	.80067	1.2489	.78061	19
42	.62524	.80115	1.2482	.78043	18
43	.62547	.80163	1.2475	.78025	17
44	.62570	.80211	1.2467	.78007	16
45	.62592	.80258	1.2460	.77988	**15**
46	.62615	.80306	1.2452	.77970	14
47	.62638	.80354	1.2445	.77952	13
48	.62660	.80402	1.2437	.77934	12
49	.62683	.80450	1.2430	.77916	11
50	.62706	.80498	1.2423	.77897	**10**
51	.62728	.80546	1.2415	.77879	9
52	.62751	.80594	1.2408	.77861	8
53	.62774	.80642	1.2401	.77843	7
54	.62796	.80690	1.2393	.77824	6
55	.62819	.80738	1.2386	.77806	**5**
56	.62842	.80786	1.2378	.77788	4
57	.62864	.80834	1.2371	.77769	3
58	.62887	.80882	1.2364	.77751	2
59	.62909	.80930	1.2356	.77733	1
60	.62932	.80978	1.2349	.77715	**0**
′	Cos	Cot	Tan	Sin	′

128° (308°) (231°) **51°**

39° (219°) (320°) **140°**

′	Sin	Tan	Cot	Cos	′
0	.62932	.80978	1.2349	.77715	**60**
1	.62955	.81027	1.2342	.77696	59
2	.62977	.81075	1.2334	.77678	58
3	.63000	.81123	1.2327	.77660	57
4	.63022	.81171	1.2320	.77641	56
5	.63045	.81220	1.2312	.77623	**55**
6	.63068	.81268	1.2305	.77605	54
7	.63090	.81316	1.2298	.77586	53
8	.63113	.81364	1.2290	.77568	52
9	.63135	.81413	1.2283	.77550	51
10	.63158	.81461	1.2276	.77531	**50**
11	.63180	.81510	1.2268	.77513	49
12	.63203	.81558	1.2261	.77494	48
13	.63225	.81606	1.2254	.77476	47
14	.63248	.81655	1.2247	.77458	46
15	.63271	.81703	1.2239	.77439	**45**
16	.63293	.81752	1.2232	.77421	44
17	.63316	.81800	1.2225	.77402	43
18	.63338	.81849	1.2218	.77384	42
19	.63361	.81898	1.2210	.77366	41
20	.63383	.81946	1.2203	.77347	**40**
21	.63406	.81995	1.2196	.77329	39
22	.63428	.82044	1.2189	.77310	38
23	.63451	.82092	1.2181	.77292	37
24	.63473	.82141	1.2174	.77273	36
25	.63496	.82190	1.2167	.77255	**35**
26	.63518	.82238	1.2160	.77236	34
27	.63540	.82287	1.2153	.77218	33
28	.63563	.82336	1.2145	.77199	32
29	.63585	.82385	1.2138	.77181	31
30	.63608	.82434	1.2131	.77162	**30**
31	.63630	.82483	1.2124	.77144	29
32	.63653	.82531	1.2117	.77125	28
33	.63675	.82580	1.2109	.77107	27
34	.63698	.82629	1.2102	.77088	26
35	.63720	.82678	1.2095	.77070	**25**
36	.63742	.82727	1.2088	.77051	24
37	.63765	.82776	1.2081	.77033	23
38	.63787	.82825	1.2074	.77014	22
39	.63810	.82874	1.2066	.76996	21
40	.63832	.82923	1.2059	.76977	**20**
41	.63854	.82972	1.2052	.76959	19
42	.63877	.83022	1.2045	.76940	18
43	.63899	.83071	1.2038	.76921	17
44	.63922	.83120	1.2031	.76903	16
45	.63944	.83169	1.2024	.76884	**15**
46	.63966	.83218	1.2017	.76866	14
47	.63989	.83268	1.2009	.76847	13
48	.64011	.83317	1.2002	.76828	12
49	.64033	.83366	1.1995	.76810	11
50	.64056	.83415	1.1988	.76791	**10**
51	.64078	.83465	1.1981	.76772	9
52	.64100	.83514	1.1974	.76754	8
53	.64123	.83564	1.1967	.76735	7
54	.64145	.83613	1.1960	.76717	6
55	.64167	.83662	1.1953	.76698	**5**
56	.64190	.83712	1.1946	.76679	4
57	.64212	.83761	1.1939	.76661	3
58	.64234	.83811	1.1932	.76642	2
59	.64256	.83860	1.1925	.76623	1
60	.64279	.83910	1.1918	.76604	**0**
′	Cos	Cot	Tan	Sin	′

129° (309°) (230°) **50"**

NATURAL FUNCTIONS (Continued)

40° (220°) (319°) **139°**

′	Sin	Tan	Cot	Cos	′
0	.64279	.83910	1.1918	.76604	**60**
1	.64301	.83960	1.1910	.76586	59
2	.64323	.84009	1.1903	.76567	58
3	.64346	.84059	1.1896	.76548	57
4	.64368	.84108	1.1889	.76530	56
5	.64390	.84158	1.1882	.76511	**55**
6	.64412	.84208	1.1875	.76492	54
7	.64435	.84258	1.1868	.76473	53
8	.64457	.84307	1.1861	.76455	52
9	.64479	.84357	1.1854	.76436	51
10	.64501	.84407	1.1847	.76417	**50**
11	.64524	.84457	1.1840	.76398	49
12	.64546	.84507	1.1833	.76380	48
13	.64568	.84556	1.1826	.76361	47
14	.64590	.84606	1.1819	.76342	46
15	.64612	.84656	1.1812	.76323	**45**
16	.64635	.84706	1.1806	.76304	44
17	.64657	.84756	1.1799	.76286	43
18	.64679	.84806	1.1792	.76267	42
19	.64701	.84856	1.1785	.76248	41
20	.64723	.84906	1.1778	.76229	**40**
21	.64746	.84956	1.1771	.76210	39
22	.64768	.85006	1.1764	.76192	38
23	.64790	.85057	1.1757	.76173	37
24	.64812	.85107	1.1750	.76154	36
25	.64834	.85157	1.1743	.76135	**35**
26	.64856	.85207	1.1736	.76116	34
27	.64878	.85257	1.1729	.76097	33
28	.64901	.85308	1.1722	.76078	32
29	.64923	.85358	1.1715	.76059	31
30	.64945	.85408	1.1708	.76041	**30**
31	.64967	.85458	1.1702	.76022	29
32	.64989	.85509	1.1695	.76003	28
33	.65011	.85559	1.1688	.75984	27
34	.65033	.85609	1.1681	.75965	26
35	.65055	.85660	1.1674	.75946	**25**
36	.65077	.85710	1.1667	.75927	24
37	.65100	.85761	1.1660	.75908	23
38	.65122	.85811	1.1653	.75889	22
39	.65144	.85862	1.1647	.75870	21
40	.65166	.85912	1.1640	.75851	**20**
41	.65188	.85963	1.1633	.75832	19
42	.65210	.86014	1.1626	.75813	18
43	.65232	.86064	1.1619	.75794	17
44	.65254	.86115	1.1612	.75775	16
45	.65276	.86166	1.1606	.75756	**15**
46	.65298	.86216	1.1599	.75738	14
47	.65320	.86267	1.1592	.75719	13
48	.65342	.86318	1.1585	.75700	12
49	.65364	.86368	1.1578	.75680	11
50	.65386	.86419	1.1571	.75661	**10**
51	.65408	.86470	1.1565	.75642	9
52	.65430	.86521	1.1558	.75623	8
53	.65452	.86572	1.1551	.75604	7
54	.65474	.86623	1.1544	.75585	6
55	.65496	.86674	1.1538	.75566	**5**
56	.65518	.86725	1.1531	.75547	4
57	.65540	.86776	1.1524	.75528	3
58	.65562	.86827	1.1517	.75509	2
59	.65584	.86878	1.1510	.75490	1
60	.65606	.86929	1.1504	.75471	**0**
′	Cos	Cot	Tan	Sin	′

130° (310°) (229°) **49°**

41° (221°) (318°) **138°**

′	Sin	Tan	Cot	Cos	′
0	.65606	.86929	1.1504	.75471	**60**
1	.65628	.86980	1.1497	.75452	59
2	.65650	.87031	1.1490	.75433	58
3	.65672	.87082	1.1483	.75414	57
4	.65694	.87133	1.1477	.75395	56
5	.65716	.87184	1.1470	.75375	**55**
6	.65738	.87236	1.1463	.75356	54
7	.65759	.87287	1.1456	.75337	53
8	.65781	.87338	1.1450	.75318	52
9	.65803	.87389	1.1443	.75299	51
10	.65825	.87441	1.1436	.75280	**50**
11	.65847	.87492	1.1430	.75261	49
12	.65869	.87543	1.1423	.75241	48
13	.65891	.87595	1.1416	.75222	47
14	.65913	.87646	1.1410	.75203	46
15	.65935	.87698	1.1403	.75184	**45**
16	.65956	.87749	1.1396	.75165	44
17	.65978	.87801	1.1389	.75146	43
18	.66000	.87852	1.1383	.75126	42
19	.66022	.87904	1.1376	.75107	41
20	.66044	.87955	1.1369	.75088	**40**
21	.66066	.88007	1.1363	.75069	39
22	.66088	.88059	1.1356	.75050	38
23	.66109	.88110	1.1349	.75030	37
24	.66131	.88162	1.1343	.75011	36
25	.66153	.88214	1.1336	.74992	**35**
26	.66175	.88265	1.1329	.74973	34
27	.66197	.88317	1.1323	.74953	33
28	.66218	.88369	1.1316	.74934	32
29	.66240	.88421	1.1310	.74915	31
30	.66262	.88473	1.1303	.74896	**30**
31	.66284	.88524	1.1296	.74876	29
32	.66306	.88576	1.1290	.74857	28
33	.66327	.88628	1.1283	.74838	27
34	.66349	.88680	1.1276	.74818	26
35	.66371	.88732	1.1270	.74799	**25**
36	.66393	.88748	1.1263	.74780	24
37	.66414	.88836	1.1257	.74760	23
38	.66436	.88888	1.1250	.74741	22
39	.66458	.88940	1.1243	.74722	21
40	.66480	.88992	1.1237	.74703	**20**
41	.66501	.89045	1.1230	.74683	19
42	.66523	.89097	1.1224	.74664	18
43	.66545	.89149	1.1217	.74644	17
44	.66566	.89201	1.1211	.74625	16
45	.66588	.89253	1.1204	.74606	**15**
46	.66610	.89306	1.1197	.74586	14
47	.66632	.89358	1.1191	.74567	13
48	.66653	.89410	1.1184	.74548	12
49	.66675	.89463	1.1178	.74528	11
50	.66697	.89515	1.1171	.74509	**10**
51	.66718	.89567	1.1165	.74489	9
52	.66740	.89620	1.1158	.74470	8
53	.66762	.89672	1.1152	.74451	7
54	.66783	.89725	1.1145	.74431	6
55	.66805	.89777	1.1139	.74412	**5**
56	.66827	.89830	1.1132	.74392	4
57	.66848	.89883	1.1126	.74373	3
58	.66870	.89935	1.1119	.74353	2
59	.66891	.89988	1.1113	.74334	1
60	.66913	.90040	1.1106	.74314	**0**
′	Cos	Cot	Tan	Sin	′

131° (311°) (228°) **48°**

NATURAL FUNCTIONS (Continued)

42° (222°) (317°) **137°**

′	Sin	Tan	Cot	Cos	′
0	.66913	.90040	1.1106	.74314	**60**
1	.66935	.90093	1.1100	.74295	59
2	.66956	.90146	1.1093	.74276	58
3	.66978	.90199	1.1087	.74256	57
4	.66999	.90251	1.1080	.74237	56
5	.67021	.90304	1.1074	.74217	**55**
6	.67043	.90357	1.1067	.74198	54
7	.67064	.90410	1.1061	.74178	53
8	.67086	.90463	1.1054	.74159	52
9	.67107	.90516	1.1048	.74139	51
10	.67129	.90569	1.1041	.74120	**50**
11	.67151	.90621	1.1035	.74100	49
12	.67172	.90674	1.1028	.74080	48
13	.67194	.90727	1.1022	.74061	47
14	.67215	.90781	1.1016	.74041	46
15	.67237	.90834	1.1009	.74022	**45**
16	.67258	.90387	1.1003	.74002	44
17	.67280	.90940	1.0996	.73983	43
18	.67301	.90993	1.0990	.73963	42
19	.67323	.91046	1.0983	.73944	41
20	.67344	.91099	1.0977	.73924	**40**
21	.67366	.91153	1.0971	.73904	39
22	.67387	.91206	1.0964	.73885	38
23	.67409	.91259	1.0958	.73865	37
24	.67430	.91313	1.0951	.73846	36
25	.67452	.91366	1.0945	.73826	**35**
26	.67473	.91419	1.0939	.73806	34
27	.67495	.91473	1.0932	.73787	33
28	.67516	.91526	1.0926	.73767	32
29	.67538	.91580	1.0919	.73747	31
30	.67559	.91633	1.0913	.73728	**30**
31	.67580	.91687	1.0907	.73708	29
32	.67602	.91740	1.0900	.73688	28
33	.67623	.91794	1.0894	.73669	27
34	.67645	.91847	1.0888	.73649	26
35	.67666	.91901	1.0881	.73629	**25**
36	.67688	.91955	1.0875	.73610	24
37	.67709	.92008	1.0869	.73590	23
38	.67730	.92062	1.0862	.73570	22
39	.67752	.92116	1.0856	.73551	21
40	.67773	.92170	1.0850	.73531	**20**
41	.67795	.92224	1.0843	.73511	19
4.	.67816	.92277	1.0837	.73491	18
43	.67837	.92331	1.0831	.73472	17
44	.67859	.92385	1.0824	.73452	16
45	.67880	.92439	1.0818	.73432	**15**
46	.67901	.92493	1.0812	.73413	14
47	.67923	.92547	1.0805	.73393	13
48	.67944	.92601	1.0799	.73373	12
49	.67965	.92655	1.0793	.73353	11
50	.67987	.92709	1.0786	.73333	**10**
51	.68008	.92763	1.0780	.73314	9
52	.68029	.92817	1.0774	.73294	8
53	.68051	.92872	1.0768	.73274	7
54	.68072	.92926	1.0761	.73254	6
55	.68093	.92980	1.0755	.73234	**5**
56	.68115	.93034	1.0749	.73215	4
57	.68136	.93088	1.0742	.73195	3
58	.68157	.93143	1.0736	.73175	2
59	.68179	.9319,	1.0730	.73155	1
60	.68200	.93252	1.0724	.73135	**0**
′	Cos	Cot	Tan	Sin	′

132° (312°) (227°) **47°**

43° (223°) (316°) **136°**

′	Sin	Tan	Cot	Cos	′
0	.68200	.93252	1.0724	.73135	**60**
1	.68221	.93306	1.0717	.73116	59
2	.68242	.93360	1.0711	.73096	58
3	.68264	.93415	1.0705	.73076	57
4	.68285	.93469	1.0699	.73056	56
5	.68306	.93524	1.0692	.73036	**55**
6	.68327	.93578	1.0686	.73016	54
7	.68349	.93633	1.0680	.72996	53
8	.68370	.93688	1.0674	.72976	52
9	.68391	.93742	1.0668	.72957	51
10	.68412	.93796	1.0661	.72937	**50**
11	.68434	.93852	1.0655	.72917	49
12	.68455	.93906	1.0649	.72897	48
13	.68476	.93961	1.0643	.72877	47
14	.68497	.94016	1.0637	.72857	46
15	.68518	.94071	1.0630	72837	**45**
16	.68539	.94125	1.0624	.72817	44
17	.68561	.94180	1.0618	.72797	43
18	.68582	.94235	1.0612	.72777	42
19	.68603	.94290	1.0606	.72757	41
20	.68624	.94345	1.0599	.72737	**40**
21	.68645	.94400	1.0593	.72717	39
22	.68666	.94455	1.0587	.72697	38
23	.68688	.94510	1.0581	.72677	37
24	.68709	.94565	1.0575	.7265,	36
25	.68730	.94620	1.0569	.72637	**35**
26	.68751	.94676	1.0562	.72617	34
27	.68772	.94731	1.0556	.72597	33
28	.68793	.94786	1.0550	.72577	32
29	.68814	.94841	1.0544	.72557	31
30	.68835	.94896	1.0538	.72537	**30**
31	.68857	.94952	1.0532	.72517	29
32	.68878	.95007	1.0526	.72497	28
33	.68899	.95062	1.0519	.72477	27
34	.68920	.95118	1.0513	.72457	26
35	.68941	.95173	1.0507	.72437	**25**
36	.68962	.95229	1.0501	.72417	24
37	.68983	.95284	1.0495	.72397	23
38	.69004	.95340	1.0489	.72377	22
39	.69025	.95395	1.0483	.72357	21
40	.69046	.95451	1.0477	.72337	**20**
41	.69067	.95506	1.0470	.72317	19
42	.69088	.95562	1.0464	.72297	18
43	.69109	.95618	1.0458	.72277	17
44	.69130	.95673	1.0452	.72257	16
45	.69151	.95729	1.0446	.72236	**15**
46	.69172	.95785	1.0440	.72216	14
47	.69193	.95841	1.0434	.72196	13
48	.69214	.95897	1.0428	.72176	12
49	.69235	.95952	1.0422	.72156	11
50	.69256	.96008	1.0416	.72136	**10**
51	.69277	.96064	1.0410	.72116	9
52	.69298	.96120	1.0404	.72095	8
53	.69319	.96176	1.0398	.72075	7
54	.69340	.96232	1.0392	.72055	6
55	.69361	.96288	1.0385	.72035	**5**
56	.69382	.96344	1.0379	.72015	4
57	.69403	.96400	1.0373	.71995	3
58	.69424	.96457	1.0367	.71974	2
59	.69445	.96513	1.0361	.71954	1
60	.69466	.96569	1.0355	.71934	**0**
′	Cos	Cot	Tan	Sin	′

133° (313°) (226°) **46°**

NATURAL FUNCTIONS (Continued)

44° (224°) (315°) **135°**

′	Sin	Tan	Cot	Cos	′
0	.69466	.96569	1.0355	.71934	**60**
1	.69487	.96625	1.0349	.71914	59
2	.69508	.96681	1.0343	.71894	58
3	.69529	.96738	1.0337	.71873	57
4	.69549	.96794	1.0331	.71853	56
5	.69570	.96850	1.0325	.71833	**55**
6	.69591	.96907	1.0319	.71813	54
7	.69612	.96963	1.0313	.71792	53
8	.69633	.97020	1.0307	.71772	52
9	.69654	.97076	1.0301	.71752	51
10	.69675	.97133	1.0295	.71732	**50**
11	.69696	.97189	1.0289	.71711	49
12	.69717	.97246	1.0283	.71691	48
13	.69737	.97302	1.0277	.71671	47
14	.69758	.97359	1.0271	.71650	46
15	.69779	.97416	1.0265	.71630	**45**
16	.69800	.97472	1.0259	.71610	44
17	.69821	.97529	1.0253	.71590	43
18	.69842	.97586	1.0247	.71569	42
19	.69862	.97643	1.0241	.71549	41
20	.69883	.97700	1.0235	.71529	**40**
21	.69904	.97756	1.0230	.71508	39
22	.69925	.97813	1.0224	.71488	38
23	.69946	.97870	1.0218	.71468	37
24	.69966	.97927	1.0212	.71447	36
25	.69987	.97984	1.0206	.71427	**35**
26	.70008	.98041	1.0200	.71407	34
27	.70029	.98098	1.0194	.71386	33
28	.70049	.98155	1.0188	.71366	32
29	.70070	.98213	1.0182	.71345	31
30	.70091	.98270	1.0176	.71325	**30**
31	.70112	.98327	1.0170	.71305	29
32	.70132	.98384	1.0164	.71284	28
33	.70153	.98441	1.0158	.71264	27
34	.70174	.98499	1.0152	.71243	26
35	.70195	.98556	1.0147	.71223	**25**
36	.70215	.98613	1.0141	.71203	24
37	.70236	.98671	1.0135	.71182	23
38	.70257	.98728	1.0129	.71162	22
39	.70277	.98786	1.0123	.71141	21
40	.70298	.98843	1.0117	.71121	**20**
41	.70319	.98901	1.0111	.71100	19
42	.70339	.98958	1.0105	.71080	18
43	.70360	.99016	1.0099	.71059	17
44	.70381	.99073	1.0094	.71039	16
45	.70401	.99131	1.0088	.71019	**15**
46	.70422	.99189	1.0082	.70998	14
47	.70443	.99247	1.0076	.70978	13
48	.70463	.99304	1.0070	.70957	12
49	.70484	.99362	1.0064	.70937	11
50	.70505	.99420	1.0058	.70916	**10**
51	.70525	.99478	1.0052	.70896	9
52	.70546	.99536	1.0047	.70875	8
53	.70567	.99594	1.0041	.70855	7
54	.70587	.99652	1.0035	.70834	6
55	.70608	.99710	1.0029	.70813	**5**
56	.70628	.99768	1.0023	.70793	4
57	.70649	.99826	1.0017	.70772	3
58	.70670	.99884	1.0012	.70752	2
59	.70690	.99942	1.0006	.70731	1
60	.70711	1.0000	1.0000	.70711	**0**
′	Cos	Cot	Tan	Sin	′

134° (314°) (225°) **45°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS

0° (180°) (359°) **179°**

′	Sec	Csc	′
0	1.0000		**60**
1	1.0000	3437.7	59
2	1.0000	1718.9	58
3	1.0000	1145.9	57
4	1.0000	859.44	56
5	1.0000	687.55	**55**
6	1.0000	572.96	54
7	1.0000	491.11	53
8	1.0000	429.72	52
9	1.0000	381.97	51
10	1.0000	343.78	**50**
11	1.0000	312.52	49
12	1.0000	286.48	48
13	1.0000	264.44	47
14	1.0000	245.55	46
15	1.0000	229.18	**45**
16	1.0000	214.86	44
17	1.0000	202.22	43
18	1.0000	190.99	42
19	1.0000	180.93	41
20	1.0000	171.89	**40**
21	1.0000	163.70	39
22	1.0000	156.26	38
23	1.0000	149.47	37
24	1.0000	143.24	36
25	1.0000	137.51	**35**
26	1.0000	132.22	34
27	1.0000	127.33	33
28	1.0000	122.78	32
29	1.0000	118.54	31
30	1.0000	114.59	**30**
31	1.0000	110.90	29
32	1.0000	107.43	28
33	1.0000	104.18	27
34	1.0000	101.11	26
35	1.0001	98.223	**25**
36	1.0001	95.495	24
37	1.0001	92.914	23
38	1.0001	90.469	22
39	1.0001	88.149	21
40	1.0001	85.946	**20**
41	1.0001	83.849	19
42	1.0001	81.853	18
43	1.0001	79.950	17
44	1.0001	78.133	16
45	1.0001	76.397	**15**
46	1.0001	74.736	14
47	1.0001	73.146	13
48	1.0001	71.622	12
49	1.0001	70.160	11
50	1.0001	68.757	**10**
51	1.0001	67.409	9
52	1.0001	66.113	8
53	1.0001	64.866	7
54	1.0001	63.665	6
55	1.0001	62.507	**5**
56	1.0001	61.391	4
57	1.0001	60.314	3
58	1.0001	59.274	2
59	1.0001	58.270	1
60	1.0002	57.299	**0**
′	Csc	Sec	′

90° (270°) (269°) **89°**

1° (181°) (358°) **178°**

′	Sec	Csc	′
0	1.0002	57.299	**60**
1	1.0002	56.359	59
2	1.0002	55.451	58
3	1.0002	54.570	57
4	1.0002	53.718	56
5	1.0002	52.892	**55**
6	1.0002	52.090	54
7	1.0002	51.313	53
8	1.0002	50.558	52
9	1.0002	49.826	51
10	1.0002	49.114	**50**
11	1.0002	48.422	49
12	1.0002	47.750	48
13	1.0002	47.096	47
14	1.0002	46.460	46
15	1.0002	45.840	**45**
16	1.0002	45.237	44
17	1.0003	44.650	43
18	1.0003	44.077	42
19	1.0003	43.520	41
20	1.0003	42.976	**40**
21	1.0003	42.445	39
22	1.0003	41.928	38
23	1.0003	41.423	37
24	1.0003	40.930	36
25	1.0003	40.448	**35**
26	1.0003	39.978	34
27	1.0003	39.519	33
28	1.0003	39.070	32
29	1.0003	38.631	31
30	1.0003	38.202	**30**
31	1.0004	37.782	29
32	1.0004	37.371	28
33	1.0004	36.970	27
34	1.0004	36.576	26
35	1.0004	36.191	**25**
36	1.0004	35.815	24
37	1.0004	35.445	23
38	1.0004	35.084	22
39	1.0004	34.730	21
40	1.0004	34.382	**20**
41	1.0004	34.042	19
42	1.0004	33.708	18
43	1.0004	33.381	17
44	1.0005	33.060	16
45	1.0005	32.746	**15**
46	1.0005	32.437	14
47	1.0005	32.134	13
48	1.0005	31.836	12
49	1.0005	31.544	11
50	1.0005	31.258	**10**
51	1.0005	30.976	9
52	1.0005	30.700	8
53	1.0005	30.428	7
54	1.0006	30.161	6
55	1.0006	29.899	**5**
56	1.0006	29.641	4
57	1.0006	29.388	3
58	1.0006	29.139	2
59	1.0006	28.894	1
60	1.0006	28.654	**0**
′	Csc	Sec	′

91° (271°) (268°) **88°**

2° (182°) (357°) **177°**

′	Sec	Csc	′
0	1.0006	28.654	**60**
1	1.0006	28.417	59
2	1.0006	28.184	58
3	1.0006	27.955	57
4	1.0007	27.730	56
5	1.0007	27.508	**55**
6	1.0007	27.290	54
7	1.0007	27.075	53
8	1.0007	26.864	52
9	1.0007	26.655	51
10	1.0007	26.451	**50**
11	1.0007	26.249	49
12	1.0007	26.050	48
13	1.0007	25.854	47
14	1.0008	25.661	46
15	1.0008	25.471	**45**
16	1.0008	25.284	44
17	1.0008	25.100	43
18	1.0008	24.918	42
19	1.0008	24.739	41
20	1.0008	24.562	**40**
21	1.0008	24.388	39
22	1.0009	24.216	38
23	1.0009	24.047	37
24	1.0009	23.880	36
25	1.0009	23.716	**35**
26	1.0009	23.553	34
27	1.0009	23.393	33
28	1.0009	23.235	32
29	1.0009	23.079	31
30	1.0010	22.926	**30**
31	1.0010	22.774	29
32	1.0010	22.624	28
33	1.0010	22.476	27
34	1.0010	22.330	26
35	1.0010	22.187	**25**
36	1.0010	22.044	24
37	1.0010	21.904	23
38	1.0011	21.766	22
39	1.0011	21.629	21
40	1.0011	21.494	**20**
41	1.0011	21.360	19
42	1.0011	21.229	18
43	1.0011	21.098	17
44	1.0011	20.970	16
45	1.0012	20.843	**15**
46	1.0012	20.717	14
47	1.0012	20.593	13
48	1.0012	20.471	12
49	1.0012	20.350	11
50	1.0012	20.230	**10**
51	1.0012	20.112	9
52	1.0013	19.995	8
53	1.0013	19.880	7
54	1.0013	19.766	6
55	1.0013	19.653	**5**
56	1.0013	19.541	4
57	1.0013	19.431	3
58	1.0013	19.322	2
59	1.0014	19.214	1
60	1.0014	19.107	**0**
′	Csc	Sec	′

92° (272°) (267°) **87°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

3° (183°) (356°) **176°**

′	Sec	Csc	′
0	1.0014	19.107	60
1	1.0014	19.002	59
2	1.0014	18.898	58
3	1.0014	18.794	57
4	1.0014	18.692	56
5	1.0014	18.591	55
6	1.0015	18.492	54
7	1.0015	18.393	53
8	1.0015	18.295	52
9	1.0015	18.198	51
10	1.0015	18.103	50
11	1.0015	18.008	49
12	1.0016	17.914	48
13	1.0016	17.822	47
14	1.0016	17.730	46
15	1.0016	17.639	45
16	1.0016	17.549	44
17	1.0016	17.460	43
18	1.0017	17.372	42
19	1.0017	17.285	41
20	1.0017	17.198	40
21	1.0017	17.113	39
22	1.0017	17.028	38
23	1.0017	16.945	37
24	1.0018	16.862	36
25	1.0018	16.779	35
26	1.0018	16.698	34
27	1.0018	16.618	33
28	1.0018	16.538	32
29	1.0019	16.459	31
30	1.0019	16.380	30
31	1.0019	16.303	29
32	1.0019	16.226	28
33	1.0019	16.150	27
34	1.0019	16.075	26
35	1.0020	16.000	25
36	1.0020	15.926	24
37	1.0020	15.853	23
38	1.0020	15.780	22
39	1.0020	15.708	21
40	1.0021	15.637	20
41	1.0021	15.566	19
42	1.0021	15.496	18
43	1.0021	15.427	17
44	1.0021	15.358	16
45	1.0021	15.290	15
46	1.0022	15.222	14
47	1.0022	15.155	13
48	1.0022	15.089	12
49	1.0022	15.023	11
50	1.0022	14.958	10
51	1.0023	14.893	9
52	1.0023	14.829	8
53	1.0023	14.766	7
54	1.0023	14.703	6
55	1.0023	14.640	5
56	1.0024	14.578	4
57	1.0024	14.517	3
58	1.0024	14.456	2
59	1.0024	14.395	1
60	1.0024	14.336	0
′	Csc	Sec	′

93° (273°) (266°) **86°**

4° (184°) (355°) **175°**

′	Sec	Csc	′
0	1.0024	14.336	60
1	1.0025	14.276	59
2	1.0025	14.217	58
3	1.0025	14.159	57
4	1.0025	14.101	56
5	1.0025	14.044	55
6	1.0026	13.987	54
7	1.0026	13.930	53
8	1.0026	13.874	52
9	1.0026	13.818	51
10	1.0027	13.763	50
11	1.0027	13.708	49
12	1.0027	13.654	48
13	1.0027	13.600	47
14	1.0027	13.547	46
15	1.0028	13.494	45
16	1.0028	13.441	44
17	1.0028	13.389	43
18	1.0028	13.337	42
19	1.0028	13.286	41
20	1.0029	13.235	40
21	1.0029	13.184	39
22	1.0029	13.134	38
23	1.0029	13.084	37
24	1.0030	13.035	36
25	1.0030	12.985	35
26	1.0030	12.937	34
27	1.0030	12.888	33
28	1.0030	12.840	32
29	1.0031	12.793	31
30	1.0031	12.745	30
31	1.0031	12.699	29
32	1.0031	12.652	28
33	1.0032	12.606	27
34	1.0032	12.560	26
35	1.0032	12.514	25
36	1.0032	12.469	24
37	1.0033	12.424	23
38	1.0033	12.379	22
39	1.0033	12.335	21
40	1.0033	12.291	20
41	1.0034	12.248	19
42	1.0034	12.204	18
43	1.0034	12.161	17
44	1.0034	12.119	16
45	1.0034	12.076	15
46	1.0035	12.034	14
47	1.0035	11.992	13
48	1.0035	11.951	12
49	1.0035	11.909	11
50	1.0036	11.868	10
51	1.0036	11.828	9
52	1.0036	11.787	8
53	1.0036	11.747	7
54	1.0037	11.707	6
55	1.0037	11.668	5
56	1.0037	11.628	4
57	1.0037	11.589	3
58	1.0038	11.551	2
59	1.0038	11.512	1
60	1.0038	11.474	0
′	Csc	Sec	′

94° (274°) (265°) **85°**

5° (185°) (354°) **174°**

′	Sec	Csc	′
0	1.0038	11.474	60
1	1.0038	11.436	59
2	1.0039	11.398	58
3	1.0039	11.360	57
4	1.0039	11.323	56
5	1.0039	11.286	55
6	1.0040	11.249	54
7	1.0040	11.213	53
8	1.0040	11.176	52
9	1.0041	11.140	51
10	1.0041	11.105	50
11	1.0041	11.069	49
12	1.0041	11.034	48
13	1.0042	10.998	47
14	1.0042	10.963	46
15	1.0042	10.929	45
16	1.0042	10.894	44
17	1.0043	10.860	43
18	1.0043	10.826	42
19	1.0043	10.792	41
20	1.0043	10.758	40
21	1.0044	10.725	39
22	1.0044	10.692	38
23	1.0044	10.659	37
24	1.0045	10.626	36
25	1.0045	10.593	35
26	1.0045	10.561	34
27	1.0045	10.529	33
28	1.0046	10.497	32
29	1.0046	10.465	31
30	1.0046	10.433	30
31	1.0047	10.402	29
32	1.0047	10.371	28
33	1.0047	10.340	27
34	1.0047	10.309	26
35	1.0048	10.278	25
36	1.0048	10.248	24
37	1.0048	10.217	23
38	1.0049	10.187	22
39	1.0049	10.157	21
40	1.0049	10.128	20
41	1.0049	10.098	19
42	1.0050	10.068	18
43	1.0050	10.039	17
44	1.0050	10.010	16
45	1.0051	9.9812	15
46	1.0051	9.9525	14
47	1.0051	9.9239	13
48	1.0051	9.8955	12
49	1.0052	9.8672	11
50	1.0052	9.8391	10
51	1.0052	9.8112	9
52	1.0053	9.7834	8
53	1.0053	9.7558	7
54	1.0053	9.7283	6
55	1.0054	9.7010	5
56	1.0054	9.6739	4
57	1.0054	9.6469	3
58	1.0054	9.6200	2
59	1.0055	9.5933	1
60	1.0055	9.5668	0
′	Csc	Sec	′

95° (275°) (264°) **84°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

6° (186°) (353°) **173°**

′	Sec	Csc	′
0	1.0055	9.5668	**60**
1	1.0055	9.5404	59
2	1.0056	9.5141	58
3	1.0056	9.4880	57
4	1.0056	9.4620	56
5	1.0057	9.4362	**55**
6	1.0057	9.4105	54
7	1.0057	9.3850	53
8	1.0058	9.3596	52
9	1.0058	9.3343	51
10	1.0058	9.3092	**50**
11	1.0059	9.2842	49
12	1.0059	9.2593	48
13	1.0059	9.2346	47
14	1.0059	9.2100	46
15	1.0060	9.1855	**45**
16	1.0060	9.1612	44
17	1.0060	9.1370	43
18	1.0061	9.1129	42
19	1.0061	9.0890	41
20	1.0061	9.0652	**40**
21	1.0062	9.0415	39
22	1.0062	9.0179	38
23	1.0062	8.9944	37
24	1.0063	8.9711	36
25	1.0063	8.9479	**35**
26	1.0063	8.9248	34
27	1.0064	8.9019	33
28	1.0064	8.8790	32
29	1.0064	8.8563	31
30	1.0065	8.8337	**30**
31	1.0065	8.8112	29
32	1.0065	8.7888	28
33	1.0066	8.7665	27
34	1.0066	8.7444	26
35	1.0066	8.7223	**25**
36	1.0067	8.7004	24
37	1.0067	8.6786	23
38	1.0067	8.6569	22
39	1.0068	8.6353	21
40	1.0068	8.6138	**20**
41	1.0068	8.5924	19
42	1.0069	8.5711	18
43	1.0069	8.5500	17
44	1.0069	8.5289	16
45	1.0070	8.5079	**15**
46	1.0070	8.4871	14
47	1.0070	8.4663	13
48	1.0071	8.4457	12
49	1.0071	8.4251	11
50	1.0072	8.4047	**10**
51	1.0072	8.3843	9
52	1.0072	8.3641	8
53	1.0073	8.3439	7
54	1.0073	8.3238	6
55	1.0073	8.3039	**5**
56	1.0074	8.2840	4
57	1.0074	8.2642	3
58	1.0074	8.2446	2
59	1.0075	8.2250	1
60	1.0075	8.2055	**0**
′	Csc	Sec	′

96° (276°) (263°) **83°**

7° (187°) (352°) **172°**

′	Sec	Csc	′
0	1.0075	8.2055	**60**
1	1.0075	8.1861	59
2	1.0076	8.1668	58
3	1.0076	8.1476	57
4	1.0077	8.1285	56
5	1.0077	8.1095	**55**
6	1.0077	8.0905	54
7	1.0078	8.0717	53
8	1.0078	8.0529	52
9	1.0078	8.0342	51
10	1.0079	8.0156	**50**
11	1.0079	7.9971	49
12	1.0079	7.9787	48
13	1.0080	7.9604	47
14	1.0080	7.9422	46
15	1.0081	7.9240	**45**
16	1.0081	7.9059	44
17	1.0081	7.8879	43
18	1.0082	7.8700	42
19	1.0082	7.8522	41
20	1.0082	7.8344	**40**
21	1.0083	7.8168	39
22	1.0083	7.7992	38
23	1.0084	7.7817	37
24	1.0084	7.7642	36
25	1.0084	7.7469	**35**
26	1.0085	7.7296	34
27	1.0085	7.7124	33
28	1.0086	7.6953	32
29	1.0086	7.6783	31
30	1.0086	7.6613	**30**
31	1.0087	7.6444	29
32	1.0087	7.6276	28
33	1.0087	7.6109	27
34	1.0088	7.5942	26
35	1.0088	7.5776	**25**
36	1.0089	7.5611	24
37	1.0089	7.5446	23
38	1.0089	7.5282	22
39	1.0090	7.5119	21
40	1.0090	7.4957	**20**
41	1.0091	7.4795	19
42	1.0091	7.4635	18
43	1.0091	7.4474	17
44	1.0092	7.4315	16
45	1.0092	7.4156	**15**
46	1.0093	7.3998	14
47	1.0093	7.3840	13
48	1.0093	7.3684	12
49	1.0094	7.3527	11
50	1.0094	7.3372	**10**
51	1.0095	7.3217	9
52	1.0095	7.3063	8
53	1.0095	7.2909	7
54	1.0096	7.2757	6
55	1.0096	7.2604	**5**
56	1.0097	7.2453	4
57	1.0097	7.2302	3
58	1.0097	7.2152	2
59	1.0098	7.2002	1
60	1.0098	7.1853	**0**
′	Csc	Sec	′

97° (277°) (262°) **82°**

8° (188°) (351°) **171°**

′	Sec	Csc	′
0	1.0098	7.1853	**60**
1	1.0099	7.1705	59
2	1.0099	7.1557	58
3	1.0100	7.1410	57
4	1.0100	7.1263	56
5	1.0100	7.1117	**55**
6	1.0101	7.0972	54
7	1.0101	7.0827	53
8	1.0102	7.0683	52
9	1.0102	7.0539	51
10	1.0102	7.0396	**50**
11	1.0103	7.0254	49
12	1.0103	7.0112	48
13	1.0104	6.9971	47
14	1.0104	6.9830	46
15	1.0105	6.9690	**45**
16	1.0105	6.9550	44
17	1.0105	6.9411	43
18	1.0106	6.9273	42
19	1.0106	6.9135	41
20	1.0107	6.8998	**40**
21	1.0107	6.8861	39
22	1.0108	6.8725	38
23	1.0108	6.8589	37
24	1.0108	6.8454	36
25	1.0109	6.8320	**35**
26	1.0109	6.8186	34
27	1.0110	6.8052	33
28	1.0110	6.7919	32
29	1.0111	6.7787	31
30	1.0111	6.7655	**30**
31	1.0112	6.7523	29
32	1.0112	6.7392	28
33	1.0112	6.7262	27
34	1.0113	6.7132	26
35	1.0113	6.7003	**25**
36	1.0114	6.6874	24
37	1.0114	6.6745	23
38	1.0115	6.6618	22
39	1.0115	6.6490	21
40	1.0116	6.6363	**20**
41	1.0116	6.6237	19
42	1.0116	6.6111	18
43	1.0117	6.5986	17
44	1.0117	6.5861	16
45	1.0118	6.5736	**15**
46	1.0118	6.5612	14
47	1.0119	6.5489	13
48	1.0119	6.5366	12
49	1.0120	6.5243	11
50	1.0120	6.5121	**10**
51	1.0120	6.4999	9
52	1.0121	6.4878	8
53	1.0121	6.4757	7
54	1.0122	6.4637	6
55	1.0122	6.4517	**5**
56	1.0123	6.4398	4
57	1.0123	6.4279	3
58	1.0124	6.4160	2
59	1.0124	6.4042	1
60	1.0125	6.3925	**0**
′	Csc	Sec	′

98° (278°) (261°) **81°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

9° (189°) (350°) **170°**

′	Sec	Csc	′
0	1.0125	6.3925	**60**
1	1.0125	6.3807	59
2	1.0126	6.3691	58
3	1.0126	6.3574	57
4	1.0127	6.3458	56
5	1.0127	6.3343	**55**
6	1.0127	6.3228	54
7	1.0128	6.3113	53
8	1.0128	6.2999	52
9	1.0129	6.2885	51
10	1.0129	6.2772	**50**
11	1.0130	6.2659	49
12	1.0130	6.2546	48
13	1.0131	6.2434	47
14	1.0131	6.2323	46
15	1.0132	6.2211	**45**
16	1.0132	6.2100	44
17	1.0133	6.1990	43
18	1.0133	6.1880	42
19	1.0134	6.1770	41
20	1.0134	6.1661	**40**
21	1.0135	6.1552	39
22	1.0135	6.1443	38
23	1.0136	6.1335	37
24	1.0136	6.1227	36
25	1.0137	6.1120	**35**
26	1.0137	6.1013	34
27	1.0138	6.0906	33
28	1.0138	6.0800	32
29	1.0139	6.0694	31
30	1.0139	6.0589	**30**
31	1.0140	6.0483	29
32	1.0140	6.0379	28
33	1.0141	6.0274	27
34	1.0141	6.0170	26
35	1.0142	6.0067	**25**
36	1.0142	5.9963	24
37	1.0143	5.9860	23
38	1.0143	5.9758	22
39	1.0144	5.9656	21
40	1.0144	5.9554	**20**
41	1.0145	5.9452	19
42	1.0145	5.9351	18
43	1.0146	5.9250	17
44	1.0146	5.9150	16
45	1.0147	5.9049	**15**
46	1.0147	5.8950	14
47	1.0148	5.8850	13
48	1.0148	5.8751	12
49	1.0149	5.8652	11
50	1.0149	5.8554	**10**
51	1.0150	5.8456	9
52	1.0150	5.8358	8
53	1.0151	5.8261	7
54	1.0151	5.8164	6
55	1.0152	5.8067	**5**
56	1.0152	5.7970	4
57	1 0153	5.7874	3
58	1.0153	5.7778	2
59	1.0154	5.7683	1
60	1.0154	5.7588	**0**
′	Csc	Sec	′

99° (279°) (260°) **80°**

10° (190°) (349°) **169°**

′	Sec	Csc	′
0	1.0154	5.7588	**60**
1	1.0155	5.7493	59
2	1.0155	5.7398	58
3	1.0156	5.7304	57
4	1.0156	5.7210	56
5	1.0157	5.7117	**55**
6	1.0157	5.7023	54
7	1.0158	5.6930	53
8	1.0158	5.6838	52
9	1.0159	5.6745	51
10	1.0160	5.6653	**50**
11	1.0160	5.6562	49
12	1.0161	5.6470	48
13	1.0161	5.6379	47
14	1.0162	5.6288	46
15	1.0162	5.6198	**45**
16	1.0163	5.6107	44
17	1.0163	5.6017	43
18	1.0164	5.5928	42
19	1.0164	5.5838	41
20	1.0165	5.5749	**40**
21	1.0165	5.5660	39
22	1.0166	5.5572	38
23	1.0166	5.5484	37
24	1.0167	5.5396	36
25	1.0168	5.5308	**35**
26	1.0168	5.5221	34
27	1.0169	5.5134	33
28	1.0169	5.5047	32
29	1.0170	5.4960	31
30	1.0170	5.4874	**30**
31	1.0171	5.4788	29
32	1.0171	5.4702	28
33	1.0172	5.4617	27
34	1.0173	5.4532	26
35	1.0173	5.4447	**25**
36	1.0174	5.4362	24
37	1.0174	5.4278	23
38	1.0175	5.4194	22
39	1.0175	5.4110	21
40	1.0176	5.4026	**20**
41	1.0176	5.3943	19
42	1.0177	5.3860	18
43	1.0178	5.3777	17
44	1.0178	5.3695	16
45	1.0179	5.3612	**15**
46	1.0179	5.3530	14
47	1.0180	5.3449	13
48	1.0180	5.3367	12
49	1.0181	5.3286	11
50	1.0181	5.3205	**10**
51	1.0182	5.3124	9
52	1.0183	5.3044	8
53	1.0183	5.2963	7
54	1.0184	5.2883	6
55	1.0184	5.2804	**5**
56	1.0185	5.2724	4
57	1.0185	5.2645	3
58	1.0186	5.2566	2
59	1.0187	5.2487	1
60	1.0187	5.2408	**0**
′	Csc	Sec	′

100° (280°) (259°) **79°**

11° (191°) (348°) **168°**

′	Sec	Csc	′
0	1.0187	5.2408	**60**
1	1.0188	5.2330	59
2	1.0188	5.2252	58
3	1.0189	5.2174	57
4	1.0189	5.2097	56
5	1.0190	5.2019	**55**
6	1.0191	5.1942	54
7	1.0191	5.1865	53
8	1.0192	5.1789	52
9	1.0192	5.1712	51
10	1.0193	5.1636	**50**
11	1.0194	5.1560	49
12	1.0194	5.1484	48
13	1.0195	5.1409	47
14	1.0195	5.1333	46
15	1.0196	5.1258	**45**
16	1.0197	5.1183	44
17	1.0197	5.1109	43
18	1.0198	5.1034	42
19	1.0198	5.0960	41
20	1.0199	5.0886	**40**
21	1.0199	5.0813	39
22	1.0200	5.0739	38
23	1.0201	5.0666	37
24	1.0201	5.0593	36
25	1.0202	5.0520	**35**
26	1.0202	5.0447	34
27	1.0203	5.0375	33
28	1.0204	5.0302	32
29	1.0204	5.0230	31
30	1.0205	5.0159	**30**
31	1.0205	5.0087	29
32	1.0206	5.0016	28
33	1.0207	4.9944	27
34	1.0207	4.9873	26
35	1.0208	4.9803	**25**
36	1.0209	4.9732	24
37	1.0209	4.9662	23
38	1.0210	4.9591	22
39	1.0210	4.9521	21
40	1.0211	4.9452	**20**
41	1.0212	4.9382	19
42	1.0212	4.9313	18
43	1.0213	4.9244	17
44	1.0213	4.9175	16
45	1.0214	4.9106	**15**
46	1.0215	4.9037	14
47	1.0215	4.8969	13
48	1.0216	4.8901	12
49	1.0217	4.8833	11
50	1.0217	4.8765	**10**
51	1.0218	4.8697	9
52	1.0218	4.8630	8
53	1.0219	4.8563	7
54	1.0220	4.8496	6
55	1.0220	4.8429	**5**
56	1.0221	4.8362	4
57	1.0222	4.8296	3
58	1.0222	4.8229	2
59	1.0223	4.8163	1
60	1.0223	4.8097	**0**
′	Csc	Sec	′

101° (281°) (258°) **78°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

12° (192°) (347°) **167°**

′	Sec	Csc	′
0	1.0223	4.8097	**60**
1	1.0224	4.8032	59
2	1.0225	4.7966	58
3	1.0225	4.7901	57
4	1.0226	4.7836	56
5	1.0227	4.7771	**55**
6	1.0227	4.7706	54
7	1.0228	4.7641	53
8	1.0228	4.7577	52
9	1.0229	4.7512	51
10	1.0230	4.7448	**50**
11	1.0230	4.7384	49
12	1.0231	4.7321	48
13	1.0232	4.7257	47
14	1.0232	4.7194	46
15	1.0233	4.7130	**45**
16	1.0234	4.7067	44
17	1.0234	4.7004	43
18	1.0235	4.6942	42
19	1.0236	4.6879	41
20	1.0236	4.6817	**40**
21	1.0237	4.6755	39
22	1.0238	4.6693	38
23	1.0238	4.6631	37
24	1.0239	4.6569	36
25	1.0240	4.6507	**35**
26	1.0240	4.6446	34
27	1.0241	4.6385	33
28	1.0241	4.6324	32
29	1.0242	4.6263	31
30	1.0243	4.6202	**30**
31	1.0243	4.6142	29
32	1.0244	4.6081	28
33	1.0245	4.6021	27
34	1.0245	4.5961	26
35	1.0246	4.5901	**25**
36	1.0247	4.5841	24
37	1.0247	4.5782	23
38	1.0248	4.5722	22
39	1.0249	4.5663	21
40	1.0249	4.5604	**20**
41	1.0250	4.5545	19
42	1.0251	4.5486	18
43	1.0251	4.5428	17
44	1.0252	4.5369	16
45	1.0253	4.5311	**15**
46	1.0253	4.5253	14
47	1.0254	4.5195	13
48	1.0255	4.5137	12
49	1.0256	4.5079	11
50	1.0256	4.5022	**10**
51	1.0257	4.4964	9
52	1.0258	4.4907	8
53	1.0258	4.4850	7
54	1.0259	4.4793	6
55	1.0260	4.4736	**5**
56	1.0260	4.4679	4
57	1.0261	4.4623	3
58	1.0262	4.4566	2
59	1.0262	4.4510	1
60	1.0263	4.4454	**0**
′	Csc	Sec	′

102° (282°) (257°) **77°**

13° (193°) (346°) **166°**

′	Sec	Csc	′
0	1.0263	4.4454	**60**
1	1.0264	4.4398	59
2	1.0264	4.4342	58
3	1.0265	4.4287	57
4	1.0266	4.4231	56
5	1.0266	4.4176	**55**
6	1.0267	4.4121	54
7	1.0268	4.4066	53
8	1.0269	4.4011	52
9	1.0269	4.3956	51
10	1.0270	4.3901	**50**
11	1.0271	4.3847	49
12	1.0271	4.3792	48
13	1.0272	4.3738	47
14	1.0273	4.3684	46
15	1.0273	4.3630	**45**
16	1.0274	4.3576	44
17	1.0275	4.3522	43
18	1.0276	4.3469	42
19	1.0276	4.3415	41
20	1.0277	4.3362	**40**
21	1.0278	4.3309	39
22	1.0278	4.3256	38
23	1.0279	4.3203	37
24	1.0280	4.3150	36
25	1.0281	4.3098	**35**
26	1.0281	4.3045	34
27	1.0282	4.2993	33
28	1.0283	4.2941	32
29	1.0283	4.2889	31
30	1.0284	4.2837	**30**
31	1.0285	4.2785	29
32	1.0286	4.2733	28
33	1.0286	4.2681	27
34	1.0287	4.2630	26
35	1.0288	4.2579	**25**
36	1.0288	4.2527	24
37	1.0289	4.2476	23
38	1.0290	4.2425	22
39	1.0291	4.2375	21
40	1.0291	4.2324	**20**
41	1.0292	4.2273	19
42	1.0293	4.2223	18
43	1.0294	4.2173	17
44	1.0294	4.2122	16
45	1.0295	4.2072	**15**
46	1.0296	4.2022	14
47	1.0297	4.1973	13
48	1.0297	4.1923	12
49	1.0298	4.1873	11
50	1.0299	4.1824	**10**
51	1.0299	4.1774	9
52	1.0300	4.1725	8
53	1.0301	4.1676	7
54	1.0302	4.1627	6
55	1.0302	4.1578	**5**
56	1.0303	4.1529	4
57	1.0304	4.1481	3
58	1.0305	4.1432	2
59	1.0305	4.1384	1
60	1.0306	4.1336	**0**
′	Csc	Sec	′

103° (283°) (256°) **76°**

14° (194°) (345°) **165°**

′	Sec	Csc	′
0	1.0306	4.1336	**60**
1	1.0307	4.1287	59
2	1.0308	4.1239	58
3	1.0308	4.1191	57
4	1.0309	4.1144	56
5	1.0310	4.1096	**55**
6	1.0311	4.1048	54
7	1.0311	4.1001	53
8	1.0312	4.0954	52
9	1.0313	4.0906	51
10	1.0314	4.0859	**50**
11	1.0314	4.0812	49
12	1.0315	4.0765	48
13	1.0316	4.0718	47
14	1.0317	4.0672	46
15	1.0317	4.0625	**45**
16	1.0318	4.0579	44
17	1.0319	4.0532	43
18	1.0320	4.0486	42
19	1.0321	4.0440	41
20	1.0321	4.0394	**40**
21	1.0322	4.0348	39
22	1.0323	4.0302	38
23	1.0324	4.0256	37
24	1.0324	4.0211	36
25	1.0325	4.0165	**35**
26	1.0326	4.0120	34
27	1.0327	4.0075	33
28	1.0327	4.0029	32
29	1.0328	3.9984	31
30	1.0329	3.9939	**30**
31	1.0330	3.9894	29
32	1.0331	3.9850	28
33	1.0331	3.9805	27
34	1.0332	3.9760	26
35	1.0333	3.9716	**25**
36	1.0334	3.9672	24
37	1.0334	3.9627	23
38	1.0335	3.9583	22
39	1.0336	3.9539	21
40	1.0337	3.9495	**20**
41	1.0338	3.9451	19
42	1.0338	3.9408	18
43	1.0339	3.9364	17
44	1.0340	3.9320	16
45	1.0341	3.9277	**15**
46	1.0342	3.9234	14
47	1.0342	3.9190	13
48	1.0343	3.9147	12
49	1.0344	3.9104	11
50	1.0345	3.9061	**10**
51	1.0346	3.9018	9
52	1.0346	3.8976	8
53	1.0347	3.8933	7
54	1.0348	3.8890	6
55	1.0349	3.8848	**5**
56	1.0350	3.8806	4
57	1.0350	3.8763	3
58	1.0351	3.8721	2
59	1.0352	3.8679	1
60	1.0353	3.8637	**0**
′	Csc	Sec	′

104° (284°) (255°) **75°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

15° (195°) (344°) **164°**

′	Sec	Csc	′
0	1.0353	3.8637	**60**
1	1.0354	3.8595	59
2	1.0354	3.8553	58
3	1.0355	3.8512	57
4	1.0356	3.8470	56
5	1.0357	3.8428	**55**
6	1.0358	3.8387	54
7	1.0358	3.8346	53
8	1.0359	3.8304	52
9	1.0360	3.8263	51
10	1.0361	3.8222	**50**
11	1.0362	3.8181	49
12	1.0363	3.8140	48
13	1.0363	3.8100	47
14	1.0364	3.8059	46
15	1.0365	3.8018	**45**
16	1.0366	3.7978	44
17	1.0367	3.7937	43
18	1.0367	3.7897	42
19	1.0368	3.7857	41
20	1.0369	3.7817	**40**
21	1.0370	3.7777	39
22	1.0371	3.7737	38
23	1.0372	3.7697	37
24	1.0372	3.7657	36
25	1.0373	3.7617	**35**
26	1.0374	3.7577	34
27	1.0375	3.7538	33
28	1.0376	3.7498	32
29	1.0377	3.7459	31
30	1.0377	3.7420	**30**
31	1.0378	3.7381	29
32	1.0379	3.7341	28
33	1.0380	3.7302	27
34	1.0381	3.7263	26
35	1.0382	3.7225	**25**
36	1.0382	3.7186	24
37	1.0383	3.7147	23
38	1.0384	3.7108	22
39	1.0385	3.7070	21
40	1.0386	3.7032	**20**
41	1.0387	3.6993	19
42	1.0388	3.6955	18
43	1.0388	3.6917	17
44	1.0389	3.6879	16
45	1.0390	3.6840	**15**
46	1.0391	3.6803	14
47	1.0392	3.6765	13
48	1.0393	3.6727	12
49	1.0394	3.6689	11
50	1.0394	3.6652	**10**
51	1.0395	3.6614	9
52	1.0396	3.6576	8
53	1.0397	3.6539	7
54	1.0398	3.6502	6
55	1.0399	3.6465	**5**
56	1.0400	3.6427	4
57	1.0400	3.6390	3
58	1.0401	3.6353	2
59	1.0402	3.6316	1
60	1.0403	3.6280	**0**
′	Csc	Sec	′

105° (285°) (254°) **74°**

16° (196°) (343°) **163°**

′	Sec	Csc	′
0	1.0403	3.6280	**60**
1	1.0404	3.6243	59
2	1.0405	3.6206	58
3	1.0406	3.6169	57
4	1.0406	3.6133	56
5	1.0407	3.6097	**55**
6	1.0408	3.6060	54
7	1.0409	3.6024	53
8	1.0410	3.5988	52
9	1.0411	3.5951	51
10	1.0412	3.5915	**50**
11	1.0413	3.5879	49
12	1.0413	3.5843	48
13	1.0414	3.5808	47
14	1.0415	3.5772	46
15	1.0416	3.5736	**45**
16	1.0417	3.5700	44
17	1.0418	3.5665	43
18	1.0419	3.5629	42
19	1.0420	3.5594	41
20	1.0421	3.5559	**40**
21	1.0421	3.5523	39
22	1.0422	3.5488	38
23	1.0423	3.5453	37
24	1.0424	3.5418	36
25	1.0425	3.5383	**35**
26	1.0426	3.5348	34
27	1.0427	3.5313	33
28	1.0428	3.5279	32
29	1.0429	3.5244	31
30	1.0429	3.5209	**30**
31	1.0430	3.5175	29
32	1.0431	3.5140	28
33	1.0432	3.5106	27
34	1.0433	3.5072	26
35	1.0434	3.5037	**25**
36	1.0435	3.5003	24
37	1.0436	3.4969	23
38	1.0437	3.4935	22
39	1.0438	3.4901	21
40	1.0439	3.4867	**20**
41	1.0439	3.4833	19
42	1.0440	3.4799	18
43	1.0441	3.4766	17
44	1.0442	3.4732	16
45	1.0443	3.4699	**15**
46	1.0444	3.4665	14
47	1.0445	3.4632	13
48	1.0446	3.4598	12
49	1.0447	3.4565	11
50	1.0448	3.4532	**10**
51	1.0449	3.4499	9
52	1.0450	3.4465	8
53	1.0450	3.4432	7
54	1.0451	3.4399	6
55	1.0452	3.4367	**5**
56	1.0453	3.4334	4
57	1.0454	3.4301	3
58	1.0455	3.4268	2
59	1.0456	3.4236	1
60	1.0457	3.4203	**0**
′	Csc	Sec	′

106° (286°) (253°) **73°**

17° (197°) (342°) **162°**

′	Sec	Csc	′
0	1.0457	3.4203	**60**
1	1.0458	3.4171	59
2	1.0459	3.4138	58
3	1.0460	3.4106	57
4	1.0461	3.4073	56
5	1.0462	3.4041	**55**
6	1.0463	3.4009	54
7	1.0463	3.3977	53
8	1.0464	3.3945	52
9	1.0465	3.3913	51
10	1.0466	3.3881	**50**
11	1.0467	3.3849	49
12	1.0468	3.3817	48
13	1.0469	3.3785	47
14	1.0470	3.3754	46
15	1.0471	3.3722	**45**
16	1.0472	3.3691	44
17	1.0473	3.3659	43
18	1.0474	3.3628	42
19	1.0475	3.3596	41
20	1.0476	3.3565	**40**
21	1.0477	3.3534	39
22	1.0478	3.3502	38
23	1.0479	3.3471	37
24	1.0480	3.3440	36
25	1.0480	3.3409	**35**
26	1.0481	3.3378	34
27	1.0482	3.3347	33
28	1.0483	3.3317	32
29	1.0484	3.3286	31
30	1.0485	3.3255	**30**
31	1.0486	3.3224	29
32	1.0487	3.3194	28
33	1.0488	3.3163	27
34	1.0489	3.3133	26
35	1.0490	3.3102	**25**
36	1.0491	3.3072	24
37	1.0492	3.3042	23
38	1.0493	3.3012	22
39	1.0494	3.2981	21
40	1.0495	3.2951	**20**
41	1.0496	3.2921	19
42	1.0497	3.2891	18
43	1.0498	3.2861	17
44	1.0499	3.2831	16
45	1.0500	3.2801	**15**
46	1.0501	3.2772	14
47	1.0502	3.2742	13
48	1.0503	3.2712	12
49	1.0504	3.2683	11
50	1.0505	3.2653	**10**
51	1.0506	3.2624	9
52	1.0507	3.2594	8
53	1.0508	3.2565	7
54	1.0509	3.2535	6
55	1.0510	3.2506	**5**
56	1.0511	3.2477	4
57	1.0512	3.2448	3
58	1.0513	3.2419	2
59	1.0514	3.2390	1
60	1.0515	3.2361	**0**
′	Csc	Sec	′

107° (287°) (252°) **72°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

18° (198°) (341°) **161°**

′	Sec	Csc	′
0	1.0515	3.2361	**60**
1	1.0516	3.2332	59
2	1.0517	3.2303	58
3	1.0518	3.2274	57
4	1.0519	3.2245	56
5	1.0520	3.2217	**55**
6	1.0521	3.2188	54
7	1.0522	3.2159	53
8	1.0523	3.2131	52
9	1.0524	3.2102	51
10	1.0525	3.2074	**50**
11	1.0526	3.2045	49
12	1.0527	3.2017	48
13	1.0528	3.1989	47
14	1.0529	3.1960	46
15	1.0530	3.1932	**45**
16	1.0531	3.1904	44
17	1.0532	3.1876	43
18	1.0533	3.1848	42
19	1.0534	3.1820	41
20	1.0535	3.1792	**40**
21	1.0536	3.1764	39
22	1.0537	3.1736	38
23	1.0538	3.1708	37
24	1.0539	3.1681	36
25	1.0540	3.1653	**35**
26	1.0541	3.1625	34
27	1.0542	3.1598	33
28	1.0543	3.1570	32
29	1.0544	3.1543	31
30	1.0545	3.1515	**30**
31	1.0546	3.1488	29
32	1.0547	3.1461	28
33	1.0548	3.1433	27
34	1.0549	3.1406	26
35	1.0550	3.1379	**25**
36	1.0551	3.1352	24
37	1.0552	3.1325	23
38	1.0553	3.1298	22
39	1.0554	3.1271	21
40	1.0555	3.1244	**20**
41	1.0556	3.1217	19
42	1.0557	3.1190	18
43	1.0558	3.1163	17
44	1.0559	3.1137	16
45	1.0560	3.1110	**15**
46	1.0561	3.1083	14
47	1.0563	3.1057	13
48	1.0564	3.1030	12
49	1.0565	3.1004	11
50	1.0566	3.0977	**10**
51	1.0567	3.0951	9
52	1.0568	3.0925	8
53	1.0569	3.0898	7
54	1.0570	3.0872	6
55	1.0571	3.0846	**5**
56	1.0572	3.0820	4
57	1.0573	3.0794	3
58	1.0574	3.0768	2
59	1.0575	3.0742	1
60	1.0576	3.0716	**0**
′	Csc	Sec	′

108° (288°) (251°) **71°**

19° (199°) (340°) **160°**

′	Sec	Csc	′
0	1.0576	3.0716	**60**
1	1.0577	3.0690	59
2	1.0578	3.0664	58
3	1.0579	3.0638	57
4	1.0580	3.0612	56
5	1.0582	3.0586	**55**
6	1.0583	3.0561	54
7	1.0584	3.0535	53
8	1.0585	3.0509	52
9	1.0586	3.0484	51
10	1.0587	3.0458	**50**
11	1.0588	3.0433	49
12	1.0589	3.0407	48
13	1.0590	3.0382	47
14	1.0591	3.0357	46
15	1.0592	3.0331	**45**
16	1.0593	3.0306	44
17	1.0594	3.0281	43
18	1.0595	3.0256	42
19	1.0597	3.0231	41
20	1.0598	3.0206	**40**
21	1.0599	3.0181	39
22	1.0600	3.0156	38
23	1.0601	3.0131	37
24	1.0602	3.0106	36
25	1.0603	3.0081	**35**
26	1.0604	3.0056	34
27	1.0605	3.0031	33
28	1.0606	3.0007	32
29	1.0607	2.9982	31
30	1.0608	2.9957	**30**
31	1.0610	2.9933	29
32	1.0611	2.9908	28
33	1.0612	2.9884	27
34	1.0613	2.9859	26
35	1.0614	2.9835	**25**
36	1.0615	2.9811	24
37	1.0616	2.9786	23
38	1.0617	2.9762	22
39	1.0618	2.9738	21
40	1.0619	2.9713	**20**
41	1.0621	2.9689	19
42	1.0622	2.9665	18
43	1.0623	2.9641	17
44	1.0624	2.9617	16
45	1.0625	2.9593	**15**
46	1.0626	2.9569	14
47	1.0627	2.9545	13
48	1.0628	2.9521	12
49	1.0629	2.9498	11
50	1.0631	2.9474	**10**
51	1.0632	2.9450	9
52	1.0633	2.9426	8
53	1.0634	2.9403	7
54	1.0635	2.9379	6
55	1.0636	2.9355	**5**
56	1.0637	2.9332	4
57	1.0638	2.9308	3
58	1.0640	2.9285	2
59	1.0641	2.9261	1
60	1.0642	2.9238	**0**
′	Csc	Sec	′

109° (289°) (250°) **70°**

20° (200°) (339°) **159°**

′	Sec	Csc	′
0	1.0642	2.9238	**60**
1	1.0643	2.9215	59
2	1.0644	2.9191	58
3	1.0645	2.9168	57
4	1.0646	2.9145	56
5	1.0647	2.9122	**55**
6	1.0649	2.9099	54
7	1.0650	2.9075	53
8	1.0651	2.9052	52
9	1.0652	2.9029	51
10	1.0653	2.9006	**50**
11	1.0654	2.8983	49
12	1.0655	2.8960	48
13	1.0657	2.8938	47
14	1.0658	2.8915	46
15	1.0659	2.8892	**45**
16	1.0660	2.8869	44
17	1.0661	2.8846	43
18	1.0662	2.8824	42
19	1.0663	2.8801	41
20	1.0665	2.8779	**40**
21	1.0666	2.8756	39
22	1.0667	2.8733	38
23	1.0668	2.8711	37
24	1.0669	2.8688	36
25	1.0670	2.8666	**35**
26	1.0671	2.8644	34
27	1.0673	2.8621	33
28	1.0674	2.8599	32
29	1.0675	2.8577	31
30	1.0676	2.8555	**30**
31	1.0677	2.8532	29
32	1.0678	2.8510	28
33	1.0680	2.8488	27
34	1.0681	2.8466	26
35	1.0682	2.8444	**25**
36	1.0683	2.8422	24
37	1.0684	2.8400	23
38	1.0685	2.8378	22
39	1.0687	2.8356	21
40	1.0688	2.8334	**20**
41	1.0689	2.8312	19
42	1.0690	2.8291	18
43	1.0691	2.8269	17
44	1.0692	2.8247	16
45	1.0694	2.8225	**15**
46	1.0695	2.8204	14
47	1.0696	2.8182	13
48	1.0697	2.8161	12
49	1.0698	2.8139	11
50	1.0700	2.8117	**10**
51	1.0701	2.8096	9
52	1.0702	2.8075	8
53	1.0703	2.8053	7
54	1.0704	2.8032	6
55	1.0705	2.8010	**5**
56	1.0707	2.7989	4
57	1.0708	2.7968	3
58	1.0709	2.7947	2
59	1.0710	2.7925	1
60	1.0711	2.7904	**0**
′	Csc	Sec	′

110° (290°) (249°) **69°**

21° (201°) (338°) **158°**

′	Sec	Csc	′
0	1.0711	2.7904	**60**
1	1.0713	2.7883	59
2	1.0714	2.7862	58
3	1.0715	2.7841	57
4	1.0716	2.7820	56
5	1.0717	2.7799	**55**
6	1.0719	2.7778	54
7	1.0720	2.7757	53
8	1.0721	2.7736	52
9	1.0722	2.7715	51
10	1.0723	2.7695	**50**
11	1.0725	2.7674	49
12	1.0726	2.7653	48
13	1.0727	2.7632	47
14	1.0728	2.7612	46
15	1.0730	2.7591	**45**
16	1.0731	2.7570	44
17	1.0732	2.7550	43
18	1.0733	2.7529	42
19	1.0734	2.7509	41
20	1.0736	2.7488	**40**
21	1.0737	2.7468	39
22	1.0738	2.7447	38
23	1.0739	2.7427	37
24	1.0740	2.7407	36
25	1.0742	2.7386	**35**
26	1.0743	2.7366	34
27	1.0744	2.7346	33
28	1.0745	2.7325	32
29	1.0747	2.7305	31
30	1.0748	2.7285	**30**
31	1.0749	2.7265	29
32	1.0760	2.7245	28
33	1.0752	2.7225	27
34	1.0753	2.7205	26
35	1.0754	2.7185	**25**
36	1.0755	2.7165	24
37	1.0757	2.7145	23
38	1.0758	2.7125	22
39	1.0759	2.7105	21
40	1.0760	2.7085	**20**
41	1.0761	2.7065	19
42	1.0763	2.7046	18
43	1.0764	2.7026	17
44	1.0765	2.7006	16
45	1.0766	2.6986	**15**
46	1.0768	2.6967	14
47	1.0769	2.6947	13
48	1.0770	2.6927	12
49	1.0771	2.6908	11
50	1.0773	2.6888	**10**
51	1.0774	2.6869	9
52	1.0775	2.6849	8
53	1.0777	2.6830	7
54	1.0778	2.6811	6
55	1.0779	2.6791	**5**
56	1.0780	2.6772	4
57	1.0782	2.6752	3
58	1.0783	2.6733	2
59	1.0784	2.6714	1
60	1.0785	2.6695	**0**
′	Csc	Sec	′

111° (291°) (248°) **68°**

22° (202°) (337°) **157°**

′	Sec	Csc	′
0	1.0785	2.6695	**60**
1	1.0787	2.6675	59
2	1.0788	2.6656	58
3	1.0789	2.6637	57
4	1.0790	2.6618	56
5	1.0792	2.6599	**55**
6	1.0793	2.6580	54
7	1.0794	2.6561	53
8	1.0796	2.6542	52
9	1.0797	2.6523	51
10	1.0798	2.6504	**50**
11	1.0799	2.6485	49
12	1.0801	2.6466	48
13	1.0802	2.6447	47
14	1.0803	2.6429	46
15	1.0804	2.6410	**45**
16	1.0806	2.6391	44
17	1.0807	2.6372	43
18	1.0808	2.6354	42
19	1.0810	2.6335	41
20	1.0811	2.6316	**40**
21	1.0812	2.6298	39
22	1.0814	2.6279	38
23	1.0815	2.6260	37
24	1.0816	2.6242	36
25	1.0817	2.6223	**35**
26	1.0819	2.6205	34
27	1.0820	2.6186	33
28	1.0821	2.6168	32
29	1.0823	2.6150	31
30	1.0824	2.6131	**30**
31	1.0825	2.6113	29
32	1.0827	2.6095	28
33	1.0828	2.6076	27
34	1.0829	2.6058	26
35	1.0830	2.6040	**25**
36	1.0832	2.6022	24
37	1.0833	2.6003	23
38	1.0834	2.5985	22
39	1.0836	2.5967	21
40	1.0837	2.5949	**20**
41	1.0838	2.5931	19
42	1.0840	2.5913	18
43	1.0841	2.5895	17
44	1.0842	2.5877	16
45	1.0844	2.5859	**15**
46	1.0845	2.5841	14
47	1.0846	2 5823	13
48	1.0848	2.5805	12
49	1.0849	2.5788	11
50	1.0850	2.5770	**10**
51	1.0852	2.5752	9
52	1.0853	2.5734	8
53	1.0854	2.5716	7
54	1.0856	2.5699	6
55	1.0857	2.5681	**5**
56	1.0858	2.5663	4
57	1.0860	2.5646	3
58	1.0861	2.5628	2
59	1.0862	2.5611	1
60	1.0864	2.5593	**0**
′	Csc	Sec	′

112° (292°) (247°) **67°**

23° (203°) (336°) **156°**

′	Sec	Csc	′
0	1.0864	2.5593	**60**
1	1.0865	2.5576	59
2	1.0866	2.5558	58
3	1.0868	2.5541	57
4	1.0869	2.5523	56
5	1.0870	2.5506	**55**
6	1.0872	2.5488	54
7	1.0873	2.5471	53
8	1.0874	2.5454	52
9	1.0876	2.5436	51
10	1.0877	2.5419	**50**
11	1.0878	2.5402	49
12	1.0880	2.5384	48
13	1.0881	2.5367	47
14	1.0883	2.5350	46
15	1.0884	2.5333	**45**
16	1.0885	2.5316	44
17	1.0887	2.5299	43
18	1.0888	2.5282	42
19	1.0889	2.5264	41
20	1.0891	2.5247	**40**
21	1.0892	2.5230	39
22	1.0893	2.5213	38
23	1.0895	2.5196	37
24	1.0896	2.5180	36
25	1.0898	2.5163	**35**
26	1.0899	2.5146	34
27	1.0900	2.5129	33
28	1.0902	2.5112	32
29	1.0903	2.5095	31
30	1.0904	2.5078	**30**
31	1.0906	2.5062	29
32	1.0907	2.5045	28
33	1.0909	2.5028	27
34	1.0910	2.5012	26
35	1.0911	2.4995	**25**
36	1.0913	2.4978	24
37	1.0914	2.4962	23
38	1.0915	2.4945	22
39	1.0917	2.4928	21
40	1.0918	2.4912	**20**
41	1.0920	2.4895	19
42	1.0921	2.4879	18
43	1.0922	2.4862	17
44	1.0924	2.4846	16
45	1.0925	2.4830	**15**
46	1.0927	2.4813	14
47	1.0928	2.4797	13
48	1.0929	2.4780	12
49	1.0931	2.4764	11
50	1.0932	2.4748	**10**
51	1.0934	2.4731	9
52	1.0935	2.4715	8
53	1.0936	2.4699	7
54	1.0938	2.4683	6
55	1.0939	2.4667	**5**
56	1.0941	2.4650	4
57	1.0942	2.4634	3
58	1.0944	2.4618	2
59	1.0945	2.4602	1
60	1.0946	2.4586	**0**
′	Csc	Sec	′

113° (293°) (246°) **66°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

24° (204°) (335°) **155°**

′	Sec	Csc	′
0	1.0946	2.4586	**60**
1	1.0948	2.4570	59
2	1.0949	2.4554	58
3	1.0951	2.4538	57
4	1.0952	2.4522	56
5	1.0953	2.4506	**55**
6	1.0955	2.4490	54
7	1.0956	2.4474	53
8	1.0958	2.4458	52
9	1.0959	2.4442	51
10	1.0961	2.4426	**50**
11	1.0962	2.4411	49
12	1.0963	2.4395	48
13	1.0965	2.4379	47
14	1.0966	2.4363	46
15	1.0968	2.4348	**45**
16	1.0969	2.4332	44
17	1.0971	2.4316	43
18	1.0972	2.4300	42
19	1.0974	2.4285	41
20	1.0975	2.4269	**40**
21	1.0976	2.4254	39
22	1.0978	2.4238	38
23	1.0979	2.4222	37
24	1.0981	2.4207	36
25	1.0982	2.4191	**35**
26	1.0984	2.4176	34
27	1.0985	2.4160	33
28	1.0987	2.4145	32
29	1.0988	2.4130	31
30	1.0989	2.4114	**30**
31	1.0991	2.4099	29
32	1.0992	2.4083	28
33	1.0994	2.4068	27
34	1.0995	2.4053	26
35	1.0997	2.4038	**25**
36	1.0998	2.4022	24
37	1.1000	2.4007	23
38	1.1001	2.3992	22
39	1.1003	2.3977	21
40	1.1004	2.3961	**20**
41	1.1006	2.3946	19
42	1.1007	2.3931	18
43	1.1009	2.3916	17
44	1.1010	2.3901	16
45	1.1011	2.3886	**15**
46	1.1013	2.3871	14
47	1.1014	2.3856	13
48	1.1016	2.3841	12
49	1.1017	2.3826	11
50	1.1019	2.3811	**10**
51	1.1020	2.3796	9
52	1.1022	2.3781	8
53	1.1023	2.3766	7
54	1.1025	2.3751	6
55	1.1026	2.3736	**5**
56	1.1028	2.3721	4
57	1.1029	2.3706	3
58	1.1031	2.3692	2
59	1.1032	2.3677	1
60	1.1034	2.3662	**0**
′	Csc	Sec	′

114° (294°) (245°) **65°**

25° (205°) (334°) **154°**

′	Sec	Csc	′
0	1.1034	2.3662	**60**
1	1.1035	2.3647	59
2	1.1037	2.3633	58
3	1.1038	2.3618	57
4	1.1040	2.3603	56
5	1.1041	2.3588	**55**
6	1.1043	2.3574	54
7	1.1044	2.3559	53
8	1.1046	2.3545	52
9	1.1047	2.3530	51
10	1.1049	2.3515	**50**
11	1.1050	2.3501	49
12	1.1052	2.3486	48
13	1.1053	2.3472	47
14	1.1055	2.3457	46
15	1.1056	2.3443	**45**
16	1.1058	2.3428	44
17	1.1059	2.3414	43
18	1.1061	2.3400	42
19	1.1062	2.3385	41
20	1.1064	2.3371	**40**
21	1.1066	2.3356	39
22	1.1067	2.3342	38
23	1.1069	2.3328	37
24	1.1070	2.3314	36
25	1.1072	2.3299	**35**
26	1.1073	2.3285	34
27	1.1075	2.3271	33
28	1.1076	2.3257	32
29	1.1078	2.3242	31
30	1.1079	2.3228	**30**
31	1.1081	2.3214	29
32	1.1082	2.3200	28
33	1.1084	2.3186	27
34	1.1085	2.3172	26
35	1.1087	2.3158	**25**
36	1.1089	2.3144	24
37	1.1090	2.3130	23
38	1.1092	2.3115	22
39	1.1093	2.3101	21
40	1.1095	2.3088	**20**
41	1.1096	2.3074	19
42	1.1098	2.3060	18
43	1.1099	2.3046	17
44	1.1101	2.3032	16
45	1.1102	2.3018	**15**
46	1.1104	2.3004	14
47	1.1106	2.2990	13
48	1.1107	2.2976	12
49	1.1109	2.2962	11
50	1.1110	2.2949	**10**
51	1.1112	2.2935	9
52	1.1113	2.2921	8
53	1.1115	2.2907	7
54	1.1117	2.2894	6
55	1.1118	2.2880	**5**
56	1.1120	2.2866	4
57	1.1121	2.2853	3
58	1.1123	2.2839	2
59	1.1124	2.2825	1
60	1.1126	2.2812	**0**
′	Csc	Sec	′

115° (295°) (244°) **64°**

26° (206°) (333°) **153°**

′	Sec	Csc	′
0	1.1126	2.2812	**60**
1	1.1128	2.2798	59
2	1.1129	2.2785	58
3	1.1131	2.2771	57
4	1.1132	2.2757	56
5	1.1134	2.2744	**55**
6	1.1136	2.2730	54
7	1.1137	2.2717	53
8	1.1139	2.2703	52
9	1.1140	2.2690	51
10	1.1142	2.2677	**50**
11	1.1143	2.2663	49
12	1.1145	2.2650	48
13	1.1147	2.2636	47
14	1.1148	2.2623	46
15	1.1150	2.2610	**45**
16	1.1151	2.2596	44
17	1.1153	2.2583	43
18	1.1155	2.2570	42
19	1.1156	2.2556	41
20	1.1158	2.2543	**40**
21	1.1159	2.2530	39
22	1.1161	2.2517	38
23	1.1163	2.2504	37
24	1.1164	2.2490	36
25	1.1166	2.2477	**35**
26	1.1168	2.2464	34
27	1.1169	2.2451	33
28	1.1171	2.2438	32
29	1.1172	2.2425	31
30	1.1174	2.2412	**30**
31	1.1176	2.2399	29
32	1.1177	2.2385	28
33	1.1179	2.2372	27
34	1.1180	2.2359	26
35	1.1182	2.2346	**25**
36	1.1184	2.2333	24
37	1.1185	2.2320	23
38	1.1187	2.2308	22
39	1.1189	2.2295	21
40	1.1190	2.2282	**20**
41	1.1192	2.2269	19
42	1.1194	2.2256	18
43	1.1195	2.2243	17
44	1.1197	2.2230	16
45	1.1198	2.2217	**15**
46	1.1200	2.2205	14
47	1.1202	2.2192	13
48	1.1203	2.2179	12
49	1.1205	2.2166	11
50	1.1207	2.2153	**10**
51	1.1208	2.2141	9
52	1.1210	2.2128	8
53	1.1212	2.2115	7
54	1.1213	2.2103	6
55	1.1215	2.2090	**5**
56	1.1217	2.2077	4
57	1.1218	2.2065	3
58	1.1220	2.2052	2
59	1.1222	2.2039	1
60	1.1223	2.2027	**0**
′	Csc	Sec	′

116° (296°) (243°) **63°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

27° (207°) (332°) **152°**

'	Sec	Csc	'
0	1.1223	2.2027	**60**
1	1.1225	2.2014	59
2	1.1227	2.2002	58
3	1.1228	2.1989	57
4	1.1230	2.1977	56
5	1.1232	2.1964	**55**
6	1.1233	2.1952	54
7	1.1235	2.1939	53
8	1.1237	2.1927	52
9	1.1238	2.1914	51
10	1.1240	2.1902	**50**
11	1.1242	2.1890	49
12	1.1243	2.1877	48
13	1.1245	2.1865	47
14	1.1247	2.1852	46
15	1.1248	2.1840	**45**
16	1.1250	2.1828	44
17	1.1252	2.1815	43
18	1.1253	2.1803	42
19	1.1255	2.1791	41
20	1.1257	2.1779	**40**
21	1.1259	2.1766	39
22	1.1260	2.1754	38
23	1.1262	2.1742	37
24	1.1264	2.1730	36
25	1.1265	2.1718	**35**
26	1.1267	2.1705	34
27	1.1269	2.1693	33
28	1.1270	2.1681	32
29	1.1272	2.1669	31
30	1.1274	2.1657	**30**
31	1.1276	2.1645	29
32	1.1277	2.1633	28
33	1.1279	2.1621	27
34	1.1281	2.1609	26
35	1.1282	2.1596	**25**
36	1.1284	2.1584	24
37	1.1286	2.1572	23
38	1.1288	2.1560	22
39	1.1289	2.1549	21
40	1.1291	2.1537	**20**
41	1.1293	2.1525	19
42	1.1294	2.1513	18
43	1.1296	2.1501	17
44	1.1298	2.1489	16
45	1.1300	2.1477	**15**
46	1.1301	2.1465	14
47	1.1303	2.1453	13
48	1.1305	2.1441	12
49	1.1307	2.1430	11
50	1.1308	2.1418	**10**
51	1.1310	2.1406	9
52	1.1312	2.1394	8
53	1.1313	2.1382	7
54	1.1315	2.1371	6
55	1.1317	2.1359	**5**
56	1.1319	2.1347	4
57	1.1320	2.1336	3
58	1.1322	2.1324	2
59	1.1324	2.1312	1
60	1.1326	2.1301	**0**
'	Csc	Sec	'

117° (297°) (242°) **62°**

28° (208°) (331°) **151°**

'	Sec	Csc	'
0	1.1326	2.1301	**60**
1	1.1327	2.1289	59
2	1.1329	2.1277	58
3	1.1331	2.1266	57
4	1.1333	2.1254	56
5	1.1334	2.1242	**55**
6	1.1336	2.1231	54
7	1.1338	2.1219	53
8	1.1340	2.1208	52
9	1.1342	2.1196	51
10	1.1343	2.1185	**50**
11	1.1345	2.1173	49
12	1.1347	2.1162	48
13	1.1349	2.1150	47
14	1.1350	2.1139	46
15	1.1352	2.1127	**45**
16	1.1354	2.1116	44
17	1.1356	2.1105	43
18	1.1357	2.1093	42
19	1.1359	2.1082	41
20	1.1361	2.1070	**40**
21	1.1363	2.1059	39
22	1.1365	2.1048	38
23	1.1366	2.1036	37
24	1.1368	2.1025	36
25	1.1370	2.1014	**35**
26	1.1372	2.1002	34
27	1.1374	2.0991	33
28	1.1375	2.0980	32
29	1.1377	2.0969	31
30	1.1379	2.0957	**30**
31	1.1381	2.0946	29
32	1.1383	2.0935	28
33	1.1384	2.0924	27
34	1.1386	2.0913	26
35	1.1388	2.0901	**25**
36	1.1390	2.0890	24
37	1.1392	2.0879	23
38	1.1393	2.0868	22
39	1.1395	2.0857	21
40	1.1397	2.0846	**20**
41	1.1399	2.0835	19
42	1.1401	2.0824	18
43	1.1402	2.0813	17
44	1.1404	2.0802	16
45	1.1406	2.0791	**15**
46	1.1408	2.0779	14
47	1.1410	2.0768	13
48	1.1412	2.0757	12
49	1.1413	2.0747	11
50	1.1415	2.0736	**10**
51	1.1417	2.0725	9
52	1.1419	2.0714	8
53	1.1421	2.0703	7
54	1.1423	2.0692	6
55	1.1424	2.0681	**5**
56	1.1426	2.0670	4
57	1.1428	2.0659	3
58	1.1430	2.0648	2
59	1.1432	2.0637	1
60	1.1434	2.0627	**0**
'	Csc	Sec	'

118° (298°) (241°) **61°**

29° (209°) (330)° **150°**

'	Sec	Csc	'
0	1.1434	2.0627	**60**
1	1.1435	2.0616	59
2	1.1437	2.0605	58
3	1.1439	2.0594	57
4	1.1441	2.0583	56
5	1.1443	2.0573	**55**
6	1.1445	2.0562	54
7	1.1446	2.0551	53
8	1.1448	2.0540	52
9	1.1450	2.0530	51
10	1.1452	2.0519	**50**
11	1.1454	2.0508	49
12	1.1456	2.0498	48
13	1.1458	2.0487	47
14	1.1460	2.0476	46
15	1.1461	2.0466	**45**
16	1.1463	2.0455	44
17	1.1465	2.0445	43
18	1.1467	2.0434	42
19	1.1469	2.0423	41
20	1.1471	2.0413	**40**
21	1.1473	2.0402	39
22	1.1474	2.0392	38
23	1.1476	2.0381	37
24	1.1478	2.0371	36
25	1.1480	2.0360	**35**
26	1.1482	2.0350	34
27	1.1484	2.0339	33
28	1.1486	2.0329	32
29	1.1488	2.0318	31
30	1.1490	2.0308	**30**
31	1.1491	2.0297	29
32	1.1493	2.0287	28
33	1.1495	2.0276	27
34	1.1497	2.0266	26
35	1.1499	2.0256	**25**
36	1.1501	2.0245	24
37	1.1503	2.0235	23
38	1.1505	2.0225	22
39	1.1507	2.0214	21
40	1.1509	2.0204	**20**
41	1.1510	2.0194	19
42	1.1512	2.0183	18
43	1.1514	2.0173	17
44	1.1516	2.0163	16
45	1.1518	2.0152	**15**
46	1.1520	2.0142	14
47	1.1522	2.0132	13
48	1.1524	2.0122	12
49	1.1526	2.0112	11
50	1.1528	2.0101	**10**
51	1.1530	2.0091	9
52	1.1532	2.0081	8
53	1.1533	2.0071	7
54	1.1535	2.0061	6
55	1.1537	2.0051	**5**
56	1.1539	2.0040	4
57	1.1541	2.0030	3
58	1.1543	2.0020	2
59	1.1545	2.0010	1
60	1.1547	2.0000	**0**
'	Csc	Sec	'

119° (299°) (240°) **60°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

30° (210°) (329°) **149°**

′	Sec	Csc	′
0	1.1547	2.0000	**60**
1	1.1549	1.9990	59
2	1.1551	1.9980	58
3	1.1553	1.9970	57
4	1.1555	1.9960	56
5	1.1557	1.9950	**55**
6	1.1559	1.9940	54
7	1.1561	1.9930	53
8	1.1563	1.9920	52
9	1.1565	1.9910	51
10	1.1566	1.9900	**50**
11	1.1568	1.9890	49
12	1.1570	1.9880	48
13	1.1572	1.9870	47
14	1.1574	1.9860	46
15	1.1576	1.9850	**45**
16	1.1578	1.9840	44
17	1.1580	1.9830	43
18	1.1582	1.9821	42
19	1.1584	1.9811	41
20	1.1586	1.9801	**40**
21	1.1588	1.9791	39
22	1.1590	1.9781	38
23	1.1592	1.9771	37
24	1.1594	1.9762	36
25	1.1596	1.9752	**35**
26	1.1598	1.9742	34
27	1.1600	1.9732	33
28	1.1602	1.9722	32
29	1.1604	1.9713	31
30	1.1606	1.9703	**30**
31	1.1608	1.9693	29
32	1.1610	1.9684	28
33	1.1612	1.9674	27
34	1.1614	1.9664	26
35	1.1616	1.9654	**25**
36	1.1618	1.9645	24
37	1.1620	1.9635	23
38	1.1622	1.9625	22
39	1.1624	1.9616	21
40	1.1626	1.9606	**20**
41	1.1628	1.9597	19
42	1.1630	1.9587	18
43	1.1632	1.9577	17
44	1.1634	1.9568	16
45	1.1636	1.9558	**15**
46	1.1638	1.9549	14
47	1.1640	1.9539	13
48	1.1642	1.9530	12
49	1.1644	1.9520	11
50	1.1646	1.9511	**10**
51	1.1648	1.9501	9
52	1.1650	1.9492	8
53	1.1652	1.9482	7
54	1.1654	1.9473	6
55	1.1656	1.9463	**5**
56	1.1658	1.9454	4
57	1.1660	1.9444	3
58	1.1662	1.9435	2
59	1.1664	1.9425	1
60	1.1666	1.9416	**0**
′	Csc	Sec	′

120° (300°) (239°) **59°**

31° (211°) (328°) **148°**

′	Sec	Csc	′
0	1.1666	1.9416	**60**
1	1.1668	1.9407	59
2	1.1670	1.9397	58
3	1.1672	1.9388	57
4	1.1675	1.9379	56
5	1.1677	1.9369	**55**
6	1.1679	1.9360	54
7	1.1681	1.9351	53
8	1.1683	1.9341	52
9	1.1685	1.9332	51
10	1.1687	1.9323	**50**
11	1.1689	1.9313	49
12	1.1691	1.9304	48
13	1.1693	1.9205	47
14	1.1695	1.9285	46
15	1.1697	1.9276	**45**
16	1.1699	1.9267	44
17	1.1701	1.9258	43
18	1.1703	1.9249	42
19	1.1705	1.9239	41
20	1.1707	1.9230	**40**
21	1.1710	1.9221	39
22	1.1712	1.9212	38
23	1.1714	1.9203	37
24	1.1716	1.9194	36
25	1.1718	1.9184	**35**
26	1.1720	1.9175	34
27	1.1722	1.9166	33
28	1.1724	1.9157	32
29	1.1726	1.9148	31
30	1.1728	1.9139	**30**
31	1.1730	1.9130	29
32	1.1732	1.9121	28
33	1.1735	1.9112	27
34	1.1737	1.9103	26
35	1.1739	1.9094	**25**
36	1.1741	1.9084	24
37	1.1743	1.9075	23
38	1.1745	1.9066	22
39	1.1747	1.9057	21
40	1.1749	1.9048	**20**
41	1.1751	1.9039	19
42	1.1753	1.9031	18
43	1.1756	1.9022	17
44	1.1758	1.9013	16
45	1.1760	1.9004	**15**
46	1.1762	1.8995	14
47	1.1764	1.8986	13
48	1.1766	1.8977	12
49	1.1768	1.8968	11
50	1.1770	1.8959	**10**
51	1.1773	1.8950	9
52	1.1775	1.8941	8
53	1.1777	1.8933	7
54	1.1779	1.8924	6
55	1.1781	1.8915	**5**
56	1.1783	1.8906	4
57	1.1785	1.8897	3
58	1.1788	1.8888	2
59	1.1790	1.8880	1
60	1.1792	1.8871	**0**
′	Csc	Sec	′

121° (301°) (238°) **58°**

32° (212°) (327°) **147°**

′	Sec	Csc	′
0	1.1792	1.8871	**60**
1	1.1794	1.8862	59
2	1.1796	1.8853	58
3	1.1798	1.8844	57
4	1.1800	1.8836	56
5	1.1803	1.8827	**55**
6	1.1805	1.8818	54
7	1.1807	1.8810	53
8	1.1809	1.8801	52
9	1.1811	1.8792	51
10	1.1813	1.8783	**50**
11	1.1815	1.8775	49
12	1.1818	1.8766	48
13	1.1820	1.8757	47
14	1.1822	1.8749	46
15	1.1824	1.8740	**45**
16	1.1826	1.8731	44
17	1.1828	1.8723	43
18	1.1831	1.8714	42
19	1.1833	1.8706	41
20	1.1835	1.8697	**40**
21	1.1837	1.8688	39
22	1.1839	1.8680	38
23	1.1842	1.8671	37
24	1.1844	1.8663	36
25	1.1846	1.8654	**35**
26	1.1848	1.8646	34
27	1.1850	1.8637	33
28	1.1852	1.8629	32
29	1.1855	1.8620	31
30	1.1857	1.8612	**30**
31	1.1859	1.8603	29
32	1.1861	1.8595	28
33	1.1863	1.8586	27
34	1.1866	1.8578	26
35	1.1868	1.8569	**25**
36	1.1870	1.8561	24
37	1.1872	1.8552	23
38	1.1875	1.8544	22
39	1.1877	1.8535	21
40	1.1879	1.8527	**20**
41	1.1881	1.8519	19
42	1.1883	1.8510	18
43	1.1886	1.8502	17
44	1.1888	1.8494	16
45	1.1890	1.8485	**15**
46	1.1892	1.8477	14
47	1.1895	1.8468	13
48	1.1897	1.8460	12
49	1.1899	1.8452	11
50	1.1901	1.8443	**10**
51	1.1903	1.8435	9
52	1.1906	1.8427	8
53	1.1908	1.8419	7
54	1.1910	1.8410	6
55	1.1912	1.8402	**5**
56	1.1915	1.8394	4
57	1.1917	1.8385	3
58	1.1919	1.8377	2
59	1.1921	1.8369	1
60	1.1924	1.8361	**0**
′	Csc	Sec	′

122° (302°) (237°) **57°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

33° (213°) (326°) **146°**

′	Sec	Csc	′
0	1.1924	1.8361	**60**
1	1.1926	1.8353	59
2	1.1928	1.8344	58
3	1.1930	1.8336	57
4	1.1933	1.8328	56
5	1.1935	1.8320	**55**
6	1.1937	1.8312	54
7	1.1939	1.8303	53
8	1.1942	1.8295	52
9	1.1944	1.8287	51
10	1.1946	1.8279	**50**
11	1.1949	1.8271	49
12	1.1951	1.8263	48
13	1.1953	1.8255	47
14	1.1955	1.8247	46
15	1.1958	1.8238	**45**
16	1.1960	1.8230	44
17	1.1962	1.8222	43
18	1.1964	1.8214	42
19	1.1967	1.8206	41
20	1.1969	1.8198	**40**
21	1.1971	1.8190	39
22	1.1974	1.8182	38
23	1.1976	1.8174	37
24	1.1978	1.8166	36
25	1.1981	1.8158	**35**
26	1.1983	1.8150	34
27	1.1985	1.8142	33
28	1.1987	1.8134	32
29	1.1990	1.8126	31
30	1.1992	1.8118	**30**
31	1.1994	1.8110	29
32	1.1997	1.8102	28
33	1.1999	1.8094	27
34	1.2001	1.8086	26
35	1.2004	1.8078	**25**
36	1.2006	1.8070	24
37	1.2008	1.8062	23
38	1.2011	1.8055	22
39	1.2013	1.8047	21
40	1.2015	1.8039	**20**
41	1.2018	1.8031	19
42	1.2020	1.8023	18
43	1.2022	1.8015	17
44	1.2025	1.8007	16
45	1.2027	1.8000	**15**
46	1.2029	1.7992	14
47	1.2032	1.7984	13
48	1.2034	1.7976	12
49	1.2036	1.7968	11
50	1.2039	1.7960	**10**
51	1.2041	1.7953	9
52	1.2043	1.7945	8
53	1.2046	1.7937	7
54	1.2048	1.7929	6
55	1.2050	1.7922	**5**
56	1.2053	1.7914	4
57	1.2055	1.7906	3
58	1.2057	1.7898	2
59	1.2060	1.7891	1
60	1.2062	1.7883	**0**
′	Csc	Sec	′

123° (303°) (236°) **56°**

34° (214°) (325°) **145°**

′	Sec	Csc	′
0	1.2062	1.7883	**60**
1	1.2065	1.7875	59
2	1.2067	1.7868	58
3	1.2069	1.7860	57
4	1.2072	1.7852	56
5	1.2074	1.7844	**55**
6	1.2076	1.7837	54
7	1.2079	1.7829	53
8	1.2081	1.7821	52
9	1.2084	1.7814	51
10	1.2086	1.7806	**50**
11	1.2088	1.7799	49
12	1.2091	1.7791	48
13	1.2093	1.7783	47
14	1.2096	1.7776	46
15	1.2098	1.7768	**45**
16	1.2100	1.7761	44
17	1.2103	1.7753	43
18	1.2105	1.7745	42
19	1.2108	1.7738	41
20	1.2110	1.7730	**40**
21	1.2112	1.7723	39
22	1.2115	1.7715	38
23	1.2117	1.7708	37
24	1.2120	1.7700	36
25	1.2122	1.7693	**35**
26	1.2124	1.7685	34
27	1.2127	1.7678	33
28	1.2129	1.7670	32
29	1.2132	1.7663	31
30	1.2134	1.7655	**30**
31	1.2136	1.7648	29
32	1.2139	1.7640	28
33	1.2141	1.7633	27
34	1.2144	1.7625	26
35	1.2146	1.7618	**25**
36	1.2149	1.7610	24
37	1.2151	1.7603	23
38	1.2154	1.7596	22
39	1.2156	1.7588	21
40	1.2158	1.7581	**20**
41	1.2161	1.7573	19
42	1.2163	1.7566	18
43	1.2166	1.7559	17
44	1.2168	1.7551	16
45	1.2171	1.7544	**15**
46	1.2173	1.7537	14
47	1.2176	1.7529	13
48	1.2178	1.7522	12
49	1.2181	1.7515	11
50	1.2183	1.7507	**10**
51	1.2185	1.7500	9
52	1.2188	1.7493	8
53	1.2190	1.7485	7
54	1.2193	1.7478	6
55	1.2195	1.7471	**5**
56	1.2198	1.7463	4
57	1.2200	1.7456	3
58	1.2203	1.7449	2
59	1.2205	1.7442	1
60	1.2208	1.7434	**0**
′	Csc	Sec	′

124° (304°) (235°) **55°**

35° (215°) (324°) **144°**

′	Sec	Csc	′
0	1.2208	1.7434	**60**
1	1.2210	1.7427	59
2	1.2213	1.7420	58
3	1.2215	1.7413	57
4	1.2218	1.7406	56
5	1.2220	1.7398	**55**
6	1.2223	1.7391	54
7	1.2225	1.7384	53
8	1.2228	1.7377	52
9	1.2230	1.7370	51
10	1.2233	1.7362	**50**
11	1.2235	1.7355	49
12	1.2238	1.7348	48
13	1.2240	1.7341	47
14	1.2243	1.7334	46
15	1.2245	1.7327	**45**
16	1.2248	1.7320	44
17	1.2250	1.7312	43
18	1.2253	1.7305	42
19	1.2255	1.7298	41
20	1.2258	1.7291	**40**
21	1.2260	1.7284	39
22	1.2263	1.7277	38
23	1.2265	1.7270	37
24	1.2268	1.7263	36
25	1.2271	1.7256	**35**
26	1.2273	1.7249	34
27	1.2276	1.7242	33
28	1.2278	1.7235	32
29	1.2281	1.7228	31
30	1.2283	1.7221	**30**
31	1.2286	1.7213	29
32	1.2288	1.7206	28
33	1.2291	1.7199	27
34	1.2293	1.7192	26
35	1.2296	1.7185	**25**
36	1.2299	1.7179	24
37	1.2301	1.7172	23
38	1.2304	1.7165	22
39	1.2306	1.7158	21
40	1.2309	1.7151	**20**
41	1.2311	1.7144	19
42	1.2314	1.7137	18
43	1.2317	1.7130	17
44	1.2319	1.7123	16
45	1.2322	1.7116	**15**
46	1.2324	1.7109	14
47	1.2327	1.7102	13
48	1.2329	1.7095	12
49	1.2332	1.7088	11
50	1.2335	1.7081	**10**
51	1.2337	1.7075	9
52	1.2340	1.7068	8
53	1.2342	1.7061	7
54	1.2345	1.7054	6
55	1.2348	1.7047	**5**
56	1.2350	1.7040	4
57	1.2353	1.7033	3
58	1.2355	1.7027	2
59	1.2358	1.7020	1
60	1.2361	1.7013	**0**
′	Csc	Sec	′

125° (305°) (234°) **54°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

36° (216°) (323°) **143°**

′	Sec	Csc	′
0	1.2361	1.7013	**60**
1	1.2363	1.7006	59
2	1.2366	1.6999	58
3	1.2369	1.6993	57
4	1.2371	1.6986	56
5	1.2374	1.6979	**55**
6	1.2376	1.6972	54
7	1.2379	1.6966	53
8	1.2382	1.6959	52
9	1.2384	1.6952	51
10	1.2387	1.6945	**50**
11	1.2390	1.6939	49
12	1.2392	1.6932	48
13	1.2395	1.6925	47
14	1.2397	1.6918	46
15	1.2400	1.6912	**45**
16	1.2403	1.6905	44
17	1.2405	1.6898	43
18	1.2408	1.6892	42
19	1.2411	1.6885	41
20	1.2413	1.6878	**40**
21	1.2416	1.6871	39
22	1.2419	1.6865	38
23	1.2421	1.6858	37
24	1.2424	1.6852	36
25	1.2427	1.6845	**35**
26	1.2429	1.6838	34
27	1.2432	1.6832	33
28	1.2435	1.6825	32
29	1.2437	1.6818	31
30	1.2440	1.6812	**30**
31	1.2443	1.6805	29
32	1.2445	1.6799	28
33	1.2448	1.6792	27
34	1.2451	1.6785	26
35	1.2453	1.6779	**25**
36	1.2456	1.6772	24
37	1.2459	1.6766	23
38	1.2462	1.6759	22
39	1.2464	1.6753	21
40	1.2467	1.6746	**20**
41	1.2470	1.6739	19
42	1.2472	1.6733	18
43	1.2475	1.6726	17
44	1.2478	1.6720	16
45	1.2480	1.6713	**15**
46	1.2483	1.6707	14
47	1.2486	1.6700	13
48	1.2489	1.6694	12
49	1.2491	1.6687	11
50	1.2494	1.6681	**10**
51	1.2497	1.6674	9
52	1.2499	1.6668	8
53	1.2502	1.6661	7
54	1.2505	1.6655	6
55	1.2508	1.6649	**5**
56	1.2510	1.6642	4
57	1.2513	1.6636	3
58	1.2516	1.6629	2
59	1.2519	1.6623	1
60	1.2521	1.6616	**0**
′	Csc	Sec	′

126° (306°) (233°) **53°**

37° (217°) (322°) **142°**

′	Sec	Csc	′
0	1.2521	1.6616	**60**
1	1.2524	1.6610	59
2	1.2527	1.6604	58
3	1.2530	1.6597	57
4	1.2532	1.6591	56
5	1.2535	1.6584	**55**
6	1.2538	1.6578	54
7	1.2541	1.6572	53
8	1.2543	1.6565	52
9	1.2546	1.6559	51
10	1.2549	1.6553	**50**
11	1.2552	1.6546	49
12	1.2554	1.6540	48
13	1.2557	1.6534	47
14	1.2560	1.6527	46
15	1.2563	1.6521	**45**
16	1.2566	1.6515	44
17	1.2568	1.6508	43
18	1.2571	1.6502	42
19	1.2574	1.6496	41
20	1.2577	1.6489	**40**
21	1.2579	1.6483	39
22	1.2582	1.6477	38
23	1.2585	1.6471	37
24	1.2588	1.6464	36
25	1.2591	1.6458	**35**
26	1.2593	1.6452	34
27	1.2596	1.6446	33
28	1.2599	1.6439	32
29	1.2602	1.6433	31
30	1.2605	1.6427	**30**
31	1.2608	1.6421	29
32	1.2610	1.6414	28
33	1.2613	1.6408	27
34	1.2616	1.6402	26
35	1.2619	1.6396	**25**
36	1.2622	1.6390	24
37	1.2624	1.6383	23
38	1.2627	1.6377	22
39	1.2630	1.6371	21
40	1.2633	1.6365	**20**
41	1.2636	1.6359	19
42	1.2639	1.6353	18
43	1.2641	1.6346	17
44	1.2644	1.6340	16
45	1.2647	1.6334	**15**
46	1.2650	1.6328	14
47	1.2653	1.6322	13
48	1.2656	1.6316	12
49	1.2659	1.6310	11
50	1.2661	1.6303	**10**
51	1.2664	1.6297	9
52	1.2667	1.6291	8
53	1.2670	1.6285	7
54	1.2673	1.6279	6
55	1.2676	1.6273	**5**
56	1.2679	1.6267	4
57	1.2682	1.6261	3
58	1.2684	1.6255	2
59	1.2687	1.6249	1
60	1.2690	1.6243	**0**
′	Csc	Sec	′

127° (307°) (232°) **52°**

38° (218°) (321°) **141°**

′	Sec	Csc	′
0	1.2690	1.6243	**60**
1	1.2693	1.6237	59
2	1.2696	1.6231	58
3	1.2699	1.6225	57
4	1.2702	1.6219	56
5	1.2705	1.6213	**55**
6	1.2708	1.6207	54
7	1.2710	1.6201	53
8	1.2713	1.6195	52
9	1.2716	1.6189	51
10	1.2719	1.6183	**50**
11	1.2722	1.6177	49
12	1.2725	1.6171	48
13	1.2728	1.6165	47
14	1.2731	1.6159	46
15	1.2734	1.6153	**45**
16	1.2737	1.6147	44
17	1.2740	1.6141	43
18	1.2742	1.6135	42
19	1.2745	1.6129	41
20	1.2748	1.6123	**40**
21	1.2751	1.6117	39
22	1.2754	1.6111	38
23	1.2757	1.6105	37
24	1.2760	1.6099	36
25	1.2763	1.6093	**35**
26	1.2766	1.6087	34
27	1.2769	1.6082	33
28	1.2772	1.6076	32
29	1.2775	1.6070	31
30	1.2778	1.6064	**30**
31	1.2781	1.6058	29
32	1.2784	1.6052	28
33	1.2787	1.6046	27
34	1.2790	1.6040	26
35	1.2793	1.6035	**25**
36	1.2796	1.6029	24
37	1.2799	1.6023	23
38	1.2802	1.6017	22
39	1.2804	1.6011	21
40	1.2807	1.6005	**20**
41	1.2810	1.6000	19
42	1.2813	1.5994	18
43	1.2816	1.5988	17
44	1.2819	1.5982	16
45	1.2822	1.5976	**15**
46	1.2825	1.5971	14
47	1.2828	1.5965	13
48	1.2831	1.5959	12
49	1.2834	1.5953	11
50	1.2837	1.5948	**10**
51	1.2840	1.5942	9
52	1.2843	1.5936	8
53	1.2846	1.5930	7
54	1.2849	1.5925	6
55	1.2852	1.5919	**5**
56	1.2855	1.5913	4
57	1.2859	1.5907	3
58	1.2862	1.5902	2
59	1.2865	1.5896	1
60	1.2868	1.5890	**0**
′	Csc	Sec	′

128° (308°) (231°) **51°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

39° (219°) (320°) **140°**

′	Sec	Csc	′
0	1.2868	1.5890	**60**
1	1.2871	1.5884	59
2	1.2874	1.5879	58
3	1.2877	1.5873	57
4	1.2880	1.5867	56
5	1.2883	1.5862	**55**
6	1.2886	1.5856	54
7	1.2889	1.5850	53
8	1.2892	1.5845	52
9	1.2895	1.5839	51
10	1.2898	1.5833	**50**
11	1.2901	1.5828	49
12	1.2904	1.5822	48
13	1.2907	1.5816	47
14	1.2910	1.5811	46
15	1.2913	1.5805	**45**
16	1.2916	1.5800	44
17	1.2919	1.5794	43
18	1.2923	1.5788	42
19	1.2926	1.5783	41
20	1.2929	1.5777	**40**
21	1.2932	1.5771	39
22	1.2935	1.5766	38
23	1.2938	1.5760	37
24	1.2941	1.5755	36
25	1.2944	1.5749	**35**
26	1.2947	1.5744	34
27	1.2950	1.5738	33
28	1.2953	1.5732	32
29	1.2957	1.5727	31
30	1.2960	1.5721	**30**
31	1.2963	1.5716	29
32	1.2966	1.5710	28
33	1.2969	1.5705	27
34	1.2972	1.5699	26
35	1.2975	1.5694	**25**
36	1.2978	1.5688	24
37	1.2981	1.5683	23
38	1.2985	1.5677	22
39	1.2988	1.5672	21
40	1.2991	1.5666	**20**
41	1.2994	1.5661	19
42	1.2997	1.5655	18
43	1.3000	1.5650	17
44	1.3003	1.5644	16
45	1.3007	1.5639	**15**
46	1.3010	1.5633	14
47	1.3013	1.5628	13
48	1.3016	1.5622	12
49	1.3019	1.5617	11
50	1.3022	1.5611	**10**
51	1.3026	1.5606	9
52	1.3029	1.5601	8
53	1.3032	1.5595	7
54	1.3035	1.5590	6
55	1.3038	1.5584	**5**
56	1.3041	1.5579	4
57	1.3045	1.5573	3
58	1.3048	1.5568	2
59	1.3051	1.5563	1
60	1.3054	1.5557	**0**
′	Csc	Sec	′

129° (309°) (230°) **50°**

40° (220°) (319°) **139°**

′	Sec	Csc	′
0	1.3054	1.5557	**60**
1	1.3057	1.5552	59
2	1.3060	1.5546	58
3	1.3064	1.5541	57
4	1.3067	1.5536	56
5	1.3070	1.5530	**55**
6	1.3076	1.5525	54
7	1.3076	1.5520	53
8	1.3080	1.5514	52
9	1.3083	1.5509	51
10	1.3086	1.5504	**50**
11	1.3089	1.5498	49
12	1.3093	1.5493	48
13	1.3096	1.5488	47
14	1.3099	1.5482	46
15	1.3102	1.5477	**45**
16	1.3105	1.5472	44
17	1.3109	1.5466	43
18	1.3112	1.5461	42
19	1.3115	1.5456	41
20	1.3118	1.5450	**40**
21	1.3122	1.5445	39
22	1.3125	1.5440	38
23	1.3128	1.5435	37
24	1.3131	1.5429	36
25	1.3135	1.5424	**35**
26	1.3138	1.5419	34
27	1.3141	1.5413	33
28	1.3144	1.5408	32
29	1.3148	1.5403	31
30	1.3151	1.5398	**30**
31	1.3154	1.5392	29
32	1.3157	1.5387	28
33	1.3161	1.5382	27
34	1.3164	1.5377	26
35	1.3167	1.5372	**25**
36	1.3171	1.5366	24
37	1.3174	1.5361	23
38	1.3177	1.5356	22
39	1.3180	1.5351	21
40	1.3184	1.5345	**20**
41	1.3187	1.5340	19
42	1.3190	1.5335	18
43	1.3194	1.5330	17
44	1.3197	1.5325	16
45	1.3200	1.5320	**15**
46	1.3203	1.5314	14
47	1.3207	1.5309	13
48	1.3210	1.5304	12
49	1.3213	1.5299	11
50	1.3217	1.5294	**10**
51	1.3220	1.5289	9
52	1.3223	1.5283	8
53	1.3227	1.5278	7
54	1.3230	1.5273	6
55	1.3233	1.5268	**5**
56	1.3237	1.5263	4
57	1.3240	1.5258	3
58	1.3243	1.5253	2
59	1.3247	1.5248	1
60	1.3250	1.5243	**0**
′	Csc	Sec	′

130° (310°) (229°) **49°**

41° (221°) (318°) **138°**

′	Sec	Csc	′
0	1.3250	1.5243	**60**
1	1.3253	1.5237	59
2	1.3257	1.5232	58
3	1.3260	1.5227	57
4	1.3264	1.5222	56
5	1.3267	1.5217	**55**
6	1.3270	1.5212	54
7	1.3274	1.5207	53
8	1.3277	1.5202	52
9	1.3280	1.5197	51
10	1.3284	1.5192	**50**
11	1.3287	1.5187	49
12	1.3291	1.5182	48
13	1.3294	1.5177	47
14	1.3297	1.5172	46
15	1.3301	1.5167	**45**
16	1.3304	1.5162	44
17	1.3307	1.5156	43
18	1.3311	1.5151	42
19	1.3314	1.5146	41
20	1.3318	1.5141	**40**
21	1.3321	1.5136	39
22	1.3325	1.5131	38
23	1.3328	1.5126	37
24	1.3331	1.5121	36
25	1.3335	1.5116	**35**
26	1.3338	1.5111	34
27	1.3342	1.5107	33
28	1.3345	1.5102	32
29	1.3348	1.5097	31
30	1.3352	1.5092	**30**
31	1.3355	1.5087	29
32	1.3359	1.5082	28
33	1.3362	1.5077	27
34	1.3366	1.5072	26
35	1.3369	1.5067	**25**
36	1.3373	1.5062	24
37	1.3376	1.5057	23
38	1.3380	1.5052	22
39	1.3383	1.5047	21
40	1.3386	1.5042	**20**
41	1.3390	1.5037	19
42	1.3393	1.5032	18
43	1.3397	1.5027	17
44	1.3400	1.5023	16
45	1.3404	1.5018	**15**
46	1.3407	1.5013	14
47	1.3411	1.5008	13
48	1.3414	1.5003	12
49	1.3418	1.4998	11
50	1.3421	1.4993	**10**
51	1.3425	1.4988	9
52	1.3428	1.4984	8
53	1.3432	1.4979	7
54	1.3435	1.4974	6
55	1.3439	1.4969	**5**
56	1.3442	1.4964	4
57	1.3446	1.4959	3
58	1.3449	1.4954	2
59	1.3453	1.4950	1
60	1.3456	1.4945	**0**
′	Csc	Sec	′

131° (311°) (228°) **48°**

NATURAL FUNCTIONS—SECANTS AND COSECANTS (Continued)

42° (222°) (317°) **137°**

′	Sec	Csc	′
0	1.3456	1.4945	**60**
1	1.3460	1.4940	59
2	1.3463	1.4935	58
3	1.3467	1.4930	57
4	1.3470	1.4925	56
5	1.3474	1.4921	**55**
6	1.3478	1.4916	54
7	1.3481	1.4911	53
8	1.3485	1.4906	52
9	1.3488	1.4901	51
10	1.3492	1.4897	**50**
11	1.3495	1.4892	49
12	1.3499	1.4887	48
13	1.3502	1.4882	47
14	1.3506	1.4878	46
15	1.3510	1.4873	**45**
16	1.3513	1.4868	44
17	1.3517	1.4863	43
18	1.3520	1.4859	42
19	1.3524	1.4854	41
20	1.3527	1.4849	**40**
21	1.3531	1.4844	39
22	1.3535	1.4840	38
23	1.3538	1.4835	37
24	1.3542	1.4830	36
25	1.3545	1.4825	**35**
26	1.3549	1.4821	34
27	1.3553	1.4816	33
28	1.3556	1.4811	32
29	1.3560	1.4807	31
30	1.3563	1.4802	**30**
31	1.3567	1.4797	29
32	1.3571	1.4792	28
33	1.3574	1.4788	27
34	1.3578	1.4783	26
35	1.3582	1.4778	**25**
36	1.3585	1.4774	24
37	1.3589	1.4769	23
38	1.3592	1.4764	22
39	1.3596	1.4760	21
40	1.3600	1.4755	**20**
41	1.3603	1.4750	19
42	1.3607	1.4746	18
43	1.3611	1.4741	17
44	1.3614	1.4737	16
45	1.3618	1.4732	**15**
46	1.3622	1.4727	14
47	1.3625	1.4723	13
48	1.3629	1.4718	12
49	1.3633	1.4713	11
50	1.3636	1.4709	**10**
51	1.3640	1.4704	9
52	1.3644	1.4700	8
53	1.3647	1.4695	7
54	1.3651	1.4690	6
55	1.3655	1.4686	**5**
56	1.3658	1.4681	4
57	1.3662	1.4677	3
58	1.3666	1.4672	2
59	1.3670	1.4667	1
60	1.3673	1.4663	**0**
′	Csc	Sec	′

132° (312°) (227°) **47°**

43° (223°) (316°) **136°**

′	Sec	Csc	′
0	1.3673	1.4663	**60**
1	1.3677	1.4658	59
2	1.3681	1.4654	58
3	1.3684	1.4649	57
4	1.3688	1.4645	56
5	1.3692	1.4640	**55**
6	1.3696	1.4635	54
7	1.3699	1.4631	53
8	1.3703	1.4626	52
9	1.3707	1.4622	51
10	1.3711	1.4617	**50**
11	1.3714	1.4613	49
12	1.3718	1.4608	48
13	1.3722	1.4604	47
14	1.3726	1.4599	46
15	1.3729	1.4595	**45**
16	1.3733	1.4590	44
17	1.3737	1.4586	43
18	1.3741	1.4581	42
19	1.3744	1.4577	41
20	1.3748	1.4572	**40**
21	1.3752	1.4568	39
22	1.3756	1.4563	38
23	1.3759	1.4559	37
24	1.3763	1.4554	36
25	1.3767	1.4550	**35**
26	1.3771	1.4545	34
27	1.3775	1.4541	33
28	1.3778	1.4536	32
29	1.3782	1.4532	31
30	1.3786	1.4527	**30**
31	1.3790	1.4523	29
32	1.3794	1.4518	28
33	1.3797	1.4514	27
34	1.3801	1.4510	26
35	1.3805	1.4505	**25**
36	1.3809	1.4501	24
37	1.3813	1.4496	23
38	1.3817	1.4492	22
39	1.3820	1.4487	21
40	1.3824	1.4483	**20**
41	1.3828	1.4479	19
42	1.3832	1.4474	18
43	1.3836	1.4470	17
44	1.3840	1.4465	16
45	1.3843	1.4461	**15**
46	1.3847	1.4457	14
47	1.3851	1.4452	13
48	1.3855	1.4448	12
49	1.3859	1.4443	11
50	1.3863	1.4439	**10**
51	1.3867	1.4435	9
52	1.3871	1.4430	8
53	1.3874	1.4426	7
54	1.3878	1.4422	6
55	1.3882	1.4417	**5**
56	1.3886	1.4413	4
57	1.3890	1.4409	3
58	1.3894	1.4404	2
59	1.3898	1.4400	1
60	1.3902	1.4396	**0**
′	Csc	Sec	

133° (313°) (226°) **46°**

44° (224°) (315°) **135°**

′	Sec	Csc	′
0	1.3902	1.4396	**60**
1	1.3906	1.4391	59
2	1.3909	1.4387	58
3	1.3913	1.4383	57
4	1.3917	1.4378	56
5	1.3921	1.4374	**55**
6	1.3925	1.4370	54
7	1.3929	1.4365	53
8	1.3933	1.4361	52
9	1.3937	1.4357	51
10	1.3941	1.4352	**50**
11	1.3945	1.4348	49
12	1.3949	1.4344	48
13	1.3953	1.4340	47
14	1.3957	1.4335	46
15	1.3961	1.4331	**45**
16	1.3965	1.4327	44
17	1.3969	1.4322	43
18	1.3972	1.4318	42
19	1.3976	1.4314	41
20	1.3980	1.4310	**40**
21	1.3984	1.4305	39
22	1.3988	1.4301	38
23	1.3992	1.4297	37
24	1.3996	1.4293	36
25	1.4000	1.4288	**35**
26	1.4004	1.4284	34
27	1.4008	1.4280	33
28	1.4012	1.4276	32
29	1.4016	1.4271	31
30	1.4020	1.4267	**30**
31	1.4024	1.4263	29
32	1.4028	1.4259	28
33	1.4032	1.4255	27
34	1.4036	1.4250	26
35	1.4040	1.4246	**25**
36	1.4044	1.4242	24
37	1.4048	1.4238	23
38	1.4052	1.4234	22
39	1.4057	1.4229	21
40	1.4061	1.4225	**20**
41	1.4065	1.4221	19
42	1.4069	1.4217	18
43	1.4073	1.4213	17
44	1.4077	1.4208	16
45	1.4081	1.4204	**15**
46	1.4085	1.4200	14
47	1.4089	1.4196	13
48	1.4093	1.4192	12
49	1.4097	1.4188	11
50	1.4101	1.4183	**10**
51	1.4105	1.4179	9
52	1.4109	1.4175	8
53	1.4113	1.4171	7
54	1.4118	1.4167	6
55	1.4122	1.4163	**5**
56	1.4126	1.4159	4
57	1.4130	1.4154	3
58	1.4134	1.4150	2
59	1.4138	1.4146	1
60	1.4142	1.4142	**0**
	Csc	Sec	′

134° (314°) (225°) **45°**

NATURAL TRIGONOMETRIC FUNCTIONS FOR ANGLES IN DEGREES AND DECIMALS

Deg.	Sin	*Tan	*Cot	Cos	Deg.
0.0	.00000	.00000	∞	1.0000	**90.0**
.1	.00175	.00175	573.0	1.0000	89.9
.2	.00349	.00349	286.5	1.0000	.8
.3	.00524	.00524	191.0	1.0000	.7
.4	.00698	.00698	143.24	1.0000	.6
.5	.00873	.00873	114.59	1.0000	.5
.6	.01047	.01047	95.49	0.9999	.4
.7	.01222	.01222	81.85	.9999	.3
.8	.01396	.01396	71.62	.9999	.2
.9	.01571	.01571	63.66	.9999	89.1
1.0	.01745	.01746	57.29	0.9998	**89.0**
.1	.01920	.01920	52.08	.9998	88.9
.2	.02094	.02095	47.74	.9998	.8
.3	.02269	.02269	44.07	.9997	.7
.4	.02443	.02444	40.92	.9997	.6
.5	.02618	.02619	38.19	.9997	.5
.6	.02792	.02793	35.80	.9996	.4
.7	.02967	.02968	33.69	.9996	.3
.8	.03141	.03143	31.82	.9995	.2
.9	.03316	.03317	30.14	.9995	88.1
2.0	.03490	.03492	28.64	0.9994	**88.0**
.1	.03664	.03667	27.27	.9993	87.9
.2	.03839	.03842	26.03	.9993	.8
.3	.04013	.04016	24.90	.9992	.7
.4	.04188	.04191	23.86	.9991	.6
.5	.04362	.04366	22.90	.9990	.5
.6	.04536	.04541	22.02	.9990	.4
.7	.04711	.04716	21.20	.9989	.3
.8	.04885	.04891	20.45	.9988	.2
.9	.05059	.05066	19.74	.9987	87.1
3.0	.05234	.05241	19.081	0.9986	**87.0**
.1	.05408	.05416	18.464	.9985	86.9
.2	.05582	.05591	17.886	.9984	.8
.3	.05756	.05766	17.343	.9983	.7
.4	.05931	.05941	16.832	.9982	.6
.5	.06105	.06116	16.350	.9981	.5
.6	.06279	.06291	15.895	.9980	.4
.7	.06453	.06467	15.464	.9979	.3
.8	.06627	.06642	15.056	.9978	.2
.9	.06802	.06817	14.669	.9977	86.1
4.0	.06976	.06993	14.301	0.9976	**86.0**
.1	.07150	.07168	13.951	.9974	85.9
.2	.07324	.07344	13.617	.9973	.8
.3	.07498	.07519	13.300	.9972	.7
.4	.07672	.07695	12.996	.9971	.6
.5	.07846	.07870	12.706	.9969	.5
.6	.08020	.08046	12.429	.9968	.4
.7	.08194	.08221	12.163	.9966	.3
.8	.08368	.08397	11.909	.9965	.2
.9	.08542	.08573	11.664	.9963	85.1
5.0	.08716	.08749	11.430	0.9962	**85.0**
.1	.08889	.08925	11.205	.9960	84.9
.2	.09063	.09101	10.988	.9959	.8
.3	.09237	.09277	10.780	.9957	.7
.4	.09411	.09453	10.579	.9956	.6
.5	.09585	.09629	10.385	.9954	.5
.6	.09758	.09805	10.199	.9952	.4
.7	.09932	.09981	10.019	.9951	.3
.8	.10106	.10158	9.845	.9949	.2
.9	.10279	.10334	9.677	.9947	84.1
6.0	.10453	.10510	9.514	0.9945	**84.0**
Deg.	Cos	*Cot	*Tan	Sin	Deg.

Deg.	Sin	Tan	Cot	Cos	Deg.
6.0	.10453	.10510	9.514	0.9945	**84.0**
.1	.10626	.10687	9.357	.9943	83.9
.2	.1080	.10863	9.205	.9942	.8
.3	.10973	.11040	9.058	.9940	.7
.4	.11147	.11217	8.915	.9938	.6
.5	.11320	.11394	8.777	.9936	.5
.6	.11494	.11570	8.643	.9934	.4
.7	.11667	.11747	8.513	.9932	.3
.8	.11840	.11924	8.386	.9930	.2
.9	.12014	.12101	8.264	.9928	83.1
7.0	.12187	.12278	8.144	0.9925	**83.0**
.1	.12360	.12456	8.028	.9923	82.9
.2	.12533	.12633	7.916	.9921	.8
.3	.12706	.12810	7.806	.9919	.7
.4	.12880	.12988	7.700	.9917	.6
.5	.13053	.13165	7.596	.9914	.5
.6	.13226	.13343	7.495	.9912	.4
.7	.13399	.13521	7.396	.9910	.3
.8	.13572	.13698	7.300	.9907	.2
.9	.13744	.13876	7.207	.9905	82.1
8.0	.13917	.14054	7.115	0.9903	**82.0**
.1	.14090	.14232	7.026	.9900	81.9
.2	.14263	.14410	6.940	.9898	.8
.3	.14436	.14588	6.855	.9895	.7
.4	.14608	.14767	6.772	.9893	.6
.5	.14781	.14945	6.691	.9890	.5
.6	.14954	.15124	6.612	.9888	.4
.7	.15126	.15302	6.535	.9885	.3
.8	.15299	.15481	6.460	.9882	.2
.9	.15471	.15660	6.386	.9880	81.1
9.0	.15643	.15838	6.314	0.9877	**81.0**
.1	.15816	.16017	6.243	.9874	80.9
.2	.15988	.16196	6.174	.9871	.8
.3	.16160	.16376	6.107	.9869	.7
.4	.16333	.16555	6.041	.9866	.6
.5	.16505	.16734	5.976	.9863	.5
.6	.16677	.16914	5.912	.9860	.4
.7	.16849	.17093	5.850	.9857	.3
.8	.17021	.17273	5.789	.9854	.2
.9	.17193	.17453	5.730	.9851	80.1
10.0	.1736	.1763	5.671	0.9848	**80.0**
.1	.1754	.1781	5.614	.9845	79.9
.2	.1771	.1799	5.558	.9842	.8
.3	.1788	.1817	5.503	.9839	.7
.4	.1805	.1835	5.449	.9836	.6
.5	.1822	.1853	5.396	.9833	.5
.6	.1840	.1871	5.343	.9829	.4
.7	.1857	.1890	5.292	.9826	.3
.8	.1874	.1908	5.242	.9823	.2
.9	.1891	.1926	5.193	.9820	79.1
11.0	.1908	.1944	5.145	0.9816	**79.0**
.1	.1925	.1962	5.097	.9813	78.9
.2	.1942	.1980	5.050	.9810	.8
.3	.1959	.1998	5.005	.9806	.7
.4	.1977	.2016	4.959	.9803	.6
.5	.1994	.2035	4.915	.9799	.5
.6	.2011	.2053	4.872	.9796	.4
.7	.2028	.2071	4.829	.9792	.3
.8	.2045	.2089	4.787	.9789	.2
.9	.2062	.2107	4.745	.9785	78.1
12.0	.2079	.2126	4.705	0.9781	**78.0**
Deg.	Cos	Cot	Tan	Sin	Deg.

* Interpolation in this section of the table is inaccurate.

NATURAL FUNCTIONS FOR DEGREES AND DECIMALS (Continued)

Deg.	Sin	Tan	Cot	Cos	Deg.
12.0	0.2079	0.2126	4.705	0.9781	**78.0**
.1	.2096	.2144	4.665	.9778	77.9
.2	.2113	.2162	4.625	.9774	.8
.3	.2130	.2180	4.586	.9770	.7
.4	.2147	.2199	4.548	.9767	.6
.5	.2164	.2217	4.511	.9763	.5
.6	.2181	.2235	4.474	.9759	.4
.7	.2198	.2254	4.437	.9755	.3
.8	.2215	.2272	4.402	.9751	.2
.9	.2233	.2290	4.366	.9748	77.1
13.0	0.2250	0.2309	4.331	0.9744	**77.0**
.1	.2267	.2327	4.297	.9740	76.9
.2	.2284	.2345	4.264	.9736	.8
.3	.2300	.2364	4.230	.9732	.7
.4	.2317	.2382	4.198	.9728	.6
.5	.2334	.2401	4.165	.9724	.5
.6	.2351	.2419	4.134	.9720	.4
.7	.2368	.2438	4.102	.9715	.3
.8	.2385	.2456	4.071	.9711	.2
.9	.2402	.2475	4.041	.9707	76.1
14.0	0.2419	0.2493	4.011	0.9703	**76.0**
.1	.2436	.2512	3.981	.9699	75.9
.2	.2453	.2530	3.952	.9694	.8
.3	.2470	.2549	3.923	.9690	.7
.4	.2487	.2568	3.895	.9686	.6
.5	.2504	.2586	3.867	.9681	.5
.6	.2521	.2605	3.839	.9677	.4
.7	.2538	.2623	3.812	.9673	.3
.8	.2554	.2642	3.785	.9668	.2
.9	.2571	.2661	3.758	.9664	75.1
15.0	0.2588	0.2679	3.732	0.9659	**75.0**
.1	.2605	.2698	3.706	.9655	74.9
.2	.2622	.2717	3.681	.9650	.8
.3	.2639	.2736	3.655	.9646	.7
.4	.2656	.2754	3.630	.9641	.6
.5	.2672	.2773	3.606	.9636	.5
.6	.2689	.2792	3.582	.9632	.4
.7	.2706	.2811	3.558	.9627	.3
.8	.2723	.2830	3.534	.9622	.2
.9	.2740	.2849	3.511	.9617	74.1
16.0	0.2756	0.2867	3.487	0.9613	**74.0**
.1	.2773	.2886	3.465	.9608	73.9
.2	.2790	.2905	3.442	.9603	.8
.3	.2807	.2924	3.420	.9598	.7
.4	.2823	.2943	3.398	.9593	.6
.5	.2840	.2962	3.376	.9588	.5
.6	.2857	.2981	3.354	.9583	.4
.7	.2874	.3000	3.333	.9578	.3
.8	.2890	.3019	3.312	.9573	.2
.9	.2907	.3038	3.291	.9568	73.1
17.0	0.2924	0.3057	3.271	0.9563	**73.0**
.1	.2940	.3076	3.251	.9558	72.9
.2	.2957	.3096	3.230	.9553	.8
.3	.2974	.3115	3.211	.9548	.7
.4	.2990	.3134	3.191	.9542	.6
.5	.3007	.3153	3.172	.9537	.5
.6	.3024	.3172	3.152	.9532	.4
.7	.3040	.3191	3.133	.9527	.3
.8	.3057	.3211	3.115	.9521	.2
.9	.3074	.3230	3.096	.9516	72.1
18.0	0.3090	0.3249	3.078	0.9511	**72.0**
Deg.	Cos	Cot	Tan	Sin	Deg.

Deg.	Sin	Tan	Cot	Cos	Deg.
18.0	0.3090	0.3249	3.078	0.9511	**72.0**
.1	.3107	.3269	3.060	.9505	71.9
.2	.3123	.3288	3.042	.9500	.8
.3	.3140	.3307	3.024	.9494	.7
.4	.3156	.3327	3.006	.9489	.6
.5	.3173	.3346	2.989	.9483	.5
.6	.3190	.3365	2.971	.9478	.4
.7	.3206	.3385	2.954	.9472	.3
.8	.3223	.3404	2.937	.9466	.2
.9	.3239	.3424	2.921	.9461	71.1
19.0	0.3256	0.3443	2.904	0.9455	**71.0**
.1	.3272	.3463	2.888	.9449	70.9
.2	.3289	.3482	2.872	.9444	.8
.3	.3305	.3502	2.856	.9438	.7
.4	.3322	.3522	2.840	.9432	.6
.5	.3338	.3541	2.824	.9426	.5
.6	.3355	.3561	2.808	.9421	.4
.7	.3371	.3581	2.793	.9415	.3
.8	.3387	.3600	2.778	.9409	.2
.9	.3404	.3620	2.762	.9403	70.1
20.0	0.3420	0.3640	2.747	0.9397	**70.0**
.1	.3437	.3659	2.733	.9391	69.9
.2	.3453	.3679	2.718	.9385	.8
.3	.3469	.3699	2.703	.9379	.7
.4	.3486	.3719	2.689	.9373	.6
.5	.3502	.3739	2.675	.9367	.5
.6	.3518	.3759	2.660	.9361	.4
.7	.3535	.3779	2.646	.9354	.3
.8	.3551	.3799	2.633	.9348	.2
.9	.3567	.3819	2.619	.9342	69.1
21.0	0.3584	0.3839	2.605	0.9336	**69.0**
.1	.3600	.3859	2.592	.9330	68.9
.2	.3616	.3879	2.578	.9323	.8
.3	.3633	.3899	2.565	.9317	.7
.4	.3649	.3919	2.552	.9311	.6
.5	.3665	.3939	2.539	.9304	.5
.6	.3681	.3959	2.526	.9298	.4
.7	.3697	.3979	2.513	.9291	.3
.8	.3714	.4000	2.500	.9285	.2
.9	.3730	.4020	2.488	.9278	68.1
22.0	0.3746	0.4040	2.475	0.9272	**68.0**
.1	.3762	.4061	2.463	.9265	67.9
.2	.3778	.4081	2.450	.9259	.8
.3	.3795	.4101	2.438	.9252	.7
.4	.3811	.4122	2.426	.9245	.6
.5	.3827	.4142	2.414	.9239	.5
.6	.3843	.4163	2.402	.9232	.4
.7	.3859	.4183	2.391	.9225	.3
.8	.3875	.4204	2.379	.9219	.2
.9	.3891	.4224	2.367	.9212	67.1
23.0	0.3907	0.4245	2.356	0.9205	**67.0**
.1	.3923	.4265	2.344	.9198	66.9
.2	.3939	.4286	2.333	.9191	.8
.3	.3955	.4307	2.322	.9184	.7
.4	.3971	.4327	2.311	.9178	.6
.5	.3987	.4348	2.300	.9171	.5
.6	.4003	.4369	2.289	.9164	.4
.7	.4019	.4390	2.278	.9157	.3
.8	.4035	.4411	2.267	.9150	.2
.9	.4051	.4431	2.257	.9143	66.1
24.0	0.4067	0.4452	2.246	0.9135	**66.0**
Deg.	Cos	Cot	Tan	Sin	Deg.

NATURAL FUNCTIONS FOR DEGREES AND DECIMALS (Continued)

Deg.	Sin	Tan	Cot	Cos	Deg.
24.0	0.4067	0.4452	2.246	0.9135	**66.0**
.1	.4083	.4473	2.236	.9128	65.9
.2	.4099	.4494	2.225	.9121	.8
.3	.4115	.4515	2.215	.9114	.7
.4	.4131	.4536	2.204	.9107	.6
.5	.4147	.4557	2.194	.9100	.5
.6	.4163	.4578	2.184	.9092	.4
.7	.4179	.4599	2.174	.9085	.3
.8	.4195	.4621	2.164	9078	.2
.9	.4210	.4642	2.154	.9070	65.1
25.0	0.4226	0.4663	2.145	0.9063	**65.0**
.1	.4242	.4684	2.135	.9056	64.9
.2	.4258	.4706	2.125	.9048	.8
.3	.4274	.4727	2.116	.9041	.7
.4	.4289	.4748	2.106	.9033	.6
.5	.4305	.4770	2.097	.9026	.5
.6	.4321	.4791	2.087	.9018	.4
.7	.4337	.4813	2.078	.9011	.3
.8	.4352	.4834	2.069	.9003	.2
.9	.4368	.4856	2.059	.8996	64.1
26.0	0.4384	0.4877	2.050	0.8988	**64.0**
.1	.4399	.4899	2.041	.8980	63.9
.2	.4415	.4921	2.032	.8973	.8
.3	.4431	.4942	2.023	.8965	.7
.4	.4446	.4964	2.014	.8957	.6
.5	.4462	.4986	2.006	.8949	.5
.6	.4478	.5008	1.997	.8942	.4
.7	.4493	.5029	1.988	.8934	.3
.8	.4509	.5051	1.980	.8926	.2
.9	.4524	.5073	1.971	.8918	63.1
27.0	0.4540	0.5095	1.963	0.8910	**63.0**
.1	.4555	.5117	1.954	.8902	62.9
.2	.4571	.5139	1.946	.8894	.8
.3	.4586	.5161	1.937	.8886	.7
.4	.4602	.5184	1.929	.8878	.6
.5	.4617	.5206	1.921	.8870	.5
.6	.4633	.5228	1.913	.8862	.4
.7	.4648	.5250	1.905	.8854	.3
.8	.4664	.5272	1.897	.8846	.2
.9	.4679	.5295	1.889	.8838	62.1
28.0	0.4695	0.5317	1.881	0.8829	**62.0**
.1	.4710	.5340	1.873	.8821	61.9
.2	.4726	.5362	1.865	.8813	.8
.3	.4741	.5384	1.857	.8805	.7
.4	.4756	.5407	1.849	.8796	.6
.5	.4772	.5430	1.842	.8788	.5
.6	.4787	.5452	1.834	.8780	.4
.7	.4802	.5475	1.827	.8771	.3
.8	.4818	.5498	1.819	8763	.2
.9	.4833	.5520	1.811	.8755	61.1
29.0	0.4848	0.5543	1.804	0.8746	**61.0**
.1	.4863	.5566	1.797	.8738	60.9
.2	.4879	.5589	1.789	.8729	.8
.3	.4894	.5612	1.782	.8721	.7
.4	.4909	.5635	1.775	.8712	.6
.5	.4924	.5658	1.767	.8704	.5
.6	.4939	.5681	1.760	.8695	.4
.7	.4955	.5704	1.753	.8686	.3
.8	.4970	.5727	1.746	.8678	.2
.9	.4985	.5750	1.739	.8669	60.1
30.0	0.5000	0.5774	1.732	0.8660	**60.0**
Deg.	Cos	Cot	Tan	Sin	Deg.

Deg.	Sin	Tan	Cot	Cos	Deg.
30.0	0.5000	0.5774	1.7321	0.8660	**60.0**
.1	.5015	.5797	1.7251	.8652	59.9
.2	.5030	.5820	1.7182	.8643	.8
.3	.5045	.5844	1.7113	.8634	.7
.4	.5060	.5867	1.7045	.8625	.6
.5	.5075	.5890	1.6977	.8616	.5
.6	.5090	.5914	1.6909	.8607	.4
.7	.5105	.5938	1.6842	.8599	.3
.8	.5120	.5961	1.6775	.8590	.2
.9	.5135	.5985	1.6709	.8581	59.1
31.0	0.5150	0.6009	1.6643	0.8572	**59.0**
.1	.5165	.6032	1.6577	.8563	58.9
.2	.5180	.6056	1.6512	.8554	.8
.3	.5195	.6080	1.6447	.8545	.7
.4	.5210	.6104	1.6383	.8536	.6
.5	.5225	.6128	1.6319	.8526	.5
.6	.5240	.6152	1.6255	.8517	.4
.7	.5255	.6176	1.6191	.8508	.3
.8	.5270	.6200	1.6128	.8499	.2
.9	.5284	.6224	1.6066	.8490	58.1
32.0	0.5299	0.6249	1.6003	0.8480	**58.0**
.1	.5314	.6273	1.5941	.8471	57.9
.2	.5329	.6297	1.5880	.8462	.8
.3	.5344	.6322	1.5818	.8453	.7
.4	.5358	.6346	1.5757	.8443	.6
.5	.5373	.6371	1.5697	.8434	.5
.6	.5388	.6395	1.5637	.8425	.4
.7	.5402	.6420	1.5577	.8415	.3
.8	.5417	.6445	1.5517	.8406	.2
.9	.5432	.6469	1.5458	.8396	57.1
33.0	0.5446	0.6494	1.5399	0.8387	**57.0**
.1	.5461	.6519	1.5340	.8377	56.9
.2	.5476	.6544	1.5282	.8368	.8
.3	.5490	6569	1.5224	.8358	.7
.4	.5505	.6594	1.5166	.8348	.6
.5	.5519	.6619	1.5108	.8339	.5
.6	.5534	.6644	1.5051	.8329	.4
.7	.5548	.6669	1.4994	.8320	.3
.8	.5563	.6694	1.4938	.8310	.2
.9	.5577	.6720	1.4882	.8300	56.1
34.0	0.5592	0.6745	1.4826	0.8290	**56.0**
.1	.5606	.6771	1.4770	.8281	55.9
.2	.5621	.6796	1.4715	.8271	.8
.3	.5635	.6822	1.4659	.8261	.7
.4	.5650	.6847	1.4605	.8251	.6
.5	.5664	.6873	1.4550	.8241	.5
.6	.5678	.6899	1.4496	.8231	.4
.7	.5693	.6924	1.4442	.8221	.3
.8	.5707	.6950	1.4388	.8211	.2
.9	.5721	.6976	1.4335	.8202	55 1
35.0	0.5736	0.7002	1.4281	0.8192	**55.0**
.1	.5750	.7028	1 4229	.8181	54.9
.2	.5764	.7054	1.4176	.8171	.8
3	.5779	.7080	1.4124	.8161	.7
.4	.5793	.7107	1.4071	.8151	.6
.5	.5807	.7133	1.4019	.8141	.5
.6	.5821	.7159	1.3968	.8131	.4
.7	.5835	.7186	1.3916	.8121	.3
.8	.5850	.7212	1.3865	.8111	.2
.9	.5864	.7239	1.3814	.8100	54.1
36.0	0.5878	0.7265	1.3764	0.8090	**54.0**
Deg.	Cos	Cot	Tan	Sin	Deg.

NATURAL FUNCTIONS FOR DEGREES AND DECIMALS (Continued)

Deg.	Sin	Tan	Cot	Cos	Deg.
36.0	0.5878	0.7265	1.3764	0.8090	**54.0**
.1	.5892	.7292	1.3713	.8080	53.9
.2	.5906	.7319	1.3663	.8070	.8
.3	.5920	.7346	1.3613	.8059	.7
.4	.5934	.7373	1.3564	.8049	.6
.5	.5948	.7400	1.3514	.8039	.5
.6	.5962	.7427	1.3465	.8028	.4
.7	.5976	.7454	1.3416	.8018	.3
.8	.5990	.7481	1.3367	.8007	.2
.9	.6004	.7508	1.3319	.7997	53.1
37.0	0.6018	0.7536	1.3270	0.7986	**53.0**
.1	.6032	.7563	1.3222	.7976	52.9
.2	.6046	.7590	1.3175	.7965	.8
.3	.6060	.7618	1.3127	.7955	.7
.4	.6074	.7646	1.3079	.7944	.6
.5	.6088	.7673	1.3032	.7934	.5
.6	.6101	.7701	1.2985	.7923	.4
.7	.6115	.7729	1.2938	.7912	.3
.8	.6129	.7757	1.2892	.7902	.2
.9	.6143	.7785	1.2846	.7891	52.1
38.0	0.6157	0.7813	1.2799	0.7880	**52.0**
.1	.6170	.7841	1.2753	.7869	51.9
.2	.6184	.7869	1.2708	.7859	.8
.3	.6198	.7898	1.2662	.7848	.7
.4	.6211	.7926	1.2617	.7837	.6
.5	.6225	.7954	1.2572	.7826	.5
.6	.6239	.7983	1.2527	.7815	.4
.7	.6252	.8012	1.2482	.7804	.3
.8	.6266	.8040	1.2437	.7793	.2
.9	.6280	.8069	1.2393	.7782	51.1
39.0	0.6293	0.8098	1.2349	0.7771	**51.0**
.1	.6307	.8127	1.2305	.7760	50.9
.2	.6320	.8156	1.2261	.7749	.8
.3	.6334	.8185	1.2218	.7738	.7
.4	.6347	.8214	1.2174	.7727	.6
.5	.6361	.8243	1.2131	.7716	.5
.6	.6374	.8273	1.2088	.7705	.4
.7	.6388	.8302	1.2045	.7694	.3
.8	.6401	.8332	1.2002	.7683	.2
.9	.6414	.8361	1.1960	.7672	50.1
40.0	0.6428	0.8391	1.1918	0.7660	**50.0**
.1	.6441	.8421	1.1875	.7649	49.9
.2	.6455	.8451	1.1833	.7638	.8
.3	.6468	.8481	1.1792	.7627	.7
.4	.6481	.8511	1.1750	.7615	.6
40.5	0.6494	0.8541	1.1708	0.7604	**49.5**
Deg.	Cos	Cot	Tan	Sin	Deg.

Deg.	Sin	Tan	Cot	Cos	Deg.
40.5	0.6494	0.8541	1.1708	0.7604	**49.5**
.6	.6508	.8571	1.1667	.7593	.4
.7	.6521	.8601	1.1626	.7581	.3
.8	.6534	.8632	1.1585	.7570	.2
.9	.6547	.8662	1.1544	.7559	49.1
41.0	0.6561	0.8693	1.1504	0.7547	**49.0**
.1	.6574	.8724	1.1463	.7536	48.9
.2	.6587	.8754	1.1423	.7524	.8
.3	.6600	.8785	1.1383	.7513	.7
.4	.6613	.8816	1.1343	.7501	.6
.5	.6626	.8847	1.1303	.7490	.5
.6	.6639	.8878	1.1263	.7478	.4
.7	.6652	.8910	1.1224	.7466	.3
.8	.6665	.8941	1.1184	.7455	.2
.9	.6678	.8972	1.1145	.7443	48.1
42.0	0.6691	0.9004	1.1106	0.7431	**48.0**
.1	.6704	.9036	1.1067	.7420	47.9
.2	.6717	.9067	1.1028	.7408	.8
.3	.6730	.9099	1.0990	.7396	.7
.4	.6743	.9131	1.0951	.7385	.6
.5	.6756	.9163	1.0913	.7373	.5
.6	.6769	.9195	1.0875	.7361	.4
.7	.6782	.9228	1.0837	.7349	.3
.8	.6794	.9260	1.0799	.7337	.2
.9	.6807	.9293	1.0761	.7325	47.1
43.0	0.6820	0.9325	1.0724	0.7314	**47.0**
.1	.6833	.9358	1.0686	.7302	46.9
.2	.6845	.9391	1.0649	.7290	.8
.3	.6858	.9424	1.0612	.7278	.7
.4	.6871	.9457	1.0575	.7266	.6
.5	.6884	.9490	1.0538	.7254	.5
.6	.6896	.9523	1.0501	.7242	.4
.7	.6909	.9556	1.0464	.7230	.3
.8	.6921	.9590	1.0428	.7218	.2
.9	.6934	.9623	1.0392	.7206	46.1
44.0	0.6947	0.9657	1.0355	0.7193	**46.0**
.1	.6959	.9691	1.0319	.7181	45.9
.2	.6972	.9725	1.0283	.7169	.8
.3	.6984	.9759	1.0247	.7157	.7
.4	.6997	.9793	1.0212	.7145	.6
.5	.7009	.9827	1.0176	.7133	.5
.6	.7022	.9861	1.0141	.7120	.4
.7	.7034	.9896	1.0105	.7108	.3
.8	.7046	.9930	1.0070	.7096	.2
.9	.7059	.9965	1.0035	.7083	45.1
45.0	0.7071	1.0000	1.0000	0.7071	**45.0**
Deg.	Cos	Cot	Tan	Sin	Deg.

LOGARITHMS OF TRIGONOMETRIC FUNCTIONS FOR ANGLES IN DEGREES AND DECIMALS

Deg.	L. Sin	*L. Tan	*L. Cot	L. Cos	Deg.
0.0	— ∞	— ∞	∞	0.0000	**90.0**
.1	7.2419	7.2419	2.7581	0.0000	89.9
.2	7.5429	7.5429	2.4571	0.0000	.8
.3	7.7190	7.7190	2.2810	0.0000	.7
.4	7.8439	7.8439	2.1561	0.0000	.6
.5	7.9408	7.9409	2 0591	0.0000	.5
.6	8.0200	8.0200	1.9800	0.0000	.4
.7	8.0870	8.0870	1.9130	0.0000	.3
.8	8.1450	8 1450	1.8550	0.0000	.2
.9	8.1961	8.1962	1.8038	9.9999	89.1
1.0	8.2419	8.2419	1.7581	9.9999	**89.0**
.1	8.2832	8.2833	1.7167	9.9999	88.9
.2	8.3210	8.3211	1.6789	9.9999	.8
.3	8.3558	8.3559	1.6441	9.9999	.7
.4	8.3880	8.3881	1.6119	9.9999	.6
.5	8.4179	8.4181	1.5819	9.9999	.5
.6	8.4459	8.4461	1.5539	9.9998	.4
.7	8.4723	8.4725	1.5275	9.9998	.3
.8	8.4971	8.4973	1.5027	9.9998	.2
.9	8.5206	8.5208	1.4792	9.9998	88.1
2.0	8.5428	8.5431	1.4569	9.9997	**88.0**
1	8.5640	8.5643	1.4357	9.9997	87.9
.2	8.5842	8.5845	1.4155	9.9997	.8
.3	8.6035	8.6038	1.3962	9.9996	.7
4	8.6220	8.6223	1.3777	9.9996	.6
.5	8.6397	8.6401	1.3599	9.9996	.5
.6	8.6567	8 6571	1.3429	9.9996	.4
.7	8.6731	8.6736	1.3264	9.9995	.3
.8	8 6889	8.6894	1.3106	9.9995	.2
9	8.7041	8.7046	1.2954	9.9994	87.1
3.0	8.7188	8.7194	1.2806	9.9994	**87.0**
.1	8.7330	8.7337	1.2663	9.9994	86.9
2	8.7468	8.7475	1.2525	9.9993	.8
.3	8.7602	8.7609	1.2391	9.9993	.7
.4	8.7731	8.7739	1.2261	9.9992	.6
.5	8.7857	8.7865	1.2135	9.9992	.5
.6	8.7979	8 7988	1.2012	9.9991	.4
.7	8.8098	8.8107	1.1893	9.9991	.3
.8	8.8213	8.8223	1.1777	9.9990	.2
.9	8.8326	8.8336	1.1664	9.9990	86.1
4.0	8 8436	8.8446	1.1554	9.9989	**86.0**
.1	8.8543	8.8554	1.1446	9.9989	85.9
.2	8.8647	8.8659	1.1341	9.9988	.8
.3	8.8749	8.8762	1.1238	9.9988	.7
.4	8.8849	8.8862	1.1138	9.9987	.6
.5	8.8946	8.8960	1.1040	9.9987	.5
.6	8.9042	8.9056	1.0944	9.9986	.4
.7	8.9135	8.9150	1.0850	9.9985	.3
.8	8 9226	8.9241	1.0759	9.9985	.2
.9	8.9315	8.9331	1.0669	9.9984	85.1
5.0	8.9403	8.9420	1.0580	9.9983	**85.0**
.1	8.9489	8.9506	1.0494	9.9983	84.9
.2	8.9573	8.9591	1.0409	9.9982	.8
.3	8.9655	8.9674	1.0326	9.9981	.7
.4	8.9736	8.9756	1.0244	9.9981	.6
.5	8.9816	8.9836	1.0164	9.9980	.5
6	8.9894	8.9915	1.0085	9.9979	.4
.7	8.9970	8.9992	1.0008	9.9978	.3
.8	9.0046	9.0068	0.9932	9.9978	.2
.9	9.0120	9.0143	0.9857	9.9977	84.1
6.0	9.0192	9.0216	0.9784	9.9976	**84.0**
Deg.	L. Cos	*L. Cot	*L. Tan	L. Sin	Deg.

Deg.	L. Sin	L. Tan	L. Cot	L. Cos	Deg.
6.0	9.0192	9.0216	0 9784	9.9976	**84.0**
.1	9 0264	9.0289	0 9711	9.9975	83.9
.2	9.0334	9.0360	0 9640	9.9975	.8
.3	9.0403	9.0430	0 9570	9.9974	.7
.4	9.0472	9.0499	0.9501	9.9973	.6
.5	9.0539	9.0567	0.9433	9.9972	.5
.6	9.0605	9.0633	0.9367	9.9971	.4
.7	9.0670	9.0699	0.9301	9.9970	.3
.8	9.0734	9.0764	0.9236	9.9969	.2
.9	9.0797	9.0828	0.9172	9.9968	83.1
7.0	9.0859	9.0891	0.9109	9.9968	**83.0**
.1	9.0920	9.0954	0.9046	9.9967	82.9
.2	9.0981	9.1015	0.8985	9.9966	.8
.3	9 1040	9.1076	0.8924	9.9965	.7
.4	9.1099	9.1135	0.8865	9.9964	.6
.5	9.1157	9.1194	0.8806	9.9963	.5
.6	9.1214	9.1252	0.8748	9.9962	.4
.7	9.1271	9.1310	0.8690	9.9961	.3
.8	9.1326	9.1367	0.8633	9.9960	.2
.9	9.1381	9.1423	0.8577	9.9959	82.1
8.0	9.1436	9.1478	0.8522	9.9958	**82.0**
.1	9.1489	9.1533	0.8467	9.9956	81.9
.2	9.1542	9.1587	0.8413	9.9955	.8
.3	9.1594	9.1640	0.8360	9.9954	.7
.4	9.1646	9.1693	0.8307	9.9953	.6
.5	9.1697	9.1745	0.8255	9.9952	.5
.6	9.1747	9.1797	0.8203	9.9951	.4
.7	9.1797	9.1848	0.8152	9.9950	.3
.8	9.1847	9.1898	0.8102	9.9949	.2
.9	9.1895	9.1948	0.8052	9.9947	81.1
9.0	9.1943	9.1997	0.8003	9.9946	**81.0**
.1	9.1991	9.2046	0.7954	9.9945	80.9
.2	9.2038	9.2094	0.7906	9.9944	.8
.3	9.2085	9.2142	0.7858	9.9943	.7
.4	9.2131	9.2189	0.7811	9.9941	.6
.5	9.2176	9.2236	0.7764	9.9940	.5
.6	9.2221	9.2282	0.7718	9.9939	.4
.7	9.2266	9.2328	0.7672	9.9937	.3
.8	9.2310	9.2374	0.7626	9.9936	.2
.9	9.2353	9.2419	0.7581	9.9935	80.1
10.0	9.2397	9.2463	0.7537	9.9934	**80.0**
.1	9.2439	9.2507	0.7493	9.9932	79.9
.2	9.2482	9.2551	0.7449	9.9931	.8
.3	9.2524	9.2594	0.7406	9.9929	.7
.4	9.2565	9.2637	0.7363	9.9928	.6
.5	9.2606	9.2680	0.7320	9.9927	.5
.6	9.2647	9.2722	0.7278	9.9925	.4
.7	9.2687	9.2764	0.7236	9.9924	.3
.8	9.2727	9.2805	0.7195	9.9922	.2
.9	9.2767	9.2846	0.7154	9.9921	79.1
11.0	9.2806	9.2887	0.7113	9.9919	**79.0**
.1	9.2845	9.2927	0.7073	9.9918	78.9
.2	9.2883	9.2967	0.7033	9.9916	.8
.3	9.2921	9.3006	0.6994	9.9915	.7
.4	9.2959	9.3046	0.6954	9.9913	.6
.5	9.2997	9.3085	0.6915	9.9912	.5
.6	9.3034	9.3123	0.6877	9.9910	.4
.7	9.3070	9.3162	0.6838	9.9909	.3
.8	9.3107	9.3200	0.6800	9.9907	.2
.9	9.3143	9.3237	0.6763	9.9906	78.1
12.0	9.3179	9.3275	0.6725	9.9904	**78.0**
Deg.	L. Cos	L. Cot	L. Tan	L. Sin	Deg.

* Interpolation in this section of the table is inaccurate.

LOGARITHMS OF FUNCTIONS FOR DEGREES AND DECIMALS (Continued)

Deg	L. Sin	L. Tan	L. Cot	L. Cos	Deg
12.0	9.3179	9.3275	0.6725	9.9904	**78.0**
.1	9.3214	9.3312	0.6688	9.9902	77.9
.2	9.3250	9.3349	0.6651	9.9901	.8
.3	9.3284	9.3385	0.6615	9.9899	.7
.4	9.3319	9.3422	0.6578	9.9897	.6
.5	9.3353	9.3458	0.6542	9.9896	.5
.6	9.3387	9.3493	0.6507	9.9894	.4
.7	9.3421	9.3529	0.6471	9.9892	.3
.8	9.3455	9.3564	0.6436	9.9891	.2
.9	9.3488	9.3599	0.6401	9.9889	77.1
13.0	9.3521	9.3634	0.6366	9.9887	**77.0**
.1	9.3554	9.3668	0.6332	9.9885	76.9
.2	9.3586	9.3702	0.6298	9.9884	.8
.3	9.3618	9.3736	0.6264	9.9882	.7
.4	9.3650	9.3770	0.6230	9.9880	.6
.5	9.3682	9.3804	0.6196	9.9878	.5
.6	9.3713	9.3837	0.6163	9.9876	.4
.7	9.3745	9.3870	0.6130	9.9875	.3
.8	9.3775	9.3903	0.6097	9.9873	.2
.9	9.3806	9.3935	0.6065	9.9871	76.1
14.0	9.3837	9.3968	0.6032	9.9869	**76.0**
.1	9.3867	9.4000	0.6000	9.9867	75.9
.2	9.3897	9.4032	0.5968	9.9865	.8
.3	9.3927	9.4064	0.5936	9.9863	.7
.4	9.3957	9.4095	0.5905	9.9861	.6
.5	9.3986	9.4127	0.5873	9.9859	.5
.6	9.4015	9.4158	0.5842	9.9857	.4
.7	9.4044	9.4189	0.5811	9.9855	.3
.8	9.4073	9.4220	0.5780	9.9853	.2
.9	9.4102	9.4250	0.5750	9.9851	75.1
15.0	9.4130	9.4281	0.5719	9.9849	**75.0**
.1	9.4158	9.4311	0.5689	9.9847	74.9
.2	9.4186	9.4341	0.5659	9.9845	.8
.3	9.4214	9.4371	0.5629	9.9843	.7
.4	9.4242	9.4400	0.5600	9.9841	.6
.5	9.4269	9.4430	0.5570	9.9839	.5
.6	9.4296	9.4459	0.5541	9.9837	.4
.7	9.4323	9.4488	0.5512	9.9835	.3
.8	9.4350	9.4517	0.5483	9.9833	.2
.9	9.4377	9.4546	0.5454	9.9831	74.1
16.0	9.4403	9.4575	0.5425	9.9828	**74.0**
.1	9.4430	9.4603	0.5397	9.9826	73.9
.2	9.4456	9.4632	0.5368	9.9824	.8
.3	9.4482	9.4660	0.5340	9.9822	.7
.4	9.4508	9.4688	0.5312	9.9820	.6
.5	9.4533	9.4716	0.5284	9.9817	.5
.6	9.4559	9.4744	0.5256	9.9815	.4
.7	9.4584	9.4771	0.5229	9.9813	.3
.8	9.4609	9.4799	0.5201	9.9811	.2
.9	9.4634	9.4826	0.5174	9.9808	73.1
17.0	9.4659	9.4853	0.5147	9.9806	**73.0**
.1	9.4684	9.4880	0.5120	9.9804	72.9
.2	9.4709	9.4907	0.5093	9.9801	.8
.3	9.4733	9.4934	0.5066	9.9799	.7
.4	9.4757	9.4961	0.5039	9.9797	.6
.5	9.4781	9.4987	0.5013	9.9794	.5
.6	9.4805	9.5014	0.4986	9.9792	.4
.7	9.4829	9.5040	0.4960	9.9789	.3
.8	9.4853	9.5066	0.4934	9.9787	.2
.9	9.4876	9.5092	0.4908	9.9785	72.1
18.0	9.4900	9.5118	0.4882	9.9782	**72.0**
Deg.	L. Cos	L. Cot	L. Tan	L. Sin	Deg.

Deg.	L. Sin	L. Tan	L. Cot	L. Cos	Deg
18.0	9.4900	9.5118	0.4882	9.9782	**72.0**
.1	9.4923	9.5143	0.4857	9.9780	71.9
.2	9.4946	9.5169	0.4831	9.9777	.8
.3	9.4969	9.5195	0.4805	9.9775	.7
.4	9.4992	9.5220	0.4780	9.9772	.6
.5	9.5015	9.5245	0.4755	9.9770	.5
.6	9.5037	9.5270	0.4730	9.9767	.4
.7	9.5060	9.5295	0.4705	9.9764	.3
.8	9.5082	9.5320	0.4680	9.9762	.2
.9	9.5104	9.5345	0.4655	9.9759	71.1
19.0	9.5126	9.5370	0.4630	9.9757	**71.0**
.1	9.5148	9.5394	0.4606	9.9754	70.9
.2	9.5170	9.5419	0.4581	9.9751	.8
.3	9.5192	9.5443	0.4557	9.9749	.7
.4	9.5213	9.5467	0.4533	9.9746	.6
.5	9.5235	9.5491	0.4509	9.9743	.5
.6	9.5256	9.5516	0.4484	9.9741	.4
.7	9.5278	9.5539	0.4461	9.9738	.3
.8	9.5299	9.5563	0.4437	9.9735	.2
.9	9.5320	9.5587	0.4413	9.9733	70.1
20.0	9.5341	9.5611	0.4389	9.9730	**70.0**
.1	9.5361	9.5634	0.4366	9.9727	69.9
.2	9.5382	9.5658	0.4342	9.9724	.8
.3	9.5402	9.5681	0.4319	9.9722	.7
.4	9.5423	9.5704	0.4296	9.9719	.6
.5	9.5443	9.5727	0.4273	9.9716	.5
.6	9.5463	9.5750	0.4250	9.9713	.4
.7	9.5484	9.5773	0.4227	9.9710	.3
.8	9.5504	9.5796	0.4204	9.9707	.2
.9	9.5523	9.5819	0.4181	9.9704	69.1
21.0	9.5543	9.5842	0.4158	9.9702	**69.0**
.1	9.5563	9.5864	0.4136	9.9699	68.9
.2	9.5583	9.5887	0.4113	9.9696	.8
.3	9.5602	9.5909	0.4091	9.9693	.7
.4	9.5621	9.5932	0.4068	9.9690	.6
.5	9.5641	9.5954	0.4046	9.9687	.5
.6	9.5660	9.5976	0.4024	9.9684	.4
.7	9.5679	9.5998	0.4002	9.9681	.3
.8	9.5698	9.6020	0.3980	9.9678	.2
.9	9.5717	9.6042	0.3958	9.9675	68.1
22.0	9.5736	9.6064	0.3936	9.9672	**68.0**
.1	9.5754	9.6086	0.3914	9.9669	67.9
.2	9.5773	9.6108	0.3892	9.9666	.8
.3	9.5792	9.6129	0.3871	9.9662	.7
.4	9.5810	9.6151	0.3849	9.9659	.6
.5	9.5828	9.6172	0.3828	9.9656	.5
.6	9.5847	9.6194	0.3806	9.9653	.4
.7	9.5865	9.6215	0.3785	9.9650	.3
.8	9.5883	9.6236	0.3764	9.9647	.2
.9	9.5901	9.6257	0.3743	9.9643	67.1
23.0	9.5919	9.6279	0.3721	9.9640	**67.0**
.1	9.5937	9.6300	0.3700	9.9637	66.9
.2	9.5954	9.6321	0.3679	9.9634	.8
.3	9.5972	9.6341	0.3659	9.9631	.7
.4	9.5990	9.6362	0.3638	9.9627	.6
.5	9.6007	9.6383	0.3617	9.9624	.5
.6	9.6024	9.6404	0.3596	9.9621	.4
.7	9.6042	9.6424	0.3576	9.9617	.3
.8	9.6059	9.6445	0.3555	9.9614	.2
.9	9.6076	9.6465	0.3535	9.9611	66.1
24.0	9.6093	9.6486	0.3514	9.9607	**66.0**
Deg.	L. Cos	L. Cot	L. Tan	L. Sin	Deg.

LOGARITHMS OF FUNCTIONS FOR DEGREES AND DECIMALS (Continued)

Deg.	L. Sin	L. Tan	L. Cot	L. Cos	Deg.
24.0	9.6093	9.6486	0.3514	9.9607	**66.0**
.1	9.6110	9.6506	0.3494	9.9604	65.9
.2	9.6127	9.6527	0.3473	9.9601	.8
.3	9.6144	9.6547	0.3453	9.9597	.7
.4	9.6161	9.6567	0.3433	9.9594	.6
.5	9.6177	9.6587	0.3413	9.9590	.5
.6	9.6194	9.6607	0.3393	9.9587	.4
.7	9.6210	9.6627	0.3373	9.9583	.3
.8	9.6227	9.6647	0.3353	9.9580	.2
.9	9.6243	9.6667	0.3333	9.9576	65.1
25.0	9.6259	9.6687	0.3313	9.9573	**65.0**
.1	9.6276	9.6706	0.3294	9.9569	64.9
.2	9.6292	9.6726	0.3274	9.9566	.8
.3	9.6308	9.6746	0.3254	9.9562	.7
.4	9.6324	9.6765	0.3235	9.9558	.6
.5	9.6340	9.6785	0.3215	9.9555	.5
.6	9.6356	9.6804	0.3196	9.9551	.4
.7	9.6371	9.6824	0.3176	9.9548	.3
.8	9.6387	9.6843	0.3157	9.9544	.2
.9	9.6403	9.6863	0.3137	9.9540	64.1
26.0	9.6418	9.6882	0.3118	9.9537	**64.0**
.1	9.6434	9.6901	0.3099	9.9533	63.9
.2	9.6449	9.6920	0.3080	9.9529	.8
.3	9.6465	9.6939	0.3061	9.9525	.7
.4	9.6480	9.6958	0.3042	9.9522	.6
.5	9.6495	9.6977	0.3023	9.9518	.5
.6	9.6510	9.6996	0.3004	9.9514	.4
.7	9.6526	9.7015	0.2985	9.9510	.3
.8	9.6541	9.7034	0.2966	9.9506	.2
.9	9.6556	9.7053	0.2947	9.9503	63.1
27.0	9.6570	9.7072	0.2928	9.9499	**63.0**
.1	9.6585	9.7090	0.2910	9.9495	62.9
.2	9.6600	9.7109	0.2891	9.9491	.8
.3	9.6615	9.7128	0.2872	9.9487	.7
.4	9.6629	9.7146	0.2854	9.9483	.6
.5	9.6644	9.7165	0.2835	9.9479	.5
.6	9.6659	9.7183	0.2817	9.9475	.4
.7	9.6673	9.7202	0.2798	9.9471	.3
.8	9.6687	9.7220	0.2780	9.9467	.2
.9	9.6702	9.7238	0.2762	9.9463	62.1
28.0	9.6716	9.7257	0.2743	9.9459	**62.0**
.1	9.6730	9.7275	0.2725	9.9455	61.9
.2	9.6744	9.7293	0.2707	9.9451	.8
.3	9.6759	9.7311	0.2689	9.9447	.7
.4	9.6773	9.7330	0.2670	9.9443	.6
.5	9.6787	9.7348	0.2652	9.9439	.5
.6	9.6801	9.7366	0.2634	9.9435	.4
.7	9.6814	9.7384	0.2616	9.9431	.3
.8	9.6828	9.7402	0.2598	9.9427	.2
.9	9.6842	9.7420	0.2580	9.9422	61.1
29.0	9.6856	9.7438	0.2562	9.9418	**61.0**
.1	9.6869	9.7455	0.2545	9.9414	60.9
.2	9.6883	9.7473	0.2527	9.9410	.8
.3	9.6896	9.7491	0.2509	9.9406	.7
.4	9.6910	9.7509	0.2491	9.9401	.6
.5	9.6923	9.7526	0.2474	9.9397	.5
.6	9.6937	9.7544	0.2456	9.9393	.4
.7	9.6950	9.7562	0.2438	9.9388	.3
.8	9.6963	9.7579	0.2421	9.9384	.2
.9	9.6977	9.7597	0.2403	9.9380	60.1
30.0	9.6990	9.7614	0.2386	9.9375	**60.0**
Deg.	L. Cos	L. Cot	L. Tan	L. Sin	Deg.

Deg.	L. Sin	L. Tan	L. Cot	L. Cos	Deg
30.0	9.6990	9.7614	0.2386	9.9375	**60.0**
.1	9.7003	9.7632	0.2368	9.9371	59.9
.2	9.7016	9.7649	0.2351	9.9367	.8
.3	9.7029	9.7667	0.2333	9.9362	.7
.4	9.7042	9.7684	0.2316	9.9358	.6
.5	9.7055	9.7701	0.2299	9.9353	.5
.6	9.7068	9.7719	0.2281	9.9349	.4
.7	9.7080	9.7736	0.2264	9.9344	.3
.8	9.7093	9.7753	0.2247	9.9340	.2
.9	9.7106	9.7771	0.2229	9.9335	59.1
31.0	9.7118	9.7788	0.2212	9.9331	**59.0**
.1	9.7131	9.7805	0.2195	9.9326	58.9
.2	9.7144	9.7822	0.2178	9.9322	.8
.3	9.7156	9.7839	0.2161	9.9317	.7
.4	9.7168	9.7856	0.2144	9.9312	.6
.5	9.7181	9.7873	0.2127	9.9308	.5
.6	9.7193	9.7890	0.2110	9.9303	.4
.7	9.7205	9.7907	0.2093	9.9298	.3
.8	9.7218	9.7924	0.2076	9.9294	.2
.9	9.7230	9.7941	0.2059	9.9289	58.1
32.0	9.7242	9.7958	0.2042	9.9284	**58.0**
.1	9.7254	9.7975	0.2025	9.9279	57.9
.2	9.7266	9.7992	0.2008	9.9275	.8
.3	9.7278	9.8008	0.1992	9.9270	.7
.4	9.7290	9.8025	0.1975	9.9265	.6
.5	9.7302	9.8042	0.1958	9.9260	.5
.6	9.7314	9.8059	0.1941	9.9255	.4
.7	9.7326	9.8075	0.1925	9.9251	.3
.8	9.7338	9.8092	0.1908	9.9246	.2
.9	9.7349	9.8109	0.1891	9.9241	57.1
33.0	9.7361	9.8125	0.1875	9.9236	**57.0**
.1	9.7373	9.8142	0.1858	9.9231	56.9
.2	9.7384	9.8158	0.1842	9.9226	.8
.3	9.7396	9.8175	0.1825	9.9221	.7
.4	9.7407	9.8191	0.1809	9.9216	.6
.5	9.7419	9.8208	0.1792	9.9211	.5
.6	9.7430	9.8224	0.1776	9.9206	.4
.7	9.7442	9.8241	0.1759	9.9201	.3
.8	9.7453	9.8257	0.1743	9.9196	.2
.9	9.7464	9.8274	0.1726	9.9191	56.1
34.0	9.7476	9.8290	0.1710	9.9186	**56.0**
.1	9.7487	9.8306	0.1694	9.9181	55.9
.2	9.7498	9.8323	0.1677	9.9175	.8
.3	9.7509	9.8339	0.1661	9.9170	.7
.4	9.7520	9.8355	0.1645	9.9165	.6
.5	9.7531	9.8371	0.1629	9.9160	.5
.6	9.7542	9.8388	0.1612	9.9155	.4
.7	9.7553	9.8404	0.1596	9.9149	.3
.8	9.7564	9.8420	0.1580	9.9144	.2
.9	9.7575	9.8436	0.1564	9.9139	55.1
35.0	9.7586	9.8452	0.1548	9.9134	**55.0**
.1	9.7597	9.8468	0.1532	9.9128	54.9
.2	9.7607	9.8484	0.1516	9.9123	.8
.3	9.7618	9.8501	0.1499	9.9118	.7
.4	9.7629	9.8517	0.1483	9.9112	.6
.5	9.7640	9.8533	0.1467	9.9107	.5
.6	9.7650	9.8549	0.1451	9.9101	.4
.7	9.7661	9.8565	0.1435	9.9096	.3
.8	9.7671	9.8581	0.1419	9.9091	.2
.9	9.7682	9.8597	0.1403	9.9085	54.1
36.0	9.7692	9.8613	0.1387	9.9080	**54.0**
Deg.	L. Cos	L. Cot	L. Tan	L. Sin	Deg

LOGARITHMS OF FUNCTIONS FOR DEGREES AND DECIMALS (Continued)

Deg.	L. Sin	L. Tan	L. Cot	L. Cos	Deg.
36.0	9.7692	9.8613	0.1387	9.9080	**54.0**
.1	9.7703	9.8629	0.1371	9.9074	53.9
.2	9.7713	9.8644	0.1356	9.9069	.8
.3	9.7723	9.8660	0.1340	9.9063	.7
.4	9.7734	9.8676	0.1324	9.9057	.6
.5	9.7744	9.8692	0.1308	9.9052	.5
.6	9.7754	9.8708	0.1292	9.9046	.4
.7	9.7764	9.8724	0.1276	9 9041	.3
.8	9.7774	9.8740	0.1260	9.9035	.2
.9	9.7785	9.8755	0.1245	9.9029	53.1
37.0	9.7795	9.8771	0.1229	9.9023	**53.0**
.1	9.7805	9.8787	0.1213	9.9018	52.9
.2	9.7815	9.8803	0.1197	9.9012	.8
.3	9.7825	9.8818	0.1182	9 9006	.7
.4	9.7835	9.8834	0.1166	9.9000	.6
.5	9.7844	9.8850	0.1150	9.8995	5
.6	9.7854	9 8865	0.1135	9.8989	.4
.7	9.7864	9 8881	0.1119	9.8983	.3
.8	9.7874	9.8897	0.1103	9.8977	.2
.9	9.7884	9.8912	0 1088	9.8971	52.1
38.0	9.7893	9.8928	0.1072	9.8965	**52.0**
1	9.7903	9.8944	0.1056	9.8959	51 9
.2	9.7913	9.8959	0.1041	9.8953	.8
.3	9.7922	9.8975	0.1025	9.8947	.7
.4	9.7932	9.8990	0.1010	9.8941	.6
.5	9.7941	9.9006	0.0994	9.8935	.5
.6	9.7951	9.9022	0.0978	9 8929	.4
.7	9.7960	9.9037	0.0963	9.8923	.3
.8	9.7970	9.9053	0 0947	9.8917	.2
.9	9.7979	9.9068	0.0932	9.8911	51.1
39.0	9.7989	9.9084	0.0916	9.8905	**51.0**
.1	9.7998	9.9099	0.0901	9.8899	50.9
.2	9.8007	9.9115	0.0885	9.8893	.8
.3	9.8017	9.9130	0.0870	9.8887	.7
.4	9.8026	9 9146	0.0854	9.8880	.6
.5	9.8035	9.9161	0.0839	9.8874	.5
.6	9.8044	9.9176	0.0824	9.8868	.4
.7	9.8053	9.9192	0.0808	9.8862	.3
.8	9.8063	9 9207	0.0793	9.8855	.2
.9	9.8072	9.9223	0.0777	9.8849	50.1
40.0	9.8081	9.9238	0.0762	9.8843	**50.0**
.1	9.8090	9.9254	0.0746	9.8836	49.9
.2	9.8099	9.9269	0.0731	9.8830	.8
.3	9.8108	9.9284	0.0716	9.8823	.7
.4	9.8117	9.9300	0.0700	9.8817	.6
.5	9.8125	9.9315	0.0685	9.8810	.5
.6	9.8134	9.9330	0.0670	9.8804	.4
.7	9.8143	9.9346	0.0654	9.8797	.3
8	9.8152	9.9361	0.0639	9.8791	2
.9	9.8161	9.9376	0.0624	9.8784	49.1
41.0	9.8169	9.9392	0.0608	9.8778	**49.0**
Deg.	L. Cos	L. Cot	L. Tan	L. Sin	Deg.

Deg.	L. Sin	L. Tan	L. Cot	L. Cos	Deg.
41.0	9.8169	9.9392	0.0608	9.8778	**49.0**
.1	9.8178	9.9407	0.0593	9.8771	48.9
.2	9.8187	9.9422	0.0578	9.8765	.8
.3	9.8195	9.9438	0.0562	9.8758	.7
.4	9.8204	9.9453	0.0547	9.8751	.6
.5	9.8213	9.9468	0.0532	9.8745	.5
.6	9.8221	9.9483	0.0517	9.8738	.4
.7	9.8230	9.9499	0.0501	9.8731	.3
.8	9.8238	9.9514	0.0486	9.8724	.2
.9	9.8247	9.9529	0.0471	9.8718	48.1
42.0	9.8255	9.9544	0.0456	9.8711	**48.0**
.1	9.8264	9.9560	0.0440	9.8704	47.9
.2	9.8272	9.9575	0.0425	9.8697	.8
.3	9.8280	9.9590	0.0410	9.8690	.7
.4	9.8289	9.9605	0.0395	9.8683	.6
.5	9.8297	9.9621	0.0379	9.8676	.5
.6	9.8305	9.9636	0.0364	9.8669	.4
.7	9 8313	9.9651	0.0349	9.8662	.3
.8	9 8322	9.9666	0.0334	9.8655	.2
9	9.8330	9.9681	0.0319	9.8648	47.1
43.0	9.8338	9.9697	0.0303	9.8641	**47.0**
.1	9.8346	9.9712	0.0288	9.8634	46.9
.2	9.8354	9.9727	0.0273	9.8627	.8
.3	9 8362	9.9742	0.0258	9.8620	.7
.4	9.8370	9.9757	0.0243	9.8613	.6
.5	9.8378	9.9772	0.0228	9.8606	.5
.6	9.8386	9.9788	0.0212	9.8598	.4
.7	9.8394	9.9803	0.0197	9.8591	.3
.8	9.8402	9.9818	0.0182	9.8584	.2
.9	9.8410	9.9833	0.0167	9.8577	46.1
44.0	9.8418	9.9848	0.0152	9.8569	**46.0**
.1	9.8426	9.9864	0.0136	9.8562	45.9
.2	9.8433	9.9879	0.0121	9.8555	.8
.3	9.8441	9.9894	0.0106	9.8547	.7
.4	9.8449	9.9909	0.0091	9.8540	.6
.5	9.8457	9.9924	0.0076	9.8532	.5
.6	9.8464	9.9939	0.0061	9.8525	.4
.7	9.8472	9.9955	0.0045	9.8517	.3
.8	9.8480	9.9970	0.0030	9.8510	.2
.9	9.8487	9.9985	0.0015	9.8502	45.1
45.0	9.8495	0.0000	0.0000	9.8495	**45.0**
Deg.	L Cos	L. Cot	L. Tan	L. Sin	Deg.

NATURAL FUNCTIONS FOR ANGLES IN RADIANS

Rad.	Sin	Tan	Cot	Cos
.00	.00000	.00000	∞	1.0000
.01	.01000	.01000	99.997	.99995
.02	.02000	.02000	49.993	.99980
.03	.03000	.03001	33.323	.99955
.04	.03999	.04002	24.987	.99920
.05	.04998	.05004	19.983	.99875
.06	.05996	.06007	16.647	.99820
.07	.06994	.07011	14.262	.99755
.08	.07991	.08017	12.473	.99680
.09	.08988	.09024	11.081	.99595
.10	.09983	.10033	9.9666	.99500
.11	.10978	.11045	9.0542	.99396
.12	11971	.12058	8.2933	.99281
.13	.12963	.13074	7.6489	.99156
.14	.13954	.14092	7.0961	.99022
.15	.14944	.15114	6.6166	.98877
.16	.15932	.16138	6.1966	.98723
.17	.16918	.17166	5.8256	.98558
.18	.17903	.18197	5.4954	.98384
.19	.18886	.19232	5.1997	.98200
.20	.19867	.20271	4.9332	.98007
.21	.20846	.21314	4.6917	.97803
.22	21823	.22362	4.4719	.97590
.23	.22798	.23414	4.2709	.97367
.24	.23770	.24472	4.0864	.97134
.25	.24740	.25534	3.9163	.96891
.26	.25708	.26602	3.7591	.96639
.27	.26673	.27676	3.6133	.96377
.28	.27636	.28755	3.4776	.96106
.29	.28595	.29841	3.3511	.95824
.30	.29552	.30934	3.2327	.95534
.31	.30506	.32033	3.1218	.95233
.32	.31457	.33139	3.0176	.94924
.33	.32404	.34252	2.9195	.94604
.34	.33349	.35374	2.8270	.94275
.35	.34290	.36503	2.7395	.93937
.36	.35227	.37640	2.6567	.93590
.37	.36162	.38786	2.5782	.93233
.38	.37092	.39941	2.5037	.92866
.39	.38019	.41105	2.4328	.92491
.40	38942	.42279	2.3652	.92106
.41	.39861	.43463	2.3008	.91712
.42	40776	.44657	2.2393	.91309
.43	.41687	.45862	2.1804	.90897
.44	.42594	.47078	2.1241	.90475
.45	.43497	.48306	2.0702	.90045
.46	.44395	.49545	2.0184	.89605
.47	.45289	.50797	1.9686	.89157
.48	46178	.52061	1.9208	.88699
.49	.47063	.53339	1.8748	.88233
.50	.47943	.54630	1.8305	.87758
Rad.	Sin	Tan	Cot	Cos

Rad.	Sin	Tan	Cot	Cos
.50	.47943	.54630	1.8305	.87758
.51	.48818	.55936	1.7878	.87274
.52	.49688	.57256	1.7465	.86782
.53	.50553	.58592	1.7067	.86281
.54	.51414	.59943	1.6683	.85771
.55	.52269	.61311	1.6310	.85252
.56	.53119	.62695	1.5950	.84726
.57	.53963	.64097	1.5601	.84190
.58	.54802	.65517	1.5263	.83646
.59	.55636	.66956	1.4935	.83094
.60	.56464	.68414	1.4617	.82534
.61	.57287	.69892	1.4308	.81965
.62	.58104	.71391	1.4007	.81388
.63	.58914	.72911	1.3715	.80803
.64	.59720	.74454	1.3431	.80210
.65	.60519	.76020	1.3154	.79608
.66	.61312	.77610	1.2885	.78999
.67	.62099	.79225	1.2622	.78382
.68	.62879	.80866	1.2366	.77757
.69	.63654	.82534	1.2116	.77125
.70	.64422	.84229	1.1872	.76484
.71	.65183	.85953	1.1634	.75836
.72	.65938	.87707	1.1402	.75181
.73	.66687	.89492	1.1174	.74517
.74	.67429	.91309	1.0952	.73847
.75	.68164	.93160	1.0734	.73169
.76	.68892	.95045	1.0521	.72484
.77	.69614	.96967	1.0313	.71791
.78	.70328	.98926	1.0109	.71091
.79	.71035	1.0092	.99084	.70385
.80	.71736	1.0296	.97121	.69671
.81	.72429	1.0505	.95197	.68950
.82	.73115	1.0717	.93309	.68222
.83	.73793	1.0934	.91455	.67488
.84	.74464	1.1156	.89635	.66746
.85	.75128	1.1383	.87848	.65998
.86	.75784	1.1616	.86091	.65244
.87	.76433	1.1853	.84365	.64483
.88	.77074	1.2097	.82668	.63715
.89	.77707	1.2346	.80998	.62941
.90	.78333	1.2602	.79355	.62161
.91	.78950	1.2864	.77738	.61375
.92	.79560	1.3133	.76146	.60582
.93	.80162	1.3409	.74578	.59783
.94	.80756	1.3692	.73034	.58979
.95	.81342	1.3984	.71511	.58168
.96	.81919	1.4284	.70010	.57352
.97	.82489	1.4592	.68531	.56530
.98	.83050	1.4910	.67071	.55702
.99	.83603	1.5237	.65631	.54869
1.00	.84147	1.5574	.64209	.54030
Rad.	Sin	Tan	Cot	Cos

FUNCTIONS FOR ANGLES IN RADIANS (Continued)

Rad.	Sin	Tan	Cot	Cos
1.00	.84147	1.5574	.64209	.54030
1.01	.84683	1.5922	.62806	.53186
1.02	.85211	1.6281	.61420	.52337
1.03	.85730	1.6652	.60051	.51482
1.04	.86240	1.7036	.58699	.50622
1.05	.86742	1.7433	.57362	.49757
1.06	.87236	1.7844	.56040	.48887
1.07	.87720	1.8270	.54734	.48012
1.08	.88196	1.8712	.53441	.47133
1.09	.88663	1.9171	.52162	.46249
1.10	.89121	1.9648	.50897	.45360
1.11	.89570	2.0143	.49644	.44466
1.12	.90010	2.0660	.48404	.43568
1.13	.90441	2.1198	.47175	.42666
1.14	.90863	2.1759	.45959	.41759
1.15	.91276	2.2345	.44753	.40849
1.16	.91680	2.2958	.43558	.39934
1.17	.92075	2.3600	.42373	.39015
1.18	.92461	2.4273	.41199	.38092
1.19	.92837	2.4979	.40034	.37166
1.20	.93204	2.5722	.38878	.36236
1.21	.93562	2.6503	.37731	.35302
1.22	.93910	2.7328	.36593	.34365
1.23	.94249	2.8198	.35463	.33424
1.24	.94578	2.9119	.34341	.32480
1.25	.94898	3.0096	.33227	.31532
1.26	.95209	3.1133	.32121	.30582
1.27	.95510	3.2236	.31021	.29628
1.28	.95802	3.3413	.29928	.28672
1.29	.96084	3.4672	.28842	.27712
1.30	.96356	3.6021	.27762	.26750
1.31	.96618	3.7471	.26687	.25785
1.32	.96872	3.9033	.25619	.24818
1.33	.97115	4.0723	.24556	.23848
1.34	.97348	4.2556	.23498	.22875
1.35	.97572	4.4552	.22446	.21901
1.36	.97786	4.6734	.21398	.20924
1.37	.97991	4.9131	.20354	.19945
1.38	.98185	5.1774	.19315	.18964
1.39	.98370	5.4707	.18279	.17981
1.40	.98545	5.7979	.17248	.16997
1.41	.98710	6.1654	.16220	.16010
1.42	.98865	6.5811	.15195	.15023
1.43	.99010	7.0555	.14173	.14033
1.44	.99146	7.6018	.13155	.13042
1.45	.99271	8.2381	.12139	.12050
1.46	.99387	8.9886	.11125	.11057
1.47	.99492	9.8874	.10114	.10063
1.48	.99588	10.983	.09105	.09067
1.49	.99674	12.350	.08097	.08071
1.50	.99749	14.101	.07091	.07074
Rad.	Sin	Tan	Cot	Cos

Rad.	Sin	Tan	Cot	Cos
1.50	.99749	14.101	.07091	.07074
1.51	.99815	16.428	.06087	.06076
1.52	.99871	19.670	.05084	.05077
1.53	.99917	24.498	.04082	.04079
1.54	.99953	32.461	.03081	.03079
1.55	.99978	48.078	.02080	.02079
1.56	.99994	92.621	.01080	.01080
1.57	1.0000	1255.8	.00080	.00080
1.58	.99996	−108.65	−.00920	−.00920
1.59	.99982	−52.067	−.01921	−.01920
1.60	.99957	−34.233	−.02921	−.02920
1.61	.99923	−25.495	−.03922	−.03919
1.62	.99879	−20.307	−.04924	−.04918
1.63	.99825	−16.871	−.05927	−.05917
1.64	.99761	−14.427	−.06931	−.06915
1.65	.99687	−12.599	−.07937	−.07912
1.66	.99602	−11.181	−.08944	−.08909
1.67	.99508	−10.047	−.09953	−.09904
1.68	.99404	−9.1208	−.10964	−.10899
1.69	.99290	−8.3492	−.11977	−.11892
1.70	.99166	−7.6966	−.12993	−.12884
1.71	.99033	−7.1373	−.14011	−.13875
1.72	.98889	−6.6524	−.15032	−.14865
1.73	.98735	−6.2281	−.16056	−.15853
1.74	.98572	−5.8535	−.17084	−.16840
1.75	.98399	−5.5204	−.18115	−.17825
1.76	.98215	−5.2221	−.19149	−.18808
1.77	.98022	−4.9534	−.20188	−.19789
1.78	.97820	−4.7101	−.21231	−.20768
1.79	.97607	−4.4887	−.22278	−.21745
1.80	.97385	−4.2863	−.23330	−.22720
1.81	.97153	−4.1005	−.24387	−.23693
1.82	.96911	−3.9294	−.25449	−.24663
1.83	.96659	−3.7712	−.26517	−.25631
1.84	.96398	−3.6245	−.27590	−.26596
1.85	.96128	−3.4881	−.28669	−.27559
1.86	.95847	−3.3608	−.29755	−.28519
1.87	.95557	−3.2419	−.30846	−.29476
1.88	.95258	−3.1304	−.31945	−.30430
1.89	.94949	−3.0257	−.33051	−.31381
1.90	.94630	−2.9271	−.34164	−.32329
1.91	.94302	−2.8341	−.35284	−.33274
1.92	.93965	−2.7463	−.36413	−.34215
1.93	.93618	−2.6632	−.37549	−.35153
1.94	.93262	−2.5843	−.38695	−.36087
1.95	.92896	−2.5095	−.39849	−.37018
1.96	.92521	−2.4383	−.41012	−.37945
1.97	.92137	−2.3705	−.42185	−.38868
1.98	.91744	−2.3058	−.43368	−.39788
1.99	.91341	−2.2441	−.44562	−.40703
2.00	.90930	−2.1850	−.45766	−.41615
Rad.	Sin	Tan	Cot	Cos

LOGARITHMS OF THE FUNCTIONS FOR ANGLES IN RADIANS

Rad.	L. Sin	L. Tan	L. Cot	L. Cos
.00	− ∞	− ∞	∞	0.00000
.01	7.99999	8.00001	1.99999	9.99998
.02	8.30100	8.30109	1.69891	9.99991
.03	8.47706	8.47725	1.52275	9.99980
.04	8.60194	8.60229	1.39771	9.99965
.05	8.69879	8.69933	1.30067	9.99946
.06	8.77789	8.77867	1.22133	9.99922
.07	8.84474	8.84581	1.15419	9.99894
.08	8.90263	8.90402	1.09598	9.99861
.09	8.95366	8.95542	1.04458	9.99824
.10	8.99928	9.00145	0.99855	9.99782
.11	9.04052	9.04315	0.95685	9.99737
.12	9.07814	9.08127	0.91873	9.99687
.13	9.11272	9.11640	0.88360	9.99632
.14	9.14471	9.14898	0.85102	9.99573
.15	9.17446	9.17937	0.82063	9.99510
.16	9.20227	9.20785	0.79215	9.99442
.17	9.22836	9.23466	0.76534	9.99369
.18	9.25292	9.26000	0.74000	9.99293
.19	9.27614	9.28402	0.71598	9.99211
.20	9.29813	9.30688	0.69312	9.99126
.21	9.31902	9.32867	0.67133	9.99035
.22	9.33891	9.34951	0.65049	9.98940
.23	9.35789	9.36948	0.63052	9.98841
.24	9.37603	9.38866	0.61134	9.98737
.25	9.39341	9.40712	0.59288	9.98628
.26	9.41007	9.42492	0.57508	9.98515
.27	9.42607	9.44210	0.55790	9.98397
.28	9.44147	9.45872	0.54128	9.98275
.29	9.45629	9.47482	0.52518	9.98148
.30	9.47059	9.49043	0.50957	9.98016
.31	9.48438	9.50559	0.49441	9.97879
.32	9.49771	9.52034	0.47966	9.97737
.33	9.51060	9.53469	0.46531	9.97591
.34	9.52308	9.54868	0.45132	9.97440
.35	9.53516	9.56233	0.43767	9.97284
.36	9.54688	9.57565	0.42435	9.97123
.37	9.55825	9.58868	0.41132	9.96957
.38	9.56928	9.60142	0.39858	9.96786
.39	9.58000	9.61390	0.38610	9.96610
.40	9.59042	9.62613	0.37387	9.96429
.41	9.60055	9.63812	0.36188	9.96243
.42	9.61041	9.64989	0.35011	9.96051
.43	9.62000	9.66145	0.33855	9.95855
.44	9.62935	9.67282	0.32718	9.95653
.45	9.63845	9.68400	0.31600	9.95446
.46	9.64733	9.69500	0.30500	9.95233
.47	9.65599	9.70583	0.29417	9.95015
.48	9.66443	9.71651	0.28349	9.94792
.49	9.67268	9.72704	0.27296	9.94563
.50	9.68072	9.73743	0.26257	9.94329
Rad	L. Sin	L. Tan	L. Cot	L. Cos

Rad.	L. Sin	L. Tan	L. Cot	L. Cos
.50	9.68072	9.73743	0.26257	9.94329
.51	9.68858	9.74769	0.25231	9.94089
.52	9.69625	9.75782	0.24218	9.93843
.53	9.70375	9.76784	0.23216	9.93591
.54	9.71108	9.77774	0.22226	9.93334
.55	9.71824	9.78754	0.21246	9.93071
.56	9.72525	9.79723	0.20277	9.92801
.57	9.73210	9.80684	0.19316	9.92526
.58	9.73880	9.81635	0.18365	9.92245
.59	9.74536	9.82579	0.17421	9.91957
.60	9.75177	9.83514	0.16486	9.91663
.61	9.75805	9.84443	0.15557	9.91363
.62	9.76420	9.85364	0.14636	9.91056
.63	9.77022	9.86280	0.13720	9.90743
.64	9.77612	9.87189	0.12811	9.90423
.65	9.78189	9.88093	0.11907	9.90096
.66	9.78754	9.88992	0.11008	9.89762
.67	9.79308	9.89886	0.10114	9.89422
.68	9.79851	9.90777	0.09223	9.89074
.69	9.80382	9.91663	0.08337	9.88719
.70	9.80903	9.92546	0.07454	9.88357
.71	9.81414	9.93426	0.06574	9.87988
.72	9.81914	9.94303	0.05697	9.87611
.73	9.82404	9.95178	0.04822	9.87226
.74	9.82885	9.96051	0.03949	9.86833
.75	9.83355	9.96923	0.03077	9.86433
.76	9.83817	9.97793	0.02207	9.86024
.77	9.84269	9.98662	0.01338	9.85607
.78	9.84713	9.99531	0.00469	9.85182
.79	9.85147	0.00400	9.99600	9.84748
.80	9.85573	0.01268	9.98732	9.84305
.81	9.85991	0.02138	9.97862	9.83853
.82	9.86400	0.03008	9.96992	9.83393
.83	9.86802	0.03879	9.96121	9.82922
.84	9.87195	0.04752	9.95248	9.82443
.85	9.87580	0.05627	9.94373	9.81953
.86	9.87958	0.06504	9.93496	9.81454
.87	9.88328	0.07384	9.92616	9.80944
.88	9.88691	0.08266	9.91734	9.80424
.89	9.89046	0.09153	9.90847	9.79894
.90	9.89394	0.10043	9.89957	9.79352
.91	9.89735	0.10937	9.89063	9.78799
.92	9.90070	0.11835	9.88165	9.78234
.93	9.90397	0.12739	9.87261	9.77658
.94	9.90717	0.13648	9.86352	9.77070
.95	9.91031	0.14563	9.85437	9.76469
.96	9.91339	0.15484	9.84516	9.75855
.97	9.91639	0.16412	9.83588	9.75228
.98	9.91934	0.17347	9.82653	9.74587
.99	9.92222	0.18289	9.81711	9.73933
1.00	9.92504	0.19240	9.80760	9.73264
Rad.	L. Sin	L. Tan	L. Cot	L. Cos

LOGARITHMS OF FUNCTIONS FOR ANGLES IN RADIANS (Continued)

Rad.	L. Sin	L. Tan	L. Cot	L. Cos
1.00	9.92504	0.19240	9.80760	9.73264
1.01	9.92780	0.20200	9.79800	9.72580
1.02	9.93049	0.21169	9.78831	9.71881
1.03	9.93313	0.22148	9.77852	9.71165
1.04	9.93571	0.23137	9.76863	9.70434
1.05	9.93823	0.24138	9.75862	9.69686
1.06	9.94069	0.25150	9.74850	9.68920
1.07	9.94310	0.26175	9.73825	9.68135
1.08	9.94545	0.27212	9.72788	9.67332
1.09	9.94774	0.28264	9.71736	9.66510
1.10	9.94998	0.29331	9.70669	9.65667
1.11	9.95216	0.30413	9.69587	9.64803
1.12	9.95429	0.31512	9.68488	9.63917
1.13	9.95637	0.32628	9.67372	9.63008
1.14	9.95839	0.33763	9.66237	9.62075
1.15	9.96036	0.34918	9.65082	9.61118
1.16	9.96228	0.36093	9.63907	9.60134
1.17	9.96414	0.37291	9.62709	9.59123
1.18	9.96596	0.38512	9.61488	9.58084
1.19	9.96772	0.39757	9.60243	9.57015
1.20	9.96943	0.41030	9.58970	9.55914
1.21	9.97110	0.42330	9.57670	9.54780
1.22	9.97271	0.43660	9.56340	9.53611
1.23	9.97428	0.45022	9.54978	9.52406
1.24	9.97579	0.46418	9.53582	9.51161
1.25	9.97726	0.47850	9.52150	9.49875
1.26	9.97868	0.49322	9.50678	9.48546
1.27	9.98005	0.50835	9.49165	9.47170
1.28	9.98137	0.52392	9.47608	9.45745
1.29	9.98265	0.53998	9.46002	9.44267
1.30	9.98388	0.55656	9.44344	9.42732
1.31	9.98506	0.57369	9.42631	9.41137
1.32	9.98620	0.59144	9.40856	9.39476
1.33	9.98729	0.60984	9.39016	9.37744
1.34	9.98833	0.62896	9.37104	9.35937
1.35	9.98933	0.64887	9.35113	9.34046
1.36	9.99028	0.66964	9.33036	9.32064
1.37	9.99119	0.69135	9.30865	9.29983
1.38	9.99205	0.71411	9.28589	9.27793
1.39	9.99286	0.73804	9.26196	9.25482
1.40	9.99363	0.76327	9.23673	9.23036
1.41	9.99436	0.78996	9.21004	9.20440
1.42	9.99504	0.81830	9.18170	9.17674
1.43	9.99568	0.84853	9.15147	9.14716
1.44	9.99627	0.88092	9.11908	9.11536
1.45	9.99682	0.91583	9.08417	9.08100
1.46	9.99733	0.95369	9.04631	9.04364
1.47	9.99779	0.99508	9.00492	9.00271
1.48	9.99821	1.04074	8.95926	8.95747
1.49	9.99858	1.09166	8.90834	8.90692
1.50	9.99891	1.14926	8.85074	8.84965
Rad.	L. Sin	L. Tan	L. Cot	L. Cos

Rad	L. Sin	L. Tan	L. Cot	L. Cos
1.50	9.99891	1.14926	8.85074	8.84965
1.51	9.99920	1.21559	8.78441	8.78361
1.52	9.99944	1.29379	8.70621	8.70565
1.53	9.99964	1.38914	8.61086	8.61050
1.54	9.99979	1.51136	8.48864	8.48843
1.55	9.99991	1.68195	8.31805	8.31796
1.56	9.99997	1.96671	8.03329	8.03327
1.57	0.00000	3.09891	6.90109	6.90109
1.58	9.99998	2.03603*	7.96397*	7.96396*
1.59	9.99992	1.71656	8.28344	8.28336
1.60	9.99981	1.53444	8.46556	8.46538
1.61	9.99967	1.40645	8.59355	8.59323
1.62	9.99947	1.30765	8.69235	8.69182
1.63	9.99924	1.22714	8.77286	8.77209
1.64	9.99896	1.15918	8.84082	8.83978
1.65	9.99864	1.10035	8.89965	8.89829
1.66	9.99827	1.04847	8.95154	8.94981
1.67	9.99786	1.00204	8.99796	8.99582
1.68	9.99741	0.96003	9.03997	9.03737
1.69	9.99691	0.92165	9.07835	9.07526
1.70	9.99636	0.88630	9.11370	9.11007
1.71	9.99578	0.85353	9.14647	9.14225
1.72	9.99515	0.82298	9.17702	9.17217
1.73	9.99447	0.79436	9.20564	9.20012
1.74	9.99375	0.76742	9.23258	9.22634
1.75	9.99299	0.74197	9.25803	9.25102
1.76	9.99218	0.71784	9.28216	9.27434
1.77	9.99133	0.69490	9.30510	9.29642
1.78	9.99043	0.67303	9.32697	9.31740
1.79	9.98948	0.65212	9.34788	9.33736
1.80	9.98849	0.63208	9.36792	9.35641
1.81	9.98745	0.61284	9.38716	9.37462
1.82	9.98637	0.59432	9.40568	9.39205
1.83	9.98524	0.57648	9.42352	9.40877
1.84	9.98407	0.55925	9.44075	9.42482
1.85	9.98285	0.54258	9.45742	9.44026
1.86	9.98158	0.52645	9.47355	9.45513
1.87	9.98026	0.51080	9.48920	9.46947
1.88	9.97890	0.49560	9.50440	9.48330
1.89	9.97749	0.48082	9.51918	9.49667
1.90	9.97603	0.46644	9.53356	9.50959
1.91	9.97452	0.45242	9.54758	9.52210
1.92	9.97296	0.43875	9.56125	9.53422
1.93	9.97136	0.42540	9.57460	9.54597
1.94	9.96970	0.41235	9.58765	9.55735
1.95	9.96800	0.39958	9.60042	9.56841
1.96	9.96624	0.38708	9.61292	9.57916
1.97	9.96443	0.37484	9.62516	9.58960
1.98	9.96258	0.36283	9.63717	9.59975
1.99	9.96067	0.35104	9.64896	9.60963
2.00	9.95871	0.33946	9.66054	9.61925
Rad.	L. Sin	L. Tan	L. Cot	L. Cos

* Values of the cosine, tangent and cotangent for angles in the table, 1.58 radians and above, are negative. As a consequence the logarithms of the functions involved are for their absolute values. For example log |cos 1.90| = 9.50959 − 10.

HAVERSINES

$\text{hav}\ \theta = \frac{1}{2}\ \text{vers}\ \theta = \frac{1}{2}(1 - \cos\theta) = \sin^2 \frac{1}{2}\theta$
$\text{hav}\ (-\theta) = \text{hav}\ \theta$
$\text{hav}\ (180^\circ - \theta) = \text{hav}\ (180^\circ + \theta) = 1 - \text{hav}\ \theta$
Characteristics of the logarithms are omitted.

θ°	0′		10′		20′		30′		40′		50′	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
0	.0000	—	.0000	$\bar{6}$.3254	.0000	$\bar{6}$.9275	.0000	$\bar{5}$.2796	.0000	$\bar{5}$.5295	.0001	$\bar{5}$.7233
1	.0001	$\bar{5}$.8817	.0001	.0156	.0001	.1316	.0002	.2339	.0002	.3254	.0003	.4081
2	.0003	.4837	.0004	.5532	.0004	.6176	.0005	.6775	.0005	.7336	.0006	.7862
3	.0007	.8358	.0008	.8828	.0008	.9273	.0009	.9697	.0010	.0101	.0011	.0487
4	.0012	.0856	.0013	.1211	.0014	.1551	.0015	.1879	.0017	.2195	.0018	.2499
5	.0019	.2794	.0020	.3078	.0022	.3354	.0023	.3621	.0024	.3880	.0026	.4132
6	.0027	.4376	.0029	.4614	.0031	.4845	.0032	.5071	.0034	.5290	.0036	.5504
7	.0037	.5714	.0039	.5918	.0041	.6117	.0043	.6312	.0045	.6503	.0047	.6689
8	.0049	.6872	.0051	.7051	.0053	.7226	.0055	.7397	.0057	.7566	.0059	.7731
9	.0062	.7893	.0064	.8052	.0066	.8208	.0069	.8361	.0071	.8512	.0073	.8660
10	.0076	.8806	.0079	.8949	.0081	.9090	.0084	.9229	.0086	.9365	.0089	.9498
11	.0092	.9631	.0095	.9762	.0097	.9890	.0100	.0016	.0103	.0141	.0106	.0264
12	.0109	.0385	.0112	.0504	.0115	.0622	.0119	.0738	.0122	.0852	.0125	.0966
13	.0128	.1077	.0131	.1187	.0135	.1296	.0138	.1404	.0142	.1510	.0145	.1614
14	.0149	.1718	.0152	.1820	.0156	.1921	.0159	.2021	.0163	.2120	.0167	.2217
15	.0170	.2314	.0174	.2409	.0178	.2504	.0182	.2597	.0186	.2689	.0190	.2781
16	.0194	.2871	.0198	.2961	.0202	.3049	.0206	.3137	.0210	.3223	.0214	.3309
17	.0218	.3394	.0223	.3478	.0227	.3561	.0281	.3644	.0236	.3726	.0240	.3807
18	.0245	.3887	.0249	.3966	.0254	.4045	.0258	.4123	.0263	.4200	.0268	.4276
19	.0272	.4352	.0277	.4427	.0282	.4502	.0287	.4576	.0292	.4649	.0297	.4721
20	.0302	.4793	.0307	.4865	.0312	.4935	.0317	.5006	.0322	.5075	.0327	.5144
21	.0332	.5213	.0337	.5281	.0343	.5348	.0348	.5415	.0353	.5481	.0359	.5547
22	.0364	.5612	.0370	.5677	.0375	.5741	.0381	.5805	.0386	.5868	.0392	.5931
23	.0397	.5993	.0403	.6055	.0409	.6116	.0415	.6177	.0421	.6238	.0426	.6298
24	.0432	.6358	.0438	.6417	.0444	.6476	.0450	.6534	.0456	.6592	.0462	.6650
25	.0468	.6707	.0475	.6764	.0481	.6820	.0487	.6876	.0493	.6932	.0500	.6987
26	.0506	.7042	.0512	.7096	.0519	.7150	.0525	.7204	.0532	.7258	.0538	.7311
27	.0545	.7364	.0552	.7416	.0558	.7468	.0565	.7520	.0572	.7572	.0578	.7623
28	.0585	.7674	.0592	.7724	.0599	.7774	.0606	.7824	.0613	.7874	.0620	.7923
29	.0627	.7972	.0634	.8021	.0641	.8069	.0648	.8117	.0655	.8165	.0663	.8213
30	.0670	.8260	.0677	.8307	.0684	.8354	.0692	.8400	.0699	.8446	.0707	.8492
31	.0714	.8538	.0722	.8583	.0729	.8629	.0737	.8673	.0744	.8718	.0752	.8763
32	.0760	.8807	.0767	.8851	.0775	.8894	.0783	.8938	.0791	.8981	.0799	.9024
33	.0807	.9067	.0815	.9109	.0823	.9152	.0831	.9194	.0839	.9236	.0847	.9277
34	.0855	.9319	.0863	.9360	.0871	.9401	.0879	.9442	.0888	.9482	.0896	.9523
35	.0904	.9563	.0913	.9603	.0921	.9643	.0929	.9682	.0938	.9721	.0946	.9761
36	.0955	.9800	.0963	.9838	.0972	.9877	.0981	.9915	.0989	.9954	.0998	.9992
37	.1007	.0030	.1016	.0067	.1024	.0105	.1033	.0142	.1042	.0179	.1051	.0216
38	.1060	.0253	.1069	.0289	.1078	.0326	.1087	.0362	.1096	.0398	.1105	.0434
39	.1114	.0470	.1123	.0505	.1133	.0541	.1142	.0576	.1151	.0611	.1160	.0646
40	.1170	.0681	.1179	.0716	.1189	.0750	.1198	.0784	.1207	.0819	.1217	.0853
41	.1226	.0887	.1236	.0920	.1246	.0954	.1255	.0987	.1265	.1020	.1275	.1054
42	.1284	.1087	.1294	.1119	.1304	.1152	.1314	.1185	.1323	.1217	.1333	.1249
43	.1343	.1282	.1353	.1314	.1363	.1345	.1373	.1377	.1383	.1409	.1393	.1440
44	.1403	.1472	.1413	.1503	.1424	.1534	.1434	.1565	.1444	.1596	.1454	.1626
45	.1464	.1657	.1475	.1687	.1485	.1718	.1495	.1748	.1506	.1778	.1516	1808
46	.1527	.1838	.1537	.1867	.1548	.1897	.1558	.1926	.1569	.1956	.1579	1985
47	.1590	.2014	.1601	.2043	.1611	.2072	.1622	.2101	.1633	.2129	.1644	.2158
48	.1654	.2186	.1665	.2215	.1676	.2243	.1687	.2271	.1698	.2299	.1709	.2327
49	.1720	.2355	.1731	.2382	.1742	.2410	.1753	.2437	.1764	.2465	.1775	.2492
50	.1786	.2519	.1797	.2546	.1808	.2573	.1820	.2600	.1831	.2627	.1842	.2653
51	.1853	.2680	.1865	.2706	.1876	.2732	.1887	.2759	.1899	.2785	.1910	.2811
52	.1922	.2837	.1933	.2863	.1945	.2888	.1956	.2914	.1968	.2940	.1979	.2965
53	.1991	.2991	.2003	.3016	.2014	.3041	.2026	.3066	.2038	.3091	.2049	.3116
54	2061	.3141	.2073	.3166	.2085	.3190	.2096	.3215	.2108	.3239	.2120	.3264
55	.2132	.3288	.2144	.3312	.2156	.3336	.2168	.3361	.2180	.3384	.2192	.3408
56	.2204	.3432	.2216	.3456	.2228	.3480	.2240	.3503	.2252	.3527	.2265	.3550
57	.2277	.3573	.2289	.3596	.2301	.3620	.2314	.3643	.2326	.3666	.2338	.3689
58	.2350	.3711	.2363	.3734	.2375	.3757	.2388	.3779	.2400	.3802	.2412	.3824
59	.2425	.3847	.2437	.3869	.2450	.3891	.2462	.3913	.2475	.3935	.2487	.3957

HAVERSINES (Continued)

Characteristics of the logarithms are omitted.

θ°	0′		10′		20′		30′		40′		50′	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
60	.2500	.3979	.2513	.4001	.2525	.4023	.2538	.4045	.2551	.4066	.2563	.4088
61	.2576	.4109	.2589	.4131	.2601	.4152	.2614	.4173	.2627	.4195	.2640	.4216
62	.2653	.4237	.2665	.4258	.2678	.4279	.2691	.4300	.2704	.4320	.2717	.4341
63	.2730	.4362	.2743	.4382	.2756	.4403	.2769	.4423	.2782	.4444	.2795	.4464
64	.2808	.4484	.2821	.4504	.2834	.4524	.2847	.4545	.2861	.4565	.2874	.4584
65	.2887	.4604	.2900	.4624	.2913	.4644	.2927	.4664	.2940	.4683	.2953	.4703
66	.2966	.4722	.2980	.4742	.2993	.4761	.3006	.4780	.3020	.4799	.3033	.4819
67	.3046	.4838	.3060	.4857	.3073	.4876	.3087	.4895	.3100	.4914	.3113	.4932
68	.3127	.4951	.3140	.4970	.3154	.4989	.3167	.5007	.3181	.5026	.3195	.5044
69	.3208	.5063	.3222	.5081	.3235	.5099	.3249	.5117	.3263	.5136	.3276	.5154
70	.3290	.5172	.3304	.5190	.3317	.5208	.3331	.5226	.3345	.5244	.3358	.5261
71	.3372	.5279	.3386	.5297	.3400	.5314	.3413	.5332	.3427	.5349	.3441	.5367
72	.3455	.5384	.3469	.5402	.3483	.5419	.3496	.5436	.3510	.5454	.3524	.5471
73	.3538	.5488	.3552	.5505	.3566	.5522	.3580	.5539	.3594	.5556	.3608	.5572
74	.3622	.5589	.3636	.5606	.3650	.5623	.3664	.5639	.3678	.5656	.3692	.5672
75	.3706	.5689	.3720	.5705	.3734	.5722	.3748	.5738	.3762	.5754	.3776	.5771
76	.3790	.5787	.3805	.5803	.3819	.5819	.3833	.5835	.3847	.5851	.3861	.5867
77	.3875	.5883	.3889	.5899	.3904	.5915	.3918	.5930	.3932	.5946	.3946	.5962
78	.3960	.5977	.3975	.5993	.3989	.6009	.4003	.6024	.4017	.6039	.4032	.6055
79	.4046	.6070	.4060	.6086	.4075	.6101	.4089	.6116	.4103	.6131	.4117	.6146
80	.4132	.6161	.4146	.6176	.4160	.6191	.4175	.6206	.4189	.6221	.4203	.6236
81	.4218	.6251	.4232	.6266	.4247	.6280	.4261	.6295	.4275	.6310	.4290	.6324
82	.4304	.6339	.4319	.6353	.4333	.6368	.4347	.6382	.4362	.6397	.4376	.6411
83	.4391	.6425	.4405	.6440	.4420	.6454	.4434	.6468	.4448	.6482	.4463	.6496
84	.4477	.6510	.4492	.6524	.4506	.6538	.4521	.6552	.4535	.6566	.4550	.6580
85	.4564	.6594	.4579	.6607	.4593	.6621	.4608	.6635	.4622	.6648	.4637	.6662
86	.4651	.6676	.4666	.6689	.4680	.6703	.4695	.6716	.4709	.6730	.4724	.6743
87	.4738	.6756	.4753	.6770	.4767	.6783	.4782	.6796	.4796	.6809	.4811	.6822
88	.4826	.6835	.4840	.6848	.4855	.6862	.4869	.6875	.4884	.6887	.4898	.6900
89	.4913	.6913	.4927	.6926	.4942	.6939	.4956	.6952	.4971	.6964	.4985	.6977
90	.5000	.6990	.5015	.7002	.5029	.7015	.5044	.7027	.5058	.7040	.5073	.7052
91	.5087	.7065	.5102	.7077	.5116	.7090	.5131	.7102	.5145	.7114	.5160	.7126
92	.5174	.7139	.5189	.7151	.5204	.7163	.5218	.7175	.5233	.7187	.5247	.7199
93	.5262	.7211	.5276	.7223	.5291	.7235	.5305	.7247	.5320	.7259	.5334	.7271
94	.5349	.7283	.5363	.7294	.5378	.7306	.5392	.7318	.5407	.7329	.5421	.7341
95	.5436	.7353	.5450	.7364	.5465	.7376	.5479	.7387	.5494	.7399	.5508	.7410
96	.5523	.7421	.5537	.7433	.5552	.7444	.5566	.7455	.5580	.7467	.5595	.7478
97	.5609	.7489	.5624	.7500	.5638	.7511	.5653	.7523	.5667	.7534	.5681	.7545
98	.5696	.7556	.5710	.7567	.5725	.7577	.5739	.7588	.5753	.7599	.5768	.7610
99	.5782	.7621	.5797	.7632	.5811	.7642	.5825	.7653	.5840	.7664	.5854	.7674
100	.5868	.7685	.5883	.7696	.5897	.7706	.5911	.7717	.5925	.7727	.5940	.7738
101	.5954	.7748	.5968	.7759	.5983	.7769	.5997	.7779	.6011	.7790	.6025	.7800
102	.6040	.7810	.6054	.7820	.6068	.7830	.6082	.7841	.6096	.7851	.6111	.7861
103	.6125	.7871	.6139	.7881	.6153	.7891	.6167	.7901	.6181	.7911	.6195	.7921
104	.6210	.7931	.6224	.7940	.6238	.7950	.6252	.7960	.6266	.7970	.6280	.7980
105	.6294	.7989	.6308	.7999	.6322	.8009	.6336	.8018	.6350	.8028	.6364	.8037
106	.6378	.8047	.6392	.8056	.6406	.8066	.6420	.8075	.6434	.8085	.6448	.8094
107	.6462	.8104	.6476	.8113	.6490	.8122	.6504	.8131	.6517	.8141	.6531	.8150
108	.6545	.8159	.6559	.8168	.6573	.8177	.6587	.8187	.6600	.8196	.6614	.8205
109	.6628	.8214	.6642	.8223	.6655	.8232	.6669	.8241	.6683	.8250	.6696	.8258
110	.6710	.8267	.6724	.8276	.6737	.8285	.6751	.8294	.6765	.8302	.6778	.8311
111	.6792	.8320	.6805	.8329	.6819	.8337	.6833	.8346	.6846	.8354	.6860	.8363
112	.6873	.8371	.6887	.8380	.6900	.8388	.6913	.8397	.6927	.8405	.6940	.8414
113	.6954	.8422	.6967	.8430	.6980	.8439	.6994	.8447	.7007	.8455	.7020	.8464
114	.7034	.8472	.7047	.8480	.7060	.8488	.7073	.8496	.7087	.8504	.7100	.8513
115	.7113	.8521	.7126	.8529	.7139	.8537	.7153	.8545	.7166	.8553	.7179	.8561
116	.7192	.8568	.7205	.8576	.7218	.8584	.7231	.8592	.7244	.8600	.7257	.8608
117	.7270	.8615	.7283	.8623	.7296	.8631	.7309	.8638	.7322	.8646	.7335	.8654
118	.7347	.8661	.7360	.8669	.7373	.8676	.7386	.8684	.7399	.8691	.7411	.8699
119	.7424	.8706	.7437	.8714	.7449	.8721	.7462	.8729	.7475	.8736	.7487	.8743

HAVERSINES (Continued)

Characteristics of the logarithms are omitted.

θ°	0′		10′		20′		30′		40′		50′	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
120	.7500	.8751	.7513	.8758	.7525	.8765	.7538	.8772	.7550	.8780	.7563	.8787
121	.7575	.8794	.7588	.8801	.7600	.8808	.7612	.8815	.7625	.8822	.7637	.8829
122	.7650	.8836	.7662	.8843	.7674	.8850	.7686	.8857	.7699	.8864	.7711	.8871
123	.7723	.8878	.7735	.8885	.7748	.8892	.7760	.8898	.7772	.8905	.7784	.8912
124	.7796	.8919	.7808	.8925	.7820	.8932	.7832	.8939	.7844	.8945	.7856	.8952
125	.7868	.8959	.7880	.8965	.7892	.8972	.7904	.8978	.7915	.8985	.7927	.8991
126	.7939	.8998	.7951	.9004	.7962	.9010	.7974	.9017	.7986	.9023	.7997	.9030
127	.8009	.9036	.8021	.9042	.8032	.9048	.8044	.9055	.8055	.9061	.8067	.9067
128	.8078	.9073	.8090	.9079	.8101	.9085	.8113	.9092	.8124	.9098	.8135	.9104
129	.8147	.9110	.8158	.9116	.8169	.9122	.8180	.9128	.8192	.9134	.8203	.9140
130	.8214	.9146	.8225	.9151	.8236	.9157	.8247	.9163	.8258	.9169	.8269	.9175
131	.8280	.9180	.8291	.9186	.8302	.9192	.8313	.9198	.8324	.9203	.8335	.9209
132	.8346	.9215	.8356	.9220	.8367	.9226	.8378	.9231	.8389	.9237	.8399	.9242
133	.8410	.9248	.8421	.9253	.8431	.9259	.8442	.9264	.8452	.9270	.8463	.9275
134	.8473	.9281	.8484	.9286	.8494	.9291	.8505	.9297	.8515	.9302	.8525	.9307
135	.8536	.9312	.8546	.9318	.8556	.9323	.8566	.9328	.8576	.9333	.8587	.9338
136	.8597	.9343	.8607	.9348	.8617	.9353	.8627	.9359	.8637	.9364	.8647	.9369
137	.8657	.9374	.8667	.9379	.8677	.9383	.8686	.9388	.8696	.9393	.8706	.9398
138	.8716	.9403	.8725	.9408	.8735	.9413	.8745	.9417	.8754	.9422	.8764	.9427
139	.8774	.9432	.8783	.9436	.8793	.9441	.8802	.9446	.8811	.9450	.8821	.9455
140	.8830	.9460	.8840	.9464	.8849	.9469	.8858	.9473	.8867	.9478	.8877	.9482
141	.8886	.9487	.8895	.9491	.8904	.9496	.8913	.9500	.8922	.9505	.8931	.9509
142	.8940	.9513	.8949	.9518	.8958	.9522	.8967	.9526	.8976	.9531	.8984	.9535
143	.8993	.9539	.9002	.9543	.9011	.9548	.9019	.9552	.9028	.9556	.9037	.9560
144	.9045	.9564	.9054	.9568	.9062	.9572	.9071	.9576	.9079	.9580	.9087	.9584
145	.9096	.9588	.9104	.9592	.9112	.9596	.9121	.9600	.9129	.9604	.9137	.9608
146	.9145	.9612	.9153	.9616	.9161	.9620	.9169	.9623	.9177	.9627	.9185	.9631
147	.9193	.9635	.9201	.9638	.9209	.9642	.9217	.9646	.9225	.9650	.9233	.9653
148	9240	.9657	.9248	.9660	.9256	.9664	.9263	.9668	.9271	.9671	.9278	.9675
149	.9286	.9678	.9293	.9682	.9301	.9685	.9308	.9689	.9316	.9692	.9323	.9695
150	.9330	.9699	.9337	.9702	.9345	.9706	.9352	.9709	.9359	.9712	.9366	.9716
151	.9373	.9719	.9380	.9722	.9387	.9725	.9394	.9729	.9401	.9732	.9408	.9735
152	.9415	.9738	.9422	.9741	.9428	.9744	.9435	.9747	.9442	.9751	.9448	.9754
153	.9455	.9757	.9462	.9760	.9468	.9763	.9475	.9766	.9481	.9769	.9488	.9772
154	.9494	.9774	.9500	.9777	.9507	.9780	.9513	.9783	.9519	.9786	.9525	.9789
155	.9532	.9792	.9538	.9794	.9544	.9797	.9550	.9800	.9556	.9803	.9562	.9805
156	.9568	.9808	.9574	.9811	.9579	.9813	.9585	.9816	.9591	.9819	.9597	.9821
157	.9603	.9824	.9608	.9826	.9614	.9829	.9619	.9831	.9625	.9834	.9630	.9836
158	.9636	.9839	.9641	.9841	.9647	.9844	.9652	.9846	.9657	.9849	.9663	.9851
159	.9668	.9853	.9673	.9856	.9678	.9858	.9683	.9860	.9688	.9863	.9693	.9865
160	.9698	.9867	.9703	.9869	.9708	.9871	.9713	.9874	.9718	.9876	.9723	.9878
161	.9728	.9880	.9732	.9882	.9737	.9884	.9742	.9886	.9746	.9888	.9751	.9890
162	.9755	.9892	.9760	.9894	.9764	.9896	.9769	.9898	.9773	.9900	.9777	.9902
163	.9782	.9904	.9786	.9906	.9790	.9908	.9794	.9910	.9798	.9911	.9802	.9913
164	.9806	.9915	.9810	.9917	.9814	.9919	.9818	.9920	.9822	.9922	.9826	.9924
165	.9830	.9925	.9833	.9927	.9837	.9929	.9841	.9930	.9844	.9932	.9848	.9933
166	.9851	.9935	.9855	.9937	.9858	.9938	.9862	.9940	.9865	.9941	.9869	.9943
167	.9872	.9944	.9875	.9945	.9878	.9947	.9881	.9948	.9885	.9950	.9888	.9951
168	.9891	.9952	.9894	.9954	.9897	.9955	.9900	.9956	.9903	.9957	.9905	.9959
169	.9908	.9960	.9911	.9961	.9914	.9962	.9916	.9963	.9919	.9965	.9921	.9966
170	.9924	.9967	.9927	.9968	.9929	.9969	.9931	.9970	.9934	.9971	.9936	.9972
171	.9938	.9973	.9941	.9974	.9943	.9975	.9945	.9976	.9947	.9977	.9949	.9978
172	.9951	.9979	.9953	.9980	.9955	.9981	.9957	.9981	.9959	.9982	.9961	.9983
173	.9963	.9984	.9964	.9985	.9966	.9985	.9968	.9986	.9969	.9987	.9971	.9987
174	.9973	.9988	.9974	.9989	.9976	.9989	.9977	.9990	.9978	.9991	.9980	.9991
175	.9981	.9992	.9982	.9992	.9983	.9993	.9985	.9993	.9986	.9994	.9987	.9994
176	.9988	.9995	.9989	.9995	.9990	.9996	.9991	.9996	.9992	.9996	.9992	.9997
177	.9993	.9997	.9994	.9997	.9995	.9998	.9995	.9998	.9996	.9998	.9996	.9998
178	.9997	.9999	.9997	.9999	.9998	.9999	.9998	.9999	.9999	.9999	.9999	.9999
179	.9999	.9999	.9999	.9999	1.0000	.0000	1.0000	.0000	1.0000	.0000	1.0000	.0000
180	1.0000	.0000										

NATURAL OR NAPERIAN LOGARITHMS

0.000-0.499

N	0	1	2	3	4	5	6	7	8	9
0.00	− ∞	−6† .90776	−6 .21461	−5 .80914	−5 .52146	−5 .29832	−5 .11600	−4 .96185	−4 .82831	−4 .71053
.01	−4.60517	.50986	.42285	.34281	.26870	.19971	.13517	.07454	.01738	*.96332
.02	−3.91202	.86323	.81671	.77226	.72970	.68888	.64966	.61192	.57555	.54046
.03	.50656	.47377	.44202	.41125	.38139	.35241	.32424	.29684	.27017	.24419
.04	.21888	.19418	.17009	.14656	.12357	.10109	.07911	.05761	.03655	.01593
.05	−2.99573	.97593	.95651	.93746	.91877	.90042	.88240	.86470	.84731	.83022
.06	.81341	.79688	.78062	.76462	.74887	.73337	.71810	.70306	.68825	.67365
.07	.65926	.64508	.63109	.61730	.60369	.59027	.57702	.56395	.55105	.53831
.08	.52573	.51331	.50104	.48891	.47694	.46510	.45341	.44185	.43042	.41912
.09	.40795	.39690	.38597	.37516	.36446	.35388	.34341	.33304	.32279	.31264
0.10	−2.30259	.29263	.28278	.27303	.26336	.25379	.24432	.23493	.22562	.21641
.11	.20727	.19823	.18926	.18037	.17156	.16282	.15417	.14558	.13707	.12863
.12	.12026	.11196	.10373	.09557	.08747	.07944	.07147	.06357	.05573	.04794
.13	.04022	.03256	.02495	.01741	.00992	.00248	*.99510	*.98777	*.98050	*.97328
.14	−1.96611	.95900	.95193	.94491	.93794	.93102	.92415	.91732	.91054	.90381
.15	.89712	.89048	.88387	.87732	.87080	.86433	.85790	.85151	.84516	.83885
.16	.83258	.82635	.82016	.81401	.80789	.80181	.79577	.78976	.78379	.77786
.17	.77196	.76609	.76026	.75446	.74870	.74297	.73727	.73161	.72597	.72037
.18	.71480	.70926	.70375	.69827	.69282	.68740	.68201	.67665	.67131	.66601
.19	.66073	.65548	.65026	.64507	.63990	.63476	.62964	.62455	.61949	.61445
0.20	−1.60944	.60445	.59949	.59455	.58964	.58475	.57988	.57504	.57022	.56542
.21	.56065	.55590	.55117	.54646	.54178	.53712	.53248	.52786	.52326	.51868
.22	.51413	.50959	.50508	.50058	.49611	.49165	.48722	.48281	.47841	.47403
.23	.46968	.46534	.46102	.45672	.45243	.44817	.44392	.43970	.43548	.43129
.24	.42712	.42296	.41882	.41469	.41059	.40650	.40242	.39837	.39433	.39030
.25	.38629	.38230	.37833	.37437	.37042	.36649	.36258	.35868	.35480	.35093
.26	.34707	.34323	.33941	.33560	.33181	.32803	.32426	.32051	.31677	.31304
.27	.30933	.30564	.30195	.29828	.29463	.29098	.28735	.28374	.28013	.27654
.28	.27297	.26940	.26585	.26231	.25878	.25527	.25176	.24827	.24479	.24133
.29	.23787	.23443	.23100	.22758	.22418	.22078	.21740	.21402	.21066	.20731
0.30	−1.20397	.20065	.19733	.19402	.19073	.18744	.18417	.18091	.17766	.17441
.31	.17118	.16796	.16475	.16155	.15836	.15518	.15201	.14885	.14570	.14256
.32	.13943	.13631	.13320	.13010	.12701	.12393	.12086	.11780	.11474	.11170
.33	.10866	.10564	.10262	.09961	.09661	.09362	.09064	.08767	.08471	.08176
.34	.07881	.07587	.07294	.07002	.06711	.06421	.06132	.05843	.05555	.05268
.35	−1.04982	.04697	.04412	.04129	.03846	.03564	.03282	.03002	.02722	.02443
.36	.02165	.01888	.01611	.01335	.01060	.00786	.00512	.00239	*.99967	*.99696
.37	−0.99425	.99155	.98886	.98618	.98350	.98083	.97817	.97551	.97286	.97022
.38	.96758	.96496	.96233	.95972	.95711	.95451	.95192	.94933	.94675	.94418
.39	.94161	.93905	.93649	.93395	.93140	.92887	.92634	.92382	.92130	.91879
0.40	−0.91629	.91379	.91130	.90882	.90634	.90387	.90140	.89894	.89649	.89404
.41	.89160	.88916	.88673	.88431	.88189	.87948	.87707	.87467	.87227	.86988
.42	.86750	.86512	.86275	.86038	.85802	.85567	.85332	.85097	.84863	.84630
.43	.84397	.84165	.83933	.83702	.83471	.83241	.83011	.82782	.82554	.82326
.44	.82098	.81871	.81645	.81419	.81193	.80968	.80744	.80520	.80296	.80073
.45	.79851	.79629	.79407	.79186	.78966	.78746	.78526	.78307	.78089	.77871
.46	.77653	.77436	.77219	.77003	.76787	.76572	.76357	.76143	.75929	.75715
.47	.75502	.75290	.75078	.74866	.74655	.74444	.74234	.74024	.73814	.73605
.48	.73397	.73189	.72981	.72774	.72567	.72361	.72155	.71949	.71744	.71539
.49	.71335	.71131	.70028	.70725	.70522	.70320	.70118	.69917	.69716	.69515

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† Note that the characteristics are given *above* the mantissa for the first line. In the second and following lines they are given at the left.

NATURAL OR NAPERIAN LOGARITHMS (Continued)

0.500-0.999

N	0	1	2	3	4	5	6	7	8	9
0.50	−0.69315	.69115	.68916	.68717	.68518	.68320	.68122	.67924	.67727	.67531
.51	.67334	.67139	.66943	.66748	.66553	.66359	.66165	.65971	.65778	.65585
.52	.65393	.65201	.65009	.64817	.64626	.64436	.64245	.64055	.63866	.63677
.53	.63488	.63299	.63111	.62923	.62736	.62549	.62362	.62176	.61990	.61804
.54	.61619	.61434	.61249	.61065	.60881	.60697	.60514	.60331	.60148	.59966
.55	.59784	.59602	.59421	.59240	.59059	.58879	.58699	.58519	.58340	.58161
.56	.57982	.57803	.57625	.57448	.57270	.57093	.56916	.56740	.56563	.56387
.57	.56212	.56037	.55862	.55687	.55513	.55339	.55165	.54991	.54818	.54645
.58	.54473	.54300	.54128	.53957	.53785	.53614	.53444	.53273	.53103	.52933
.59	.52763	.52594	.52425	.52256	.52088	.51919	.51751	.51584	.51416	.51249
0.60	−0.51083	.50916	.50750	.50584	.50418	.50253	.50088	.49923	.49758	.49594
.61	.49430	.49266	.49102	.48939	.48776	.48613	.48451	.48289	.48127	.47965
.62	.47804	.47642	.47482	.47321	.47160	.47000	.46840	.46681	.46522	.46362
.63	.46204	.46045	.45887	.45728	.45571	.45413	.45256	.45099	.44942	.44785
.64	.44629	.44473	.44317	.44161	.44006	.43850	.43696	.43541	.43386	.43232
.65	.43078	.42925	.42771	.42618	.42465	.42312	.42159	.42007	.41855	.41703
.66	.41552	.41400	.41249	.41098	.40947	.40797	.40647	.40497	.40347	.40197
.67	.40048	.39899	.39750	.39601	.39453	.39304	.39156	.39008	.38861	.38713
.68	.38566	.38419	.38273	.38126	.37980	.37834	.37688	.37542	.37397	.37251
.69	.37106	.36962	.36817	.36673	.36528	.36384	.36241	.36097	.35954	.35810
0.70	−0.35667	.35525	.35382	.35240	.35098	.34956	.34814	.34672	.34531	.34390
.71	.34249	.34108	.33968	.33827	.33687	.33547	.33408	.33268	.33129	.32989
.72	.32850	.32712	.32573	.32435	.32296	.32158	.32021	.31883	.31745	.31608
.73	.31471	.31334	.31197	.31061	.30925	.30788	.30653	.30517	.30381	.30246
.74	.30111	.29975	.29841	.29706	.29571	.29437	.29303	.29169	.29035	.28902
.75	.28768	.28635	.28502	.28369	.28236	.28104	.27971	.27839	.27707	.27575
.76	.27444	.27312	.27181	.27050	.26919	.26788	.26657	.26527	.26397	.26266
.77	.26136	.26007	.25877	.25748	.25618	.25489	.25360	.25231	.25103	.24974
.78	.24846	.24718	.24590	.24462	.24335	.24207	.24080	.23953	.23826	.23699
.79	.23572	.23446	.23319	.23193	.23067	.22941	.22816	.22690	.22565	.22439
0.80	−0.22314	.22189	.22065	.21940	.21816	.21691	.21567	.21443	.21319	.21196
.81	.21072	.20949	.20825	.20702	.20579	.20457	.20334	.20212	.20089	.19967
.82	.19845	.19723	.19601	.19480	.19358	.19237	.19116	.18995	.18874	.18754
.83	.18633	.18513	.18392	.18272	.18152	.18032	.17913	.17793	.17674	.17554
.84	.17435	.17316	.17198	.17079	.16960	.16842	.16724	.16605	.16487	.16370
.85	−0.16252	.16134	.16017	.15900	.15782	.15665	.15548	.15432	.15315	.15199
.86	.15032	.14966	.14850	.14734	.14618	.14503	.14387	.14272	.14156	.14041
.87	.13926	.13811	.13697	.13582	.13467	.13353	.13239	.13125	.13011	.12897
.88	.12783	.12670	.12556	.12443	.12330	.12217	.12104	.11991	.11878	.11766
.89	.11653	.11541	.11429	.11317	.11205	.11093	.10981	.10870	.10759	.10647
0.90	−0.10536	.10425	.10314	.10203	.10093	.09982	.09872	.09761	.09651	.09541
.91	.09431	.09321	.09212	.09102	.08992	.08883	.08774	.08665	.08556	.08447
.92	.08338	.08230	.08121	.08013	.07904	.07796	.07688	.07580	.07472	.07365
.93	.07257	.07150	.07042	.06935	.06828	.06721	.06614	.06507	.06401	.06294
.94	.06188	.06081	.05975	.05869	.05763	.05657	.05551	.05446	.05340	.05235
.95	.05129	.05024	.04919	.04814	.04709	.04604	.04500	.04395	.04291	.04186
.96	.04082	.03978	.03874	.03770	.03666	.03563	.03459	.03356	.03252	.03149
.97	.03046	.02943	.02840	.02737	.02634	.02532	.02429	.02327	.02225	.02122
.98	.02020	.01918	.01816	.01715	.01613	.01511	.01410	.01309	.01207	.01106
.99	.01005	.00904	.00803	.00702	.00602	.00501	.00401	.00300	.00200	.00100

NATURAL OR NAPERIAN LOGARITHMS (Continued)

To find the natural logarithm of a number which is $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, etc. of a number whose logarithm is given, subtract from the given logarithm $\log_e 10$, $2 \log_e 10$, $3 \log_e 10$, etc.

To find the natural logarithm of a number which is 10, 100, 1000, etc. times a number whose logarithm is given, add to the given logarithm $\log_e 10$, $2 \log_e 10$, $3 \log_e 10$, etc.

$\log_e 10 = 2.30258\ 50930$
$2 \log_e 10 = 4.60517\ 01860$
$3 \log_e 10 = 6.90775\ 52790$
$4 \log_e 10 = 9.21034\ 03720$
$5 \log_e 10 = 11.51292\ 54650$
$6 \log_e 10 = 13.81551\ 05580$
$7 \log_e 10 = 16.11809\ 56510$
$8 \log_e 10 = 18.42068\ 07440$
$9 \log_e 10 = 20.72326\ 58369$
$10 \log_e 10 = 23.02585\ 09299$

See preceding table for logarithms for numbers between 0.000 and 0.999.

1.00–4.99

N	0	1	2	3	4	5	6	7	8	9
1.0	0.00000	.00995	.01980	.02956	.03922	.04879	.05827	.06766	.07696	.08618
.1	.09531	.10436	.11333	.12222	.13103	.13976	.14842	.15700	.16551	.17395
.2	.18232	.19062	.19885	.20701	.21511	.22314	.23111	.23902	.24686	.25464
.3	.26236	.27003	.27763	.28518	.29267	.30010	.30748	.31481	.32208	.32930
.4	.33647	.34359	.35066	.35767	.36464	.37156	.37844	.38526	.39204	.39878
.5	.40547	.41211	.41871	.42527	.43178	.43825	.44469	.45108	.45742	.46373
.6	.47000	.47623	.48243	.48858	.49470	.50078	.50682	.51282	.51879	.52473
.7	.53063	.53649	.54232	.54812	.55389	.55962	.56531	.57098	.57661	.58222
.8	.58779	.59333	.59884	.60432	.60977	.61519	.62058	.62594	.63127	.63658
.9	.64185	.64710	.65233	.65752	.66269	.66783	.67294	.67803	.68310	.68813
2.0	0.69315	.69813	.70310	.70804	.71295	.71784	.72271	.72755	.73237	.73716
.1	.74194	.74669	.75142	.75612	.76081	.76547	.77011	.77473	.77932	.78390
.2	.78846	.79299	.79751	.80200	.80648	.81093	.81536	.81978	.82418	.82855
.3	.83291	.83725	.84157	.84587	.85015	.85442	.85866	.86289	.86710	.87129
.4	.87547	.87963	.88377	.88789	.89200	.89609	.90016	.90422	.90826	.91228
.5	.91629	.92028	.92426	.92822	.93216	.93609	.94001	.94391	.94779	.95166
.6	.95551	.95935	.96317	.96698	.97078	.97456	.97833	.98208	.98582	.98954
.7	.99325	.99695	*.00063	*.00430	*.00796	*.01160	*.01523	*.01885	*.02245	*.02604
.8	1.02962	.03318	.03674	.04028	.04380	.04732	.05082	.05431	.05779	.06126
.9	.06471	.06815	.07158	.07500	.07841	.08181	.08519	.08856	.09192	.09527
3.0	1.09861	.10194	.10526	.10856	.11186	.11514	.11841	.12168	.12493	.12817
.1	.13140	.13462	.13783	.14103	.14422	.14740	.15057	.15373	.15688	.16002
.2	.16315	.16627	.16938	.17248	.17557	.17865	.18173	.18479	.18784	.19089
.3	.19392	.19695	.19996	.20297	.20597	.20896	.21194	.21491	.21788	.22083
.4	.22378	.22671	.22964	.23256	.23547	.23837	.24127	.24415	.24703	.24990
.5	.25276	.25562	.25846	.26130	.26413	.26695	.26976	.27257	.27536	.27815
.6	.28093	.28371	.28647	.28923	.29198	.29473	.29746	.30019	.30291	.30563
.7	.30833	.31103	.31372	.31641	.31909	.32176	.32442	.32708	.32972	.33237
.8	.33500	.33763	.34025	.34286	.34547	.34807	.35067	.35325	.35584	.35841
.9	.36098	.36354	.36609	.36864	.37118	.37372	.37624	.37877	.38128	.38379
4.0	1.38629	.38879	.39128	.39377	.39624	.39872	.40118	.40364	.40610	.40854
.1	.41099	.41342	.41585	.41828	.42070	.42311	.42552	.42792	.43031	.43270
.2	.43508	.43746	.43984	.44220	.44456	.44692	.44927	.45161	.45395	.45629
.3	.45862	.46094	.46326	.46557	.46787	.47018	.47247	.47476	.47705	.47933
.4	.48160	.48387	.48614	.48840	.49065	.49290	.49515	.49739	.49962	.50185
.5	.50408	.50630	.50851	.51072	.51293	.51513	.51732	.51951	.52170	.52388
.6	.52606	.52823	.53039	.53256	.53471	.53687	.53902	.54116	.54330	.54543
.7	.54756	.54969	.55181	.55393	.55604	.55814	.56025	.56235	.56444	.56653
.8	.56862	.57070	.57277	.57485	.57691	.57898	.58104	.58309	.58515	.58719
.9	.58924	.59127	.59331	.59534	.59737	.59939	.60141	.60342	.60543	.60744

NATURAL OR NAPERIAN LOGARITHMS (Continued)

5.00–9.99

N	0	1	2	3	4	5	6	7	8	9
5.0	1.60944	.61144	.61343	.61542	.61741	.61939	.62137	.62334	.62531	.62728
.1	.62924	.63120	.63315	.63511	.63705	.63900	.64094	.64287	.64481	.64673
.2	.64866	.65058	.65250	.65441	.65632	.65823	.66013	.66203	.66393	.66582
.3	.66771	.66959	.67147	.67335	.67523	.67710	.67896	.68083	.68269	.68455
.4	.68640	.68825	.69010	.69194	.69378	.69562	.69745	.69928	.70111	.70293
.5	.70475	.70656	.70838	.71019	.71199	.71380	.71560	.71740	.71919	.72098
.6	.72277	.72455	.72633	.72811	.72988	.73166	.73342	.73519	.73695	.73871
.7	.74047	.74222	.74397	.74572	.74746	.74920	.75094	.75267	.75440	.75613
.8	.75786	.75958	.76130	.76302	.76473	.76644	.76815	.76985	.77156	.77326
.9	.77495	.77665	.77834	.78002	.78171	.78339	.78507	.78675	.78842	.79009
6.0	1.79176	.79342	.79509	.79675	.79840	.80006	.80171	.80336	.80500	.80665
.1	.80829	.80993	.81156	.81319	.81482	.81645	.81808	.81970	.82132	.82294
.2	.82455	.82616	.82777	.82938	.83098	.83258	.83418	.83578	.83737	.83896
.3	.84055	.84214	.84372	.84530	.84688	.84845	.85003	.85160	.85317	.85473
.4	.85630	.85786	.85942	.86097	.86253	.86408	.86563	.86718	.86872	.87026
.5	.87180	.87334	.87487	.87641	.87794	.87947	.88099	.88251	.88403	.88555
.6	.88707	.88858	.89010	.89160	.89311	.89462	.89612	.89762	.89912	.90061
.7	.90211	.90360	.90509	.90658	.90806	.90954	.91102	.91250	.91398	.91545
.8	.91692	.91839	.91986	.92132	.92279	.92425	.92571	.92716	.92862	.93007
.9	.93152	.93297	.93442	.93586	.93730	.93874	.94018	.94162	.94305	.94448
7.0	1.94591	.94734	.94876	.95019	.95161	.95303	.95445	.95586	.95727	.95869
.1	.96009	.96150	.96291	.96431	.96571	.96711	.96851	.96991	.97130	.97269
.2	.97408	.97547	.97685	.97824	.97962	.98100	.98238	.98376	.98513	.98650
.3	.98787	.98924	.99061	.99198	.99334	.99470	.99606	.99742	.99877	*.00013
.4	2.00148	.00283	.00418	.00553	.00687	.00821	.00956	.01089	.01223	.01357
.5	.01490	.01624	.01757	.01890	.02022	.02155	.02287	.02419	.02551	.02683
.6	.02815	.02946	.03078	.03209	.03340	.03471	.03601	.03732	.03862	.03992
.7	.04122	.04252	.04381	.04511	.04640	.04769	.04898	.05027	.05156	.05284
.8	.05412	.05540	.05668	.05796	.05924	.06051	.06179	.06306	.06433	.06560
.9	.06686	.06813	.06939	.07065	.07191	.07317	.07443	.07568	.07694	.07819
8.0	2.07944	.08069	.08194	.08318	.08443	.08567	.08691	.08815	.08939	.09063
.1	.09186	.09310	.09433	.09556	.09679	.09802	.09924	.10047	.10169	.10291
.2	.10413	.10535	.10657	.10779	.10900	.11021	.11142	.11263	.11384	.11505
.3	.11626	.11746	.11866	.11986	.12106	.12226	.12346	.12465	.12585	.12704
.4	.12823	.12942	.13061	.13180	.13298	.13417	.13535	.13653	.13771	.13889
.5	.14007	.14124	.14242	.14359	.14476	.14593	.14710	.14827	.14943	.15060
.6	.15176	.15292	.15409	.15524	.15640	.15756	.15871	.15987	.16102	.16217
.7	.16332	.16447	.16562	.16677	.16791	.16905	.17020	.17134	.17248	.17361
.8	.17475	.17589	.17702	.17816	.17929	.18042	.18155	.18267	.18380	.18493
.9	.18605	.18717	.18830	.18942	.19054	.19165	.19277	.19389	.19500	.19611
9.0	2.19722	.19834	.19944	.20055	.20166	.20276	.20387	.20497	.20607	.20717
.1	.20827	.20937	.21047	.21157	.21266	.21375	.21485	.21594	.21703	.21812
.2	.21920	.22029	.22138	.22246	.22354	.22462	.22570	.22678	.22786	.22894
.3	.23001	.23109	.23216	.23324	.23431	.23538	.23645	.23751	.23858	.23965
.4	.24071	.24177	.24284	.24390	.24496	.24601	.24707	.24813	.24918	.25024
.5	.25129	.25234	.25339	.25444	.25549	.25654	.25759	.25863	.25968	.26072
.6	.26176	.26280	.26384	.26488	.26592	.26696	.26799	.26903	.27006	.27109
.7	.27213	.27316	.27419	.27521	.27624	.27727	.27829	.27932	.28034	.28136
.8	.28238	.28340	.28442	.28544	.28646	.28747	.28849	.28950	.29051	.29152
.9	.29253	.29354	.29455	.29556	.29657	.29757	.29858	.29958	.30058	.30158

NATURAL OR NAPERIAN LOGARITHMS (Continued)

Constants

$\log_e 10 = 2.30258\ 50930$
$2 \log_e 10 = 4.60517\ 01860$
$3 \log_e 10 = 6.90775\ 52790$
$4 \log_e 10 = 9.21034\ 03720$
$5 \log_e 10 = 11.51292\ 54650$
$6 \log_e 10 = 13.81551\ 05580$
$7 \log_e 10 = 16.11809\ 56510$
$8 \log_e 10 = 18.42068\ 07440$
$9 \log_e 10 = 20.72326\ 58369$
$10 \log_e 10 = 23.02585\ 09299$

10.0–49.9

N	0	1	2	3	4	5	6	7	8	9
10.	2.30259	.31254	.32239	.33214	.34181	.35138	.36085	.37024	.37955	.38876
11.	.39790	.40695	.41591	.42480	.43361	.44235	.45101	.45959	.46810	.47654
12.	.48491	.49321	.50144	.50960	.51770	.52573	.53370	.54160	.54945	.55723
13.	.56495	.57261	.58022	.58776	.59525	.60269	.61007	.61740	.62467	.63189
14.	.63906	.64617	.65324	.66026	.66723	.67415	.68102	.68785	.69463	.70136
15.	.70805	.71469	.72130	.72785	.73437	.74084	.74727	.75366	.76001	.76632
16.	.77259	.77882	.78501	.79117	.79728	.80336	.80940	.81541	.82138	.82731
17.	.83321	.83908	.84491	.85071	.85647	.86220	.86790	.87356	.87920	.88480
18.	.89037	.89591	.90142	.90690	.91235	.91777	.92316	.92852	.93386	.93916
19.	.94444	.94969	.95491	.96011	.96527	.97041	.97553	.98062	.98568	.99072
20.	2.99573	*.00072	*.00568	*.01062	*.01553	*.02042	*.02529	*.03013	*.03495	*.03975
21.	3.04452	.04927	.05400	.05871	.06339	.06805	.07269	.07731	.08191	.08649
22.	.09104	.09558	.10009	.10459	.10906	.11352	.11795	.12236	.12676	.13114
23.	.13549	.13983	.14415	.14845	.15274	.15700	.16125	.16548	.16969	.17388
24.	.17805	.18221	.18635	.19048	.19458	.19867	.20275	.20680	.21084	.21487
25.	.21888	.22287	.22684	.23080	.23475	.23868	.24259	.24649	.25037	.25424
26.	.25810	.26194	.26576	.26957	.27336	.27714	.28091	.28466	.28840	.29213
27.	.29584	.29953	.30322	.30689	.31054	.31419	.31782	.32143	.32504	.32863
28.	.33220	.33577	.33932	.34286	.34639	.34990	.35341	.35690	.36038	.36384
29.	.36730	.37074	.37417	.37759	.38099	.38439	.38777	.39115	.39451	.39786
30.	3.40120	.40453	.40784	.41115	.41444	.41773	.42100	.42426	.42751	.43076
31.	.43399	.43721	.44042	.44362	.44681	.44999	.45316	.45632	.45947	.46261
32.	.46574	.46886	.47197	.47507	.47816	.48124	.48431	.48738	.49043	.49347
33.	.49651	.49953	.50255	.50556	.50856	.51155	.51453	.51750	.52046	.52342
34.	.52636	.52930	.53223	.53515	.53806	.54096	.54385	.54674	.54962	.55249
35.	.55535	.55820	.56105	.56388	.56671	.56953	.57235	.57515	.57795	.58074
36.	.58352	.58629	.58906	.59182	.59457	.59731	.60005	.60278	.60550	.60821
37.	.61092	.61362	.61631	.61899	.62167	.62434	.62700	.62966	.63231	.63495
38.	.63759	.64021	.64284	.64545	.64806	.65066	.65325	.65584	.65842	.66099
39.	.66356	.66612	.66868	.67122	.67377	.67630	.67883	.68135	.68387	.68638
40.	3.68888	.69138	.69387	.69635	.69883	.70130	.70377	.70623	.70868	.71113
41.	.71357	.71601	.71844	.72086	.72328	.72569	.72810	.73050	.73290	.73529
42.	.73767	.74005	.74242	.74479	.74715	.74950	.75185	.75420	.75654	.75887
43.	.76120	.76352	.76584	.76815	.77046	.77276	.77506	.77735	.77963	.78191
44.	.78419	.78646	.78872	.79098	.79324	.79549	.79773	.79997	.80221	.80444
45.	.80666	.80888	.81110	.81331	.81551	.81771	.81991	.82210	.82428	.82647
46.	.82864	.83081	.83298	.83514	.83730	.83945	.84160	.84374	.84588	.84802
47.	.85015	.85227	.85439	.85651	.85862	.86073	.86283	.86493	.86703	.86912
48.	.87120	.87328	.87536	.87743	.87950	.88156	.88362	.88568	.88773	.88978
49.	.89182	.89386	.89589	.89792	.89995	.90197	.90399	.90600	.90801	.91002

NATURAL OR NAPERIAN LOGARITHMS (Continued)

50.0–99.9

N	0	1	2	3	4	5	6	7	8	9
50.	3.91202	.91402	.91602	.91801	.91999	.92197	.92395	.92593	.92790	.92986
51.	.93183	.93378	.93574	.93769	.93964	.94158	.94352	.94546	.94739	.94932
52.	.95124	.95316	.95508	.95700	.95891	.96081	.96272	.96462	.96651	.96840
53.	.97029	.97218	.97406	.97594	.97781	.97968	.98155	.98341	.98527	.98713
54.	.98898	.99083	.99268	.99452	.99636	.99820	*.00003	*.00186	*.00369	*.00551
55.	4.00733	.00915	.01096	.01277	.01458	.01638	.01818	.01998	.02177	.02356
56.	.02535	.02714	.02892	.03069	.03247	.03424	.03601	.03777	.03954	.04130
57.	.04305	.04480	.04655	.04830	.05004	.05178	.05352	.05526	.05699	.05872
58.	.06044	.06217	.06389	.06560	.06732	.06903	.07073	.07244	.07414	.07584
59.	.07754	.07923	.08092	.08261	.08429	.08598	.08766	.08933	.09101	.09268
60.	4.09434	.09601	.09767	.09933	.10099	.10264	.10429	.10594	.10759	.10923
61.	.11087	.11251	.11415	.11578	.11741	.11904	.12066	.12228	.12390	.12552
62.	.12713	.12875	.13036	.13196	.13357	.13517	.13677	.13836	.13996	.14155
63.	.14313	.14472	.14630	.14789	.14946	.15104	.15261	.15418	.15575	.15732
64.	.15888	.16044	.16200	.16356	.16511	.16667	.16821	.16976	.17131	.17285
65.	.17439	.17592	.17746	.17899	.18052	.18205	.18358	18510	.18662	.18814
66.	.18965	.19117	.19268	.19419	.19570	.19720	.19870	.20020	.20170	.20320
67.	.20469	.20618	.20767	.20916	.21065	.21213	.21361	.21509	.21656	21804
68.	.21951	.22098	.22244	.22391	.22537	.22683	.22829	.22975	.23120	.23266
69.	.23411	.23555	.23700	.23844	.23989	.24133	.24276	.24420	.24563	.24707
70.	4.24850	.24992	.25135	.25277	.25419	.25561	.25703	.25845	.25986	.26127
71.	.26268	.26409	.26549	.26690	.26830	.26970	.27110	.27249	.27388	.27528
72.	.27667	.27805	.27944	.28082	.28221	.28359	.28496	.28634	.28772	.28909
73.	.29046	.29183	.29320	.29456	.29592	.29729	.29865	.30000	.30136	.30271
74.	.30407	.30542	.30676	.30811	.30946	.31080	.31214	.31348	.31482	.31615
75.	.31749	.31882	.32015	.32149	.32281	.32413	.32546	.32678	.32810	.32942
76.	.33073	.33205	.33336	.33467	.33598	.33729	.33860	.33990	.34120	.34251
77.	.34381	.34510	.34640	.34769	.34899	.35028	.35157	.35286	.35414	.35543
78.	.35671	.35800	.35927	.36055	.36182	.36310	.36437	.36564	.36691	.36818
79.	.36945	.37071	.37198	.37324	.37450	.37576	.37701	.37827	.37952	.38078
80.	4.38203	.38328	.38452	.38577	.38701	.38826	.38950	.39074	.39198	.39321
81.	.39445	.39568	.39692	.39815	.39938	.40060	.40183	.40305	.40428	.40550
82.	.40672	.40794	.40916	.41037	.41159	.41280	.41401	.41522	.41643	41764
83.	.41884	.42004	.42125	.42245	.42365	.42485	.42604	.42724	.42843	.42963
84.	.43082	.43201	.43319	.43438	.43557	.43675	.43793	.43912	.44030	.44147
85.	.44265	.44383	.44500	.44617	.44735	.44852	.44969	.45085	.45202	.45318
86.	.45435	.45551	.45667	.45783	.45899	.46014	.46130	.46245	.46361	.46476
87.	.46591	.46706	.46820	.46935	.47050	.47164	.47278	.47392	.47506	.47620
88.	.47734	.47847	.47961	.48074	.48187	.48300	.48413	.48526	.48639	.48751
89.	.48864	.48976	.49088	.49200	.49312	.49424	.49536	.49647	.49758	.49870
90.	4.49981	.50092	.50203	.50314	.50424	.50535	.50645	.50756	.50866	.50976
91.	.51086	.51196	51305	.51415	.51525	.51634	.51743	.51852	.51961	.52070
92.	.52179	.52287	.52396	.52504	.52613	.52721	.52829	52937	.53045	.53152
93.	.53260	.53367	.53475	.53582	.53689	.53796	.53903	.54010	.54116	.54223
94.	.54329	.54436	.54542	.54648	.54754	.54860	.54966	.55071	.55177	.55282
95.	.55388	.55493	.55598	.55703	.55808	.55913	.56017	.56122	.56226	.56331
96.	.56435	.56539	.56643	.56747	.56851	.56954	.57058	.57161	.57265	.57368
97.	.57471	.57574	.57677	.57780	.57883	.57985	.58088	.58190	.58292	.58395
98.	.58497	.58599	.58701	.58802	.58904	.59006	59107	.59208	.59310	.59411
99.	.59512	.59613	.59714	.59815	.59915	.60016	.60116	.60217	.60317	.60417

NATURAL OR NAPERIAN LOGARITHMS (Continued)

0–499

N	0	1	2	3	4	5	6	7	8	9
0	∞	0.00000	0.69315	1.09861	.38629	.60944	.79176	.94591	*.07944	*.19722
1	2.30259	.39790	.48491	.56495	.63906	.70805	.77259	.83321	.89037	.94444
2	.99573	*.04452	*.09104	*.13549	*.17805	*.21888	*.25810	*.29584	*.33220	*.36730
3	3.40120	.43399	.46574	.49651	.52636	.55535	.58352	.61092	.63759	.66356
4	.68888	.71357	.73767	.76120	.78419	.80666	.82864	.85015	.87120	.89182
5	.91202	.93183	.95124	.97029	.98898	*.00733	*.02535	*.04305	*.06044	*.07754
6	4.09434	.11087	.12713	.14313	.15888	.17439	.18965	.20469	.21951	.23411
7	.24850	.26268	.27667	.29046	.30407	.31749	.33073	.34381	.35671	.36945
8	.38203	.39445	.40672	.41884	.43082	.44265	.45435	.46591	.47734	.48864
9	.49981	.51086	.52179	.53260	.54329	.55388	.56435	.57471	.58497	.59512
10	4.60517	.61512	.62497	.63473	.64439	.65396	.66344	.67283	.68213	.69135
11	.70048	.70953	.71850	.72739	.73620	.74493	.75359	.76217	.77068	.77912
12	.78749	.79579	.80402	.81218	.82028	.82831	.83628	.84419	.85203	.85981
13	.86753	.87520	.88280	.89035	.89784	.90527	.91265	.91998	.92725	.93447
14	.94164	.94876	.95583	.96284	.96981	.97673	.98361	.99043	.99721	*.00395
15	5.01064	.01728	.02388	.03044	.03695	.04343	.04986	.05625	.06260	.06890
16	.07517	.08140	.08760	.09375	.09987	.10595	.11199	.11799	.12396	.12990
17	.13580	.14166	.14749	.15329	.15906	.16479	.17048	.17615	.18178	.18739
18	.19296	.19850	.20401	.20949	.21494	.22036	.22575	.23111	.23644	.24175
19	.24702	.25227	.25750	.26269	.26786	.27300	.27811	.28320	.28827	.29330
20	5.29832	.30330	.30827	.31321	.31812	.32301	.32788	.33272	.33754	.34233
21	.34711	.35186	.35659	.36129	.36598	.37064	.37528	.37990	.38450	.38907
22	.39363	.39816	.40268	.40717	.41165	.41610	.42053	.42495	.42935	.43372
23	.43808	.44242	.44674	.45104	.45532	.45959	.46383	.46806	.47227	.47646
24	.48064	.48480	.48894	.49306	.49717	.50126	.50533	.50939	.51343	.51745
25	.52146	.52545	.52943	.53339	.53733	.54126	.54518	.54908	.55296	.55683
26	.56068	.56452	.56834	.57215	.57595	.57973	.58350	.58725	.59099	.59471
27	.59842	.60212	.60580	.60947	.61313	.61677	.62040	.62402	.62762	.63121
28	.63479	.63835	.64191	.64545	.64897	.65249	.65599	.65948	.66296	.66643
29	.66988	.67332	.67675	.68017	.68358	.68698	.69036	.69373	.69709	.70044
30	5.70378	.70711	.71043	.71373	.71703	.72031	.72359	.72685	.73010	.73334
31	.73657	.73979	.74300	.74620	.74939	.75257	.75574	.75890	.76205	.76519
32	.76832	.77144	.77455	.77765	.78074	.78383	.78690	.78996	.79301	.79606
33	.79909	.80212	.80513	.80814	.81114	.81413	.81711	.82008	.82305	.82600
34	.82895	.83188	.83481	.83773	.84064	.84354	.84644	.84932	.85220	.85507
35	.85793	.86079	.86363	.86647	.86930	.87212	.87493	.87774	.88053	.88332
36	.88610	.88888	.89164	.89440	.89715	.89990	.90263	.90536	.90808	.91080
37	.91350	.91620	.91889	.92158	.92426	.92693	.92959	.93225	.93489	.93754
38	.94017	.94280	.94542	.94803	.95064	.95324	.95584	.95842	.96101	.96358
39	.96615	.96871	.97126	.97381	.97635	.97889	.98141	.98394	.98645	.98896
40	5.99146	.99396	.99645	.99894	*.00141	*.00389	*.00635	*.00881	*.01127	*.01372
41	6.01616	.01859	.02102	.02345	.02587	.02828	.03069	.03309	.03548	.03787
42	.04025	.04263	.04501	.04737	.04973	.05209	.05444	.05678	.05912	.06146
43	.06379	.06611	.06843	.07074	.07304	.07535	.07764	.07993	.08222	.08450
44	.08677	.08904	.09131	.09357	.09582	.09807	.10032	.10256	.10479	.10702
45	.10925	.11147	.11368	.11589	.11810	.12030	.12249	.12468	.12687	.12905
46	.13123	.13340	.13556	.13773	.13988	.14204	.14419	.14633	.14847	.15060
47	.15273	.15486	.15698	.15910	.16121	.16331	.16542	.16752	.16961	.17170
48	.17379	.17587	.17794	.18002	18208	.18415	.18621	.18826	.19032	.19236
49	.19441	.19644	.19848	.20051	.20254	.20456	.20658	.20859	.21060	.21261

NATURAL OR NAPERIAN LOGARITHMS (Continued)

500-999

N	0	1	2	3	4	5	6	7	8	9
50	6.21461	.21661	.21860	.22059	.22258	.22456	.22654	.22851	.23048	.23245
51	.23441	.23637	.23832	.24028	.24222	.24417	.24611	.24804	.24998	.25190
52	.25383	.25575	.25767	.25958	.26149	.26340	.26530	.26720	.26910	.27099
53	.27288	.27476	.27664	.27852	.28040	.28227	.28413	.28600	.28786	.28972
54	.29157	.29342	.29527	.29711	.29895	.30079	.30262	.30445	.30628	.30810
55	.30992	.31173	.31355	.31536	.31716	.31897	.32077	.32257	.32436	.32615
56	.32794	.32972	.33150	.33328	.33505	.33683	.33859	.34036	.34212	.34388
57	.34564	.34739	.34914	.35089	.35263	.35437	.35611	.35784	.35957	.36130
58	.36303	.36475	.36647	.36819	.36990	.37161	.37332	.37502	.37673	.37843
59	.38012	.38182	.38351	.38519	.38688	.38856	.39024	.39192	.39359	.39526
60	6.39693	.39859	.40026	.40192	.40357	.40523	.40688	.40853	.41017	.41182
61	.41346	.41510	.41673	.41836	.41999	.42162	.42325	.42487	.42649	.42811
62	.42972	.43133	.43294	.43455	.43615	.43775	.43935	.44095	.44254	.44413
63	.44572	.44731	.44889	.45047	.45205	.45362	.45520	.45677	.45834	.45990
64	.46147	.46303	.46459	.46614	.46770	.46925	.47080	.47235	.47389	.47543
65	.47697	.47851	.48004	.48158	.48311	.48464	.48616	.48768	.48920	.49072
66	.49224	.49375	.49527	.49677	.49828	.49979	.50129	.50279	.50429	.50578
67	.50728	.50877	.51026	.51175	.51323	.51471	.51619	.51767	.51915	.52062
68	.52209	.52356	.52503	.52649	.52796	.52942	.53088	.53233	.53379	.53524
69	.53669	.53814	.53959	.54103	.54247	.54391	.54535	.54679	.54822	.54965
70	6.55108	.55251	.55393	.55536	.55678	.55820	.55962	.56103	.56244	.56386
71	.56526	.56667	.56808	.56948	.57088	.57228	.57368	.57508	.57647	.57786
72	.57925	.58064	.58203	.58341	.58479	.58617	.58755	.58893	.59030	.59167
73	.59304	.59441	.59578	.59715	.59851	.59987	.60123	.60259	.60394	.60530
74	.60665	.60800	.60935	.61070	.61204	.61338	.61473	.61607	.61740	61874
75	.62007	.62141	.62274	.62407	.62539	.62672	.62804	.62936	.63068	.63200
76	.63332	.63463	.63595	.63726	.63857	.63988	.64118	.64249	.64379	.64509
77	.64639	.64769	.64898	65028	.65157	.65286	.65415	.65544	.65673	.65801
78	.65929	.66058	.66185	.66313	.66441	.66568	.66696	.66823	.66950	.67077
79	.67203	.67330	.67456	.67582	.67708	.67834	.67960	.68085	.68211	.68336
80	6.68461	.68586	.68711	.68835	.68960	.69084	.69208	.69332	.69456	.69580
81	.69703	.69827	.69950	.70073	.70196	.70319	.70441	.70564	.70686	.70808
82	.70930	.71052	.71174	.71296	.71417	.71538	.71659	.71780	.71901	.72022
83	.72143	.72263	.72383	.72503	.72623	.72743	.72863	.72982	.73102	.73221
84	.73340	.73459	.73578	.73697	.73815	.73934	.74052	.74170	.74288	.74406
85	.74524	.74641	.74759	.74876	.74993	.75110	.75227	.75344	.75460	.75577
86	.75693	.75809	.75926	.76041	.76157	.76273	.76388	.76504	.76619	.76734
87	.76849	.76964	.77079	.77194	.77308	.77422	.77537	.77651	.77765	.77878
88	.77992	.78106	.78219	.78333	.78446	.78559	.78672	.78784	.78897	.79010
89	.79122	.79234	.79347	.79459	.79571	.79682	.79794	.79906	.80017	.80128
90	6.80239	80351	.80461	.80572	.80683	.80793	.80904	.81014	.81124	.81235
91	.81344	.81454	.81564	.81674	.81783	.81892	.82002	.82111	.82220	.82329
92	.82437	.82546	.82655	.82763	.82871	.82979	.83087	.83195	.83303	.83411
93	.83518	.83626	.83733	.83841	.83948	.84055	.84162	.84268	.84375	.84482
94	.84588	.84694	.84801	.84907	.85013	.85118	.85224	.85330	.85435	.85541
95	.85646	.85751	.85857	.85961	.86066	.86171	.86276	.86380	.86485	.86589
96	.86693	.86797	.86901	.87005	.87109	.87213	.87316	.87420	.87523	.87626
97	.87730	.87833	.87936	.88038	.88141	.88244	.88346	.88449	.88551	.88653
98	.88755	.88857	.88959	.89061	.89163	.89264	.89366	.89467	.89568	.89669
99	.89770	.89871	.89972	.90073	.90174	.90274	.90375	.90475	.90575	.90675

EXPONENTIAL FUNCTIONS

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
0.00	1.0000	0.00000	1.000000	**0.50**	1.6487	0.21715	0.606531
0.01	1.0101	.00434	0.990050	0.51	1.6653	.22149	.600496
0.02	1.0202	.00869	.980199	0.52	1.6820	.22583	.594521
0.03	1.0305	.01303	.970446	0.53	1.6989	.23018	.588605
0.04	1.0408	.01737	.960789	0.54	1.7160	.23452	.582748
0.05	1.0513	0.02171	0.951229	**0.55**	1.7333	0.23886	0.576950
0.06	1.0618	.02606	.941765	0.56	1.7507	.24320	.571209
0.07	1.0725	.03040	.932394	0.57	1.7683	.24755	.565525
0.08	1.0833	.03474	.923116	0.58	1.7860	.25189	.559898
0.09	1.0942	.03909	.913931	0.59	1.8040	.25623	.554327
0.10	1.1052	0.04343	0.904837	**0.60**	1.8221	0.26058	0.548812
0.11	1.1163	.04777	.895834	0.61	1.8404	.26492	.543351
0.12	1.1275	.05212	.886920	0.62	1.8589	.26926	.537944
0.13	1.1388	.05646	.878095	0.63	1.8776	.27361	.532592
0.14	1.1503	.06080	.869358	0.64	1.8965	.27795	.527292
0.15	1.1618	0.06514	0.860708	**0.65**	1.9155	0.28229	0.522046
0.16	1.1735	.06949	.852144	0.66	1.9348	.28663	.516851
0.17	1.1853	.07383	.843665	0.67	1.9542	.29098	.511709
0.18	1.1972	.07817	.835270	0.68	1.9739	.29532	.506617
0.19	1.2092	.08252	.826959	0.69	1.9937	.29966	.501576
0.20	1.2214	0.08686	0.818731	**0.70**	2.0138	0.30401	0.496585
0.21	1.2337	.09120	.810584	0.71	2.0340	.30835	.491644
0.22	1.2461	.09554	.802519	0.72	2.0544	.31269	.486752
0.23	1.2586	.09989	.794534	0.73	2.0751	.31703	.481909
0.24	1.2712	.10423	.786628	0.74	2.0959	.32138	.477114
0.25	1.2840	0.10857	0.778801	**0.75**	2.1170	0.32572	0.472367
0.26	1.2969	.11292	.771052	0.76	2.1383	.33006	.467666
0.27	1.3100	.11726	.763379	0.77	2.1598	.33441	.463013
0.28	1.3231	.12160	.755784	0.78	2.1815	.33875	.458406
0.29	1.3364	.12595	.748264	0.79	2.2034	.34309	.453845
0.30	1.3499	0.13029	0.740818	**0.80**	2.2255	0.34744	0.449329
0.31	1.3634	.13463	.733447	0.81	2.2479	.35178	.444858
0.32	1.3771	.13897	.726149	0.82	2.2705	.35612	.440432
0.33	1.3910	.14332	.718924	0.83	2.2933	.36046	.436049
0.34	1.4049	.14766	.711770	0.84	2.3164	.36481	.431711
0.35	1.4191	0.15200	0.704688	**0.85**	2.3396	0.36915	0.427415
0.36	1.4333	.15635	.697676	0.86	2.3632	.37349	.423162
0.37	1.4477	.16069	.690734	0.87	2.3869	.37784	.418952
0.38	1.4623	.16503	.683861	0.88	2.4109	.38218	.414783
0.39	1.4770	.16937	.677057	0.89	2.4351	.38652	.410656
0.40	1.4918	0.17372	0.670320	**0.90**	2.4596	0.39087	0.406570
0.41	1.5068	.17806	.663650	0.91	2.4843	.39521	.402524
0.42	1.5220	.18240	.657047	0.92	2.5093	.39955	.398519
0.43	1.5373	.18675	.650509	0.93	2.5345	.40389	.394554
0.44	1.5527	.19109	.644036	0.94	2.5600	.40824	.390628
0.45	1.5683	0.19543	0.637628	**0.95**	2.5857	0.41258	0.386741
0.46	1.5841	.19978	.631284	0.96	2.6117	.41692	.382893
0.47	1.6000	.20412	.625002	0.97	2.6379	.42127	.379083
0.48	1.6161	.20846	.618783	0.98	2.6645	.42561	.375311
0.49	1.6323	.21280	.612626	0.99	2.6912	.42995	.371577
0.50	1.6487	0.21715	0.606531	**1.00**	2.7183	0.43429	0.367879

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
1.00	2.7183	0.43429	0.367879	**1.50**	4.4817	0.65144	0.223130
1.01	2.7456	.43864	.364219	1.51	4.5267	.65578	.220910
1.02	2.7732	.44298	.360595	1.52	4.5722	.66013	.218712
1.03	2.8011	.44732	.357007	1.53	4.6182	.66447	.216536
1.04	2.8292	.45167	.353455	1.54	4.6646	.66881	.214381
1.05	2.8577	0.45601	0.349938	**1.55**	4.7115	0.67316	0.212248
1.06	2.8864	.46035	.346456	1.56	4.7588	.67750	.210136
1.07	2.9154	.46470	.343009	1.57	4.8066	.68184	.208045
1.08	2.9447	.46904	.339596	1.58	4.8550	.68619	.205975
1.09	2.9743	.47338	.336216	1.59	4.9037	.69053	.203926
1.10	3.0042	0.47772	0.332871	**1.60**	4.9530	0.69487	0.201897
1.11	3.0344	.48207	.329559	1.61	5.0028	.69921	.199888
1.12	3.0649	.48641	.326280	1.62	5.0531	.70356	.197899
1.13	3.0957	.49075	.323033	1.63	5.1039	.70790	.195930
1.14	3.1268	.49510	.319819	1.64	5.1552	.71224	.193980
1.15	3.1582	0.49944	0.316637	**1.65**	5.2070	0.71659	0.192050
1.16	3.1899	.50378	.313486	1.66	5.2593	.72093	.190139
1.17	3.2220	.50812	.310367	1.67	5.3122	.72527	.188247
1.18	3.2544	.51247	.307279	1.68	5.3656	.72961	.186374
1.19	3.2871	.51681	.304221	1.69	5.4195	.73396	.184520
1.20	3.3201	0.52115	0.301194	**1.70**	5.4739	0.73830	0.182684
1.21	3.3535	.52550	.298197	1.71	5.5290	.74264	.180866
1.22	3.3872	.52984	.295230	1.72	5.5845	.74699	.179066
1.23	3.4212	.53418	.292293	1.73	5.6407	.75133	.177284
1.24	3.4556	.53853	.289384	1.74	5.6973	.75567	.175520
1.25	3.4903	0.54287	0.286505	**1.75**	5.7546	0.76002	0.173774
1.26	3.5254	.54721	.283654	1.76	5.8124	.76436	.172045
1.27	3.5609	.55155	.280832	1.77	5.8709	.76870	.170333
1.28	3.5966	.55590	.278037	1.78	5.9299	.77304	.168638
1.29	3.6328	.56024	.275271	1.79	5.9895	.77739	.166960
1.30	3.6693	0.56458	0.272532	**1.80**	6.0496	0.78173	0.165299
1.31	3.7062	.56893	.269820	1.81	6.1104	.78607	.163654
1.32	3.7434	.57327	.267135	1.82	6.1719	.79042	.162026
1.33	3.7810	.57761	.264477	1.83	6.2339	.79476	.160414
1.34	3.8190	.58195	.261846	1.84	6.2965	.79910	.158817
1.35	3.8574	0.58630	0.259240	**1.85**	6.3598	0.80344	0.157237
1.36	3.8962	.59064	.256661	1.86	6.4237	.80779	.155673
1.37	3.9354	.59498	.254107	1.87	6.4883	.81213	.154124
1.38	3.9749	.59933	.251579	1.88	6.5535	.81647	.152590
1.39	4.0149	.60367	.249075	1.89	6.6194	.82082	.151072
1.40	4.0552	0.60801	0.246597	**1.90**	6.6859	0.82516	0.149569
1.41	4.0960	.61236	.244143	1.91	6.7531	.82950	.148080
1.42	4.1371	.61670	.241714	1.92	6.8210	.83385	.146607
1.43	4.1787	.62104	.239309	1.93	6.8895	.83819	.145148
1.44	4.2207	.62538	.236928	1.94	6.9588	.84253	.143704
1.45	4.2631	0.62973	0.234570	**1.95**	7.0287	0.84687	0.142274
1.46	4.3060	.63407	.232236	1.96	7.0993	.85122	.140858
1.47	4.3492	.63841	.229925	1.97	7.1707	.85556	.139457
1.48	4.3929	.64276	.227638	1.98	7.2427	.85990	.138069
1.49	4.4371	.64710	.225373	1.99	7.3155	.86425	.136695
1.50	4.4817	0.65144	0.223130	**2.00**	7.3891	0.86859	0.135335

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
2.00	7.3891	0.86859	0.135335	**2.50**	12.182	1.08574	0.082085
2.01	7.4633	.87293	.133989	2.51	12.305	1.09008	.081268
2.02	7.5383	.87727	.132655	2.52	12.429	1.09442	.080460
2.03	7.6141	.88162	.131336	2.53	12.554	1.09877	.079659
2.04	7.6906	.88596	.130029	2.54	12.680	1.10311	.078866
2.05	7.7679	0.89030	0.128735	**2.55**	12.807	1.10745	0.078082
2.06	7.8460	.89465	.127454	2.56	12.936	1.11179	.077305
2.07	7.9248	.89899	.126186	2.57	13.066	1.11614	.076536
2.08	8.0045	.90333	.124930	2.58	13.197	1.12048	.075774
2.09	8.0849	.90768	.123687	2.59	13.330	1.12482	.075020
2.10	8.1662	0.91202	0.122456	**2.60**	13.464	1.12917	0.074274
2.11	8.2482	.91636	.121238	2.61	13.599	1.13351	.073535
2.12	8.3311	.92070	.120032	2.62	13.736	1.13785	.072803
2.13	8.4149	.92505	.118837	2.63	13.874	1.14219	.072078
2.14	8.4994	.92939	.117655	2.64	14.013	1.14654	.071361
2.15	8.5849	0.93373	0.116484	**2.65**	14.154	1.15088	0.070651
2.16	8.6711	.93808	.115325	2.66	14.296	1.15522	.069948
2.17	8.7583	.94242	.114178	2.67	14.440	1.15957	.069252
2.18	8.8463	.94676	.113042	2.68	14.585	1.16391	.068563
2.19	8.9352	.95110	.111917	2.69	14.732	1.16825	.067881
2.20	9.0250	0.95545	0.110803	**2.70**	14.880	1.17260	0.067206
2.21	9.1157	.95979	.109701	2.71	15.029	1.17694	.066537
2.22	9.2073	.96413	.108609	2.72	15.180	1.18128	.065875
2.23	9.2999	.96848	.107528	2.73	15.333	1.18562	.065219
2.24	9.3933	.97282	.106459	2.74	15.487	1.18997	.064570
2.25	9.4877	0.97716	0.105399	**2.75**	15.643	1.19431	0.063928
2.26	9.5831	.98151	.104350	2.76	15.800	1.19865	.063292
2.27	9.6794	.98585	.103312	2.77	15.959	1.20300	.062662
2.28	9.7767	.99019	.102284	2.78	16.119	1.20734	.062039
2.29	9.8749	.99453	.101266	2.79	16.281	1.21168	.061421
2.30	9.9742	0.99888	0.100259	**2.80**	16.445	1.21602	0.060810
2.31	10.074	1.00322	.099261	2.81	16.610	1.22037	.060205
2.32	10.176	1.00756	.098274	2.82	16.777	1.22471	.059606
2.33	10.278	1.01191	.097296	2.83	16.945	1.22905	.059013
2.34	10.381	1.01625	.096328	2.84	17.116	1.23340	.058426
2.35	10.486	1.02059	0.095369	**2.85**	17.288	1.23774	0.057844
2.36	10.591	1.02493	.094420	2.86	17.462	1.24208	.057269
2.37	10.697	1.02928	.093481	2.87	17.637	1.24643	.056699
2.38	10.805	1.03362	.092551	2.88	17.814	1.25077	.056135
2.39	10.913	1.03796	.091630	2.89	17.993	1.25511	.055576
2.40	11.023	1.04231	0.090718	**2.90**	18.174	1.25945	0.055023
2.41	11.134	1.04665	.089815	2.91	18.357	1.26380	.054476
2.42	11.246	1.05099	.088922	2.92	18.541	1.26814	.053934
2.43	11.359	1.05534	.088037	2.93	18.728	1.27248	.053397
2.44	11.473	1.05968	.087161	2.94	18.916	1.27683	.052866
2.45	11.588	1.06402	0.086294	**2.95**	19.106	1.28117	0.052340
2.46	11.705	1.06836	.085435	2.96	19.298	1.28551	.051819
2.47	11.822	1.07271	.084585	2.97	19.492	1.28985	.051303
2.48	11.941	1.07705	.083743	2.98	19.688	1.29420	.050793
2.49	12.061	1.08139	.082910	2.99	19.886	1.29854	.050287
2.50	12.182	1.08574	0.082085	**3.00**	20.086	1.30288	0.049787

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
3.00	20.086	1.30288	0.049787	**3.50**	33.115	1.52003	0.030197
3.01	20.287	1.30723	.049292	3.51	33.448	1.52437	.029897
3.02	20.491	1.31157	.048801	3.52	33.784	1.52872	.029599
3.03	20.697	1.31591	.048316	3.53	34.124	1.53306	.029305
3.04	20.905	1.32026	.047835	3.54	34.467	1.53740	.029013
3.05	21.115	1.32460	0.047359	**3.55**	34.813	1.54175	0.028725
3.06	21.328	1.32894	.046888	3.56	35.163	1.54609	.028439
3.07	21.542	1.33328	.046421	3.57	35.517	1.55043	.028156
3.08	21.758	1.33763	.045959	3.58	35.874	1.55477	.027876
3.09	21.977	1.34197	.045502	3.59	36.234	1.55912	.027598
3.10	22.198	1.34631	0.045049	**3.60**	36.598	1.56346	0.027324
3.11	22.421	1.35066	.044601	3.61	36.966	1.56780	.027052
3.12	22.646	1.35500	.044157	3.62	37.338	1.57215	.026783
3.13	22.874	1.35934	.043718	3.63	37.713	1.57649	.026516
3.14	23.104	1.36368	.043283	3.64	38.092	1.58083	.026252
3.15	23.336	1.36803	0.042852	**3.65**	38.475	1.58517	0.025991
3.16	23.571	1.37237	.042426	3.66	38.861	1.58952	.025733
3.17	23.807	1.37671	.042004	3.67	39.252	1.59386	.025476
3.18	24.047	1.38106	.041586	3.68	39.646	1.59820	.025223
3.19	24.288	1.38540	.041172	3.69	40.045	1.60255	.024972
3.20	24.533	1.38974	0.040762	**3.70**	40.447	1.60689	0.024724
3.21	24.779	1.39409	.040357	3.71	40.854	1.61123	.024478
3.22	25.028	1.39843	.039955	3.72	41.264	1.61558	.024234
3.23	25.280	1.40277	.039557	3.73	41.679	1.61992	.023993
3.24	25.534	1.40711	.039164	3.74	42.098	1.62426	.023754
3.25	25.790	1.41146	0.038774	**3.75**	42.521	1.62860	0.023518
3.26	26.050	1.41580	.038388	3.76	42.948	1.63295	.023284
3.27	26.311	1.42014	.038006	3.77	43.380	1.63729	.023052
3.28	26.576	1.42449	.037628	3.78	43.816	1.64163	.022823
3.29	26.843	1.42883	.037254	3.79	44.256	1.64598	.022596
3.30	27.113	1.43317	0.036883	**3.80**	44.701	1.65032	0.022371
3.31	27.385	1.43751	.036516	3.81	45.150	1.65466	.022148
3.32	27.660	1.44186	.036153	3.82	45.604	1.65900	.021928
3.33	27.938	1.44620	.035793	3.83	46.063	1.66335	.021710
3.34	28.219	1.45054	.035437	3.84	46.525	1.66769	.021494
3.35	28.503	1.45489	0.035084	**3.85**	46.993	1.67203	0.021280
3.36	28.789	1.45923	.034735	3.86	47.465	1.67638	.021068
3.37	29.079	1.46357	.034390	3.87	47.942	1.68072	.020858
3.38	29.371	1.46792	.034047	3.88	48.424	1.68506	.020651
3.39	29.666	1.47226	.033709	3.89	48.911	1.68941	.020445
3.40	29.964	1.47660	0.033373	**3.90**	49.402	1.69375	0.020242
3.41	30.265	1.48094	.033041	3.91	49.899	1.69809	.020041
3.42	30.569	1.48529	.032712	3.92	50.400	1.70243	.019841
3.43	30.877	1.48963	.032387	3.93	50.907	1.70678	.019644
3.44	31.187	1.49397	.032065	3.94	51.419	1.71112	.019448
3.45	31.500	1.49832	0.031746	**3.95**	51.935	1.71546	0.019255
3.46	31.817	1.50266	.031430	3.96	52.457	1.71981	.019063
3.47	32.137	1.50700	.031117	3.97	52.985	1.72415	.018873
3.48	32.460	1.51134	.030807	3.98	53.517	1.72849	.018686
3.49	32.786	1.51569	.030501	3.99	54.055	1.73283	.018500
3.50	33.115	1.52003	0.030197	**4.00**	54.598	1.73718	0.018316

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
4.00	54.598	1.73718	0.018316	**4.50**	90.017	1.95433	0.011109
4.01	55.147	1.74152	.018133	4.51	90.922	1.95867	.010998
4.02	55.701	1.74586	.017953	4.52	91.836	1.96301	.010889
4.03	56.261	1.75021	.017774	4.53	92.759	1.96735	.010781
4.04	56.826	1.75455	.017597	4.54	93.691	1.97170	.010673
4.05	57.397	1.75889	0.017422	**4.55**	94.632	1.97604	0.010567
4.06	57.974	1.76324	.017249	4.56	95.583	1.98038	.010462
4.07	58.557	1.76758	.017077	4.57	96.544	1.98473	.010358
4.08	59.145	1.77192	.016907	4.58	97.514	1.98907	.010255
4.09	59.740	1.77626	.016739	4.59	98.494	1.99341	.010153
4.10	60.340	1.78061	0.016573	**4.60**	99.484	1.99775	0.010052
4.11	60.947	1.78495	.016408	4.61	100.48	2.00210	.009952
4.12	61.559	1.78929	.016245	4.62	101.49	2.00644	.009853
4.13	62.178	1.79364	.016083	4.63	102.51	2.01078	.009755
4.14	62.803	1.79798	.015923	4.64	103.54	2.01513	.009658
4.15	63.434	1.80232	0.015764	**4.65**	104.58	2.01947	0.009562
4.16	64.072	1.80667	.015608	4.66	105.64	2.02381	.009466
4.17	64.715	1.81101	.015452	4.67	106.70	2.02816	.009372
4.18	65.366	1.81535	.015299	4.68	107.77	2.03250	.009279
4.19	66.023	1.81969	.015146	4.69	108.85	2.03684	.009187
4.20	66.686	1.82404	0.014996	**4.70**	109.95	2.04118	0.009095
4.21	67.357	1.82838	.014846	4.71	111.05	2.04553	.009005
4.22	68.033	1.83272	.014699	4.72	112.17	2.04987	.008915
4.23	68.717	1.83707	.014552	4.73	113.30	2.05421	.008826
4.24	69.408	1.84141	.014408	4.74	114.43	2.05856	.008739
4.25	70.105	1.84575	0.014264	**4.75**	115.58	2.06290	0.008652
4.26	70.810	1.85009	.014122	4.76	116.75	2.06724	.008566
4.27	71.522	1.85444	.013982	4.77	117.92	2.07158	.008480
4.28	72.240	1.85878	.013843	4.78	119.10	2.07593	.008396
4.29	72.966	1.86312	.013705	4.79	120.30	2.08027	.008312
4.30	73.700	1.86747	0.013569	**4.80**	121.51	2.08461	0.008230
4.31	74.440	1.87181	.013434	4.81	122.73	2.08896	.008148
4.32	75.189	1.87615	.013300	4.82	123.97	2.09330	.008067
4.33	75.944	1.88050	.013168	4.83	125.21	2.09764	.007987
4.34	76.708	1.88484	.013037	4.84	126.47	2.10199	.007907
4.35	77.478	1.88918	0.012907	**4.85**	127.74	2.10633	0.007828
4.36	78.257	1.89352	.012778	4.86	129.02	2.11067	.007750
4.37	79.044	1.89787	.012651	4.87	130.32	2.11501	.007673
4.38	79.838	1.90221	.012525	4.88	131.63	2.11936	.007597
4.39	80.640	1.90655	.012401	4.89	132.95	2.12370	.007521
4.40	81.451	1.91090	0.012277	**4.90**	134.29	2.12804	0.007447
4.41	82.269	1.91524	.012155	4.91	135.64	2.13239	.007372
4.42	83.096	1.91958	.012034	4.92	137.00	2.13673	.007299
4.43	83.931	1.92392	.011914	4.93	138.38	2.14107	.007227
4.44	84.775	1.92827	.011796	4.94	139.77	2.14541	.007155
4.45	85.627	1.93261	0.011679	**4.95**	141.17	2.14976	0.007083
4.46	86.488	1.93695	.011562	4.96	142.59	2.15410	.007013
4.47	87.357	1.94130	.011447	4.97	144.03	2.15844	.006943
4.48	88.235	1.94564	.011333	4.98	145.47	2.16279	.006874
4.49	89.121	1.94998	.011221	4.99	146.94	2.16713	.006806
4.50	90.017	1.95433	0.011109	**5.00**	**148.41**	**2.17147**	0.006738

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\text{Log}_{10}(e^x)$	e^{-x}
5.00	148.41	2.17147	0.006738	**5.50**	244.69	2.38862	0.0040868
5.01	149.90	2.17582	.006671	5.55	257.24	2.41033	.0038875
5.02	151.41	2.18016	.006605	5.60	270.43	2.43205	.0036979
5.03	152.93	2.18450	.006539	5.65	284.29	2.45376	.0035175
5.04	154.47	2.18884	.006474	5.70	298.87	2.47548	.0033460
5.05	156.02	2.19319	0.006409	**5.75**	314.19	2.49719	0.0031828
5.06	157.59	2.19753	.006346	5.80	330.30	2.51891	.0030276
5.07	159.17	2.20187	.006282	5.85	347.23	2.54062	.0028799
5.08	160.77	2.20622	.006220	5.90	365.04	2.56234	.0027394
5.09	162.39	2.21056	.006158	5.95	383.75	2.58405	.0026058
5.10	164.02	2.21490	0.006097	**6.00**	403.43	2.60577	0.0024788
5.11	165.67	2.21924	.006036	6.05	424.11	2.62748	.0023579
5.12	167.34	2.22359	.005976	6.10	445.86	2.64920	.0022429
5.13	169.02	2.22793	.005917	6.15	468.72	2.67091	.0021335
5.14	170.72	2.23227	.005858	6.20	492.75	2.69263	.0020294
5.15	172.43	2.23662	0.005799	**6.25**	518.01	2.71434	0.0019305
5.16	174.16	2.24096	.005742	6.30	544.57	2.73606	.0018363
5.17	175.91	2.24530	.005685	6.35	572.49	2.75777	.0017467
5.18	177.68	2.24965	.005628	6.40	601.85	2.77948	.0016616
5.19	179.47	2.25399	.005572	6.45	632.70	2.80120	.0015805
5.20	181.27	2.25833	0.005517	**6.50**	665.14	2.82291	0.0015034
5.21	183.09	2.26267	.005462	6.55	699.24	2.84463	.0014301
5.22	184.93	2.26702	.005407	6.60	735.10	2.86634	.0013604
5.23	186.79	2.27136	.005354	6.65	772.78	2.88806	.0012940
5.24	188.67	2.27570	.005300	6.70	812.41	2.90977	.0012309
5.25	190.57	2.28005	0.005248	**6.75**	854.06	2.93149	0.0011709
5.26	192.48	2.28439	.005195	6.80	897.85	2.95320	.0011138
5.27	194.42	2.28873	.005144	6.85	943.88	2.97492	.0010595
5.28	196.37	2.29307	.005092	6.90	992.27	2.99663	.0010078
5.29	198.34	2.29742	.005042	6.95	1043.1	3.01835	.0009586
5.30	200.34	2.30176	0.004992	**7.00**	1096.6	3.04006	0.0009119
5.31	202.35	2.30610	.004942	7.05	1152.9	3.06178	.0008674
5.32	204.38	2.31045	.004893	7.10	1212.0	3.08349	.0008251
5.33	206.44	2.31479	.004844	7.15	1274.1	3.10521	.0007849
5.34	208.51	2.31913	.004796	7.20	1339.4	3.12692	.0007466
5.35	210.61	2.32348	0.004748	**7.25**	1408.1	3.14863	0.0007102
5.36	212.72	2.32782	.004701	7.30	1480.3	3.17035	.0006755
5.37	214.86	2.33216	.004654	7.35	1556.2	3.19206	.0006426
5.38	217.02	2.33650	.004608	7.40	1636.0	3.21378	.0006113
5.39	219.20	2.34085	.004562	7.45	1719.9	3.23549	.0005814
5.40	221.41	2.34519	0.004517	**7.50**	1808.0	3.25721	0.0005531
5.41	223.63	2.34953	.004472	7.55	1900.7	3.27892	.0005261
5.42	225.88	2.35388	.004427	7.60	1998.2	3.30064	.0005005
5.43	228.15	2.35822	.004383	7.65	2100.6	3.32235	.0004760
5.44	230.44	2.36256	.004339	7.70	2208.3	3.33407	.0004528
5.45	232.76	2.36690	0.004296	**7.75**	2321.6	3.36578	0.0004307
5.46	235.10	2.37125	.004254	7.80	2440.6	3.38750	.0004097
5.47	237.46	2.37559	.004211	7.85	2565.7	3.40921	.0003898
5.48	239.85	2.37993	.004169	7.90	2697.3	3.43093	.0003707
5.49	242.26	2.38428	.004128	7.95	2835.6	3.45264	.0003527
5.50	244.69	2.38862	0.004087	**8.00**	2981.0	3.47436	0.0003355

EXPONENTIAL FUNCTIONS (Continued)

x	e^x	$\mathrm{Log}_{10}(e^x)$	e^{-x}	x	e^x	$\mathrm{Log}_{10}(e^x)$	e^{-x}
8.00	2981.0	3.47436	0.0003355	**9.00**	8103.1	3.90865	0.0001234
8.05	3133.8	3.49607	.0003191	9.05	8518.5	3.93037	.0001174
8.10	3294.5	3.51779	.0003035	9.10	8955.3	3.95208	.0001117
8.15	3463.4	3.53950	.0002887	9.15	9414.4	3.97379	.0001062
8.20	3641.0	3.56121	.0002747	9.20	9897.1	3.99551	.0001010
8.25	3827.6	3.58293	0.0002613	**9.25**	10405	4.01722	0.0000961
8.30	4023.9	3.60464	.0002485	9.30	10938	4.03894	.0000914
8.35	4230.2	3.62636	.0002364	9.35	11499	4.06065	.0000870
8.40	4447.1	3.64807	.0002249	9.40	12088	4.08237	.0000827
8.45	4675.1	3.66979	.0002139	9.45	12708	4.10408	.0000787
8.50	4914.8	3.69150	0.0002035	**9.50**	13360	4.12580	0.0000749
8.55	5166.8	3.71322	.0001935	9.55	14045	4.14751	.0000712
8.60	5431.7	3.73493	.0001841	9.60	14765	4.16923	.0000677
8.65	5710.1	3.75665	.0001751	9.65	15522	4.19094	.0000644
8.70	6002.9	3.77836	.0001666	9.70	16318	4.21266	.0000613
8.75	6310.7	3.80008	0.0001585	**9.75**	17154	4.23437	0.0000583
8.80	6634.2	3.82179	.0001507	9.80	18034	4.25609	.0000555
8.85	6974.4	3.84351	.0001434	9.85	18958	4.27780	.0000527
8.90	7332.0	3.86522	.0001364	9.90	19930	4.29952	.0000502
8.95	7707.9	3.88694	.0001297	9.95	20952	4.32123	0.0000477
9.00	8103.1	3.90865	0.0001234	**10.00**	22026	4.34294	0.0000454

HYPERBOLIC FUNCTIONS

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
0.00	0.00000	$-\infty$	1.00000	.00000	0.00000	$-\infty$	∞	∞
0.01	.01000	.00001	1.00005	.00002	.01000	.99999	100.003	.00001
0.02	.02000	.30106	1.00020	.00009	.02000	.30097	50.007	.69903
0 03	.03000	.47719	1.00045	.00020	.02999	.47699	33.343	.52301
0.04	.04001	.60218	1.00080	.00035	.03998	.60183	25.013	.39817
0.05	0.05002	.69915	1.00125	.00054	0.04993	.69861	20.017	.30139
0.06	.06004	.77841	1.00180	.00078	.05993	.77763	16.687	.22237
0 07	.07006	.84545	1.00245	.00106	.06989	.84439	14.309	.15561
0.08	.08009	.90355	1.00320	.00139	.07983	.90216	12.527	.09784
0.09	.09012	.95483	1.00405	.00176	.08976	.95307	11.141	.04693
0.10	0.10017	.00072	1.00500	.00217	0.09967	.99856	10.0333	.00144
0 11	.11022	.04227	1.00606	.00262	.10956	.03965	9.1275	.96035
0.12	.12029	08022	1.00721	.00312	.11943	.07710	8 3733	.92290
0.13	.13037	.11517	1.00846	.00366	.12927	.11151	7.7356	.88849
0.14	.14046	.14755	1.00932	.00424	.13909	.14330	7.1895	.85670
0.15	0.15056	.17772	1.01127	.00487	0.14889	.17285	6.7166	.82715
0.16	.16068	.20597	1.01283	.00554	.15865	.20044	6.3032	.79956
0.17	.17082	.23254	1.01448	.00625	.16838	.22629	5.9389	.77371
0.18	.18097	.25762	1.01624	.00700	.17808	.25062	5.6154	.74938
0 19	.19115	.28136	1.01810	.00779	.18775	.27357	5.3263	.72643
0.20	0.20134	.30392	1.02007	.00863	0.19738	.29529	5.0665	.70471
0.21	.21155	.32541	1.02213	.00951	.20697	.31590	4.8317	.68410
0.22	.22178	.34592	1.02430	.01043	.21652	.33549	4.6186	.66451
0 23	.23203	.36555	1.02657	.01139	.22603	.35416	4.4242	.64584
0.24	.24231	.38437	1.02894	.01239	.23550	.37198	4.2464	.62802
0.25	0.25261	.40245	1.03141	.01343	0.24492	.38902	4.0830	.61098
0.26	.26294	.41986	1.03399	.01452	.25430	.40534	3.9324	.59466
0.27	.27329	.43663	1.03667	.01564	.26362	.42099	3.7933	.57901
0.28	.28367	.45282	1.03946	.01681	.27291	.43601	3.6643	.56399
0.29	.29408	.46847	1.04235	.01801	.28213	.45046	3.5444	.54954
0.30	0.30452	.48362	1.04534	.01926	0.29131	.46436	3.4327	.53564
0.31	.31499	.49830	1.04844	.02054	.30044	.47775	3.3285	.52225
0.32	.32549	.51254	1.05164	.02187	.30951	.49067	3.2309	.50933
0.33	.33602	.52637	1.05495	.02323	.31852	.50314	3.1395	.49686
0.34	.34659	.53981	1.05836	.02463	.32748	.51518	3.0536	.48482
0.35	0.35719	.55290	1.06188	.02607	0.33638	.52682	2.9729	.47318
0.36	.36783	.56564	1.06550	.02755	.34521	.53809	2.8968	.46191
0.37	.37850	.57807	1.06923	.02907	.35399	.54899	2.8249	.45101
0.38	.38921	.59019	1.07307	.03063	.36271	.55956	2.7570	.44044
0.39	.39996	.60202	1.07702	.03222	.37136	.56980	2.6928	.43020
0.40	0.41075	.61358	1.08107	.03385	0.37995	.57973	2.6319	.42027
0.41	.42158	.62488	1.08523	.03552	.38847	.58936	2.5742	.41064
0.42	.43246	.63594	1.08950	.03723	.39693	.59871	2.5193	.40129
0.43	.44337	.64677	1.09388	.03897	.40532	.60780	2.4672	.39220
0.44	.45434	.65738	1.09837	.04075	.41364	.61663	2.4175	.38337
0.45	0.46534	.66777	1.10297	.04256	0.42190	.62521	2.3702	.37479
0.46	.47640	.67797	1.10768	.04441	.43008	.63355	2.3251	.36645
0.47	.48750	.68797	1.11250	.04630	.43820	.64167	2.2821	.35833
0.48	.49865	.69779	1.11743	.04822	.44624	.64957	2.2409	.35043
0.49	.50984	.70744	1.12247	.05018	.45422	.65726	2.2016	34274

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
0.50	0.52110	.71692	1.12763	.05217	0.46212	.66475	2.1640	.33525
0.51	.53240	.72624	1.13289	.05419	.46995	.67205	2.1279	.32795
0.52	.54375	.73540	1.13827	.05625	.47770	.67916	2.0934	.32084
0.53	.55516	.74442	1.14377	.05834	.48538	.68608	2.0602	.31392
0.54	.56663	.75330	1.14938	.06046	.49299	.69284	2.0284	.30716
0.55	0.57815	.76204	1.15510	.06262	0.50052	.69942	1.9979	.30058
0.56	.58973	.77065	1.16094	.06481	.50798	.70584	1.9686	.29416
0.57	.60137	.77914	1.16690	.06703	.51536	.71211	1.9404	.28789
0.58	.61307	.78751	1.17297	.06929	.52267	.71822	1.9133	.28178
0.59	.62483	.79576	1.17916	.07157	.52990	.72419	1.8872	.27581
0.60	0.63665	.80390	1.18547	.07389	0.53705	.73001	1.8620	.26999
0.61	.64854	.81194	1.19189	.07624	.54413	.73570	1.8378	.26430
0.62	.66049	.81987	1.19844	.07861	.55113	.74125	1.8145	.25875
0.63	.67251	.82770	1.20510	.08102	.55805	.74667	1.7919	.25333
0.64	.68459	.83543	1.21189	.08346	.56490	.75197	1.7702	.24803
0.65	0.69675	.84308	1.21879	.08593	0.57167	.75715	1.7493	.24285
0.66	.70897	.85063	1.22582	.08843	.57836	.76220	1.7290	.23780
0.67	.72126	.85809	1.23297	.09095	.58498	.76714	1.7095	.23286
0.68	.73363	.86548	1.24025	.09351	.59152	.77197	1.6906	.22803
0.69	.74607	.87278	1.24765	.09609	.59798	.77669	1.6723	.22331
0.70	0.75858	.88000	1.25517	.09870	0.60437	.78130	1.6546	.21870
0.71	.77117	.88715	1.26282	.10134	.61068	.78581	1.6375	.21419
0.72	.78384	.89423	1.27059	.10401	.61691	.79022	1.6210	.20978
0.73	.79659	.90123	1.27849	.10670	.62307	.79453	1.6050	.20547
0.74	.80941	.90817	1.28652	.10942	.62915	.79875	1.5895	.20125
0.75	0.82232	.91504	1.29468	.11216	0.63515	.80288	1.5744	.19712
0.76	.83530	.92185	1.30297	.11493	.64108	.80691	1.5599	.19309
0.77	.84838	.92859	1.31139	.11773	.64693	.81086	1.5458	.18914
0.78	.86153	.93527	1.31994	.12055	.65271	.81472	1.5321	.18528
0.79	.87478	.94190	1.32862	.12340	.65841	.81850	1.5188	.18150
0.80	0.88811	.94846	1.33743	.12627	0.66404	.82219	1.5059	.17781
0.81	.90152	.95498	1.34638	.12917	.66959	.82581	1.4935	.17419
0.82	.91503	.96144	1.35547	.13209	.67507	.82935	1.4813	.17065
0.83	.92863	.96784	1.36468	.13503	.68048	.83281	1.4696	.16719
0.84	.94233	.97420	1.37404	.13800	.68581	.83620	1.4581	.16380
0.85	0.95612	.98051	1.38353	.14099	0.69107	.83952	1.4470	.16048
0.86	.97000	.98677	1.39316	.14400	.69626	.84277	1.4362	.15723
0.87	.98398	.99299	1.40293	.14704	.70137	.84595	1.4258	.15405
0.88	.99806	.99916	1.41284	.15009	.70642	.84906	1.4156	.15094
0.89	1.01224	.00528	1.42289	.15317	.71139	.85211	1.4057	.14789
0.90	1.02652	.01137	1.43309	.15627	0.71630	.85509	1.3961	.14491
0.91	1.04090	.01741	1.44342	.15939	.72113	.85801	1.3867	.14199
0.92	1.05539	.02341	1.45390	.16254	.72590	.86088	1.3776	.13912
0.93	1.06998	.02937	1.46453	.16570	.73059	.86368	1.3687	.13632
0.94	1.08468	.03530	1.47530	.16888	.73522	.86642	1.3601	.13358
0.95	1.09948	.04119	1.48623	.17208	0.73978	.86910	1.3517	.13090
0.96	1.11440	.04704	1.49729	.17531	.74428	.87173	1.3436	.12827
0.97	1.12943	.05286	1.50851	.17855	.74870	.87431	1.3356	.12569
0.98	1.14457	.05864	1.51988	.18181	.75307	.87683	1.3279	.12317
0.99	1.15983	.06439	1.53141	.18509	.75736	.87930	1.3204	.12070

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
1.00	1.17520	.07011	1.54308	.18839	0 76159	88172	1.3130	.11828
1.01	1.19069	.07580	1.55491	.19171	.76576	.88409	1.3059	.11591
1.02	1.20630	.08146	1.56689	.19504	.76987	.88642	1.2989	.11358
1.03	1.22203	.08708	1.57904	.19839	.77391	.88869	1.2921	.11131
1.04	1.23788	.09268	1.59134	.20176	.77789	.89092	1.2855	.10908
1.05	1.25386	.09825	1.60379	.20515	0.78181	.89310	1.2791	.10690
1.06	1.26996	.10379	1.61641	.20855	.78566	.89524	1.2728	.10476
1.07	1.28619	.10930	1.62919	.21197	.78946	.89733	1.2667	.10267
1.08	1.30254	.11479	1.64214	.21541	.79320	.89938	1.2607	.10062
1.09	1.31903	.12025	1.65525	.21886	.79688	.90139	1.2549	.09861
1.10	1.33565	.12569	1.66852	.22233	0.80050	.90336	1.2492	.09664
1.11	1.35240	.13111	1.68196	.22582	.80406	.90529	1.2437	.09471
1.12	1.36929	.13649	1.69557	.22931	.80757	.90718	1.2383	.09282
1.13	1.38631	.14186	1.70934	.23283	.81102	.90903	1.2330	.09097
1.14	1.40347	.14720	1.72329	.23636	.81441	.91085	1.2279	.08915
1.15	1.42078	.15253	1.73741	.23990	0.81775	.91262	1.2229	.08738
1.16	1.43822	.15783	1.75171	.24346	.82104	.91436	1.2180	.08564
1.17	1.45581	.16311	1.76618	.24703	.82427	.91607	1.2132	.08393
1.18	1.47355	.16836	1.78083	.25062	.82745	.91774	1.2085	.08226
1.19	1.49143	.17360	1.79565	.25422	.83058	.91938	1.2040	.08062
1.20	1.50946	.17882	1.81066	.25784	0.83365	.92099	1.1995	.07901
1.21	1.52764	.18402	1.82584	.26146	.83668	.92256	1.1952	.07744
1.22	1.54598	.18920	1.84121	.26510	.83965	.92410	1.1910	.07590
1.23	1.56447	.19437	1.85676	.26876	.84258	.92561	1.1868	.07439
1.24	1.58311	.19951	1.87250	.27242	.84546	.92709	1.1828	.07291
1.25	1.60192	.20464	1.88842	.27610	0.84828	.92854	1.1789	.07146
1.26	1.62088	.20975	1.90454	.27979	.85106	.92996	1.1750	.07004
1.27	1.64001	.21485	1.92084	.28349	.85380	.93135	1.1712	.06865
1.28	1.65930	.21993	1.93734	.28721	.85648	.93272	1.1676	.06728
1.29	1.67876	.22499	1.95403	.29093	.85913	.93406	1.1640	.06594
1.30	1.69838	.23004	1.97091	.29467	0.86172	.93537	1.1605	.06463
1.31	1.71818	.23507	1.98800	.29842	.86428	.93665	1.1570	.06335
1.32	1.73814	.24009	2.00528	.30217	.86678	.93791	1.1537	.06209
1.33	1.75828	.24509	2.02276	.30594	.86925	.93914	1.1504	.06086
1.34	1.77860	.25008	2.04044	.30972	.87167	.94035	1.1472	.05965
1.35	1.79909	.25505	2.05833	.31352	0.87405	.94154	1.1441	.05846
1.36	1.81977	.26002	2.07643	.31732	.87639	.94270	1 1410	.05730
1.37	1.84062	.26496	2.09473	.32113	.87869	94384	1.1381	.05616
1.38	1.86166	.26990	2.11324	.32495	.88095	.94495	1.1351	.05505
1.39	1.88289	.27482	2.13196	.32878	.88317	.94604	1.1323	.05396
1.40	1.90430	.27974	2.15090	.33262	0.88535	.94712	1.1295	.05288
1.41	1.92591	.28464	2.17005	.33647	.88749	.94817	1.1268	.05183
1.42	1.94770	.28952	2.18942	.34033	.88960	.94919	1.1241	.05081
1.43	1.96970	.29440	2.20900	.34420	.89167	.95020	1.1215	.04980
1.44	1.99188	.29926	2.22881	.34807	.89370	.95119	1.1189	.04881
1.45	2.01427	.30412	2.24884	.35196	0.89569	.95216	1.1165	.04784
1.46	2 03686	.30896	2.26910	.35585	.89765	.95311	1.1140	.04689
1.47	2.05965	.31379	2.28958	.35976	.89958	.95404	1.1116	.04596
1.48	2.08265	.31862	2.31029	.36367	.90147	.95495	1.1093	.04505
1.49	2.10586	.32343	2.33123	.36759	.90332	.95584	1.1070	.04416

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
1.50	2.12928	.32823	2.35241	.37151	0.90515	.95672	1.1048	.04328
1.51	2.15291	.33303	2.37382	.37545	.90694	.95758	1.1026	.04242
1.52	2.17676	.33781	2.39547	.37939	.90870	.95842	1.1005	.04158
1.53	2.20082	.34258	2.41736	.38334	.91042	.95924	1.0984	.04076
1.54	2.22510	.34735	2.43949	.38730	.91212	.96005	1.0963	.03995
1.55	2.24961	.35211	2.46186	.39126	0.91379	.96084	1.0943	.03916
1.56	2.27434	.35686	2.48448	.39524	.91542	.96162	1.0924	.03838
1.57	2.29930	.36160	2.50735	.39921	.91703	.96238	1.0905	.03762
1.58	2.32449	.36633	2.53047	.40320	.91860	.96313	1.0886	.03687
1.59	2.34991	.37105	2.55384	.40719	.92015	.96386	1.0868	.03614
1.60	2.37557	.37577	2.57746	.41119	0.92167	.96457	1.0850	.03543
1.61	2.40146	.38048	2.60135	.41520	.92316	.96528	1.0832	.03472
1.62	2.42760	.38518	2.62549	.41921	.92462	.96597	1.0815	.03403
1.63	2.45397	.38987	2.64990	.42323	.92606	.96664	1.0798	.03336
1.64	2.48059	.39456	2.67457	.42725	.92747	.96730	1.0782	.03270
1.65	2.50746	.39923	2.69951	.43129	0.92886	.96795	1.0766	.03205
1.66	2.53459	.40391	2.72472	.43532	.93022	.96858	1.0750	.03142
1.67	2.56196	.40857	2.75021	.43937	.93155	.96921	1.0735	.03079
1.68	2.58959	.41323	2.77596	.44341	.93286	.96982	1.0720	.03018
1.69	2.61748	.41788	2.80200	.44747	.93415	.97042	1.0705	.02958
1.70	2.64563	.42253	2.82832	.45153	.93541	.97100	1.0691	.02900
1.71	2.67405	.42717	2.85491	.45559	.93665	.97158	1.0676	.02842
1.72	2.70273	.43180	2.88180	.45966	.93786	.97214	1.0663	.02786
1.73	2.73168	.43643	2.90897	.46374	.93906	.97269	1.0649	.02731
1.74	2.76091	.44105	2.93643	.46782	.94023	.97323	1.0636	.02677
1.75	2.79041	.44567	2.96419	.47191	0.94138	.97376	1.0623	.02624
1.76	2.82020	.45028	2.99224	.47600	.94250	.97428	1.0610	.02572
1.77	2.85026	.45488	3.02059	.48009	.94361	.97479	1.0598	.02521
1.78	2.88061	.45948	3.04925	.48419	.94470	.97529	1.0585	.02471
1.79	2.91125	.46408	3.07821	.48830	.94576	.97578	1.0574	.02422
1.80	2.94217	.46867	3.10747	.49241	0.94681	.97626	1.0562	.02374
1.81	2.97340	.47325	3.13705	.49652	.94783	.97673	1.0550	.02327
1.82	3.00492	.47783	3.16694	.50064	.94884	.97719	1.0539	.02281
1.83	3.03674	.48241	3.19715	.50476	.94983	.97764	1.0528	.02236
1.84	3.06886	.48698	3.22768	.50889	.95080	.97809	1.0518	.02191
1.85	3.10129	.49154	3.25853	.51302	0.95175	.97852	1.0507	.02148
1.86	3.13403	.49610	3.28970	.51716	.95268	.97895	1.0497	.02105
1.87	3.16709	.50066	3.32121	.52130	.95359	.97936	1.0487	.02064
1.88	3.20046	.50521	3.35305	.52544	.95449	.97977	1.0477	.02023
1.89	3.23415	.50976	3.38522	.52959	.95537	.98017	1.0467	.01983
1.90	3.26816	.51430	3.41773	.53374	0.95624	.98057	1.0458	.01943
1.91	3.30250	.51884	3.45058	.53789	.95709	.98095	1.0448	.01905
1.92	3.33718	.52338	3.48378	.54205	.95792	.98133	1.0439	.01867
1.93	3.37218	.52791	3.51733	.54621	.95873	.98170	1.0430	.01830
1.94	3.40752	.53244	3.55123	.55038	.95953	.98206	1.0422	.01794
1.95	3.44321	.53696	3.58548	.55455	0.96032	.98242	1.0413	.01758
1.96	3.47923	.54148	3.62009	.55872	.96109	.98276	1.0405	.01724
1.97	3.51561	.54600	3.65507	.56290	.96185	.98311	1.0397	.01689
1.98	3.55234	.55051	3.69041	.56707	.96259	.98344	1.0389	.01656
1.99	3.58942	.55502	3.72611	.57126	.96331	.98377	1.0381	.01623

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
2.00	3.62686	.55953	3.76220	.57544	0.96403	.98409	1.0373	.01591
2.01	3.66466	.56403	3.79865	.57963	.96473	.98440	1.0366	.01560
2.02	3.70283	.56853	3.83549	.58382	.96541	.98471	1.0358	.01529
2.03	3.74138	.57303	3.87271	.58802	.96609	.98502	1.0351	.01498
2.04	3.78029	.57753	3.91032	.59221	.96675	.98531	1.0344	.01469
2.05	3.81958	.58202	3.94832	.59641	0.96740	.98560	1.0337	.01440
2.06	3.85 26	.58650	3.98671	.60061	.96803	.98589	1.0330	.01411
2.07	3.89932	.59099	4.02550	.60482	.96865	.98617	1.0324	.01383
2.08	3.93977	.59547	4.06470	.60903	.96926	.98644	1.0317	.01356
2.09	3.98061	.59995	4.10430	.61324	.96986	.98671	1.0311	.01329
2.10	4.02186	.60443	4.14431	.61745	0.97045	.98697	1.0304	.01303
2.11	4.06350	.60890	4.18474	.62167	.97103	.98723	1.0298	.01277
2.12	4.10555	.61337	4.22558	.62589	.97159	.98748	1.0292	.01252
2.13	4.14801	.61784	4.26685	.63011	.97215	.98773	1.0286	.01227
2.14	4.19089	.62231	4.30855	.63433	.97269	.98798	1.0281	.01202
2.15	4.23419	.62677	4.35067	.63856	0.97323	.98821	1.0275	.01179
2.16	4.27791	.63123	4.39323	.64278	.97375	.98845	1.0270	.01155
2.17	4.32205	.63569	4.43623	.64701	.97426	.98868	1.0264	.01132
2.18	4.36663	.64015	4.47967	.65125	.97477	.98890	1.0259	.01110
2.19	4.41165	.64460	4.52356	.65548	.97526	.98912	1.0254	.01088
2.20	4.45711	.64905	4.56791	.65972	0.97574	.98934	1.0249	.01066
2.21	4.50301	.65350	4.61271	.66396	.97622	.98955	1.0244	.01045
2.22	4.54936	.65795	4.65797	.66820	.97668	.98975	1.0239	.01025
2.23	4.59617	.66240	4.70370	.67244	.97714	.98996	1.0234	.01004
2.24	4.64344	.66684	4.74989	.67668	.97759	.99016	1.0229	.00984
2.25	4.69117	.67128	4.79657	.68093	0.97803	.99035	1.0225	.00965
2.26	4.73937	.67572	4.84372	.68518	.97846	.99054	1.0220	.00946
2.27	4.78804	.68016	4.89136	.68943	.97888	.99073	1.0216	.00927
2.28	4.83720	.68459	4.93948	.69368	.97929	.99091	1.0211	.00909
2.29	4.88684	.68903	4.98810	.69794	.97970	.99109	1.0207	.00891
2.30	4.93696	.69346	5.03722	.70219	0.98010	.99127	1.0203	.00873
2.31	4.98758	.69789	5.08684	.70645	.98049	.99144	1.0199	.00856
2.32	5.03870	.70232	5.13697	.71071	.98087	.99161	1.0195	.00839
2.33	5.09032	.70675	5.18762	.71497	.98124	.99178	1.0191	.00822
2.34	5.14245	.71117	5.23878	.71923	.98161	.99194	1.0187	.00806
2.35	5.19510	.71559	5.29047	.72349	0.98197	.99210	1.0184	.00790
2.36	5.24827	.72002	5.34269	.72776	.98233	.99226	1.0180	.00774
2.37	5.30196	.72444	5.39544	.73203	.98267	.99241	1.0176	.00759
2.38	5.35618	.72885	5.44873	.73630	.98301	.99256	1.0173	.00744
2.39	5.41093	.73327	5.50256	.74056	.98335	.99271	1.0169	.00729
2.40	5.46623	.73769	5.55695	.74484	0.98367	.99285	1.0166	.00715
2.41	5.52207	.74210	5.61189	.74911	.98400	.99299	1.0163	.00701
2.42	5.57847	.74652	5.66739	.75338	.98431	.99313	1.0159	.00687
2.43	5.63542	.75093	5.72346	.75766	.98462	.99327	1.0156	.00673
2.44	5.69294	.75534	5.78010	.76194	.98492	.99340	1.0153	.00660
2.45	5.75103	.75975	5.83732	.76621	0.98522	.99353	1.0150	.00647
2.46	5.80969	.76415	5.89512	.77049	.98551	.99366	1.0147	.00634
2.47	5.86893	.76856	5.95352	.77477	.98579	.99379	1.0144	.00621
2.48	5.92876	.77296	6.01250	.77906	.98607	.99391	1.0141	.00609
2.49	5.98918	.77737	6.07209	.78334	.98635	.99403	1.0138	.00597

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	log₁₀	Value	log₁₀	Value	log₁₀	Value	log₁₀
2.50	6.05020	.78177	6.13229	.78762	0.98661	.99415	1.0136	.00585
2.51	6.11183	.78617	6.19310	.79191	.98688	.99426	1.0133	.00574
2.52	6.17407	.79057	6.25453	.79619	.98714	.99438	1.0130	.00562
2.53	6.23692	.79497	6.31658	.80048	.98739	.99449	1.0128	.00551
2.54	6.30040	.79937	6.37927	.80477	.98764	.99460	1.0125	.00540
2.55	6.36451	.80377	6.44259	.80906	0.98788	.99470	1.0123	.00530
2.56	6.42926	.80816	6.50656	.81335	.98812	.99481	1.0120	.00519
2.57	6.49464	.81256	6.57118	.81764	.98835	.99491	1.0118	.00509
2.58	6.56068	.81695	6.63646	.82194	.98858	.99501	1.0115	.00499
2.59	6.62738	.82134	6.70240	.82623	.98881	.99511	1.0113	.00489
2.60	6.69473	.82573	6.76901	.83052	0.98903	.99521	1.0111	.00479
2.61	6.76276	.83012	6.83629	.83482	.98924	.99530	1.0109	.00470
2.62	6.83146	.83451	6.90426	.83912	.98946	.99540	1.0107	.00460
2.63	6.90085	.83890	6.97292	.84341	.98966	.99549	1.0104	.00451
2.64	6.97092	.84329	7.04228	.84771	.98987	.99558	1.0102	.00442
2.65	7.04169	.84768	7.11234	.85201	0.99007	.99566	1.0100	.00434
2.66	7.11317	.85206	7.18312	.85631	.99026	.99575	1.0098	.00425
2.67	7.18536	.85645	7.25461	.86061	.99045	.99583	1.0096	.00417
2.68	7.25827	.86083	7.32683	.86492	.99064	.99592	1.0094	.00408
2.69	7.33190	.86522	7.39978	.86922	.99083	.99600	1.0093	.00400
2.70	7.40626	.86960	7.47347	.87352	0.99101	.99608	1.0091	.00392
2.71	7.48137	.87398	7.54791	.87783	.99118	.99615	1.0089	.00385
2.72	7.55722	.87836	7.62310	.88213	.99136	.99623	1.0087	.00377
2.73	7.63383	.88274	7.69905	.88644	.99153	.99631	1.0085	.00369
2.74	7.71121	.88712	7.77578	.89074	.99170	.99638	1.0084	.00362
2.75	7.78935	.89150	7.85328	.89505	0.99186	.99645	1.0082	.00355
2.76	7.86828	.89588	7.93157	.89936	.99202	.99652	1.0080	.00348
2.77	7.94799	.90026	8.01065	.90367	.99218	.99659	1.0079	.00341
2.78	8.02849	.90463	8.09053	.90798	.99233	.99666	1.0077	.00334
2.79	8.10980	.90901	8.17122	.91229	.99248	.99672	1.0076	.00328
2.80	8.19192	.91339	8.25273	.91660	0.99263	.99679	1.0074	.00321
2.81	8.27486	.91776	8.33506	.92091	.99278	.99685	1.0073	.00315
2.82	8.35862	.92213	8.41823	.92522	.99292	.99691	1.0071	.00309
2.83	8.44322	.92651	8.50224	.92953	.99306	.99698	1.0070	.00302
2.84	8.52867	.93088	8.58710	.93385	.99320	.99704	1.0069	.00296
2.85	8.61497	.93525	8.67281	.93816	0.99333	.99709	1.0067	.00291
2.86	8.70213	.93963	8.75940	.94247	.99346	.99715	1.0066	.00285
2.87	8.79016	.94400	8.84686	.94679	.99359	.99721	1.0065	.00279
2.88	8.87907	.94837	8.93520	.95110	.99372	.99726	1.0063	.00274
2.89	8.96887	.95274	9.02444	.95542	.99384	.99732	1.0062	.00268
2.90	9.05956	.95711	9.11458	.95974	0.99396	.99737	1.0061	.00263
2.91	9.15116	.96148	9.20564	.96405	.99408	.99742	1.0060	.00258
2.92	9.24368	.96584	9.29761	.96837	.99420	.99747	1.0058	.00253
2.93	9.33712	.97021	9.39051	.97269	.99431	.99752	1.0057	.00248
2.94	9.43149	.97458	9.48436	.97701	.99443	.99757	1.0056	.00243
2.95	9.52681	.97895	9.57915	.98133	0.99454	.99762	1.0055	.00238
2.96	9.62308	.98331	9.67490	.98565	.99464	.99767	1.0054	.00233
2.97	9.72051	.98768	9.77161	.98997	.99475	.99771	1.0053	.00229
2.98	9.81851	.99205	9.86930	.99429	.99485	.99776	1.0052	.00224
2.99	9.91770	.99641	9.96798	.99861	.99496	.99780	1.0051	.00220
3.00	10.01787	.00078	10.06766	.00293	0.99505	.99785	1.0050	.00215

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	log$_{10}$	Value	log$_{10}$	Value	log$_{10}$	Value	log$_{10}$
3.0	10.0179	.00078	10.0677	.00293	0.99505	.99785	1.0050	.00215
3.1	11.0765	.04440	11.1215	.04616	.99595	.99824	1.0041	.00176
3.2	12.2459	.08799	12.2866	.08943	.99668	.99856	1.0033	.00144
3.3	13.5379	.13155	13.5748	.13273	.99728	.99882	1.0027	.00118
3.4	14.9654	.17509	14.9987	.17605	.99777	.99903	1.0022	.00097
3.5	16.5426	.21860	16.5728	.21940	0.99818	.99921	1.0018	.00079
3.6	18.2855	.26211	18.3128	.26275	.99851	.99935	1.0015	.00065
3.7	20.2113	.30559	20.2360	.30612	.99878	.99947	1.0012	.00053
3.8	22.3394	.34907	22.3618	.34951	.99900	.99957	1.0010	.00043
3.9	24.6911	.39254	24.7113	.39290	.99918	.99964	1.0008	.00036
4.0	27.2899	.43600	27.3082	.43629	0.99933	.99971	1.0007	.00029
4.1	30.1619	.47946	30.1784	.47970	.99945	.99976	1.0005	.00024
4.2	33.3357	.52291	33.3507	.52310	.99955	.99980	1.0004	.00020
4.3	36.8431	.56636	36.8567	.56652	.99963	.99984	1.0004	.00016
4.4	40.7193	.60980	40.7316	.60993	.99970	.99987	1.0003	.00013
4.5	45.0030	.65324	45.0141	.65335	0.99975	.99989	1.0002	.00011
4.6	49.7371	.69668	49.7472	.69677	.99980	.99991	1.0002	.00009
4.7	54.9690	.74012	54.9781	.74019	.99983	.99993	1.0002	.00007
4.8	60.7511	.78355	60.7593	.78361	.99986	.99994	1.0001	.00006
4.9	67.1412	.82699	67.1486	.82704	.99989	.99995	1.0001	.00005
5.0	74.2032	.87042	74.2099	.87046	0.99991	.99996	1.0001	.00004
5.1	82.008	.91386	82.014	.91389	.99993	.99997	1.0001	.00003
5.2	90.633	.95729	90.639	.95732	.99994	.99997	1.0001	.00003
5.3	100.17	.00074	100.17	.00074	.99995	.99998	1.0000	.00002
5.4	110.70	.04415	110.71	.04419	.99996	.99998	1.0000	.00002
5.5	122.34	.08757	122.35	.08760	0.99997	.99999	1.0000	.00001
5.6	135.21	.13101	135.22	.13104	.99997	.99999	1.0000	.00001
5.7	149.43	.17444	149.44	.17447	.99998	.99999	1.0000	.00001
5.8	165.15	.21788	165.15	.21788	.99998	.99999	1.0000	.00001
5.9	182.52	.26131	182.52	.26131	.99998	.99999	1.0000	.00001
6.0	201.71	.30473	201.72	.30475	0.99999	.00000	1.0000	.00000
6.1	222.93	.34817	222.93	.34817	.99999	.00000	1.0000	.00000
6.2	246.37	.39159	246.38	.39161	.99999	.00000	1.0000	.00000
6.3	272.29	.43503	272.29	.43503	.99999	.00000	1.0000	.00000
6.4	300.92	.47845	300.92	.47845	.99999	.00000	1.0000	.00000
6.5	332.57	.52188	332.57	.52188	1.0000	.00000	1.0000	.00000
6.6	367.55	.56532	367.55	.56532	1.0000	.00000	1.0000	.00000
6.7	406.20	.60874	406.20	.60874	1.0000	.00000	1.0000	.00000
6.8	448.92	.65217	448.92	.65217	1.0000	.00000	1.0000	.00000
6.9	496.14	.69560	496.14	.69560	1.0000	.00000	1.0000	.00000
7.0	548.32	.73903	548.32	.73903	1.0000	.00000	1.0000	.00000
7.1	605.98	.78246	605.98	.78246	1.0000	.00000	1.0000	.00000
7.2	669.72	.82589	669.72	.82589	1.0000	.00000	1.0000	.00000
7.3	740.15	.86932	740.15	.86932	1.0000	.00000	1.0000	.00000
7.4	817.99	.91275	817.99	.91275	1.0000	.00000	1.0000	.00000
7.5	904.02	.95618	904.02	.95618	1.0000	.00000	1.0000	.00000
7.6	999.10	.99961	999.10	.99961	1.0000	.00000	1.0000	.00000
7.7	1104.2	.04305	1104.2	.04305	1.0000	.00000	1.0000	.00000
7.8	1220.3	.08647	1220.3	.08647	1.0000	.00000	1.0000	.00000
7.9	1348.6	.12988	1348.6	.12988	1.0000	.00000	1.0000	.00000
8.0	1490.5	.17333	1490.5	.17333	1.0000	.00000	1.0000	.00000

HYPERBOLIC FUNCTIONS (Continued)

The logarithms given below show the mantissa only. The proper characteristic must be added.

x	Sinh x		Cosh x		Tanh x		Coth x	
	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$	Value	$\log_{10}$
8.0	1490.5	.17333	1490.5	.17333	1.0000	.00000	1.0000	.00000
8.1	1647.2	.21675	1647.2	.21675	1.0000	.00000	1.0000	.00000
8.2	1820.5	.26019	1820.5	.26019	1.0000	.00000	1.0000	.00000
8.3	2011.9	.30360	2011.9	.30360	1.0000	.00000	1.0000	.00000
8.4	2223.5	.34704	2223.5	.34704	1.0000	.00000	1.0000	.00000
8.5	2457.4	.39048	2457.4	.39048	1.0000	.00000	1.0000	.00000
8.6	2715.8	.43390	2715.8	.43390	1.0000	.00000	1.0000	.00000
8.7	3001.5	.47734	3001.5	.47734	1.0000	.00000	1.0000	.00000
8.8	3317.1	.52076	3317.1	.52076	1.0000	.00000	1.0000	.00000
8.9	3666.0	.56419	3666.0	.56419	1.0000	.00000	1.0000	.00000
9.0	4051.5	.60762	4051.5	.60762	1.0000	.00000	1.0000	.00000
9.1	4477.6	.65105	4477.6	.65105	1.0000	.00000	1.0000	.00000
9.2	4948.6	.69448	4948.6	.69448	1.0000	.00000	1.0000	.00000
9.3	5469.0	.73791	5469.0	.73791	1.0000	.00000	1.0000	.00000
9.4	6044.2	.78134	6044.2	.78134	1.0000	.00000	1.0000	.00000
9.5	6679.9	.82477	6679.9	.82477	1.0000	.00000	1.0000	.00000
9.6	7382.4	.86820	7382.4	.86820	1.0000	.00000	1.0000	.00000
9.7	8158.8	.91163	8158.8	.91163	1.0000	.00000	1.0000	.00000
9.8	9016.9	.95506	9016.9	.95506	1.0000	.00000	1.0000	.00000
9.9	9965.2	.99849	9965.2	.99849	1.0000	.00000	1.0000	.00000
10.0	11013.2	.04191	11013.2	.04191	1.0000	.0000	1.0000	.00000

FACTORIALS, EXACT VALUES AND RECIPROCALS

n	$n!$	n	$n!$	n	$1/n!$	n	$1/n!$
1	1	11	39916800	1	1.	11	.25052 × 10^{-7}
2	2	12	479001600	2	0.5	12	.20877 × 10^{-8}
3	6	13	6227020800	3	.16667	13	.16059 × 10^{-9}
4	24	14	87178291200	4	.41667 × 10^{-1}	14	.11471 × 10^{-10}
5	120	15	1307674368000	5	.83333 × 10^{-2}	15	.76472 × 10^{-12}
6	720	16	20922789888000	6	.13889 × 10^{-2}	16	.47795 × 10^{-13}
7	5040	17	355687428096000	7	.19841 × 10^{-3}	17	.28115 × 10^{-14}
8	40320	18	6402373705728000	8	.24802 × 10^{-4}	18	.15619 × 10^{-15}
9	362880	19	121645100408832000	9	.27557 × 10^{-5}	19	.82206 × 10^{-17}
10	3628800	20	2432902008176640000	10	.27557 × 10^{6}	20	.41103 × 10^{-18}

MILS—RADIANS—DEGREES

1 mil = 0.00098175 radians = 0.05625° = 3.375′ = 202.5″
1000 mils = 0.98175 radians = 56.25°
6400 mils = 360° = 2π radians
1 radian = 1018.6 mils
1° = 17.777778 mils
1′ = 0.296296 mils
1″ = 0.0049382 mils

DEGREES—RADIANS

1 radian = 57° 17′ 44″.80625

	log
1 radian = 57.29577 95131 degrees	1.75812 26324
1 radian = 3437.74677 07849 minutes	3.53627 38828
1 radian = 206264.80625 seconds	5.31442 51332
1 degree = 0.01745 32925 19943 radians	8.24187 73676–10
1 minute = 0.00029 08882 08666 radians	6.46372 61172–10
1 second = 0.00000 48481 36811 radians	4.68557 48668–10

DEGREES—RADIANS

The table gives in radians the angle which is expressed in degrees and minutes at the side and top. Angles expressed to the nearest minute and second can readily be converted to radians by adding to the equivalent of the whole number of degrees the equivalents of the minutes and seconds found on the third page of this table.

°	00′	10	20	30	40	50
0	0.00000	0.00291	0.00582	0.00873	0.01164	0.01454
1	0.01745	0.02036	0.02327	0.02618	0.02909	0.03200
2	0.03491	0.03782	0.04072	0.04363	0.04654	0.04945
3	0.05236	0.05527	0.05818	0.06109	0.06400	0.06690
4	0.06981	0.07272	0.07563	0.07854	0.08145	0.08436
5	0.08727	0.09018	0.09308	0.09599	0.09890	0.10181
6	0.10472	0.10763	0.11054	0.11345	0.11636	0.11926
7	0.12217	0.12508	0.12799	0.13090	0.13381	0.13672
8	0.13963	0.14254	0.14544	0.14835	0.15126	0.15417
9	0.15708	0.15999	0.16290	0.16581	0.16872	0.17162
10	0.17453	0.17744	0.18035	0.18326	0.18617	0.18908
11	0.19199	0.19490	0.19780	0.20071	0.20362	0.20653
12	0.20944	0.21235	0.21526	0.21817	0.22108	0.22398
13	0.22689	0.22980	0.23271	0.23562	0.23853	0.24144
14	0.24435	0.24725	0.25016	0.25307	0.25598	0.25889
15	0.26180	0.26471	0.26762	0.27053	0.27343	0.27634
16	0.27925	0.28216	0.28507	0.28798	0.29089	0.29380
17	0.29671	0.29961	0.30252	0.30543	0.30834	0.31125
18	0.31416	0.31707	0.31998	0.32289	0.32579	0.32870
19	0.33161	0.33452	0.33743	0.34034	0.34325	0.34616
20	0.34907	0.35197	0.35488	0.35779	0.36070	0.36361
21	0.36652	0.36943	0.37234	0.37525	0.37815	0.38106
22	0.38397	0.38688	0.38979	0.39270	0.39561	0.39852
23	0.40143	0.40433	0.40724	0.41015	0.41306	0.41597
24	0.41888	0.42179	0.42470	0.42761	0.43051	0.43342
25	0.43633	0.43924	0.44215	0.44506	0.44797	0.45088
26	0.45379	0.45669	0.45960	0.46251	0.46542	0.46833
27	0.47124	0.47415	0.47706	0.47997	0.48287	0.48578
28	0.48869	0.49160	0.49451	0.49742	0.50033	0.50324
29	0.50615	0.50905	0.51196	0.51487	0.51778	0.52069
30	0.52360	0.52651	0.52942	0.53233	0.53523	0.53814
31	0.54105	0.54396	0.54687	0.54978	0.55269	0.55560
32	0.55851	0.56141	0.56432	0.56723	0.57014	0.57305
33	0.57596	0.57887	0.58178	0.58469	0.58759	0.59050
34	0.59341	0.59632	0.59923	0.60214	0.60505	0.60796
35	0.61087	0.61377	0.61668	0.61959	0.62250	0.62541
36	0.62832	0.63123	0.63414	0.63705	0.63995	0.64286
37	0.64577	0.64868	0.65159	0.65450	0.65741	0.66032
38	0.66323	0.66613	0.66904	0.67195	0.67486	0.67777
39	0.68068	0.68359	0.68650	0.68941	0.69231	0.69522
40	0.69813	0.70104	0.70395	0.70686	0.70977	0.71268
41	0.71558	0.71849	0.72140	0.72431	0.72722	0.73013
42	0.73304	0.73595	0.73886	0.74176	0.74467	0.74758
43	0.75049	0.75340	0.75631	0.75922	0.76213	0.76504
44	0.76794	0.77085	0.77376	0.77667	0.77958	0.78249
45	0.78540	0.78831	0.79122	0.79412	0.79703	0.79994
46	0.80285	0.80576	0.80867	0.81158	0.81449	0.81740
47	0.82030	0.82321	0.82612	0.82903	0.83194	0.83485
48	0.83776	0.84067	0.84358	0.84648	0.84939	0.85230
49	0.85521	0.85812	0.86103	0.86394	0.86685	0.86976
50	0.87266	0.87557	0.87848	0.88139	0.88430	0.88721

DEGREES—RADIANS (Continued)

°	00′	10	20	30	40	50
50	0.87266	0.87557	0.87848	0.88139	0.88430	0.88721
51	0.89012	0.89303	0.89594	0.89884	0.90175	0.90466
52	0.90757	0.91048	0.91339	0.91630	0.91921	0.92212
53	0.92502	0.92793	0.93084	0.93375	0.93666	0.93957
54	0.94248	0.94539	0.94830	0.95120	0.95411	0.95702
55	0.95993	0.96284	0.96575	0.96866	0.97157	0.97448
56	0.97738	0.98029	0.98320	0.98611	0.98902	0.99193
57	0.99484	0.99775	1.00066	1.00356	1.00647	1.00938
58	1.01229	1.01520	1.01811	1.02102	1.02393	1.02684
59	1.02974	1.03265	1.03556	1.03847	1.04138	1.04429
60	1.04720	1.05011	1.05302	1.05592	1.05883	1.06174
61	1.06465	1.06756	1.07047	1.07338	1.07629	1.07920
62	1.08210	1.08501	1.08792	1.09083	1.09374	1.09665
63	1.09956	1.10247	1.10538	1.10828	1.11119	1.11410
64	1.11701	1.11992	1.12283	1.12574	1.12865	1.13156
65	1.13446	1.13737	1.14028	1.14319	1.14610	1.14901
66	1.15192	1.15483	1.15774	1.16064	1.16355	1.16646
67	1.16937	1.17228	1.17519	1.17810	1.18101	1.18392
68	1.18682	1.18973	1.19264	1.19555	1.19846	1.20137
69	1.20428	1.20719	1.21009	1.21300	1.21591	1.21882
70	1.22173	1.22464	1.22755	1.23046	1.23337	1.23627
71	1.23918	1.24209	1.24500	1.24791	1.25082	1.25373
72	1.25664	1.25955	1.26245	1.26536	1.26827	1.27118
73	1.27409	1.27700	1.27991	1.28282	1.28573	1.28863
74	1.29154	1.29445	1.29736	1.30027	1.30318	1.30609
75	1.30900	1.31191	1.31481	1.31772	1.32063	1.32354
76	1.32645	1.32936	1.33227	1.33518	1.33809	1.34099
77	1.34390	1.34681	1.34972	1.35263	1.35554	1 35845
78	1.36136	1.36427	1.36717	1.37008	1.37299	1.37590
79	1.37881	1.38172	1.38463	1.38754	1.39045	1.39335
80	1.39626	1.39917	1.40208	1.40499	1.40790	1.41081
81	1.41372	1.41663	1.41953	1.42244	1.42535	1.42826
82	1.43117	1.43408	1.43699	1.43990	1.44281	1.44571
83	1.44862	1.45153	1.45444	1.45735	1.46026	1.46317
84	1.46608	1.46899	1.47189	1.47480	1.47771	1.48062
85	1.48353	1.48644	1.48935	1.49226	1.49517	1.49807
86	1.50098	1.50389	1.50680	1.50971	1.51262	1.51553
87	1.51844	1.52135	1.52425	1.52716	1.53007	1.53298
88	1.53589	1.53880	1.54171	1.54462	1.54753	1.55043
89	1.55334	1.55625	1.55916	1.56207	1.56498	1.56789
90	1.57080	1.57371	1.57661	1.57952	1.58243	1.58534
91	1.58825	1.59116	1.59407	1.59698	1.59989	1.60279
92	1.60570	1.60861	1.61152	1.61443	1.61734	1.62025
93	1.62316	1.62607	1.62897	1.63188	1.63479	1.63770
94	1.64061	1.64352	1.64643	1.64934	1.65225	1.65515
95	1.65806	1.66097	1.66388	1.66679	1.66970	1.67261
96	1.67552	1.67842	1.68133	1.68424	1.68715	1.69006
97	1.69297	1.69588	1.69879	1.70170	1.70460	1.70751
98	1.71042	1.71333	1.71624	1.71915	1.72206	1.72497
99	1.72788	1.73078	1.73369	1.73660	1.73951	1.74242
100	1.74533	1.74824	1.75115	1.75406	1.75696	1.75987
101	1.76278	1.76569	1.76860	1.77151	1.77442	1.77733
102	1.78024	1.78314	1.78605	1.78896	1.79187	1.79478
103	1.79769	1.80060	1.80351	1.80642	1.80932	1.81223
104	1.81514	1.81805	1.82096	1.82387	1.82678	1.82969
105	1.83260	1.83550	1.83841	1.84132	1.84423	1.84714
106	1.85004	1.85296	1.85587	1.85878	1.86168	1.86459
107	1.86750	1.87041	1.87332	1.87623	1.87914	1.88205
108	1.88496	1.88786	1.89077	1.89368	1.89659	1.89950
109	1.90241	1.90532	1.90823	1.91114	1.91404	1.91695
110	1.91986	1.92277	1.92568	1.92859	1.93150	1.93441

DEGREES—RADIANS (Concluded)

Deg.	Radians	Deg.	Radians	Min.	Radians	Sec.	Radians
90	1.57080	**150**	2.61799	**0**	0.00000	**0**	0.00000
91	1.58825	151	2.63545	1	0.00029	1	0.00000
92	1.60570	152	2.65290	2	0.00058	2	0.00001
93	1.62316	153	2.67035	3	0.00087	3	0.00001
94	1.64061	154	2.68781	4	0.00116	4	0.00002
95	1.65806	**155**	2.70526	**5**	0.00145	**5**	0.00002
96	1.67552	156	2.72271	6	0.00175	6	0.00003
97	1.69297	157	2.74017	7	0.00204	7	0.00003
98	1.71042	158	2.75762	8	0.00233	8	0.00004
99	1.72788	159	2.77507	9	0.00262	9	0.00004
100	1.74533	**160**	2.79253	**10**	0.00291	**10**	0.00005
101	1.76278	161	2.80998	11	0.00320	11	0.00005
102	1.78024	162	2.82743	12	0.00349	12	0.00006
103	1.79769	163	2.84489	13	0.00378	13	0.00006
104	1.81514	164	2.86234	14	0.00407	14	0.00007
105	1.83260	**165**	2.87979	**15**	0.00436	**15**	0.00007
106	1.85005	166	2.89725	16	0.00465	16	0.00008
107	1.86750	167	2.91470	17	0.00495	17	0.00008
108	1.88496	168	2.93215	18	0.00524	18	0.00009
109	1.90241	169	2.94961	19	0.00553	19	0.00009
110	1.91986	**170**	2.96706	**20**	0.00582	**20**	0.00010
111	1.93732	171	2.98451	21	0.00611	21	0.00010
112	1.95477	172	3.00197	22	0.00640	22	0.00011
113	1.97222	173	3.01942	23	0.00669	23	0.00011
114	1.98968	174	3.03687	24	0.00698	24	0.00012
115	2.00713	**175**	3.05433	**25**	0.00727	**25**	0.00012
116	2.02458	176	3.07178	26	0.00756	26	0.00013
117	2.04204	177	3.08923	27	0.00785	27	0.00013
118	2.05949	178	3.10669	28	0.00814	28	0.00014
119	2.07694	179	3.12414	29	0.00844	29	0.00014
120	2.09440	**180**	3.14159	**30**	0.00873	**30**	0.00015
121	2.11185	190	3.31613	31	0.00902	31	0.00015
122	2.12930	200	3.49066	32	0.00931	32	0.00016
123	2.14676	210	3.66519	33	0.00960	33	0.00016
124	2.16421	220	3.83972	34	0.00989	34	0.00016
125	2.18166	**230**	4.01426	**35**	0.01018	**35**	0.00017
126	2.19911	240	4.18879	36	0.01047	36	0.00017
127	2.21657	250	4.36332	37	0.01076	37	0.00018
128	2.23402	260	4.53786	38	0.01105	38	0.00018
129	2.25147	270	4.71239	39	0.01134	39	0.00019
130	2.26893	**280**	4.88692	**40**	0.01164	**40**	0.00019
131	2.28638	290	5.06145	41	0.01193	41	0.00020
132	2.30383	300	5.23599	42	0.01222	42	0.00020
133	2.32129	310	5.41052	43	0.01251	43	0.00021
134	2.33874	320	5.58505	44	0.01280	44	0.00021
135	2.35619	**330**	5.75959	**45**	0.01309	**45**	0.00022
136	2.37365	340	5.93412	46	0.01338	46	0.00022
137	2.39110	350	6.10865	47	0.01367	47	0.00023
138	2.40855	360	6.28319	48	0.01396	48	0.00023
139	2.42601	370	6.45772	49	0.01425	49	0.00024
140	2.44346	**380**	6.63225	**50**	0.01454	**50**	0.00024
141	2.46091	390	6.80678	51	0.01484	51	0.00025
142	2.47837	400	6.98132	52	0.01513	52	0.00025
143	2.49582	410	7.15585	53	0.01542	53	0.00026
144	2.51327	420	7.33038	54	0.01571	54	0.00026
145	2.53073	**430**	7.50492	**55**	0.01600	**55**	0.00027
146	2.54818	440	7.67945	56	0.01629	56	0.00027
147	2.56563	450	7.85398	57	0.01658	57	0.00028
148	2.58309	460	8.02851	58	0.01687	58	0.00028
149	2.60054	470	8.20305	59	0.01716	59	0.00029
150	2.61799	**480**	8.37758	**60**	0.01745	**60**	0.00029

DEGREES, MINUTES, AND SECONDS TO RADIANS

Units in degrees, minutes *or* seconds	Degrees to Radians	Minutes to Radians	Seconds to Radians
10	0.174 5329	0.002 9089	0.000 0485
20	0.349 0659	0.005 8178	0.000 0970
30	0.523 5988	0.008 7266	0.000 1454
40	0.698 1317	0.011 6355	0.000 1939
50	0.872 6646	0.014 5444	0.000 2424
60	1.047 1976	0.017 4533	0.000 2909
70	1.221 7305	(0.020 3622)	(0.000 3394)
80	1.396 2634	(0.023 2711)	(0.000 3879)
90	1.570 7963	(0.026 1800)	(0.000 4364)
100	1.745 3293	....	....
200	3.490 6585	....	....
300	5.235 9878	....	....

where n = 1, 2, 3, 4, etc.   n(100) = n(1.745 3293)

*RADIANS TO DEGREES, MINUTES, AND SECONDS

Radians	1.0	0.1	0.01	0.001	0.0001
1	57° 17′ 44.8″	5° 43′ 46.5″	0° 34′ 22.6″	0° 03′ 26.3″	0° 00′ 20.6″
2	114° 35′ 29.6″	11° 27′ 33.0″	1° 08′ 45.3″	0° 06′ 52.5″	0° 00′ 41.3″
3	171° 53′ 14.4″	17° 11′ 19.4″	1° 43′ 07.9″	0° 10′ 18.8″	0° 01′ 01.9″
4	229° 10′ 59.2″	22° 55′ 05.9″	2° 17′ 30.6″	0° 13′ 45.1″	0° 01′ 22.5″
5	286° 28′ 44.0″	28° 38′ 52.4″	2° 51′ 53.2″	0° 17′ 11.3″	0° 01′ 43.1″
6	343° 46′ 28.8″	34° 22′ 38.9″	3° 26′ 15.9″	0° 20′ 37.6″	0° 02′ 03.8″
7	401° 04′ 13.6″	40° 06′ 25.4″	4° 00′ 38.5″	0° 24′ 03.9″	0° 02′ 24.4″
8	458° 21′ 58.4″	45° 50′ 11.8″	4° 35′ 01.2″	0° 27′ 30.1″	0° 02′ 45.0″
9	515° 39′ 43.3″	51° 33′ 58.3″	5° 09′ 23.8″	0° 30′ 56.4″	0° 03′ 05.6″

* If 3.214 is desired in degrees, minutes and seconds it is obtained as follows:

3 = 171° 53′ 14.4″
.2 = 11° 27′ 33.0″
.01 = 0° 34′ 22.6″
.004 = 0° 13′ 45.1″
3.214 = 184° 8′ 55.1″

DEGREES AND DECIMAL FRACTIONS TO RADIANS

The table below facilitates conversion of an angle expressed in degrees and decimal fractions into radians. To convert 25.78 into radians, find the equivalents, successively, of 20°, 5°, 0°.7, 0°.08 and add.

Deg.	Radians	Deg.	Radians	Deg.	Radians	Deg.	Radians	Deg.	Radians
10	0.174533	1	0.017453	0.1	0.001745	0.01	0.000175	0.001	0.000017
20	0.349066	2	.034907	.2	.003491	.02	.000349	.002	.000035
30	0.523599	3	.052360	.3	.005236	.03	.000524	.003	.000052
40	0.698132	4	.069813	.4	.006981	.04	.000698	.004	.000070
50	0.872665	5	.087266	.5	.008727	.05	.000873	.005	.000087
60	1.047198	6	.104720	.6	.010472	.06	.001047	.006	.000105
70	1.221730	7	.122173	.7	.012217	.07	.001222	.007	.000122
80	1.396263	8	.139626	.8	.013963	.08	.001396	.008	000140
90	1.570796	9	.157080	.9	.015708	.09	.001571	.009	.000157

RADIANS TO DEGREES AND DECIMALS

Radians	Degrees	Radians	Degrees	Radians	Degrees	Radians	Degrees
1	57.2958	0.1	5.7296	0.01	0.5730	0.001	0.0573
2	114.5916	.2	11.4592	.02	1.1459	.002	.1146
3	171.8873	.3	17.1887	.03	1.7189	.003	.1719
4	229.1831	.4	22.9183	.04	2.2918	.004	.2292
5	286.4789	.5	28.6479	.05	2.8648	.005	.2865
6	343.7747	.6	34.3775	.06	3.4377	.006	.3438
7	401.0705	.7	40.1070	.07	4.0107	.007	.4011
8	458.3662	.8	45.8366	.08	4.5837	.008	.4584
9	515.6620	.9	51.5662	.09	5.1566	.009	.5157
10	572.9578	1.0	57.2958	.10	5.7296	.010	.5730

RADIANS—DEGREES

Multiples and Fractions of π Radians in Degrees

Radians	Radians	Deg.	Radians	Radians	Deg.	Radians	Radians	Deg.
π	3.1416	180	$\pi/2$	1.5708	90	$2\pi/3$	2.0944	120
2π	6.2832	360	$\pi/3$	1.0472	60	$3\pi/4$	2.3562	135
3π	9.4248	540	$\pi/4$	0.7854	45	$5\pi/6$	2.6180	150
4π	12.5664	720	$\pi/5$	0.6283	36	$7\pi/6$	3.6652	210
5π	15.7080	900	$\pi/6$	0.5236	30	$5\pi/4$	3.9270	225
6π	18.8496	1080	$\pi/7$	0.4488	25.714	$4\pi/3$	4.1888	240
7π	21.9911	1260	$\pi/8$	0.3927	22.5	$3\pi/2$	4.7124	270
8π	25.1327	1440	$\pi/9$	0.3491	20	$5\pi/3$	5.2360	300
9π	28.2743	1620	$\pi/10$	0.3142	18	$7\pi/4$	5.4978	315
10π	31.4159	1800	$\pi/12$	0.2618	15	$11\pi/6$	5.7596	330

CONVERSION OF ANGLES FROM ARC TO TIME

Arc	Time	Arc	Time	Arc	Time	Arc	Time
°	h m	°	h m	″	s	″	s
′	m s	′	m s				
0	0 00	20	1 20	0	0.00	8	0.53
1	0 04	30	2 00	1	0.07	9	0.60
2	0 08	40	2 40	2	0.13	10	0.67
3	0 12	50	3 20	3	0.20	20	1.33
4	0 16	60	4 00	4	0.27	30	2.00
5	0 20	70	4 40	5	0.33	40	2.67
6	0 24	80	5 20	6	0.40	50	3.33
7	0 28	90	6 00	7	0.47	60	4.00
8	0 32	100	6 40				
9	0 36	200	13 20				
10	0 40	300	20 00				

MINUTES AND SECONDS TO DECIMAL PARTS OF A DEGREE

MINUTES AND SECONDS TO DECIMAL PARTS OF A DEG.				DECIMAL PARTS OF A DEGREE TO MINUTES AND SECONDS					
Min.	Degrees	Sec	Degrees	Deg.	′	″	Deg.	′	″
0	0.00000	**0**	0.00000	**0.00**	0	00	**0.60**	36	
1	.01667	1	.00028	.01	0	36	.61	36	36
2	.03333	2	.00056	.02	1	12	.62	37	12
3	.05	3	.00083	.03	1	48	.63	37	48
4	.06667	4	.00111	.04	2	24	.64	38	24
5	.08333	5	.00139	.05	3		.65	39	
6	.10	6	.00167	.06	3	36	.66	39	36
7	.11667	7	.00194	.07	4	12	.67	40	12
8	.13333	8	.00222	.08	4	48	.68	40	48
9	.15	9	.0025	.09	5	24	.69	41	24
10	0.16667	**10**	0.00278	**0.10**	6		**0.70**	42	
11	.18333	11	.00306	.11	6	36	.71	42	36
12	.20	12	.00333	.12	7	12	.72	43	12
13	.21667	13	.00361	.13	7	48	.73	43	48
14	.23333	14	.00389	.14	8	24	.74	44	24
15	.25	15	.00417	.15	9		.75	45	
16	.26667	16	.00444	.16	9	36	.76	45	36
17	.28333	17	.00472	.17	10	12	.77	46	12
18	.30	18	.005	.18	10	48	.78	46	48
19	.31667	19	.00528	.19	11	24	.79	47	24
20	0.33333	**20**	0.00556	**0.20**	12		**0.80**	48	
21	.35	21	.00583	.21	12	36	.81	48	36
22	.36667	22	.00611	.22	13	12	.82	49	12
23	.38333	23	.00639	.23	13	48	.83	49	48
24	.40	24	.00667	.24	14	24	.84	50	24
25	.41667	25	.00694	.25	15		.85	51	
26	.43333	26	.00722	.26	15	36	.86	51	36
27	.45	27	.0075	.27	16	12	.87	52	12
28	.46667	28	.00778	.28	16	48	.88	52	48
29	.48333	29	.00806	.29	17	24	.89	53	24
30	0.50	**30**	0.00833	**0.30**	18		**0.90**	54	
31	.51667	31	.00861	.31	18	36	.91	54	36
32	.53333	32	.00889	.32	19	12	.92	55	12
33	.55	33	.00917	.33	19	48	.93	55	48
34	.56667	34	.00944	.34	20	24	.94	56	24
35	.58333	35	.00972	.35	21		.95	57	
36	.60	36	.01	.36	21	36	.96	57	36
37	.61667	37	.01028	.37	22	12	.97	58	12
38	.63333	38	.01056	.38	22	48	.98	58	48
39	.65	39	.01083	.39	23	24	.99	59	24
40	0.66667	**40**	0.01111	**0.40**	24		**1.00**	60	
41	.68333	41	.01139	.41	24	36			
42	.70	42	.01167	.42	25	12			
43	.71667	43	.01194	.43	25	48			
44	.73333	44	.01222	.44	26	24			
45	.75	45	.0125	.45	27				
46	.76667	46	.01278	.46	27	36			
47	.78333	47	.01306	.47	28	12			
48	.80	48	.01333	.48	28	48			
49	.81667	49	.01361	.49	29	24			
50	0.83333	**50**	0.01389	**0.50**	30				
51	.85	51	.01417	.51	30	36			
52	.86667	52	.01444	.52	31	12			
53	.88333	53	.01472	.53	31	48			
54	.90	54	.015	.54	32	24			
55	.91667	55	.01528	.55	33				
56	.93333	56	.01556	.56	33	36			
57	.95	57	.01583	.57	34	12			
58	.96667	58	.01611	.58	34	48			
59	.98333	59	.01639	.59	35	24			
60	1.00	**60**	0.01667	**0.60**	36				

Deg.	Sec.
0.000	0.0
.001	3.6
.002	7.2
.003	10.8
.004	14.4
.005	18.
.006	21.6
.007	25.2
.008	28.8
.009	32.4
0.010	36.

Reciprocals, Circumference and Area of Circles

As a matter of convenience, the values of 1000 × $(1/n)$ are given in the table. To obtain the actual value of the reciprocal, shift the decimal point three places to the left.

Circumferences and areas of circles are given for the values of n as the diameter.

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
0	∞	0.000000	.0000000	**50**	20.00000	157.0796	1963.495
1	1000.000	3.141593	.7853982	51	19.60784	160.2212	2042.821
2	500.0000	6.283185	3.141593	52	19.23077	163.3628	2123.717
3	333.3333	9.424778	7.068583	53	18.86792	166.5044	2206.183
4	250.0000	12.56637	12.56637	54	18.51852	169.6460	2290.221
5	200.0000	15.70796	19.63495	55	18.18182	172.7876	2375.829
6	166.6667	18.84956	28.27433	56	17.85714	175.9292	2463.009
7	142.8571	21.99115	38.48451	57	17.54386	179.0708	2551.759
8	125.0000	25.13274	50.26548	58	17.24138	182.2124	2642.079
9	111.1111	28.27433	63.61725	59	16.94915	185.3540	2733.971
10	100.0000	31.41593	78.53982	**60**	16.66667	188.4956	2827.433
11	90.90909	34.55752	95.03318	61	16.39344	191.6372	2922.467
12	83.33333	37.69911	113.0973	62	16.12903	194.7787	3019.071
13	76.92308	40.84070	132.7323	63	15.87302	197.9203	3117.245
14	71.42857	43.98230	153.9380	64	15.62500	201.0619	3216.991
15	66.66667	47.12389	176.7146	65	15.38462	204.2035	3318.307
16	62.50000	50.26548	201.0619	66	15.15152	207.3451	3421.194
17	58.82353	53.40708	226.9801	67	14.92537	210.4867	3525.652
18	55.55556	56.54867	254.4690	68	14.70588	213.6283	3631.681
19	52.63158	59.69026	283.5287	69	14.49275	216.7699	3739.281
20	50.00000	62.83185	314.1593	**70**	14.28571	219.9115	3848.451
21	47.61905	65.97345	346.3606	71	14.08451	223.0531	3959.192
22	45.45455	69.11504	380.1327	72	13.88889	226.1947	4071.504
23	43.47826	72.25663	415.4756	73	13.69863	229.3363	4185.387
24	41.66667	75.39822	452.3893	74	13.51351	232.4779	4300.840
25	40.00000	78.53982	490.8739	75	13.33333	235.6194	4417.865
26	38.46154	81.68141	530.9292	76	13.15789	238.7610	4536.460
27	37.03704	84.82300	572.5553	77	12.98701	241.9026	4656.626
28	35.71429	87.96459	615.7522	78	12.82051	245.0442	4778.362
29	34.48276	91.10619	660.5199	79	12.65823	248.1858	4901.670
30	33.33333	94.24778	706.8583	**80**	12.50000	251.3274	5026.548
31	32.25806	97.38937	754.7676	81	12.34568	254.4690	5152.997
32	31.25000	100.5310	804.2477	82	12.19512	257.6106	5281.017
33	30.30303	103.6726	855.2986	83	12.04819	260.7522	5410.608
34	29.41176	106.8142	907.9203	84	11.90476	263.8938	5541.769
35	28.57143	109.9557	962.1128	85	11.76471	267.0354	5674.502
36	27.77778	113.0973	1017.876	86	11.62791	270.1770	5808.805
37	27.02703	116.2389	1075.210	87	11.49425	273.3186	5944.679
38	26.31579	119.3805	1134.115	88	11.36364	276.4602	6082.123
39	25.64103	122.5221	1194.591	89	11.23596	279.6017	6221.139
40	25.00000	125.6637	1256.637	**90**	11.11111	282.7433	6361.725
41	24.39024	128.8053	1320.254	91	10.98901	285.8849	6503.882
42	23.80952	131.9469	1385.442	92	10.86957	289.0265	6647.610
43	23.25581	135.0885	1452.201	93	10.75269	292.1681	6792.909
44	22.72727	138.2301	1520.531	94	10.63830	295.3097	6939.778
45	22.22222	141.3717	1590.431	95	10.52632	298.4513	7088.218
46	21.73913	144.5133	1661.903	96	10.41667	301.5929	7238.229
47	21.27660	147.6549	1734.945	97	10.30928	304.7345	7389.811
48	20.83333	150.7964	1809.557	98	10.20408	307.8761	7542.964
49	20.40816	153.9380	1885.741	99	10.10101	311.0177	7697.687
50	20.00000	157.0796	1963.495	**100**	10.00000	314.1593	7853.982

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES
(Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
100	10.00000	314.1593	7853.982	**150**	6.666 667	471.2389	17671.46
101	9.900 990	317.3009	8011.847	151	6.622 517	474.3805	17907.86
102	9.803 922	320.4425	8171.282	152	6.578 947	477.5221	18145.84
103	9.708 738	323.5840	8332.289	153	6.535 948	480.6637	18385.39
104	9.615 385	326.7256	8494.867	154	6.493 506	483.8053	18626.50
105	9.523 810	329.8672	8659.015	155	6.451 613	486.9469	18869.19
106	9.433 962	333.0088	8824.734	156	6.410 256	490.0885	19113.45
107	9.345 794	336.1504	8992.024	157	6.369 427	493.2300	19359.28
108	9.259 259	339.2920	9160.884	158	6.329 114	496.3716	19606.68
109	9.174 312	342.4336	9331.316	159	6.289 308	499.5132	19855.65
110	9.090 909	345.5752	9503.318	**160**	6.250 000	502.6548	20106.19
111	9.009 009	348.7168	9676.891	161	6.211 180	505.7964	20358.31
112	8.928 571	351.8584	9852.035	162	6.172 840	508.9380	20611.99
113	8.849 558	355.0000	10028.75	163	6.134 969	512.0796	20867.24
114	8.771 930	358.1416	10207.03	164	6.097 561	515.2212	21124.07
115	8.695 652	361.2832	10386.89	165	6.060 606	518.3628	21382.46
116	8.620 690	364.4247	10568.32	166	6.024 096	521.5044	21642.43
117	8.547 009	367.5663	10751.32	167	5.988 024	524.6460	21903.97
118	8.474 576	370.7079	10935.88	168	5.952 381	527.7876	22167.08
119	8.403 361	373.8495	11122.02	169	5.917 160	530.9292	22431.76
120	8.333 333	376.9911	11309.73	**170**	5.882 353	534.0708	22698.01
121	8.264 463	380.1327	11499.01	171	5.847 953	537.2123	22965.83
122	8.196 721	383.2743	11689.87	172	5.813 953	540.3539	23235.22
123	8.130 081	386.4159	11882.29	173	5.780 347	543.4955	23506.18
124	8.064 516	389.5575	12076.28	174	5.747 126	546.6371	23778.71
125	8.000 000	392.6991	12271.85	175	5.714 286	549.7787	24052.82
126	7.936 508	395.8407	12468.98	176	5.681 818	552.9203	24328.49
127	7.874 016	398.9823	12667.69	177	5.649 718	556.0619	24605.74
128	7.812 500	402.1239	12867.96	178	5.617 978	559.2035	24884.56
129	7.751 938	405.2655	13069.81	179	5.586 592	562.3451	25164.94
130	7.692 308	408.4070	13273.23	**180**	5.555 556	565.4867	25446.90
131	7.633 588	411.5486	13478.22	181	5.524 862	568.6283	25730.43
132	7.575 758	414.6902	13684.78	182	5.494 505	571.7699	26015.53
133	7.518 797	417.8318	13892.91	183	5.464 481	574.9115	26302.20
134	7.462 687	420.9734	14102.61	184	5.434 783	578.0530	26590.44
135	7.407 407	424.1150	14313.88	185	5.405 405	581.1946	26880.25
136	7.352 941	427.2566	14526.72	186	5.376 344	584.3362	27171.63
137	7.299 270	430.3982	14741.14	187	5.347 594	587.4778	27464.59
138	7.246 377	433.5398	14957.12	188	5.319 149	590.6194	27759.11
139	7.194 245	436.6814	15174.68	189	5.291 005	593.7610	28055.21
140	7.142 857	439.8230	15393.80	**190**	5.263 158	596.9026	28352.87
141	7.092 199	442.9646	15614.50	191	5.235 602	600.0442	28652.11
142	7.042 254	446.1062	15836.77	192	5.208 333	603.1858	28952.92
143	6.993 007	449.2477	16060.61	193	5.181 347	606.3274	29255.30
144	6.944 444	452.3893	16286.02	194	5.154 639	609.4690	29559.25
145	6.896 552	455.5309	16513.00	195	5.128 205	612.6106	29864.77
146	6.849 315	458.6725	16741.55	196	5.102 041	615.7522	30171.86
147	6.802 721	461.8141	16971.67	197	5.076 142	618.8938	30480.52
148	6.756 757	464.9557	17203.36	198	5.050 505	622.0353	30790.75
149	6.711 409	468.0973	17436.62	199	5.025 126	625.1769	31102.55
150	6.666 667	471.2389	17671.46	**200**	5.000 000	628.3185	31415.93

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES
(Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
200	5.000 000	628.3185	31415.93	**250**	4.000 000	785.3982	49087.39
201	4.975 124	631.4601	31730.87	251	3.984 064	788.5398	49480.87
202	4.950 495	634.6017	32047.39	252	3.968 254	791.6813	49875.92
203	4.926 108	637.7433	32365.47	253	3.952 569	794.8229	50272.55
204	4.901 961	640.8849	32685.13	254	3.937 008	797.9645	50670.75
205	4.878 049	644.0265	33006.36	255	3.921 569	801.1061	51070.52
206	4.854 369	647.1681	33329.16	256	3.906 250	804.2477	51471.85
207	4.830 918	650.3097	33653.53	257	3.891 051	807.3893	51874.76
208	4.807 692	653.4513	33979.47	258	3.875 969	810.5309	52279.24
209	4.784 689	656.5929	34306.98	259	3.861 004	813.6725	52685.29
210	4.761 905	659.7345	34636.06	**260**	3.846 154	816.8141	53092.92
211	4.739 336	662.8760	34966.71	261	3.831 418	819.9557	53502.11
212	4.716 981	666.0176	35298.94	262	3.816 794	823.0973	53912.87
213	4.694 836	669.1592	35632.73	263	3.802 281	826.2389	54325.21
214	4.672 897	672.3008	35968.09	264	3.787 879	829.3805	54739.11
215	4.651 163	675.4424	36305.03	265	3.773 585	832.5221	55154.59
216	4.629 630	678.5840	36643.54	266	3.759 398	835.6636	55571.63
217	4.608 295	681.7256	36983.61	267	3.745 318	838.8052	55990.25
218	4.587 156	684.8672	37325.26	268	3.731 343	841.9468	56410.44
219	4.566 210	688.0088	37668.48	269	3.717 472	845.0884	56832.20
220	4.545 455	691.1504	38013.27	**270**	3.703 704	848.2300	57255.53
221	4.524 887	694.2920	38359.63	271	3.690 037	851.3716	57680.43
222	4.504 505	697.4336	38707.56	272	3.676 471	854.5132	58106.90
223	4.484 305	700.5752	39057.07	273	3.663 004	857.6548	58534.94
224	4.464 286	703.7168	39408.14	274	3.649 635	860.7964	58964.55
225	4.444 444	706.8583	39760.78	275	3.636 364	863.9380	59395.74
226	4.424 779	709.9999	40115.00	276	3.623 188	867.0796	59828.49
227	4.405 286	713.1415	40470.78	277	3.610 108	870.2212	60262.82
228	4.385 965	716.2831	40828.14	278	3.597 122	873.3628	60698.71
229	4.366 812	719.4247	41187.07	279	3.584 229	876.5044	61136.18
230	4.347 826	722.5663	41547.56	**280**	3.571 429	879.6459	61575.22
231	4.329 004	725.7079	41909.63	281	3.558 719	882.7875	62015.82
232	4.310 345	728.8495	42273.27	282	3.546 099	885.9291	62458.00
233	4.291 845	731.9911	42638.48	283	3.533 569	889.0707	62901.75
234	4.273 504	735.1327	43005.26	284	3.521 127	892.2123	63347.07
235	4.255 319	738.2743	43373.61	285	3.508 772	895.3539	63793.97
236	4.237 288	741.4159	43743.54	286	3.496 503	898.4955	64242.43
237	4.219 409	744.5575	44115.03	287	3.484 321	901.6371	64692.46
238	4.201 681	747.6991	44488.09	288	3.472 222	904.7787	65144.07
239	4.184 100	750.8406	44862.73	289	3.460 208	907.9203	65597.24
240	4.166 667	753.9822	45238.93	**290**	3.448 276	911.0619	66051.99
241	4.149 378	757.1238	45616.71	291	3.436 426	914.2035	66508.30
242	4.132 231	760.2654	45996.06	292	3.424 658	917.3451	66966.19
243	4.115 226	763.4070	46376.98	293	3.412 969	920.4866	67425.65
244	4.098 361	766.5486	46759.47	294	3.401 361	923.6282	67886.68
245	4.081 633	769.6902	47143.52	295	3.389 831	926.7698	68349.28
246	4.065 041	772.8318	47529.16	296	3.378 378	929.9114	68813.45
247	4.048 583	775.9734	47916.36	297	3.367 003	933.0530	69279.19
248	4.032 258	779.1150	48305.13	298	3.355 705	936.1946	69746.50
249	4.016 064	782.2566	48695.47	299	3.344 482	939.3362	70215.38
250	4.000 000	785.3982	49087.39	**300**	3.333 333	942.4778	70685.83

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES
(Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
300	3.333 333	942.4778	70685.83	**350**	2.857 143	1099.557	96211.28
301	3.322 259	945.6194	71157.86	351	2.849 003	1102.699	96761.84
302	3.311 258	948.7610	71631.45	352	2.840 909	1105.841	97313.97
303	3.300 330	951.9026	72106.62	353	2.832 861	1108.982	97867.68
304	3.289 474	955.0442	72583.36	354	2.824 859	1112.124	98422.96
305	3.278 689	958.1858	73061.66	355	2.816 901	1115.265	98979.80
306	3.267 974	961.3274	73541.54	356	2.808 989	1118.407	99538.22
307	3.257 329	964.4689	74022.99	357	2.801 120	1121.549	100 098.2
308	3.246 753	967.6105	74506.01	358	2.793 296	1124.690	100 659.8
309	3.236 246	970.7521	74990.60	359	2.785 515	1127.832	101 222.9
310	3.225 806	973.8937	75476.76	**360**	2.777 778	1130.973	101 787.6
311	3.215 434	977.0353	75964.50	361	2.770 083	1134.115	102 353.9
312	3.205 128	980.1769	76453.80	362	2.762 431	1137.257	102 921.7
313	3.194 888	983.3185	76944.67	363	2.754 821	1140.398	103 491.1
314	3.184 713	986.4601	77437.12	364	2.747 253	1143.540	104 062.1
315	3.174 603	989.6017	77931.13	365	2.739 726	1146.681	104 634.7
316	3.164 557	992.7433	78426.72	366	2.732 240	1149.823	105 208.8
317	3.154 574	995.8849	78923.88	367	2.724 796	1152.965	105 784.5
318	3.144 654	999.0265	79422.60	368	2.717 391	1156.106	106 361.8
319	3.134 796	1002.168	79922.90	369	2.710 027	1159.248	106 940.6
320	3.125 000	1005.310	80424.77	**370**	2.702 703	1162.389	107 521.0
321	3.115 265	1008.451	80928.21	371	2.695 418	1165.531	108 103.0
322	3.105 590	1011.593	81433.22	372	2.688 172	1168.672	108 686.5
323	3.095 975	1014.734	81939.80	373	2.680 965	1171.814	109 271.7
324	3.086 420	1017.876	82447.96	374	2.673 797	1174.956	109 858.4
325	3.076 923	1021.018	82957.68	375	2.666 667	1178.097	110 446.6
326	3.067 485	1024.159	83468.98	376	2.659 574	1181.239	111 036.5
327	3.058 104	1027.301	83981.84	377	2.652 520	1184.380	111 627.9
328	3.048 780	1030.442	84496.28	378	2.645 503	1187.522	112 220.8
329	3.039 514	1033.584	85012.28	379	2.638 522	1190.664	112 815.4
330	3.030 303	1036.726	85529.86	**380**	2.631 579	1193.805	113 411.5
331	3.021 148	1039.867	86049.01	381	2.624 672	1196.947	114 009.2
332	3.012 048	1043.009	86569.73	382	2.617 801	1200.088	114 608.4
333	3.003 003	1046.150	87092.02	383	2.610 966	1203.230	115 209.3
334	2.994 012	1049.292	87615.88	384	2.604 167	1206.372	115 811.7
335	2.985 075	1052.434	88141.31	385	2.597 403	1209.513	116 415.6
336	2.976 190	1055.575	88668.31	386	2.590 674	1212.655	117 021.2
337	2.967 359	1058.717	89196.88	387	2.583 979	1215.796	117 628.3
338	2.958 580	1061.858	89727.03	388	2.577 320	1218.938	118 237.0
339	2.949 853	1065.000	90258.74	389	2.570 694	1222.080	118 847.2
340	2.941 176	1068.142	90792.03	**390**	2.564 103	1225.221	119 459.1
341	2.932 551	1071.283	91326.88	391	2.557 545	1228.363	120 072.5
342	2.923 977	1074.425	91863.31	392	2.551 020	1231.504	120 687.4
343	2.915 452	1077.566	92401.31	393	2.544 529	1234.646	121 304.0
344	2.906 977	1080.708	92940.88	394	2.538 071	1237.788	121 922.1
345	2.898 551	1083.849	93482.02	395	2.531 646	1240.929	122 541.7
346	2.890 173	1086.991	94024.73	396	2.525 253	1244.071	123 163.0
347	2.881 844	1090.133	94569.01	397	2.518 892	1247.212	123 785.8
348	2.873 563	1093.274	95114.86	398	2.512 563	1250.354	124 410.2
349	2.865 330	1096.416	95662.28	399	2.506 266	1253.495	125 036.2
350	2.857 143	1099.557	96211.28	**400**	2.500 000	1256.637	125 663.7

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES
(Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
400	2.500 000	1256.637	125 663.7	**450**	2.222 222	1413.717	159 043.1
401	2.493 766	1259.779	126 292.8	451	2.217 295	1416.858	159 750.8
402	2.487 562	1262.920	126 923.5	452	2.212 389	1420.000	160 460.0
403	2.481 390	1266.062	127 555.7	453	2.207 506	1423.141	161 170.9
404	2.475 248	1269.203	128 189.5	454	2.202 643	1426.283	161 883.1
405	2.469 136	1272.345	128 824.9	455	2.197 802	1429.425	162 597.1
406	2.463 054	1275.487	129 461.9	456	2.192 982	1432.566	163 312.6
407	2.457 002	1278.628	130 100.4	457	2.188 184	1435.708	164 029.6
408	2.450 980	1281.770	130 740.5	458	2.183 406	1438.849	164 748.3
409	2.444 988	1284.911	131 382.2	459	2.178 649	1441.991	165 468.5
410	2.439 024	1288.053	132 025.4	**460**	2.173 913	1445.133	166 190.3
411	2.433 090	1291.195	132 670.2	461	2.169 197	1448.274	166 913.6
412	2.427 184	1294.336	133 316.6	462	2.164 502	1451.416	167 638.5
413	2.421 308	1297.478	133 964.6	463	2.159 827	1454.557	168 365.0
414	2.415 459	1300.619	134 614.1	464	2.155 172	1457.699	169 093.1
415	2.409 639	1303.761	135 265.2	465	2.150 538	1460.841	169 822.7
416	2.403 846	1306.903	135 917.9	466	2.145 923	1463.982	170 553.9
417	2.398 082	1310.044	136 572.1	467	2.141 328	1467.124	171 286.7
418	2.392 344	1313.186	137 227.9	468	2.136 752	1470.265	172 021.0
419	2.386 635	1316.327	137 885.3	469	2.132 196	1473.407	172 757.0
420	2.380 952	1319.469	138 544.2	**470**	2.127 660	1476.549	173 494.5
421	2.375 297	1322.611	139 204.8	471	2.123 142	1479.690	174 233.5
422	2.369 668	1325.752	139 866.8	472	2.118 644	1482.832	174 974.1
423	2.364 066	1328.894	140 530.5	473	2.114 165	1485.973	175 716.3
424	2.358 491	1332.035	141 195.7	474	2.109 705	1489.115	176 460.1
425	2.352 941	1335.177	141 862.5	475	2.105 263	1492.257	177 205.5
426	2.347 418	1338.318	142 530.9	476	2.100 840	1495.398	177 952.4
427	2.341 920	1341.460	143 200.9	477	2.096 436	1498.540	178 700.9
428	2.336 449	1344.602	143 872.4	478	2.092 050	1501.681	179 450.9
429	2.331 002	1347.743	144 545.5	479	2.087 683	1504.823	180 202.5
430	2.325 581	1350.885	145 220.1	**480**	2.083 333	1507.964	180 955.7
431	2.320 186	1354.026	145 896.3	481	2.079 002	1511.106	181 710.5
432	2.314 815	1357.168	146 574.1	482	2.074 689	1514.248	182 466.8
433	2.309 469	1360.310	147 253.5	483	2.070 393	1517.389	183 224.8
434	2.304 147	1363.451	147 934.5	484	2.066 116	1520.531	183 984.2
435	2.298 851	1366.593	148 617.0	485	2.061 856	1523.672	184 745.3
436	2.293 578	1369.734	149 301.0	486	2.057 613	1526.814	185 507.9
437	2.288 330	1372.876	149 986.7	487	2.053 388	1529.956	186 272.1
438	2.283 105	1376.018	150 673.9	488	2.049 180	1533.097	187 037.9
439	2.277 904	1379.159	151 362.7	489	2.044 990	1536.239	187 805.2
440	2.272 727	1382.301	152 053.1	**490**	2.040 816	1539.380	188 574.1
441	2.267 574	1385.442	152 745.0	491	2.036 660	1542.522	189 344.6
442	2.262 443	1388.584	153 438.5	492	2.032 520	1545.664	190 116.6
443	2.257 336	1391.726	154 133.6	493	2.028 398	1548.805	190 890.2
444	2.252 252	1394.867	154 830.3	494	2.024 291	1551.947	191 665.4
445	2.247 191	1398.009	155 528.5	495	2.020 202	1555.088	192 442.2
446	2.242 152	1401.150	156 228.3	496	2.016 129	1558.230	193 220.5
447	2.237 136	1404.292	156 929.6	497	2.012 072	1561.372	194 000.4
448	2.232 143	1407.434	157 632.6	498	2.008 032	1564.513	194 781.9
449	2.227 171	1410.575	158 337.1	499	2.004 008	1567.655	195 564.9
450	2.222 222	1413.717	159 043.1	**500**	2.000 000	1570.796	196 349.5

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
500	2.000 000	1570.796	196 349.5	**550**	1.818 182	1727.876	237 582.9
501	1.996 008	1573.938	197 135.7	551	1.814 882	1731.018	238 447.7
502	1.992 032	1577.080	197 923.5	552	1.811 594	1734.159	239 314.0
503	1.988 072	1580.221	198 712.8	553	1.808 318	1737.301	240 181.8
504	1.984 127	1583.363	199 503.7	554	1.805 054	1740.442	241 051.3
505	1.980 198	1586.504	200 296.2	555	1.801 802	1743.584	241 922.3
506	1.976 285	1589.646	201 090.2	556	1.798 561	1746.726	242 794.8
507	1.972 387	1592.787	201 885.8	557	1.795 332	1749.867	243 669.0
508	1.968 504	1595.929	202 683.0	558	1.792 115	1753.009	244 544.7
509	1.964 637	1599.071	203 481.7	559	1.788 909	1756.150	245 422.0
510	1.960 784	1602.212	204 282.1	**560**	1.785 714	1759.292	246 300.9
511	1.956 947	1605.354	205 084.0	561	1.782 531	1762.433	247 181.3
512	1.953 125	1608.495	205 887.4	562	1.779 359	1765.575	248 063.3
513	1.949 318	1611.637	206 692.4	563	1.776 199	1768.717	248 946.9
514	1.945 525	1614.779	207 499.1	564	1.773 050	1771.858	249 832.0
515	1.941 748	1617.920	208 307.2	565	1.769 912	1775.000	250 718.7
516	1.937 984	1621.062	209 117.0	566	1.766 784	1778.141	251 607.0
517	1.934 236	1624.203	209 928.3	567	1.763 668	1781.283	252 496.9
518	1.930 502	1627.345	210 741.2	568	1.760 563	1784.425	253 388.3
519	1.926 782	1630.487	211 555.6	569	1.757 469	1787.566	254 281.3
520	1.923 077	1633.628	212 371.7	**570**	1.754 386	1790.708	255 175.9
521	1.919 386	1636.770	213 189.3	571	1.751 313	1793.849	256 072.0
522	1.915 709	1639.911	214 008.4	572	1.748 252	1796.991	256 969.7
523	1.912 046	1643.053	214 829.2	573	1.745 201	1800.133	257 869.0
524	1.908 397	1646.195	215 651.5	574	1.742 160	1803.274	258 769.8
525	1.904 762	1649.336	216 475.4	575	1.739 130	1806.416	259 672.3
526	1.901 141	1652.478	217 300.8	576	1.736 111	1809.557	260 576.3
527	1.897 533	1655.619	218 127.8	577	1.733 102	1812.699	261 481.8
528	1.893 939	1658.761	218 956.4	578	1.730 104	1815.841	262 389.0
529	1.890 359	1661.903	219 786.6	579	1.727 116	1818.982	263 297.7
530	1.886 792	1665.044	220 618.3	**580**	1.724 138	1822.124	264 207.9
531	1.883 239	1668.186	221 451.7	581	1.721 170	1825.265	265 119.8
532	1.879 699	1671.327	222 286.5	582	1.718 213	1828.407	266 033.2
533	1.876 173	1674.469	223 123.0	583	1.715 266	1831.549	266 948.2
534	1.872 659	1677.610	223 961.0	584	1.712 329	1834.690	267 864.8
535	1.869 159	1680.752	224 800.6	585	1.709 402	1837.832	268 782.9
536	1.865 672	1683.894	225 641.8	586	1.706 485	1840.973	269 702.6
537	1.862 197	1687.035	226 484.5	587	1.703 578	1844.115	270 623.9
538	1.858 736	1690.177	227 328.8	588	1.700 680	1847.256	271 546.7
539	1.855 288	1693.318	228 174.7	589	1.697 793	1850.398	272 471.1
540	1.851 852	1696.460	229 022.1	**590**	1.694 915	1853.540	273 397.1
541	1.848 429	1699.602	229 871.1	591	1.692 047	1856.681	274 324.7
542	1.845 018	1702.743	230 721.7	592	1.689 189	1859.823	275 253.8
543	1.841 621	1705.885	231 573.9	593	1.686 341	1862.964	276 184.5
544	1.838 235	1709.026	232 427.6	594	1.683 502	1866.106	277 116.7
545	1.834 862	1712.168	233 282.9	595	1.680 672	1869.248	278 050.6
546	1.831 502	1715.310	234 139.8	596	1.677 852	1872.389	278 986.0
547	1.828 154	1718.451	234 998.2	597	1.675 042	1875.531	279 923.0
548	1.824 818	1721.593	235.858.2	598	1.672 241	1878.672	280 861.5
549	1.821 494	1724.734	236 719.8	599	1.669 449	1881.814	281 801.6
550	1.818 182	1727.876	237.582.9	**600**	1.666 667	1884.956	282 743.3

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
600	1.666 667	1884.956	282 743.3	**650**	1.538 462	2042.035	331 830.7
601	1.663 894	1888.097	283 686.6	651	1.536 098	2045.177	332 852.5
602	1.661 130	1891.239	284 631.4	652	1.533 742	2048.318	333 875.9
603	1.658 375	1894.380	285 577.8	653	1.531 394	2051.460	334 900.8
604	1.655 629	1897.522	286 525.8	654	1.529 052	2054.602	335 927.4
605	1.652 893	1900.664	287 475.4	655	1.526 718	2057.743	336 955.4
606	1.650 165	1903.805	288 426.5	656	1.524 390	2060.885	337 985.1
607	1.647 446	1906.947	289 379.2	657	1.522 070	2064.026	339 016.3
608	1.644 737	1910.088	290 333.4	658	1.519 757	2067.168	340 049.1
609	1.642 036	1913.230	291 289.3	659	1.517 451	2070.310	341 083.5
610	1.639 344	1916.372	292 246.7	**660**	1.515 152	2073.451	342 119.4
611	1.636 661	1919.513	293 205.6	661	1.512 859	2076.593	343 157.0
612	1.633 987	1922.655	294 166.2	662	1.510 574	2079.734	344 196.0
613	1.631 321	1925.796	295 128.3	663	1.508 296	2082.876	345 236.7
614	1.628 664	1928.938	296 092.0	664	1.506 024	2086.018	346 278.9
615	1.626 016	1932.079	297 057.2	665	1.503 759	2089.159	347 322.7
616	1.623 377	1935.221	298 024.0	666	1.501 502	2092.301	348 368.1
617	1.620 746	1938.363	298 992.4	667	1.499 250	2095.442	349 415.0
618	1.618 123	1941.504	299 962.4	668	1.497 006	2098.584	350 463.5
619	1.615 509	1944.646	300 933.9	669	1.494 768	2101.725	351 513.6
620	1.612 903	1947.787	301 907.1	**670**	1.492 537	2104.867	352 565.2
621	1.610 306	1950.929	302 881.7	671	1.490 313	2108.009	353 618.5
622	1.607 717	1954.071	303 858.0	672	1.488 095	2111.150	354 673.2
623	1.605 136	1957.212	304 835.8	673	1.485 884	2114.292	355 729.6
624	1.602 564	1960.354	305 815.2	674	1.483 680	2117.433	356 787.5
625	1.600 000	1963.495	306 796.2	675	1.481 481	2120.575	357 847.0
626	1.597 444	1966.637	307 778.7	676	1.479 290	2123.717	358 908.1
627	1.594 896	1969.779	308 762.8	677	1.477 105	2126.858	359 970.8
628	1.592 357	1972.920	309 748.5	678	1.474 926	2130.000	361 035.0
629	1.589 825	1976.062	310 735.7	679	1.472 754	2133.141	362 100.8
630	1.587 302	1979 203	311 724.5	**680**	1.470 588	2136.283	363 168.1
631	1.584 786	1982.345	312 714.9	681	1.468 429	2139.425	364 237.0
632	1.582 278	1985.437	313 706.9	682	1.466 276	2142.566	365 307.5
633	1.579 779	1988.628	314 700.4	683	1.464 129	2145.708	366 379.6
634	1.577 287	1991.770	315 695.5	684	1.461 988	2148.849	367 453.2
635	1.574 803	1994.911	316 692.2	685	1.459 854	2151.991	368 528.5
636	1.572 327	1998.053	317 690.4	686	1.457 726	2155.133	369 605.2
637	1.569 859	2001.195	318 690.2	687	1.455 604	2158.274	370 683.6
638	1.567 398	2004.336	319 691.6	688	1.453 488	2161.416	371 763.5
639	1.564 945	2007.478	320 694.6	689	1.451 379	2164.557	372 845.0
640	1.562 500	2010.619	321 699.1	**690**	1.449 275	2167.699	373 928.1
641	1.560 062	2013.761	322 705.2	691	1.447 178	2170.841	375 012.7
642	1.557 632	2016 902	323 712.8	692	1.445 087	2173.982	376 098.9
643	1.555 210	2020.044	324 722.1	693	1.443 001	2177.124	377 186.7
644	1.552 795	2023.186	325 732.9	694	1.440 922	2180.265	378 276.0
645	1.550 388	2026.327	326 745.3	695	1.438 849	2183.407	379 366.9
646	1.547 988	2029.469	327 759.2	696	1.436 782	2186.548	380 459.4
647	1.545 595	2032.610	328 774.7	697	1.434 720	2189.690	381 553.5
648	1.543 210	2035.752	329 791.8	698	1.432 665	2192.832	382 649.1
649	1.540 832	2038.894	330 810.5	699	1.430 615	2195.973	383 746.3
650	1.538 462	2042.035	331 830.7	**700**	1.428 571	2199.115	384 845.1

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES
(Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
700	1.428 571	2199.115	384 845.1	**750**	1.333 333	2356.194	441 786.5
701	1.426 534	2202.256	385 945.4	751	1.331 558	2359.336	442 965.3
702	1.424 501	2205.398	387 047.4	752	1.329 787	2362.478	444 145.8
703	1.422 475	2208.540	388 150.8	753	1.328 021	2365.619	445 327.8
704	1.420 455	2211.681	389 255.9	754	1.326 260	2368.761	446 511.4
705	1.418 440	2214.823	390 362.5	755	1.324 503	2371.902	447 696.6
706	1.416 431	2217.964	391 470.7	756	1.322 751	2375.044	448 883.3
707	1.414 427	2221.106	392 580.5	757	1.321 004	2378.186	450 071.6
708	1.412 429	2224.248	393 691.8	758	1.319 261	2381.327	451 261.5
709	1.410 437	2227.389	394 804.7	759	1.317 523	2384.469	452 453.0
710	1.408 451	2230.531	395 919.2	**760**	1.315 789	2387.610	453 646.0
711	1.406 470	2233.672	397 035.3	761	1.314 060	2390.752	454 840.6
712	1.404 494	2236.814	398 152.9	762	1.312 336	2393.894	456 036.7
713	1.402 525	2239.956	399 272.1	763	1.310 616	2397.035	457 234.5
714	1.400 560	2243.097	400 392.8	764	1.308 901	2400.177	458 433.8
715	1.398 601	2246.239	401 515.2	765	1.307 190	2403.318	459 634.6
716	1.396 648	2249.380	402 639.1	766	1.305 483	2406.460	460 837.1
717	1.394 700	2252.522	403 764.6	767	1.303 781	2409.602	462 041.1
718	1.392 758	2255.664	404 891.6	768	1.302 083	2412.743	463 246.7
719	1.390 821	2258.805	406 020.2	769	1.300 390	2415.885	464 453.8
720	1.388 889	2261.947	407 150.4	**770**	1.298 701	2419.026	465.662.6
721	1.386 963	2265.088	408 282.2	771	1.297 017	2422.168	466 872.9
722	1.385 042	2268.230	409 415.5	772	1.295 337	2425.310	468 084.7
723	1.383 126	2271.371	410 550.4	773	1.293 661	2428.451	469 298.2
724	1.381 215	2274.513	411 686.9	774	1.291 990	2431.593	470 513.2
725	1.379 310	2277.655	412 824.9	775	1.290 323	2434.734	471 729.8
726	1.377 410	2280.796	413 964.5	776	1.288 660	2437.876	472 947.9
727	1.375 516	2283.938	415 105.7	777	1.287 001	2441.017	474 167.6
728	1.373 626	2287.079	416 248.5	778	1.285 347	2444.159	475 388.9
729	1.371 742	2290.221	417 392.8	779	1.283 697	2447.301	476 611.8
730	1.369 863	2293.363	418 538.7	**780**	1.282 051	2450.442	477.836.2
731	1.367 989	2296.504	419 686.1	781	1.280 410	2453.584	479 062.2
732	1.366 120	2299.646	420 835.2	782	1.278 772	2456.725	480 289.8
733	1.364 256	2302.787	421 985.8	783	1.277 139	2459.867	481 519.0
734	1.362 398	2305.929	423 138.0	784	1.275 510	2463.009	482 749.7
735	1.360 544	2309.071	424 291.7	785	1.273 885	2466.150	483 982.0
736	1.358 696	2312.212	425 447.0	786	1.272 265	2469.292	485 215.8
737	1.356 852	2315.354	426 603.9	787	1.270 648	2472.433	486 451.3
738	1.355 014	2318.495	427 762.4	788	1.269 036	2475.575	487 688.3
739	1.353 180	2321.637	428 922.4	789	1.267 427	2478.717	488 926.9
740	1.351 351	2324.779	430 084.0	**790**	1.265 823	2481.858	490 167.0
741	1.349 528	2327.920	431 247.2	791	1.264 223	2485.000	491 408.7
742	1.347 709	2331.062	432 412.0	792	1.262 626	2488.141	492 652.0
743	1.345 895	2334.203	433 578.3	793	1.261 034	2491.283	493 896.8
744	1.344 086	2337.345	434 746.2	794	1.259 446	2494.425	495 143.3
745	1.342 282	2340.487	435 915.6	795	1.257 862	2497.566	496 391.3
746	1.340 483	2343.628	437 086.6	796	1.256 281	2500.708	497 640.8
747	1.338 688	2346.770	438 259.2	797	1.254 705	2503.849	498 892.0
748	1.336 898	2349.911	439 433.4	798	1.253 133	2506.991	500 144.7
749	1.335 113	2353.053	440 609.2	799	1.251 564	2510.133	501 399.0
750	1.333 333	2356.194	441 786.5	**800**	1.250 000	2513.274	502 654.8

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES (Continued)

n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circumference πn	Area $\frac{\pi n^2}{4}$
800	1.250 000	2513.274	502 654.8	**850**	1.176 471	2670.354	567 450.2
801	1.248 439	2516.416	503 912.2	851	1.175 088	2673.495	568 786.1
802	1.246 883	2519.557	505 171.2	852	1.173 709	2676.637	570 123.7
803	1.245 330	2522.699	506 431.8	853	1.172 333	2679.779	571 462.8
804	1.243 781	2525.840	507 693.9	854	1.170 960	2682.920	572 803.4
805	1.242 236	2528.982	508 957.6	855	1.169 591	2686.062	574 145.7
806	1.240 695	2532.124	510 222.9	856	1.168 224	2689.203	575 489.5
807	1.239 157	2535.265	511 489.8	857	1.166 861	2692.345	576 834.9
808	1.237 624	2538.407	512 758.2	858	1.165 501	2695.486	578 181.9
809	1.236 094	2541.548	514 028.2	859	1.164 144	2698.628	579 530.4
810	1.234 568	2544.690	515 299.7	**860**	1.162 791	2701.770	580 880.5
811	1.233 046	2547.832	516 572.9	861	1.161 440	2704.911	582 232.2
812	1.231 527	2550.973	517 847.6	862	1.160 093	2708.053	583 585.4
813	1.230 012	2554.115	519 123.8	863	1.158 749	2711.194	584 940.2
814	1.228 501	2557.256	520 401.7	864	1.157 407	2714.336	586 296.6
815	1.226 994	2560.398	521 681.1	865	1.156 069	2717.478	587 654.5
816	1.225 490	2563.540	522 962.1	866	1.154 734	2720.619	589 014.1
817	1.223 990	2566 681	524 244.6	867	1.153 403	2723.761	590 375.2
818	1.222 494	2569.823	525 528.8	868	1.152 074	2726.902	591 737.8
819	1.221 001	2572.964	526 814.5	869	1.150 748	2730.044	593 102.1
820	1.219 512	2576.106	528 101.7	**870**	1.149 425	2733.186	594 467.9
821	1.218 027	2579.248	529 390.6	871	1.148 106	2736.327	595 835.2
822	1.216 545	2582.389	530 681.0	872	1.146 789	2739.469	597 204.2
823	1.215 067	2585.531	531 973.0	873	1.145 475	2742.610	598 574.7
824	1.213 592	2588.672	533 266.5	874	1.144 165	2745.752	599 946.8
825	1.212 121	2591.814	534 561.6	875	1.142 857	2748.894	601 320.5
826	1.210 654	2594.956	535 858.3	876	1.141 553	2752.035	602 695.7
827	1.209 190	2598.097	537 156.6	877	1.140 251	2755.177	604 072.5
828	1.207 729	2601.239	538 456.4	878	1.138 952	2758.318	605 450.9
829	1.206 273	2604.380	539 757.8	879	1.137 656	2761.460	606 830.8
830	1.204 819	2607.522	541.060.8	**880**	1.136 364	2764.602	608 212.8
831	1.203 369	2610.663	542 365.3	881	1.135 074	2767.743	609 595.4
832	1.201 923	2613.805	543 671.5	882	1.133 787	2770.885	610 980.1
833	1.200 480	2616.947	544 979.1	883	1.132 503	2774.026	612 366.8
834	1.199 041	2620.088	546 288.4	884	1.131 222	2777.168	613 754.1
835	1.197 605	2623.230	547 599.2	885	1.129 944	2780.309	615 143.5
836	1.196 172	2626.371	548 911.6	886	1.128 668	2783.451	616 534.4
837	1.194 743	2629.513	550 225.6	887	1.127 396	2786.593	617 926.9
838	1.193 317	2632.655	551 541.1	888	1.126 126	2789.734	619 321.0
839	1.191 895	2635.796	552 858.3	889	1.124 859	2792.876	620 716.7
840	1.190 476	2638.938	554 176.9	**890**	1.123 596	2796.017	622 113.9
841	1.189 061	2642.079	555 497.2	891	1.122 334	2799.159	623 512.7
842	1.187 648	2645.221	556 819.0	892	1.121 076	2802.301	624 913.0
843	1.186 240	2648.363	558 142.4	893	1.119 821	2805.442	626 315.0
844	1.184 834	2651.504	559 467.4	894	1.118 568	2808.584	627 718.5
845	1.183 432	2654.646	560 793.9	895	1.117 318	2811.725	629 123.6
846	1.182 033	2657.787	562 122.0	896	1.116 071	2814.867	630 530.2
847	1.180 638	2660.929	563 451.7	897	1.114 827	2818.009	631 938.4
848	1.179 245	2664.071	564 783.0	898	1.113 586	2821.150	633 348.2
849	1.177 856	2667.212	566 115.8	899	1.112 347	2824.292	634 759.6
850	1.176 471	2670.354	567 450.2	**900**	1.111 111	2827.433	636 172.5

RECIPROCALS, CIRCUMFERENCE AND AREA OF CIRCLES
(Continued)

n	$1000\frac{1}{n}$	Circum-ference πn	Area $\frac{\pi n^2}{4}$	n	$1000\frac{1}{n}$	Circum-ference πn	Area $\frac{\pi n^2}{4}$
900	1.111 111	2827.433	636 172.5	**950**	1.052 632	2984.513	708 821.8
901	1.109 878	2830.575	637 587.0	951	1.051 525	2987.655	710 314.9
902	1.108 647	2833.717	639 003.1	952	1.050 420	2990.796	711 809.5
903	1.107 420	2836.858	640 420.7	953	1.049 318	2993.938	713 305.7
904	1.106 195	2840.000	641 839.9	954	1.048 218	2997.079	714 803.4
905	1.104 972	2843.141	643 260.7	955	1.047 120	3000.221	716 302.8
906	1.103 753	2846.283	644 683.1	956	1.046 025	3003.363	717 803.7
907	1.102 536	2849.425	646 107.0	957	1.044 932	3006.504	719 306.1
908	1.101 322	2852.566	647 532.5	958	1.043 841	3009.646	720 810.2
909	1.100 110	2855.708	648 959.6	959	1.042 753	3012.787	722 315.8
910	1.098 901	2858.849	650 388.2	**960**	1.041 667	3015.929	723 822.9
911	1.097 695	2861.991	651 818.4	961	1.040 583	3019.071	725 331.7
912	1.096 491	2865.133	653 250.2	962	1.039 501	3022.212	726 842.0
913	1.095 290	2868.274	654 683.6	963	1.038 422	3025.354	728 353.9
914	1.094 092	2871.416	656 118.5	964	1.037 344	3028.495	729 867.4
915	1.092 896	2874.557	657 555.0	965	1.036 269	3031.637	731 382.4
916	1.091 703	2877.699	658 993.0	966	1.035 197	3034.779	732 899.0
917	1.090 513	2880.840	660 432.7	967	1.034 126	3037.920	734 417.2
918	1.089 325	2883.982	661 873.9	968	1.033 058	3041.062	735 936.9
919	1.088 139	2887.124	663 316.7	969	1.031 992	3044.203	737 458.2
920	1.086 957	2890.265	664 761.0	**970**	1.030 928	3047.345	738 981.1
921	1.085 776	2893.407	666 206.9	971	1.029 866	3050.486	740 505.6
922	1.084 599	2896.548	667 654.4	972	1.028 807	3053.628	742 031.6
923	1.083 424	2899.690	669 103.5	973	1.027 749	3056.770	743 559.2
924	1.082 251	2902.832	670 554.1	974	1.026 694	3059.911	745 088.4
925	1.081 081	2905.973	672 006.3	975	1.025 641	3063.053	746 619.1
926	1.079 914	2909.115	673 460.1	976	1.024 590	3066.194	748 151.4
927	1.078 749	2912.256	674 915.4	977	1.023 541	3069.336	749 685.3
928	1.077 586	2915.398	676 372.3	978	1.022 495	3072.478	751 220.8
929	1.076 426	2918.540	677 830.8	979	1.021 450	3075.619	752 757.8
930	1.075 269	2921.681	679 290.9	**980**	1.020 408	3078.761	754 296.4
931	1.074 114	2924.823	680 752.5	981	1.019 368	3081.902	755 836.6
932	1.072 961	2927.964	682 215.7	982	1.018 330	3085.044	757 378.3
933	1.071 811	2931.106	683 680.5	983	1.017 294	3088.186	758 921.6
934	1.070 664	2934.248	685 146.8	984	1.016 260	3091.327	760 466.5
935	1.069 519	2937.389	686 614.7	985	1.015 228	3094.469	762 012.9
936	1.068 376	2940.531	688 084.2	986	1.014 199	3097.610	763 561.0
937	1.067 236	2943.672	689 555.2	987	1.013 171	3100.752	765 110.5
938	1.066 098	2946.814	691 027.9	988	1.012 146	3103.894	766 661.7
939	1.064 963	2949.956	692 502.1	989	1.011 122	3107.035	768 214.4
940	1.063 830	2953.097	693 977.8	**990**	1.010 101	3110.177	769 768.7
941	1.062 699	2956.239	695 455.2	991	1.009 082	3113.318	771 324.6
942	1.061 571	2959.380	696 934.1	992	1.008 065	3116.460	772 882.1
943	1.060 445	2962.522	698 414.5	993	1.007 049	3119.602	774 441.1
944	1.059 322	2965.663	699 896.6	994	1.006 036	3122.743	776 001.7
945	1.058 201	2968.805	701 380.2	995	1.005 025	3125.885	777 563.8
946	1.057 082	2971.947	702 865.4	996	1.004 016	3129.026	779 127.5
947	1.055 966	2975.088	704 352.1	997	1.003 009	3132.168	780 692.8
948	1.054 852	2978.230	705 840.5	998	1.002 004	3135.309	782 259.7
949	1.053 741	2981.371	707 330.4	999	1.001 001	3138.451	783 828.2
950	1.052 632	2984.513	708 821.8	**1000**	1.000 000	3141.593	785 398.2

Squares, Cubes and Roots

Roots of numbers other than those given directly may be found by the following relations:

$\sqrt{100n} = 10\sqrt{n}$; $\sqrt{1000n} = 10\sqrt{10n}$; $\sqrt{\frac{1}{10}n} = \frac{1}{10}\sqrt{10n}$; $\sqrt{\frac{1}{100}n} = \frac{1}{10}\sqrt{n}$. $\sqrt{\frac{1}{1000}n} = \frac{1}{100}\sqrt{10n}$; $\sqrt[3]{1000n} = 10\sqrt[3]{n}$; $\sqrt[3]{10{,}000n} = 10\sqrt[3]{10n}$; $\sqrt[3]{100{,}000n} = 10\sqrt[3]{100n}$; $\sqrt[3]{\frac{1}{10}n} = \frac{1}{10}\sqrt[3]{100n}$; $\sqrt[3]{\frac{1}{100}n} = \frac{1}{10}\sqrt[3]{10n}$; $\sqrt[3]{\frac{1}{1000}n} = \frac{1}{10}\sqrt[3]{n}$.

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
1	1	1.000 000	3.162 278	1	1.000 000	2.154 435	4.641 589
2	4	1.414 214	4.472 136	8	1.259 921	2.714 418	5.848 035
3	9	1.732 051	5.477 226	27	1.442 250	3.107 233	6.694 330
4	16	2.000 000	6.324 555	64	1.587 401	3.419 952	7.368 063
5	25	2.236 068	7.071 068	125	1.709 976	3.684 031	7.937 005
6	36	2.449 490	7.745 967	216	1.817 121	3.914 868	8.434 327
7	49	2.645 751	8.366 600	343	1.912 931	4.121 285	8.879 040
8	64	2.828 427	8.944 272	512	2.000 000	4.308 869	9.283 178
9	81	3.000 000	9.486 833	729	2.080 084	4.481 405	9.654 894
10	100	3.162 278	10.00000	1 000	2.154 435	4.641 589	10.00000
11	121	3.316 625	10.48809	1 331	2.223 980	4.791 420	10.32280
12	144	3.464 102	10.95445	1 728	2.289 428	4.932 424	10.62659
13	169	3.605 551	11.40175	2 197	2.351 335	5.065 797	10.91393
14	196	3.741 657	11.83216	2 744	2.410 142	5.192 494	11.18689
15	225	3.872 983	12.24745	3 375	2.466 212	5.313 293	11.44714
16	256	4.000 000	12.64911	4 096	2.519 842	5.428 835	11.69607
17	289	4.123 106	13.03840	4 913	2.571 282	5.539 658	11.93483
18	324	4.242 641	13.41641	5 832	2.620 741	5.646 216	12.16440
19	361	4.358 899	13.78405	6 859	2.668 402	5.748 897	12.38562
20	400	4.472 136	14.14214	8 000	2.714 418	5.848 035	12.59921
21	441	4.582 576	14.49138	9 261	2.758 924	5.943 922	12.80579
22	484	4.690 416	14.83240	10 648	2.802 039	6.036 811	13.00591
23	529	4.795 832	15.16575	12 167	2.843 867	6.126 926	13.20006
24	576	4.898 979	15.49193	13 824	2.884 499	6.214 465	13.38866
25	625	5.000 000	15.81139	15 625	2.924 018	6.299 605	13.57209
26	676	5.099 020	16.12452	17 576	2.962 496	6.382 504	13.75069
27	729	5.196 152	16.43168	19 683	3.000 000	6.463 304	13.92477
28	784	5.291 503	16.73320	21 952	3.036 589	6.542 133	14.09460
29	841	5.385 165	17.02939	24 389	3.072 317	6.619 106	14.26043
30	900	5.477 226	17.32051	27 000	3.107 233	6.694 330	14.42250
31	961	5.567 764	17.60682	29 791	3.141 381	6.767 899	14.58100
32	1 024	5.656 854	17.88854	32 768	3.174 802	6.839 904	14.73613
33	1 089	5.744 563	18.16590	35 937	3.207 534	6.910 423	14.88806
34	1 156	5.830 952	18.43909	39 304	3.239 612	6.979 532	15.03695
35	1 225	5.916 080	18.70829	42 875	3.271 066	7.047 299	15.18294
36	1 296	6.000 000	18.97367	46 656	3.301 927	7.113 787	15.32619
37	1 369	6.082 763	19.23538	50 653	3.332 222	7.179 054	15.46680
38	1 444	6.164 414	19.49359	54 872	3.361 975	7.243 156	15.60491
39	1 521	6.244 998	19.74842	59 319	3.391 211	7.306 144	15.74061
40	1 600	6.324 555	20.00000	64 000	3.419 952	7.368 063	15.87401
41	1 681	6.403 124	20.24846	68 921	3.448 217	7.428 959	16.00521
42	1 764	6.480 741	20.49390	74 088	3.476 027	7.488 872	16.13429
43	1 849	6.557 439	20.73644	79 507	3.503 398	7.547 842	16.26133
44	1 936	6.633 250	20.97618	85 184	3.530 348	7.605 905	16.38643
45	2 025	6.708 204	21.21320	91 125	3.556 893	7.663 094	16.50964
46	2 116	6.782 330	21.44761	97 336	3.583 048	7.719 443	16.63103
47	2 209	6.855 655	21.67948	103 823	3.608 826	7.774 980	16.75069
48	2 304	6.928 203	21.90890	110 592	3.634 241	7.829 735	16.86865
49	2 401	7.000 000	22.13594	117 649	3.659 306	7.883 735	16.98499
50	2 500	7.071 068	22.36068	125 000	3.684 031	7.937 005	17.09976

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
50	2 500	7.071 068	22.36068	125 000	3.684 031	7.937 005	17.09976
51	2 601	7.141 428	22.58318	132 651	3.708 430	7.989 570	17.21301
52	2 704	7.211 103	22.80351	140 608	3.732 511	8.041 452	17.32478
53	2 809	7.280 110	23.02173	148 877	3.756 286	8.092 672	17.43513
54	2 916	7.348 469	23.23790	157 464	3.779 763	8.143 253	17.54411
55	3 025	7.416 198	23.45208	166 375	3.802 952	8.193 213	17.65174
56	3 136	7.483 315	23.66432	175 616	3.825 862	8.242 571	17.75808
57	3 249	7.549 834	23.87467	185 193	3.848 501	8.291 344	17.86316
58	3 364	7.615 773	24.08319	195 112	3.870 877	8.339 551	17.96702
59	3 481	7.681 146	24.28992	205 379	3.892 996	8.387 207	18.06969
60	3 600	7.745 967	24.49490	216 000	3.914 868	8.434 327	18.17121
61	3 721	7.810 250	24.69818	226 981	3.936 497	8.480 926	18.27160
62	3 844	7.874 008	24.89980	238 328	3.957 892	8.527 019	18.37091
63	3 969	7.937 254	25.09980	250 047	3.979 057	8.572 619	18.46915
64	4 096	8.000 000	25.29822	262 144	4.000 000	8.617 739	18.56636
65	4 225	8.062 258	25.49510	274 625	4.020 726	8.662 391	18.66256
66	4 356	8.124 038	25.69047	287 496	4.041 240	8.706 588	18.75777
67	4 489	8.185 353	25.88436	300 763	4.061 548	8.750 340	18.85204
68	4 624	8.246 211	26.07681	314 432	4.081 655	8.793 659	18.94536
69	4 761	8.306 624	26.26785	328 509	4.101 566	8.836 556	19.03778
70	4 900	8.366 600	26.45751	343 000	4.121 285	8.879 040	19.12931
71	5 041	8.426 150	26.64583	357 911	4.140 818	8.921 121	19.21997
72	5 184	8.485 281	26.83282	373 248	4.160 168	8.962 809	19.30979
73	5 329	8.544 004	27.01851	389 017	4.179 339	9.004 113	19.39877
74	5 476	8.602 325	27.20294	405 224	4.198 336	9.045 042	19.48695
75	5 625	8.660 254	27.38613	421 875	4.217 163	9.085 603	19.57434
76	5 776	8.717 798	27.56810	438 976	4.235 824	9.125 805	19.66095
77	5 929	8.774 964	27.74887	456 533	4.254 321	9.165 656	19.74681
78	6 084	8.831 761	27.92848	474 552	4.272 659	9.205 164	19.83192
79	6 241	8.888 194	28.10694	493 039	4.290 840	9.244 335	19.91632
80	6 400	8.944 272	28.28427	512 000	4.308 869	9.283 178	20.00000
81	6 561	9.000 000	28.46050	531 441	4.326 749	9.321 698	20.08299
82	6 724	9.055 385	28.63564	551 368	4.344 481	9.359 902	20.16530
83	6 889	9.110 434	28.80972	571 787	4.362 071	9.397 796	20.24694
84	7 056	9.165 151	28.98275	592 704	4.379 519	9.435 388	20.32793
85	7 225	9.219 544	29.15476	614 125	4.396 830	9.472 682	20.40828
86	7 396	9.273 618	29.32576	636 056	4.414 005	9.509 685	20.48800
87	7 569	9.327 379	29.49576	658 503	4.431 048	9.546 403	20.56710
88	7 744	9.380 832	29.66479	681 472	4.447 960	9.582 840	20.64560
89	7 921	9.433 981	29.83287	704 969	4.464 745	9.619 002	20.72351
90	8 100	9.486 833	30.00000	729 000	4.481 405	9.654 894	20.80084
91	8 281	9.539 392	30.16621	753 571	4.497 941	9.690 521	20.87759
92	8 464	9.591 663	30.33150	778 688	4.514 357	9.725 888	20.95379
93	8 649	9.643 651	30.49590	804 357	4.530 655	9.761 000	21.02944
94	8 836	9.695 360	30.65942	830 584	4.546 836	9.795 861	21.10454
95	9 025	9.746 794	30.82207	857 375	4.562 903	9.830 476	21.17912
96	9 216	9.797 959	30.98387	884 736	4.578 857	9.864 848	21.25317
97	9 409	9.848 858	31.14482	912 673	4.594 701	9.898 983	21.32671
98	9 604	9.899 495	31.30495	941 192	4.610 436	9.932 884	21.39975
99	9 801	9.949 874	31.46427	970 299	4.626 065	9.966 555	21.47229
100	10 000	10.00000	31.62278	1 000 000	4.641 589	10.00000	21.54435

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
100	10 000	10.00000	31.62278	1 000 000	4.641 589	10.00000	21.54435
101	10 201	10.04988	31.78050	1 030 301	4.657 010	10.03322	21.61592
102	10 404	10.09950	31.93744	1 061 208	4.672 329	10.06623	21.68703
103	10 609	10.14889	32.09361	1 092 727	4.687 548	10.09902	21.75767
104	10 816	10.19804	32.24903	1 124 864	4.702 669	10.13159	21.82786
105	11 025	10.24695	32.40370	1 157 625	4.717 694	10.16396	21.89760
106	11 236	10.29563	32.55764	1 191 016	4.732 623	10.19613	21.96689
107	11 449	10.34408	32.71085	1 225 043	4.747 459	10.22809	22.03575
108	11 664	10.39230	32.86335	1 259 712	4.762 203	10.25986	22.10419
109	11 881	10.44031	33.01515	1 295 029	4.776 856	10.29142	22.17220
110	12 100	10.48809	33.16625	1 331 000	4.791 420	10.32280	22.23980
111	12 321	10.53565	33.31666	1 367 631	4.805 896	10.35399	22.30699
112	12 544	10.58301	33.46640	1 404 928	4.820 285	10.38499	22.37378
113	12 769	10.63015	33.61547	1 442 897	4.834 588	10.41580	22.44017
114	12 996	10.67708	33.76389	1 481 544	4.848 808	10.44644	22.50617
115	13 225	10.72381	33.91165	1 520 875	4.862 944	10.47690	22.57179
116	13 456	10.77033	34.05877	1 560 896	4.876 999	10.50718	22.63702
117	13 689	10.81665	34.20526	1 601 613	4.890 973	10.53728	22.70189
118	13 924	10.86278	34.35113	1 643 032	4.904 868	10.56722	22.76638
119	14 161	10.90871	34.49638	1 685 159	4.918 685	10.59699	22.83051
120	14 400	10.95445	34.64102	1 728 000	4.932 424	10.62659	22.89428
121	14 641	11.00000	34.78505	1 771 561	4.946 087	10.65602	22.95770
122	14 884	11.04536	34.92850	1 815 848	4.959 676	10.68530	23.02078
123	15 129	11.09054	35.07136	1 860 867	4.973 190	10.71441	23.08350
124	15 376	11.13553	35.21363	1 906 624	4.986 631	10.74337	23.14589
125	15 625	11.18034	35.35534	1 953 125	5.000 000	10.77217	23.20794
126	15 876	11.22497	35.49648	2 000 376	5.013 298	10.80082	23.26967
127	16 129	11.26943	35.63706	2 048 383	5.026 526	10.82932	23.33107
128	16 384	11.31371	35.77709	2 097 152	5.039 684	10.85767	23.39214
129	16 641	11.35782	35.91657	2 146 689	5.052 774	10.88587	23.45290
130	16 900	11.40175	36.05551	2 197 000	5.065 797	10.91393	23.51335
131	17 161	11.44552	36.19392	2 248 091	5.078 753	10.94184	23.57348
132	17 424	11.48913	36.33180	2 299 968	5.091 643	10.96961	23.63332
133	17 689	11.53256	36.46917	2 352 637	5.104 469	10.99724	23.69285
134	17 956	11.57584	36.60601	2 406 104	5.117 230	11.02474	23.75208
135	18 225	11.61895	36.74235	2 460 375	5.129 928	11.05209	23.81102
136	18 496	11.66190	36.87818	2 515 456	5.142 563	11.07932	23.86966
137	18 769	11.70470	37.01351	2 571 353	5.155 137	11.10641	23.92803
138	19 044	11.74734	37.14835	2 628 072	5.167 649	11.13336	23.98610
139	19 321	11.78983	37.28270	2 685 619	5.180 101	11.16019	24.04390
140	19 600	11.83216	37.41657	2 744 000	5.192 494	11.18689	24.10142
141	19 881	11.87434	37.54997	2 803 221	5.204 828	11.21346	24.15867
142	20 164	11.91638	37.68289	2 863 288	5.217 103	11.23991	24.21565
143	20 449	11.95826	37.81534	2 924 207	5.229 322	11.26623	24.27236
144	20 736	12.00000	37.94733	2 985 984	5.241 483	11.29243	24.32881
145	21 025	12.04159	38.07887	3 048 625	5.253 588	11.31851	24.38499
146	21 316	12.08305	38.20995	3 112 136	5.265 637	11.34447	24.44092
147	21 609	12.12436	38.34058	3 176 523	5.277 632	11.37031	24.49660
148	21 904	12.16553	38.47077	3 241 792	5.289 572	11.39604	24.55202
149	22 201	12.20656	38.60052	3 307 949	5.301 459	11.42165	24.60719
150	22 500	12.24745	38.72983	3 375 000	5.313 293	11.44714	24.66212

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
150	22 500	12.24745	38.72983	3 375 000	5.313 293	11.44714	24.66212
151	22 801	12.28821	38.85872	3 442 951	5.325 074	11.47252	24.71680
152	23 104	12.32883	38.98718	3 511 808	5.336 803	11.49779	24.77125
153	23 409	12.36932	39.11521	3 581 577	5.348 481	11.52295	24.82545
154	23 716	12.40967	39.24283	3 652 264	5.360 108	11.54800	24.87942
155	24 025	12.44990	39.37004	3 723 875	5.371 685	11 57295	24.93315
156	24 336	12.49000	39.49684	3 796 416	5.383 213	11.59778	24.98666
157	24 649	12.52996	39.62323	3 869 893	5.394 091	11.62251	25.03994
158	24 964	12.56981	39.74921	3 944 312	5.406 120	11.64713	25.09299
159	25 281	12.60952	39.87480	4 019 679	5.417 502	11.67165	25.14581
160	25 600	12.64911	40.00000	4 096 000	5.428 835	11.69607	25.19842
161	25 921	12.68858	40.12481	4 173 281	5.440 122	11.72039	25.25081
162	26 244	12.72792	40.24922	4 251 528	5.451 362	11.74460	25.30298
163	26 569	12.76715	40.37326	4 330 747	5.462 556	11.76872	25.35494
164	26 896	12.80625	40.49691	4 410 944	5.473 704	11.79274	25.40668
165	27 225	12.84523	40.62019	4 492 125	5.484 807	11.81666	25.45822
166	27 556	12.88410	40.74310	4 574 296	5.495 865	11.84048	25.50954
167	27 889	12.92285	40.86563	4 657 463	5.506 878	11.86421	25.56067
168	28 224	12.96148	40.98780	4 741 632	5.517 848	11.88784	25.61158
169	28 561	13.00000	41.10961	4 826 809	5.528 775	11.91138	25.66230
170	28 900	13.03840	41.23106	4 913 000	5.539 658	11.93483	25.71282
171	29 241	13.07670	41.35215	5 000 211	5.550 499	11.95819	25.76313
172	29 584	13.11488	41.47288	5 088 448	5.561 298	11.98145	25.81326
173	29 929	13.15295	41.59327	5 177 717	5.572 055	12.00463	25.86319
174	30 276	13.19091	41.71331	5 268 024	5.582 770	12.02771	25.91292
175	30 625	13.22876	41.83300	5 359 375	5.593 445	12.05071	25.96247
176	30 976	13.26650	41.95235	5 451 776	5.604 079	12.07362	26.01183
177	31 329	13.30413	42.07137	5 545 233	5.614 672	12.09645	26.06100
178	31 684	13.34166	42.19005	5 639 752	5.625 226	12.11918	26.10999
179	32 041	13.37909	42.30839	5 735 339	5.635 741	12.14184	26.15879
180	32 400	13.41641	42.42641	5 832 000	5.646 216	12.16440	26.20741
181	32 761	13.45362	42.54409	5 929 741	5.656 653	12.18689	26.25586
182	33 124	13.49074	42.66146	6 028 568	5.667 051	12.20929	26.30412
183	33 489	13.52775	42.77850	6 128 487	5.677 411	12.23161	26.35221
184	33 856	13.56466	42.89522	6 229 504	5.687 734	12.25385	26.40012
185	34 225	13.60147	43.01163	6 331 625	5.698 019	12.27601	26.44786
186	34 596	13.63818	43.12772	6 434 856	5.708 267	12.29809	26.49543
187	34 969	13.67479	43.24350	6 539 203	5.718 479	12.32009	26.54283
188	35 344	13.71131	43.35897	6 644 672	5.728 654	12.34201	26.59006
189	35 721	13.74773	43.47413	6 751 269	5.738 794	12.36386	26.63712
190	36 100	13.78405	43.58899	6 859 000	5.748 897	12.38562	26.68402
191	36 481	13.82027	43.70355	6 967 871	5.758 965	12.40731	26.73075
192	36 864	13.85641	43.81780	7 077 888	5.768 998	12.42893	26.77732
193	37 249	13.89244	43.93177	7 189 057	5.778 997	12.45047	26.82373
194	37 636	13.92839	44.04543	7 301 384	5.788 960	12.47194	26.86997
195	38 025	13.96424	44.15880	7 414 875	5.798 890	12.49333	26.91606
196	38 416	14.00000	44.27189	7 529 536	5.808 786	12.51465	26.96199
197	38 809	14.03567	44.38468	7 645 373	5.818 648	12.53590	27.00777
198	39 204	14.07125	44.49719	7 762 392	5.828 477	12.55707	27.05339
199	39 601	14.10674	44.60942	7 880 599	5.838 272	12.57818	27.09886
300	40 000	14.14214	44.72136	8 000 000	5.848 035	12.59921	27.14418

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
200	40 000	14.14214	44.72136	8 000 000	5.848 035	12.59921	27.14418
201	40 401	14.17745	44.83302	8 120 601	5.857 766	12.62017	27.18934
202	40 804	14.21267	44.94441	8 242 408	5.867 464	12.64107	27.23436
203	41 209	14.24781	45.05552	8 365 427	5.877 131	12.66189	27.27922
204	41 616	14.28286	45.16636	8 489 664	5.886 765	12.68265	27.32394
205	42 025	14.31782	45.27693	8 615 125	5.896 369	12.70334	27.36852
206	42 436	14.35270	45.38722	8 741 816	5.905 941	12.72396	27.41295
207	42 849	14.38749	45.49725	8 869 743	5.915 482	12.74452	27.45723
208	43 264	14.42221	45.60702	8 998 912	5.924 992	12.76501	27.50138
209	43 681	14.45683	45.71652	9 129 329	5.934 472	12.78543	27.54538
210	44 100	14.49138	45.82576	9 261 000	5.943 922	12.80579	27.58924
211	44 521	14.52584	45.93474	9 393 931	5.953 342	12.82609	27.63296
212	44 944	14.56022	46.04346	9 528 128	5.962 732	12.84632	27.67655
213	45 369	14.59452	46.15192	9 663 597	5.972 093	12.86648	27.72000
214	45 796	14.62874	46.26013	9 800 344	5.981 424	12.88659	27.76331
215	46 225	14.66288	46.36809	9 938 375	5.990 726	12.90663	27.80649
216	46 656	14.69694	46.47580	10 077 696	6.000 000	12.92661	27.84953
217	47 089	14.73092	46.58326	10 218 313	6.009 245	12.94653	27.89244
218	47 524	14.76482	46.69047	10 360 232	6.018 462	12.96638	27.93522
219	47 961	14.79865	46.79744	10 503 459	6.027 650	12.98618	27.97787
220	48 400	14.83240	46.90416	10 648 000	6.036 811	13.00591	28.02039
221	48 841	14.86607	47.01064	10 793 861	6.045 944	13.02559	28.06278
222	49 284	14.89966	47.11688	10 941 048	6.055 049	13.04521	28.10505
223	49 729	14.93318	47.22288	11 089 567	6.064 127	13.06477	28.14718
224	50 176	14.96663	47.32864	11 239 424	6.073 178	13.08427	28.18919
225	50 625	15.00000	47.43416	11 390 625	6.082 202	13.10371	28.23108
226	51 076	15.03330	47.53946	11 543 176	6.091 199	13.12309	28.27284
227	51 529	15.06652	47.64452	11 697 083	6.100 170	13.14242	28.31448
228	51 984	15.09967	47.74935	11 852 352	6.109 115	13.16169	28.35600
229	52 441	15.13275	47.85394	12 008 989	6.118 033	13.18090	28.39739
230	52 900	15.16575	47.95832	12 167 000	6.126 926	13.20006	28.43867
231	53 361	15.19868	48.06246	12 326 391	6.135 792	13.21916	28.47983
222	53 824	15.23155	48.16638	12 487 168	6.144 634	13.23821	28.52086
233	54 289	15.26434	48.27007	12 649 337	6.153 449	13.25721	28.56178
234	54 756	15.29706	48.37355	12 812 904	6.162 240	13.27614	28.60259
235	55 225	15.32971	48.47680	12 977 875	6.171 006	13.29503	28.64327
236	55 696	15.36229	48.57983	13 144 256	6.179 747	13.31386	28.68384
237	56 169	15.39480	48.68265	13 312 053	6.188 463	13.33264	28.72430
238	56 644	15.42725	48.78524	13 481 272	6.197 154	13.35136	28.76464
239	57 121	15.45962	48.88763	13 651 919	6.205 822	13.37004	28.80487
240	57 600	15.49193	48.98979	13 824 000	6.214 465	13.38866	28.84499
241	58 081	15.52417	49.09175	13 997 521	6.223 084	13.40723	28.88500
242	58 564	15.55635	49.19350	14 172 488	6.231 680	13.42575	28.92489
243	59 049	15.58846	49.29503	14 348 907	6.240 251	13.44421	28.96468
244	59 536	15.62050	49.39636	14 526 784	6.248 800	13.46263	29.00436
245	60 025	15.65248	49.49747	14 706 125	6.257 325	13.48100	29.04393
246	60 516	15.68439	49.59839	14 886 936	6.265 827	13.49931	29.08339
247	61 009	15.71623	49.69909	15 069 223	6.274 305	13.51758	29.12275
248	61 504	15.74802	49.79960	15 252 992	6.282 761	13.53580	29.16199
249	62 001	15.77973	49.89990	15 438 249	6.291 195	13.55397	29.20114
250	62 500	15.81139	50.00000	15 625 000	6.299 605	13.57209	29.24018

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
250	62 500	15.81139	50.00000	15 625 000	6.299 605	13.57209	29.24018
251	63 001	15.84298	50.09990	15 813 251	6.307 994	13.59016	29.27911
252	63 504	15.87451	50.19960	16 003 008	6.316 360	13.60818	29.31794
253	64 009	15.90597	50.29911	16 194 277	6.324 704	13.62616	29.35667
254	64 516	15.93738	50.39841	16 387 064	6.333 026	13.64409	29.39530
255	65 025	15.96872	50.49752	16 581 375	6.341 326	13.66197	29.43383
256	65 536	16.00000	50.59644	16 777 216	6.349 604	13.67981	29.47225
257	66 049	16.03122	50.69517	16 974 593	6.357 861	13.69760	29.51058
258	66 564	16.06238	50.79370	17 173 512	6.366 097	13.71534	29.54880
259	67 081	16.09348	50.89204	17 373 979	6.374 311	13.73304	29.58693
260	67 600	16.12452	50.99020	17 576 000	6.382 504	13.75069	29.62496
261	68 121	16.15549	51.08816	17 779 581	6.390 677	13.76830	29.66289
262	68 644	16.18641	51.18594	17 984 728	6.398 828	13.78586	29.70073
263	69 169	16.21727	51.28353	18 191 447	6.406 959	13.80337	29.73847
264	69 696	16.24808	51.38093	18 399 744	6.415 069	13.82085	29.77611
265	70 225	16.27882	51.47815	18 609 625	6.423 158	13.83828	29.81366
266	70 756	16.30951	51.57519	18 821 096	6.431 228	13.85566	29.85111
267	71 289	16 34013	51.67204	19 034 163	6.439 277	13.87300	29.88847
268	71 824	16.37071	51.76872	19 248 832	6.447 306	13.89030	29.92574
269	72 361	16.40122	51.86521	19 465 109	6.455 315	13.90755	29.96292
270	72 900	16.43168	51.96152	19 683 000	6.463 304	13.92477	30.00000
271	73 441	16.46208	52.05766	19 902 511	6.471 274	13.94194	30.03699
272	73 984	16.49242	52.15362	20 123 648	6.479 224	13.95906	30.07389
273	74 529	16.52271	52.24940	20 346 417	6.487 154	13.97615	30.11070
274	75 076	16.55295	52.34501	20 570 824	6.495 065	13.99319	30.14742
275	75 625	16.58312	52.44044	20 796 875	6.502 957	14.01020	30.18405
276	76 176	16.61325	52.53570	21 024 576	6.510 830	14.02716	30.22060
277	76 729	16.64332	52.63079	21 253 933	6.518 684	14.04408	30.25705
278	77 284	16.67333	52.72571	21 484 952	6.526 519	14.06096	30.29342
279	77 841	16.70329	52.82045	21 717 639	6.534 335	14.07780	30.32970
280	78 400	16.73320	52.91503	21 952 000	6.542 133	14.09460	30.36589
281	78 961	16.76305	53.00943	22 188 041	6.549 912	14.11136	30.40200
282	79 524	16.79286	53.10367	22 425 768	6.557 672	14.12808	30.43802
283	80 089	16.82260	53.19774	22 665 187	6.565 414	14.14476	30.47395
284	80 656	16.85230	53.29165	22 906 304	6.573 138	14.16140	30.50981
285	81 225	16.88194	53.38539	23 149 125	6.580 844	14.17800	30.54557
286	81 796	16.91153	53.47897	23 393 656	6.588 532	14.19456	30.58126
287	82 369	16.94107	53.57238	23 639 903	6.596 202	14.21109	30.61686
288	82 944	16.97056	53.66563	23 887 872	6.603 854	14.22757	30.65238
289	83 521	17.00000	53.75872	24 137 569	6.611 489	14.24402	30.68781
290	84 100	17 02939	53.85165	24 389 000	6.619 106	14.26043	30.72317
291	84 681	17.05872	53.94442	24 642 171	6.626 705	14.27680	30.75844
292	85 264	17.08801	54.03702	24 897 088	6.634 287	14.29314	30.79363
293	85 849	17.11724	54.12947	25 153 757	6.641 852	14.30944	30.82875
294	86 436	17.14643	54.22177	25 412 184	6.649 400	14.32570	30.86378
295	87 025	17.17556	54.31390	25 672 375	6.656 930	14.34192	30.89873
296	87 616	17.20465	54.40588	25 934 336	6.664 444	14.35811	30.93361
297	88 209	17.23369	54.49771	26 198 073	6.671 940	14.37426	30.96840
298	88 804	17.26268	54.58938	26 463 592	6.679 420	14.39037	31.00312
299	89 401	17.29162	54.68089	26 730 899	6.686 883	14.40645	31.03776
300	90 000	17.32051	54.77226	27 000 000	6.694 330	14.42250	31.07233

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
300	90 000	17.32051	54.77226	27 000 000	6.694 330	14.42250	31.07233
301	90 601	17.34935	54.86347	27 270 901	6.701 759	14.43850	31.10681
302	91 204	17.37815	54.95453	27 543 608	6.709 173	14.45447	31.14122
303	91 809	17.40690	55.04544	27 818 127	6.716 570	14.47041	31.17556
304	92 416	17.43560	55.13620	28 094 464	6.723 951	14.48631	31.20982
305	93 025	17.46425	55.22681	28 372 625	6.731 315	14.50218	31.24400
306	93 636	17.49286	55.31727	28 652 616	6.738 664	14.51801	31.27811
307	94 249	17.52142	55.40758	28 934 443	6.745 997	14.53381	31.31214
308	94 864	17.54993	55.49775	29 218 112	6.753 313	14.54957	31.34610
309	95 481	17.57840	55.58777	29 503 629	6.760 614	14.56530	31.37999
310	96 100	17.60682	55.67764	29 791 000	6.767 899	14.58100	31.41381
311	96 721	17.63519	55.76737	30 080 231	6.775 169	14.59666	31.44755
312	97 344	17.66352	55.85696	30 371 328	6.782 423	14.61229	31.48122
313	97 969	17.69181	55.94640	30 664 297	6.789 661	14.62788	31.51482
314	98 596	17.72005	56.03570	30 959 144	6.796 884	14.64344	31.54834
315	99 225	17.74824	56.12486	31 255 875	6.804 092	14.65897	31.58180
316	99 856	17.77639	56.21388	31 554 496	6.811 285	14.67447	31.61518
317	100 489	17.80449	56.30275	31 855 013	6.818 462	14.68993	31.64850
318	101 124	17.83255	56.39149	32 157 432	6.825 624	14.70536	31.68174
319	101 761	17.86057	56.48008	32 461 759	6.832 771	14.72076	31.71492
320	102 400	17.88854	56.56854	32 768 000	6.839 904	14.73613	31.74802
321	103 041	17.91647	56.65686	33 076 161	6.847 021	14.75146	31.78106
322	103 684	17.94436	56.74504	33 386 248	6.854 124	14.76676	31.81403
323	104 329	17.97220	56.83309	33 698 267	6.861 212	14.78203	31.84693
324	104 976	18.00000	56.92100	34 012 224	6.868 285	14.79727	31.87976
325	105 625	18.02776	57.00877	34 328 125	6.875 344	14.81248	31.91252
326	106 276	18.05547	57.09641	34 645 976	6.882 389	14.82766	31.94522
327	106 929	18.08314	57.18391	34 965 783	6.889 419	14.84280	31.97785
328	107 584	18.11077	57.27128	35 287 552	6.896 434	14.85792	32.01041
329	108 241	18.13836	57.35852	35 611 289	6.903 436	14.87300	32.04291
330	108 900	18.16590	57.44563	35 937 000	6.910 423	14.88806	32.07534
331	109 561	18.19341	57.53260	36 264 691	6.917 396	14.90308	32.10771
332	110 224	18.22087	57.61944	36 594 368	6.924 356	14.91807	32.14001
333	110 889	18.24829	57.70615	36 926 037	6.931 301	14.93303	32.17225
334	111 556	18.27567	57.79273	37 259 704	6.938 232	14.94797	32.20442
335	112 225	18.30301	57.87918	37 595 375	6.945 150	14.96287	32.23653
336	112 896	18.33030	57.96551	37 933 056	6.952 053	14.97774	32.26857
337	113 569	18.35756	58.05170	38 272 753	6.958 943	14.99259	32.30055
338	114 244	18.38478	58.13777	38 614 472	6.965 820	15.00740	32.33247
339	114 921	18.41195	58.22371	38 958 219	6.972 683	15.02219	32.36433
340	115 600	18.43909	58.30952	39 304 000	6.979 532	15.03695	32.39612
341	116 281	18.46619	58.39521	39 651 821	6.986 368	15.05167	32.42785
342	116 964	18.49324	58.48077	40 001 688	6.993 191	15.06637	32.45952
343	117 649	18.52026	58.56620	40 353 607	7.000 000	15.08104	32.49112
344	118 336	18.54724	58.65151	40 707 584	7.006 796	15.09568	32.52267
345	119 025	18.57418	58.73670	41 063 625	7.013 579	15.11030	32.55415
346	119 716	18.60108	58.82176	41 421 736	7.020 349	15.12488	32.58557
347	120 409	18.62794	58.90671	41 781 923	7.027 106	15.13944	32.61694
348	121 104	18.65476	58.99152	42 144 192	7.033 850	15.15397	32.64824
349	121 801	18.68154	59.07622	42 508 549	7.040 581	15.16847	32.67948
350	122 500	18.70829	59.16080	42 875 000	7.047 299	15.18294	32.71066

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
350	122 500	18.70829	59.16080	42 875 000	7.047 299	15.18294	32.71066
351	123 201	18.73499	59.24525	43 243 551	7.054 004	15.19739	32.74179
352	123 904	18.76166	59.32959	43 614 208	7.060 697	15.21181	32.77285
353	124 609	18.78829	59.41380	43 986 977	7.067 377	15.22620	32.80386
354	125 316	18.81489	59.49790	44 361 864	7.074 044	15.24057	32.83480
355	126 025	18.84144	59.58188	44 738 875	7.080 699	15.25490	32.86569
356	126 736	18.86796	59.66574	45 118 016	7.087 341	15.26921	32.89652
357	127 449	18.89444	59.74948	45 499 293	7.093 971	15.28350	32.92730
358	128 164	18.92089	59.83310	45 882 712	7.100 588	15.29775	32.95801
359	128 881	18.94730	59.91661	46 268 279	7.107 194	15.31198	32.98867
360	129 600	18.97367	60.00000	46 656 000	7.113 787	15.32619	33.01927
361	130 321	19.00000	60.08328	47 045 881	7.120 367	15.34037	33.04982
362	131 044	19.02630	60.16644	47 437 928	7.126 936	15.35452	33.08031
363	131 769	19.05256	60.24948	47 832 147	7.133 492	15.36864	33.11074
364	132 496	19.07878	60.33241	48 228 544	7.140 037	15.38274	33.14112
365	133 225	19.10497	60.41523	48 627 125	7.146 569	15.39682	33.17144
366	133 956	19.13113	60.49793	49 027 896	7.153 090	15.41087	33.20170
367	134 689	19.15724	60.58052	49 430 863	7.159 599	15.42489	33.23191
368	135 424	19.18333	60.66300	49 836 032	7.166 096	15.43889	33.26207
369	136 161	19.20937	60.74537	50 243 409	7.172 581	15.45286	33.29217
370	136 900	19.23538	60.82763	50 653 000	7.179 054	15.46680	33.32222
371	137 641	19.26136	60.90977	51 064 811	7.185 516	15.48073	33.35221
372	138 384	19.28730	60.99180	51 478 848	7.191 966	15.49462	33.38215
373	139 129	19.31321	61.07373	51 895 117	7.198 405	15.50849	33.41204
374	139 876	19.33908	61.15554	52 313 624	7.204 832	15.52234	33.44187
375	140 625	19.36492	61.23724	52 734 375	7.211 248	15.53616	33.47165
376	141 376	19.39072	61.31884	53 157 376	7.217 652	15.54996	33.50137
377	142 129	19.41649	61.40033	53 582 633	7.224 045	15.56373	33.53105
378	142 884	19.44222	61.48170	54 010 152	7.230 427	15.57748	33.56067
379	143 641	19.46792	61.56298	54 439 939	7.236 797	15.59121	33.59024
380	144 400	19.49359	61.64414	54 872 000	7.243 156	15.60491	33.61975
381	145 161	19.51922	61.72520	55 306 341	7.249 505	15.61858	33.64922
382	145 924	19.54482	61.80615	55 742 968	7.255 842	15.63224	33.67863
383	146 689	19.57039	61.88699	56 181 887	7.262 167	15.64587	33.70800
384	147 456	19.59592	61.96773	56 623 104	7.268 482	15.65947	33.73731
385	148 225	19.62142	62.04837	57 066 625	7.274 786	15.67305	33.76657
386	148 996	19.64688	62.12890	57 512 456	7.281 079	15.68661	33.79578
387	149 769	19.67232	62.20932	57 960 603	7.287 362	15.70014	33.82494
388	150 544	19.69772	62.28965	58 411 072	7.293 633	15.71366	33.85405
389	151 321	19.72308	62.36986	58 863 869	7.299 894	15.72714	33.88310
390	152 100	19.74842	62.44998	59 319 000	7.306 144	15.74061	33.91211
391	152 881	19.77372	62.52999	59 776 471	7.312 383	15.75405	33.94107
392	153 664	19.79899	62.60990	60 236 288	7.318 611	15.76747	33.96999
393	154 449	19.82423	62.68971	60 698 457	7.324 829	15.78087	33.99885
394	155 236	19.84943	62.76942	61 162 984	7.331 037	15.79424	34.02766
395	156 025	19.87461	62.84903	61 629 875	7.337 234	15.80759	34.05642
396	156 816	19.89975	62.92853	62 099 136	7.343 420	15.82092	34.08514
397	157 609	19.92486	63.00794	62 570 773	7.349 597	15.83423	34.11381
398	158 404	19.94994	63.08724	63 044 792	7.355 762	15.84751	34.14242
399	159 201	19.97498	63.16645	63 521 199	7.361 918	15.86077	34.17100
400	160 000	20.00000	63.24555	64 000 000	7.368 063	15.87401	34.19952

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
400	160 000	20.00000	63.24555	64 000 000	7.368 063	15.87401	34.19952
401	160 801	20.02498	63.32456	64 481 201	7.374 198	15.88723	34.22799
402	161 604	20.04994	63.40347	64 964 808	7.380 323	15.90042	34.25642
403	162 409	20.07486	63.48228	65 450 827	7.386 437	15.91360	34.28480
404	163 216	20.09975	63.56099	65 939 264	7.392 542	15.92675	34.31314
405	164 025	20.12461	63.63961	66 430 125	7.398 636	15.93988	34.34143
406	164 836	20.14944	63.71813	66 923 416	7.404 721	15.95299	34.36967
407	165 649	20.17424	63.79655	67 419 143	7.410 795	15.96607	34.39786
408	166 464	20.19901	63.87488	67 917 312	7.416 860	15.97914	34.42601
409	167 281	20.22375	63.95311	68 417 929	7.422 914	15.99218	34.45412
410	168 100	20.24846	64.03124	68 921 000	7.428 959	16.00521	34.48217
411	168 921	20.27313	64.10928	69 426 531	7.434 994	16.01821	34.51018
412	169 744	20.29778	64.18723	69 934 528	7.441 019	16.03119	34.53815
413	170 569	20.32240	64.26508	70 444 997	7.447 034	16.04415	34.56607
414	171 396	20.34699	64.34283	70 957 944	7.453 040	16.05709	34.59395
415	172 225	20.37155	64.42049	71 473 375	7.459 036	16.07001	34.62178
416	173 056	20.39608	64.49806	71 991 296	7.465 022	16.08290	34.64956
417	173 889	20.42058	64.57554	72 511 713	7.470 999	16.09578	34.67731
418	174 724	20.44505	64.65292	73 034 632	7.476 966	16.10864	34.70500
419	175 561	20.46949	64.73021	73 560 059	7.482 924	16.12147	34.73266
420	176 400	20.49390	64.80741	74 088 000	7.488 872	16.13429	34.76027
421	177 241	20.51828	64.88451	74 618 461	7.494 811	16.14708	34.78783
422	178 084	20.54264	64.96153	75 151 448	7.500 741	16.15986	34.81535
423	178 929	20.56696	65.03845	75 686 967	7.506 661	16.17261	34.84283
424	179 776	20.59126	65.11528	76 225 024	7.512 572	16.18534	34.87027
425	180 625	20.61553	65.19202	76 765 625	7.518 473	16.19806	34.89766
426	181 476	20.63977	65.26868	77 308 776	7.524 365	16.21075	34.92501
427	182 329	20.66398	65.34524	77 854 483	7.530 248	16.22343	34.95232
428	183 184	20.68816	65.42171	78 402 752	7.536 122	16.23608	34.97958
429	184 041	20.71232	65.49809	78 953 589	7.541 987	16.24872	35.00680
430	184 900	20.73644	65.57439	79 507 000	7.547 842	16.26133	35.03398
431	185 761	20.76054	65.65059	80 062 991	7.553 689	16.27393	35.06112
432	186 624	20.78461	65.72671	80 621 568	7.559 526	16.28651	35.08821
433	187 489	20.80865	65.80274	81 182 737	7.565 355	16.29906	35.11527
434	188 356	20.83267	65.87868	81 746 504	7.571 174	16.31160	35.14228
435	189 225	20.85665	65.95453	82 312 875	7.576 985	16.32412	35.16925
436	190 096	20.88061	66.03030	82 881 856	7.582 787	16.33662	35.19618
437	190 969	20.90454	66.10598	83 453 453	7.588 579	16.34910	35.22307
438	191 844	20.92845	66.18157	84 027 672	7.594 363	16.36156	35.24991
439	192 721	20.95233	66.25708	84 604 519	7.600 139	16.37400	35.27672
440	193 600	20.97618	66.33250	85 184 000	7.605 905	16.38643	35.30348
441	194 481	21.00000	66.40783	85 766 121	7.611 663	16.39883	35.33021
442	195 364	21.02380	66.48308	86 350 888	7.617 412	16.41122	35.35689
443	196 249	21.04757	66.55825	86 938 307	7.623 152	16.42358	35.38354
444	197 136	21.07131	66.63332	87 528 384	7.628 884	16.43593	35.41014
445	198 025	21.09502	66.70832	88 121 125	7.634 607	16.44826	35.43671
446	198 916	21.11871	66.78323	88 716 536	7.640 321	16.46057	35.46323
447	199 809	21.14237	66.85806	89 314 623	7.646 027	16.47287	35.48971
448	200 704	21.16601	66.93280	89 915 392	7.651 725	16.48514	35.51616
449	201 601	21.18962	67.00746	90 518 849	7.657 414	16.49740	35.54257
450	202 500	21.21320	67.08204	91 125 000	7.663 094	16.50964	35.56893

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
450	202 500	21.21320	67.08204	91 125 000	7.663 094	16.50964	35.56893
451	203 401	21.23676	67.15653	91 733 851	7.668 766	16.52186	35.59526
452	204 304	21.26029	67.23095	92 345 408	7.674 430	16.53406	35.62155
453	205 209	21.28380	67.30527	92 959 677	7.680 086	16.54624	35.64780
454	206 116	21.30728	67.37952	93 576 664	7.685 733	16.55841	35.67401
455	207 025	21.33073	67.45369	94 196 375	7.691 372	16.57056	35.70018
456	207 936	21.35416	67.52777	94 818 816	7.697 002	16.58269	35.72632
457	208 849	21.37756	67.60178	95 443 993	7.702 625	16.59480	35.75242
458	209 764	21.40093	67.67570	96 071 912	7.708 239	16.60690	35.77848
459	210 681	21.42429	67.74954	96 702 579	7.713 845	16.61897	35.80450
460	211 600	21.44761	67.82330	97 336 000	7.719 443	16.63103	35.83048
461	212 521	21.47091	67.89698	97 972 181	7.725 032	16.64308	35.85642
462	213 444	21.49419	67.97058	98 611 128	7.730 614	16.65510	35.88233
463	214 369	21.51743	68.04410	99 252 847	7.736 188	16.66711	35.90820
464	215 296	21.54066	68.11755	99 897 344	7.741 753	16.67910	35.93404
465	216 225	21 56386	68.19091	100 544 625	7.747 311	16.69108	35.95983
466	217 156	21.58703	68.26419	101 194 696	7.752 861	16.70303	35.98559
467	218 089	21.61018	68.33740	101 847 563	7.758 402	16.71497	36.01131
468	219 024	21.63331	68.41053	102 503 232	7.763 936	16 72689	36.03700
469	219 961	21.65641	68.48357	103 161 709	7.769 462	16.73880	36.06265
470	220 900	21.67948	68.55655	103 823 000	7.774 980	16.75069	36.08826
471	221 841	21.70253	68.62944	104 487 111	7.780 490	16.76256	36.11384
472	222 784	21.72556	68.70226	105 154 048	7.785 993	16.77441	36.13938
473	223 729	21.74856	68.77500	105 823 817	7.791 488	16.78625	36.16488
474	224 676	21.77154	68.84766	106 496 424	7.796 975	16.79807	36.19035
475	225 625	21.79449	68.92024	107 171 875	7.802 454	16.80988	36.21578
476	226 576	21.81742	68.99275	107 850 176	7.807 925	16.82167	36.24118
477	227 529	21.84033	69.06519	108 531 333	7.813 389	16.83344	36.26654
478	228 484	21.86321	69.13754	109 215 352	7.818 846	16.84519	36.29187
479	229 441	21.88607	69.20983	109 902 239	7.824 294	16.85693	36.31716
480	230 400	21.90890	69.28203	110 592 000	7.829 735	16.86865	36.34241
481	231 361	21.93171	69.35416	111 284 641	7.835 169	16.88036	36.36763
482	232 324	21.95450	69.42622	111 980 168	7.840 595	16.89205	36.39282
483	233 289	21.97726	69.49820	112 678 587	7.846 013	16 90372	36.41797
484	234 256	22.00000	69.57011	113 379 904	7.851 424	16.91538	36.44308
485	235 225	22.02272	69.64194	114.084 125	7.856 828	16.92702	36.46817
486	236 196	22.04541	69.71370	114 791 256	7.862 224	16.93865	36.49321
487	237 169	22.06808	69.78539	115 501 303	7.867 613	16.95026	36 51822
488	238 144	22.09072	69.85700	116 214 272	7.872 994	16.96185	36 54320
489	239 121	22.11334	69.92853	116 930 169	7.878 368	16.97343	36.56815
490	240 100	22.13594	70.00000	117 649 000	7.883 735	16.98499	36.59306
491	241 081	22.15852	70.07139	118 370 771	7.889 095	16.99654	36 61793
492	242 064	22.18107	70.14271	119 095 488	7.894 447	17.00807	36.64278
493	243 049	22.20360	70.21396	119 823 157	7.899 792	17.01959	36.66758
494	244 036	22.22611	70.28513	120 553 784	7.905 129	17.03108	36.69236
495	245 025	22.24860	70.35624	121 287 375	7.910 460	17.04257	36.71710
496	246 016	22.27106	70.42727	122 023 936	7.915 783	17.05404	36.74181
497	247 009	22.29350	70.49823	122 763 473	7.921 099	17.06549	36.76649
498	248 004	22.31591	70.56912	123 505 992	7.926 408	17.07693	36.79113
499	249 001	22.33831	70.63993	124 251 499	7.931 710	17.08835	36.81574
500	250 000	22.36068	70.71068	125 000 000	7.937 005	17.09976	36.84031

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
500	250 000	22.36068	70.71068	125 000 000	7.937 005	17.09976	36.84031
501	251 001	22.38303	70.78135	125 751 501	7.942 293	17.11115	36.86486
502	252 004	22.40536	70.85196	126 506 008	7.947 574	17.12253	36.88937
503	253 009	22.42766	70.92249	127 263 527	7.952 848	17.13389	36.91385
504	254 016	22.44994	70.99296	128 024 064	7.958 114	17.14524	36.93830
505	255 025	22.47221	71.06335	128 787 625	7.963 374	17.15657	36.96271
506	256 036	22.49444	71.13368	129 554 216	7.968 627	17.16789	36.98709
507	257 049	22.51666	71.20393	130 323 843	7.973 873	17.17919	37.01144
508	258 064	22.53886	71.27412	131 096 512	7.979 112	17.19048	37.03576
509	259 081	22.56103	71.34424	131 872 229	7.984 344	17.20175	37.06004
510	260 100	22.58318	71.41428	132 651 000	7.989 570	17.21301	37.08430
511	261 121	22.60531	71.48426	133 432 831	7.994 788	17.22425	37.10852
512	262 144	22.62742	71.55418	134 217 728	8.000 000	17.23548	37.13271
513	263 169	22.64950	71.62402	135 005 697	8.005 205	17.24669	37.15687
514	264 196	22.67157	71.69379	135 796 744	8.010 403	17.25789	37.18100
515	265 225	22.69361	71.76350	136 590 875	8.015 595	17.26908	37.20509
516	266 256	22.71563	71.83314	137 388 096	8.020 779	17.28025	37.22916
517	267 289	22.73763	71.90271	138 188 413	8.025 957	17.29140	37.25319
518	268 324	22.75961	71.97222	138 991 832	8.031 129	17.30254	37.27720
519	269 361	22.78157	72.04165	139 798 359	8.036 293	17.31367	37.30117
520	270 400	22.80351	72.11103	140 608 000	8.041 452	17.32478	37.32511
521	271 441	22.82542	72.18033	141 420 761	8.046 603	17.33588	37.34902
522	272 484	22.84732	72.24957	142 236 648	8.051 748	17.34696	37.37290
523	273 529	22.86919	72.31874	143 055 667	8.056 886	17.35804	37.39675
524	274 576	22.89105	72.38784	143 877 824	8.062 018	17.36909	37.42057
525	275 625	22.91288	72.45688	144 703 125	8.067 143	17.38013	37.44436
526	276 676	22.93469	72.52586	145 531 576	8.072 262	17.39116	37.46812
527	277 729	22.95648	72.59477	146 363 183	8.077 374	17.40218	37.49185
528	278 784	22.97825	72.66361	147 197 952	8.082 480	17.41318	37.51555
529	279 841	23.00000	72.73239	148 035 889	8.087 579	17.42416	37.53922
530	280 900	23.02173	72.80110	148 877 000	8.092 672	17.43513	37.56286
531	281 961	23.04344	72.86975	149 721 291	8.097 759	17.44609	37.58647
532	283 024	23.06513	72.93833	150 568 768	8.102 839	17.45704	37.61005
533	284 089	23.08679	73.00685	151 419 437	8.107 913	17.46797	37.63360
534	285 156	23.10844	73.07530	152 273 304	8.112 980	17.47889	37.65712
535	286 225	23.13007	73.14369	153 130 375	8.118 041	17.48979	37.68061
536	287 296	23.15167	73.21202	153 990 656	8.123 096	17.50068	37.70407
537	288 369	23.17326	73.28028	154 854 153	8.128 145	17.51156	37.72751
538	289 444	23.19483	73.34848	155 720 872	8.133 187	17.52242	37.75091
539	290 521	23.21637	73.41662	156 590 819	8.138 223	17.53327	37.77429
540	291 600	23.23790	73.48469	157 464 000	8.143 253	17.54411	37.79763
541	292 681	23.25941	73.55270	158 340 421	8.148 276	17.55493	37.82095
542	293 764	23.28089	73.62065	159 220 088	8.153 294	17.56574	37.84424
543	294 849	23.30236	73.68853	160 103 007	8.158 305	17.57654	37.86750
544	295 936	23.32381	73.75636	160 989 184	8.163 310	17.58732	37.89073
545	297 025	23.34524	73.82412	161 878 625	8.168 309	17.59809	37.91393
546	298 116	23.36664	73.89181	162 771 336	8.173 302	17.60885	37.93711
547	299 209	23.38803	73.95945	163 667 323	8.178 289	17.61959	37.96025
548	300 304	23.40940	74.02702	164 566 592	8.183 269	17.63032	37.98337
549	301 401	23.43075	74.09453	165 469 149	8.188 244	17.64104	38.00646
550	302 500	23.45208	74.16198	166 375 000	8.193 213	17.65174	38.02952

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
550	302 500	23.45208	74.16198	166 375 000	8.193 213	17.65174	38.02952
551	303 601	23.47339	74.22937	167 284 151	8.198 175	17.66243	38.05256
552	304 704	23.49468	74.29670	168 196 608	8.203 132	17.67311	38.07557
553	305 809	23.51595	74.36397	169 112 377	8.208 082	17.68378	38.09854
554	306 916	23.53720	74.43118	170 031 464	8.213 027	17.69443	38.12149
555	308 025	23.55844	74.49832	170 953 875	8.217 966	17.70507	38.14442
556	309 136	23.57965	74.56541	171 879 616	8.222 899	17.71570	38.16731
557	310 249	23.60085	74.63243	172 808 693	8.227 825	17.72631	38.19018
558	311 364	23.62202	74.69940	173 741 112	8.232 746	17.73691	38.21302
559	312 481	23.64318	74.76630	174 676 879	8.237 661	17.74750	38.23584
560	313 600	23.66432	74.83315	175 616 000	8.242 571	17.75808	38.25862
561	314 721	23.68544	74.89993	176 558 481	8.247 474	17.76864	38.28138
562	315 844	23.70654	74.96666	177 504 328	8.252 372	17.77920	38.30412
563	316 969	23.72762	75.03333	178 453 547	8.257 263	17.78973	38.32682
564	318 096	23.74868	75.09993	179 406 144	8.262 149	17.80026	38.34950
565	319 225	23.76973	75.16648	180 362 125	8.267 029	17.81077	38.37215
566	320 356	23.79075	75.23297	181 321 496	8.271 904	17.82128	38.39478
567	321 489	23.81176	75.29940	182 284 263	8.276 773	17.83177	38.41737
568	322 624	23.83275	75.36577	183 250 432	8.281 635	17.84224	38.43995
569	323 761	23.85372	75.43209	184 220 009	8.286 493	17.85271	38.46249
570	324 900	23.87467	75.49834	185 193 000	8.291 344	17.86316	38.48501
571	326 041	23.89561	75.56454	186 169 411	8.296 190	17.87360	38.50750
572	327 184	23.91652	75.63068	187 149 248	8.301 031	17.88403	38.52997
573	328 329	23.93742	75.69676	188 132 517	8.305 865	17.89444	38.55241
574	329 476	23.95830	75.76279	189 119 224	8.310 694	17.90485	38.57482
575	330 625	23.97916	75.82875	190 109 375	8.315 517	17.91524	38.59721
576	331 776	24.00000	75.89466	191 102 976	8.320 335	17.92562	38.61958
577	332 929	24.02082	75.96052	192 100 033	8.325 148	17.93599	38.64191
578	334 084	24.04163	76.02631	193 100 552	8.329 954	17.94634	38.66422
579	335 241	24.06242	76.09205	194 104 539	8.334 755	17.95669	38.68651
580	336 400	24.08319	76.15773	195 112 000	8.339 551	17.96702	38.70877
581	337 561	24.10394	76.22336	196 122 941	8.344 341	17.97734	38.73100
582	338 724	24.12468	76.28892	197 137 368	8.349 126	17.98765	38.75321
583	339 889	24.14539	76.35444	198 155 287	8.353 905	17.99794	38.77539
584	341 056	24.16609	76.41989	199 176 704	8.358 678	18.00823	38.79755
585	342 225	24.18677	76.48529	200 201 625	8.363 447	18.01850	38.81968
586	343 396	24.20744	76.55064	201 230 056	8.368 209	18.02876	38.84179
587	344 569	24.22808	76.61593	202 262 003	8.372 967	18.03901	38.86387
588	345 744	24.24871	76.68116	203 297 472	8.377 719	18.04925	38.88593
589	346 921	24.26932	76.74634	204 336 469	8.382 465	18.05947	38.90796
590	348 100	24.28992	76.81146	205 379 000	8.387 207	18.06969	38.92996
591	349 281	24.31049	76.87652	206 425 071	8.391 942	18.07989	38.95195
592	350 464	24.33105	76.94154	207 474 688	8.396 673	18.09008	38.97390
593	351 649	24.35159	77.00649	208 527 857	8.401 398	18.10026	38.99584
594	352 836	24.37212	77.07140	209 584 584	8.406 118	18.11043	39.01774
595	354 025	24.39262	77.13624	210 644 875	8.410 833	18.12059	39.03963
596	355 216	24.41311	77.20104	211 708 736	8.415 542	18.13074	39.06149
597	356 409	24.43358	77.26578	212 776 173	8.420 246	18.14087	39.08332
598	357 604	24.45404	77.33046	213 847 192	8.424 945	18.15099	39.10513
599	358 801	24.47448	77.39509	214 921 799	8.429 638	18 16111	39.12692
600	360 000	24.49490	77.45967	216 000 000	8.434 327	18.17121	39.14868

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
600	360 000	24.49490	77.45967	216 000 000	8.434 327	18.17121	39.14868
601	361 201	24.51530	77.52419	217 081 801	8.439 010	18.18130	39.17041
602	362 404	24.53569	77.58866	218 167 208	8.443 688	18.19137	39.19213
603	363 609	24.55606	77.65307	219 256 227	8.448 361	18.20144	39.21382
604	364 816	24.57641	77.71744	220 348 864	8.453 028	18.21150	39.23548
605	366 025	24.59675	77.78175	221 445 125	8.457 691	18.22154	39.25712
606	367 236	24.61707	77.84600	222 545 016	8.462 348	18.23158	39.27874
607	368 449	24.63737	77.91020	223 648 543	8.467 000	18.24160	39.30033
608	369 664	24.65766	77.97435	224 755 712	8.471 647	18.25161	39.32190
609	370 881	24.67793	78.03845	225 866 529	8.476 289	18.26161	39.34345
610	372 100	24.69818	78.10250	226 981 000	8.480 926	18.27160	39.36497
611	373 321	24.71841	78.16649	228 099 131	8.485 558	18.28158	39.38647
612	374 544	24.73863	78.23043	229 220 928	8.490 185	18.29155	39.40795
613	375 769	24.75884	78.29432	230 346 397	8.494 807	18.30151	39.42940
614	376 996	24.77902	78.35815	231 475 544	8.499 423	18.31145	39.45083
615	378 225	24.79919	78.42194	232 608 375	8 504 035	18.32139	39.47223
616	379 456	24.81935	78.48567	233 744 896	8.508 642	18.33131	39.49362
617	380 689	24.83948	78.54935	234 885 113	8.513 243	18.34123	39.51498
618	381 924	24.85961	78.61298	236 029 032	8.517 840	18.35113	39.53631
619	383 161	24.87971	78.67655	237 176 659	8.522 432	18.36102	39.55763
620	384 400	24.89980	78.74008	238 328 000	8.527 019	18.37091	39.57892
621	385 641	24.91987	78.80355	239 483 061	8.531 601	18.38078	39.60018
622	386 884	24.93993	78.86698	240 641 848	8.536 178	18.39064	39.62143
623	388 129	24.95997	78.93035	241 804 367	8.540 750	18.40049	39.64265
624	389 376	24.97999	78.99367	242 970 624	8.545 317	18.41033	39.66385
625	390 625	25.00000	79.05694	244 140 625	8.549 880	18.42016	39.68503
626	391 876	25.01999	79.12016	245 314 376	8.554 437	18.42998	39.70618
627	393 129	25.03997	79.18333	246 491 883	8.558 990	18.43978	39.72731
628	394 384	25.05993	79.24645	247 673 152	8.563 538	18.44958	39.74842
629	395 641	25.07987	79.30952	248 858 189	8.568 081	18.45937	39.76951
630	396 900	25.09980	79.37254	250 047 000	8.572 619	18.46915	39.79057
631	398 161	25.11971	79.43551	251 239 591	8.577 152	18.47891	39.81161
632	399 424	25.13961	79.49843	252 435 968	8.581 681	18.48867	39.83263
633	400 689	25.15949	79.56130	253 636 137	8.586 205	18.49842	39.85363
634	401 956	25.17936	79.62412	254 840 104	8.590 724	18.50815	39.87461
635	403 225	25.19921	79.68689	256 047 875	8.595 238	18.51788	39.89556
636	404 496	25.21904	79.74961	257 259 456	8.599 748	18.52759	39.91649
637	405 769	25.23886	79.81228	258 474 853	8.604 252	18.53730	39.93740
638	407 044	25.25866	79.87490	259 694 072	8.608 753	18.54700	39.95829
639	408 321	25.27845	79.93748	260 917 119	8.613 248	18.55668	39.97916
640	409 600	25.29822	80.00000	262 144 000	8.617 739	18.56636	40.00000
641	410 881	25.31798	80.06248	263 374 721	8.622 225	18.57602	40.02082
642	412 164	25.33772	80.12490	264 609 288	8.626 706	18.58568	40.04162
643	413 449	25.35744	80.18728	265 847 707	8.631 183	18.59532	40.06240
644	414 736	25.37716	80.24961	267 089 984	8.635 655	18.60495	40.08316
645	416 025	25.39685	80.31189	268 336 125	8.640 123	18.61458	40.10390
646	417 316	25.41653	80.37413	269 586 136	8.644 585	18.62419	40.12461
647	418 609	25.43619	80.43631	270 840 023	8.649 044	18.63380	40.14530
648	419 904	25.45584	80.49845	272 097 792	8.653 497	18.64340	40.16598
649	421 201	25.47548	80.56054	273 359 449	8.657 947	18.65298	40.18663
650	422 500	25.49510	80.62258	274 625 000	8.662 391	18.66256	40.20726

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
650	422 500	25.49510	80.62258	274 625 000	8.662 391	18.66256	40.20726
651	423 801	25.51470	80.68457	275 894 451	8.666 831	18.67212	40.22787
652	425 104	25.53429	80.74652	277 167 808	8.671 266	18.68168	40.24845
653	426 409	25.55386	80.80842	278 445 077	8.675 697	18.69122	40.26902
654	427 716	25.57342	80.87027	279 726 264	8.680 124	18.70076	40.28957
655	429 025	25.59297	80.93207	281 011 375	8.684 546	18.71029	40.31009
656	430 336	25.61250	80.99383	282 300 416	8.688 963	18.71980	40.33059
657	431 649	25.63201	81.05554	283 593 393	8.693 376	18.72931	40.35108
658	432 964	25.65151	81.11720	284 890 312	8.697 784	18.73881	40.37154
659	434 281	25.67100	81.17881	286 191 179	8.702 188	18.74830	40.39198
660	435 600	25.69047	81.24038	287 496 000	8.706 588	18.75777	40.41240
661	436 921	25.70992	81.30191	288 804 781	8.710 983	18.76724	40.43280
662	438 244	25.72936	81.36338	290 117 528	8.715 373	18.77670	40.45318
663	439 569	25.74879	81.42481	291 434 247	8.719 760	18.78615	40.47354
664	440 896	25.76820	81.48620	292 754 944	8.724 141	18.79559	40.49388
665	442 225	25.78759	81.54753	294 079 625	8.728 519	18.80502	40.51420
666	443 556	25.80698	81.60882	295 408 296	8.732 892	18.81444	40.53449
667	444 889	25.82634	81.67007	296 740 963	8.737 260	13.82386	40.55477
668	446 224	25.84570	81.73127	298 077 632	8.741 625	18.83326	40.57503
669	447 561	25.86503	81.79242	299 418 309	8.745 985	18.84265	40.59526
670	448 900	25.88436	81.85353	300 763 000	8.750 340	18.85204	40.61548
671	450 241	25.90367	81.91459	302 111 711	8.754 691	18.86141	40.63568
672	451 584	25.92296	81.97561	303 464 448	8.759 038	18.87078	40.65585
673	452 929	25.94224	82.03658	304 821 217	8.763 381	18.88013	40.67601
674	454 276	25.96151	82.09750	306 182 024	8.767 719	18.88948	40.69615
675	455 625	25.98076	82.15838	307 546 875	8.772 053	18.89882	40.71626
676	456 976	26.00000	82.21922	308 915 776	8.776 383	18.90814	40.73636
677	458 329	26.01922	82.28001	310 288 733	8.780 708	18.91746	40.75644
678	459 684	26.03843	82.34076	311 665 752	8.785 030	18.92677	40.77650
679	461 041	26.05763	82.40146	313 046 839	8.789 347	18.93607	40.79653
680	462 400	26.07681	82.46211	314 432 000	8.793 659	18.94536	40.81655
681	463 761	26.09598	82.52272	315 821 241	8.797 968	18.95465	40.83655
682	465 124	26.11513	82.58329	317 214 568	8.802 272	18.96392	40.85653
683	466 489	26.13427	82.64381	318 611 987	8.806 572	18.97318	40.87649
684	467 856	26.15339	82.70429	320 013 504	8.810 868	18.98244	40.89643
685	469 225	26.17250	82.76473	321 419 125	8.815 160	18.99169	40.91635
686	470 596	26.19160	82.82512	322 828 856	8.819 447	19.00092	40.93625
687	471 969	26.21068	82.88546	324 242 703	8.823 731	19.01015	40.95613
688	473 344	26.22975	82.94577	325 660 672	8.828 010	19.01937	40.97599
689	474 721	26.24881	83.00602	327 082 769	8.832 285	19.02858	40.99584
690	476 100	26.26785	83.06624	328 509 000	8.836 556	19.03778	41.01566
691	477 481	26.28688	83.12641	329 939 371	8.840 823	19.04698	41.03546
692	478 864	26.30589	83.18654	331 373 888	8.845 085	19.05616	41.05525
693	480 249	26.32489	83.24662	332 812 557	8.849 344	19.06533	41.07502
694	481 636	26.34388	83.30666	334 255 384	8.853 599	19.07450	41.09476
695	483 025	26.36285	83.36666	335 702 375	8.857 849	19.08366	41.11449
696	484 416	26.38181	83.42661	337 153 536	8.862 095	19.09281	41.13420
697	485 809	26.40076	83.48653	338 608 873	8.866 338	19.10195	41.15389
698	487 204	26.41969	83.54639	340 068 392	8.870 576	19.11108	41.17357
699	488 601	26.43861	83.60622	341 532 099	8.874 810	19.12020	41.19322
700	490 000	26.45751	83.66600	343 000 000	8.879 040	19.12931	41.21285

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
700	490 000	26.45751	83.66600	343 000 000	8.879 040	19.12931	41.21285
701	491 401	26.47640	83.72574	344 472 101	8.883 266	19.13842	41.23247
702	492 804	26.49528	83.78544	345 948 408	8.887 488	19.14751	41.25207
703	494 209	26.51415	83.84510	347 428 927	8.891 706	19.15660	41.27164
704	495 616	26.53300	83.90471	348 913 664	8.895 920	19.16568	41.29120
705	497 025	26.55184	83.96428	350 402 625	8.900 130	19.17475	41.31075
706	498 436	26.57066	84.02381	351 895 816	8.904 337	19.18381	41.33027
707	499 849	26.58947	84.08329	353 393 243	8.908 539	19.19286	41.34977
708	501 264	26.60827	84.14274	354 894 912	8.912 737	19.20191	41.36926
709	502 681	26.62705	84.20214	356 400 829	8.916 931	19.21095	41.38873
710	504 100	26.64583	84.26150	357 911 000	8.921 121	19.21997	41.40818
711	505 521	26.66458	84.32082	359 425 431	8.925 308	19.22899	41.42761
712	506 944	26.68333	84.38009	360 944 128	8.929 490	19.23800	41.44702
713	508 369	26.70206	84.43933	362 467 097	8.933 669	19.24701	41.46642
714	509 796	26.72078	84.49852	363 994 344	8.937 843	19.25600	41.48579
715	511 225	26.73948	84.55767	365 525 875	8.942 014	19.26499	41.50515
716	512 656	26.75818	84.61678	367 061 696	8.946 181	19.27396	41.52449
717	514 089	26.77686	84.67585	368 601 813	8.950 344	19.28293	41.54382
718	515 524	26.79552	84.73488	370 146 232	8.954 503	19.29189	41.56312
719	516 961	26.81418	84.79387	371 694 959	8.958 658	19.30084	41.58241
720	518 400	26.83282	84.85281	373 248 000	8.962 809	19.30979	41.60168
721	519 841	26.85144	84.91172	374 805 361	8.966 957	19.31872	41.62093
722	521 284	26.87006	84.97058	376 367 048	8.971 101	19.32765	41.64016
723	522 729	26.88866	85.02941	377 933 067	8.975 241	19.33657	41.65938
724	524 176	26.90725	85.08819	379 503 424	8.979 377	19.34548	41.67857
725	525 625	26.92582	85.14693	381 078 125	8.983 509	19.35438	41.69775
726	527 076	26.94439	85.20563	382 657 176	8.987 637	19.36328	41.71692
727	528 529	26.96294	85.26429	384 240 583	8.991 762	19.37216	41.73606
728	529 984	26.98148	85.32292	385 828 352	8.995 883	19.38104	41.75519
729	531 441	27.00000	85.38150	387 420 489	9.000 000	19.38991	41.77430
730	532 900	27.01851	85.44004	389 017 000	9.004 113	19.39877	41.79339
731	534 361	27.03701	85.49854	390 617 891	9.008 223	19.40763	41.81247
732	535 824	27.05550	85.55700	392 223 168	9.012 329	19.41647	41.83152
733	537 289	27.07397	85.61542	393 832 837	9.016 431	19.42531	41.85056
734	538 756	27.09243	85.67380	395 446 904	9.020 529	19.43414	41.86959
735	540 225	27.11088	85.73214	397 065 375	9.024 624	19.44296	41.88859
736	541 696	27.12932	85.79044	398 688 256	9.028 715	19.45178	41.90758
737	543 169	27.14774	85.84870	400 315 553	9.032 802	19.46058	41.92655
738	544 644	27.16616	85.90693	401 947 272	9.036 886	19.46938	41.94551
739	546 121	27.18455	85.96511	403 583 419	9.040 966	19.47817	41.96444
740	547 600	27.20294	86.02325	405 224 000	9.045 042	19.48695	41.98336
741	549 081	27.22132	86.08136	406 869 021	9.049 114	19.49573	42.00227
742	550 564	27.23968	86.13942	408 518 488	9.053 183	19.50449	42.02115
743	552 049	27.25803	86.19745	410 172 407	9.057 248	19.51325	42.04002
744	553 536	27.27636	86.25543	411 830 784	9.061 310	19.52200	42.05887
745	555 025	27.29469	86.31338	413 493 625	9.065 368	19.53074	42.07771
746	556 516	27.31300	86.37129	415 160 936	9.069 422	19.53948	42.09653
747	558 009	27.33130	86.42916	416 832 723	9.073 473	19.54820	42.11533
748	559 504	27.34959	86.48699	418 508 992	9.077 520	19.55692	42.13411
749	561 001	27.36786	86.54479	420 189 749	9.081 563	19.56563	42.15288
750	562 500	27.38613	86.60254	421 875 000	9.085 603	19.57434	42.17163

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
750	562 500	27.38613	86.60254	421 875 000	9.085 603	19.57434	42.17163
751	564 001	27.40438	86.66026	423 564 751	9.089 639	19.58303	42.19037
752	565 504	27.42262	86.71793	425 259 008	9.093 672	19.59172	42.20909
753	567 009	27.44085	86.77557	426 957 777	9.097 701	19.60040	42 22779
754	568 516	27.45906	86.83317	428 661 064	9.101 727	19.60908	42.24647
755	570 025	27.47726	86.89074	430 368 875	9.105 748	19.61774	42.26514
756	571 536	27.49545	86.94826	432 081 216	9.109 767	19.62640	42.28379
757	573 049	27.51363	87.00575	433 798 093	9.113 782	19.63505	42.30243
758	574 564	27.53180	87.06320	435 519 512	9.117 793	19.64369	42.32105
759	576 081	27.54995	87.12061	437 245 479	9.121 801	19.65232	42.33965
760	577 600	27.56810	87.17798	438 976 000	9.125 805	19.66095	42.35824
761	579 121	27.58623	87.23531	440 711 081	9.129 806	19.66957	42.37681
762	580 644	27.60435	87.29261	442 450 728	9.133 803	19.67818	42.39536
763	582 169	27.62245	87.34987	444 194 947	9.137 797	19.68679	42.41390
764	583 696	27.64055	87.40709	445 943 744	9.141 787	19.69538	42.43242
765	585 225	27.65863	87.46428	447 697 125	9.145 774	19.70397	42.45092
766	586 756	27.67671	87.52143	449 455 096	9.149 758	19.71256	42.46941
767	588 289	27.69476	87.57854	451 217 663	9.153 738	19.72113	42.48789
768	589 824	27.71281	87.63561	452 984 832	9.157 714	19.72970	42.50634
769	591 361	27.73085	87.69265	454 756 609	9.161 687	19.73826	42.52478
770	592 900	27.74887	87.74964	456 533 000	9.165 656	19.74681	42.54321
771	594 441	27.76689	87.80661	458 314 011	9.169 623	19.75535	42.56162
772	595 984	27.78489	87.86353	460 099 648	9.173 585	19.76389	42.58001
773	597 529	27.80288	87.92042	461 889 917	9.177 544	19.77242	42.59839
774	599 076	27.82086	87.97727	463 684 824	9.181 500	19.78094	42.61675
775	600 625	27.83882	88.03408	465 484 375	9.185 453	19.78946	42.63509
776	602 176	27.85678	88.09086	467 288 576	9.189 402	19.79797	42.65342
777	603 729	27.87472	88.14760	469 097 433	9.193 347	19.80647	42.67174
778	605 284	27.89265	88.20431	470 910 952	9.197 290	19.81496	42.69004
779	606 841	27.91057	88.26098	472 729 139	9.201 229	19.82345	42.70832
780	608 400	27.92848	88.31761	474 552 000	9.205 164	19.83192	42.72659
781	609 961	27.94638	88.37420	476 379 541	9.209 096	19.84040	42.74484
782	611 524	27.96426	88.43076	478 211 768	9.213 025	19.84886	42.76307
783	613 089	27.98214	88.48729	480 048 687	9.216 950	19.85732	42.78129
784	614 656	28.00000	88.54377	481 890 304	9.220 873	19.86577	42.79950
785	616 225	28.01785	88.60023	483 736 625	9.224 791	19.87421	42.81769
786	617 796	28.03569	88.65664	485 587 656	9.228 707	19.88265	42.83586
787	619 369	28.05352	88.71302	487 443 403	9.232 619	19.89107	42.85402
788	620 944	28.07134	88.76936	489 303 872	9.236 528	19.89950	42.87216
789	622 521	28.08914	88.82567	491 169 069	9.240 433	19.90791	42.89029
790	624 100	28.10694	88.88194	493 039 000	9.244 335	19.91632	42.90840
791	625 681	28.12472	88.93818	494 913 671	9.248 234	19.92472	42.92650
792	627 264	28.14249	88.99438	496 793 088	9.252 130	19.93311	42.94458
793	628 849	28.16026	89.05055	498 677 257	9.256 022	19.94150	42.96265
794	630 436	28.17801	89.10668	500 566 184	9.259 911	19.94987	42.98070
795	632 025	28.19574	89.16277	502 459 875	9.263 797	19.95825	42.99874
796	633 616	28.21347	89.21883	504 358 336	9.267 680	19.96661	43.01676
797	635 209	28.23119	89.27486	506 261 573	9.271 559	19.97497	43.03477
798	636 804	28.24889	89.33085	508 169 592	9.275 435	19.98332	43.05276
799	638 401	28.26659	89.38680	510 082 399	9.279 308	19.99166	43.07073
800	640 000	28.28427	89.44272	512 000 000	9.283 178	20.00000	43.08869

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
800	640 000	28.28427	89.44272	512 000 000	9.283 178	20.00000	43.08869
801	641 601	28.30194	89.49860	513 922 401	9.287 044	20.00833	43.10664
802	643 204	28.31960	89.55445	515 849 608	9.290 907	20.01665	43.12457
803	644 809	28.33725	89.61027	517 781 627	9.294 767	20.02497	43.14249
804	646 416	28.35489	89.66605	519 718 464	9.298 624	20.03328	43.16039
805	648 025	28.37252	89.72179	521 660 125	9.302 477	20.04158	43.17828
806	649 636	28.39014	89.77750	523 606 616	9.306 328	20.04988	43.19615
807	651 249	28.40775	89.83318	525 557 943	9.310 175	20.05816	43.21400
808	652 864	28.42534	89.88882	527 514 112	9.314 019	20.06645	43.23185
809	654 481	28.44293	89.94443	529 475 129	9.317 860	20.07472	43.24967
810	656 100	28.46050	90.00000	531 441 000	9.321 698	20.08299	43.26749
811	657 721	28.47806	90.05554	533 411 731	9.325 532	20.09125	43.28529
812	659 344	28.49561	90.11104	535 387 328	9.329 363	20.09950	43.30307
813	660 969	28.51315	90.16651	537 367 797	9.333 192	20.10775	43.32084
814	662 596	28.53069	90.22195	539 353 144	9.337 017	20.11599	43.33859
815	664 225	28.54820	90.27735	541 343 375	9.340 839	20.12423	43.35633
816	665 856	28.56571	90.33272	543 338 496	9.344 657	20.13245	43.37406
817	667 489	28.58321	90.38805	545 338 513	9.348 473	20.14067	43.39177
818	669 124	28.60070	90.44335	547 343 432	9.352 286	20.14889	43.40947
819	670 761	28.61818	90.49862	549 353 259	9.356 095	20.15710	43.42715
820	672 400	28.63564	90.55385	551 368 000	9.359 902	20.16530	43.44481
821	674 041	28.65310	90.60905	553 387 661	9.363 705	20.17349	43.46247
822	675 684	28.67054	90.36422	555 412 248	9.367 505	20.18168	43.48011
823	677 329	28.68798	90.71935	557 441 767	9.371 302	20.18986	43.49773
824	678 976	28.70540	90.77445	559 476 224	9.375 096	20.19803	43.51534
825	680 625	28.72281	90.82951	561 515 625	9.378 887	20.20620	43.53294
826	682 276	28.74022	90.88454	563 559 976	9.382 675	20.21436	43.55052
827	683 929	28.75761	90.93954	565 609 283	9.386 460	20.22252	43.56809
828	685 584	28.77499	90.99451	567 663 552	9.390 242	20.23066	43.58564
829	687 241	28.79236	91.04944	569 722 789	9.394 021	20.23880	43.60318
830	688 900	28.80972	91.10434	571 787 000	9.397 796	20.24694	43.62071
831	690 561	28.82707	91.15920	573 856 191	9.401 569	20.25507	43.63822
832	692 224	28.84441	91.21403	575 930 368	9.405 339	20.26319	43.65572
833	693 889	28.86174	91.26883	578 009 537	9.409 105	20.27130	43.67320
834	695 556	28.87906	91.32360	580 093 704	9.412 869	20.27941	43.69067
835	697 225	28.89637	91.37833	582 182 875	9.416 630	20.28751	43.70812
836	698 896	28.91366	91.43304	584 277 056	9.420 387	20.29561	43.72556
837	700 569	28.93095	91.48770	586 376 253	9.424 142	20.30370	43.74299
838	702 244	28.94823	91.54234	588 480 472	9.427 894	20.31178	43.76041
839	703 921	28.96550	91.59694	590 589 719	9.431 642	20.31986	43.77781
840	705 600	28.98275	91.65151	592 704 000	9.435 388	20.32793	43.79519
841	707 281	29.00000	91.70605	594 823 321	9.439 131	20.33599	43.81256
842	708 964	29.01724	91.76056	596 947 688	9.442 870	20.34405	43.82992
843	710 649	29.03446	91.81503	599 077 107	9.446 607	20.35210	43.84727
844	712 336	29.05168	91.86947	601 211 584	9.450 341	20.36014	43.86460
845	714 025	29.06888	91.92388	603 351 125	9.454 072	20.36818	43.88191
846	715 716	29.08608	91.97826	605 495 736	9.457 800	20.37621	43.89922
847	717 409	29.10326	92.03260	607 645 423	9.461 525	20.38424	43.91651
848	719 104	29.12044	92.08692	609 800 192	9.465 247	20.39226	43.93378
849	720 801	29.13760	92.14120	611 960 049	9.468 966	20.40027	43.95105
850	722 500	29.15476	92.19544	614 125 000	9.472 682	20.40828	43.96830

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
850	722 500	29.15476	92.19544	614 125 000	9.472 682	20.40828	43.96830
851	724 201	29.17190	92.24966	616 295 051	9.476 396	20.41628	43.98553
852	725 904	29.18904	92.30385	618 470 208	9.480 106	20.42427	44.00275
853	727 609	29.20616	92.35800	620 650 477	9.483 814	20.43226	44.01996
854	729 316	29.22328	92.41212	622 835 864	9.487 518	20.44024	44.03716
855	731 025	29.24038	92.46621	625 026 375	9.491 220	20.44821	44.05434
856	732 736	29.25748	92.52027	627 222 016	9.494 919	20.45618	44.07151
857	734 449	29.27456	92.57429	629 422 793	9.498 615	20.46415	44.08866
858	736 164	29.29164	92.62829	631 628 712	9.502 308	20.47210	44.10581
859	737 881	29.30870	92.68225	633 839 779	9.505 998	20.48005	44.12293
860	739 600	29.32576	92.73618	636 056 000	9.509 685	20.48800	44.14005
861	741 321	29.34280	92.79009	638 277 381	9.513 370	20.49593	44.15715
862	743 044	29.35984	92.84396	640 503 928	9.517 052	20.50387	44.17424
863	744 769	29.37686	92.89779	642 735 647	9.520 730	20.51179	44.19132
864	746 496	29.39388	92.95160	644 972 544	9.524 406	20.51971	44.20838
865	748 225	29.41088	93.00538	647 214 625	9.528 079	20.52762	44.22543
866	749 956	29.42788	93.05912	649 461 896	9.531 750	20.53553	44.24246
867	751 689	29.44486	93.11283	651 714 363	9.535 417	20.54343	44.25949
868	753 424	29.46184	93.16652	653 972 032	9.539 082	20.55133	44.27650
869	755 161	29.47881	93.22017	656 234 909	9.542 744	20.55922	44.29349
870	756 900	29.49576	93.27379	658 503 000	9.546 403	20.56710	44.31048
871	758 641	29.51271	93.32738	660 776 311	9.550 059	20.57498	44.32745
872	760 384	29.52965	93.38094	663 054 848	9.553 712	20.58285	44.34440
873	762 129	29.54657	93.43447	665 338 617	9.557 363	20.59071	44.36135
874	763 876	29.56349	93.48797	667 627 624	9.561 011	20.59857	44.37828
875	765 625	29.58040	93.54143	669 921 875	9.564 656	20.60643	44.39520
876	767 376	29.59730	93.59487	672 221 376	9.568 298	20.61427	44.41211
877	769 129	29.61419	93.64828	674 526 133	9.571 938	20.62211	44.42900
878	770 884	29.63106	93.70165	676 836 152	9.575 574	20.62995	44.44588
879	772 641	29.64793	93.75500	679 151 439	9.579 208	20.63778	44.46275
880	774 400	29.66479	93.80832	681 472 000	9.582 840	20.64560	44.47960
881	776 161	29.68164	93.86160	683 797 841	9.586 468	20.65342	44.49644
882	777 924	29.69848	93.91486	686 128 968	9.590 094	20.66123	44.51327
883	779 689	29.71532	93.96808	688 465 387	9.593 717	20.66904	44.53009
884	781 456	29.73214	94.02127	690 807 104	9.597 337	20.67684	44.54689
885	783 225	29.74895	94.07444	693 154 125	9.600 955	20.68463	44.56368
886	784 996	29.76575	94.12757	695 506 456	9.604 570	20.69242	44.58046
887	786 769	29.78255	94.18068	697 864 103	9.608 182	20.70020	44.59723
888	788 544	29.79933	94.23375	700 227 072	9.611 791	20.70798	44.61398
889	790 321	29.81610	94.28680	702 595 369	9.615 398	20.71575	44.63072
890	792 100	29.83287	94.33981	704 969 000	9.619 002	20.72351	44.64745
891	793 881	29.84962	94.39280	707 347 971	9.622 603	20.73127	44.66417
892	795 664	29.86637	94.44575	709 732 288	9.626 202	20.73902	44.68087
893	797 449	29.88311	94.49868	712 121 957	9.629 797	20.74677	44.69756
894	799 236	29.89983	94.55157	714 516 984	9.633 391	20.75451	44.71424
895	801 025	29.91655	94.60444	716 917 375	9.636 981	20.76225	44.73090
896	802 816	29.93326	94.65728	719 323 136	9.640 569	20.76998	44.74756
897	804 609	29.94996	94.71008	721 734 273	9.644 154	20.77770	44.76420
898	806 404	29.96665	94.76286	724 150 792	9.647 737	20.78542	44.78083
899	808 201	29.98333	94.81561	726 572 699	9.651 317	20.79313	44.79744
900	810 000	30.00000	94.86833	729 000 000	9.654 894	20.80084	44.81405

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
900	810 000	30.00000	94.86833	729 000 000	9.654 894	20.80084	44.81405
901	811 801	30.01666	94.92102	731 432 701	9.658 468	20.80854	44.83064
902	813 604	30.03331	94.97368	733 870 808	9.662 040	20.81623	44.84722
903	815 409	30.04996	95.02631	736 314 327	9.665 610	20.82392	44.86379
904	817 216	30.06659	95.07891	738 763 264	9.669 176	20.83161	44.88034
905	819 025	30.08322	95.13149	741 217 625	9.672 740	20.83929	44.89688
906	820 836	30.09983	95.18403	743 677 416	9.676 302	20.84696	44.91341
907	822 649	30.11644	95.23655	746 142 643	9.679 860	20.85463	44.92993
908	824 464	30.13304	95.28903	748 613 312	9.683 417	20.86229	44.94644
909	826 281	30.14963	95.34149	751 089 429	9.686 970	20.86994	44.96293
910	828 100	30.16621	95.39392	753 571 000	9.690 521	20.87759	44.97941
911	829 921	30.18278	95.44632	756 058 031	9.694 069	20.88524	44.99588
912	831 744	30.19934	95.49869	758 550 528	9.697 615	20.89288	45.01234
913	833 569	30.21589	95.55103	761 048 497	9.701 158	20.90051	45.02879
914	835 396	30.23243	95.60335	763 551 944	9.704 699	20.90814	45.04522
915	837 225	30.24897	95.65563	766 060 875	9.708 237	20.91576	45.06164
916	839 056	30.26549	95.70789	768 575 296	9.711 772	20.92338	45.07805
917	840 889	30.28201	95.76012	771 095 213	9.715 305	20.93099	45.09445
918	842 724	30.29851	95.81232	773 620 632	9.718 835	20.93860	45 11084
919	844 561	30.31501	95.86449	776 151 559	9.722 363	20.94620	45.12721
920	846 400	30.33150	95.91663	778 688 000	9.725 888	20.95379	45.14357
921	848 241	30.34798	95.96874	781 229 961	9.729 411	20.96138	45.15992
922	850 084	30.36445	96.02083	783 777 448	9.732 931	20.96896	45.17626
923	851 929	30.38092	96.07289	786 330 467	9.736 448	20.97654	45.19259
924	853 776	30.39737	96.12492	788 889 024	9.739 963	20.98411	45.20891
925	855 625	30.41381	96.17692	791 453 125	9.743 476	20.99168	45.22521
926	857 476	30.43025	96.22889	794 022 776	9.746 986	20.99924	45.24150
927	859 329	30.44667	96.28084	796 597 983	9.750 493	21.00680	45.25778
928	861 184	30.46309	96.33276	799 178 752	9.753 998	21.01435	45.27405
929	863 041	30.47950	96.38465	801 765 089	9.757 500	21.02190	45.29030
930	864 900	30.49590	96.43651	804 357 000	9.761 000	21.02944	45.30655
931	866 761	30.51229	96.48834	806 954 491	9.764 497	21.03697	45.32278
932	868 324	30.52868	96.54015	809 557 568	9.767 992	21.04450	45.33900
933	870 489	30.54505	96.59193	812 166 237	9.771 485	21.05203	45.35521
934	872 356	30.56141	96.64368	814 780 504	9.774 974	21.05954	45.37141
935	874 225	30.57777	96.69540	817 400 375	9.778 462	21.06706	45.38760
936	876 096	30.59412	96.74709	820 025 856	9.781 946	21.07456	45.40377
937	877 969	30.61046	96.79876	822 656 953	9.785 429	21.08207	45.41994
938	879 844	30.62679	96.85040	825 293 672	9.788 909	21.08956	45.43609
939	881 721	30.64311	96.90201	827 936 019	9.792 386	21.09706	45.45223
940	883 600	30.65942	96.95360	830 584 000	9.795 861	21.10454	45.46836
941	885 481	30.67572	97.00515	833 237 621	9.799 334	21.11202	45.48448
942	887 364	30.69202	97.05668	835 896 888	9.802 804	21.11950	45.50058
943	889 249	30.70831	97.10819	838 561 807	9.806 271	21.12697	45.51668
944	891 136	30.72458	97.15966	841 232 384	9.809 736	21.13444	45.53276
945	893 025	30.74085	97.21111	843 908 625	9.813 199	21.14190	45.54883
946	894 916	30.75711	97 26253	846 590 536	9.816 659	21.14935	45.56490
947	896 809	30.77337	97.31393	849 278 123	9.820 117	21.15680	45.58095
948	898 704	30.78961	97.36529	851 971 392	9.823 572	21.16424	45.59698
949	900 601	30.80584	97.41663	854 670 349	9.827 025	21.17168	45.61301
950	902 500	30.82207	97.46794	857 375 000	9.830 476	21.17912	45.62903

SQUARES, CUBES AND ROOTS (Continued)

n	n^2	$\sqrt{n}$	$\sqrt{10n}$	n^3	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
950	902 500	30.82207	97.46794	857 375 000	9.830 476	21.17912	45.62903
951	904 401	30.83829	97.51923	860 085 351	9.833 924	21.18655	45.64503
952	906 304	30.85450	97.57049	862 801 408	9.837 369	21.19397	45.66102
953	908 209	30.87070	97.62172	865 523 177	9.840 813	21.20139	45.67701
954	910 116	30.88689	97.67292	868 250 664	9.844 254	21.20880	45.69298
955	912 025	30.90307	97.72410	870 983 875	9.847 692	21.21621	45.70894
956	913 936	30.91925	97.77525	873 722 816	9.851 128	21.22361	45.72489
957	915 849	30.93542	97.82638	876 467 493	9.854 562	21.23101	45.74082
958	917 764	30.95158	97.87747	879 217 912	9.857 993	21.23840	45.75675
959	919 681	30.96773	97.92855	881 974 079	9.861 422	21.24579	45.77267
960	921 600	30.98387	97.97959	884 736 000	9.864 848	21.25317	45.78857
961	923 521	31.00000	98.03061	887 503 681	9.868 272	21.26055	45.80446
962	925 444	31.01612	98.08160	890 277 128	9.871 694	21.26792	45.82035
963	927 369	31.03224	98.13256	893 056 347	9.875 113	21.27529	45.83622
964	929 296	31.04835	98.18350	895 841 344	9.878 530	21.28265	45.85208
965	931 225	31.06445	98.23441	898 632 125	9.881 945	21.29001	45.86793
966	933 156	31.08054	98.28530	901 428 696	9.885 357	21.29736	45.88376
967	935 089	31.09662	98.33616	904 231 063	9.888 767	21.30470	45.89959
968	937 024	31.11270	98.38699	907 039 232	9.892 175	21.31204	45.91541
969	938 961	31.12876	98.43780	909 853 209	9.895 580	21.31938	45.93121
970	940 900	31.14482	98.48858	912 673 000	9.898 983	21.32671	45.94701
971	942 841	31.16087	98.53933	915 498 611	9.902 384	21.33404	45.96279
972	944 784	31.17691	98.59006	918 330 048	9.905 782	21.34136	45.97857
973	946 729	31.19295	98.64076	921 167 317	9.909 178	21.34868	45.99433
974	948 676	31.20897	98.69144	924 010 424	9.912 571	21.35599	46.01008
975	950 625	31.22499	98.74209	926 859 375	9.915 962	21.36329	46.02582
976	952 576	31.24100	98.79271	929 714 176	9.919 351	21.37059	46.04155
977	954 529	31.25700	98.84331	932 574 833	9.922 738	21.37789	46.05727
978	956 484	31.27299	98.89388	935 441 352	9.926 122	21.38518	46.07298
979	958 441	31.28898	98.94443	938 313 739	9.929 504	21.39247	46.08868
980	960 400	31.30495	98.99495	941 192 000	9.932 884	21.39975	46.10436
981	962 361	31.32092	99.04544	944 076 141	9.936 261	21.40703	46.12004
982	964 324	31.33688	99.09591	946 966 168	9.939 636	21.41430	46.13571
983	966 289	31.35283	99.14636	949 862 087	9.943 009	21.42156	46.15136
984	968 256	31.36877	99.19677	952 763 904	9.946 380	21.42883	46.16700
985	970 225	31.38471	99.24717	955 671 625	9.949 748	21.43608	46.18264
986	972 196	31.40064	99.29753	958 585 256	9.953 114	21.44333	46.19826
987	974 169	31.41656	99.34787	961 504 803	9.956 478	21.45058	46.21387
988	976 144	31.43247	99.39819	964 430 272	9.959 839	21.45782	46.22948
989	978 121	31.44837	99.44848	967 361 669	9.963 198	21.46506	46.24507
990	980 100	31.46427	99.49874	970 299 000	9.966 555	21.47229	46.26065
991	982 081	31.48015	99.54898	973 242 271	9.969 910	21.47952	46.27622
992	984 064	31.49603	99.59920	976 191 488	9.973 262	21.48674	46.29178
993	986 049	31.51190	99.64939	979 146 657	9.976 612	21.49396	46.30733
994	988 036	31.52777	99.69955	982 107 784	9.979 960	21.50117	46.32287
995	990 025	31.54362	99.74969	985 074 875	9.983 305	21.50838	46.33840
996	992 016	31.55947	99.79980	988 047 936	9.986 649	21.51558	46.35392
997	994 009	31.57531	99.84989	991 026 973	9.989 990	21.52278	46.36943
998	996 004	31.59114	99.89995	994 011 992	9.993 329	21.52997	46.38492
999	998 001	31.60696	99.94999	997 002 999	9.996 666	21.53716	46.40041
1000	1 000 000	31.62278	100.00000	1 000 000 000	10.000 000	21.54435	46.41589

POWERS OF NUMBERS

n	n^4	n^5	n^6	n^7	n^8
1	1	1	1	1	1
2	16	32	64	128	256
3	81	243	729	2187	6561
4	256	1024	4096	16384	65536
5	625	3125	15625	78125	390625
6	1296	7776	46656	279936	1679616
7	2401	16807	117649	823543	5764801
8	4096	32768	262144	2097152	16777216
9	6561	59049	531441	4782969	43046721
					$\times 10^8$
10	10000	100000	1000000	10000000	1.000000
11	14641	161051	1771561	19487171	2.143589
12	20736	248832	2985984	35831808	4.299817
13	28561	371293	4826809	62748517	8.157307
14	38416	537824	7529536	105413504	14.757891
15	50625	759375	11390625	170859375	25.628906
16	65536	1048576	16777216	268435456	42.949673
17	83521	1419857	24137569	410338673	69.757574
18	104976	1889568	34012224	612220032	110.199606
19	130321	2476099	47045881	893871739	169.835630
				$\times 10^9$	$\times 10^{10}$
20	160000	3200000	64000000	1.280000	2.560000
21	194481	4084101	85766121	1.801089	3.782286
22	234256	5153632	113379904	2.494358	5.487587
23	279841	6436343	148035889	3.404825	7.831099
24	331776	7962624	191102976	4.586471	11.007531
25	390625	9765625	244140625	6.103516	15.258789
26	456976	11881376	308915776	8.031810	20.882706
27	531441	14348907	387420489	10.460353	28.242954
28	614656	17210368	481890304	13.492929	37.780200
29	707281	20511149	594823321	17.249876	50.024641
			$\times 10^8$	$\times 10^{10}$	$\times 10^{11}$
30	810000	24300000	7.290000	2.187000	6.561000
31	923521	28629151	8.875037	2.751261	8.528910
32	1048576	33554432	10.737418	3.435974	10.995116
33	1185921	39135393	12.914680	4.261844	14.064086
34	1336336	45435424	15.448044	5.252335	17.857939
35	1500625	52521875	18.382656	6.433930	22.518754
36	1679616	60466176	21.767823	7.836416	28.211099
37	1874161	69343957	25.657264	9.493188	35.124795
38	2085136	79235168	30.109364	11.441558	43.477921
39	2313441	90224199	35.187438	13.723101	53.520093
			$\times 10^9$	$\times 10^{10}$	$\times 10^{12}$
40	2560000	102400000	4.096000	16.384000	6.553600
41	2825761	115856201	4.750104	19.475427	7.984925
42	3111696	130691232	5.489032	23.053933	9.682652
43	3418801	147008443	6.321363	27.181861	11.688200
44	3748096	164916224	7.256314	31.927781	14.048224
45	4100625	184528125	8.303766	37.366945	16.815125
46	4477456	205962976	9.474297	43.581766	20.047612
47	4879681	229345007	10.779215	50.662312	23.811287
48	5308416	254803968	12.230590	58.706834	28.179280
49	5764801	282475249	13.841287	67.822307	33.232931
50	6250000	312500000	15.625000	78.125000	39.062500

POWERS OF NUMBERS (Continued)

n	n^4	n^5	n^6	n^7	n^8
			$\times 10^{9}$	$\times 10^{11}$	$\times 10^{13}$
50	6250000	312500000	15.625000	7.812500	3.906250
51	6765201	345025251	17.596288	8.974107	4.576794
52	7311616	380204032	19.770610	10.280717	5.345973
53	7890481	418195493	22.164361	11.747111	6.225969
54	8503056	459165024	24.794911	13.389252	7.230196
55	9150625	503284375	27.680641	15.224352	8.373394
56	9834496	550731776	30.840979	17.270948	9.671731
57	10556001	601692057	34.296447	19.548975	11.142916
58	11316496	656356768	38.068693	22.079842	12.806308
59	12117361	714924299	42.180534	24.886515	14.683044
		$\times 10^{8}$	$\times 10^{10}$	$\times 10^{11}$	$\times 10^{13}$
60	12960000	7.776000	4.665600	27.993600	16.796160
61	13845841	8.445963	5.152037	31.427428	19.170731
62	14776336	9.161328	5.680024	35.216146	21.834011
63	15752961	9.924365	6.252350	39.389806	24.815578
64	16777216	10.737418	6.871948	43.980465	28.147498
65	17850625	11.602906	7.541889	49.022279	31.864481
66	18974736	12.523326	8.265395	54.551607	36.004061
67	20151121	13.501251	9.045838	60.607116	40.606768
68	21381376	14.539336	9.886748	67.229888	45.716324
69	22667121	15.640313	10.791816	74.463533	51.379837
		$\times 10^{8}$	$\times 10^{10}$	$\times 10^{12}$	$\times 10^{14}$
70	24010000	16.807000	11.764900	8.235430	5.764801
71	25411681	18.042294	12.810028	9.095120	6.457535
72	26873856	19.349176	13.931407	10.030613	7.222041
73	28398241	20.730716	15.133423	11.047399	8.064601
74	29986576	22.190066	16.420649	12.151280	8.991947
75	31640625	23.730469	17.797852	13.348389	10.011292
76	33362176	25.355254	19.269993	14.645195	11.130348
77	35153041	27.067842	20.842238	16.048523	12.357363
78	37015056	28.871744	22.519960	17.565569	13.701144
79	38950081	30.770564	24.308746	19.203909	15.171088
		$\times 10^{8}$	$\times 10^{10}$	$\times 10^{12}$	$\times 10^{14}$
80	40960000	32.768000	26.214400	20.971520	16.777216
81	43046721	34.867844	28.242954	22.876792	18.530202
82	45212176	37.073984	30.400667	24.928547	20.441409
83	47458321	39.390406	32.694037	27.136051	22.522922
84	49787136	41.821194	35.129803	29.509035	24.787589
85	52200625	44.370531	37.714952	32.057709	27.249053
86	54700816	47.042702	40.456724	34.792782	29.921793
87	57289761	49.842092	43.362620	37.725479	32.821167
88	59969536	52.773192	46.440409	40.867560	35.963452
89	62742241	55.840594	49.698129	44.231335	39.365888
		$\times 10^{9}$	$\times 10^{11}$	$\times 10^{13}$	$\times 10^{15}$
90	65610000	5.904900	5.314410	4.782969	4.304672
91	68574961	6.240321	5.678693	5.167610	4.702525
92	71639296	6.590815	6.063550	5.578466	5.132189
93	74805201	6.956884	6.469902	6.017009	5.595818
94	78074896	7.339040	6.898698	6.484776	6.095689
95	81450625	7.737809	7.350919	6.983373	6.634204
96	84934656	8.153727	7.827578	7.514475	7.213896
97	88529281	8.587340	8.329720	8.079828	7.837434
98	92236816	9.039208	8.858424	8.681255	8.507630
99	96059601	9.509900	9.414801	9.320653	9.227447
100	100000000	10.000000	10.000000	10.000000	10.000000

POWERS OF TWO

n	2^n	n	2^n
1	2	41	21990 23255 552
2	4	42	43980 46511 104
3	8	43	87960 93022 208
4	16	44	17592 18604 4416
5	32	45	35184 37208 8832
6	64	46	70368 74417 7664
7	128	47	14073 74883 55328
8	256	48	28147 49767 10656
9	512	49	56294 99534 21312
10	1024	50	11258 99906 84262 4
11	2048	51	22517 99813 68524 8
12	4096	52	45035 99627 37049 6
13	8192	53	90071 99254 74099 2
14	16384	54	18014 39850 94819 84
15	32768	55	36028 79701 89639 68
16	65536	56	72057 59403 79279 36
17	13107 2	57	14411 51880 75855 872
18	26214 4	58	28823 03761 51711 744
19	52428 8	59	57646 07523 03423 488
20	10485 76	60	11529 21504 60684 6976
21	20971 52	61	23058 43009 21369 3952
22	41943 04	62	46116 86018 42738 7904
23	83886 08	63	92233 72036 85477 5808
24	16777 216	64	18446 74407 37095 51616
25	33554 432	65	36893 48814 74191 03232
26	67108 864	66	73786 97629 48382 06464
27	13421 7728	67	14757 39525 89676 41292 8
28	26843 5456	68	29514 79051 79352 82585 6
29	53687 0912	69	59029 58103 58705 65171 2
30	10737 41824	70	11805 91620 71741 13034 24
31	21474 83648	71	23611 83241 43482 26068 48
32	42949 67296	72	47223 66482 86964 52136 96
33	85899 34592	73	94447 32965 73929 04273 92
34	17179 86918 4	74	18889 46593 14785 80854 784
35	34359 73836 8	75	37778 93186 29571 61709 568
36	68719 47673 6	76	75557 86372 59143 23419 136
37	13743 89534 72	77	15111 57274 51828 64683 8272
38	27487 79069 44	78	30223 14549 03657 29367 6544
39	54975 58138 88	79	60446 29098 07314 58735 3088
40	10995 11627 776	80	12089 25819 61462 91747 06176

n	2^n
81	24178 51639 22925 83494 12352
82	48357 03278 45851 66988 24704
83	96714 06556 91703 33976 49408
84	19342 81311 38340 66795 29881 6
85	38685 62622 76681 33590 59763 2
86	77371 25245 53362 67181 19526 4
87	15474 25049 10672 53436 23905 28
88	30948 50098 21345 06872 47810 56
89	61897 00196 42690 13744 95621 12
90	12379 40039 28538 02748 99124 224
91	24758 80078 57076 05497 98248 448
92	49517 60157 14152 10995 96496 896
93	99035 20314 28304 21991 92993 792
94	19807 04062 85660 84398 38598 7584
95	39614 08125 71321 68796 77197 5168
96	79228 16251 42643 37593 54395 0336
97	15845 63250 28528 67518 70879 00672
98	31691 26500 57057 35037 41758 01344
99	63382 53001 14114 70074 83516 02688
100	12676 50600 22822 94014 96703 20537 6
101	25353 01200 45645 88029 93406 41075 2

FACTORIALS AND THEIR LOGARITHMS

n	$n!$	$\log n!$	n	$n!$	$\log n!$
			50	3.0414×10^{64}	64.48307
1	1.0000	0.00000	51	1.5511×10^{66}	66.19065
2	2.0000	0.30103	52	8.0658×10^{67}	67.90665
3	6.0000	0.77815	53	4.2749×10^{69}	69.63092
4	2.4000×10	1.38021	54	2.3084×10^{71}	71.36332
5	1.2000×10^{2}	2.07918	**55**	1.2696×10^{73}	73.10368
6	7.2000×10^{2}	2.85733	56	7.1100×10^{74}	74.85187
7	5.0400×10^{3}	3.70243	57	4.0527×10^{76}	76.60774
8	4.0320×10^{4}	4.60552	58	2.3506×10^{78}	78.37117
9	3.6288×10^{5}	5.55976	59	1.3868×10^{80}	80.14202
10	3.6288×10^{6}	6.55976	**60**	8.3210×10^{81}	81.92017
11	3.9917×10^{7}	7.60116	61	5.0758×10^{83}	83.70550
12	4.7900×10^{8}	8.68034	62	3.1470×10^{85}	85.49790
13	6.2270×10^{9}	9.79428	63	1.9826×10^{87}	87.29724
14	8.7178×10^{10}	10.94041	64	1.2689×10^{89}	89.10342
15	1.3077×10^{12}	12.11650	**65**	8.2477×10^{90}	90.91633
16	2.0923×10^{13}	13.32062	66	5.4435×10^{92}	92.73587
17	3.5569×10^{14}	14.55107	67	3.6471×10^{94}	94.56195
18	6.4024×10^{15}	15.80634	68	2.4800×10^{96}	96.39446
19	1.2165×10^{17}	17.08509	69	1.7112×10^{98}	98.23331
20	2.4329×10^{18}	18.38612	**70**	1.1979×10^{100}	100.07841
21	5.1091×10^{19}	19.70834	71	8.5048×10^{101}	101.92966
22	1.1240×10^{21}	21.05077	72	6.1234×10^{103}	103.78700
23	2.5852×10^{22}	22.41249	73	4.4701×10^{105}	105.65032
24	6.2045×10^{23}	23.79271	74	3.3079×10^{107}	107.51955
25	1.5511×10^{25}	25.19065	**75**	2.4809×10^{109}	109.39461
26	4.0329×10^{26}	26.60562	76	1.8855×10^{111}	111.27543
27	1.0889×10^{28}	28.03698	77	1.4518×10^{113}	113.16192
28	3.0489×10^{29}	29.48414	78	1.1324×10^{115}	115.05401
29	8.8418×10^{30}	30.94654	79	8.9462×10^{116}	116.95164
30	2.6525×10^{32}	32.42366	**80**	7.1569×10^{118}	118.85473
31	8.2228×10^{33}	33.91502	81	5.7971×10^{120}	120.76321
32	2.6313×10^{35}	35.42017	82	4.7536×10^{122}	122.67703
33	8.6833×10^{36}	36.93869	83	3.9455×10^{124}	124.59610
34	2.9523×10^{38}	38.47016	84	3.3142×10^{126}	126.52038
35	1.0333×10^{40}	40.01423	**85**	2.8171×10^{128}	128.44980
36	3.7199×10^{41}	41.57054	86	2.4227×10^{130}	130.38430
37	1.3764×10^{43}	43.13874	87	2.1078×10^{132}	132.32382
38	5.2302×10^{44}	44.71852	88	1.8548×10^{134}	134.26830
39	2.0398×10^{46}	46.30959	89	1.6508×10^{136}	136.21769
40	8.1592×10^{47}	47.91165	**90**	1.4857×10^{138}	138.17194
41	3.3453×10^{49}	49.52443	91	1.3520×10^{140}	140.13098
42	1.4050×10^{51}	51.14768	92	1.2438×10^{142}	142.09477
43	6.0415×10^{52}	52.78115	93	1.1568×10^{144}	144.06325
44	2.6583×10^{54}	54.42460	94	1.0874×10^{146}	146.03638
45	1.1962×10^{56}	56.07781	**95**	1.0330×10^{148}	148.01410
46	5.5026×10^{57}	57.74057	96	9.9168×10^{149}	149.99637
47	2.5862×10^{59}	59.41267	97	9.6193×10^{151}	151.98314
48	1.2414×10^{61}	61.09391	98	9.4269×10^{153}	153.97437
49	6.0828×10^{62}	62.78410	99	9.3326×10^{155}	155.97000
50	3.0414×10^{64}	64.48307	**100**	9.3326×10^{157}	157.97000

FACTORS FOR COMPUTING PROBABLE ERRORS

n	$\frac{1}{\sqrt{n}}$	$\frac{1}{\sqrt{n(n-1)}}$	$\frac{.6745}{\sqrt{n-1}}$	$\frac{.6745}{\sqrt{n(n-1)}}$	$\frac{.8453}{n\sqrt{n-1}}$	$\frac{.8453}{\sqrt{n(n-1)}}$
2	.707107	.707107	.6745	.4769	.4227	.5978
3	.577350	.408248	.4769	.2754	.1993	.3451
4	.500000	.288675	.3894	.1947	.1220	.2440
5	.447214	.223607	.3372	.1508	.0845	.1890
6	.408248	.182574	.3016	.1231	.0630	.1543
7	.377964	.154303	.2754	.1041	.0493	.1304
8	.353553	.133631	.2549	.0901	.0399	.1130
9	.333333	.117851	.2385	.0795	.0332	.0996
10	.316228	.105409	.2248	.0711	.0282	.0891
11	.301511	.095346	.2133	.0643	.0243	.0806
12	.288675	.087039	.2034	.0587	.0212	.0736
13	.277350	.080064	.1947	.0540	.0188	.0677
14	.267261	.074125	.1871	.0500	.0167	.0627
15	.258199	.069007	.1803	.0465	.0151	.0583
16	.250000	.064550	.1742	.0435	.0136	.0546
17	.242536	.060634	.1686	.0409	.0124	.0513
18	.235702	.057166	.1636	.0386	.0114	.0483
19	.229416	.054074	.1590	.0365	.0105	.0457
20	.223607	.051299	.1547	.0346	.0097	.0434
21	.218218	.048795	.1508	.0329	.0090	.0412
22	.213201	.046524	.1472	.0314	.0084	.0393
23	.208514	.044455	.1438	.0300	.0078	.0376
24	.204124	.042563	.1406	.0287	.0073	.0360
25	.200000	.040825	.1377	.0275	.0069	.0345
26	.196116	.039223	.1349	.0265	.0065	.0332
27	.192450	.037743	.1323	.0255	.0061	.0319
28	.188982	.036370	.1298	.0245	.0058	.0307
29	.185695	.035093	.1275	.0237	.0055	.0297
30	.182574	.033903	.1252	.0229	.0052	.0287
31	.179605	.032791	.1231	.0221	.0050	.0277
32	.176777	.031750	.1211	.0214	0047	.0268
33	.174078	.030773	.1192	.0208	.0045	.0260
34	.171499	.029854	.1174	.0201	.0043	.0252
35	.169031	.028989	.1157	.0196	.0041	.0245
36	.166667	.028172	.1140	.0190	.0040	.0238
37	.164399	.027400	.1124	.0185	.0038	.0232
38	.162221	.026669	.1109	.0180	.0037	.0225
39	.160128	.025976	.1094	.0175	.0035	.0220
40	.158114	.025318	.1080	.0171	.0034	.0214
41	.156174	.024693	.1066	.0167	.0033	.0209
42	.154303	.024098	.1053	.0163	.0031	.0204
43	.152499	.023531	.1041	.0159	.0030	.0199
44	.150756	.022990	.1029	.0155	.0029	.0194
45	.149071	.022473	.1017	.0152	.0028	.0190
46	.147442	.021979	.1005	.0148	.0027	.0186
47	.145865	.021507	.0994	.0145	.0027	.0182
48	.144338	.021054	.0984	.0142	.0026	.0178
49	.142857	.020620	.0974	.0139	.0025	.0174
50	.141421	.020203	.0964	.0136	.0024	.0171

FACTORS FOR COMPUTING PROBABLE ERRORS
(Continued)

n	$\frac{1}{\sqrt{n}}$	$\frac{1}{\sqrt{n(n-1)}}$	$\frac{.6745}{\sqrt{n-1}}$	$\frac{.6745}{\sqrt{n(n-1)}}$	$\frac{.8453}{n\sqrt{n-1}}$	$\frac{.8453}{\sqrt{n(n-1}}$
50	.141421	.020203	.0964	.0136	.0024	.0171
51	.140028	.019803	.0954	.0134	.0023	.0167
52	.138675	.019418	.0945	.0131	.0023	.0164
53	.137361	.019048	.0935	.0129	.0022	.0161
54	.136083	.018692	.0927	.0126	.0022	.0158
55	.134840	.018349	.0918	.0124	.0021	.0155
56	.133631	.018019	.0910	.0122	.0020	.0152
57	.132453	.017700	.0901	.0119	.0020	.0150
58	.131306	.017392	.0893	.0117	.0019	.0147
59	.130189	.017095	.0886	.0115	.0019	.0145
60	.129099	.016807	.0878	.0113	.0018	.0142
61	.128037	.016529	.0871	.0112	.0018	.0140
62	.127000	.016261	.0864	.0110	.0018	.0138
63	.125988	.016001	.0857	.0108	.0017	.0135
64	.125000	.015749	.0850	.0106	.0017	.0133
65	.124035	.015504	.0843	.0105	.0016	.0131
66	.123091	.015268	.0837	.0103	.0016	.0129
67	.122169	.015038	.0830	.0101	.0016	.0127
68	.121268	.014815	.0824	.0100	.0015	.0125
69	.120386	.014599	.0818	.0099	.0015	.0123
70	.119523	.014389	.0812	.0097	.0015	.0122
71	.118678	.014185	.0806	.0096	.0014	.0120
72	.117851	.013986	.0801	.0094	.0014	.0118
73	.117041	.013793	.0795	.0093	.0014	.0117
74	.116248	.013606	.0789	.0092	.0013	.0115
75	.115470	.013423	.0784	.0091	.0013	.0113
76	.114708	.013245	.0779	.0089	.0013	.0112
77	.113961	.013072	.0773	.0088	.0013	.0111
78	.113228	.012904	.0769	.0087	.0012	.0109
79	.112509	.012739	.0764	.0086	.0012	.0108
80	.111803	.012579	.0759	.0085	.0012	.0106
81	.111111	.012423	.0754	.0084	.0012	.0105
82	.110432	.012270	.0749	.0083	.0012	.0104
83	.109764	.012121	.0745	.0082	.0011	.0103
84	.109109	.011976	.0740	.0081	.0011	.0101
85	.108465	.011835	.0736	.0080	.0011	.0100
86	.107833	.011696	.0732	.0079	.0011	.0099
87	.107211	.011561	.0727	.0078	.0011	.0098
88	.106600	.011429	.0723	.0077	.0010	.0097
89	.106000	.011300	.0719	.0076	.0010	.0096
90	.105409	.011173	.0715	.0075	.0010	.0094
91	.104828	.011050	.0711	.0075	.0010	.0093
92	.104257	.010929	.0707	.0074	.0010	.0092
93	.103695	.010811	.0703	.0073	.0010	.0091
94	.103142	.010695	.0699	.0072	.0009	.0090
95	.102598	.010582	.0696	.0071	.0009	.0089
96	.102062	.010471	.0692	.0071	.0009	.0089
97	.101535	.010363	.0688	.0070	.0009	.0088
98	.101015	.010257	.0685	.0069	.0009	.0087
99	.100504	.010152	.0681	.0069	.0009	.0086
100	.100000	.010050	.0678	.0068	.0008	.0085

PROBABILITY OF OCCURRENCE OF DEVIATIONS

Valid for thirty or more samples.

Probability of occurrence, expressed as per cent, and odds against a deviation as great or greater than that designated is given for various ratios of the deviation to the probable error and to the standard deviation.

(From Pearl, Medical Biometry and Statistics, W. B. Saunders Company, publishers, by permission.)

Ratio dev. to P.E.	Probable occurrence %	Odds against, to 1	Ratio dev. to std. dev.	Probable occurrence %	Odds against, to 1
1.0	50.00	1.00	0.67449	50.00	1.00
1.1	45.81	1.18	0.7	48.39	1.07
1.2	41.83	1.39	0.8	42.37	1.36
1.3	38.06	1.63	0.9	36.81	1.72
1.4	34.50	1.90	1.0	31.73	2.15
1.5	31.17	2.21	1.1	27.13	2.69
1.6	28.05	2.57	1.2	23.01	3.35
1.7	25.15	2.98	1.3	19.36	4.17
1.8	22.47	3.45	1.4	16.15	5.19
1.9	20.00	4.00	1.5	13.36	6.48
2.0	17.73	4.64	1.6	10.96	8.12
2.1	15.67	5.38	1.7	8.91	10.22
2.2	13.78	6.25	1.8	7.19	12.92
2.3	12.08	7.28	1.9	5.74	16.41
2.4	10.55	8.48	2.0	4.55	20.98
2.5	9.18	9.90	2.1	3.57	26.99
2.6	7.95	11.58	2.2	2.78	34.96
2.7	6.86	13.58	2.3	2.14	45.62
2.8	5.89	15.96	2.4	1.64	59.99
2.9	5.05	18.82	2.5	1.24	79.52
3.0	4.30	22.24	2.6	.932	106.3
3.1	3.65	26.37	2.7	.693	143.2
3.2	3.09	31.36	2.8	.511	194.7
3.3	2.60	37.42	2.9	.373	267.0
3.4	2.18	44.80	3.0	.270	369.4
3.5	1.82	53.82	3.1	.194	515.7
3.6	1.52	64.89	3.2	.137	726.7
3.7	1.26	78.53	3.3	.0967	1,033.
3.8	1.04	95.38	3.4	.0674	1,483.
3.9	.853	116.3	3.5	.0465	2,149.
4.0	.698	142.3	3.6	.0318	3,142.
4.1	.569	174.9	3.7	.0216	4,637.
4.2	.461	215.8	3.8	.0145	6,915.
4.3	.373	267.2	3.9	.00962	10,394.
4.4	.300	332.4	4.0	.00634	15,772.
4.5	.240	415.0	5.0	5.73×10^{-5}	1.744×10^{6}
4.6	.192	520.4	6.0	2.0×10^{-7}	5.0×10^{8}
4.7	.152	655.3	7.0	2.6×10^{-10}	3.9×10^{11}
4.8	.121	828.3			
4.9	.0950	1,052.			
5.0	.0745	1,341.			
6.0	.0052	19,300.			
7.0	.00023	4.27×10^{5}			
8.0	6.8×10^{-6}	1.47×10^{7}			
9.0	1.3×10^{-7}	7.30×10^{8}			
10.0	1.5×10^{-9}	6.5×10^{10}			

NORMAL CURVE OF ERROR

$$\textbf{Normal Curve}\quad \phi(x) = \frac{1}{\sqrt{2\pi}}\, e^{-\frac{x^2}{2}}$$

The following table gives values of the area under the curve from the ordinate at $t = 0$ to the ordinate for the values of t given in the column at the left. Values of the ordinate and of the second, third and fourth derivatives are also given.

t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$	t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$
.00	.0000	.3989	−.3989	.0000	1.1968	**.50**	.1915	.3521	−.2641	.4841	.5501
.01	.0040	.3989	−.3989	.0120	1.1965	.51	.1950	.3503	−.2592	.4895	.5279
.02	.0080	.3989	−.3987	.0239	1.1956	.52	.1985	.3485	−.2543	.4947	.5056
.03	.0120	.3988	−.3984	.0359	1.1941	.53	.2019	.3467	−.2493	.4996	.4831
.04	.0160	.3986	−.3980	.0478	1.1920	.54	.2054	.3448	−.2443	.5043	.4605
.05	.0199	.3984	−.3975	.0597	1.1894	**.55**	.2088	.3429	−.2392	.5088	.4378
.06	.0239	.3982	−.3968	.0716	1.1861	.56	.2123	.3411	−.2341	.5131	.4150
.07	.0279	.3980	−.3960	.0834	1.1822	.57	.2157	.3391	−.2289	.5171	.3921
.08	.0319	.3977	−.3951	.0952	1.1778	.58	.2190	.3372	−.2238	.5209	.3691
.09	.0359	.3973	−.3941	.1070	1.1727	.59	.2224	.3352	−.2185	.5245	.3461
.10	.0398	.3970	−.3930	.1187	1.1671	**.60**	.2258	.3332	−.2133	.5278	.3231
.11	.0438	.3965	−.3917	.1303	1.1609	.61	.2291	.3312	−.2080	.5309	.3000
.12	.0478	.3961	−.3904	.1419	1.1541	.62	.2324	.3292	−.2027	.5338	.2770
.13	.0517	.3956	−.3889	.1534	1.1468	.63	.2357	.3271	−.1973	.5365	.2539
.14	.0557	.3951	−.3873	.1648	1.1389	.64	.2389	.3251	−.1919	.5389	.2309
.15	.0596	.3945	−.3856	.1762	1.1304	**.65**	.2422	.3230	−.1865	.5411	.2078
.16	.0636	.3939	−.3838	.1874	1.1214	.66	.2454	.3209	−.1811	.5431	.1849
.17	.0675	.3932	−.3819	.1986	1.1118	.67	.2486	.3187	−.1757	.5448	.1620
.18	.0714	.3925	−.3798	.2097	1.1017	.68	.2518	.3166	−.1702	.5463	.1391
.19	.0754	.3918	−.3777	.2206	1.0911	.69	.2549	.3144	−.1647	.5476	.1164
.20	.0793	.3910	−.3754	.2315	1.0799	**.70**	.2580	.3123	−.1593	.5486	.0937
.21	.0832	.3902	−.3730	.2422	1.0682	.71	.2612	.3101	−.1538	.5495	.0712
.22	.0871	.3894	−.3706	.2529	1.0560	.72	.2642	.3079	−.1483	.5501	.0487
.23	.0910	.3885	−.3680	.2634	1.0434	.73	.2673	.3056	−.1428	.5504	.0265
.24	.0948	.3876	−.3653	.2737	1.0302	.74	.2704	.3034	−.1373	.5506	.0043
.25	.0987	.3867	−.3625	.2840	1.0165	**.75**	.2734	.3011	−.1318	.5505	−.0176
.26	.1026	.3857	−.3596	.2941	1.0024	.76	.2764	.2989	−.1262	.5502	−.0394
.27	.1064	.3847	−.3566	.3040	0.9878	.77	.2794	.2966	−.1207	.5497	−.0611
.28	.1103	.3836	−.3535	.3138	0.9727	.78	.2823	.2943	−.1153	.5490	−.0825
.29	.1141	.3825	−.3504	.3235	0.9572	.79	.2852	.2920	−.1098	.5481	−.1037
.30	.1179	.3814	−.3471	.3330	0.9413	**.80**	.2881	.2897	−.1043	.5469	−.1247
.31	.1217	.3802	−.3437	.3423	0.9250	.81	.2910	.2874	−.0988	.5456	−.1455
.32	.1255	.3790	−.3402	.3515	0.9082	.82	.2939	.2850	−.0934	.5440	−.1660
.33	.1293	.3778	−.3367	.3605	0.8910	.83	.2967	.2827	−.0880	.5423	−.1862
.34	.1331	.3765	−.3330	.3693	0.8735	.84	.2996	.2803	−.0825	.5403	−.2063
.35	.1368	.3752	−.3293	.3779	0.8556	**.85**	.3023	.2780	−.0771	.5381	−.2260
.36	.1406	.3739	−.3255	.3864	0.8373	.86	.3051	.2756	−.0718	.5358	−.2455
.37	.1443	.3726	−.3216	.3947	0.8186	.87	.3079	.2732	−.0664	.5332	−.2646
.38	.1480	.3712	−.3176	.4028	0.7996	.88	.3106	.2709	−.0611	.5305	−.2835
.39	.1517	.3697	−.3135	.4107	0.7803	.89	.3133	.2685	−.0558	.5276	−.3021
.40	.1554	.3683	−.3094	.4184	0.7607	**.90**	.3159	.2661	−.0506	.5245	−.3203
.41	.1591	.3668	−.3051	.4259	0.7408	.91	.3186	.2637	−.0453	.5212	−.3383
.42	.1628	.3653	−.3008	.4332	0.7206	.92	.3212	.2613	−.0401	.5177	−.3559
.43	.1664	.3637	−.2965	.4403	0.7001	.93	.3238	.2589	−.0350	.5140	−.3731
.44	.1700	.3621	−.2920	.4472	0.6793	.94	.3264	.2565	−.0299	.5102	−.3901
.45	.1736	.3605	−.2875	.4539	0.6583	**.95**	.3289	.2541	−.0248	.5062	−.4066
.46	.1772	.3589	−.2830	.4603	0.6371	.96	.3315	.2516	−.0197	.5021	−.4228
.47	.1808	.3572	−.2783	.4666	0.6156	.97	.3340	.2492	−.0147	.4978	−.4387
.48	.1844	.3555	−.2736	.4727	0.5940	.98	.3365	.2468	−.0098	.4933	−.4541
.49	.1879	.3538	−.2689	.4785	0.5721	.99	.3389	.2444	−.0049	.4887	−.4692
.50	.1915	.3521	−.2641	.4841	0.5501	**1.00**	.3413	.2420	.0000	.4839	−.4839

Normal Curve $\phi(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$ (Continued)

t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$	t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$
1.00	.3413	.2420	.0000	.4839	−.4839	**1.50**	.4332	.1295	.1619	.1457	−.7043
1.01	.3438	.2396	.0048	.4790	−.4983	1.51	.4345	.1276	.1633	.1387	−.6994
1.02	.3461	.2371	.0096	.4740	−.5122	1.52	.4357	.1257	.1647	.1317	−.6942
1.03	.3485	.2347	.0143	.4688	−.5257	1.53	.4370	.1238	.1660	.1248	−.6888
1.04	.3508	.2323	.0190	.4635	−.5389	1.54	.4382	.1219	.1672	.1180	−.6831
1.05	.3531	.2299	.0236	.4580	−.5516	**1.55**	.4394	.1200	.1683	.1111	−.6772
1.06	.3554	.2275	.0281	.4524	−.5639	1.56	.4406	.1182	.1694	.1044	−.6710
1.07	.3577	.2251	.0326	.4467	−.5758	1.57	.4418	.1163	.1704	.0977	−.6646
1.08	.3599	.2227	.0371	.4409	−.5873	1.58	.4430	.1145	.1714	.0911	−.6580
1.09	.3621	.2203	.0414	.4350	−.5984	1.59	.4441	.1127	.1722	.0846	−.6511
1.10	.3643	.2179	.0458	.4290	−.6091	**1.60**	.4452	.1109	.1730	.0781	−.6441
1.11	.3665	.2155	.0500	.4228	−.6193	1.61	.4463	.1092	.1738	.0717	−.6368
1.12	.3686	.2131	.0542	.4166	−.6292	1.62	.4474	.1074	.1745	.0654	−.6293
1.13	.3708	.2107	.0583	.4102	−.6386	1.63	.4485	.1057	.1751	.0591	−.6216
1.14	.3729	.2083	.0624	.4038	−.6476	1.64	.4495	.1040	.1757	.0529	−.6138
1.15	.3749	.2059	.0664	.3973	−.6561	**1.65**	.4505	.1023	.1762	.0468	−.6057
1.16	.3770	.2036	.0704	.3907	−.6643	1.66	.4515	.1006	.1766	.0408	−.5975
1.17	.3790	.2012	.0742	.3840	−.6720	1.67	.4525	.0989	.1770	.0349	−.5891
1.18	.3810	.1989	.0780	.3772	−.6792	1.68	.4535	.0973	.1773	.0290	−.5806
1.19	.3830	.1965	.0818	.3704	−.6861	1.69	.4545	.0957	.1776	.0233	−.5720
1.20	.3849	.1942	.0854	.3635	−.6926	**1.70**	.4554	.0941	.1778	.0176	−.5632
1.21	.3869	.1919	.0890	.3566	−.6986	1.71	.4564	.0925	.1779	.0120	−.5542
1.22	.3888	.1895	.0926	.3496	−.7042	1.72	.4573	.0909	.1780	.0065	−.5452
1.23	.3907	.1872	.0960	.3425	−.7094	1.73	.4582	.0893	.1780	.0011	−.5360
1.24	.3925	.1849	.0994	.3354	−.7141	1.74	.4591	.0878	.1780	−.0042	−.5267
1.25	.3944	.1827	.1027	.3282	−.7185	**1.75**	.4599	.0863	.1780	−.0094	−.5173
1.26	.3962	.1804	.1060	.3210	−.7224	1.76	.4608	.0848	.1778	−.0146	−.5079
1.27	.3980	.1781	.1092	.3138	−.7259	1.77	.4616	.0833	.1777	−.0196	−.4983
1.28	.3997	.1759	.1123	.3065	−.7291	1.78	.4625	.0818	.1774	−.0245	−.4887
1.29	.4015	.1736	.1153	.2992	−.7318	1.79	.4633	.0804	.1772	−.0294	−.4789
1.30	.4032	.1714	.1182	.2918	−.7341	**1.80**	.4641	.0790	.1769	−.0341	−.4692
1.31	.4049	.1692	.1211	.2845	−.7361	1.81	.4649	.0775	.1765	−.0388	−.4593
1.32	.4066	.1669	.1239	.2771	−.7376	1.82	.4656	.0761	.1761	−.0433	−.4494
1.33	.4082	.1647	.1267	.2697	−.7388	1.83	.4664	.0748	.1756	−.0477	−.4395
1.34	.4099	.1626	.1293	.2624	−.7395	1.84	.4671	.0734	.1751	−.0521	−.4295
1.35	.4115	.1604	.1319	.2550	−.7399	**1.85**	.4678	.0721	.1746	−.0563	−.4195
1.36	.4131	.1582	.1344	.2476	−.7400	1.86	.4686	.0707	.1740	−.0605	−.4095
1.37	.4147	.1561	.1369	.2402	−.7396	1.87	.4693	.0694	.1734	−.0645	−.3995
1.38	.4162	.1540	.1392	.2328	−.7389	1.88	.4700	.0681	.1727	−.0685	−.3894
1.39	.4177	.1518	.1415	.2254	−.7378	1.89	.4706	.0669	.1720	−.0723	−.3793
1.40	.4192	.1497	.1437	.2180	−.7364	**1.90**	.4713	.0656	.1713	−.0761	−.3693
1.41	.4207	.1476	.1459	.2107	−.7347	1.91	.4719	.0644	.1705	−.0797	−.3592
1.42	.4222	.1456	.1480	.2033	−.7326	1.92	.4726	.0632	.1697	−.0832	−.3492
1.43	.4236	.1435	.1500	.1960	−.7301	1.93	.4732	.0620	.1688	−.0867	−.3392
1.44	.4251	.1415	.1519	.1887	−.7274	1.94	.4738	.0608	.1679	−.0900	−.3292
1.45	.4265	.1394	.1537	.1815	−.7243	**1.95**	.4744	.0596	.1670	−.0933	−.3192
1.46	.4279	.1374	.1555	.1742	−.7209	1.96	.4750	.0584	.1661	−.0964	−.3093
1.47	.4292	.1354	.1572	.1670	−.7172	1.97	.4756	.0573	.1651	−.0994	−.2994
1.48	.4306	.1334	.1588	.1599	−.7132	1.98	.4762	.0562	.1641	−.1024	−.2895
1.49	.4319	.1315	.1604	.1528	−.7089	1.99	.4767	.0551	.1630	−.1052	−.2797
1.50	.4332	.1295	.1619	.1457	−.7043	**2.00**	.4773	.0540	.1620	−.1080	−.2700

Normal Curve $\phi(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$ (Continued)

t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$	t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$
2.00	.4773	.0540	.1620	−.1080	−.2700	**2.50**	.4938	.0175	.0920	−.1424	.0800
2.01	.4778	.0529	.1609	−.1106	−.2603	2.51	.4940	.0171	.0906	−.1416	.0836
2.02	.4783	.0519	.1598	−.1132	−.2506	2.52	.4941	.0167	.0892	−.1408	.0871
2.03	.4788	.0508	.1586	−.1157	−.2411	2.53	.4943	.0163	.0878	−.1399	.0905
2.04	.4793	.0498	.1575	−.1180	−.2316	2.54	.4945	.0159	.0864	−.1389	.0937
2.05	.4798	.0488	.1563	−.1203	−.2222	**2.55**	.4946	.0155	.0850	−.1380	.0968
2.06	.4803	.0478	.1550	−.1225	−.2129	2.56	.4948	.0151	.0836	−.1370	.0998
2.07	.4808	.0468	.1538	−.1245	−.2036	2.57	.4949	.0147	.0823	−.1360	.1027
2.08	.4812	.0459	.1526	−.1265	−.1945	2.58	.4951	.0143	.0809	−.1350	.1054
2.09	.4817	.0449	1513	−.1284	−.1854	2.59	.4952	.0139	.0796	−.1339	.1080
2.10	.4821	.0440	.1500	−.1302	−.1765	**2.60**	.4953	.0136	.0782	−.1328	.1105
2.11	.4826	.0431	.1487	−.1320	−.1676	2.61	.4955	.0132	.0769	−.1317	.1129
2.12	.4830	.0422	.1474	−.1336	−.1588	2.62	.4956	.0129	.0756	−.1305	.1152
2.13	.4834	.0413	.1460	−.1351	−.1502	2.63	.4957	.0126	.0743	−.1294	.1173
2.14	.4838	.0404	.1446	−.1366	−.1416	2.64	.4959	.0122	.0730	−.1282	.1194
2.15	.4842	.0396	.1433	−.1380	−.1332	**2.65**	.4960	.0119	.0717	−.1270	.1213
2.16	.4846	.0387	.1419	−.1393	−.1249	2.66	.4961	.0116	.0705	−.1258	.1231
2.17	.4850	.0379	.1405	−.1405	−.1167	2.67	.4962	.0113	.0692	−.1245	.1248
2.18	.4854	.0371	.1391	−.1416	−.1086	2.68	.4963	.0110	.0680	−.1233	.1264
2.19	.4857	.0363	.1377	−.1426	−.1006	2.69	.4964	.0107	.0668	−.1220	.1279
2.20	.4861	.0355	.1362	−.1436	−.0927	**2.70**	.4965	.0104	.0656	−.1207	.1293
2.21	.4865	.0347	.1348	−.1445	−.0850	2.71	.4966	.0101	.0644	−.1194	.1306
2.22	.4868	.0339	.1333	−.1453	−.0774	2.72	.4967	.0099	.0632	−.1181	.1317
2.23	.4871	.0332	.1319	−.1460	−.0700	2.73	.4968	.0096	.0620	−.1168	.1328
2.24	.4875	.0325	.1304	−.1467	−.0626	2.74	.4969	.0094	.0608	−.1154	.1338
2.25	.4878	.0317	.1289	−.1473	−.0554	**2.75**	.4970	.0091	.0597	−.1141	.1347
2.26	.4881	.0310	.1275	−.1478	−.0484	2.76	.4971	.0089	.0585	−.1127	.1356
2.27	.4884	.0303	.1260	−.1483	−.0414	2.77	.4972	.0086	.0574	−.1114	.1363
2.28	.4887	.0297	.1245	−.1486	−.0346	2.78	.4973	.0084	.0563	−.1100	.1369
2.29	.4890	.0290	.1230	−.1490	−.0279	2.79	.4974	.0081	.0552	−.1087	.1375
2.30	.4893	.0283	.1215	−.1492	−.0214	**2.80**	.4974	.0079	.0541	−.1073	.1379
2.31	.4896	.0277	.1200	−.1494	−.0150	2.81	.4975	.0077	.0531	−.1059	.1383
2.32	.4898	.0271	.1185	−.1495	−.0088	2.82	.4976	.0075	.0520	−.1045	.1386
2.33	.4901	.0264	.1170	−.1496	−.0027	2.83	.4977	.0073	.0510	−.1031	.1389
2.34	.4904	.0258	.1155	−.1496	.0033	2.84	.4977	.0071	.0500	−.1017	.1390
2.35	.4906	.0252	.1141	−.1495	.0092	**2.85**	.4978	.0069	.0490	−.1003	.1391
2.36	.4909	.0246	.1126	−.1494	.0149	2.86	.4979	.0067	.0480	−.0990	.1391
2.37	.4911	.0241	.1111	−.1492	.0204	2.87	.4980	.0065	.0470	−.0976	.1391
2.38	.4913	.0235	.1096	−.1490	.0258	2.88	.4980	.0063	.0460	−.0962	.1389
2.39	.4916	.0229	.1081	−.1487	.0311	2.89	.4981	.0061	.0451	−.0948	.1388
2.40	.4918	.0224	.1066	−.1483	.0362	**2.90**	.4981	.0060	.0441	−.0934	.1385
2.41	.4920	.0219	.1051	−.1480	.0412	2.91	.4982	.0058	.0432	−.0920	.1382
2.42	.4922	.0213	.1036	−.1475	.0461	2.92	.4983	.0056	.0423	−.0906	.1378
2.43	.4925	.0208	.1022	−.1470	.0508	2.93	.4983	.0055	.0414	−.0893	.1374
2.44	.4927	.0203	.1007	−.1465	.0554	2.94	.4984	.0053	.0405	−.0879	.1369
2.45	.4929	.0198	.0992	−.1459	.0598	**2.95**	.4984	.0051	.0396	−.0865	.1364
2.46	.4931	.0194	.0978	−.1453	.0641	2.96	.4985	.0050	.0388	−.0852	.1358
2.47	.4932	.0189	.0963	−.1446	.0683	2.97	.4985	.0049	.0379	−.0838	.1352
2.48	.4934	.0184	.0949	−.1439	.0723	2.98	.4986	.0047	.0371	−.0825	.1345
2.49	.4936	.0180	.0935	−.1432	.0762	2.99	.4986	.0046	.0363	−.0811	.1337
2.50	.4938	.0175	.0920	−.1424	.0800	**3.00**	.4987	.0044	.0355	−.0798	.1330

NORMAL CURVE OF ERROR

Normal Curve $\phi(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$ (Continued)

t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$	t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$
3.00	.4987	.0044	.0355	−.0798	.1330	**3.50**	.4998	.0009	.0098	−.0283	.0694
3.01	.4987	.0043	.0347	−.0785	.1321	3.51	.4998	.0008	.0095	−.0276	.0681
3.02	.4987	.0042	.0339	−.0771	.1313	3.52	.4998	.0008	.0093	−.0269	.0669
3.03	.4988	.0041	.0331	−.0758	.1304	3.53	.4998	.0008	.0090	−.0262	.0656
3.04	.4988	.0039	.0324	−.0745	.1294	3.54	.4998	.0008	.0087	−.0256	.0643
3.05	.4989	.0038	.0316	−.0732	.1285	**3.55**	.4998	.0007	.0085	−.0249	.0631
3.06	.4989	.0037	.0309	−.0720	.1275	3.56	.4998	.0007	.0082	−.0243	.0618
3.07	.4989	.0036	.0302	−.0707	.1264	3.57	.4998	.0007	.0080	−.0237	.0606
3.08	.4990	.0035	.0295	−.0694	.1254	3.58	.4998	.0007	.0078	−.0231	.0594
3.09	.4990	.0034	.0288	−.0682	.1243	3.59	.4998	.0006	.0075	−.0225	.0582
3.10	.4990	.0033	.0281	−.0669	.1231	**3.60**	.4998	.0006	.0073	−.0219	.0570
3.11	.4991	.0032	.0275	−.0657	.1220	3.61	.4999	.0006	.0071	−.0214	.0559
3.12	.4991	.0031	.0268	−.0645	.1208	3.62	4999	.0006	.0069	−.0208	.0547
3.13	.4991	.0030	.0262	−.0633	.1196	3.63	.4999	.0006	.0067	−.0203	.0536
3.14	.4992	.0029	.0256	−.0621	.1184	3.64	.4999	.0005	.0065	−.0198	.0524
3.15	.4992	.0028	.0249	−.0609	.1171	**3.65**	.4999	.0005	.0063	−.0192	.0513
3.16	.4992	.0027	.0243	−.0598	.1159	3.66	.4999	.0005	.0061	−.0187	.0502
3.17	.4992	.0026	.0237	−.0586	.1146	3.67	.4999	.0005	.0059	−.0182	.0492
3.18	.4993	.0025	.0232	−.0575	.1133	3.68	.4999	.0005	.0057	−.0177	.0481
3.19	.4993	.0025	.0226	−.0564	.1120	3.69	.4999	.0004	.0056	−.0173	.0470
3.20	.4993	.0024	.0220	−.0552	.1107	**3.70**	.4999	.0004	.0054	−.0168	.0460
3.21	.4993	.0023	.0215	−.0541	.1093	3.71	.4999	.0004	.0052	−.0164	.0450
3.22	.4994	.0022	.0210	−.0531	.1080	3.72	.4999	.0004	.0051	−.0159	.0440
3.23	.4994	.0022	.0204	−.0520	.1066	3.73	.4999	.0004	.0049	−.0155	.0430
3.24	.4994	.0021	.0199	−.0509	.1053	3.74	.4999	.0004	.0048	−.0150	.0420
3.25	.4994	.0020	.0194	−.0499	.1039	**3.75**	.4999	.0004	.0046	−.0146	.0410
3.26	.4994	.0020	.0189	−.0488	.1025	3.76	.4999	.0003	.0045	−.0142	.0401
3.27	.4995	.0019	.0184	−.0478	.1011	3.77	.4999	.0003	.0043	−.0138	.0392
3.28	.4995	.0018	.0180	−.0468	.0997	3.78	.4999	.0003	.0042	−.0134	.0382
3.29	.4995	.0018	.0175	−.0458	.0983	3.79	.4999	.0003	.0041	−.0131	.0373
3.30	.4995	.0017	.0170	−.0449	.0969	**3.80**	.4999	.0003	.0039	−.0127	.0365
3.31	.4995	.0017	.0166	−.0439	.0955	3.81	.4999	.0003	.0038	−.0123	.0356
3.32	.4996	.0016	.0162	−.0429	.0941	3.82	.4999	.0003	.0037	−.0120	.0347
3.33	.4996	.0016	.0157	−.0420	.0927	3.83	.4999	.0003	.0036	−.0116	.0339
3.34	.4996	.0015	.0153	−.0411	.0913	3.84	.4999	.0003	.0034	−.0113	.0331
3.35	.4996	.0015	.0149	−.0402	.0899	**3.85**	.4999	.0002	.0033	−.0110	.0323
3.36	.4996	.0014	.0145	−.0393	.0885	3.86	.4999	.0002	.0032	−.0107	.0315
3.37	.4996	.0014	.0141	−.0384	.0871	3.87	.5000	.0002	.0031	−.0104	.0307
3.38	.4996	.0013	.0138	−.0376	.0857	3.88	.5000	.0002	.0030	−.0100	.0299
3.39	.4997	.0013	.0134	−.0367	.0843	3.89	.5000	.0002	.0029	−.0098	.0292
3.40	.4997	.0012	.0130	−.0359	.0829	**3.90**	.5000	.0002	.0028	−.0095	.0284
3.41	.4997	.0012	.0127	−.0350	.0815	3.91	.5000	.0002	.0027	−.0092	.0277
3.42	.4997	.0012	.0123	−.0342	.0801	3.92	.5000	.0002	.0026	−.0089	.0270
3.43	.4997	.0011	.0120	−.0334	.0788	3.93	.5000	.0002	.0026	−.0086	.0263
3.44	.4997	.0011	.0116	−.0327	.0774	3.94	.5000	.0002	.0025	−.0084	.0256
3.45	.4997	.0010	.0113	−.0319	.0761	**3.95**	.5000	.0002	.0024	−.0081	.0250
3.46	.4997	.0010	.0110	−.0311	.0747	3.96	.5000	.0002	.0023	−.0079	.0243
3.47	.4997	.0010	.0107	−.0304	.0734	3.97	.5000	.0002	.0022	−.0076	.0237
3.48	.4998	.0009	.0104	−.0297	.0721	3.98	.5000	.0001	.0022	−.0074	.0230
3.49	.4998	.0009	.0101	−.0290	.0707	3.99	.5000	.0001	.0021	−.0072	.0224
3.50	.4998	.0009	.0098	−.0283	.0694	**4.00**	5000	0001	.0020	−.0070	.0218

Normal Curve $\phi(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$ (Continued)

t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$	t	Area	Ordinate $\phi(x)$	Second derivative $\phi''(x)$	Third derivative $\phi'''(x)$	Fourth derivative $\phi^{iv}(x)$
4.00	.5000	.0001	.0020	−.0070	.0218	**4.50**	.5000	.0000	.0003	−.0012	.0047
4.01	.5000	.0001	.0019	−.0067	.0212	4.51	.5000	.0000	.0003	−.0012	.0045
4.02	.5000	.0001	.0019	−.0065	.0207	4.52	.5000	.0000	.0003	−.0012	.0044
4.03	.5000	.0001	.0018	−.0063	.0201	4.53	.5000	.0000	.0003	−.0011	.0042
4.04	.5000	.0001	.0018	−.0061	.0195	4.54	.5000	.0000	.0003	−.0011	.0041
4.05	.5000	.0001	.0017	−.0059	.0190	**4.55**	.5000	.0000	.0003	−.0010	.0039
4.06	.5000	.0001	.0016	−.0058	.0185	4.56	.5000	.0000	.0002	−.0010	.0038
4.07	.5000	.0001	.0016	−.0056	.0180	4.57	.5000	.0000	.0002	−.0010	.0037
4.08	.5000	.0001	.0015	−.0054	.0175	4.58	.5000	.0000	.0002	−.0009	.0035
4.09	.5000	.0001	.0015	−.0052	.0170	4.59	.5000	.0000	.0002	−.0009	.0034
4.10	.5000	.0001	.0014	−.0051	.0165	**4.60**	.5000	.0000	.0002	−.0009	.0033
4.11	.5000	.0001	.0014	−.0049	.0160	4.61	.5000	.0000	.0002	−.0008	.0032
4.12	.5000	.0001	.0013	−.0047	.0156	4.62	.5000	.0000	.0002	−.0008	.0031
4.13	.5000	.0001	.0013	−.0046	.0151	4.63	.5000	.0000	.0002	−.0008	.0030
4.14	.5000	.0001	.0012	−.0044	.0147	4.64	.5000	.0000	.0002	−.0007	.0028
4.15	.5000	.0001	.0012	−.0043	.0143	**4.65**	.5000	.0000	.0002	−.0007	.0027
4.16	.5000	.0001	.0011	−.0042	.0138	4.66	.5000	.0000	.0002	−.0007	.0026
4.17	.5000	.0001	.0011	−.0040	.0134	4.67	.5000	.0000	.0002	−.0006	.0026
4.18	.5000	.0001	.0011	−.0039	.0130	4.68	.5000	.0000	.0002	−.0006	.0025
4.19	.5000	.0001	.0010	−.0038	.0127	4.69	.5000	.0000	.0001	−.0006	.0024
4.20	.5000	.0001	.0010	−.0036	.0123	**4.70**	.5000	.0000	.0001	−.0006	.0023
4.21	.5000	.0001	.0009	−.0035	.0119	4.71	.5000	.0000	.0001	−.0006	.0022
4.22	.5000	.0001	.0009	−.0034	.0116	4.72	.5000	.0000	.0001	−.0005	.0021
4.23	.5000	.0001	.0009	−.0033	.0112	4.73	.5000	.0000	.0001	−.0005	.0020
4.24	.5000	.0001	.0009	−.0032	.0109	4.74	.5000	.0000	.0001	−.0005	.0020
4.25	.5000	.0001	.0008	−.0031	.0105	**4.75**	.5000	.0000	.0001	−.0005	.0019
4.26	.5000	.0001	.0008	−.0030	.0102	4.76	.5000	.0000	.0001	−.0005	.0018
4.27	.5000	.0000	.0008	−.0029	.0099	4.77	.5000	.0000	.0001	−.0004	.0018
4.28	.5000	.0000	.0007	−.0028	.0096	4.78	.5000	.0000	.0001	−.0004	.0017
4.29	.5000	.0000	.0007	−.0027	.0093	4.79	.5000	.0000	.0001	−.0004	.0016
4.30	.5000	.0000	.0007	−.0026	.0090	**4.80**	.5000	.0000	.0001	−.0004	.0016
4.31	.5000	.0000	.0007	−.0025	.0087	4.81	.5000	.0000	.0001	−.0004	.0015
4.32	.5000	.0000	.0006	−.0024	.0085	4.82	.5000	.0000	.0001	−.0004	.0015
4.33	.5000	.0000	.0006	−.0023	.0082	4.83	.5000	.0000	.0001	−.0003	.0014
4.34	.5000	.0000	.0006	−.0022	.0079	4.84	.5000	.0000	.0001	−.0003	.0013
4.35	.5000	.0000	.0006	−.0022	.0077	**4.85**	.5000	.0000	.0001	−.0003	.0013
4.36	.5000	.0000	.0005	−.0021	.0074	4.86	.5000	.0000	.0001	−.0003	.0012
4.37	.5000	.0000	.0005	−.0020	.0072	4.87	.5000	.0000	.0001	−.0003	.0012
4.38	.5000	.0000	.0005	−.0019	.0070	4.88	.5000	.0000	.0001	−.0003	.0012
4.39	.5000	.0000	.0005	−.0019	.0067	4.89	.5000	.0000	.0001	−.0003	.0011
4.40	.5000	.0000	.0005	−.0018	.0065	**4.90**	.5000	.0000	.0001	−.0003	.0011
4.41	.5000	.0000	.0004	−.0017	.0063	4.91	.5000	.0000	.0001	−.0002	.0010
4.42	.5000	.0000	.0004	−.0017	.0061	4.92	.5000	.0000	.0001	−.0002	.0010
4.43	.5000	.0000	.0004	−.0016	.0059	4.93	.5000	.0000	.0001	−.0002	.0009
4.44	.5000	.0000	.0004	−.0016	.0057	4.94	.5000	.0000	.0001	−.0002	.0009
4.45	.5000	.0000	.0004	−.0015	.0055	**4.95**	.5000	.0000	.0000	−.0002	.0009
4.46	.5000	.0000	.0004	−.0014	.0053	4.96	.5000	.0000	.0000	−.0002	.0008
4.47	.5000	.0000	.0004	−.0014	.0052	4.97	.5000	.0000	.0000	−.0002	.0008
4.48	.5000	.0000	.0003	−.0013	.0050	4.98	.5000	.0000	.0000	−.0002	.0008
4.49	.5000	.0000	.0003	−.0013	.0048	4.99	.5000	.0000	.0000	−.0002	.0007
4.50	.5000	.0000	.0003	−.0012	.0047						

STATISTICAL TABLES

"t" Test of Significance Between Two Sample Means ($\bar{x}_1$ and $\bar{x}_2$).

(Use Fisher's t distribution)

Paired variates:

$$t = \frac{\bar{d}}{\sqrt{\frac{\Sigma(d_i - \bar{d})^2}{N(N-1)}}} \text{ with } N - 1 \text{ degrees of freedom}$$

where $\bar{d} = \bar{x}_1 - \bar{x}_2$
$d_1 = x_{11} - x_{21}$
$d_2 = x_{12} - x_{22}$ etc.
N = sample size

Unpaired variates:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\Sigma_i(x_i - \bar{x}_1)^2 + \Sigma_i(x_{2i} - \bar{x}_2)^2}{N_1 + N_2 - 2}\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

with $N_1 + N_2 - 2$ degrees of freedom

where N_1 = size of sample 1
N_2 = size of sample 2

Chi Square Table

The column headings "P" are probabilities, while the body of the table gives values of χ^2; the left column the degrees of freedom. The probability of a value $\chi^2 \geqq$ than the value specified is thus obtained. For $n = 20$, $P(\chi^2 \geqq 10.851)$ the table gives .95, and accordingly by subtraction $P(\chi^2 \leqq 10.851)$ is .05.

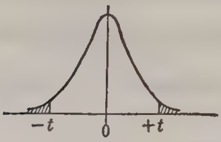
F Test for Equality of Variances

$$F = \frac{\sigma_1^2}{\sigma_2^2}$$

where σ_1^2 = variance of sample with size N_1
σ_2^2 = variance of sample with size N_2
with $N_1 - 1$ = degrees of freedom for numerator
$N_2 - 1$ = degrees of freedom for denominator

(Use Snedecor's F distribution)

TABLE FOR t TEST OF SIGNIFICANCE



Degrees of freedom	*$P = 0.9$	0.8	0.7	0.6	0.5	0.4
1	0.158	0.325	0.510	0.727	1.000	1.376
2	0.142	0.289	0.445	0.617	0.816	1.061
3	0.137	0.277	0.424	0.584	0.765	0.978
4	0.134	0.271	0.414	0.569	0.741	0.941
5	0.132	0.267	0.408	0.559	0.727	0.920
6	0.131	0.265	0.404	0.553	0.718	0.906
7	0.130	0.263	0.402	0.549	0.711	0.896
8	0.130	0.262	0.399	0.546	0.706	0.889
9	0.129	0.261	0.398	0.543	0.703	0.883
10	0.129	0.260	0.397	0.542	0.700	0.879
11	0.129	0.260	0.396	0.540	0.697	0.876
12	0.128	0.259	0.395	0.539	0.695	0.873
13	0.128	0.259	0.394	0.538	0.694	0.870
14	0.128	0.258	0.393	0.537	0.692	0.868
15	0.128	0.258	0.393	0.536	0.691	0.866
16	0.128	0.258	0.392	0.535	0.690	0.865
17	0.128	0.257	0.392	0.534	0.689	0.863
18	0.127	0.257	0.392	0.534	0.688	0.862
19	0.127	0.257	0.391	0.533	0.688	0.861
20	0.127	0.257	0.391	0.533	0.687	0.860
21	0.127	0.257	0.391	0.532	0.686	0.859
22	0.127	0.256	0.390	0.532	0.686	0.858
23	0.127	0.256	0.390	0.532	0.685	0.858
24	0.127	0.256	0.390	0.531	0.685	0.857
25	0.127	0.256	0.390	0.531	0.684	0.856
26	0.127	0.256	0.390	0.531	0.684	0.856
27	0.127	0.256	0.389	0.531	0.684	0.855
28	0.127	0.256	0.389	0.530	0.683	0.855
29	0.127	0.256	0.389	0.530	0.683	0.854
30	0.127	0.256	0.389	0.530	0.683	0.854
∞	0.12566	0.25335	0.38532	0.52440	0.67449	0.84162

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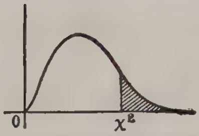
* P is the probability of having t this large or larger in size by chance.

BETWEEN TWO SAMPLE MEANS ($\bar{x}_1$ AND $\bar{x}_2$)

Degrees of freedom	0.3	0.2	0.1	0.05	0.02	0.01
1	1.963	3.078	6.314	12.706	31.821	63.657
2	1.386	1.886	2.920	4.303	6.965	9.925
3	1.250	1.638	2.353	3.182	4.541	5.841
4	1.190	1.533	2.132	2.776	3.747	4.604
5	1.156	1.476	2.015	2.571	3.365	4.032
6	1.134	1.440	1.943	2.447	3.143	3.707
7	1.119	1.415	1.895	2.365	2.998	3.499
8	1.108	1.397	1.860	2.306	2.896	3.355
9	1.100	1.383	1.833	2.262	2.821	3.250
10	1.093	1.372	1.812	2.228	2.764	3.169
11	1.088	1.363	1.796	2.201	2.718	3.106
12	1.083	1.356	1.782	2.179	2.681	3.055
13	1.079	1.350	1.771	2.160	2.650	3.012
14	1.076	1.345	1.761	2.145	2.624	2.977
15	1.074	1.341	1.753	2.131	2.602	2.947
16	1.071	1.337	1.746	2.120	2.583	2.921
17	1.069	1.333	1.740	2.110	2.567	2.898
18	1.067	1.330	1.734	2.101	2.552	2.878
19	1.066	1.328	1.729	2.093	2.539	2.861
20	1.064	1.325	1.725	2.086	2.528	2.845
21	1.063	1.323	1.721	2.080	2.518	2.831
22	1.061	1.321	1.717	2.074	2.508	2.819
23	1.060	1.319	1.714	2.069	2.500	2.807
24	1.059	1.318	1.711	2.064	2.492	2.797
25	1.058	1.316	1.708	2.060	2.485	2.787
26	1.058	1.315	1.706	2.056	2.479	2.779
27	1.057	1.314	1.703	2.052	2.473	2.771
28	1.056	1.313	1.701	2.048	2.467	2.763
29	1.055	1.311	1.699	2.045	2.462	2.756
30	1.055	1.310	1.697	2.042	2.457	2.750
∞	1.03643	1.28155	1.64485	1.95996	2.32634	2.57582

χ^2 TABLE



Degrees of freedom	$P = 0.99$	0.98	0.95	0.90	0.80	0.70
1	0.000157	0.000628	0.00393	0.0158	0.0642	0.148
2	0.0201	0.0404	0.103	0.211	0.446	0.713
3	0.115	0.185	0.352	0.584	1.005	1.424
4	0.297	0.429	0.711	1.064	1.649	2.195
5	0.554	0.752	1.145	1.610	2.343	3.000
6	0.872	1.134	1.635	2.204	3.070	3.828
7	1.239	1.564	2.167	2.833	3.822	4.671
8	1.646	2.032	2.733	3.490	4.594	5.527
9	2.088	2.532	3.325	4.168	5.380	6.393
10	2.558	3.059	3.940	4.865	6.179	7.267
11	3.053	3.609	4.575	5.578	6.989	8.148
12	3.571	4.178	5.226	6.304	7.807	9.034
13	4.107	4.765	5.892	7.042	8.634	9.926
14	4.660	5.368	6.571	7.790	9.467	10.821
15	5.229	5.985	7.261	8.547	10.307	11.721
16	5.812	6.614	7.962	9.312	11.152	12.624
17	6.408	7.255	8.672	10.085	12.002	13.531
18	7.015	7.906	9.390	10.865	12.857	14.440
19	7.633	8.567	10.117	11.651	13.716	15.352
20	8.260	9.237	10.851	12.443	14.578	16.266
21	8.897	9.915	11.591	13.240	15.445	17.182
22	9.542	10.600	12.338	14.041	16.314	18.101
23	10.196	11.293	13.091	14.848	17.187	19.021
24	10.856	11.992	13.848	15.659	18.062	19.943
25	11.524	12.697	14.611	16.473	18.940	20.867
26	12.198	13.409	15.379	17.292	19.820	21.792
27	12.879	14.125	16.151	18.114	20.703	22.719
28	13.565	14.847	16.928	18.939	21.588	23.647
29	14.256	15.574	17.708	19.768	22.475	24.577
30	14.953	16.306	18.493	20.599	23.364	25.508

For degrees of freedom greater than 30, the expression $\sqrt{2\chi^2} - \sqrt{2n' - 1}$ may be used as a normal deviate with unit variance, where n' is the number of degrees of freedom.

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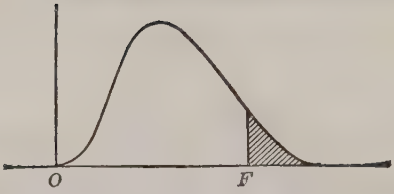
χ^2 TABLE (Continued)

Degrees of freedom	0.50	0.30	0.20	0.10	0.05	0.02	0.01
1	0.455	1.074	1.642	2.706	3.841	5.412	6.635
2	1.386	2.408	3.219	4.605	5.991	7.824	9.210
3	2.366	3.665	4.642	6.251	7.815	9.837	11.341
4	3.357	4.878	5.989	7.779	9.488	11.668	13.277
5	4.351	6.064	7.289	9.236	11.070	13.388	15.086
6	5.348	7.231	8.558	10.645	12.592	15.033	16.812
7	6.346	8.383	9.803	12.017	14.067	16.622	18.475
8	7.344	9.524	11.030	13.362	15.507	18.168	20.090
9	8.343	10.656	12.242	14.684	16.919	19.679	21.666
10	9.342	11.781	13.442	15.987	18.307	21.161	23.209
11	10.341	12.899	14.631	17.275	19.675	22.618	24.725
12	11.340	14.011	15.812	18.549	21.026	24.054	26.217
13	12.340	15.119	16.985	19.812	22.362	25.472	27.688
14	13.339	16.222	18.151	21.064	23.685	26.873	29.141
15	14.339	17.322	19.311	22.307	24.996	28.259	30.578
16	15.338	18.418	20.465	23.542	26.296	29.633	32.000
17	16.338	19.511	21.615	24.769	27.587	30.995	33.409
18	17.338	20.601	22.760	25.989	28.869	32.346	34.805
19	18.338	21.689	23.900	27.204	30.144	33.687	36.191
20	19.337	22.775	25.038	28.412	31.410	35.020	37.566
21	20.337	23.858	26.171	29.615	32.671	36.343	38.932
22	21.337	24.939	27.301	30.813	33.924	37.659	40.289
23	22.337	26.018	28.429	32.007	35.172	38.968	41.638
24	23.337	27.096	29.553	33.196	36.415	40.270	42.980
25	24.337	28.172	30.675	34.382	37.652	41.566	44.314
26	25.336	29.246	31.795	35.563	38.885	42.856	45.642
27	26.336	30.319	32.912	36.741	40.113	44.140	46.963
28	27.336	31.391	34.027	37.916	41.337	45.419	48.278
29	28.336	32.461	35.139	39.087	42.557	46.693	49.588
30	29.336	33.530	36.250	40.256	43.773	47.962	50.892

TABLE FOR *F* TEST FOR



*5 % (ROMAN TYPE) AND 1 % (**BOLD-FACE TYPE**)

Degrees of freedom for lesser mean square	Degrees of freedom for greater mean square											
	1	2	3	4	5	6	7	8	9	10	11	12
1	161 **4052**	200 **4999**	216 **5403**	225 **5625**	230 **5764**	234 **5859**	237 **5928**	239 **5981**	241 **6022**	242 **6056**	243 **6082**	244 **6106**
2	18.51 **98.49**	19.00 **99.01**	19.16 **99.17**	19.25 **99.25**	19.30 **99.30**	19.33 **99.33**	19.36 **99.34**	19.37 **99.36**	19.38 **99.38**	19.39 **99.40**	19.40 **99.41**	19.41 **99.42**
3	10.13 **34.12**	9.55 **30.81**	9.28 **29.46**	9.12 **28.71**	9.01 **28.24**	8.94 **27.91**	8.88 **27.67**	8.84 **27.49**	8.81 **27.34**	8.78 **27.23**	8.76 **27.13**	8.74 **27.05**
4	7.71 **21.20**	6.94 **18.00**	6.59 **16.69**	6.39 **15.98**	6.26 **15.52**	6.16 **15.21**	6.09 **14.98**	6.04 **14.80**	6.00 **14.66**	5.96 **14.54**	5.93 **14.45**	5.91 **14.37**
5	6.61 **16.26**	5.79 **13.27**	5.41 **12.06**	5.19 **11.39**	5.05 **10.97**	4.95 **10.67**	4.88 **10.45**	4.82 **10.27**	4.78 **10.15**	4.74 **10.05**	4.70 **9.96**	4.68 **9.89**
6	5.99 **13.74**	5.14 **10.92**	4.76 **9.78**	4.53 **9.15**	4.39 **8.75**	4.28 **8.47**	4.21 **8.26**	4.15 **8.10**	4.10 **7.98**	4.06 **7.87**	4.03 **7.79**	4.00 **7.72**
7	5.59 **12.25**	4.74 **9.55**	4.35 **8.45**	4.12 **7.85**	3.97 **7.46**	3.87 **7.19**	3.79 **7.00**	3.73 **6.84**	3.68 **6.71**	3.63 **6.62**	3.60 **6.54**	3.57 **6.47**
8	5.32 **11.26**	4.46 **8.65**	4.07 **7.59**	3.84 **7.01**	3.69 **6.63**	3.58 **6.37**	3.50 **6.19**	3.44 **6.03**	3.39 **5.91**	3.34 **5.82**	3.31 **5.74**	3.28 **5.67**
9	5.12 **10.56**	4.26 **8.02**	3.86 **6.99**	3.63 **6.42**	3.48 **6.06**	3.37 **5.80**	3.29 **5.62**	3.23 **5.47**	3.18 **5.35**	3.13 **5.26**	3.10 **5.18**	3.07 **5.11**
10	4.96 **10.04**	4.10 **7.56**	3.71 **6.55**	3.48 **5.99**	3.33 **5.64**	3.22 **5.39**	3.14 **5.21**	3.07 **5.06**	3.02 **4.95**	2.97 **4.85**	2.94 **4.78**	2.91 **4.71**
11	4.84 **9.65**	3.98 **7.20**	3.59 **6.22**	3.36 **5.67**	3.20 **5.32**	3.09 **5.07**	3.01 **4.88**	2.95 **4.74**	2.90 **4.63**	2.86 **4.54**	2.82 **4.46**	2.79 **4.40**
12	4.75 **9.33**	3.88 **6.93**	3.49 **5.95**	3.26 **5.41**	3.11 **5.06**	3.00 **4.82**	2.92 **4.65**	2.85 **4.50**	2.80 **4.39**	2.76 **4.30**	2.72 **4.22**	2.69 **4.16**
13	4.67 **9.07**	3.80 **6.70**	3.41 **5.74**	3.18 **5.20**	3.02 **4.86**	2.92 **4.62**	2.84 **4.44**	2.77 **4.30**	2.72 **4.19**	2.67 **4.10**	2.63 **4.02**	2.60 **3.96**
14	4.60 **8.86**	3.74 **6.51**	3.34 **5.56**	3.11 **5.03**	2.96 **4.69**	2.85 **4.46**	2.77 **4.28**	2.70 **4.14**	2.65 **4.03**	2.60 **3.94**	2.56 **3.86**	2.53 **3.80**
15	4.54 **8.68**	3.68 **6.36**	3.29 **5.42**	3.06 **4.89**	2.90 **4.56**	2.79 **4.32**	2.70 **4.14**	2.64 **4.00**	2.59 **3.89**	2.55 **3.80**	2.51 **3.73**	2.48 **3.67**
16	4.49 **8.53**	3.63 **6.23**	3.24 **5.29**	3.01 **4.77**	2.85 **4.44**	2.74 **4.20**	2.66 **4.03**	2.59 **3.89**	2.54 **3.78**	2.49 **3.69**	2.45 **3.61**	2.42 **3.55**

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* This table gives values of *F* which one would expect to exceed by chance alone 5% and 1% of the time.

EQUALITY OF VARIANCES

Points for the Distribution of F

Degrees of freedom for lesser mean square	Degrees of freedom for greater mean square											
	14	16	20	24	30	40	50	75	100	200	500	∞
1	245 **6142**	246 **6169**	248 **6208**	249 **6234**	250 **6258**	251 **6286**	252 **6302**	253 **6323**	253 **6334**	254 **6352**	254 **6361**	254 **6366**
2	19.42 **99.43**	19.43 **99.44**	19.44 **99.45**	19.45 **99.46**	19.46 **99.47**	19.47 **99.48**	19.47 **99.48**	19.48 **99.49**	19.49 **99.49**	19.49 **99.49**	19.50 **99.50**	19.50 **99.50**
3	8.71 **26.92**	8.69 **26.83**	8.66 **26.69**	8.64 **26.60**	8.62 **26.50**	8.60 **26.41**	8.58 **26.30**	8.57 **26.27**	8.56 **26.23**	8.54 **26.18**	8.54 **26.14**	8.53 **26.12**
4	5.87 **14.24**	5.84 **14.15**	5.80 **14.02**	5.77 **13.93**	5.74 **13.83**	5.71 **13.74**	5.70 **13.69**	5.68 **13.61**	5.66 **13.57**	5.65 **13.52**	5.64 **13.48**	5.63 **13.46**
5	4.64 **9.77**	4.60 **9.68**	4.56 **9.55**	4.53 **9.47**	4.50 **9.38**	4.46 **9.29**	4.44 **9.24**	4.42 **9.17**	4.40 **9.13**	4.38 **9.07**	4.37 **9.04**	4.36 **9.02**
6	3.96 **7.60**	3.92 **7.52**	3.87 **7.39**	3.84 **7.31**	3.81 **7.23**	3.77 **7.14**	3.75 **7.09**	3.72 **7.02**	3.71 **6.99**	3.69 **6.94**	3.68 **6.90**	3.67 **6.88**
7	3.52 **6.35**	3.49 **6.27**	3.44 **6.15**	3.41 **6.07**	3.38 **5.98**	3.34 **5.90**	3.32 **5.85**	3.29 **5.78**	3.28 **5.75**	3.25 **5.70**	3.24 **5.67**	3.23 **5.65**
8	3.23 **5.56**	3.20 **5.48**	3.15 **5.36**	3.12 **5.28**	3.08 **5.20**	3.05 **5.11**	3.03 **5.06**	3.00 **5.00**	2.98 **4.96**	2.96 **4.91**	2.94 **4.88**	2.93 **4.86**
9	3.02 **5.00**	2.98 **4.92**	2.93 **4.80**	2.90 **4.73**	2.86 **4.64**	2.82 **4.56**	2.80 **4.51**	2.77 **4.45**	2.76 **4.41**	2.73 **4.36**	2.72 **4.33**	2.71 **4.31**
10	2.86 **4.60**	2.82 **4.52**	2.77 **4.41**	2.74 **4.33**	2.70 **4.25**	2.67 **4.17**	2.64 **4.12**	2.61 **4.05**	2.59 **4.01**	2.56 **3.96**	2.55 **3.93**	2.54 **3.91**
11	2.74 **4.29**	2.70 **4.21**	2.65 **4.10**	2.61 **4.02**	2.57 **3.94**	2.53 **3.86**	2.50 **3.80**	2.47 **3.74**	2.45 **3.70**	2.42 **3.66**	2.41 **3.62**	2.40 **3.60**
12	2.64 **4.05**	2.60 **3.98**	2.54 **3.86**	2.50 **3.78**	2.46 **3.70**	2.42 **3.61**	2.40 **3.56**	2.36 **3.49**	2.35 **3.46**	2.32 **3.41**	2.31 **3.38**	2.30 **3.36**
13	2.55 **3.85**	2.51 **3.78**	2.46 **3.67**	2.42 **3.59**	2.38 **3.51**	2.34 **3.42**	2.32 **3.37**	2.28 **3.30**	2.26 **3.27**	2.24 **3.21**	2.22 **3.18**	2.21 **3.16**
14	2.48 **3.70**	2.44 **3.62**	2.39 **3.51**	2.35 **3.43**	2.31 **3.34**	2.27 **3.26**	2.24 **3.21**	2.21 **3.14**	2.19 **3.11**	2.16 **3.06**	2.14 **3.02**	2.13 **3.00**
15	2.43 **3.56**	2.39 **3.48**	2.33 **3.36**	2.29 **3.29**	2.25 **3.20**	2.21 **3.12**	2.18 **3.07**	2.15 **3.00**	2.12 **2.97**	2.10 **2.92**	2.08 **2.89**	2.07 **2.87**
16	2.37 **3.45**	2.33 **3.37**	2.28 **3.25**	2.24 **3.18**	2.20 **3.10**	2.16 **3.01**	2.13 **2.96**	2.09 **2.89**	2.07 **2.86**	2.04 **2.80**	2.02 **2.77**	2.01 **2.75**

TABLE FOR *F* TEST FOR

5% (Roman Type) and 1% (Bold-Face Type) Points

Degrees of freedom for lesser mean square	Degrees of freedom for greater mean square											
	1	2	3	4	5	6	7	8	9	10	11	12
17	4.45 **8.40**	3.59 **6.11**	3.20 **5.18**	2.96 **4.67**	2.81 **4.34**	2.70 **4.10**	2.62 **3.93**	2.55 **3.79**	2.50 **3.68**	2.45 **3.59**	2.41 **3.52**	2.38 **3.45**
18	4.41 **8.28**	3.55 **6.01**	3.16 **5.09**	2.93 **4.58**	2.77 **4.25**	2.66 **4.01**	2.58 **3.85**	2.51 **3.71**	2.46 **3.60**	2.41 **3.51**	2.37 **3.44**	2.34 **3.37**
19	4.38 **8.18**	3.52 **5.93**	3.13 **5.01**	2.90 **4.50**	2.74 **4.17**	2.63 **3.94**	2.55 **3.77**	2.48 **3.63**	2.43 **3.52**	2.38 **3.43**	2.34 **3.36**	2.31 **3.30**
20	4.35 **8.10**	3.49 **5.85**	3.10 **4.94**	2.87 **4.43**	2.71 **4.10**	2.60 **3.87**	2.52 **3.71**	2.45 **3.56**	2.40 **3.45**	2.35 **3.37**	2.31 **3.30**	2.28 **3.23**
21	4.32 **8.02**	3.47 **5.78**	3.07 **4.87**	2.84 **4.37**	2.68 **4.04**	2.57 **3.81**	2.49 **3.65**	2.42 **3.51**	2.37 **3.40**	2.32 **3.31**	2.28 **3.24**	2.25 **3.17**
22	4.30 **7.94**	3.44 **5.72**	3.05 **4.82**	2.82 **4.31**	2.66 **3.99**	2.55 **3.76**	2.47 **3.59**	2.40 **3.45**	2.35 **3.35**	2.30 **3.26**	2.26 **3.18**	2.23 **3.12**
23	4.28 **7.88**	3.42 **5.66**	3.03 **4.76**	2.80 **4.26**	2.64 **3.94**	2.53 **3.71**	2.45 **3.54**	2.38 **3.41**	2.32 **3.30**	2.28 **3.21**	2.24 **3.14**	2.20 **3.07**
24	4.26 **7.82**	3.40 **5.61**	3.01 **4.72**	2.78 **4.22**	2.62 **3.90**	2.51 **3.67**	2.43 **3.50**	2.36 **3.36**	2.30 **3.25**	2.26 **3.17**	2.22 **3.09**	2.18 **3.03**
25	4.24 **7.77**	3.38 **5.57**	2.99 **4.68**	2.76 **4.18**	2.60 **3.86**	2.49 **3.63**	2.41 **3.46**	2.34 **3.32**	2.28 **3.21**	2.24 **3.13**	2.20 **3.05**	2.16 **2.99**
26	4.22 **7.72**	3.37 **5.53**	2.89 **4.64**	2.74 **4.14**	2.59 **3.82**	2.47 **3.59**	2.39 **3.42**	2.32 **3.29**	2.27 **3.17**	2.22 **3.09**	2.18 **3.02**	2.15 **2.96**
27	4.21 **7.68**	3.35 **5.49**	2.96 **4.60**	2.73 **4.11**	2.57 **3.79**	2.46 **3.56**	2.37 **3.39**	2.30 **3.26**	2.25 **3.14**	2.20 **3.06**	2.16 **2.98**	2.13 **2.93**
28	4.20 **7.64**	3.34 **5.45**	2.95 **4.57**	2.71 **4.07**	2.56 **3.76**	2.44 **3.53**	2.36 **3.36**	2.29 **3.23**	3.24 **3.11**	2.19 **3.03**	2.15 **2.95**	2.12 **2.90**
29	4.18 **7.60**	3.33 **5.52**	2.93 **4.54**	2.70 **4.04**	2.54 **3.73**	2.43 **3.50**	2.35 **3.33**	2.28 **3.20**	2.22 **3.08**	2.18 **3.00**	2.14 **2.92**	2.10 **2.87**
30	4.17 **7.56**	3.32 **5.39**	2.92 **4.51**	2.69 **4.02**	2.53 **3.70**	2.42 **3.47**	2.34 **3.30**	2.27 **3.17**	2.21 **3.06**	2.16 **2.98**	2.12 **2.90**	2.09 **2.84**
32	4.15 **7.50**	3.30 **5.34**	2.90 **4.46**	2.67 **3.97**	2.51 **3.66**	2.40 **3.42**	2.32 **3.25**	2.25 **3.12**	2.19 **3.01**	2.14 **2.94**	2.10 **2.86**	2.07 **2.80**
34	4.13 **7.44**	3.28 **5.29**	2.88 **4.42**	2.65 **3.93**	2.49 **3.61**	2.38 **3.38**	2.30 **3.21**	2.23 **3.08**	2.17 **2.97**	2.12 **2.89**	2.08 **2.82**	2.05 **2.76**
36	4.11 **7.39**	3.26 **5.25**	2.86 **4.38**	2.63 **3.89**	2.48 **3.58**	2.36 **3.35**	2.28 **3.18**	2.21 **3.04**	2.15 **2.94**	2.10 **2.86**	2.06 **2.78**	2.03 **2.72**
38	4.10 **7.35**	3.25 **5.21**	2.85 **4.34**	2.62 **3.86**	2.46 **3.54**	2.35 **3.32**	2.26 **3.15**	2.19 **3.02**	2.14 **2.91**	2.09 **2.82**	2.05 **2.75**	2.02 **2.69**
40	4.08 **7.31**	3.23 **5.18**	2.84 **4.31**	2.61 **3.83**	2.45 **3.51**	2.34 **3.29**	2.25 **3.12**	2.18 **2.99**	2.12 **2.88**	2.07 **2.80**	2.04 **2.73**	2.00 **2.66**
42	4.07 **7.27**	3.22 **5.15**	2.83 **4.29**	2.59 **3.80**	2.44 **3.49**	2.32 **3.26**	2.24 **3.10**	2.17 **2.96**	2.11 **2.86**	2.06 **2.77**	2.02 **2.70**	1.99 **2.64**
44	4.06 **7.24**	3.21 **5.12**	2.82 **4.26**	2.58 **3.78**	2.43 **3.46**	2.31 **3.24**	2.23 **3.07**	2.16 **2.94**	2.10 **2.84**	2.05 **2.75**	2.01 **2.68**	1.98 **2.62**

EQUALITY OF VARIANCES (Continued)

FOR THE DISTRIBUTION OF F (Continued)

Degrees of freedom for lesser mean square	Degrees of freedom for greater mean square											
	14	16	20	24	30	40	50	75	100	200	500	∞
17	2.33 **3.35**	2.29 **3.27**	2.23 **3.16**	2.19 **3.08**	2.15 **3.00**	2.11 **2.92**	2.08 **2.86**	2.04 **2.79**	2.02 **2.76**	1.99 **2.70**	1.97 **2.67**	1.96 **2.65**
18	2.29 **3.27**	2.25 **3.19**	2.19 **3.07**	2.15 **3.00**	2.11 **2.91**	2.07 **2.83**	2.04 **2.78**	2.00 **2.71**	1.98 **2.68**	1.95 **2.62**	1.93 **2.59**	1.92 **2.57**
19	2.26 **3.19**	2.21 **3.12**	2.15 **3.00**	2.11 **2.92**	2.07 **2.84**	2.02 **2.76**	2.00 **2.70**	1.96 **2.63**	1.94 **2.60**	1.91 **2.54**	1.90 **2.51**	1.88 **2.49**
20	2.23 **3.13**	2.18 **3.05**	2.12 **2.94**	2.08 **2.86**	2.04 **2.77**	1.99 **2.69**	1.96 **2.63**	1.92 **2.56**	1.90 **2.53**	1.87 **2.47**	1.85 **2.44**	1.84 **2.42**
21	2.20 **3.07**	2.15 **2.99**	2.09 **2.88**	2.05 **2.80**	2.00 **2.72**	1.96 **2.63**	1.93 **2.58**	1.89 **2.51**	1.87 **2.47**	1.84 **2.42**	1.82 **2.38**	1.81 **2.36**
22	2.18 **3.02**	2.13 **2.94**	2.07 **2.83**	2.03 **2.75**	1.98 **2.67**	1.93 **2.58**	1.91 **2.53**	1.87 **2.46**	1.84 **2.42**	1.81 **2.37**	1.80 **2.33**	1.78 **2.31**
23	2.14 **2.97**	2.10 **2.89**	2.04 **2.78**	2.00 **2.70**	1.96 **2.62**	1.91 **2.53**	1.88 **2.48**	1.84 **2.41**	1.82 **2.37**	1.79 **2.32**	1.77 **2.28**	1.76 **2.26**
24	2.13 **2.93**	2.09 **2.85**	2.02 **2.74**	1.98 **2.66**	1.94 **2.58**	1.89 **2.49**	1.86 **2.44**	1.82 **2.36**	1.80 **2.33**	1.76 **2.27**	1.74 **2.23**	1.73 **2.21**
25	2.11 **2.89**	2.06 **2.81**	2.00 **2.70**	1.96 **2.62**	1.92 **2.54**	1.87 **2.45**	1.84 **2.40**	1.80 **2.32**	1.77 **2.29**	1.74 **2.23**	1.72 **2.19**	1.71 **2.17**
26	2.10 **2.86**	2.05 **2.77**	1.99 **2.66**	1.95 **2.58**	1.90 **2.50**	1.85 **2.41**	1.82 **2.36**	1.78 **2.28**	1.76 **2.25**	1.72 **2.19**	1.70 **2.15**	1.69 **2.13**
27	2.08 **2.83**	2.03 **2.74**	1.97 **2.63**	1.93 **2.55**	1.88 **2.47**	1.84 **2.38**	1.80 **2.33**	1.76 **2.25**	1.74 **2.21**	1.71 **2.16**	1.68 **2.12**	1.67 **2.10**
28	2.06 **2.80**	2.02 **2.71**	1.96 **2.60**	1.91 **2.52**	1.87 **2.44**	1.81 **2.35**	1.78 **2.30**	1.75 **2.22**	1.72 **2.18**	1.69 **2.13**	1.67 **2.09**	1.65 **2.06**
29	2.05 **2.77**	2.00 **2.68**	1.94 **2.57**	1.90 **2.49**	1.85 **2.41**	1.80 **2.32**	1.77 **2.27**	1.73 **2.19**	1.71 **2.15**	1.68 **2.10**	1.65 **2.06**	1.64 **2.03**
30	2.04 **2.74**	1.99 **2.66**	1.93 **2.55**	1.89 **2.47**	1.84 **2.38**	1.79 **2.29**	1.76 **2.24**	1.72 **2.16**	1.69 **2.13**	1.66 **2.07**	1.64 **2.03**	1.62 **2.01**
32	2.02 **2.70**	1.97 **2.62**	1.91 **2.51**	1.86 **2.42**	1.82 **2.34**	1.76 **2.25**	1.74 **2.20**	1.69 **2.12**	1.67 **2.08**	1.64 **2.02**	1.61 **1.98**	1.59 **1.96**
34	2.00 **2.66**	1.95 **2.58**	1.89 **2.47**	1.84 **2.38**	1.80 **2.30**	1.74 **2.21**	1.71 **2.15**	1.67 **2.08**	1.64 **2.04**	1.61 **1.98**	1.59 **1.94**	1.57 **1.91**
36	1.89 **2.62**	1.93 **2.54**	1.87 **2.43**	1.82 **2.35**	1.78 **2.26**	1.72 **2.17**	1.69 **2.12**	1.65 **2.04**	1.62 **2.00**	1.59 **1.94**	1.56 **1.90**	1.55 **1.87**
38	1.96 **2.59**	1.92 **2.51**	1.85 **2.40**	1.80 **2.32**	1.76 **2.22**	1.71 **2.14**	1.67 **2.08**	1.63 **2.00**	1.60 **1.97**	1.57 **1.90**	1.54 **1.86**	1.53 **1.84**
40	1.95 **2.56**	1.90 **2.49**	1.84 **2.37**	1.79 **2.29**	1.74 **2.20**	1.69 **2.11**	1.66 **2.05**	1.61 **1.97**	1.59 **1.94**	1.55 **1.88**	1.53 **1.84**	1.51 **1.81**
42	1.94 **2.54**	1.89 **2.46**	1.82 **2.35**	1.78 **2.26**	1.73 **2.17**	1.68 **2.08**	1.64 **2.02**	1.60 **1.94**	1.57 **1.91**	1.54 **1.85**	1.51 **1.80**	1.49 **1.78**
44	1.92 **2.52**	1.88 **2.44**	1.81 **2.32**	1.76 **2.24**	1.72 **2.15**	1.66 **2.06**	1.63 **2.00**	1.58 **1.92**	1.56 **1.88**	1.52 **1.82**	1.50 **1.78**	1.48 **1.75**

TABLE FOR *F* TEST FOR

5% (Roman Type) and 1% (**Bold-Face Type**) Points

Degrees of freedom for lesser mean square	Degrees of freedom for greater mean square											
	1	2	3	4	5	6	7	8	9	10	11	12
46	4.05 **7.21**	3.20 **5.10**	2.81 **4.24**	2.57 **3.76**	2.42 **3.44**	2.30 **3.22**	2.22 **3.05**	2.14 **2.92**	2.09 **2.82**	2.04 **2.73**	2.00 **2.66**	1.97 **2.60**
48	4.04 **7.19**	3.19 **5.08**	2.80 **4.22**	2.56 **3.74**	2.41 **3.42**	2.30 **3.20**	2.21 **3.04**	2.14 **2.90**	2.08 **2.80**	2.03 **2.71**	1.99 **2.64**	1.96 **2.58**
50	4.03 **7.17**	3.18 **5.06**	2.79 **4.20**	2.56 **3.72**	2.40 **3.41**	2.29 **3.18**	2.20 **3.02**	2.13 **2.88**	2.07 **2.78**	2.02 **2.70**	1.98 **2.62**	1.95 **2.56**
55	4.02 **7.12**	3.17 **5.01**	2.78 **4.16**	2.54 **3.68**	2.38 **3.37**	2.27 **3.15**	2.18 **2.98**	2.11 **2.85**	2.05 **2.75**	2.00 **2.66**	1.97 **2.59**	1.93 **2.53**
60	4.00 **7.08**	3.15 **4.98**	2.76 **4.13**	2.52 **3.65**	2.37 **3.34**	2.25 **3.12**	2.17 **2.95**	2.10 **2.82**	2.04 **2.72**	1.99 **2.63**	1.95 **2.56**	1.92 **2.50**
65	3.99 **7.04**	3.14 **4.95**	2.75 **4.10**	2.51 **3.62**	2.36 **3.31**	2.24 **3.09**	2.15 **2.93**	2.08 **2.79**	2.02 **2.70**	1.98 **2.61**	1.94 **2.54**	1.90 **2.47**
70	3.98 **7.01**	3.13 **4.92**	2.74 **4.08**	2.50 **3.60**	2.35 **3.29**	2.32 **3.07**	2.14 **2.91**	2.07 **2.77**	2.01 **2.67**	1.97 **2.59**	1.93 **2.51**	1.89 **2.45**
80	3.96 **6.96**	3.11 **4.88**	2.72 **4.04**	2.48 **3.56**	2.33 **3.25**	2.21 **3.04**	2.12 **2.87**	2.05 **2.74**	1.99 **2.64**	1.95 **2.55**	1.91 **2.48**	1.88 **2.41**
100	3.94 **6.90**	3.09 **4.82**	2.70 **3.98**	2.46 **3.51**	2.30 **3.20**	2.19 **2.99**	2.10 **2.82**	2.03 **2.69**	1.97 **2.59**	1.92 **2.51**	1.88 **2.43**	1.85 **2.36**
125	3.92 **6.84**	3.07 **4.78**	2.68 **3.94**	2.44 **3.47**	2.29 **3.17**	2.17 **2.95**	2.08 **2.79**	2.01 **2.65**	1.95 **2.56**	1.90 **2.47**	1.86 **2.40**	1.83 **2.33**
150	3.91 **6.81**	3.06 **4.75**	2.67 **3.91**	2.43 **3.44**	2.27 **3.13**	2.16 **2.92**	2.07 **2.76**	2.00 **2.62**	1.94 **2.53**	1.89 **2.44**	1.85 **2.37**	1.82 **2.30**
200	3.89 **6.76**	3.04 **4.71**	2.65 **3.88**	2.41 **3.41**	2.26 **3.11**	2.14 **2.90**	2.05 **2.73**	1.98 **2.60**	1.92 **2.50**	1.87 **2.41**	1.83 **2.34**	1.80 **2.28**
400	3.86 **6.70**	3.02 **4.66**	2.62 **3.83**	2.39 **3.36**	2.23 **3.06**	2.12 **2.85**	2.03 **2.69**	1.96 **2.55**	1.90 **2.46**	1.85 **2.37**	1.81 **2.29**	1.78 **2.23**
1000	3.85 **6.66**	3.00 **4.62**	2.61 **3.80**	2.38 **3.34**	2.22 **3.04**	2.10 **2.82**	2.02 **2.66**	1.95 **2.53**	1.89 **2.43**	1.84 **2.34**	1.80 **2.26**	1.76 **2.20**
∞	3.84 **6.64**	2.99 **4.60**	2.60 **3.78**	2.37 **3.32**	2.21 **3.02**	2.09 **2.80**	2.01 **2.64**	1.94 **2.51**	1.88 **2.41**	1.83 **2.32**	1.79 **2.24**	1.75 **2.18**

EQUALITY OF VARIANCES (Continued)

FOR THE DISTRIBUTION OF F (Continued)

Degrees of freedom for lesser mean square	Degrees of freedom for greater mean square											
	14	16	20	24	30	40	50	75	100	200	500	∞
46	1.91 **2.50**	1.87 **2.42**	1.80 **2.30**	1.75 **2.22**	1.71 **2.13**	1.65 **2.04**	1.62 **1.98**	1.57 **1.90**	1.54 **1.86**	1.51 **1.80**	1.48 **1.76**	1.46 **1.72**
48	1.90 **2.48**	1.86 **2.40**	1.79 **2.28**	1.74 **2.20**	1.70 **2.11**	1.64 **2.02**	1.61 **1.96**	1.56 **1.88**	1.53 **1.84**	1.50 **1.78**	1.47 **1.73**	1.45 **1.70**
50	1.90 **2.46**	1.85 **2.39**	1.78 **2.26**	1.74 **2.18**	1.69 **2.10**	1.63 **2.00**	1.60 **1.94**	1.55 **1.86**	1.52 **1.82**	1.48 **1.76**	1.46 **1.71**	1.44 **1.68**
55	1.88 **2.43**	1.83 **2.35**	1.76 **2.23**	1.72 **2.15**	1.67 **2.06**	1.61 **1.96**	1.58 **1.90**	1.52 **1.82**	1.50 **1.78**	1.46 **1.71**	1.43 **1.66**	1.41 **1.64**
60	1.86 **2.40**	1.81 **2.32**	1.75 **2.20**	1.70 **2.12**	1.65 **2.03**	1.59 **1.93**	1.56 **1.87**	1.50 **1.79**	1.48 **1.74**	1.44 **1.68**	1.41 **1.63**	1.39 **1.60**
65	1.85 **2.37**	1.80 **2.30**	1.73 **2.18**	1.68 **2.09**	1.63 **2.00**	1.57 **1.90**	1.54 **1.84**	1.49 **1.76**	1.46 **1.71**	1.42 **1.64**	1.39 **1.60**	1.37 **1.56**
70	1.84 **2.35**	1.79 **2.28**	1.72 **2.15**	1.67 **2.07**	1.62 **1.98**	1.56 **1.88**	1.53 **1.82**	1.47 **1.74**	1.45 **1.69**	1.40 **1.62**	1.37 **1.56**	1.35 **1.53**
80	1.82 **2.32**	1.77 **2.24**	1.70 **2.11**	1.65 **2.03**	1.60 **1.94**	1.54 **1.84**	1.51 **1.78**	1.45 **1.70**	1.42 **1.65**	1.38 **1.57**	1.35 **1.52**	1.32 **1.49**
100	1.79 **2.26**	1.75 **2.19**	1.68 **2.06**	1.63 **1.98**	1.57 **1.89**	1.51 **1.79**	1.48 **1.73**	1.42 **1.64**	1.39 **1.59**	1.34 **1.51**	1.30 **1.46**	1.28 **1.43**
125	1.77 **2.23**	1.72 **2.15**	1.65 **2.03**	1.60 **1.94**	1.55 **1.85**	1.49 **1.75**	1.45 **1.68**	1.39 **1.59**	1.36 **1.54**	1.31 **1.46**	1.27 **1.40**	1.25 **1.37**
150	1.76 **2.20**	1.71 **2.12**	1.64 **2.00**	1.59 **1.91**	1.54 **1.83**	1.47 **1.72**	1.44 **1.66**	1.37 **1.56**	1.34 **1.51**	1.29 **1.43**	1.25 **1.37**	1.22 **1.33**
200	1.74 **1.17**	1.69 **2.09**	1.62 **1.97**	1.57 **1.88**	1.52 **1.79**	1.45 **1.69**	1.42 **1.62**	1.35 **1.53**	1.32 **1.48**	1.26 **1.39**	1.22 **1.33**	1.19 **1.28**
400	1.72 **2.12**	1.67 **2.04**	1.60 **1.92**	1.54 **1.84**	1.49 **1.74**	1.42 **1.64**	1.38 **1.57**	1.32 **1.47**	1.28 **1.42**	1.22 **1.32**	1.16 **1.24**	1.13 **1.19**
1000	1.70 **2.09**	1.65 **2.01**	1.58 **1.89**	1.53 **1.81**	1.47 **1.71**	1.41 **1.61**	1.36 **1.54**	1.30 **1.44**	1.26 **1.38**	1.19 **1.28**	1.13 **1.19**	1.08 **1.11**
∞	1.69 **2.07**	1.64 **1.99**	1.57 **1.87**	1.52 **1.79**	1.46 **1.69**	1.40 **1.59**	1.35 **1.52**	1.28 **1.41**	1.24 **1.36**	1.17 **1.25**	1.11 **1.15**	1.00 **1.00**

ELLIPTIC INTEGRALS

COMPLETE ELLIPTIC INTEGRALS

$$K = \int_0^{\pi/2} \frac{d\Phi}{\sqrt{1 - k^2 \sin^2 \Phi}}.$$

$$E = \int_0^{\pi/2} \sqrt{1 - k^2 \sin^2 \Phi} \cdot d\Phi = E\left(k, \frac{\pi}{2}\right)$$

$\sin^{-1} k$	K	$\log K$	$\sin^{-1} k$	K	$\log K$
0°	1.5708	0.196120	**40°**	1.7868	0.252068
1	1.5709	0.196153	41	1.7992	0.255085
2	1.5713	0.196252	42	1.8122	0.258197
3	1.5719	0.196418	43	1.8256	0.261406
4	1.5727	0.196649	44	1.8396	0.264716
5	1.5738	0.196947	**45**	1.8541	0.268127
6	1.5751	0.197312	46	1.8691	0.271644
7	1.5767	0.197743	47	1.8848	0.275267
8	1.5785	0.198241	48	1.9011	0.279001
9	1.5805	0.198806	49	1.9180	0.282848
10	1.5828	0.199438	**50**	1.9356	0.286811
11	1.5854	0.200137	51	1.9539	0.290895
12	1.5882	0.200904	52	1.9729	0.295101
13	1.5913	0.201740	53	1.9927	0.299435
14	1.5946	0.202643	54	2.0133	0.303901
15	1.5981	0.203615	**55**	2.0347	0.308504
16	1.6020	0.204657	56	2.0571	0.313247
17	1.6061	0.205768	57	2.0804	0.318138
18	1.6105	0.206948	58	2.1047	0.323182
19	1.6151	0.208200	59	2.1300	0.328384
20	1.6200	0.209522	**60**	2.1565	0.333753
21	1.6252	0.210916	61	2.1842	0.339295
22	1.6307	0.212382	62	2.2132	0.345020
23	1.6365	0.213921	63	2.2435	0.350936
24	1.6426	0.215533	64	2.2754	0.357053
25	1.6490	0.217219	**65**	2.3088	0.363384
26	1.6557	0.218981	66	2.3439	0.369940
27	1.6627	0.220818	67	2.3809	0.376736
28	1.6701	0.222732	68	2.4198	0.383787
29	1.6777	0.224723	69	2.4610	0.391112
30	1.6858	0.226793	**70**	2.5046	0.398730
31	1.6941	0.228943	71	2.5507	0.406665
32	1.7028	0.231173	72	2.5998	0.414943
33	1.7119	0.233485	73	2.6521	0.423596
34	1.7214	0.235880	74	2.7081	0.432660
35	1.7312	0.238359	**75**	2.7681	0.442176
36	1.7415	0.240923	76	2.8327	0.452196
37	1.7522	0.243575	77	2.9026	0.462782
38	1.7633	0.246315	78	2.9786	0.474008
39	1.7748	0.249146	79	3.0617	0.485967
40	1.7868	0.252068	**80**	3.1534	0.498777

COMPLETE ELLIPTIC INTEGRALS (Continued)

$\sin^{-1} k$	K	$\log K$	$\sin^{-1} k$	K	$\log K$
80°	3.1534	0.498777	**85°**	3.8317	0.583396
81	3.2553	0.512591	86	4.0528	0.607751
82	3.3699	0.527613	87	4.3387	0.637355
83	3.5004	0.544120	88	4.7427	0.676027
84	3.6519	0.562514	89	5.4349	0.735192
85	3.8317	0.583396	**90**	∞	∞

Values of K for $\sin^{-1} k$ = 85° to 89° by 0.1° and 89° to 90° by minutes.

$\sin^{-1} k$	K	$\log K$	$\sin^{-1} k$	K	$\log K$
85.0°	3.832	0.58343	**89° 0′**	5.435	0.73520
85.1	3.852	0.58569	89 2	5.469	0.73791
85.2	3.872	0.58794	89 4	5.504	0.74068
85.3	3.893	0.59028	89 6	5.540	0.74351
85.4	3.914	0.59262	89 8	5.578	0.74648
85.5	3.936	0.59506	**89 10**	5.617	0.74950
85.6	3.958	0.59748	89 12	5.658	0.75266
85.7	3.981	0.59999	89 14	5.700	0.75587
85.8	4.004	0.60249	89 16	5.745	0.75929
85.9	4.028	0.60509	89 18	5.791	0.76275
86.0	4.053	0.60778	**89 20**	5.840	0.76641
86.1	4.078	0.61045	89 22	5.891	0.77019
86.2	4.104	0.61321	89 24	5.946	0.77422
86.3	4.130	0.61595	89 26	6.003	0.77837
86.4	4.157	0.61878	89 28	6.063	0.78269
86.5	4.185	0.62170	**89 30**	6.128	0.78732
86.6	4.214	0.62469	89 32	6.197	0.79218
86.7	4.244	0.62778	89 34	6.271	0.79734
86.8	4.274	0.63083	89 36	6.351	0.80284
86.9	4.306	0.63407	89 38	6.438	0.80875
87.0	4.339	0.63739	**89 40**	6.533	0.81511
87.1	4.372	0.64068	89 41	6.584	0.81849
87.2	4.407	0.64414	89 42	6.639	0.82210
87.3	4.444	0.64777	89 43	6.696	0.82582
87.4	4.481	0.65137	89 44	6.756	0.82969
87.5	4.520	0.65514	**89 45**	6.821	0.83385
87.6	4.562	0.65916	89 46	6.890	0.83822
87.7	4.603	0.66304	89 47	6.964	0.84286
87.8	4.648	0.66727	89 48	7.044	0.84782
87.9	4.694	0.67154	89 49	7.131	0.85315
88.0	4.743	0.67605	**89 50**	7.226	0.85890
88.1	4.794	0.68070	89 51	7.332	0.86522
88.2	4.848	0.68556	89 52	7.449	0.87210
88.3	4.905	0.69064	89 53	7.583	0.87984
88.4	4.965	0.69592	89 54	7.737	0.88857
88.5	5.030	0.70157	**89 55**	7.919	0.89867
88.6	5.099	0.70749	89 56	8.143	0.91078
88.7	5.173	0.71374	89 57	8.430	0.92583
88.8	5.253	0.72041	89 58	8.836	0.94626
88.9	5.340	0.72754	89 59	9.529	0.97905
89.0	5.435	0.73520	**90 0**	∞	∞

COMPLETE ELLIPTIC INTEGRALS (Continued)

$\sin^{-1} k$	E	$\log E$	$\sin^{-1} k$	E	$\log E$
0°	1.5708	0.196120	**45°**	1.3506	0.130541
1	1.5707	0.196087	46	1.3418	0.127690
2	1.5703	0.195988	47	1.3329	0.124788
3	1.5697	0.195822	48	1.3238	0.121836
4	1.5689	0.195591	49	1.3147	0.118836
5	1.5678	0.195293	**50**	1.3055	0.115790
6	1.5665	0.194930	51	1.2963	0.112698
7	1.5649	0.194500	52	1.2870	0.109563
8	1.5632	0.194004	53	1.2776	0.106386
9	1.5611	0.193442	54	1.2681	0.103169
10	1.5589	0.192815	**55**	1.2587	0.099915
11	1.5564	0.192121	56	1.2492	0.096626
12	1.5537	0.191362	57	1.2397	0.093303
13	1.5507	0.190537	58	1.2301	0.089950
14	1.5476	0.189646	59	1.2206	0.086569
15	1.5442	0.188690	**60**	1.2111	0.083164
16	1.5405	0.187668	61	1.2015	0.079738
17	1.5367	0.186581	62	1.1920	0.076293
18	1.5326	0.185428	63	1.1826	0.072834
19	1.5283	0.184210	64	1.1732	0.069364
20	1.5238	0.182928	**65**	1.1638	0.065889
21	1.5191	0.181580	66	1.1545	0.062412
22	1.5141	0.180168	67	1.1453	0.058937
23	1.5090	0.178691	68	1.1362	0.055472
24	1.5037	0.177150	69	1.1272	0.052020
25	1.4981	0.175545	**70**	1.1184	0.048589
26	1.4924	0.173876	71	1.1096	0.045183
27	1.4864	0.172144	72	1.1011	0.041812
28	1.4803	0.170348	73	1.0927	0.038481
29	1.4740	0.168489	74	1.0844	0.035200
30	1.4675	0.166567	**75**	1.0764	0.031976
31	1.4608	0.164583	76	1.0686	0.028819
32	1.4539	0.162537	77	1.0611	0.025740
33	1.4469	0.160429	78	1.0538	0.022749
34	1.4397	0.158261	79	1.0468	0.019858
35	1.4323	0.156031	**80**	1.0401	0.017081
36	1.4248	0.153742	81	1.0338	0.014432
37	1.4171	0.151393	82	1.0278	0.011927
38	1.4092	0.148985	83	1.0223	0.009584
39	1.4013	0.146519	84	1.0172	0.007422
40	1.3931	0.143995	**85**	1.0127	0.005465
41	1.3849	0.141414	86	1.0086	0.003740
42	1.3765	0.138778	87	1.0053	0.002278
43	1.3680	0.136086	88	1.0026	0.001121
44	1.3594	0.133340	89	1.0008	0.000326
45	1.3506	0.130541	**90**	1.0000	0.000000

ELLIPTIC INTEGRALS OF THE FIRST KIND: *F*(*k*, *φ*)

$$F(k, \phi) = \int_0^{\phi} \frac{d\Phi}{\sqrt{1 - k^2 \sin^2 \Phi}}, \qquad \theta = \sin^{-1} k$$

φ \ θ	5°	10°	15°	20°	25°	30°	35°	40°	45°
1°	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175
2°	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349
3°	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524
4°	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698
5°	0.0873	0.0873	0.0873	0.0873	0.0873	0.0873	0.0873	0.0873	0.0873
6°	0.1047	0.1047	0.1047	0.1047	0.1048	0.1048	0.1048	0.1048	0.1048
7°	0.1222	0.1222	0.1222	0.1222	0.1222	0.1222	0.1223	0.1223	0.1223
8°	0.1396	0.1396	0.1397	0.1397	0.1397	0.1397	0.1398	0.1398	0.1399
9°	0.1571	0.1571	0.1571	0.1572	0.1572	0.1572	0.1573	0.1573	0.1574
10°	0.1745	0.1746	0.1746	0.1746	0.1747	0.1748	0.1748	0.1749	0.1750
11°	0.1920	0.1920	0.1921	0.1921	0.1922	0.1923	0.1924	0.1925	0.1926
12°	0.2095	0.2095	0.2095	0.2096	0.2097	0.2098	0.2099	0.2101	0.2102
13°	0.2269	0.2270	0.2270	0.2271	0.2272	0.2274	0.2275	0.2277	0.2279
14°	0.2444	0.2444	0.2445	0.2446	0.2448	0.2450	0.2451	0.2453	0.2456
15°	0.2618	0.2619	0.2620	0.2621	0.2623	0.2625	0.2628	0.2630	0.2633
16°	0.2793	0.2794	0.2795	0.2797	0.2799	0.2802	0.2804	0.2808	0.2811
17°	0.2967	0.2968	0.2970	0.2972	0.2975	0.2978	0.2981	0.2985	0.2989
18°	0.3142	0.3143	0.3145	0.3148	0.3151	0.3154	0.3159	0.3163	0.3167
19°	0.3317	0.3318	0.3320	0.3323	0.3327	0.3331	0.3336	0.3341	0.3347
20°	0.3491	0.3493	0.3495	0.3499	0.3503	0.3508	0.3514	0.3520	0.3526
21°	0.3666	0.3668	0.3671	0.3675	0.3680	0.3685	0.3692	0.3699	0.3706
22°	0.3840	0.3842	0.3846	0.3851	0.3856	0.3863	0.3871	0.3879	0.3887
23°	0.4015	0.4017	0.4021	0.4027	0.4033	0.4041	0.4049	0.4059	0.4068
24°	0.4190	0.4192	0.4197	0.4203	0.4210	0.4219	0.4229	0.4239	0.4250
25°	0.4364	0.4367	0.4372	0.4379	0.4387	0.4397	0.4408	0.4420	0.4433
26°	0.4539	0.4542	0.4548	0.4556	0.4565	0.4576	0.4588	0.4602	0.4616
27°	0.4714	0.4717	0.4724	0.4732	0.4743	0.4755	0.4769	0.4784	0.4800
28°	0.4888	0.4893	0.4899	0.4909	0.4921	0.4934	0.4950	0.4967	0.4985
29°	0.5063	0.5068	0.5075	0.5086	0.5099	0.5114	0.5132	0.5150	0.5170
30°	0.5238	0.5243	0.5251	0.5263	0.5277	0.5294	0.5313	0.5334	0.5356
31°	0.5412	0.5418	0.5427	0.5440	0.5456	0.5475	0.5496	0.5519	0.5543
32°	0.5587	0.5593	0.5603	0.5617	0.5635	0.5656	0.5679	0.5704	0.5731
33°	0.5762	0.5769	0.5780	0.5795	0.5814	0.5837	0.5862	0.5890	0.5920
34°	0.5937	0.5944	0.5956	0.5973	0.5994	0.6018	0.6046	0.6077	0.6109
35°	0.6111	0.6119	0.6133	0.6151	0.6173	0.6200	0.6231	0.6264	0.6300
36°	0.6286	0.6295	0.6309	0.6329	0 6353	0.6383	0.6416	0.6452	0.6491
37°	0.6461	0.6470	0.6486	0.6507	0.6534	0.6565	0.6602	0.6641	0.6684
38°	0.6636	0.6646	0.6662	0.6685	0.6714	0.6749	0.6788	0.6831	0.6877
39°	0.6810	0.6821	0.6839	0.6864	0.6895	0.6932	0.6975	0.7021	0.7071
40°	0.6985	0.6997	0.7016	0.7043	0.7076	0.7116	0.7162	0.7213	0.7267
41°	0.7160	0.7173	0.7193	0.7222	0.7258	0.7301	0.7350	0.7405	0.7463
42°	0.7335	0.7348	0.7370	0.7401	0.7440	0.7486	0.7539	0.7598	0.7661
43°	0.7510	0.7524	0.7548	0.7580	0.7622	0.7671	0.7728	0.7791	0.7859
44°	0.7685	0.7700	0.7725	0.7760	0.7804	0.7857	0.7918	0.7986	0.8059
45°	0.7859	0.7876	0.7903	0.7940	0.7987	0.8044	0.8109	0.8181	0.8260

ELLIPTIC INTEGRALS OF THE FIRST KIND: $F(k, \phi)$
(Continued)

$$F(k, \phi) = \int_0^\phi \frac{d\Phi}{\sqrt{1 - k^2 \sin^2 \Phi}}, \qquad \theta = \sin^{-1} k$$

ϕ \ θ	50°	55°	60°	65°	70°	75°	80°	85°	90°
1°	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175
2°	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349
3°	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524
4°	0.0698	0.0699	0.0699	0.0699	0.0699	0.0699	0.0699	0.0699	0.0699
5°	0.0873	0.0873	0.0873	0.0874	0.0874	0.0874	0.0874	0.0874	0.0874
6°	0.1048	0.1048	0.1049	0.1049	0.1049	0.1049	0.1049	0.1049	0.1049
7°	0.1224	0.1224	0.1224	0.1224	0.1224	0.1225	0.1225	0.1225	0.1225
8°	0.1399	0.1399	0.1400	0.1400	0.1400	0.1401	0.1401	0.1401	0.1401
9°	0.1575	0.1575	0.1576	0.1576	0.1577	0.1577	0.1577	0.1577	0.1577
10°	0.1751	0.1751	0.1752	0.1753	0.1753	0.1754	0.1754	0.1754	0.1754
11°	0.1927	0.1928	0.1929	0.1930	0.1930	0.1931	0.1931	0.1932	0.1932
12°	0.2103	0.2105	0.2106	0.2107	0.2108	0.2109	0.2109	0.2110	0.2110
13°	0.2280	0.2282	0.2284	0.2285	0.2286	0.2287	0.2288	0.2288	0.2289
14°	0.2458	0.2460	0.2462	0.2464	0.2465	0.2466	0.2467	0.2468	0.2468
15°	0.2636	0.2638	0.2641	0.2643	0.2645	0.2646	0.2647	0.2648	0.2648
16°	0.2814	0.2817	0.2820	0.2823	0.2825	0.2827	0.2828	0.2829	0.2830
17°	0.2993	0.2997	0.3000	0.3003	0.3006	0.3008	0.3010	0.3011	0.3012
18°	0.3172	0.3177	0.3181	0.3185	0.3188	0.3191	0.3193	0.3194	0.3195
19°	0.3352	0.3357	0.3362	0.3367	0.3371	0.3374	0.3377	0.3378	0.3379
20°	0.3533	0.3539	0.3545	0.3550	0.3555	0.3559	0.3561	0.3563	0.3564
21°	0.3714	0.3721	0.3728	0.3734	0.3740	0.3744	0.3747	0.3749	0.3750
22°	0.3896	0.3904	0.3912	0.3919	0.3926	0.3931	0.3935	0.3937	0.3938
23°	0.4078	0.4088	0.4097	0.4105	0.4113	0.4119	0.4123	0.4126	0.4127
24°	0.4261	0.4272	0.4283	0.4292	0.4301	0.4308	0.4313	0.4316	0.4317
25°	0.4446	0.4458	0.4470	0.4481	0.4490	0.4498	0.4504	0.4508	0.4509
26°	0.4630	0.4645	0.4658	0.4670	0.4681	0.4690	0.4697	0.4701	0.4702
27°	0.4816	0.4832	0.4847	0.4861	0.4873	0.4884	0.4891	0.4896	0.4897
28°	0.5003	0.5021	0.5038	0.5053	0.5067	0.5079	0.5087	0.5092	0.5094
29°	0.5190	0.5210	0.5229	0.5247	0.5262	0.5275	0.5285	0.5291	0.5293
30°	0.5379	0.5401	0.5422	0.5442	0.5459	0.5474	0.5484	0.5491	0.5493
31°	0.5568	0.5593	0.5617	0.5639	0.5658	0.5674	0.5686	0.5693	0.5696
32°	0.5759	0.5786	0.5812	0.5837	0.5858	0.5876	0.5889	0.5898	0.5900
33°	0.5950	0.5980	0.6010	0.6037	0.6060	0.6080	0.6095	0.6104	0.6107
34°	0.6143	0.6176	0.6208	0.6238	0.6265	0.6287	0.6303	0.6313	0.6317
35°	0.6336	0.6373	0.6408	0.6441	0.6471	0.6495	0.6513	0.6525	0.6528
36°	0.6531	0.6571	0.6610	0.6647	0.6679	0.6706	0.6726	0.6739	0.6743
37°	0.6727	0.6771	0.6814	0.6854	0.6890	0.6919	0.6941	0.6955	0.6960
38°	0.6925	0.6973	0.7019	0.7063	0.7102	0.7135	0.7159	0.7175	0.7180
39°	0.7123	0.7176	0.7227	0.7275	0.7318	0.7353	0.7380	0.7397	0.7403
40°	0.7323	0.7380	0.7436	0.7488	0.7535	0.7575	0.7604	0.7623	0.7629
41°	0.7524	0.7586	0.7647	0.7704	0.7756	0.7799	0.7331	0.7852	0.7859
42°	0.7727	0.7794	0.7860	0.7922	0.7979	0.8026	0.8062	0.8084	0.8092
43°	0.7931	0.8004	0.8075	0.8143	0.8204	0.8256	0.8295	0.8320	0.8328
44°	0.8136	0.8215	0.8293	0.8367	0.8433	0.8490	0.8533	0.8560	0.8569
45°	0.8343	0.8428	0.8512	0.8592	0.8665	0.8727	0.8774	0.8804	0.8814

ELLIPTIC INTEGRALS OF THE FIRST KIND: $F(k, \phi$
(Continued)

$$F(k, \phi) = \int_0^\phi \frac{d\Phi}{\sqrt{1 - k^2 \sin^2 \Phi}}, \qquad \theta = \sin^{-1} k$$

ϕ \ θ	5°	10°	15°	20°	25°	30°	35°	40°	45°
46°	0.8034	0.8052	0.8080	0.8120	0.8170	0.8230	0.8300	0.8378	0.8462
47°	0.8209	0.8227	0.8258	0.8300	0.8353	0.8418	0.8492	0.8575	0.8666
48°	0.8384	0.8403	0.8436	0.8480	0.8537	0.8606	0.8685	0.8773	0.8870
49°	0.8559	0.8579	0.8614	0.8661	0.8721	0.8794	0.8878	0.8972	0.9076
50°	0.8734	0.8756	0.8792	0.8842	0.8905	0.8982	0.9072	0.9173	0.9283
51°	0.8909	0.8932	0.8970	0.9023	0.9090	0.9172	0.9267	0.9374	0.9491
52°	0.9084	0.9108	0.9148	0.9204	0.9275	0.9361	0.9462	0.9575	0.9701
53°	0.9259	0.9284	0.9326	0.9385	0.9460	0.9551	0.9658	0.9778	0.9912
54°	0.9434	0.9460	0.9505	0.9567	0.9646	0.9742	0.9855	0.9982	1.0124
55°	0.9609	0.9637	0.9683	0.9748	0.9832	0.9933	1.0052	1.0187	1.0337
56°	0.9784	0.9813	0.9862	0.9930	1.0018	1.0125	1.0250	1.0393	1.0552
57°	0.9959	0.9989	1.0041	1.0112	1.0204	1.0317	1.0449	1.0600	1.0768
58°	1.0134	1.0166	1.0219	1.0295	1.0391	1.0509	1.0648	1.0807	1.0985
59°	1.0309	1.0342	1.0398	1.0477	1.0578	1.0702	1.0848	1.1016	1.1204
60°	1.0484	1.0519	1.0577	1.0660	1.0766	1.0896	1.1049	1.1226	1.1424
61°	1.0659	1.0695	1.0757	1.0843	1.0953	1.1089	1.1250	1.1436	1.1646
62°	1.0834	1.0872	1.0936	1.1026	1.1141	1.1284	1.1452	1.1648	1.1868
63°	1.1009	1.1049	1.1115	1.1209	1.1330	1.1478	1.1655	1.1860	1.2093
64°	1.1184	1.1225	1.1295	1.1392	1.1518	1.1674	1.1859	1.2073	1.2318
65°	1.1359	1.1402	1.1474	1.1575	1.1707	1.1869	1.2063	1.2288	1.2545
66°	1.1534	1.1579	1.1654	1.1759	1.1896	1.2065	1.2267	1.2503	1.2773
67°	1.1709	1.1756	1.1833	1.1943	1.2085	1.2262	1.2472	1.2719	1.3002
68°	1.1884	1.1932	1.2013	1.2127	1.2275	1.2458	1.2678	1.2936	1.3232
69°	1.2059	1.2109	1.2193	1.2311	1.2465	1.2655	1.2885	1.3154	1.3464
70°	1.2234	1.2286	1.2373	1.2495	1.2655	1.2853	1.3092	1.3372	1.3697
71°	1.2410	1.2463	1.2553	1.2680	1.2845	1.3051	1.3209	1.3592	1.3931
72°	1.2585	1.2640	1.2733	1.2864	1.3036	1.3249	1.3507	1.3812	1.4167
73°	1.2760	1.2817	1.2913	1.3049	1.3226	1.3448	1.3715	1.4033	1.4403
74°	1.2935	1.2994	1.3093	1.3234	1.3417	1.3647	1.3924	1.4254	1.4640
75°	1.3110	1.3171	1.3273	1.3418	1.3608	1.3846	1.4134	1.4477	1.4879
76°	1.3285	1.3348	1.3454	1.3603	1.3800	1.4045	1.4344	1.4700	1.5118
77°	1.3460	1.3525	1.3634	1.3788	1.3991	1.4245	1.4554	1.4923	1.5359
78°	1.3636	1.3702	1.3814	1.3974	1.4183	1.4445	1.4765	1.5147	1.5600
79°	1.3811	1.3879	1.3995	1.4159	1.4374	1.4645	1.4976	1.5372	1.5842
80°	1.3986	1.4056	1.4175	1.4344	1.4566	1.4846	1.5187	1.5597	1.6085
81°	1.4161	1.4234	1.4356	1.4530	1.4758	1.5046	1.5399	1.5823	1.6328
82°	1.4336	1.4411	1.4536	1.4715	1.4950	1.5247	1.5611	1.6049	1.6572
83°	1.4512	1.4588	1.4717	1.4901	1.5143	1.5448	1.5823	1.6276	1.6817
84°	1.4687	1.4765	1.4897	1.5086	1.5335	1.5649	1.6035	1.6502	1.7062
85°	1.4862	1.4942	1.5078	1.5272	1.5527	1.5850	1.6248	1.6730	1.7308
86°	1.5037	1.5120	1.5259	1.5457	1.5720	1.6052	1.6461	1.6957	1.7554
87°	1.5212	1.5297	1.5439	1.5643	1.5912	1.6253	1.6673	1.7184	1.7801
88°	1.5388	1.5474	1.5620	1.5829	1.6105	1.6454	1.6886	1.7412	1.8047
89°	1.5563	1.5651	1.5801	1.6015	1.6297	1.6656	1.7099	1.7640	1.8294
90°	1.5738	1.5828	1.5981	1.6200	1.6490	1.6858	1.7312	1.7868	1.8541

ELLIPTIC INTEGRALS OF THE FIRST KIND: $F(k, \phi)$
(Continued)

$$F(k, \phi) = \int_0^\phi \frac{d\Phi}{\sqrt{1 - k^2 \sin^2 \Phi}}, \qquad \theta = \sin^{-1} k$$

ϕ \ θ	50°	55°	60°	65°	70°	75°	80°	85°	90°
46°	0.8552	0.8643	0.8734	0.8821	0.8900	0.8968	0.9019	0.9052	0.9063
47°	0.8761	0.8860	0.8958	0.9053	0.9139	0.9212	0.9269	0.9304	0.9316
48°	0.8973	0.9079	0.9185	0.9287	0.9381	0.9461	0.9523	0.9561	0.9575
49°	0.9186	0.9300	0.9415	0.9525	0.9627	0.9714	0.9781	0.9824	0.9838
50°	0.9401	0.9523	0.9647	0.9766	0.9876	0.9971	1.0044	1.0091	1.0107
51°	0.9617	0.9748	0.9881	1.0010	1.0130	1.0233	1.0313	1.0364	1.0381
52°	0.9835	0.9976	1.0118	1.0258	1.0387	1.0499	1.0587	1.0642	1.0662
53°	1.0055	1.0205	1.0359	1.0509	1.0649	1.0771	1.0866	1.0927	1.0948
54°	1.0277	1.0437	1.0602	1.0764	1.0915	1.1048	1.1152	1.1219	1.1242
55°	1.0500	1.0672	1.0848	1.1022	1.1186	1.1331	1.1444	1.1517	1.1542
56°	1.0725	1.0908	1.1097	1.1285	1.1462	1.1619	1.1743	1.1823	1.1851
57°	1.0952	1.1147	1.1349	1.1551	1.1743	1.1914	1.2049	1.2136	1.2167
58°	1.1180	1.1389	1.1605	1.1822	1.2030	1.2215	1.2362	1.2458	1.2492
59°	1.1411	1.1632	1.1864	1.2097	1.2321	1.2522	1.2684	1.2789	1.2826
60°	1.1643	1.1879	1.2125	1.2376	1.2619	1.2837	1.3014	1.3129	1.3170
61°	1.1877	1.2128	1.2392	1.2660	1.2922	1.3159	1.3352	1.3480	1.3524
62°	1.2113	1.2379	1.2661	1.2949	1.3231	1.3490	1.3701	1.3841	1.3890
63°	1.2351	1.2633	1.2933	1.3242	1.3547	1.3828	1.4059	1.4214	1.4268
64°	1.2591	1.2890	1.3209	1.3541	1.3870	1.4175	1.4429	1.4599	1.4659
65°	1.2833	1.3149	1.3489	1.3844	1.4199	1.4532	1.4810	1.4998	1.5065
66°	1.3076	1.3411	1.3773	1.4153	1.4536	1.4898	1.5203	1.5411	1.5485
67°	1.3321	1.3675	1.4060	1.4467	1.4880	1.5274	1.5610	1.5840	1.5923
68°	1.3568	1.3942	1.4351	1.4786	1.5232	1.5661	1.6030	1.6287	1.6379
69°	1.3817	1.4212	1.4646	1.5111	1.5591	1.6059	1.6466	1.6752	1.6856
70°	1.4068	1.4484	1.4944	1.5441	1.5959	1.6468	1.6918	1.7237	1.7354
71°	1.4320	1.4759	1.5246	1.5777	1.6335	1.6891	1.7388	1.7745	1.7877
72°	1.4574	1.5036	1.5552	1.6118	1.6720	1.7326	1.7876	1.8277	1.8427
73°	1.4830	1.5315	1.5862	1.6465	1.7113	1.7774	1.8384	1.8837	1.9008
74°	1.5087	1.5597	1.6175	1.6818	1.7516	1.8237	1.8915	1.9427	1.9623
75°	1.5345	1.5882	1.6492	1.7176	1.7927	1.8715	1.9468	2.0050	2.0276
76°	1.5606	1.6168	1.6812	1.7540	1.8347	1.9207	2.0047	2.0711	2.0973
77°	1.5867	1.6457	1.7136	1.7909	1.8777	1.9716	2.0653	2.1414	2.1721
78°	1.6130	1.6748	1.7462	1.8284	1.9215	2.0240	2.1288	2.2164	2.2528
79°	1.6394	1.7040	1.7792	1.8664	1.9663	2.0781	2.1954	2.2969	2.3404
80°	1.6660	1.7335	1.8125	1.9048	2.0119	2.1339	2.2653	2.3836	2.4362
81°	1.6926	1.7631	1.8461	1.9438	2.0584	2.1913	2.3387	2.4775	2.5421
82°	1.7193	1.7929	1.8799	1.9831	2.1057	2.2504	2.4157	2.5795	2.6603
83°	1.7462	1.8228	1.9140	2.0229	2.1537	2.3110	2.4965	2.6911	2.7942
84°	1.7731	1.8528	1.9482	2.0630	2.2024	2.3731	2.5811	2.8136	2.9487
85°	1.8001	1.8830	1.9826	2.1035	2.2518	2.4366	2.6694	2.9487	3.1313
86°	1.8271	1.9132	2.0172	2.1442	2.3017	2.5013	2.7612	3.0978	3.3547
87°	1.8542	1.9435	2.0519	2.1852	2.3520	2.5670	2.8561	3.2620	3.6425
88°	1.8813	1.9739	2.0867	2.2263	2.4026	2.6336	2.9537	3.4412	4.0481
89°	1.9084	2.0043	2.1216	2.2675	2.4535	2.7007	3.0530	3.6328	4.7413
90°	1.9356	2.0347	2.1565	2.3088	2.5046	2.7681	3.1534	3.8317	——

ELLIPTIC INTEGRALS OF THE SECOND KIND: $E(k, \phi)$

$$E(k, \phi) = \int_0^\phi \sqrt{(1 - k^2 \sin^2 \Phi)}\, d\Phi, \qquad \theta = \sin^{-1} k$$

ϕ \ θ	5°	10°	15°	20°	25°	30°	35°	40°	45°
1°	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175
2°	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349
3°	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524	0.0524	0.0523	0.0523
4°	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698
5°	0.0873	0.0873	0.0873	0.0873	0.0872	0.0872	0.0872	0.0872	0.0872
6°	0.1047	0.1047	0.1047	0.1047	0.1047	0.1047	0.1047	0.1046	0.1046
7°	0.1222	0.1222	0.1222	0.1221	0.1221	0.1221	0.1221	0.1220	0.1220
8°	0.1396	0.1396	0.1396	0.1396	0.1395	0.1395	0.1395	0.1394	0.1394
9°	0.1571	0.1571	0.1570	0.1570	0.1570	0.1569	0.1569	0.1568	0.1568
10°	0.1745	0.1745	0.1745	0.1744	0.1744	0.1743	0.1742	0.1742	0.1741
11°	0.1920	0.1920	0.1919	0.1918	0.1918	0.1917	0.1916	0.1915	0.1914
12°	0.2094	0.2094	0.2093	0.2093	0.2092	0.2091	0.2089	0.2088	0.2087
13°	0.2269	0.2268	0.2268	0.2267	0.2265	0.2264	0.2263	0.2261	0.2259
14°	0.2443	0.2443	0.2442	0.2441	0.2439	0.2437	0.2436	0.2433	0.2431
15°	0.2618	0.2617	0.2616	0.2615	0.2613	0.2611	0.2608	0.2606	0.2603
16°	0.2792	0.2791	0.2790	0.2788	0.2786	0.2784	0.2781	0.2778	0.2775
17°	0.2967	0.2966	0.2964	0.2962	0.2959	0.2956	0.2953	0.2949	0.2946
18°	0.3141	0.3140	0.3138	0.3136	0.3133	0.3129	0.3125	0.3121	0.3116
19°	0.3316	0.3314	0.3312	0.3309	0.3305	0.3301	0.3296	0.3291	0.3286
20°	0.3490	0.3489	0.3486	0.3483	0.3478	0.3473	0.3468	0.3462	0.3456
21°	0.3665	0.3663	0.3660	0.3656	0.3651	0.3645	0.3639	0.3632	0.3625
22°	0.3839	0.3837	0.3834	0.3829	0.3823	0.3817	0.3809	0.3802	0.3793
23°	0.4013	0.4011	0.4007	0.4002	0.3996	0.3988	0.3980	0.3971	0.3961
24°	0.4188	0.4185	0.4181	0.4175	0.4168	0.4159	0.4150	0.4139	0.4129
25°	0.4362	0.4359	0.4354	0.4348	0.4339	0.4330	0.4319	0.4308	0.4296
26°	0.4537	0.4533	0.4528	0.4520	0.4511	0.4500	0.4488	0.4475	0.4462
27°	0.4711	0.4707	0.4701	0.4693	0.4682	0.4670	0.4657	0.4643	0.4628
28°	0.4886	0.4881	0.4874	0.4865	0.4854	0.4840	0.4825	0.4809	0.4793
29°	0.5060	0.5055	0.5048	0.5037	0.5025	0.5010	0.4993	0.4975	0.4957
30°	0.5234	0.5229	0.5221	0.5209	0.5195	0.5179	0.5161	0.5141	0.5120
31°	0.5409	0.5403	0.5394	0.5381	0.5366	0.5348	0.5327	0.5306	0.5283
32°	0.5583	0.5577	0.5567	0.5553	0.5536	0.5516	0.5494	0.5470	0.5446
33°	0.5757	0.5751	0.5740	0.5725	0.5706	0.5684	0.5660	0.5634	0.5607
34°	0.5932	0.5924	0.5912	0.5896	0.5876	0.5852	0.5826	0.5797	0.5768
35°	0.6106	0.6098	0.6085	0.6067	0.6045	0.6019	0.5991	0.5960	0.5928
36°	0.6280	0.6272	0.6258	0.6238	0.6214	0.6186	0.6155	0.6122	0.6087
37°	0.6455	0.6445	0.6430	0.6409	0.6383	0.6353	0.6319	0.6283	0.6245
38°	0.6629	0.6619	0.6602	0.6580	0.6552	0.6519	0.6483	0.6444	0.6403
39°	0.6803	0.6792	0.6775	0.6750	0.6720	0.6685	0.6646	0.6604	0.6559
40°	0.6977	0.6966	0.6947	0.6921	0.6888	0.6851	0.6808	0.6763	0.6715
41°	0.7152	0.7139	0.7119	0.7091	0.7056	0.7016	0.6970	0.6921	0.6870
42°	0.7326	0.7313	0.7291	0.7261	0.7224	0.7180	0.7132	0.7079	0.7024
43°	0.7500	0.7486	0.7463	0.7431	0.7391	0.7345	0.7293	0.7237	0.7178
44°	0.7674	0.7659	0.7634	0.7600	0.7558	0.7508	0.7453	0.7393	0.7330
45°	0.7849	0.7832	0.7806	0.7770	0.7725	0.7672	0.7613	0.7549	0.7482

ELLIPTIC INTEGRALS OF THE SECOND KIND: $E(k, \phi)$

(Continued)

$$E(k, \phi) = \int_0^{\phi} \sqrt{(1 - k^2 \sin^2 \Phi)}\, d\Phi, \qquad \theta = \sin^{-1} k$$

θ ϕ	50°	55°	60°	65°	70°	75°	80°	85°	90°
1°	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175	0.0175
2°	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349	0.0349
3°	0.0523	0.0523	0.0523	0.0523	0.0523	0.0523	0.0523	0.0523	0.0523
4°	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698	0.0698
5°	0.0872	0.0872	0.0872	0.0872	0.0872	0.0872	0.0872	0.0872	0.0872
6°	0.1046	0.1046	0.1046	0.1046	0.1046	0.1045	0.1045	0.1045	0.1045
7°	0.1220	0.1220	0.1219	0.1219	0.1219	0.1219	0.1219	0.1219	0.1219
8°	0.1394	0.1393	0.1393	0.1393	0.1392	0.1392	0.1392	0.1392	0.1392
9°	0.1567	0.1566	0.1566	0.1566	0.1565	0.1565	0.1565	0.1564	0.1564
10°	0.1740	0.1739	0.1739	0.1738	0.1738	0.1737	0.1737	0.1737	0.1736
11°	0.1913	0.1912	0.1911	0.1910	0.1909	0.1909	0.1908	0.1908	0.1908
12°	0.2085	0.2084	0.2083	0.2082	0.2081	0.2080	0.2080	0.2079	0.2079
13°	0.2258	0.2256	0.2254	0.2253	0.2252	0.2251	0.2250	0.2250	0.2250
14°	0.2429	0.2427	0.2425	0.2424	0.2422	0.2421	0.2420	0.2419	0.2419
15°	0.2601	0.2598	0.2596	0.2594	0.2592	0.2590	0.2589	0.2588	0.2588
16°	0.2771	0.2768	0.2765	0.2763	0.2761	0.2759	0.2757	0.2757	0.2756
17°	0.2942	0.2938	0.2935	0.2932	0.2929	0.2927	0.2925	0.2924	0.2924
18°	0.3112	0.3107	0.3103	0.3099	0.3096	0.3094	0.3092	0.3091	0.3090
19°	0.3281	0.3276	0.3271	0.3267	0.3263	0.3260	0.3258	0.3256	0.3256
20°	0.3450	0.3444	0.3438	0.3433	0.3429	0.3425	0.3422	0.3421	0.3420
21°	0.3618	0.3611	0.3604	0.3598	0.3593	0.3589	0.3586	0.3584	0.3584
22°	0.3785	0.3777	0.3770	0.3763	0.3757	0.3752	0.3749	0.3747	0.3746
23°	0.3952	0.3943	0.3935	0.3927	0.3920	0.3915	0.3911	0.3908	0.3907
24°	0.4118	0.4108	0.4098	0.4090	0.4082	0.4076	0.4071	0.4068	0.4067
25°	0.4284	0.4272	0.4261	0.4251	0.4243	0.4236	0.4230	0.4227	0.4226
26°	0.4449	0.4436	0.4423	0.4412	0.4402	0.4394	0.4389	0.4385	0.4384
27°	0.4613	0.4598	0.4584	0.4572	0.4561	0.4552	0.4545	0.4541	0.4540
28°	0.4776	0.4760	0.4744	0.4730	0.4718	0.4708	0.4701	0.4696	0.4695
29°	0.4938	0.4920	0.4903	0.4887	0.4874	0.4863	0.4855	0.4850	0.4848
30°	0.5100	0.5080	0.5061	0.5044	0.5029	0.5016	0.5007	0.5002	0.5000
31°	0.5261	0.5239	0.5218	0.5199	0.5182	0.5169	0.5159	0.5152	0.5150
32°	0.5421	0.5396	0.5373	0.5352	0.5334	0.5319	0.5308	0.5301	0.5299
33°	0.5580	0.5553	0.5528	0.5505	0.5485	0.5468	0.5456	0.5449	0.5446
34°	0.5738	0.5709	0.5681	0.5656	0.5634	0.5616	0.5603	0.5595	0.5592
35°	0.5895	0.5863	0.5833	0.5806	0.5782	0.5762	0.5748	0.5739	0.5736
36°	0.6051	0.6017	0.5984	0.5954	0.5928	0.5907	0.5891	0.5881	0.5878
37°	0.6207	0.6169	0.6134	0.6101	0.6073	0.6050	0.6032	0.6022	0.6018
38°	0.6361	0.6321	0.6282	0.6247	0.6216	0.6191	0.6172	0.6160	0.6157
39°	0.6515	0.6471	0.6429	0.6391	0.6357	0.6330	0.6310	0.6297	0.6293
40°	0.6667	0.6620	0.6575	0.6533	0.6497	0.6468	0.6446	0.6432	0.6428
41°	0.6818	0.6767	0.6719	0.6674	0.6636	0.6604	0.6580	0.6566	0.6561
42°	0.6969	0.6914	0.6862	0.6814	0.6772	0.6738	0.6712	0.6697	0.6691
43°	0.7118	0.7059	0.7003	0.6952	0.6907	0.6870	0.6843	0.6826	0.6820
44°	0.7266	0.7204	0.7144	0.7088	0.7040	0.7000	0.6971	0.6953	0.6947
45°	0.7414	0.7346	0.7282	0.7223	0.7171	0.7129	0.7097	0.7078	0.7071

ELLIPTIC INTEGRALS OF THE SECOND KIND: $E(k, \phi)$
(Continued)

$$E(k, \phi) = \int_0^{\phi} \sqrt{(1 - k^2 \sin^2 \Phi)}\, d\Phi, \qquad \theta = \sin^{-1} k$$

ϕ \ θ	5°	10°	15°	20°	25°	30°	35°	40°	45°
46°	0.8023	0.8006	0.7977	0.7939	0.7891	0.7835	0.7772	0.7704	0.7633
47°	0.8197	0.8179	0.8149	0.8108	0.8057	0.7998	0.7931	0.7858	0.7782
48°	0.8371	0.8352	0.8320	0.8277	0.8223	0.8160	0.8089	0.8012	0.7931
49°	0.8545	0.8525	0.8491	0.8446	0.8389	0.8322	0.8247	0.8165	0.8079
50°	0.8719	0.8698	0.8663	0.8614	0.8554	0.8483	0.8404	0.8317	0.8227
51°	0.8894	0.8871	0.8834	0.8783	0.8719	0.8644	0.8560	0.8469	0.8373
52°	0.9068	0.9044	0.9004	0.8951	0.8884	0.8805	0.8716	0.8620	0.8518
53°	0.9242	0.9217	0.9175	0.9119	0.9048	0.8965	0.8872	0.8770	0.8663
54°	0.9416	0.9389	0.9345	0.9287	0.9212	0.9125	0.9026	0.8919	0.8806
55°	0.9590	0.9562	0.9517	0.9454	0.9376	0.9284	0.9181	0.9068	0.8949
56°	0.9764	0.9735	0.9687	0.9622	0.9540	0.9443	0.9335	0.9216	0.9091
57°	0.9938	0.9908	0.9858	0.9789	0.9703	0.9602	0.9488	0.9363	0.9232
58°	1.0112	1.0080	1.0028	0.9956	0.9866	0.9760	0.9641	0.9510	0.9372
59°	1.0286	1.0253	1.0198	1.0123	1.0029	1.9918	0.9793	0.9656	0.9511
60°	1.0460	1.0426	1.0368	1.0290	1.0191	1.0076	0.9945	0.9801	0.9650
61°	1.0634	1.0598	1.0538	1.0456	1.0354	1.0233	1.0096	0.9946	0.9787
62°	1.0808	1.0771	1.0708	1.0623	1.0516	1.0389	1.0246	1.0090	0.9924
63°	1.0982	1.0943	1.0878	1.0789	1.0678	1.0546	1.0397	1.0233	1.0060
64°	1.1156	1.1115	1.1048	1.0955	1.0839	1.0702	1.0547	1.0376	1.0195
65°	1.1330	1.1288	1.1218	1.1121	1.1001	1.0858	1.0696	1.0518	1.0329
66°	1.1504	1.1460	1.1387	1.1287	1.1162	1.1013	1.0845	1.0660	1.0463
67°	1.1678	1.1632	1.1557	1.1453	1.1323	1.1168	1.0993	1.0801	1.0596
68°	1.1852	1.1805	1.1726	1.1618	1.1483	1.1323	1.1141	1.0941	1.0728
69°	1.2026	1.1977	1.1896	1.1784	1.1644	1.1478	1.1289	1.1081	1.0859
70°	1.2200	1.2149	1.2065	1.1949	1.1804	1.1632	1.1436	1.1221	1.0990
71°	1.2374	1.2321	1.2234	1.2114	1.1964	1.1786	1.1583	1.1359	1.1120
72°	1.2548	1.2493	1.2403	1.2280	1.2124	1.1939	1.1729	1.1498	1.1250
73°	1.2722	1.2666	1.2573	1.2445	1.2284	1.2093	1.1875	1.1636	1.1379
74°	1.2896	1.2838	1.2742	1.2609	1.2443	1.2246	1.2021	1.1773	1.1507
75°	1.3070	1.3010	1.2911	1.2774	1.2603	1.2399	1.2167	1.1910	1.1635
76°	1.3244	1.3182	1.3080	1.2939	1.2762	1.2552	1.2312	1.2047	1.1762
77°	1.3418	1.3354	1.3249	1.3104	1.2921	1.2704	1.2457	1.2183	1.1889
78°	1.3592	1.3526	1.3417	1.3268	1.3080	1.2856	1.2601	1.2319	1.2015
79°	1.3765	1.3698	1.3586	1.3432	1.3239	1.3009	1.2746	1.2454	1.2141
80°	1.3939	1.3870	1.3755	1.3597	1.3398	1.3161	1.2890	1.2590	1.2266
81°	1.4113	1.4042	1.3924	1.3761	1.3556	1.3312	1.3034	1.2725	1.2391
82°	1.4287	1.4214	1.4093	1.3925	1.3715	1.3464	1.3177	1.2859	1.2516
83°	1.4461	1.4386	1.4261	1.4090	1.3873	1.3616	1.3321	1.2994	1.2640
84°	1.4635	1.4558	1.4430	1.4254	1.4032	1.3767	1.3464	1.3128	1.2765
85°	1.4809	1.4729	1.4598	1.4418	1.4190	1.3919	1.3608	1.3262	1.2889
86°	1.4983	1.4901	1.4767	1.4582	1.4348	1.4070	1.3751	1.3396	1.3012
87°	1.5156	1.5073	1.4936	1.4746	1.4507	1.4221	1.3894	1.3530	1.3136
88°	1.5330	1.5245	1.5104	1.4910	1.4665	1.4372	1.4037	1.3664	1.3260
89°	1.5504	1.5417	1.5273	1.5074	1.4823	1.4523	1.4180	1.3798	1.3383
90°	1.5678	1.5589	1.5442	1.5238	1.4981	1.4675	1.4323	1.3931	1.3506

ELLIPTIC INTEGRALS OF THE SECOND KIND: $E(k, \phi)$
(Continued)

$$E(k, \phi) = \int_0^\phi \sqrt{(1 - k^2 \sin^2 \Phi)}\, d\Phi, \qquad \theta = \sin^{-1} k$$

ϕ \ θ	50°	55°	60°	65°	70°	75°	80°	85°	90°
46°	0.7560	0.7488	0.7419	0.7356	0.7301	0.7255	0.7221	0.7200	0.7193
47°	0.7705	0.7628	0.7555	0.7488	0.7429	0.7380	0.7344	0.7321	0.7314
48°	0.7849	0.7768	0.7690	0.7618	0.7555	0.7502	0.7464	0.7440	0.7431
49°	0.7992	0.7905	0.7822	0.7746	0.7679	0.7623	0.7581	0.7556	0.7547
50°	0.8134	0.8042	0.7954	0.7872	0.7801	0.7741	0.7697	0.7670	0.7660
51°	0.8275	0.8177	0.8084	0.7997	0.7921	0.7858	0.7811	0.7781	0.7771
52°	0.8414	0.8311	0.8212	0.8120	0.8039	0.7972	0.7922	0.7891	0.7880
53°	0.8553	0.8444	0.8339	0.8241	0.8155	0.8084	0.8031	0.7998	0.7986
54°	0.8690	0.8575	0.8464	0.8361	0.8270	0.8194	0.8137	0.8102	0.8090
55°	0.8827	0.8705	0.8588	0.8479	0.8382	0.8302	0.8242	0.8204	0.8192
56°	0.8962	0.8834	0.8710	0.8595	0.8493	0.8408	0.8344	0.8304	0.8290
57°	0.9096	0.8961	0.8831	0.8709	0.8601	0.8511	0.8443	0.8401	0.8387
58°	0.9230	0.9088	0.8950	0.8822	0.8707	0.8612	0.8540	0.8496	0.8480
59°	0.9362	0.9213	0.9068	0.8932	0.8812	0.8711	0.8635	0.8588	0.8572
60°	0.9493	0.9336	0.9184	0.9042	0.8914	0.8808	0.8728	0.8677	0.8660
61°	0.9623	0.9459	0.9299	0.9149	0.9015	0.8903	0.8817	0.8764	0.8746
62°	0.9752	0.9580	0.9412	0.9254	0.9113	0.8995	0.8905	0.8849	0.8829
63°	0.9880	0.9700	0.9524	0.9358	0.9210	0.9085	0.8990	0.8930	0.8910
64°	1.0007	0.9818	0.9634	0.9460	0.9304	0.9173	0.9072	0.9009	0.8988
65°	1.0133	0.9936	0.9743	0.9561	0.9397	0.9258	0.9152	0.9086	0.9063
66°	1.0258	1.0052	0.9850	0.9659	0.9487	0.9341	0.9230	0.9159	0.9135
67°	1.0383	1.0167	0.9956	0.9756	0.9576	0.9422	0.9305	0.9230	0.9205
68°	1.0506	1.0281	1.0061	0.9852	0.9662	0.9501	0.9377	0.9299	0.9272
69°	1.0628	1.0394	1.0164	0.9946	0.9747	0.9578	0.9447	0.9364	0.9336
70°	1.0750	1.0506	1.0266	1.0038	0.9830	0.9652	0.9514	0.9427	0.9397
71°	1.0871	1.0617	1.0367	1.0129	0.9911	0.9724	0.9579	0.9487	0.9455
72°	1.0991	1.0727	1.0467	1.0218	0.9990	0.9794	0.9642	0.9544	0.9511
73°	1.1110	1.0836	1.0565	1.0306	1.0067	0.9862	0.9702	0.9599	0.9563
74°	1.1228	1.0944	1.0662	1.0392	1.0143	0.9928	0.9759	0.9650	0.9613
75°	1.1346	1.1051	1.0759	1.0477	1.0217	0.9992	0.9814	0.9699	0.9659
76°	1.1463	1.1158	1.0854	1.0561	1.0290	1.0053	0.9867	0.9745	0.9703
77°	1.1580	1.1263	1.0948	1.0643	1.0361	1.0113	0.9917	0.9789	0.9744
78°	1.1695	1.1368	1.1041	1.0724	1.0430	1.0171	0.9965	0.9829	0.9781
79°	1.1811	1.1472	1.1133	1.0805	1.0498	1.0228	1.0011	0.9867	0.9816
80°	1.1926	1.1576	1.1225	1.0884	1.0565	1.0282	1.0054	0.9902	0.9848
81°	1.2040	1.1678	1.1316	1.0962	1.0630	1.0335	1.0096	0.9935	0.9877
82°	1.2154	1.1781	1.1406	1.1040	1.0695	1.0387	1.0135	0.9965	0.9903
83°	1.2267	1.1883	1.1495	1.1116	1.0758	1.0437	1.0173	0.9992	0.9925
84°	1.2381	1.1984	1.1584	1.1192	1.0821	1.0486	1.0209	1.0017	0.9945
85°	1.2493	1.2085	1.1673	1.1267	1.0882	1.0534	1.0244	1.0039	0.9962
86°	1.2606	1.2186	1.1761	1.1342	1.0944	1.0581	1.0277	1.0060	0.9976
87°	1.2719	1.2286	1.1848	1.1417	1.1004	1.0628	1.0309	1.0078	0.9986
88°	1.2831	1.2386	1.1936	1.1491	1.1064	1.0673	1.0340	1.0095	0.9994
89°	1.2943	1.2487	1.2023	1.1565	1.1124	1.0719	1.0371	1.0111	0.9998
90°	1.3055	1.2587	1.2111	1.1638	1.1184	1.0764	1.0401	1.0127	1.0000

FACTORS AND PRIMES

If n is prime the mantissa of its logarithm is given.

n	0	1	2	3	4
0	....	**0000000**	**3010300**	**4771213**	2^2
1	$2 \cdot 5$	**0413927**	$2^2 \cdot 3$	**1139434**	$2 \cdot 7$
2	$2^2 \cdot 5$	$3 \cdot 7$	$2 \cdot 11$	**3617278**	$2^3 \cdot 3$
3	$2 \cdot 3 \cdot 5$	**4913617**	2^5	$3 \cdot 11$	$2 \cdot 17$
4	$2^3 \cdot 5$	**6127839**	$2 \cdot 3 \cdot 7$	**6334685**	$2^2 \cdot 11$
5	$2 \cdot 5^2$	$3 \cdot 17$	$2^2 \cdot 13$	**7242759**	$2 \cdot 3^3$
6	$2^2 \cdot 3 \cdot 5$	**7853298**	$2 \cdot 31$	$3^2 \cdot 7$	2^6
7	$2 \cdot 5 \cdot 7$	**8512583**	$2^3 \cdot 3^2$	**8633229**	$2 \cdot 37$
8	$2^4 \cdot 5$	3^4	$2 \cdot 41$	**9190781**	$2^2 \cdot 3 \cdot 7$
9	$2 \cdot 3^2 \cdot 5$	$7 \cdot 13$	$2^2 \cdot 23$	$3 \cdot 31$	$2 \cdot 47$
10	$2^2 \cdot 5^2$	**0043214**	$2 \cdot 3 \cdot 17$	**0128372**	$2^3 \cdot 13$
11	$2 \cdot 5 \cdot 11$	$3 \cdot 37$	$2^4 \cdot 7$	**0530784**	$2 \cdot 3 \cdot 19$
12	$2^3 \cdot 3 \cdot 5$	11^2	$2 \cdot 61$	$3 \cdot 41$	$2^2 \cdot 31$
13	$2 \cdot 5 \cdot 13$	**1172713**	$2^2 \cdot 3 \cdot 11$	$7 \cdot 19$	$2 \cdot 67$
14	$2^2 \cdot 5 \cdot 7$	$3 \cdot 47$	$2 \cdot 71$	$11 \cdot 13$	$2^4 \cdot 3^2$
15	$2 \cdot 3 \cdot 5^2$	**1789769**	$2^3 \cdot 19$	$3^2 \cdot 17$	$2 \cdot 7 \cdot 11$
16	$2^5 \cdot 5$	$7 \cdot 23$	$2 \cdot 3^4$	**2121876**	$2^2 \cdot 41$
17	$2 \cdot 5 \cdot 17$	$3^2 \cdot 19$	$2^2 \cdot 43$	**2380461**	$2 \cdot 3 \cdot 29$
18	$2^2 \cdot 3^2 \cdot 5$	**2576786**	$2 \cdot 7 \cdot 13$	$3 \cdot 61$	$2^3 \cdot 23$
19	$2 \cdot 5 \cdot 19$	**2810334**	$2^6 \cdot 3$	**2855573**	$2 \cdot 97$
20	$2^3 \cdot 5^2$	$3 \cdot 67$	$2 \cdot 101$	$7 \cdot 29$	$2^2 \cdot 3 \cdot 17$
21	$2 \cdot 3 \cdot 5 \cdot 7$	**3242825**	$2^2 \cdot 53$	$3 \cdot 71$	$2 \cdot 107$
22	$2^2 \cdot 5 \cdot 11$	$13 \cdot 17$	$2 \cdot 3 \cdot 37$	**3483049**	$2^5 \cdot 7$
23	$2 \cdot 5 \cdot 23$	$3 \cdot 7 \cdot 11$	$2^3 \cdot 29$	**3673559**	$2 \cdot 3^2 \cdot 13$
24	$2^4 \cdot 3 \cdot 5$	**3820170**	$2 \cdot 11^2$	3^5	$2^2 \cdot 61$
25	$2 \cdot 5^3$	**3996737**	$2^2 \cdot 3^2 \cdot 7$	$11 \cdot 23$	$2 \cdot 127$
26	$2^2 \cdot 5 \cdot 13$	$3^2 \cdot 29$	$2 \cdot 131$	**4199557**	$2^3 \cdot 3 \cdot 11$
27	$2 \cdot 3^3 \cdot 5$	**4329693**	$2^4 \cdot 17$	$3 \cdot 7 \cdot 13$	$2 \cdot 137$
28	$2^3 \cdot 5 \cdot 7$	**4487063**	$2 \cdot 3 \cdot 47$	**4517864**	$2^2 \cdot 71$
29	$2 \cdot 5 \cdot 29$	$3 \cdot 97$	$2^2 \cdot 73$	**4668676**	$2 \cdot 3 \cdot 7^2$
30	$2^2 \cdot 3 \cdot 5^2$	$7 \cdot 43$	$2 \cdot 151$	$3 \cdot 101$	$2^4 \cdot 19$
31	$2 \cdot 5 \cdot 31$	**4927604**	$2^3 \cdot 3 \cdot 13$	**4955443**	$2 \cdot 157$
32	$2^6 \cdot 5$	$3 \cdot 107$	$2 \cdot 7 \cdot 23$	$17 \cdot 19$	$2^2 \cdot 3^4$
33	$2 \cdot 3 \cdot 5 \cdot 11$	**5198280**	$2^2 \cdot 83$	$3^2 \cdot 37$	$2 \cdot 167$
34	$2^2 \cdot 5 \cdot 17$	$11 \cdot 31$	$2 \cdot 3^2 \cdot 19$	7^3	$2^3 \cdot 43$
35	$2 \cdot 5^2 \cdot 7$	$3^3 \cdot 13$	$2^5 \cdot 11$	**5477747**	$2 \cdot 3 \cdot 59$
36	$2^3 \cdot 3^2 \cdot 5$	19^2	$2 \cdot 181$	$3 \cdot 11^2$	$2^2 \cdot 7 \cdot 13$
37	$2 \cdot 5 \cdot 37$	$7 \cdot 53$	$2^2 \cdot 3 \cdot 31$	**5717088**	$2 \cdot 11 \cdot 17$
38	$2^2 \cdot 5 \cdot 19$	$3 \cdot 127$	$2 \cdot 191$	**5831988**	$2^7 \cdot 3$
39	$2 \cdot 3 \cdot 5 \cdot 13$	$17 \cdot 23$	$2^3 \cdot 7^2$	$3 \cdot 131$	$2 \cdot 197$
40	$2^4 \cdot 5^2$	**6031444**	$2 \cdot 3 \cdot 67$	$13 \cdot 31$	$2^2 \cdot 101$
41	$2 \cdot 5 \cdot 41$	$3 \cdot 137$	$2^2 \cdot 103$	$7 \cdot 59$	$2 \cdot 3^2 \cdot 23$
42	$2^2 \cdot 3 \cdot 5 \cdot 7$	**6242821**	$2 \cdot 211$	$3^2 \cdot 47$	$2^3 \cdot 53$
43	$2 \cdot 5 \cdot 43$	**6344773**	$2^4 \cdot 3^3$	**6364879**	$2 \cdot 7 \cdot 31$
44	$2^3 \cdot 5 \cdot 11$	$3^2 \cdot 7^2$	$2 \cdot 13 \cdot 17$	**6464037**	$2^2 \cdot 3 \cdot 37$
45	$2 \cdot 3^2 \cdot 5^2$	$11 \cdot 41$	$2^2 \cdot 113$	$3 \cdot 151$	$2 \cdot 227$
46	$2^2 \cdot 5 \cdot 23$	**6637009**	$2 \cdot 3 \cdot 7 \cdot 11$	**6655810**	$2^4 \cdot 29$
47	$2 \cdot 5 \cdot 47$	$3 \cdot 157$	$2^3 \cdot 59$	$11 \cdot 43$	$2 \cdot 3 \cdot 79$
48	$2^5 \cdot 3 \cdot 5$	$13 \cdot 37$	$2 \cdot 241$	$3 \cdot 7 \cdot 23$	$2^2 \cdot 11^2$
49	$2 \cdot 5 \cdot 7^2$	**6910815**	$2^2 \cdot 3 \cdot 41$	$17 \cdot 29$	$2 \cdot 13 \cdot 19$
50	$2^2 \cdot 5^3$	$3 \cdot 167$	$2 \cdot 251$	**7015680**	$2^3 \cdot 3^2 \cdot 7$

FACTORS AND PRIMES (Continued)

If *n* is not prime its prime factors are given.

n	5	6	7	8	9
0	**6989700**	$2 \cdot 3$	**8450980**	2^3	3^2
1	$3 \cdot 5$	2^4	**2304489**	$2 \cdot 3^2$	**2787536**
2	5^2	$2 \cdot 13$	3^3	$2^2 \cdot 7$	**4623980**
3	$5 \cdot 7$	$2^2 \cdot 3^2$	**5682017**	$2 \cdot 19$	$3 \cdot 13$
4	$3^2 \cdot 5$	$2 \cdot 23$	**6720979**	$2^4 \cdot 3$	7^2
5	$5 \cdot 11$	$2^3 \cdot 7$	$3 \cdot 19$	$2 \cdot 29$	**7708520**
6	$5 \cdot 13$	$2 \cdot 3 \cdot 11$	**8260748**	$2^2 \cdot 17$	$3 \cdot 23$
7	$3 \cdot 5^2$	$2^2 \cdot 19$	$7 \cdot 11$	$2 \cdot 3 \cdot 13$	**8976271**
8	$5 \cdot 17$	$2 \cdot 43$	$3 \cdot 29$	$2^3 \cdot 11$	**9493900**
9	$5 \cdot 19$	$2^5 \cdot 3$	**9867717**	$2 \cdot 7^2$	$3^2 \cdot 11$
10	$3 \cdot 5 \cdot 7$	$2 \cdot 53$	**0293838**	$2^2 \cdot 3^3$	**0374265**
11	$5 \cdot 23$	$2^2 \cdot 29$	$3^2 \cdot 13$	$2 \cdot 59$	$7 \cdot 17$
12	5^3	$2 \cdot 3^2 \cdot 7$	**1038037**	2^7	$3 \cdot 43$
13	$3^3 \cdot 5$	$2^3 \cdot 17$	**1367206**	$2 \cdot 3 \cdot 23$	**1430148**
14	$5 \cdot 29$	$2 \cdot 73$	$3 \cdot 7^2$	$2^2 \cdot 37$	**1731863**
15	$5 \cdot 31$	$2^2 \cdot 3 \cdot 13$	**1958997**	$2 \cdot 79$	$3 \cdot 53$
16	$3 \cdot 5 \cdot 11$	$2 \cdot 83$	**2227165**	$2^3 \cdot 3 \cdot 7$	13^2
17	$5^2 \cdot 7$	$2^4 \cdot 11$	$3 \cdot 59$	$2 \cdot 89$	**2528530**
18	$5 \cdot 37$	$2 \cdot 3 \cdot 31$	$11 \cdot 17$	$2^2 \cdot 47$	$3^3 \cdot 7$
19	$3 \cdot 5 \cdot 13$	$2^2 \cdot 7^2$	**2944662**	$2 \cdot 3^2 \cdot 11$	**2988531**
20	$5 \cdot 41$	$2 \cdot 103$	$3^2 \cdot 23$	$2^4 \cdot 13$	$11 \cdot 19$
21	$5 \cdot 43$	$2^3 \cdot 3^3$	$7 \cdot 31$	$2 \cdot 109$	$3 \cdot 73$
22	$3^2 \cdot 5^2$	$2 \cdot 113$	**3560259**	$2^2 \cdot 3 \cdot 19$	**3598355**
23	$5 \cdot 47$	$2^2 \cdot 59$	$3 \cdot 79$	$2 \cdot 7 \cdot 17$	**3783979**
24	$5 \cdot 7^2$	$2 \cdot 3 \cdot 41$	$13 \cdot 19$	$2^3 \cdot 31$	$3 \cdot 83$
25	$3 \cdot 5 \cdot 17$	2^8	**4099331**	$2 \cdot 3 \cdot 43$	$7 \cdot 37$
26	$5 \cdot 53$	$2 \cdot 7 \cdot 19$	$3 \cdot 89$	$2^2 \cdot 67$	**4297523**
27	$5^2 \cdot 11$	$2^2 \cdot 3 \cdot 23$	**4424798**	$2 \cdot 139$	$3^2 \cdot 31$
28	$3 \cdot 5 \cdot 19$	$2 \cdot 11 \cdot 13$	$7 \cdot 41$	$2^5 \cdot 3^2$	17^2
29	$5 \cdot 59$	$2^3 \cdot 37$	$3^3 \cdot 11$	$2 \cdot 149$	$13 \cdot 23$
30	$5 \cdot 61$	$2 \cdot 3^2 \cdot 17$	**4871384**	$2^2 \cdot 7 \cdot 11$	$3 \cdot 103$
31	$3^2 \cdot 5 \cdot 7$	$2^2 \cdot 79$	**5010593**	$2 \cdot 3 \cdot 53$	$11 \cdot 29$
32	$5^2 \cdot 13$	$2 \cdot 163$	$3 \cdot 109$	$2^3 \cdot 41$	$7 \cdot 47$
33	$5 \cdot 67$	$2^4 \cdot 3 \cdot 7$	**5276299**	$2 \cdot 13^2$	$3 \cdot 113$
34	$3 \cdot 5 \cdot 23$	$2 \cdot 173$	**5403295**	$2^2 \cdot 3 \cdot 29$	**5428254**
35	$5 \cdot 71$	$2^2 \cdot 89$	$3 \cdot 7 \cdot 17$	$2 \cdot 179$	**5550944**
36	$5 \cdot 73$	$2 \cdot 3 \cdot 61$	**5646661**	$2^4 \cdot 23$	$3^2 \cdot 41$
37	$3 \cdot 5^3$	$2^3 \cdot 47$	$13 \cdot 29$	$2 \cdot 3^3 \cdot 7$	**5786392**
38	$5 \cdot 7 \cdot 11$	$2 \cdot 193$	$3^2 \cdot 43$	$2^2 \cdot 97$	**5899496**
39	$5 \cdot 79$	$2^2 \cdot 3^2 \cdot 11$	**5987905**	$2 \cdot 199$	$3 \cdot 7 \cdot 19$
40	$3^4 \cdot 5$	$2 \cdot 7 \cdot 29$	$11 \cdot 37$	$2^3 \cdot 3 \cdot 17$	**6117233**
41	$5 \cdot 83$	$2^5 \cdot 13$	$3 \cdot 139$	$2 \cdot 11 \cdot 19$	**6222140**
42	$5^2 \cdot 17$	$2 \cdot 3 \cdot 71$	$7 \cdot 61$	$2^2 \cdot 107$	$3 \cdot 11 \cdot 13$
43	$3 \cdot 5 \cdot 29$	$2^2 \cdot 109$	$19 \cdot 23$	$2 \cdot 3 \cdot 73$	**6424645**
44	$5 \cdot 89$	$2 \cdot 223$	$3 \cdot 149$	$2^6 \cdot 7$	**6522463**
45	$5 \cdot 7 \cdot 13$	$2^3 \cdot 3 \cdot 19$	**6599162**	$2 \cdot 229$	$3^3 \cdot 17$
46	$3 \cdot 5 \cdot 31$	$2 \cdot 233$	**6693169**	$2^2 \cdot 3^2 \cdot 13$	$7 \cdot 67$
47	$5^2 \cdot 19$	$2^2 \cdot 7 \cdot 17$	$3^2 \cdot 53$	$2 \cdot 239$	**6803355**
48	$5 \cdot 97$	$2 \cdot 3^5$	**6875290**	$2^3 \cdot 61$	$3 \cdot 163$
49	$3^2 \cdot 5 \cdot 11$	$2^4 \cdot 31$	$7 \cdot 71$	$2 \cdot 3 \cdot 83$	**6981005**
50	$5 \cdot 101$	$2 \cdot 11 \cdot 23$	$3 \cdot 13^2$	$2^2 \cdot 127$	**7067178**

FACTORS AND PRIMES (Continued)

n	0	1	2	3	4
50	$2^2 \cdot 5^3$	$3 \cdot 167$	$2 \cdot 251$	**7015680**	$2^3 \cdot 3^2 \cdot 7$
51	$2 \cdot 3 \cdot 5 \cdot 17$	$7 \cdot 73$	2^9	$3^3 \cdot 19$	$2 \cdot 257$
52	$2^3 \cdot 5 \cdot 13$	**7168377**	$2 \cdot 3^2 \cdot 29$	**7185017**	$2^2 \cdot 131$
53	$2 \cdot 5 \cdot 53$	$3^2 \cdot 59$	$2^2 \cdot 7 \cdot 19$	$13 \cdot 41$	$2 \cdot 3 \cdot 89$
54	$2^2 \cdot 3^3 \cdot 5$	**7331973**	$2 \cdot 271$	$3 \cdot 181$	$2^5 \cdot 17$
55	$2 \cdot 5^2 \cdot 11$	$19 \cdot 29$	$2^3 \cdot 3 \cdot 23$	$7 \cdot 79$	$2 \cdot 277$
56	$2^4 \cdot 5 \cdot 7$	$3 \cdot 11 \cdot 17$	$2 \cdot 281$	**7505084**	$2^2 \cdot 3 \cdot 47$
57	$2 \cdot 3 \cdot 5 \cdot 19$	**7566361**	$2^2 \cdot 11 \cdot 13$	$3 \cdot 191$	$2 \cdot 7 \cdot 41$
58	$2^2 \cdot 5 \cdot 29$	$7 \cdot 83$	$2 \cdot 3 \cdot 97$	$11 \cdot 53$	$2^3 \cdot 73$
59	$2 \cdot 5 \cdot 59$	$3 \cdot 197$	$2^4 \cdot 37$	**7730547**	$2 \cdot 3^3 \cdot 11$
60	$2^3 \cdot 3 \cdot 5^2$	**7788745**	$2 \cdot 7 \cdot 43$	$3^2 \cdot 67$	$2^2 \cdot 151$
61	$2 \cdot 5 \cdot 61$	$13 \cdot 47$	$2^2 \cdot 3^2 \cdot 17$	**7874605**	$2 \cdot 307$
62	$2^2 \cdot 5 \cdot 31$	$3^3 \cdot 23$	$2 \cdot 311$	$7 \cdot 89$	$2^4 \cdot 3 \cdot 13$
63	$2 \cdot 3^2 \cdot 5 \cdot 7$	**8000294**	$2^3 \cdot 79$	$3 \cdot 211$	$2 \cdot 317$
64	$2^7 \cdot 5$	**8068580**	$2 \cdot 3 \cdot 107$	**8082110**	$2^2 \cdot 7 \cdot 23$
65	$2 \cdot 5^2 \cdot 13$	$3 \cdot 7 \cdot 31$	$2^2 \cdot 163$	**8149132**	$2 \cdot 3 \cdot 109$
66	$2^2 \cdot 3 \cdot 5 \cdot 11$	**8202015**	$2 \cdot 331$	$3 \cdot 13 \cdot 17$	$2^3 \cdot 83$
67	$2 \cdot 5 \cdot 67$	$11 \cdot 61$	$2^5 \cdot 3 \cdot 7$	**8280151**	$2 \cdot 337$
68	$2^3 \cdot 5 \cdot 17$	$3 \cdot 227$	$2 \cdot 11 \cdot 31$	**8344207**	$2^2 \cdot 3^2 \cdot 19$
69	$2 \cdot 3 \cdot 5 \cdot 23$	**8394780**	$2^2 \cdot 173$	$3^2 \cdot 7 \cdot 11$	$2 \cdot 347$
70	$2^2 \cdot 5^2 \cdot 7$	**8457180**	$2 \cdot 3^3 \cdot 13$	$19 \cdot 37$	$2^6 \cdot 11$
71	$2 \cdot 5 \cdot 71$	$3^2 \cdot 79$	$2^3 \cdot 89$	$23 \cdot 31$	$2 \cdot 3 \cdot 7 \cdot 17$
72	$2^4 \cdot 3^2 \cdot 5$	$7 \cdot 103$	$2 \cdot 19^2$	$3 \cdot 241$	$2^2 \cdot 181$
73	$2 \cdot 5 \cdot 73$	$17 \cdot 43$	$2^2 \cdot 3 \cdot 61$	**8651040**	$2 \cdot 367$
74	$2^2 \cdot 5 \cdot 37$	$3 \cdot 13 \cdot 19$	$2 \cdot 7 \cdot 53$	**8709888**	$2^3 \cdot 3 \cdot 31$
75	$2 \cdot 3 \cdot 5^3$	**8756399**	$2^4 \cdot 47$	$3 \cdot 251$	$2 \cdot 13 \cdot 29$
76	$2^3 \cdot 5 \cdot 19$	**8813847**	$2 \cdot 3 \cdot 127$	$7 \cdot 109$	$2^2 \cdot 191$
77	$2 \cdot 5 \cdot 7 \cdot 11$	$3 \cdot 257$	$2^2 \cdot 193$	**8881795**	$2 \cdot 3^2 \cdot 43$
78	$2^2 \cdot 3 \cdot 5 \cdot 13$	$11 \cdot 71$	$2 \cdot 17 \cdot 23$	$3^3 \cdot 29$	$2^4 \cdot 7^2$
79	$2 \cdot 5 \cdot 79$	$7 \cdot 113$	$2^3 \cdot 3^2 \cdot 11$	$13 \cdot 61$	$2 \cdot 397$
80	$2^5 \cdot 5^2$	$3^2 \cdot 89$	$2 \cdot 401$	$11 \cdot 73$	$2^2 \cdot 3 \cdot 67$
81	$2 \cdot 3^4 \cdot 5$	**9090209**	$2^2 \cdot 7 \cdot 29$	$3 \cdot 271$	$2 \cdot 11 \cdot 37$
82	$2^2 \cdot 5 \cdot 41$	**9143432**	$2 \cdot 3 \cdot 137$	**9153998**	$2^3 \cdot 103$
83	$2 \cdot 5 \cdot 83$	$3 \cdot 277$	$2^6 \cdot 13$	$7^2 \cdot 17$	$2 \cdot 3 \cdot 139$
84	$2^3 \cdot 3 \cdot 5 \cdot 7$	29^2	$2 \cdot 421$	$3 \cdot 281$	$2^2 \cdot 211$
85	$2 \cdot 5^2 \cdot 17$	$23 \cdot 37$	$2^2 \cdot 3 \cdot 71$	**9309490**	$2 \cdot 7 \cdot 61$
86	$2^2 \cdot 5 \cdot 43$	$3 \cdot 7 \cdot 41$	$2 \cdot 431$	**9360108**	$2^5 \cdot 3^3$
87	$2 \cdot 3 \cdot 5 \cdot 29$	$13 \cdot 67$	$2^3 \cdot 109$	$3^2 \cdot 97$	$2 \cdot 19 \cdot 23$
88	$2^4 \cdot 5 \cdot 11$	**9449759**	$2 \cdot 3^2 \cdot 7^2$	**9459607**	$2^2 \cdot 13 \cdot 17$
89	$2 \cdot 5 \cdot 89$	$3^4 \cdot 11$	$2^2 \cdot 223$	$19 \cdot 47$	$2 \cdot 3 \cdot 149$
90	$2^2 \cdot 3^2 \cdot 5^2$	$17 \cdot 53$	$2 \cdot 11 \cdot 41$	$3 \cdot 7 \cdot 43$	$2^3 \cdot 113$
91	$2 \cdot 5 \cdot 7 \cdot 13$	**9595184**	$2^4 \cdot 3 \cdot 19$	$11 \cdot 83$	$2 \cdot 457$
92	$2^3 \cdot 5 \cdot 23$	$3 \cdot 307$	$2 \cdot 461$	$13 \cdot 71$	$2^2 \cdot 3 \cdot 7 \cdot 11$
93	$2 \cdot 3 \cdot 5 \cdot 31$	$7^2 \cdot 19$	$2^2 \cdot 233$	$3 \cdot 311$	$2 \cdot 467$
94	$2^2 \cdot 5 \cdot 47$	**9735896**	$2 \cdot 3 \cdot 157$	$23 \cdot 41$	$2^4 \cdot 59$
95	$2 \cdot 5^2 \cdot 19$	$3 \cdot 317$	$2^3 \cdot 7 \cdot 17$	**9790929**	$2 \cdot 3^2 \cdot 53$
96	$2^6 \cdot 3 \cdot 5$	31^2	$2 \cdot 13 \cdot 37$	$3^2 \cdot 107$	$2^2 \cdot 241$
97	$2 \cdot 5 \cdot 97$	**9872192**	$2^2 \cdot 3^5$	$7 \cdot 139$	$2 \cdot 487$
98	$2^2 \cdot 5 \cdot 7^2$	$3^2 \cdot 109$	$2 \cdot 491$	**9925535**	$2^3 \cdot 3 \cdot 41$
99	$2 \cdot 3^2 \cdot 5 \cdot 11$	**9960737**	$2^5 \cdot 31$	$3 \cdot 331$	$2 \cdot 7 \cdot 71$
100	$2^3 \cdot 5^3$	$7 \cdot 11 \cdot 13$	$2 \cdot 3 \cdot 167$	$17 \cdot 59$	$2^2 \cdot 251$

FACTORS AND PRIMES (Continued)

n	5	6	7	8	9
50	$5 \cdot 101$	$2 \cdot 11 \cdot 23$	$3 \cdot 13^2$	$2^2 \cdot 127$	**7067178**
51	$5 \cdot 103$	$2^2 \cdot 3 \cdot 43$	$11 \cdot 47$	$2 \cdot 7 \cdot 37$	$3 \cdot 173$
52	$3 \cdot 5^2 \cdot 7$	$2 \cdot 263$	$17 \cdot 31$	$2^4 \cdot 3 \cdot 11$	23^2
53	$5 \cdot 107$	$2^3 \cdot 67$	$3 \cdot 179$	$2 \cdot 269$	$7^2 \cdot 11$
54	$5 \cdot 109$	$2 \cdot 3 \cdot 7 \cdot 13$	**7379873**	$2^2 \cdot 137$	$3^2 \cdot 61$
55	$3 \cdot 5 \cdot 37$	$2^2 \cdot 139$	**7458552**	$2 \cdot 3^2 \cdot 31$	$13 \cdot 43$
56	$5 \cdot 113$	$2 \cdot 283$	$3^4 \cdot 7$	$2^3 \cdot 71$	**7551123**
57	$5^2 \cdot 23$	$2^6 \cdot 3^2$	**7611758**	$2 \cdot 17^2$	$3 \cdot 193$
58	$3^2 \cdot 5 \cdot 13$	$2 \cdot 293$	**7686381**	$2^2 \cdot 3 \cdot 7^2$	$19 \cdot 31$
59	$5 \cdot 7 \cdot 17$	$2^2 \cdot 149$	$3 \cdot 199$	$2 \cdot 13 \cdot 23$	**7774268**
60	$5 \cdot 11^2$	$2 \cdot 3 \cdot 101$	**7831887**	$2^5 \cdot 19$	$3 \cdot 7 \cdot 29$
61	$3 \cdot 5 \cdot 41$	$2^3 \cdot 7 \cdot 11$	**7902852**	$2 \cdot 3 \cdot 103$	**7916906**
62	5^4	$2 \cdot 313$	$3 \cdot 11 \cdot 19$	$2^2 \cdot 157$	$17 \cdot 37$
63	$5 \cdot 127$	$2^2 \cdot 3 \cdot 53$	$7^2 \cdot 13$	$2 \cdot 11 \cdot 29$	$3^2 \cdot 71$
64	$3 \cdot 5 \cdot 43$	$2 \cdot 17 \cdot 19$	**8109043**	$2^3 \cdot 3^4$	$11 \cdot 59$
65	$5 \cdot 131$	$2^4 \cdot 41$	$3^2 \cdot 73$	$2 \cdot 7 \cdot 47$	**8188854**
66	$5 \cdot 7 \cdot 19$	$2 \cdot 3^2 \cdot 37$	$23 \cdot 29$	$2^2 \cdot 167$	$3 \cdot 223$
67	$3^3 \cdot 5^2$	$2^2 \cdot 13^2$	**8305887**	$2 \cdot 3 \cdot 113$	$7 \cdot 97$
68	$5 \cdot 137$	$2 \cdot 7^3$	$3 \cdot 229$	$2^4 \cdot 43$	$13 \cdot 53$
69	$5 \cdot 139$	$2^3 \cdot 3 \cdot 29$	$17 \cdot 41$	$2 \cdot 349$	$3 \cdot 233$
70	$3 \cdot 5 \cdot 47$	$2 \cdot 353$	$7 \cdot 101$	$2^2 \cdot 3 \cdot 59$	**8506462**
71	$5 \cdot 11 \cdot 13$	$2^2 \cdot 179$	$3 \cdot 239$	$2 \cdot 359$	**8567289**
72	$5^2 \cdot 29$	$2 \cdot 3 \cdot 11^2$	**8615344**	$2^3 \cdot 7 \cdot 13$	3^6
73	$3 \cdot 5 \cdot 7^2$	$2^5 \cdot 23$	$11 \cdot 67$	$2 \cdot 3^2 \cdot 41$	**8686444**
74	$5 \cdot 149$	$2 \cdot 373$	$3^2 \cdot 83$	$2^2 \cdot 11 \cdot 17$	$7 \cdot 107$
75	$5 \cdot 151$	$2^2 \cdot 3^3 \cdot 7$	**8790959**	$2 \cdot 379$	$3 \cdot 11 \cdot 23$
76	$3^2 \cdot 5 \cdot 17$	$2 \cdot 383$	$13 \cdot 59$	$2^8 \cdot 3$	**8859263**
77	$5^2 \cdot 31$	$2^3 \cdot 97$	$3 \cdot 7 \cdot 37$	$2 \cdot 389$	$19 \cdot 41$
78	$5 \cdot 157$	$2 \cdot 3 \cdot 131$	**8959747**	$2^2 \cdot 197$	$3 \cdot 263$
79	$3 \cdot 5 \cdot 53$	$2^2 \cdot 199$	**9014583**	$2 \cdot 3 \cdot 7 \cdot 19$	$17 \cdot 47$
80	$5 \cdot 7 \cdot 23$	$2 \cdot 13 \cdot 31$	$3 \cdot 269$	$2^3 \cdot 101$	**9079485**
81	$5 \cdot 163$	$2^4 \cdot 3 \cdot 17$	$19 \cdot 43$	$2 \cdot 409$	$3^2 \cdot 7 \cdot 13$
82	$3 \cdot 5^2 \cdot 11$	$2 \cdot 7 \cdot 59$	**9175055**	$2^2 \cdot 3^2 \cdot 23$	**9185545**
83	$5 \cdot 167$	$2^2 \cdot 11 \cdot 19$	$3^3 \cdot 31$	$2 \cdot 419$	**9237620**
84	$5 \cdot 13^2$	$2 \cdot 3^2 \cdot 47$	$7 \cdot 11^2$	$2^4 \cdot 53$	$3 \cdot 283$
85	$3^2 \cdot 5 \cdot 19$	$2^3 \cdot 107$	**9329808**	$2 \cdot 3 \cdot 11 \cdot 13$	**9339932**
86	$5 \cdot 173$	$2 \cdot 433$	$3 \cdot 17^2$	$2^2 \cdot 7 \cdot 31$	$11 \cdot 79$
87	$5^3 \cdot 7$	$2^2 \cdot 3 \cdot 73$	**9429996**	$2 \cdot 439$	$3 \cdot 293$
88	$3 \cdot 5 \cdot 59$	$2 \cdot 443$	**9479236**	$2^3 \cdot 3 \cdot 37$	$7 \cdot 127$
89	$5 \cdot 179$	$2^7 \cdot 7$	$3 \cdot 13 \cdot 23$	$2 \cdot 449$	$29 \cdot 31$
90	$5 \cdot 181$	$2 \cdot 3 \cdot 151$	**9576073**	$2^2 \cdot 227$	$3^2 \cdot 101$
91	$3 \cdot 5 \cdot 61$	$2^2 \cdot 229$	$7 \cdot 131$	$2 \cdot 3^3 \cdot 17$	**9633155**
92	$5^2 \cdot 37$	$2 \cdot 463$	$3^2 \cdot 103$	$2^5 \cdot 29$	**9680157**
93	$5 \cdot 11 \cdot 17$	$2^3 \cdot 3^2 \cdot 13$	**9717396**	$2 \cdot 7 \cdot 67$	$3 \cdot 313$
94	$3^3 \cdot 5 \cdot 7$	$2 \cdot 11 \cdot 43$	**9763500**	$2^2 \cdot 3 \cdot 79$	$13 \cdot 73$
95	$5 \cdot 191$	$2^2 \cdot 239$	$3 \cdot 11 \cdot 29$	$2 \cdot 479$	$7 \cdot 137$
96	$5 \cdot 193$	$2 \cdot 3 \cdot 7 \cdot 23$	**9854265**	$2^3 \cdot 11^2$	$3 \cdot 17 \cdot 19$
97	$3 \cdot 5^2 \cdot 13$	$2^4 \cdot 61$	**9898946**	$2 \cdot 3 \cdot 163$	$11 \cdot 89$
98	$5 \cdot 197$	$2 \cdot 17 \cdot 29$	$3 \cdot 7 \cdot 47$	$2^2 \cdot 13 \cdot 19$	$23 \cdot 43$
99	$5 \cdot 199$	$2^2 \cdot 3 \cdot 83$	**9986952**	$2 \cdot 499$	$3^3 \cdot 37$
100	$3 \cdot 5 \cdot 67$	$2 \cdot 503$	$19 \cdot 53$	$2^4 \cdot 3^2 \cdot 7$	**0038912**

FACTORS AND PRIMES (Continued)

n	0	1	2	3	4
100	$2^3 \cdot 5^3$	$7 \cdot 11 \cdot 13$	$2 \cdot 3 \cdot 167$	$17 \cdot 59$	$2^2 \cdot 251$
101	$2 \cdot 5 \cdot 101$	$3 \cdot 337$	$2^2 \cdot 11 \cdot 23$	**0056094**	$2 \cdot 3 \cdot 13^2$
102	$2^2 \cdot 3 \cdot 5 \cdot 17$	**0090257**	$2 \cdot 7 \cdot 73$	$3 \cdot 11 \cdot 31$	2^{10}
103	$2 \cdot 5 \cdot 103$	**0132587**	$2^3 \cdot 3 \cdot 43$	**0141003**	$2 \cdot 11 \cdot 47$
104	$2^4 \cdot 5 \cdot 13$	$3 \cdot 347$	$2 \cdot 521$	$7 \cdot 149$	$2^2 \cdot 3^2 \cdot 29$
105	$2 \cdot 3 \cdot 5^2 \cdot 7$	**0216027**	$2^2 \cdot 263$	$3^4 \cdot 13$	$2 \cdot 17 \cdot 31$
106	$2^2 \cdot 5 \cdot 53$	**0257154**	$2 \cdot 3^2 \cdot 59$	**0265333**	$2^3 \cdot 7 \cdot 19$
107	$2 \cdot 5 \cdot 107$	$3^2 \cdot 7 \cdot 17$	$2^4 \cdot 67$	$29 \cdot 37$	$2 \cdot 3 \cdot 179$
108	$2^3 \cdot 3^3 \cdot 5$	$23 \cdot 47$	$2 \cdot 541$	$3 \cdot 19^2$	$2^2 \cdot 271$
109	$2 \cdot 5 \cdot 109$	**0378248**	$2^2 \cdot 3 \cdot 7 \cdot 13$	**0386202**	$2 \cdot 547$
110	$2^2 \cdot 5^2 \cdot 11$	$3 \cdot 367$	$2 \cdot 19 \cdot 29$	**0425755**	$2^4 \cdot 3 \cdot 23$
111	$2 \cdot 3 \cdot 5 \cdot 37$	$11 \cdot 101$	$2^3 \cdot 139$	$3 \cdot 7 \cdot 53$	$2 \cdot 557$
112	$2^5 \cdot 5 \cdot 7$	$19 \cdot 59$	$2 \cdot 3 \cdot 11 \cdot 17$	**0503798**	$2^2 \cdot 281$
113	$2 \cdot 5 \cdot 113$	$3 \cdot 13 \cdot 29$	$2^2 \cdot 283$	$11 \cdot 103$	$2 \cdot 3^4 \cdot 7$
114	$2^2 \cdot 3 \cdot 5 \cdot 19$	$7 \cdot 163$	$2 \cdot 571$	$3^2 \cdot 127$	$2^3 \cdot 11 \cdot 13$
115	$2 \cdot 5^2 \cdot 23$	**0610753**	$2^7 \cdot 3^2$	**0618293**	$2 \cdot 577$
116	$2^3 \cdot 5 \cdot 29$	$3^3 \cdot 43$	$2 \cdot 7 \cdot 83$	**0655797**	$2^2 \cdot 3 \cdot 97$
117	$2 \cdot 3^2 \cdot 5 \cdot 13$	**0685569**	$2^2 \cdot 293$	$3 \cdot 17 \cdot 23$	$2 \cdot 587$
118	$2^2 \cdot 5 \cdot 59$	**0722499**	$2 \cdot 3 \cdot 197$	$7 \cdot 13^2$	$2^5 \cdot 37$
119	$2 \cdot 5 \cdot 7 \cdot 17$	$3 \cdot 397$	$2^3 \cdot 149$	**0766404**	$2 \cdot 3 \cdot 199$
120	$2^4 \cdot 3 \cdot 5^2$	**0795430**	$2 \cdot 601$	$3 \cdot 401$	$2^2 \cdot 7 \cdot 43$
121	$2 \cdot 5 \cdot 11^2$	$7 \cdot 173$	$2^2 \cdot 3 \cdot 101$	**0838608**	$2 \cdot 607$
122	$2^2 \cdot 5 \cdot 61$	$3 \cdot 11 \cdot 37$	$2 \cdot 13 \cdot 47$	**0874265**	$2^3 \cdot 3^2 \cdot 17$
123	$2 \cdot 3 \cdot 5 \cdot 41$	**0902581**	$2^4 \cdot 7 \cdot 11$	$3^2 \cdot 137$	$2 \cdot 617$
124	$2^3 \cdot 5 \cdot 31$	$17 \cdot 73$	$2 \cdot 3^3 \cdot 23$	$11 \cdot 113$	$2^2 \cdot 311$
125	$2 \cdot 5^4$	$3^2 \cdot 139$	$2^2 \cdot 313$	$7 \cdot 179$	$2 \cdot 3 \cdot 11 \cdot 19$
126	$2^2 \cdot 3^2 \cdot 5 \cdot 7$	$13 \cdot 97$	$2 \cdot 631$	$3 \cdot 421$	$2^4 \cdot 79$
127	$2 \cdot 5 \cdot 127$	$31 \cdot 41$	$2^3 \cdot 3 \cdot 53$	$19 \cdot 67$	$2 \cdot 7^2 \cdot 13$
128	$2^8 \cdot 5$	$3 \cdot 7 \cdot 61$	$2 \cdot 641$	**1082267**	$2^2 \cdot 3 \cdot 107$
129	$2 \cdot 3 \cdot 5 \cdot 43$	**1109262**	$2^2 \cdot 17 \cdot 19$	$3 \cdot 431$	$2 \cdot 647$
130	$2^2 \cdot 5^2 \cdot 13$	**1142773**	$2 \cdot 3 \cdot 7 \cdot 31$	**1149444**	$2^3 \cdot 163$
131	$2 \cdot 5 \cdot 131$	$3 \cdot 19 \cdot 23$	$2^5 \cdot 41$	$13 \cdot 101$	$2 \cdot 3^2 \cdot 73$
132	$2^3 \cdot 3 \cdot 5 \cdot 11$	**1209028**	$2 \cdot 661$	$3^3 \cdot 7^2$	$2^2 \cdot 331$
133	$2 \cdot 5 \cdot 7 \cdot 19$	11^3	$2^2 \cdot 3^2 \cdot 37$	$31 \cdot 43$	$2 \cdot 23 \cdot 29$
134	$2^2 \cdot 5 \cdot 67$	$3^2 \cdot 149$	$2 \cdot 11 \cdot 61$	$17 \cdot 79$	$2^6 \cdot 3 \cdot 7$
135	$2 \cdot 3^3 \cdot 5^2$	$7 \cdot 193$	$2^3 \cdot 13^2$	$3 \cdot 11 \cdot 41$	$2 \cdot 677$
136	$2^4 \cdot 5 \cdot 17$	**1338581**	$2 \cdot 3 \cdot 227$	$29 \cdot 47$	$2^2 \cdot 11 \cdot 31$
137	$2 \cdot 5 \cdot 137$	$3 \cdot 457$	$2^2 \cdot 7^3$	**1376705**	$2 \cdot 3 \cdot 229$
138	$2^2 \cdot 3 \cdot 5 \cdot 23$	**1401937**	$2 \cdot 691$	$3 \cdot 461$	$2^3 \cdot 173$
139	$2 \cdot 5 \cdot 139$	$13 \cdot 107$	$2^4 \cdot 3 \cdot 29$	$7 \cdot 199$	$2 \cdot 17 \cdot 41$
140	$2^3 \cdot 5^2 \cdot 7$	$3 \cdot 467$	$2 \cdot 701$	$23 \cdot 61$	$2^2 \cdot 3^3 \cdot 13$
141	$2 \cdot 3 \cdot 5 \cdot 47$	$17 \cdot 83$	$2^2 \cdot 353$	$3^2 \cdot 157$	$2 \cdot 7 \cdot 101$
142	$2^2 \cdot 5 \cdot 71$	$7^2 \cdot 29$	$2 \cdot 3^2 \cdot 79$	**1532049**	$2^4 \cdot 89$
143	$2 \cdot 5 \cdot 11 \cdot 13$	$3^3 \cdot 53$	$2^3 \cdot 179$	**1562462**	$2 \cdot 3 \cdot 239$
144	$2^5 \cdot 3^2 \cdot 5$	$11 \cdot 131$	$2 \cdot 7 \cdot 103$	$3 \cdot 13 \cdot 37$	$2^2 \cdot 19^2$
145	$2 \cdot 5^2 \cdot 29$	**1616674**	$2^2 \cdot 3 \cdot 11^2$	**1622656**	$2 \cdot 727$
146	$2^2 \cdot 5 \cdot 73$	$3 \cdot 487$	$2 \cdot 17 \cdot 43$	$7 \cdot 11 \cdot 19$	$2^3 \cdot 3 \cdot 61$
147	$2 \cdot 3 \cdot 5 \cdot 7^2$	**1676127**	$2^6 \cdot 23$	$3 \cdot 491$	$2 \cdot 11 \cdot 67$
148	$2^3 \cdot 5 \cdot 37$	**1705551**	$2 \cdot 3 \cdot 13 \cdot 19$	**1711412**	$2^2 \cdot 7 \cdot 53$
149	$2 \cdot 5 \cdot 149$	$3 \cdot 7 \cdot 71$	$2^2 \cdot 373$	**1740598**	$2 \cdot 3^2 \cdot 83$
150	$2^2 \cdot 3 \cdot 5^3$	$19 \cdot 79$	$2 \cdot 751$	$3^2 \cdot 167$	$2^5 \cdot 47$

FACTORS AND PRIMES (Continued)

n	5	6	7	8	9
100	$3 \cdot 5 \cdot 67$	$2 \cdot 503$	$19 \cdot 53$	$2^4 \cdot 3^2 \cdot 7$	**0038912**
101	$5 \cdot 7 \cdot 29$	$2^3 \cdot 127$	$3^2 \cdot 113$	$2 \cdot 509$	**0081742**
102	$5^2 \cdot 41$	$2 \cdot 3^3 \cdot 19$	$13 \cdot 79$	$2^2 \cdot 257$	$3 \cdot 7^3$
103	$3^2 \cdot 5 \cdot 23$	$2^2 \cdot 7 \cdot 37$	$17 \cdot 61$	$2 \cdot 3 \cdot 173$	**0166155**
104	$5 \cdot 11 \cdot 19$	$2 \cdot 523$	$3 \cdot 349$	$2^3 \cdot 131$	**0207755**
105	$5 \cdot 211$	$2^5 \cdot 3 \cdot 11$	$7 \cdot 151$	$2 \cdot 23^2$	$3 \cdot 353$
106	$3 \cdot 5 \cdot 71$	$2 \cdot 13 \cdot 41$	$11 \cdot 97$	$2^2 \cdot 3 \cdot 89$	**0289777**
107	$5^2 \cdot 43$	$2^2 \cdot 269$	$3 \cdot 359$	$2 \cdot 7^2 \cdot 11$	$13 \cdot 83$
108	$5 \cdot 7 \cdot 31$	$2 \cdot 3 \cdot 181$	**0362295**	$2^6 \cdot 17$	$3^2 \cdot 11^2$
109	$3 \cdot 5 \cdot 73$	$2^3 \cdot 137$	**0402066**	$2 \cdot 3^2 \cdot 61$	$7 \cdot 157$
110	$5 \cdot 13 \cdot 17$	$2 \cdot 7 \cdot 79$	$3^3 \cdot 41$	$2^2 \cdot 277$	**0449315**
111	$5 \cdot 223$	$2^2 \cdot 3^2 \cdot 31$	**0480532**	$2 \cdot 13 \cdot 43$	$3 \cdot 373$
112	$3^2 \cdot 5^3$	$2 \cdot 563$	$7^2 \cdot 23$	$2^3 \cdot 3 \cdot 47$	**0526939**
113	$5 \cdot 227$	$2^4 \cdot 71$	$3 \cdot 379$	$2 \cdot 569$	$17 \cdot 67$
114	$5 \cdot 229$	$2 \cdot 3 \cdot 191$	$31 \cdot 37$	$2^2 \cdot 7 \cdot 41$	$3 \cdot 383$
115	$3 \cdot 5 \cdot 7 \cdot 11$	$2^2 \cdot 17^2$	$13 \cdot 89$	$2 \cdot 3 \cdot 193$	$19 \cdot 61$
116	$5 \cdot 233$	$2 \cdot 11 \cdot 53$	$3 \cdot 389$	$2^4 \cdot 73$	$7 \cdot 167$
117	$5^2 \cdot 47$	$2^3 \cdot 3 \cdot 7^2$	$11 \cdot 107$	$2 \cdot 19 \cdot 31$	$3^2 \cdot 131$
118	$3 \cdot 5 \cdot 79$	$2 \cdot 593$	**0744507**	$2^2 \cdot 3^3 \cdot 11$	$29 \cdot 41$
119	$5 \cdot 239$	$2^2 \cdot 13 \cdot 23$	$3^2 \cdot 7 \cdot 19$	$2 \cdot 599$	$11 \cdot 109$
120	$5 \cdot 241$	$2 \cdot 3^2 \cdot 67$	$17 \cdot 71$	$2^3 \cdot 151$	$3 \cdot 13 \cdot 31$
121	$3^5 \cdot 5$	$2^6 \cdot 19$	**0852906**	$2 \cdot 3 \cdot 7 \cdot 29$	$23 \cdot 53$
122	$5^2 \cdot 7^2$	$2 \cdot 613$	$3 \cdot 409$	$2^2 \cdot 307$	**0895519**
123	$5 \cdot 13 \cdot 19$	$2^2 \cdot 3 \cdot 103$	**0923697**	$2 \cdot 619$	$3 \cdot 7 \cdot 59$
124	$3 \cdot 5 \cdot 83$	$2 \cdot 7 \cdot 89$	$29 \cdot 43$	$2^5 \cdot 3 \cdot 13$	**0965624**
125	$5 \cdot 251$	$2^3 \cdot 157$	$3 \cdot 419$	$2 \cdot 17 \cdot 37$	**1000257**
126	$5 \cdot 11 \cdot 23$	$2 \cdot 3 \cdot 211$	$7 \cdot 181$	$2^2 \cdot 317$	$3^3 \cdot 47$
127	$3 \cdot 5^2 \cdot 17$	$2^2 \cdot 11 \cdot 29$	**1061909**	$2 \cdot 3^2 \cdot 71$	**1068705**
128	$5 \cdot 257$	$2 \cdot 643$	$3^2 \cdot 11 \cdot 13$	$2^3 \cdot 7 \cdot 23$	**1102529**
129	$5 \cdot 7 \cdot 37$	$2^4 \cdot 3^4$	**1129400**	$2 \cdot 11 \cdot 59$	$3 \cdot 433$
130	$3^2 \cdot 5 \cdot 29$	$2 \cdot 653$	**1162756**	$2^2 \cdot 3 \cdot 109$	$7 \cdot 11 \cdot 17$
131	$5 \cdot 263$	$2^2 \cdot 7 \cdot 47$	$3 \cdot 439$	$2 \cdot 659$	**1202448**
132	$5^2 \cdot 53$	$2 \cdot 3 \cdot 13 \cdot 17$	**1228709**	$2^4 \cdot 83$	$3 \cdot 443$
133	$3 \cdot 5 \cdot 89$	$2^3 \cdot 167$	$7 \cdot 191$	$2 \cdot 3 \cdot 223$	$13 \cdot 103$
134	$5 \cdot 269$	$2 \cdot 673$	$3 \cdot 449$	$2^2 \cdot 337$	$19 \cdot 71$
135	$5 \cdot 271$	$2^2 \cdot 3 \cdot 113$	$23 \cdot 59$	$2 \cdot 7 \cdot 97$	$3^2 \cdot 151$
136	$3 \cdot 5 \cdot 7 \cdot 13$	$2 \cdot 683$	**1357685**	$2^3 \cdot 3^2 \cdot 19$	37^2
137	$5^3 \cdot 11$	$2^5 \cdot 43$	$3^4 \cdot 17$	$2 \cdot 13 \cdot 53$	$7 \cdot 197$
138	$5 \cdot 277$	$2 \cdot 3^2 \cdot 7 \cdot 11$	$19 \cdot 73$	$2^2 \cdot 347$	$3 \cdot 463$
139	$3^2 \cdot 5 \cdot 31$	$2^2 \cdot 349$	$11 \cdot 127$	$2 \cdot 3 \cdot 233$	**1458177**
140	$5 \cdot 281$	$2 \cdot 19 \cdot 37$	$3 \cdot 7 \cdot 67$	$2^7 \cdot 11$	**1489110**
141	$5 \cdot 283$	$2^3 \cdot 3 \cdot 59$	$13 \cdot 109$	$2 \cdot 709$	$3 \cdot 11 \cdot 43$
142	$3 \cdot 5^2 \cdot 19$	$2 \cdot 23 \cdot 31$	**1544240**	$2^2 \cdot 3 \cdot 7 \cdot 17$	**1550322**
143	$5 \cdot 7 \cdot 41$	$2^2 \cdot 359$	$3 \cdot 479$	$2 \cdot 719$	**1580608**
144	$5 \cdot 17^2$	$2 \cdot 3 \cdot 241$	**1604685**	$2^3 \cdot 181$	$3^2 \cdot 7 \cdot 23$
145	$3 \cdot 5 \cdot 97$	$2^4 \cdot 7 \cdot 13$	$31 \cdot 47$	$2 \cdot 3^6$	**1640553**
146	$5 \cdot 293$	$2 \cdot 733$	$3^2 \cdot 163$	$2^2 \cdot 367$	$13 \cdot 113$
147	$5^2 \cdot 59$	$2^2 \cdot 3^2 \cdot 41$	$7 \cdot 211$	$2 \cdot 739$	$3 \cdot 17 \cdot 29$
148	$3^3 \cdot 5 \cdot 11$	$2 \cdot 743$	**1723110**	$2^4 \cdot 3 \cdot 31$	**1728947**
149	$5 \cdot 13 \cdot 23$	$2^3 \cdot 11 \cdot 17$	$3 \cdot 499$	$2 \cdot 7 \cdot 107$	**1758016**
150	$5 \cdot 7 \cdot 43$	$2 \cdot 3 \cdot 251$	$11 \cdot 137$	$2^2 \cdot 13 \cdot 29$	$3 \cdot 503$

FACTORS AND PRIMES (Continued)

n	0	1	2	3	4
150	$2^2 \cdot 3 \cdot 5^3$	$19 \cdot 79$	$2 \cdot 751$	$3^2 \cdot 167$	$2^5 \cdot 47$
151	$2 \cdot 5 \cdot 151$	**1792645**	$2^3 \cdot 3^3 \cdot 7$	$17 \cdot 89$	$2 \cdot 757$
152	$2^4 \cdot 5 \cdot 19$	$3^2 \cdot 13^2$	$2 \cdot 761$	**1826999**	$2^2 \cdot 3 \cdot 127$
153	$2 \cdot 3^2 \cdot 5 \cdot 17$	**1849752**	$2^2 \cdot 383$	$3 \cdot 7 \cdot 73$	$2 \cdot 13 \cdot 59$
154	$2^2 \cdot 5 \cdot 7 \cdot 11$	$23 \cdot 67$	$2 \cdot 3 \cdot 257$	**1883659**	$2^3 \cdot 193$
155	$2 \cdot 5^2 \cdot 31$	$3 \cdot 11 \cdot 47$	$2^4 \cdot 97$	**1911715**	$2 \cdot 3 \cdot 7 \cdot 37$
156	$2^3 \cdot 3 \cdot 5 \cdot 13$	$7 \cdot 223$	$2 \cdot 11 \cdot 71$	$3 \cdot 521$	$2^2 \cdot 17 \cdot 23$
157	$2 \cdot 5 \cdot 157$	**1961762**	$2^2 \cdot 3 \cdot 131$	$11^2 \cdot 13$	$2 \cdot 787$
158	$2^2 \cdot 5 \cdot 79$	$3 \cdot 17 \cdot 31$	$2 \cdot 7 \cdot 113$	**1994809**	$2^4 \cdot 3^2 \cdot 11$
159	$2 \cdot 3 \cdot 5 \cdot 53$	$37 \cdot 43$	$2^3 \cdot 199$	$3^3 \cdot 59$	$2 \cdot 797$
160	$2^6 \cdot 5^2$	**2043913**	$2 \cdot 3^2 \cdot 89$	$7 \cdot 229$	$2^2 \cdot 401$
161	$2 \cdot 5 \cdot 7 \cdot 23$	$3^2 \cdot 179$	$2^2 \cdot 13 \cdot 31$	**2076344**	$2 \cdot 3 \cdot 269$
162	$2^2 \cdot 3^4 \cdot 5$	**2097830**	$2 \cdot 811$	$3 \cdot 541$	$2^3 \cdot 7 \cdot 29$
163	$2 \cdot 5 \cdot 163$	$7 \cdot 233$	$2^5 \cdot 3 \cdot 17$	$23 \cdot 71$	$2 \cdot 19 \cdot 43$
164	$2^3 \cdot 5 \cdot 41$	$3 \cdot 547$	$2 \cdot 821$	$31 \cdot 53$	$2^2 \cdot 3 \cdot 137$
165	$2 \cdot 3 \cdot 5^2 \cdot 11$	$13 \cdot 127$	$2^2 \cdot 7 \cdot 59$	$3 \cdot 19 \cdot 29$	$2 \cdot 827$
166	$2^2 \cdot 5 \cdot 83$	$11 \cdot 151$	$2 \cdot 3 \cdot 277$	**2208922**	$2^7 \cdot 13$
167	$2 \cdot 5 \cdot 167$	$3 \cdot 557$	$2^3 \cdot 11 \cdot 19$	$7 \cdot 239$	$2 \cdot 3^3 \cdot 31$
168	$2^4 \cdot 3 \cdot 5 \cdot 7$	41^2	$2 \cdot 29^2$	$3^2 \cdot 11 \cdot 17$	$2^2 \cdot 421$
169	$2 \cdot 5 \cdot 13^2$	$19 \cdot 89$	$2^2 \cdot 3^2 \cdot 47$	**2286570**	$2 \cdot 7 \cdot 11^2$
170	$2^2 \cdot 5^2 \cdot 17$	$3^5 \cdot 7$	$2 \cdot 23 \cdot 37$	$13 \cdot 131$	$2^3 \cdot 3 \cdot 71$
171	$2 \cdot 3^2 \cdot 5 \cdot 19$	$29 \cdot 59$	$2^4 \cdot 107$	$3 \cdot 571$	$2 \cdot 857$
172	$2^3 \cdot 5 \cdot 43$	**2357809**	$2 \cdot 3 \cdot 7 \cdot 41$	**2362853**	$2^2 \cdot 431$
173	$2 \cdot 5 \cdot 173$	$3 \cdot 577$	$2^2 \cdot 433$	**2387986**	$2 \cdot 3 \cdot 17^2$
174	$2^2 \cdot 3 \cdot 5 \cdot 29$	**2407988**	$2 \cdot 13 \cdot 67$	$3 \cdot 7 \cdot 83$	$2^4 \cdot 109$
175	$2 \cdot 5^3 \cdot 7$	$17 \cdot 103$	$2^3 \cdot 3 \cdot 73$	**2437819**	$2 \cdot 877$
176	$2^5 \cdot 5 \cdot 11$	$3 \cdot 587$	$2 \cdot 881$	$41 \cdot 43$	$2^2 \cdot 3^2 \cdot 7^2$
177	$2 \cdot 3 \cdot 5 \cdot 59$	$7 \cdot 11 \cdot 23$	$2^2 \cdot 443$	$3^2 \cdot 197$	$2 \cdot 887$
178	$2^2 \cdot 5 \cdot 89$	$13 \cdot 137$	$2 \cdot 3^4 \cdot 11$	**2511513**	$2^3 \cdot 223$
179	$2 \cdot 5 \cdot 179$	$3^2 \cdot 199$	$2^8 \cdot 7$	$11 \cdot 163$	$2 \cdot 3 \cdot 13 \cdot 23$
180	$2^3 \cdot 3^2 \cdot 5^2$	**2555137**	$2 \cdot 17 \cdot 53$	$3 \cdot 601$	$2^2 \cdot 11 \cdot 41$
181	$2 \cdot 5 \cdot 181$	**2579185**	$2^2 \cdot 3 \cdot 151$	$7^2 \cdot 37$	$2 \cdot 907$
182	$2^2 \cdot 5 \cdot 7 \cdot 13$	$3 \cdot 607$	$2 \cdot 911$	**2607867**	$2^5 \cdot 3 \cdot 19$
183	$2 \cdot 3 \cdot 5 \cdot 61$	**2626883**	$2^3 \cdot 229$	$3 \cdot 13 \cdot 47$	$2 \cdot 7 \cdot 131$
184	$2^4 \cdot 5 \cdot 23$	$7 \cdot 263$	$2 \cdot 3 \cdot 307$	$19 \cdot 97$	$2^2 \cdot 461$
185	$2 \cdot 5^2 \cdot 37$	$3 \cdot 617$	$2^2 \cdot 463$	$17 \cdot 109$	$2 \cdot 3^2 \cdot 103$
186	$2^2 \cdot 3 \cdot 5 \cdot 31$	**2697464**	$2 \cdot 7^2 \cdot 19$	$3^4 \cdot 23$	$2^3 \cdot 233$
187	$2 \cdot 5 \cdot 11 \cdot 17$	**2720738**	$2^4 \cdot 3^2 \cdot 13$	**2725378**	$2 \cdot 937$
188	$2^3 \cdot 5 \cdot 47$	$3^2 \cdot 11 \cdot 19$	$2 \cdot 941$	$7 \cdot 269$	$2^2 \cdot 3 \cdot 157$
189	$2 \cdot 3^3 \cdot 5 \cdot 7$	$31 \cdot 61$	$2^2 \cdot 11 \cdot 43$	$3 \cdot 631$	$2 \cdot 947$
190	$2^2 \cdot 5^2 \cdot 19$	**2789821**	$2 \cdot 3 \cdot 317$	$11 \cdot 173$	$2^4 \cdot 7 \cdot 17$
191	$2 \cdot 5 \cdot 191$	$3 \cdot 7^2 \cdot 13$	$2^3 \cdot 239$	**2817150**	$2 \cdot 3 \cdot 11 \cdot 29$
192	$2^7 \cdot 3 \cdot 5$	$17 \cdot 113$	$2 \cdot 31^2$	$3 \cdot 641$	$2^2 \cdot 13 \cdot 37$
193	$2 \cdot 5 \cdot 193$	**2857823**	$2^2 \cdot 3 \cdot 7 \cdot 23$	**2862319**	$2 \cdot 967$
194	$2^2 \cdot 5 \cdot 97$	$3 \cdot 647$	$2 \cdot 971$	$29 \cdot 67$	$2^3 \cdot 3^5$
195	$2 \cdot 3 \cdot 5^2 \cdot 13$	**2902573**	$2^5 \cdot 61$	$3^2 \cdot 7 \cdot 31$	$2 \cdot 977$
196	$2^3 \cdot 5 \cdot 7^2$	$37 \cdot 53$	$2 \cdot 3^2 \cdot 109$	$13 \cdot 151$	$2^2 \cdot 491$
197	$2 \cdot 5 \cdot 197$	$3^3 \cdot 73$	$2^2 \cdot 17 \cdot 29$	**2951271**	$2 \cdot 3 \cdot 7 \cdot 47$
198	$2^2 \cdot 3^2 \cdot 5 \cdot 11$	$7 \cdot 283$	$2 \cdot 991$	$3 \cdot 661$	$2^6 \cdot 31$
199	$2 \cdot 5 \cdot 199$	$11 \cdot 181$	$2^3 \cdot 3 \cdot 83$	**2995073**	$2 \cdot 997$
200	$2^4 \cdot 5^3$	$3 \cdot 23 \cdot 29$	$2 \cdot 7 \cdot 11 \cdot 13$	**3016809**	$2^2 \cdot 3 \cdot 167$

FACTORS AND PRIMES (Continued)

n	5	6	7	8	9
150	$5 \cdot 7 \cdot 43$	$2 \cdot 3 \cdot 251$	$11 \cdot 137$	$2^2 \cdot 13 \cdot 29$	$3 \cdot 503$
151	$3 \cdot 5 \cdot 101$	$2^2 \cdot 379$	$37 \cdot 41$	$2 \cdot 3 \cdot 11 \cdot 23$	$7^2 \cdot 31$
152	$5^2 \cdot 61$	$2 \cdot 7 \cdot 109$	$3 \cdot 509$	$2^3 \cdot 191$	$11 \cdot 139$
153	$5 \cdot 307$	$2^9 \cdot 3$	$29 \cdot 53$	$2 \cdot 769$	$3^4 \cdot 19$
154	$3 \cdot 5 \cdot 103$	$2 \cdot 773$	$7 \cdot 13 \cdot 17$	$2^2 \cdot 3^2 \cdot 43$	**1900514**
155	$5 \cdot 311$	$2^2 \cdot 389$	$3^2 \cdot 173$	$2 \cdot 19 \cdot 41$	**1928461**
156	$5 \cdot 313$	$2 \cdot 3^3 \cdot 29$	**1950690**	$2^5 \cdot 7^2$	$3 \cdot 523$
157	$3^2 \cdot 5^2 \cdot 7$	$2^3 \cdot 197$	$19 \cdot 83$	$2 \cdot 3 \cdot 263$	**1983821**
158	$5 \cdot 317$	$2 \cdot 13 \cdot 61$	$3 \cdot 23^2$	$2^2 \cdot 397$	$7 \cdot 227$
159	$5 \cdot 11 \cdot 29$	$2^2 \cdot 3 \cdot 7 \cdot 19$	**2033049**	$2 \cdot 17 \cdot 47$	$3 \cdot 13 \cdot 41$
160	$3 \cdot 5 \cdot 107$	$2 \cdot 11 \cdot 73$	**2060159**	$2^3 \cdot 3 \cdot 67$	**2065560**
161	$5 \cdot 17 \cdot 19$	$2^4 \cdot 101$	$3 \cdot 7^2 \cdot 11$	$2 \cdot 809$	**2092468**
162	$5^3 \cdot 13$	$2 \cdot 3 \cdot 271$	**2113876**	$2^2 \cdot 11 \cdot 37$	$3^2 \cdot 181$
163	$3 \cdot 5 \cdot 109$	$2^2 \cdot 409$	**2140487**	$2 \cdot 3^2 \cdot 7 \cdot 13$	$11 \cdot 149$
164	$5 \cdot 7 \cdot 47$	$2 \cdot 823$	$3^3 \cdot 61$	$2^4 \cdot 103$	$17 \cdot 97$
165	$5 \cdot 331$	$2^3 \cdot 3^2 \cdot 23$	**2193225**	$2 \cdot 829$	$3 \cdot 7 \cdot 79$
166	$3^2 \cdot 5 \cdot 37$	$2 \cdot 7^2 \cdot 17$	**2219356**	$2^2 \cdot 3 \cdot 139$	**2224563**
167	$5^2 \cdot 67$	$2^2 \cdot 419$	$3 \cdot 13 \cdot 43$	$2 \cdot 839$	$23 \cdot 73$
168	$5 \cdot 337$	$2 \cdot 3 \cdot 281$	$7 \cdot 241$	$2^3 \cdot 211$	$3 \cdot 563$
169	$3 \cdot 5 \cdot 113$	$2^5 \cdot 53$	**2296818**	$2 \cdot 3 \cdot 283$	**2301934**
170	$5 \cdot 11 \cdot 31$	$2 \cdot 853$	$3 \cdot 569$	$2^2 \cdot 7 \cdot 61$	**2327421**
171	$5 \cdot 7^3$	$2^2 \cdot 3 \cdot 11 \cdot 13$	$17 \cdot 101$	$2 \cdot 859$	$3^2 \cdot 191$
172	$3 \cdot 5^2 \cdot 23$	$2 \cdot 863$	$11 \cdot 157$	$2^6 \cdot 3^3$	$7 \cdot 13 \cdot 19$
173	$5 \cdot 347$	$2^3 \cdot 7 \cdot 31$	$3^2 \cdot 193$	$2 \cdot 11 \cdot 79$	$37 \cdot 47$
174	$5 \cdot 349$	$2 \cdot 3^2 \cdot 97$	**2422929**	$2^2 \cdot 19 \cdot 23$	$3 \cdot 11 \cdot 53$
175	$3^3 \cdot 5 \cdot 13$	$2^2 \cdot 439$	$7 \cdot 251$	$2 \cdot 3 \cdot 293$	**2452658**
176	$5 \cdot 353$	$2 \cdot 883$	$3 \cdot 19 \cdot 31$	$2^3 \cdot 13 \cdot 17$	$29 \cdot 61$
177	$5^2 \cdot 71$	$2^4 \cdot 3 \cdot 37$	**2496874**	$2 \cdot 7 \cdot 127$	$3 \cdot 593$
178	$3 \cdot 5 \cdot 7 \cdot 17$	$2 \cdot 19 \cdot 47$	**2521246**	$2^2 \cdot 3 \cdot 149$	**2526103**
179	$5 \cdot 359$	$2^2 \cdot 449$	$3 \cdot 599$	$2 \cdot 29 \cdot 31$	$7 \cdot 257$
180	$5 \cdot 19^2$	$2 \cdot 3 \cdot 7 \cdot 43$	$13 \cdot 139$	$2^4 \cdot 113$	$3^3 \cdot 67$
181	$3 \cdot 5 \cdot 11^2$	$2^3 \cdot 227$	$23 \cdot 79$	$2 \cdot 3^2 \cdot 101$	$17 \cdot 107$
182	$5^2 \cdot 73$	$2 \cdot 11 \cdot 83$	$3^2 \cdot 7 \cdot 29$	$2^2 \cdot 457$	$31 \cdot 59$
183	$5 \cdot 367$	$2^2 \cdot 3^3 \cdot 17$	$11 \cdot 167$	$2 \cdot 919$	$3 \cdot 613$
184	$3^2 \cdot 5 \cdot 41$	$2 \cdot 13 \cdot 71$	**2664669**	$2^3 \cdot 3 \cdot 7 \cdot 11$	43^2
185	$5 \cdot 7 \cdot 53$	$2^6 \cdot 29$	$3 \cdot 619$	$2 \cdot 929$	$11 \cdot 13^2$
186	$5 \cdot 373$	$2 \cdot 3 \cdot 311$	**2711443**	$2^2 \cdot 467$	$3 \cdot 7 \cdot 89$
187	$3 \cdot 5^4$	$2^2 \cdot 7 \cdot 67$	**2734643**	$2 \cdot 3 \cdot 313$	**2739268**
188	$5 \cdot 13 \cdot 29$	$2 \cdot 23 \cdot 41$	$3 \cdot 17 \cdot 37$	$2^5 \cdot 59$	**2762320**
189	$5 \cdot 379$	$2^3 \cdot 3 \cdot 79$	$7 \cdot 271$	$2 \cdot 13 \cdot 73$	$3^2 \cdot 211$
190	$3 \cdot 5 \cdot 127$	$2 \cdot 953$	**2803507**	$2^2 \cdot 3^2 \cdot 53$	$23 \cdot 83$
191	$5 \cdot 383$	$2^2 \cdot 479$	$3^3 \cdot 71$	$2 \cdot 7 \cdot 137$	$19 \cdot 101$
192	$5^2 \cdot 7 \cdot 11$	$2 \cdot 3^2 \cdot 107$	$41 \cdot 47$	$2^3 \cdot 241$	$3 \cdot 643$
193	$3^2 \cdot 5 \cdot 43$	$2^4 \cdot 11^2$	$13 \cdot 149$	$2 \cdot 3 \cdot 17 \cdot 19$	$7 \cdot 277$
194	$5 \cdot 389$	$2 \cdot 7 \cdot 139$	$3 \cdot 11 \cdot 59$	$2^2 \cdot 487$	**2898118**
195	$5 \cdot 17 \cdot 23$	$2^2 \cdot 3 \cdot 163$	$19 \cdot 103$	$2 \cdot 11 \cdot 89$	$3 \cdot 653$
196	$3 \cdot 5 \cdot 131$	$2 \cdot 983$	$7 \cdot 281$	$2^4 \cdot 3 \cdot 41$	$11 \cdot 179$
197	$5^2 \cdot 79$	$2^3 \cdot 13 \cdot 19$	$3 \cdot 659$	$2 \cdot 23 \cdot 43$	**2964458**
198	$5 \cdot 397$	$2 \cdot 3 \cdot 331$	**2981979**	$2^2 \cdot 7 \cdot 71$	$3^2 \cdot 13 \cdot 17$
199	$3 \cdot 5 \cdot 7 \cdot 19$	$2^2 \cdot 499$	**3003781**	$2 \cdot 3^3 \cdot 37$	**3008128**
200	$5 \cdot 401$	$2 \cdot 17 \cdot 59$	$3^2 \cdot 223$	$2^3 \cdot 251$	$7^2 \cdot 41$

CALCULUS

DIFFERENTIALS

$d\,(au) = a\,du$
$d\,(u + v - w) = du + dv - dw$
$d\,(uv) = u\,dv + v\,du$
$d\left(\frac{u}{v}\right) = \frac{v\,du - u\,dv}{v^2}$
$d(u^n) = nu^{n-1}\,du$
$d(u^v) = vu^{v-1}\,du + u^v(\log_e u)\,dv$
$d\,(e^u) = e^u\,du$
$d(e^{au}) = ae^{au}\,du$
$d\,(a^u) = a^u(\log_e a)\,du$
$d\,(\log_e u = u^{-1}du$
$d\,(\log_a u) = u^{-1}(\log_a e)\,du$
$d\,(u^u) = u^u(1 + \log_e u)\,du$

$d \sin u = \cos u\,du$
$d \cos u = -\sin u\,du$
$d \tan u = \sec^2 u\,du$
$d \cot u = -\csc^2 u\,du$
$d \sec u = \tan u \sec u\,du$
$d \csc u = -\cot u \cdot \csc u\,du$
$d\,\mathrm{vers}\,u = \sin u\,du$
$d \sin^{-1} u = (1 - u^2)^{-\frac{1}{2}}\,du$
$d \cos^{-1} u = -(1 - u^2)^{-\frac{1}{2}}du$
$d \tan^{-1} u = (1 + u^2)^{-1}du$
$d \cot^{-1} u = -(1 + u^2)^{-1}du$
$d \sec^{-1} u = u^{-1}(u^2 - 1)^{-\frac{1}{2}}du$
$d \csc^{-1} u = -u^{-1}(u^2 - 1)^{-\frac{1}{2}}du$
$d \sinh u = \cosh u\,du$
$d \cosh u = \sinh u\,du$
$d \tanh u = \mathrm{sech}^2\,u\,du$
$d \coth u = -\mathrm{csch}^2\,u\,du$
$d\,\mathrm{sech}\,u = -\mathrm{sech}\,u \tanh u\,du$
$d\,\mathrm{csch}\,u = -\mathrm{csch}\,u \coth u\,du$
$d\,\mathrm{vers}^{-1}\,u = (2u - u^2)^{-\frac{1}{2}}\,du$
$d \sinh^{-1} u = (u^2 + 1)^{-\frac{1}{2}}du$
$d \cosh^{-1} u = (u^2 - 1)^{-\frac{1}{2}}\,du$
$d \tanh^{-1} u = (1 - u^2)^{-1}\,du$
$d \coth^{-1} u = -(u^2 - 1)^{-1}du$
$d\,\mathrm{sech}^{-1}\,u = -u^{-1}(1 - u^2)^{-\frac{1}{2}}\,du$
$d\,\mathrm{csch}^{-1}\,u = -u^{-1}(u^2 + 1)^{-\frac{1}{2}}du$

TABLE OF INTEGRALS

The following points should be observed when using this table.

1. A constant of integration is to be supplied with the answers for indefinite integrals.

2. Logarithmic expressions are to base $e = 2.71828 \cdots$, unless otherwise specified, and are to be evaluated for the absolute value of the arguments involved therein.

3. All angles are measured in radians, and inverse trigonometric functions represent principal angles.

4. If the application of a formula produces either a zero denominator or a radical involving the unit $i = \sqrt{-1}$ in the result, there is always available another form of the answer which avoids this difficulty. In many of the results, the excluded values are specified, but when such are omitted it is presumed that one can tell what these should be, especially when difficulties of the type herein mentioned are obtained.

ELEMENTARY FORMS

1. $\int a\,dx = ax.$

2. $\int a \cdot f(x)dx = a\int f(x)dx.$

3. $\int \phi(y)dx = \int \frac{\phi(y)}{y'}\,dy,$ where $y' = dy/dx.$

4. $\int (u + v)\,dx = \int u\,dx + \int v\,dx,$ where u and v are any functions of x.

5. $\int u\,dv = u\int dv - \int v\,du = uv - \int v\,du.$

6. $\int u\frac{dv}{dx}\,dx = uv - \int v\frac{du}{dx}\,dx.$

7. $\int x^n\,dx = \frac{x^{n+1}}{n+1},$ except $n = -1.$

8. $\int \frac{f'(x)\,dx}{f(x)} = \log f(x),$ $[d\,f(x) = f'(x)\,dx].$

9. $\int \frac{dx}{x} = \log x,$ or $\log(-x).$

10. $\int \frac{f'(x)\,dx}{2\sqrt{f(x)}} = \sqrt{f(x)},$ $[d\,f(x) = f'(x)\,dx].$

11. $\int e^x\,dx = e^x.$

12. $\int e^{ax}\,dx = e^{ax}/a.$

13. $$\int b^{ax}\,dx = \frac{b^{ax}}{a \log b}.$$

14. $$\int \log x\,dx = x \log x - x.$$

15. $$\int a^{x} \log a\,dx = a^{x}.$$

16. $$\int \frac{dx}{a^2 + x^2} = \frac{1}{a} \tan^{-1}\left(\frac{x}{a}\right), \text{ or } -\frac{1}{a} \cot^{-1}\left(\frac{x}{a}\right).$$

17. $$\int \frac{dx}{a^2 - x^2} = \frac{1}{a} \tanh^{-1}\left(\frac{x}{a}\right), \text{ or } \frac{1}{2a} \log \frac{a + x}{a - x}.$$

18. $$\int \frac{dx}{x^2 - a^2} = -\frac{1}{a} \coth^{-1}\left(\frac{x}{a}\right), \text{ or } \frac{1}{2a} \log \frac{x - a}{x + a}.$$

19. $$\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1}\left(\frac{x}{a}\right), \text{ or } -\cos^{-1}\left(\frac{x}{a}\right).$$

20. $$\int \frac{dx}{\sqrt{x^2 \pm a^2}} = \log\left(x + \sqrt{x^2 \pm a^2}\right).$$

21. $$\int \frac{dx}{x\sqrt{x^2 - a^2}} = \frac{1}{a} \cos^{-1}\left(\frac{a}{x}\right).$$

22. $$\int \frac{dx}{x\sqrt{a^2 \pm x^2}} = -\frac{1}{a} \log\left(\frac{a + \sqrt{a^2 \pm x^2}}{x}\right).$$

23. $$\int \frac{dx}{x\sqrt{a + bx}} = \frac{2}{\sqrt{-a}} \tan^{-1}\sqrt{\frac{a + bx}{-a}}, \text{ or}$$
$$\frac{-2}{\sqrt{a}} \tanh^{-1}\sqrt{\frac{a + bx}{a}}, \text{ or } \frac{1}{\sqrt{a}} \log \frac{\sqrt{a + bx} - \sqrt{a}}{\sqrt{a + bx} + \sqrt{a}}.$$

Forms Containing $(a + bx)$

24. $$\int (a + bx)^n dx = \frac{(a + bx)^{n+1}}{(n + 1)b}, \text{ except } n = -1.$$

25. $$\int x\,(a + bx)^n dx = \frac{1}{b^2(n + 2)}(a + bx)^{n+2}$$
$$-\frac{a}{b^2(n + 1)}(a + bx)^{n+1}, \text{ except } n = -1 \text{ or } -2.$$

26. $$\int x^2\,(a + bx)^n\,dx = \frac{1}{b^3}\left[\frac{(a + bx)^{n+3}}{n + 3} - 2a\,\frac{(a + bx)^{n+2}}{n + 2} + a^2\,\frac{(a + bx)^{n+1}}{n + 1}\right].$$

27. $\displaystyle \int x^m (a+bx)^n\,dx = \frac{x^{m+1}(a+bx)^n}{m+n+1} + \frac{an}{m+n+1} \int x^m (a+bx)^{n-1}\,dx.$

28. $\displaystyle \int x^m (a+bx)^n\,dx = \frac{1}{a(n+1)}\left[-x^{m+1}(a+bx)^{n+1} + (m+n+2)\int x^m(a+bx)^{n+1}\,dx\right].$

29. $\displaystyle \int \frac{dx}{a+bx} = \frac{1}{b}\log(a+bx).$

30. $\displaystyle \int \frac{dx}{(a+bx)^2} = -\frac{1}{b(a+bx)}.$

31. $\displaystyle \int \frac{dx}{(a+bx)^3} = -\frac{1}{2b(a+bx)^2}.$

32. $\displaystyle \int \frac{xdx}{a+bx} = \frac{1}{b^2}[a+bx-a\log(a+bx)].$

33. $\displaystyle \int \frac{xdx}{(a+bx)^2} = \frac{1}{b^2}\left[\log(a+bx)+\frac{a}{a+bx}\right].$

34. $\displaystyle \int \frac{xdx}{(a+bx)^3} = \frac{1}{b^2}\left[-\frac{1}{a+bx}+\frac{a}{2(a+bx)^2}\right].$

35. $\displaystyle \int \frac{xdx}{(a+bx)^n} = \frac{1}{b^2}\left[\frac{-1}{(n-2)(a+bx)^{n-2}} + \frac{a}{(n-1)(a+bx)^{n-1}}\right], n \neq 1, 2.$

36. $\displaystyle \int \frac{x^2dx}{a+bx} = \frac{1}{b^3}\left[\frac{1}{2}(a+bx)^2 - 2a(a+bx) + a^2\log(a+bx)\right].$

37. $\displaystyle \int \frac{x^2\,dx}{(a+bx)^2} = \frac{1}{b^3}\left[a+bx-2a\log(a+bx)-\frac{a^2}{a+bx}\right].$

38. $\displaystyle \int \frac{x^2\,dx}{(a+bx)^3} = \frac{1}{b^3}\left[\log(a+bx)+\frac{2a}{a+bx}-\frac{a^2}{2(a+bx)^2}\right].$

39. $\displaystyle \int \frac{x^2\,dx}{(a+bx)^n} = \frac{1}{b^3}\left[\frac{-1}{(n-3)(a+bx)^{n-3}} + \frac{2a}{(n-2)(a+bx)^{n-2}} - \frac{a^2}{(n-1)(a+bx)^{n-1}}\right], n \neq 1, 2, 3.$

40. $\displaystyle \int \frac{dx}{x(a+bx)} = -\frac{1}{a}\log\frac{a+bx}{x}.$

41. $\displaystyle \int \frac{dx}{x(a+bx)^2} = \frac{1}{a(a+bx)} - \frac{1}{a^2}\log\frac{a+bx}{x}.$

42. $$\int \frac{dx}{x^2(a+bx)} = -\frac{1}{ax} + \frac{b}{a^2}\log\frac{a+bx}{x}.$$

43. $$\int \frac{dx}{x^2(a+bx)^2} = -\frac{a+2\,bx}{a^2x\,(a+bx)} + \frac{2b}{a^3}\log\frac{a+bx}{x}.$$

FORMS CONTAINING $c^2 \pm x^2$, $x^2 - c^2$

44. $$\int \frac{dx}{c^2+x^2} = \frac{1}{c}\tan^{-1}\frac{x}{c}, \text{ or } \frac{1}{c}\sin^{-1}\frac{x}{\sqrt{c^2+x^2}}.$$

45. $$\int \frac{dx}{c^2-x^2} = \frac{1}{2c}\log\frac{c+x}{c-x}, \text{ or } \frac{1}{c}\tanh^{-1}\left(\frac{x}{c}\right).$$

46. $$\int \frac{dx}{x^2-c^2} = \frac{1}{2c}\log\frac{x-c}{x+c}, \text{ or } -\frac{1}{c}\coth^{-1}\left(\frac{x}{c}\right).$$

FORMS CONTAINING $a + bx$ AND $a' + b'x$

47. $$\int \frac{dx}{(a+bx)(a'+b'x)} = \frac{1}{ab'-a'b}\cdot\log\left(\frac{a'+b'x}{a+bx}\right).$$

48. $$\int \frac{x\,dx}{(a+bx)(a'+b'x)} = \frac{1}{ab'-a'b}\left[\frac{a}{b}\log(a+bx) - \frac{a'}{b'}\log(a'+b'x)\right].$$

49. $$\int \frac{dx}{(a+bx)^2(a'+b'x)} = \frac{1}{ab'-a'b}\left(\frac{1}{a+bx} + \frac{b'}{ab'-a'b}\log\frac{a'+b'x}{a+bx}\right).$$

50. $$\int \frac{x\,dx}{(a+bx)^2(a'+b'x)} = \frac{-a}{b(ab'-a'b)(a+bx)} - \frac{a'}{(ab'-a'b)^2}\log\frac{a'+b'x}{a+bx}.$$

51. $$\int \frac{x^2\,dx}{(a+bx)^2(a'+b'x)} = \frac{a^2}{b^2(ab'-a'b)(a+bx)} + \frac{1}{(ab'-a'b)^2}\left[\frac{a'^2}{b'}\log(a'+b'x) + \frac{a(ab'-2\,a'b)}{b^2}\log(a+bx)\right].$$

52. $$\int \frac{dx}{(a+bx)^n(a'+b'x)^m} = \frac{1}{(m-1)(ab'-a'b)}\left(\frac{-1}{(a+bx)^{n-1}(a'+b'x)^{m-1}} - (m+n-2)b\int\frac{dx}{(a+bx)^n(a'+b'x)^{m-1}}\right).$$

53. $$\int \frac{a+bx}{a'+b'x}\,dx = \frac{bx}{b'} + \frac{ab'-a'b}{b'^2}\log(a'+b'x).$$

$$54.\ \int \frac{(a+bx)^m dx}{(a'+b'x)^n} = -\frac{1}{(n-1)(ab'-a'b)}\left[\frac{(a+bx)^{m+1}}{(a'+b'x)^{n-1}} + b(n-m-2)\int \frac{(a+bx)^m\,dx}{(a'+b'x)^{n-1}}\right]$$

$$= -\frac{1}{b'(n-m-1)}\left[\frac{(a+bx)^m}{(a'+b'x)^{n-1}} + m(ab'-a'b)\int \frac{(a+bx)^{m-1}dx}{(a'+b'x)^n}\right]$$

$$= -\frac{-1}{(n-1)b'}\left[\frac{(a+bx)^m}{(a'+b'x)^{n-1}} - mb\int \frac{(a+bx)^{m-1}dx}{(a'+b'x)^{n-1}}\right].$$

FORMS CONTAINING $\sqrt{a+bx} = \sqrt{u}$ AND $\sqrt{a'+b'x} = \sqrt{v}$ WITH $k = ab' - a'b$

$$55.\ \int \sqrt{uv}\,dx = \frac{k+2\,bv}{4\,bb'}\sqrt{uv} - \frac{k^2}{8\,bb'}\int \frac{dx}{\sqrt{uv}}.$$

$$56.\ \int \frac{dx}{v\sqrt{u}} = \frac{1}{\sqrt{kb'}}\log\frac{b'\sqrt{u}-\sqrt{kb'}}{b'\sqrt{u}+\sqrt{kb'}},\ \text{or}\quad \frac{2}{\sqrt{-kb'}}\tan^{-1}\frac{b'\sqrt{u}}{\sqrt{-kb'}}.$$

$$57.\ \int \frac{dx}{\sqrt{uv}} = \frac{2}{\sqrt{bb'}}\log(\sqrt{bb'u} + b\sqrt{v}),\ \text{or}\quad \frac{2}{\sqrt{bb'}}\tanh^{-1}\sqrt{\frac{b'u}{bv}}, = \frac{2}{\sqrt{-bb'}}\tan^{-1}\sqrt{\frac{-b'u}{bv}},\ \text{or}\quad \frac{-1}{\sqrt{-bb'}}\sin^{-1}\frac{2bb'x + a'b + ab'}{|k|}.$$

$$58.\ \int \frac{x\,dx}{\sqrt{uv}} = \frac{\sqrt{uv}}{bb'} - \frac{ab'+a'b}{2bb'}\int \frac{dx}{\sqrt{uv}}.$$

$$59.\ \int \frac{dx}{v\sqrt{uv}} = -\frac{2\sqrt{u}}{k\sqrt{v}}.$$

$$60.\ \int \frac{\sqrt{v}\,dx}{\sqrt{u}} = \frac{1}{b}\sqrt{uv} - \frac{k}{2b}\int \frac{dx}{\sqrt{uv}}.$$

$$61.\ \int v^m\sqrt{u}\,dx = \frac{1}{(2m+3)b'}\left(2v^{m+1}\sqrt{u} + k\int \frac{v^m dx}{\sqrt{u}}\right).$$

$$62.\ \int \frac{dx}{v^m\sqrt{u}} = -\frac{1}{(m-1)k}\left(\frac{\sqrt{u}}{v^{m-1}} + \left(m-\frac{3}{2}\right)b\int \frac{dx}{v^{m-1}\sqrt{u}}\right).$$

FORMS CONTAINING $(a + bx^n)$

63. $$\int \frac{dx}{a + bx^2} = \frac{1}{\sqrt{ab}} \tan^{-1} \frac{x\sqrt{ab}}{a}.$$

64. $$\int \frac{dx}{a + bx^2} = \frac{1}{2\sqrt{-ab}} \log \frac{a + x\sqrt{-ab}}{a - x\sqrt{-ab}}, \text{ or } \frac{1}{\sqrt{-ab}} \tanh^{-1} \frac{x\sqrt{-ab}}{a}.$$

65. $$\int \frac{xdx}{a + bx^2} = \frac{1}{2b} \log \left(x^2 + \frac{a}{b}\right).$$

66. $$\int \frac{x^2\,dx}{a + bx^2} = \frac{x}{b} - \frac{a}{b} \int \frac{dx}{a + bx^2}.$$

67. $$\int \frac{dx}{(a + bx^2)^2} = \frac{x}{2a(a + bx^2)} + \frac{1}{2a} \int \frac{dx}{a + bx^2}.$$

68. $$\int \frac{dx}{(a + bx^2)^{m+1}} = \frac{1}{2ma} \frac{x}{(a + bx^2)^m} + \frac{2m - 1}{2\,ma} \int \frac{dx}{(a + bx^2)^m}.$$

69. $$\int \frac{xdx}{(a + bx^2)^{m+1}} = \frac{1}{2} \int \frac{dz}{(a + bz)^{m+1}}, \qquad [z = x^2].$$

70. $$\int \frac{x^2dx}{(a + bx^2)^{m+1}} = \frac{-x}{2\,mb(a + bx^2)^m} + \frac{1}{2\,mb} \int \frac{dx}{(a + bx^2)^m}.$$

71. $$\int \frac{dx}{x(a + bx^2)} = \frac{1}{2a} \log \frac{x^2}{a + bx^2}.$$

72. $$\int \frac{dx}{x^2(a + bx^2)} = -\frac{1}{ax} - \frac{b}{a} \int \frac{dx}{a + bx^2}.$$

73. $$\int \frac{dx}{x(a + bx^2)^{m+1}} = \frac{1}{2am(a + bx^2)^m} + \frac{1}{a} \int \frac{dx}{x(a + bx^2)^m}, \qquad m \neq 0.$$

74. $$\int \frac{dx}{x^2(a + bx^2)^{m+1}} = \frac{1}{a} \int \frac{dx}{x^2(a + bx^2)^m} - \frac{b}{a} \int \frac{dx}{(a + bx^2)^{m+1}}.$$

75. $$\int \frac{dx}{a + bx^3} = \frac{k}{3a} \left[\frac{1}{2} \log \frac{(k + x)^2}{k^2 - kx + x^2} + \sqrt{3} \tan^{-1} \frac{2x - k}{k\sqrt{3}}\right], \qquad [bk^3 = a].$$

76. $$\int \frac{xdx}{a + bx^3} = \frac{1}{3bk} \left[\frac{1}{2} \log \frac{k^2 - kx + x^2}{(k + x)^2} + \sqrt{3} \tan^{-1} \frac{2x - k}{k\sqrt{3}}\right], \qquad [bk^3 = a].$$

77. $$\int \frac{dx}{x(a + bx^n)} = \frac{1}{an} \log \frac{x^n}{a + bx^n}.$$

78. $$\int \frac{dx}{(a + bx^n)^{m+1}} = \frac{1}{a} \int \frac{dx}{(a + bx^n)^m} - \frac{b}{a} \int \frac{x^n dx}{(a + bx^n)^{m+1}}.$$

79. $$\int \frac{x^m dx}{(a + bx^n)^{p+1}} = \frac{1}{b} \int \frac{x^{m-n} dx}{(a + bx^n)^p} - \frac{a}{b} \int \frac{x^{m-n} dx}{(a + bx^n)^{p+1}}.$$

80. $$\int \frac{dx}{x^m(a + bx^n)^{p+1}} = \frac{1}{a} \int \frac{dx}{x^m(a + bx^n)^p} - \frac{b}{a} \int \frac{dx}{x^{m-n}(a + bx^n)^{p+1}}.$$

81. $$\int x^m(a + bx^n)^p dx = \frac{x^{m-n+1}(a + bx^n)^{p+1}}{b(np + m + 1)} - \frac{a(m - n + 1)}{b(np + m + 1)} \int x^{m-n}(a + bx^n)^p \, dx.$$

82. $$\int x^m(a + bx^n)^p \, dx = \frac{x^{m+1}(a + bx^n)^p}{np + m + 1} + \frac{anp}{np + m + 1} \int x^m(a + bx^n)^{p-1} \, dx.$$

83. $$\int x^{m-1}(a + bx^n)^p \, dx = \frac{1}{b(m + np)} \left[x^{m-n}(a + bx^n)^{p+1} - (m - n) \, a \int x^{m-n-1}(a + bx^n)^p \, dx \right].$$

84. $$\int x^{m-1}(a + bx^n)^p \, dx = \frac{1}{m + np} \left[x^m(a + bx^n)^p + npa \int x^{m-1}(a + bx^n)^{p-1} \, dx \right].$$

85. $$\int x^{m-1}(a + bx^n)^p \, dx = \frac{1}{ma} \left[x^m(a + bx^n)^{p+1} - (m + np + n)b \int x^{m+n-1}(a + bx^n)^p \, dx \right].$$

86. $$\int x^{m-1}(a + bx^n)^p \, dx = \frac{1}{an(p + 1)} \left[- x^m(a + bx^n)^{p+1} + (m + np + n) \int x^{m-1}(a + bx^n)^{p+1} \, dx \right].$$

FORMS CONTAINING $(a + bx + cx^2)$

$X = a + bx + cx^2$ and $q = 4\,ac - b^2$

87. $$\int \frac{dx}{X} = \frac{2}{\sqrt{q}} \tan^{-1} \frac{2\,cx + b}{\sqrt{q}}.$$

88. $$\int \frac{dx}{X} = \frac{-2}{\sqrt{-q}} \tanh^{-1} \frac{2\,cx + b}{\sqrt{-q}}.$$

89. $$\int \frac{dx}{X} = \frac{1}{\sqrt{-q}} \log \frac{2\,cx + b - \sqrt{-q}}{2\,cx + b + \sqrt{-q}}.$$

90. $$\int \frac{dx}{X^2} = \frac{2\,cx + b}{qX} + \frac{2c}{q} \int \frac{dx}{X}.$$

91. $$\int \frac{dx}{X^3} = \frac{2\,cx + b}{q} \left(\frac{1}{2\,X^2} + \frac{3c}{qX} \right) + \frac{6c^2}{q^2} \int \frac{dx}{X}.$$

92. $$\int \frac{dx}{X^{n+1}} = \frac{2\,cx + b}{nqX^n} + \frac{2\,(2n - 1)\,c}{qn} \int \frac{dx}{X^n}.$$

93. $$\int \frac{xdx}{X} = \frac{1}{2c} \log X - \frac{b}{2c} \int \frac{dx}{X}.$$

94. $$\int \frac{xdx}{X^2} = -\frac{bx + 2a}{qX} - \frac{b}{q} \int \frac{dx}{X}.$$

95. $$\int \frac{xdx}{X^{n+1}} = -\frac{2\,a + bx}{nqX^n} - \frac{b\,(2\,n - 1)}{nq} \int \frac{dx}{X^n}.$$

96. $$\int \frac{x^2}{X}\,dx = \frac{x}{c} - \frac{b}{2\,c^2} \log X + \frac{b^2 - 2\,ac}{2\,c^2} \int \frac{dx}{X}.$$

97. $$\int \frac{x^2}{X^2}\,dx = \frac{(b^2 - 2\,ac)x + ab}{cqX} + \frac{2\,a}{q} \int \frac{dx}{X}.$$

98. $$\int \frac{x^m\,dx}{X^{n+1}} = -\frac{x^{m-1}}{(2\,n - m + 1)cX^n} - \frac{n - m + 1}{2n - m + 1} \cdot \frac{b}{c} \int \frac{x^{m-1}\,dx}{X^{n+1}} + \frac{m - 1}{2\,n - m + 1} \cdot \frac{a}{c} \int \frac{x^{m-2}\,dx}{X^{n+1}}.$$

99. $$\int \frac{dx}{xX} = \frac{1}{2a} \log \frac{x^2}{X} - \frac{b}{2\,a} \int \frac{dx}{X}.$$

100. $$\int \frac{dx}{x^2X} = \frac{b}{2\,a^2} \log \frac{X}{x^2} - \frac{1}{ax} + \left(\frac{b^2}{2\,a^2} - \frac{c}{a} \right) \int \frac{dx}{X}.$$

101. $$\int \frac{dx}{xX^n} = \frac{1}{2a(n - 1)X^{n-1}} - \frac{b}{2a} \int \frac{dx}{X^n} + \frac{1}{a} \int \frac{dx}{xX^{n-1}}.$$

102. $$\int \frac{dx}{x^mX^{n+1}} = -\frac{1}{(m - 1)ax^{m-1}\,X^n} - \frac{n + m - 1}{m - 1} \cdot \frac{b}{a} \int \frac{dx}{x^{m-1}\,X^{n+1}} - \frac{2\,n + m - 1}{m - 1} \cdot \frac{c}{a} \int \frac{dx}{x^{m-2}\,X^{n+1}}.$$

Forms Containing $\sqrt{a + bx}$

103. $$\int \sqrt{a + bx}\,dx = \frac{2}{3b} \sqrt{(a + bx)^3}.$$

104. $$\int x \sqrt{a + bx}\,dx = -\frac{2(2a - 3\,bx)\sqrt{(a + bx)^3}}{15\,b^2}.$$

105. $$\int x^2 \sqrt{a+bx}\, dx = \frac{2(8\,a^2 - 12\,abx + 15\,b^2x^2)\sqrt{(a+bx)^3}}{105\,b^3}.$$

106. $$\int x^m \sqrt{a+bx}\, dx = \frac{2}{b(2m+3)}\left[x^m \sqrt{(a+bx)^3} - ma \int x^{m-1}\sqrt{a+bx}\, dx\right].$$

107. $$\int \frac{\sqrt{a+bx}}{x}\, dx = 2\sqrt{a+bx} + a\int \frac{dx}{x\sqrt{a+bx}}.$$

(see No. 114 and No. 115).

108. $$\int \frac{\sqrt{a+bx}}{x^2}\, dx = -\frac{\sqrt{a+bx}}{x} + \frac{b}{2}\int \frac{dx}{x\sqrt{a+bx}}.$$

(see No. 114 and No. 115).

109. $$\int \frac{\sqrt{a+bx}}{x^m} = -\frac{1}{(m-1)a}\left[\frac{\sqrt{(a+bx)^3}}{x^{m-1}} + \frac{(2m-5)b}{2}\int \frac{\sqrt{a+bx}\, dx}{x^{m-1}}\right] \qquad m \neq 1.$$

110. $$\int \frac{dx}{\sqrt{a+bx}} = \frac{2\sqrt{a+bx}}{b}.$$

111. $$\int \frac{xdx}{\sqrt{a+bx}} = -\frac{2\,(2a-bx)}{3\,b^2}\sqrt{a+bx}.$$

112. $$\int \frac{x^2dx}{\sqrt{a+bx}} = \frac{2\,(8\,a^2 - 4\,abx + 3\,b^2x^2)}{15\,b^3}\sqrt{a+bx}.$$

113. $$\int \frac{x^m dx}{\sqrt{a+bx}} = \frac{2x^m\sqrt{a+bx}}{(2m+1)b} - \frac{2ma}{(2m+1)b}\int \frac{x^{m-1}dx}{\sqrt{a+bx}}.$$

114. $$\int \frac{dx}{x\sqrt{a+bx}} = \frac{1}{\sqrt{a}}\log\left(\frac{\sqrt{a+bx}-\sqrt{a}}{\sqrt{a+bx}+\sqrt{a}}\right).$$

115. $$\int \frac{dx}{x\sqrt{a+bx}} = \frac{-2}{\sqrt{a}}\tanh^{-1}\sqrt{\frac{a+bx}{a}}.$$

116. $$\int \frac{dx}{x^2\sqrt{a+bx}} = -\frac{\sqrt{a+bx}}{ax} - \frac{b}{2\,a}\int \frac{dx}{x\sqrt{a+bx}}.$$

117. $$\int \frac{dx}{x^n\sqrt{a+bx}} = -\frac{\sqrt{a+bx}}{(n-1)ax^{n-1}} - \frac{(2n-3)b}{(2n-2)a}\int \frac{dx}{x^{n-1}\sqrt{a+bx}}.$$

118. $$\int (a+bx)^{\pm n/2}dx = \frac{2\,(a+bx)^{\frac{2\pm n}{2}}}{b(2\pm n)}.$$

119. $$\int x(a+bx)^{\pm n/2}dx = \frac{2}{b^2}\left[\frac{(a+bx)^{\frac{4\pm n}{2}}}{4\pm n} - \frac{a\,(a+bx)^{\frac{2\pm n}{2}}}{2\pm n}\right].$$

120. $$\int \frac{dx}{x(a+bx)^{m/2}} = \frac{1}{a}\int \frac{dx}{x(a+bx)^{\frac{m-2}{2}}} - \frac{b}{a}\int \frac{dx}{(a+bx)^{m/2}}.$$

121. $$\int \frac{(a+bx)^{n/2}dx}{x} = b\int (a+bx)^{\frac{n-2}{2}}\,dx + a\int \frac{(a+bx)^{\frac{n-2}{2}}}{x}\,dx.$$

122. $$\int f(x, \sqrt{a+bx})\,dx = \frac{2}{b}\int f\left(\frac{z^2-a}{b}, z\right) zdz \qquad (z^2 = a+bx).$$

Forms Containing $\sqrt{x^2 \pm a^2}$

123. $$\int \sqrt{x^2 \pm a^2}\,dx = \tfrac{1}{2}[x\sqrt{x^2 \pm a^2} \pm a^2 \log (x + \sqrt{x^2 \pm a^2})].$$

124. $$\int \frac{dx}{\sqrt{x^2 \pm a^2}} = \log (x + \sqrt{x^2 \pm a^2}).$$

125. $$\int \frac{dx}{x\sqrt{x^2 - a^2}} = \frac{1}{a}\cos^{-1}\left(\frac{a}{x}\right), \text{ or } \frac{1}{a}\sec^{-1}\left(\frac{x}{a}\right).$$

126. $$\int \frac{dx}{x\sqrt{x^2 + a^2}} = -\frac{1}{a}\log\left(\frac{a + \sqrt{x^2 + a^2}}{x}\right).$$

127. $$\int \frac{\sqrt{x^2 + a^2}}{x}\,dx = \sqrt{x^2 + a^2} - a\log\left(\frac{a + \sqrt{x^2 + a^2}}{x}\right).$$

128. $$\int \frac{\sqrt{x^2 - a^2}}{x}\,dx = \sqrt{x^2 - a^2} - a\cos^{-1}\frac{a}{x}.$$

129. $$\int \frac{x\,dx}{\sqrt{x^2 \pm a^2}} = \sqrt{x^2 \pm a^2}.$$

130. $$\int x\sqrt{x^2 \pm a^2}\,dx = \tfrac{1}{3}\sqrt{(x^2 \pm a^2)^3}.$$

131. $$\int \sqrt{(x^2 \pm a^2)^3}\,dx = \frac{1}{4}\left[x\sqrt{(x^2 \pm a^2)^3} \pm \frac{3\,a^2x}{2}\sqrt{x^2 \pm a^2} + \frac{3\,a^4}{2}\log (x + \sqrt{x^2 \pm a^2})\right].$$

132. $$\int \frac{dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{\pm x}{a^2 \sqrt{x^2 \pm a^2}}.$$

133. $$\int \frac{x\,dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{-1}{\sqrt{x^2 \pm a^2}}.$$

134. $$\int x \sqrt{(x^2 \pm a^2)^3}\, dx = \tfrac{1}{5} \sqrt{(x^2 \pm a^2)^5}.$$

135. $$\int x^2 \sqrt{x^2 \pm a^2}\, dx = \frac{x}{4} \sqrt{(x^2 \pm a^2)^3} \mp \frac{a^2}{8} x \sqrt{x^2 \pm a^2} - \frac{a^4}{8} \log (x + \sqrt{x^2 \pm a^2}).$$

136. $$\int x^3 \sqrt{x^2 + a^2}\, dx = (\tfrac{1}{5}x^2 - \tfrac{2}{15}a^2) \sqrt{(a^2 + x^2)^3}.$$

137. $$\int x^3 \sqrt{x^2 - a^2}\, dx = \frac{1}{5} \sqrt{(x^2 - a^2)^5} + \frac{a^2}{3} \sqrt{(x^2 - a^2)^3}.$$

138. $$\int \frac{x^2 dx}{\sqrt{x^2 \pm a^2}} = \frac{x}{2} \sqrt{x^2 \pm a^2} \mp \frac{a^2}{2} \log (x + \sqrt{x^2 \pm a^2}).$$

139. $$\int \frac{x^3 dx}{\sqrt{x^2 \pm a^2}} = \frac{1}{3} \sqrt{(x^2 \pm a^2)^3} \mp a^2 \sqrt{x^2 \pm a^2}.$$

140. $$\int \frac{dx}{x^2 \sqrt{x^2 \pm a^2}} = \mp \frac{\sqrt{x^2 \pm a^2}}{a^2 x}.$$

141. $$\int \frac{dx}{x^3 \sqrt{x^2 + a^2}} = -\frac{\sqrt{x^2 + a^2}}{2a^2x^2} + \frac{1}{2a^3} \log \frac{a + \sqrt{x^2 + a^2}}{x}.$$

142. $$\int \frac{dx}{x^3 \sqrt{x^2 - a^2}} = \frac{\sqrt{x^2 - a^2}}{2a^2x^2} + \frac{1}{2a^3} \text{arc cos } \frac{a}{x}.$$

143. $$\int x^2 \sqrt{(x^2 \pm a^2)^3}\, dx = \frac{x}{6} \sqrt{(x^2 \pm a^2)^5} \mp \frac{a^2x}{24} \sqrt{(x^2 \pm a^2)^3} - \frac{a^4x}{16} \sqrt{x^2 \pm a^2} \mp \frac{a^6}{16} \log (x + \sqrt{x^2 \pm a^2}).$$

144. $$\int x^3 \sqrt{(x^2 \pm a^2)^3}\, dx = \frac{1}{7} \sqrt{(x^2 \pm a^2)^7} \mp \frac{a^2}{5} \sqrt{(x^2 \pm a^2)^5}.$$

145. $$\int \frac{\sqrt{x^2 \pm a^2}\, dx}{x^2} = -\frac{\sqrt{x^2 \pm a^2}}{x} + \log (x + \sqrt{x^2 \pm a^2}).$$

146. $$\int \frac{\sqrt{x^2 + a^2}}{x^3}\, dx = -\frac{\sqrt{x^2 + a^2}}{2x^2} - \frac{1}{2a} \log \frac{a + \sqrt{x^2 + a^2}}{x}.$$

147. $$\int \frac{\sqrt{x^2 - a^2}}{x^3}\, dx = -\frac{\sqrt{x^2 - a^2}}{2x^2} + \frac{1}{2a} \text{arc cos } \frac{a}{x}.$$

148. $$\int \frac{x^2dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{-x}{\sqrt{x^2 \pm a^2}} + \log\,(x + \sqrt{x^2 \pm a^2}).$$

149. $$\int \frac{x^3dx}{\sqrt{(x^2 \pm a^2)^3}} = \sqrt{x^2 \pm a^2} \pm \frac{a^2}{\sqrt{x^2 \pm a^2}}.$$

150. $$\int \frac{dx}{x\sqrt{(x^2 + a^2)^3}} = \frac{1}{a^2\sqrt{x^2 + a^2}} - \frac{1}{a^3}\log\frac{a + \sqrt{x^2 + a^2}}{x}.$$

151. $$\int \frac{dx}{x\sqrt{(x^2 - a^2)^3}} = -\frac{1}{a^2\sqrt{x^2 - a^2}} - \frac{1}{a^3}\operatorname{arc\,cos}\frac{a}{x}.$$

152. $$\int \frac{dx}{x^2\sqrt{(x^2 \pm a^2)^3}} = -\frac{1}{a^4}\left[\frac{\sqrt{x^2 \pm a^2}}{x} + \frac{x}{\sqrt{x^2 \pm a^2}}\right].$$

153. $$\int \frac{dx}{x^3\sqrt{(x^2 + a^2)^3}} = -\frac{1}{2a^2x^2\sqrt{x^2 + a^2}} - \frac{3}{2a^4\sqrt{x^2 + a^2}} + \frac{3}{2a^5}\log\frac{a + \sqrt{x^2 + a^2}}{x}.$$

154. $$\int \frac{dx}{x^3\sqrt{(x^2 - a^2)^3}} = \frac{1}{2a^2x^2\sqrt{x^2 - a^2}} - \frac{3}{2a^4\sqrt{x^2 - a^2}} - \frac{3}{2a^5}\operatorname{arc\,cos}\frac{a}{x}.$$

155. $$\int f(x, \sqrt{x^2 + a^2})\,dx = a\int f(a\tan u, a\sec u)\sec^2 u\,du \qquad (x = a\tan u).$$

156. $$\int f(x, \sqrt{x^2 - a^2})\,dx = a\int f(a\sec u, a\tan u) \sec u\tan u\,du \qquad (x = a\sec u).$$

FORMS CONTAINING $\sqrt{a^2 - x^2}$

157. $$\int \sqrt{a^2 - x^2}\,dx = \frac{1}{2}\left[x\sqrt{a^2 - x^2} + a^2\sin^{-1}\left(\frac{x}{a}\right)\right].$$

158. $$\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1}\left(\frac{x}{a}\right),\text{ or } -\cos^{-1}\left(\frac{x}{a}\right)\Bigg].$$

159. $$\frac{dx}{x\sqrt{a^2 - x^2}} = -\frac{1}{a}\log\left(\frac{a + \sqrt{a^2 - x^2}}{x}\right).$$

160. $$\int \frac{\sqrt{a^2 - x^2}}{x}\,dx = \sqrt{a^2 - x^2} - a\log\left(\frac{a + \sqrt{a^2 - x^2}}{x}\right).$$

161. $$\int \frac{x\,dx}{\sqrt{a^2 - x^2}} = -\sqrt{a^2 - x^2}.$$

162. $$\int x\sqrt{a^2 - x^2}\,dx = -\tfrac{1}{3}\sqrt{(a^2 - x^2)^3}.$$

163. $$\int \sqrt{(a^2 - x^2)^3}\, dx = \frac{1}{4}\left[x\sqrt{(a^2 - x^2)^3} + \frac{3\,a^2x}{2}\sqrt{a^2 - x^2} + \frac{3\,a^4}{2}\sin^{-1}\frac{x}{a}\right].$$

164. $$\int \frac{dx}{\sqrt{(a^2 - x^2)^3}} = \frac{x}{a^2\sqrt{a^2 - x^2}}.$$

165. $$\int \frac{x\, dx}{\sqrt{(a^2 - x^2)^3}} = \frac{1}{\sqrt{a^2 - x^2}}.$$

166. $$\int x\sqrt{(a^2 - x^2)^3}\, dx = -\tfrac{1}{5}\sqrt{(a^2 - x^2)^5}.$$

167. $$\int x^2\sqrt{a^2 - x^2}\, dx = -\frac{x}{4}\sqrt{(a^2 - x^2)^3} + \frac{a^2}{8}\left(x\sqrt{a^2 - x^2} + a^2\sin^{-1}\frac{x}{a}\right).$$

168. $$\int x^3\sqrt{a^2 - x^2}\, dx = (-\tfrac{1}{5}x^2 - \tfrac{2}{15}a^2)\sqrt{(a^2 - x^2)^3}.$$

169. $$\int x^2\sqrt{(a^2 - x^2)^3}\, dx = -\frac{1}{6}x\sqrt{(a^2 - x^2)^5} + \frac{a^2x}{24}\sqrt{(a^2 - x^2)^3} + \frac{a^4x}{16}\sqrt{a^2 - x^2} + \frac{a^6}{16}\text{ arc sin }\frac{x}{a}.$$

170. $$\int x^3\sqrt{(a^2 - x^2)^3}\, dx = \frac{1}{7}\sqrt{(a^2 - x^2)^7} - \frac{a^2}{5}\sqrt{(a^2 - x^2)^5}.$$

171. $$\int \frac{x^2\, dx}{\sqrt{a^2 - x^2}} = -\frac{x}{2}\sqrt{a^2 - x^2} + \frac{a^2}{2}\sin^{-1}\frac{x}{a}.$$

172. $$\int \frac{dx}{x^2\sqrt{a^2 - x^2}} = -\frac{\sqrt{a^2 - x^2}}{a^2x}.$$

173. $$\int \frac{\sqrt{a^2 - x^2}}{x^2}\, dx = -\frac{\sqrt{a^2 - x^2}}{x} - \sin^{-1}\frac{x}{a}.$$

173a. $$\int \frac{\sqrt{a^2 - x^2}}{x^3}\, dx = -\frac{\sqrt{a^2 - x^2}}{2x^2} + \frac{1}{2a}\log\frac{a + \sqrt{a^2 - x^2}}{x}.$$

174. $$\int \frac{x^2\, dx}{\sqrt{(a^2 - x^2)^3}} = \frac{x}{\sqrt{a^2 - x^2}} - \sin^{-1}\frac{x}{a}.$$

175. $$\int \frac{x^3 dx}{\sqrt{a^2 - x^2}} = \frac{1}{3}\sqrt{(a^2 - x^2)^3} - a^2\sqrt{a^2 - x^2}.$$

176. $$\int \frac{x^3 dx}{\sqrt{(a^2 - x^2)^3}} = \sqrt{a^2 - x^2} + \frac{a^2}{\sqrt{a^2 - x^2}}.$$

177. $$\int \frac{dx}{x^3\sqrt{a^2 - x^2}} = -\frac{\sqrt{a^2 - x^2}}{2a^2x^2} - \frac{1}{2a^3}\log\frac{a + \sqrt{a^2 - x^2}}{x}.$$

177a. $$\int \frac{dx}{x\sqrt{(a^2 - x^2)^3}} = \frac{1}{a^2\sqrt{a^2 - x^2}} - \frac{1}{a^3}\log\frac{a + \sqrt{a^2 - x^2}}{x}.$$

178. $$\int \frac{dx}{x^2\sqrt{(a^2-x^2)^3}} = \frac{1}{a^4}\left[-\frac{\sqrt{a^2-x^2}}{x} + \frac{x}{\sqrt{a^2-x^2}}\right].$$

179. $$\int \frac{dx}{x^3\sqrt{(a^2-x^2)^3}} = -\frac{1}{2a^2x^2\sqrt{a^2-x^2}} + \frac{3}{2a^4\sqrt{a^2-x^2}} - \frac{3}{2a^5}\log\frac{a+\sqrt{a^2+x^2}}{x}.$$

180. $$\int f(x, \sqrt{a^2-x^2})\,dx = a\int f(a\sin u, a\cos u)\cos u\,du \qquad (x = a\sin u).$$

FORMS CONTAINING $\sqrt{a+bx+cx^2}$

$$X = a + bx + cx^2,\ q = 4ac - b^2, \text{ and } k = \frac{4c}{q}.$$

181. $$\int \frac{dx}{\sqrt{X}} = \frac{1}{\sqrt{c}}\log\left(\sqrt{X} + x\sqrt{c} + \frac{b}{2\sqrt{c}}\right).$$

182. $$\int \frac{dx}{\sqrt{X}} = \frac{1}{\sqrt{c}}\sinh^{-1}\left(\frac{2cx+b}{\sqrt{4ac-b^2}}\right), \qquad \text{if } c > 0.$$

183. $$\int \frac{dx}{\sqrt{X}} = \frac{1}{\sqrt{-c}}\sin^{-1}\left(\frac{-2cx-b}{\sqrt{b^2-4ac}}\right), \qquad \text{if } c < 0.$$

184. $$\int \frac{dx}{X\sqrt{X}} = \frac{2(2cx+b)}{q\sqrt{X}}.$$

185. $$\int \frac{dx}{X^2\sqrt{X}} = \frac{2(2cx+b)}{3q\sqrt{X}}\left(\frac{1}{X} + 2k\right).$$

186. $$\int \frac{dx}{X^n\sqrt{X}} = \frac{2(2cx+b)\sqrt{X}}{(2n-1)qX^n} + \frac{2k(n-1)}{2n-1}\int \frac{dx}{X^{n-1}\sqrt{X}}.$$

187. $$\int \sqrt{X}\,dx = \frac{(2cx+b)\sqrt{X}}{4c} + \frac{1}{2k}\int \frac{dx}{\sqrt{X}}.$$

188. $$\int X\sqrt{X}\,dx = \frac{(2cx+b)\sqrt{X}}{8c}\left(X + \frac{3}{2k}\right) + \frac{3}{8k^2}\int \frac{dx}{\sqrt{X}}.$$

189. $$\int X^2\sqrt{X}\,dx = \frac{(2cx+b)\sqrt{X}}{12c}\left(X^2 + \frac{5X}{4k} + \frac{15}{8k^2}\right) + \frac{5}{16k^3}\int \frac{dx}{\sqrt{X}}.$$

190. $$\int X^n \sqrt{X}\,dx = \frac{(2\,cx + b)\,X^n \sqrt{X}}{4(n+1)c} + \frac{2n+1}{2(n+1)\,k} \int \frac{X^n dx}{\sqrt{X}}.$$

191. $$\int \frac{x\,dx}{\sqrt{X}} = \frac{\sqrt{X}}{c} - \frac{b}{2\,c} \int \frac{dx}{\sqrt{X}}.$$

192. $$\int \frac{x\,dx}{X\sqrt{X}} = -\frac{2\,(bx + 2a)}{q\sqrt{X}}.$$

193. $$\int \frac{x\,dx}{X^n \sqrt{X}} = -\frac{\sqrt{X}}{(2n-1)\,cX^n} - \frac{b}{2\,c} \int \frac{dx}{X^n \sqrt{X}}.$$

194. $$\int \frac{x^2\,dx}{\sqrt{X}} = \left(\frac{x}{2\,c} - \frac{3\,b}{4\,c^2}\right)\sqrt{X} + \frac{3\,b^2 - 4\,ac}{8\,c^2} \int \frac{dx}{\sqrt{X}}.$$

195. $$\int \frac{x^2\,dx}{X\sqrt{X}} = \frac{(2\,b^2 - 4\,ac)x + 2\,ab}{cq\sqrt{X}} + \frac{1}{c} \int \frac{dx}{\sqrt{X}}.$$

196. $$\int \frac{x^2\,dx}{X^n \sqrt{X}} = \frac{(2\,b^2 - 4\,ac)x + 2\,ab}{(2n-1)\,cq\,X^{n-1}\sqrt{X}} + \frac{4\,ac + (2\,n - 3)b^2}{(2n-1)\,cq} \int \frac{dx}{X^{n-1}\sqrt{X}}.$$

197. $$\int \frac{x^3\,dx}{\sqrt{X}} = \left(\frac{x^2}{3\,c} - \frac{5\,bx}{12\,c^2} + \frac{5\,b^2}{8\,c^3} - \frac{2\,a}{3\,c^2}\right)\sqrt{X} + \left(\frac{3\,ab}{4\,c^2} - \frac{5\,b^3}{16\,c^3}\right) \int \frac{dx}{\sqrt{X}}.$$

198. $$\int x\sqrt{X}\,dx = \frac{X\sqrt{X}}{3\,c} - \frac{b}{2\,c} \int \sqrt{X}\,dx.$$

199. $$\int x\,X\sqrt{X}\,dx = \frac{X^2\sqrt{X}}{5\,c} - \frac{b}{2\,c} \int X\sqrt{X}\,dx.$$

200. $$\int \frac{x\,X^n\,dx}{\sqrt{X}} = \frac{X^n\sqrt{X}}{(2n+1)c} - \frac{b}{2\,c} \int \frac{X^n dx}{\sqrt{X}}.$$

201. $$\int x^2\sqrt{X}\,dx = \left(x - \frac{5\,b}{6\,c}\right)\frac{X\sqrt{X}}{4\,c} + \frac{5\,b^2 - 4\,ac}{16\,c^2} \int \sqrt{X}\,dx.$$

202. $$\int \frac{dx}{x\sqrt{X}} = -\frac{1}{\sqrt{a}} \log\left(\frac{\sqrt{X} + \sqrt{a}}{x} + \frac{b}{2\sqrt{a}}\right),$$ if $a > 0$.

203. $$\int \frac{dx}{x\sqrt{X}} = \frac{1}{\sqrt{-a}} \sin^{-1}\left(\frac{bx + 2\,a}{x\sqrt{b^2 - 4\,ac}}\right),$$ if $a < 0$.

204. $$\int \frac{dx}{x\sqrt{X}} = -\frac{2\sqrt{X}}{bx}, \qquad \text{if } a = 0.$$

205. $$\int \frac{dx}{x^2\sqrt{X}} = -\frac{\sqrt{X}}{ax} - \frac{b}{2a}\int \frac{dx}{x\sqrt{X}}.$$

206. $$\int \frac{\sqrt{X}\,dx}{x} = \sqrt{X} + \frac{b}{2}\int \frac{dx}{\sqrt{X}} + a\int \frac{dx}{x\sqrt{X}}.$$

207. $$\int \frac{\sqrt{X}\,dx}{x^2} = -\frac{\sqrt{X}}{x} + \frac{b}{2}\int \frac{dx}{x\sqrt{X}} + c\int \frac{dx}{\sqrt{X}}.$$

FORMS INVOLVING $\sqrt{2ax - x^2}$

208. $$\int \sqrt{2ax - x^2}\,dx = \tfrac{1}{2}[(x - a)\sqrt{2ax - x^2} + a^2 \sin^{-1}(x - a)/a].$$

209. $$\int \frac{dx}{\sqrt{2ax - x^2}} = \cos^{-1}\left(\frac{a - x}{a}\right) = 2\sin^{-1}\frac{\sqrt{x}}{2a}.$$

210. $$\int x^n\sqrt{2ax - x^2}\,dx = -\frac{x^{n-1}(2ax - x^2)^{\frac{3}{2}}}{n + 2} + \frac{(2n + 1)a}{n + 2}\int x^{n-1}\sqrt{2ax - x^2}\,dx \qquad n \neq -2.$$

211. $$\int \frac{\sqrt{2ax - x^2}}{x^n}\,dx = \frac{(2ax - x^2)^{\frac{3}{2}}}{(3 - 2n)ax^n} + \frac{n - 3}{(2n - 3)a}\int \frac{\sqrt{2ax - x^2}}{x^{n-1}}\,dx \qquad n \neq \frac{3}{2}.$$

212. $$\int \frac{x^n dx}{\sqrt{2ax - x^2}} = \frac{-x^{n-1}\sqrt{2ax - x^2}}{n} + \frac{a(2n - 1)}{n}\int \frac{x^{n-1}}{\sqrt{2ax - x^2}}\,dx \qquad n \neq 0.$$

213. $$\int \frac{dx}{x^n\sqrt{2ax - x^2}} = \frac{\sqrt{2ax - x^2}}{a(1 - 2n)\,x^n} + \frac{n - 1}{(2n - 1)a}\int \frac{dx}{x^{n-1}\sqrt{2ax - x^2}} \qquad n \neq \frac{1}{2}.$$

214. $$\int \frac{dx}{(2ax - x^2)^{\frac{3}{2}}} = \frac{x - a}{a^2\sqrt{2ax - x^2}}.$$

215. $$\int \frac{x\,dx}{(2ax - x^2)^{\frac{3}{2}}} = \frac{x}{a\sqrt{2ax - x^2}}.$$

216. $$\int \frac{dx}{\sqrt{2ax + x^2}} = \log(x + a + \sqrt{2ax + x^2}).$$

MISCELLANEOUS ALGEBRAIC FORMS

217. $$\int \sqrt{ax^2+c}\,dx = \frac{x}{2}\sqrt{ax^2+c} + \frac{c}{2\sqrt{a}}\log\left(x\sqrt{a} + \sqrt{ax^2+c}\right), \quad [a>0].$$

$$= \frac{x}{2}\sqrt{ax^2+c} + \frac{c}{2\sqrt{-a}}\sin^{-1}\left(x\sqrt{\frac{-a}{c}}\right), \quad [a<0].$$

218. $$\int \frac{dx}{\sqrt{a+bx}\cdot\sqrt{a'+b'x}} = \frac{2}{\sqrt{-bb'}}\tan^{-1}\sqrt{\frac{-b'(a+bx)}{b(a'+b'x)}}.$$

219. $$\int \sqrt{\frac{1+x}{1-x}}\,dx = \sin^{-1}x - \sqrt{1-x^2}.$$

220. $$\int \frac{dx}{\sqrt{a\pm 2bx+cx^2}} = \frac{1}{\sqrt{c}}\log\left(\pm b + cx + \sqrt{c}\sqrt{a\pm 2bx+cx^2}\right).$$

221. $$\int \frac{dx}{\sqrt{a\pm 2bx-cx^2}} = \frac{1}{\sqrt{c}}\sin^{-1}\frac{cx\mp b}{\sqrt{b^2+ac}}.$$

222. $$\int \frac{xdx}{\sqrt{a\pm 2bx+cx^2}} = \frac{1}{c}\sqrt{a\pm 2bx+cx^2} - \frac{b}{\sqrt{c^3}}\log\left(\pm b + cx + \sqrt{c}\sqrt{a\pm 2bx+cx^2}\right).$$

223. $$\int \frac{xdx}{\sqrt{a\pm 2bx-cx^2}} = \frac{1}{c}\sqrt{a\pm 2bx-cx^2} \pm \frac{b}{\sqrt{c^3}}\sin^{-1}\frac{cx\mp b}{\sqrt{b^2+ac}}.$$

FORMS INVOLVING TRIGONOMETRIC FUNCTIONS

224. $$\int \sin x\,dx = -\cos x, \text{ or versin } x.$$

225. $$\int \cos x\,dx = \sin x, \text{ or } -\text{coversin } x.$$

226. $$\int \tan x\,dx = -\log\cos x.$$

227. $$\int \cot x\,dx = \log\sin x.$$

228. $$\int \sec x\,dx = \log(\sec x + \tan x) = \log\tan\left(\frac{\pi}{4}+\frac{x}{2}\right).$$

229. $$\int \csc x\,dx = \log(\csc x - \cot x) = \log\tan\frac{x}{2}.$$

230. $$\int \sin^2 x\,dx = -\tfrac{1}{2}\cos x\sin x + \tfrac{1}{2}x = \tfrac{1}{2}x - \tfrac{1}{4}\sin 2x.$$

231. $\int \sin^3 x\,dx = -\tfrac{1}{3}\cos x\,(\sin^2 x + 2).$

232. $\int \sin^n x\,dx = -\dfrac{\sin^{n-1} x \cos x}{n} + \dfrac{n-1}{n}\int \sin^{n-2} x\,dx.$

233. $\int \cos^2 x\,dx = \tfrac{1}{2}\sin x \cos x + \tfrac{1}{2}x = \tfrac{1}{2}x + \tfrac{1}{4}\sin 2x.$

234. $\int \cos^3 x\,dx = \tfrac{1}{3}\sin x\,(\cos^2 x + 2).$

235. $\int \cos^n x\,dx = \dfrac{1}{n}\cos^{n-1} x \sin x + \dfrac{n-1}{n}\int \cos^{n-2} x\,dx.$

236. $\int \sin\dfrac{x}{a}\,dx = -a\cos\dfrac{x}{a}.$

237. $\int \cos\dfrac{x}{a}\,dx = a\sin\dfrac{x}{a}.$

238. $\int \sin(a + bx)\,dx = -\dfrac{1}{b}\cos(a + bx).$

239. $\int \cos(a + bx)\,dx = \dfrac{1}{b}\sin(a + bx).$

240. $\int \dfrac{dx}{\sin x} = \int \csc x\,dx = \log(\csc x - \cot x)$

$$= -\frac{1}{2}\log\frac{1 + \cos x}{1 - \cos x} = \log\tan\frac{x}{2}.$$

241. $\int \dfrac{dx}{\cos x} = \int \sec x\,dx = \log(\sec x + \tan x)$

$$= \frac{1}{2}\log\left(\frac{1 + \sin x}{1 - \sin x}\right) = \log\tan\left(\frac{\pi}{4} + \frac{x}{2}\right).$$

242. $\int \dfrac{dx}{\cos^2 x} = \int \sec^2 x\,dx = \tan x.$

243. $\int \dfrac{dx}{\cos^n x} = \dfrac{1}{n-1}\cdot\dfrac{\sin x}{\cos^{n-1} x} + \dfrac{n-2}{n-1}\int \dfrac{dx}{\cos^{n-2} x}.$

244. $\int \dfrac{dx}{1 \pm \sin x} = \mp\tan\left(\dfrac{\pi}{4} \mp \dfrac{x}{2}\right).$

245. $\int \dfrac{dx}{1 + \cos x} = \tan\dfrac{x}{2}.$

246. $\int \dfrac{dx}{1 - \cos x} = -\cot\dfrac{x}{2}.$

247. $\int \dfrac{dx}{a + b\sin x} = \dfrac{2}{\sqrt{a^2 - b^2}}\tan^{-1}\dfrac{a\tan\frac{1}{2}x + b}{\sqrt{a^2 - b^2}}$

$$= \frac{1}{\sqrt{b^2 - a^2}}\log\frac{a\tan\frac{1}{2}x + b - \sqrt{b^2 - a^2}}{a\tan\frac{1}{2}x + b + \sqrt{b^2 - a^2}}.$$

248. $$\int \frac{dx}{a + b\cos x} = \frac{2}{\sqrt{a^2 - b^2}} \tan^{-1} \frac{\sqrt{a^2 - b^2}\tan\frac{1}{2}x}{a + b}$$

$$= \frac{1}{\sqrt{b^2 - a^2}} \log\left(\frac{\sqrt{b^2 - a^2}\tan\frac{1}{2}x + a + b}{\sqrt{b^2 - a^2}\tan\frac{1}{2}x - a - b}\right).$$

249. $$\int \frac{dx}{a + b\sin x + c\cos x}$$

$$= \begin{cases} \dfrac{1}{\sqrt{b^2 + c^2 - a^2}} \log \dfrac{b - \sqrt{b^2 + c^2 - a^2} + (a - c)\tan\dfrac{x}{2}}{b + \sqrt{b^2 + c^2 - a^2} + (a - c)\tan\dfrac{x}{2}} & \text{if } a^2 < b^2 + c^2. \\ \dfrac{2}{\sqrt{a^2 - b^2 - c^2}} \tan^{-1} \dfrac{b + (a - c)\tan\dfrac{x}{2}}{\sqrt{a^2 - b^2 - c^2}} & \text{if } a^2 > b^2 + c^2. \end{cases}$$

250. $$\int \sqrt{1 - \cos x}\, dx = -2\sqrt{2}\cos\frac{x}{2}.$$

251. $$\int \sqrt{1 + \cos x}\, dx = 2\sqrt{2}\sin\frac{x}{2}.$$

252. $$\int \sin mx \sin nx\, dx = \frac{\sin(m - n)x}{2(m - n)} - \frac{\sin(m + n)x}{2(m + n)}, \quad [m^2 \neq n^2].$$

253. $$\int x\sin^2 x\, dx = \frac{x^2}{4} - \frac{x\sin 2x}{4} - \frac{\cos 2x}{8}.$$

254. $$\int x^2\sin^2 x\, dx = \frac{x^3}{6} - \left(\frac{x^2}{4} - \frac{1}{8}\right)\sin 2x - \frac{x\cos 2x}{4}.$$

255. $$\int x\sin^3 x\, dx = \frac{x\cos 3x}{12} - \frac{\sin 3x}{36} - \frac{3}{4}x\cos x + \frac{3}{4}\sin x.$$

256. $$\int \sin^4 x\, dx = \frac{3x}{8} - \frac{\sin 2x}{4} + \frac{\sin 4x}{32}.$$

257. $$\int \cos mx \cos nx\, dx = \frac{\sin(m - n)x}{2(m - n)} + \frac{\sin(m + n)x}{2(m + n)}, \quad [m^2 \neq n^2].$$

258. $$\int x\cos^2 x\, dx = \frac{x^2}{4} + \frac{x\sin 2x}{4} + \frac{\cos 2x}{8}.$$

259. $$\int x^2\cos^2 x\, dx = \frac{x^3}{6} + \left(\frac{x^2}{4} - \frac{1}{8}\right)\sin 2x + \frac{x\cos 2x}{4}.$$

260. $$\int x\cos^3 x\, dx = \frac{x\sin 3x}{12} + \frac{\cos 3x}{36} + \frac{3}{4}x\sin x + \frac{3}{4}\cos x.$$

261. $\int \cos^4 x\,dx = \frac{3x}{8} + \frac{\sin 2x}{4} + \frac{\sin 4x}{32}.$

262. $\int \frac{\sin x\,dx}{x^m} = -\frac{\sin x}{(m-1)\,x^{m-1}} + \frac{1}{m-1}\int \frac{\cos x\,dx}{x^{m-1}}.$

263. $\int \frac{\cos x\,dx}{x^m} = -\frac{\cos x}{(m-1)x^{m-1}} - \frac{1}{m-1}\int \frac{\sin x\,dx}{x^{m-1}}.$

264. $\int \tan^3 x\,dx = \tfrac{1}{2}\tan^2 x + \log\cos x.$

265. $\int \tan^4 x\,dx = \tfrac{1}{3}\tan^3 x - \tan x + x.$

265a. $\int \tan^n x\,dx = \frac{\tan^{n-1} x}{n-1} - \int \tan^{n-2} x\,dx, \qquad [n \neq 1].$

266. $\int \cot^3 x\,dx = -\tfrac{1}{2}\cot^2 x - \log\sin x.$

267. $\int \cot^4 x\,dx = -\tfrac{1}{3}\cot^3 x + \cot x + x.$

268. $\int \cot^n x\,dx = -\frac{\cot^{n-1} x}{n-1} - \int \cot^{n-2} x\,dx, \qquad [n \neq 1]$

269. $\int \sin x\cos x\,dx = \tfrac{1}{2}\sin^2 x.$

270. $\int \sin mx\cos nx\,dx = -\frac{\cos(m-n)x}{2(m-n)} - \frac{\cos(m+n)x}{2(m+n)}.$

271. $\int \sin^2 x\cos^2 x\,dx = -\tfrac{1}{8}(\tfrac{1}{4}\sin 4x - x).$

272. $\int \sin x\cos^m x\,dx = -\frac{\cos^{m+1} x}{m+1}.$

273. $\int \sin^m x\cos x\,dx = \frac{\sin^{m+1} x}{m+1}.$

274. $$\int \cos^m x\sin^n x\,dx = \frac{\cos^{m-1} x\sin^{n+1} x}{m+n} + \frac{m-1}{m+n}\int \cos^{m-2} x\sin^n x\,dx.$$

275. $$\int \cos^m x\sin^n x\,dx = -\frac{\sin^{n-1} x\cos^{m+1} x}{m+n} + \frac{n-1}{m+n}\int \cos^m x\sin^{n-2} x\,dx.$$

276. $$\int \frac{\cos^m x\,dx}{\sin^n x} = -\frac{\cos^{m+1} x}{(n-1)\sin^{n-1} x} - \frac{m-n+2}{n-1}\int \frac{\cos^m x\,dx}{\sin^{n-2} x}.$$

277. $\int \frac{\cos^m x\,dx}{\sin^n x} = \frac{\cos^{m-1} x}{(m-n)\sin^{n-1} x} + \frac{m-1}{m-n}\int \frac{\cos^{m-2} x\,dx}{\sin^n x}.$

278. $$\int \frac{\sin^m x\,dx}{\cos^n x} = -\int \frac{\cos^m\left(\frac{\pi}{2}-x\right)d\left(\frac{\pi}{2}-x\right)}{\sin^n\left(\frac{\pi}{2}-x\right)}.$$

279. $$\int \frac{\sin x\,dx}{\cos^2 x} = \frac{1}{\cos x} = \sec x.$$

280. $$\int \frac{\sin^2 x\,dx}{\cos x} = -\sin x + \log\tan\left(\frac{\pi}{4}+\frac{x}{2}\right).$$

281. $$\int \frac{\cos x\,dx}{\sin^2 x} = \frac{-1}{\sin x} = -\operatorname{cosec} x.$$

282. $$\int \frac{dx}{\sin x\cos x} = \log\tan x.$$

283. $$\int \frac{dx}{\sin x\cos^2 x} = \frac{1}{\cos x} + \log\tan\frac{x}{2}.$$

284. $$\int \frac{dx}{\sin x\cos^n x} = \frac{1}{(n-1)\cos^{n-1} x} + \int \frac{dx}{\sin x\cos^{n-2} x}, \quad [n \neq 1].$$

285. $$\int \frac{dx}{\sin^2 x\cos x} = -\frac{1}{\sin x} + \log\tan\left(\frac{\pi}{4}+\frac{x}{2}\right).$$

286. $$\int \frac{dx}{\sin^2 x\cos^2 x} = -2\cot 2x.$$

287. $$\int \frac{dx}{\sin^m x\cos^n x} = -\frac{1}{m-1}\cdot\frac{1}{\sin^{m-1} x\cdot\cos^{n-1} x} + \frac{m+n-2}{m-1}\int \frac{dx}{\sin^{m-2} x\cdot\cos^n x}.$$

288. $$\int \frac{dx}{\sin^m x} = -\frac{1}{m-1}\cdot\frac{\cos x}{\sin^{m-1} x} + \frac{m-2}{m-1}\int \frac{dx}{\sin^{m-2} x}.$$

289. $$\int \frac{dx}{\sin^2 x} = -\cot x.$$

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290. $$\int \tan^2 x\,dx = \tan x - x.$$

291. $$\int \tan^n x\,dx = \frac{\tan^{n-1} x}{n-1} - \int \tan^{n-2} x\,dx.$$

292. $$\int \cot^2 x\,dx = -\cot x - x.$$

293. $$\int \cot^n x\,dx = -\frac{\cot^{n-1} x}{n-1} - \int \cot^{n-2} x\,dx.$$

294. $$\int \sec^2 x\,dx = \tan x.$$

295. $$\int \sec^n x\,dx = \int \frac{dx}{\cos^n x} = \frac{1}{n-1}\frac{\sin x}{\cos^{n-1} x} + \frac{n-2}{n-1}\int \frac{dx}{\cos^{n-2} x}.$$

296. $$\int \csc^2 x\,dx = -\cot x.$$

297. $$\int \csc^n x\,dx = \int \frac{dx}{\sin^n x} = -\frac{1}{n-1}\frac{\cos x}{\sin^{n-1} x} + \frac{n-2}{n-1}\int \frac{dx}{\sin^{n-2} x}.$$

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298. $$\int x \sin x\,dx = \sin x - x\cos x.$$

299. $$\int x^2 \sin x\,dx = 2\,x \sin x - (x^2 - 2)\cos x.$$

300. $$\int x^3 \sin x\,dx = (3\,x^2 - 6)\sin x - (x^3 - 6\,x)\cos x.$$

301. $$\int x^m \sin x\,dx = -x^m \cos x + m\int x^{m-1}\cos x\,dx.$$

302. $$\int x \cos x\,dx = \cos x + x\sin x.$$

303. $$\int x^2 \cos x\,dx = 2\,x\cos x + (x^2 - 2)\sin x.$$

304. $$\int x^3 \cos x\,dx = (3\,x^2 - 6)\cos x + (x^3 - 6\,x)\sin x.$$

305. $$\int x^m \cos x\,dx = x^m \sin x - m\int x^{m-1}\sin x\,dx.$$

306. $$\int \frac{\sin x}{x}\,dx = x - \frac{x^3}{3\cdot 3!} + \frac{x^5}{5\cdot 5!} - \frac{x^7}{7\cdot 7!} + \frac{x^9}{9\cdot 9!}\cdots$$

307. $$\int \frac{\cos x}{x}\,dx = \log x - \frac{x^2}{2\cdot 2!} + \frac{x^4}{4\cdot 4!} - \frac{x^6}{6\cdot 6!} + \frac{x^8}{8\cdot 8!}\cdots$$

FORMS INVOLVING INVERSE TRIGONOMETRIC FUNCTIONS

308. $$\int \sin^{-1} x\,dx = x\sin^{-1} x + \sqrt{1 - x^2}.$$

309. $$\int \cos^{-1} x\,dx = x\cos^{-1} x - \sqrt{1 - x^2}.$$

310. $$\int \tan^{-1} x\,dx = x\tan^{-1} x - \tfrac{1}{2}\log(1 + x^2).$$

311. $$\int \cot^{-1} x\,dx = x\cot^{-1} x + \tfrac{1}{2}\log(1 + x^2).$$

312. $$\int \sec^{-1} x\,dx = x\sec^{-1} x - \log(x + \sqrt{x^2 - 1}).$$

313. $$\int \csc^{-1} x\,dx = x\csc^{-1} x + \log(x + \sqrt{x^2 - 1}).$$

314. $\int \operatorname{vers}^{-1} x \, dx = (x - 1) \operatorname{vers}^{-1} x + \sqrt{2x - x^2}.$

315. $\int \sin^{-1} \frac{x}{a} \, dx = x \sin^{-1} \frac{x}{a} + \sqrt{a^2 - x^2}.$

316. $\int \cos^{-1} \frac{x}{a} \, dx = x \cos^{-1} \frac{x}{a} - \sqrt{a^2 - x^2}.$

317. $\int \tan^{-1} \frac{x}{a} \, dx = x \tan^{-1} \frac{x}{a} - \frac{a}{2} \log (a^2 + x^2).$

318. $\int \cot^{-1} \frac{x}{a} \, dx = x \cot^{-1} \frac{x}{a} + \frac{a}{2} \log (a^2 + x^2).$

319. $\int (\sin^{-1} x)^2 \, dx = x (\sin^{-1} x)^2 - 2x + 2 \sqrt{1 - x^2} (\sin^{-1} x).$

320. $\int (\cos^{-1} x)^2 \, dx = x (\cos^{-1} x)^2 - 2x - 2 \sqrt{1 - x^2} (\cos^{-1} x).$

321. $\int x \cdot \sin^{-1} x \, dx = \frac{1}{4}[(2 x^2 - 1) \sin^{-1} x + x \sqrt{1 - x^2}].$

321a. $\int x \cos^{-1} x \, dx = \frac{1}{4}[(2x^2 - 1) \cos^{-1} x - x \sqrt{1 - x^2}].$

322. $\int x^n \sin^{-1} x \, dx = \frac{x^{n+1} \sin^{-1} x}{n + 1} - \frac{1}{n + 1} \int \frac{x^{n+1} \, dx}{\sqrt{1 - x^2}}.$

323. $\int x^n \cos^{-1} x \, dx = \frac{x^{n+1} \cos^{-1} x}{n + 1} + \frac{1}{n + 1} \int \frac{x^{n+1} \, dx}{\sqrt{1 - x^2}}.$

324. $\int x^n \tan^{-1} x \, dx = \frac{x^{n+1} \tan^{-1} x}{n + 1} - \frac{1}{n + 1} \int \frac{x^{n+1} \, dx}{1 + x^2}.$

325. $\int \frac{\sin^{-1} x \, dx}{x^2} = \log \left(\frac{1 - \sqrt{1 - x^2}}{x}\right) - \frac{\sin^{-1} x}{x}.$

326. $\int \frac{\tan^{-1} x \, dx}{x^2} = \log x - \frac{1}{2} \log (1 + x^2) - \frac{\tan^{-1} x}{x}.$

Forms Involving Trigonometric Substitutions

327. $\int f(\sin x) \, dx = 2 \int f\left(\frac{2z}{1 + z^2}\right) \cdot \frac{dz}{1 + z^2}; \left(z = \tan \frac{x}{2}\right).$

328. $\int f(\cos x) \, dx = 2 \int f\left(\frac{1 - z^2}{1 + z^2}\right) \frac{dz}{1 + z^2}; \left(z = \tan \frac{x}{2}\right).$

329. $\int f(\sin x) \, dx = \int f(u) \frac{du}{\sqrt{1 - u^2}}; \ (u = \sin x).$

330. $\int f(\cos x) \, dx = - \int f(u) \frac{du}{\sqrt{1 - u^2}}; \ (u = \cos x).$

331. $\int f(\sin x, \cos x) \, dx = \int f(u, \sqrt{1 - u^2}) \frac{du}{\sqrt{1 - u^2}}; \ (u = \sin x).$

332. $$\int f(\sin x, \cos x)\, dx = 2\int f\left(\frac{2z}{1+z^2}, \frac{1-z^2}{1+z^2}\right)\frac{dz}{1+z^2};$$ $$\left(z = \tan\frac{x}{2}\right).$$

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333. $$\int \frac{dx}{a + b\tan x} = \frac{1}{a^2+b^2}\,[ax + b\log(a\cos x + b\sin x)].$$

334. $$\int \frac{dx}{a + b\cot x} = \frac{1}{a^2+b^2}\,[ax - b\log(a\sin x + b\cos x)].$$

LOGARITHMIC FORMS

335. $$\int \log x\, dx = x\log x - x.$$

336. $$\int x\log x\, dx = \frac{x^2}{2}\log x - \frac{x^2}{4}.$$

337. $$\int x^2\log x\, dx = \frac{x^3}{3}\log x - \frac{x^3}{9}.$$

338. $$\int x^p\log(ax)\, dx = \frac{x^{p+1}}{p+1}\log(ax) - \frac{x^{p+1}}{(p+1)^2}\quad [p \neq -1].$$

339. $$\int (\log x)^2\, dx = x(\log x)^2 - 2x\log x + 2x.$$

340. $$\int (\log x)^n\, dx = x(\log x)^n - n\int(\log x)^{n-1}\, dx\quad [n \neq -1].$$

341. $$\int \frac{(\log x)^n}{x}\, dx = \frac{1}{n+1}(\log x)^{n+1}.$$

342. $$\int \frac{dx}{\log x} = \log(\log x) + \log x + \frac{(\log x)^2}{2\cdot 2!} + \frac{(\log x)^3}{3\cdot 3!} + \cdots$$

343. $$\int \frac{dx}{x\log x} = \log(\log x).$$

344. $$\int \frac{dx}{x(\log x)^n} = -\frac{1}{(n-1)(\log x)^{n-1}}.$$

345. $$\int \frac{x^m\, dx}{(\log x)^n} = -\frac{x^{m+1}}{(n-1)(\log x)^{n-1}} + \frac{m+1}{n-1}\int\frac{x^m\, dx}{(\log x)^{n-1}}.$$

346. $$\int x^m\log x\, dx = x^{m+1}\left[\frac{\log x}{m+1} - \frac{1}{(m+1)^2}\right].$$

347. $$\int x^m(\log x)^n\, dx = \frac{x^{m+1}(\log x)^n}{m+1} - \frac{n}{m+1}\int x^m(\log x)^{n-1}\, dx,\quad [m, n \neq -1].$$

348. $\int \sin \log x \, dx = \frac{1}{2}x \sin \log x - \frac{1}{2}x \cos \log x.$

349. $\int \cos \log x \, dx = \frac{1}{2}x \sin \log x + \frac{1}{2}x \cos \log x.$

Exponential Forms

350. $\int e^x \, dx = e^x.$

351. $\int e^{-x} \, dx = -e^{-x}.$

352. $\int e^{ax} \, dx = \frac{e^{ax}}{a}.$

353. $\int x \, e^{ax} \, dx = \frac{e^{ax}}{a^2}(ax - 1).$

354. $\int x^m \, e^{ax} \, dx = \frac{x^m \, e^{ax}}{a} - \frac{m}{a}\int x^{m-1} \, e^{ax} \, dx.$

355. $\int \frac{e^{ax} \, dx}{x} = \log x + \frac{ax}{1!} + \frac{a^2x^2}{2 \cdot 2!} + \frac{a^3x^3}{3 \cdot 3!} + \cdots$

356. $\int \frac{e^{ax}}{x^m} \, dx = -\frac{1}{m-1}\frac{e^{ax}}{x^{m-1}} + \frac{a}{m-1}\int \frac{e^{ax}}{x^{m-1}} \, dx.$

357. $\int e^{ax} \log x \, dx = \frac{e^{ax} \log x}{a} - \frac{1}{a}\int \frac{e^{ax}}{x} \, dx.$

358. $\int e^{ax} \cdot \sin px \, dx = \frac{e^{ax}(a \sin px - p \cos px)}{a^2 + p^2}.$

359. $\int e^{ax} \cdot \cos px \, dx = \frac{e^{ax}(a \cos px + p \sin px)}{a^2 + p^2}.$

360. $\int \frac{dx}{1 + e^x} = x - \log(1 + e^x) = \log \frac{e^x}{1 + e^x}.$

361. $\int \frac{dx}{a + be^{px}} = \frac{x}{a} - \frac{1}{ap}\log(a + be^{px}).$

362. $\int \frac{dx}{ae^{mx} + be^{-mx}} = \frac{1}{m\sqrt{ab}}\tan^{-1}\left(e^{mx}\sqrt{\frac{a}{b}}\right).$

363. $\int e^{ax} \sin^n bx \, dx = \frac{1}{a^2 + n^2b^2}\Bigg((a \sin bx - nb \cos bx)$

$e^{ax} \sin^{n-1} bx + n(n-1)b^2 \int e^{ax} \sin^{n-2} bx \cdot dx\Bigg).$

364. $\int e^{ax} \cos^n bx \, dx = \frac{1}{a^2 + n^2b^2}\Bigg((a \cos bx + nb \sin bx)$

$e^{ax} \cos^{n-1} bx + n(n-1)b^2 \int e^{ax} \cos^{n-2} bx \, dx\Bigg).$

Hyperbolic Forms

365. $\int \sinh x \, dx = \cosh x.$

366. $\int \cosh x \, dx = \sinh x.$

367. $\int \tanh x \, dx = \log \cosh x.$

368. $\int \coth x \, dx = \log \sinh x.$

369. $\int \operatorname{sech} x \, dx = 2 \tan^{-1} (e^x) = \tan^{-1} (\sinh x).$

370. $\int \operatorname{csch} x \, dx = \log \tanh \left(\frac{x}{2}\right).$

371. $\int x \sinh x \, dx = x \cosh x - \sinh x.$

372. $\int x \cosh x \, dx = x \sinh x - \cosh x.$

373. $\int \operatorname{sech} x \tanh x \, dx = - \operatorname{sech} x.$

374. $\int \operatorname{csch} x \coth x \, dx = - \operatorname{csch} x.$

375. $\int \sinh^2 x \, dx = \frac{\sinh 2x}{4} - \frac{x}{2}.$

376. $\int \tanh^2 x \, dx = x - \tanh x.$

377. $\int \operatorname{sech}^2 x \, dx = \tanh x.$

378. $\int \cosh^2 x \, dx = \frac{\sinh 2x}{4} + \frac{x}{2}.$

379. $\int \operatorname{ctnh}^2 x \, dx = x - \operatorname{ctnh} x.$

380. $\int \operatorname{csch}^2 x \, dx = - \operatorname{ctnh} x.$

381. $$\int \sinh mx \sinh nx \, dx = \frac{\sinh (m+n)x}{2(m+n)} - \frac{\sinh (m-n)x}{2(m-n)} \qquad m^2 \neq n^2.$$

382. $$\int \cosh mx \cosh nx \, dx = \frac{\sinh (m+n)x}{2(m+n)} + \frac{\sinh (m-n)x}{2(m-n)} \qquad m^2 \neq n^2.$$

383. $$\int \sinh mx \cosh mx \, dx = \frac{\cosh (m+n)x}{2(m+n)} + \frac{\cosh (m-n)x}{2(m-n)} \qquad m^2 \neq n^2.$$

384. $$\int \text{arc sinh} \frac{x}{a} \, dx = x \text{ arc sinh} \frac{x}{a} - \sqrt{x^2 + a^2}.$$

385. $$\int x \text{ arc sinh} \frac{x}{a} \, dx = \left(\frac{x^2}{2} + \frac{a^2}{4}\right) \text{arc sinh} \frac{x}{a} - \frac{x}{4} \sqrt{x^2 + a^2}.$$

386. $$\int \text{arc cosh} \frac{x}{a} \, dx = x \text{ arc cosh} \frac{x}{a} - \sqrt{x^2 - a^2}, \qquad \left[\text{arc cosh} \frac{x}{a} > 0\right].$$
$$= x \text{ arc cosh} \frac{x}{a} + \sqrt{x^2 - a^2}, \left[\text{arc cosh} \frac{x}{a} < 0\right].$$

387. $$\int \text{arc tanh} \frac{x}{a} \, dx = x \text{ arc tanh} \frac{x}{a} + \frac{a}{2} \log (a^2 - x^2).$$

388. $$\int x \text{ arc tanh} \frac{x}{a} \, dx = \frac{x^2 - a^2}{2} \text{arc tanh} \frac{x}{a} + \frac{ax}{2}.$$

DEFINITE INTEGRALS

389. $$\int_0^\infty x^{n-1} e^{-x} \, dx = \int_0^1 \left(\log \frac{1}{x}\right)^{n-1} dx = \Gamma(n).$$

(Gamma function).

390. $\Gamma(n)$ is finite if $n > 0$, $\Gamma(n + 1) = n\Gamma(n)$.

391. $\Gamma(n) \cdot \Gamma(1 - n) = \dfrac{\pi}{\sin n\pi}$.

392. $\Gamma(n) = (n - 1)!$ if $n =$ integer > 0.

393. $\Gamma(\frac{1}{2}) = \sqrt{\pi}$.

394. $\Gamma\left(n + \dfrac{1}{2}\right) = \dfrac{1 \cdot 3 \cdot 5 \cdot 7 \cdots (2n - 1)}{2^n} \sqrt{\pi}$, where n is an integer and > 0.

(See values of $\Gamma(n)$ at end of integral table)

395. $$\int_0^1 x^{m-1}(1 - x)^{n-1} \, dx = B(m,n). \qquad \text{(Beta function).}$$

396. $B(m,n) = B(n,m) = \dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m + n)}$, where m and n are any positive real members.

397. $$\int_0^1 x^{m-1} (1 - x)^{n-1} \, dx = \int_0^\infty \frac{x^{m-1} \, dx}{(1 + x)^{m+n}} = \frac{\Gamma(m)\,\Gamma(n)}{\Gamma(m + n)}.$$

398. $$\int_1^\infty \frac{dx}{x^m} = \frac{1}{m - 1}, \qquad [m > 1].$$

399. $$\int_0^\infty \frac{dx}{(1+x)x^p} = \pi \csc p\pi, \qquad [p < 1].$$

400. $$\int_0^\infty \frac{dx}{(1-x)x^p} = -\pi \cot p\pi, \qquad [p < 1].$$

401. $$\int_0^\infty \frac{x^{p-1}\,dx}{1+x} = \frac{\pi}{\sin p\pi}, \qquad [0 < p < 1].$$

402. $$\int_0^\infty \frac{x^{m-1}\,dx}{1+x^n} = \frac{\pi}{n \sin \dfrac{m\pi}{n}}, \qquad [0 < m < n].$$

403. $$\int_0^\infty \frac{dx}{(1+x)\sqrt{x}} = \pi.$$

404. $$\int_0^\infty \frac{a\,dx}{a^2+x^2} = \frac{\pi}{2}, \text{ if } a > 0;\ 0, \text{ if } a = 0;\ -\frac{\pi}{2}, \text{ if } a < 0.$$

405. $$\begin{aligned} \int_0^{\pi/2} \sin^n x\,dx &= \int_0^{\pi/2} \cos^n x\,dx \\ &= \frac{1\cdot 3\cdot 5 \cdots (n-1)}{2\cdot 4\cdot 6 \cdots (n)} \cdot \frac{\pi}{2}, \quad [n \text{ an even integer}], \\ &= \frac{2\cdot 4\cdot 6 \cdots (n-1)}{1\cdot 3\cdot 5\cdot 7 \cdots n}, \quad [n \text{ an odd integer}], \\ &= \frac{1}{2}\sqrt{\pi}\,\frac{\Gamma\left(\dfrac{n+1}{2}\right)}{\Gamma\left(\dfrac{n}{2}+1\right)}, \quad [n > -1]. \end{aligned}$$

406. $$\int_0^\infty \frac{\sin mx\,dx}{x} = \frac{\pi}{2}, \text{ if } m > 0;\ 0, \text{ if } m = 0;\ -\frac{\pi}{2}, \text{ if } m < 0.$$

407. $$\int_0^\infty \frac{\cos x\,dx}{x} = \infty.$$

408. $$\int_0^\infty \frac{\tan x\,dx}{x} = \frac{\pi}{2}.$$

409. $$\int_0^\pi \sin kx \cdot \sin mx\,dx = \int_0^\pi \cos kx \cdot \cos mx\,dx = 0, \qquad [k \neq m;\ m, n = \text{integers}].$$

410. $$\begin{aligned} \int_0^\infty \frac{\sin x \cos mx\,dx}{x} &= 0, \text{ if } m < -1 \text{ or } m > 1, \\ &= \frac{\pi}{4}, \text{ if } m = \pm 1;\ = \frac{\pi}{2}, \text{ if } m^2 < 1. \end{aligned}$$

411. $$\int_0^\pi \sin^2 mx\,dx = \int_0^\pi \cos^2 mx\,dx = \frac{\pi}{2}.$$

412. $$\int_0^\infty \frac{\sin^2 x\,dx}{x^2} = \frac{\pi}{2}.$$

413. $$\int_0^\infty \frac{\cos mx}{1+x^2}\,dx = \frac{\pi}{2}e^{-m}, \qquad [m > 0].$$
$$= \frac{\pi}{2}e^{m}, \qquad [m < 0].$$

414. $$\int_0^\infty \cos(x^2)\,dx = \int_0^\infty \sin(x^2)\,dx = \frac{1}{2}\sqrt{\frac{\pi}{2}}.$$

415. $$\int_0^\infty \frac{\sin x\,dx}{\sqrt{x}} = \int_0^\infty \frac{\cos x\,dx}{\sqrt{x}} = \sqrt{\frac{\pi}{2}}.$$

416. $$\int_0^{\pi/2} \frac{dx}{1+a\cos x} = \frac{\cos^{-1} a}{\sqrt{1-a^2}}, \qquad [a < 1].$$

417. $$\int_0^{2\pi} \frac{dx}{1+a\cos x} = \frac{2\pi}{\sqrt{1-a^2}}, \qquad [a^2 < 1].$$

418. $$\int_0^\infty \frac{\cos ax - \cos bx}{x}\,dx = \log\frac{b}{a}.$$

419. $$\int_0^{\pi/2} \frac{dx}{a^2\sin^2 x + b^2\cos^2 x} = \frac{\pi}{2ab}.$$

420. $$\int_0^{\pi/2} \sin^{n-1} x \cos^{m-1} x\,dx = \frac{1}{2}\,\mathrm{B}\left(\frac{n}{2}, \frac{m}{2}\right),$$

m and n positive integers.

421. $$\int_0^\infty e^{-ax}\,dx = \frac{1}{a}, \qquad [a > 0].$$

422. $$\int_0^\infty x^n e^{-ax}\,dx = \frac{\Gamma(n+1)}{a^{n+1}}, \qquad [n > -1,\ a > 0],$$
$$= \frac{n!}{a^{n+1}}, \qquad [n \text{ pos. integ.},\ a > 0].$$

423. $$\int_0^\infty e^{-a^2x^2}\,dx = \frac{1}{2a}\sqrt{\pi} = \frac{1}{2a}\Gamma\left(\frac{1}{2}\right), \qquad [a > 0].$$

424. $$\int_0^\infty xe^{-x^2}\,dx = \tfrac{1}{2}.$$

425. $$\int_0^\infty x^2e^{-x^2}\,dx = \frac{\sqrt{\pi}}{4}.$$

426. $$\int_0^\infty x^{2n} e^{-ax^2}\,dx = \frac{1\cdot 3\cdot 5 \cdots (2n-1)}{2^{n+1}a^n}\sqrt{\frac{\pi}{a}}.$$

427. $$\int_0^\infty e^{(-x^2-a^2/x^2)}\,dx = \frac{e^{-2a}\sqrt{\pi}}{2}.$$

428. $$\int_0^\infty e^{-nx}\sqrt{x}\,dx = \frac{1}{2n}\sqrt{\frac{\pi}{n}}.$$

429. $$\int_0^\infty \frac{e^{-nx}}{\sqrt{x}}\,dx = \sqrt{\frac{\pi}{n}}.$$

430. $\int_0^\infty e^{-ax} \cos mx \, dx = \frac{a}{a^2 + m^2}, \qquad [a > 0].$

431. $\int_0^\infty e^{-ax} \sin mx \, dx = \frac{m}{a^2 + m^2}, \qquad [a > 0].$

432. $\int_0^\infty e^{-a^2x^2} \cos bx \, dx = \frac{\sqrt{\pi} \cdot e^{-b^2/4a^2}}{2a}, \qquad [a > 0].$

433. $\int_0^1 (\log x)^n \, dx = (-1)^n \cdot n!.$

434. $\int_0^1 \left(\log \frac{1}{x}\right)^{\frac{1}{2}} dx = \frac{\sqrt{\pi}}{2}.$

435. $\int_0^1 \left(\log \frac{1}{x}\right)^{-\frac{1}{2}} dx = \sqrt{\pi}.$

436. $\int_0^1 \left(\log \frac{1}{x}\right)^n dx = n!.$

437. $\int_0^1 x \log (1 - x) \, dx = -\frac{3}{4}.$

438. $\int_0^1 x \log (1 + x) \, dx = \frac{1}{4}.$

439. $\int_0^1 \frac{\log x}{1 + x} \, dx = -\frac{\pi^2}{12}.$

440. $\int_0^1 \frac{\log x}{1 - x} \, dx = -\frac{\pi^2}{6}.$

441. $\int_0^1 \frac{\log x}{1 - x^2} \, dx = -\frac{\pi^2}{8}.$

442. $\int_0^1 \log \left(\frac{1 + x}{1 - x}\right) \cdot \frac{dx}{x} = \frac{\pi^2}{4}.$

443. $\int_0^1 \frac{\log x \, dx}{\sqrt{1 - x^2}} = -\frac{\pi}{2} \log 2.$

444. $\int_0^1 x^m \left[\log \left(\frac{1}{x}\right)\right]^n dx = \frac{\Gamma(n + 1)}{(m + 1)^{n+1}},$

if $m + 1 > 0,\ n + 1 > 0.$

445. $\int_0^1 \frac{(x^p - x^q) \, dx}{\log x} = \log \left(\frac{p + 1}{q + 1}\right),$

$[p + 1 > 0,\ q + 1 > 0].$

446. $\int_0^1 \frac{dx}{\sqrt{\log \left(\frac{1}{x}\right)}} = \sqrt{\pi}.$

447. $\int_0^\infty \log \left(\frac{e^x + 1}{e^x - 1}\right) dx = \frac{\pi^2}{4}.$

448. $$\int_0^{\pi/2} \log \sin x \, dx = \int_0^{\pi/2} \log \cos x \, dx = -\frac{\pi}{2} \log 2.$$

449. $$\int_0^{\pi/2} \log \sec x \, dx = \int_0^{\pi/2} \log \csc x \, dx = \frac{\pi}{2} \log 2.$$

450. $$\int_0^{\pi} x \log \sin x \, dx = -\frac{\pi^2}{2} \log 2.$$

451. $$\int_0^{\pi/2} \sin x \log \sin x \, dx = \log 2 - 1.$$

452. $$\int_0^{\pi/2} \log \tan x \, dx = 0.$$

453. $$\int_0^{\pi} \log (a \pm b \cos x) \, dx = \pi \log \left(\frac{a + \sqrt{a^2 - b^2}}{2} \right), \qquad [a \geqq b].$$

454. $$\int_0^{\infty} \frac{dx}{\sinh ax} = \frac{\pi}{2a}.$$

455. $$\int_0^{\infty} \frac{x \, dx}{\sinh ax} = \frac{\pi}{4a^2}.$$

456. $$\int_0^{\infty} e^{-ax} \cosh bx \, dx = \frac{a}{a^2 - b^2} \qquad a > 0.$$

457. $$\int_0^{\infty} e^{-ax} \sinh bx \, dx = \frac{b}{a^2 - b^2} \qquad a > 0.$$

458. $$\int_{+\infty}^{1} \frac{e^{-xu}}{u} \, du = \gamma + \log x - x + \frac{x^2}{2 \cdot 2!} - \frac{x^3}{3 \cdot 3!} + \frac{x^4}{4 \cdot 4!} - \cdots, \text{ where } \gamma = \lim_{z \to \infty} \left(1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{z} - \log z \right) = 0.5772157 \cdots, \; 0 < x < \infty.$$

459. $$\int_0^{\pi/2} \frac{dx}{\sqrt{1 - k^2 \sin^2 x}} = \frac{\pi}{2} \left[1 + \left(\frac{1}{2} \right)^2 k^2 + \left(\frac{1 \cdot 3}{2 \cdot 4} \right)^2 k^4 + \left(\frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6} \right)^2 k^6 + \cdots \right], \text{ if } k^2 < 1.$$

460. $$\int_0^{\pi/2} \sqrt{1 - k^2 \sin^2 x} \, dx = \frac{\pi}{2} \left[1 - \left(\frac{1}{2} \right)^2 k^2 - \left(\frac{1 \cdot 3}{2 \cdot 4} \right)^2 \frac{k^4}{3} - \left(\frac{1 \cdot 3 \cdot 5}{2 \cdot 4 \cdot 6} \right)^2 \frac{k^6}{5} - \cdots \right], \text{ if } k^2 < 1.$$

461. $$\int_0^{\infty} e^{-x} \log x \, dx = -\gamma = -0.5772157 \cdots$$

462. $$\int_0^{\infty} \left(\frac{1}{1 - e^{-x}} - \frac{1}{x} \right) e^{-x} dx = \gamma = 0.5772157 \cdots \qquad \text{[Euler's Constant].}$$

463. $$\int_0^{\infty} \frac{1}{x} \left(\frac{1}{1 + x} - e^{-x} \right) dx = \gamma = 0.5772157 \cdots$$

*GAMMA FUNCTION

Values of $\Gamma(n) = \int_0^\infty e^{-x}x^{n-1}dx;\ \Gamma(n+1) = n\Gamma(n)$

n	$\Gamma(n)$	n	$\Gamma(n)$	n	$\Gamma(n)$	n	$\Gamma(n)$
1.00	1.00000	1.25	.90640	1.50	.88623	1.75	.91906
1.01	.99433	1.26	.90440	1.51	.88659	1.76	.92137
1.02	.98884	1.27	.90250	1.52	.88704	1.77	.92376
1.03	.98355	1.28	.90072	1.53	.88757	1.78	.92623
1.04	.97844	1.29	.89904	1.54	.88818	1.79	.92877
1.05	.97350	1.30	.89747	1.55	.88887	1.80	.93138
1.06	.96874	1.31	.89600	1.56	.88964	1.81	.93408
1.07	.96415	1.32	.89464	1.57	.89049	1.82	.93685
1.08	.95973	1.33	.89338	1.58	.89142	1.83	.93969
1.09	.95546	1.34	.89222	1.59	.89243	1.84	.94261
1.10	.95135	1.35	.89115	1.60	.89352	1.85	.94561
1.11	.94739	1.36	.89018	1.61	.89468	1.86	.94869
1.12	.94359	1.37	.88931	1.62	.89592	1.87	.95184
1.13	.93993	1.38	.88854	1.63	.89724	1.88	.95507
1.14	.93642	1.39	.88785	1.64	.89864	1.89	.95838
1.15	.93304	1.40	.88726	1.65	.90012	1.90	.96177
1.16	.92980	1.41	.88676	1.66	.90167	1.91	.96523
1.17	.92670	1.42	.88636	1.67	.90330	1.92	.96878
1.18	.92373	1.43	.88604	1.68	.90500	1.93	.97240
1.19	.92088	1.44	.88580	1.69	.90678	1.94	.97610
1.20	.91817	1.45	.88565	1.70	.90864	1.95	.97988
1.21	.91558	1.46	.88560	1.71	.91057	1.96	.98374
1.22	.91311	1.47	.88563	1.72	.91258	1.97	.98768
1.23	.91075	1.48	.88575	1.73	.91466	1.98	.99171
1.24	.90852	1.49	.88595	1.74	.91683	1.99	.99581
						2.00	1.00000

* For large positive values of x, $\Gamma(x)$ approximates the asymptotic series
$$x^x e^{-x}\sqrt{\frac{2\pi}{x}}\left[1 + \frac{1}{12x} + \frac{1}{288x^2} - \frac{139}{51840x^3} - \frac{571}{2488320x^4} + \cdots\right].$$

BESSEL FUNCTIONS $J_0(x)$ AND $J_1(x)$

$$J_0(x) = 1 - \left(\frac{x}{2}\right)^2 + \frac{\left(\frac{x}{2}\right)^4}{1^2 \cdot 2^2} - \frac{\left(\frac{x}{2}\right)^6}{1^2 \cdot 2^2 \cdot 3^2} + - \cdots$$

$$J_1(x) = -J_0^1(x) = \frac{x}{2} - \frac{\left(\frac{x}{2}\right)^3}{1^2 \cdot 2} + \frac{\left(\frac{x}{2}\right)^5}{1^2 \cdot 2^2 \cdot 3} - + \cdots$$

$$J_n(x) = \sum_{k=0}^{\infty} \frac{(-1)^k X^{n+2k}}{2^{n+2k} k!(n+k)!} \qquad (n = 0, 1, 2, 3, \ldots)$$

x	$J_0(x)$	$J_1(x)$	x	$J_0(x)$	$J_1(x)$	x	$J_0(x)$	$J_1(x)$
0.0	1.0000	.0000	**5.0**	−.1776	−.3276	**10.0**	−.2459	.0435
0.1	.9975	.0499	5.1	−.1443	−.3371	10.1	−.2490	.0184
0.2	.9900	.0995	5.2	−.1103	−.3432	10.2	−.2496	−.0066
0.3	.9776	.1483	5.3	−.0758	−.3460	10.3	−.2477	−.0313
0.4	.9604	.1960	5.4	−.0412	−.3453	10.4	−.2434	−.0555
0.5	.9385	.2423	**5.5**	−.0068	−.3414	**10.5**	−.2366	−.0789
0.6	.9120	.2867	5.6	.0270	−.3343	10.6	−.2276	−.1012
0.7	.8812	.3290	5.7	.0599	−.3241	10.7	−.2164	−.1224
0.8	.8463	.3688	5.8	.0917	−.3110	10.8	−.2032	−.1422
0.9	.8075	.4059	5.9	.1220	−.2951	10.9	−.1881	−.1603
1.0	.7652	.4401	**6.0**	.1506	−.2767	**11.0**	−.1712	−.1768
1.1	.7196	.4709	6.1	.1773	−.2559	11.1	−.1528	−.1913
1.2	.6711	.4983	6.2	.2017	−.2329	11.2	−.1330	−.2039
1.3	.6201	.5220	6.3	.2238	−.2081	11.3	−.1121	−.2143
1.4	.5669	.5419	6.4	.2433	−.1816	11.4	−.0902	−.2225
1.5	.5118	.5579	**6.5**	.2601	−.1538	**11.5**	−.0677	−.2284
1.6	.4554	.5699	6.6	.2740	−.1250	11.6	−.0446	−.2320
1.7	.3980	.5778	6.7	.2851	−.0953	11.7	−.0213	−.2333
1.8	.3400	.5815	6.8	.2931	−.0652	11.8	.0020	−.2323
1.9	.2818	.5812	6.9	.2981	−.0349	11.9	.0250	−.2290
2.0	.2239	.5767	**7.0**	.3001	−.0047	**12.0**	.0477	−.2234
2.1	.1666	.5683	7.1	.2991	.0252	12.1	.0697	−.2157
2.2	.1104	.5560	7.2	.2951	.0543	12.2	.0908	−.2060
2.3	.0555	.5399	7.3	.2882	.0826	12.3	.1108	−.1943
2.4	.0025	.5202	7.4	.2786	.1096	12.4	.1296	−.1807
2.5	−.0484	.4971	**7.5**	.2663	.1352	**12.5**	.1469	−.1655
2.6	−.0968	.4708	7.6	.2516	.1592	12.6	.1626	−.1487
2.7	−.1424	.4416	7.7	.2346	.1813	12.7	.1766	−.1307
2.8	−.1850	.4097	7.8	.2154	.2014	12.8	.1887	−.1114
2.9	−.2243	.3754	7.9	.1944	.2192	12.9	.1988	−.0912
3.0	−.2601	.3391	**8.0**	.1717	.2346	**13.0**	.2069	−.0703
3.1	−.2921	.3009	8.1	.1475	.2476	13.1	.2129	−.0489
3.2	−.3202	.2613	8.2	.1222	.2580	13.2	.2167	−.0271
3.3	−.3443	.2207	8.3	.0960	.2657	13.3	.2183	−.0052
3.4	−.3643	.1792	8.4	.0692	.2708	13.4	.2177	.0166
3.5	−.3801	.1374	**8.5**	.0419	.2731	**13.5**	.2150	.0380
3.6	−.3918	.0955	8.6	.0146	.2728	13.6	.2101	.0590
3.7	−.3992	.0538	8.7	−.0125	.2697	13.7	.2032	.0791
3.8	−.4026	.0128	8.8	−.0392	.2641	13.8	.1943	.0984
3.9	−.4018	−.0272	8.9	−.0653	.2559	13.9	.1836	.1165
4.0	−.3971	−.0660	**9.0**	−.0903	.2453	**14.0**	.1711	.1334
4.1	−.3887	−.1033	9.1	−.1142	.2324	14.1	.1570	.1488
4.2	−.3766	−.1386	9.2	−.1367	.2174	14.2	.1414	.1626
4.3	−.3610	−.1719	9.3	−.1577	.2004	14.3	.1245	.1747
4.4	−.3423	−.2028	9.4	−.1768	.1816	14.4	.1065	.1850
4.5	−.3205	−.2311	**9.5**	−.1939	.1613	**14.5**	.0875	.1934
4.6	−.2961	−.2566	9.6	−.2090	.1395	14.6	.0679	.1999
4.7	−.2693	−.2791	9.7	−.2218	.1166	14.7	.0476	.2043
4.8	−.2404	−.2985	9.8	−.2323	.0928	14.8	.0271	.2066
4.9	−.2097	−.3147	9.9	−.2403	.0684	14.9	.0064	.2069

$J_0(x) = 0$; $x = 2.405, 5.520, 8.654, 11.792, 14.931, 18.071, 21.212, 24.352.$
$J_1(x) = 0$: $x = 3.832, 7.016, 10.173, 13.324, 16.471, 19.616.$

BESSEL FUNCTIONS FOR SPHERICAL COORDINATES

$j_n(x) = \sqrt{\pi/2x}\, J_{n+\frac{1}{2}}(x), \qquad n_n(x) = \sqrt{\pi/2x}\, N_{n+\frac{1}{2}}(x)$

x	$j_0(x)$	$n_0(x)$	$j_1(x)$	$n_1(x)$	$j_2(x)$	$n_2(x)$
0.0	1.0000	$-\infty$	0.0000	$-\infty$	0.0000	$-\infty$
0.1	0.9983	−9.9500	0.0333	−100.50	0.0007	−3005.0
0.2	0.9933	−4.9003	0.0664	−25.495	0.0027	−377.52
0.4	0.9735	−2.3027	0.1312	−6.7302	0.0105	−48.174
0.6	0.9411	−1.3756	0.1929	−3.2337	0.0234	−14.793
0.8	0.8967	−0.8709	0.2500	−1.9853	0.0408	−6.5740
1.0	0.8415	−0.5403	0.3012	−1.3818	0.0620	−3.6050
1.2	0.7767	−0.3020	0.3453	−1.0283	0.0865	−2.2689
1.4	0.7039	−0.1214	0.3814	−0.7906	0.1133	−1.5728
1.6	0.6247	+0.0183	0.4087	−0.6133	0.1416	−1.1682
1.8	0.5410	0.1262	0.4268	−0.4709	0.1703	−0.9111
2.0	0.4546	0.2081	0.4354	−0.3506	0.1985	−0.7340
2.2	0.3675	0.2675	0.4346	−0.2459	0.2251	−0.6028
2.4	0.2814	0.3072	0.4245	−0.1534	0.2492	−0.4990
2.6	0.1983	0.3296	0.4058	−0.0715	0.2700	−0.4121
2.8	0.1196	0.3365	0.3792	+0.0005	0.2867	−0.3359
3.0	+0.0470	0.3300	0.3457	0.0630	0.2986	−0.2670
3.2	−0.0182	0.3120	0.3063	0.1157	0.3084	−0.2035
3.4	−0.0752	0.2844	0.2623	0.1588	0.3066	−0.1442
3.6	−0.1229	0.2491	0.2150	0.1921	0.3021	−0.0890
3.8	−0.1610	0.2082	0.1658	0.2158	0.2919	−0.0378
4.0	−0.1892	0.1634	0.1161	0.2300	0.2763	+0.0091
4.2	−0.2075	0.1167	0.0673	0.2353	0.2556	0.0514
4.4	−0.2163	0.0699	+0.0207	0.2321	0.2304	0.0884
4.6	−0.2160	+0.0244	−0.0226	0.2213	0.2013	0.1200
4.8	−0.2075	−0.0182	−0.0615	0.2037	0.1691	0.1456
5.0	−0.1918	−0.0567	−0.0951	0.1804	0.1347	0.1650
5.2	−0.1699	−0.0901	−0.1228	0.1526	0.0991	0.1781
5.4	−0.1431	−0.1175	−0.1440	0.1213	0.0631	0.1850
5.6	−0.1127	−0.1385	−0.1586	0.0880	+0.0278	0.1856
5.8	−0.0801	−0.1527	−0.1665	0.0538	−0.0060	0.1805
6.0	−0.0466	−0.1600	−0.1678	+0.0199	−0.0373	0.1700
6.2	−0.0134	−0.1607	−0.1629	−0.0125	−0.0654	0.1547
6.4	+0.0182	−0.1552	−0.1523	−0.0425	−0.0896	0.1353
6.6	0.0472	−0.1440	−0.1368	−0.0690	−0.1094	0.1126
6.8	0.0727	−0.1278	−0.1172	−0.0915	−0.1243	0.0875
7.0	0.0939	−0.1077	−0.0943	−0.1092	−0.1343	0.0609
7.2	0.1102	−0.0845	−0.0692	−0.1220	−0.1391	0.0337
7.4	0.1215	−0.0593	−0.0429	−0.1294	−0.1388	+0.0068
7.6	0.1274	−0.0331	−0.0163	−0.1317	−0.1338	−0.0189
7.8	0.1280	−0.0069	+0.0095	−0.1289	−0.1244	−0.0427
8.0	0.1237	+0.0182	0.0336	−0.1214	−0.1111	−0.0637

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HYPERBOLIC BESSEL FUNCTIONS

$I_m(z) = i^{-m}J_m(iz)$

z	$I_0(z)$	$I_1(z)$	$I_2(z)$
0.0	1.0000	0.0000	0.0000
0.1	1.0025	0.0501	0.0012
0.2	1.0100	0.1005	0.0050
0.4	1.0404	0.2040	0.0203
0.6	1.0921	0.3137	0.0464
0.8	1.1665	0.4329	0.0843
1.0	1.2661	0.5652	0.1358
1.2	1.3937	0.7147	0.2026
1.4	1.5534	0.8861	0.2876
1.6	1.7500	1.0848	0.3940
1.8	1.9895	1.3172	0.5260
2.0	2.2796	1.5906	0.6890
2.2	2.6292	1.9141	0.8891
2.4	3.0492	2.2981	1.1111
2.6	3.5532	2.7554	1.4338
2.8	4.1574	3.3011	1.7994
3.0	4.8808	3.9534	2.2452
3.2	5.7472	4.7343	2.7884
3.4	6.7848	5.6701	3.4495
3.6	8.0278	6.7926	4.2538
3.8	9.5169	8.1405	5.2323
4.0	11.302	9.7594	6.4224
4.2	13.443	11.705	7.8683
4.4	16.010	14.046	9.6259
4.6	19.097	16.863	11.761
4.8	22.794	20.253	14.355
5.0	27.240	24.335	17.505
5.2	32.584	29.254	21.332
5.4	39.010	35.181	25.980
5.6	46.738	42.327	31.621
5.8	56.039	50.945	38.472
6.0	67.235	61.341	46.788
6.2	80.717	73.888	56.882
6.4	96.963	89.025	69.143
6.6	116.54	107.31	84.021
6.8	140.14	129.38	102.08
7.0	168.59	156.04	124.01
7.2	202.92	188.25	150.63
7.4	244.34	227.17	182.94
7.6	294.33	274.22	222.17
7.8	354.68	331.10	269.79
8.0	427.57	399.87	327.60

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SINE, COSINE, AND EXPONENTIAL INTEGRALS

$$Si(x) = \int_0^x \frac{\sin v}{v}\,dv; \qquad Ci(x) = \int_\infty^x \frac{\cos v}{v}\,dv;$$

$$Ei(x) = \int_{-\infty}^x \frac{e^v}{v}\,dv; \qquad -Ei(-x) = \int_x^\infty \frac{e^{-v}}{v}\,dv$$

x	$Si(x)$	$Ci(x)$	$Ei(x)$	$-Ei(-x)$
0.0	0.00000	$-\infty$	$-\infty$	$+\infty$
0.1	0.09994	−1.72787	−1.62281	1.82292
0.2	.19956	−1.04221	− .82176	1.22265
0.3	.29850	− .64917	− .30267	.90568
0.4	.39646	− .37881	.10477	.70238
0.5	.49311	− .17778	.45422	.55977
0.6	.58813	− .02227	.76988	.45438
0.7	.68122	.10051	1.06491	.37377
0.8	.77210	.19828	1.34740	.31060
0.9	.86047	.27607	1.62281	.26018
1.0	.94608	.33740	1.89512	.21938
1.1	1.02869	.38487	2.16738	.18599
1.2	1.10805	.42046	2.44209	.15841
1.3	1.18396	.44574	2.72140	.13545
1.4	1.25623	.46201	3.00721	.11622
1.5	1.32468	.47036	3.30128	.10002
1.6	1.38918	.47173	3.60532	.08631
1.7	1.44959	.46697	3.92096	.07465
1.8	1.50582	.45681	4.24987	.06471
1.9	1.55778	.44194	4.59371	.05620
2.0	1.60541	.42298	4.95423	.04890
2.1	1.64870	.40051	5.33324	.04261
2.2	1.68762	.37507	5.73261	.03719
2.3	1.72221	.34718	6.15438	.03250
2.4	1.75249	.31729	6.60067	.02844
2.5	1.77852	.28587	7.07377	.02491
2.6	1.80039	.25337	7.57611	.02185
2.7	1.81821	.22008	8.11035	.01918
2.8	1.83210	.18649	8.67930	.01686
2.9	1.84219	.15290	9.28602	.01482
3.0	1.84865	.11963	9.93383	.01305
3.1	1.85166	.08699	10.6263	.01149
3.2	1.85140	.05526	11.3673	.01013
3.3	1.84808	.02468	12.1610	.00894
3.4	1.84191	− .00452	13.0121	.00789
3.5	1.83313	− .03213	13.9254	.00697
3.6	1.82195	− .05797	14.9063	.00616
3.7	1.80862	− .08190	15.9606	.00545
3.8	1.79339	− .10378	17.0948	.00482
3.9	1.77650	− .12350	18.3157	.00427
4.0	1.75820	− .14098	19.6309	.00378
4.1	1.73874	− .15617	21.0485	.00335
4.2	1.71837	− .16901	22.5774	.00297
4.3	1.69732	− .17951	24.2274	.00263
4.4	1.67583	− .18766	26.0090	.00234
4.5	1.65414	− .19349	27.9337	.00207
4.6	1.63246	− .19705	30.0141	.00184
4.7	1.61100	− .19839	32.2639	.00164
4.8	1.58998	− .19760	34.6979	.00145
4.9	1.56956	− .19478	37.3325	.00129
5.0	1.54993	− .19002	40.1853	.00115
5.1	1.53125	− .18348	43.2757	.00102
5.2	1.51367	− .17525	46.6249	.00091
5.3	1.49731	− .16551	50.2557	.00081
5.4	1.48230	− .15439	54.1935	.00072
5.5	1.46872	− .14205	58.4655	.00064
5.6	1.45667	− .12867	63.1018	.00057
5.7	1.44620	− .11441	68.1350	.00051

SINE, COSINE, AND EXPONENTIAL INTEGRALS
(Continued)

x	$Si(x)$	$Ci(x)$	$Ei(x)$	$-Ei(-x)$
5.8	1.43736	− .09944	73.6008	.00045
5.9	1.43018	− .08393	79.5382	.00040
6.0	1.42469	− .06806	85.9898	.00036
6.1	1.42087	− .05198	93.0020	.00032
6.2	1.41871	− .03587	100.626	.00029
6.3	1.41817	− .01988	108.916	.00026
6.4	1.41922	− .00418	117.935	.00023
6.5	1.42179	+ .01110	127.747	.00020
6.6	1.42582	+ .02582	138.426	.00018
6.7	1.43121	.03986	150.050	.00016
6.8	1.43787	.05308	162.707	.00014
6.9	1.44570	.06539	176.491	.00013
7.0	1.45460	.07670	191.505	.00012
7.1	1.46443	.08691	207.863	.00010
7.2	1.47509	.09596	225.688	.00009
7.3	1.48644	.10379	245.116	.00008
7.4	1.49834	.11036	266.296	.00007
7.5	1.51068	.11563	289.388	.00007
7.6	1.52331	.11960	314.572	.00006
7.7	1.53611	.12225	342.040	.00005
7.8	1.54894	.12359	372.006	.00005
7.9	1.56167	.12334	404.701	.00004
8.0	1.57419	.12243	440.380	.00004
8.1	1.58637	.12002	479.322	.00003
8.2	1.59810	.11644	521.831	.00003
8.3	1.60928	.11177	568.242	.00003
8.4	1.61981	.10607	618.919	.00002
8.5	1.62960	.09943	674.264	.00002
8.6	1.63857	.09194	734.714	.00002
8.7	1.64665	.08368	800.749	.00002
8.8	1.65379	.07476	872.895	.00002
8.9	1.65993	.06528	951.723	.00001
9.0	1.66504	.05535	1037.88	.00001
9.1	1.66908	.04507	1132.04	.00001
9.2	1.67205	.03455	1234.96	.00001
9.3	1.67393	.02391	1347.48	.00001
9.4	1.67473	.01325	1470.51	.00001
9.5	1.67446	.00268	1605.03	.00001
9.6	1.67316	− .00771	1752.14	.00001
9.7	1.67084	− .01780	1913.05	.00001
9.8	1.66757	− .02752	2089.05	.00001
9.9	1.66338	− .03676	2281.58	.00000
10.0	1.65834	− .04546	2492.23	.00000
10.5	1.62294	− .07828	3883.74	.00000
11.0	1.57831	− .08956	6071.41	.00000
11.5	1.53572	− .07857	9518.20	.00000
12.0	1.50497	− .04978	14959.5	.00000
12.5	1.49234	− .01141	23565.1	.00000
13.0	1.49936	+ .02676	37197.7	.00000
13.5	1.52291	+ .05576	58827.0	.00000
14.0	1.55621	.06940	93193.0	.00000
14.5	1.59072	.06554	147866.	.00000
15.0	1.61819	.04628	234955.	.00000

LAPLACE TRANSFORMS

The following tables of Operations and Transforms were taken from "Modern Operational Mathematics in Engineering" by permission from the author, R. V. Churchill, and the publisher, McGraw-Hill Book Company, Inc.

The operational method for solving differential equations makes use of the Laplace transformation which associates a given function $F(t)$ with a second function $f(s)$, so that

$$f(s) = L\{F(t)\} = \int_0^\infty e^{-st}F(t)\,dt,$$

where t = a real variable, $F(t)$ = a real function of t; $F(t) = 0$, $t < 0$; $f(s)$ = a function of s; s = a complex variable; and $e = 2.71828\ldots$

$f(s)$ is called the Laplace transform of $F(t)$

$F(t)$ can also be expressed as follows:

$$F(t) = \frac{1}{2\pi i}\int_{a-i\infty}^{a+i\infty} e^{st}f(s)\,ds$$

where a is chosen to the right of any singularity of $f(s)$.

The following tables give many useful theorems and important transform pairs.

LAPLACE OPERATIONS

	$F(t)$	$f(s)$
1	$F(t)$	$\int_0^\infty e^{-st}F(t)\,dt$
2	$AF(t) + BG(t)$	$Af(s) + Bg(s)$
3	$F'(t)$	$sf(s) - F(+0)$
4	$F^{(n)}(t)$	$s^n f(s) - s^{n-1}F(+0) - s^{n-2}F'(+0) - \cdots - F^{(n-1)}(+0)$
5	$\int_0^t F(\tau)\,d\tau$	$\frac{1}{s} f(s)$
6	$\int_0^t \int_0^\tau F(\lambda)\,d\lambda\,d\tau$	$\frac{1}{s^2} f(s)$
7	$\int_0^t F_1(t-\tau)F_2(\tau)\,d\tau = F_1 * F_2$	$f_1(s)f_2(s)$
8	$tF(t)$	$-f'(s)$
9	$t^n F(t)$	$(-1)^n f^{(n)}(s)$
10	$\frac{1}{t} F(t)$	$\int_s^\infty f(x)\,dx$
11	$e^{at}F(t)$	$f(s-a)$
12	$F(t-b)$, where $F(t) = 0$ when $t < 0$	$e^{-bs}f(s)$
13	$\frac{1}{c} F\left(\frac{t}{c}\right)$	$f(cs)$
14	$\frac{1}{c} e^{\frac{bt}{c}} F\left(\frac{t}{c}\right)$	$f(cs-b)$
15	$F(t+a) = F(t)$	$\dfrac{\int_0^a e^{-st}F(t)\,dt}{1-e^{-as}}$
16	$F(t+a) = -F(t)$	$\dfrac{\int_0^a e^{-st}F(t)\,dt}{1+e^{-as}}$
17	$F_1(t)$, the half-wave rectification of $F(t)$ in No. 16	$\dfrac{f(s)}{1-e^{-as}}$
18	$F_2(t)$, the full-wave rectification of $F(t)$ in No. 16	$f(s) \coth \frac{as}{2}$
19	$\sum_1^m \frac{p(a_n)}{q'(a_n)} e^{a_n t}$	$\frac{p(s)}{q(s)}$, $q(s) = (s-a_1)(s-a_2)\cdots(s-a_m)$
20	$e^{at} \sum_{n=1}^{r} \frac{\phi^{(r-n)}(a)}{(r-n)!} \frac{t^{n-1}}{(n-1)!} + \cdots$	$\frac{p(s)}{q(s)} = \frac{\phi(s)}{(s-a)^r}$

LAPLACE TRANSFORMS

	$f(s)$	$F(t)$
1	$\frac{1}{s}$	1
2	$\frac{1}{s^2}$	t
3	$\frac{1}{s^n}\ (n = 1, 2, \cdots)$	$\frac{t^{n-1}}{(n-1)!}$
4	$\frac{1}{\sqrt{s}}$	$\frac{1}{\sqrt{\pi t}}$
5	$s^{-\frac{3}{2}}$	$2\sqrt{\frac{t}{\pi}}$
6	$s^{-(n+\frac{1}{2})}\ (n = 1, 2, \cdots)$	$\frac{2^n t^{n-\frac{1}{2}}}{1 \cdot 3 \cdot 5 \cdots (2n-1)\sqrt{\pi}}$
7	$\frac{\Gamma(k)}{s^k}\ (k > 0)$	t^{k-1}
8	$\frac{1}{s-a}$	e^{at}
9	$\frac{1}{(s-a)^2}$	te^{at}
10	$\frac{1}{(s-a)^n}\ (n = 1, 2, \cdots)$	$\frac{1}{(n-1)!} t^{n-1} e^{at}$
11	$\frac{\Gamma(k)}{(s-a)^k}\ (k > 0)$	$t^{k-1} e^{at}$
12*	$\frac{1}{(s-a)(s-b)}$	$\frac{1}{a-b}(e^{at} - e^{bt})$
13*	$\frac{s}{(s-a)(s-b)}$	$\frac{1}{a-b}(ae^{at} - be^{bt})$
14*	$\frac{1}{(s-a)(s-b)(s-c)}$	$-\frac{(b-c)e^{at} + (c-a)e^{bt} + (a-b)e^{ct}}{(a-b)(b-c)(c-a)}$
15	$\frac{1}{s^2+a^2}$	$\frac{1}{a}\sin at$
16	$\frac{s}{s^2+a^2}$	$\cos at$
17	$\frac{1}{s^2-a^2}$	$\frac{1}{a}\sinh at$
18	$\frac{s}{s^2-a^2}$	$\cosh at$
19	$\frac{1}{s(s^2+a^2)}$	$\frac{1}{a^2}(1 - \cos at)$
20	$\frac{1}{s^2(s^2+a^2)}$	$\frac{1}{a^3}(at - \sin at)$
21	$\frac{1}{(s^2+a^2)^2}$	$\frac{1}{2a^3}(\sin at - at\cos at)$
22	$\frac{s}{(s^2+a^2)^2}$	$\frac{t}{2a}\sin at$
23	$\frac{s^2}{(s^2+a^2)^2}$	$\frac{1}{2a}(\sin at + at\cos at)$

* Here a, b, and (in 14) c represent distinct constants.

LAPLACE TRANSFORMS (Continued)

	$f(s)$	$F(t)$
24	$\frac{s^2 - a^2}{(s^2 + a^2)^2}$	$t \cos at$
25	$\frac{s}{(s^2 + a^2)(s^2 + b^2)} \quad (a^2 \neq b^2)$	$\frac{\cos at - \cos bt}{b^2 - a^2}$
26	$\frac{1}{(s - a)^2 + b^2}$	$\frac{1}{b} e^{at} \sin bt$
27	$\frac{s - a}{(s - a)^2 + b^2}$	$e^{at} \cos bt$
28	$\frac{3a^2}{s^3 + a^3}$	$e^{-at} - e^{\frac{at}{2}} \left(\cos \frac{at\sqrt{3}}{2} - \sqrt{3} \sin \frac{at\sqrt{3}}{2} \right)$
29	$\frac{4a^3}{s^4 + 4a^4}$	$\sin at \cosh at - \cos at \sinh at$
30	$\frac{s}{s^4 + 4a^4}$	$\frac{1}{2a^2} \sin at \sinh at$
31	$\frac{1}{s^4 - a^4}$	$\frac{1}{2a^3} (\sinh at - \sin at)$
32	$\frac{s}{s^4 - a^4}$	$\frac{1}{2a^2} (\cosh at - \cos at)$
33	$\frac{8a^3 s^2}{(s^2 + a^2)^3}$	$(1 + a^2 t^2) \sin at - at \cos at$
34*	$\frac{1}{s} \left(\frac{s - 1}{s} \right)^n$	$L_n(t) = \frac{e^t}{n!} \frac{d^n}{dt^n} (t^n e^{-t})$
35	$\frac{s}{(s - a)^{\frac{3}{2}}}$	$\frac{1}{\sqrt{\pi t}} e^{at} (1 + 2at)$
36	$\sqrt{s - a} - \sqrt{s - b}$	$\frac{1}{2\sqrt{\pi t^3}} (e^{bt} - e^{at})$
37	$\frac{1}{\sqrt{s} + a}$	$\frac{1}{\sqrt{\pi t}} - a e^{a^2 t} \operatorname{erfc} (a\sqrt{t})$
38	$\frac{\sqrt{s}}{s - a^2}$	$\frac{1}{\sqrt{\pi t}} + a e^{a^2 t} \operatorname{erf} (a\sqrt{t})$
39	$\frac{\sqrt{s}}{s + a^2}$	$\frac{1}{\sqrt{\pi t}} - \frac{2a}{\sqrt{\pi}} e^{-a^2 t} \int_0^{a\sqrt{t}} e^{\lambda^2} \, d\lambda$
40	$\frac{1}{\sqrt{s}\,(s - a^2)}$	$\frac{1}{a} e^{a^2 t} \operatorname{erf} (a\sqrt{t})$
41	$\frac{1}{\sqrt{s}\,(s + a^2)}$	$\frac{2}{a\sqrt{\pi}} e^{-a^2 t} \int_0^{a\sqrt{t}} e^{\lambda^2} \, d\lambda$
42	$\frac{b^2 - a^2}{(s - a^2)(b + \sqrt{s})}$	$e^{a^2 t}[b - a \operatorname{erf} (a\sqrt{t})] - b e^{b^2 t} \operatorname{erfc} (b\sqrt{t})$
43	$\frac{1}{\sqrt{s}\,(\sqrt{s} + a)}$	$e^{a^2 t} \operatorname{erfc} (a\sqrt{t})$
44	$\frac{1}{(s + a)\sqrt{s + b}}$	$\frac{1}{\sqrt{b - a}} e^{-at} \operatorname{erf} (\sqrt{b - a}\,\sqrt{t})$

* $L_n(t)$ is the Laguerre polynomial of degree n.

LAPLACE TRANSFORMS (Continued)

	$f(s)$	$F(t)$
45	$\frac{b^2 - a^2}{\sqrt{s}\,(s - a^2)(\sqrt{s} + b)}$	$e^{a^2t}\left[\frac{b}{a}\operatorname{erf}(a\sqrt{t}) - 1\right] + e^{b^2t}\operatorname{erfc}(b\sqrt{t})$
46*	$\frac{(1-s)^n}{s^{n+\frac{1}{2}}}$	$\frac{n!}{(2n)!\,\sqrt{\pi t}}\,H_{2n}(\sqrt{t})$
47	$\frac{(1-s)^n}{s^{n+\frac{3}{2}}}$	$-\frac{n!}{\sqrt{\pi}\,(2n+1)!}\,H_{2n+1}(\sqrt{t})$
48†	$\frac{\sqrt{s+2a}}{\sqrt{s}} - 1$	$ae^{-at}[I_1(at) + I_0(at)]$
49	$\frac{1}{\sqrt{s+a}\,\sqrt{s+b}}$	$e^{-\frac{1}{2}(a+b)t}I_0\left(\frac{a-b}{2}t\right)$
50	$\frac{\Gamma(k)}{(s+a)^k\,(s+b)^k}\ (k > 0)$	$\sqrt{\pi}\left(\frac{t}{a-b}\right)^{k-\frac{1}{2}} e^{-\frac{1}{2}(a+b)t}\, I_{k-\frac{1}{2}}\left(\frac{a-b}{2}t\right)$
51	$\frac{1}{(s+a)^{\frac{1}{2}}(s+b)^{\frac{3}{2}}}$	$te^{-\frac{1}{2}(a+b)t}\left[I_0\left(\frac{a-b}{2}t\right) + I_1\left(\frac{a-b}{2}t\right)\right]$
52	$\frac{\sqrt{s+2a} - \sqrt{s}}{\sqrt{s+2a} + \sqrt{s}}$	$\frac{1}{t}\,e^{-at}I_1(at)$
53	$\frac{(a-b)^k}{(\sqrt{s+a} + \sqrt{s+b})^{2k}}\ (k > 0)$	$\frac{k}{t}\,e^{-\frac{1}{2}(a+b)t}I_k\left(\frac{a-b}{2}t\right)$
54	$\frac{(\sqrt{s+a} + \sqrt{s})^{-2\nu}}{\sqrt{s}\sqrt{s+a}}\ (\nu > -1)$	$\frac{1}{a^\nu}\,e^{-\frac{1}{2}at}I_\nu\left(\frac{1}{2}at\right)$
55	$\frac{1}{\sqrt{s^2 + a^2}}$	$J_0(at)$
56	$\frac{(\sqrt{s^2 + a^2} - s)^\nu}{\sqrt{s^2 + a^2}}\ (\nu > -1)$	$a^\nu J_\nu(at)$
57	$\frac{1}{(s^2 + a^2)^k}\ (k > 0)$	$\frac{\sqrt{\pi}}{\Gamma(k)}\left(\frac{t}{2a}\right)^{k-\frac{1}{2}} J_{k-\frac{1}{2}}(at)$
58	$(\sqrt{s^2 + a^2} - s)^k (k > 0)$	$\frac{ka^k}{t}\,J_k(at)$
59	$\frac{(s - \sqrt{s^2 - a^2})^\nu}{\sqrt{s^2 - a^2}}\ (\nu > -1)$	$a^\nu I_\nu(at)$
60	$\frac{1}{(s^2 - a^2)^k}\ (k > 0)$	$\frac{\sqrt{\pi}}{\Gamma(k)}\left(\frac{t}{2a}\right)^{k-\frac{1}{2}} I_{k-\frac{1}{2}}(at)$
61	$\frac{e^{-ks}}{s}$	$S_k(t) = \begin{cases} 0 & \text{when } 0 < t < k \\ 1 & \text{when } t > k \end{cases}$
62	$\frac{e^{-ks}}{s^2}$	$\begin{cases} 0 & \text{when } 0 < t < k \\ t - k & \text{when } t > k \end{cases}$

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* $H_n(x)$ is the Hermite polynomial, $H_n(x) = e^{x^2}\frac{d^n}{dx^n}(e^{-x^2})$.

† $I_n(x) = i^{-n}J_n(ix)$, where J_n is Bessel's function of the first kind.

	$f(s)$	$F(t)$
63	$\frac{e^{-ks}}{s^{\mu}}\ (\mu > 0)$	$\begin{cases} 0 & \text{when } 0 < t < k \\ \frac{(t-k)^{\mu-1}}{\Gamma(\mu)} & \text{when } t > k \end{cases}$
64	$\frac{1 - e^{-ks}}{s}$	$\begin{cases} 1 \text{ when } 0 < t < k \\ 0 \text{ when } t > k \end{cases}$
65	$\frac{1}{s(1 - e^{-ks})} = \frac{1 + \coth \frac{1}{2}ks}{2s}$	$S(k, t) = n$ when $(n-1)k < t < nk (n = 1, 2, \cdots)$
66	$\frac{1}{s(e^{ks} - a)}$	$\begin{cases} 0 \quad \text{when } 0 < t < k \\ 1 + a + a^2 + \cdots + a^{n-1} \\ \quad \text{when } nk < t < (n+1)k \\ \qquad (n = 1, 2, \cdots) \end{cases}$
67	$\frac{1}{s} \tanh ks$	$M(2k, t) = (-1)^{n-1}$ when $2k(n-1) < t < 2kn$ $(n = 1, 2, \cdots)$
68	$\frac{1}{s(1 + e^{-ks})}$	$\frac{1}{2} M(k, t) + \frac{1}{2} = \frac{1 - (-1)^n}{2}$ when $(n-1)k < t < nk$
69	$\frac{1}{s^2} \tanh ks$	$H(2k, t)$
70	$\frac{1}{s \sinh ks}$	$2S(2k, t + k) - 2 = 2(n-1)$ when $(2n-3)k < t < (2n-1)k$ $(t > 0)$
71	$\frac{1}{s \cosh ks}$	$M(2k, t + 3k) + 1 = 1 + (-1)^n$ when $(2n-3)k < t < (2n-1)k$ $(t > 0)$
72	$\frac{1}{s} \coth ks$	$2S(2k, t) - 1 = 2n - 1$ when $2k(n-1) < t < 2kn$
73	$\frac{k}{s^2 + k^2} \coth \frac{\pi s}{2k}$	$\lvert \sin kt \rvert$
74	$\frac{1}{(s^2 + 1)(1 - e^{-\pi s})}$	$\begin{cases} \sin t \text{ when } (2n-2)\pi < t < (2n-1)\pi \\ 0 \quad \text{when } (2n-1)\pi < t < 2n\pi \end{cases}$
75	$\frac{1}{s} e^{-\frac{k}{s}}$	$J_0(2\sqrt{kt})$
76	$\frac{1}{\sqrt{s}} e^{-\frac{k}{s}}$	$\frac{1}{\sqrt{\pi t}} \cos 2\sqrt{kt}$
77	$\frac{1}{\sqrt{s}} e^{\frac{k}{s}}$	$\frac{1}{\sqrt{\pi t}} \cosh 2\sqrt{kt}$
78	$\frac{1}{s^{\frac{3}{2}}} e^{-\frac{k}{s}}$	$\frac{1}{\sqrt{\pi k}} \sin 2\sqrt{kt}$
79	$\frac{1}{s^{\frac{3}{2}}} e^{\frac{k}{s}}$	$\frac{1}{\sqrt{\pi k}} \sinh 2\sqrt{kt}$
80	$\frac{1}{s^{\mu}} e^{-\frac{k}{s}}\ (\mu > 0)$	$\left(\frac{t}{k}\right)^{\frac{\mu-1}{2}} J_{\mu-1}(2\sqrt{kt})$

LAPLACE TRANSFORMS (Continued)

	$f(s)$	$F(t)$
81	$\frac{1}{s^{\mu}} e^{\frac{k}{s}}$ $(\mu > 0)$	$\left(\frac{t}{k}\right)^{\frac{\mu-1}{2}} I_{\mu-1}(2\sqrt{kt})$
82	$e^{-k\sqrt{s}}$ $(k > 0)$	$\frac{k}{2\sqrt{\pi t^3}} \exp\left(-\frac{k^2}{4t}\right)$
83	$\frac{1}{s} e^{-k\sqrt{s}}$ $(k \geqq 0)$	$\operatorname{erfc}\left(\frac{k}{2\sqrt{t}}\right)$
84	$\frac{1}{\sqrt{s}} e^{-k\sqrt{s}}$ $(k \geqq 0)$	$\frac{1}{\sqrt{\pi t}} \exp\left(-\frac{k^2}{4t}\right)$
85	$s^{-\frac{3}{2}} e^{-k\sqrt{s}}$ $(k \geqq 0)$	$2\sqrt{\frac{t}{\pi}} \exp\left(-\frac{k^2}{4t}\right)$ $- k \operatorname{erfc}\left(\frac{k}{2\sqrt{t}}\right)$
86	$\frac{ae^{-k\sqrt{s}}}{s(a + \sqrt{s})}$ $(k \geqq 0)$	$-e^{ak}e^{a^2t} \operatorname{erfc}\left(a\sqrt{t} + \frac{k}{2\sqrt{t}}\right)$ $+ \operatorname{erfc}\left(\frac{k}{2\sqrt{t}}\right)$
87	$\frac{e^{-k\sqrt{s}}}{\sqrt{s}(a + \sqrt{s})}$ $(k \geqq 0)$	$e^{ak}e^{a^2t} \operatorname{erfc}\left(a\sqrt{t} + \frac{k}{2\sqrt{t}}\right)$
88	$\frac{e^{-k\sqrt{s(s+a)}}}{\sqrt{s(s+a)}}$	$\begin{cases} 0 & \text{when } 0 < t < k \\ e^{-\frac{1}{2}at} I_0(\frac{1}{2}a\sqrt{t^2 - k^2}) & \text{when } t > k \end{cases}$
89	$\frac{e^{-k\sqrt{s^2+a^2}}}{\sqrt{s^2 + a^2}}$	$\begin{cases} 0 & \text{when } 0 < t < k \\ J_0(a\sqrt{t^2 - k^2}) & \text{when } t > k \end{cases}$
90	$\frac{e^{-k\sqrt{s^2-a^2}}}{\sqrt{s^2 - a^2}}$	$\begin{cases} 0 & \text{when } 0 < t < k \\ I_0(a\sqrt{t^2 - k^2}) & \text{when } t > k \end{cases}$
91	$\frac{e^{-k(\sqrt{s^2+a^2}-s)}}{\sqrt{s^2 + a^2}}$ $(k \geqq 0)$	$J_0(a\sqrt{t^2 + 2kt})$
92	$e^{-ks} - e^{-k\sqrt{s^2+a^2}}$	$\begin{cases} 0 & \text{when } 0 < t < k \\ \frac{ak}{\sqrt{t^2 - k^2}} J_1(a\sqrt{t^2 - k^2}) & \text{when } t > k \end{cases}$
93	$e^{-k\sqrt{s^2-a^2}} - e^{-ks}$	$\begin{cases} 0 & \text{when } 0 < t < k \\ \frac{ak}{\sqrt{t^2 - k^2}} I_1(a\sqrt{t^2 - k^2}) & \text{when } t > k \end{cases}$
94	$\frac{a^{\nu} e^{-k\sqrt{s^2+a^2}}}{\sqrt{s^2 + a^2}\,(\sqrt{s^2 + a^2} + s)^{\nu}}$ $(\nu > -1)$	$\begin{cases} 0 & \text{when } 0 < t < k \\ \left(\frac{t - k}{t + k}\right)^{\frac{1}{2}\nu} J_{\nu}(a\sqrt{t^2 - k^2}) & \text{when } t > k \end{cases}$
95	$\frac{1}{s} \log s$	$\Gamma'(1) - \log t$ $[\Gamma'(1) = -0.5772]$

LAPLACE TRANSFORMS (Continued)

	$f(s)$	$F(t)$
96	$\frac{1}{s^k}\log s\ (k > 0)$	$t^{k-1}\left\{\frac{\Gamma'(k)}{[\Gamma(k)]^2} - \frac{\log t}{\Gamma(k)}\right\}$
97	$\frac{\log s}{s-a}\ (a > 0)$	$e^{at}[\log a - \mathrm{Ei}(-at)]$
98	$\frac{\log s}{s^2+1}$	$\cos t\ \mathrm{Si}(t) - \sin t\ \mathrm{Ci}(t)$
99	$\frac{s \log s}{s^2+1}$	$-\sin t\ \mathrm{Si}(t) - \cos t\ \mathrm{Ci}(t)$
100	$\frac{1}{s}\log(1+ks)\ (k > 0)$	$-\mathrm{Ei}\left(-\frac{t}{k}\right)$
101	$\log\frac{s-a}{s-b}$	$\frac{1}{t}(e^{bt} - e^{at})$
102	$\frac{1}{s}\log(1+k^2s^2)$	$-2\mathrm{Ci}\left(\frac{t}{k}\right)$
103	$\frac{1}{s}\log(s^2+a^2)\ (a > 0)$	$2\log a - 2\mathrm{Ci}(at)$
104	$\frac{1}{s^2}\log(s^2+a^2)\ (a > 0)$	$\frac{2}{a}[at\log a + \sin at - at\ \mathrm{Ci}(at)]$
105	$\log\frac{s^2+a^2}{s^2}$	$\frac{2}{t}(1-\cos at)$
106	$\log\frac{s^2-a^2}{s^2}$	$\frac{2}{t}(1-\cosh at)$
107	$\arctan\frac{k}{s}$	$\frac{1}{t}\sin kt$
108	$\frac{1}{s}\arctan\frac{k}{s}$	$\mathrm{Si}(kt)$
109	$e^{k^2s^2}\,\mathrm{erfc}\,(ks)\ (k > 0)$	$\frac{1}{k\sqrt{\pi}}\exp\left(-\frac{t^2}{4k^2}\right)$
110	$\frac{1}{s}e^{k^2s^2}\,\mathrm{erfc}\,(ks)\ (k > 0)$	$\mathrm{erf}\left(\frac{t}{2k}\right)$
111	$e^{ks}\,\mathrm{erfc}\,(\sqrt{ks})(k > 0)$	$\frac{\sqrt{k}}{\pi\sqrt{t}\,(t+k)}$
112	$\frac{1}{\sqrt{s}}\,\mathrm{erfc}\,(\sqrt{ks})$	$\begin{cases} 0 & \text{when } 0 < t < k \\ (\pi t)^{-\frac{1}{2}} & \text{when } t > k \end{cases}$
113	$\frac{1}{\sqrt{s}}e^{ks}\,\mathrm{erfc}\,(\sqrt{ks})\ (k > 0)$	$\frac{1}{\sqrt{\pi(t+k)}}$
114	$\mathrm{erf}\left(\frac{k}{\sqrt{s}}\right)$	$\frac{1}{\pi t}\sin(2k\sqrt{t})$
115	$\frac{1}{\sqrt{s}}e^{\frac{k^2}{s}}\,\mathrm{erfc}\left(\frac{k}{\sqrt{s}}\right)$	$\frac{1}{\sqrt{\pi t}}\,e - 2k\sqrt{t}$
116*	$K_0(ks)$	$\begin{cases} 0 & \text{when } 0 < t < k \\ (t^2-k^2)^{-\frac{1}{2}} & \text{when } t > k \end{cases}$
117	$K_0(k\sqrt{s})$	$\frac{1}{2t}\exp\left(-\frac{k^2}{4t}\right)$

* $K_n(x)$ is Bessel's function of the second kind for the imaginary argument.

LAPLACE TRANSFORMS (Continued)

	$f(s)$	$F(t)$
118	$\frac{1}{s} e^{ks} K_1(ks)$	$\frac{1}{k} \sqrt{t(t + 2k)}$
119	$\frac{1}{\sqrt{s}} K_1(k \sqrt{s})$	$\frac{1}{k} \exp \left(- \frac{k^2}{4t} \right)$
120	$\frac{1}{\sqrt{s}} e^{\frac{k}{s}} K_0 \left(\frac{k}{s} \right)$	$\frac{2}{\sqrt{\pi t}} K_0(2 \sqrt{2kt})$
121	$\pi e^{-ks} I_0(ks)$	$\begin{cases} [t(2k - t)]^{-\frac{1}{2}} & \text{when } 0 < t < 2k \\ 0 & \text{when } t > 2k \end{cases}$
122*	$e^{-ks} I_1(ks)$	$\begin{cases} \frac{k - t}{\pi k \sqrt{t(2k - t)}} & \text{when } 0 < t < 2k \\ 0 & \text{when } t > 2k \end{cases}$

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* Several additional transforms, especially those involving other Bessel functions, can be found in the tables by G. A. Campbell and R. M. Foster, "Fourier Integrals for Practical Applications," or N. W. McLachlan and P. Humbert, "Formulaire pour le calcul symbolique." In the tables by Campbell and Foster, only those entries containing the condition $0 < g$ or $k < g$, where g is our t, are Laplace transforms.

ALGEBRA

Factors and Expansions

$$(a \pm b)^2 = a^2 \pm 2ab + b^2.$$

$$(a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3.$$

$$(a \pm b)^4 = a^4 \pm 4a^3b + 6a^2b^2 \pm 4ab^3 + b^4.$$

$$a^2 - b^2 = (a - b)(a + b).$$

$$a^2 + b^2 = \left(a + b\sqrt{-1}\right)\left(a - b\sqrt{-1}\right).$$

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2).$$

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2).$$

$$a^4 + b^4 = \left(a^2 + ab\sqrt{2} + b^2\right)\left(a^2 - ab\sqrt{2} + b^2\right).$$

$$a^n - b^n = (a - b)(a^{n-1} + a^{n-2}b + \ldots . + b^{n-1}).$$

$$a^n - b^n = (a + b)(a^{n-1} - a^{n-2}b + \ldots . - b^{n-1}),$$

for even values of n.

$$a^n + b^n = (a + b)\ (a^{n-1} - a^{n-2}b + \ldots . + b^{n-1}),$$

for odd values of n.

$$a^4 + a^2b^2 + b^4 = (a^2 + ab + b^2)(a^2 - ab + b^2).$$

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc.$$

$$(a + b + c)^3 = a^3 + b^3 + c^3 + 3a^2(b + c) + 3b^2(a + c) + 3c^2(a + b) + 6abc.$$

$$(a + b + c + d + \ldots)^2 = a^2 + b^2 + c^2 + d^2 + \ldots + 2a(b + c + d + \ldots) + 2b(c + d + \ldots) + 2c(d + \ldots) + \ldots$$

See also under Series

Powers and Roots

$$a^x \times a^y = a^{(x+y)}. \qquad a^0 = 1 \text{ [if } a \neq 0]. \qquad (ab)^x = a^xb^x.$$

$$\frac{a^x}{a^y} = a^{(x-y)}. \qquad a^{-x} = \frac{1}{a^x}. \qquad \left(\frac{a}{b}\right)^x = \frac{a^x}{b^x}.$$

$$(a^x)^y = a^{xy}. \qquad a^{\frac{1}{x}} = \sqrt[x]{a}. \qquad \sqrt[x]{ab} = \sqrt[x]{a}\,\sqrt[x]{b}.$$

$$\sqrt[x]{\sqrt[y]{a}} = \sqrt[xy]{a}. \qquad a^{\frac{x}{y}} = \sqrt[y]{a^x}. \qquad \sqrt[x]{\frac{a}{b}} = \frac{\sqrt[x]{a}}{\sqrt[x]{b}}.$$

Proportion

If $\dfrac{a}{b} = \dfrac{c}{d}$, then $\dfrac{a + b}{b} = \dfrac{c + d}{d}$,

$$\frac{a - b}{b} = \frac{c - d}{d}, \qquad \frac{a - b}{a + b} = \frac{c - d}{c + d}.$$

ALGEBRA—(Continued)

SUMS OF NUMBERS

The sum of the first n numbers,—

$$\Sigma(n) = 1+2+3+4+5 \dots +n = \frac{n(n+1)}{2}$$

The sum of the squares of the first n numbers,

$$\Sigma(n^2) = 1^2+2^2+3^2+4^2+5^2 \dots +n^2 = \frac{n(n+1)(2n+1)}{6}$$

The sum of the cubes of the first n numbers,

$$\Sigma(n^3) = 1^3+2^3+3^3+4^3+5^3 \dots +n^3 = \frac{n^2(n+1)^2}{4}$$

ARITHMETICAL PROGRESSION

If a is the first term; l, the last term; d, the common difference; n, the number of terms and s, the sum of n terms,—

$$l = a + (n-1)d \qquad s = \frac{n}{2}(a+l)$$

$$s = \frac{n}{2}\left\{ 2a + (n-1)d \right\}$$

GEOMETRICAL PROGRESSION

If a is the first term; l, the last term; r, the common ratio; n, the number of terms and s, the sum of n terms,—

$$l = ar^{n-1} \qquad s = a\frac{(1-r^n)}{1-r}$$

$$s = a\frac{(r^n-1)}{r-1} \qquad s = \frac{lr-a}{r-1}$$

If n is infinity and r^2 less than unity,—

$$s = \frac{a}{1-r}$$

FACTORIALS

$\underline{\lfloor n} = n! = e^{-n}n^n\sqrt{2\pi n}$, approximately.

PERMUTATIONS

If M denote the number of permutations of n things taken p at a time,—

$$M = n(n-1)(n-2) \dots (n-p+1)$$

COMBINATIONS

If M denote the number of combinations of n things taken p at a time,—

$$M = \frac{n(n-1)(n-2) \dots (n-p+1)}{p!}$$

$$M = \frac{n!}{p!(n-p)!}$$

Quadratic Equations

Any quadratic equation may be reduced to the form, —

$$ax^2 + bx + c = 0$$

Then $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

If a, b, and c, are real, then
if $b^2 - 4ac$ is positive, the roots are real and unequal;
if $b^2 - 4ac$ is zero, the roots are real and equal;
if $b^2 - 4ac$ is negative, the roots are imaginary and unequal;
a, b, and c, are rational.

Cubic Equations

A cubic equation, $y^3 + py^2 + qy + r = 0$ may be reduced to the form, —

$$x^3 + ax + b = 0$$

by substituting for y the value, $\left(x - \frac{p}{3}\right)$. Here

$$a = \tfrac{1}{3}(3q - p^2) \text{ and } b = \tfrac{1}{27}(2p^3 - 9pq + 27r).$$

For solution let, —

$$A = \sqrt[3]{-\frac{b}{2} + \sqrt{\frac{b^2}{4} + \frac{a^3}{27}}}, \qquad B = \sqrt[3]{-\frac{b}{2} - \sqrt{\frac{b^2}{4} + \frac{a^3}{27}}},$$

then the values of x will be given by,

$$x = A + B, \quad -\frac{A+B}{2} + \frac{A-B}{2}\sqrt{-3}, \quad -\frac{A+B}{2} - \frac{A-B}{2}\sqrt{-3}$$

If $\frac{b^2}{4} + \frac{a^3}{27} > 0$, there will be one real root and two conjugate imaginary roots.

If $\frac{b^2}{4} + \frac{a^3}{27} = 0$, there will be three real roots of which two at least are equal

If $\frac{b^2}{4} + \frac{a^3}{27} < 0$, there will be three real and unequal roots.

In the last case a trigonometric solution is useful. Compute the value of the angle ϕ in the expression, —

$$\cos\phi = -\frac{b}{2} \div \sqrt{\left(-\frac{a^3}{27}\right)},$$

then x will have the following values:—

$$2\sqrt{-\frac{a}{3}}\cos\frac{\phi}{3}, \qquad 2\sqrt{-\frac{a}{3}}\cos\left(\frac{\phi}{3} + 120°\right),$$

$$2\sqrt{-\frac{a}{3}}\cos\left(\frac{\phi}{3} + 240°\right).$$

APPROXIMATIONS

If a and b are small quantities, the following relations are approximately true,—

$$(1 \pm a)^m = 1 \pm ma,$$

$$(1 \pm a)^m (1 \pm b)^n = 1 \pm ma \pm nb.$$

If n is nearly equal to m,

$$\sqrt{mn} = \frac{n+m}{2}, \text{ approximately.}$$

If θ is a very small angle expressed in radians,—

$$\frac{\sin \theta}{\theta} = 1 \text{ and } \frac{\tan \theta}{\theta} = 1, \text{ approximately.}$$

SERIES

The expression in parentheses following certain of the series indicates the region of convergence. If not otherwise indicated it is to be understood that the series converges for all finite values of x.

BINOMIAL

$$(x+y)^n = x^n + nx^{n-1}y + \frac{n(n-1)}{2!}x^{n-2}y^2$$

$$+ \frac{n(n-1)(n-2)}{3!}x^{(n-3)}y^3 + \dots \quad (y^2 < x^2)$$

$$(1 \pm x)^n = 1 \pm nx + \frac{n(n-1)x^2}{2!} \pm \frac{n(n-1)(n-2)x^3}{3!} + \dots \text{ etc.} \quad (x^2 < 1)$$

$$(1 \pm x)^{-n} = 1 \mp nx + \frac{n(n+1)x^2}{2!} \mp \frac{n(n+1)(n+2)x^3}{3!} + \dots \text{ etc.} \quad (x^2 < 1)$$

$$(1 \pm x)^{-1} = 1 \mp x + x^2 \mp x^3 + x^4 \mp x^5 + \dots \quad (x^2 < 1)$$

$$(1 \pm x)^{-2} = 1 \mp 2x + 3x^2 \mp 4x^3 + 5x^4 \mp 6x^5 + \dots \quad (x^2 < 1)$$

TAYLOR'S SERIES

$$f(x+h) = f(x) + hf'(x) + \frac{h^2}{2!}f''(x) + \frac{h^3}{3!}f'''(x) + \dots$$

$$= f(h) + xf'(h) + \frac{x^2}{2!}f''(h) + \frac{x^3}{3!}f'''(h) + \dots$$

MACLAURIN'S SERIES

$$f(x) = f(o) + xf'(o) + \frac{x^2}{2!}f''(o) + \frac{x^3}{3!}f'''(o) + \dots$$

EXPONENTIAL

$$e = 1 + \frac{1}{1} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \dots$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \dots$$

$$a^x = 1 + x \log_e a + \frac{(x \log a)^2}{2!} + \frac{(x \log a)^3}{3!} + \dots$$

SERIES (Continued)

LOGARITHMIC

$$\log_e x = \frac{x-1}{x} + \frac{1}{2}\left(\frac{x-1}{x}\right)^2 + \frac{1}{3}\left(\frac{x-1}{x}\right)^3 + \dots \qquad (x > \tfrac{1}{2})$$

$$\log_e x = (x-1) - \tfrac{1}{2}(x-1)^2 + \tfrac{1}{3}(x-1)^3 - \dots \qquad (2 > x > 0)$$

$$\log_e x = 2\left[\frac{x-1}{x+1} + \frac{1}{3}\left(\frac{x-1}{x+1}\right)^3 + \frac{1}{5}\left(\frac{x-1}{x+1}\right)^5 + \dots\right] \qquad (x > 0)$$

$$\log_e(1+x) = x - \tfrac{1}{2}x^2 + \tfrac{1}{3}x^3 - \tfrac{1}{4}x^4 + \dots \qquad (-1 < x < 1)$$

$$\log_e(n+1) - \log_e(n-1) = 2\left[\frac{1}{n} + \frac{1}{3n^3} + \frac{1}{5n^5} + \dots\right]$$

$$\log_e(a+x) = \log_e a + 2\left[\frac{x}{2a+x} + \frac{1}{3}\left(\frac{x}{2a+x}\right)^3 + \frac{1}{5}\left(\frac{x}{2a+x}\right)^5 + \dots\right]$$

$$(a > 0,\ -a < x < +\infty)$$

TRIGONOMETRIC

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \frac{17x^7}{315} + \frac{62x^9}{2835} + \cdots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$\sin^{-1} x = x + \frac{x^3}{6} + \frac{1}{2}\cdot\frac{3}{4}\cdot\frac{x^5}{5} + \frac{1}{2}\cdot\frac{3}{4}\cdot\frac{5}{6}\cdot\frac{x^7}{7} + \cdots \qquad (x^2 < 1)$$

$$\tan^{-1} x = x - \tfrac{1}{3}x^3 + \tfrac{1}{5}x^5 - \tfrac{1}{7}x^7 + \cdots \qquad (x^2 < 1)$$

$$= \frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \cdots \qquad (x^2 > 1)$$

$$\log_e \sin x = \log_e x - \frac{x^2}{6} - \frac{x^4}{180} - \frac{x^6}{2835} - \cdots \qquad (x^2 < \pi^2)$$

$$\log_e \cos x = -\frac{x^2}{2} - \frac{x^4}{12} - \frac{x^6}{45} - \frac{17x^8}{2520} - \cdots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$\log_e \tan x = \log_e x + \frac{x^2}{3} + \frac{7x^4}{90} + \frac{62x^6}{2835} + \cdots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

$$e^{\sin x} = 1 + x + \frac{x^2}{2!} - \frac{3x^4}{4!} - \frac{8x^5}{5!} - \frac{3x^6}{6!} + \frac{56x^7}{7!} + \cdots$$

$$e^{\cos x} = e\left(1 - \frac{x^2}{2!} + \frac{4x^4}{4!} - \frac{31x^6}{6!} + \cdots\right)$$

$$e^{\tan x} = 1 + x + \frac{x^2}{2!} + \frac{3x^3}{3!} + \frac{9x^4}{4!} + \frac{37x^5}{5!} + \cdots \qquad \left(x^2 < \frac{\pi^2}{4}\right)$$

FOURIER SERIES

If $f(x) = \frac{a_0}{2} + a_1 \cos \frac{2\pi x}{T} + a_2 \cos \frac{4\pi x}{T} + \cdots$

$$+ a_m \cos \frac{2\pi m x}{T} + \cdots + b_1 \sin \frac{2\pi x}{T} + b_2 \sin \frac{4\pi x}{T}$$

$$+ b_3 \sin \frac{6\pi x}{T} + \cdots + b_n \sin \frac{2\pi n x}{T} + \cdots,$$

where

$a_0 = \frac{2}{T} \int_c^{c+T} f(x) dx, \quad a_m = \frac{2}{T} \int_c^{c+T} f(x) \cos \frac{2\pi m x}{T} dx,$ $b_n = \frac{2}{T} \int_c^{c+T} f(x) \sin \frac{2\pi n x}{T} dx,$ and $f(x + T) = f(x)$, with c and T constants.

VECTOR ANALYSIS

Definitions

Any quantity which is completely determined by its magnitude is called a *scalar*. Examples of such are mass, density, temperature, etc. Any quantity which is completely determined by its magnitude and direction is called a *vector*. Examples of such are velocity, acceleration, force, etc. A vector quantity is represented by a directed line segment, the length of which represents the magnitude of the vector. A vector quantity is usually represented by a bold-faced letter such as $\mathbf{V}$. Two vectors $\mathbf{V}_1$ and $\mathbf{V}_2$ are equal to one another if they have equal magnitudes and are acting in the same directions. A negative vector, written as $-\mathbf{V}$ is one which acts in the opposite direction to $\mathbf{V}$, but is of equal magnitude to it. If we represent the magnitude of $\mathbf{V}$ by v, we write $|\mathbf{V}| = v$. A vector parallel to $\mathbf{V}$, but equal to the reciprocal of its magnitude is written as $\mathbf{V}^{-1}$ or as $\frac{1}{\mathbf{V}}$.

The unit vector $\frac{\mathbf{V}}{|\mathbf{V}|}$ $(\mathbf{V} \neq 0)$ is the one which has the same direction as $\mathbf{V}$, but has a magnitude of 1.

Vector Algebra

The vector sum of $\mathbf{V}_1$ and $\mathbf{V}_2$ is represented by $\mathbf{V}_1 + \mathbf{V}_2$. The vector sum of $\mathbf{V}_1$ and $-\mathbf{V}_2$, or the difference of the vector $\mathbf{V}_2$ from $\mathbf{V}_1$ is represented by $\mathbf{V}_1 - \mathbf{V}_2$.

If r is a scalar, then $r\mathbf{V} = \mathbf{V}r$, and represents a vector r times the magnitude of $\mathbf{V}$, in the same direction as $\mathbf{V}$ if r is positive, and in the opposite direction if r is negative. If r and s are scalars, $\mathbf{V}_1$, $\mathbf{V}_2$, $\mathbf{V}_3$, vectors, then the following rules of scalars and vectors hold:

$$\mathbf{V}_1 + \mathbf{V}_2 = \mathbf{V}_2 + \mathbf{V}_1$$
$$(r + s)\mathbf{V}_1 = r\mathbf{V}_1 + s\mathbf{V}_1; \qquad r(\mathbf{V}_1 + \mathbf{V}_2) = r\mathbf{V}_1 + r\mathbf{V}_2$$
$$\mathbf{V}_1 + (\mathbf{V}_2 + \mathbf{V}_3) = (\mathbf{V}_1 + \mathbf{V}_2) + \mathbf{V}_3 = \mathbf{V}_1 + \mathbf{V}_2 + \mathbf{V}_3$$

If $\mathbf{V}_1$ is a vector in space, and a_1, b_1, c_1, the respective magnitudes of the projections of the vector along the coordinate Ox, Oy, Oz axes, then

$\mathbf{V}_1 = a_1\mathbf{i} + b_1\mathbf{j} + c_1\mathbf{k}$, where $\mathbf{i}$, $\mathbf{j}$, $\mathbf{k}$ are respectively the unit vectors along Ox, Oy, and Oz. Its magnitude is

$$|\mathbf{V}_1| = \sqrt{a_1^2 + b_1^2 + c_1^2},$$

and its direction cosines satisfy the proportion

$$a_1 : b_1 : c_1 = \cos\alpha : \cos\beta : \cos\gamma.$$

Thus, if $\mathbf{V}_1 = a_1\mathbf{i} + b_1\mathbf{j} + c_1\mathbf{k}$ and $\mathbf{V}_2 = a_2\mathbf{i} + b_2\mathbf{j} + c_2\mathbf{k}$,
Then $\mathbf{V}_1 + \mathbf{V}_2 = (a_1 + a_2)\mathbf{i} + (b_1 + b_2)\mathbf{j} + (c_1 + c_2)\mathbf{k}$

VECTOR ANALYSIS (Continued)

The Scalar, Dot, or Inner Product of Two Vectors $\mathbf{V}_1$ and $\mathbf{V}_2$

This product is represented as $\mathbf{V}_1 \cdot \mathbf{V}_2$ and is defined to be equal to $|\mathbf{V}_1|\,|\mathbf{V}_2| \cos \theta$, where θ is the angle from $\mathbf{V}_1$ to $\mathbf{V}_2$, i.e.,

$$\mathbf{V}_1 \cdot \mathbf{V}_2 = |\mathbf{V}_1|\,|\mathbf{V}_2| \cos \theta$$

The following rules apply for this product:

$$\mathbf{V}_1 \cdot \mathbf{V}_2 = a_1a_2 + b_1b_2 + c_1c_2 = \mathbf{V}_2 \cdot \mathbf{V}_1$$

It should be noted that scalar multiplication is commutative.

If $\mathbf{V}_1 = \mathbf{V}_2$, then $\mathbf{V}_1 \cdot \mathbf{V}_2 = |\mathbf{V}_1|^2$

$$(\mathbf{V}_1 + \mathbf{V}_2) \cdot \mathbf{V}_3 = \mathbf{V}_1 \cdot \mathbf{V}_3 + \mathbf{V}_2 \cdot \mathbf{V}_3$$

$$\mathbf{V}_1 \cdot (\mathbf{V}_2 + \mathbf{V}_3) = \mathbf{V}_1 \cdot \mathbf{V}_2 + \mathbf{V}_1 \cdot \mathbf{V}_3$$

$$\mathbf{i} \cdot \mathbf{i} = \mathbf{j} \cdot \mathbf{j} = \mathbf{k} \cdot \mathbf{k} = 1; \qquad \mathbf{i} \cdot \mathbf{j} = \mathbf{j} \cdot \mathbf{k} = \mathbf{k} \cdot \mathbf{i} = 0$$

The Vector or Cross Product of Vectors $\mathbf{V}_1$ and $\mathbf{V}_2$

This product is represented as $\mathbf{V}_1 \times \mathbf{V}_2$ and is defined to be equal to $|\mathbf{V}_1|\,|\mathbf{V}_2|\,(\sin \theta)\mathbf{l}$, where θ is the angle from $\mathbf{V}_1$ to $\mathbf{V}_2$ and $\mathbf{l}$ is a unit vector perpendicular to the plane of $\mathbf{V}_1$ and $\mathbf{V}_2$ and so directed that a right-handed screw driven in the direction of $\mathbf{l}$ would carry $\mathbf{V}_1$ into $\mathbf{V}_2$,, i.e.,

$$\mathbf{V}_1 \times \mathbf{V}_2 = |\mathbf{V}_1|\,|\mathbf{V}_2|\,(\sin \theta)\mathbf{l}$$

The following rules apply for vector products:

$$\mathbf{V}_1 \times \mathbf{V}_2 = -\mathbf{V}_2 \times \mathbf{V}_1$$

$$\mathbf{V}_1 \times (\mathbf{V}_2 + \mathbf{V}_3) = \mathbf{V}_1 \times \mathbf{V}_2 + \mathbf{V}_1 \times \mathbf{V}_3$$

$$(\mathbf{V}_1 + \mathbf{V}_2) \times \mathbf{V}_3 = \mathbf{V}_1 \times \mathbf{V}_3 + \mathbf{V}_2 \times \mathbf{V}_3$$

$$\mathbf{V}_1 \times (\mathbf{V}_2 \times \mathbf{V}_3) = \mathbf{V}_2(\mathbf{V}_1 \cdot \mathbf{V}_3) - \mathbf{V}_3(\mathbf{V}_1 \cdot \mathbf{V}_2)$$

$$\begin{aligned}\mathbf{i} \times \mathbf{i} = \mathbf{j} \times \mathbf{j} = \mathbf{k} \times \mathbf{k} &= 0.\mathbf{l} \text{ (zero vector)} \\ &= 0\end{aligned}$$

$$\mathbf{i} \times \mathbf{j} = \mathbf{k}, \qquad \mathbf{j} \times \mathbf{k} = \mathbf{i}, \qquad \mathbf{k} \times \mathbf{i} = \mathbf{j}$$

If $\mathbf{V}_1 = a_1\mathbf{i} + b_1\mathbf{j} + c_1\mathbf{k}$, $\quad \mathbf{V}_2 = a_2\mathbf{i} + b_2\mathbf{j} + c_2\mathbf{k}$,
$\mathbf{V}_3 = a_3\mathbf{i} + b_3\mathbf{j} + c_3\mathbf{k}$,

then

$$\mathbf{V}_1 \times \mathbf{V}_2 = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \end{vmatrix} = (b_1c_2 - b_2c_1)\mathbf{i} + (c_1a_2 - c_2a_1)\mathbf{j} + (a_1b_2 - a_2b_1)\mathbf{k}$$

It should be noted that, since $\mathbf{V}_1 \times \mathbf{V}_2 = -\mathbf{V}_2 \times \mathbf{V}_1$, the vector product is not commutative.

$$\begin{aligned}\mathbf{V}_1 \cdot (\mathbf{V}_2 \times \mathbf{V}_3) = (\mathbf{V}_1 \times \mathbf{V}_2) \cdot \mathbf{V}_3 &= \mathbf{V}_2 \cdot (\mathbf{V}_3 \times \mathbf{V}_1) \\ = (\mathbf{V}_1\mathbf{V}_2\mathbf{V}_3) &= \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}\end{aligned}$$

which is equal to the volume of a parallelepiped whose three determining edges are $\mathbf{V}_1$, $\mathbf{V}_2$, $\mathbf{V}_3$.

Differentiation of Vectors

If $\mathbf{V}_1 = a_1\mathbf{i} + b_1\mathbf{j} + c_1\mathbf{k}$, and $\mathbf{V}_2 = a_2\mathbf{i} + b_2\mathbf{j} + c_2\mathbf{k}$, and if $\mathbf{V}_1$ and $\mathbf{V}_2$ are functions of the scalar t, then

$$\frac{d}{dt}(\mathbf{V}_1 + \mathbf{V}_2 + \cdot\cdot\cdot) = \frac{d\mathbf{V}_1}{dt} + \frac{d\mathbf{V}_2}{dt} + \cdot\cdot\cdot,$$

where $\frac{d\mathbf{V}_1}{dt} = \frac{da_1}{dt}\mathbf{i} + \frac{db_1}{dt}\mathbf{j} + \frac{dc_1}{dt}\mathbf{k}$, etc.

$$\frac{d}{dt}(\mathrm{V}_1 \cdot \mathbf{V}_2) = \frac{d\mathbf{V}_1}{dt} \cdot \mathbf{V}_2 + \mathbf{V}_1 \cdot \frac{d\mathbf{V}_2}{dt}$$

$$\frac{d}{dt}(\mathbf{V}_1 \times \mathbf{V}_2) = \frac{d\mathbf{V}_1}{dt} \times \mathbf{V}_2 + \mathbf{V}_1 \times \frac{d\mathbf{V}_2}{dt}$$

Differential Operators—Rectangular Coordinates

By definition

$$\nabla \equiv \text{del} \equiv \mathbf{i}\frac{\delta}{\delta x} + \mathbf{j}\frac{\delta}{\delta y} + \mathbf{k}\frac{\delta}{\delta z}$$

$$\nabla^2 \equiv \text{Laplacian} \equiv \frac{\delta^2}{\delta x^2} + \frac{\delta^2}{\delta y^2} + \frac{\delta^2}{\delta z^2}$$

If S is a scalar function, then

$$\nabla S \equiv \text{grad } S \equiv \frac{\delta S}{\delta x}\mathbf{i} + \frac{\delta S}{\delta y}\mathbf{j} + \frac{\delta S}{\delta z}\mathbf{k}$$

The *distributive* law holds for finding a gradient. Thus if S and T are scalar functions

$$\nabla(S + T) = \nabla S + \nabla T$$

The *associative* law becomes the rule for differentiating a product:

$$\nabla(ST) = S\nabla T + T\nabla S$$

If $\mathbf{V}$ is a vector function with the magnitudes of the components parallel to the three coordinate axes V_x, V_y, V_z, then

$$\nabla \cdot \mathbf{V} \equiv \text{div } \mathbf{V} \equiv \frac{\delta V_x}{\delta x} + \frac{\delta V_y}{\delta y} + \frac{\delta V_z}{\delta z}$$

The divergence obeys the distributive law. Thus, if **V** and **U** are vector functions, then

$$\nabla \cdot (\mathbf{V} + \mathbf{U}) = \nabla \cdot \mathbf{V} + \nabla \cdot \mathbf{U}$$

$$\nabla \times \mathbf{V} \equiv \text{curl } \mathbf{V} \equiv \text{rot } \mathbf{V} \equiv \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \dfrac{\delta}{\delta x} & \dfrac{\delta}{\delta y} & \dfrac{\delta}{\delta z} \\ V_x & V_y & V_z \end{vmatrix}$$

The operator ∇ can be used more than once. The number of possibilities where ∇ is used twice are

$$\begin{aligned} \nabla \cdot (\nabla\theta) &\equiv \text{div grad } \theta \\ \nabla \times (\nabla\theta) &\equiv \text{curl grad } \theta \\ \nabla(\nabla \cdot \mathbf{V}) &\equiv \text{grad div } \mathbf{V} \\ \nabla \cdot (\nabla \times \mathbf{V}) &\equiv \text{div curl } \mathbf{V} \\ \nabla \times (\nabla \times \mathbf{V}) &\equiv \text{curl curl } \mathbf{V} \end{aligned}$$

Thus: $\text{div grad } S \equiv \nabla \cdot (\nabla S) \equiv \text{Laplacian } S \equiv \nabla^2 S$

$$\equiv \frac{\delta^2 S}{\delta x^2} + \frac{\delta^2 S}{\delta y^2} + \frac{\delta^2 S}{\delta z^2}$$

$$\text{curl grad } S \equiv 0; \qquad \text{curl curl } \mathbf{V} \equiv \text{grad div } \mathbf{V} - \nabla^2\mathbf{V};$$

$$\text{div curl } \mathbf{V} \equiv 0$$

Green's Theorem

Let **F** be a vector function and v a volume bounded by a surface s, then

$$\iiint_{(v)} \text{div } \mathbf{F} = \iiint_{(v)} \nabla \cdot \mathbf{F}\, dv = \iint_{(s)} \mathbf{F} \cdot ds,$$

where the integrations are to be carried out over the volume v and the surface s.

Stokes Theorem

Let **F** be a vector function and s a surface bounded by a simple closed curve c, then

$$\int_{(c)} \mathbf{F} \cdot d\,\mathbf{1} = \iint_{(s)} (\nabla \times \mathbf{F}) \cdot ds = \iint_{(s)} \text{curl } \mathbf{F} \cdot ds,$$

where the integrations are to be carried out over the curve c and the surface s. It should be noted that

$$d\,\mathbf{1} = dx\,\mathbf{i} + dy\,\mathbf{j} + dz\,\mathbf{k}$$

The theorem implies that the line integral of **F** over the contour c equals the surface integral of $\nabla \times \mathbf{F}$ over a surface s which is bounded by c.

MISCELLANEOUS

The Sum (Σ, = Sigma) and Product (Π, = Pi) Notations

Σ denotes the sum, and Π, the product of all quantities of a given collection. In particular,

$$\sum_{i=m}^{m+n} x_i \text{ means } x_m + x_{m+1} + \ldots + x_{m+n}, \ (n+1 \text{ terms in all}),$$

$$\prod_{i=m}^{m+n} x_i \text{ means } x_m x_{m+1} \ldots x_{m+n}, \ (n+1 \text{ factors in all}).$$

For indicated **range**, R, (such as $m \leqq i \leqq m+n$), one may write $\sum\limits_R x_i$, $\prod\limits_R x_i$, respectively. Where the range is clear from the context one writes Σx_i, Πx_i, or even Σx, Πx, respectively. For c a constant and for x_i and y_i with common range (say of n elements),

$$\Sigma c x_i = c\Sigma x_i, \ \Sigma(x_i + y_i) = \Sigma x_i + \Sigma y_i, \ \Sigma(x_i + c) = nc + \Sigma x_i.$$

Special Numerical Relations

(i) For range, $i = 1, 2, \ldots, n$, with $x_i = i$.
$\Sigma x_i = n(n+1)/2$, $\Sigma(2x_i - 1) = n^2$,
$\Sigma x_i^2 = n(n+1)(2n+1)/6$.
$\Sigma x_i^3 = (\Sigma x_i)^2$, $\Sigma x_i^4 = (\Sigma x_i^2)[6(\Sigma x_i) - 1]/5$.
$\Pi(c + 1 - x_i) = c^{(n)}$, $\Pi x_i = n^{(n)} = n!$ ("factorial n").
Hence $n! = n\,.\,(n-1)!$ $0!$ is defined to be 1.
Stirling's formula (used for n large),

$$\sqrt{2n\pi}(n/e)^n < n! < \sqrt{2n\pi}(n/e)^n\left(1 + \frac{1}{12n-1}\right).$$

$$(\pi = 3.14159\ldots, e = 2.71828\ldots).$$

$n!/(n-m)!$ gives the number of **permutations** of n distinct things taken m at a time.

(ii) For range, $i = -\left(\frac{n-1}{2}\right), -\left(\frac{n-1}{2}\right) + 1, \ldots, \left(\frac{n-1}{2}\right) - 1, \left(\frac{n-1}{2}\right)$, with $x_i = i$ (whether n is odd or even),

$$\sum x_i = \sum x_i^3 = 0, \ \sum x_i^2 = \frac{n(n^2-1)}{12}, \ \sum x_i^4 = \frac{3n^2-7}{20}\sum x_i^2.$$

(iii) **The Binomial Coefficients, $\binom{n}{m}$.**

$\binom{n}{m} = n!/[(n-m)!m!]$, for integers m, n, $0 \leqq m \leqq n$. $\binom{n}{0} = \binom{n}{n} = 1$.

$(x + c)^n = \sum\limits_r \binom{n}{r} x^{n-r} c^r$, $(0 \leqq r \leqq n)$, the **binomial expansion.** $\binom{n}{m}$ gives also the number of **combinations of n distinct things taken m at a time.**

$\binom{n}{m} + \binom{n}{m+1} = \binom{n+1}{m+1}$, **recursion relation** for binomial coefficients.

$$\binom{n}{n-m} = \binom{n}{m},\ \sum_r (-1)^r \binom{n}{r} = 0,\ \sum_r \binom{n}{r}^2 = \binom{2n}{n},\ \sum_{s=m}^{n} \binom{s}{m} = \binom{n+1}{m+1}$$

Table of Binomial Coefficients

n	$\binom{n}{0}$	$\binom{n}{1}$	$\binom{n}{2}$	$\binom{n}{3}$	$\binom{n}{4}$	$\binom{n}{5}$	$\binom{n}{6}$	$\binom{n}{7}$	$\binom{n}{8}$	$\binom{n}{9}$	$\binom{n}{10}$
0	1										
1	1	1									
2	1	2	1								
3	1	3	3	1							
4	1	4	6	4	1						
5	1	5	10	10	5	1					
6	1	6	15	20	15	6	1				
7	1	7	21	35	35	21	7	1			
8	1	8	28	56	70	56	28	8	1		
9	1	9	36	84	126	126	84	36	9	1	
10	1	10	45	120	210	252	210	120	45	10	1
11	1	11	55	165	330	462	462	330	165	55	11
12	1	12	66	220	495	792	924	792	495	220	66
13	1	13	78	286	715	1287	1716	1716	1287	715	286
14	1	14	91	364	1001	2002	3003	3432	3003	2002	1001
15	1	15	105	455	1365	3003	5005	6435	6435	5005	3003
16	1	16	120	560	1820	4368	8008	11440	12870	11440	8008
17	1	17	136	680	2380	6188	12376	19448	24310	24310	19448
18	1	18	153	816	3060	8568	18564	31824	43758	48620	43758
19	1	19	171	969	3876	11628	27132	50388	75582	92378	92378
20	1	20	190	1140	4845	15504	38760	77520	125970	167960	184756

NOTE: $\binom{n}{m} = \dfrac{n(n-1)(n-2)\ldots(n-m+1)}{m(m-1)(m-2)\ldots 3.2.1}$; $\binom{n}{0} = 1$; $\binom{n}{1} = n$.

For coefficients missing from the above table, use the relation

$\binom{n}{m} = \binom{n}{n-m}$, e.g. $\binom{20}{11} = \binom{20}{9} = 167960$.

Finite Differences

For equi-spaced arguments x_i, and associated y_i, the successive advancing y-differences are, $\Delta^0 y_i = y_i$, $\Delta y_i = y_{i+1} - y_i$, $\Delta^2 y_i = \Delta y_{i+1} - \Delta y_i = y_{i+2} - 2y_{i+1} + y_i, \ldots,$ $\Delta^m y_i = \Delta^{m-1} y_{i+1} - \Delta^{m-1} y_i = \sum_r (-1)^r \binom{m}{r} y_{i+m-r}$. With arbitrary origin A and class-interval length, $x_{i+1} - x_i = h$, using $u_i = (x_i - A)/h$, write $y(u_i)$ for y_i. Then if for some fixed m, for the portion of the table considered, the values of $\Delta^{m+1} y_i$ be zero (or approximately, if these be regarded as negligible) **Newton's formula** gives

$$y(u) = \sum \frac{u^{(r)}}{r!} \Delta^r y(0) = y(0) + u\Delta y(0) + \frac{u(u-1)}{1 \cdot 2} \Delta^2 y(0) + \cdots + \frac{u(u-1)\ldots(u-m+1)}{m!} \Delta^m y(0).$$

This formula reduces to an identity for $u = u_0, u_1, \ldots, u_n$, $(u_i = i)$, and may be used to interpolate for intermediate values.

Example. Given

x	−4,	−2,	0,	2,	4,	6,	8, . . .
y	10,	14,	30,	64,	122,	210,	334, . . .

to find a value for y when $x = 10$, and when $x = 1$. Suppose for some reason A has been taken at $x = 2$. The work may be arranged as follows:

u	x	y	Δ	Δ^2	Δ^3	Δ^4
−3	−4	10				
			4			
−2	−2	14		12		
			16		6	
−1	0	30		18		0
			34		6	
0	2	64		24		0
			58		6	
1	4	122		30		0
			88		6	
2	6	210		36		—
			124		—	
3	8	334		—		—
			—		—	
—	—	—		—		—

$$y(u) = 64 + 58u + 30\frac{u(u-1)}{1 \cdot 2} + 6\frac{u(u-1)(u-2)}{1 \cdot 2 \cdot 3}$$
$$= 64 + 58u + 15u(u-1) + u(u-1)(u-2).$$

At $x = 10$, $u = 4$. Substituting $u = 4$, one has $y|_{x=10} = 500$.
At $x = 1$, $u = -\frac{1}{2}$. Substituting $u = -\frac{1}{2}$, one has $y|_{x=1} = 44\frac{3}{8}$

STATISTICS

Central Measures

Here the range of i is from 1 to n. With each value x_i is associated a weighting factor $f_i \geq 0$ (such as the frequency, the probability, the mass, the reliability, or other multiplier).

N, **the total weight,** $= \Sigma f_i$.

$\bar{x}$, **the arithmetic mean,** $= \Sigma f_i x_i / N = \Sigma f_i x_i / \Sigma f_i$.

GM, **the geometric mean** (available when each x_i is positive), $= \sqrt[N]{\Pi x_i^{f_i}}$. $\text{Log } GM = \Sigma f_i \log x_i / N$.

Mo, **the mode,** = value among $(x_1, \ldots, x_n)$ having maximum associated f_i (usually obtained by interpolating after the data are graduated). For unweighted items, x_i, a mode is a value about which the values of x_i cluster most densely.

RMS, **the root-mean-square,** $= \sqrt{\Sigma f_i x_i^2 / N}$.

Md, **the median** (see below). For unweighted items, the median is the value, equaled or exceeded by exactly half of the values x_i in the given list. In case of a central pair, the median is usually taken as the arithmetic mean of this pair.

Mm, **the mid-mean** (see below). For unweighted items, the mid-mean is the arithmetic mean of the half-list obtained upon dropping out the highest quarter and lowest quarter of the items.

Cum $f|_X$, the value of "cumulative f" at X, $= \sum_{x_i < X} f_i$ (interpolation being used for X if necessary).

The M-Tiles

For **ungrouped data,** X is called the **rth m-tile** (or **rth m-tile mark**) $(r = 0, 1, \ldots, m)$ if simultaneously, $\sum_{x_i < X} f_i/N \leq r/m$, and $\sum_{x_i > X} f_i/N \leq (m - r)/m$. In particular the zeroth m-tile is **min,** the minimal value among the list $(x_1, \ldots, x_n)$, and the mth m-tile is **max,** the maximal value among the list.

For **grouped data,** the rth m-tile mark, X, is such that

$$\text{Cum } f|_X = Nr/m, \ (r = 0, 1, 2, \ldots, m).$$

$$\text{Cum } f|_{\min} = 0, \qquad \text{Cum } f|_{\max} = N.$$

In particular, certain intermediate $(0 < r < m)$ m-tile **marks** are named as follows:

m	$r = 1$	2	3	. . .
2	Md (median)			
3	T_1 (lower tertile)	T_2 (upper tertile)		
4	Q_1 (lower quartile)	Md	Q_3 (upper quartile)	
10	D_1 (first decile)	D_2	D_3	etc.
100	PC_1 (first percentile)	PC_2	PC_3	etc.

The term "rth m-tile" ($r = 1, \ldots, m$) is also used to denote the class interval extending from the $(r-1)$st to rth m-tile mark as defined above.

Mm, **the mid-mean,** =

$$2 \sum_{Q_1 \le x_i \le Q_3} f_i x_i / N = \sum_{Q_1 \le x_i \le Q_3} f_i x_i \Big/ \sum_{Q_1 \le x_i \le Q_3} f_i .$$

When each x_i is positive, and not all are equal, one always has $0 < \min < GM < \bar{x} < RMS < \max$.

For moderately-skewed distributions, one has approximately $Mo - \bar{x} = 3(Md - \bar{x})$, or $3Md = Mo + 2\bar{x}$.

Measures of Dispersion and Skewness

Here A is an arbitrary reference value, usually a convenient integral measure near $\bar{x}$.

ν_k, **kth moment about A,** $= \Sigma f_i (x_i - A)^k / N$, $(k = 0, 1, \ldots)$.

$\nu_0 = 1$, $\nu_1 = \bar{x} - A$. ν_2 as function of A is minimum for $A = \bar{x}$.

μ_k, **kth moment about $\bar{x}$,** $= \Sigma f_i (x_i - \bar{x})^k / N$, $(k = 0, 1, \ldots)$.

$$\begin{aligned}
\mu_0 &= 1, \\
\mu_1 &= 0, \\
\mu_2 &= \nu_2 - \nu_1^2 \ (\mu_2 = \text{variance}), \\
\mu_3 &= \nu_3 - 3\nu_1\nu_2 + 2\nu_1^3, \\
\mu_4 &= \nu_4 - 4\nu_1\nu_3 + 6\nu_1^2\nu_2 - 3\nu_1^4. \\
\beta_1 &= \mu_3^2/\mu_2^3,\ \beta_2 = \mu_4/\mu_2^2.
\end{aligned}$$

σ, **standard deviation,** $= \sqrt{\mu_2}$.

$\alpha_3/2$, **momental skewness;** $\alpha_3 = \sqrt{\beta_1} = \mu_3/\sigma^3$.

$(\alpha_4 - 3)/2$, **kurtosis;** $\alpha_4 = \beta_2$.

MD, **mean deviation** (from the mean), $= \Sigma f_i |x_i - \bar{x}| / N$

$$= 2\left[\bar{x} \sum_{x_i < \bar{x}} f_i - \sum_{x_i < \bar{x}} f_i x_i \right] / N.$$

(This latter form is convenient for computation.)

s, **quartile deviation,** $= |Q_3 - Q_1|/2$.

$P.E.$, **probable error,** $= 0.6745\sigma$.

V, **coefficient of variation,** $= 100\sigma/\bar{x}\,\%$.

Pearson's measure of skewness $= (\bar{x} - Mo)/\sigma$. (Usually approximately $\alpha_3/2$.)

Bowley's measure of skewness $= (Q_3 - 2Md + Q_1)/(2s)$. (Bowley's measure of skewness lies between -1 and $+1$.)

The Class Interval

$$\Delta x_i = x_{i+1} - x_i.$$

For equi-spaced arguments, $\Delta x_i = h$, the **length of the class interval,** x_i is the mid-value or **class mark.** The interval from $x_i - (h/2)$ to $x_i + (h/2)$ is the **class interval** with these as given **initial** and **terminal end values.**

$$\begin{aligned} u_i &= (x_i - A)/h. \\ \bar{u} &= \Sigma f_i u_i/N,\ \bar{x} = h\bar{u} + A. \\ (\mu_k)_x &= h^k(\mu_k)_u,\ (k = 0, 1, \ldots). \\ \sigma_u{}^2 &= [\Sigma f_i u_i{}^2/N] - \bar{u}^2,\ \sigma_x = h\sigma_u. \\ (\beta_1)_x &= (\beta_1)_u,\ (\beta_2)_x = (\beta_2)_u. \end{aligned}$$

Sheppard's corrections (to correct approximately for the error due to treating all elements in a given class interval of length h as though concentrated at the class mark).

For μ_0, μ_1, μ_3, no corrections.

In x-units,

corrected $(\mu_2)_x$ = uncorrected $(\mu_2)_x - h^2/12$,

corrected $(\mu_4)_x$ = uncorrected $(\mu_4)_x - h^2$ uncorrected $(\mu_2)_x/2 + 7h^4/240$.

In u-units, replace h by 1 in the formulae given above.

Least Squares

The **normal equations** for finding coefficients, $a_0, a_1, \ldots, a_m$, in fitting a curve of the form $y = a_0 + a_1x + \ldots + a_mx^m$ to data (X_i, Y_i), $i = 1, \ldots, n$, $(n > m)$, are $m + 1$ in number as follows:

$$\begin{aligned} \Sigma Y_i &= a_0n + a_1\Sigma X_i + a_2\Sigma X_i{}^2 + \ldots + a_m\Sigma X_i{}^m, \\ \Sigma X_iY_i &= a_0\Sigma X_i + a_1\Sigma X_i{}^2 + a_2\Sigma X_i{}^3 + \ldots + a_m\Sigma X_i{}^{m+1}, \\ &\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ \Sigma X_i{}^mY_i &= a_0\Sigma X_i{}^m + a_1\Sigma X_i{}^{m+1} + a_2\Sigma X_i{}^{m+2} + \ldots + a_m\Sigma X_i{}^{2m}. \end{aligned}$$

Deviation from fitted curve,

$$d_i = Y_i - (a_0 + a_1X_i + \ldots + a_mX_i{}^m).$$

$$\Sigma d_i{}^2 = \Sigma Y_i{}^2 - (a_0\Sigma Y_i + a_1\Sigma X_iY_i + \ldots + a_m\Sigma X_i{}^mY_i).$$

For $z = ab^x$, use $y = \log z$, $a_0 = \log a$, $a_1 = \log b$.

For $z = at^p$, use $y = \log z$, $a_0 = \log a$, $a_1 = p$, $x = \log t$.

S_y, **standard error of estimate,** = root-mean-square of the y-deviations about a fitted curve $= \sqrt{\Sigma d_i{}^2/n}$.

Simple Correlation

Product Moment Method

Given n equi-spaced measurements X_i, $i = 1, 2, \ldots, n$, with $h = X_{i+1} - X_i$, $x_i = X_i - \bar{X}$; and m equi-spaced measurements Y_j, $j = 1, 2, \ldots, m$, with $k = Y_{j+1} - Y_j$, $y_j = Y_j - \bar{Y}$; and a weight (frequency, probability, etc.) e_{ij} (≥ 0), associated with (X_i, Y_j). Here e_{ij} is an entry in the table.

$$f_i = \sum_j e_{ij},\ g_j = \sum_i e_{ij}.$$

$$N = \sum_{ij} e_{ij} = \sum_i f_i = \sum_j g_j. \quad \text{(Check)}$$

$$\bar{x} = \sum_{ij} e_{ij}X_i/N = \sum_i f_iX_i/N;\ \bar{y} = \sum_{ij} e_{ij}Y_j/N = \sum_j g_jY_j/N.$$

Let A and B be arbitrary reference values, usually convenient integral measures near $\bar{X}$ and $\bar{Y}$, respectively.

$$u_i = (X_i - A)/h,\ v_j = (Y_j - B)/k;$$

$$\bar{u} = \Sigma f_iu_i/N,\ \bar{X} = h\bar{u} + A,\ \bar{v} = \Sigma g_jv_j/N,\ \bar{Y} = k\bar{v} + B.$$

$$\left.\begin{aligned}\sigma_u^2 &= (\mu_2)_u = (\Sigma f_iu_i^2/N) - \bar{u}^2,\ \sigma_x = h\sigma_u.\\ \sigma_v^2 &= (\mu_2)_v = (\Sigma g_jv_j^2/N) - \bar{v}^2,\ \sigma_y = k\sigma_v.\end{aligned}\right\} \text{Apply Sheppard's corrections.}$$

$$U_j = \sum_i e_{ij}u_i,\ V_i = \sum_j e_{ij}v_j,\ P = \sum u_iV_i = \sum v_jU_j. \quad \text{(Check)}$$

$$p_{uv} = \sum_{ij} e_{ij}(u_i - \bar{u})(v_j - \bar{v})/N$$

$$= (P/N) - \bar{u}\bar{v}.$$

$$p_{xy} = hkp_{uv}.$$

$r = p_{uv}/(\sigma_u\sigma_v) = p_{xy}/(\sigma_x\sigma_y)$ **(product-moment) coefficient of correlation.** In every case $-1 \leq r \leq 1$.

$Y - \bar{Y} = r\dfrac{\sigma_y}{\sigma_x}(X - \bar{X})$, or $y = r\dfrac{\sigma_y}{\sigma_x}x$, **regression line of y on x.**

$X - \bar{X} = r\dfrac{\sigma_x}{\sigma_y}(Y - \bar{Y})$, or $x = r\dfrac{\sigma_x}{\sigma_y}y$, **regression line of x on y.**

Example of Computation for Product-Moment Coefficient of Correlation

	u_i	−3	−2	−1	0	1	2	g_j	g_jv_j	$g_jv_j^2$	U_j $\left(=\sum_i e_{ij}u_i\right)$	v_jU_j
v_j	y_j \ x_i	12	16	20	24	28	32					
2	21			1	5	7	1	14	28	56	8	16
1	18		1	3	7	5	2	18	18	18	4	4
0	15		2	3	4	1		10	0	0		0
−1	12		3	1	1			5	−5	5	−7	7
−2	9	2	1					3	−6	12	−8	16
f_i		2	7	8	17	13	3	50	35	91		43
f_iu_i		−6	−14	−8	0	13	6	−9				
$f_iu_i^2$		18	28	8	0	13	12	79				
$V_i \left(=\sum_j e_{ij}v_j\right)$		−4	−4	4		19	4					
u_iV_i		12	8	−4	0	19	8	43				

$A = 24,\ B = 15,$
$h = 4,\ k = 3,$
$N = \Sigma f_i = \Sigma g_j = 50,$
$\Sigma f_iu_i = -9,\ \Sigma g_jv_j = 35,$
$\Sigma f_iu_i^2 = 79,\ \Sigma g_jv_j^2 = 91,$
$P = \Sigma u_iV_i = \Sigma v_jU_j = 43.$

$\bar{u} = -9/50 = -.18 \quad \bar{v} = 35/50 = .70$

$\sigma_u^2 = (79/50) - (-.18)^2 - .083 = 1.46, \quad \sigma_u = 1.21$

$\sigma_v^2 = (91/50) - (.70)^2 - .083 = 1.247. \quad \sigma_v = 1.117$

$p_{uv} = (43/50) - (-.18)(.70) = +0.986$

$r = +0.986/(1.21 \times 1.117) = +.730 \quad$ Ans. $r = +.730$

RANK DIFFERENCE METHOD

Given n corresponding pairs of measured items (X_i, Y_i), $(i = 1, \ldots, n)$. Let (u_i, v_i) be the corresponding rank numbers. Here $u_i = 1$ for the largest X_i, 2 for the next largest X_i, etc., and similarly $v_i = 1$ for the largest Y_i, 2 for the next largest Y_i, etc. $\rho = 1 - \dfrac{6\Sigma(u_i - v_i)^2}{n(n^2 - 1)}$, (rank difference) **coefficient of correlation.** In every case $-1 \leq \rho \leq 1$. Check: $\Sigma(u_i - v_i) = 0$.

Example of Computation for Rank-Difference Coefficient of Correlation

X_i	Y_i	u_i	v_i	$u_i - v_i$	$(u_i - v_i)^2$	
76	52	3	1	+2	4	Check: $\Sigma(u_i - v_i) = 0$.
66	34	8	9	−1	1	
63	32	10	10	0	0	
74	45	4	4	0	0	$\rho = 1 - \dfrac{6 \times 62}{10(10^2 - 1)}$
79	50	1	2	−1	1	
69	37	7	7	0	0	
77	35	2	8	−6	36	$= +0.63$
65	42	9	5	+4	16	
71	40	6	6	0	0	Ans. $\rho = +.63$
73	48	5	3	+2	4	
$N = 10$				0	62	

Probability

If among $a + b$ equi-probable and mutually exclusive events, a are regarded as favorable and b unfavorable, then for a single trial

p, probability of favorable outcome, $= \dfrac{a}{a + b}$,

q, probability of unfavorable outcome, $= 1 - p = \dfrac{b}{a + b}$.

The successive terms in the binomial expansion $(p + q)^n = \sum_r \binom{n}{r} p^{n-r} q^r$ give the respective probabilities that in n trials, the event will be favorable exactly $n - r$ times, $r = 0, \ldots, n$.

The mean number of favorable events is np, of unfavorable, nq; the standard deviation is $\sigma = \sqrt{npq}$, $\alpha_3 = (p - q)/\sigma$ (the positive direction being that of increasing unfavorability).

Normal curve (x measured in σ-units from the mean, and with area = 1):

$$y = \frac{1}{\sqrt{2\pi}} e^{-x^2/2} = 0.3989 e^{-x^2/2}.$$

STATISTICS (Continued)

MD (mean deviation from the mean) $= \sigma\sqrt{2/\pi} = 0.7979\sigma$.
s (quartile deviation from the mean) $= 0.6745\sigma = 0.845\ MD$.

Percentage areas, under normal curve, for successive class intervals measured from the mean:

Multiples of σ: 34 %, 14 %, 2 %.
Multiples of s: 25 %, 16 %, 7 %, 2 %.

Normal surface (x measured in σ_x-units y in σ_y-units from their means),

$$z = \frac{1}{2\pi\sqrt{1 - r^2}} e^{-(x^2 - 2rxy + y^2)/[2(1-r^2)]}.$$

***Goodness of Fit.** For a universe of objects falling into n mutually exclusive classes with class marks, $x_i (i = 1, 2, \ldots, n)$, let p_i be the probability for the ith class. Given a sample of N items, with f_i items in the ith class ($\Sigma f_i = N$), the probability that a random sample of N items gives no better fit, expressed in terms of n and χ^2 ("Chi square"), $= \Sigma(f_i - Np_i)^2/(Np_i)$, is given by a table, portions of which are as follows:

Probability that a Random Sample Gives no Better Fit

n \ χ^2	1	2	3	4	6	8	10	15	20
3	.607	.368	.223	.135	.050	.018	.007	.001	.000
4	.801	.572	.392	.261	.112	.046	.019	.002	.000
5	.910	.736	.558	.406	.199	.092	.040	.005	.000
6	.963	.849	.700	.549	.306	.156	.075	.010	.001
7	.986	.920	.809	.677	.423	.238	.125	.020	.003
8	.995	.960	.885	.780	.540	.333	.189	.036	.006
9	.998	.981	.934	.857	.647	.433	.265	.059	.010
10	.999	.991	.964	.911	.740	.534	.350	.091	.018
11	1.000	.996	.981	.947	.815	.629	.440	.132	.029
12	1.000	.998	.991	.970	.873	.713	.530	.182	.045

n \ χ^2	8	10	12	14	16	18	20	25	30
10	.534	.350	.213	.122	.067	.035	.018	.003	.000
11	.629	.440	.285	.173	.100	.055	.029	.005	.001
12	.713	.530	.363	.233	.141	.082	.045	.009	.002
13	.785	.616	.446	.301	.191	.116	.067	.015	.003
14	.844	.694	.528	.374	.249	.158	.095	.023	.005
15	.889	.762	.606	.450	.313	.207	.130	.035	.008
16	.924	.820	.679	.526	.382	.263	.172	.050	.012
17	.949	.867	.744	.599	.453	.324	.220	.070	.018
18	.967	.904	.800	.667	.524	.389	.274	.095	.026
19	.979	.932	.847	.729	.593	.456	.333	.125	.037
20	.987	.953	.886	.784	.657	.522	.395	.161	.052

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* See index for t Test and F Test Tables.

MENSURATION FORMULÆ

Plane Figures Bounded by Straight Lines

The **area of a triangle** whose base is b and altitude h

$$= \frac{hb}{2}.$$

The area of a **triangle** with angles A, B, and C and sides opposite a, b, and c, respectively

$$= \tfrac{1}{2}ab \sin C.$$

or $$= \sqrt{s(s-a)(s-b)(s-c)},$$
where $s = \frac{1}{2}(a+b+c)$.

A **rectangle** with sides a and b has an area $= ab$.

The area of a **parallelogram** with side b and the perpendicular distance to the parallel side h

$$= bh.$$

The area of a **parallelogram** with sides a and b and the included angle θ

$$= ab \sin \theta.$$

The area of a **rhombus** with diagonals c and d,

$$= \tfrac{1}{2}cd.$$

The area of a **trapezoid** whose parallel sides are a and b and altitude h

$$= \tfrac{1}{2}(a+b)h.$$

The area of any **quadrilateral** with diagonals a and b and the angle between them θ

$$= \tfrac{1}{2}ab \sin \theta.$$

The area of a **regular polygon** with n sides, each of length l,

$$= \tfrac{1}{4}nl^2 \cot \frac{180°}{n}.$$

For a regular polygon of n sides, each side of length l, the radius of the **inscribed circle**,

$$= \frac{l}{2} \cot \frac{180°}{n}.$$

The radius of the **circumscribed circle**,

$$= \frac{l}{2} \operatorname{cosec} \frac{180°}{n}.$$

MENSURATION FORMULAE (Continued)

Area, Radius of Inscribed and Circumscribed Circles for Regular Polygons

l = length of one side.

Name.	Number of sides.	Area.	Radius of inscribed circle.	Radius of circumscribed circle.
Triangle, equilateral..........	3	$0.43301l^2$	$0.28867l$	$0.57735l$
Square..........	4	$1.00000l^2$	$0.50000l$	$0.70710l$
Pentagon........	5	$1.72048l^2$	$0.68819l$	$0.85065l$
Hexagon........	6	$2.59808l^2$	$0.86602l$	$1.0000l$
Heptagon.......	7	$3.63391l^2$	$1.0383l$	$1.1523l$
Octagon.........	8	$4.82843l^2$	$1.2071l$	$1.3065l$
Nonagon........	9	$6.18182l^2$	$1.3737l$	$1.4619l$
Decagon........	10	$7.69421l^2$	$1.5388l$	$1.6180l$
Undecagon......	11	$9.36564l^2$	$1.7028l$	$1.7747l$
Dodecagon......	12	$11.19615l^2$	$1.8660l$	$1.9318l$

Radius of circle inscribed in any triangle, whose sides are a, b, and c, where $s = \frac{1}{2}(a + b + c)$ is given by r

$$= \frac{\sqrt{s(s-a)(s-b)(s-c)}}{s}.$$

The radius of the **circumscribed** circle is given by R

$$= \frac{abc}{4\sqrt{s(s-a)(s-b)(s-c)}}.$$

The **perimeter of a polygon inscribed in a circle** of radius , where n is the number of sides,

$$= 2nr \sin \frac{\pi}{n}. \qquad (\pi \text{ radians} = 180°)$$

The area of the **inscribed** polygon,

$$= \tfrac{1}{2}nr^2 \sin \frac{2\pi}{n}.$$

The perimeter of a polygon circumscribed about a circle of radius r, number of sides n

$$= 2nr \tan \frac{\pi}{n}.$$

The area of the **circumscribed** polygon

$$= nr^2 \tan \frac{\pi}{n}.$$

Plane Figures Bounded by Curved Lines

The **circumference of a circle** whose radius is r and diameter $d(d = 2r)$

$$= 2\pi r = \pi d. \qquad (\pi = 3.14159)$$

The **area of a circle**

$$= \pi r^2 = \tfrac{1}{4}\pi d^2 = .7854d^2.$$

The **length of an arc** of a circle for an arc of θ degrees

$$= \frac{\pi r \theta}{180}.$$

NOTE.—In this and following similar formulæ r denotes the radius of the circle, (OC, Fig. 1).

For an arc of θ radians the length s

$$= r\theta.$$

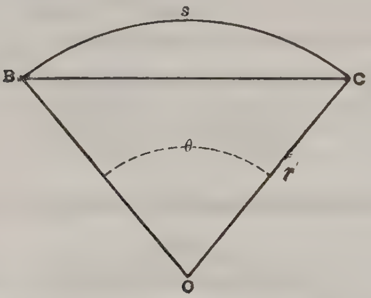


FIG. 1.

The **length of a chord** subtending an angle θ.

$$= 2r \sin \tfrac{1}{2}\theta.$$

The **area of a sector** where θ is the angle between the radii in degrees

$$= \frac{\pi r^2 \theta}{360}.$$

If s is the length of the arc, the area of the sector

$$= \frac{sr}{2}.$$

The **area of a segment** where θ is the angle between the two radii in degrees

$$= \frac{\pi r^2 \theta}{360} - \frac{r^2 \sin\theta}{2}. \qquad \left[\begin{array}{l} \theta^\circ = 180^\circ - [2 \sin^{-1}(x/r)] \\ x = \perp \text{ dist. center to chord} \end{array}\right]$$

If θ is in radians the area $= \frac{1}{2}r^2(\theta - \sin\theta)$.

The **area of the segment of a circle**

$$= \frac{\pi r^2}{2} - \left[x\sqrt{r^2 - x^2} + r^2 \operatorname{Sin}^{-1}\left(\frac{x}{r}\right)\right]$$

where r is the radius of the circle and x the perpendicular distance of the chord from the center. The principal angle must be used in this formula.

The **area of the ring** between two circles of radius r_1 and r_2, one of which encloses the other,

$$= \pi(r_1 + r_2)(r_1 - r_2).$$

The two circles are not necessarily concentric.

Area of the sector of an annulus. (Fig. 2.)—If angle $GOH = \theta$ and the lines GO and $JO = r_1$ and r_2 respectively, the area $GHIJ = \frac{1}{2}\theta(r_1 + r_2)(r_1 - r_2)$.

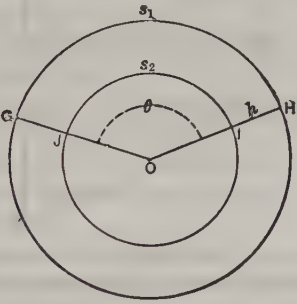


FIG. 2.

If s_1 = the length of the arc GH and s_2 = the arc JI and $h = HI = r_1 - r_2$, the area $GHIJ = \frac{1}{2}h(s_1 + s_2)$.

The **circumference of an ellipse** whose semiaxes are a and b

$= 2\pi\sqrt{\frac{a^2+b^2}{2}}$ (approx.) $= 4aE$ exactly. See tables of elliptic integrals for E, using $k = \frac{\sqrt{a^2 - b^2}}{a}$

The **area of an ellipse** $= \pi ab$.

The length of the **arc of a parabola,** as arc SPQ in Fig. 3, where $x = PR$, and $y = QR$

$$\sqrt{4x^2 + y^2} + \frac{y^2}{2x}\log_e\frac{2x + \sqrt{4x^2 + y^2}}{y}$$

The area of the section of the parabola $PQRS$, $= \frac{4}{3}xy$.

Solids Bounded by Planes

The **lateral area of a regular prism** = perimeter of a right section × the length.

The **volume of a regular prism** = area of base × the altitude.

The **lateral area of a regular pyramid,** slant height l, length of one side of base a, and a number of sides n,

$$= \tfrac{1}{2}nal.$$

The **volume of a pyramid** = $\frac{1}{3}$ area of base × altitude.

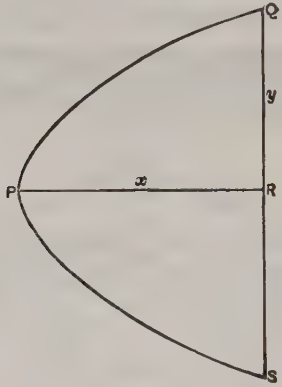


FIG. 3.

Surface and Volume of Regular Polyhedra

Surface and volume of regular polyhedra in terms of the length of one edge l.

Name.	Nature of surface.	Surface.	Volume.
Tetrahedron...	4 equilateral triangles	$1.73205l^2$	$0.11785l^3$
Hexahedron or cube........	6 squares...........	$6.00000l^2$	$1.00000l^3$
Octahedron....	8 equilateral triangles	$3.46410l^2$	$0.47140l^3$
Dodecahedron .	12 pentagons.........	$20.64573l^2$	$7.66312l^3$
Icosahedron...	20 equilateral triangles	$8.66025l^2$	$2.18170l^3$

Solids Bounded by Curved Surfaces

The **surface of a sphere** of radius r and diameter $d(= 2r)$

$$= 4\pi r^2 = \pi d^2 = 12.57r^2.$$

The **volume of a sphere**

$$= \tfrac{4}{3}\pi r^3 = \tfrac{1}{6}\pi d^3 = 4.189r^3.$$

The **area of a lune** on the surface of a sphere of radius r, included between two great circles whose inclination is θ radians.

$$= 2r^2\theta.$$

The **area of a spherical triangle** whose angles are A, B, and C (radians) on a sphere of radius r

$$= (A + B + C - \pi)r^2.$$

The **area of a spherical polygon** of n sides where θ is the sum of its angles in radians

$$= [\theta - (n - 2)\pi]r^2.$$

The area of the curved surface of a **spherical segment** of height h, radius of sphere r

$$= 2\pi\, rh.$$

The **volume of a spherical segment**, data as above

$$= \tfrac{1}{3}\pi h^2\,(3r - h).$$

If a = radius of the base of the segment, the volume

$$= \tfrac{1}{6}\pi h(h^2 + 3a^2).$$

The **curved surface of a right cylinder where** r = the radius of the base and h, the altitude,

$$= 2\pi rh.$$

The **volume of a cylinder,** data as above,

$$= \pi r^2 h.$$

The **curved surface of a right cone** whose altitude is h and radius of base r

$$= \pi r\,\sqrt{r^2 + h^2}.$$

The **volume of a cone,** data as above,

$$= \frac{\pi}{3} r^2 h = 1.047\, r^2 h.$$

The **curved surface of the frustum of a right cone,** radius of base r_1, of top r_2 and altitude h,

$$= \pi(r_1 + r_2)\,\sqrt{h^2 + (r_1 - r_2)^2}.$$

The **volume of the frustum of a cone,** data as above,

$$= \pi\,\frac{h}{3}\,(r_1^2 + r_1 r_2 + r_2^2).$$

The **oblate spheroid** is formed by the rotation of an ellipse about its minor axis. If a and b are the major and minor semi-axes respectively, and ϵ the eccentricity, the surface

$$= 2\pi a^2 + \pi\,\frac{b^2}{\epsilon}\,\log_e \frac{1 + \epsilon}{1 - \epsilon},$$

and volume $= \tfrac{4}{3}\pi a^2 b$.

The prolate spheroid is formed by the rotation of an ellipse about its major axis ($2a$), data as above.

Surface $=2\pi b^2+2\pi \frac{ab}{\epsilon}\sin^{-1}\epsilon$,

volume $=\frac{4}{3}\pi ab^2$.

SIMPSON'S RULE FOR IRREGULAR AREAS

Divide the area into an even number ($2m$) of panels by means of $2m+1$ parallel lines, drawn at constant distance h apart; and denote the lengths of the intercepted segments by $y_0, y_1, \ldots, y_{2m-1}, y_{2m}$. The first and last of these may be zero. The area will then be

$$A=\tfrac{1}{3}h[(y_0+y_{2m})+4(y_1+y_3+\ldots+y_{2m-1})+2(y_2+y_4+\ldots+y_{2m-2})]$$

While the formula is exact in many simple cases, ordinarily the formula provides only an approximation, for which the accuracy increases with an increase in the number of divisions. Simpson's Rule may be applied to finding volumes, if the measures $y_0, y_1, \ldots, y_{2m}$ be interpreted as the areas of parallel plane sections at constant distance h apart.

PRISMOIDAL FORMULA

As a special case where $m=1$, and H, ($=2h$) is the distance between two limiting parallel planes, one has for the volume of a solid figure,

$$V=\tfrac{1}{6}H(S_0+4S_1+S_2).$$

Here S_0 and S_2 are the cross-sectional areas in these limiting planes (lower and upper bases, respectively), and S_1 is the cross section of the mid-section. The formula is exact for the cone, sphere, ellipsoid, and prismoid.

TRIGONOMETRIC FORMULAE

TRIGONOMETRIC FUNCTIONS IN A RIGHT-ANGLED TRIANGLE

If A, B, and C are the vertices (C the right angle), and a, b, and h the sides opposite respectively,

$$\text{sine } A = \sin A = \frac{a}{h}, \qquad \text{cosine } A = \cos A = \frac{b}{h},$$

$$\text{tangent } A = \tan A = \frac{a}{b}, \qquad \text{cotangent } A = \cot A = \text{ctn } A = \frac{b}{a},$$

$$\text{secant } A = \sec A = \frac{h}{b}, \qquad \text{cosecant } A = \csc A = \frac{h}{a}.$$

$$\text{exsecant } A = \text{exsec } A = \sec A - 1$$

$$\text{versine } A = \text{vers } A = 1 - \cos A$$

$$\text{coversine } A = \text{covers } A = 1 - \sin A$$

$$\text{haversine } A = \text{hav } A = \tfrac{1}{2} \text{ vers } A$$

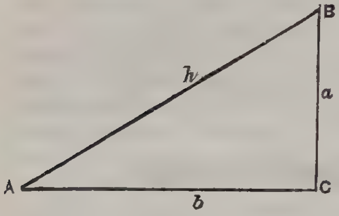


FIG. 4.

SIGNS AND LIMITS OF VALUE ASSUMED BY THE FUNCTIONS

Function.	Quadrant I.		Quadrant II.		Quadrant III.		Quadrant IV.	
	Sign.	Value.	Sign.	Value.	Sign.	Value.	Sign.	Value.
sin.....	+	0 to 1	+	1 to 0	−	0 to 1	−	1 to 0
cos.....	+	1 to 0	−	0 to 1	−	1 to 0	+	0 to 1
tan.....	+	0 to ∞	−	∞ to 0	+	0 to ∞	−	∞ to 0
cot.....	+	∞ to 0	−	0 to ∞	+	∞ to 0	−	0 to ∞
sec.....	+	1 to ∞	−	∞ to 1	−	1 to ∞	+	∞ to 1
cosec...	+	∞ to 1	+	1 to ∞	−	∞ to 1	−	1 to ∞

TRIGONOMETRIC FORMULAE (Continued)

VALUE OF THE FUNCTIONS OF VARIOUS ANGLES

	0°	30°	45°	60°	90°	180°	270°
sin..........	0	$\frac{1}{2}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}\sqrt{3}$	1	0	-1
cos..........	1	$\frac{1}{2}\sqrt{3}$	$\frac{1}{2}\sqrt{2}$	$\frac{1}{2}$	0	-1	0
tan..........	0	$\frac{1}{3}\sqrt{3}$	1	$\sqrt{3}$	∞	0	∞
cot..........	∞	$\sqrt{3}$	1	$\frac{1}{3}\sqrt{3}$	0	∞	0
sec..........	1	$\frac{2\sqrt{3}}{3}$	$\sqrt{2}$	2	∞	-1	∞
cosec........	∞	2	$\sqrt{2}$	$\frac{2\sqrt{3}}{3}$	1	∞	-1

EXPONENTIAL DEFINITIONS OF CIRCULAR FUNCTIONS

$$\sin x = \frac{1}{2i}(e^{ix} - e^{-ix}) \qquad (i^2 = -1)$$

$$\operatorname{cosec} x = \frac{2i}{e^{ix} - e^{-ix}}$$

$$\cos x = \frac{e^{ix} + e^{-ix}}{2}$$

$$\sec x = \frac{2}{e^{ix} + e^{-ix}}$$

$$\tan x = \frac{e^{ix} - e^{-ix}}{ie^{ix} + ie^{-ix}}$$

$$\cot x = \frac{ie^{ix} + ie^{-ix}}{e^{ix} - e^{-ix}}$$

RELATIONS OF THE FUNCTIONS

$$\sin x = \frac{1}{\operatorname{cosec} x}.$$

$$\operatorname{cosec} x = \frac{1}{\sin x}.$$

$$\cos x = \frac{1}{\sec x}.$$

$$\sec x = \frac{1}{\cos x}.$$

$$\tan x = \frac{1}{\cot x} = \frac{\sin x}{\cos x}.$$

$$\sin^2 x + \cos^2 x = 1.$$

$$\cot x = \frac{1}{\tan x} = \frac{\cos x}{\sin x}.$$

$$1 + \tan^2 x = \sec^2 x.$$

$$1 + \cot^2 x = \operatorname{cosec}^2 x.$$

$${}^{*}\sin x = \pm\sqrt{1 - \cos^2 x}.$$

$$\cos x = \pm\sqrt{1 - \sin^2 x}.$$

$$\tan x = \pm\sqrt{\sec^2 x - 1}.$$

$$\sec x = \pm\sqrt{\tan^2 x + 1}.$$

$$\cot x = \pm\sqrt{\operatorname{cosec}^2 x - 1}.$$

$$\operatorname{cosec} x = \pm\sqrt{\cot^2 x + 1}.$$

$$\sin x = \cos(90^\circ - x) = \sin(180^\circ - x).$$

---

* The sign in front of radical depends on quadrant in which x falls.

RELATIONS OF THE FUNCTIONS (Continued)

$\cos x = \sin(90^\circ - x) = -\cos(180^\circ - x).$

$\tan x = \cot(90^\circ - x) = -\tan(180^\circ - x).$

$\cot x = \tan(90^\circ - x) = -\cot(180^\circ - x).$

$$\operatorname{cosec} x = \cot\frac{x}{2} - \cot x.$$

FUNCTIONS OF SUMS OF ANGLES

$\sin(x \pm y) = \sin x \cos y \pm \cos x \sin y.$

$\cos(x \pm y) = \cos x \cos y \mp \sin x \sin y.$

$$\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x \tan y}.$$

FUNCTIONS OF MULTIPLE ANGLES

$\sin 2x = 2 \sin x \cos x.$

$\cos 2x = \cos^2 x - \sin^2 x = 2\cos^2 x - 1 = 1 - 2\sin^2 x.$

$\sin 3x = 3 \sin x - 4 \sin^3 x.$

$\cos 3x = 4 \cos^3 x - 3 \cos x.$

$\sin 4x = 8 \cos^3 x \sin x - 4 \cos x \sin x.$

$\cos 4x = 8 \cos^4 x - 8 \cos^2 x + 1.$

$\sin 5x = 5 \sin x - 20 \sin^3 x + 16 \sin^5 x.$

$\cos 5x = 16 \cos^5 x - 20 \cos^3 x + 5 \cos x.$

$\sin 6x = 32 \cos^5 x \sin x - 32 \cos^3 x \sin x + 6 \cos x \sin x.$

$\cos 6x = 32 \cos^6 x - 48 \cos^4 x + 18 \cos^2 x - 1.$

$$\tan 2x = \frac{2 \tan x}{1 - \tan^2 x}.$$

$$\cot 2x = \frac{\cot^2 x - 1}{2 \cot x}.$$

$$\tan 3x = \frac{3 \tan x - \tan^3 x}{1 - 3 \tan^2 x}.$$

$${}^*\sin \tfrac{1}{2}x = \pm\sqrt{\frac{1 - \cos x}{2}}.$$

$$\cos \tfrac{1}{2}x = \pm\sqrt{\frac{1 + \cos x}{2}}.$$

$$\tan \tfrac{1}{2}x = \pm\sqrt{\frac{1 - \cos x}{1 + \cos x}} = \frac{1 - \cos x}{\sin x} = \frac{\sin x}{1 + \cos x}.$$

---

* The sign in front of radical depends on quadrant in which x falls.

MISCELLANEOUS RELATIONS

$$\sin x \pm \sin y = 2 \sin \tfrac{1}{2}(x \pm y) \cdot \cos \tfrac{1}{2}(x \mp y).$$
$$\cos x + \cos y = 2 \cos \tfrac{1}{2}(x + y) \cdot \cos \tfrac{1}{2}(x - y).$$
$$\cos x - \cos y = -2 \sin \tfrac{1}{2}(x + y) \cdot \sin \tfrac{1}{2}(x - y).$$
$$\tan x \pm \tan y = \frac{\sin (x \pm y)}{\cos x \cdot \cos y}. \quad \cot x \pm \cot y = \frac{\pm \sin (x \pm y)}{\sin x \cdot \sin y}.$$
$$\frac{1 + \tan x}{1 - \tan x} = \tan (45^\circ + x). \quad \frac{\cot x + 1}{\cot x - 1} = \cot (45^\circ - x)$$
$$\frac{\sin x \pm \sin y}{\cos x + \cos y} = \tan \tfrac{1}{2}(x \pm y).$$
$$\frac{\sin x \pm \sin y}{\cos x - \cos y} = -\cot \tfrac{1}{2}(x \mp y).$$
$$\frac{\sin x + \sin y}{\sin x - \sin y} = \frac{\tan \frac{1}{2}(x + y)}{\tan \frac{1}{2}(x - y)}.$$
$$\sin^2 x - \sin^2 y = \sin (x + y) \cdot \sin (x - y).$$
$$\cos^2 x - \cos^2 y = -\sin (x + y) \sin (x - y).$$
$$\cos^2 x - \sin^2 y = \cos (x + y) \cos (x - y).$$

INVERSE TRIGONOMETRIC FUNCTIONS

The following table lists each of the six inverse trigonometric functions together with the interval of its principal value:

Function	Interval containing principal value	
	x positive or zero	x negative
$y = \sin^{-1} x$ and $\tan^{-1} x$. .	$0 \leqq y \leqq \pi/2$	$-\pi/2 \leqq y < 0$
$y = \cos^{-1} x$ and $\cot^{-1} x$. .	$0 \leqq y \leqq \pi/2$	$\pi/2 < y \leqq \pi$
$y = \sec^{-1} x$ and $\csc^{-1} x$. .	$0 \leqq y \leqq \pi/2$	$-\pi \leqq y \leqq -\pi/2$

Usually the first letter in "arc" or the name of the inverse trigonometric functions is capitalized if the principal value is desired. Thus

$$\text{Arc} \sin \frac{1}{2} = \text{Sin}^{-1} \frac{1}{2} = \frac{\pi}{6},$$

while
$$\text{arc} \sin \frac{1}{2} = \frac{\pi}{6} + 2\pi n \text{ or } \frac{5\pi}{6} + 2\pi n$$

In the calculus both for differentiation or integral formulas, capitalization is not adhered to strictly, but principal values are always understood for inverse trigonometric functions when used unless specifically stated otherwise.

RELATIONS BETWEEN SIDES AND ANGLES OF ANY PLANE TRIANGLE

In a triangle with angles A, B, and C and sides opposite a, b, and c respectively,

$$\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}=\text{diameter of the circumscribed circle.}$$

$$a^2=b^2+c^2-2bc\cos A.$$

$$a=b\cos C+c\cos B.$$

$$\cos A=\frac{b^2+c^2-a^2}{2bc}.$$

$$\tan\frac{A-B}{2}=\frac{a-b}{a+b}\cot\frac{C}{2}.$$

$$\sin A=\frac{2}{bc}\sqrt{s(s-a)(s-b)(s-c)},$$

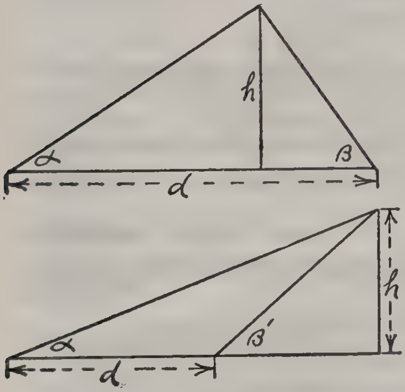
where $s=\frac{1}{2}(a+b+c)$ and $r=\sqrt{\frac{(s-a)(s-b)(s-c)}{s}}$.

$$\sin\frac{A}{2}=\sqrt{\frac{(s-b)(s-c)}{bc}}.$$

$$\cos\frac{A}{2}=\sqrt{\frac{s(s-a)}{bc}}.$$

$$\tan\frac{A}{2}=\sqrt{\frac{(s-b)(s-c)}{s(s-a)}}=\frac{r}{s-a}.$$

$$\frac{a+b}{a-b}=\frac{\sin A+\sin B}{\sin A-\sin B}=\frac{\tan\frac{1}{2}(A+B)}{\tan\frac{1}{2}(A-B)}=\frac{\cot\frac{1}{2}C}{\tan\frac{1}{2}(A-B)}.$$



$$h=d\frac{\sin\alpha\sin\beta}{\sin(\alpha+\beta)}=\frac{d}{\cot\alpha+\cot\beta}$$

Similarly

$$h=d\frac{\sin\alpha\sin\beta'}{\sin(\beta'-\alpha)}=\frac{d}{\cot\alpha-\cot\beta'}$$

FIG. 8.

RELATIONS IN ANY SPHERICAL TRIANGLE

If A, B and C be the three angles and a, b, and c the opposite sides,

$$\frac{\sin A}{\sin a}=\frac{\sin B}{\sin b}=\frac{\sin C}{\sin c}.$$

$$\cos a=\cos b\cos c+\sin b\sin c\cos A=\frac{\cos b\cos(c\pm\theta)}{\cos\theta}.$$

where $\tan\theta=\tan b\cos A.$

$$\cos A=-\cos B\cos C+\sin B\sin C\cos a.$$

$$\sin\tfrac{1}{2}A=\sqrt{\frac{\sin(s-b)\sin(s-c)}{\sin b\sin c}}.$$

where $s=\frac{1}{2}(a+b+c).$

$$\cos\tfrac{1}{2}A=\sqrt{\frac{\sin s\sin(s-a)}{\sin b\sin c}}.$$

$$\tan\tfrac{1}{2}A=\frac{r}{\sin(s-a)}.$$

where $r=\sqrt{\dfrac{\sin(s-a)\sin(s-b)\sin(s-c)}{\sin s}}.$

$$\cos\tfrac{1}{2}a=\sqrt{\frac{\cos(S-B)\cos(S-C)}{\sin B\sin C}}.$$

where $S=\frac{1}{2}(A+B+C).$

$$\sin\tfrac{1}{2}a=\sqrt{-\frac{\cos S\cos(S-A)}{\sin B\sin C}}.$$

$$\tan\tfrac{1}{2}a=R\cos(S-A)$$

where $R=\sqrt{\dfrac{-\cos S}{\cos(S-A)\cos(S-B)\cos(S-C)}}.$

$$\frac{\tan\frac{a+b}{2}}{\tan\frac{c}{2}}=\frac{\cos\frac{A-B}{2}}{\cos\frac{A+B}{2}},\qquad\frac{\tan\frac{A+B}{2}}{\cot\frac{C}{2}}=\frac{\cos\frac{a-b}{2}}{\cos\frac{a+b}{2}}.$$

$$\frac{\tan\frac{a-b}{2}}{\tan\frac{c}{2}}=\frac{\sin\frac{A-B}{2}}{\sin\frac{A+B}{2}},\qquad\frac{\tan\frac{A-B}{2}}{\cot\frac{C}{2}}=\frac{\sin\frac{a-b}{2}}{\sin\frac{a+b}{2}}$$

$$\operatorname{hav} a=\operatorname{hav}(b-c)+\sin b\sin c\operatorname{hav} A$$

$$\operatorname{hav} A=\frac{\sqrt{\operatorname{hav}[a+(b-c)]\operatorname{hav}[a-(b-c)]}}{\sin b\sin c}$$

The distance between two points x_1, y_1, and x_2, y_2,—rectangular coördinates:

$$d = \pm \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

For polar coördinates and points r_1, θ_1, and r_2, θ_2:

$$d = \pm \sqrt{r_1^2 + r_2^2 - 2r_1r_2 \cos(\theta_1 - \theta_2)}$$

The area of a triangle whose vertices are x_1, y_1; x_2, y_2, and x_3, y_3:

$$A = \tfrac{1}{2}|x_1y_2 - x_2y_1 + x_2y_3 - x_3y_2 + x_3y_1 - x_1y_3|$$

For polar coördinates and vertices, r_1, θ_1; r_2, θ_2, and r_3, θ_3:

$$A = \tfrac{1}{2}\{r_1r_2 \sin(\theta_2 - \theta_1) + r_2r_3 \sin(\theta_3 - \theta_2) + r_3r_1 \sin(\theta_1 - \theta_3)\}$$

The equation of a straight line where m is the tangent of the angle of inclination and c, the distance of intersection with the Y axis from the origin:

$$y = mx + c$$

If a line of slope m passes through the point x_1, y_1 its equation is:

$$y - y_1 = m(x - x_1)$$

The equation of a line through the points x_1, y_1, and x_2, y_2 is:

$$\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$$

If the intercepts on the X and Y axes are a and b respectively, the equation is:

$$\frac{x}{a} + \frac{y}{b} = 1$$

If the length of the perpendicular from the origin is p and its angle of inclination θ the equation is:

$$x \cos\theta + y \sin\theta = p$$

General equation of the straight line:

$Ax + By + C = 0$, where slope $m = \dfrac{-A}{B}$; x-intercept $a = \dfrac{-C}{A}$; y-intercept $b = \dfrac{-C}{B}$.

The equation of a circle whose center is at a, b, and whose radius is c:

$$(x - a)^2 + (y - b)^2 = c^2$$

If the origin is at the center:

$$x^2 + y^2 = c^2$$

The polar equation of a circle with the origin on the circumference and its center at point c, α:

$$r = 2c \cos(\theta - \alpha).$$

If the origin is not on the circumference, the radius a and the center at a point, l, α, the equation becomes:

$$a^2 = r^2 + l^2 - 2rl \cos(\theta - \alpha)$$

The equation of a parabola with the origin at the vertex, where f is the distance from the focus to the vertex:

$$y^2 = 4fx$$

If p is the semi-latus rectum $(=2f)$ the equation is:

$$y^2 = 2px$$

The polar equation where the pole is at the focus and p the semi-latus rectum is:

$$r = \frac{p}{1 - \cos\theta}$$

If the pole is at the vertex and p as above:

$$r = \frac{2p\cos\theta}{\sin^3\theta}$$

The equation of the ellipse with the origin at the center and semi-axes a and b:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Polar equation where the pole is at the center:

$$r^2 = \frac{a^2b^2}{a^2\sin^2\theta + b^2\cos^2\theta}$$

The equation of the hyperbola with the origin at the center, semi-axes a and b:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

Polar equation, pole at center:

$$r^2 = \frac{a^2b^2}{a^2\sin^2\theta - b^2\cos^2\theta}$$

TRANSFORMATION OF COORDINATES

Rectangular System

(1) Translation only of axes parallel to themselves.

The coordinates of new origin with respect to old axes: $x = h$, $y = k$. Primed letters designate new coordinates.

$$\begin{aligned} x' &= x - h & \qquad x &= x' + h \\ y' &= y - k & \qquad y &= y' + k \end{aligned}$$

(2) Rotation of axes with fixed origin.

Angle of rotation $= \theta$

$$\begin{aligned} x' &= x \cos\theta + y \sin\theta & \qquad x &= x' \cos\theta - y' \sin\theta \\ y' &= y \cos\theta - x \sin\theta & \qquad y &= y' \cos\theta + x' \sin\theta \end{aligned}$$

(3) Origin translated and axes rotated.

Symbols same as above

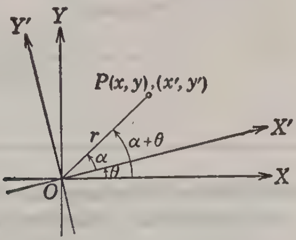
$$\begin{aligned} x' &= (x - h) \cos\theta + (y - k) \sin\theta \\ y' &= (y - k) \cos\theta - (x - h) \sin\theta \\ x &= x' \cos\theta - y' \sin\theta + h \\ y &= y' \cos\theta + x' \sin\theta + k \end{aligned}$$

Relation between Rectangular and Polar Coordinates

$$\begin{aligned} x &= r\cos\theta & \qquad r &= \sqrt{x^2 + y^2} & \qquad \sin\theta &= \frac{y}{\sqrt{x^2 + y^2}} \\ y &= r\sin\theta & \qquad \theta &= \tan^{-1}\frac{y}{x} & \qquad \cos\theta &= \frac{x}{\sqrt{x^2 + y^2}} \end{aligned}$$

Rotation of Polar Axes through Angle θ

$$\begin{aligned} x' &= r\cos\alpha \\ y' &= r\sin\alpha \\ x &= r\cos(\alpha + \theta) \\ y &= r\sin(\alpha + \theta) \end{aligned}$$

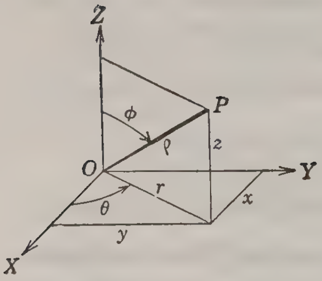


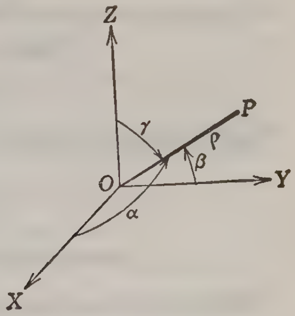
TRANSFORMATION OF COORDINATES (Continued)

SOLID ANALYTICAL GEOMETRY

Space Coordinates

1. Rectangular System x, y, z.
2. Cylindrical System r, θ, z.
3. Spherical System ρ, θ, ϕ.
4. Polar Space System ρ, α, β, γ.





Relations of Coordinates of Systems in Terms of x, y, z

Cylindrical	Spherical	Polar Space
$r = \sqrt{x^2 + y^2}$	$\rho = \sqrt{x^2 + y^2 + z^2}$	$\rho = \sqrt{x^2 + y^2 + z^2}$
$\theta = \tan^{-1}\frac{y}{x}$	$\theta = \tan^{-1}\frac{y}{x}$	$\alpha = \cos^{-1}\left(\frac{x}{\sqrt{x^2 + y^2 + z^2}}\right)$
$z = z$	$\phi = \cos^{-1}\left(\frac{z}{\sqrt{x^2 + y^2 + z^2}}\right)$	$\beta = \cos^{-1}\left(\frac{y}{\sqrt{x^2 + y^2 + z^2}}\right)$
		$\gamma = \cos^{-1}\left(\frac{z}{\sqrt{x^2 + y^2 + z^2}}\right)$

Relations of Rectangular Coordinates (x, y, z) in Terms of Cylindrical, Spherical and Polar Space Coordinates

Cylindrical	Spherical	Polar Space
$x = r \cos\theta$ $y = r \sin\theta$ $z = z$	$x = \rho \sin\phi \cos\theta$ $y = \rho \sin\phi \sin\theta$ $z = \rho \cos\phi$	$x = \rho \cos\alpha$ $y = \rho \cos\beta$ $z = \rho \cos\gamma$

TRANSFORMATION OF COORDINATES (Continued)

TRANSFORMATION OF RECTANGULAR SPACE COORDINATES FOR TRANSLATION WITHOUT ROTATION

Coordinates of new origin are (h, k, l) in terms of the old coordinates. New coordinates are (x', y', z')

$$\begin{aligned} x' &= x - h & x &= x' + h \\ y' &= y - k & y &= y' + k \\ z' &= z - l & z &= z' + l \end{aligned}$$

For rotation only about the origin where λ_1, μ_1, ν_1; λ_2, μ_2, ν_2 and λ_3, μ_3, ν_3 are the direction cosines of the new axes with respect to the old axes. The coordinates of point P are (x, y, z) referred to the original axes and (x', y', z') referred to the new rotated axes.

$$\begin{aligned} x' &= \lambda_1 x + \mu_1 y + \nu_1 z \\ y' &= \lambda_2 x + \mu_2 y + \nu_2 z \\ z' &= \lambda_3 x + \mu_3 y + \nu_3 z \\ x &= \lambda_1 x' + \lambda_2 y' + \lambda_3 z' \\ y &= \mu_1 x' + \mu_2 y' + \mu_3 z' \\ z &= \nu_1 x' + \nu_2 y' + \nu_3 z' \end{aligned}$$

HYPERBOLIC FUNCTIONS

Definitions

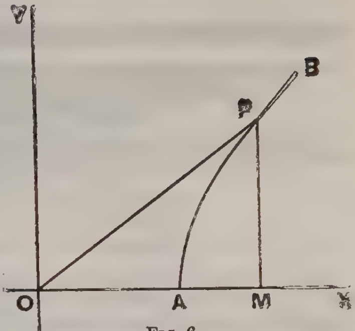


FIG. 6.

An hyperbolic function represents a relation between the coordinates of a given point on the arc of a rectangular hyperbola.

If O is the center, A the vertex, and P any point of the hyperbola APB,

$$\text{OM} = x,\quad \text{MP} = y,\quad \text{OA} = a.$$

The function u may be defined by the following relation,

$$u = \frac{2 \times \text{Area OAP}}{\text{OA}^2}$$

The hyperbolic sine of u = $\sinh u = y/a$.
The hyperbolic cosine of u = $\cosh u = x/a$.

Exponential Definitions of Hyperbolic Functions and Their Power Series

$$\sinh u = \frac{e^u - e^{-u}}{2} = \frac{1}{2}(e^u - e^{-u}) = u + \frac{u^3}{3\,!} + \frac{u^5}{5\,!} + \cdots$$

$$\cosh u = \frac{e^u + e^{-u}}{2} = \frac{1}{2}(e^u + e^{-u}) = 1 + \frac{u^2}{2\,!} + \frac{u^4}{4\,!} + \cdots$$

$$\tanh u = \frac{e^u - e^{-u}}{e^u + e^{-u}} = u - \frac{u^3}{3} + \frac{2u^5}{15} - \frac{17u^7}{315} + \cdots \qquad \left(u^2 < \frac{1}{4}\pi^2\right).$$

$$\sinh^{-1} u = u - \frac{1}{2}\cdot\frac{u^3}{3} + \frac{1\cdot 3}{2\cdot 4}\cdot\frac{u^5}{5} - \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\cdot\frac{u^7}{7} + \cdots \qquad (u^2 < 1).$$

$$\sinh^{-1} u = \log 2u + \frac{1}{2}\cdot\frac{1}{2u^2} - \frac{1\cdot 3}{2\cdot 4}\cdot\frac{1}{4u^4} + \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\cdot\frac{1}{6u^6} - \cdots \qquad (u^2 > 1).$$

$$\cosh^{-1} u = \log 2u - \frac{1}{2}\cdot\frac{1}{2u^2} - \frac{1\cdot 3}{2\cdot 4}\cdot\frac{1}{4u^4} - \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\cdot\frac{1}{6u^6} - \cdots \qquad (u^2 > 1).$$

$$\tanh^{-1} u = u + \frac{u^3}{3} + \frac{u^5}{5} + \frac{u^7}{7} + \cdots \qquad (u^2 < 1).$$

$$\tanh u = \frac{\sinh u}{\cosh u}. \qquad \operatorname{sech} u = \frac{1}{\cosh u}.$$

$$\coth u = \frac{1}{\tanh u}. \qquad \operatorname{csch} u = \frac{1}{\sinh u}.$$

HYPERBOLIC FUNCTIONS (Continued)

Relations of the Functions

$$\sinh x = -\sinh(-x). \qquad \operatorname{sech} x = \operatorname{sech}(-x).$$
$$\cosh x = \cosh(-x). \qquad \operatorname{csch} x = -\operatorname{csch}(-x).$$
$$\tanh x = -\tanh(-x). \qquad \coth x = -\coth(-x).$$

$$\sinh x = \frac{2\tanh\frac{1}{2}x}{1-\tanh^2\frac{1}{2}x} = \frac{\tanh x}{\sqrt{1-\tanh^2 x}}.$$

$$\cosh x = \frac{1+\tanh^2\frac{1}{2}x}{1-\tanh^2\frac{1}{2}x} = \frac{1}{\sqrt{1-\tanh^2 x}}.$$

$$\cosh^2 x - \sinh^2 x = 1.$$

$$\tanh x = \sqrt{1-\operatorname{sech}^2 x}. \qquad \operatorname{sech} x = \sqrt{1-\tanh^2 x}.$$
$$\coth x = \sqrt{\operatorname{csch}^2 x + 1}. \qquad \operatorname{csch} x = \sqrt{\coth^2 x - 1}.$$

$$\sinh(\tfrac{1}{2}x) = \sqrt{\tfrac{1}{2}(\cosh x - 1)}.$$
$$\cosh(\tfrac{1}{2}x) = \sqrt{\tfrac{1}{2}(\cosh x + 1)}.$$
$$\tanh(\tfrac{1}{2}x) = (\cosh x - 1) \div \sinh x = \sinh x \div (\cosh x + 1).$$
$$\sinh(2x) = 2\sinh x\cosh x.$$
$$\cosh(2x) = \cosh^2 x + \sinh^2 x = 2\cosh^2 x - 1 = 1 + 2\sinh^2 x$$
$$\tanh(2x) = 2\tanh x \div (1 + \tanh^2 x).$$
$$\sinh 3x = 3\sinh x + 4\sinh^3 x.$$
$$\cosh 3x = 4\cosh^3 x - 3\cosh x.$$
$$\tanh 3x = (3\tanh x + \tanh^3 x) \div (1 + 3\tanh^2 x).$$
$$\sinh(x \pm y) = \sinh x \cdot \cosh y \pm \cosh x \cdot \sinh y.$$
$$\cosh(x \pm y) = \cosh x \cdot \cosh y \pm \sinh x \cdot \sinh y.$$
$$\tanh(x \pm y) = (\tanh x \pm \tanh y) \div (1 \pm \tanh x \cdot \tanh y).$$
$$\sinh x + \sinh y = 2\sinh\tfrac{1}{2}(x+y) \cdot \cosh\tfrac{1}{2}(x-y).$$
$$\sinh x - \sinh y = 2\cosh\tfrac{1}{2}(x+y) \cdot \sinh\tfrac{1}{2}(x-y).$$
$$\cosh x + \cosh y = 2\cosh\tfrac{1}{2}(x+y) \cdot \cosh\tfrac{1}{2}(x-y).$$
$$\cosh x - \cosh y = 2\sinh\tfrac{1}{2}(x+y) \cdot \sinh\tfrac{1}{2}(x-y).$$

$$\sinh x + \cosh x = \frac{1+\tanh\frac{1}{2}x}{1-\tanh\frac{1}{2}x}$$

$$\tanh x \pm \tanh y = \frac{\sinh(x \pm y)}{\cosh x\cosh y}.$$

$$\coth x \pm \coth y = \pm\frac{\sinh(x \pm y)}{\sinh x\sinh y}.$$

Inverse Functions

$$\sinh^{-1} x = \log(x + \sqrt{x^2+1}) = \int\frac{dx}{\sqrt{x^2+1}} = \cosh^{-1}\sqrt{x^2+1}.$$

$$\cosh^{-1} x = \log\,(x + \sqrt{x^2 - 1}) = \int \frac{dx}{\sqrt{x^2 - 1}} = \sinh^{-1} \sqrt{x^2 - 1}.$$

$$\tanh^{-1} x = \frac{1}{2}\log\,(1 + x) - \frac{1}{2}\log\,(1 - x) = \int \frac{dx}{1 - x^2}.$$

$$\coth^{-1} x = \frac{1}{2}\log\,(1 + x) - \frac{1}{2}\log\,(x - 1) = \int \frac{dx}{1 - x^2}.$$

$$\operatorname{sech}^{-1} x = \log\left(\frac{1}{x} + \sqrt{\frac{1}{x^2} - 1}\right) = -\int \frac{dx}{x\sqrt{1 - x^2}}.$$

$$\operatorname{csch}^{-1} x = \log\left(\frac{1}{x} + \sqrt{\frac{1}{x^2} + 1}\right) = -\int \frac{dx}{x\sqrt{x^2 + 1}}.$$

Relations to Circular Functions

$$\begin{aligned} \sinh x &= -i \sin ix. & \sinh ix &= i \sin x. \\ \cosh x &= \cos ix. & \cosh ix &= \cos x. \\ \tanh x &= -i \tan ix. & \tanh ix &= i \tan x. \end{aligned}$$

If $x = \log \tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right) = \log\,(\sec\theta + \tan\theta)$,

θ = the **gudermannian** of $x = \operatorname{gd} x$.

$$\begin{aligned} \sinh x &= \tan \operatorname{gd} x. & \tanh x &= \sin \operatorname{gd} x. \\ \cosh x &= \sec \operatorname{gd} x. & \tanh \tfrac{1}{2} x &= \tan \tfrac{1}{2} \operatorname{gd} x. \end{aligned}$$

$$\frac{d \operatorname{gd} x}{dx} = \operatorname{sech} x.$$

Integrals involving the hyperbolic functions will be found in the table of integrals.

ELLIPTIC FUNCTIONS

$$u = F(k, \phi) = \int_0^{\phi} \frac{d\Phi}{\sqrt{1 - k^2 \sin^2 \Phi}}, \qquad (k^2 < 1),$$

= elliptic integral of the first kind.

$$u = \int_0^{x} \frac{dx}{\sqrt{(1 - z^2)(1 - k^2 z^2)}}, \quad \text{where } x = \sin \phi.$$

ϕ is called the amplitude of u or am u.
k is called the modulus.

$k' = \sqrt{1 - k^2}$ = the complementary modulus.

$\sin \phi = \operatorname{sn} u = x.$ $\qquad \tan \phi = \operatorname{tn} u = \dfrac{x}{\sqrt{1 - x^2}}.$

$\cos \phi = \operatorname{cn} u = \sqrt{1 - x^2}.$ $\qquad \Delta\phi = \operatorname{dn} u = \sqrt{1 - k^2 x^2}.$
$\operatorname{am} 0 = 0.$ $\qquad \operatorname{sn} 0 = 0.$
$\operatorname{cn} 0 = 1.$ $\qquad \operatorname{dn} 0 = 1.$
$\operatorname{am} (-u) = -\operatorname{am} u.$ $\qquad \operatorname{sn} (-u) = -\operatorname{sn} u.$
$\operatorname{cn} (-u) = \operatorname{cn} u.$ $\qquad \operatorname{dn} (-u) = \operatorname{dn} u.$
$\operatorname{tn} (-u) = -\operatorname{tn} u.$
$\operatorname{sn}^2 u + \operatorname{cn}^2 u = 1.$
$\operatorname{dn}^2 u + k^2 \operatorname{sn}^2 u = 1.$
$\operatorname{dn}^2 u - k^2 \operatorname{cn}^2 u = 1 - k^2 = k'^2.$

$$E(\phi, k) = \int_0^{\phi} \sqrt{1 - k^2 \sin^2 \Phi}\, d\Phi$$

$$= \int_0^{x} \frac{\sqrt{1 - k^2 z^2}}{\sqrt{1 - z^2}}\, dx \qquad \text{where } x = \sin \phi.$$

= the elliptic integral of the second kind.

Complete Elliptic Integrals

$$K = \int_0^{\pi/2} \frac{d\Phi}{\sqrt{1 - k^2 \sin^2 \Phi}} = F\left(k, \frac{\pi}{2}\right)$$

$$E = \int_0^{\pi/2} \sqrt{1 - k^2 \sin^2 \Phi}\, d\Phi = E\left(k, \frac{\pi}{2}\right)$$

See index for other elliptic integral tables.

These pages are reserved for future expansion and revision of Section I.

PROPERTIES AND PHYSICAL CONSTANTS

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ATOMIC WEIGHTS

For the sake of completeness all known elements are included in the list. Several of those more recently discovered are represented only by the unstable isotopes. The value in parenthesis in the atomic weight column is, in each case, the mass number of the most stable isotope.

Name	Symbol	At. No.	International atomic weight		Valence
			1925	1956	
Actinium	Ac	89	....	227	....
Aluminum	Al	13	26.97	26.98	3
Americium	Am	95	....	(243)	3, 4, 5, 6
Antimony, stibium	Sb	51	121.77	121.76	3, 5
Argon	A	18	39.91	39.944	0
Arsenic	As	33	74.96	74.91	3, 5
Astatine	At	85	....	(211)	1, 3, 5, 7
Barium	Ba	56	137.37	137.36	2
Berkelium	Bk	97	....	(249)	3, 4
Beryllium	Be	4	9.02	9.013	2
Bismuth	Bi	83	209.00	209.00	3, 5
Boron	B	5	10.82	10.82	3
Bromine	Br	35	79.916	79.916	1, 3, 5, 7
Cadmium	Cd	48	112.41	112.41	2
Calcium	Ca	20	40.07	40.08	2
Californium	Cf	98	....	(249)	....
Carbon	C	6	12.000	12.011	2, 4
Cerium	Ce	58	140.25	140.13	3, 4
Cesium	Cs	55	132.81	132.91	1
Chlorine	Cl	17	35.457	35.457	1, 3, 5, 7
Chromium	Cr	24	52.01	52.01	2, 3, 6
Cobalt	Co	27	58.94	58.94	2, 3
Columbium, see *Niobium*					
Copper	Cu	29	63.57	63.54	1, 2
Curium	Cm	96	....	(245)	3
Dysprosium	Dy	66	162.52	162.51	3
Einsteinium	E	99	....	(254)	....
Erbium	Er	68	167.7	167.27	3
Europium	Eu	63	152.0	152.0	2, 3
Fermium	Fm	100	....	(252)	....
Fluorine	F	9	19.00	19.00	1
Francium	Fr	87	....	(223)	1
Gadolinium	Gd	64	157.26	157.26	3
Gallium	Ga	31	69.72	69.72	2, 3
Germanium	Ge	32	72.60	72.60	4
Gold, aurum	Au	79	197.2	197.0	1, 3
Hafnium	Hf	72	....	178.58	4
Helium	He	2	4.00	4.003	0
Holmium	Ho	67	163.4	164.94	3
Hydrogen	H	1	1.008	1.0080	1
Indium	In	49	114.8	114.82	3
Iodine	I	53	126.932	126.91	1, 3, 5, 7
Iridium	Ir	77	193.1	192.2	3, 4
Iron, ferrum	Fe	26	55.84	55.85	2, 3
Krypton	Kr	36	82.9	83.8	0
Lanthanum	La	57	138.90	138.92	3
Lead, plumbum	Pb	82	207.20	207.21	2, 4
Lithium	Li	3	6.940	6.940	1
Lutetium	Lu	71	175.0	174.99	3
Magnesium	Mg	12	24.32	24.32	2
Manganese	Mn	25	54.93	54.94	2, 3, 4, 6, 7
Mendelevium	Mv	101	....	(256)	....
Mercury, hydrargyrum	Hg	80	200.61	200.61	1, 2
Molybdenum	Mo	42	96.0	95.95	3, 4, 6
Neodymium	Nd	60	144.27	144.27	3
Neon	Ne	10	20.2	20.183	0

ATOMIC WEIGHTS (Continued)

Name	Symbol	At. No.	International atomic weight		Valence
			1925	1956	
Neptunium	Np	93	....	(237)	4, 5, 6
Nickel	Ni	28	58.69	58.71	2, 3
Niobium, columbium	Nb	41	93.1	92.91	3, 5
Nitrogen	N	7	14.008	14.008	3, 5
Nobelium	No	102	....	(253)	....
Osmium	Os	76	190.8	190.2	2, 3, 4, 8
Oxygen	O	8	16.000	16.000	2
Palladium	Pd	46	106.7	106.7	2, 4
Phosphorus	P	15	31.027	30.975	3, 5
Platinum	Pt	78	195.23	195.09	2, 4
Plutonium	Pu	94	....	(242)	3, 4, 5, 6
Polonium	Po	84	....	210	....
Potassium, kalium	K	19	39.096	39.100	1
Praseodymium	Pr	59	140.92	140.92	3
Promethium	Pm	61	....	(145)	3
Protactinium	Pa	91	....	231	....
Radium	Ra	88	225.95	226.05	2
Radon	Rn	86	222	222	0
Rhenium	Re	75	....	186.22	....
Rhodium	Rh	45	102.91	102.91	3
Rubidium	Rb	37	85.44	85.48	1
Ruthenium	Ru	44	101.7	101.1	3, 4, 6, 8
Samarium	Sm, Sa	62	150.43	150.35	2, 3
Scandium	Sc	21	45.10	44.96	3
Selenium	Se	34	79.2	78.96	2, 4, 6
Silicon	Si	14	28.06	28.09	4
Silver, argentum	Ag	47	107.880	107.880	1
Sodium, natrium	Na	11	22.997	22.991	1
Strontium	Sr	38	87.63	87.63	2
Sulfur	S	16	32.064	32.066*	2, 4, 6
Tantalum	Ta	73	181.5	180.95	5
Technetium	Tc	43	....	(99)	6, 7
Tellurium	Te	52	127.5	127.61	2, 4, 6
Terbium	Tb	65	159.2	158.93	3
Thallium	Tl	81	204.39	204.39	1, 3
Thorium	Th	90	232.15	232.05	4
Thulium	Tm	69	169.4	168.94	3
Tin, stannum	Sn	50	118.70	118.70	2, 4
Titanium	Ti	22	48.1	47.90	3, 4
Tungsten	W	74	184.0	183.86	6
Uranium	U	92	238.17	238.07	4, 6
Vanadium	V	23	50.96	50.95	3, 5
Xenon	Xe	54	130.2	131.30	0
Ytterbium	Yb	70	173.6	173.04	2, 3
Yttrium	Y	39	88.9	88.92	3
Zinc	Zn	30	65.38	65.38	2
Zirconium	Zr	40	91	91.22	4

* Because of natural variations in the relative abundances of the isotopes of sulfur the atomic weight of this element has a range of ±0.003.

ELECTRONIC CONFIGURATION OF THE ELEMENTS

By Laurence S. Foster

References

1. Key furnished with "Periodic Chart of the Atoms," 1947 Ed, by Henry D. Hubbard and William F. Meggers, W. M. Welch Sci., Chicago.
2. "Electron Configurations of 'Rare Earth' Elements," by William F. Meggers, Science, May 16, 1947, page 514–516.

Atomic No.	Element	K	L		M			N				O				P				Q			
		1	2		3			4				5				6				7			
		s	s	p	s	p	d	s	p	d	f	s	p	d	f	s	p	d	f	s	p	d	f
1	H	1																					
2	He	2																					
3	Li	2	1																				
4	Be	2	2																				
5	B	2	2	1																			
6	C	2	2	2																			
7	N	2	2	3																			
8	O	2	2	4																			
9	F	2	2	5																			
10	Ne	2	2	6																			
11	Na	2	2	6	1																		
12	Mg	2	2	6	2																		
13	Al	2	2	6	2	1																	
14	Si	2	2	6	2	2																	
15	P	2	2	6	2	3																	
16	S	2	2	6	2	4																	
17	Cl	2	2	6	2	5																	
18	A	2	2	6	2	6																	
19	K	2	2	6	2	6	..	1															
20	Ca	2	2	6	2	6	..	2															
21	Sc	2	2	6	2	6	1	2															
22	Ti	2	2	6	2	6	2	2															
23	V	2	2	6	2	6	3	2															
24	Cr	2	2	6	2	6	5*	1															
25	Mn	2	2	6	2	6	5	2															
26	Fe	2	2	6	2	6	6	2															
27	Co	2	2	6	2	6	7	2															
28	Ni	2	2	6	2	6	8	2															
29	Cu	2	2	6	2	6	10*	1															
30	Zn	2	2	6	2	6	10	2															
31	Ga	2	2	6	2	6	10	2	1														
32	Ge	2	2	6	2	6	10	2	2														
33	As	2	2	6	2	6	10	2	3														
34	Se	2	2	6	2	6	10	2	4														
35	Br	2	2	6	2	6	10	2	5														
36	Kr	2	2	6	2	6	10	2	6														

* Note irregularity.

ELECTRONIC CONFIGURATION OF THE ELEMENTS
(Continued

Atomic No.	Element	K	L		M			N				O				P				Q			
		1	2		3			4				5				6				7			
		s	s	p	s	p	d	s	p	d	f	s	p	d	f	s	p	d	f	s	p	d	f
37	Rb	2	2	6	2	6	10	2	6	..	..	1											
38	Sr	2	2	6	2	6	10	2	6	..	..	2											
39	Y	2	2	6	2	6	10	2	6	1	..	2											
40	Zr	2	2	6	2	6	10	2	6	2	..	2											
41	Cb	2	2	6	2	6	10	2	6	4*	..	1											
42	Mo	2	2	6	2	6	10	2	6	5	..	1											
43	Tc	2	2	6	2	6	10	2	6	6	..	1											
44	Ru	2	2	6	2	6	10	2	6	7	..	1											
45	Rh	2	2	6	2	6	10	2	6	8	..	1											
46	Pd	2	2	6	2	6	10	2	6	10*	..	..											
47	Ag	2	2	6	2	6	10	2	6	10	..	1											
48	Cd	2	2	6	2	6	10	2	6	10	..	2											
49	In	2	2	6	2	6	10	2	6	10	..	2	1										
50	Sn	2	2	6	2	6	10	2	6	10	..	2	2										
51	Sb	2	2	6	2	6	10	2	6	10	..	2	3										
52	Te	2	2	6	2	6	10	2	6	10	..	2	4										
53	I	2	2	6	2	6	10	2	6	10	..	2	5										
54	Xe	2	2	6	2	6	10	2	6	10	..	2	6										
55	Cs	2	2	6	2	6	10	2	6	10	..	2	6	..	..	1							
56	Ba	2	2	6	2	6	10	2	6	10	..	2	6	..	..	2							
57	La	2	2	6	2	6	10	2	6	10	..	2	6	1	..	2							
58	Ce	2	2	6	2	6	10	2	6	10	2*	2	6	..	..	2							
59	Pr	2	2	6	2	6	10	2	6	10	3	2	6	..	..	2							
60	Nd	2	2	6	2	6	10	2	6	10	4	2	6	..	..	2							
61	Pm	2	2	6	2	6	10	2	6	10	5	2	6	..	..	2							
62	Sm	2	2	6	2	6	10	2	6	10	6	2	6	..	..	2							
63	Eu	2	2	6	2	6	10	2	6	10	7	2	6	..	..	2							
64	Gd	2	2	6	2	6	10	2	6	10	7	2	6	1	..	2							
65	Tb	2	2	6	2	6	10	2	6	10	9*	2	6	..	..	2							
66	Dy	2	2	6	2	6	10	2	6	10	10	2	6	..	..	2							
67	Ho	2	2	6	2	6	10	2	6	10	11	2	6	..	..	2							
68	Er	2	2	6	2	6	10	2	6	10	12	2	6	..	..	2							
69	Tm	2	2	6	2	6	10	2	6	10	13	2	6	..	..	2							
70	Yb	2	2	6	2	6	10	2	6	10	14	2	6	..	..	2							
71	Lu	2	2	6	2	6	10	2	6	10	14	2	6	1	..	2							
72	Hf	2	2	6	2	6	10	2	6	10	14	2	6	2	..	2							
73	Ta	2	2	6	2	6	10	2	6	10	14	2	6	3	..	2							
74	W	2	2	6	2	6	10	2	6	10	14	2	6	4	..	2							
75	Re	2	2	6	2	6	10	2	6	10	14	2	6	5	..	2							
76	Os	2	2	6	2	6	10	2	6	10	14	2	6	6	..	2							
77	Ir	2	2	6	2	6	10	2	6	10	14	2	6	7	..	2							
78	Pt	2	2	6	2	6	10	2	6	10	14	2	6	9*	..	1							
79	Au	2	2	6	2	6	10	2	6	10	14	2	6	10	..	1							
80	Hg	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2							
81	Tl	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	1						
82	Pb	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	2						
83	Bi	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	3						
84	Po	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	4						
85	At	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	5						
86	Rn	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	6						
87	Fr	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	6	..	..	1			
88	Ra	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	6	..	..	2			
89	Ac	2	2	6	2	6	10	2	6	10	14	1	6	10	..	2	6	1	..	2			
90	Th	2	2	6	2	6	10	2	6	10	14	2	6	10	..	2	6	2	..	2			
91	Pa	2	2	6	2	6	10	2	6	10	14	2	6	10	2*	2	6	1	..	2			
92	U	2	2	6	2	6	10	2	6	10	14	2	6	10	3	2	6	1	..	2			
93	Np	2	2	6	2	6	10	2	6	10	14	2	6	10	5	2	6	..	..	2			
94	Pu	2	2	6	2	6	10	2	6	10	14	2	6	10	6	2	6	..	..	2			
95	Am	2	2	6	2	6	10	2	6	10	14	2	6	10	7	2	6	..	..	2			
96	Cm	2	2	6	2	6	10	2	6	10	14	2	6	10	7	2	6	1	..	2			
97	Bk	2	2	6	2	6	10	2	6	10	14	2	6	10	8	2	6	1	..	2			
98	Cf	2	2	6	2	6	10	2	6	10	14	2	6	10	10	2	6	..	..	2			
99	E	2	2	6	2	6	10	2	6	10	14	2	6	10	11	2	6	..	..	2			
100	Fm	2	2	6	2	6	10	2	6	10	14	2	6	10	12	2	6	..	..	2			
101	Mv	2	2	6	2	6	10	2	6	10	14	2	6	10	13	2	6	..	..	2			

* Note irregularity.

THE ELEMENTS

By Harrison Hale

The most striking fact about the elements is their unequal distribution and occurrence. In the earth's crust, including the ocean and the atmosphere, F. W. Clarke reported after careful calculation that oxygen makes up 50% and silicon 25%, the two elements being three-fourths of all matter. Further he concludes that twelve elements form 99% of all this material, leaving only 1% for the other elements. Fully half of the elements are of minor commercial importance at present. No one knows when an element may become of unusual commercial importance. Several theories have been suggested to explain this wide difference in occurrence, but none of these is generally accepted. Of the twelve most common elements only one has an atomic weight of more than 40, iron with 56. The lightness of these common elements is emphasized by the heaviness of the other elements with atomic weights above 200. And yet by no means are all the light elements common.

Besides the weight of the atom it has become increasingly evident that other characteristics are of the greatest importance. F. W. Aston received the Nobel Prize in 1922 for his discovery of isotopes. The discovery of the electron, of the X-ray, and of radioactivity made possible an explanation of isotopes, and the study of atomic energy has given an idea of their very large number. Each element from atomic number 1 to 96 has at least one radioactive isotope. More than 400 of these isotopes are known.

Actinium (Gr. *aktis, aktinos*, beam or ray), Ac; at. wt. 227; at. no. 89. Discovered in 1899 by Andre Debierne and independently by F. Giesel in 1902. Radioactive, decomposing into other elements of smaller atomic weight at certain intervals of time. It is a more basic higher homolog of lanthanum.

Aluminum (L. *alumen*, alum), Al; at. wt. 26.98; at. no. 13; m.p. 659.7°C; b.p. 2057°C; sp. gr. 2.699 (20°C); valence 3. Wöhler is generally accredited with obtaining the metal in 1827, though an impure form was prepared by Oersted two years earlier. The method of obtaining the metal by electrolysis of pure alumina dissolved in cryolite was patented independently by Hall in the United States and Heroult in France, soon after its discovery in 1886. Although aluminum occurs in larger quantities than any other metal, ranking third among all elements, it does not appear free. It is found as the silicate in clays, feldspars, etc., while the commercial ore at present is bauxite, an impure hydrated oxide. Its production from clay is possible. The metal is white and strongly resists the action of the air, becoming covered with a white oxide coating in time; it was selected as the cap for Washington's monument, and is widely used for outside building decoration. It stands second among metals in the scale of malleability, sixth in ductility. The electrical conductivity is about 60% that of copper per area of cross-section, but aluminum is much lighter, giving it use for transmission lines. It is but slightly magnetic and is strongly electro-positive, so that in contact with many other metals it corrodes rapidly. Its many alloys have strength and lightness, finding increasing use. The compounds of greatest importance are its oxide, its sulfate, and its double sulfate with potassium (alum). The oxide, alumina, occurs naturally as ruby, sapphire, corundum and emery, and is very hard, ranking next to the diamond. War's necessity increased greatly the production of aluminum, and this has extended widely its use in time of peace. In 1856 the price was about $90 a pound, thirty years later just before Hall's discovery about $5. Then the price dropped rapidly to 30¢ and has gone as low as 15¢.

****Americium** (the Americas), Am; at. wt. 243; at. no. 95; valence 3, 4, 5, or 6. Observed in fission products in 1945 by Glenn T. Seaborg, R. A. James, L. O. Morgan, and A. Ghiorso working in the Metallurgical Laboratory in Chicago. As a member of the actinide series of elements with its six 5f electrons, Seaborg suggested the name americium by analogy with europium of the lanthanide series with its six 4f electrons.

Antimony (L. *antimonium*), Sb; (L. *stibium*, mark); at. wt. 121.76; at. no. 51; m.p. 630.5°C; b.p. 1380°C; sp. gr. 6.691 (20°C); valence 3 or 5. Recognized in compounds by the ancients; known as a metal at the beginning of the seventeenth century and possibly before that date. Antimony is a metallic element, common, but neither abundant nor widely diffused; sometimes found native, but more frequently as the sulfide, *stibnite* (Sb_2S_3); also as antimonides and sulfantimonides of the heavy metals, and as oxides. It is extracted from the sulfide by roasting to the oxide, which is reduced by salt and scrap iron; from its oxides it is also prepared by reduction with carbon. Antimony is an extremely brittle metal of a flaky, crystalline texture, blue-white color and metallic luster; hardness, 3 to 3.5; not acted on by air at room temperature, but burns brilliantly when heated with formation of white fumes of oxide Sb_2O_3; it is a poor conductor of heat and electricity. The metal is widely used in alloys in a percentage varying from one to twenty. It greatly increases the hardness and mechanical strength of lead Batteries, antifriction alloys, type metal, cable sheathing, and minor products use about half of the metal. Compounds taking up the other half are oxides, sulfide, sodium antimonate, and antimony trichloride. These are used in the manufacture of flame proofing compounds, in paints, ceramic enamels, glass, and pottery. Tartar emetic (hydrated potassium antimonyl tartrate) is used as a medicine.

Argon (Gr. *argon*, inactive), A; at. wt. 39.944; at. no. 18; m.p. −189.2°C; b.p. −185.7°C; density 1.7837 g/l; valence 0 (does not combine with any other element). Its presence in air was suspected by Cavendish in 1785; discovered by Lord Rayleigh and Sir William Ramsay in 1894. The gas is prepared by fractionation of liquid air, the atmosphere containing 0.94% argon. It is 2½ times as soluble in water as nitrogen, having about the same solubility as oxygen; best recognized by the characteristic lines in the red end of the spectrum. It is used in electric light bulbs and in fluorescent tubes at a pressure of about 3 mm.

** For further description see following section "Transuranium Elements."

Arsenic (L. *arsenicum*, Gr. *arsenikon*, yellow orpiment—identified with *arsenikos*, male, from the belief that metals were of different sexes—Arab. *az-zernikh*, the orpiment from Persian *zerni-zar*. gold-), As; at. wt. 74.91; at. no. 33; m.p. $814^{36\text{ atm.}}$; b.p. 615°C; sp. gr. 5.73; valence 3 or 5. The amorphous form of arsenic has a sp. gr. of 3.70. It is believed that Albertus Magnus obtained the element in 1250. In 1649 Schroeder published two methods of preparing it. Found native, in sulfides, *realgar* and *orpiment*, as arsenides and sulfarsenides of heavy metals and as oxide, and arsenate. *Mispickel* or arsenopyrite ($FeSAs$) is the most common mineral, from which on heating the arsenic sublimes leaving ferrous sulfide. The element is a steel gray, very brittle, crystalline, semi-metallic solid, which sublimes on heating, being deposited partly as crystals and partly as a black, amorphous solid; it tarnishes in air and when heated is rapidly oxidized to arsenous oxide (As_2O_3) with the odor of garlic. Though the free element is not considered poisonous, many of its compounds are extremely so, being used as insecticides. Arsenic is also used in bronzing, pyrotechny, and for hardening and improving the sphericity of shot. The most important compounds are white arsenic (As_2O_3), the sulfide, Paris green $3Cu(AsO_2)_2 \cdot Cu(C_2H_3O_2)_2$, calcium arsenate and lead arsenate, the last three being used in agricultural poisons. Marsh's test makes use of the formation and ready decomposition of arsine (AsH_3). Important war gases as Adamsite and Lewisite, are compounds of arsenic.

Astatine (Gr. astatos, unstable) At; at. wt. 210; at no. 85; valence probably 1, 3, 5, or 7. Synthesized in 1940 by D. R. Corson, K. R MacKenzie, and E. Segré at the University of California by bombarding bismuth with alpha-particles. It is the only halogen without stable isotope.

Barium (Gr. *barys*, heavy), Ba; at. wt 137.36; at. no. 56; m.p. 850°C; b.p. 1140°C; sp. gr. 3.5 (20°C); valence 2. Baryta was distinguished from lime by Scheele in 1774; the element was discovered by Sir Humphry Davy in 1808. It is found only in combination with other elements chiefly in *barite* or *heavy spar* (sulfate) and *witherite* (carbonate) and is prepared by electrolysis of the chloride Barium is a metallic element, soft and silvery white like lead; it belongs to the alkaline earth group, resembling calcium chemically The most important compounds are the peroxide (BaO_2), chloride, sulfate, carbonate, nitrate and chlorate. The sulfate, as permanent white or *blanc fixé*, is used in paint, the carbonate as a rat poison, while the nitrate and chlorate give green colors in pyrotechny. The sulfide phosphoresces after exposure to the light. The compounds are not expensive and the metal is not in great demand.

****Berkelium** (Berkeley, home of the University of California), Bk, at. wt. 245; at. no. 97; valence 3 or 4. Discovered early in 1950 by Glenn T. Seaborg, Stanley G. Thompson, and Albert Ghiorso, University of California scientists, working under the

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** For further description see following section "Transuranium Elements."

sponsorship of the U. S. Atomic Energy Commission. Produced by irradiation of americium-241 with helium ions in the Berkeley 60 inch cyclotron. Decays with a 4.8 hour half-life by electron capture. An actinide homologue of the element terbium (No. 65) with similar properties; as its earlier homologue it is named for the town of discovery.

Beryllium (L. fr. *beryl;* also called *Glucinum,* Gr. *glykys,* sweet), Be; at. wt. 9.013; at. no. 4; m.p. 1278 ± 5°C; b.p. 2970^{760}°C (5 mm.); sp. gr. 1.8 (20°C); valence 2. Discovered as the oxide by Vauquelin in beryl and in emerald in 1798; the metal was isolated in 1828 by Wöhler and by Bussy independently. Beryllium aluminum silicates are the chief sources of the metal today. It is prepared by electrolysis of the double fluoride, K_2BeF_4. Hard enough to scratch glass, the metal resembles magnesium in appearance and chemical properties. Its soluble compounds are sweet. Its alloys are strong, light and resistant to corrosion. The metal is widely found, but in only small quantities of ore. The use in light alloys is increasing with the decrease in price of the metal. Addition of small amounts brings to the alloy much higher fatigue endurance.

Bismuth (Ger. *Weisse Masse,* white mass; later *Wismuth*). Bi; at. wt. 209.00; at. no. 83; m.p. 271.3°C; b.p. 1560 ± 5^{760}°C; sp. gr, 9.747; valence 3 or 5. In early times bismuth was confused with tin and lead. Claude Geoffroy showed it to be distinct from lead in 1753. It is a white, crystalline, brittle metal with a pinkish tinge. It occurs native, but the common ore is the sulfide, *bismuthinite;* from this it is extracted by melting out the free metal, the oxides and sulfides being decomposed by the addition of carbon and iron. It is also recovered as a by-product in lead smelting. Bismuth is a poor conductor of electricity, is very diamagnetic, solidifies with expansion, heated in air it burns with a blue flame forming yellow fumes of the oxide. It forms many alloys with metals, which are often used in fire extinguishers for their property of low melting (fusible metals) and because of their expansion on cooling, making them particularly suited for sharp castings of objects subject to damage by high temperatures. Its soluble salts are characterized by forming insoluble basic salts on the addition of water—a property sometimes used in detection. The important compounds are the trioxides and the subnitrates of medicinal use, (*pearl white, pearl powder, blanc de fard* and *blanc d'Espagne*).

Boron (Ar. *būraq,* Pers. *būrah*), B; at. wt. 10.82; at. no. 5; m.p. 2300°C; b.p. sublimes 2550°C; sp. gr. of crystals 3.33^{20}, of amorphous variety 2.34; valence 3. Discovered in 1808 by Sir Humphry Davy and by Gay-Lussac and Thenard. The element is not found free in nature, but occurs as orthoboric acid usually in certain volcanic spring waters and as borates in *borax* and *colemanite.* Boron is obtained by heating the trioxide with magnesium powder, and has little or no commercial value The most important compounds are boric, or boracic, acid widely used as a mild antiseptic, and borax ($Na_2B_4O_7.10H_2O$), which serves as a cleansing flux in welding and as a water softener in washing powders. Boron compounds are used in production of enamels and glasses for covering steel in refrigerators, washing machines, and like products.

Bromine (Gr. *bromos*, stench), Br; at. wt. 79.916; at. no. 35; m.p. −7.2°C; b.p. 58.78°C; density of gas 7.59 g/l, liquid 3.12 (20°C); valence 1, 3, 5, or 7. Discovered by Balard in 1826, but not prepared in quantity until 1860. A member of the halogen group of elements, it is obtained from natural brines from wells in Michigan and West Virginia and from sea water by displacement with chlorine; electrolysis might be used. Bromine is the only liquid non-metallic element. It is a heavy, mobile, reddish-brown liquid, volatilizing readily at room temperature to a red vapor with a strong disagreeable odor, resembling chlorine, and having a very irritating effect on the eyes and throat; it is readily soluble in water or carbon disulfide, forming a red solution; it is less active than chlorine but more so than iodine; it unites readily with many elements and has a bleaching action; when spilled on the skin it produces painful sores. It is chiefly employed for the preparation of its compounds, which are useful in photography, medicine, coal tar derivatives, and as ethylene bromide in anti-knock gasoline. Organic compounds are important.

Cadmium (Gr. *kadmia*, earth), Cd; at. wt. 112.41; at. no. 48; m.p. 320.9°C; b.p. 767°C; sp. gr. 8.65 (20°C); valence 2 Discovered by Stromeyer in 1817 from an impurity in zinc carbonate Cadmium occurs in small quantities associated with zinc It comes off before zinc in the preparation of the metal, condensing as the brown oxide, which is then reduced with carbon. It tarnishes in air and burns when heated, forming the oxide. It is a soft, bluish-white metal, used in standard cells for the accurate determination of E.M.F. The use of the metal industrially has increased greatly; it is a component of one of the lowest melting alloys; it is extensively used in bearing alloys with low coefficients of friction and great resistance to fatigue; it is used in electroplating. Cadmium barriers to control atomic fission greatly increased U. S. production. It forms a number of salts of which the sulfate is the most common; the sulfide is used as a yellow pigment.

Calcium (L. *calx*, lime), Ca; at. wt. 40.08; at. no. 20; m.p. 842–8°C; b.p. 1240°C; sp. gr. 1.55 (20°C); valence 2. Though lime was prepared by the Romans in the first century under the name calx, not until 1808 was the metal discovered by Davy and by Berzelius and Pontin independently by preparation of an amalgam electrolytically and removal of the mercury by distillation. Calcium is a metallic element, fifth in abundance in the earth's crust, of which it forms more than three per cent; an essential constituent of leaves, bones, teeth and shells. Never found in nature uncombined, it occurs abundantly as *limestone* ($CaCO_3$), *gypsum* ($CaSO_4.2H_2O$) and fluorite (CaF_2); *apatite* is the fluophosphate or chlorophosphate of calcium. It is prepared by electrolysis of the fused chloride; chemically it is one of the alkaline earth elements; it readily forms a white coating of oxide in the air, reacts with water, burns with a yellow red flame to the oxide. Its natural and prepared compounds are widely used. Quick lime (CaO) made by heating limestone and changed into slaked lime by the careful addition of water is the great cheap base of chemical industry with countless uses. Mixed with sand it hardens as mortar and plaster by taking up carbon dioxide from the air. Calcium from limestone is an important element in Portland cement. The solubility of the carbonate in water containing carbon dioxide causes the formation of caves with stalactites and stalagmites and hardness in water. Other important compounds are the carbide (CaC_2), chloride ($CaCl_2$), cyanamide ($CaCN_2$), hypochlorite ($Ca(OCl)_2$), nitrate $Ca(NO_3)_2$, and sulfide (CaS).

****Californium** (State of California) Cf; at. wt. 248; at. no. 98. Discovered in 1950 by Glenn T. Seaborg, Stanley G. Thompson, Albert Ghiorso, and Kenneth Street, Jr., University of California scientists, working under the sponsorship of the U. S. Atomic Energy Commission. Produced by bombarding a few millionths of a gram of curium-242 with 35 m.e.v. alpha particles in the 60 inch cyclotron at Berkeley. It is an alpha emitter with a half-life of only 45 minutes. An actinide homologue of the element dysprosium (No. 66) with similar properties.

Carbon (L. *carbo*, charcoal), C; at. wt. 12.011; at. no. 6; m.p. 3550°C, sublimes above 3500°C; b.p. 4200°C; sp. gr. amorphous 1.88, graphite 2.25, diamond 3.51; valence 2, 3 or 4. Carbon, an element of prehistoric discovery and characteristic of organic matter, is very widely distributed in nature, occurring free as diamond and graphite. In combination it is found as carbon dioxide in the atmosphere and dissolved in all natural waters, as great rock masses composed of carbonates of calcium, magnesium and iron, as hydrocarbons in supplies of petroleum and natural gas. Coal consists chiefly of carbon compounds. It appears in three allotropic forms, diamond, graphite and amorphous, all solids, insoluble in any common solvent but dissolving in melted metals from which it crystallizes on cooling in the form of graphite; when the cooling takes place under pressure some of the carbon is obtained as diamond. Carbon is unique in forming an almost infinite number of compounds, often linking carbon atom to carbon atom, there being at present half a million known compounds. Some of the most important compounds are carbon dioxide, carbon monoxide, carbon disulfide, chloroform ($CHCl_3$), carbon tetrachloride (CCl_4), methane (CH_4), ethylene (C_2H_4), acetylene (C_2H_2), benzene (C_6H_6), ethyl alcohol (C_2H_5OH), acetic acid (CH_3COOH) and countless derivatives.

Cerium (named for the planetoid *Ceres*, which was discovered in 1801 only two years before the element), Ce; at. wt. 140.13; at. no. 58; m.p. 804°C; b.p. 1400°C; sp. gr. 3.92 (20°C); valence 3 or 4. Discovered in 1803 by Klaproth and by Berzelius and Hisinger; metal prepared by Hillebrand and Norton in 1875. Cerium is the most abundant of the metals from the so-called

** For further description see following section "Transuranium Elements."

rare earths; it is found in a number of minerals including *orthite*, *cerite* and *samarskite* of North Carolina. The metal exists in three, and possibly four, allotropic states. Prepared by the electrolysis of the chloride it is a steel-gray lustrous metal; used as a pyrophoric alloy with iron, it gives off showers of sparks when struck. As the oxide it is an important constituent of incandescent gas mantles; as ceric sulfate it finds extensive use as a volumetric oxidizing agent in quantitative analysis.

Cesium (L. *caesius*, sky blue), Cs; at. wt. 132.91; at. no. 55; m.p. 28.5°C; b.p 670°C; sp. gr. 1.873 (20°C); valence 1. The first metal discovered by Bunsen and Kirchhoff with the spectroscope. This was in 1860, the source being a mineral water from Dürkheim. Cesium is an alkali metal occurring in *lepidolite*, *pollucite* (a hydrated silicate of aluminum and cesium) and in the water from certain mineral springs; it is isolated by electrolysis of the fused cyanide. The metal is characterized by a spectrum containing two bright lines in the blue along with several others in the red, yellow and green. Because of its great affinity for oxygen the metal is used as a "getter" in radio tubes. It is also used in photo-electric cells, as well as for a catalyst in the hydrogenation of certain organic compounds. Its chief compounds are the chloride and the nitrate.

Chlorine (Gr. *chloros*, greenish-yellow), Cl; at. wt. 35.457; at. no. 17; m.p. −103 ± 5°C; b.p. −34.6°C; density 3.214 g/l; sp. gr. 1.56 (−33.6°C); valence 1, 3, 5 or 7. Discovered in 1774 by Scheele, who thought it contained oxygen; named in 1810 by Davy, who insisted it was an element. In nature it is found in the combined state only, chiefly with sodium as common salt (NaCl), *carnallite* ($KMgCl_3.6H_2O$), and *sylvite* (KCl). A member of the halogen (salt forming) group of elements it is obtained from chlorides by the action of oxidizing agents and more often by electrolysis; it is a greenish-yellow gas, with an irritating and suffocating odor, attacking the respiratory tract; combines directly with nearly all elements. At 10°C one volume of water dissolves 3.10 volumes of chlorine, at 30° only 1.77 volumes. Being a heavy gas, it was first used as a war gas by the Germans in 1915; most war gases contain chlorine. Berthollet suggested its use for bleaching, a most important reagent for vegetable fibers to-day. Around the globe it is used as a germicide in drinking water; further use is in the manufacture of bleaching powder, hypochlorites and chlorates, chloroform, carbon tetrachloride and in the extraction of bromine. Organic chemistry demands much both as an oxidizing agent and in substitution, since it often brings desired properties in an organic compound when substituted for hydrogen, as in one form of synthetic rubber.

Chromium (Gr. *chroma*, color), Cr; at. wt. 52.01; at. no. 24; m.p. 1890°C; b.p. 2480°C; sp. gr. 7.1 (20°C); valence, 2, 3, or 6. Discovered in 1797 by Vauquelin, who prepared the metal the next year. Chromium is a metallic element, resembling iron, occurring chiefly in chrome iron ore ($FeO \cdot Cr_2O_3$), prepared by the reduction of the oxide with aluminum; it is a very infusible, hard gray metal, used to harden steel, to manufacture stainless steel and in many very useful alloys. Much is used in plating, giving a hard, beautiful surface. It finds wide use as a catalyst. All compounds of chromium are colored; the most important are the chromates of sodium and potassium (K_2CrO_4) and the dichromates ($K_2Cr_2O_7$) and the potassium and ammonium chrome alums $KCr(SO_4)_2.12H_2O$. The dichromates are used as oxidizing agents in quantitative analysis, also in tanning leather. Other compounds are of industrial value; lead chromate is chrome yellow, a valued pigment.

Cobalt (*kobold*, from the German, goblin or evil spirit), Co; at. wt. 58.94; at. no. 27; m.p. 1495°C; b.p. 2900°C; sp. gr. 8.9 (20°C); valence 2 or 3. Discovered by Brandt in 1735. Cobalt is a metal occurring in ores sparingly distributed, usually sulfide or arsenide. It is prepared by reducing the oxide with aluminum; it is brittle, hard, very magnetic, and of a gray color with a reddish tinge. Its alloys are important. Stellite, or stellite type, containing cobalt, chromium, and tungsten, are used for high speed, heavy duty, high temperature cutting, and for dies. It occurs also in magnet steels and stainless steels, and in alloys used in jet-propulsion gas turbine and tubo-superchargers. The metal is used in electroplating because of its appearance, hardness, and resistance. The salts have been used for centuries for the production of brilliant and permanent blue colors in porcelain, glass, pottery, tiles and enamels, being the principal ingredient in *Sevres blue* and *Thenard's blue*. As little as 0.1% of the metal gives an intense blue color. A solution of the chloride ($CoCl_2.6H_2O$) is used as sympathetic ink, the solution being pink and practically colorless when spread on paper, turns blue on heating which removes the water of crystallization. The cobalt ammines are of interest; the oxide and the nitrate are important.

Columbium (see Niobium).

Copper (L. *cuprum*, from the island of Cyprus), Cu; at. wt. 63.54; at. no. 29; m.p. 1083°C; b.p. 2336°C; sp. gr. 8.93–8.95; valence 1 or 2. The discovery of copper dates from prehistoric times; it is said to have been mined for more than 5000 years. Copper is a metallic element, reddish colored, bright, metallic luster, malleable, ductile, a good conductor of heat and electricity (second only to silver in electrical conductivity). It occurs native and in many minerals; the most important of these compounds are sulfides, oxides and carbonates. From these it is obtained by smelting, leaching or electrolysis. Its alloys, brass and bronze, long used are still most important; all American coins are copper alloys; monel and gun metals also contain copper. The most important compounds are the oxide and the sulfate, blue vitriol; the latter has wide use as an agricultural poison and as an algicide in water purification. Copper compounds are widely used in analytical chemistry, as Fehling's solution in tests for sugar.

****Curium** (Pierre and Marie Curie), Cm; at. wt. 245; at. no. 96; chief valence 3. Observed in fission products in 1944 by

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** For further description see following section "Transuranium Elements."

Glenn T. Seaborg, R. A. James, L. O. Morgan, and A. Ghiorso working in the Metallurgical Laboratory in Chicago. As a member of the actinide series of elements with its seven 5f electrons, Seaborg suggested for it the name curium, honoring the historical leading investigators in the field of radioactivity. This is by analogy with gadolinium, containing seven 4f electrons, which honors Gadolin, the great Finnish investigator of the rare earths.

Deuterium, an isotope of hydrogen—see Hydrogen.

Dysprosium (Gr. *dysprositos*, hard to get at), Dy; at. wt. 162.51; at. no. 66; m.p. . . . . . ; b.p. . . . . ; sp. gr. . . . . ; valence 3. Discovered in 1886 by Lecoq de Boisbaudran. The so-called rare earths may be divided into two groups, the cerium and the yttrium. Dysprosium is in the latter group, a member of the erbium family, closely related to holmium. It is best separated from similar elements by fractional crystallization of the bromates. It occurs in the minerals usually found in granite or in pegmatite veins, such as *xenotime*, *fergusonite*, *gadolinite*, *euxonite*, *polycrase* and *blomstrandine*. The free element has never been isolated; its salts are highly colored.

***Erbium** (Ytterby, a town in Sweden), Er; at. wt. 167.27; at. no. 68; m.p. . . . . . ; b.p. . . . . . . ; sp. gr. 4.77 (?); valence 3. Discovered in 1843 by Mosander. Erbium is in the yttrium group of rare earth metals with atomic numbers of 64 to 71 in addition to yttrium, 39. In order of increasing basicity are included thulium, erbium, holmium and dysprosium, with decreasing atomic weights. Erbium occurs in the minerals mentioned under dysprosium above. It forms an oxide Er_2O_3 and highly colored salts.

Europium (Europe), Eu; at. wt. 152.0; at. no. 63; m.p. 1150 ± 50; bp. . . . . . ; sp. gr. . . . . . . ; valence 2 or 3. Discovered in 1896 by Demarcay. Europium is in the cerium group with atomic numbers from 57 to 63 and related in order of discovery. It is very sparsely distributed and of slight importance at present. Salts of the type EuX_3 and EuX_2, where X is a univalent atom or radical, are known.

***Fluorine** (L. *fluo*, flow), F; at. wt. 19.00; at. no. 9; m.p. −223°C; b.p. −188°C; density 1.69 g/l (15°C); sp. gr. of liquid 1.11 (−187°C); valence 1. Discovered by Scheele in 1771, but not isolated until 1886, by Moissan. It occurs chiefly in *fluor spar* (CaF_2) and *cryolite* (Na_3AlF_6), but seems rather widely distributed. Fluorine, a member of the halogen family of elements, is obtained by electrolyzing a solution of potassium hydrogen fluoride in anhydrous hydrogen fluoride in a vessel of metal or transparent fluorspar. It is a pale yellow gas, uniting directly with silicon, carbon, hydrogen and nearly all other elements in the dark; decomposes almost all compounds to form fluorides. The most important compounds are hydrogen fluoride, which is used in etching glass, and calcium fluoride. Freon-12, used in air conditioning, is difluorodichloro methane. Both the element and hydrofluoric acid are dangerous poisons.

* See new elements Einsteinium and Fermium at end of table.

The presence of fluorides in drinking water to the extent of approximately two parts per million, may cause mottled enamel in teeth, when used by children acquiring permanent teeth. Organic compounds of fluorine are now receiving attention.

Francium (France), Fr; at. wt. 223; at. no. 87; valence 1. Discovered in 1939 by Mlle. Marguerite Perey of the Curie Institute, Paris. It is a natural isotope, occurring as the result of an alpha disintegration of actinium. It has the properties of an alkali metal, and the highest equivalent weight of any element.

Gadolinium (*gadolinite*, name for Gadolin, a chemist of Finland), Gd; at. wt. 157.26; at. no. 64; m.p. . . . ; b.p. . . . . ; sp. gr. . . . . . ; valence 3. Separated by Marignac in 1880 and by Lecoq de Boisbaudran in 1886. In order of discovery gadolinium belongs in the yttrium group, being a member of the terbium family. It is named for the mineral from which the earth was obtained. The free element has never been isolated; the element forms oxides of the type R_2O_3, and its salts are usually more soluble than the corresponding terbium salts; its compounds are more plentiful than those of terbium or of europium. These elements decrease in order of basicity, Eu, Gd, Tb.

Gallium (L. *Gallia*, France), Ga; at. wt. 69.72; at. no. 31; m.p. 29.78°C; b.p. 1983°C; sp. gr. 5.91 (20°C); valence 2 or 3. Discovered spectroscopically by Lecoq de Boisbaudran in 1875, who in the same year obtained the free metal by electrolysis of a solution of the hydroxide in potassium hydroxide. A very rare metal, whose salts resemble those of aluminum; found in traces in many zinc blendes and nearly always in bauxite. Gallium was discovered in zinc blende from a mine in Hautes-Pyrenees; had been predicted and described as eka-aluminum by Mendeleeff. Besides mercury, cesium and rubidium, gallium is the only metal which can be liquid at near room temperatures; this makes possible its use in high temperature thermometers; the solid is hard and grayish-white. The metal forms two sets of oxides and salts in which it has a valence of two or of three.

Germanium (L. *Germania*, Germany), Ge; at. wt. 72.60; at. no. 32; m.p. 958.5°C; b.p. volatilizes at 2700°C; sp. gr. 5.36 (20°C); valence 4. Discovered by Winkler in 1886; had been predicted and described as eka-silicon by Mendeleeff. The metal is prepared by reducing the oxide with carbon or with hydrogen. The oxide was first obtained from *argyrodite*, a sulfide of germanium and silver; in 1916 the mineral, *germanite*, containing 8% of germanium was discovered. Obtained from residues of certain American zinc ores, germanium is separated from other metals by fractional distillation of its volatile tetrachloride. Being in the silicon group, the metal lies between silicon and tin in physical and chemical properties; it is a gray-white, brittle, crystalline metal, retaining its luster in air at room temperatures. The most important compounds are the oxide GeO_2, and the halides, as $GeCl_4$, which is volatile. Used to make transitors in large numbers.

Gold (Sanskrit *Jval;* Anglo-Saxon *gold*), Au (L. *aurum*, shining dawn); at. wt. 197.0; at. no. 79; m.p. 1063°C; b.p. 2600°C; sp. gr. 19.32 (17.5°C); valence 1 or 3. Known and highly valued from earliest times. Gold is found in nature as the free metal and in tellurides; very widely distributed but almost always associated with quartz or pyrite; occurs in veins and in alluvial deposits. The metal is obtained from its ores by cyanidation, amalgamation and smelting. Refining is frequently done by electrolysis. It has been estimated that all the gold in the world could be placed in a single cube, forty feet on the side. As with most metals, recent production has greatly increased. Gold is a metallic element, having a yellow color when in mass, but when finely divided it may be black, ruby or purple; colloidal gold has been used to color ruby cathedral glass windows. It is the most malleable and ductile, and also one of the softest of the metals; it is a good conductor of heat and electricity and is not affected by air and most reagents. Its chief use is in coinage and jewelry, when it is alloyed with other metals, pure gold being expressed as 24 carat. When used as a standard of value by the United States, one Troy ounce was worth $20.67 plus; since 1934 this value has been fixed by law and the President's order at $35.00 per ounce. The commonest compounds are auric chloride ($AuCl_3$) and chlorauric acid ($HAuCl_4$), the latter being used in photography for toning the silver image. A mixture of one part of nitric acid with three of hydrochloric acid is called *aqua regia*, because it dissolves Gold, the King of Metals.

Hafnium (*Hafnia*, Copenhagen), Hf; at. wt. 178.58; at. no. 72; m.p. 1700°C; b.p. above 3200°C; sp gr. 13.3; valence 4. Discovered in 1923 by D Coster and G von Hevesey in a *zircon* from Norway by means of Röntgen spectroscopic analysis. On the basis of the Bohr theory the new element was expected to be associated with zirconium. On treatment of the mineral with potassium bifluoride and separation K_2ZrF_6, the mother liquors became richer in the new element. Apparently all zirconium minerals contain hafnium. It has been separated from zirconia by repeated recrystallization of the double ammonium or potassium fluorides. Metallic hafnium was prepared by passing the vapor of the tetraiodide over a heated tungsten filament; this was done by van Arkel and deBoer; it has the same crystalline structure as zirconium. Hafnium also resembles zirconium in chemical properties. There is an oxide (HfO_2), a white powder, with corresponding hydroxide and salts.

Helium (Gr. *helios*, the sun), He; at. wt. 4.003; at. no. 2; m.p. below −272.2°C (26 atm.); b.p. −268.9°C; density 0.177 g/l; valence 0. Evidence of the existence of helium was first obtained by Janssen during the eclipse of 1868, when he detected a new line in the solar spectrum; Lockyer and Frankland suggested the name for the new element; in 1895 Ramsay isolated helium from *uraninite*. The small amount of helium in the atmosphere does not seem to vary with the altitude up to 25 kilometers (about 15 miles). Helium is a gas, inert chemically, obtained by compression and fractionation of the gas from certain wells and from many radioactive minerals. During World War II the greatly increased production exceeded consumption demand. Onnes has cooled the element to the lowest temperature ever obtained, −272.918°C, and expressed the opinion that helium may remain a liquid even at absolute zero under normal pressure. In 1926 Keesom solidified it under a pressure of 26 atmospheres. Approximately twice as heavy as hydrogen it is used for inflating balloons because it will not burn. A mixture of 80% helium and 20% oxygen is used as an artificial atmosphere for divers and others working under pressure; since helium is less soluble in the blood than nitrogen it does not produce the "bends."

Holmium (L. *Holmia*, for Stockholm), Ho; at. wt. 164.94; at. no. 67; m.p. . . . . . ; b.p. . . . . ; sp. gr. . . . . . ; valence 3. Discovered by Cleve while working on erbia earth in 1879; pure holmia earth was isolated by Homberg in 1911. Holmium is in the yttrium group of rare earth metals in order of discovery; it is a member of the erbium family, which includes thulium, erbium, holmium, dysprosium in the order of increasing basicity. It occurs in gadolinite and similar minerals. The element has not been isolated, but the oxide (Ho_2O_3), pale yellow in color, dissolving in certain acids to produce yellow or orange salts, has been prepared.

Hydrogen (Gr. *hydro*, water, and *genes*, forming), H; at. wt. 1.0080; at. no 1; m.p. −259.14°C; b.p. −252.8°C; density 0.08988 g/l; sp. gr. liquid 0.070 (−252°C); valence 1. First recognized as a distinct substance by Cavendish in 1766; named by Lavoisier Hydrogen occurs chiefly in combination with oxygen as water; also in acids, bases and alcohols as well as in carbohydrates, in petroleum and other hydrocarbons. It is usually a constituent of organic compounds, especially those used as fuels and as food. It is the lightest of all gases, insoluble in water, uniting with many elements to form compounds; it is used as a reducing agent, as a means of obtaining high temperature flames, in atomic hydrogen welding and for inflating balloons. Great quantities are required commercially for the fixation of nitrogen from the air in the Haber ammonia process and for the hydrogenation of fats and oils. It is prepared by action of steam on heated carbon, by decomposition of certain hydrocarbons with heat, by the electrolysis of water, or by the displacement from acids by certain metals. In 1932 Urey announced the preparation of the isotope with an atomic weight of 2, commonly called deuterium; tritium with an atomic weight of 3 was discovered two years later. One part of deuterium is found to about 5000 ordinary hydrogen atoms. Tritium occurs in much smaller proportion, the ratio being only one to 10^{17} atoms of ordinary hydrogen; but tritium is readily produced in the atomic energy pile.

Indium (from its indigo blue spectrum), In; at. wt. 114.82; at. no. 49; m.p. 156.4°C; b.p. 2000 ± 10°C; sp. gr. 7.28 (20°C); valence 1 or 3. Discovered in 1863 by the use of the spectroscope by Reich and Richter, who later isolated the metal. Indium is a rare metallic element, occurring usually in zinc blendes, sometimes with pyrites and siderite. The metal is obtained by electrolysis from baths of complex cyanide, chloride and sulfate. It belongs to the aluminum group in properties, being a very soft, silvery metal, not acted on by water or air, burning to the oxide (In_2O_3). Electroplates of indium increase the resistance of certain bearing alloys to organic acid corrosion. The metal finds use in alloys for jewelry and in dental alloys.

Iodine (Gr. *iodes*, violet), I; at. wt. 126.91; at. no. 53; m.p. 113.5°C; b.p. 184.35°; density of the gas 11.27 g/l; sp. gr. solid 4.93 (20°C); valence 1, 3, 5, or 7. Discovered by Courtois in 1811. Iodine, a halogen, occurs sparingly in the form of iodides in sea water from which it is assimilated by seaweeds, in Chile saltpeter, in brines from old sea deposits and in caliche (as sodium iodate); from iodides it is obtained on treatment with sulfuric acid and some oxidizing agent (MnO_2) and from the iodates by heating with sodium bisulfite. A process patented in the United States in 1932 and 1933, using finely divided silver on brines from salt wells, so increased production that the price was reduced to about one-third. Iodine is a grayish-black lustrous solid, volatilizing at ordinary temperatures into a blue-violet gas with an irritating odor; it forms compounds with many elements, but is less active than the other halogens, which displace it from iodides. It dissolves slightly in water, readily in chloroform, carbon tetrachloride or carbon disulfide to beautiful purple solutions. Iodine compounds are important in organic chemistry. The most common compounds are the iodides of sodium and potassium (KI) and the iodates (KIO_3). Lack of iodine is the cause of goiter. The iodide and thyroxin, which contains iodine, are used internally in medicine, and a solution of iodine in alcohol for external wounds. Potassium iodide finds some use in photography. The deep blue color with starch solution is characteristic of the free element.

Iridium (L. *iris*, rainbow), Ir; at. wt. 192.2; at. no. 77; m.p. 2454°C; b.p. above 4800°C; sp. gr. 22.42 (17°C); valence 3 or 4. Discovered in 1803 by Tennant in the residue left when crude platinum is dissolved by aqua regia. The name shows the colors of its salts—green, red, violet. Iridium, a metal of the platinum family, is white, very hard, and brittle. It is the heaviest of all elements known with the exception of osmium. The standard meter in Paris is an alloy of platinum (90%) and iridium (10%). Iridium occurs, uncombined with platinum and other metals of this family in alluvial deposits. It is used in apparatus for high temperatures; alloyed with platinum for standard weights and measures; alloyed with osmium in tipping pens and compass bearings. Iridium black, prepared by exposing alcoholic solutions of the sulfate to light, is used as a catalytic agent. The most important salt is $IrCl_4$.

Iron (Anglo-Saxon, *iron*), Fe (L. *ferrum*); at. wt. 55.85; at. no. 26; m.p. 1535°C; b.p. 3000°C; sp. gr. 7.85–7.88 (20°C); valence 2, 3, or 6. Iron implements are said to have been made by the Egyptians 3000 B.C. The most common ore is *hematite* (Fe_2O_3), from which the metal is obtained by reduction with carbon. Iron is the most abundantly produced of the metals, though aluminum occurs in larger percentage in the earth's crust than iron. The pure metal, which is practically unknown in industry (although some grades of soft steel have a very high percentage of iron), is silver-white, very ductile and magnetic; the pure metal may be prepared by electrolytic deposition from ferrous sulfate, or by reduction of the pure oxide with hydrogen or aluminum. Pig iron is hard, brittle and fairly fusible, containing about 3% carbon and varying amounts of sulfur, silicon manganese and phosphorus; wrought iron is tough, grayish-white and malleable, having usually a fibrous structure, very infusible, with only a few tenths per cent or less of carbon; steel is a solid solution of iron carbide in iron with a carbon content usually below 2%. Iron is the cheapest metal known. Alloying with other metals has greatly improved the properties and widened the use of steel.

Krypton (Gr. *kryptos*, hidden), Kr; at. wt. 83.8; at. no. 36; m.p. −156.6°C; b.p. −152.9°C; density 3.708 g/l (0°C); valence 0. Discovered in 1898 by Ramsay and Travers in the residue left after liquid air had nearly boiled away. There is one part of krypton in a million parts of air; it is an inert, rare, gaseous element, and is characterized by brilliant green and yellow lines in its spectrum.

Lanthanum (Gr. *lanthano*, to lie hidden, La; at. wt. 138.92; at. no. 57; m.p. 826°C; b.p. . . . ; sp. gr. 6.155; valence 3. Occurs in the cerium group of the rare earth metals, lanthana being separated from ceria by Mosander in 1839. It is found in ores *cerite, orthite* and *monazite*. The white metal is prepared from the chloride by treatment with sodium, or by electrolysis of a fused bath of lanthanum and potassium chlorides and calcium fluoride. Lanthanum resembles iron in its physical properties, burning brilliantly in the air to form La_2O_3. Salts are colorless.

Lead (Anglo-Saxon *lead*), Pb (L. *plumbum*); at. wt. 207.21; at. no. 82; m.p. 327.4°C; b.p. 1620°C; sp. gr. 11.35 (20°C); valence 2 or 4. Long known; mentioned in Exodus. Lead is obtained chiefly from galena (PbS) by a roasting process. It is a bluish-white metal of bright luster, very soft, highly malleable; has slight tenacity, is ductile and a poor conductor of electricity; lasts very long, since lead pipes bearing the insignia of Roman emperors, used as drains from the baths, are still in service. It is also used as containers for corrosive liquids, as in sulfuric acid chambers; it may be toughened by the addition of a small percentage of antimony or other metal. Its alloys include solder, type metal and various antifriction metals. Great weights of lead both as the metal and as the dioxide are used in storage batteries. Much metal also goes into cable covering, plumbing, ammunition, and in the manufacture of lead tetraethyl, used generally as an anti-knock in gasoline. White lead, the basic lead carbonate, sublimed white lead ($PbSO_4$), chrome yellow ($PbCrO_4$), red lead (Pb_3O_4) and other lead compounds are extensively used in paints. The nitrate and the acetate are soluble salts. Lead salts are used in medicine, as antiseptics and astringents. Care must be used in both medicine and industry as lead is a cumulative poison.

Lithium (Gr. *lithos*, stone), Li; at. wt. 6.940; at. no. 3; m.p. 186°C; b.p. 1336 ± 5°C; sp. gr. 0.534 (20°C); valence 1. Discovered by Arfvedson in 1817. Lithium is the lightest alkali metal; never found free in nature, traces of it occur in nearly all igneous rocks and in the waters of many mineral springs. *Lepidolite*, *spodumene*, *petalite* and *amblygonite* are the more important minerals containing it. The metal is produced from the fused chloride electrolytically. It has the highest specific heat of any solid element. It is the lightest metal known, soft and white; burned in air it forms Li_2O; its salts are analogous to those of sodium and potassium. The carbonate and citrate were used in medicine to remove uric acid from the body, since lithium urate is soluble. To a limited extent the metal is used industrially in various alloys increasing tensile strength and resistance to corrosion. In the flame test for lithium a brilliant crimson is given.

Lutetium (*Lutetia*, ancient name of Paris—sometimes called cassiopeium by the Germans), Lu; at. wt. 174.99; at. no. 71; m.p. . . . . ; b.p. . . . . . . ; sp. gr. . . . . . . ; valence 3 or 4. In 1907 Urbain and in 1908 von Welsbach described a process by which Marignac's ytterbium (1879) could be separated into the two elements, ytterbium (neoytterbium) and lutetium. Both elements occur in very small amounts in nearly all minerals containing yttrium. Charles James of New Hampshire prepared lutetia independently. This rare earth has little practical use. The oxide is white and its salts are colorless.

Magnesium (Magnesia, district in Thessaly), Mg; at. wt. 24.32; at. no. 12; m.p. 651°C; b.p. 1107°C; sp. gr. 1.74 (20°C); valence 2. Compounds long known, recognized by Black as an element in 1755, isolated by Davy in 1808, prepared in coherent form by Bussy in 1831. Magnesium is one of the most abundant metals and the eighth element in estimated amount in the earth's crust. It does not occur uncombined but many carbonates and silicates contain considerable percentages, while soluble sulfate and chloride are found in mineral springs and in the ocean. It has been obtained by the electrolysis of the fused chloride; this method has been used for commercial production in the U. S. since 1916, using brines from wells and recently sea water from the Gulf of Mexico also. Electrothermic methods have also been proposed, being difficult because the metal combines when heated both with oxygen and with nitrogen. Recognition of its importance in war caused the one producing company in the U. S. in 1939 to expand its productive capacity six fold. By government direction this was expected to be increased ten times. However, the world output in 1947 was only 20,000 tons, as the postwar demand is far below expectations. It is a light, white, and fairly tough metal; tarnishes slightly in air, and as ribbon, wire or powder ignites on heating, burning with a dazzling white flame. It is useful in flash-light photography, flares and for pyrotechnics, including incendiary bombs. It is one-third lighter than aluminum and in its alloys is essential for airplane construction. The first metallic magnesium produced commercially sold for $10 a pound; the price is now less than 30¢. Important compounds are the oxide, chloride, sulfate and citrate, which find use in medicine. In Grignard's reaction, organic magnesium compounds are useful.

Manganese (L. *magnes*, magnet), Mn; at. wt. 54.94; at. no. 25; m.p. 1260°C; b.p. 1900°C; sp. gr. 7.2 (20°C); valence 2, 3, 4, 6, or 7. Recognized by Bergman, Scheele and others, discovered by Gahn in 1774 by reduction of dioxide with carbon. Manganese minerals are widely distributed, oxides, silicates and carbonates being most common. Pyrolusite (MnO_2) and psilomelane are common ores. The metal is obtained by reduction of the oxide with sodium, magnesium, aluminum, or by electrolysis. It is gray-white, resembling iron, but is harder and very brittle. Its alloys with iron, copper and nickel are important. The mineral, *pyrolusite*, has been used since very early times to give color to glass; a smaller amount gives a weaker amethyst color which removes the greenish color due to iron and other impurities and makes colorless glass. Other compounds are the chloride, sulfate and permanganate, which is used as an antiseptic and in quantitative analysis because of its oxidizing power. The U. S. production is only a small fraction of the consumption. Of this 95% goes into steel alloys with only 5% into chemicals and dry batteries.

*__Mercury__ (Planet Mercury), Hg (*hydrargyrum*, liquid silver); at. wt. 200.61; at. no. 80; m.p. −38.87°C; b.p. 356.9°C; sp. gr. 13.546 (20°C); valence 1 or 2. Known to ancient Chinese and Hindus; found in Egyptian tombs of 1500 B.C. Mercury, the only common metal liquid at ordinary temperatures, occurs free in nature, but the chief source is the sulfide (*cinnabar*, HgS), from which it may be obtained by heating in a current of air. It is a heavy silver-white, shining metal, a fair conductor of heat and electricity, having a regular coefficient of expansion. These properties make it generally useful in the laboratory for thermometers, barometers and many other instruments. It tarnishes but slightly in the air except when heated to near the boiling point, where it is slowly converted to the oxide (HgO), from which the oxygen is set free again at higher temperatures. Mercury forms alloys, called *amalgams*, with many metals. The most important salts are mercuric chloride ($HgCl_2$, violent poison and antiseptic), mercurous chloride (HgCl, calomel laxative of medicine), mercury fulminate ($Hg(ONC)_2$, a detonator widely used in explosives), and mercuric sulfide (HgS, vermilion, a high grade red paint). Organic mercury compounds are likewise important.

Molybdenum (Gr. *molybdos*, lead), Mo; at. wt. 95.95; at. no. 42; m.p. 2620°C; b.p. 4800°C; sp. gr. 10.2; valence 2, 3, 4, 5, or

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* See new element Mendelevium at end of table.

6. Recognized by Scheele in 1778; prepared in an impure form in 1782 by Hjelm. Molybdenum does not occur native, being obtained from *molybdenite* (MoS_2) and from *wulfenite* ($PbMoO_4$). The metal is prepared by the reduction of the oxide with carbon, usually in the electric furnace. It is a very hard silver-white metal; it is widely used in the manufacture of certain grades of tool steel, boiler plate, rifle barrels and large cranks, as it increases toughness and tensile strength. Being softer and more ductile than tungsten it is invaluable for the filaments, grids and screens for radios.

Neodymium (Gr. *neos*, new and *didymos*, twin), Nd; at. wt. 144.27; at. no. 60; m.p. 840°C; b.p. . . . . . . ; sp. gr. 6.95; valence 3. In 1843 Mosander reported the supposed element didymium obtained from *cerite*. In 1885 von Welsbach separated didymium into two new elements, neodymium and praseodymium by repeated fractionation of ammonium didymium nitrate. Neodymium is a faintly yellow metal, belonging to the rare earths, and forming a series of pink salts with a characteristic absorption spectrum.

Neon (Gr. *neos*, new), Ne; at. wt. 20.183; at. no. 10; m.p. −248.67°C; b.p. −245.9°C; density 0.8990 g/l (0°C); valence 0. Discovered by Ramsay and Travers in 1898. Neon is a gaseous element present in the atmosphere to the extent of 18 parts per million. It is obtained by liquefaction of air and separated from the other elements by fractional distillation. It is an inert element forming no compounds. Neon glows red-orange in a vacuum tube and is therefore widely used in electric signs and beacons. Its spectrum is marked by pronounced red and green lines.

****Neptunium** (Planet Neptune, next to Uranus in solar system), Np; at. wt. 237; at. no. 93; valence 4, 5, or 6. Discovered by tracer technique by E. M. McMillan and P. H. Abelson at the University of California in 1940. This Np 93^{239} is the decay product of the 23 minute U^{239} formed by the radioactive neutron capture in U^{238}. Amounts used were so small as to be unweighable, so that radioactivity rather than chemical analysis had to be basis of work. By greatest care and most skillful work the elements and its pure compounds were prepared and studied. By loss of a β particle Np^{239} becomes Pn^{239}, which is fissionable.

Nickel (Sw. abbr. of *kopparnickel*, false copper), Ni; at. wt. 58.71; at. no. 28; m.p. 1455°C; b.p. 2900°C; sp. gr. 8.90 (20°C); valence 2 or 3. Discovered by Cronstedt in 1751. Nickel is obtained chiefly from the nickel bearing *pyrrhotite* of Ontario and the *garnierite* (hydrated silicate of nickel, iron and magnesium found in New Caledonia) by roasting to the oxide, which is then reduced with carbon or carbon monoxide, volatile nickel carbonyl being formed and then decomposed by heat. The metal is hard, malleable, ductile and tenacious, of a white color, somewhat magnetic, a fair conductor of heat and electricity; it belongs to the iron-cobalt group of metals. Nickel is chiefly valuable for the alloys it forms; coinage with 75% of copper, Monel metal with copper and iron, nickel steel for armor plates and burglar proof safes, invar, constantan, permalloy, nichrome, platinite and others. Nickel plate by electrodeposition is used as a protective coating for metals, and finely divided nickel as a catalyst in the hydrogenation of vegetable oils. Early in this century Edison developed a storage battery, using an alkaline solution with nickel hydroxide and iron oxide. The sulfate and the oxides, NiO and Ni_2O_3, are important compounds.

** For further description see following section "Transuranium Elements."

Niobium (Niobe, daughter of Tantalos) Nb; (or Cb); at. wt. 92.91; at. no. 41; m.p. 2500°C; b.p. 3700°C; sp. gr. 8.4 (20°C); valence 3 or 5. Discovered in 1801 by Hatchett in an ore sent to England more than a century before by John Winthrop, first governor of Connecticut. Metal prepared by Blomstrand, who reduced the chloride by heating in hydrogen in 1864. Niobium is a rare metallic element, found as *columbite* in pegmatite veins, volcanic intrusions through the earth's crust. Added to stainless steel this metal by combining with carbon preserves the corrosion resistance even when heated. This use has greatly increased the demand for the metal now obtained from an African ore. After removing tin from this ore, the residue is reduced with silicon or aluminum in an electric furnace, giving ferro-niobium, suited to steel making. The metal is gray; it forms an acid oxide, Nb_2O_5, from which salts are derived.

Nitrogen (L. niter forming), N; at. wt. 14.008; at. no. 7; m.p. −209.86°C; b.p. −195.8°C; density 1.2506 g/l; sp. gr. liquid 0.808 (−195.8°C) solid 1.026 (−252°C) valence 3 or 5. Discovered by Daniel Rutherford in 1772. Nitrogen makes up 78% of the air by volume, the estimated amount in the atmosphere being more than 4000 billion tons; from this inexhaustible source it can be obtained by liquefaction and fractional distillation. The element is so inert that Lavoisier named it *azote*, without life, yet its compounds are so active as to be most important in foods, poisons, fertilizers, and explosives. In 1947–48 there were the largest production, consumption, and importation of nitrogen compounds yet recorded. Nitrogen is also prepared easily by heating a water solution of ammonium nitrite (made from ammonium chloride and sodium nitrite). Nitrogen is colorless, odorless and generally inert element. When heated it will combine directly with magnesium, lithium or calcium; when mixed with oxygen and subjected to electric sparks it forms first nitric oxide (NO) and then the peroxide (NO_2); when heated under pressure with a catalyst with hydrogen ammonia is formed (Haber process). The ammonia thus formed is of the utmost importance, and may be oxidized to nitric acid (Ostwald process). Sodium and potassium nitrates are formed by the decomposition of organic matter with compounds of the metals present; in certain dry areas these saltpeters are found in quantity. The chief compounds are ammonia, nitric acid, the nitrates, the five oxides (N_2O, NO, N_2O_3, NO_2, and N_2O_5) as well as very many organic substances.

***Osmium** (Gr. *osme*, odor) Os; at. wt. 190.2; at. no. 76; m.p. 2700°C; b.p. above 5300°C; sp. gr. 22.48 (20°C); valence 2, 3, 4, or 8. Discovered in 1803 by Tennant in the residue left when crude platinum is dissolved by *aqua regia*. Osmium occurs in *iridosime* and in platinum bearing river sands of the Urals, North America and South America. The metal is bluish-white, hard and crystalline, belonging to the platinum family. It is the heaviest known form of matter and is very infusible. When heated in air it is oxidized to OsO_4 with a pungent, irritating and poisonous vapor, which is easily reduced by organic matter. The oxide gives the element its name, and is useful in making microscopic slides. The metal has been used in making lamp filaments and with iridium forms the alloy osmiridium, which is very hard, suggesting its use for tipping gold pen points and for fine machine bearings.

Oxygen (Gr. *oxys*, acid, and *genes*, forming, acid former), O; at. wt. 16.0000; at. no. 8; m.p. −218.4°C; b.p. −183.0°C; density 1.429 g/l (0°C); sp. gr. liquid 1.14 (−182.96°C); valence 2. Discovered in 1774 by Priestley, who obtained it by heating mercuric oxide, using the sun's rays with a burning glass; independently by Scheele from other sources. Oxygen as a gaseous element forms 21% of the atmosphere by volume, from which it can be obtained by liquefaction and fractional distillation. Free and in compounds it makes up approximately one-half of the total material on the surface of the earth, forming by weight more than one-fifth of the air, about two-thirds of the human body and eight-ninths of the water, with a very high percentage in the minerals of the earth's crust. In the laboratory it is usually prepared by the electrolysis of water, or by heating potassium chlorate with manganese dioxide as a catalyst. The critical temperature and pressure are −118°C and 50 atmospheres. The gas is colorless, odorless, and tasteless; the liquid and solid forms are a pale blue color and are magnetic, but much less so than iron. Oxygen is very reactive, capable of combining with all the other elements except the inert gases in Group O and fluorine. Its atomic weight is the standard of comparison for the atomic weight of each of the other elements. It is used with combustible gases in the oxyhydrogen and oxy-acetylene flames. It is essential for respiration of all animals and for practically all combustion; in medicine it is used to aid respiration.

Palladium (Planetoid Pallas), Pd; at. wt. 106.7; at. no. 46; m.p. 1549.4°C; b.p. 2200°C; sp. gr. 12.16 (20°C); valence 2 or 4. Discovered in 1803 by Wollaston. Palladium occurs with platinum and is obtained by ignition of the precipitated cyanide. It is a steel-white metal of the platinum family; does not tarnish in air and has the property of taking up large volumes of hydrogen with the formation of the hydride. It is used in the construction of non-magnetic watches and parts of delicate balances and in surgical instruments. Both the metal and its compounds are used as catalysts. The most important compound is the chloride, $PdCl_2$.

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* See new element Nobelium at end of table.

Phosphorus (Gr. *phosphoros*, light bearing), P; at. wt. 30.975; at. no. 15; m.p. 44.1°C; b.p. 280°C; sp. gr. yellow 1.82, red 2.20; valence 3 or 5. Discovered in 1669 by Brand, who prepared it from urine. Phosphorus may be prepared in three allotropic forms; white or yellow, red, black. Never found free in nature, it is widely distributed in combination in minerals, the most important being the *apatites* ($3Ca_3(PO_4)_2.CaF_2$ and $3Ca_3(PO_4)_2.CaCl_2$), which are the chief ingredients of commercial phosphates derived from South Carolina, Florida, Canada and Spain; it is an essential ingredient of all cell protoplasm, nervous tissue and bones. It may be obtained from phosphates by treatment with dilute sulfuric acid to form *o*-phosphoric acid, the concentrated solution of which is mixed with crushed charcoal or coke and dried; on heating this mixture in retorts, the phosphorus distils and is condensed. It is also prepared by heating crude phosphate with sand and coke in the electric furnace, the phosphorus distilling off. Ordinary phosphorus is a waxy solid, which is colorless when very pure, insoluble in water but soluble in carbon disulfide. It takes fire spontaneously in air, burning to the pentoxide; it is very poisonous. When heated in its own vapor to 250°C it is converted into the red variety, which does not glow in the air, does not ignite spontaneously, and is not poisonous. The production of phosphorus and its compounds has increased very rapidly in recent years; phosphoric acid is replacing sulfuric acid in the treatment of natural phosphates to make them soluble for use as fertilizers, since this causes a great increase in the percentage of P_2O_5 present and available. World wide demand for fertilizer materials has caused record phosphate production in the years following World War II. Organic compounds are increasing in number and in importance. Di- and tri-sodium phosphates are used as detergents in large quantities, while hexametaphosphate is in frequent use for the prevention of boiler scale and of corrosion in pipes and boiler tubes. Other important compounds are the phosphoric anhydride, used as a toxic smoke in warfare and made from burning phosphorus, and the chlorides, PCl_3 and PCl_5.

Platinum (Sp. *platina*, little silver), Pt; at. wt. 195.09; at. no. 78; m.p. 1773.5°C; b.p. 4300°C; sp. gr. 21.37 (20°C); valence 2 or 4. Discovered in South America by Ulloa in 1735 and by Wood in 1744. Platinum usually occurs native, accompanied by small quantities of iridium, osmium, ruthenium, rhodium and palladium, all belonging to the same group of metals. These are usually found in alluvial deposits in the Ural mountains, in Colombia and in certain western American states. Sperrylite ($PtAs_2$) occurring with nickel bearing deposits in Canada is the source of a considerable weight of the platinum metals, which are recovered as by-products in refining the nickel. The heavy nickel production offsets the fact that there is only one part of the platinum metals in two million parts of ore. Platinum is a tin-white metal of metallic luster, tenacious, malleable and ductile; it is welded at a red heat; has a coefficient of expansion approximately equal to that of glass. The metal does not oxidize in air at any temperature, but is corroded by halogens, cyanide, sulfur and caustic alkalies; it is insoluble in hydrochloric or nitric acids, but dissolves when they are mixed as *aqua regia*, forming chloroplatinic acid (H_2PtCl_6), a very important compound. The metal is extensively used in jewelry, in wire and vessels for laboratory use, as well as many valuable instruments; in finely divided state it is an excellent catalyst, having long been used in the contact process for sulfuric acid, of which it does not now have a monopoly. The price of platinum has varied widely, the metal being used more than a century ago to adulterate South American gold; in 1920 platinum was nearly eight times as valuable as gold, but is much less now.

[**] **Plutonium** (Planet Pluto, next in order beyond Uranus and Neptune in solar system), Pu; at. wt. 242; at. no. 94; valence 3, 4, 5, or 6. Discovered by G. T. Seaborg, E. M. McMillan, A. C. Wahl, and J. W. Kennedy at the University of California late in 1940 by the deuteron bombardment of uranium. This gave Np^{238}, which decays after a two day half-life to an alpha emitting isotope of element 94 with a half-life of about 50 years. A more important isotope of plutonium—94^{239}—was discovered in the spring of 1941 by G. T. Seaborg, E. Segré, J. W. Kennedy, and E. O. Lawrence at the University of California. This is the daughter of 2.3 day neptunium with a half-life of 24,000 years, and is fissionable. The element and pure compounds were prepared. Its study was the basis of the atomic energy plant at Hanford, Washington, with a stepup of 10^{10} in the plans prepared.

Polonium (Poland, native country of Mme. Marie Curie), Po; at. wt. approximately 210; at. no. 84. First element discovered by Mme. Curie (1898) in seeking cause of radioactivity of pitchblende from Joachimisthal, Bohemia. The electroscope, claimed to be 500,000 times more sensitive than the spectroscope, showed it separating with the bismuth. Polonium is also called Radium F. (See Radioactive Elements.)

Potassium (English *potash*), K (L. *kalium*); at. wt. 39.100; at. no. 19; m.p. 62.3°C; b.p. 760°C; sp. gr. 0.87 (20°C); valence 1. Discovered in 1807 by Davy, who obtained it from caustic potash (KOH); this was the first metal isolated by the aid of the electric current. The metal occurs abundantly, being the eighth element in the earth's crust, of which it makes more than 2%; most of its minerals are insoluble and the metal is obtained from them with great difficulty. Under certain conditions the salts of potassium have been concentrated from ancient ocean beds; before World War I the principal source of potassium was the mines of Stassfurt in Prussian Saxony from such beds. During this war the United States suffered a severe shortage of potassium salts, which form an essential constituent of fertilizers. Before World War II began the American production was sufficient to meet all needs; this supply came from mines in New Mexico, ancient lake beds in California and Utah, as a by-product from cement plant dust and from distillery waste. Recent fertilizer demand has greatly increased production and consumption of salts of potassium. Potassium is never found free but is obtained by the electrolysis of the hydroxide. On exposure to moist air it becomes coated with a film of the oxide, and so is preserved by immersion in kerosene or naphtha. It is a soft, bright, silvery metal belonging to the alkali group; dropped on water it evolves hydrogen which takes fire spontaneously, the flame being colored violet by the potassium. In some cases its compounds are more readily purified by crystallization than those of sodium; important are the hydroxide, carbonate, nitrate, chloride, chlorate, bromide, iodide, cyanide, sulfate, chromate, dichromate and silicate.

[**] For further description see following section "Transuranium Elements."

Praseodymium (Gr. *prasinos*, green, and *didymos*, twin), Pr; at. wt. 140.92; at. no. 59; m.p. 940°C; b.p. . . . . . ; sp. gr. 6.5 (20°C); valence 3, 4 or 5. In 1843 Mosander reported the rare earth didymia obtained from lanthana; in 1879 Lecoq de Boisbaudran isolated a new earth from didymia extracted from samarskite and called it samaria. Six years later Von Welsbach separated it into two earths which gave salts of different colors. Praseodymium is a faintly yellow metal from the cerium group of rare earths. It forms green salts with a characteristic spectrum. The metal has been prepared by the electrolysis of the chloride.

Promethium (Prometheus, who, according to mythology, stole fire from heaven) Pm; at. wt. uncertain, probably approximates 145; at. no. 61; valence doubtless 3. Discovery claimed in 1947 by J. A. Marinsky and L. E. Glendenen at Clinton National Laboratory, Oak Ridge, Tennessee. Work was done by fission of uranium and by neutron bombardment of neodymium. In 1902 Branner predicted the existence of an element between neodymium and samarium, and this was confirmed by Moseley in 1914. Since then several independent men or groups have claimed discovery and given a name, as illinium, florentium, cyclonium. Three milligrams each of the yellow chloride and of the rose nitrate have been exhibited. The name has not been finally and generally accepted.

Protactinium (Gr. *protos*, first), Pa; at. wt. 231; at. no. 91. The first element of the actinium series of radioactive elements was discovered by Soddy and Cranston and independently by Hahn and Meitner, both in 1917. Later Grosse prepared the pure pentoxide and from this in 1934 the metal. Protactinium has been called the "mother substance" or the "parent" of actinium, which it forms by the loss of an alpha particle, and the "patriarch" of the series; known also as ekatantalum and uranium X_2.

Radium (L. *radius*, ray) Ra; at. wt. 226.05; at. no. 88; m.p. 700°C; b.p. 1140°C; sp. gr. 5(?); valence 2. In the form of a salt ($RaBr_2$) it was first separated by M. and Mme Curie in 1898 from the *pitchblende* in North Bohemia, in which it occurs in about one part in three million. Isolated in 1911 by Mme. Curie and Debierne by the electrolysis of a solution of pure radium chloride, employing a mercury cathode; on distillation in an atmosphere of hydrogen this amalgam yielded the pure metal. The *carnotite* sands of Colorado furnished some radium, but richer ores were found in the Belgian Congo and later in the Great Bear Lake region of Canada, which is now the principal source. Radium is obtained commercially as the bromide or chloride. The metal is brilliant white, shows luminescence, alters very rapidly in contact with the air, decomposes water, and is somewhat more volatile than barium. The primary uses of the compounds are in producing self-luminous paints and in the treatment of certain types of cancer and skin affections. One gram of radium produces about 0.1 cubic millimeter of emanation per day; this is pumped from the radium and sealed in minute tubes, which are then applied to the diseased parts. Radium loses about 1% of its activity in 25 years, being transformed into elements of lower atomic weights. Study of radium and its activity has decidedly changed our ideas of the structure of the atom.

Radon (from radium, called niton at first, L. *nitens*, shining), Rn; at. wt. 222; at. no. 86; valence 0; m.p. −71°C; b.p. −61.8°C; sp. gr. 9.73 g/l. Discovered in 1900 by Dorn and called radium emanation; isolated in 1908 by Ramsay and Gray, who named it niton. They determined its density, finding it to be the heaviest gas known. It occupies the last place in the zero group of gases in the Periodic Table. Since 1923 it has been called radon to show its origin from radium. Thoron and actinon are isotopes. (See Radioactive Elements.)

Rhenium (L. *Rhenus*, Rhine), Re; at. wt. 186.22; at. no. 75; m.p. 3167 ± 60°C; b.p. . . . . . ; sp. gr. 20.53 (20°C); valence 4, 5, 6, 7, 8. One of the eka-manganeses (dwi-manganese) discovered in 1925 by Noddack, Tacke and Berg in the minerals columbite, tantalite, wolframite. It has been found also in molybdenum ore concentrates. Rhenium was detected with the aid of the Röntgen spectrum; its arc spectrum has been carefully studied by Meggers. The metal can be hot forged or rolled; dissolved readily in nitric acid, slowly in sulfuric, hardly at all in hydrochloric. The price of $10,000 per gram in 1928 dropped to $3 in 1930, the production increasing a thousand fold. This has made possible the use of the element as a catalyst for dehydrogenation and in connection with other metals.

Rhodium (Gr. *rhodon*, rose), Rh; at. wt. 102.91; at. no. 45; m.p. 1966 ± 3°C; b.p. above 2500°C; sp. gr. 12.5 (20°C); valence 1, 2, 3, or 4. Discovered in 1803 by Wollaston. Rhodium is a silver-white metal of the platinum family, occurring native with other members of this family in river sands in the Urals and in North and South America. The salts form red solutions. An alloy with platinum is used in connection with pure platinum to make thermojunctions in some forms of pyrometers. In electroplating it gives a surface unaffected by exposure to air or to strong acids or alkalies.

Rubidium (L. *rubidius*, dark red), Rb; at. wt. 85.48; at. no. 37; m.p. 38.5°C; b.p. 700°C; sp. gr. 1.53 (20°C); valence 1.

Discovered in 1861 by Bunsen and Kirchhoff by the use of the spectroscope in the mineral *lepidolite*. Rubidium occurs in small quantities, also, in some mineral springs and in the rare minerals, *castor* and *pollux*, found in Elba. It is prepared by the electrolysis of the cyanide. Rubidium is a soft, white, rare, metallic element of the alkali group; it forms salts similar to those of potassium and colors the flame dark red, when held in a burner.

Ruthenium (Ruthenia, Ukraine), Ru; at. wt. 101.1; at. no. 44; m.p. 2450°C; b.p. above 2700°C; sp. gr. 12.2 (20°C); valence 3, 4, 6 or 8. Discovered in 1844 by Klaus more than a century after the discovery of platinum. Ruthenium, belonging to the platinum group, occurs native with the other members of this group. The metal is hard, gray, and brittle; it forms red or brown salts; ruthenous chloride ($RuCl_3$) gives a characteristic fine black precipitate with water. Practical uses are needed to consume accumulated stocks.

Samarium (Samarski, a Russian), Sm; at. wt. 150.35; at. no. 62; m.p. above 1300°C; b.p. . . . . . ; sp. gr. 7.7–7.8; valence 2 or 3. Discovered in 1879 by Lecoq de Boisbaudran in the mineral *samarskite*, named in honor of a Russian mine official. Samarium is a grayish-white metal belonging to the cerium group of the rare earths, occurring in very minute quantities in *samarskite*, *cerite*, and certain Scandinavian minerals. The metal has been prepared by electrolysis of the fused anhydrous chloride. The yellow oxide, Sm_2O_3, dissolves in most acids to form yellow salts.

Scandium (Scandinavia), Sc.; at. wt. 44.96; at. no. 21; m.p. 1200°C; b.p. 2400°C, calculated; sp. gr. 3.02 (10°C) — ?; valence 3. Predicted by Mendeleeff on the basis of the Periodic Law; discovered by Nilson in 1879. By some scandium is placed in the rare earth group. The metal has not been isolated; it forms colorless salts derived from the oxide Sc_2O_3.

Selenium (Gr. *Selene*, moon), Se; at. wt. 78.96; at. no. 34; m.p. of gray form 220°C; b.p. 688°C; sp. gr. gray 4.8 (20°C); valence 2, 4 or 6. Discovered in 1817 by Berzelius associated with tellurium, named for the earth, hence the name chosen. The principal source of selenium is the flue dust obtained in burning pyrites in the manufacture of sulfuric acid. It is prepared in red amorphous form by reduction of selenic acid, and this on melting and keeping somewhat below the melting point becomes gray and crystalline. It is in the sulfur family, which it resembles both in the various forms of the element and in its compounds. The conductivity of electricity of the gray form increases with the brightness of the light with which it is illuminated. For this reason it can be used in photo-electric cells; its chief use is in the glass and ceramic industries. Red glass may contain colloidal selenium. It occurs in some soils in amounts sufficient to produce serious effects on animals feeding on plants grown in such soils.

Silicon (L. *silex*, flint), Si; at. wt. 28.09; at. no. 14; m.p. 1420°C; b.p. 2355°C; sp. gr. 2.42 (20°C); valence 4. First prepared by Berzelius in 1823. Next to oxygen, the most abundant element; characteristic of all abundant and important rocks except carbonates. It makes up about one-fourth of the crust of the earth. Silicon is not found free, it occurs chiefly as the oxide, silica (SiO_2) (sand, quartz, rock crystal, amethyst, agate, flint, jasper, opal, etc.) both free and in combination with the metallic oxides as silicates (granite, hornblende, asbestos, feldspar, clay, mica, etc). It is obtained as an amorphous brown powder on fusion of potassium fluosilicate with sodium or potassium; the crystalline form is obtained by passing silicon tetrachloride over melted aluminum in an atmosphere of hydrogen, or by heating potassium fluosilicate with zinc and sodium at a temperature just below the boiling point of zinc. Silicon is a non-metallic element resembling carbon in having several allotropic forms and in compounds formed. It is not attacked by acids except by a mixture of nitric and hydrofluoric acids; it is soluble in hot caustic potash or soda, evolving hydrogen and forming the corresponding silicate (K_2SiO_3 or Na_2SiO_3). Sodium silicate is of wide industrial importance. Glass, cement and clay working are called the silicate industries. An alloy of iron containing 14% of silicon is brittle, but extremely resistant to the action of acids, making it widely useful in the equipment of acid plants and in laboratory drains. Silicon carbide (SiC) is a most efficient abrasive. Silicones, organic compounds in which silicon replaces all or part of the carbon, are finding increasing uses.

Silver (Anglo-Saxon, *soelfor*), Ag (L. *argentum*); at. wt. 107.880; at. no. 47; m.p. 960.5°C; b.p. 1950°C; sp. gr. 10.50 (20°C); valence 1. Known to ancients. Silver occurs native and in ores in combination with many non-metallic elements, as *argentite* (Ag_2S) and horn silver (AgCl); lead and copper ores yield considerable silver. It is obtained from its ores by smelting with lead or copper, by cyanidation, or by amalgamation with mercury. The metal is pure white having a brilliant luster, a little harder than gold and excelled only by that metal in malleability and ductility; it excels all other metals as a conductor of heat and electricity; it undergoes no change in water or pure air, but absorbs 22 times its volume of oxygen when melted, which is again expelled on cooling; it tarnishes in the vapors of sulfur compounds forming the black sulfide (Ag_2S). The most important compounds of silver are the nitrate ($AgNO_3$), or lunar caustic, the oxide (Ag_2O), and the halides (AgCl, AgBr), which darken on exposure to light, which is the basis of photography. A dilute solution of silver nitrate is used in medicine as an antiseptic. The metal is extensively used for coins, in jewelry and in tableware.

Sodium (English, *soda*), Na (L. *natrium*); at. wt. 22.991; at. no. 11; m.p. 97.5°C; b.p. 880°C; sp. gr. 0.971 (20°C); valence 1. Long recognized in compounds; first isolated by Davy in 1807 by electrolysis. Sodium is the most abundant of the alkali metals, being the seventh element in amount in the crust of the earth. Sodium chloride is the most common compound, but it occurs in many others. Never found free, it is obtained by the electrolysis of the chloride or hydroxide; it is a soft, bright, silvery metal. On exposure to moist air it becomes coated with a film of the oxide or hydroxide, and is preserved by immersing in kerosene or naphtha. It decomposes water with the formation of hydrogen and sodium hydroxide; it burns in air with the formation of the peroxide (Na_2O_2); it is used for the reduction of organic compounds, in the preparation of the peroxide and cyanide, and for keeping mercury clean and active in gold extraction. Soap is generally a sodium salt of certain fatty acids. Its compounds are of the widest industrial importance, being manufactured in hundreds of thousands of tons annually. Some of these are common salt ($NaCl$), soda ash (Na_2CO_3), baking soda ($NaHCO_3$), caustic soda ($NaOH$), Chile saltpeter ($NaNO_3$), di- and tri-sodium phosphates, sodium thiosulfate (hypo, $Na_2S_2O_3.5H_2O$), borate (borax, $Na_2B_4O_7.10H_2O$).

Strontium (Strontian, town in Scotland), Sr; at. wt. 87.63; at. no. 38; m.p. 800°C; b.p. 1150°C; sp. gr. 2.54 (20°C); valence 2. Discovered by Crawford, a Scotchman in 1790; metal isolated by Davy by electrolysis in 1808. Strontium is found chiefly in *celestite* ($SrSO_4$) and *strontianite* ($SrCO_3$). Prepared by the electrolysis of the fused chloride, it resembles metallic calcium in its properties; it is a hard silver-white metal. The salts are generally soluble in water with the exception of the sulfate, phosphate and carbonate; they impart a brilliant, blood-red color to the flame, and are used in pyrotechny for red fire. Strontium salts are also used in beet sugar refining.

Sulfur (L. *sulfur*), S; at. wt. 32.066; at. no. 16; m.p. rhombic 112.8°C, monoclinic 119.0°C; b.p. 444.6°C; sp. gr. rhombic 2.07, monoclinic 1.957 (20°C); valence 2, 4, or 6. Known to the ancients. Formerly obtained from the vicinity of volcanoes, active or extinct, since the beginning of this century the chief supply has come from wells sunk into the salt domes along the Gulf coast. The Frasch process of concentric pipes with great quantities of superheated water has been used to melt and raise the sulfur, giving a product of very high purity. Sulfur is widely distributed in nature in free form; in sulfides, as iron (*pyrites*), lead (*galena*), zinc (*blende*), mercury (*cinnabar*) and antimony (*stibnite*); in sulfates, as calcium (*gypsum*), magnesium (*Epsom salt*), strontium (*celestite*) and barium (*barite* or *heavy spar*). Sulfur is a pale yellow, odorless, brittle solid, which is insoluble in water, soluble in carbon disulfide. It occurs in two crystalline forms and an allotropic form known as plastic sulfur, which reverts to the crystalline form on standing; a finely divided form known as flowers of sulfur is obtained by sublimation. It readily forms compounds known as sulfides with many elements. Sulfur is a component of black gunpowder, is widely used in the vulcanization of rubber and as a fungicide. A tremendous tonnage is used after burning to form sulfur dioxide in the manufacture of sulfuric acid, the most important manufactured chemical, and in the processes for making wood pulp for paper; sulfur dioxide is also used in fumigation and in the bleaching of dried fruits. The element is a good electrical insulating agent, and organic compounds containing sulfur are very important.

Tantalum (Gr. *Tantalos,* mythological character) Ta; at. wt. 180.88; at. no. 73; m.p. 2996°C; b.p. above 4100°C; sp. gr. 16.6; valence 3 or 5. Discovered in 1802 by Ekeberg. Tantalum occurs principally in the mineral *tantalite* ($FeTa_2O_6$), very similar to columbite, and is prepared by the reduction of K_2TaF_7 with hydrogen followed by fusion in a vacuum. It can be drawn into a wire with a very high point of fusion and great tenacity, which has been used in the construction of filaments for incandescent lamps; it has been generally replaced by tungsten, but tantalum is still used when lamps have to resist more than ordinary vibration. It is also used to alloy with other metals. Tantalum finds use in radio and radar tubes, as a catalyst in the manufacture of synthetic rubber, in carbide cutting tools, in aerial camera lenses, in corrosion resistant chemical equipment, in surgical wire and skull plates. The metal is soluble in fused alkalies, insoluble in acids; especially suited for plant work with halogens, hydrochloric acid, and *aqua regia.* The common oxide is Ta_2O_5.

Technetium (Gr. technetos, artificial), Tc; at. wt. 99; at. no. 43; valence 6 and 7 observed. First produced in 1937 by C. Perrier and E. Segré at the University of California by bombarding molybdenum with deuterons or neutrons. Wu and Segré later found that this element can be isolated in large amounts from the fission products of uranium. The name was given "in recognition of the fact that technetium is the first artificially made element." A pink colored sample of mixed compounds of technetium in its plus six and plus seven valence states was exhibited in 1948.

Tellurium (L. *tellus,* earth), Te; at. wt. 127.61; at. no. 52; m.p. 452°C; b.p. 1390°C; sp. gr. 6.24 (20°C); valence 2, 4, or 6. Discovered by Muller von Richenstein in 1782; named by Klaproth in 1798. Tellurium is found native and as the telluride of gold and other metals. It is obtained by reduction of telluric oxide and forms a powder of grayish-white, metallic appearance. It is a semi-metallic element of the sulfur group and forms tellurides with hydrogen and metals similar to the sulfides; the compounds H_2TeO_3 and H_2TeO_4 are only slightly acidic. The inhalation of the vapors of tellurium produces the very offensive "tellurium breath." It is used as a coloring agent in glass, giving a blue to brown color. Certain alloys give high electrical resistance. Addition of less than a tenth of one per cent to lead greatly increases its strength and hardness.

Terbium (Ytterby, village in Sweden), Tb; at. wt. 158.93; at. no. 65; m.p. . . . . ; b.p. . . . . . ; sp. gr. . . . . . ; valence 3. Discovered by Mosander in 1843 from *gadolinite.* Terbium is a metal of the rare earths; in order of discovery it falls in the Yttria group; the metal has not been isolated. It yields a white oxide Tb_2O_3, and forms trivalent salts. Its name together with the names yttrium, ytterbium, and erbium, are all derived from the little Swedish town, Ytterby, where the rare earth minerals were first found.

Thallium (Gr. *thallos*, budding twig), Tl; at. wt. 204.39; at. no. 81; m.p. 302°C; b.p. 1457 ± 10°C; sp. gr. 11.85 (20°C); valence 1 or 3. Discovered by the use of the spectroscope in 1861 by Crookes, who isolated the metal in 1862. Lamy also isolated the metal in 1862. Thallium occurs in *pyrites* and is prepared from the flue dust of sulfuric acid works. The metal is obtained by heating thallium iodide with metallic sodium; it resembles lead, having a hardness of 1.2 compared with 1.5 for lead; the malleability is high and the tenacity is low; there are two allotropic forms with a transition temperature of 226°C; it is a poor conductor of electricity, tarnishes in air forming the oxide Tl_2O, or the hydroxide TlOH in the presence of water. The element is displaced from solutions of its salts by zinc. Because of its resemblance to both the alkali metals and to the metals of Group III, thallium has been called the "paradoxical metal" and the "bird-beast metal." Its salts are poisonous, and are used in the control of rodents such as squirrels.

Thorium (*Thor*, Scandinavian god of war), Th; at. wt. 232.05; at. no. 90; m.p. 1845°C; b.p. above 4500°C; sp. gr. 11.3 (20°C); valence 4. Discovered by Berzelius in 1828. Thorium occurs chiefly in *thorite* ($ThSiO_4$) and other rare minerals. In the U. S. it is obtained chiefly from *monazite*, which contains from 3 to 9% of ThO_2. The free element has been prepared by heating the double chloride or fluoride of thorium and potassium with metallic sodium or potassium; it is a heavy, gray, difficultly fusible metal. It burns brightly in oxygen to form ThO_2, which is also obtained on heating the nitrate, a reaction of which use is made in the manufacture of incandescent gas mantles. Thorium emits radiations similar to but not identical with those of radium.

Thulium (*Thule*, Northland), Tm; at. wt. 168.94; at. no. 69; m.p. . . . . ; b.p. . . . . . ; sp. gr. . . . . . . ; valence 3. Discovered in 1879 by Cleve; pure thulia was prepared in 1911 by James. Thulium is in the yttrium group of the rare earth metals in order of discovery and belongs to the erbium family, which includes dysprosium, holmium and erbium also. They are obtained from certain rare minerals occurring in granite or pegmatite veins. These elements are characterized by their absorption spectra and the formation of highly colored salts; they form basic oxides of the type M_2O_3 with the following order of increasing basicity; thulium, erbium, holmium and dysprosium. The free elements have not been isolated.

Tin (Anglo-Saxon *tin*), Sn (L. *stannum*); at. wt. 118.70; at. no. 50; m.p. 231.89°C; b.p. 2270°C; sp. gr. gray 5.75, rhombic 6.55, tetragonal 7.31 (20°C); valence 2 or 4. Known to the ancients. Tin is found chiefly in the mineral *cassiterite* (SnO_2), found in association with granitic rocks, almost none found in the U. S. It is obtained by roasting to remove sulfur and arsenic and smelting with powdered anthracite in a reverberatory furnace. A smelter built in Texas to handle Bolivian ores during World

War II continued in operation after 1945. Tin is found in several varieties; as ordinarily used it is a silver white metal, malleable and somewhat ductile with a low tenacity and highly crystalline structure. Due to a breaking of these crystals, the "tin cry" is heard when a bar is bent. Crystalline tin changes to gray tin at low temperatures, the speed of change reaching a maximum at −50°C. Ordinarily it takes a high polish and is used to coat other metals to prevent corrosion or other chemical action. Such tin plate over steel is used in the so called tin can for preserving food; enough is used in America each year to make a 100 foot wide belt around the earth at the equator. When heated in air, tin forms SnO_2, which is feebly acid, forming stannate salts with basic oxides. The most important salt is the chloride ($SnCl_2.2H_2O$), which is used as a reducing agent and as a mordant in calico-printing. Alloys of the metal are very important, including solder, type metal, fusible metal, pewter, bronze and bell metal.

Titanium (L. *Titans*, the first sons of the Earth, myth.), Ti; at. wt. 47.90; at. no. 22; m.p. 1800°C; b.p. above 3000°C; sp. gr. 4.5 (20°C); valence 2, 3, or 4. Discovered by Gregor in 1791; named by Klaproth in 1795; pure metal prepared in 1910 by Hunter by heating $TiCl_4$ with sodium in a steel bomb. Titanium is almost invariably present in igneous rocks and the sedimentary material derived from them, occurring as the oxide (TiO_2), in titanates and with many iron ores. The metal is prepared by heating the oxide with aluminum or by electrolysis of the oxide dissolved in fused calcium chloride. It is a lustrous white metal in the same group with tin; it burns in air and is the only element which burns in nitrogen. The most important compounds are the oxide (TiO_2), which is feebly acidic and from which the titanates are derived; the halides (TiX_4), some of which are volatile; and the nitrides (Ti_2N_2, Ti_3N_4), metallic in appearance. The oxide is used in high grade white pigments of great opacity and covering power. The metal is used in steel alloys to increase strength.

Tritium, an isotope of hydrogen—see Hydrogen.

Tungsten (wolframite) W; (G. Wolfram); commonly known as tungsten (Sw. heavy stone); at. wt. 183.86; at. no. 74; M.P. 3370°C; b.p. 5900°C; sp. gr. 19.3 (20°C); valence 2, 4, 5, or 6. Recognized and named by Scheele in 1781; discovered by d'Elhujar brothers in 1783. Wolfram occurs in tungstates as *wolframite* ($FeWO_4$), *scheelite* ($CaWO_4$), *hübnerite* ($MnWO_4$). The metal is obtained by reduction of the oxide (WO_3) with hydrogen, carbon or aluminum. It is hard, brittle, nonmagnetic and forms the oxide when heated in the air. The only solvent for tungsten is a mixture of nitric and hydrofluoric acids. Because its melting point is higher than that of any other known metal, its vapor pressure is extremely low, making it useful for electric wiring for furnaces, targets of X-ray tubes, contacts, arcing points; its higher electrical efficiency causes its almost exclusive use in light filaments. About 90% of the world's production is used in steel manufacture, its various steel alloys being used in armor plate, projectiles and high speed cutting tools. Salts of tungsten are used in chemical, pigment and tanning industries.

Uranium (Planet Uranus), U; at. wt. 238.07; at. no. 92; m.p. about 1150°C; b.p. . . . . . . ; sp. gr. 18.68 (20°C); valence 3, 4 or 6. Discovered by Klaproth in *pitchblende* in 1789; metal first prepared in 1841 by Peligot by reducing the chloride with metallic potassium. This method is still used. The chief ore is *uraninite*, or *pitchblende*, uranous uranate, $U(UO_4)_2$; the metal is hard, white, heavy. Uranium is used chiefly in compounds which give a canary-yellow fluorescent glass and a black pigment for china painting; its compounds are used in photography. Of the generally recognized elements it has the highest atomic weight and is the last in the Periodic Table. Uranium compounds are radioactive. It has been the most important element in work on nuclear energy and the atomic bomb.

Vanadium (Scandinavian goddess, *Vanadis*), V; at. wt. 50.95; at. no. 23; m.p. 1710°C; b.p. 3000°C; sp. gr. 5.96 (20°C); valence 2, 3, 4 or 5. Discovered by Sefstrom in 1830; isolated by Roscoe in 1869. Though relatively rare, vanadium is found in a variety of minerals; prominent among these are *vanadinite* ($3PO_3(VO_4)_2.PbCl_2$) and *patronite* (possibly VS_4) occurring in Peru. Vanadium is obtained by reduction of the chloride in hydrogen, forming a gray and very infusible metal. The vanadates are employed in the preparation of aniline black and for coloring glass. Most of it is produced as ferro-vanadium and used in the manufacture of steel alloys, greatly increasing toughness, elasticity and tensile strength. V_2O_5 masses are used in the contact process for manufacture of sulfuric acid.

Wolfram (see Tungsten).

Xenon (Gr. *xenon*, stranger), Xe; at. wt. 131.3; at. no. 54; m.p. −112°C; b.p. −107.1°C; density 5.85 g/l, sp. gr. liquid 3.52 (−109°C); valence 0. Discovered by Ramsay and Travers in 1898 in the residue left on evaporating liquid air. It is the rarest and heaviest of the gases of the argon family from the atmosphere, in which it is present to the extent of about one part in twenty million. It is inert and forms no compounds with other elements. Vacuum tubes containing it show a beautiful blue glow.

Ytterbium (Ytterby, village in Sweden), Yb; at. wt. 173.04; at. no. 70; m.p. 1800°C; b.p. . . . . ; sp. gr. . . . . . . ; valence 3. Separated by Marignac in 1878. In 1907 Urbain and in 1908 von Welsbach described a process by which this earth containing the metal, could be resolved into earths of two other metals—neo-ytterbium, or simply ytterbium, and lutetium. These elements occur in nearly all minerals which contain yttrium, but in very small amounts The best sources are probably *gadolinite*, *xenotime*, *polycrase* and *blomstrandine*. The oxide, chloride and sulfate have been prepared.

Yttrium (Ytterby, village in Sweden), Y; at. wt. 88.92; at. no. 39; m.p. 1490°C; b.p. 2500°C; sp. gr. 5.51; valence 3. The rare earth yttria, which contained a new element, was discovered by Gadolin in 1794; in 1843 Mosander showed that yttria could be resolved into the earths of three other elements, the name yttria being reserved for the most basic one, the others being named erbia and terbia. Yttrium occurs in nearly all of the rare earths minerals. Wöhler obtained the free element by reduction of the chloride with potassium; it has also been obtained by the electrolysis of a mixture of the chloride and sodium chloride. The metal forms small scales with a metallic luster and an iron-gray color; it is readily oxidized in air and is converted to the hydroxide by boiling water. Y_2O_3 is white; rapidly attacked by most acids to give colorless solutions.

Zinc (G. *Zink*), Zn; at. wt. 65.38; at. no. 30; m.p. 419.5°C; b.p. 907°C; sp. gr. 7.14 (20°C); valence 2. Its ores were used for making brass for centuries before it was recognized as a separate metal in 1746 by Marggraf, who obtained it by heating calamine with charcoal. The principal ores are *sphalerite* or *blende* (sulfide), *smithsonite* (carbonate) and *calamine* (silicate). The old method of heating the roasted ore with carbon in a retort is still used, being replaced to some extent by the electrolytic process. Zinc is a bluish-white metal, brittle at ordinary temperatures but malleable at 100°C, a fair conductor of electricity; it burns in air at high red heat with evolution of white clouds of the oxide; it is used to form numerous alloys with other metals, as brass with copper. Galvanizing is coating other metals, especially iron, with zinc to prevent corrosion; the coating is sometimes applied by dipping in molten zinc. This is the most important use of the metal; die casting and brass making use large quantities. Zinc is used as the negative electrode in various types of electric batteries. Compounds are widely used in paints, the oxide being an important white pigment; its compounds have antiseptic properties and are used in medicine. Nearly a century ago Frankland showed the use of zinc in preparing organic compounds.

Zirconium (Arabic *zargun*, gold color), Zr; at. wt. 91.22; at. no. 40; m.p. 1857°C; b.p. above 2900°C; sp. gr. 6.4 (20°C); valence 4. Discovered in *zircon* by Klaproth in 1789; isolated by Berzelius in 1824. Rather widely diffused in igneous rocks, zirconium usually occurs in the silicate, $ZrSiO_4$. The element is in the titanium family, its oxide being either base or acid forming. Prepared from the tetrachloride by heating with sodium in a bomb, the metal can be pressed into rods, drawn into wire, or burnished to a bright surface. A number of alloys have been made. Ferro-zirconium, made by aluminum reduction in an electric furnace, is used for desulfurizing and deoxidizing steel. Zircon, the silicate, is sometimes a gem. The oxide has been used in gas mantles, in paints as an opacifier, in lacquers, in insulators and as an abrasive.

****Einsteinium** (Albert Einstein), E; at no. 99. Was produced in the thermonuclear explosion staged by the Los Alamos Scientific Laboratory in 1952 by A. Ghiorso and coworkers. The existence of a relatively long-lived isomeric form of E^{254} produced by neutron bombardment makes it possible to isolate this element in weighable amounts.

****Fermium** (Enrico Fermi), Fm; at. no. 100. Was discovered in the thermonuclear explosion during the same series of experiments that resulted in the discovery of Einsteinium. Since Fm^{255} is the longest-lived fermium isotope known it seems improbable that this element can ever be obtained in weighable amount.

****Mendelevium** (D. Mendeleev), Mv; at. no. 101. Was discovered by Ghiorso, Harvey, Choppin, Thompson, and Seaborg in 1955 as a result of the irradiation of extremely small amounts of E^{253} with helium ions in the Berkeley 60 inch cyclotron. The isotope produced was Mv^{256} which has a half-life of about 0.5 hours. Since there appear to be no long-lived isotopes it seems improbable that this element will ever be isolated in weighable amount.

Nobelium (A. Nobel), No; at. no. 102. Was discovered by P. R. Fields and coworkers at Argonne National Laboratory, British Atomic Energy Est., Harwell, England, and Nobel Institute at Stockholm, Sweden, in 1957, as the result of irradiation of specially prepared targets of Cf with carbon C^{13} ions in the Nobel Institute cyclotron at Stockholm. The isotope produced was No^{253} which has a half-life of about ten minutes.

** For further description see following section "Transuranium Elements."

TRANSURANIUM ELEMENTS

The available evidence leads to the natural conclusion that the heaviest elements of the *periodic system* of atomic numbers 89 (actinium) through 103 are so chemically similar to another group of elements, the *rare earths* or lanthanide series (atomic numbers 57–71) that their electronic structures must also be similar, and they have been given the name *actinides*. An inner electron shell, consisting of fourteen 5f electrons, is filled in progressing across the series. Those elements with atomic number greater than 92, uranium, have half-lives too short to have existed since their original creation. They were discovered and produced by nuclear reactions and synthesis and are called the *transuranium* elements. The presently known (1955) transuranium elements have the following names and symbols: 93, neptunium (Np); 94, plutonium (Pu); 95, americium (Am); 96, curium (Cm); 97, berkelium (Bk); 98, californium (Cf); 99, einsteinium (E); 100, fermium (Fm); and 101, mendelevium (Mv).

Chemically the transuranium elements are very similar, although the observed differences are those expected and anticipated from their unique position in the periodic system as part of a second rare-earth series. All have trivalent ions, which form inorganic complex ions and organic chelates. Also in common are acid-insoluble trifluorides and oxalates, soluble sulfates, nitrates, chlorides, and perchlorates. Neptunium, plutonium, and americium have higher oxidation states in aqueous solution (similar to uranium), but the relative stability of these states to the common trivalent ion becomes progressively less as one proceeds to the higher atomic numbers. This is a direct consequence, indeed an identifying feature, of the actinide role as a second rare-earth type transition series.

One of the most important methods for study and elucidation of chemical behavior of the actinide elements has been ion-exchange chromatography. Adsorption on and elution from ion-exchange columns has made possible the identification and separation of trace quantities of all of the actinides and in particular the transuranium elements. The behavior of each actinide and transuranium element in this respect is very similar to its analogous rare-earth element. This has made it possible to detect as little as one or two atoms when this small a number has been made in some of the transmutation experiments.

Neptunium (Np, atomic number 93, after the planet Neptune). Neptunium was the first of the synthetic transuranium elements to be discovered; the isotope Np^{239} was produced by McMillan and Abelson in 1940 at Berkeley, California, as the result of the bombardment of uranium with cyclotron-produced neutrons. The isotope Np^{237} (half-life of 2.2×10^6 years) is currently obtained in gram quantities as a by-product from nuclear reactors in the production of plutonium. Trace quantities of the element are actually found in nature due to transmutation reactions in uranium ores produced by the neutrons which are present.

Neptunium metal has a silvery appearance, is chemically reactive, melts at 640° C and exists in at least three structural modifications: α-neptunium, orthorhombic, density = 20.45 g/cm^3; β-neptunium (above 278° C), tetragonal, density (313° C) = 19.36 g/cm^3; γ-neptunium (above 500° C) cubic, density (600° C) = 18.0 g/cm^3.

Neptunium gives rise to four ionic oxidation states in solution: Np^{+3} (pale purple), analogous to the rare earth ion Pm^{+3}, Np^{+4} (yellow green), NpO_2^+ (green blue), and NpO_2^{++} (pale pink). These latter oxygenated species are in contrast to the rare earths which exhibit only simple ions of the (II), (III), and (IV) oxidation states in aqueous solution. The element forms tri- and tetrahalides such as NpF_3, NpF_4, $NpCl_4$, $NpBr_3$, NpI_3, and oxides of various compositions such as are found in the uranium-oxygen system, including Np_3O_8 and NpO_2.

Plutonium (Pu, atomic number 94, after the planet Pluto). Plutonium was the second transuranium element to be discovered; the isotope Pu^{238} was produced in 1940 by Seaborg, McMillan, Kennedy, and Wahl at Berkeley, California, by deuteron bombardment of uranium in the 60-inch cyclotron. By far of greatest importance is the isotope Pu^{239} (half-life of 24,400 years), produced in extensive quantities in nuclear reactors from natural uranium:

$$U^{238}(n,\gamma)U^{239} \xrightarrow{\beta^-} Np^{239} \xrightarrow{\beta^-} Pu^{239}.$$

Plutonium has assumed the position of dominant importance among the transuranium elements because of its successful use as an explosive ingredient in nuclear weapons and the place which it holds as a key material in the development of industrial utilization of nuclear energy, one pound being equivalent to about 10,000,000 kilowatt hours of heat energy. Its importance depends on the nuclear property of being readily fissionable with neutrons and its availability in quantity.

Plutonium also exists in trace quantities in naturally occurring uranium ores. It is formed in much the same manner as neptunium, by irradiation of natural uranium with the neutrons which are present.

Plutonium metal can be prepared, in common with neptunium and uranium, by reduction of the trifluoride with alkaline-earth metals. The metal has a silvery appearance, is chemically reactive, and melts at 635° C. It exhibits at least five crystalline modifications: α-plutonium, orthorhombic, below 117° C; β,γ-plutonium, of unknown crystalline forms, 117°–300° C; δ-plutonium, face-centered cubic, 300°–475° C; and ϵ-plutonium, body-centered cubic, 475° C up to the melting point.

Plutonium also exhibits four ionic valence states in aqueous solutions: Pu^{+3} (blue lavender), Pu^{+4} (yellow brown), PuO_2^+ (presumably pink), and PuO_2^{+2} (pink orange). The ion PuO_2^+ is unstable in aqueous solutions, disproportionating into Pu^{+4} and PuO_2^{+2}; the Pu^{+4} thus formed, however, oxidizes the

PuO_2^+ into PuO_2^{+2}, itself being reduced to Pu^{+3}, giving finally Pu^{+3} and PuO_2^{+2}.

Plutonium forms binary compounds with oxygen: PuO, PuO_2, and intermediate oxides of variable composition; with the halides: PuF_3, PuF_4, $PuCl_3$, $PuBr_3$, PuI_3; with carbon, nitrogen and silicon: PuC, PuN, $PuSi_2$; in addition, oxyhalides are well known: PuOCl, PuOBr, PuOI.

Because of the high rate of emission of alpha particles, and the physiological fact that the element is specifically absorbed by bone marrow, plutonium, as well as all of the other transuranium elements except neptunium, are radiological poisons and must be handled with special equipment and precautions.

Americium (Am, atomic number 95, after the Americas). Americium was the fourth transuranium element to be discovered; the isotope Am^{241} was identified by Seaborg, James, Morgan and Ghiorso late in 1944 at the wartime Metallurgical Laboratory (now the Argonne National Laboratory) of the University of Chicago as the result of successive neutron capture reactions by plutonium isotopes in a nuclear reactor:

$$Pu^{239}(n,\gamma)Pu^{240}(n,\gamma)Pu^{241} \xrightarrow{\beta^-} Am^{241}.$$

Americium is produced in gram quantities. Since the isotope Am^{241} can be prepared in relatively pure form by extraction as a decay product over a period of years from strongly neutron-bombarded plutonium containing Pu^{241}, this isotope is used for much of the chemical investigation of this element. Better suited is the isotope Am^{243} due to its longer half-life (8.8×10^3 years as compared to 470 years for Am^{241}). A mixture of the isotopes Am^{241}, Am^{242}, and Am^{243} can be prepared by intense neutron irradiation of Am^{241} according to the reactions $Am^{241}(n,\gamma)Am^{242}(n,\gamma)Am^{243}$. Nearly isotopically pure Am^{243} can be prepared by a sequence of neutron bombardments and chemical separations as follows. Neutron-bombardment of Am^{241} yields Pu^{242} by the reactions $Am^{241}(n,\gamma)Am^{242} \xrightarrow{EC} Pu^{242}$; after chemical separation the Pu^{242} can be transformed to Am^{243} via the reactions $Pu^{242}(n,\gamma)Pu^{243} \xrightarrow{\beta^-} Am^{243}$, and the Am^{243} can be chemically separated. Fairly pure Pu^{242} can be prepared more simply by very intense neutron irradiation of Pu^{239} as the result of successive neutron-capture reactions.

Americium can be obtained as a silvery white reactive metal by reduction of americium trifluoride with barium vapor at 1000°–1200° C. It appears to be more malleable than uranium or neptunium and tarnishes slowly in dry air at room temperature. The density is 11.7 g/cm^3 with melting point somewhat higher than 850° C.

The element exists in three oxidation states in aqueous solution: Am^{+3} (light salmon), AmO_2^+ (color unknown), and AmO_2^{+2} (light tan). The trivalent state is highly stable and difficult to oxidize. AmO_2^+, like plutonium, is unstable with respect to disproportionation into Am^{+3} and AmO_2^{+2}. The ion Am^{+4} is so unstable in solution that it has not yet been detected, although tetravalent solid compounds are well known. There is some evidence that Am^{+2} has been prepared in tracer experiments at very low concentrations; this would be very similar to the analogous lanthanide, europium, which can be reduced to the divalent state.

Americium dioxide, AmO_2, is the important oxide; Am_2O_3 and, as with previous actinide elements, oxides of variable composition between $AmO_{1.5}$ and AmO_2 are known. The halides AmF_3, AmF_4, $AmCl_3$, $AmBr_3$, and AmI_3 have also been prepared.

Curium (Cm, atomic number 96, after Pierre and Marie Curie). Although curium comes after americium in the periodic system, it was actually known before americium and was the third transuranium element to be discovered. It was identified by Seaborg, James, and Ghiorso in the summer of 1944 at the wartime Metallurgical Laboratory in Chicago as a result of helium-ion bombardment of Pu^{239} in the Berkeley, California, 60-inch cyclotron. It is of special interest because it is in this element that the first half of the transition series of actinide elements is completed.

The isotope Cm^{242} (half-life 162.5 days) produced from Am^{241} by the reactions $Am^{241}(n,\gamma)Am^{242} \xrightarrow{\beta^-} Cm^{242}$ has been used for much work with macroscopic quantities, although this is difficult due to the extremely high specific alpha activity. An excellent isotope for the investigation of curium in weighable amounts is Cm^{244} because it has a half-life of 19 years and can be prepared in fairly pure form by a sequence of neutron bombardments and chemical separations as follows. The neutron-bombardment of Am^{241} yields Pu^{242} by the reactions $Am^{241}(n,\gamma)Am^{242} \xrightarrow{EC} Pu^{242}$; after chemical separation the Pu^{242} can be transformed to Am^{243} via the reactions $Pu^{242}(n,\gamma)Pu^{243} \xrightarrow{\beta^-} Am^{243}$. Fairly pure Pu^{242} can be prepared more simply by very intense neutron irradiation of Pu^{239} as the result of successive neutron-capture reactions. The Am^{243} can be chemically separated and finally transmuted to Cm^{244} through neutron bombardment by the reactions $Am^{243}(n,\gamma)Am^{244} \xrightarrow{\beta^-} Cm^{244}$. Further neutron bombardment of Cm^{244} produces higher-mass isotopes of longer half-life which are even better for use in the investigation of curium.

Curium metal resembles the other actinide metals quite closely. Also, in common with other metals, it can be prepared by heating curium trifluoride with barium vapor at 1275° C.

The only oxidation state in aqueous solutions which has been definitely identified is Cm^{+3}, although a solid, black CmO_2 has been prepared. Cm_2O_3 and CmF_3, both white compounds, have also been characterized. The general trend of decreasing stability of higher oxidation states with increasing atomic number would indicate that oxidation states of curium higher than curium(III) will probably not be stable in aqueous solutions. It has further been demonstrated that curium(III) cannot be reduced in aqueous solutions.

It is interesting to note that the experimentally determined magnetic susceptibility of CmF_3 is in good agreement with the value expected for the electronic structure $5f^7$ in curium(III), assuming a Russell-Saunders coupling scheme.

Berkelium (Bk, atomic number 97, after Berkeley, California). Berkelium, the eighth member of the actinide transition series, was discovered in December, 1949 by Thompson, Ghiorso, and Seaborg and was the fifth transuranium element synthesized. It was produced by cyclotron bombardment of Am^{241} with helium ions at Berkeley, California.

The chemical properties of berkelium have been studied entirely to date through the use of tracer amounts. These studies have demonstrated that berkelium exists in aqueous solutions in two oxidation states, berkelium(III) and berkelium(IV). The chemistry and solubility of compounds appears to closely follow the other transuranium elements.

The existence of Bk^{249} with a half-life of about 300 days makes it feasible to isolate berkelium in weighable amounts so that its properties can be investigated with macroscopic quantities. This isotope can be prepared by the intense neutron bombardment of Cm^{244} as the result of the capture of successive neutrons by the reactions

$$Cm^{244}(n,\gamma)Cm^{245}(n,\gamma)Cm^{246}(n,\gamma)Cm^{247}(n,\gamma)Cm^{248}(n,\gamma)Cm^{249} \xrightarrow{\beta^-} Bk^{249}.$$

Californium (Cf, atomic number 98, after the state and University of California). Californium, the sixth transuranium element to be discovered, was produced by Thompson, Street, Ghiorso, and Seaborg in January, 1950 by helium-ion bombardment of microgram quantities of Cm^{242} in the Berkeley 60-inch cyclotron. Like berkelium, its chemical properties have been studied solely with tracer amounts. Californium(III) is the only ion stable in aqueous solutions, all attempts to reduce or oxidize californium(III) having failed. The existence of the isotopes Cf^{249}, Cf^{250}, Cf^{251}, and Cf^{252} makes it feasible to isolate californium in weighable amounts so that its properties can be investigated with macroscopic quantities. The isotope Cf^{249} results from the beta decay of Bk^{249} while the heavier isotopes are produced by intense neutron irradiation by the reactions $Bk^{249}(n,\gamma)Bk^{250} \xrightarrow{\beta^-} Cf^{250}$ and $Cf^{249}(n,\gamma)Cf^{250}$ followed by $Cf^{250}(n,\gamma)Cf^{251}(n,\gamma)Cf^{252}$.

Einsteinium (E, atomic number 99, after Albert Einstein). Einsteinium, the seventh transuranium element to be discovered, was identified by Ghiorso *et al.* in December, 1952 in the debris from a thermonuclear explosion in work involving the University of California Radiation Laboratory, the Argonne

National Laboratory, and the Los Alamos Scientific Laboratory. The isotope produced was the 20-day E^{253}, originating from beta decay of U^{253} and daughters. Its chemical properties have been studied solely with tracer amounts and indicate that the (III) oxidation state may be the only one which exists in aqueous solution. Existence of a relatively long-lived isomeric form of E^{254} makes it possible to isolate this element in weighable amounts. The isotope E^{253} and heavier isotopes can be produced by intense neutron irradiation of lower elements such as plutonium, by a process of successive neutron capture interspersed with beta decays until these mass numbers and atomic numbers are reached.

Fermium (Fm, atomic number 100, after Enrico Fermi). Fermium, the eighth transuranium element to be discovered, was identified by Ghiorso *et al.* early in 1953 in the debris from a thermonuclear explosion in work involving the University of California Radiation Laboratory, the Argonne National Laboratory, and the Los Alamos Scientific Laboratory. The isotope produced was the 16-hour Fm^{255}, originating from the beta decay of U^{255} and daughters. Since this is the longest-lived presently known fermium isotope it seems unlikely that this element can be isolated in weighable amount. Its chemical properties have been studied solely with tracer amounts and in normal aqueous media only the (III) oxidation state appears to exist. The isotope Fm^{254} and heavier isotopes can be produced by intense neutron irradiation of lower elements, such as plutonium, by a process of successive neutron capture interspersed with beta decays until these mass numbers and atomic numbers are reached.

Mendelevium (Mv, atomic number 101, after Dmitri Mendeleev). Mendelevium, the ninth transuranium element to be discovered, was first identified by Ghiorso, Harvey, Choppin, Thompson, and Seaborg in early 1955 as a result of the bombardment of the isotope E^{253} with helium ions in the Berkeley 60-inch cyclotron. The isotope produced was presumably Mv^{256} which apparently decays by electron capture to Fm^{256}, which in turn decays predominantly by spontaneous fission with a half-life of about 3 hours. This first identification was notable in that only of the order of one to three atoms per experiment were produced. The extreme sensitivity for detection depended on the fact that its chemical properties could be accurately predicted as eka-thulium and there was a high sensitivity for detection because of the spontaneous fission decay. The chemical properties have been investigated solely by the tracer technique and seem to indicate that the predominant oxidation state in aqueous solution is the (III) state. There seem to be no isotopes of sufficiently long half-life to make it possible to isolate this element in weighable quantity.

PERIODIC ARRANGEMENT AND CHART OF THE ELEMENTS

PERIODIC ARRANGEMENT OF THE ELEMENTS

See explanation at end of table

Period	GROUP I	GROUP II	GROUP III
I	**1 1.0080** **Hydrogen (H)** **1,2,**3		
II	**3 6.940** **Lithium (Li)** **6,7,**8	**4 9.013** **Beryllium (Be)** 7,8,**9,**10	**5 10.82** **Boron (B)** **10,11,**12
III	**11 22.991** **Sodium (Na)** 21,22,**23,**24,25	**12 24.32** **Magnesium (Mg)** 23,**24,25,26,**27	**13 26.98** **Aluminum (Al)** 25,26,**27,**28,29
IV	**19 39.100** **Potassium (K)** 38,**39,**40*n*,**41,**42,43	**20 40.08** **Calcium (Ca)** **40,42,43,44,**45,**46,48,** 49	**21 44.96** **Scandium (Sc)** 41,43,44*m*,44,**45,**46*m*, 46,47,48,49
	29 63.54 **Copper (Cu)** 58,60,61,62,**63,**64, **65,**66,67	**30 65.38** **Zinc (Zn)** 62,63,**64,**65,**66,67,68,** 69*m*,69,**70,**71,72	**31 69.72** **Gallium (Ga)** 64,65,66,67,68,**69,**70, **71,**72,73
V	**37 85.48** **Rubidium (Rb)** 81,82,84,**85,**86,87*n*, 88,89,90,91,93,94,97	**38 87.63** **Strontium (Sr)** **84,**85*m*,85,**86,**87*m*,**87,** **88,**89,90,91,92,93,94, 97	**39 88.92** **Yttrium (Y)** 87*m*,87,88,**89,**90,91*m*, 91,92,93,94,97
	47 107.880 **Silver (Ag)** 106,**107,**107*m*,108, 109*m*,**109,**110,111, 112,113	**48 112.41** **Cadmium (Cd)** **106,**107,**108,**109,**110,** 111*m*,**111,112,113,** 113*m*,**114,**115,115*m*, **116,**117	**49 114.82** **Indium (In)** 109,110,111,112*m*,112, 113*m*,**113,**114*m*,114, 115*m*,**115,**116,117
VI	**55 132.91** **Cesium (Cs)** 130,131,132,**133,** 134*m*,134,136,137, 139,141,143,144	**56 137.36** **Barium (Ba)** **130,**131,**132,**133*m*, 133,**134,135,136,** 137*m*,**137,138,**139, 140,141,143,144	RARE EARTHS See last page of table
	79 197.0 **Gold (Au)** 192,193,194,195,196, **197,**197*m*,198,199	**80 200.61** **Mercury (Hg)** **196,**197,**198,199,200,** **201,202,204,**205	**81 204.39** **Thallum (Tl)** 199,200,202,**203,**204, **205,**206,207*n* AcC″, 208*n* ThC″, 209,210*n* RaC″
VII	87 (223) Francium (Fr) 218,219,220,221, 223*n* AcK	88 226.05 Radium (Ra) 220,221,222,223*n* AcX,224*n* ThX,225, 226*n*,227,228*n* $MsTh_1$	89 227 Actinium (Ac) 222,223,224,225,226, 227*n*,228*n* $MsTh_2$

PERIODIC ARRANGEMENT OF THE ELEMENTS

GROUP IV	GROUP V	GROUP VI	GROUP VII
6 **12.011** **Carbon (C)** 10,11,**12**,**13**,14	**7** **14.008** **Nitrogen (N)** 13,**14**,**15**,16,17	**8** **16.000** **Oxygen (O)** 14,15,**16**,**17**,**18**,19	**9** **19.00** **Fluorine (F)** 17,18,**19**,20
14 **28.09** **Silicon (Si)** 27,**28**,**29**,**30**,31	**15** **30.975** **Phosphorus (P)** 29,30,**31**,32,34	**16** **32.066** **Sulfur (S)** 31,**32**,**33**,**34**,35,**36**,37	**17** **35.457** **Chlorine (Cl)** 33,34,**35**,36,**37**,38,39
22 **47.90** **Titanium (Ti)** **46**,**47**,**48**,**49**,**50**,51*m*,51	**23** **50.95** **Vanadium (V)** 47,48,49,**51**,52	**24** **52.01** **Chromium (Cr)** 49,**50**,51,**52**,**53**,**54**,55	**25** **54.94** **Manganese (Mn)** 51,52*m*,52,54,**55**,56
32 **72.60** **Germanium(Ge)** 66,67,68,**70**,71,72*m*,**72**,**73**,74,75,**76**,77,77*m*	**33** **74.91** **Arsenic (As)** 71,72,73,74,**75**,76,77,78	**34** **78.96** **Selenium (Se)** 71,72,73,**74**,75,**76**,77*m*,**77**,**78**,**80**,81*m*,81,**82**,83*m*,83,84	**35** **79.916** **Bromine (Br)** 75,77,78,**79**,80*m*,80,**81**,82,83,84,85,87,88
40 **91.22** **Zirconium (Zr)** 89,**90**,**91**,**92**,**94**,95,**96**,97	**41** **92.91** **Niobium (Nb)** **(Columbium Cb)** 90,91*m*,92,**93**,94*m*,94,95*m*,95,96,97,98	**42** **95.95** **Molybdenum (Mo)** **92**,93,**94**,**95**,**96**,**97**,**98**,99,**100**,101,105	43 (99) Technetium (Tc) 92,94*m*,94,95,96,97*m*,97,98,99*m*,99,100,101,105
50 **118.70** **Tin (Sn)** **112**,113,**114**,**115**,**116**,**117**,**118**,**119**,**120**,121,**122**,**124**,125	**51** **121.76** **Antimony (Sb)** 118,119,120,**121**,122*m*,**123**,124,124*m*,125,127,129,132,133,134	**52** **127.61** **Tellurium (Te)** 118,119,**120**,121*m*,**122**,**123**,**124**,**125**,125*m*,**126**,127*m*,127,**128**,129*m*,129,**130**,131*m*,131,132,133,134,135	**53** **126.91** **Iodine (I)** 124,125,126,**127**,128,129,130,131,132,133,134,135
72 **178.58** **Hafnium (Hf)** **174**,175,**176**,**177**,**178**,**179**,**180**,181	**73** **180.95** **Tantalum (Ta)** 176,177,180,181*m*,**181**,182	**74** **183.86** **Tungsten (W)** **(Wolfram)** **180**,181,**182**,**183**,**184**,185,**186**,187	**75** **186.22** **Rhenium (Re)** 182,184,**185**,186,187*m*,**187***n*,188
82 **207.21** **Lead (Pb)** 199,200,203,**204**,204*m*,**206**,**207**,**208**,209,210*n* RaD,211*n* AcB,212*n* ThB,214*n* RaB	**83** **209.0** **Bismuth (Bi)** 199,200,204,206,**209**,210*n* RaE,211*n* AcC,212*n* ThC,213,214*n* RaC	84 210 Polonium (Po) 206,207,208,210*n*,211 AcC′,212 ThC′,213,214 RaC′,215 AcA,216 ThA,218 RaA	85 (211) Astatine (At) 210,211,212,214,215*n*,216*n*,217

PERIODIC ARRANGEMENT OF THE ELEMENTS

Period	GROUP VIII			ZERO GROUP
I				**2 4.003** **Helium (He)** **3**,**4**,6
II				**10 20.183** **Neon (Ne)** 19,**20**,**21**,**22**,23
III				**18 39.944** **Argon (A)** 35,**36**,37,**38**,**40**, 41
IV	**26 55.85** **Iron (Fe)** 52,53,**54**,55,**56**, **57**,**58**,59	**27 58.94** **Cobalt (Co)** 55,56,57,58,**59**, 60,60*m*,61,62	**28 58.71** **Nickel (Ni)** 57,**58**,59,**60**,**61**, **62**,63,**64**,65,66	
				36 83.8 **Krypton (Kr)** 77,**78**,79,**80**,**82**, **83**,83*m*,**84**,85, **86**,87,88,89, 90,91,92,93,94, 97
V	**44 101.1** **Ruthenium (Ru)** 95,**96**,97,**98**,**99**, **100**,**101**,**102**, 103,**104**,105, 106	**45 102.91** **Rhodium (Rh)** 100,101,102, **103**,103*m*, 104*m*,104,105, 106	**46 106.7** **Palladium (Pd)** 100,101,**102**, 103,**104**,**105**, **106**,**108**,109, **110**,111,112	
				54 131.30 **Xenon (Xe)** **124**,**126**,127, **128**,**129**,**130**, **131**,**132**,133, **134**,135,135*m*, **136**,137,139,140, 141,143,144
VI	**76 190.2** **Osmium (Os)** **184**,185,**186**, **187**,**188**,**189**, **190**,191,**192**, 193	**77 192.2** **Iridium (Ir)** 190,**191**,192*m*, 192,**193**,194	**78 195.23** **Platinum (Pt)** 191,**192**,193,**194**, **195**,**196**,197, **198**,199	
				86 222 Radon (Rn) (Emanation, Em) 216,217,218, 219*n* An,220*n* Tn,222*n*

PERIODIC ARRANGEMENT OF THE ELEMENTS

THE RARE EARTH ELEMENTS

57 **138.92** **Lanthanum (La)** 135,136,137,**138**,**139**,140,141,143,144	**58** **140.13** **Cerium (Ce)** 135,**136**,137,**138**,139,**140**,141,**142**,143,144	**59** **140.92** **Praseodymium (Pr)** 140,**141**,142,143,144	**60** **144.27** **Neodymium (Nd)** 141,**142**,**143**,**144**,**145**,**146**,147,**148**,149,**150**
61 (145) Promethium (Pm) 143,147,148,149	**62** **150.35** **Samarium (Sm)** **144**,**147**,**148**,**149**,**150**,151,**152**,152*n*,153,**154**,155,156	**63** **152.0** **Europium (Eu)** **151**,**152**,**153**,154,155,156	**64** **157.26** **Gadolinium (Gd)** **152**,153,**154**,**155**,**156**,**157**,**158**,**160**,161
65 **158.93** **Terbium (Tb)** **159**,160,161	**66** **162.51** **Dysprosium (Dy)** **156**,**158**,**160**,**161** **162**,**163**,**164**,165*m*,165	**67** **164.94** **Holmium (Ho)** 163,**165**,166	**68** **167.27** **Erbium (Er)** **162**,**164**,**166**,**167**,**168**,169,**170**,171
69 **168.94** **Thulium (Tm)** 166,167,169*m*,**169**,170,171*m*,171	**70** **173.04** **Ytterbium (Yb)** **168**,169,**170**,**171**,**172**,**173**,**174**,175,**176**,177	**71** **174.99** **Lutetium (Lu)** 170,171,**175**,176*n*,176*m*,177	

ACTINIUM SERIES

90 232.15 Thorium (Th) 224,225,226,227*n* RdAc,228*n* RdTh,229,230*n* Io,231*n* UY,232*n*,233,234*n* UX$_1$	91 231 Protactinium (Pa) 226,227,228,229,230,231*n*,232,233,234*n* UZ,234*mn* UX$_2$	92 238.07 Uranium (U) 228,229,230,231,232,233,234*n* UII,235*n* AcU,237,238*n* UI,239	93 (237) Neptunium (Np) 231,234,235,236,237,238,239
94 (242) Plutonium (Pu) 232,234,236,237,238,239*n*,240,241	95 (243) Americium (Am) 239,240,241,242*m*,242	96 (245) Curium (Cm) 238,240,242	97 (249) Berkelium (Bk) 243,244,245,246,247,248,249,250
98 (249) Californium (Cf) 244,245,246,247,248,249,250,251,252,253,254	99 (254) Einsteinium (E) 246,247,248,249,250,251,252,253,254,255,256	100 (252) Fermium (Fm) 250,251,252,253,254,255,256	101 (256) Mendelevium (Mv) 256

EXPLANATION

The atomic number for each element appears in the upper left corner and the atomic weight in the right corner of each box.

Following the name and symbol there are given the mass numbers of the isotopes which have been established as certain or probable (Classes A and B, Seaborg and Perlman, 1948).

The stable elements and stable isotopes are in bold face type.

The radioactive elements and isotopes are in Roman type.

m following the mass number denotes a metastable isomer.

n following the mass number denotes a naturally occurring radioactive isotope.

PERIODIC CHART OF THE ELEMENTS

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I A	II A	III B	IV B	V B	VI B	VII B	VIII		
1 H 1.0080									
3 Li 6.940	4 Be 9.013								
11 Na 22.991	12 Mg 24.32								
19 K 39.100	20 Ca 40.08	21 Sc 45.10	22 Ti 47.90	23 V 50.95	24 Cr 52.01	25 Mn 54.94	26 Fe 55.85	27 Co 58.94	28 Ni 58.71
37 Rb 85.48	38 Sr 87.63	39 Y 88.92	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc (99)	44 Ru 101.1	45 Rh 102.91	46 Pd 106.7
55 Cs 132.91	56 Ba 137.36	57 *La 138.92	72 Hf 178.58	73 Ta 180.95	74 W 183.86	75 Re 186.22	76 Os 190.2	77 Ir 192.2	78 Pt 195.23
87 Fr (223)	88 Ra 226.05	89 †Ac 227.0							

* Lanthanum Series	58 Ce 140.13	59 Pr 140.92	60 Nd 144.27	61 Pm (145)	62 Sm 150.35	63 Eu 152.0
† Actinium Series	90 Th 232.15	91 Pa 231.	92 U 238.07	93 Np (237)	94 Pu (242)	95 Am (243)

( ) Nos. in parenthesis indicate atomic mass of most stable known isotope.

PERIODIC CHART OF THE ELEMENTS (Continued)

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I B	II B	III A	IV A	V A	VI A	VII A	INERT GASES	
						1 H 1.0080	**2** He 4.003	2
		5 B 10.82	**6** C 12.011	**7** N 14.008	**8** O 16.000	**9** F 19.00	**10** Ne 20.183	2 8
		13 Al 26.98	**14** Si 28.09	**15** P 30.975	**16** S 32.066	**17** Cl 35.457	**18** A 39.944	2 8 8
29 Cu 63.54	**30** Zn 65.38	**31** Ga 69.72	**32** Ge 72.60	**33** As 74.91	**34** Se 78.96	**35** Br 79.916	**36** Kr 83.8	2 8 18 8
47 Ag 107.880	**48** Cd 112.41	**49** In 114.82	**50** Sn 118.70	**51** Sb 121.76	**52** Te 127.61	**53** I 126.91	**54** Xe 131.30	2 8 18 18 8
79 Au 197.0	**80** Hg 200.61	**81** Tl 204.39	**82** Pb 207.21	**83** Bi 209.00	**84** Po 210.	**85** At (211)	**86** Rn 222.	2 8 18 32 18 8

64 Gd 157.26	**65** Tb 158.93	**66** Dy 162.51	**67** Ho 164.94	**68** Er 167.27	**69** Tm 168.94	**70** Yb 173.04	**71** Lu 174.99	2 8 18 32 9 2
96 Cm (245)	**97** Bk (249)	**98** Cf (249)	**99** E (254)	**100** Fm (252)	**101** Mv (256)	**102** No (253)		2 8 18 32 ? 9 2

TABLE OF THE ISOTOPES

Compiled by John R. Bradford

The isotopes are listed by atomic number Z (number of protons), and by mass number A (number of protons and neutrons). The percentage of abundance of the nuclide in the naturally occurring mixtur of isotopes is given for the stable isotopes and for some long-live natural radioisotopes. The relative natural isotope abundance value are expressed as percentage of total number of atoms.

The atomic mass values are given for neutral atoms on the physica scale. The O^{16} nuclide is arbitrarily assigned the mass of 16.000000

Data included up to February 1, 1953.

Half-life values are given in terms of seconds s, minutes m, hours h days d, and years y.

The modes of decay and types of radiation are given using th symbols:

α alpha particle	n neutron
β^- beta particle	p proton
β^+ positron	↓IT isomeric transition
γ gamma ray	f fission product (thermal neutron fission of U^{235})
e^- internal electron conversion	NR natural radioactivity
K orbital electron capture	

All energies of radiation are given in Mev (Million electron volts) The series name for natural occurring radioisotopes is given in th atomic mass column.

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
0	n^{1}		1.00896		β^-	
1	H^1	99.9844	1.00813			
	H^2	0.0156	2.01471			
	H^3		3.01695	12.5 y	β^-	0.018 no γ
2	He^3	~1.34 × 10^{-4} (atm.)	3.01693			
	He^4	~100%	4.00388			
	He^5			~2.4 × 10^{-21}s (calc.)	n + α	
	He^6		6.02086	0.85 s	β^-	3.7 no γ
3	Li^5			very very short	p + α	
	Li^6	7.40	6.01690			
	Li^7	92.6	7.01818			
	Li^8		8.02502	0.88 s	β^-	12.0 no γ
	Li^9			0.17 s		
4	Be^7			54.5 d	γ K	0.479
	Be^8			~10^{-16} s	2α	0.103
	Be^9	100%	9.01506			

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
4	Be^{10}		10.01675	2.7×10^{6} y	β^- 0.56 no γ
5	B^{8}			0.61 s	β^+
	B^{9}			$>3 \times 10^{-19}$ s	
	B^{10}	18.83	10.01618		
	B^{11}	81.17	11.01284		
	B^{12}		12.0182	0.027 s	β^- 13.4
6	C^{10}		10.02084	19.1 s	β^+ 2.2 γ $\sim$1
	C^{11}		11.01499	20.5 m	β^+ 0.97
	C^{12}	98.892	12.00386		
	C^{13}	1.108	13.00756		
	C^{14}		14.00770	5700 y	β^- 0.155 no γ
	C^{15}				γ $\sim$5.5
7	N^{12}		12.0226	0.012 s	β^+ 16.6
	N^{13}		13.00991	10.1 m	β^+ 1.25 no γ
	N^{14}	99.64	14.00754		
	N^{15}	0.36	15.00489		
	N^{16}		16.0107	7.3 s	β^- $\sim$4.0 $\sim$10.3 γ $\sim$6.5
	N^{17}			4.13 s	β^- 3.7
8	O^{14}			76.5 s	β^+ 1.8 γ 2.3
	O^{15}		15.0078	2.1 m	β^+ 1.7
	O^{16}	99.76	16.000000 (standard)		
	O^{17}	0.04	17.00450		
	O^{18}	0.20	18.0049		
	O^{19}		19.00938	29.5 s	β^- 2.9 4.5 γ 1.6
9	F^{17}		17.00784	66 s	β^+ 1.7
	F^{18}		18.0067	1.87 h	β^+ 0.6
	F^{19}	100%	19.00454		
	F^{20}		20.0065	12 s	β^- 5.1 γ 1.6
10	Ne^{19}		19.00798	18.2 s	β^+ 2.3 no γ
	Ne^{20}	90.51	19.99872		

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
10	Ne^{21}	0.28	20.99963		
	Ne^{22}	9.21	21.99844		
	Ne^{23}		23.0006	40 s	β^- 4.2
11	Na^{20}			23 s	β^+ >3.5
	Na^{21}		20.99963	23 s	β^+ 2.53
	Na^{22}		22.00154	2.6 y	β^+ 0.54 1.8 γ 1.28
	Na^{23}	100	22.99618		
	Na^{24}		23.99831	14.9 h	β^- 1.39 γ 1.38 2.758
	Na^{25}		24.99715	62 s	β^- 2.7 3.7 γ >0.5
12	Mg^{23}		23.0002	11.9 s	β^+ 2.82
	Mg^{24}	78.6	23.9924		
	Mg^{25}	10.1	24.9938		
	Mg^{26}	11.3	25.9898		
	Mg^{27}		26.9926	9.6 m	β^- 0.8 1.8 γ 0.64 0.84 1.01
13	Al^{24}			2.3 s	
	Al^{25}			7.3 s	β^+
	Al^{26}		25.9941	7 s	β^+ 2.8
	Al^{27}	100			
	Al^{28}		27.9917	2.30 m	β^- 3.01 γ 1.80
	Al^{29}		28.9893	6.7 m	β^- 1.4 2.5 γ 1.2 2.3
14	Si^{27}		26.9946	4.9 s	β^+ 3.6
	Si^{28}	92.28	27.9866		
	Si^{29}	4.67	28.9866		
	Si^{30}	3.05	29.9832		
	Si^{31}		30.9862	2.6 h	β^- 1.486 no γ
15	P^{29}		28.9916	4.6 s	β^+ 3.6
	P^{30}		29.9880	2.5 m	β^+ 3.0
	P^{31}	100	30.9843		
	P^{32}		31.98272	14.3 d	β^- 1.718 no γ

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
15	P^{33}			25 d	β^-	0.26
	P^{34}		33.9825	12.4 s	β^- γ	3.2 5.1 1.9
16	S^{31}		30.9895	2.9 s	β^+	3.85
	S^{32}	95.06	31.98085			
	S^{33}	0.74	32.9800			
	S^{34}	4.18	33.97710			
	S^{35}		34.9788	87.1 d	β^-	0.167
	S^{36}	0.0136	35.978			
	S^{37}		36.98212	5.0 m	β^- γ	1.6 4.3 2.7
17	Cl^{33}		32.9860	2.8 s	β^+	4.1
	Cl^{34}		33.9826	33.0 m	β^+ γ	1.3 2.6 4.5 0.15 2.13 3.30
	Cl^{35}	75.4	34.97867			
	Cl^{36}		35.9787	4 × 10^5 y	β^- β^+ γ	0.716 (?)
	Cl^{37}	24.6	36.97750			
	Cl^{38}		37.981	38.5 m	β^- γ	1.11 2.77 4.81 1.6 2.15
	Cl^{39}			55.5 m	β^-	2.5
18	A^{35}		34.9850	1.84 s	β^+	4.4
	A^{36}	0.34	35.9780			
	A^{37}		36.9777	34.1 d	K	no γ
	A^{38}	0.06	37.974			
	A^{39}			2.4 m ↓ IT	β^-	2.1
				265 y	β^-	0.565
	A^{40}	99.6	39.9756			
	A^{41}		40.9774	1.8 h	β^- γ	1.25 2.55 1.3
	A^{42}			>200 d		
19	K^{37}			1.2 s	β^+	4.57
	K^{38}		37.9795	7.5 m	β^+ γ	2.53 2.1
	K^{39}	93.1				

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
19	K^{40}	0.0119% NR	39.9773	~1.4 × 10^9 y	β^- β^+ γ K	1.4 1.5
	K^{41}	6.9%	40.9747			
	K^{42}		41.9749	12.4 h	β^- γ	3.6 2.4 1.5
	K^{43}			22.4 h	β^- γ	0.24 0.81 no β^+ ~0.4
	K^{44}			18 m	β^-	
20	$Ca^{<39(?)}$			4.5 m	β^+	
	Ca^{39}			1.1 s	β^+	5.13
	Ca^{40}	96.92	39.9753			
	Ca^{41}			1.2 × 10^5 y	K X-Rays	
	Ca^{42}	0.64	41.9711			
	Ca^{43}	0.13	42.9723			
	Ca^{44}	2.13				
	Ca^{45}		44.9672	152 d	β^-	0.255 no γ
	Ca^{46}	0.0032				
	$Ca^{47(?)}$			5.8 d	β^- γ	1.1 1.3
	Ca^{48}	0.179				
	Ca^{49}		48.9698	8.5 m	β^- γ	2.7 2.7
				2.5 h	β^- γ	2.3 0.8
21	Sc^{41}			0.87 s	β^+	4.94
	Sc^{43}		42.9764	3.9 h	β^+ γ	1.1 1.05
	Sc^{44}			2.44 d ↓ IT	e^-	0.271
				3.96 h	β^+ γ K	1.45 1.18
	Sc^{45}	100	44.9669			
	Sc^{46}		45.9686	20 s ↓ IT	e^-	0.140 no β^-
				85 d	β^- γ	0.36 1.2 0.89

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
21	Sc^{47}			3.4 d	β^- γ	0.61 (?)
	Sc^{48}			1.83 d	β^- γ K	0.64 0.98 1.33
	Sc^{49}			57 m	β^- γ n	2.4
22	Ti^{43}			0.58 s		
	Ti^{45}			3.09 h	β^+ γ	1.0 0.48 0.80
	Ti^{46}	7.95	45.9661			
	Ti^{47}	7.75	46.9647			
	Ti^{48}	73.45	47.9631			
	Ti^{49}	5.51	48.9646			
	Ti^{50}	5.34	49.9621			
	Ti^{51}			6 m	β^- γ	1.6 0.32
23	V^{47}			33 m	β^+ γ	1.7
	V^{48}			16.0 d	β^+ γ K	0.72 1.32 0.99 2.22
	V^{49}			600 d	K	no β^+ no γ no e^-
	V^{50}	0.25				
	V^{51}	99.75	50.9577			
	V^{52}			2.6 m	β^- γ	2.0 1.45
				3.74 m	γ	0.25
24	Cr^{48}			~23 h		
	Cr^{49}			41.9 m	β^+ γ	1.45 0.19 1.55
	Cr^{50}	4.41	49.96436			
	Cr^{51}		50.958	26 d	γ e^- K	0.32 0.267 no β^+
	Cr^{52}	83.46	51.95590			
	Cr^{53}	9.54	52.95519			
	Cr^{54}	2.61	53.95419			

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV				
24	Cr^{55}			1.3 h						
25	Mn^{51}			46 m	β^+	2.4				
	Mn^{52}			21 m	β^+	2.66				
					γ	1.46				
					e^-	0.39				
				↓ IT						
				6.2 d	β	0.582				
					γ	0.734	0.94	1.46		
					K					
	Mn^{54}			310 d	β^-	1.0				no β^+
					γ	0.835				
					K					
	Mn^{55}	100	54.957							
	Mn^{56}			2.59 h	β^-	2.86	1.05	0.73		
					γ	0.845	1.81	2.13	2.7	3.0
26	Fe^{52}			7.8 h	β^+	$\sim$0.55				no γ
					K					
	Fe^{53}			8.9 m	β^+	2.8				
					γ	(?)				
	Fe^{54}	5.90	53.95766							
	Fe^{55}			2.94 y	K					no β^+ no γ no e^-
	Fe^{56}	91.52	55.95332							
	Fe^{57}	2.245	56.95477							
	Fe^{58}	0.33	57.95083							
	Fe^{59}			46 d	β^-	0.46				
					γ	1.1	1.3			
27	Co^{55}			18 h	β^+	1.50	1.01			
					γ	0.935	1.41	0.477	0.095	
					K					
	Co^{56}		55.9618	80 d	β^+	1.50				
					γ	0.845	1.26			
						1.74	2.01			
						2.55	3.25			
					e^-					
					K					
	Co^{57}				β^+	0.26				
					γ	0.131	0.119	0.014		
					e^-					
					K					
	Co^{58}			9.2 h ↓ IT	e^-	0.025				
				72 d	β^+	0.47				
					γ	0.81				
					K					

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay				
					Radiation	— Energies in MEV			
27	Co^{59}	100							
	Co^{60}		59.9529	10.7 m	β^-	1.56			
					γ	1.33			
					e^-	0.059			
				↓ IT					
				5.25 y	β	0.31			
					γ	1.17	1.332		
	Co^{61}			1.75 h	β^-	1.0	1.42		
					γ	0.5			
	Co^{62}			13.9 m	β^-	2.3			
					γ	1.3			
				↓ IT					
				1.6 m	β^-				
					γ				
	Co^{64}			4.5 m	β^-				
28	Ni^{56}			6.4 d	β^+				
					γ	0.17	0.96	0.48	0.28
					K				
	Ni^{57}			36.4 h	β^+	0.845			
					γ	1.39	1.9		
					e^-	0.114			
	Ni^{58}	67.8							
	Ni^{59}			7.5×10^5 y	K				no β^+
	Ni^{60}	26.2	59.94981						
	Ni^{61}	1.2	60.9540						
	Ni^{62}	3.7	61.94959						
	Ni^{63}			85 y	β	0.067			no β^+ no γ
	Ni^{64}	1.1	63.94744						
	Ni^{65}			2.56 h	β^-	2.10	0.60	1.01	
					γ	1.49	1.12	0.37	
	Ni^{66}			56 h	β^-				
29	Cu^{58}			3 s					
				1.3 m	β^+				
	Cu^{59}			10 m	β^+				
	Cu^{60}			24.6 m	β^+	~1.8	3.3		
					γ	~1.5			
	Cu^{61}			3.33 h	β^+	1.205	0.550	0.266	0.190
					γ	0.655	0.284	0.076	
					K				

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
29	Cu^{62}			9.9 m	β^- 2.92 γ 0.56
	Cu^{63}	69.09			
	Cu^{64}			12.8 h	β^- 0.57 β^+ 0.65 γ 1.34 K
	Cu^{65}	30 91	64.955		
	Cu^{66}			5.18 m	β^- 2.58 γ 1.32
	Cu^{67}			58.5 h	β^- 0.54 γ
30	Zn^{62}			9.33 h	β^+ 0.66 γ 0.42 K
	Zn^{63}			38.3 m	β^+ 2.36 1.4 0.47 γ 0.960 1.89 2.60 K
	Zn^{64}	48.87	63.95356		
	Zn^{65}			250 d	β^+ 0.32 γ 1.14 0.201 e$^-$
	Zn^{66}	27.62	65.94667		
	Zn^{67}	4.12	66.9482		
	Zn^{68}	18.71	67.9488		
	Zn^{69}			13.8 h ↓ IT	e$^-$ 0.439
				52 m	β^+ 0.86 no γ
	Zn^{70}	0.69	69.9460		
	Zn^{71}			2.2 m	β^- 2.1 γ
	Zn^{72}			49 h	β^- 0.3 1.6 γ f
	Zn^{73}			<2 m	β^-
31	Ga^{64}			48 m	β^+
	Ga^{65}			18.5 m	γ 0.54 0.117 e$^-$ K
	Ga^{66}			9.2 h	β^+ 4.14 0.88 1.4 0.4 γ 1.03 2.75 4.8 K

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay	
					Radiation	— Energies in MEV
31	Ga^{67}			78.3 h	γ e^- K	0.93 0.297 0.180
	Ga^{68}			68 m	β^+ γ K	0.8 1.88 1.10
	Ga^{69}	60.0	68.956			
	Ga^{70}			20 m	β^- γ	1.65
	Ga^{71}	40.0	70.954			
	Ga^{72}			14.2 h	β^- γ	0.64 0.96 1.48 3.15 0.84 2.21 2.51
	Ga^{73}			5.0 h	β^-	1.4 no γ f
	$\mathrm{Ga}^{74(?)76}$			14.5 d	β^-	1.7 no γ
32	Ge^{66}			~2.5 h	β^+	
	Ge^{67}			21 m	β^+	
	Ge^{68}			250 d	β^+ K	
	Ge^{69}			40 h	β^+ γ K	1.215 0.610 0.220 1.120 0.576 0.870
	Ge^{70}	20.45				
	Ge^{71}			11.0 d	e^- K	0.32
	Ge^{72}	27.41				
	Ge^{73}	7.77				
	Ge^{74}	36.58				
	Ge^{75}			48 s	γ	0.175
				82 m	β^- γ	1.137 0.614 0.265 0.408 0.572
	Ge^{76}	7.79				
	Ge^{77}			59 s	β^- e^-	2.8 0.380 f
				12 h	β^- γ	2.2 complex 0.263 f
	Ge^{78}			2.1 h	β^- γ	~0.9 f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
33	As^{70}			52 m	β^+
	As^{71}			50 h	β^+ 0.6 γ 0.173 K
	As^{72}			26 h	β^+ 2.50 3.34 1.84 0.67 γ 0.6 0.7 0.84 1.4 2.4 K
	As^{73}			76 d	e^- 0.052 K
	As^{74}			17.5 d	β^- 0.69 1.36 β^+ 0.92 1.53 γ 0.635 0.596 K
	As^{75}	100			
	As^{76}			27.6 h	β^- 3.12 2.56 1.4 0.4 γ 0.58 1.20 1.76 2.02
	As^{77}			40 h	β^- 0.68 no γ f
	As^{78}			1.33 h	β^- 1.4 4.1 γ 0.27 f
	As^{79}			9 m	β^- ~2.1
	As^{81}			<10 m	β^- f
34	Se^{70}			44 m	β^+
	Se^{72}			9.7 d	K
	Se^{73}			7.08 h	β^+ 1.318 0.750 1.680 0.250 γ 1.310 0.860 K
	Se^{74}	0.96			
	Se^{75}			128 d	γ 0.025 0.121 0.280 0.066 0.136 0.305 0.081 0.199 0.402 0.097 0.265 e^- no β^+ K
	Se^{76}	9.12			
	Se^{77}			17.5 s ↓IT	e^- 0.165
		7.50		stable	
	Se^{78}	23.61			
	Se^{79}			3.5 m ↓IT	e^- 0.096
				6.5×10^4 y	β^- 0.160 no γ

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
34	Se^{80}	49.96				
	Se^{81}			59 m ↓ IT	e^-	0.098 f
				17 m	β^-	1.38 no γ
	Se^{82}	8.84				
	Se^{83}			69 s	β^-	3.4 no γ f
				25 m	β^- γ	1.5 0.176 0.950 f
	Se^{84}			$\sim$2 m		f
35	Br^{74}			35 m		
	Br^{75}			1.7 h	β^+ K	1.70 0.80 0.3 0.6 no γ
	Br^{76}			17 h	β^+ γ e^-	3.57 0.6 0.8 1.1 1.21 0.33 0.75 0.18
	Br^{77}			57 h	β^+ γ e^- K	0.336 0.813 0.520 0.237 0.35
	Br^{78}			6.3 m	β^+ γ	2.3 0.046 0.108
	Br^{79}	50.57	79.9440			
	Br^{80}			4.4 h ↓ IT	γ e^-	0.037 0.049
				18.5 m	β^- β^+ K	1.97 1.1 0.7 0.868
	Br^{81}	49.43				
	Br^{82}			35.7 h	β^- γ K(?)	0.465 0.547 0.787 1.35 1.7 2.0 f
	Br^{83}			2.4 h	β^-	0.940 no γ f
	Br^{84}			33 m	β^- γ	5.3 f
	Br^{85}			3 m	β^-	2.5 no γ f
	Br^{87}			55.6 s	β^- γ n	$\sim$2 $\sim$8 5.2 f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
35	Br^{88}			15.5 s	β^- f
	Br^{89}			4.51 s	β^- n f
36	Kr^{77}			1.1 h	β^+ 1.7 γ K
	Kr^{78}	0.354	77.945		
	Kr^{79}			55 s ↓ IT	e^- 0.127
				34.5 h	β^+ 0.595 γ 0.263 0.044 K
	Kr^{80}	2.27			
	Kr^{81}			13 s ↓ IT	e^- 0.187 no β^+
				10^5 y	K
	Kr^{82}	11.56	81.938		
	Kr^{83}			1.9 h ↓ IT	γ 0.009 e^- 0.032 f
		11.55		stable	f
	Kr^{84}	56.90	83.939		
	Kr^{85}			4.4 h ↓ IT	β^- 0.855 γ 0.149 e^- 0.305 f
				9.4 y	β^- 0.72 γ 0.54 f
	Kr^{86}	17.37	85.939		f
	Kr^{87}			78 m	β^- 3.2 f
	Kr^{88}			2.77 h	β^- 2.4 ~0.5 γ 0.027 f
	Kr^{89}			3.18 m	β^- 4.0 2.0 γ f
	Kr^{90}			33 s	β^- 3.2 γ f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
36	Kr^{91}			10 s	β^- γ (?)	~3.6 f
	Kr^{92}			2.4 s	β^-	f
	Kr^{93}			2.3 s	β^-	f
	Kr^{94}			1.4 s	β^1	f
	Kr^{97}			1–2 s	β^-	f
37	Rb^{81}			4.7 h	β γ e^- K	0.99 0.95 0.2
	Rb^{82}			short	β^+ γ	3.15 0.95 ~0.40 ~0.15
				6.3 h	β^+ γ K	0.67 1.2 0.7
	Rb^{83}			107 d	γ K	0.8 ~0.45 ~0.15
	Rb^{84}			23 m	e^- K	0.32
				40 d	β^+ K	
	Rb^{85}	72.15				
	Rb^{86}			19.5 h ↓ IT	β^- γ	1.822 0.716 1.08 f
				1.06 m	γ K	0.78 f
	Rb^{87}	27.85 NR		6×10^{10} y	β^- γ (?)	0.275
	Rb^{88}			17.8 m	β^- γ	5.13 3.29 2.04 0.90 1.86 2.8 f
	Rb^{89}			15.4 m	β^-	4.5 f
	Rb^{90}			2.74 m	β^- γ	5.7 f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
37	Rb^{91}			100 s	β^- γ	4.6 f
				14 m	β^- γ	3.0 f
	Rb^{92}			short	β^-	f
	Rb^{93}			short	β^-	f
	Rb^{94}			short	β^-	f
	Rb^{97}			short	β^-	f
38	Sr^{81}			29 m		
	Sr^{82}			25.5 d		
	Sr^{83}			38 h	β^+ γ	1.15 0.040 0.074 0.101 1.151 0.165
	Sr^{84}	0.55				
	Sr^{85}			70 m ↓ IT	γ e^- K	0.185 0.0075 0.225 0.150
				65 d	γ K	0.513 no β^+
	Sr^{86}	9.75				
	Sr^{87}			2.80 h ↓ IT	e^-	0.390
		6.96		stable		
	Sr^{88}	82.74				
	Sr^{89}			54 d	β^-	1.5 no γ f
	Sr^{90}			25 y	β^-	0.54 no γ f
	Sr^{91}			9.7 h	β^- γ	3.2 1.3 1.3 f
	Sr^{92}			2.7 h	β^-	f
	Sr^{93}			7 m	β^-	f

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV	
38	Sr^{94}			~2 m	β^-		f
	Sr^{97}			short	β^-		f
39	Y^{84}			3.7 h	β^+ γ K	2.0	
	Y^{86}			14.6 h	β^+ γ	1.19 1.80 1.4	
	Y^{87}			14 h ↓ IT	β^+ e$^-$	1.1 0.384	
				80 h	β^+ γ K	0.70 0.485	
	Y^{88}			2.0 h	β^+	1.6	
				105 d	β^+ γ K	0.83 0.9 1.85 2.76	
	Y^{89}			14 s ↓ IT	e$^-$	0.913	
		100		stable			
	Y^{90}			65 h	β^-	2.24	no γ f
	Y^{91}			51 m ↓ IT	e$^-$ β	0.555 1.56	f no γ
				57 d			f
	Y^{92}			3.5 h	β^- γ	3.5 0.7	f
	Y^{93}			10 h	β^- γ	3.1 0.7	f
	Y^{94}			16.5 m	β^- γ	5.4 1.4	f
	Y^{95}			10.5 m	β^-		f
	Y^{97}			short	β^-		f
40	Zr^{86}			17 h			
	Zr^{87}			1.6 h	β^+ γ K	2.10 0.35 0.65	

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV	
40	Zr^{88}			$\sim$150 d	γ K	0.406	
	Zr^{89}			4.4 m ↓ IT	β^+ γ e$^-$	0.85 1.53 0.588	
				80.1 h	β^+ K	0.890	
	Zr^{90}	51.46					
	Zr^{91}	11.23					
	Zr^{92}	17.11					
	Zr^{93}			$\sim 5 \times 10^6$ y	β^-	0.06	f
	Zr^{94}	17.40					
	Zr^{95}			65 d	β^- γ e$^-$	0.39 1.0 0.73 0.23 0.92	f
	Zr^{96}	2.8					
	Zr^{97}			17.0 h	β^- γ	2.50 0.74 1.42	f
41	Nb^{90}			15 h	β^+ γ	1.9 0.14 1.14 2.23	
	Nb^{91}			62 d ↓ IT	e$^-$	0.104	
				8 y	K		
	Nb^{92}			10.1 d	γ K	0.933 0.20	
	Nb^{93}			40 d ↓ IT			
		100%		stable			
	Nb^{94}			6.6 m ↓ IT	β^- γ e$^-$	1.3 0.9 0.0415	
				5×10^4 y			
	Nb^{95}			90 h ↓ IT	e$^-$	0.216	f
				35 d	β^- γ	0.163 0.771	
	Nb^{96}			22.9 h	β^- γ	0.370 0.750 1.1 0.9 0.45	

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
41	Nb^{97}			60 s ↓ IT	e^-	0.747 f
				74 m	β^- γ	1.267 0.665 f
	Nb^{98}			30 m	β^-	
	Nb^{99}			2.5 m	β^-	3.2
42	Mo^{91}			15.5 m	β^+	3.7 no γ
				75 s	β^+ γ	2.6 0.3
	Mo^{92}	15.05				
	Mo^{93}			6.75 h ↓ IT	γ e^-	0.687 1.51 0.256
				<2 y	γ K	
	Mo^{94}	9.35				
	Mo^{95}	15.78	94.945			
	Mo^{96}	16.56	95.946			
	Mo^{97}	9.60	96.945			
	Mo^{98}	24.60	97.994			
	Mo^{99}			67 h	β^- γ	1.23 0.445 <0.2 0.04 0.367 0.740 0.780 f
	Mo^{100}	9.68	99.939			
	Mo^{101}			14.6 m	β^- γ	1.0 2.2 0.3 0.9 f
	Mo^{102}			12 m	β^-	f
	Mo^{105}			short	β^-	f
43	Tc^{92}			4.5 m	γ e^- K	1.51 0.39
	Tc^{93}			44 m	β^+ γ e^-	0.800 1.32 0.390
	Tc^{94}			52.5 m	β^+ γ K	2.41 0.87 1.85 2.73 3.27

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay					
					Radiation	— Energies in MEV				
43	Tc^{95}			62 d	β^+	0.4				
					γ	1.02	0.76	0.57	0.20	
					e^-	0.039				
					K					
				↓ IT						
				20.0 h	γ	1.07	0.76	0.57	0.20	
					K					
	Tc^{96}			51.5 m	e^-	0.034				
				↓ IT						
				4.35 d	γ	0.312	1.119	0.806	0.77	
							0.84			
	Tc^{97}			90 d	e^-	0.096				
				↓ IT						
				>1000 y	β^+ or K					
	Tc^{98}			2.7 d	β^-	0.75				
					γ	1.0				
				↓ IT						
				41 m	β^+	2.1				
					γ	0.2	0.86			
					K					
	Tc^{99}					(chem state)				
				5.9 h	γ	0.002	0.140			
					e^-	0.142				
				↓ IT						f
				5×10^6 y	β^-	0.292				
										f
	Tc^{100}			15.8 s	β^-	2.8				
					γ					
	Tc^{101}			15 m	β^-	1.30				
					γ	0.307				
										f
	Tc^{102}			<25 s	β^-	3.7				
					γ					
										f
	Tc^{105}			short						
										f
44	Ru			57 m						
	Ru^{95}			1.6 h	β^+	1.1				
					γ	0.95				
					K					
	Ru^{96}	5.68	95.945							
	Ru^{97}			2.8 d	γ	0.217				
					e^-					
					K					
	Ru^{98}	2.22								

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay		
					Radiation	Energies in MEV	
44	Ru^{99}	12.81	98.944				
	Ru^{100}	12.70					
	Ru^{101}	16.98					
	Ru^{102}	31.34					
	Ru^{103}			39.8 d	β^- γ	0.684 0.222 0.0404 0.494	f
	Ru^{104}	18.27					
	Ru^{105}			4.5 h	β^- γ	1.15 0.726 0.13	f
	Ru^{106}			1 y	β^-	0.041	f
	Ru^{107}			4 m	β^-	$\sim$4	f
45	Rh^{99}			4.5 h	β^+	0.74	no γ
	Rh^{100}			21 h	β^+ γ e^-	1.3 3.0 1.8 0.6	
	Rh^{101}			4.5 d	γ K	0.35 0.13 0.08	no β^+
	Rh^{102}			210 d	β^+ β^- γ	1.3 1.04 $\sim$0.46	
	Rh^{103}		102.949	57 m ↓ IT	e^-	0.040	f
		100		stable			
	Rh^{104}			4.3 m ↓ IT	e^-	0.052	
				44 s	β^- γ	2.6 0.041 0.18 0.95	
	Rh^{105}			45 s ↓ IT	e^-	1.30	f
				36.2 h	β^- γ	0.25 0.57 0.32	f
	Rh^{106}			30 s	β^- γ	3.55 2.30 3.1 0.513 0.624 1.045	f
	Rh^{107}			26 m	β^- γ (?)	1.2	f
	$Rh^{108?}$			9 h	β^- γ	$\sim$1.3 0.8	f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV			
45	Rh^{109}			<1 h					f
46	Pd^{100}			4.0 d	γ K	0.09	1.8		
	Pd^{101}			9 h	β^+ K	2.3	0.53		no e^- no γ
	Pd^{102}	0.8							
	Pd^{103}			17 d	K				no e^- no γ
	Pd^{104}	9.3							
	Pd^{105}	22.6							
	Pd^{106}	27.1	105.946						
	Pd^{107}			7×10^6 y	β^-	0.035			f
	Pd^{108}	26.7							
	Pd^{109}			4.8 m ↓ IT	e^-	0.19			f
				13.1 h	β^-	0.95			no γ f
	Pd^{110}	13.5	109.944						
	Pd^{111}			5.5 h ↓ IT	β^- γ	2.15 0.16	 1.77		f
				22 m	β^- γ	2.15 0.38	 0.65	 0.73	f
	Pd^{112}			21 h	β^-	0.2			no γ f
47	Ag^{102}			73 m	β^+ K				
	Ag^{104}			16.3 m	β^+ ?				
	Ag^{105}			40 d	γ K	0.28	0.35	0.43	no β^+ 0.063
	Ag^{106}			8.6 d	γ e^- K	1.24 0.624	1.045 0.513	1.55 0.410	
				24 m	β^+ γ	1.945 0.513	1.5		
	Ag^{107}			44.3 s ↓ IT	e^-	0.093			
		51.35	106.950	stable					

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
47	Ag^{108}			2.4 m	β^- γ	1.49 0.83 0.615 0.420 0.188
	Ag^{109}			39.2 s ↓ IT	e^-	0.087 f
		48.65	108.949	stable		
	Ag^{110}			270 d ↓ IT	β^- γ e^-	0.087 0.53 1.516 1.389 0.706 0.885 0.759 0.656 0.116
				24.5 s	β^- γ	2.12 2.86 0.656
	Ag^{111}			↓ IT	e^-	0.085
				7.5 d	β^- γ	1.04 0.70 0.80 0.093 0.243 0.340
	Ag^{112}			3.20 h	β^- γ	3.5 0.86
	Ag^{113}			5.3 h	β^-	2.0 no γ
	Ag^{114}			2 m	β^-	
	Ag^{115}			20 m	β^-	3.0 no γ
48	Cd^{105}			38 m	β^+ γ K	1.5
	Cd^{106}	1.22				
	Cd^{107}			6.7 h	β^+ γ K	0.32 0.847
	Cd^{108}	0.89				
	Cd^{109}			330 d	γ K	0.08
	Cd^{110}	12.43				
	Cd^{111}			48.7 m ↓ IT	γ e^-	0.243 0.149 f
		12.86		stable		
	Cd^{112}	23.79				
	Cd^{113}			5.1 y ↓ IT	β^-	0.5
		12.34		stable		
	Cd^{114}	28.81				

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
48	Cd^{115}			2.33 d	β^- γ	0.46 1.1 0.52 f
				43 d	β^- γ	1.41 1.10
	Cd^{116}	7.66				
	Cd^{117}			40 m		f
				2.83 h	β^-	~1.5 f
49	In^{107}			33 m	β^+	
	In^{108}			50 m	β^+ γ	2.31 0.285
	In^{109}			4.2 h	β^+ γ K	0.75 0.5
	In^{110}			4.9 h ↓ IT	γ e^-	0.935 0.885 0.656 0.119
				66 m	β^+ γ	2.25 0.65
	In^{111}			2.84 d	γ K	no β^+ 0.172 0.246 0.093 0.330
	In^{112}			23 m ↓ IT	e^-	0.16
				9 m	β^+ β^- K	1.7 1.0
	In^{113}			1.73 h ↓ IT	e^-	0.393
		4.16		stable		
	In^{114}			50 d ↓ IT	e^-	0.192
				72 s	β^+ β^- γ K	0.65 1.98 0.715 0.548
	In^{115}			4.5 h ↓ IT	β^- e^-	0.83 0.336 f
		95.84 NR		6×10^{14} y	β^-	0.63
	In^{116}			54 m ↓ IT	β^- γ	0.6 0.87 1.0 1.274 1.085 2.09 0.406 1.487
				13 s	β^-	2.95 no γ

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	Energies in MEV	
49	In^{117}			1.9 h	β^-	1.95	no γ
	In^{118}			4.5 m	β^- γ	1.5	
	In^{119}			17.5 m	β^-	2.7	no γ
50	$\mathrm{Sn}^{108?}$			4.0	K		
	$\mathrm{Sn}^{109?}$			15 m	β^+		
	$\mathrm{Sn}^{110?}$			4.5 h	K		
	Sn^{111}			35 m	β^+ K	1.51	
	Sn^{112}	1.01					
	Sn^{113}			118 d	γ K	0.255 0.401	
	Sn^{114}	0.68					
	Sn^{115}	0.35					
	Sn^{116}	14.28	115.943				
	Sn^{117}			14.5 d ↓ IT	γ e^-	0.162 0.159	
		7.67		stable			
	Sn^{118}	23.84	117.940				
	Sn^{119}			245 d ↓ IT	e^-	0.065 0.024	
		8.68		stable			
	Sn^{120}	32.75	119.920				
	Sn^{121}			27.5 h	β^-	0.38	no γ no e^-
				>400 d	β^-	0.42	f
	Sn^{122}	4.74	121.946				
	Sn^{123}			125 d	β^-	1.42	f
				39.5 m	β^- γ	1.26 0.15 0.4	
	Sn^{124}	6.01 NR	123.945	$>1.7 \times 10^{17}$ y	$2\beta^-$'s		
	Sn^{125}			9.5 m	β^- γ	1.17 0.5 1.86	
				9.4 d	β^- γ	2.33 2.04 0.326	f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
50	Sn^{126}			70 m	β^- γ	0.7 2.7 1.2 f
	Sn^{127}			1.5 h		
51	Sb^{116}			60 m	β^+ γ	~1.45 ~0.70
	Sb^{117}			2.8 h	γ e^- K	0.156 no β^+ 0.46
	Sb^{118}			5.1 h ↓ IT	γ e^- K	0.26 1.50 0.20
				3.3 m	β^+ γ	3.1
	Sb^{119}			39 h	K	no β^+ no γ
	Sb^{120}			16.4 m ↓ IT	β^+ γ	1.7 1.3 0.9 2.2
				6.0 d	γ e^- K	1.1
	Sb^{121}	57.25				
	Sb^{122}			3.5 m ↓ IT	γ e^-	0.14 0.069
				2.8 d	β^- γ	1.36 1.94 0.58 1.24 0.680
	Sb^{123}	42.75				
	Sb^{124}			21 m ↓ IT	β^- γ e^-	2.5 0.607 0.0185
				60 d	β^- γ	3.2 0.6 1.7 0.607
				IT ↑ 1.3 m	β^- γ e^-	3.2 0.607 0.012
	Sb^{125}			2.7 y	β^- γ	0.299 0.128 0.616 0.465 0.425 0.637 0.035 f
	Sb^{126}			9 h	β^- γ	1.0 0.4 0.9 f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV	
51	Sb^{127}			93 h	β^- γ	1.2 0.72	f
	Sb^{128}			1.1 h	β^-		f
	Sb^{129}			4.2 h	β^-		f
	Sb^{131}			23.2 m	β^-		f
	Sb^{132}			2.2 m	β^-		f
	Sb^{133}			4.5 m	β^-		f
	Sb^{134}?			~50 s	β^-		f
52	Te^{117}?			2.5 h	β^+ e^-		
	Te^{118}			6.0 d	K		
	Te^{119}			4.5 d	γ e^- K	1.6 0.2 0.5	
	Te^{120}	0.090					
	Te^{121}			154 d ↓ IT	γ e^-	0.213 0.082	
				17 d	γ K	0.575	
	Te^{122}	2.47					
	Te^{123}			121 d ↓ IT	e^-	0.088 0.159	
		0.89		stable			
	Te^{124}	4.74					
	Te^{125}			58 d ↓ IT	e^-	0.110 0.035	f
		7.03		stable			
	Te^{126}	18.72					
	Te^{127}			113 d ↓ IT	e^-	0.088	f
				9.3 h	β^-	0.70 no γ	f
	Te^{128}	31.75					

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV	
52	Te^{129}			34 d ↓ IT	β^- e^-	 0.106	f
				72 m	β^- γ	1.8 0.3	f
	Te^{130}	34.27					
	Te^{131}			1.25 d ↓ IT	β^- e^-	 0.183	f
				25 m	β^- γ	2.0	f
	Te^{132}			77.7 h	β^- γ	0.28 0.22	f
	Te^{133}			63 m ↓ IT	β^- e^-	 0.30	f
				2 m	β^- γ	1.3 2.4 0.6 1.0	f
	Te^{134}			44 m	β^-		f
	Te^{135}			<2 m	β^-		f
	$Te^{137?}$			~1 m	β^-		f
53	I^{121}			1.8 h	β^+ e^-	1.2 0.185	
	I^{122}			3.6 m	β^+	3.1	
	I^{123}			13 h	γ e^- K	0.159	
	I^{124}			4 d	β^+ γ K	2.2 1.5 0.67 0.6 0.7 1.95 1.72	
	I^{125}			56 d	γ K	0.0355	
	I^{126}			13 d	β^+ β^- γ K	 0.85 1.24 0.395 0.640	
	I^{127}	100	126.932				
	I^{128}			25 m	β^- γ	2.02 1.59 0.428	

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV				
53	I^{129}			1.72 × 10^7 y	β^-	0.13				
					γ	0.039				f
	I^{130}			12.5 h	β^-	1.03	0.61			
					γ	0.417	0.744	0.667	0.537	
	I^{131}			8.04 d	β^-	0.60	0.32			
					γ	0.364	0.284	0.080	0.638	f
	I^{132}			2.4 h	β^-	1.5	2.2			
					γ	0.6	1.4			f
	I^{133}			22.4 h	β^-	1.4	0.5			
					γ	0.53	0.85	1.4		f
	I^{134}			52.5 m	β^-	3.9	1.6			
					γ	2.3				f
	I^{135}			6.7 h	β^-	1.0	0.47	1.4		
					γ	1.3	1.6	2.4		f
	I^{136}			86 s	β^-	6.5				
					γ	2.9				f
	I^{137}			22 s	β^-					f
	I^{138}			5.9 s	β^-					f
	I^{139}			2.7 s	β^-					f
54	Xe^{124}	0.095								
	Xe^{125}			18 h						No β^-
					γ	0.054	0.096	0.106		No β^+
						0.187	0.243			
					K					
	Xe^{126}	0.088								
	Xe^{127}			75 s ↓ IT	e^-	0.175	0.096			
				32 d	γ	0.057	0.145	0.170	0.200	
					e^-					
					K					
	Xe^{128}	1.91								
	Xe^{129}			8.0 d ↓ IT	e^-	0.196	0.039			
		26.24	128.946	stable						
	Xe^{130}	4.053								

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
54	Xe^{131}			12.0 d ↓ IT	e^- 0.163 f
		21.24		stable	stable f
	Xe^{132}	26.93	131.946		f
	Xe^{133}			2.3 d ↓ IT	β^- e^- 0.232 f
				5.27 d	β^- 0.345 γ 0.081 0.232 f
	Xe^{134}	10.52			f
	Xe^{135}			15.3 m ↓ IT	e^- 0.52
				9.2 h	β^- 0.93 γ 0.247 f
	Xe^{136}	8.93			
	Xe^{137}			3.9 m	β^- ~4.0 f
	Xe^{138}			17 m	β^- f
	Xe^{139}			41 s	β^- f
	Xe^{140}			16 s	β^- f
	Xe^{141}			3 s	β^- f
	Xe^{143}			~1 s	β^- f
	Xe^{144}			~1 s	β^- f
	Xe^{145}			0.8 s	β^- f
55	Cs^{127}			5.5 h	β^+ ~1.2
	Cs^{128}			3.1 m	β^+ 3.0
	Cs^{129}			31 h	γ ~0.5 e^- 0.33 no β^+
	Cs^{130}			30 m	β^- 0.442 β^+ 1.97 no γ K

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
55	Cs^{131}			10 d	K	no β^+
	Cs^{132}			7.1 d	γ e^- K	0.62
	Cs^{133}	100				
	Cs^{134}			3.15 h ↓ IT	β^- γ e^-	2.4 0.7 0.128
				2.3 y	β^- γ	0.648 0.092 0.793 0.601 0.567
	Cs^{135}			2.9×10^6 y	β^-	0.19 no γ f
	Cs^{136}			13 d	β^- γ	0.35 0.28 0.9 1.2 f
	Cs^{137}			33 y	β^- γ	0.518 1.17 0.663
	Cs^{138}			33 m	β^- γ	2.68 1.2
	Cs^{139}			9.5 m	β^-	f
	Cs^{140}			66 s	β^-	f
	Cs^{141}			short	β^-	f
	Cs^{142}			~1 m	β^-	f
	Cs^{143}			short	β^-	f
	Cs^{144}			short	β^-	f
	Cs^{145}			short	β^-	f
56	Ba^{128}			2.4 d	β^+ γ	3.1
	Ba^{129}			2.0 h	β^+	
	Ba^{130}	0.103				
	Ba^{131}			13 d	γ K	no β^+ 0.494 0.122 0.372 0.206 no e^-
	Ba^{132}	0.096				

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV	
56	Ba^{133}			38.9 h ↓ IT	e^-	0.275 0.012	
				10 y	γ e^- K	0.085 0.320	
	Ba^{134}		2.39				
	Ba^{135}			28.7 h ↓ IT	e^-	0.269	
		6.56		stable			
	Ba^{136}	7.74					
	Ba^{137}			2.6 m ↓ IT	e^-	0.661	f
		11.25		stable			
	Ba^{138}	71.83					
	Ba^{139}			85 m	β^- γ	2.27 0.165 1.05	f
	Ba^{140}			12.8 d	β^- γ	1.022 0.48 0.54 0.306 0.160	f
	Ba^{141}			18 m	β^- γ	2.8	f
	Ba^{142}			6 m	β^-		f
	Ba^{143}			<30 s	β^-		f
	Ba^{144}			short	β^-		f
	Ba^{145}			short	β^-		f
57	La^{131}			58 m	β^+	1.6	
	La^{132}			4.5 h	β^+ γ	3.5 1.0	
	La^{133}			4.0 h	β^+ γ K	1.2 0.8	
	La^{134}			6.5 m	β^+ K	2.7	no γ no e^-
	La^{135}			19.5 h	γ K	0.76	
	La^{136}			9.5 m	β^+ γ K	2.1	

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
57	La^{137}			>400 y		
	La^{138}	0.089 NR		1.2 × 10^{12} y	β^- γ e^-	1.0 1.0
	La^{139}	99.911	138.955			
	La^{140}			40.0 h	β^- γ	1.32 1.67 2.26 1.65 0.87 2.3 0.33 f
	La^{141}			3.7 h	β^-	2.8 f
	La^{142}			77 m	β^- γ	f
	La^{143}			19 m	β^-	f
	La^{144}			short	β^-	f
	La^{145}			short	β^-	f
58	Ce^{133}			6.3 h	β^+ γ K	1.3 1.8
	Ce^{134}			72.0 h	K	no γ
	Ce^{135}			22 h	β^+	0.8
	Ce^{136}	0.195				
	Ce^{137}			36 h	γ K	0.28 0.75 no β^+ no e^-
	Ce^{138}	0.265				
	Ce^{139}			140 d	γ K	0.166 0.275
	Ce^{140}	88.45				
	Ce^{141}			32.5 d	β^- γ	0.41 0.56 0.141 f
	Ce^{142}	11.10				
	Ce^{143}			33 h	β^- γ	1.36 0.04 0.20 0.87 f
	Ce^{144}			290 d	β^- γ	0.307 0.446 0.03 0.134 f
	Ce^{145}			1.8 h	β^-	f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
58	Ce^{146}			14.6	β^-	f
59	Pr^{138}			2.0 h	β^+ γ e^- K	1.4 0.16 0.50 1.3
	Pr^{139}			4.5 h	β^+ γ K	1.0 1.0
	Pr^{140}			3.5 m	β^+ γ K	2.5 1.2
	Pr^{141}	100				
	Pr^{142}			19.1 h	β^- γ	2.154 0.636 1.576 0.135
	Pr^{143}			13.8 d	β^-	0.93 no γ f
	Pr^{144}			17 m	β^- γ	2.87 1.25 0.695 0.22 f
	Pr^{145}			4.5 h	β^-	3.2 no γ f
	Pr^{146}			24.6 m	β^- γ	3.0 1.4 f
60	$Nd^{138?}$			22 m	β^+	2.4
	Nd^{139}			5.5 h	β^+ γ e^- K	3.1 0.28 1.3
	Nd^{140}			3.3 d	γ K	
	Nd^{141}			2.42 h	β^+ γ K	0.7 1.05
	Nd^{142}	27.13				
	Nd^{143}	12.20				
	Nd^{144}	23.87				
	Nd^{145}	8.30				
	Nd^{146}	17.18	145.964			
	Nd^{147}			11.6	β^- γ	0.78 0.35 0.091 0.520 f
	Nd^{148}	5.72	147.946			

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
60	Nd^{149}			1.8 h	β^- 0.95 1.1 1.5 γ 0.030...0.650
	Nd^{150}	5.60 NR	149.970	$>2 \times 10^{15}$ y	
	Nd^{151}			12 m	β^- 1.93 γ 0.085 0.72 1.14
61	Pm^{141}			20 m	β^+ $\sim$2.6 γ
	Pm^{142}			? <2 m	
	Pm^{143}			285 d	γ 0.95 K
	Pm^{145}			$\sim$30 y	
	Pm^{146}			2.7 h	β^- 2.0 γ
	Pm^{147}			2.26 y	β^- 0.229 no γ f
	Pm^{148}			5.3 d	β^- 2.5 γ 0.8
				48 d	β^- 0.6 1.7 γ 0.54
	Pm^{149}			48 h	β^- 1.05 γ 0.25 f
	Pm^{150}			2.7 h	β^- 2.01 3.00 γ 0.3 1.4
	Pm^{151}			28 h	β^- 1.1 γ 0.065...0.715 f
	Pm^{153}			<5 m	β^-
	Pm^{156}			<5 m	β^-
62	Sm^{143}			8 m	
	Sm^{144}	2.87			
	Sm^{145}			410 d	γ 0.061 K
	Sm^{147}	14.94 NR		6.7×10^{11} y	α 2.1 no e^-
	Sm^{148}	11.24			
	Sm^{149}	13.85			
	Sm^{150}	7.36			
	Sm^{151}			70 y	β^- 0.075 no e^- f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay: Radiation	Mode of Decay: Energies in MEV
62	Sm^{152}	26.90				
	Sm^{153}			47 h	β^- γ	0.820 0.069 0.103 0.61 f
	Sm^{154}	22.84				
	Sm^{155}			23.5 m	β^- γ	1.8 0.105 0.246 f
	Sm^{156}			~10 h	β^-	~0.8 f
63	Eu^{145}			5 d	e^-	0.2
	Eu^{146}			38 h	e^-	0.4
	Eu^{147}			24 d	β^- e^- K	1.0 0.4 0.2
	Eu^{148}			58.6 d	γ e^- K	0.69 0.38
	Eu^{149}			14 d	γ e^- K	1.0 0.1
	Eu^{150}			13.1 h	β^- β^+	0.8 1.0 1.1 1.8
	Eu^{151}	47.77				
	Eu^{152}			9.2 h ↓ IT	β^- γ K	0.36 1.8 0.12 0.16 0.72 1.0
				5.3 y	β^- γ K	0.9 1.7 0.3 1.2
	Eu^{153}	52.23				
	Eu^{154}			5.4 y	β^- γ	0.3 0.7 1.9 1.22 1.17
	Eu^{155}			1.7 y	β^- γ	0.154 0.243 2.23 0.085 0.099 f
	Eu^{156}			15.4 d	β^- γ	0.5 2.5 2.0 f
	Eu^{157}			15.4 h	β^- γ	1.0 1.7 0.2 0.6 f
	Eu^{158}			60 m	β^-	2.6 f

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
63	Eu$^{159?}$			20 m	β^-
64	Gd^{149}			9 d	γ 3.0 e^- 0.35
	Gd^{150}			$>10^4$ y	α 2.7
	Gd^{151}			150 d	γ 0.265 no β^+ e^- 0.22 K
	Gd^{152}	0.20			
	Gd^{153}			236 d	γ 0.106 0.260 no β^+ e^- K
	Gd^{154}	2.15			
	Gd^{155}	14.78	154.977		
	Gd^{156}	20.59	155.977		
	Gd^{157}	15.71	156.976		
	Gd^{158}	24.78	157.976		
	Gd^{159}			18.0 h	β^- 0.85 γ 0.055 0.35
	Gd^{160}	21.79	159.976		
	Gd^{161}			3.6 m	β^- 1.5 γ 0.37 e^- 0.066
65	Tb^{152}			4.5 h	K
	Tb^{153}			5.1 d	γ 0.23 1.2 no β^+ e^- 0.15 K
	Tb^{154}			17.2 h	β^+ 2.6 γ 1.4 e^- 0.22 K
	Tb^{155}			190 d	γ 1.4 e^- 0.1 K
	Tb^{156}				β^+ 1.3 γ 0.3 1.1 K
	Tb^{157}			4.7 d	γ 1.4 e^- 0.09 0.2 K
	Tb^{158}			3.6 m	β^+
	Tb^{159}	100			

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
65	Tb^{160}			71 d	β^-	0.546 0.882 0.71
					γ	0.086...0.297 1.15
	Tb^{161}			7.2 d	β^-	0.50
					γ	0.05
66	Dy$^{154?}$			20 m	α	4.1
	Dy^{156}	0.052				
	Dy^{158}	0.0902				
	Dy^{159}			134 d	β^+	
					e^-	
					K	
	Dy^{160}	2.29				
	Dy^{161}	18.88				
	Dy^{162}	25.52				
	Dy^{163}	24.97				
	Dy^{164}	28.18				
	Dy^{165}			1.25 m ↓ IT	e^-	0.109
				2.42 h	β^-	0.42 0.88 1.25
					γ	0.76 0.36 0.27 0.095
	Dy^{166}			81 h	β^-	0.4
					γ	
67	Ho^{160}			22.5 m	β^+	1.3
					γ	1.2
					e^-	0.17
					K	
	Ho^{161}			4.6 h	γ	1.1
					e^-	0.1
					K	
	Ho^{162}			65.0 d	β^-	0.8
					γ	1.0
					e^-	0.1
					K	
	Ho^{163}			5.2 d	γ	0.5 1.4
					e^-	
					K	
	Ho^{164}			34.0 m	β^-	0.95
	Ho^{165}	100				
	Ho^{166}			>30 y	β^-	0.18 0.28
					γ	0.09 0.21 0.72 0.83
				27.3 h	β^-	1.84 0.55
					γ	0.081 1.36
	Ho$^{169?}$			44 m	β^-	

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	Mode of Decay Energies in MEV
68	Er^{162}	0.136				
	Er^{163}			11.2 h	γ e^- K	1.1 0.08
	Er^{164}	1.56				
	Er^{165}			10.0 h	K	
	Er^{166}	33.41				
	Er^{167}	22.94				
	Er^{168}	27.07				
	Er^{169}			9.4 d	β^-	0.33 no γ
	Er^{170}	14.88				
	Er^{171}			7.5 h	β^- γ	1.05 0.67 1.49 0.305 0.113 0.805
	Er?			2.5 s ↓ IT	e^-	0.180
				(stable?)		
69	Tm^{166}			7.7 h	β^+ γ e^- K	2.1 1.7 0.24
	Tm^{167}			9.6 d	γ e^- K	0.22 0.95 0.21
	Tm^{168}			85 d	β^- γ e^- K	0.5 0.21 0.85 0.16
	Tm^{169}	100				
	Tm^{170}			127 d	β^- γ	0.990 0.886 0.085
	Tm^{171}			680 d	β^-	0.10
70	Yb^{167}	<0.002				
	Yb^{168}	0.14				
	Yd^{169}			31.8 d	γ e^- K	0.064...0.308
	Yb^{170}	3.03				
	Yb^{171}	14.34				
	Yb^{172}	21.88				
	Yb^{173}	16.18				

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV		
70	Yb^{174}	31.77						
	Yb^{175}			4.2 d	β^-	0.13	0.5	
					γ	0.35		
	Yb^{176}	12.65						
	Yb^{177}			1.8 h	β^-	1.3		
					γ	0.15		
71	Lu^{170}			1.7 d	γ	2.5		
					e^-	0.1		
					K			
	Lu^{171}			8.5 d	γ	1.2		
					e^-	0.17	0.5	
					K			
				~600 d	γ	1.0		
					e^-	0.1		
					K			
	Lu^{172}			6.70 d	γ	1.2		
					e^-	0.13	0.6	
					K			
	Lu^{173}			~500 d	γ	0.22	0.88	
					e^-			
					K			
	Lu^{174}			165 d	β^-	0.6		
					γ			
					e^-	0.16		
					K			
	Lu^{175}	97.5						
	Lu^{176}			3.75 h	β^-	1.1	1.2	
					γ	0.089		
		2.5%		7.2×10^{10} y	β^-	0.4		
		NR			γ	0.27	0.18	
	Lu^{177}			6.7 d	β^-	0.495	0.366	0.169
					γ	0.112	0.206	0.317
	Lu^{178}?			8 h				
	Lu^{179}			22 m				
72	Hf^{170}			1.87 h	β^+	2.4		
	Hf^{171}			16.0 h	γ	1.4		
					e^-	0.15		
					K			
	Hf^{172}			~5 y	γ	0.28	0.80	
					e^-			
					K			
	Hf^{173}			23.6 h	γ	1.0		
					e^-	0.12	0.22	
					K			

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay				
					Radiation	Energies in MEV			
72	Hf^{174}	0.18							
	Hf^{175}			70 d	γ	0.342	0.228	0.113	
					e^-				
					K				
	Hf^{176}	5.15							
	Hf^{177}	18.39							
	Hf^{178}	27.08							
	Hf^{179}			19 s	γ	0.215			
					e^-	0.160			
					K				
				↓IT					
		13.78		stable					
	Hf^{180}			5.5 h	e^-	0.330	0.442		
					K				
				↓IT					
		35.44		stable					
	Hf^{181}			45 d	β^-	0.410			
					γ	0.133	0.345	0.136	0.481
73	Ta^{176}			8.0 h	γ	1.3			no β^+
					e^-	0.12	0.18		
					K				
	Ta^{177}			2.2 d	γ	1.4			
					e^-	0.1			
					K				
	Ta^{178}			9.35 m	β^+	1.06			
					γ	1.05			
					e^-	0.08			
					K				
				2.1 h	β^+	1.0			
					γ	1.3	1.5		
					e^-	0.1			
					K				
	Ta^{179}			~600 d	γ	0.7			
					e^-	0.1			
					K				
	Ta^{180}			8.15 h	β^-	0.6	0.7		
					γ	0.092	0.103		
					e^-	0.48			
					K				
	Ta^{181}	100							
	Ta^{182}			16.4 m	β^-	0.2			
					e^-	0.180			
				↓IT	K				
				115 d	β^-	0.52	1.1		
					γ	complex			

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
73	Ta^{183}			4.8 d	β^-	0.6
	Ta^{185}			46 m	β^- e^- K	1.7 0.075
74	W^{176}			80 m	β^+ γ e^- K	2.0 1.3 0.1 0.2
	W^{177}			2.2 h	γ e^- K	0.45 1.2 0.13 0.4
	W^{178}			21.5 d	γ	0.27
	W^{179}			5.2 m	e^- K	
				30 m	K	no γ no e^-
	W^{180}	0.126				
	W^{181}			140 d	γ e^- K	1.83 0.07 0.09
	W^{182}	26.31				
	W^{183}			5.5 s ↓ IT	e^-	0.08
		14.28		stable		
	W^{184}	30.64				
	W^{185}			1.85 m ↓ IT	e^-	0.075
				73 d	β^- γ	0.43 0.134
	W^{186}	28.64				
	W^{187}			24.1 h	β^- γ	0.627 1.318 0.680 0.615 0.478 0.133 0.078
	W^{188}			65 d	β^- γ	 ~2
75	$\mathrm{Re}^{?181?}$			~1 h		
	Re^{182}			14 h	γ K	0.11....0.346 0.92 1.6
	Re^{183}			67 h	γ K	1.75
				240 d	γ K	0.081 0.252 1.0

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
75	Re^{184}			50 d ↓ IT	γ e^- K	0.205 0.285 1.05
				2.2 d	γ e^- K	0.043 0.159 0.2 1.1
	Re^{185}	37.07				
	Re^{186}			92.8 h	β^- γ K	1.07 0.93 0.3 0.137 0.764 0.627 0.123
	Re^{187}	62.93 NR		4 × 10^{12} y	β^-	0.043
	Re^{188}			16.9 h	β^- γ	2.10 0.15 0.48 0.64 0.95 1.40
	Re^{189}?			~150 d	γ e^-	1.0 0.16
76	Os^{184}	0.018				
	Os^{185}			97 d	γ K	0.65 0.88
	Os^{186}	1.59				
	Os^{187}	1.64				
	Os^{188}	13.3				
	Os^{189}	16.1				
	Os^{190}	26.4				
	Os^{191}			14 h ↓ IT	e^-	0.074
				15.0 d	β^- γ	0.143 0.042 0.128
	Os^{192}	41.0				
	Os^{193}			32 h	β^- γ e^-	1.10 1.5 0.14
	Os^{194}			~700 d		
77	Ir^{187}			11.8 h	β^+ γ e^- K	2.2 1.3 0.28
	Ir^{188}			41.5 h	β^+ γ e^-	2.0 1.8 0.16
	Ir^{189}			>100 d		

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay		
					Radiation	— Energies in MEV	
77	Ir^{190}			3.2 h ↓ IT	β^+ e^-	1.7 0.2	 0.8
				12.6 d	γ e^- K	0.17 0.17	0.55 0.5
	Ir^{191}	38.5	191.038				
	Ir^{192}			1.5 m ↓ IT	γ e^-	 0.057	
				74.7 d	β^- γ	complex 0.137 . . . 0.651	
	Ir^{193}	61.5	193.039				
	Ir^{194}			19.0 h	β^- γ	2.1 1.43	0.48 0.4
	$\mathrm{Ir}^{195?}$			2.3 h	β^-	$\sim$1.0	
	$\mathrm{Ir}^{197?}$			7 m			
78	Pt^{190}	0.012					
	Pt^{191}			3.0 d	γ K	0.57	1.5
	Pt^{192}	0.78					
	Pt^{193}			4.3 d	γ e^- K	0.126 0.115	1.5
	Pt^{194}	32.8	194.039				
	Pt^{195}			3.8 d ↓ IT	γ e^-	0.126 0.129	0.337
		33.7		stable			
	Pt^{196}	25.4	195.039				
	Pt^{197}			80 m ↓ IT	e^-	0.337	
				18 h	β^- γ	0.40 0.191	0.67 0.077
	Pt^{198}	7.23	198.044				
	Pt^{199}			29 m	β^-	1.8	
79	$\mathrm{Au}^{190?}$			4.3 m	β^+ K		
	Au^{191}			18 h	K		
	Au^{192}			4.0 h	β^- γ e^- K	1.9 2.3 0.4	 1.5

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV			
79	Au^{193}			15.8 h	e^-	0.2			
					K				
	Au^{194}			39.5 h	β^+	1.8			
					γ	0.291	2.1	1.48	
					K				
	Au^{195}			185 d	γ	0.097	0.029	0.126	1.6
					K				
	Au^{196}			14.0 h	e^-				
					K				
				↓ IT					
				5.6 d	β^-	0.30			
					γ	0.175	0.330	0.358	
					K				
	Au^{197}			7.4 s	γ				
					e^-	0.130	0.279	0.077	
				↓ IT					
		100%		stable					
	Au^{198}			2.7 d	β^-	0.290	0.957	1.38	
					γ	0.676	0.411	1.087	
									no K
	Au^{199}			3.3 d	β^-	0.300	0.250	0.460	
					γ	0.23	0.156	0.207	0.024
	Au^{200}			48 m	β^-	2.5			
80	Hg^{191}			12.4 h	γ				
					e^-				
					K				
	Hg^{192}			8.4 h	γ				
					e^-				
					K				
	Hg^{193}			10 h	γ				
					e^-				
					K				
	Hg^{194}			~1 d					
	Hg^{195}			31 h	γ				
					e^-				
					K				
	Hg^{196}	0.16							
	Hg^{197}			23 h	γ	0.275	0.165	0.135	
					e^-	0.165			
				↓ IT	K				
					γ	0.191	0.077		
				65 h	K				
	Hg^{198}	10.02							
	Hg^{199}			44 m	γ	0.155			
					e^-	0.368			
				↓ IT					
		16.92		stable					

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV			
80	Hg^{200}	23.10							
	Hg^{201}	13.22							
	Hg^{202}	29.72							
	Hg^{203}			46.5 d	β^-	0.208			
					γ	0.279			
					e^-				
	Hg^{204}	6.84							
	Hg^{205}			5.66 m	β^-	1.75			
81	Tl^{198}			1.8 h	γ	1.3			
					e^-	0.4			
					K				
	Tl^{199}			7 h	γ	0.047...0.490			
					e^-	0.5			
					K				
	Tl^{200}			27 h	γ	0.365	0.577	1.210	1.360
					e^-	0.4			
					K				
	Tl^{201}			72 h	γ	0.21			
					K				
	Tl^{202}			11.5 d	γ	0.435			
					e^-	0.35			
					K				
	Tl^{203}	29.52	203.059						
	Tl^{204}			2.7 y	β^-	0.762			no γ
					K				
	Tl^{205}	70.48	205.059						
	Tl^{206}	NR	RaE″	4.23 m	β^-	1.8			no γ
	Tl^{207}	NR	AcC″	4.76 m	β^-	1.44			
					γ	0.87			
	Tl^{208}	NR	ThC″	3.1 m	β^-	1.792			
					γ	0.582	2.615	0.233	
						0.277	0.510	0.859	
					e^-				
	Tl^{209}			2.2 m	β^-	1.8			
	Tl^{210}	NR	RaC″	1.32 m	β^-	1.8			
					γ	1.9	~.5		
82	Pb^{198}			~25 m					
	Pb^{199}			~80 m	K				
	Pb^{200}			18 h	K				
	Pb^{201}			8 h	γ				
					e^-				
					K				

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay	
					Radiation	Energies in MEV
82	Pb^{202}			>500 y		
	Pb^{203}			47.9 h	γ e^- K	0.279 0.47
	Pb^{204}			68 m ↓ IT	γ e^-	0.374 0.905
		1.37		stable		
	Pb^{205}			~10 m	β^+	
	Pb^{206}	26.26	206.061			
	Pb^{207}			0.9 s ↓ IT	γ	0.54 1.06
		20.82		stable		
	Pb^{208}	51.55	208.060			
	Pb^{209}			3.32 h	β^-	0.68 no γ
	Pb^{210}	NR	RaD	25 y	β^- γ	0.029 0.017 0.007...0.047
	Pb^{211}	NR	AcB	36.1 m	β^- γ	1.4 0.5 0.829
	Pb^{212}	NR	ThB	10.6 h	β^- γ	0.355 0.590 0.238 0.115 0.176 0.250 0.300
	Pb^{214}	NR	RaB	26.8 m	β^- γ	0.72 0.053...0.351 0.584...1.438
83	Bi^{197}			1.7 m	α	6.2
	Bi^{198}			7 m	α K	5.83
	Bi^{199}			25 m	α K	5.47
	Bi^{200}			35 m	K	
	Bi^{201}			62 m	α K	5.15
				2 h	K	
	Bi^{202}			95 m	γ K	no β^+
	Bi^{203}			12 h	α K	~4.85
	Bi^{204}			12 h	γ e^- K	0.217 0.2

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
83	Bi^{205}			14.5 d	γ	0.431 0.527 0.550 0.746 1.84
					K	
	Bi^{206}			6.2 d	γ	0.182...1.720 no β^+
					K	
	Bi^{207}			~50 y	γ	0.565 1.063 1.46 2.05....2.49
					K	
	Bi^{208}			short	K	
	Bi^{209}	100	209.056			
	Bi^{210}	NR	RaE	4.85 d	α	5.0
					β^-	1.080 1.165
					γ	0.08
				$\sim 10^6$ y	α	4.93
	Bi^{211}	NR	AcC	2.16 m	α	6.618 6.272
					β^-	
					γ	0.35 0.46
	Bi^{212}	NR	ThC	60.5 m	α	6.074 6.113 5.762 5.601
					β^-	2.25
					γ	0.040...0.719
	Bi^{213}			47 m	α	6.0
					β^-	1.2
	Bi^{214}	NR	RaC	19.7 m	α	5.444 5.505
					β^-	1.650 3.173
					γ	0.426...2.420
	Bi^{215}			8 m	α	8.3
84	Po^{200}			11 m	α	5.84
					K	
	Po^{201}			18 m	α	5.70
	Po^{202}			52 m	α	5.59
					K	
	Po^{203}			47 m	K	no α
	Po^{204}			3.8 h	α	5.37
					K	
	Po^{205}			1.5 h	α	5.2
					K	
	Po^{206}			9 d	α	5.2
					γ	0.3 0.8
					K	
	Po^{207}			5.7 h	α	5.1
					γ	1.3
					K	
	Po^{208}			2.93 y	α	5.14 no γ

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
84	Po^{209}			~200 y	α	4.90
	Po^{210}	NR	RaF	138 d	α γ	5.303 0.803
	Po^{211}	NR	AcC′	0.52 s ↓ IT	α	7.434
				25 s	α	7.14
	Po^{212}	NR	ThC′	3×10^{-7} s	α	8.776 10.574
	Po^{213}			3.2×10^{-6} s	α	8.34
	Po^{214}	NR	RaC′	1.64×10^{-4} s	α	7.683
	Po^{215}	NR	AcA	1.83×10^{-3} s	α β^-	7.365
	Po^{216}	NR	ThA	0.158 s	α β^-	6.774
	Po^{217}			short	α	6.5
	Po^{218}	NR	RaA	3.05 m	α β^-	5.998
85	At^{201}?			43 s	α	6.50
	At^{202}?			1.7 m	α	6.35
	At^{203}?			7 m	α	6.10
	At^{204}			25 m	K	
	At^{205}			25 m	α K	5.9
	At^{206}			2.6 h	K	
	At^{207}			2.0 h	α K	5.75
	At^{208}			6.3 h	K	
	At^{209}			5.5 h	α K	5.65
	At^{210}			8.3 h	α K	1.0
	At^{211}			7.5 h	α K	5.89
	At^{212}			0.25 s	α	
	At^{214}			very short	α	8.78
	At^{215}	NR		~10^{-4} s	α	8.04
	At^{216}			3×10^{-4} s	α	7.79
	At^{217}			0.018 s	α	7.00

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay	
					Radiation —	Energies in MEV
85	At^{218}	NR		$\sim$2 s	α β^-	6.72
	At^{219}			0.9 m	α β^-	6.27
86	Rn^{209}			31 m	α K	6.02
	Rn^{210}			2.7 h	α K	6.02
	Rn^{211}			16 h	α K	5.82
	Rn^{212}			23 m	α K	6.17
	Rn^{215}			short	α	8.6
	Rn^{216}			short	α	8.01
	Rn^{217}			10^{-3} s	α	7.74
	Rn^{218}			0.019 s	α	7.12
	Rn^{219}	NR	An	3.92 s	α γ	6.824 6.558 6.434 6.224 0.067 0.392
	Rn^{220}	NR	Tn	54.5 s	α	6.282
	Rn^{221}			24 m	α β^-	
	Rn^{222}	NR	Rn	3.825 d	α	5.486
87	Fr^{211}			8 m	K	
	Fr^{212}			19.3 m	α K	6.25
	Fr^{213}			<5 m		
	Fr^{217}			short	α	8.3
	Fr^{218}			short	α	7.85
	Fr^{219}			$\sim$0.02 s	α	7.30
	Fr^{220}			27.5 s	α	6.69
	Fr^{221}			4.8 m	α	6.30
	Fr^{222}			14.8 m	β^-	
	Fr^{223}	NR	AcK	21 m	β^- γ	1.20 0.049 0.095
88	Ra^{219}			short	α	8.0
	Ra^{220}			short	α	7.49
	Ra^{221}			30 s	α	6.71

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay	
					Radiation —	Energies in MEV
88	Ra^{222}			38.0 s	α	6.51
	Ra^{223}	NR	AcX	11.2 d	α γ	5.719 5.607 5.533 5.439 0.144...0.340
	Ra^{224}	NR	ThX	3.64 d	α γ	5.66 5.448 5.194 0.250
	Ra^{225}			14.8 d	β^-	0.2
	Ra^{226}	NR		1620 y	α γ	4.795 4.611 4.21 0.188
	Ra^{227}			41.2 m	β^-	
	Ra^{228}	NR	MsTh$_1$	6.7 y	β^-	0.030
	Ra^{230}			1 h	β^-	1.2
89	Ac^{222}			5.5 s	α	6.96
	Ac^{223}			2.2 m	α K	6.64
	Ac^{224}			2.9 h	α K	6.17
	Ac^{225}			10.0	α	5.80
	Ac^{226}			22 h	β^-	
	Ac^{227}	NR		27.7 y	α β^- γ	4.94 0.02 0.037
	Ac^{228}	NR	MsTh$_2$	6.13 h	α β^- γ	4.54 1.5 2.0 0.058...0.969
	Ac^{229}			66 m		
	Ac^{230}			<1 m	β^-	2.2
90	Th^{223}			$\sim$0.1 s	α	7.55
	Th^{224}			$\sim$1 s	α	7.13
	Th^{225}			8.0 m	α K	6.57
	Th^{226}			30.9 m	α	6.30
	Th^{227}	NR	RdAc	18.6 d	α γ	5.674...6.051 0.043...0.638
	Th^{228}	NR	RdTh	1.90 y	α γ	5.423 5.338 0.083 0.087
	Th^{229}			7340 y	α	4.85 4.94 5.02
	Th^{230}	NR	Io	8×10^4 y	α γ	4.682 4.612 0.068 0.15....0.20
	Th^{231}	NR	UY	25.6 y	β^- γ	0.093 0.302 0.216 0.022 0.085 0.059

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation — Energies in MEV
90	Th^{232}	100% NR		1.39×10^{10} y	α 3.98 γ 0.055
	Th^{233}			23.5 m	β^- 1.23 no γ
	Th^{234}	NR	UX$_1$	24.10 d	β^- 0.192 0.104 γ 0.090
91	Pa^{225}			2.0 s	α
	Pa^{226}			1.8 m	α 6.81
	Pa^{227}			38.3 m	α 6.46 K
	Pa^{228}			22 h	α 6.09 5.85 K
	Pa^{229}			1.5 d	α 5.69 K
	Pa^{230}			17.7 d	α β^- 1.1 γ 0.94 K
	Pa^{231}	NR		34,300 y	α 4.66 5.042 γ 0.095 0.294 0.323
	Pa^{232}			1.32 d	β^- 0.28 γ 0.23 1.05
	Pa^{233}			27.4 d	β^- 0.530 γ 0.0289 0.4164
	Pa^{234}		UX$_2$	1.14 m ↓IT	β^- 2.32 0.8 γ 1.5 0.782 0.822 e^- 0.394
			UZ	6.7 h	β^- 0.45 1.2 γ 0.782 0.822
	Pa^{235}			23.7 m	β^- 1.4 no γ
92	U^{227}			1.3 m	α 6.8
	U^{228}			9.3 m	α 6.67 K
	U^{229}			58 m	α 6.42 K
	U^{230}			20.8 d	α 5.86
	U^{231}			4.2 d	α no γ K
	U^{232}			70 y	α 5.31 γ 0.060
	U^{233}			1.62×10^{5} y	α 4.80 γ 0.04 0.08 0.31

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Radiation	Mode of Decay — Energies in MEV
92	U^{234}	0.0058 NR		2.48×10^5 y	α γ	4.76 0.055
	U^{235}	0.71 NR	AcU	7.1×10^8 y	α	4.40 4.58
	U^{236}			2.46×10^7 y	α γ	4.499 0.050
	U^{237}			6.63 d	β^- γ e^-	~0.25 0.05 0.22 0.40
	U^{238}	99.28 NR	U_1	4.498×10^9 y	α γ	4.180 0.045
	U^{239}			23.5 m	β^- γ	1.12 0.073
	U^{240}			~18 h	β^-	
93	Np^{231}			50 m	α K	6.2
	Np^{232}			13 m	γ K	
	Np^{233}			35 m	α γ K	5.53
	Np^{234}			4.40 d	γ K	1.9
	Np^{235}			435 d	α K	5.06
	Np^{236}			22 h	β^- γ K	0.51 0.36 0.15
	Np^{237}			2.2×10^6 y	α γ	4.77 0.065
	Np^{238}			2.10 d	β^- γ	0.258 1.272 0.983 0.047 1.030 0.043 0.103
	Np^{239}			2.33 d	β^- γ	0.288 0.403 0.676 0.0229..0.277
	Np^{240}			7.3 m	β^-	~1.3
	Np^{241}			60 m	β^- γ	0.89
94	Pu^{232}			36 m	α K	6.6
	Pu^{234}			8.5 h	α K	6.2
	Pu^{235}			26 m	α K	5.85

TABLE OF THE ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
94	Pu^{236}			2.7 y	α γ	5.75 0.045
	Pu^{237}			40 d	K	no γ
	Pu^{238}			92 y	α γ	5.49 0.040
	Pu^{239}			24, 100 y	α γ	5.147 5.1 0.035 0.050
	Pu^{240}			6580 y	α	5.16
	Pu^{241}			14 y	α β$^-$	4.91 0.01
	Pu^{242}			5 × 10^5 y	α	4.88
	Pu^{243}			5 h	β$^-$ γ	0.39 0.095 0.12
95	Am^{237}			~1.3 h	α K	6.01
	Am^{238}			2.1 h	e$^-$ K	
	Am^{239}			12 h	α γ K	5.77 0.285
	Am^{240}			50 h	γ K	1.3 no γ
	Am^{241}			475 y	α γ	5.476 5.433 0.0597 0.100 0.041
	Am^{242}			16 h ↓IT	β$^-$ γ e$^-$ K	0.628 0.038 0.052 0.052
				~100 y	α β	 0.58
	Am^{243}			~10^4 y	α	5.21
	Am^{244}			25 m	β$^-$	
96	Cm^{238}			2.5 h	α	6.50
	Cm^{239}			~3 h	K	
	Cm^{240}			26.8 d	α K	6.26
	Cm^{241}			35.0 d	α K	5.89
	Cm^{242}			162 d	α γ	6.08 0.045

TABLE OF ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation	— Energies in MEV
96	Cm^{243}			35 y	α	5.777 5.732 5.985 6.003 5.672
	Cm^{244}			19 y	α	5.798 5.755
	Cm^{245}			2 × 10^{4} y	α	5.36
	Cm^{246}			3000 y	α	5.36
	Cm^{247}			>60 d	α	
	Cm^{248}			4.7 × 10^{5} y	α	5.054
	Cm^{249}			~1 h	β^-	
97	Bk^{243}			4.5 h	K α	 6.55 6.72 6.20
	Bk^{244}			~4.4 h	K α	 6.66
	Bk^{245}			4.95 d	K α	 6.33 6.17 5.89
	Bk^{246}			1.9 d	K	
	Bk^{247}			7 × 10^{3} y	α	5.50 5.67 5.30
	Bk^{248}			23 h	β^- K	0.670
	Bk^{249}			270 d	β^- α	0.1 5.4 5.08
	Bk^{250}			3.13 h	β^-	0.9 1.9
98	Cf^{244}			25 m	α K	7.17
	Cf^{245}			44 m	K α	 7.11
	Cf^{246}			35.7 h	α	6.753 6.711
	Cf^{247}			2.4 h	K	
	Cf^{248}			250 d	α	6.26
	Cf^{249}			470 y	α	5.82 5.91 6.190
	Cf^{250}			12 y	α	6.024 5.980
	Cf^{251}			≫18 d	α	
	Cf^{252}			2.2 y	α	6.112 6.069 SF
	Cf^{253}			~20 d	β^-	
	Cf^{254}			55 d		SF
99	E^{246}			~m	K	
	E^{247}			7.3 m	α	7.35

TABLE OF ISOTOPES (Continued)

Z	Isotope	% Nat. Abund.	Atomic Mass (A)	Half Life	Mode of Decay Radiation —	Energies in MEV
99	E^{248}			25 m	K α	 6.76
	E^{249}			2 h	α	6.76
	E^{250}			8 h	K	
	E^{251}			1.5 d	α K	6.48
	E^{252}			~140 d	α	6.64
	E^{253}			~20 d	α	6.633 6.592 6.543
	E^{254}			36 h 320 d	β^- K α	1.1 6.44
	E^{255}			24 d	β^-	
	E^{256}			short	β^-	
100	Fm^{250}			~0.5 h	α	7.43
	Fm^{251}			6 h	K α	 6.9
	Fm^{252}			30 h	α	7.1
	Fm^{253}			~d	K	
	Fm^{254}			3.2 h	α	7.22
	Fm^{255}			~16 h	α	7.1
	Fm^{256}			3 h		SF
101	Mv^{256}			~0.5 h	K	
102	No^{253}			10 m		

Packing fraction is the difference between the actual mass of the isotope and the nearest whole number divided by the mass number. Thus the packing fraction is equal to $(M - A)/A$ where M is the actual mass and A is the mass number. For example, one of the chlorine isotopes has a mass of 32.9860. The packing fraction for this isotope is $\frac{32.9860 - 33.0000}{33.0000} = -0.00042$. Packing fractions are usually expressed as parts per 10,000 and so the packing fraction for this isotope of chlorine is written as -4.2. Since oxygen is taken as the standard, elements with positive packing fractions are less stable than oxygen, those with negative packing fractions are more stable. It is positive for nuclides with mass number 16 or greater than 180 and negative for most others.

THERMAL NEUTRON CROSS SECTIONS

Compiled by John R. Bradford

The table of Thermal Neutron Cross Sections is taken from data published by the Neutron Cross Section Advisory Group of the Atomic Energy Commission.

All values given for an element refer to the natural mixture of isotopes, that is, they are atomic cross sections, while those given for specific isotopes are isotopic cross sections. All cross sections, unless marked mb (millibarns) are in barns (10^{-24} cm^2).

The reaction cross sections listed are those for a neutron velocity of 2200 meters per second. The reaction cross sections refer to all cases in which the neutron is not re-emitted, that is, to (n,γ), (n,p), and (n,α) reactions. Practically all the reaction cross sections are for (n,γ) reactions and the few that are not are so marked. The absorption cross sections, σ_{abs}, are the particular reaction cross sections that are measured by observing the reaction itself in which the neutron is absorbed. The activation cross sections, σ_{act}, are those determined from the radioactivity of the product nucleus, usually the result of an (n,γ) reaction, and in a few cases, which are specially marked, by (n,p) or (n,α) reactions. The activation cross sections always refer to particular isotopes and hence are isotopic cross sections; for mono-isotopic elements they are atomic cross sections as well. For a few cases in which the 2200 m/s value could not be determined, the cross sections are still included but are marked with an asterisk* indicating "pile neutrons."

The scattering cross sections are usually constant with energy in the thermal region, except for crystal effects, and are hence not quoted for 2200 m/s. The average scattering cross section, $\bar{\sigma}_s$, is that averaged over the Maxwell distribution and will depend on the crystalline form of the sample and even upon the size of the crystal grain, but it is listed here because of utility in certain practical applications.

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_1$H		330 ± 3 mb			38 ± 4 (gas)
	H^1				
	H^2	0.46 ± 0.10 mb	12.4 y	0.57 ± 0.01 mb	7 ± 1
$_2$He					0.8 ± 0.2
	He^3	np 5400 ± 300			1.0 ± 0.7
	He^4	0		0	
$_3$Li		71.0 ± 1.0			1.4 ± 0.3
	Li^6	(nα 945)		<0.1	
	Li^7		0.85 s	33 ± 5 mb	
$_4$Be	Be^7	np 51,000 ± 6000			
		nα <1			
	Be^9	10 ± 1 mb	2.7 × 10^6 y	9 ± 3 mb	7 ± 1
$_5$B		755 ± 4			4 ± 1
	B^{10}	(nα 4010)			
		np <0.2			
	B^{11}		0.03 s	50 mb	
$_6$C		3.2 ± 0.2 mb			4.8 ± 0.2
	C^{12}			3.3 ± 0.2	
	C^{13}	0.5 ± 0.2 mb	5570 y	0.9 ± 0.3 mb	
	C^{14}	<200	2.4 s	<1 μb	
$_7$N		1.88 ± 0.05			10 ± 1
	N^{14}	np 1.75 ± 0.05			
		nγ 0.10 ± 0.05			
	N^{15}		7.4 s	24 ± 8 μb	
$_8$O		<0.2 mb			4.2 ± 0.3
	O^{16}				
	O^{17}		5570 y C^{14}	0.5 ± 0.1	
	O^{18}		29 s	0.21 ± 0.04 mb	
$_9$F	F^{19}	<10 mb	11 s	9 ± 2 mb	3.9 ± 0.2

THERMAL NEUTRON CROSS SECTIONS (Continued)

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_{10}$Ne		<2.8			2.4 ± 0.3
	Ne^{20}				
	Ne^{21}				
	Ne^{22}		40 s	36 ± 15 mb	
$_{11}$Na	Na^{23}	505 ± 10 mb	15.0 h	0.56 ± 0.03	4.0 ± 0.5
$_{12}$Mg		63 ± 4 mb			3.6 ± 0.4
	Mg^{24}	33 ± 10 mb			
	Mg^{25}	270 ± 90 mb			
	Mg^{26}	60 ± 60 mb	9.5 m	50 ± 10 mb	
$_{13}$Al	Al^{27}	230 ± 5 mb	2.27 m	0.21 ± 0.04	1.4 ± 0.1
$_{14}$Si		0.13 ± 0.03			1.7 ± 0.3
	Si^{28}	80 ± 30 mb			
	Si^{29}	0.27 ± 0.09			
	Si^{30}	0.4 ± 0.4	2.62 h	110 ± 10 mb	
$_{15}$P	P^{31}	0.19 ± 0.03	14.3 d	0.23 ± 0.05	5 ± 1
$_{16}$S		0.49 ± 0.02			1.1 ± 0.2
	S^{32}				
	S^{33}		25.1 d P^{33}	2.3 ± 1.0 mb	
	S^{34}		87 d	0.26 ± 0.05	
	S^{36}		5.0 m	0.14 ± 0.04	
$_{17}$Cl		31.6 ± 1.0			16 ± 3
	Cl^{35}	np 0.30 ± 0.10	3.08 × 10^{5} y	30 ± 20	
			87 d S^{35}	0.17 ± 0.04	
	Cl^{36}			90 ± 30	
	Cl^{37}		37.5 m	0.56 ± 0.12	
$_{18}$A		0.62 ± 0.04			1.5 ± 0.5
	A^{36}		35 d	6 ± 2	
	A^{38}		265 y	0.8 ± 0.2	
	A^{40}		109 m	0.53 ± 0.02	
	A^{41}		>3.5 y	>60 mb	
$_{19}$K		1.97 ± 0.06			1.5 ± 0.3
	K^{39}	1.87 ± 0.15	1.3 × 10^{9} y	3 ± 2*	
	K^{40}	70 ± 20			
		np <1			
	K^{41}	1.19 ± 0.10	12.4 h	1.0 ± 0.2	
$_{20}$Ca		0.43 ± 0.02			
	Ca^{40}	0.22 ± 0.04			
	Ca^{42}	40 ± 3			
	Ca^{43}				
	Ca^{44}		152 d	0.63 ± 0.12	
	Ca^{46}		4.8 d	0.25 ± 0.10	
	Ca^{48}		8.5 m	1.1 ± 0.1	
$_{21}$Sc	Sc^{45}	24.0 ± 1.0	20 s	10 ± 4	24 ± 2
			85 d	12 ± 6	
			20 s + 85 d	22 ± 2	
			(20 s → 85 d)		
$_{22}$Ti		5.6 ± 0.4			4 ± 1
	Ti^{46}	0.6 ± 0.2			2 ± 2
	Ti^{47}	1.6 ± 0.3			4 ± 1

* Pile neutrons.

THERMAL NEUTRON CROSS SECTIONS (Continued)

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_{22}$Ti (Cont.)	Ti^{48}	8.0 ± 0.6			4 ± 2
	Ti^{49}	1.8 ± 0.5			1 ± 1
	Ti^{50}	<0.2	5.8 m	0.14 ± 0.03	3 ± 1
$_{23}$V		5.1 ± 0.2			5 ± 1
	V^{50}	250 ± 200			
	V^{51}		3.76 m	4.5 ± 0.9	
$_{24}$Cr		2.9 ± 0.2			3.0 ± 0.5
	Cr^{50}	16.3 ± 1.3	27.8 d	11 ± 5	
	Cr^{52}	0.73 ± 0.06			
	Cr^{53}	17.5 ± 1.4			
	Cr^{54}	<0.3	3.6 m	0.37 ± 0.04	
$_{25}$Mn	Mn^{55}	13.2 ± 0.4	2.58 h	13.4 ± 0.3	2.3 ± 0.3
$_{26}$Fe		2.53 ± 0.06			11 ± 1
		nα <5 mb			
	Fe^{54}	2.2 ± 0.2	2.96 y	2.2 ± 0.5	
	Fe^{56}	2.6 ± 0.2			
	Fe^{57}	2.4 ± 0.2			
	Fe^{58}	2.5 ± 2.0	46 d	0.9 ± 0.2	
		nα <1.5 mb			
$_{27}$Co	Co^{59}	37.0 ± 1.5	10.4 m	16 ± 3	7 ± 1
			5.28 y	20 ± 3	
			10.4 m + 5.28 y	36.0 ± 1.5	
			(99.7% of 10.4 m → 5.28 y)		
	Co^{60m}		1.75 h	100 ± 50	
	Co^{60}		1.75 h	6 ± 2	
$_{28}$Ni		4.6 ± 0.2			17.5 ± 1.0
	Ni^{58}	4.2 ± 0.3			
	Ni^{60}	2.5 ± 0.2			
	Ni^{61}	1.9 ± 1.0			
	Ni^{62}	15 ± 2			
	Ni^{64}		2.57 h	2.6 ± 0.4	
	Ni^{65}		56 h	6 ± 3	
$_{29}$Cu		3.69 ± 0.12			7.2 ± 0.7
	Cu^{63}	4.3 ± 0.3	12.8 h	3.9 ± 0.8	
	Cu^{65}	2.11 ± 0.17	5.14 m	1.8 ± 0.4	
$_{30}$Zn		1.06 ± 0.05			3.6 ± 0.4
	Zn^{64}	nα 15 ± 10 μb	250 d	0.5 ± 0.1	
	Zn^{66}	nα <20 μb	12.8 h Cu^{64}	<10 μb	
	Zn^{67}	nα 6 ± 4 μb			
	Zn^{68}	nα <20 μb	13.8 h	0.10 ± 0.03	
			52 m	1.0 ± 0.2	
	Zn^{70}		2.2 m	85 ± 20 mb	
$_{31}$Ga		2.77 ± 0.12			4 ± 1
	Ga^{69}	2.0 ± 0.2	20.2 m	1.4 ± 0.3	
	Ga^{71}	4.9 ± 0.4	14.2 h	3.4 ± 0.7	
$_{32}$Ge		2.35 ± 0.20			3 ± 1
	Ge^{70}	3.3 ± 0.3	11.3 d	3 ± 1	
	Ge^{72}	0.94 ± 0.09			
	Ge^{73}	13.7 ± 1.1			
	Ge^{74}	0.60 ± 0.06	82 m	0.45 ± 0.08	
	Ge^{76}	0.35 ± 0.07	57 s	30 ± 20 mb	
			12 h	0.2 ± 0.1	
			(~50% of 57 s → 12 h)		

THERMAL NEUTRON CROSS SECTIONS (Continued)

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_{33}$As	As^{75}	4.1 ± 0.2	27 h	4.2 ± 0.8	6 ± 1
$_{34}$Se		11.8 ± 0.4			11 ± 2
	Se^{74}	48 ± 7	123 d	26 ± 6	
	Se^{76}	82 ± 7	18 s	7 ± 3	
	Se^{77}	40 ± 4			
	Se^{78}	0.4 ± 0.4			
	Se^{80}	0.59 ± 0.06	57 m	30 ± 10 mb	
			17 m	0.5 ± 0.1	
	Se^{82}	2.0 ± 1.4	67 s	50 ± 25 mb	
			25 m	4 ± 2 mb	
			(order of isomers unknown)		
$_{35}$Br		6.6 ± 0.5			6 ± 1
	Br^{79}	10.4 ± 1.0	4.6 h	2.9 ± 0.5	
			18 m	8.5 ± 1.4	
	Br^{81}	2.6 ± 0.4	35.9 h	3.5 ± 0.5	
$_{36}$Kr		28 ± 5			7.2 ± 0.7
	Kr^{78}		34.5 h	2.0 ± 0.5	
	Kr^{80}	95 ± 15			
	Kr^{82}	45 ± 15			
	Kr^{83}	205 ± 10			
	Kr^{84}	<2	4.4 h	0.10 ± 0.03	
			9.4 y	60 ± 20 mb	
			(23% of 4.4 h → 9.4 y)		
	Kr^{85}	<15			
	Kr^{86}	<2	77 m	60 ± 20 mb	
	Kr^{87}		2.8 h	<600	
$_{37}$Rb		0.70 ± 0.07			12 ± 2
	Rb^{85}		19.5 d	0.72 ± 0.15	
	Rb^{87}		17.8 m	0.12 ± 0.03	
	Rb^{88}		15.4 m	<200	
$_{38}$Sr		1.16 ± 0.06			10 ± 1
	Sr^{84}	<3	65 d	1.0 ± 0.3	
	Sr^{86}		2.80 h	1.3 ± 0.4	
	Sr^{87}				
	Sr^{88}		53 d	5 ± 1 mb	
	Sr^{89}		19.9 d	<90	
	Sr^{90}		9.7 h	1.0 ± 0.6	
$_{39}$Y	Y^{89}	1.38 ± 0.14	63 h	1.2 ± 0.3	3 ± 2
	Y^{90}		61 d	<7	
$_{40}$Zr		180 ± 4 mb			8 ± 1
	Zr^{90}	0.10 ± 0.07			
	Zr^{91}	1.52 ± 0.12			
	Zr^{92}	0.25 ± 0.12			
	Zr^{94}	0.08 ± 0.06	65 d	0.10 ± 0.05	
	Zr^{96}	0.1 ± 0.1	17.0 h	0.2 ± 0.1	
$_{41}$Nb	Nb^{93}	1.1 ± 0.1	6.6 m	1.0 ± 0.5	5 ± 1
	Nb^{94}		36 d	15 ± 4	
$_{42}$Mo		2.5 ± 0.2			7 ± 1
	Mo^{92}	<0.3	6.9 h	<6 mb	
	Mo^{94}				
	Mo^{95}	13.4 ± 1.3			
	Mo^{96}	1.2 ± 0.6			
	Mo^{97}	2.1 ± 0.7			
	Mo^{98}	0.4 ± 0.4	67 h	0.13 ± 0.05	
	Mo^{100}	0.5 ± 0.5	14.3 m	0.20 ± 0.05	

THERMAL NEUTRON CROSS SECTIONS (Continued)

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_{43}$Tc	Tc^{99}	100 ± 25			
$_{44}$Ru		2.46 ± 0.12			6 ± 1
	Ru^{96}		2.8 d	10 ± 4 mb	
	Ru^{98}				
	Ru^{99}				
	Ru^{100}				
	Ru^{101}				
	Ru^{102}		41 d	1.2 ± 0.3	
	Ru^{104}		4.5 h	0.7 ± 0.2	
$_{45}$Rh	Rh^{103}	150 ± 7	4.5 m	12 ± 2	5 ± 1
			44 s	140 ± 30	
$_{46}$Pd		8.0 ± 1.5			3.6 ± 0.6
	Pd^{102}		17.0 d	4.8 ± 1.5	
	Pd^{104}				
	Pd^{105}				
	Pd^{106}				
	Pd^{108}		13.6 h	12 ± 3	
	Pd^{110}		22 m	0.3 ± 0.1	
$_{47}$Ag		62 ± 2			6 ± 1
	Ag^{107}	30 ± 2	2.3 m	44 ± 9	
	Ag^{109}	84 ± 7	270 d	2.8 ± 0.5	
			24.2 s	110 ± 20	
$_{48}$Cd		2550 ± 100			7 ± 1
		(not 1/v, × 1.3)			
	Cd^{106}		6.7 h	1.0 ± 0.5	
	Cd^{108}				
	Cd^{110}		49 m	0.2 ± 0.1	
	Cd^{111}				
	Cd^{112}		5.1 y	30 ± 15 mb	
	Cd^{113}	(20,800)			
		(not 1/v, × 1.3)			
	Cd^{114}		43 d	0.14 ± 0.03	
			53 h	1.1 ± 0.3	
	Cd^{116}		2.9 h	1.5 ± 0.3	
$_{49}$In		190 ± 10			2.2 ± 0.5
	In^{113}		49 d	56 ± 12	
			72 s	2.0 ± 0.6	
	In^{115}		54.1 m	145 ± 15	
			13 s	52 ± 6	
$_{50}$Sn		0.60 ± 0.10			4 ± 1
	Sn^{112}		112 d	1.3 ± 0.3	
	Sn^{114}				
	Sn^{115}				
	Sn^{116}		14.5 d	6 ± 2 mb	
	Sn^{117}				
	Sn^{118}		250 d	10 ± 6 mb	
	Sn^{119}				
	Sn^{120}		>400 d	1 ± 1 mb	
			27.5 h	0.14 ± 0.03	
	Sn^{122}		40 m	0.16 ± 0.04	
			130 d	1.0 ± 0.5 mb	
			(order of isomers unknown)		
	Sn^{124}		10 m	0.2 ± 0.1	
			10 d	4 ± 2 mb	
			(none of 10 m → 10d)		

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_{51}$Sb		5.5 ± 1.0			4.3 ± 0.5
	Sb^{121}	5.7 ± 0.5	2.8 d	6.8 ± 1.5	
	Sb^{123}	3.9 ± 0.3	21 m	30 ± 15 mb	
			1.3 m	30 ± 15 mb	
			60 d	2.5 ± 0.5	
			(% of 21 m and 1.3 m → 60 d unknown)		
$_{52}$Te		4.5 ± 0.2			5 ± 1
	Te^{120}	70 ± 70			
	Te^{122}	2.7 ± 0.9	110 d	1.1 ± 0.5	
	Te^{123}	390 ± 30			
	Te^{124}	6.5 ± 1.2	58 d	5 ± 3	
	Te^{125}	1.50 ± 0.15			
	Te^{126}	0.8 ± 0.2	110 d	90 ± 20 mb	
			9.3 h	0.8 ± 0.2	
	Te^{128}	0.3 ± 0.3	33 d	15 ± 5 mb	
			72 m	0.13 ± 0.03	
	Te^{130}	0.5 ± 0.3	30 h	<8 mb	
			25 m	0.22 ± 0.05	
$_{53}$I	I^{127}	6.7 ± 0.6	25.0 m	5.5 ± 0.5	3.6 ± 0.5
	I^{129}		12.6 h	11 ± 4	
	I^{131}		2.4 h	600 ± 300	
$_{54}$Xe		35 ± 5			4.3 ± 0.4
	Xe^{124}				
	Xe^{126}				
	Xe^{128}	<5			
	Xe^{129}	45 ± 15			
	Xe^{130}	<5			
	Xe^{131}	120 ± 15			
	Xe^{132}	<5	5.3 d	0.2 ± 0.1	
	Xe^{134}	<5	9.13 h	0.2 ± 0.1	
	Xe^{135}	$2.7 \pm 0.3 \times 10^6$ (not 1/v, × 1.2)			
	Xe^{136}	<5	3.9 m	0.15 ± 0.08	
$_{55}$Cs	Cs^{133}	29.0 ± 1.5	3.2 h	17 ± 4 mb	20 ± 10
			2.3 y	26 ± 5	
			(~100% of 3.2 h → 2.3 y)		
	Cs^{135}		13.7 d	15 ± 8	
	Cs^{137}		33 m	<2	
$_{56}$Ba		1.17 ± 0.10			8 ± 1
	Ba^{130}		12.0 d	24 ± 8 mb	
	Ba^{132}		10 y	3 ± 2	
	Ba^{134}	2 ± 2			
	Ba^{135}	5.6 ± 0.9			
	Ba^{136}	0.4 ± 0.4			
	Ba^{137}	4.9 ± 0.4			
	Ba^{138}	0.68 ± 0.10	85 m	0.5 ± 0.1	
	Ba^{139}		12.8 d	4 ± 1	
$_{57}$La		8.9 ± 0.3			15 ± 5
	La^{138}				
	La^{139}		40 h	8.4 ± 1.7	
	La^{140}		3.7 h	3.1 ± 1.0	
$_{58}$Ce		0.70 ± 0.08			9 ± 6
	Ce^{136}	25 ± 25			
	Ce^{138}	9 ± 6	140 d	<0.4	
	Ce^{140}	0.63 ± 0.06	32 d	0.31 ± 0.10	
	Ce^{142}	1.8 ± 0.3	34 h	1.0 ± 0.2	

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_{59}$Pr	Pr^{141}	11.2 ± 0.6	19.2 h	10 ± 3	
	Pr^{142}		13.7 d	18 ± 3	
$_{60}$Nd		46 ± 2			
	Nd^{142}	18 ± 2			
	Nd^{143}	280 ± 20			
	Nd^{144}	4.5 ± 0.5			
	Nd^{145}	52 ± 4			
	Nd^{146}	9.2 ± 0.8	11.3 d	1.8 ± 0.6	
	Nd^{148}	3.2 ± 1.0	1.8 h	3.7 ± 1.2	
	Nd^{150}	2.8 ± 1.5			
$_{61}$Pm	Pm^{147}		5.3 d	60 ± 20	
$_{62}$Sm		5500 ± 200 (not 1/v, × 1.5)			
	Sm^{144}		400 d	<2	
	Sm^{147}				
	Sm^{148}				
	Sm^{149}	50,000 ± 20,000*			
	Sm^{150}				
	Sm^{151}	7,000 ± 2000*			
	Sm^{152}		47 h	140 ± 40	
	Sm^{154}		24 m	5.5 ± 1.1	
$_{63}$Eu		4600 ± 400 (not 1/v, × 0.95)			8 ± 1
	Eu^{151}	9000 ± 3000*	9.2 h	1400 ± 300*	
	Eu^{152}	5500 ± 1500*			
	Eu^{153}	420 ± 100*			
	Eu^{154}	1500 ± 400*			
	Eu^{155}	14,000 ± 4000*			
$_{64}$Gd		46,000 ± 2000 (not 1/v, × 0.85)			
	Gd^{152}		230 d	<125	
	Gd^{154}				
	Gd^{155}	70,000 ± 20,000*			
	Gd^{156}				
	Gd^{157}	160,000 ± 60,000*			
	Gd^{158}		18.0 h	4 ± 2	
	Gd^{160}		3.6 m	0.8 ± 0.3	
$_{65}$Tb	Tb^{159}	44 ± 4	73 d	>22	
$_{66}$Dy		1100 ± 150			100 ± 20
	Dy^{156}				
	Dy^{158}				
	Dy^{160}				
	Dy^{161}				
	Dy^{162}				
	Dy^{163}				
	Dy^{164}		1.3 m	2600 ± 300*	
			139 m	<1000*	
			(1.3 m → 139 m)		
	Dy^{165}		82 h	5000 ± 2000*	
$_{67}$Ho	Ho^{165}	64 ± 3	27.3 h	60 ± 12	
$_{68}$Er		166 ± 16			15 ± 4
	Er^{162}				

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* Pile neutrons.

THERMAL NEUTRON CROSS SECTIONS (Continued)

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_{68}$Er (Cont.)	Er^{164}				
	Er^{166}				
	Er^{167}				
	Er^{168}		9.4 d	2.0 ± 0.4	
	Er^{170}		2.5 s + 7.5 h	9 ± 2	
$_{69}$Tm	Tm^{169}	118 ± 6	129 d	130 ± 30	
$_{70}$Yb		36 ± 4			12 ± 5
	Yb^{168}		32 d	11,000 ± 3000*	
	Yb^{170}				
	Yb^{171}				
	Yb^{172}				
	Yb^{173}				
	Yb^{174}		101 h	60 ± 40	
	Yb^{176}		1.8 h	5.5 ± 1.0	
$_{71}$Lu		108 ± 5			
	Lu^{175}		3.7 h	35 ± 15	
	Lu^{176}		6.8 h	4000 ± 800	
$_{72}$Hf		105 ± 5			8 ± 2
	Hf^{174}	1500 ± 1000			
	Hf^{176}	15 ± 15			
	Hf^{177}	380 ± 30			
	Hf^{178}	75 ± 10			
	Hf^{179}	65 ± 15			
	Hf^{180}	13 ± 5	46 d	10 ± 3	
$_{73}$Ta	Ta^{181}	21.3 ± 1.0	16.4 m	30 ± 10 mb	5 ± 1
			111 d	19 ± 7	
			(~95% of 16.4 m → 111 d)		
	Ta^{182}		5.5 d	30,000 ± 15,000	
$_{74}$W		19.2 ± 1.0			5 ± 1
	W^{180}	60 ± 60	140 d	10 ± 10	
	W^{182}	19 ± 2			
	W^{183}	11 ± 1			
	W^{184}	2.0 ± 0.3	73 d	2.1 ± 0.6	
	W^{186}	34 ± 3	24 h	34 ± 7	
	W^{187}		65 d	90 ± 40	
$_{75}$Re		84 ± 4			14 ± 4
	Re^{185}	100 ± 8	92 h	100 ± 20	
	Re^{187}	63 ± 5	18 h	75 ± 15	
$_{76}$Os		14.7 ± 0.7			11 ± 1
	Os^{184}		97 d	<200	
	Os^{186}				
	Os^{187}				
	Os^{188}				
	Os^{189}				
	Os^{190}		16.0 d	8 ± 3	
	Os^{192}		31 h	1.6 ± 0.4	
	Os^{193}		700 d	60 ± 20	
$_{77}$Ir		430 ± 20			
	Ir^{191}		1.4 m	260 ± 100	
			74 d	700 ± 200	
			(1.4 m → 74 d)		
	Ir^{193}		19.0 h	130 ± 30	

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* Pile neutrons.

THERMAL NEUTRON CROSS SECTIONS (Continued)

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections $\bar{\sigma}_s$
		σ_{abs}		σ_{act}	
$_{78}$Pt		8.1 ± 0.4			10 ± 1
	Pt^{190}				
	Pt^{192}		4.3 d	90 ± 40	
	Pt^{194}				
	Pt^{195}				
	Pt^{196}		18 h	1.1 ± 0.3	
	Pt^{198}		31 m	3.9 ± 0.8	
$_{79}$Au	Au^{197}	98.0 ± 1.0	2.7 d	96 ± 10	9.3 ± 1.0
	Au^{198}		3.2 d	35,000 ± 10,000	
$_{80}$Hg		380 ± 20 (not 1/v, × 0.95)			20 ± 5
	Hg^{196}	3100 ± 1000*			
	Hg^{198}				
	Hg^{199}	2500 ± 800*			
	Hg^{200}	<60*			
	Hg^{201}	<60*			
	Hg^{202}	<60*	47 d	3.8 ± 0.8	
	Hg^{204}	<60*	5.5 m	0.43 ± 0.10	
$_{81}$Tl		3.3 ± 0.5			14 ± 2
	Tl^{203}	11.0 ± 0.9	2.7 y	8 ± 3	
	Tl^{205}	0.77 ± 0.08	4.2 m	0.10 ± 0.03	
$_{82}$Pb		170 ± 10 mb			11 ± 1
	Pb^{204}	0.8 ± 0.6			
	Pb^{206}	25 ± 5 mb			
	Pb^{207}	0.70 ± 0.03			
	Pb^{208}	<30 mb	3.2 h	0.6 ± 0.2 mb	
$_{83}$Bi	Bi^{209}	32 ± 2 mb	5.0 d	19 ± 2 mb	9 ± 1

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections
		σ_{abs}		σ_{act}	
$_{86}$Rn	Rn^{220}		30 s	<0.2*	
	Rn^{222}		11.2 d	0.72 ± 0.07*	
$_{88}$Ra	Ra^{223}		3.64 d	130 ± 20*	
	Ra^{224}		14.8 d	12.0 ± 0.5*	
	Ra^{226}		41.2 m	20 ± 3*	
	Ra^{228}		<10 m	36 ± 5*	
$_{89}$Ac	Ac^{227}	510 ± 40	6.13 h	520 ± 50	
$_{90}$Th	Th^{227}				
	Th^{228}		7.3 × 10^{3} y	123 ± 15*	
	Th^{229}				
	Th^{230}	27 ± 2	25.6 h	35 ± 10*	
	Th^{232}	7.0 ± 0.4	23.3 m	7.7 ± 0.4	†12.6 ± 0.2 ‡12.8 ± 0.5 (+) §12.5 ± 0.3
	Th^{233}		24.1 d	1400 ± 200*	
	Th^{234}		≲10 m	1.8 ± 0.5*	

* Pile neutrons.

† $\sigma_{fs}\left(\frac{A+1}{A}\right)^2$.

‡ σ_{coh}.

§ $\sigma_T - \sigma_{abs}$ at 2200 m/s.

THERMAL NEUTRON CROSS SECTIONS (Continued)

Element	Isotope	Reaction Cross Sections (2200 m/s)			Scattering Cross Sections
		σ_{abs}		σ_{act}	
$_{91}$Pa	Pa^{230}				
	Pa^{231}		1.31 d	260 ± 50*	
	Pa^{232}		27.4 d	50 ± 30*	
	Pa^{233}		1.18 m	40 ± 6	
			6.7 h	26 ± 4	
	Pa^{234}				
$_{92}$U		7.68 ± 0.07			‡9.0 ± 0.5 (+)
		(not 1/v, × 0.99)			§8.3 ± 0.2
	U^{230}				
	U^{231}				
	U^{232}		1.62×10^{5} y	300 ± 200*	
	U^{233}	585 ± 10	2.52×10^{5} y	52 ± 2	
	U^{234}	92 ± 7	7.1×10^{8} y	72 ± 10*	
	U^{235}	687 ± 7	240×10^{7} y	107 ± 5	‖10 ± 2
		(not 1/v, × 0.981 ± 0.005)			
	U^{236}	6 ± 2	6.7 d	9 ± 2*	
	U^{238}	2.75 ± 0.04	23.5 m	2.8 ± 0.2	
	U^{239}		17 h	22 ± 5*	
$_{93}$Np	Np^{234}				
	Np^{236}				
	Np^{237}	170 ± 20	2.10 d	170 ± 20	
	Np^{238}				
	Np^{239}		7.3 m	80 ± 20*	
$_{94}$Pu	Pu^{238}		2.44×10^{4} y	430 ± 70	
	Pu^{239}	1065 ± 15	6.6×10^{3} y	315 ± 15	‖9.6 ± 0.5
		(not 1/v, × 1.075 ± 0.010)			
	Pu^{240}		12.9 y	510 ± 50*	
	Pu^{241}		$\sim 5 \times 10^{5}$ y	380 ± 50*	
	Pu^{242}		4.98 h	30 ± 10*	
	Pu^{243}		$>10^{3}$ y	100 ± 50*	
	Pu^{244}		10 h	1.4 ± 0.5*	
	Pu^{245}		11.2 d	260 ± 150*	
$_{95}$Am	Am^{241}	620 ± 30	15.8 h	700 ± 200*	
			500 y	<50*	
			(20% of 15.8 h → 500 y)		
	Am^{242m}				
	Am^{242}	8000 ± 1000*			
	Am^{243}		~25 m	120 ± 30*	
$_{96}$Cm	Cm^{242}			20 ± 10*	
	Cm^{243}	500 ± 300*	19.2 y	250 ± 150*	
	Cm^{244}		>500 y	15 ± 10*	
	Cm^{245}		2000 y	200 ± 100*	
	Cm^{246}			15 ± 10*	
$_{97}$Bk	Bk^{249}			500 ± 200*	
$_{98}$Cf	Cf^{249}	900 ± 400*		270 ± 100*	
	Cf^{250}			1500 ± 1000*	
	Cf^{251}		2.2 y	3000 ± 2000*	
	Cf^{252}		18 d	30 ± 10*	
	Cf^{254}			<2*	
$_{99}$E	99^{253}			160 ± 70*	
	99^{254}			<15*	

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* Pile neutrons.

‡ σ_{coh}.

§ $\sigma_T - \sigma_{abs}$ at 2200 m/s.

‖ $\bar{\sigma}_s$.

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS

PHYSICAL CONSTANTS OF INORGANIC AND METAL-ORGANIC COMPOUNDS

The names, formulas and order of entries for the inorganic compounds only have been in charge of

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EXPLANATION OF TABLE

The table presents data for about four thousand compounds. The first section includes inorganic compounds and the metallic salts of organic acids, and the second metal-organic compounds.

It is intended that the substances listed include the more important definite compounds for which data are available. Some are listed because of their theoretical importance, even when no constants can be given.

Nomenclature and Arrangement.—The names used for the compounds conform to the best current usage insofar as this could be ascertained, the Rules for Naming Inorganic Compounds adopted January 28–29, 1938, by the Committee for the Reform of Inorganic Chemical Nomenclature of the International Union for Chemistry and the names used in Chemical Abstracts indexes being used as a guide to some extent. The compounds are listed under the names of the elements in alphabetical order, except that acids and a few other compounds (e.g. hydrazine, hydroxylamine, and sulfuryl, thionyl and uranyl compounds) have their own headings. Ferrous and ferric compounds are entered under iron, stannous and stannic, under tin, cuprous and cupric, under copper and aurous and auric, under gold. "Acid salts" (including hydrosulfides) and many "basic salts" are placed immediately after the normal salts. Names like bicarbonate and bisulfate have not been used for acid salts, (the hydrogen usually being named instead), but names like antimony oxychloride and uranyl nitrate have been used for some basic salts. Prefixes such as di-, tri-, ortho-, meta-, pyro-, hypo-, and per- are not alphabetized. Iso-, however, and prefixes like chloro- in chloroplatinic acid are alphabetized. For the naming of binary compounds of nonmetallic elements the order of decreasing electropositivity given in the Report of the German Commission for Nomenclature (Meyer, *Helvetica Chimica Acta* 20, 159–75 (1937)) has been followed: Sb, As, B, Si, C, P, Te, Se, S, I, Br, Cl, N, O, F, except in the case of nitrogen chlorides, nitrogen iodides, etc. Binary compounds of hydrogen (except ammonia and water) are listed under hydrogen arsenide (instead of arsine), hydrogen chloride, hydrogen phosphide (instead of phosphine), hydrogen sulfide and like names. Most ammino and related compounds are grouped under headings like **Cobalt complexes** following the other compounds of the element in question, while complexes that have reasonably well-established names like chloroplatinate, cyanoplatinite, fluoborate, ferrocyanide and ferricyanide are listed under these names just like simpler salts. In a few less common names for anions, particularly of elements having more than two oxidation states, stock names with Roman numerals to indicate oxidation state have been introduced, for example, ferrate (III) (ferrite), chloroosmate (III) (chloroosmite), nitrocobaltate (III) (cobaltinitrite). Double salts (including alums) are entered only once: (1) those with two cations are given with the more electropositive cation first in the order of the electromotive force series: Li, Rb, K, Na, NH_4, Sr, Ba, Ca, Mg, Al, U, Mn, Zn, Cr, Ga, Fe^{++}, Cd, In, Tl, Co, Ni, Sn, Pb, Fe^{+++}, Sb, Bi, As, Cu, Ag, Hg, Pd, Pt, Au (e.g. sodium aluminum sulfate, ammonium magnesium phosphate); (2) those with two anions are given with the anions in alphabetical order (e.g., strontium chloride fluoride). The finding of compounds known also under names about as common as those listed is facilitated by a **Synonym Index,** which precedes the table. Organic names conform to those used in the Table of Physical Constants of Organic Compounds.

Molecular weights have been computed to the nearest hundredth, based on the **International Atomic Weights of 1949.**

The **Crystalline form and color** are stated in easily interpreted abbreviations. Other important characteristics are often added. **Indices of refraction** are given in the same column. For crystals with two or three indices, they are invariably given in the order ω, ϵ or α, β, γ. All indices are for sodium light ($\lambda = .5893\mu$) unless otherwise stated. The temperature is assumed to be normal room temperature unless otherwise indicated by a superior figure following the index. 1.536^{25} (Li) would be interpreted as giving the value for the index of refraction of a substance for the red line of lithium at 25°C.

Specific gravity at 20°C, referred to water at 4°C, is normally given. Other temperatures are indicated by superior and inferior figures. For example: 2.64^{25}_{15} indicates a specific gravity of 2.64 at 25°C, referred to water at 15°C. It should be noted that values of specific gravity referred to water at 4°C are numerically equivalent to density in grams per milliliter. The **density of gases** is given in grams per liter, indicated g/l, at 0°C and 1 atm.

Melting and boiling points are given in °C. The boiling point is stated at normal atmospheric pressure (760 mm of Hg) unless otherwise indicated by a superscript which is to be interpreted as the pressure in mm of Hg under which the compound boils at the temperature given. For example: 250^{732} indicates a boiling point of 250°C under a pressure of 732 mm Hg; $426^{2\ \mathrm{atm.}}$ indicates a boiling point of 426°C under a pressure of 2 atmospheres. Decomposition on heating is indicated by the abbreviation d. in melting or boiling point column. If decomposition occurs without change of state, the form d. 120 is used indicating the occurrence of decomposition at 120°C. The form 120 d. would indicate a melting or boiling point of 120°C with decomposition. Loss of water of crystallization or oxygen is indicated by the form $-2H_2O$ or $-O$. The figures $-5H_2O$, 350 indicate the loss of five molecules of water of crystallization at 350°C.

Solubilities are stated for normal room temperatures, 20°C, unless otherwise indicated by a superior figure. 6.8^{25} indicates a solubility of 6.8 grams of substance in 100 ml of the solvent at 25°C. The term insoluble (i.) must be usually understood to mean that a negligible quantity of the compound dissolves. A large proportion of salts commonly regarded as insoluble really dissolve to a very slight extent. The form s.d. indicates solubility with more or less decomposition. The abbreviation d. alone in the solubility column indicates that decomposition is the primary action occurring. Solubility in acids and alkalies is usually understood to be accompanied by decomposition.

ABBREVIATIONS

a	acid
abs	absolute
ac. a	acetic acid
acet	acetone
act	active
al	alcohol
alk	alkali
amm	ammonium
amor	amorphous
anh	anhydrous
appr	approximately
aq	aqua, water
aq. reg	aqua regia
asym	asymmetrical
atm	atmospheres
bipyr	bipyramidal
bl	blue
blk	black
boil	boiling
br., brn	brown
brnsh	brownish
bz	benzene
c	cold
calc	calculated
carb	carbon
caust	caustic
chl	chloroform
choc	chocolate
cit. a	citric acid
col	colorless
coll	colloidal
com'l	commercial
comp	compounds
compl	completely
conc	concentrated
const	constant
cont	contains
corros	corrosion
cr	crystalline
cub	cubic
d., dec	decomposes
deliq	deliquescent
deriv	derivative
dibas	dibasic
di-H	dihydrogen
dil	dilute
dimorph	dimorphous
disg	disagreeable
dk	dark
doubt	doubtful
duct	ductile
effl	efflorescent
em	emerald
eth	ether
ev	evolves
evln	evolution
ex	excess
exist	existence
exp	explodes
extr	extreme(ly)
f., fr	from
feath	feathery
fl	flakes
floc	flocculent
fluo, fluores	fluorescent
form	formic
fum	fuming
fus	fused
fxd	fixed
gel., gelat	gelatinous
gl	glass
glac	glacial
glit	glittering
glob	globular
glyc	glycerin
gran	granular
greas	greasy
grn	green
h	hot
hex	hexagonal
ht	heat
hyd	hydrolyzed
hydx	hydroxides
hyg	hygroscopic
i	insoluble
ign	ignites
ind	indigo
indef	indefinite
infl., inflam	inflammable
infus	infusible
irid	iridescent
leaf	leaflets
lem	lemon
lgr	ligroin
lng	long
lq., liq	liquid
lt	light
lum	luminous
lust	lustrous
me., meth	methyl
met	metal or metallic
micr	microscopic
min	mineral
misc	miscible
mixt	mixture
mod	modifications
monbas	monobasic
mon-H	monohydrogen
monocl	monoclinic
near	nearly
need	needles
nit	nitrate
oct	octahedral
odorl	odorless
offen	offensive
olv	olive
opt	optical or optically
or	orange
ord	ordinary
org	organic
oxal	oxalate or oxalic
pa	pale
pet	petroleum
pl	plates
pois	poisonous
polymorph	polymorphous
powd	powder
ppt	precipitate
pr	prisms
press	pressure
prob	probably
prop	properties
purp	purple
pyr	pyridine
quad	quadrilateral
quest	questioned
rect	rectangular
redsh	reddish
reg	regular
rhbdr	rhombohedral
rhomb	rhombic, orthorhombic
s	soluble
satd	saturated
sld	solid
sensit	sensitive
sc	scales
sec	secondary
silv	silver
sl	slightly
sly	slowly
sm	small
sod	sodium
soln	solution
solv	solvents
spont	spontaneous
st	steel
stab	stable
subl	sublimes
suffoc	suffocating
sulfd	sulfides
sulf	sulfur
sym	symmetrical
tabl	tablets
tart. a	tartaric acid
tetr	tetragonal
tetrah	tetrahedral
tol	toluene
trac	trace, traces
trans	transparent
translu	translucent
tri., trig	trigonal
tribas	tribasic
tricl	triclinic
trim	trimetric
tr	transition point
turp	turpentine
unpleas	unpleasant
unst	unstable
v	very
vac	vacuum
var	various
viol	violent, violence
visc	viscous
vitr	vitreous
vlt	violet
volt., volat	volatizes
wh	white
wh. lt	white light
yel	yellow
yelsh	yellowish
∞	soluble in all proportions
>	above
<	below

SYNONYM INDEX

Compound sought	Listed
Acanthite	Silver sulfide
Acetylacetonate	2,4-pentanedione deriv.
Alabandite	Manganese sulfide (ous)
Alamosite	Lead *meta*silicate
Albite	Sodium aluminosilicate
Altaite	Lead telluride
Alum, ammonium	Ammonium aluminum sulfate
Alum, cesium	Cesium aluminum sulfate
Alum, ammonium chrome	Ammonium chromium sulfate
Alum, ammonium gallium	Ammonium gallium sulfate
Alum, ammonium vanadium	Ammonium vanadium sulfate
Alum, iron ammonium	Ammonium iron sulfate
Alum, iron potassium	Potassium iron sulfate
Alum, manganese potassium	Potassium manganese sulfate
Alum, potassium	Potassium aluminum sulfate
Alum, potassium chrome	Potassium chromium sulfate
Alum, rubidium	Rubidium aluminum sulfate
Alum, sodium	Sodium aluminum sulfate
Alum, thallium	Aluminum thallium sulfate
Alumina	Aluminum oxide
Alunogenite	Aluminum sulfate
Amidosulfonic acid	Sulfamic acid
Amidosulfuric acid	Sulfamic acid
Aminosulfonic acid	Sulfamic acid
Anatase	Titanium oxide, di-
Anglesite	Lead sulfate
Anhydrite	Calcium sulfate
Anhydrite, soluble	Calcium sulfate
Anorthite	Calcium aluminosilicate
Antimony hydride	Hydrogen antimonide
Antimony thioglycolamide	Antimony α mercaptoacetamide
Aquopentamminecobalt (III) chloride	under Cobalt complexes
Aragonite	Calcium carbonate
Arcanite	Potassium sulfate
Argentic, argentous	under Silver
Argentite	Silver sulfide
Arsenic hydride	Hydrogen arsenide
Arsenic red	Arsenic sulfide, di-
Arsenoferrite	Iron arsonide, di-
Arsenolite	Arsenic oxide, tri-
Arsine	Hydrogen arsenide
Artinite	Magnesium carbonate, basic
Ascharite	Magnesium *pyro*borate
Atacamite	Copper oxychloride (ic)
Auricyanide	Cyanoaurate (III)
Auric salts	under Gold
Auroauric	under Gold
Aurocyanide	Cyanoaurate (I)
Aurous salts	under Gold
Avogadrite	Potassium fluoborate
Azoimide	Hydrazoic acid
Azurite	Copper carbonate, basic (ic)
Baddeleyite	Zirconium oxide, di-
Baking soda	Sodium carbonate, hydrogen
Barite	Barium sulfate
Baryta	Barium oxide
Barytes	Barium sulfate
Bayerite	Aluminum oxide
Benzylate	Benzyloxide
Berlin green	Iron ferricyanide (ic)
Bertrandite	Beryllium *ortho*silicate
Beryl	Beryllium aluminum silicate
Bicarbonate	Carbonate, hydrogen
Bieberite	Cobalt sulfate (ous)
Binoxalate	Oxalate, hydrogen
Bischofite	Magnesium chloride
Bismite	Bismuth oxide, tri-
Bismuth oxynitrate	Bismuth nitrate, basic
Bismuth subnitrate	Bismuth nitrate, basic
Bismuthic acid, meta-	Bismuth oxide, pent-
Bismuthine	Hydroxide bismuthide
Bismuthinite	Bismuth sulfide, tri-
Bismuthyl	Bismuth oxy-
Bisulfate, -ite	Sulfate, -ite, hydrogen
Bisulfide	Disulfide
Bleaching powder, chlorinated lime	Calcium chloride hypochlorite
Bloedite	Sodium magnesium sulfate
Blue verdigris	Copper acetate, basic
Blue vitriol	Copper sulfate (ic)
Bobierrite	Magnesium *ortho*phosphate
Boehmite	Aluminum hydroxide
Boracic acid	Boric acid
Borax	Sodium *tetra*borate
Boric anhydride	Boron oxide
Borobutane	Boron hydride
Boroethane	Boron hydride
Borofluoric acid	Fluoboric acid
Borofluoride	Fluoborate
Boussingaultite	Ammonium magnesium sulfate
Breithauptite	Nickel antimonide
Bromellite	Beryllium oxide
Bromoazide	Bromine azide
Bromyrite	Silver bromide
Brookite	Titanium oxide, di-

SYNONYM INDEX (Continued)

Compound sought	Listed
Brucite	Magnesium hydroxide
Brunswick green	Copper oxychloride
Brushite	Calcium *ortho*phosphate
Bunsenite	Nickel oxide, mon-
Butter of antimony	Antimony chloride, tri-
Butylate	Butoxide
Calcite	Calcium carbonate
Calomel	Mercury chloride (ous)
Carbon oxybromide	Carbonyl bromide
Carbon oxychloride	Carbonyl chloride
Carbon oxysulfide	Carbonyl sulfide
Carnallite	Potassium magnesium chloride
Caro's acid	Sulfuric acid, peroxymono-
Cassel yellow	Lead oxychloride
Cassiopeum	Lutetium
Cassiterite	Tin oxide mon-
Celestite	Strontium sulfate
Cerargyrite	Silver chloride
Cerussite	Lead carbonate
Cervantite	Antimony oxide, tetra-
Chalcanthite	Copper sulfate (ic)
Chalcocite	Copper sulfide (ous)
Chamber crystals	Nitrosylsulfuric acid
Chessylite	Copper carbonate, basic (ic)
Chloride of Millon's base	Mercury chloride (ic), aquobasic ammonobasic
Chlorinated lime	Calcium chloride hypochlorite
cis-Chloroaquotetrammine cobalt (III) chloride	under Cobalt complexes
Chlor(o)azide	Chlorine azide
Chlorocalcite	Potassium calcium chloride
Chloromanganokalite	Potassium manganese chloride (ous)
Chloropentammine chromium (III) chloride	under Chromium complexes
Chloropentamminecobalt (III) chloride	under Cobalt complexes
Chrome red	Lead chromate, basic
Chrome yellow	Lead chromate
Chromic anhydride	Chromium oxide, tri-
Chromyl	Chromium oxy-
Chrysoberyl	Beryllium aluminate
Cinnabar	Mercury sulfide (ic) (α)
Claudetite	Arsenic oxide, tri-
Clausthalite	Lead selenide
Clinoenstatite	Magnesium silicate
Cobalticyanic acid	Cyanocobaltic (III) acid
Cobalticyanide	Cyanocobaltate (III)
Cobaltinitrite	Nitrocobaltate (III)
Cobaltite	Cobalt arsenic sulfide
Columbic acid	Niobium oxide, pent-
Columbium	Niobium
Common salt	Sodium chloride
Coquimbite	Iron sulfate (ic)
Corrosive sublimate	Mercury chloride
Corundum	Aluminum oxide, α-
Cotunnite	Lead chloride
Covellite	Copper sulfide (ic)
Cream of tartar, soluble	Potassium borotartrate
Cristobalite	Silicon oxide, di-
Crocoite	Lead chromate
Cryolite	Sodium fluoaluminate
Cryolithionite	Lithium sodium fluoaluminate
Cryptohalite	Ammonium fluosilicate
Crystal carbonate	Sodium carbonate
Crythrosiderite	Iron chloride (ic)
Cuprammonium	under Copper complexes
Cupric	under Copper
Cuprite	Copper oxide (ous)
Cuprous	under Copper
Cyanoauric acid	Gold cyanide (ic)
Cyanoferrates (II)	Ferrocyanides
Cyanoferrates (III)	Ferricyanides
Cyanoferric (II) acid	Ferrocyanic acid
Cyanoferric (III) acid	Ferricyanic acid
Decaborane	Boron hydride
Decaborate	Ammonium pentaborate
Deuterioammonia, tri-	Ammonia-d_3
Diamminecopper (II) acetate	under Copper complexes
Diamminepalladium (II) hydroxide	under Palladium complexes
Diaquotetramminenickel (II) nitrate	under Nickel complexes
Diaspore	Aluminum hydroxide
Diborane	Boron hydride
Dichlorodiamminepalladium (II) *trans.*	under Palladium complexes
Digallane	Gallium hydride
Digermane	Germanium hydride
Dihydropentaborane	Borane hydride
Dihydrotetraborane	Boron hydride
Diopside	Calcium magnesium silicate
Disilane	Silicon hydride
Disilicoethane	Silicon hydride
Disiloxane	Silicyl oxide
Dithionite	Hydrosulfite
Dolomite	Calcium magnesium carbonate
Domeykite	Copper (tri) arsenide
Double nickel salt	Ammonium nickel sulfate
Dysprosia	Dyprosium oxide
Epsom salt	Magnesium sulfate
Erbia	Erbium oxide
Erythrite	Cobalt *ortho*arsenate (ous)

SYNONYM INDEX (Continued)

Compound sought	Listed
Erythrosiderite	Potassium iron chloride
Ethylate	Ethoxide
Ethylxanthate	Xanthate
Ethylxanthogenate	Copper Xanthate
Euclase	Beryllium aluminum silicate
Europia	Europium oxide
Ferric salts	under Iron
Ferrosoferric	under Iron
Ferrous salts	under Iron
Fischer's salt	Potassium nitrocobaltate (III)
Fluellite	Aluminum fluoride
Fluorine oxide	Oxygen fluoride
Fluorite	Calcium fluoride
Fluorophosphate, etc.	Fluophosphate, etc.
Fusible white precipitate	Mercury chloride (ic) diammine
Gadolinia	Gadolinium oxide
Gahnite	Zinc aluminate
Galena	Lead sulfide
Galloethane	Gallium hydride
Germane	Germanium hydride, tetra-
Germanium bromoform	Germane, tribromo-
Germanium chloroform	Germane, trichloro-
Gibbsite	Aluminum oxide
Glauber's salt	Sodium sulfate
Glucinum	Beryllium
Goethite	Iron hydroxide
Gold sodium thiosulfate	Sodium thiosulfateoaurate (I)
Goslarite	Zinc sulfate
Greenockite	Cadmium sulfide
Guanajuatite	Bismuth selenide, tri-
Guanite	Ammonium magnesium phosphate
Gypsum	Calcium sulfate
Hafnia	Hafnium oxide
Halite	Sodium chloride
Hambergite	Beryllium *ortho*borate, basic
Hauerite	Manganese sulfide (ic)
Hausmannite	Manganese oxide (ous, ic)
Heazlewoodite	Nickel sulfide, sub-
Heavy hydrogen	Deuterium
Heavy water	Deuterium oxide
Hematite	Iron oxide (ic)
Hemimorphite	Zinc silicate
Hessite	Silver telluride
Hexaantipyrineyttrium *per*chlorate	under Yttrium complexes
Hexaantipyrineyttrium iodide	under Yttrium complexes
Hexaborane	Boron hydride
Hexabromodisilane	Silicon (di-) bromide, hexa (di-)
Hexabromoethane	Carbon (di-) bromide, hexa
Hexachlorodisilane	Silicon (di-) chloride, hexa-
Hexachloroethane	Carbon (di-) chloride, hexa-
Hexaiododisilane	Silicon (di-) iodide, hexa-
Hexamminechromium (III) chloride	under Chromium complexes
Hexamminecobalt (III) chloride	under Cobalt complexes
Hexamminecobalt (III) *per*rhenate	under Cobalt complexes
Hexaureachromium (III) fluosilicate	under Chromium complexes
Hexaureachromium (III) *per*rhenate	under Chromium complexes
Hieratite	Potassium fluosilicate
Hoernesite	Magnesium *ortho*arsenate
Hopeite, α	Zinc *ortho*phosphate
Hopeite, β-	Zinc *ortho*phosphate
Hyacinth	Zinc *ortho*silicate
Hydrargillite	Aluminum oxide
Hydrazonium salts	under Hydrazine
Hydriodic acid	Hydrogen iodide
Hydrobromic acid	Hydrogen bromide
Hydrocerussite	Lead carbonate, basic
Hydrochloric acid	Hydrogen chloride
Hydrocyanic acid	Hydrogen cyanide
Hydrocyanite	Copper sulfate (ic)
Hydrofluosilicic acid	Fluosilicic acid
Hydromagnesite	Magnesium carbonate, basic
Hydroxide	Oxide (for aluminum, iron, etc.)
Hydroxoplatinic acid	Platinum oxide, di- (ic)
Hydroxylammonium salts	under Hydroxylamine
Hyposulfite	Thiosulfate, hydrosulfite
Infusible white precipitate	Mercury chloride (ic), ammonobasic
Iodide of Millon's base	Mercury iodide (ic), aquobasic ammonobasic
Iodine hydroxide	Iodous acid, hypo-
Iod(o)azide	Iodine azide
Iodyrite	Silver iodide
Kainite	Potassium magnesium chloride sulfate
Kalinite	Potassium aluminum sulfate
Kaluszite	Potassium calcium sulfate
Kieserite	Magnesium sulfate
Köttigite	Zinc *ortho*arsenate
Krausite	Potassium iron sulfate (ic)
Krugite	Potassium calcium magnesium sulfate
Lanarkite	Lead sulfate, basic

SYNONYM INDEX (Continued)

Compound sought	Listed
Langbeinite	Potassium magnesium sulfate
Lansfordite	Magnesium carbonate
Lanthana	Lanthanum oxide
Laurionite	Lead oxychloride
Laurite	Ruthenium sulfide
Lautarite	Calcium iodate
Lawrencite	Iron chloride (ous)
Lechatelierite	Silicon oxide, di-
Leonite	Potassium magnesium sulfate
Lime	Calcium oxide
Litharge	Lead oxide, mono-
Magnesia	Magnesium oxide
Magnesite	Magnesium carbonate
Magnetite	Iron oxide, ferrosoferric
Malachite	Copper carbonate, basic (ic)
Manganite	Manganese hydroxide (ic)
Manganolangbeinite	Potassium manganese sulfate (ic)
Manganosite	Manganese oxide, mon- (ous)
Marcasite	Iron sulfide, di-
Marshite	Copper iodide (ous)
Mascagnite	Ammonium sulfate
Massicot	Lead oxide, mono-
Matlockite	Lead oxychloride
Melanterite	Iron sulfate (ous)
Mendipite	Lead oxychloride
Mercallite	Potassium sulfate, hydrogen
Mercuric bromide, ammonobasic, and similar compounds	under Mercury-nitrogen compounds
Merwinite	Calcium magnesium *ortho*silicate
Metabisulfite	*Pyro*sulfite
Metacinnabarite	Mercury sulfide (ic) (β-)
Methylate	Methoxide
Microcline	Potassium aluminosilicate
Microcosmic salt	Sodium ammonium salt
Millerite	Nickel sulfide, mono-
Minium	Lead oxide, red
Mirabilite	Sodium sulfate
Misenite	Potassium sulfate, hydrogen
Molybdenite	Molybdenum sulfide, di-
Molybdenum blue	Molybdenum oxide
Molybdic anhydride	Molybdenum oxide, tri-
Molybdite	Molybdenum oxide, tri-
Molysite	Iron chloride (ic)
Montanite	Bismuth tellurate
Montroydite	Mercury oxide (ic)
Morenosite	Nickel sulfate
Mosaic gold	Tin sulfide (ic)
Mullite	Aluminum silicate
Muscovite	Potassium aluminosilicate
Nantokite	Copper chloride (ous)
Neodymia	Neodymium oxide
Nesquehonite	Magnesium carbonate
Neutral verdigris	Copper acetate (ic)
Newberyite	Magnesium *ortho*phosphate
Niccolite	Nickel arsenide
Niobic acid	Niobium oxide, pent-
Niton	Radon
Nitratoauric acid	Gold nitrate, hydrogen (ic)
Nitric anhydride	Nitrogen oxide, pent-
Nitrilotrissilane	Silicylamine, tri-
Nitrobarite	Barium nitrate
Nitrogen sulfide	Sulfur nitride
Nitrosoferricyanide	Nitroprusside
Nitrous anhydride	Nitrogen (di-) oxide, tri-
Nitroxyl	Nitryl
Octahedrite	Titanium oxide, di-
Oldhamite	Calcium sulfide
Opal	Silicon oxide, di-
Orpiment	Arsenic sulfide, tri-
Ortho clase	Potassium aluminum silicate
Parahopeite	Zinc *ortho*phosphate
Paralaurionite	Lead oxychloride
Paramelaconite	Copper oxide (ic)
Paris green	Copper acetate *meta*rsenite (ic)
Peligot's salt	Potassium chlorochromate
Pentaborane	Boron hydride
Periclase	Magnesium oxide
Permonosulfuric acid	Sulfuric acid, peroxymono-
Perovskite	Calcium *meta*titanate
Per(di)sulfuric acid	Sulfuric acid, peroxydi
Phenacite	Beryllium *ortho*silicate
Phenate	Phenoxide
Phenolate	Phenoxide
Phosgene	Carbonyl chloride
Phosphine	Hydrogen phosphide
Phosphoric anhydride	Phosphorus oxide pent-
Phosphorus sulfobromide or thiobromide, etc	Thiophosphoryl bromide, etc.
Phosphoryl (tri)amide	Phosphoramide
Phosphoryl bromide, etc.	Phosphorus oxybromide, etc.
Picromerite	Potassium magnesium sulfate
Pinnoite	Magnesium *meta*borate
Plaster of Paris	Calcium sulfate

SYNONYM INDEX (Continued)

Compound sought	Listed
Platinichloride	Chloroplatinate
Platinic hydroxide	Platinum oxide, di- (ic)
Platinochloride	Chloroplatinite
Platinocyanide	Cyanoplatinite
Platinonitrite	Nitroplatinite
Plattnerite	Lead oxide, di-
Plumbic	under Lead
Plumbous	under Lead
Polydymite	Nickel sulfide (ous, ic)
Polyhalite	Potassium calcium magnesium sulfate
Potassamide	Potassium amide
Potassium diboranide	Potassium *di*borane
Potassium fluocolumbate, penta	Potassium fluoniobate, penta-
Potassium oxyfluocolumbate	Potassium oxyfluoniobate
Potassium pentaboranide	Potassium *penta*borane
Praseodymia	Praseodymium oxide, sesqui-
Propylate	Propoxide
Proustite	Silver thioarsenite
Prussiate of soda, yellow	Sodium ferrocyanide
Pseudocotunnite	Potassium lead chloride
Pseudowollastonite	Calcium *meta*silicate (α)
Pyrargyrite	Silver thioantimonite
Pyrite	Iron sulfide (di-)
Pyroborate	*Tetra*borate
Pyrochroite	Manganese hydroxide (ous)
Quartz	Silicon oxide, di-
Racemate	*dl*-Tartrate
Radium emanation	Radon
Raspite	Lead tungstate
Realgar	Arsenic sulfide, di-
Reddingite	Manganese *ortho*phosphate
Rhodanate, rhodanide	Thiocyanate
Rhodochrosite	Manganese carbonate (ous)
Rhodonite	Manganese *meta*silicate (ous)
Rinneite	Potassium iron chloride
Rochelle salt	Potassium sodium tartrate
Roesslerite	Magnesium *ortho*arsenate
Rutile	Titanium oxide, di-
Sal ammoniac	Ammonium chloride
Saltpeter	Potassium nitrate
Samaria	Samarium oxide
Scacchite	Manganese chloride, di-
Scandia	Scandium oxide
Scheele's green	Copper *ortho*arsenite, acid (?) (ic)
Scheelite	Calcium tungstate
Schlippe's salt	Sodium thioantimonate
Schönite	Potassium magnesium sulfate
Scorodite	Iron *ortho*arsenate
Seignette salt	Potassium sodium tartrate
Sellaite	Magnesium fluoride
Senarmontite	Antimony oxide, tri-
Siderite	Iron carbonate (ous)
Siderotil	Iron sulfide
Silanes	Silicon hydrides
Silica	Silicon oxide
Silicobromoform	Silane, tribromo-
Silicochloroform	Silane, trichloro-
Silicofluoride	Fluosilicate
Silicofluoroform	Silane, trifluoro-
Silicoiodoform	Silane, triiodo-
Single nickel salt	Nickel sulfate
Smithsonite	Zinc carbonate
Sodamide	Sodium amide
Soda niter	Sodium nitrate
Sodium heptanoate	Sodium enanthate
Sodium hyposulfite	Sodium thiosulfate, sodium hydrosulfite
Sperrylite	Platinum arsenide
Sphalerite	Zinc sulfide (β)
Spherocobaltite	Cobalt carbonate (ous)
Spinel	Magnesium aluminate
Stannane	Tin hydride
Stercorite	Sodium ammonium phosphate
Stibine	Hydrogen antimonide
Stibnite	Antimony sulfide, tri-
Stolzite	Lead tungstate
Struvite	Ammonium magnesium phosphate
Sulfocarbolate	Phenolsulfonate
Sulfochloride	Chloride sulfide
Sulfocyanate, sulfocyanide	Thiocyanate
Sulfur oxychlorides	Sulfuryl chloride, sulfuryl, pyrochloride, thionyl chloride
Sulfuryl amide	Sulfamide
Sylvite	Potassium chloride
Syngenite	Potassium calcium sulfate
Szmikite	Manganese sulfate (ous)
Tantalic acid	Tantalum oxide, pent-
Tantalum hydroxide	Tantalum oxide, pent-
Tarapacaite	Potassium chromate
Tartar emetic	Potassium antimony tartrate
Tenorite	Copper oxide (ic)
Tephroite	Manganese *ortho*silicate (ous)

SYNONYM INDEX (Continued)

Compound sought	Listed
Terbia	Terbium oxide
Tetrabromoethylene	Carbon (di-) bromo, tetra-
Tetrabromomethane	Carbon bromide, tetra-
Tetrabromosilane	Silicon bromide, tetra-
Tetrachlorodiammineplatinum (IV), *cis*-	under Platinum complexes
Tetrachlorodiammineplatinum (IV), *trans*-	under Platinum complexes
Tetrachloroethylene	Carbon (di-) chloride, tetra-
Tetrachloromethane	Carbon chloride, tetra-
Tetrachlorosilane	Silicon chloride, tetra-
Tetradymite	Bismuth telluride, tri-
Tetrafluoromethane	Carbon fluoride, tetra-
Tetrafluorosilane	Silicon fluoride, tetra
Tetraiodomethane	Carbon iodide, tetra-
Tetraiodosilane	Silicon iodide, tetra-
Tetramminecopper (II) sulfate	under Copper complexes
Tetramminepalladium (II) chloride	under Palladium complexes
Tetrammineplatinum (II) chloride	under Platinum complexes
Tetrammine platinum (II) chloroplatinite	under Platinum complexes
Tetramminezinc *per*rhenate	under Zinc complexes
Tetrapyridinecopper (II) fluosilicate (ic)	under Copper complexes
Tetrapyridinecopper *per*rhenate	under Copper complexes
Tetrapyridinenickel (II) fluosilicate	under Nickel complexes
Tetrapyridinezinc fluosilicate	under Zinc complexes
Tetrasilane	Silicon hydride
Tetrasilicobutane	Silicon hydride
Thenard's blue	Cobalt aluminate
Thenardite	Sodium sulfate
Thermonatrite	Sodium carbonate
Thiophosgene	Thiocarbonyl chloride

Compound sought	Listed
Thoria	Thorium oxide, di-
Thorite	Thorium *ortho*silicate
Thulia	Thulium oxide
Tiemannite	Mercury selenide (ic)
Titanic acids	Titanium oxide, di-
Tridymite	Silicon oxide, di-
Trigermane	Germanium hydride
Trisilane	Silicon hydride
Trisilicopropane	Silicon hydride
Troilite	Iron sulfide (ous)
Uranium nitrate	Uranyl nitrate
Uranyl hydroxide	Uranic acid, meta-
Uranyl oxide	Uranium oxide, tri-
Valentinite	Antimony oxide, tri-
Vanadyl bromide, etc.	Vanadium oxybromide, etc.
Verdigris	Copper acetate
Vermilion	Mercury sulfide (ic) (α)
Villiaumite	Sodium fluoride
Vitriol blue	Copper sulfate (ic)
Vivianite	Iron *ortho*phosphate
Washing soda	Sodium carbonate
Water Glass	Sodium silicate
White arsenic	Arsenic oxide, tri-
White lead	Lead carbonate, basic
White mica	Potassium aluminosilicate
Willemite	Zinc *ortho*silicate
Witherite	Barium carbonate
Wolfram	Tungsten
Wollastonite	Calcium *meta*silicate (β)
Wulfenite	Lead molybdate
Wurtzite	Zinc sulfide (α)
Xanthogenate	Xanthate
Ytterbia	Ytterbium oxide
Yttria	Yttrium oxide
Zaratite	Nickel carbonate, basic
Zincite	Zinc oxide
Zinkosite	Zinc sulfate
Zircon	Zirconium *ortho*silicate
Zirconia	Zirconium oxide, di-
Zirconic acid, meta-	Zirconium oxide, di-
Zirconium hydroxide	Zirconium oxide, di-

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Aluminum**	Al	26.98	cub. silv. wh. duct. met
2	acetate, tri-	$Al(C_2H_3O_2)_3$	204.10	solid
3	" di- (com'l)	$Al(OH)(C_2H_3O_2)_2\cdot xH_2O$		wh. powd
4	*ortho*arsenate	$AlAsO_4\cdot 8H_2O$	310.01	wh. powd
5	benzoate	$Al(C_7H_5O_2)_3$	390.30	wh. cr. powd
6	benzyloxide	$Al(C_7H_7O)_3$	348.35	
7	boride, di-	AlB_2	48.61	hex
8	bromate	$Al(BrO_3)_3\cdot 9H_2O$	572.86	wh. cr. hyg
9	bromide	$AlBr_3$ (or Al_2Br_6)	266.72	col. rhomb. deliq. pl
10	"	$AlBr_3\cdot 6H_2O$	374.82	col.-yelsh need., deliq
11	"	$AlBr_3\cdot 15H_2O$	536.96	need., col
12	butoxide	$Al(C_4H_9O)_3$	246.31	wh. cr.
13	carbide	Al_4C_3	143.91	hex., yel-grn
14	chlorate	$Al(ClO_3)_3\cdot 6H_2O$	385.44	rhbdr. col., deliq
15	chloride	$AlCl_3$ (or Al_2Cl_6)	133.34	hex., wh.-col.; odor HCl; v. deliq
16	"	$AlCl_3\cdot 6H_2O$	241.44	col. rhomb., deliq.; near odorl. 1.6
17	diethyl malonate deriv.	$Al(C_7H_{11}O_4)_3$	504.44	
18	ethoxide	$Al(C_2H_5O)_3$	162.15	wh. cr.
19	α-ethylacetoacetate deriv.	$Al(C_6H_9O_3)_3$	414.37	wh. cr.
20	ferrocyanide	$Al_4[Fe(CN)_6]_3\cdot 17H_2O$	1050.03	br. powd
21	fluoride	AlF_3	83.97	col. trans. tricl
22	" (fluellite)	$AlF_3\cdot H_2O$	101.99	rhomb., 1.473, 1.490, 1.511
23	"	$AlF_3\cdot 3\frac{1}{2}H_2O$	147.03	wh. cr. powd
24	fluosilicate	$Al_2(SiF_6)_3$	480.12	wh. powd
25	hydroxide (boehmite)	$AlO(OH)$	59.98	orthorh. wh. micro. cr
26	" (diaspore)	$AlO(OH)$	59.98	col. rhomb. cr
27	iodide	AlI_2 (or Al_2I_6)	407.73	wh.-br. pl., cont. free I_2, deliq
28	"	$AlI_3\cdot 6H_2O$	515.83	wh.-yel. cr
29	isopropoxide	$Al(C_3H_7O)_3$	204.23	wh. cr.
30	lactate	$Al(C_3H_5O_3)_3$	294.18	wh.-yelsh. powd
31	nitrate	$Al(NO_3)_3\cdot 9H_2O$	375.14	rhomb. col. deliq
32	nitride	AlN	40.98	hex. clear wh. cr.
33	oleate (com'l)	$Al(C_{18}H_{33}O_2)_3$(?)	871.30	wh. powd.; exist. doubted except as a basic salt
34	oxalate	$Al_2(C_2O_4)_3\cdot 4H_2O$	390.06	wh. powd
35	oxide	Al_2O_3	101.94	hex. col., 1.765
36	oxide (α alumina) (corundum)	Al_2O_3	101.94	trig., col. cr., n 1.765
37	oxide γ (γ alumina)	Al_2O_3	101.94	wh. micro. cr., n. 1.7
38	" (gibbsite, hydrargillite)	$Al_2O_3\cdot 3H_2O$	155.99	monocl., wh. cr.
39	" ("Bayerite")	$Al_2O_3\cdot 3H_2O$	155.99	wh. micro. cr.

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.702	659.7	2057	i.	i.	s. alk., HCl, H_2SO_4; i. HNO_3, ac. a.
2	....	d.	....	s.	d.	....
3	....	d.	....	v. sl. s.	s.	s. a.; i. NH_4 salts
4	3.011	$-H_2O$	....	i.	i.	sl. s. a.
5	....	....	....	v. sl. s.	....	....
6	....	59–60	$283–4^{9.5}$	....	....	....
7	3.19	....	....	....	....	....
8	....	62.3	d. 100	s.	s.	sl. s. a.
9	3.01^{25}	97.5	263.3^{747}	s. with viol.	d.	s. al., CS_2, acet.
10	2.54	93	d.>100	s.	d.	s. al., amyl. al. sl. s. CS_2
11	....	−7.5	d. 7	s.	s.	s. al.
12	$1.0251\frac{20}{0}$	101.5–102	284.5^{10}	d.	d.	s. al.
13	2.36	stab. to 1400	d. at high temp.	d. to CH_4	d.	d. dil. a.; i. acet.
14	....	d.	....	v. s.	v. s.	s. dil. HCl
15	2.44^{25}; lq. 1.31^{200}	$190^{2.5\ atm}$	182.7^{752}; subl. 177.8	69.9^{15}; s. with viol.	s. d.	$100^{12.5}$ abs. al., 072^{25} chl.; s. CCl_4, eth.; sl. s. bz.
16	2.398–.440	....	d.	s.	v. s., ev. HCl	s. eth., 50 abs. al.
17	1.084^{100}	98	....	i.	....	s. org. solv.
18	$1.142\frac{20}{0}$	134	205^{14}	d.	s.	v. sl. s. al., eth.
19	1.101^{80}	78–9	$190–200^{11}$	d.	....	s. lgr.
20	....	....	....	sl. s.	sl. s.	s. dil. a.
21	3.07	1040	....	s.	s.	i. a., al., alk., acet.
22	2.17	....	....	sl. s.	....	....
23	....	$-2H_2O$, 100	$-3H_2O$, 250	i.	sl. s.	....
24	....	....	....	i.	....	....
25	3.01	$-H_2O$ tr. to $Al_2O_3\gamma$	....	i.	i.	s. h. a., alk.
26	3.3–.5	$-H_2O$ tr. to Al_2O_3 (corundum)	....	i.	i.	s. h. a., alk.
27	3.98^{25}	191	360 (382)	s. d.	s.	s. al., eth., CS_2
28	2.63	185 d.	d.	v. s.	v. s.	s. al., CS_2
29	$1.0346\frac{20}{0}$	118.5	140.5^{8}	d.	....	s. bz.
30	....	....	....	v. s.	....	....
31	....	70	d. 150	63.7^{25}	v. s. d.	100 al.; s. alk., acet., HNO_3
32	3.26	>2200	subl. 2000	d. ev. NH_3	d.	d. a., alk.
33	....	....	....	d.	d.	v. sl. s. bz.; i. al.
34	....	....	....	i.	i.	s. a.; i. al.
35	3.5–.9	2050	2250	$.000098^{29}$	i.	v. sl. s. a., alk.
36	3.97	2015 ± 15	3500	$.000098^{29}$	i.	v. sl. s. a., alk.
37	3.5–.9	tr. to alpha	....	i.	i.	sl. s. a., alk.
38	2.42	tr. to $Al_2O_3\cdot H_2O$ (Boehmite)	....	i.	i.	s. h. a., alk.
39	2.53	tr. to $Al_2O_3\cdot H_2O$ (Boehmite)	....	i.	i.	s. h. a., alk.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Aluminum			
1	oxide	$Al_2O_3 \cdot xH_2O$		amor. wh. powd
2	palmitate, mono- (com'l)	$Al(OH)_2C_{16}H_{31}O_2$	316.39	wh.
3	2,4-pentanedione deriv. (acetylacetonate)	$Al(C_5H_7O_2)_3$	324.29	monocl. pr
4	1-phenol-4-sulfonate	$Al(C_6H_5O_4S)_3$	546.47	redsh. wh. powd
5	phenoxide	$Al(C_6H_5O)_3$	306.27	grayish wh. cr. mass
6	*ortho*phosphate	$AlPO_4$	121.95	rhomb. pl., 1.546, 1.556, 1.578
7	propoxide	$Al(C_3H_7O)_3$	204.23	wh. cr.
8	salicylate	$Al(C_7H_5O_3)_3$	438.30	redsh.-wh. powd
9	silicate (mullite)	$Al_6Si_2O_{13}$	425.94	col. rhomb
10	stearate, tri- (com'l)	$Al(C_{18}H_{35}O_2)_3$	877.35	wh.
11	stearate, mono- (com'l)	$Al(OH)_2C_{18}H_{35}O_2$	344.45	wh.
12	stearate, di- (com'l)	$Al(OH)(C_{18}H_{35}O_2)_2$	610.90	wh.
13	sulfate	$Al_2(SO_4)_3$	342.14	wh. powd
14	"	$Al_2(SO_4)_3 \cdot 9H_2O$	504.28	monocl. wh., 1.459
15	" (alunogenite)	$Al_2(SO_4)_3 \cdot 18H_2O$	648.41	monocl. col., 1.474, 1.476, 1.483
16	sulfide	Al_2S_3	150.14	hex. yel., odor H_2S, d. moist air
17	thallium sulfate	$AlTl(SO_4)_2 \cdot 12H_2O$	639.68	cub. oct. col., 1.4976
18	**Ammonia**	NH_3	17.03	col. gas., $1.325^{16.5}$ lq
19	Ammonia-d_3 (trideuterioammonia)	ND_3	20.05	
	Ammonium			
20	acetate	$NH_4C_2H_3O_2$	77.08	wh. cr. hyg
21	acetate, hydrogen	$NH_4C_2H_3O_2 \cdot HC_2H_3O_2$	137.14	deliq. need
22	aluminum chloride	$NH_4Cl \cdot AlCl_3$	186.84	wh. cr.
23	" sulfate	$NH_4Al(SO_4)_2$	237.14	hex. col
24	" "	$NH_4Al(SO_4)_2 \cdot 12H_2O$	453.33	cub. col., 1.459
25	*ortho*arsenate	$(NH_4)_3AsO_4 \cdot 3H_2O$	247.08	rhomb. cr
26	" , mono-H	$(NH_4)_2HAsO_4$	176.00	monocl. col., odor NH_3
27	" , di-H	$NH_4H_2AsO_4$	158.97	tetr. col
28	*meta*arsenite	NH_4AsO_2	124.95	rhomb. pr., col
29	azide	NH_4N_3	60.06	col. pl
30	benzenesulfonate	$NH_4C_6H_5SO_3$	175.21	rhomb
31	benzoate	$NH_4C_7H_5O_2$	139.15	rhomb. col
32	*penta*borate (decaborate)	$NH_4B_5O_8 \cdot 4H_2O$	272.20	
33	*peroxy*borate	$NH_4BO_3 \cdot \frac{1}{2}H_2O$	85.87	wh. cr.
34	*tetra*borate (biborate)	$(NH_4)_2B_4O_7 \cdot 4H_2O$	263.42	col. tetr
35	bromate	NH_4BrO_3	145.96	hex. col
36	bromide	NH_4Br	97.96	cub. col.; sl. hyg.; 1.712^{25}
37	bromoplatinate	$(NH_4)_2PtBr_6$	710.81	cub. red-br
38	bromoselenate	$(NH_4)_2SeBr_6$	594.54	red oct. cr
39	bromostannate	$(NH_4)_2SnBr_6$	634.28	cub. col
40	cadmium chloride	$4NH_4Cl \cdot CdCl_2$	397.31	rhomb. 1.6038
41	calcium arsenate	$NH_4CaAsO_4 \cdot 6H_2O$	305.13	monocl. col

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	$-x H_2O$, tr. to Al_2O_3 (γ)	....	i.	i.	s. a., alk.
2	1.095	200	....	i.	....	s. alk., hydro-carbons
3	1.007^{195}	194	314–50	sl. s.	....	s. al., eth., bz.
4	....	....	....	s.	....	s. al., glyc.
5	1.23	265 d.	....	d.	....	s. al., chl., eth.
6	2.566	>1500	....	i.	i.	s. a., alk.; i. al.
7	$1.0578\frac{20}{0}$	106	248^{14}	d.	d.	s. al.
8	....	....	....	i.	....	s. dil. alk.; i. al.
9	3.15	d. 1810	....	v. sl. s.	....	....
10	1.010	103	....	i.	....	s. oil. turp., pet., alk.; sl. s. al.
11	1.010	160	....	....	....	s. min. oil, pet., turp.
12	1.010	145	....	....	....	s. min. oil, pet., turp.
13	2.71	d. 770	....	31.3^{0}	98.1^{100}	s. dil. a.; sl. s. al.
14	$1.705\frac{20}{0}$	d.	....	s.	s.	s. a., alk.
15	1.69^{17}	d. 86.5	....	s.	s.	i. al.
16	2.02^{13}	1100	subl. 1550 (N_2)	d.	....	s. a.; i. acet.
17	2.32	91	....	10^{20}	65.19^{60}	....
18	$.7710^{0}$ g/l; lq. 0.817^{-79}	−77.7	−33.35	89.9^{0}; 52.0	7.4^{100}	13.2^{20} al.; s. eth., org. solv.
19	....	−74	−30.9	....	....	....
20	1.073	114	d.	148^{4}	d.	s. al.; sl. s. acet.
21	....	66	....	s.	....	s. al.
22	....	304	....	s.	....	....
23	2.039	....	....	s.	....	s. glyc.; i. al.
24	1.64	93.5	$-10H_2O$, 120 $-12H_2O$, 200	15^{20}	∞	s. dil. a.; i. al.
25	....	d-loses NH_3	....	....	....	....
26	1.989	d.	....	s.	d.	....
27	2.311^{9}	d., $-NH_3^{300}$	....	33.74	122.4^{90}	....
28	....	....	....	v. s.	d.	sl. s. NH_4OH; i. al., acet.
29	1.346	160	subl. 134; exp.	20.16/ 100 cc soln.	27.07^{40}/ 100 cc soln.	1.06 al.; s. NH_3; i. eth.
30	1.342	271–5 d.	....	98	320	19 cold al.; i. eth., bz.
31	1.260	198 d.	subl. 160	$19.6^{14.5}$	83.3^{100}	1.63^{25} al.; i. eth.
32	....	....	....	7.03^{18}	....	....
33	....	d.	....	$1.55^{17.5}$	d.	i. al.
34	....	d.	....	7.27^{18}	52.68 g./ 100 g. soln. at 90°C	....
35	....	exp.	....	v. s.	v. s.	sl. s. al.
36	2.429	subl. 542	235^{vac}	59.8^{0}	145.6^{100}	s. al., acet., eth., NH_3
37	4.265^{24}	d. 145	....	0.40^{0}, 0.59^{20}	0.36^{100}	....
38	3.326	....	....	d.	d.	sl. s. eth.
39	3.50	d.	....	v. s.	....	....
40	2.01	....	....	s.	....	....
41	1.905^{15}	d. 140	....	0.02	s.	s. NH_4Cl; i. NH_4OH

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Ammonium			
1	calcium phosphate	$NH_4CaPO_4 \cdot 7H_2O$	279.21	monocl. col
2	carbamate	$NH_4NH_2CO_2$	78.07	rhomb. col
3	" acid carbonate (com'l, sal. volatile)	$NH_4NH_2CO_2 \cdot NH_4HCO_3$	157.13	wh. cr
4	carbonate	$(NH_4)_2CO_3$	96.09	cub. col
5	carbonate, hydrogen (bicarbonate)	NH_4HCO_3	79.05	rhomb. or monocl. col. 1.423, 1.536, 1.555
6	cerium nitrate (ous)	$2NH_4NO_3 \cdot Ce(NO_3)_3 \cdot 4H_2O$	558.32	monocl
7	cerium sulfate (ous)	$(NH_4)_2SO_4 \cdot Ce_2(SO_4)_3 \cdot 8H_2O$	844.73	monocl
8	chlorate	NH_4ClO_3	101.50	monocl. need. col
9	*per*chlorate	NH_4ClO_4	117.50	rhomb. col., 1.482
10	chloride (sal ammoniac)	NH_4Cl	53.50	cub. col. 1.642
11	chloroaurate	NH_4AuCl_4	357.07	rhomb. or monocl. yel
12	"	$(NH_4AuCl_4)_4 \cdot 5H_2O$	1518.35	monocl. yel
13	chlorogallate	NH_4GaCl_4	229.59	wh. cr
14	chloroiridate	$(NH_4)_2IrCl_3$	441.92	cub. red-blk
15	chloroiridite	$(NH_4)_3IrCl_3 \cdot 1\frac{1}{2}H_2O$	486.99	grn.-br
16	chloroösmate	$(NH_4)_2OsCl_6$	439.02	cub
17	chloropalladate	$(NH_4)_2PdCl_6$	355.52	cub. red-br
18	chloropalladite	$(NH_4)_2PdCl_4$	284.61	tetr. olive grn
19	chloroplatinate	$(NH_4)_2PtCl_6$	444.05	cub. yel
20	chloroplatinite	$(NH_4)_2PtCl_4$	373.14	rhomb. red (tetr.)
21	chloroplumbate	$(NH_4)_2PbCl_6$	456.03	cub. yel
22	chlorostannate	$(NH_4)_2SnCl_6$	367.52	cub. wh
23	chromate	$(NH_4)_2CrO_4$	152.09	monocl. yel
24	*di*chromate	$(NH_4)_2Cr_2O_7$	252.10	monocl. or
25	*peroxy*chromate	$(NH_4)_3CrO_8$	234.13	cub. red-br
26	chromium sulfate (ic)	$(NH_4)Cr(SO_4)_2 \cdot 12H_2O$	478.38	cub. grn. or vlt., 1.4842
27	citrate, tri- (tert.)	$(NH_4)_3C_6H_5O_7$	243.22	wh. cr. deliq
28	" , di- (sec.)	$(NH_4)_2HC_6H_5O_7$	226.19	wh. gran. or powd
29	cobalt *ortho*phosphate (ous)	$NH_4CoPO_4 \cdot H_2O$	189.98	vlt. cr. powd
30	cobalt sulfate (ous)	$(NH_4)_2SO_4 \cdot CoSO_4 \cdot 6H_2O$	395.25	monocl. ruby-red, 1.490, 1.495, 1.503
31	copper chloride (ic)	$2NH_4Cl \cdot CuCl_2 \cdot 2H_2O$	277.48	tetr. blue, 1.744, 1.724
32	" iodide (ous)	$NH_4I \cdot CuI \cdot H_2O$	353.44	rhomb. pl
33	cyanate	NH_4OCN	60.06	wh. cr
34	cyanide	NH_4CN	44.06	cub. col
35	cyanoaurate	$NH_4Au(CN)_4 \cdot H_2O$	337.33	col. pl
36	cyanoaurite	$NH_4Au(CN)_2$	267.28	cub. col
37	cyanoplatinite	$(NH_4)_2Pt(CN)_4 \cdot H_2O$	353.40	yel. cr
38	ethyl sulfate	$NH_4C_2H_5SO_4$	143.16	col. to sl. yelsh. hyg. cr
39	ferricyanide	$(NH_4)_3Fe(CN)_6$	266.08	red. cr
40	ferrocyanide	$(NH_4)_4Fe(CN)_6 \cdot 3H_2O$	338.17	monocl. yel., turns bl. in air
41	fluoantimonite	$(NH_4)_2SbF_5$	252.84	rhomb. col
42	fluoborate	NH_4BF_4	104.86	rhomb. pr
43	fluogallate	$(NH_4)_3GaF_6$	237.84	wh. oct. cr
44	fluogermanate	$(NH_4)_2GeF_6$	222.14	col. hex. pr. and bipyr.; 1.428, 1.425

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.561^{15}	d.	....	i.	d.	s. a.
2	....	subl. 60	....	v. s.	d.	v. s. NH_4OH; sl. s. al.; i. acet.
3	....	subl.	....	25^{150}	67^{650}	....
4	....	d. 58	....	100^{15}	d.	i. al., CS_2, NH_3
5	1.58	107.5, (d. 36-60)	subl.	11.9^0	d.	i. al., acet.
6	....	74	....	318^{20}	817.4^{65}	....
7	2.523	$-6H_2O$, 100 $-8H_2O$, 150	....	anh. 5.33^{22}; 3.29^{40}	1.05^{90}	....
8	....	exp. 102	....	v. s.	v. s.	sl. s. al.
9	1.95	d.	....	10.74^0	42.54^{85}	s. acet.; sl. s. al.
10	1.527	subl. 335	....	29.7^0	75.8^{100}	0.6^{19} al.; s. NH_3
11	....	....	....	s.	....	sl. s. al.
12	....	$-5H_2O$, 100	....	s.	....	s. al.
13	....	275	....	v. s.	v. s.	s. al.; i. pet. eth.
14	2.856	d.	....	$.556^0$; $.69^{14}$	4.38^{80}	s. HCl; i. al.
15	....	....	....	s.	....	....
16	2.93	....	....	....	....	....
17	2.418	d.	....	sl. s.	....	....
18	2.17	d.	....	s.	....	i. al.
19	3.065	d.	....	$.29^0$; 67^{20}	3.37^{100}	.005 al.; i. eth., c. HCl
20	2.936	d.	....	s.	s.	i. al.
21	2.925	d. 120	....	sl. s.	d.	s. a.
22	2.4	d.	....	$33^{14.5}$	v. s.	....
23	1.91^{12}	d.	....	40.5^{30}	d.	sl. s. NH_3, acet.; i. al.
24	2.15^{25}	d.	....	30.8^{15}	89^{30}	s. al.; i. acet.
25	....	d. 40	exp. 50	sl. s.	d.	sl. s. NH_3; i. al., eth.
26	1.72	94; $-9H_2O$, 100	....	21.2^{25}	32.8^{40}; grn. at 70	s. al., dil. a.
27	....	d.	....	v. s.	d.	i. al., eth., acet.
28	....	....	....	v. s.	....	sl. s. al.
29	....	....	....	i.	....	s. a.
30	1.902	....	....	20.5^{20}	45.4^{80}	i. al.
31	1.993	d. 110	....	33.8^0	99.3^{80}	s. a., al.; sl. s. NH_3
32	....	....	....	d.	d.	s. NH_4I
33	....	d. 60	....	v. s.	d.	sl. s. al.; i. eth.
34	1.02^{100} g/l	d. 36	subl. 40	v. s.	d.	v. s. al.
35	....	d. 200	....	v. s.	....	v. s. al.; i. eth.
36	....	d. 100	....	v. s.	v. s.	s. al.; i. eth.
37	....	....	....	s.	....	....
38	....	99	....	s.	....	....
39	....	d.	....	v. s.	....	....
40	....	d.	....	s.	d.	i. al.
41	....	subl., d.	....	108	....	....
42	1.851^{17}	subl.	....	25^{16}	95^{100}	s. al.
43	....	....	d.>250-GaF_3	sl. s.	....	....
44	2.564^{25}_{25}	....	....	s.	....	i. al., meth. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Ammonium			
1	fluophosphate, hexa-	NH_4PF_6	163.02	col. pl
2	" , di-	$NH_4PO_2F_2$	119.02	col., rhomb
3	fluoride	NH_4F	37.04	hex. col., deliq., 1.315^{25}
4	" hydrogen	NH_4HF_2	57.05	rhomb. or tetr., deliq
5	fluosilicate (cryptohalite)	$(NH_4)_2SiF_6$	178.14	cub. or hex., col., 1.370
6	fluosulfonate	NH_4SO_3F	117.11	long col. need
7	fluotitanate	$(NH_4)_2TiF_6$	197.98	hex. pr
8	fluozirconate	$(NH_4)_2ZrF_6$	241.30	rhomb. hex
9	"	$(NH_4)_3ZrF_7$	278.34	col. cub., 1.433
10	formate	NH_4CHO_2	63.06	monocl. wh., deliq
11	gallium sulfate	$NH_4Ga(SO_4)_2\cdot 12H_2O$	496.08	cub. oct. col., 1.4684
12	hydroxide	NH_4OH	35.05	in soln. only at ord. temp.
13	iodate	NH_4IO_3	192.96	rhomb. or monocl
14	*metaper*iodate	NH_4IO_4	208.96	tetr. col
15	iodide	NH_4I	144.96	cub. col. hyg., 1.701^{25}
16	*trï*iodide	NH_4I_3	398.80	br. rhomb
17	iodoplatinate	$(NH_4)_2PtI_6$	992.83	cub
18	iridium sulfate	$NH_4Ir(SO_4)_2\cdot 12H_2O$	619.46	yel. red
19	iron sulfate (ous)	$(NH_4)_2SO_4\cdot FeSO_4\cdot 6H_2O$	392.16	monocl. grn., 1.487, 1.492, 1.499
20	" " (ic)	$NH_4Fe(SO_4)_2\cdot 12H_2O$	482.21	cub. oct., vlt.; eff., 1.4854
21	lactate	$NH_4C_3H_5O_3$	107.11	col.-yelsh. syrupy liq
22	laurate, acid (mixt.)	$NH_4C_{12}H_{23}O_2\cdot C_{12}H_{24}O_2$	417.66	wh. sld
23	magnesium arsenate	$NH_4MgAsO_4\cdot 6H_2O$	289.37	tetr. col., 1.608
24	" carbonate	$(NH_4)_2CO_3\cdot MgCO_3\cdot 4H_2O$	252.49	wh
25	" chloride	$NH_4Cl\cdot MgCl_2\cdot 6H_2O$	256.83	rhomb., doub. pyram. deliq
26	" chromate	$(NH_4)_2CrO_4\cdot MgCrO_4\cdot 6H_2O$	400.52	monocl. yel., 1.636, 1.637, 1.653
27	" phosphate (guanite, struvite)	$NH_4MgPO_4\cdot 6H_2O$	245.44	rhomb. col., 1.495, 1.496, 1.504; NH_3 on exposure
28	magnesium sulfate (boussingaultite)	$(NH_4)_2SO_4\cdot MgSO_4\cdot 6H_2O$	360.63	monocl. col., 1.472, 1.473, 1.479
29	*l*-malate, hydrogen	$NH_4HC_4H_4O_5$	151.12	rhomb. col
30	*per*manganate	NH_4MnO_4	136.97	rhomb
31	manganese phosphate(ic)	$NH_4MnPO_4\cdot H_2O$	185.97	wh. cr
32	" sulfate (ous)	$(NH_4)_2SO_4\cdot MnSO_4\cdot 6H_2O$	391.24	monocl. pa. red, 1.480, 1.484, 1.491
33	molybdate	$(NH_4)_2MoO_4$	196.03	monocl. pr. col
34	*para*molybdate ("molybdic acid") (com'l)	$(NH_4)_6Mo_7O_{24}\cdot 4H_2O$ (or $(NH_4)_6H_8Mo_7O_{28}$) (approx.)	1235.95	monocl. col.-yelsh
35	molybdotellurate	$(NH_4)_6[TeMo_6O_{24}]\cdot 7H_2O$	1321.66	col. rhomb
36	myristate, acid (mixt.)	$NH_4C_{14}H_{27}O_2\cdot C_{14}H_{28}O_2$	473.76	wh. sld
37	nickel chloride	$NH_4Cl\cdot NiCl_2\cdot 6H_2O$	291.20	monocl. grn., deliq
38	" sulfate (double nickel salt)	$(NH_4)_2SO_4\cdot NiSO_4\cdot 6H_2O$	395.00	monocl. dk. bl.-grn. 1.495, 1.501, 1.508
39	nitrate	NH_4NO_3	80.05	rhomb. col. (monocl. >32.1°)
40	nitratocerate	$(NH_4)_2[Ce(NO_3)_6]$	548.26	monocl. yel.-red
41	nitrite	NH_4NO_2	64.05	wh.-yelsh. cr

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.180^{18}	d.	....	s.	s.	s. al., acet.
2	....	213	....	s.	s.	s. al., acet.
3	1.315	subl.	....	v. s.	d.	s. al.; i. NH_3
4	liq. $1.21\frac{12}{12}$	subl.	....	v. s.	v. s.	sl. s. al.
5	2.01	subl.	....	18.6^{17}	55.5^{100}	sl. s. al.; i. acet.
6	....	244.7	....	s.	s.	sl. s. al.; s. meth. al.; d. NH_4OH
7	....	d.	....	s.	s.	i. al., eth.
8	1.154	....	....	....	....	....
9	....	....	....	sl. s.	....	....
10	1.266	116	d. 180	102^{0}	531^{80}	s. al., NH_3
11	1.777	....	....	30.9^{25}	....	.00864 70 % al.
12	....	−77	....	s.	....	....
13	3.309^{21}	d. 150	....	2.6^{15}	14.5^{100}	....
14	3.056^{18}	exp.	....	2.7^{16}	....	....
15	2.514	subl. 551	220 vac.	154.2^{0}	250.3^{100}	v. s. al., acet., NH_3; sl. s. eth.
16	3.749	....	....	s. d.	d.	....
17	4.61	....	....	....	....	....
18	....	106	....	s.	....	....
19	1.864	d.	....	26.9^{20}	73.0^{80}	i. al.
20	1.71	230	$-12H_2O$, 230	124^{25}	400^{100}	s. dil. a.; i. al.
21	$1.19\text{–}.21^{15}$	....	....	∞	....	∞ al.
22	....	75	d.	s.	s.	4.8^{7} al.; sl. s. eth., acet.
23	1.932^{15}	d.	....	0.038^{20}	0.024^{80}	s. a.; i. al.
24	....	....	....	s.	v. s.	s. a.; i. al.
25	1.456	d.	....	16.7	....	....
26	1.84	d.	....	v. s.	v. s.	....
27	1.711-.715	d.	....	0.0231^{0}; 0.052^{20}	0.0195^{80}	v. s. dil. a.; s. a.; i. al.
28	1.723	>120	....	17.68^{0}	130.58^{100}	....
29	1.5	161	d.	$32.2^{15.7}$	....	....
30	2.208	exp.	....	7.9^{15}	d.	....
31	....	....	....	0.0031	0.05	i. al., NH_4 salts
32	1.83	....	....	51.3^{25}	v. s.	....
33	2.27	d.	....	s. (d.)	d.	s. a.; i. al., NH_3, SO_2, acet.
34	2.498	d.	....	40	d.	s. a., alk.
35	2.78	550 d.	d.	s.	s.	....
36	....	75–90	d.	sl. s.	s.	s. al.; i. c. eth.
37	1.645	....	....	v. s.	v. s.	....
38	1.923	....	....	10.4^{20}	30^{80}	s. $(NH_4)_2SO_4$; i. al.
39	1.725^{25}	169.6	d. 210	118.3^{0}	871^{100}	3.8^{20} al., 17.1^{20} meth. al.; s. acet., NH_3
40	....	....	....	142.6^{25}	$232.^{90}$	sl. s. HNO_3; s. al.
41	1.69	d.	....	v. s.	d.	s. al.; i. eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Ammonium			
1	oleate, acid (mixt.)	$NH_4C_{18}H_{33}O_2 \cdot C_{18}H_{34}O_2$	581.94	wh. powd
2	oxalate	$(NH_4)_2C_2O_4 \cdot H_2O$	142.12	rhomb. col., 1.439, 1.546, 1.594
3	" ; acid (binoxalate)	$NH_4HC_2O_4 \cdot H_2O$	125.08	rhomb. col
4	oxalatoferrate (III)	$(NH_4)_3[Fe(C_2O_4)_3] \cdot 3H_2O$	428.08	monocl. grn
5	palmitate, acid (mixt.)	$NH_4C_{16}H_{31}O_2 \cdot C_{16}H_{32}O_2$	529.86	yelsh. soapy mass or yel. powd
6	*hypo*phosphate	$(NH_4)_2H_2P_2O_6$	196.06	
7	*ortho*phosphate, mono-H	$(NH_4)_2HPO_4$	132.07	monocl. col
8	" , di-H	$NH_4H_2PO_4$	115.04	tetr. col., 1.525, 1.479
9	*hypo*phosphite	$NH_4H_2PO_2$	83.04	rhomb. tabl
10	*ortho*phosphite, di-H	$NH_4H_2PO_3$	99.04	monocl. col. pr
11	phosphomolybdate (molybdiphosphate)	$(NH_4)_3[PMo_{12}O_{40}]$	1876.50	yel. powd
12	phosphotungstate	$(NH_4)_3[P(W_3O_{10})_4]$	2932.14	white
13	picramate	$NH_4C_6H_4N_3O_5$	216.16	redsh.-br. cr. powd
14	picrate	$NH_4C_6H_2N_3O_7$	246.14	rhomb. red or yel
15	praseodymium sulfate	$(NH_4)_2SO_4 \cdot Pr_2(SO_4)_3 \cdot 8H_2O$	846.31	cr
16	propionate	$NH_4C_3H_5O_2$	91.11	pr. deliq
17	*per*rhenate	NH_4ReO_4	268.35	wh. hex. pl
18	*d*-saccharate, hydrogen	$NH_4HC_6H_8O_8$	227.17	need. or monocl. pr
19	salicylate	$NH_4C_7H_5O_3$	155.15	monocl. col
20	selenate	$(NH_4)_2SeO_4$	179.04	monocl. col., 1.561, 1.563, 1.585
21	selenate, hydrogen	NH_4HSeO_4	162.01	rhomb
22	selenide	$(NH_4)_2Se$	115.04	br
23	stearate, acid (mixt.)	$NH_4C_{18}H_{35}O_2 \cdot C_{18}H_{36}O_2$	585.97	wh. cr
24	succinate	$(NH_4)_2C_4H_4O_4$	152.15	col. cr
25	sulfamate	$NH_4NH_2SO_3$	114.13	large pl., deliq
26	sulfate (mascagnite)	$(NH_4)_2SO_4$	132.15	rhomb. col., 1.521, 1.523, 1.533
27	sulfate, hydrogen (bisulfate)	NH_4HSO_4	115.11	rhomb
28	*peroxydi*sulfate	$(NH_4)_2S_2O_8$	228.21	monocl. col., 1.498, 1.502, 1.587
29	sulfide, mono-	$(NH_4)_2S$	68.15	col.-yel. cr., hyg
30	" , hydro-	NH_4HS	51.11	rhomb. wh
31	sulfite	$(NH_4)_2SO_3 \cdot H_2O$	134.16	monocl. col
32	sulfite, hydrogen (bisulfite)	NH_4HSO_3	99.11	hex. pr
33	*dl*-tartrate	$(NH_4)_2C_4H_4O_6$	184.15	monocl. col.; *d*, α 1.55, β 1.581
34	*dl*-tartrate, hydrogen	$NH_4HC_4H_4O_6$	167.12	monocl. pr. col., 1.519, 1.561, 1.591
35	tellurate	$(NH_4)_2TeO_4$	227.69	wh. powd
36	thallium chloride	$3NH_4Cl \cdot TlCl_3 \cdot 2H_2O$	507.28	col
37	thioantimonate	$(NH_4)_3SbS_4 \cdot 4H_2O$	376.21	yel. pr
38	thiocarbinate, tri-	$(NH_4)_2CS_3$	144.29	yel. cr
39	thiocyanate	NH_4SCN	76.12	monocl. col., deliq
40	*di*thionate	$(NH_4)_2S_2O_6 \cdot \frac{1}{2}H_2O$	205.22	monocl
41	thiosulfate	$(NH_4)_2S_2O_3$	148.21	monocl. col
42	titanium oxalate, basic	$(NH_4)_2TiO(C_2O_4)_2 \cdot H_2O$	294.04	wh. cr. mass
43	*para*tungstate	$(NH_4)_6W_7O_{24} \cdot 6H_2O$	1887.78	
44	uranyl carbonate	$2(NH_4)_2CO_3 \cdot UO_2CO_3 \cdot 2H_2O$	558.29	monocl. yel
45	" flouoride, -penta	$(NH_4)_3UO_2F_5$	419.19	tetr., 1.495
46	valerate	$NH_4C_5H_9O_2$	119.16	col. or wh. cr.; disg. odor

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	78 d.	....	s.	s.	31^{0}, 80^{50}, 47^{10} al., 13.3^{15} eth.
2	1.50	d.	....	2.54^{0}; $4.0^{16.8}$	11.8^{50}; 34.8	i. NH_3
3	1.556	d.	....	s.	....	i. eth., bz.
4	1.78	d. 165	....	42.7^{0}	345^{100}	....
5	....	$>100^{0}$	d.	sl. s.	s.	5.0^{0}, 8.80^{50} al.; 0.23^{13} eth.
6	....	170	....	....	....	....
7	1.619	d.	d.	42.9^{0}; 57.5^{10}	106.0^{70}	i. al., acet.
8	1.803^{19}	....	....	22.7^{0}	173.2^{100}	i. acet.
9	2.515	200	d. 240	s.	s.	s. al., NH_3; i. acet.
10	....	123	d. 145	171^{0}	v. s.	i. al.
11	....	d.	....	sl. s.	sl. s.	s. alk.; i. al., HNO_3
12	....	....	....	sl. s.	sl. s.	....
13	....	....	....	s.	....	s. al.
14	1.719	d.	exp. 423	1.1^{20}	s.	sl. s. al.
15	$2.531^{16.5}$	$-8H_2O$, 170	....	sl. s.	....	....
16	1.108^{25}	45	....	v. s.	....	s. al., ac. a.
17	....	d.	d.	6.1^{20}	s.	....
18	....	....	....	1.22^{15}	24.35^{100}	i. c. al.; s. h. al.
19	....	....	subl.	111^{25}	v. s.	28.8^{25} al.
20	2.194	d.	....	117^{7}	197^{100}	i. al., NH_3, acet.
21	2.162	d.	....	....	....	....
22	....	....	d.	s.	....	....
23	....	110 d.	s.	v. s.	....	0.3^{25} al., 0.19^{25} eth., 0.08^{25} acet.
24	....	....	....	s.	....	s. al.
25	....	125	d. 160	166.6^{10}	357^{50}	i. al.
26	1.769	d. 280	....	70.6^{0}; 76	103.8^{100}	i. al., NH_3, acet.
27	1.78	146.9	....	100	v. s.	sl. s. al.; i. acet.
28	1.982	d. 120	....	58.2^{0}	v. s.	....
29	....	d.	....	v. s.	d.	v. s. NH_3; s. al.
30	....	118^{0} d.	subl.	128.1^{0}	d.	s. al.
31	1.41^{25}	d.	subl. 150	32.4^{0}	60.4^{100} d.	sl. s. al.; i. acet.
32	....	d.	....	267^{0}	620^{60}	....
33	1.601	d.	....	6.3^{15}	d.	sl. s. al.
34	1.636	d.	....	1^{20}	s.	s. a., alk.; i. al.
35	3.01^{25}; $3.024^{24.5}$	d.	....	s.	s.	i. al.; s. dil. a.
36	2.39	....	....	s.	....	....
37	....	d.	....	71.2^{0}	d.	i. al.
38	....	subl.	....	v. s.	d.	sl. s. al., eth.
39	1.305	149.6	d. 170	128^{0}; 165^{19}	v. s.	s. al., NH_3, acet.
40	1.704	d. 130	....	135^{0}	v. s.	i. al.
41	....	d. 150	....	v. s.	....	sl. s. acet.; i. al.
42	....	....	....	v. s.	....	....
43	....	$-4H_2O$, 100	....	2.8^{15}; 4.5^{22}	....	i., al.
44	2.773	d. 100	....	5.8^{19}	d.	s. $(NH_4)_2CO_3$, aq. SO_2
45	3.186	subl.	....	s.	....	....
46	....	d.	....	s.	....	s. al., eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Ammonium			
1	*meta*vanadate	NH_4VO_3	116.99	col. cr., wh.-yelsh
2	vanadium sulfate	$NH_4V(SO_4)_2{\cdot}12H_2O$	477.31	red to blue
3	zinc sulfate	$(NH_4)_2SO_4{\cdot}ZnSO_4{\cdot}6H_2O$	401.69	monocl. wh., 1.489, 1.493, 1.499
4	**Antimony**	Sb	121.76	hex. silv. wh. met
5	bromide, tri-	$SbBr_3$	361.51	rhomb. col
6	chloride, tri- (butter of antimony)	$SbCl_3$	228.13	rhomb. col., deliq
7	chloride, penta-	$SbCl_5$	299.05	liq. or monocl. wh. 1.601^{14}
8	fluoride, tri-	SbF_3	178.76	oct
9	" , penta-	SbF_5	216.76	oily, col. liq
10	iodide, tri-	SbI_3	502.52	trig.; monocl. red; rhomb. yel
11	" , penta-	SbI_5	756.36	br
12	*α*-mercaptoacetamide (thioglycolamide)	$Sb(C_2H_4NOS)_3$	392.14	wh. cr
13	oxide, tri- (senarmontite)	Sb_2O_3 (or Sb_4O_6)	291.52	cub. wh., 2.087
14	" , tri- (valentinite)	Sb_2O_3 (or Sb_4O_6)	291.52	rhomb. col., 2.18, 2.35, 2.35
15	" , tetra- (cervantite)	Sb_2O_4 (or $Sb_2O_3{\cdot}Sb_2O_5$)	307.52	wh. powd. $n_D = 2.00$
16	" , penta-	Sb_2O_5 (or Sb_4O_{10})	323.52	yel. powd
17	oxychloride (ous)	$SbOCl$	173.22	monocl. wh
18	" (ous)	$Sb_4O_5Cl_2$	637.95	col. mixt. $SbOCl = Sb_2O_3$
19	oxysulfate, di- (ous)	$Sb_2O_2SO_4$	371.59	wh
20	selenide, tri-	Sb_2Se_3	480.40	gray cr
21	sulfate (ous)	$Sb_2(SO_4)_3$	531.72	wh. powd., deliq
22	sulfide, tri- (stibnite)	Sb_2S_3	339.72	rhomb. blk.-or. red, 3.194, 4.046, 4.303
23	" , penta-	Sb_2S_5	403.85	pr.-yel. powd
24	*d*-tartrate	$Sb_2(C_4H_4O_6)_3{\cdot}6H_2O$	795.83	wh. cr. powd
25	telluride, tri-	Sb_2Te_3	626.35	gray
26	**Argentic** or Argentous	See *Silver*		
27	**Argon**	A	39.944	col. inert gas
28	**Arsenic** (black cryst.)	As_4	299.64	hex. silv. gray-blk. met
29	" (black amor.)	As_4	299.64	amor. blk
30	" (yellow)	As_4	299.64	cub. yel
31	**Arsenic acid,** ortho-	$H_3AsO_4{\cdot}\frac{1}{2}H_2O$	150.94	wh. translu. cr.; hyg
32	" " , pyro-	$H_4As_2O_7$	265.85	col. cr
33	" " , meta-	$HAsO_3$	123.92	wh. cr
	Arsenic			
34	bromide, tri-	$AsBr_3$	314.66	pr., col.-yelsh.; hyg
35	chloride, tri-	$AsCl_3$	181.28	oily liq. or need. $n_F = 1.621^{14}$
36	chloride, penta-	$AsCl_5$	252.20	col. exist. quest
37	fluoride, tri-	AsF_3	131.91	oily liq
38	" , penta-	AsF_5	169.91	gas, col
39	iodide, di-	AsI_2	328.75	red pr
40	" , tri-	AsI_3	455.67	hex., red
41	" , penta-	AsI_5	709.51	
42	oxide, tri- (arsenolite)	As_2O_3 (or As_4O_6)	197.82	col. cub. or fibrous, 1.755
43	" , tri- (claudetite)	As_2O_3 (or As_4O_6)	197.82	monocl. col., 1.871, 1.92, 2.01
44	" , tri- (amor. or vitreous)	As_2O_3	197.82	amor. or vitreous
45	" , penta-	As_2O_5 (or As_4O_{10})	229.82	amor. wh

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.326	d.	...	0.52^{15}	6.95^{96} d.	i. al., eth., NH_4Cl
2	1.687	49	...	28.45^{20}	...	...
3	1.931	d.	...	anh. 7^{0}	anh. 42^{80}	...
4	6.684^{25}	630.5	1380	i.	i.	s. h. conc. H_2SO_4, aq. reg.
5	4.148^{23}	96.6	280	d.	d.	s. HCl, HBr, CS_2, NH_3, al., acet.
6	3.140^{25}	73.4	223	601.6^{0}	∞^{80}	s. al., HCl, tart. a., CS_2
7	liq. 2.336	2.8	140; 92^{30}	d.	d.	s. HCl tart. a.
8	$4.379^{20.9}$	292	subl.	384.7^{0}	563.6^{30}	i. NH_3
9	liq. 2.99^{23}	7.0	149.5	s.	...	s. KF
10	mon. 4.768^{22}	167	401	d.	d.	s. HI, HCl, KI, al., acet. CS_2
11	...	79	400.6	...	...	...
12	...	139	...	200	...	sl. s. al.; i. eth.
13	5.2	656	1550, subl.	v. sl. s.	sl. s.	s. HCl, KOH, tart. a., ac. a.
14	5.67	656	1550	v. sl. s.	sl. s.	s. HCl, KOH, tart. a., ac. a.
15	4.07	−O, 930	...	i.	i.	s. HCl, HI, KOH
16	3.78	−O, 380	−2O, 930	i.	i.	s. HCl, HI, KOH
17	...	170 d.	...	i.	d.	s. HCl, acet., CS_2; i. al., NH_3 chl.
18	5.01	...	...	v. sl. s.	...	...
19	4.89	...	...	d.	d.	...
20	...	611	...	v. sl. s.	...	...
21	3.625^{4}	d.	...	i.	d.	s. a.
22	4.64	550	...	0.000175^{18}	d.	s. alk., NH_4HS, K_2S, HCl; i. ac. a.
23	4.120	d.	...	i.	i.	s. alk., NH_4HS, HCl; i. al.
24	...	...	...	s.	...	...
25	...	629	...	...	...	...
26	...	...	...	...	...	...
27	1.784^{0} g/l; lq. 1.40^{-186}; cr. 1.65^{-233}	−189.2	−185.7	5.6^{0} cm^3	3.01^{50} cm^3	...
28	5.727^{14}	814^{36} atm.	subl. 615	i.	i.	s. HNO_3
29	4.7	...	...	i.	i.	s. HNO_3, aq. Cl_2, aq. reg. h. alk.
30	2.0^{20}	...	...	i.	...	s. CS_2
31	2.0–2.5	35.5	$-H_2O$, 160	16.7	50	s. alk., al., glyc.
32	...	d. 206	...	Forms orthoarsenic acid		
33	...	d.	...	Forms orthoarsenic acid		
34	3.54^{25}	32.8	221	d.	d.	s. HCl, HBr, CS_2
35	liq. 2.163	−18	130.2 (122)	d.	d.	s. HBr, HCl, PCl_3, al., eth.
36	...	*ca.* −40	...	hydr.	...	...
37	liq. 2.666	−8.5	63^{752}	d.	d.	s. al., eth., bz., NH_4OH
38	7.71 g/l	−80	−53	s.	...	s. alk., al., eth., bz.
39	...	d. 136	...	d.	...	s. al., eth., chl., CS_2
40	4.39^{13}	146	403	sl. s. d.	30 d.	s. al., eth., chl., bz., CS_2
41	3.93	76	...	...	...	...
42	3.865^{25}	subl. 193	...	1.2^{2}; 2.04^{25}	11.46^{100}	s. al., alk., HCl
43	4.15	315; subl. 193	...	1.2^{2}; 2.04^{25}	11.46^{100}	s. al., alk., HCl
44	3.738	...	...	3.7^{20}	10.14^{100}	s. alk., alk. carb., HCl
45	4.086	d. 315	...	150^{16}	v. s.	s. al., a., alk.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Arsenic			
1	oxychloride (ous)	$AsOCl$	126.37	brownish
2	phosphide, mono-	AsP	105.89	br. red powd
3	selenide, tri-	As_2Se_3	386.70	br. cr
4	sulfide, di- (or mono-) (realgar)	As_2S_2 (or AsS)	213.95	monocl. red-br., 2.46, 2.59, 2.61
5	“ , tri- (orpiment)	As_2S_3	246.02	monocl., yel or red $\beta > 2.72$ (Li)
6	“ , penta-	As_2S_5	310.15	yellow
7	**Auric or Aurous**	See *Gold*		
8	**Barium**	Ba	137.36	yelsh.-silv. met
9	acetate	$Ba(C_2H_3O_2)_2$	255.45	col
10	“	$Ba(C_2H_3O_2)_2 \cdot H_2O$	273.46	tricl. col., 1.500, 1.517, 1.525
11	amide	$Ba(NH_2)_2$	169.41	gray-wh
12	*ortho*arsenate	$Ba_3(AsO_4)_2$	689.90	blk
13	“ , mono-H	$BaHAsO_4 \cdot H_2O$	295.29	rhomb. or monocl. col
14	arsenide	Ba_3As_2	561.90	brn
15	azide	$Ba(N_3)_2$	221.41	monocl. pr
16	“	$Ba(N_3)_2 \cdot H_2O$	239.42	cr. tricl., av. 1.7
17	benzoate	$Ba(C_7H_5O_2)_2 \cdot 2H_2O$	415.61	col. nacreous leaf
18	boride (hexa)	BaB_6	202.28	cub. blk. met
19	bromate	$Ba(BrO_3)_2 \cdot H_2O$	411.21	monocl. col
20	bromide	$BaBr_2$	297.19	col. cr
21	“	$BaBr_2 \cdot 2H_2O$	333.22	monocl. col., 1.713, 1.727, 1.744
22	“ fluoride	$BaBr_2 \cdot BaF_2$	472.55	pl
23	bromoplatinate	$BaPtBr_6 \cdot 10H_2O$	992.25	monocl
24	butyrate	$Ba(C_4H_7O_2)_2 \cdot 2H_2O$	347.59	
25	carbide	BaC_2	161.38	tetr. gray
26	carbonate (α)	$BaCO_3$	197.37	hex. wh
27	carbonate (β)	$BaCO_3$	197.37	wh
28	carbonate (witherite) γ	$BaCO_3$	197.37	rhomb. wh., 1.529, 1.676, 1.677
29	chlorate	$Ba(ClO_3)_2 \cdot H_2O$	322.29	monoc. col., 1.562, 1.577, 1.635
30	*per*chlorate	$Ba(ClO_4)_2$	336.27	hex. col
31	*per*chlorate	$Ba(ClO_4)_2 \cdot 3H_2O$	390.32	hex. 1.533
32	chloride	$BaCl_2$	208.27	monocl. col
33	“	$BaCl_2$	208.27	cub. col
34	“	$BaCl_2 \cdot 2H_2O$	244.31	rhomb. col., 1.635, 1.646, 1.660
35	“ , fluoride	$BaCl_2 \cdot BaF_2$	383.63	tetr
36	*hypo*chlorite	$Ba(ClO)_2 \cdot 2H_2O$	276.31	col. cr
37	chloroplatinate	$BaPtCl_6 \cdot 6H_2O$	653.43	rhomb. orange-yel
38	chloroplatinite	$BaPtCl_4 \cdot 3H_2O$	528.47	
39	chromate	$BaCrO_4$	253.37	rhomb. yel
40	*di*chromate	$BaCr_2O_7$	353.38	monocl. red
41	“	$BaCr_2O_7 \cdot 2H_2O$	389.41	br. red-yel. need
42	citrate	$Ba_3(C_6H_5O_7)_2 \cdot 7H_2O$	916.39	wh. powd
43	cyanide	$Ba(CN)_2$	189.40	wh. cr. powd
44	cyanoplatinite	$BaPt(CN)_4 \cdot 4H_2O$	508.73	(a) monocl. yel., α 1.6704 (b) rhomb. grn
45	ethyl sulfate	$Ba(C_2H_5SO_4)_2 \cdot 2H_2O$	423.64	wh. lust. leaf
46	ferrocyanide	$Ba_2Fe(CN)_6 \cdot 6H_2O$	594.77	monocl. yel
47	fluogallate	$Ba_3(GaF_6)_2 \cdot H_2O$	797.54	wh. cr
48	fluoride	BaF_2	175.36	cub. col
49	“ iodide	$BaF_2 \cdot BaI_2$	566.56	pl
50	fluosilicate	$BaSiF_6$	279.42	rhomb. need
51	formate	$Ba(CHO_2)_2$	227.40	rhomb. col., 1.573, 1.597, 1.636
52	D-gluconate	$Ba(C_6H_{11}O_7)_2 \cdot 3H_2O$	581.71	pr. or rhomb. leaf

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	......	d.	d.	d.	......
2	......	subl. d.	......	d.	d.	s. H_2SO_4, HCl; sl. s. CS_2; i. al., eth., chl.
3	4.75	360	......	i.	d.	s. alk.
4	α 3.506^{19}; β 3.254^{19}	tr. 267; β 307	565	i.	i.	s. K_2S, $NaHCO_3$
5	3.43	300	707	0.0005^{18}	sl. s.	s. al., alk., alk. carb.
6	......	......	subl.	i.	i.	s. alk., HNO_3, alk. sulf.
7	......	......	......	......	......	......
8	3.5^{20}	725	1140	d. ev. H_2	d.	s. al., q.; i. bz.
9	2.468	......	......	58.8^{0}	75.0^{100}	......
10	2.19	$-H_2O$, 150	......	76.4^{26}	74^{70}	sl. s. al.
11	......	280	......	d.	d.	......
12	......	......	......	0.055	......	s. a., NH_4Cl
13	3.93^{15}	$-H_2O$, 150	......	sl. s.	d.	......
14	4.1^{15}	......	......	......	......	d. Cl_2, F_2 or Br_2
15	2.936	$-N_2$ about 120	exp.	......	......	......
16	......	exp.	......	v. s.	v. s.	sl. s. al.; i. eth.
17	......	$-2H_2O$, 100	......	s.	......	sl. s. al.
18	436^{15}	2270	......	i.	i.	i. HCl; s. HNO_3
19	3.99^{18}	d. 260	......	0.8	5.67^{100}	i. al., acet.
20	4.781^{24}	847	......	98^{0}	149^{100}	v. s. meth. al.
21	3.58^{24}	$-H_2O$, 75	$-2H_2O$, 120	151^{20}	204^{100}	v. s. meth.; al.; s. al.
22	4.96^{18}	......	......	d.	d.	s. conc. HCl, HNO_3; i. al.
23	3.71	......	......	......	......	......
24	......	......	......	37.42^{0}	42.12^{80}	......
25	3.75	......	......	d. to C_2H_2	......	d. a.
26	4.43	$1740^{90 \text{ atm.}}$	d.	0.002^{20}	0.006^{100}	s. a. NH_4Cl; i. al.
27	......	tr. 982 to α	d.	0.0022^{18}	0.0065^{100}	s. a. NH_4Cl; i. al.
28	4.43	tr. 811 to β	d. 1450	0.0022^{18}	0.0065^{100}	s. a. NH_4Cl; i. al.
29	3.18	anh. 414	$-H_2O$, 120	27.4^{25}	111.2^{100}	sl. s. al., acet., HCl
30	($3H_2O$) 2.74	505	......	198.5^{25}	v. s.	v. s. al.
31	2.74	d. 400	......	s.	s.	v. s. al.
32	3.856^{24}	tr. 925 to cub.	1560	31^{0}	59^{100}	sl. s. HCl, HNO_3; i. al.
33	......	962	1560	......	......	......
34	3.097^{24}	$-2H_2O$, 113	......	35.7^{20}	58.7^{100}	sl. s. HCl, HNO_3; i. al.
35	4.51^{18}	......	......	d.	d.	s. conc. HCl, HNO_3; i. al.
36	......	d.	......	......	......	......
37	2.868	$-5H_2O$, 70	......	s.	......	d. a.; i. eth., meth. al.
38	2.868	......	......	s.	......	v. s. al.
39	4.498^{15}	......	......	$.00034^{15}$	$.00044^{28}$	s. min. a.
40	......	......	......	sl. s.	......	s. h. conc. H_2SO_4
41	......	......	......	d.	......	s. conc. soln. CrO_3
42	......	......	......	0.0406^{18}	......	sl. s. al.
43	......	......	......	80^{14}	......	18^{14} 70 % al.
44	(a) 2.076 (b) 2.085	$-2H_2O$, 100	......	sl. s.	s.	i. al.
45	......	......	......	s.	......	sl. s. al.
46	......	......	......	0.17^{15}	0.9^{100}	......
47	4.06	$-\frac{1}{2}H_2O$, 110° $-\frac{1}{2}H_2O$, 230°	......	i.	......	s. HF
48	4.83	1280	2137	0.17^{10}	sl. s.	s. a., NH_4Cl
49	5.21^{18}	......	......	d.	d.	s. conc. HCl, HNO_3; i. al.
50	4.29^{21}	......	......	0.026^{17}	0.09^{100}	sl. s. a., NH_4Cl; i. al.
51	3.21	......	......	27.76^{0}	39.71^{80}	i. al., eth.
52	......	$-3H_2O$, 100; 120 d.	......	$3.3^{15.5}$	......	i. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Barium			
1	hydride	BaH_2	139.38	gray cr
2	hydroxide	$Ba(OH)_2 \cdot 8H_2O$	315.51	monocl. col., 1.471, 1.502, 1.50
3	iodate	$Ba(IO_3)_2$	487.20	monocl
4	"	$Ba(IO_3)_2 \cdot H_2O$	505.22	monocl. col
5	iodide	BaI_2	391.19	col. cr
6	"	$BaI_2 \cdot 2H_2O$	427.23	rhomb. col., deliq
7	"	$BaI_2 \cdot 6H_2O$	499.30	hex
8	laurate	$Ba(C_{12}H_{23}O_2)_2$	535.97	wh. leaf. cr
9	*l*-malate	$BaC_4H_4O_5$	269.43	
10	malonate	$BaC_3H_2O_4 \cdot H_2O$	257.42	
11	manganate	$BaMnO_4$	256.29	hex. gray-grn
12	*per*manganate	$Ba(MnO_4)_2$	375.22	br.-vlt. cr
13	methyl sulfate	$Ba(CH_3SO_4)_2 \cdot 2H_2O$	395.59	col. effl. cr
14	molybdate	$BaMoO_4$	297.31	wh. powd., tetr. cr
15	myristate	$Ba(C_{14}H_{27}O_2)_2$	592.07	wh. cr. powd
16	nitrate (nitrobarite)	$Ba(NO_3)_2$	261.38	cub. col. 1.572
17	nitride	Ba_3N_2	440.10	col
18	nitrite	$Ba(NO_2)_2$	229.38	col
19	"	$Ba(NO_2)_2 \cdot H_2O$	247.39	hex. col.-yelsh
20	oxalate	BaC_2O_4	225.38	cr
21	oxide	BaO	153.36	cub. or hex., col.; wh.-yelsh. powd
22	" , per-	BaO_2	169.36	wh.-gray powd
23	" , "	$BaO_2 \cdot 8H_2O$	313.49	hex. col
24	palmitate	$Ba(C_{16}H_{31}O_2)_2$	648.19	wh. cr. powd
25	*hypo*phosphate	$BaPO_3$	216.34	need
26	*ortho*phosphate, tri-	$Ba_3(PO_4)_2$	602.04	cub. wh
27	" , di-	$BaHPO_4$	233.35	rhomb. wh
28	" , mono-	$BaH_4(PO_4)_2$	331.35	tricl
29	*pyro*phosphate	$Ba_2P_2O_7$	448.68	rhomb. wh
30	*hypo*phosphite	$Ba(H_2PO_2)_2 \cdot H_2O$	285.37	monocl. wh
31	propionate	$Ba(C_3H_5O_2)_2 \cdot H_2O$	301.52	rhomb. β1.518
32	salicylate	$Ba(C_7H_9O_3)_2 \cdot H_2O$	429.60	wh. need
33	selenate	$BaSeO_4$	280.32	rhomb
34	*meta*silicate	$BaSiO_3$	213.42	rhomb. col., 1.673, 1.674, 1.678
35	"	$BaSiO_3 \cdot 6H_2O$	321.52	rhomb. 1.542, 1.548, 1.548
36	stearate	$Ba(C_{18}H_{35}O_2)_2$	704.28	wh. powd
37	succinate	$BaC_4H_4O_4$	253.43	
38	sulfate (barite)	$BaSO_4$	233.43	rhomb. wh. (monocl.), 1.637, 1.638, 1.649
39	*peroxydi*sulfate	$BaS_2O_8 \cdot 4H_2O$	401.56	monocl. wh
40	sulfide, hydro-	$Ba(HS)_2 \cdot 4H_2O$	275.57	rhomb. yel
41	" , mono-	BaS	169.43	cub. col
42	" , tetra-	BaS_4	265.63	rhomb. red or yel. powd
43	" , tri-	BaS_3	233.54	yel-grn
44	sulfite	$BaSO_3$	217.42	cub. (hex.) col
45	tartrate	$BaC_4H_4O_6 \cdot H_2O$	303.45	
46	tellurate	$BaTeO_4 \cdot 3H_2O$	383.02	voluminous wh
47	*pyro*tellurate, hydrogen	$Ba(HTe_2O_7)_2 \cdot H_2O$	891.83	voluminous ppt.; yel.-hot; wh.-cold
48	thiocyanate	$Ba(SCN)_2 \cdot 2H_2O$	289.56	need
49	*di*thionate	$BaS_2O_6 \cdot 2H_2O$	333.52	rhomb., or monocl. col., 1.586, 1.595, 1.607
50	thiosulfate	BaS_2O_3	249.49	rhomb. wh
51	"	$BaS_2O_3 \cdot H_2O$	267.51	wh. cr. powd
52	tungstate	$BaWO_4$	385.28	tetr. col
53	*meta*tungstate	$Ba_3[H_2W_{12}O_{40}] \cdot 27H_2O$	3747.57	rhomb

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	4.21^{0}	d. 675	1400	d. to Ba(	$OH)_2+H_2$	d. a.
2	2.18^{16}; anh. 4.50	78	$-8H_2O$, 780	5.6^{15}	94.7^{78}	sl. s. al.
3	4.998	d.	....	0.022	0.197	s. HNO_3, HCl
4	5.23	$-H_2O$, 130	....	v. sl. s.	sl. s.	s. HCl, HNO_3; i. al., acet. H_2SO_4
5	4.917	740	....	170^{0} 205.3^{20}	....	77^{20} al.
6	5.15	$-H_2O$, 98.9	$-2H_2O$, 539	200^{15}	269^{100}	1.07^{15} al.; s. acet.
7	....	25.7	....	410^{0}	v. s.	v. s. al.
8	....	260	....	$0.008^{15.3}$	0.011^{50}	0.008^{25} al., 0.006^{25} eth.
9	....	....	....	0.883^{20}	1.044^{80}	....
10	....	....	....	0.143^{0}	0.326^{80}	....
11	4.85	....	....	v. sl. s.	....	s. a.
12	....	....	....	62.5^{11}	75.4^{25}	....
13	....	....	....	s.	....	s. al.
14	4.65–4.97	....	....	0.0058^{23}	....	sl. s. a.
15	....	....	....	0.007^{25}	0.010^{50}	0.009^{25} al.; 0.003^{25} eth.; 0.046^{15} meth. al.
16	3.24^{23}	592	d.	8.7^{20}	34.2^{100}	sl. s. a.; i. al.
17	....	1000	....	....	....	....
18	3.23^{23}	d. 217	....	67.5^{20}	300^{100}	sl. s. al.
19	3.173^{29}	d. 115	....	63^{20}	109.6^{80}	v. s. HCl; 1.6 al.; i. acet.
20	2.658	....	....	0.0093^{18}	0.0228^{100}	s. a., NH_4Cl; i. al.
21	5.72; hex. 532	1923	*ca.* 2000	1.5^{0} d.	90.8^{80}	s. dil. a., al.; i. NH_3, acet.
22	4.96	450	$-O$, 800	v. sl. s.	d.	s. dil. a.; i. acet.
23	....	$-8H_2O$, 100	....	0.168	d.	s. dil. a.; i. al., eth., acet.
24	....	d.	....	0.004^{15}	0.007^{50}	0.001^{25} eth.; $0.008^{16.5}$ al.
25	....	....	....	sl. s.	....	s. al.; v. sl. s. ac. a.
26	4.1^{16}	....	....	i.	i.	s. a.
27	4.165^{15}	....	....	0.01–.02	....	s. a. NH_4Cl
28	2.9^{4}	....	....	d.	d.	s. a.
29	3.9^{20}	....	....	0.01	sl. s.	s. a., NH_4 salts
30	2.90^{17}	d.	....	30^{15}	33^{100}	i. al.
31	....	300 d.	....	48^{0}	67.9^{80}	.08 al.
32	....	....	....	s.	....	....
33	4.75	d.	....	0.0118	0.0138^{100}	s. HCl; i. HNO_3
34	4.399	1604	....	i.	d.	s. HCl
35	2.59	....	....	....	....	....
36	....	....	....	0.004^{15}	0.006^{50}	$0.005^{16.5}$, 0.008^{25}, al.; 0.001^{25}, eth.
37	....	....	....	0.421^{0}	0.237^{80}	sl. s. al.
38	4.50^{15}	1580	tr. 1149– monocl.	$.000222^{18}$ $.000246^{25}$	$.000336^{50}$ $.000413^{100}$	.006 3 % HCl; sl. s. H_2SO_4
39	....	d.	....	52.2^{0}	d.	i. al.
40	....	d. 50	....	s.	....	i. al.
41	4.25^{15}	....	....	d.	d.	i. al.
42	2.988	d. 300	....	41^{15}	v. s.	i. al., CS_2
43	....	....	....	s.	s.	....
44	....	....	d.	0.02^{20}	0.002^{80}	v. s. HCl
45	$2.980^{20.8}$	....	....	0.026^{18}	0.058^{80}	0.032^{18} al.
46	4.2, dried at 200	d.>200	....	sl. s.	sl. s.	s. HCl, HNO_3
47	....	....	....	s.	s.	acids
48	....	....	....	43^{20}	s.	35^{20} al.
49	$4.536^{13.5}$	d.	....	24.75^{18}	90.9^{100}	sl. s. al.
50	....	d.	....	0.2	....	....
51	3.5	....	....	v. sl. s.	....	....
52	5.04	....	....	sl. s.	sl. s.	d. a.
53	4.30	....	....	d.	v. s.	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Barium			
1	*pyro*vanadate	$Ba_2V_2O_7$	488.62	wh.
2	**Beryllium** (glucinum)	Be(Gl)	9.013	hex. gray met
3	acetate	$Be(C_2H_3O_2)_2$	127.10	pl
4	" , basic	$Be_4O(C_2H_3O_2)_6$	406.32	oct
5	" , propionate, basic	$Be_4O(C_2H_3O_2)_3$-$(C_3H_5O_2)_3$	448.39	
6	aluminate (chrysoberyl)	$BeAl_2O_4$	126.95	rhomb., 1.747, 1.748, 1.757
7	aluminum silicate (euclase)	$Be_2Al_2(SiO_4)_2(OH)_2$	290.10	monocl., 1.652, 1.655, 1.671
8	" " (beryl)	$Be_3Al_2Si_6O_{18}$	537.34	hex. col. transp. 1.580, 1.574
9	benzenesulfonate	$Be(C_6H_5O_3S)_2$	323.35	monocl
10	*ortho*borate, basic (hambergite)	$Be_2(OH)BO_3$	93.85	rhomb., 1.560, 1.591, 1.631
11	bromide	$BeBr_2$	168.85	wh. need., deliq
12	butyrate, basic	$Be_4O(C_4H_7O_2)_6$	574.63	
13	carbide	Be_2C	30.04	hex. yel
14	carbonate, basic	$BeCO_3 + Be(OH)_2$	112.05	wh. powd
15	chloride	$BeCl_2$	79.93	col. need., deliq
16	fluoride	BeF_2	47.01	amor. col
17	iodide	BeI_2	262.85	col. need
18	nitrate	$Be(NO_3)_2 \cdot 3H_2O$	187.08	wh.-yelsh. cr., deliq
19	nitride	Be_3N_2	55.06	cub. col
20	oxalate	$BeC_2O_4 \cdot 3H_2O$	151.08	rhomb., β 1.487
21	oxide (bromellite)	BeO	25.01	hex. wh. 1.719, 1.733
22	"	$BeO \cdot xH_2O$		wh. amor. powd. or gel
23	2,4-pentanedione deriv. (acetylacetonate)	$Be(C_5H_7O_2)_2$	207.23	monocl. wh
24	*ortho*phosphate	$Be_3(PO_4)_2 \cdot 3H_2O$	271.05	
25	propionate, basic	$Be_4O(C_3H_5O_2)_6$	490.47	monocl
26	selenate	$BeSeO_4 \cdot 4H_2O$	224.04	rhomb., 1.466, 1.501, 1.503
27	*ortho*silicate (phenacite)	Be_2SiO_4	110.09	tricl., 1.654, 1.670
28	*di*silicate (bertrandite)	$Be_4Si_2O_7(OH)_2$	238.19	rhomb., 1.591, 1.605, 1.614
29	stearate (com'l)	$Be(C_{18}H_{35}O_2)_2$	575.94	wh., waxy
30	sulfate	$BeSO_4$	105.08	
31	"	$BeSO_4 \cdot 4H_2O$	177.15	tetr. col., 1.472, 1.440
32	sulfide	BeS	41.08	
33	**Bismuth**	Bi	209.00	hex. silv. wh. or redsh. met
34	acetate	$Bi(C_2H_3O_2)_3$	386.13	wh. cr
35	*ortho*arsenate	$BiAsO_4$	347.91	monocl., 2.14, 2.15, 2.18
36	benzoate	$Bi(C_7H_5O_2)_3$	572.33	wh. powd
37	bromide, tri-	$BiBr_3$	448.75	yel. cr. powd., deliq
38	carbonate, basic (oxycarbonate, bismutospherite)	$Bi_2O_2CO_3$	510.01	wh. powd
39	chloride, tri-	$BiCl_3$	315.37	wh. cr., deliq
40	" , tetra-	$BiCl_4$	350.83	col. cr
41	*di*chromate, basic	$(BiO)_2Cr_2O_7$	666.02	yel.-or red
42	citrate	$BiC_6H_5O_7$	398.10	wh. cr
43	fluoride, tri-	BiF_3	266.00	cub. gray cr
44	gallate, basic (subgallate) (dermatol) (com'l)	$Bi(OH)_2C_7H_5O_5$ (approx.)	412.13	yel. amor

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	863	......	......	......	......
2	1.85	1278±	2970^{760}	i.	sl. s. d.	s. dil. a., alk.; i. Hg
3	......	d. 300	......	i.	......	i. al., eth., CCl_4
4	1.36^{4}	284	331	sl. d.	d.	s. chl., ac. a.; sl. s. al., eth
5	......	127	330	......	......	......
6	3.76	......	......	......	......	i. a.
7	3.1	......	......	......	......	......
8	2.66	1410 ± 100	......	......	......	i. a.
9	......	......	......	v. s.	v. s.	v. s. ac. a., al., acet.; i. CS_2, eth., bz., CCl_4
10	2.35	......	......	......	......	......
11	3.465^{25}	490 ± 10 subl.	520	s.	v. s.	s. al., eth.; i. bz.
12	......	......	239^{19}	......	......	......
13	1.90^{15}	>2100 d.	......	d.	d.	s. a.
14	......	......	......	i.	d.	s. a., alk.
15	1.899^{25}	440 ± 10	520	v. s.	v. s. d.	v. s. al., eth., bz., pyr.; sl. s. chl., CS_2; i. acet., NH_3
16	1.986^{25}	800	......	∞	∞	s. al., H_2SO_4
17	4.325^{25}	510 ± 10	590	d.	d.	s. al., eth., CS_2
18	1.557	60	142	v. s.	v. s.	v. s. al.
19	......	2200 ± 100	d. 2240	d.	d.	d. a., conc. alk.; i. al.
20	......	$-2H_2O$, 100; $-3H_2O$, 220	d. 350	38.22^{25}	......	......
21	3.01	2530 ± 30	*ca.* 3900	$.0002^{30}$	......	s. conc. H_2SO_4, fus. KOH
22	......	d.	......	i.	i.	s. a., alk., $(NH_4)_2CO_3$
23	1.168^{4}	108	270	sl. s.	d.	s. a., al., eth.
24	......	$-H_2O$, 100	......	s.	s.	s. ac. a.
25	......	120	......	......	......	......
26	2.03	$-2H_2O$, 100; $-4H_2O$, 300	......	......	......	......
27	3.0	......	......	......	......	......
28	2.6	......	......	......	......	......
29	......	45	......	i.	i.	s. eth., CCl_4; i. al.
30	2.443	d. 550–600	......	i.	d. to BeS	$O_4 \cdot 4H_2O$
31	$1.713^{10.5}$	$-2H_2O$, 100	$-4H_2O$, 400	42.5^{25}	100^{100}	sl. s. conc. H_2SO_4
32	2.36	......	......	d.	d.	......
33	9.80	271.3	1560 ± 5^{760} 1420–1560	i.	i.	s. HNO_3, h. H_2SO_4, aq. reg.; sl. s. h. HCl
34	......	d.	......	i.	i.	s. ac. a.
35	7.14	......	......	......	......	......
36	......	......	......	i.	......	s. a.; i. eth.
37	5.7	218	453	d. to BiOBr	d.	s. HCl, HBr, eth.; i. al.
38	6.86	d.	......	i.	i.	s. a.
39	4.75	230–2	447	d. to BiOCl	d.	s. a., al., eth., acet.
40	......	225	......	d.	......	......
41	......	......	......	i.	i.	s. a.; i. alk.
42	3.458	d.	......	sl. s.	sl. s.	s. NH_4OH; sl. s. al.
43	8.75	......	......	i.	......	s. a., acet.; i. al.
44	......	d.	......	i.	......	i. al., eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Bismuth			
1	hydroxide	$Bi(OH)_3$ (approx.)	260.02	wh. amor. powd
2	iodate	$Bi(IO_3)_3$	733.76	wh
3	iodide, tri-	BiI_3	589.76	hex. redsh. br.-gray bl.
4	*dl*-lactate	$Bi(C_6H_9C_6)\cdot 7H_2O$	512.25	pr. need
5	molybdate	$Bi_2(MoO_4)_3$	897.85	tetr. need
6	nitrate	$Bi(NO_3)_3\cdot 5H_2O$	485.10	tricl. col., sl. hyg
7	“ , basic (subnitrate) (com'l)	$xBi_2O_3\cdot yN_2O_5\cdot zH_2O$		hex. pl. or wh. powd. (variable compn.)
8	oxalate	$Bi_2(C_2O_4)_3$	682.06	
9	oxide, tetr-	$Bi_2O_4\cdot 2H_2O$ (approx)	518.03	br. powd. (mixt.?)
10	“ , tri-	Bi_2O_3	466.00	rhomb. yel
11	“ , tri-	Bi_2O_3	466.00	cub. gray-blk
12	“ , tri-	Bi_2O_3	466.00	rhomb., 1.91, av., wh. lt
13	“ , pent- (bismuthic acid, meta-)	Bi_2O_5	498.00	br. or dk. red
14	“ , “	$Bi_2O_5\cdot H_2O$ (or $HBiO_3$)	516.02	red
15	oxybromide	$BiOBr$	304.92	col. cr. or wh. powd
16	oxychloride	$BiOCl$	260.46	cr. or wh. powd
17	oxyfluoride	$BiOF$	244.00	wh. cr. or powd
18	oxyiodide	$BiOI$	351.92	rhomb. red cr
19	*ortho*phosphate	$BiPO_4$	303.98	monocl. wh
20	propionate, basic	$BiOC_3H_5O_2$	298.07	wh. powd.; faint odor prop. acid
21	salicylate, basic (subsalicylate) (com'l)	$Bi(C_7H_5O_3)_3\cdot Bi_2O_3$ (approx.)	1086.33	wh. micro. cr. (variable comp.)
22	selenide, tri- (guanajuatite)	Bi_2Se_3	654.88	rhomb. blk
23	sulfate	$Bi_2(SO_4)_3$	706.20	wh. need
24	sulfide, mono-	BiS	241.07	gray (exist. quest)
25	“ , tri- (Bismuthinite, bismuthglance)	Bi_2S_3	514.20	rhomb. br.-blk., 1.315, 1.900, 1.670
26	tartrate	$Bi_2(C_4H_4O_6)_3\cdot 6H_2O$	970.31	wh. powd
27	tellurate (montanite)	$Bi_2TeO_6\cdot 2H_2O$	677.64	biaxial, β2.09
28	telluride, tri- (tetradymite)	Bi_2Te_3	800.83	rhbdr., gray
29	**Borazole**	$B_3N_3H_6$	80.53	col. liq
30	**Boric acid,** ortho- (boracic acid)	H_3BO_3	61.84	tricl. col., 1.340, 1.456, 1.459
31	“ “ , tetra- (pyro-)	$H_2B_4O_7$	157.30	vitr. or wh. powd
32	**Borinoaminoborine**	B_2H_7N	42.70	col. liq
33	**Boron**	B	10.82	monocl. yel. or br. amor. powd., 2.5 lq. (λ579μ)
34	bromide, tri-	BBr_3	250.57	col. fum. liq., $1.553^{6.3}$ (F)
35	“ , (mono-) hydride, penta-	B_2H_5Br	106.60	col. gas
36	“ , (mono-) iodide, di-	$BBrI_2$	344.58	col. liq
37	“ (di-) iodide	BBr_2I	297.57	col. liq
38	(*tetra-*) carbide	B_4C	55.29	rhbdr, blk
39	chloride, tri-	BCl_3	117.19	col. fum. liq., $1.428^{5.7}$, (F)
40	“ , (mono-) hydride, penta-	B_2H_5Cl	62.14	col. gas, highly unstable
41	fluoride, tri-	BF_3	67.82	col. gas
42	hydride (diborane, boroethane)	B_2H_6	27.69	col. gas; sickly sweet odor in low conc.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	4.36	$-H_2O$, 100 d. 415	$-1\frac{1}{2}H_2O$, 400	0.00014	d.	s. a.; i. or sl. s. conc. alk.
2	......	......	......	i.	d.	sl. s. HNO_3; s. HI, KI, 3.5 abs. al.
3	5.7	439 (408)	d. 500	i.	d.	s. HCl, HI, KI, 3.5 abs. al.
4	......	......	......	14.4^{25}	......	......
5	6.07	643	......	......	......	v. s. a.
6	2.83	d. 30	$-5H_2O$, 80	d.	d.	v. s. HNO_3; s. a., 42^{19} acet.
7	4.928^{18}	d. 260	......	i.	i.	s. a.; i. al.
8	......	......	......	i.	i.	s. a.
9	5.6	$-H_2O$, 110	$-2H_2O$, 180 $-O$, 305	i.	......	s. a.
10	8.9	820	1890 (?)	i.	i.	s. a.
11	8.20	tr. 704	......	i.	i.	s. a.
12	8.5	860	......	......	......	sl. s. a.
13	5.10	$-O$, 150	$-2O$, 357	i.	i.	s. a. KOH
14	5.75	$-H_2O$, 120	$-2O$, 300 (357)	i.	i.	s. a., KOH
15	8.08	......	......	i.	......	s. a.; i. al.
16	7.72	red ht.	......	i.	i.	s. a.; i. acet., tart. a., NH_3
17	7.5	d.	......	i.	......	s. a.
18	7.92	d.	......	i.	......	s. a.; i. al., chl., KI
19	6.323^{15}	d.	......	i.	i.	s. HCl; i. dil. HNO_3, al.
20	......	......	......	i.	......	v. s. dil. HCl; i. al.
21	......	......	......	i.	......	s. a., alk.; i. al., eth.
22	6.82	710	d.	i.	......	i. alk.
23	5.08^{15}	d.	......	d.	d.	s. a.
24	7.7	685	......	v. sl. s.	......	......
25	7.39	685 d.	......	0.000018^{18}	......	s. HNO_3; i. dil. a.
26	2.595^{25}	$-3H_2O$, 105	......	i.	i.	s. a., alk.; i. al.
27	3.79	......	......	......	......	......
28	7.7	573	......	......	......	......
29	0.824^{0}; 0.898^{57}	-58	53	hyd.	hyd.	......
30	1.435^{15}	185 d.	$-1\frac{1}{2}H_2O$, 300	1.95^{0}; 5.15^{21}	39.1^{100}	28^{20} glyc., .0078 eth., 5.56 al.; sl. s. acet.
31	......	......	......	s.	s.	s. al.
32	......	-66.5	76.2	......	......	s. in triborine triamine
33	3.33^{20}; 2.34 (am.)	2300	2550	i.	i.	s. HNO_3, H_2SO_4; i. al., eth. alk.
34	2.650^{0}	-46	90.1^{740}	d.	......	s. al., CCl_4
35	......	-104	*ca.* 10	hyd. to H $HBr+H_2$	BO_2 +	......
36	......	......	180	d.	d.	......
37	......	......	125	d.	d.	......
38	2.50	2450	>3500	i.	i.	i., a.; s. fus. alk.
39	1.434^{0}	-107	12.5	d. to HCl	$+H_3BO_3$	d. al.
40	......	......	-78^{18}	hyd.	......	......
41	2.99 g/l	-127	-101	106 cm^3	d.	d. al.; s. conc. H_2SO_4
42	lq. 0.447^{-112}; sld. 0.577^{-183}	-165.5	-92.5	sl. s. d. to H_3BO	$_3 + H_2$	s. NH_4OH

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Boron			
1	hydride (dihydrotetraborane, borobutane)	B_4H_{10}	53.36	col. pois. gas, disg. odor
2	hydride (pentaborane, stable)	B_5H_9	63.17	col. liq., pois., bad odor, spont. inflam
3	hydride (pentaborane, unstable; dihydropentaborane)	B_5H_{11}	65.19	col. liq., turns yel. on standing
4	hydride (hexaborane)	B_6H_{10}	75.00	col. liq. turns yel. on standing
5	" (decaborane)	$B_{10}H_{14}$	122.31	col. need. rhomb
6	iodide, tri-	BI_3	391.58	col. pl., hyg
7	nitride	BN	24.83	hex., wh
8	oxide	B_2O_3	69.64	vitr. col., 1.464
9	oxide	B_2O_3	69.64	cr
10	phosphide	BP	41.80	maroon powd
11	selenide, tri-	B_2Se_3	258.52	yel. gray powd
12	(tri-) silicide	B_3Si	60.52	rhomb. blk
13	(hexa-) silicide	B_6Si	92.98	blk. cr
14	sulfide, tri-	B_2S_3	117.84	wh. cr. or vitr
15	" , penta-	B_2S_5	181.97	wh. cr. (exist. quest)
16	**Borotungstic acid**	$H_5BW_{12}O_{40} \cdot 30H_2O$	3403.39	tetrag. col
17	**Bromic acid**	$HBrO_3$	128.92	known in soln. only, col. or yelsh
18	**Bromine**	Br_2	159.83	rhomb. or dk. red liq., 1.661
19	azide (bromoazide)	BrN_3	121.94	cr. red liq
20	chloride	$BrCl$	115.37	red-yel. liq. or gas
21	fluoride, tri-	BrF_3	136.92	col.-gray yel. liq
22	" , penta-	BrF_5	174.92	col. liq
23	hydrate	$Br_2 \cdot 10H_2O$	339.99	oct. red
24	oxide, di-	BrO_2	111.92	lt. yel
25	" , mon-	Br_2O	175.83	dk. br
26	(tri-) oxide, oct-	Br_3O_8 (or $Br_3O_8)_n$)	367.75	wh
27	**Bromoauric acid**	$HAuBr_4 \cdot 5H_2O$	607.95	red-br. cr
28	**Bromoplatinic acid**	$H_2PtBr \cdot 9H_2O$	838.89	monocl. red, deliq
29	**Bromous acid,** hypo-	$HBrO$	96.92	known only in soln. col. yel
30	**Cadmium**	Cd	112.41	hex. silv.-wh. malleable met., 1.13
31	acetate	$Cd(C_2H_3O_2)_2$	230.50	col
32	"	$Cd(C_2H_3O_2)_2 \cdot 3H_2O$	284.55	monocl. col.; odor ac. a
33	amide	$Cd(NH_2)_2$	144.46	
34	arsenate, hydrogen	$CdHAsO_4 \cdot H_2O$	270.34	
35	arsenide	Cd_3As_2	487.05	dk. gray, cub
36	benzoate	$Cd(C_7H_5O_2)_2 \cdot 2H_2O$	390.66	
37	borotungstate	$Cd_5(BW_{12}O_{40})_2 \cdot 18H_2O$	6602.06	yel. cr. tricl
38	bromate	$Cd(BrO_3)_2 \cdot H_2O$	386.26	rhomb. wh
39	bromide	$CdBr_2$	272.24	yel. cr
40	"	$CdBr_2 \cdot 4H_2O$	344.31	sm. wh. need., effl
41	carbonate	$CdCO_3$	172.42	trig. wh
42	chlorate	$Cd(ClO_3)_2 \cdot 2H_2O$	315.36	col. pr., deliq
43	chloride	$CdCl_2$	183.32	hex. col
44	"	$CdCl_2 \cdot 2\frac{1}{2}H_2O$	228.36	monocl. col., 1.6513
45	chloroacetate, tri-	$Cd(C_2Cl_3O_2)_2 \cdot 1\frac{1}{2}H_2O$	464.22	rhomb

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	lq. 0.59^{-70}; 0.56^{-35}	−120 (−112)	17.6–18.0	sl. s., hyd.	....	d. al.; s. bz.
2	0.61^{0}	−46.6	0^{66}	hyd.	....	....
3	....	−123.4	65	hyd.	....	....
4	....	−65.1	0$^{7.2}$	hyd.	....	....
5	0.94; liq. 0.78^{100}	99.7	100^{19}; 156$^{162.4}$; 213 extrap.	sl. s.	d.	v. s. CS_2; s. al., eth. bz.
6	3.35^{50}	43	210	d.	d.	d. al.; v. s. CS_2, CCl_4 bz.
7	2.20	3000 (subl.)	....	i.	d. sl.	sl. s. h. a.
8	1.844	*ca.* 450	1500	d. 1.1^{0}	15.7^{100}	s. a., al.
9	1.805	294 + 1	....	sl., s.	s.	....
10	....	ign. 200	....	i.	i.	i. all solv.
11	....	....	....	d.	d.	....
12	2.52	....	....	i.	....	d. H_2SO_4, KOH; sl. s. HNO_3
13	2.47	....	....	i.	....	d. H_2SO_4; s. HNO_3; i. KOH
14	1.55	310	....	d.	....	d. al.; sl. s. PCl_3, SCl_2
15	1.85	390	....	d.	d.	d. al.
16	3.0	45–51	....	s.	....	s. al., eth.
17	....	d. 100	....	v. s.	s. d.	....
18	2.928^{59}	−7.2	58.78	4.17^{0}; 3.58^{20}	3.52^{50}	v. s. al., chl., eth., CS_2
19	....	*ca.* 45	exp.	....	....	s. eth., KI; sl. s. bz. lgr.
20	....	....	d. 10	s. d.	....	s. CS_2, eth.
21	2.49^{135}	(−2) 8.8	135	d. viol to HF, HB	O_2, HOBr, rO_3	d. alk.
22	2.466^{25}	−61.3	40.5	d.	d.	....
23	....	d. 6.8	....	s.	....	....
24	....	d. 0^{0}	....	....	....	....
25	....	−17 to −18 d.	....	....	....	s. CCl_4 d.
26	....	stable at −40	....	....	....	....
27	....	27	....	v. s.	....	s. al.
28	....	<100 d.	....	v. s.	v. s.	....
29	....	40 (vac.)	....	s.	s., d.	s. al., eth., chl.
30	8.642	320.9	767 ± 2	i.	i.	s. a., NH_4NO_3, h. H_2SO_4
31	2.341	256	d.	v. s.	....	s. meth. al.
32	2.01	−H_2O, 130	....	v. s.	v. s.	v. s. al.
33	3.05^{25}	d. 120	....	....	....	....
34	$4.164\frac{15}{4}$	>120	....	....	....	....
35	$6.21\frac{15}{4}$	721	....	....	....	....
36	....	....	....	3.34^{20}	....	sl. s. al.
37	....	75	....	1250^{19}	v. s.	....
38	3.758	d.	....	125^{17}	....	i. al.
39	5.192^{25}	567	963	57^{10}	162^{104}	26.6^{15} al.; 0.4^{15} eth.; s., HCl
40	....	tr. 36	....	121^{10}	....	25 al., s. acet.; sl. s. eth.
41	4.258^{4}	d.<500	....	i.	i.	s. a., KCN, NH_4 salts; i. NH_3
42	2.28^{18}	80	....	298^{0}	487^{65}	s. a., acet., al.
43	4.047^{25}	568	960	140^{20}	150^{100}	1.52^{15} al.; i. acet., eth.
44	3.327	tr. 34	....	168^{20}	180^{100}	2.05^{15} meth. al.; sl. s. al.
45	2.093^{25}	....	....	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cadmium			
1	chloroacetate, di-	$Cd(C_2HCl_2O_2)_2\cdot H_2O$	386.31	need
2	“ , mono-	$Cd(C_2H_2ClO_2)_2\cdot 6H_2O$	407.49	
3	cyanide	$Cd(CN)_2$	164.45	cr
4	ferrocyanide	$Cd_2Fe(CN)_6\cdot xH_2O$		
5	fluogallate	$[Cd(H_2O)_6][GaF_5H_2O]$	403.24	col. cr., n. 1.45
6	fluoride	CdF_2	150.41	cub. wh
7	fluosilicate	$CdSiF_6\cdot 6H_2O$	362.57	hex. col
8	formate	$Cd(CHO_2)_2\cdot 2H_2O$	238.48	monocl
9	fumarate	$CdC_4H_2O_4$	226.47	
10	hydroxide	$Cd(OH)_2$	146.43	trig. or amor. wh
11	iodate	$Cd(IO_3)_2$	462.25	wh. cr.
12	iodide, (α)	CdI_2	366.25	hex. brnsh
13	“ , (β)	CdI_2	366.25	
14	lactate	$Cd(C_3H_5O_3)_2$	290.55	need
15	maleate	$CdC_4H_2O_4\cdot 2H_2O$	262.50	
16	*per*manganate	$Cd(MnO_4)_2\cdot 6H_2O$	458.37	
17	molybdate	$CdMoO_4$	272.36	
18	nitrate	$Cd(NO_3)_2$	236.43	
19	“	$Cd(NO_3)_2\cdot 4H_2O$	308.49	prism. need. wh., hyg
20	nitrocobaltate (III) (cobaltinitrite)	$Cd_3[Co(NO_2)_6]_2$	1007.21	yel
21	oxalate	CdC_2O_4	200.43	col
22	“	$CdC_2O_4\cdot 3H_2O$	254.48	col
23	oxide	CdO	128.41	amor., br
24	“	CdO	128.41	cub. br
25	*ortho*phosphate	$Cd_3(PO_4)_2$	527.19	amor., col
26	phosphate, di-H	$Cd(H_2PO_4)_2\cdot 2H_2O$,	342.43	tricl
27	salicylate	$Cd(C_7H_5O_3)_2\cdot H_2O$	404.65	need. wh
28	selenate	$CdSeO_4\cdot 2H_2O$	291.40	rhomb
29	selenide	$CdSe$	191.37	gray-brn. hex. or red powd
30	*meta*silicate	$CdSiO_3$	188.47	col. rhomb
31	sulfate	$CdSO_4$	208.48	rhomb. wh
32	“	$CdSO_4\cdot H_2O$	226.49	monocl
33	“	$CdSO_4\cdot 4H_2O$	280.54	
34	“	$3CdSO_4\cdot 8H_2O$	769.56	monocl. wh. effl. 1.565
35	sulfide (greenockite)	CdS	144.48	hex. yel.-or., 2.506, 2.529
36	sulfite	$CdSO_3$	192.48	cr
37	tartrate	$CdC_4H_4O_6$	260.48	wh. cr. powd
38	telluride	$CdTe$	240.02	blk. cub
39	tungstate	$CdWO_4$	360.33	yel. cr
	Cadmium complexes:			
40	Tetramminecadmium *per*rhenate	$[Cd(NH_3)_4](ReO_4)_2$	681.16	
41	Tetrapyridinecadmium fluosilicate	$[Cd(C_5H_5N)_4]SiF_6$	570.86	tricl. wh
42	**Calcium**	Ca	40.08	cub. silv. wh. soft met
43	acetate	$Ca(C_2H_3O_2)_2$	158.17	col., 1.55, 1.56, 1.57
44	“	$Ca(C_2H_3O_2)_2\cdot H_2O$	176.18	col. need
45	“	$Ca(C_2H_3O_2)_2\cdot 2H_2O$	194.20	col. need
46	aluminate	$CaAl_2O_4$ (or $CaOAl_2O_3$)	158.02	rhomb. or monocl. col., 1.643, 1.655, 1.663

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.132^{25}	....	....	....	....	....
2	1.942^{25}	....	....	....	....	....
3	....	d.>200	....	1.7^{15}	....	s. a., KCN, NH_4OH
4	....	....	....	i.	i.	s. HCl
5	2.79	$-5H_2O$, 110	....	v. s.	....	....
6	6.64	1100	1758	4.35^{25}	....	s. a., HF; i. al., NH_3
7	....	....	....	s.	s.	s. 50 % al.
8	2.44	d.	....	v. s.	....	....
9	....	....	....	0.9^{30}	....	....
10	4.79^{15}	d. 300	....	0.00026^{25}	....	s. a. NH_4 salts; i. alk.
11	6.43	d.	....	sl. s.	sl. s.	s. HNO_3, NH_4OH
12	5.670^{30}	3.88	713	79.8^0; 85.2^{18}	127.6^{100}	s. a., eth., al., NH_4OH; sl. s. NH_3, acet.
13	5.305^{30}	....	....	....	....	....
14	....	....	....	10	12.5	i. al.
15	....	....	....	0.66^{30}	....	....
16	2.81	d. 95	....	v. s.	v. s.	....
17	5.347	....	....	sl. s.	....	s. a., NH_4OH, KCN
18	....	350	....	109^0	326^{60}	v. s. a.; s. et. ac.
19	2.455^{17}	59.4	132	215	....	s. al., NH_3; i. HNO_3
20	....	d. 175	....	sl. s.	v. s.	d. a., alk., org. solv.
21	$3.32\frac{18}{4}$	d. 340	....	0.00337^0; $.005^{18}$	0.009	s. a.; i. al.
22	....	d.	....	....	....	s. a. NH_4OH; i. al.
23	6.95	>1426	d. 900–1000	i.	i.	s. a., NH_4 salts; i. alk.
24	8.15	d. 900	....	i.	i.	s. a., NH_4 salts; i. alk.
25	....	1500	....	i.	....	s. a., NH_4 salts
26	$2.74\frac{15}{4}$	d. 100	....	....	....	s. HCl; i. al., eth.
27	....	....	....	sl. s.	s.	s. a., NH_4OH, al., eth. glycerol
28	3.632	$-1H_2O$, 100	....	v. s.	....	....
29	$5.81\frac{15}{4}$	>1350	....	i.	....	d. a.
30	4.93	1242	....	v. sl. s.	....	....
31	4.691	1000	....	75.5^0	60.8^{100}	i. al., acet., NH_3
32	3.79	tr. 108	....	s.	s.	i. al.
33	3.05	....	....	140^0	135.5^{100}	i. al.
34	3.09	tr. 41.5	....	114.2^0	87^{100}	50 al.
35	4.82	$1750^{100\ \text{atm.}}$	subl. in N_2	0.0001^{18}	colloidal	v. sl. s. NH_4OH; s. a.
36	....	d.	....	sl. s.	....	s. a. NH_4OH; i. al.
37	....	....	....	sl. s.	....	s. a. NH_4OH
38	6.20^{15}	1041	....	i.	....	d. HNO_3; i. a.
39	....	....	....	0.05	....	s. NH_4OH
40	$3.714\frac{25}{4}$	....	....	....	....	0.037 conc. NH_4OH
41	2.282	....	....	....	....	....
42	1.55	842	1240	d. to $Ca(OH)_2 + H_2$		s. a.; sl. s. al.; i. bz., liq NH_3
43	....	d.	....	37.4^0	29.7^{100}	sl. s. al.
44	....	d.	....	43.6^0	34.3^{100}	sl. s. al.
45	....	$-1H_2O$, 84	....	34.7^{20}	33.5^{80}	....
46	3.67	1600	....	d.	....	s. HCl; i. HNO_3, H_2SO_4

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Calcium			
1	(tetra-) “aluminoferrite” (celite)	$Ca_4Al_2Fe_2O_{10}$ (or $4CaO·Al_2O_3·Fe_2O_3$) (approx.)	485.96	α 1.96 β 2.01 γ 2.04
2	(tri-) aluminate	$Ca_3Al_2O_6$ (or $3CaO·Al_2O_3$)	270.18	cub., 1.710
3	aluminosilicate (anorthite)	$CaAl_2Si_2O_8$ (or $CaO·Al_2O_3·2SiO_2$)	278.14	tricl 1.5832
4	*ortho*arsenate	$Ca_3(AsO_4)_2$	398.06	wh. amor. powd
5	“	$Ca_3(AsO_4)_2·3H_2O$	452.11	col. or wh. powd
6	arsenide	Ca_3As_2	270.06	red cr
7	azide	$Ca(N_3)_2$	124.13	rhomb. col
8	benzoate	$Ca(C_7H_5O_2)_2·3H_2O$	336.35	rhomb. col
9	*meta*borate	$Ca(BO_2)_2$	125.72	col. long flat pl. rhomb., 1.540, 1.656, 1.682
10	“	$Ca(BO_2)_2·2H_2O$	161.75	cub
11	“	$Ca(BO_2)_2·6H_2O$	233.82	col. hex
12	*tetra*borate	CaB_4O_7	195.36	readily vitrified
13	boride	CaB_6	105.00	cub. blk
14	boride, hexa-	CaB_6	105.00	cub., blk
15	bromate	$Ca(BrO_3)_2·H_2O$	313.93	monocl
16	bromide	$CaBr_2$	199.91	need., deliq
17	“	$CaBr_2·3H_2O$	253.96	rhomb
18	“	$CaBr_2·6H_2O$	308.01	hex. col
19	butyrate	$Ca(C_4H_7O_2)_2·H_2O$	232.29	col
20	carbide (CaC_2“I”)	CaC_2	64.10	tetr. col
21	carbonate (aragonite)	$CaCO_3$	100.09	rhomb. col., 1.530, 1.681, 1.685
22	“ (calcite)	$CaCO_3$	100.09	hex. col. 1.658, 1.486
23	“	$CaCO_3·6H_2O$	208.19	monocl., 1.460, 1.535, 1.545
24	chlorate	$Ca(ClO_3)_2·2H_2O$	243.03	monocl. wh.-yelsh., deliq
25	*per*chlorate	$Ca(ClO_4)_2$	238.99	col
26	chloride	$CaCl_2$	110.99	cub. col., deliq., 1.52
27	“	$CaCl_2·H_2O$	129.01	col. deliq
28	“	$CaCl_2·2H_2O$	147.03	col
29	“	$CaCl_2·6H_2O$	219.09	trig. col., deliq., 1.417, 1.393
30	“ hypochlorite (basic) (?) (bleaching powder, chlorinated lime)	$Ca(ClO)_2·CaCl_2·xCa(OH)_2·xH_2O$	....	wh. powd.; strong Cl odor; comp. varies
31	chloride fluoride *ortho*phosphate	$CaClF·3Ca_3(PO_4)_2$	1025.14	col., 1.634, 1.631
32	*hypo*chlorite	$Ca(ClO)_2·2H_2O$	178.93	tetr. plates 1.53, 1.63
33	“ (basic)	$Ca(ClO)_2·2Ca(OH)_2$	257.17	hexa. or hemihedral 1.51, 1.585
34	chromate	$CaCrO_4·2H_2O$	192.12	monocl. pr., yel
35	cinnamate	$Ca(C_9H_7O_2)_2·3H_2O$	388.42	col. cr
36	citrate	$Ca_3(C_6H_5O_7)_2·4H_2O$	570.50	need. wh., 1.515, 1.530, 1.580
37	cyanamide	$CaCN_2$	80.11	hex. rhbdr. col

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	1415 (incongruent)	....	....	....	....
2	....	1535 d.	....	i.	....	s. a.; not d. by KOH soln.
3	2.765	1551	....	....	....	....
4	....	....	....	0.0048; $.013^{25}$	....	....
5	....	....	....	i.	i.	s. a.
6	3.031^{25}	d.	....	d.	d.	d. a.; s. hot HNO_3
7	....	exp. 144–56	....	....	....	$.211^{16}$ al.; i. eth.
8	1.436	$-3H_2O$, 110	....	2.67^0	8.3^{80}	....
9	....	1154	....	sl. s.	....	s. a., NH_4 salts; sl. s. ac. a.
10	....	d.	....	$.310^{30}$	0.40^{90}	s. a., NH_4 salts
11	....	....	....	0.25^{30}	....	....
12	....	986	....	....	....	....
13	2.33^{15}; 2.3^{20}	....	....	i.	i.	s. HNO_3; sl. s. conc. H_2SO_4
14	2.45	2235	....	i.	i.	s. HNO_3, sl. s. conc. H_2SO_4
15	3.329	$-H_2O$, 180	....	v. s.	v. s.	....
16	3.353^{25}	765	806–812	125^0	312^{105}	s. a., al., acet.; sl. s. NH_3
17	....	80.5	....	240^0	1850^{80}	s. a., al., acet.
18	....	38.2	....	594^0	1360^{25}	s. a., al., acet.
19	....	....	....	22.0^0	17.3^{100}	....
20	2.22	stable 25–447	....	d. to $Ca(OH)_2 + C_2H_2$		not d. by conc. H_2SO_4
21	2.93	d. 825	....	$.00153^{25}$ $(.146^9)$*	$.0019^{75}$ $(.088^{35})$*	s. a., NH_4Cl
22	$2.711^{25.2}$	$1339^{102.5\text{ atm.}}$	d. 894.4	$.0014^{25}$ $(.13^9)$*	$.0018^{75}$ $(.077^{35})$*	s. a., NH_4Cl
23	1.771^0	....	....	....	....	....
24	2.711	$-H_2O$, >100	....	177.7^8	v. s.	s. al., acet.
25	....	....	....	188.6^{25}	v. s.	$166.2\frac{25}{25}$ al.; 237.4 meth. al.; s. acet.; v. sl. s. eth.
26	2.512^{25}	772	>1600	59.5^0	159^{100}	s. al., ac. a., acet.
27	....	260	....	76.8^0	249^{100}	s. al.; i. acet.
28	....	....	....	97.7^0	326^{60}	s. al.
29	1.68^{17}	29.92	$-4H_2O$, 30; $-6H_2O$, 200	279^0	536^{20}	s. al.
30	....	d.	....	d. evln. Cl	....	d. a.
31	3.14	1270	....	v. sl. s.	....	....
32	....	$-H_2O$, 74	....	v. s.	d.	d. a.
33	....	....	....	slowly s. solns. with 5–6% available Cl	....	....
34	....	$-2H_2O$, 200	....	22.4^0; 16.3^{20}	18.2^{45}	s. a., al.
35	....	....	....	0.22^2	1.34^{100}	....
36	....	$-2H_2O$, 130	$-4H_2O$, 185	0.85^{18}	0.96^{23}	0.0065^{18} al.
37	....	1300 subl. >1150	....	d. evln. NH_3	d.	....

*Solubility in water containing CO_2 (?).

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Calcium			
1	cyanide	$Ca(CN)_2$	92.12	wh. powd
2	cyanoplatinite	$CaPt(CN)_4 \cdot 5H_2O$	429.46	rhomb., yel. grn. fluores, 1.6226
3	ferricyanide	$Ca_3[Fe(CN)_6]_2 \cdot 12H_2O$	760.33	red, need., deliq
4	ferrocyanide	$Ca_2Fe(CN)_6 \cdot 11$(or 12)H_2O	490.29	tricl. yel., 1.570, 1.582, 1.596
5	fluoride (fluorite)	CaF_2	78.08	cub. col., lum. with heat, 1.434
6	fluosilicate	$CaSiF_6$	182.14	wh. cr. powd. tetr
7	“	$CaSiF_6 \cdot 2H_2O$	218.17	tetr. col
8	formate	$Ca(CHO_2)_2$	130.12	rhomb., col., 1.510, 1.514, 1.578
9	fumarate	$CaC_4H_2O_4 \cdot 3H_2O$	208.18	rhomb. col
10	D-gluconate	$Ca(C_6H_{11}O_7)_2 \cdot H_2O$	448.39	cr. powd., need
11	glycerophosphate	$CaC_3H_5(OH)_2PO_4$	210.15	wh. cr. hyg. powd
12	hydride	CaH_2	42.10	wh. cr. powd
13	hydroxide	$Ca(OH)_2$	74.10	rhomb. trig. col
14	iodate (lautarite)	$Ca(IO_3)_2$	389.92	tricl
15	“	$Ca(IO_3)_2 \cdot 6H_2O$	498.02	rhomb., 1.686, 1.644, 1.604
16	iodide	CaI_2	293.92	yelsh.-wh. pl. deliq
17	“	$CaI_2 \cdot 6H_2O$	402.02	
18	isobutyrate	$Ca(C_4H_7O_2)_2 \cdot H_2O$	232.29	col
19	lactate	$Ca(C_3H_5O_3)_2 \cdot 5H_2O$	308.30	wh. powd
20	laurate	$Ca(C_{12}H_{23}O_2)_2 \cdot H_2O$	456.70	wh. need., effl
21	linoleate	$Ca(C_{18}H_{31}O_2)_2$	598.94	wh. amor. powd
22	magnesium carbonate (dolomite)	$CaCO_3 \cdot MgCO_3$	184.42	trig. 1.6817
23	“ *ortho*silicate (merwinite)	$Ca_3Mg(SiO_4)_2$	328.68	monocl. col. to pa. grn., 1.708, 1.711, 1.718
24	magnesium *meta*silicate (diopside)	$CaMg(SiO_3)_2$	216.52	wh. monocl
25	DL-malate	$CaC_4H_4O_5 \cdot 3H_2O$	226.20	rhomb. col., 1.545, 1.555, 1.575
26	L-malate	$CaC_4H_4O_5 \cdot 2H_2O$	208.18	col
27	malate, dihydrogen	$Ca(HC_4H_4O_5)_2 \cdot 6H_2O$	414.34	rhomb. or wh. cr. powd., 1.493, 1.507, 1.545
28	maleate	$CaC_4H_2O_4 \cdot H_2O$	172.15	rhomb. col., 1.495, 1.575, 1.640
29	malonate	$CaC_3H_2O_4 \cdot 4H_2O$	214.19	
30	*per*manganate	$Ca(MnO_4)_2 \cdot 5H_2O$	368.02	purp., pr
31	α-methylbutyrate (ethylmethylacetate)	$Ca(C_5H_9O_2)_2$	242.32	
32	molybdate	$CaMoO_4$	200.03	tetr. col., 1.967, 1.978
33	nitrate	$Ca(NO_3)_2$	164.10	cub. col., hyg
34	“	$Ca(NO_3)_2 \cdot 3H_2O$	218.14	
35	“	$Ca(NO_3)_2 \cdot 4H_2O$	236.16	monocl., col., deliq., 1.465, 1.498 1.504
36	nitride	Ca_3N_2	148.26	br. cr
37	nitrite	$Ca(NO_2)_2 \cdot H_2O$	150.11	hex. col.-yelsh., deliq
38	“	$Ca(NO_2)_2 \cdot 4H_2O$	204.16	col
39	oleate	$Ca(C_{18}H_{33}O_2)_2$	602.97	wh. wax-like cr
40	oxalate	CaC_2O_4	128.10	cub. col
41	“	$CaC_2O_4 \cdot H_2O$	146.12	col
42	oxide (lime) (calcia)	CaO	56.08	cub. col. 1.838
43	“ , per	CaO_2	72.08	wh
44	“ , “	$CaO_2 \cdot 8H_2O$	216.21	tetr. pearly
45	palmitate	$Ca(C_{16}H_{31}O_2)_2$	550.90	wh. or yelsh.-wh. fatty powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	...	d. >350 *ca.* 640	...	d.	d.	...
2	...	...	...	s.	...	...
3	...	...	...	v. s.	v. s.	...
4	1.68	d.	...	86.8$^{24.9}$	115$^{64.7}$	...
5	3.180	1360	...	0.0016^{18}	0.0017^{26}	s. soln. NH_4 salts; sl. s. a.; i. acet.
6	2.662$^{17.5}$	...	...	sl. s.	...	s. HF, HCl, al.
7	2.254	...	...	sl. s. d.	...	s. HF, HCl; i. al.
8	2.015	d.	...	16.2^{0}	18.4^{100}	i. al.
9	...	...	...	2.11^{30}	...	...
10	...	$-H_2O$, 120	...	3.3^{15}	...	v. sl. s. al.
11	...	...	...	2^{25}	less s.	i. al.
12	1.7	816 in H; d. *ca.* 600	...	d. to Ca($OH)_2$ + H_2		d. a., no known solv.
13	2.343	$-H_2O$, 580	d.	0.185^{0}	0.077^{100}	s. NH_4Cl soln., a.; i. al.
14	4.519^{15}	d.	...	0.10^{0}	0.95^{100}	s. HNO_3
15	...	d.	...	0.13^{0}	1.22^{100}	s. HNO_3
16	3.956^{25}	575	718	66^{10}	81^{100}	s. a., al., acet.
17	...	42	...	757^{0}	1680^{30}	s. a., acet., al.
18	...	...	...	28.8^{0}	37.6^{100}	...
19	...	$-3H_2O$, 100	...	3.1^{0}	7.9^{30}	sl. s. a.; i. al., eth.
20	...	182–3	...	0.004^{15}	0.055^{100}	0.059^{15} al., 1.72^{78} al.
21	...	...	...	i.	...	s. al., eth.
22	2.872	d. 730–760	...	0.032^{18}	...	...
23	3.150	...	...	...	...	...
24	3.3	1391	...	i.	i.	...
25	...	...	...	0.321^{0}	0.451$^{37.5}$	i. al.
26	...	...	...	0.812^{0}	1.224$^{37.5}$	i. al.
27	...	...	...	sl. s.	...	...
28	...	...	...	2.89^{25}	3.21^{40}	...
29	...	...	...	0.44^{0}	0.72^{100}	...
30	2.4	d.	...	331^{14}	338^{25}	s. NH_4OH
31	...	...	...	24.24^{0}	25.65^{70}	...
32	4.38–4.53	...	...	i.	...	s. a.; i. al., eth.
33	2.36	561	...	102.0^{0}; 341^{25}	376^{100}	s. al., acet.
34	...	51.1	...	...	...	...
35	1.82	α 42.7; β 39.7	d. 132	266^{0}	660^{30}	s. al., acet.
36	2.63^{17}	900	...	75.5 d.	247 d.	s. dil. a.; i. abs. al.
37	2.23^{34}; anh. 2.53^{30}	$-H_2O$, 100	...	45.9^{0}	89.6^{91}	sl. s. al.
38	1.674^{0}_{0}	$-2H_2O$, 44	...	74.9^{0}	106^{42}	s. al.
39	...	83–4	...	0.04^{25}	0.03^{50}	sl. s. eth.
40	2.2^{4}	d.	...	0.00067^{13}	0.0014^{95}	s. a.; i. ac. a.
41	2.2	$-H_2O$, 200	...	i.	i.	s. a.; i. ac. a.
42	3.346	2580	2850	0.131^{10} d.	0.07^{80} d.	s. a.
43	...	d. 275	...	sl. s.	...	s. a.
44	...	$-8H_2O$, 100	d. 275, exp.	sl. s.	d.	s. a., NH_4 salts; i. al., eth.
45	...	...	...	0.003^{25}	...	v. sl. s. al., 0.008^{25} eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Calcium			
1	1-phenol-4-sulfonate (*p*-)	$Ca[C_6H_4(OH)SO_3]_2 \cdot H_2O$	404.43	wh. to pinkish powd
2	phenoxide	$Ca(OC_6H_5)_2$	226.28	redsh. powd
3	*hypo*phosphate	$Ca_2P_2O_6 \cdot 2H_2O$	274.23	gel
4	*ortho*phosphate, tri (tert.)	$Ca_3(PO_4)_2$	310.20	amor. wh. powd
5	" , di- (sec., brushite)	$CaHPO_4 \cdot 2H_2O$	172.10	monocl. wh., 1.5576, 1.5457, 1.5392
6	" , mono- (prim.)	$Ca(H_2PO_4)_2 \cdot H_2O$	252.09	tricl. col., deliq., 1.5292, 1.5176, 1.4932
7	*pyro*phosphate	$Ca_2P_2O_7$	254.12	biaxial, col
8	"	$Ca_2P_2O_7 \cdot 5H_2O$	344.20	monocl., 1.539, 1.545, 1.551
9	*meta*phosphate	$Ca(PO_3)_2$	198.04	col
10	phosphide	Ca_3P_2	182.20	red cr
11	*hypo*phosphite	$Ca(H_2PO_2)_2$	170.07	monocl. wh.-gray
12	*ortho*phosphite, di-	$2CaHPO_3 \cdot 3H_2O$	294.18	
13	*ortho*plumbate	Ca_2PbO_4	351.37	red-br. cr
14	propionate	$Ca(C_3H_5O_2)_2 \cdot H_2O$	204.24	col. monocl. tabl
15	*l*-quinate	$Ca(C_7H_{11}O_6)_2 \cdot 10H_2O$	602.56	rhomb. leaf
16	salicylate	$Ca(C_7H_5O_3)_2 \cdot 2H_2O$	350.33	oct
17	"	$Ca(C_7H_5O_3)_2 \cdot 3H_2O$	368.35	monocl. wh.; $2H_2O$ oct
18	selenate	$CaSeO_4$	183.04	col., ($2H_2O$, monocl.)
19				
20	selenide	$CaSe$	119.04	simple cub., 2.274
21	(tri-) silicate (alite)	Ca_3SiO_5 (or $3CaO \cdot SiO_2$)	228.30	small, col. grains α 1.718, γ 1.724
22	(di-) *ortho*silicate (α)	Ca_2SiO_4 (or $2CaO \cdot SiO_2$	172.22	
23	" (β) (bellite)	Ca_2SiO_4 (or $2CaO \cdot SiO_2$)	172.22	rounded grains α 1.717, γ 1.735
24	metasilicate (α) (pseudowollastonite)	$CaSiO_3$	116.14	monocl. col., 1.610, 1.611, 1.664
25	metasilicate (β) (wollastonite)	$CaSiO_3$	116.14	monocl. col., 1.616, 1.629, 1.631
26	silicide	$CaSi_2$	96.20	
27	stearate	$Ca(C_{18}H_{35}O_2)_2$	607.00	cr. powd
28	succinate	$CaC_4H_6O_4 \cdot 3H_2O$	210.20	col., 1.460, 1.540, 1.610
29	sulfate (anhydrite)	$CaSO_4$	136.15	rhomb. or monocl. col., 1.569, 1.575, 1.613
30	" (soluble anhydrite	$CaSO_4$	136.15	tricl. need
31	" (gypsum)	$CaSO_4 \cdot 2H_2O$	172.18	monocl. col., 1.521, 1.523, 1.530
32	" (plaster of Paris)	$CaSO_4 \cdot \frac{1}{2}H_2O$	145.15	wh. powd
33	sulfide (oldhamite)	CaS	72.15	cub. col., 2.137
34	" , hydro-	$Ca(HS)_2 \cdot 6H_2O$	214.32	pr. col
35	sulfite	$CaSO_3 \cdot 2H_2O$	156.18	hex. col
36	" , dihydrogen	$Ca(HSO_3)_2$	202.23	yelsh. liq. strong SO_2 odor
37	*d*-tartrate	$CaC_4H_4O_6 \cdot 4H_2O$	260.22	rhomb., 1.525, 1.535, 1.550
38	*dl*-tartrate	$CaC_4H_4O_6 \cdot 4H_2O$	260.22	tricl., powd. or need
39	*meso*tartrate	$CaC_4H_4O_6 \cdot 3H_2O$	242.20	monocl. or tricl. pr
40	telluride	$CaTe$	167.69	simple cub., 2.51–.58
41	tellurite	$CaTeO_3$	215.69	wh. flecks
42	thiocarbonate, tri-	$CaCS_3$	148.29	yel
43	thiocyanate	$Ca(SCN)_2 \cdot 3H_2O$	210.30	wh. cr. deliq
44	*di*thionate	$CaS_2O_6 \cdot 4H_2O$	272.28	trig. col., 1.5496
45	thiosulfate	$CaS_2O_3 \cdot 6H_2O$	260.31	tricl

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	s.	....	s. al.
2	....	....	....	sl. s.	....	sl. s. al.
3	....	....	....	i.	....	s. HCl, $H_4P_2O_6$, $H_2P_2O_6$
4	3.14	1670	....	0.002–3	d.	s. a.; i. al.
5	2.306^{16}	d. 25	....	0.02^{25}; 0.0316^{38}	0.075^{100}, d	s. a.; i. al.
6	2.220^{16}	$-H_2O$, 109	d. 203	1.8^{30}	d.	s. a.
7	3.09	1230	....	i.	....	s. a.
8	2.25	....	....	sl. s.	....	s. a.; i. NH_4Cl
9	2.82	975	....	i.	i.	i. a.
10	2.238^{25}	>1600	....	d. ev. PH_3	....	s. a.; i. al., eth., bz.
11	....	d.	....	15.4^{25}	12.5^{100}	i. al.
12	....	....	....	sl. s.	d.	s. NH_4Cl
13	5.71	d.	....	i.	d.	s. a.
14	....	....	....	49.0^{0}	55.8^{100}	i. al.
15	....	50; $-10H_2O$, 120	....	16^{16}	....	i. al.
16	....	....	....	s.	s.	s. al.
17	....	....	....	2.70^{15}	44.7^{100}	s. al.
18	2.93; $(2H_2O)$	....	....	7.9^{6}	5.4^{67}	....
19	2.68					
20	7.593	....	....	....	....	....
21	....	$-CaO$, 1900	....	....	....	....
22	....	2130	tr. to β 1456	....	....	....
23	....	....	tr. to γ 675	....	....	....
24	2.905	1540	....	0.0095^{17}	....	s. HCl
25	2.915	tr. 1200	....	....	....	....
26	2.5	....	....	i.	d.	d. a., bases
27	....	179–180	....	0.004^{15}	....	i. al., eth.
28	....	....	....	0.193^{10}	0.89^{80}	....
29	2.96	monocl. 1450	tr. to rhomb. 1193	0.209^{30}	0.1619^{100}	s. a., $Na_2S_2O_3$, NH_4 salts glyc.
30	2.45	....	....	....	....	....
31	2.32	$-1\frac{1}{2}H_2O$, 128	$-2H_2O$, 163	0.241^{0}	0.222^{100}	s. a., $Na_2S_2O_3$, NH_4 salts, glyc.
32	....	$-\frac{1}{2}H_2O$, 163	....	0.3^{20}	sl. s.	s. a., $Na_2S_2O_3$, NH_4 salts
33	2.18^{15}	....	d.	$.0121^{15}$ d.	$.4614^{100}$ d.	d. a.
34	....	d. 15–18	....	v. s.	....	s. al.
35	....	$-2H_2O$, 100	....	0.0043^{18}	0.0011^{100}	s. H_2SO_3
36	....	....	....	s.	....	s. a.
37	....	d.	....	0.0266^{0}	$0.0689^{37.5}$	sl. s. al.
38	....	$-4H_2O$, 200	....	0.0032^{0}	$.0078^{37.5}$	s. HCl; i. acet. a.
39	....	$-3H_2O<170$	....	i.	0.16^{100}	0.28^{18}, $.085^{100}$ acet. a.
40	7.593	....	....	....	....	....
41	....	>960	....	sl. s.	s.	s. a.
42	....	....	....	s.	....	s. al.
43	....	....	....	v. s.	v. s.	v. s. al.
44	2.176	....	....	16^{0}	30^{30}	....
45	1.872	d.	....	100^{3}	d.	i. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Calcium			
1	*meta*titanate (perovskite)	$CaTiO_3$	135.98	rhomb., β 2.34
2	tungstate (scheelite)	$CaWO_4$	288.00	tetr. col. or wh. sc., 1.918, 1.934
3	*meta*tungstate	$Ca_3[H_2W_{12}O_{40}]\cdot 27H_2O$	3455.73	col. tricl
4	valerate	$Ca(C_5H_9O_2)_2$	242.32	
5	*meta*zirconate	$CaZrO_3$	179.30	monocl
6	**Carbon** "amorphous"	C	12.01	amor. blk
7	" graphite	C	12.01	hex. blk
8	" diamond	C	12.01	cub. col., 2.4173
9	(di-) bromide, tetra- (tetrabromethylene)	C_2Br_4	343.68	
10	(di-) bromide, hexa- (hexabromoethane)	C_2Br_6	503.52	rhomb. pr. 1.740, 1.847, 1.863
11	bromide, tetra- (tetrabromomethane)	CBr_4	331.67	col. monocl. tab
12	(di-) chloride, tetra- (tetrachloroethylene)	C_2Cl_4	165.85	col. liq. eth. odor, 1.5055
13	(di-) chloride, hexa- (hexachloroethane)	C_2Cl_6	236.76	rhomb., tricl., or cub., col
14	chloride, tetra- (tetrachloromethane)	CCl_4	153.84	col. liq., 1.46305^{15}
15	fluoride, tetra- (tetrafluoromethane)	CF_4	88.01	col. gas
16	iodide, tetra- (tetraiodomethane)	CI_4	519.69	octahdr. red
17	oxide, sub-	C_3O_2	68.03	col. gas or liq., 1.4538^0
18	" , mon-	CO	28.01	col. odorl. **poisonous** gas
19	" , di-	CO_2	44.01	col. odorl. gas or col. liq
20	selenide sulfide	CSeS	123.04	yel. oily liq
21	silicide	See *Silicon carbide*		
22	sulfide, sub-	C_3S_2	100.16	red liq
23	" , mono	CS (or $(CS)_x$)	44.08	red. powd
24	" , di-	CS_2	76.14	inflam. col. liq., 1.62950^{18}
25	" telluride	CSTe	171.69	yel.-red
26	**Carbonic acid**	H_2CO_3	62.03	exists only in solution
27	**Carbonyl bromide** (carbon oxybromide)	$COBr_2$	187.84	
28	**Carbonyl chloride** (phosgene, carbon oxychloride)	$COCl_2$	98.92	col. pois. gas or col. volat. liq
29	**Carbonyl sulfide** (carbon oxysulfide)	COS	60.08	gas
30	**Cerium**	Ce	140.13	cub. or hex. steel gray met
31	acetate (ous)	$Ce(C_2H_3O_2)_3$	317.26	col
32	" "	$Ce(C_2H_3O_2)_3\cdot 1\frac{1}{2}H_2O$	344.29	wh.-redsh. cr. powd
33	benzoate (ous)	$Ce(C_7H_5O_2)_3\cdot 3H_2O$	557.51	wh. to redsh.-wh. powd
34	boride, tetra-	CeB_4	183.41	tetr
35	" , hexa	CeB_6	205.05	cub., blue met
36	bromate (ous)	$Ce(BrO_3)_3\cdot 9H_2O$	686.02	hex. redsh. wh
37	carbide	CeC_2	164.15	hex. red
38	carbonate (ous)	$Ce_2(CO_3)_3\cdot 5H_2O$	550.37	micro. pr., wh

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	4.10	....	....	....	....	....
2	6.06	....	....	0.2	....	s. NH_4Cl; i. a., al.
3	....	d.	....	....	....	d. a.
4	....	....	....	8.28^{0}	7.39^{100}	....
5	4.78	2550	....	....	....	....
6	1.8–2.1	subl. 3652–97	4200	i.	i.	i. a., alk.
7	2.25	subl. 3652–97	4200	i.	i.	s. liq. Fe; i. a., alk.
8	3.51	>3500	4200	i.	i.	i. a., alk.
9	....	57.5	227	....	....	....
10	3.823	148–9 d.	210	i.	....	s. CS_2 v. sl. s. al., eth.
11	3.42	α 48.4; β 90.1	189.5	0.024^{30}	....	s. al., eth., chl.
12	$1.6311\frac{15}{4}$	−22.4	120.8	i.	....	s. al., eth.
13	2.091	subl. 187	....	i.	....	s. al., eth., oils
14	1.595	−23.0	76.8	v. sl. s.	....	s. al., bz., chl., eth.
15	1.96^{-184}	−184	−128	sl. s.	....	....
16	4.32	171 d.	....	i.	d.	s. d. h. al., CS_2, eth.
17	liq. 1.114^{0}	−111.3	7	d.	....	....
18	1.250^{0} g/l; liq. 0.793	−207	−190 (−192)	3.5^{0} cm^3	20^{20} cm^3	s. al., Cu_2Cl_2, bz., ac. a.
19	1.977^{0} g/l; liq. 1.101^{-37} s. 1.56^{-79}	$-56.6^{5.2 atm.}$	−78.5 subl.	171.3^{0} cm^3; $.348^{0}$ g; $.145^{25}$ g.	90.1^{20} cm^3; $.097^{40}$ g; $.058^{60}$ g.	31^{15} al. cm^3; s. acet.
20	1.9874	−85	84.5	i.	i.	s. CS_2; sl. s. al.
21	....	....	....	....	....	....
22	1.274	−0.5	....	....	....	....
23	1.66	d. 200	....	i.	....	s. CS_2, eth.; i. al.
24	$1.261\frac{22}{20}$	−108.6; frz. −111	46.3	0.22^{22}	$.014^{50}$	s. al., eth.
25	2.9^{-50}	−54	d.>-54.0	....	....	s. CS_2, bz.
26	....	....	....	s.	....	....
27	2.44	....	64.5	....	....	....
28	1.392	−104	8.3	d.	....	d. a., al.; v. s. bz., tol.; s. ac. a.
29	2.72 g/l; lq. 1.24^{-87}	−138	−48	133^{0} cm^3	40.3^{30} cm^3	v. s. al., alk.
30	cub. 392; hex. 6.7	804	1400	i.	i.	s. dil. a.; i. al.
31	....	308 d.	....	20^{15}	12^{75}	....
32	....	$-1\frac{1}{2}H_2O$, 115	d.	26.5^{15}	16.2^{75}	....
33	....	$-3H_2O$, 100	....	....	sl. s.	sl. s. hot al.
34	5.74	....	....	....	....	....
35	....	2190	d.	i.	i.	i. HCl
36	....	49	....	s.	....	....
37	5.23	....	....	d.	d.	s. a.
38	....	....	....	v. sl. s.	....	s. dil. a., $(NH_4)_2CO_3$

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cerium			
1	chloride (ous)	$CeCl_3$	246.50	col. cr., deliq
2	citrate (ous)	$Ce(C_6H_5O_7)\cdot 3\frac{1}{2}H_2O$	392.29	wh. powd
3	cyanoplatinite (ous)	$Ce_2[Pt(CN)_4]_3\cdot 18H_2O$	1502.45	monocl. yel. bl. lust
4	fluoride (ous)	CeF_3	197.13	hex. wh
5	" (ic)	$CeF_4\cdot H_2O$	234.15	wh. amor. powd
6	hydride (ous)	CeH_3	143.15	amor. powd., dk. bl
7	hydroxide (ous)	$Ce(OH)_3$	191.15	wh. gelat. ppt
9	iodate (ic)	$Ce(IO_3)_4$	839.81	col
10	iodide (ous)	$CeI_3\cdot 9H_2O$	683.03	redsh.-wh. cr
11	molybdate (ous)	$Ce_2(MoO_4)_3$	760.11	yel., tetr., 2.04
12	nitrate (ous)	$Ce(NO_3)_3\cdot 6H_2O$	434.25	col. or redsh. (trac. La, Di) cr. deliq.
13	" (ic), basic	$Ce(OH)(NO_3)_3\cdot 3H_2O$	397.21	long red need
14	oxalate (ous)	$Ce_2(C_2O_4)_3\cdot 9H_2O$	706.46	yel.-wh. cr
15	oxide (ous)	Ce_2O_3	328.26	gray-grn. powd
16	" (di) (ic) (ceria)	CeO_2	172.13	cub., col
17	" (ic)	$CeO_2\cdot xH_2O$		yelsh. gelat. ppt
18	oxychloride (ous)	$CeOCl$	191.59	purp. leaf
19	2,4-pentanedione deriv. (ous) (acetylacetonate)	$Ce(C_5H_7O_2)_3\cdot 3H_2O$	491.50	lt. yel. cr. ppt
20	*ortho*phosphate (ous)	$CePO_4$	235.11	monocl. red or rhomb. yel
21	*meta*phosphate (ous)	$Ce(PO_3)_3$	377.07	micr. need
22	salicylate (ous)	$Ce(C_7H_5O_3)_3$	551.46	wh. to redsh.-wh. powd
23	selenate (ous)	$Ce_2(SeO_4)_3$	709.14	rhomb
24	silicide	$CeSi_2$	196.25	
25	sulfate (ous)	$Ce_2(SO_4)_3$	568.46	monocl. or rhomb. col., grn. powd., hyg
26	" "	$Ce_2(SO_4)_3\cdot 4H_2O$	640.52	rhomb. asbestos like need. ($5H_2O$ monocl.)
27	" "	$Ce_2(SO_4)_3\cdot 8H_2O$	712.59	tricl. or monocl. sm. pink cr
28	" "	$Ce_2(SO_4)_3\cdot 9H_2O$	730.60	asbestos-like need. hex. cr
29	" (ic)	$Ce(SO_4)_2$	332.26	deep yel. cr
30	" "	$Ce(SO_4)_2\cdot 4H_2O$	404.33	rhomb. sulf. yel
31	sulfide (ous)	Ce_2S_3	376.46	red cr.; br.-dk. purp. powd
32	tungstate (ous)	$Ce_2(WO_4)_3$	1024.02	yel., tetr
	Cerium complexes:			
33	hexaantipyrinecerium (III) (*per*chlorate)	$[Ce(C_{11}H_{12}N_2O)_6]\cdot(ClO_4)_3$	1567.83	col. hex. cr
34	hexaantipyrinecerium (III) (iodide)	$[Ce(C_{11}H_{12}N_2O)_6]I_3$	1650.22	large yel. cr
35	**Cesium**	Cs	132.91	hex. silv.-wh. duct. met
36	acetate	$CsC_2H_3O_2$	191.95	deliq
37	aluminum sulfate	$CsAl(SO_4)_2\cdot 12H_2O$	568.20	cub. col., 1.4587
38	benzoate	$CsC_7H_5O_2$	254.02	
39	bromate	$CsBrO_3$	260.83	
40	bromide, mono-	$CsBr$	212.83	cub. col., 1.6984
41	" , tri-	$CsBr_3$	372.66	rhomb
42	bromochloroiodide	$CsBrClI$	375.20	rhomb. yel.-red
43	bromoiodide, di-	$CsIBr_2$	419.66	rhomb
44	bromodiiodide	CsI_2Br	466.67	
45	carbonate	Cs_2CO_3	325.83	col. cr., deliq
46	" , hydrogen	$CsHCO_3$	193.93	rhomb
47	chlorate	$CsClO_3$	216.37	

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.92^0	848 (794–812)	d.	100	d.	30 al.; s. acet.
2	....	....	....	i.	....	s. dil. min. a.
3	2.657	....	....	....	....	....
4	6.16	1324	....	i.	....	....
5	....	d.	....	i.	....	s. a.
6	....	ign.	....	d.	....	....
7	....	....	....	....	....	s. a., $(NH_4)_2CO_3$; i. alk.
9	....	....	....	0.015^{20}	....	....
10	....	....	d. ev. I_2	v. s.	....	v. s. al.
11	4.83	930	....	....	....	....
12	....	$-3H_2O$, 150	d. 200	v. s.	v. s.	50 al.; s. acet.
13	....	....	....	s.	....	....
14	....	d.	....	0.053^{25}	....	s. H_2SO_4, HCl; i. $H_2C_2O_4$, al., alk., eth.
15	6.9–7.0	ign. 200; 1692	....	i.	i.	s. H_2SO_4; i. HCl
16	7.3	2600	....	i.	i.	i. dil. a. s. H_2SO_4, HNO_3
17	....	....	....	....	....	s. a.; sl. s. alk. carb.; i. alk.
18	....	....	....	i.	....	s. dil. a.
19	....	131–2	....	d.	....	v. s. al.
20	5.22	....	....	i.	i.	s. a.; i. al.
21	3.272	....	....	....	....	i. a.
22	....	....	....	i.	....	....
23	4.456	....	....	39.55	2.513^{100}	....
24	5.67^{17}	....	....	i.	....	....
25	3.912	....	....	10.1^0	4.06^{60}; 2.25^{100}	....
26	3.22 ($5H_2O$)	....	....	3.90^{50}	0.514^{100}	....
27	2.886^{17}	$-8H_2O$, 630	....	23.8^0; 12^{20}	6^{50}	....
28	2.831	....	....	11.87^{15}; 9.42^{30}	....	....
29	3.91^{18}	....	d. 195	sl. d. to form basic salt		
30	....	....	....	v. s., d.	....	s. dil. H_2SO_4
31	5.020^{11}	d.	....	i.	d.	s. dil. a.
32	$6.77^{16.5}$	1089	....	....	....	....
33	....	295–300 d.	....	1.08^{20}	....	....
34	....	268–270	....	15.10^{20}	....	....
35	1.873	28.5	670	d.	d.	s. a., d. al.
36	....	194	....	$945.1^{-2.5}$	$1345.5^{83.5}$	....
37	1.97	117	....	0.34^0	42.54^{100}	s. dil. a.; i. al.
38	....	....	....	294.5^0	398.5^{100}	....
39	....	....	....	4.53^{30}	....	....
40	4.44; lq. 3.04^{700}	636	1300	124.3^{25}	....	s. a.
41	....	180	....	....	....	....
42	....	235	d. 290	....	....	....
43	....	248	d. 320	....	....	....
44	....	195.5	....	260.5^{15} d.	....	s. al.
45	....	d. 610	....	260.5^{15}	v. s.	11^{19} al. s. eth.
46	....	$-\frac{1}{2}CO_2$, 175	....	209.3^{15}	v. s.	s. al.
47	3.57	....	....	....	37.9^{100}	s. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cesium			
1	*per*chlorate	$CsClO_4$	232.37	rhomb. col
2	chloride	$CsCl$	168.37	cub. col. deliq., 1.6418
3	chloroaurate	$CsAuCl_4$	471.94	monocl., yel
4	chloro*di*bromide	$CsBr_2Cl$	328.20	yel
5	chlorobromide, di-	$CsBrCl_2$	283.74	
6	chloroiodide, di	$CsICl_2$	330.74	rhomb. pa. or
7	chloroplatinate	Cs_2PtCl_6	673.79	cub. yel
8	chlorostannate	Cs_2SnCl_6	597.26	cub. wh
9	chromate	Cs_2CrO_4	381.83	α yel. pr.; β yel. rhomb
10	cyanide	$CsCN$	158.93	col. cr
11	fluogermanate	Cs_2GeF_6	452.42	isotropic cr., reg. octahedra
12	fluoride	CsF	151.91	cub. col
13	"	$CsF \cdot 1\frac{1}{2}H_2O$	178.93	
14	fluosilicate	Cs_2SiF_6	407.88	cub. wh
15	fluotellurite	$CsTeF_5$	355.52	col. need
16	formate	$CsCHO_2$	177.93	
17	"	$CsCHO_2 \cdot H_2O$	195.94	
18	gallium selenate	$CsGa(SeO_4)_2 \cdot 12H_2O$	704.74	col. cr
19	" sulfate	$CsGa(SO_4)_2 \cdot 12H_2O$	610.95	cub. col., 1.46495
20	hydride	CsH	133.92	wh. cr.
21	hydroxide	$CsOH$	149.92	col.-yelsh., v. deliq.
22	iodate	$CsIO_3$	307.83	monocl. wh
23	*metaper*iodate	$CsIO_4$	323.83	rhomb. wh. pl
24	iodide, mono-	CsI	259.83	cub. col., 1.7876
25	" , tri-	CsI_3	513.67	rhomb. blk
26	" , penta-	CsI_5	767.71	tricl. blk
27	*per*manganate	$CsMnO_4$	251.84	
28	mercury bromide (ic)	$CsBr \cdot 2HgBr_2$	933.71	rhomb
29	" chloride (ic)	$CsCl \cdot HgCl_2$	439.89	cub. or rhomb. col., 1.792
30	nitrate	$CsNO_3$	194.92	col. hex. or cub., glit
31	" , hydrogen	$CsNO_3 \cdot HNO_3$	257.93	oct
32	" , di-H.	$CsNO_3 \cdot 2HNO_3$	320.95	col. pl
33	nitrite	$CsNO_2$	178.92	yel. cr.
34	oxalate	$Cs_2C_2O_4$	353.84	
35	oxide, mon-	Cs_2O	281.82	or-red cr
36	" , per-	Cs_2O_2	297.82	pa. yel. need
37	" , tri- (sesqui-)	Cs_2O_3	313.82	cub. choc. br. cr
38	" , super-	CsO_2	164.91	yel. cr
39	phthalate, hydrogen	$CsHC_8H_4O_4$	298.03	rhomb
40	rhodium sulfate	$CsRh(SO_4)_2 \cdot 12H_2O$	644.13	yel. oct
41	salicylate	$CsC_7H_5O_3$	270.02	
43	sulfate	Cs_2SO_4	361.89	rhomb. or hex. col., 1.560, 1.564, 1.566
44	" , hydrogen	$CsHSO_4$	229.98	rhomb. col. pr
45	sulfide	$Cs_2S \cdot 4H_2O$	369.95	wh. cr. deliq
46	" , di-	Cs_2S_2	329.95	amor., dk. red
47	" "	$Cs_2S_2 \cdot H_2O$	347.97	tetr
48	" , tri-	Cs_2S_3	362.02	yel. leaf
49	" , tetra	Cs_2S_4	394.08	yel
50	" , penta-	Cs_2S_5	426.15	
51	" , hexa-	Cs_2S_6	458.22	br. red
52	tartrate, hydrogen	$CsHC_4H_4O_6$	281.99	wh. rhomb. cr
53	**Chloric acid**	$HClO_3 \cdot 7H_2O$ (?)	210.58	known only as col. soln
54	" " per	$HClO_4$	100.47	col. unst. liq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.327	d.	...	0.8^{0}	30^{100}	i. abs. al.
2	3.97	646	1290 subl.	161.7^{0}; 185.7^{20}	270.5^{100}	v. s. al.
3	...	...	...	0.5^{10}	27.5^{100}	s. al.
4	...	191	...	...	...	...
5	...	205	...	...	...	...
6	3.86	230	d. 290	...	...	...
7	...	d.	...	$.024^{0}$; $.135^{20}$	0.377^{100}	i. al.
8	3.33	...	...	...	...	i. conc HCl
9	4.237	...	...	71.4^{13}	95.5^{30}	...
10	...	...	...	s.	...	i. al.
11	4.10	...	...	sl. s.	v. s.	sl. s. a.
12	3.586	684	1250	v. s.	...	i. al.
13	...	...	...	366.5^{18}	...	...
14	3.372^{17}	...	...	60^{17}	less s.	i. al.
15	...	...	...	d.	d.	soln. HF
16	...	265	...	...	$2012^{95.4}$	...
17	...	$-H_2O$, 41	...	369.9^{1}	...	...
18	...	...	...	4.14^{25}	...	...
19	2.113	...	...	1.51^{25}	...	$.0035^{25}$ 70 % al.
20	3.41	d.	...	d.	d.	d. a.
21	3.675	272.3	...	395.5^{15}	...	s. al.
22	4.85	...	...	2.6^{24}	...	...
23	4.259	...	...	2.15^{15}	...	...
24	4.510	621	1280	44^{0}	160^{61}	s. al.
25	...	207.5	...	v. sl. s.	...	...
26	...	73	...	...	...	...
27	3.597	d.	...	0.097^{1}	1.27^{59}	...
28	...	...	...	0.807^{17}	...	sl. s. al.
29	...	...	...	1.44^{17}	...	i. abs. al.
30	3.685; liq. 2.71^{500}	414	d.	9.16^{0}; 14.9^{10}	196.8^{100}	s. acet.
31	...	100	...	...	...	...
32	...	32–36	...	...	...	...
33	...	...	...	v. s.	v. s.	...
34	...	...	...	282.9^{25}	...	...
35	4.36	d. 360–400	...	v. s.	d.	s. abs. al.
36	4.25	400	$-O_2$, 650	s.	d.	s. a.
37	4.25^{0}	400	...	d.	...	s. a.
38	3.77^{19}	600	d.	d. to CsOH	d.	s. a.
39	2.178	...	...	...	...	...
40	2.238	110–111	...	sl. s.	...	...
41	...	...	...	196.2^{0}	1522^{100}	...
43	4.243	1010	tr. hex. 600	167^{0}	220^{100}	i. al., acet.
44	3.352^{16}	d.	...	s.	...	...
45	...	...	...	v. s.	v. s.	...
46	...	460	>800	hyg.	...	...
47	...	...	...	s.	...	...
48	...	217	780	...	...	...
49	...	160 d.	...	...	...	...
50	2.806^{16}	210	...	...	...	...
51	...	186	...	...	...	...
52	...	...	...	9.7^{25}	98^{100}	...
53	$1.282^{14.2}$	<-20	d. 40	v. s.	...	...
54	1.764^{22}	-112	39^{56}	∞	...	...

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Chloric acid			
1	" " per (hydronium perchlorate)	$HClO_4\cdot H_2O$ or $[H_3O]^+[ClO_4]^-$	118.48	need. fairly stable
2	**Chloric acid** per di-H_2O	$HClO_4\cdot 2H_2O$	136.50	stable, liq
3	**Chlorine**	Cl_2	70.91	grnsh.-yel. gas or liq. or rhomb. cr. gas 1.000768, liq. 1.367
4	azide (chlor(o)azide)	ClN_3	77.48	gas, exp
5	fluoride, mono-	ClF	54.46	nearly col. gas
6	" , tri-	ClF_3	92.46	col. gas
7	hydrate	$Cl_2\cdot 8H_2O$	215.04	rhomb. lt. yel
8	oxide, mon-	Cl_2O	86.91	yel.-red gas or red-br. liq
9	" , di-	ClO_2	67.46	red-yel. gas or or.-red cr. exp
10	" , tetr-	ClO_4 or Cl_2O_8	99.46	
11	" , hept-	Cl_2O_7	182.91	col. oil
12	**Chloroauric acid**	$HAuCl_4\cdot 4H_2O$	412.10	brt. yel. need., deliq
13	**Chloroplatinic acid**	$H_2PtCl_6\cdot 6H_2O$	518.08	red. br. pr., deliq
14	**Chlorostannic acid**	$H_2SnCl_6\cdot 6H_2O$	441.55	col. leaf
15	**Chlorosulfonic acid**	$ClSO_3H$	116.53	col. fum. liq., 1.437^{14}
16	**Chromium**	Cr	52.01	cub. steel gray, v. hard met
17	acetate (ous)	$Cr(C_2H_3O_2)_2$	170.10	red cr
18	" (ic)	$Cr(C_2H_3O_2)_3\cdot H_2O$	247.16	gray-grn. powd. or bluish-grn., pasty mass
19	arsenide, mon-	$CrAs$	126.92	gray, hex
20	boride, mono-	CrB	62.83	ortho rhomb., silv. cr
21	bromide (ous)	$CrBr_2$	211.84	wh. cr
22	" (ic)	$CrBr_3$	291.76	hex. olv. grn
23	" "	$CrBr_3\cdot 6H_2O$	399.85	hex. pl., grn., deliq
24	(tri-) carbide, di-	Cr_3C_2	180.05	gray cr
25	(penta-) carbide, di-	Cr_5C_2	284.07	silv. cr
26	carbonyl	$Cr(CO)_6$	220.07	col. orthorhomb
27	chloride (ous)	$CrCl_2$	122.92	wh. need., deliq
28	" (ic)	$CrCl_3$	158.38	i. vlt. pl. (or deliq. s. cr.)
29	" "	$[Cr(H_2O)_6]Cl_3$	266.48	monocl. vlt
30	" "	$[Cr(H_2O)_5Cl]Cl_2\cdot H_2O$	266.48	grn. cr. powd
31	" "	$[Cr(H_2O)_4Cl_2]Cl\cdot 2H_2O$	266.48	rhomb. grn
32	" "	$CrCl_3\cdot 10H_2O$	338.54	grn. cr. powd
33	fluoride (ous)	CrF_2	90.01	grn. cr
34	" (ic)	CrF_3	109.01	rhomb. grn
35	" "	$CrF_3\cdot 4H_2O$	181.07	cub. oct. grn
36	" "	$CrF_3\cdot 3H_2O$	163.05	green
37	hydroxide (ous)	$Cr(OH)_2$	86.03	yel. br
38	iodide (ous)	CrI_2	305.85	grayish powd
39	nitrate (ic)	$Cr(NO_3)_3\cdot 7\frac{1}{2}H_2O$	373.15	monocl. br
40	" "	$Cr(NO_3)_3\cdot 9H_2O$	400.18	monocl. purp
41	nitride, mono-	CrN	66.02	cub., or amor
42	oxalate (ous)	$CrC_2O_4\cdot H_2O$	158.05	yel. cr. powd
43	oxide, mon- (ous)	CrO	68.01	black
44	" sesqui- (ic)	Cr_2O_3	152.02	hex. grn
45	" " "	$Cr_2O_3\cdot xH_2O$	....	bl.-gray grn. gel. or vlt. amor
46	" di-	CrO_2	84.01	br.-blk. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.88; lq. 1.776^{50}	50	exp. 110	v. s.	v. s.	...
2	1.65	−17.8	200	v. s.	v. s.	s. al.
3	3.214^0	−103 ± 5	−34.6	310^{10} cm^3; 1.46^0 g	177^{30} cm^3 0.57^{30} g	s. alk.
4	...	...	...	sl. s.	...	d. alk.
5	1.62^{-100}	−154 ± 0.5	−100.8	d.	d.	...
6	1.77^{13}	−83	11.3	d.	d.	...
7	1.23	d. 9.6	...	i.	...	s. alk.
8	3.89^0 g/l	−20	3.8^{766}; exp.	200 cm^3	d. to HOCl	exp. C. comp.; s. alk., H_2SO_4
9	3.09^{11} g/l	−59	9.9^{731}; exp. 100	2000^4 cm^3	d. $HClO_3$, Cl_2, O_2	exp. C. comp.; s. alk., H_2SO_4
10	...	...	d.	s. d.	...	s. bz.
11	...	−91.5	82	s. d.	...	s. bz.
12	...	d.	...	s.	v. s.	s. al., eth.
13	2.431	60	...	v. s.	v. s.	s. al., eth.
14	1.93	9	...	s.	...	...
15	1.766^{18}	−80	158	d. to H_2SO_4 + HCl		d. al., a.; i. CS_2
16	7.20^{28}	1890	2480	i.	i.	s. HCl dil. H_2SO_4; i. HNO_3
17	...	...	...	sl. s.	s.	sl. s. al.
18	...	...	...	s.	...	i. al.
19	6.35^{16}	...	...	i.	i.	i. a.
20	6.17	2760 (?)	...	i.	i.	s. fus. Na_2O_2
21	4.356	842	...	...	...	s. al.
22	4.250	...	subl.	(1) 200[*] (2) i.	... i.	v. s. al.; d. alk.
23	5.4^{17}	...	...	200	...	v. s. al.; s. fus. Na_2O_2; i. eth.
24	6.68	1890	3800	i.	i.	s. dil. HCl
25	6.915^{25}	1665	...	...	...	...
26	1.77	subl. at room temp., sinters 90^0	d. 130^0; exp. 210^0	...	...	i. bz., eth., al., acetic acid; sl. s. $CHCl_3$, CCl_4
27	2.75	824	...	v. s.	v. s.	sl. s. al.; i. eth.
28	2.76^{15}	*ca.* 1150	1300 subl.	(1) i. (2) 233^{25}	i. s.	i. a., CS_2 acet., al.
29	2.76	95	...	58.7^{25}	s.	s. al.; i. eth.
30	1.760^{25}	...	...	...	...	...
31	2.76	83	...	58.5^{25}	s.	s. al.; i. eth.
32	...	...	...	v. s.	...	v. s. al.
33	4.11	1100	>1300	sl. s.	...	s. h. HCl; i. al.
34	3.8	>1000	subl.	i.	...	sl. s. a.; i. al., NH_3
35	3.78	...	...	44.8 %^{25}	s.	s. a.; i. al., NH_3
36	...	...	...	2.63 %	3.46 %	s. a., HCl, KOH; i. al.
37	...	...	...	d.	...	s. a.
38	5.196	...	...	v. s.	...	...
39	...	100	...	s.	s.	...
40	...	37	d. 125.5	s.	s.	s. a., al., alk., acet.
41	5.9	d. 1770	...	i.	i.	sl. s. aq. reg.
42	...	...	...	...	s.	...
43	...	...	...	i.	i.	i. dil. HNO_3
44	5.21	1990	...	i.	i.	i. a., al., alk.
45	...	...	...	i.	i.	s. a., alk.; sl. s. NH_4OH
46	...	−O, 300	...	i.	...	s. HNO_3

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[*] Several chromic salts exist in two forms, a soluble and insoluble modification.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Chromium			
1	oxide tri- (chromic anhydride, "chromic acid")	CrO_3	100.01	rhomb. red. deliq
2	oxychloride	CrO_2Cl_2	154.92	dk. red liq
3	2,4-pentanedione deriv. (acetylacetonate)	$Cr(C_5H_7O_2)_3$	349.33	
4	*ortho*phosphate (ic)	$Cr(PO_4)\cdot 2H_2O$	183.02	violet cr
5	" "	$Cr(PO_4)\cdot 4H_2O$	219.05	grn. cr
6	" "	$Cr(PO_4)\cdot 6H_2O$	255.09	tricl. vlt. 1.568, 1.591, 1.599
7	phosphide, mono-	CrP	82.99	gray-blk. cr
8	silicide	Cr_3Si_2	212.15	tetr. pr
9	sulfate (ous)	$CrSO_4\cdot 7H_2O$	274.19	blue cr
10	" (ic)	$Cr_2(SO_4)_3$	392.22	vlt. or red powd
11	" "	$Cr_2(SO_4)_3\cdot 15H_2O$	662.46	vlt. amor. sc
12	" "	$Cr_2(SO_4)_3\cdot 18H_2O$	716.51	cub. oct., bl.-vlt
13	sulfide, mono- (ous)	CrS	84.08	blk. powd
14	sulfide, sesqui (ic)	Cr_2S_3	200.20	br.-blk. powd
15	sulfite (ic)	$Cr_2(SO_3)_3$	344.22	grnsh. wh
	Chromium complexes:			
16	Chloropentamminechromium (III) chloride	$[Cr(NH_3)_5Cl]Cl_2$	243.54	oct. red
17	Hexamminechromium (III) chloride	$[Cr(NH_3)_6]Cl_3\cdot H_2O$	278.59	yel. cr
18	Hexaureachromium (III) fluosilicate	$[Cr(CON_2H_4)_6]_2[SiF_6]_3\cdot 3H_2O$	1304.94	leaves, lt. grn
19	Hexaureachromium (III) *per*rhenate	$[Cr(CON_2H_4)_6](ReO_4)_3$	1163.29	grn. need
20	**Cobalt**	Co	58.94	cub. silv. gray metal
21	acetate (ous)	$Co(C_2H_3O_2)_2\cdot 4H_2O$	249.09	monocl. red-vlt., deliq
22	" (ic)	$Co(C_2H_3O_2)_3$	236.07	oct. grn
23	aluminate (approx. Thenard's blue)	$CoAl_2O_4$	176.88	cub. blue
24	*ortho*arsenate (ous), (erythrite)	$Co_3(AsO_4)_2\cdot 8H_2O$	598.77	monocl. vlt.-red, 1.626, 1.661, 1.699
25	arsenic sulfide (cobaltite	$CoAsS$	165.92	gray-redsh
26	benzoate (ous)	$Co(C_7H_5O_2)_2\cdot 4H_2O$	373.22	gray red leaf
27	boride, mono-	CoB	69.76	pr
28	bromate (ous)	$Co(BrO_3)_2\cdot 6H_2O$	422.87	oct. red
29	bromide (ous)	$CoBr_2$	218.77	grn. cr., deliq
30	" "	$CoBr_2\cdot 6H_2O$	326.87	pr. red-vlt., deliq
31	bromoplatinate	$CoPtBr_6\cdot 12H_2O$	949.86	trig
32	carbonate (ous) (spherocobaltite)	$CoCO_3$	118.95	trig., red. 1.855, 1.60
33	carbonate, basic, (ous)	$2CoCO_3 3Co(OH)_2\cdot H_2O$	534.78	vlt.-red prisms
34	carbonyl (tri-) (tetracobalt dodecacarbonyl)	$[Co(CO)_3]_4$ (or $Co_4(CO)_{12}$)	571.88	blk. cr
35	carbonyl (tetra-) (dicobaltoctacarbonyl	$[Co(CO)_4]_2$ (or $Co_2(CO)_8$)	341.96	or. cr. or dk. br. microcr
36	chlorate (ous)	$Co(ClO_3)_2\cdot 6H_2O$	333.95	cub. red. deliq
37	*per*chlorate (ous)	$Co(ClO_4)_2$	257.85	red need

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.70	196	d.	166^{15}	206.7^{100}	s. eth., al., H_2SO_4
2	1.911	−96.5	117	d.	d.	d. al.; s. eth., ac. a.
3	....	216	340	i.	....	s. org. solvts., except lgr.
4	$2.42^{32.5}$	....	....	sl. s.	....	s. a., alk.; i. ac. a.
5	$2.10^{32.5}$	....	....	sl. s.	....	s. a.
6	2.121	$-3\frac{1}{2}H_2O$, 100	....	sl. s.	....	s. a., alk.; i. ac. a.
7	5.7^{15}	....	....	i.	....	s. HNO_3, HF; i. a.
8	5.5	....	....	i.	i.	s. HCl, HF; i. HNO_3 H_2SO_4
9	....	....	....	12.35^{0}	....	sl. s. al.
10	3.012	....	....	i.; s.*	....	sl. s. al.; i. a.
11	1.867^{17}	100	$-10H_2O$, 100	s.	s., $d.^{67}$	i. al.
12	1.7^{22}	$-12H_2O$, 100	....	120^{20}	d.	s. al.
13	4.1	....	....	i.	....	v. s. a.
14	3.77^{19}	....	....	i. d.	d.	d. al.; s. HNO_3
15	2.2	d.	....	....	....	....
16	1.696	....	....	.65 g. at 16	....	i. HCl
17	1.585	....	....	s.	....	....
18	....	....	....	$.522^{20}$	....	i. al.
19	$2.652\frac{25}{4}$	....	....	1.786	....	.667 al.
20	8.9	1495	2900	i.	i.	s. a.
21	1.705^{19}	....	$-4H_2O$, 140	s.	s.	s. a., al.
22	....	....	....	hyd. read	ily	s. glac. acet., a.
23	....	....	....	i.	i.	i. a.
24	2.948	d.	....	i.	i.	s. dil. a., NH_4OH
25	6.2–6.3	d.	....	....	....	....
26	....	$-4H_2O$, 115	....	v. s.	....	....
27	7.25^{18}	....	....	d.	d.	s. HNO_3
28	....	....	....	45.5^{17}	....	s. NH_4OH
29	4.909^{25}	d.	....	66.7^{59}	68.1^{97}	77.1^{20} al.; s. eth.
30	2.46	47–8; $-4H_2O$,100	$-6H_2O$, 130	s. red color	153.2^{97}	s. a., eth., al. bl. color
31	2.762	....	....	....	....	....
32	4.13	d.	....	i.	i.	s. a.; i. NH_3
33	....	....	....	i.	d.	s. a., $(NH_4)_2CO_3$
34	....	....	....	sl. s.	....	d. with Br
35	1.73^{18}	51	d. 52	i.	i.	s. al., CS_2, eth.
36	1.92	61	d. 100	558.3^{0}	v. s.	s. al.
37	3.327	....	....	100^{0}	115^{45}	s. al., acet.

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* Several chromic salts exist in two forms, a soluble and an insoluble modification.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cobalt			
1	*per*chlorate (ous)	$Co(ClO_4)_2 \cdot 6H_2O$	365.95	hex., red 1.55
2	chloride (ous)	$CoCl_2$	129.85	bl. cr
3	“ (ous)	$CoCl_2 \cdot 2H_2O$	165.89	
4	“ (ous)	$CoCl_2 \cdot 6H_2O$	237.95	monocl. red
5	“ (ic)	$CoCl_3$	165.31	red cr
6	chloroplatinate	$CoPtCl_6 \cdot 6H_2O$	575.01	trig
7	chlorostannate	$CoSnCl_6 \cdot 6H_2O$	498.48	rhomb. or trig
8	chromate (ous)	$CoCrO_4$	174.95	gray-blk. cr
9	citrate (ous)	$Co_3(C_6H_5O_7)_2 \cdot 2H_2O$	591.05	rose-red
10	cyanide (ous)	$Co(CN)_2 \cdot 2H_2O$	147.01	buff; anh. bl-vlt. powd
11	“ “	$Co(CN)_2 \cdot 3H_2O$	165.02	amor. red-gray powd
12	ferricyanide (ous)	$Co_3[Fe(CN)_6]_2$	600.74	red need
13	ferrocyanide (ous)	$Co_2Fe(CN)_6 \cdot xH_2O$		gray-grn
14	fluogallate (ous)	$[Co(H_2O)_6][GaF_5 \cdot H_2O]$	349.77	monocl.(?), pink cr., n 1.45
15	fluoride (ous)	$CoF_2 \cdot 2H_2O$	132.97	monocl. rose-red
16	“ “	$CoF_2 \cdot 4H_2O$	169.00	α rhomb. oct., red; β cr. powd. rose
17	“ (ic)	CoF_3 (or Co_2F_6)	115.94	hex. brown
18	“ (ic)	$CoF_3 \cdot 3\frac{1}{2}H_2O$ (or $Co_2F_6 \cdot 7H_2O$)	179.00	grn. powd
19	fluosilicate (ous)	$CoSiF_6 \cdot 6H_2O$	309.10	trig. pink, 1.382, 1.387
20	formate (ous)	$Co(CHO_2)_2 \cdot 2H_2O$	185.01	red cr
21	hydroxide (ous)	$Co(OH)_2$	92.96	rhomb. rose-red
22	“ (ic)	$Co(OH)_3$ or $Co_2O_3 \cdot 3H_2O$	109.96	blk.-br. powd
23	iodate (ous)	$Co(IO_3)_2$	408.78	bl.-vlt. need
24	“ “	$Co(IO_3)_2 \cdot 6H_2O$	516.88	red oct
25	iodide (ous), (α) stable	CoI_2	312.78	hexag. blk
26	“ “ , (β)	CoI_2	312.78	yel. need., unst
27	“ “	$CoI_2 \cdot 2H_2O$	348.81	grn. deliq
28	“ “	$CoI_2 \cdot 6H_2O$	420.88	hex. br.-red
29	iodoplatinate	$CoPtI_6 \cdot 9H_2O$	1177.83	trig
30	linoleate (ous)	$Co(C_{18}H_{31}O_2)_2$	617.80	brown amor
31	nitrate (ous)	$Co(NO_3)_2 \cdot 6H_2O$	291.05	monocl. red, deliq
32	oleate (ous)	$Co(C_{18}H_{33}O_2)_2$	621.83	br. amor. powd
33	oxalate (ous)	CoC_2O_4	146.96	redsh. wh
34	oxide (ous)	CoO	74.94	cub. grn.-br
35	“ (ous, ic)	Co_3O_4	240.82	cub. blk
36	“ (ic)	Co_2O_3	165.88	blk.-gray powd
37	palmitate	$Co(C_{16}H_{31}O_2)_2$	569.76	
38	*ortho*phosphate (ous)	$Co_3(PO_4)_2$	366.78	rdsh. cr
39	“ “	$Co_3(PO_4)_2 \cdot 2H_2O$	402.81	pink powd
40	“ “	$Co_3(PO_4)_2 \cdot 8H_2O$	510.91	redsh. powd
41	phosphide	Co_2P	148.90	sm. need. gray
42	propionate (ous)	$Co(C_3H_5O_2)_2 \cdot 3H_2O$	259.13	dk. red cr
43	*per*rhenate (ous)	$Co(ReO_4)_2 \cdot 5H_2O$	649.64	dk. pink
44	selenate (ous)	$CoSeO_4 \cdot 5H_2O$	291.98	tricl. ruby red
45	“ “	$CoSeO_4 \cdot 7H_2O$	328.01	monocl

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	143 ($5H_2O$)	....	$5H_2O$; 100^0	115^{45}	s. al., acet.
2	3.356	subl.	1049	45^7	105^{96}	54.4 al.; 8.6 acet.; 38.5 meth. al.
3	$2.477\frac{25}{25}$	....	....	....	....	....
4	$1.924\frac{25}{25}$	86	$-6H_2O$, 110	76.7^0 (red); 49.9^{20}	190.7^{100}	v. s. al. bl. color; 0.29 eth.; s. acet.
5	2.94	subl.	....	s.	s.	....
6	2.699	d.	....	....	....	....
7	....	d. 100	....	....	....	....
8	....	d.	....	i.	....	s. a., NH_4OH
9	....	$-2H_2O$, 150	....	0.8	....	....
10	anh. 1.872^{25}	$-2H_2O$, 280	....	i.	....	s. KCN, HCl, NH_4OH
11	....	$-3H_3O$, 250	....	i.	....	s. KCN soln.
12	....	....	....	i.	....	s. NH_4OH; i. HCl
13	....	....	....	i.	....	s. KCN; i. HCl
14	2.35	$-5H_2O$, 110	....	sl. s.	....	d. a.
15	4.46	....	....	s.	d.	s. HF
16	2.192^{25}	....	....	....	....	....
17	3.88	....	....	d. to $Co(OH)_3$	....	....
18	2.314^{25}	....	....	....	....	....
19	2.113^{19}	....	....	$118.1^{21.5}$	s.	....
20	2.129^{22}	$-2H_2O$, 140	anh. d. 175	5.03^{20}	....	....
21	3.597^{15}	d.	....	.00032	....	s. a., NH_4 salts; i. alk.
22	....	d.	$-1\frac{1}{2}H_2O$, 100	0.00032	....	s. a.; i. al.
23	5.008^{18}	....	....	0.4^{15}	1.33^{100}	s. HCl, HNO_3
24	3.689^{21}	61 d.; $-4H_2O$,135	....	s.	....	....
25	5.68	....	....	159^9	420^{100}	v. s. al., acet.
26	5.45^{25}	....	....	....	....	....
27	....	....	....	376.2^{46}	s.	....
28	2.90	$-6H_2O$, 130	....	s.	s.	s. al., eth., chl.
29	3.618	....	....	....	....	....
30	....	....	....	i.	....	s. al., eth., acet.
31	1.87	<100	$-3H_2O$, 55	133.8^0	v. s.	$100^{12.5}$ al.; s. acet.; sl. s. NH_3
32	....	....	....	i.	....	s. al., eth., oils, bz.
33	3.021^{25}	....	....	i.	....	s. a., NH_4OH
34	5.7–6.7	1800 d.	....	i.	i.	s. a.; i. NH_4OH, al.
35	6.07	....	....	i.	i.	s. H_2SO_4; i. HCl, HNO_3, aq. reg.
36	5.18	d. 895	....	i.	i.	s. a.; i. al.
37	....	70.5	....	....	....	s. pyridine, hot CS_2, CCl_4, sl. s. eth., CS_2; i. meth. al., acet.
38	2.587^{25}	....	....	i.	i.	s. H_3PO_4, NH_4OH
39	....	....	....	i.	....	s. H_3PO_4
40	2.769^{25}	$-8H_2O$, 200	....	sl. s.	....	s. min. a., H_3PO_4; i. al.
41	6.4^{15}	1386	....	i.	i.	s. HNO_3
42	....	*ca.* 250	....	anh. 33.5^{11}	....	v. s. al.
43	....	d.	....	d.	....	....
44	2.512	d.	....	v. s.	....	....
45	2.135	....	....	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Cobalt			
1	selenide, mono-	$CoSe$	137.90	hex. yel
2	*ortho*silicate (ous)	Co_2SiO_4	209.94	vlt. cr
3	(di-) silicide	Co_2Si	145.94	gray cr
4	silicide	$CoSi$	87.00	rhomb
5	" , di-	$CoSi_2$	115.06	cub. dk. bluish
6	sulfate (ous)	$CoSO_4$	155.01	hex. and oct. red. powd
7	" "	$CoSO_4 \cdot H_2O$	173.02	red cr
8	" "	$CoSO_4 \cdot 6H_2O$	263.10	monocl. red
9	" " (bieberite)	$CoSO_4 \cdot 7H_2O$	281.12	monocl. red-pink 1.477, 1.483, 1.489
10	" (ic)	$Co_2(SO_4)_3 \cdot 18H_2O$	730.37	bl. need
11	sulfide, mono-	CoS	91.01	oct. reddsh, silver-wh
12	(tri-) sulfide, tetra- (ous, ic)	Co_3S_4	305.08	cub., dk. gray
13	sulfide, sesqui- (ic)	Co_2S_3	214.08	blk. cryst
14	" di-	CoS_2	123.07	cub. blk
15	sulfite (ous)	$CoSO_3 \cdot 5H_2O$	229.08	red
16	tartrate (ous)	$CoC_4H_4O_6$	207.01	monocl. redsh
17	thiocyanate (ous)	$Co(SCN)_2 \cdot 3H_2O$	229.16	rhomb. violet
18	*orthotitanate*	Co_2TiO_4	229.78	cub. grnsh. blk
19	tungstate (ous)	$CoWO_4$	306.86	monoc., bl.-grn
	Cobalt complexes:			
20	Diamminecobalt (II) chloride	$CoCl_2 \cdot 2NH_3$	163.92	rose
21	Diamminecobalt (II) chloride	$CoCl_2 \cdot 2NH_3$	163.92	blue-violet
22	Hexamminecobalt (II) chloride	$[Co(NH_3)_6]Cl_2$	232.05	rose-red oct
23	Aquopentamminecobalt (III) chloride (roseo)	$[Co(NH_3)_5H_2O]Cl_3$	268.49	brick-red cr
24	*cis*-Chloraquotetramminecobalt (III) chloride	$[Co(NH_3)_4(H_2O)Cl]Cl_2$	251.40	rhomb. violet
25	Chloropentamminecobalt (III) chloride (purpureo)	$[Co(NH_3)_5Cl]Cl_2$	250.47	rhomb. dk. red-violet
26	Hexamminecobalt (III) chloride (luteo)	$Co(NH_3)_6Cl_3$	267.50	monocl. or
27	Hexamminecobalt (III) *per*rhenate	$[Co(NH_3)_6](ReO_4)_3 \cdot 2H_2O$	948.09	or.-yel. doubly refracting pr
28	**Columbium**	See *Niobium*		
29	**Copper**	Cu	63.54	Cub. redsh. metal
30	acetate (ic) (neutral verdigris)	$Cu(C_2H_3O_2)_2 \cdot H_2O$	199.64	dk. grn. powd., 1.545, 1.550
31	acetate, basic (blue verdigris	$Cu(C_2H_3O_2)_2 \cdot CuO \cdot 6H_2O$	369.26	grnsh.-bl. powd
32	acetate *meta*arsenate (ic) (Paris green)	$Cu(C_2H_3O_2)_2 \cdot 3Cu(ASO_2)_2$ (approx.)	1013.71	em. grn. powd
33	acetylide (ous)	Cu_2C_2	151.10	amor. red exp
34	(tri-) antimonide	Cu_3Sb	312.38	gray
35	*ortho*arsenate (ic)	$Cu_3(AsO_4)_2 \cdot 4H_2O$	540.50	bluish-grn
36	" , di-H (ic)	$Cu_5H_2(AsO_4)_4 \cdot 2H_2O$	911.39	blue
37	(tri-) arsenide (domeykite)	Cu_3As	265.53	hex
38	arsenide	Cu_5As_2	467.52	oct. bl

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	7.65	red ht.	....	....	....	....
2	4.63	....	....	i.	....	s. dil. HCl
3	7.28	1327	....	....	....	d. a.
4	6.30^{20}	1395	....	....	....	....
5	5.3	1277	....	....	....	....
6	$3.71\frac{25}{25}$	989	....	36.2^{20}	83^{100}	1.04^{18} meth. al.; i. NH_3
7	3.075^{25}	d.	....	s.	s.	....
8	$2.019\frac{15}{15}$	....	....	....	....	....
9	$1.948\frac{25}{25}$	96.8	$-7H_2O$, 420	60.4^{3}	67^{70}	2.5^{3} al.; s. meth. al.
10	....	....	....	s. d.	....	s. H_2SO_4; i. pyr.
11	5.45	>1116	....	0.00038^{18}	....	s. a., al.
12	4.86	....	....	....	....	....
13	4.8	....	....	i.	....	d. a.
14	4.269	....	....	i.	....	s. HNO_3, aq. reg.
15	....	....	....	i.	....	s. H_2SO_3
16	....	....	....	sl. s.	....	s. dil. a.
17	....	$-3H_2O$, 105	....	s.	....	....
18	5.07–.12	....	....	....	....	s. conc. HCl; sl. s. dil. HCl
19	8.42	....	....	i.	....	s. hot conc. acids; sl. s. cold dil. acids
20	2.097	273	....	....	....	....
21	2.073	210 → α	form	....	....	....
22	1.497	....	....	....	....	s. NH_4OH; i. al.
23	1.7^{25}	d. 100	....	16.12^{0}; 24.87^{25}	24.87^{16}	sl. s. HCl; i. al.
24	1.847	d.	....	1.4^{0}	....	s. a.; i. al.
25	$1.819\frac{25}{25}$	d.	....	0.232^{0}; 0.4^{25}	$1.031^{46.6}$	s. conc. H_2SO_4; i. al.
26	1.702	....	....	4.26^{0}	$12.74^{46.5}$	s.conc. HCl; i. al., NH_4OH
27	3.329^{25}	....	....	0.0469	....	....
28	....	....	....	....	....	....
29	8.92	1083	2336	i.	i.	s. HNO_3, h. H_2SO_4; v. sl. s. HCl, NH_4OH
30	1.882; anh. 1.93	115	240 d.	7.2	20	7.14 al.; s. eth.
31	....	....	....	sl. s.	....	s. dil. a., NH_4OH; sl. s. al.
32	....	....	....	i.	....	s. a., NH_4OH; i. al.
33	....	exp.	....	v. sl. s.	....	s. a., KCN
34	8.51	687	....	....	....	....
35	....	....	....	i.	i.	s. a., NH_4OH
36	....	....	....	i.	....	s. a., NH_4OH
37	8.0	830	....	....	....	....
38	7.56	d.	....	i.	i.	s. a., NH_4OH

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Copper			
1	orthoarsenite, hydrogen (?) (ic) (Scheele's green)	$CuHAsO_3$ (?)	187.46	green powd
2	benzoate (ic)	$Cu(C_7H_5O_2)_2 \cdot 2H_2O$	341.79	lt. bl. cr. powd
3	metaborate (ic)	$Cu(BO_2)_2$	149.18	bluish-grn. cr. powd
4	boride	Cu_3B_2	212.26	yellow
5	bromate (ic)	$Cu(BrO_3)_2 \cdot 6H_2O$	427.47	cub. bl.-grn
6	bromide (ous)	$CuBr$ (or Cu_2Br_2)	143.46	cub. tetrah. wh
7	“ (ic)	$CuBr_2$	223.37	monocl. blk., deliq
8	butyrate (ic)	$Cu(C_4H_7O_2)_2 \cdot 2H_2O$	273.76	dk.-grn. cr.; odor butyric a.
9	carbonate (ous)	Cu_2CO_3	187.09	yellow (exist. quest.)
10	“ , basic (ic) (malachite)	$CuCO_3Cu(OH)_2$	221.11	monocl. dk. grn., 1.655, 1.875, 1.909
11	“ , basic (ic) (azurite, chessylite)	$2CuCO_3 \cdot Cu(OH)_2$	344.66	monocl. bl., 1.730, 1.758, 1.838
12	chlorate (ic)	$Cu(ClO_3)_2 \cdot 6H_2O$	338.55	cub. green, deliq
13	chloride (ous) (nantokite)	$CuCl$ (or Cu_2Cl_2)	99.00	cub. wh., 1.93
14	chloride (ic)	$CuCl_2$	134.45	br. yel. powd. hyg
15	“ “	$CuCl_2 \cdot 2H_2O$	170.49	rhomb grn., deliq., β 1.685
16	chromate, basic (ic)	$CuCrO_4 \cdot 2CuO \cdot 2H_2O$	374.66	yel. br
17	*di*chromate (ic)	$CuCr_2O_7 \cdot 2H_2O$	315.59	blk. cryst., deliq
18	citrate (ic)	$2Cu_2C_6H_4O_7 \cdot 5H_2O$	720.42	bluish-grn. powd
19	cyanide (ous)	$CuCN$	89.56	monocl. prisms wh
20	“ (ic)	$Cu(CN)_2$	115.58	yel. grn. powd
21	ethylacetoacetate (ic)	$Cu(C_6H_9O_3)_2$	321.80	grn. need
22	ferricyanide (ous)	$Cu_3Fe(CN)_6$	402.59	br.-red
23	“ (ic)	$Cu_3[Fe(CN)_6]_2 \cdot 14H_2O$	870.76	yel.-grn
24	ferrocyanide (ic) (Hatchett's brown)	$Cu_2Fe(CN)_6 \cdot xH_2O$	......	red-brown
25	fluogallate (ous)	$[Cu(H_2O)_6][GaF_5 \cdot H_2O]$	354.37	monocl. (?), n. 1.45, pale bl
26	fluoride (ous)	CuF (or Cu_2F_2)	82.54	red cr
27	“ (ic)	$CuF_2 \cdot 2H_2O$	137.57	monocl. bl
28	fluosilicate (ous)	Cu_2SiF_6	269.14	red powd
29	“ (ic)	$CuSiF_6 \cdot 4H_2O$	277.66	monocl. pr
30	“ “	$CuSiF_6 \cdot 6H_2O$	313.70	rhomb. bl., deliq., 1.409, 1.408
31	formate (ic)	$Cu(CHO_2)_2$	153.58	monocl. bl.
32	“ “	$Cu(CHO_2)_2 \cdot 4H_2O$	225.64	blue cr
33	glycerine deriv. (ic)	$Cu(C_2H_4NO_2)_2 \cdot H_2O$	229.68	bl. need
34	hydride	CuH (or Cu_2H_2)	64.55	red-br. (exist. quest.)
35	hydroxide (ous)	$CuOH$	80.55	yellow (exist. quest.)
36	“ (ic)	$Cu(OH)_2$	97.56	bl. gel, amor. bl. powd., or bl. cr.
37	iodate (ic)	$Cu(IO_3)_2$	413.38	monocl. grn
38	“ “	$Cu(IO_3)_2 \cdot H_2O$	431.40	tricl. blue
39	“ , basic (ic)	$Cu(OH)IO_3$	255.47	rhomb. grn
40	*para*periodate (ic)	Cu_2HIO_6	351.01	grn. powd. cr
41	iodide (ous) (marshite)	CuI (or Cu_2I_2)	190.46	cub. wh., 2.346, brnsh. wh., or brn.
42	lactate (ic)	$Cu(C_3H_5O_3)_2 \cdot 2H_2O$	277.71	monocl. dk. bl
43	laurate (ic)	$Cu(C_{12}H_{23}O_2)_2$	462.15	lt blue powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	d.	....	i.	i.	s. a., al., NH_4OH
2	....	$-2H_2O$, 110	....	sl. s.	....	s. dil. a.; sl. s. al.
3	3.859	....	....	s.	....	....
4	8.116	....	....	....	....	....
5	2.583	d. 180	$-6H_2O$, 200	v. s.	....	s. NH_4OH
6	4.718	504	1345	v. sl. s.	d.	s. HBr, HCl, HNO_3, NH_4OH; i. acet.
7	....	498	....	v. s.	....	s. al., acet., NH_3, pyr.; i. bz.
8	....	....	....	v. sl. s.	....	s. al., eth., NH_4OH, dil. a
9	4.40	d.	....	i.	i.	s. a., NH_4OH
10	4.0	d. 200	....	i.	d.	0.026 aq. CO_2; s. a., NH_4OH, KCN; i. al.
11	3.88	d. 220	....	i.	d.	s. NH_4OH, h. aq. $NaHCO_3$
12	....	65	d. 100	207^0	v. s.	s. al., acet.
13	3.53	422	1366	0.0062	....	s. HCl, NH_4OH
14	3.054	498	d. to CuCl, 993	70.6^0	107.9^{100}	53^{15} al.; 68^{15} meth. al.
15	2.38	$-2H_2O$, 110	d.	110.4^0	192.4^{100}	s. al., NH_4Cl
16	....	$-2H_2O$, 260	....	i.	....	s. HNO_3, dil. a., NH_4OH; i. al.
17	2.283	$-2H_2O$, 100	....	v. s.	d.	s. a. al., NH_4OH
18	....	....	....	i.	....	s. a., NH_4OH
19	2.92	473 in N_2	d.	i.	i.	s. HCl, NH_4OH, KCN; sl. s. NH_3
20	....	d.	....	i.	....	s. a., alk., KCN, C_5H_5N, pyr.
21	....	192–3	subl.	i.	....	v. s. al., eth.; 10^{80} bz.
22	....	....	....	i.	....	s. NH_4OH; i. HCl
23	....	....	....	i.	....	s. NH_4OH; i. HCl
24	....	....	....	i.	i.	s. NH_4OH; i. a., NH_3
25	2.20	$-5H_2O$, 110°	....	sl. s.	....	s. HF
26	....	908	subl. 1100	i.	....	s. HCl, HF, HNO_3; i. al.
27	2.93	....	....	sl. s.	d.	s. al., HCl, HNO_3, HF; i. acet., NH_3
28	....	....	d. → SiF_4	....	d., 100	....
29	2.158	....	....	42.8	....	....
30	2.207	....	....	232^{17}	....	0.16^{20}, 92 % al.
31	1.831	....	....	12.5	d.	0.25 al.
32	1.81	....	....	6.2	....	....
33	....	$-H_2O$, 130	....	0.57^{15}	....	s. alk.
34	6.29 (6.38)	d. sl. 25°	....	i.	dec.	s. HCl d.
35	3.37	$-\frac{1}{2}H_2O$, 360	....	i.	i.	s. a., NH_4OH
36	3.368	d. $-H_2O$	....	i.	d.	s. a., NH_4OH, KCN
37	5.241^{15}	d.	....	0.1364^{25}	i.	s. dil. HNO_3, H_2SO_4
38	4.872	$-H_2O$, 240	d. 290	0.33^{15}	0.65^{100}	s. NH_4OH, dil. H_2SO_4; i. al., dil. HNO_3
39	4.873	d. 290	....	i.	i.	s. dil. H_2SO_4
40	....	d. 110	....	i.	i.	d. dil. HNO_3
41	5.62	605	1290	0.0008^{18}	....	s. KI, KCN, NH_4OH; i. a., al.
42	....	....	....	16.7	45^{100}	s. NH_4OH; sl. s. al.
43	....	111–13	....	sl. s.	sl. s.	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Copper			
1	nitrate (ic)	$Cu(NO_3)_2 \cdot 3H_2O$	241.60	blue, deliq
2	“ “	$Cu(NO_3)_2 \cdot 6H_2O$	295.65	bl. cr. deliq
3	nitride	Cu_3N	204.63	dk. gr. powd
4	nitrite, basic (ic)	$Cu(NO_2)_2 \cdot 3Cu(OH)_2$	448.22	grn. powd
5	nitroprusside (ic)	$CuFe(CN)_5NO \cdot 2H_2O$	315.52	wh.-grnsh powd
6	oleate (ic)	$Cu(C_{18}H_{33}O_2)_2$	626.43	br.-powd. or grn. bl. mass. pois
7	oxalate (ic)	$CuC_2O_4 \cdot \frac{1}{2}H_2O$	160.57	bl. wh
8	oxide, sub-	Cu_4O	270.16	olive grn. (exist. quest.)
9	“ (ous) (cuprite)	Cu_2O	143.08	oct., cub. red
10	“ (ic) (paramelaconite)	CuO	79.54	tetr. cub. blk. hyg
11	“ “ (tenorite)	CuO	79.54	tricl. blk, β 2.63
12	“ per-	$CuO_2 \cdot H_2O$	113.56	br. or brownish-blk. cr
13	oxychloride (ic) (Brunswick green)	$CuCl_2 \cdot 3CuO \cdot 4H_2O$ (?)	445.14	pa. grn. powd. or em. grn. to grnsh. blk. rhomb.
14	“ “ (atacamite)	$Cu_2(OH)_3Cl$ (or $CuCl_2 \cdot 3Cu(OH)_2$	213.56	orthorhomb. grn
15	palmitate (ic)	$Cu(C_{16}H_{31}O_2)_2$	574.36	grn.-bl. powd
16	2,4-pentanedione deriv. (acetylacetonate)	$Cu(C_5H_7O_2)_2$	261.75	bl.-cr
17	orthophosphate (ic)	$Cu_3(PO_4)_2 \cdot 3H_2O$	434.63	rhomb. bl
18	(tri-) phosphide	Cu_3P	221.60	gray blk
19	“ “ di-	Cu_3P_2	252.58	gray-blk. met. powd
20	salicylate (ic)	$Cu(C_7H_5O_3)_2 \cdot 4H_2O$	409.82	bl.-grn. need
21	selenate (ic)	$CuSeO_4 \cdot 5H_2O$	296.58	tricl. bl
22	selenide (ous)	Cu_2Se	206.04	blk. cub
23	silicide	Cu_4Si	282.22	wh., met
24	stearate (ic)	$Cu(C_{18}H_{35}O_2)_2$	630.46	lt. grn.-bl. amor. powd
25	sulfate (ous)	Cu_2SO_4	223.15	gray powd
26	“ (ic) (hydrocyanite)	$CuSO_4$	159.61	grn. wh. rhomb
27	“ (ic) (blue vitriol or chalcanthite)	$CuSO_4 \cdot 5H_2O$	249.69	tricl. blue, 1.514, 1.537, 1.543
28	sulfide (ous) (chalcocite)	Cu_2S	159.15	rhomb. blk
29	“ “	Cu_2S	159.15	cub. blk
30	“ (ic) (covellite)	CuS	95.61	hex. or monocl. blk
31	sulfite (ous)	$Cu_2SO_3 \cdot H_2O$	225.16	red pr
32	“ “	$Cu_2SO_3 \cdot H_2O$	225.16	hex. wh
33	tartrate (ic)	$CuC_4H_4O_6$	211.61	lt.-bl. powd
34	“ “	$CuC_4H_4O_6 \cdot 3H_2O$	265.66	lt. gray-bl. powd
35	tellurite	$CuTeO_3$	239.15	ppt. siskin grn
36	thiocyanate (ous)	$CuSCN$	121.62	wh
37	“ (ic)	$Cu(SCN)_2$	179.71	black
38	tungstate (ic)	$CuWO_4 \cdot 2H_2O$	347.49	oct. lt. grn

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	$2.04^{3.9}$	114.5	$-HNO_3$, 170	137.8^0; 381^{40}	666^{80}; 1270^{100}	$100^{12.5}$ al.
2	2.074	$-3H_2O$, 26.4	....	243.7^0	∞	s. al.
3	....	d. 300	....	d.	....	d. a.
4	....	....	....	sl. s.	....	s. NH_4OH; sl. s. al.; d. dil. a.
5	....	....	....	i.	....	s. alk.; i. al.
6	....	....	....	i.	i.	s. eth.
7	....	....	....	$.00253^{25}$	....	s. NH_4OH; i. ac. a.
8	....	d.	....	i.	....	d. a.
9	6.0	1235	−O, 1800	i.	i.	s. HCl, NH_4Cl, NH_4OH; sl. s. HNO_3; i. al.
10	6.40	d. 1026	....	i.	i.	s. a., NH_4Cl, KCN
11	6.45	d. 1026	....	i.	i.	s. a., NH_4Cl, KCN
12	....	....	....	i.	....	s. a. d.; i. al.
13	....	$-3H_2O$, 140	....	i.	d. 100	s. a., NH_4OH
14	3.76–3.78	....	....	....	....	....
15	....	120	....	i.	....	s. h. bz., CS_2, CCl_4; sl. s. al., eth., chl., pyr.; i. meth. al., acet.
16	....	>230	subl.	i.	....	sl. s. al.; s. chl.
17	....	....	....	i.	sl. s.	s. a., NH_4OH, H_3PO_4; i. NH_3
18	6.4–6.8	....	....	i.	....	s. HNO_3; i. HCl
19	6.67	d.	....	i.	....	s. HNO_3; i. HCl
20	....	....	....	v. s.	....	v. s. al., NH_4OH
21	2.559	....	....	25.7^{15}	d.	s. a., NH_4OH; i. al.
22	$6.749\frac{30}{4}$	1113	....	....	....	d. HCl
23	7.53	850	....	....	....	d. HNO_3; i. HCl
24	....	125	....	i.	....	s. eth., h. bz., chl., turp.; sl. s. pyr.; i. meth. al., acet. c. bz.
25	....	+O, 200	....	d.	....	s. conc. HCl, NH_3, glac. acet., a.
26	3.603	Slowly d. above 200	d. 650 to CuO	14.3^0	75.4^{100}	1.04^{18} meth. al.; i. al.
27	2.284	$-4H_2O$, 110	$-5H_2O$, 150	31.6^0	203.3^{100}	15.6^{18} meth. al.; i. al.
28	5.6	1100	....	1×10^{-14}	....	s. HNO_3, NH_4OH; i. acet.
29	5.78	1130	....	1×10^{-14}	....	s. HNO_3, NH_4OH; i. acet.
30	4.6	tr. 103	d. 220	0.000033^{18}	....	s. HNO_3, KCN, h. conc. HCl, H_2SO_4; i. al., alk.
31	4.46^{15}	....	....	....	....	....
32	3.83^{15}	d.	....	sl. s.	....	s. NH_4OH, HCl; i. al., eth.
33	....	....	....	v. sl. s.	....	s. a. alk.
34	....	d.	....	0.02^{15}	0.14^{85}	s. a. alk.
35	....	....	....	i.	i.	....
36	2.843	1084	....	0.0005^{18}	....	s. NH_4OH, conc. a., eth.; i. al.
37	....	d. 100	....	d.	d.	s. a., NH_4OH
38	....	red ht.	....	0.1^{15}	....	s. NH_4OH; sl. s. ac. a.; i. al.; d. min. a.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Copper			
1	xanthate (ethylxanthogenate)	$Cu(C_3H_5OS_2)_2$	305.94	yellow ppt
	Copper complexes:			
2	Diamminecopper (II) acetate	$Cu(C_2H_3O_2)_2{\cdot}2NH_3$	215.69	vlt.-bl. cr
3	Tetramminecopper (II) sulfate	$[Cu(NH_3)_4]SO_4{\cdot}H_2O$	245.75	rhomb. bl
4	Tetrapyridinecopper (II) fluosilicate	$[Cu(C_5H_5N)_4]SiF_6$	521.99	rhomb. purplish-blue
5	Tetrapyridinecopper (II) *per*rhenate	$[Cu(C_5H_5N)_4](ReO_4)_2$	880.55	bl. monocl. cr
6	**Cyanic acid** (isocyanic acid)	HOCN (or HNCO)	43.03	
7	**Cyanoauric acid**	$HAu(CN)_4{\cdot}3H_2O$	356.33	tab.
8	**Cyanocobaltic(III) acid** (Cobalticyanic acid)	$[H_3Co(CN)_6]_2H_2O$	454.16	col. need. deliq
9	**Cyanogen**	$(CN)_2$	52.04	col. gas. pungent odor. v. poi
10	**Cyanogen compounds**	See *Organic Tables*		
11	**Deuterium** (heavy hydrogen)	D_2	4.03	col. gas
12	**Dysprosium**	Dy	162.51	
13	acetate	$Dy(C_2H_3O_2)_3{\cdot}4H_2O$	411.66	yel. need
14	bromate	$Dy(BrO_3)_3{\cdot}9H_2O$	708.35	yel. hex. need
15	carbonate	$Dy_2(CO_3)_3{\cdot}4H_2O$	577.01	
16	chloride	$DyCl_3$	268.83	shining yel. pl
17	chromate	$Dy_2(CrO_4)_3{\cdot}10H_2O$	853.11	yel. cr
18	nitrate	$Dy(NO_3)_3{\cdot}5H_2O$	438.56	yel. cr
19	oxalate	$Dy_2(C_2O_4)_3{\cdot}10H_2O$	769.14	pr
20	oxide (dysprosia)	Dy_2O_3	372.92	wh. powd
21	*ortho*phosphate	$DyPO_4{\cdot}5H_2O$	347.52	yellowish white powd
22	selenate	$Dy_2(SeO_4)_3{\cdot}8H_2O$	897.93	yel. need
23	sulfate	$Dy_2(SO_4)_3{\cdot}8H_2O$	757.25	bril. yel. cr
24	**Erbium**	Er	167.20	dk. gray powd
25	acetate	$Er(C_2H_3O_2)_3{\cdot}4H_2O$	416.40	triclinic
26	chloride	$ErCl_3{\cdot}6H_2O$	381.67	deliq
27	nitrate	$Er(NO_3)_3{\cdot}5H_2O$	443.30	redsh. cr
28	oxalate	$Er_2(C_2O_4)_3{\cdot}10H_2O$	778.62	redsh micr. powd
29	oxide (erbia)	Er_2O_3	382.40	rose-red powd
30	sulfate	$Er_2(SO_4)_3$	622.60	
31	"	$Er_2(SO_4)_3{\cdot}8H_2O$	766.73	monocl. rose-red
32	**Europium**	Eu	152.00	st. gray
33	chloride	$EuCl_3$	258.37	fine yel. need
34	oxide (europia)	Eu_2O_3	352.00	pa. rose powd
35	sulfate	$Eu_2(SO_4)_3{\cdot}8H_2O$	736.33	pa. rose cr
36	**Ferric or Ferrous**	See *Iron*		
37	**Ferricyanic acid**	$H_3Fe(CN)_6$	214.98	grn.-br. need. deliq
38	**Ferrocyanic acid**	$H_4Fe(CN)_6$	215.99	wh. need. bl. in moist air
39	**Fluoboric acid**	HBF_4	87.83	col. liq
40	**Fluorine**	F_2	38.00	grn. yel. gas, pois., 1.000195
41	**Fluorophosphoric acid, mono-**	H_2PO_3F (or $(HO)_2POF$)	100.00	col. visc. liq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	d.	....	i.	......	s. NH_4OH; v. sl. s. al.; i. CS_2
2	....	d. *ca.* 175	....	s., d.	......	s. ac. a., NH_4OH; i. al.
3	1.81	d. 150	....	$18.5^{21.5}$	d.	i. al.
4	2.108	....	....	......	......	....
5	2.338	....	....	.5555	......	....
6	1.140^{0}_{0}	....	....	d.	......	....
7	....	50	d.	s.	......	s. al., eth.
8	....	d. 100	....	s.	......	s. al., HCl, dil. HNO_3, dil. H_2SO_4
9	2.335 g/l; 0.9577	−27.9	−20.7	450^{20}cm^3	......	230 cm^3 al.; 500 cm^3 eth.
10	....	....	....	......	......	....
11	....	-254.6^{121}	−249.7	sl. s.	......	....
12	....	....	....	......	......	....
13	....	d. 120	....	s.	......	v. sl. s. al.
14	....	78	$-6H_2O$, 110	v. s.	......	sl. s. al.
15	....	$-3H_2O$, 15	....	i.	......	....
16	3.67^{0}	680	....	s.	......	....
17	....	$-3\frac{1}{2}H_2O$, 150	d.	1.002^{25}	......	....
18	....	88.6	....	s.	......	....
19	....	....	....	i.	......	s. dil. a.
20	7.81^{27}	....	....	......	......	s. a. grn. soln.
21	....	$-5H_2O$, >200	....	i.	......	s. dil. a., ac. a.
22	....	$-8H_2O$, 200	....	v. s.	......	i. al.
23	....	stab. 110	$-8H_2O$, 360	s.	......	....
24	4.77^{15} (?)	....	....	......	......	....
25	2.114	....	....	......	......	....
26	....	....	....	s.	s.	s. al.
27	....	....	....	s.	......	s. al., eth., acet.
28	2.64 (?)	d. 575	....	......	......	....
29	8.640	infus.	....	0.00049^{29}	......	sl. s. min. a.
30	3.678	d. 630	....	43^{0}	......	....
31	3.217	$-8H_2O$, 400	....	16^{20}	6.53^{40}	....
32	....	1150 ± 50	....	i.	i.	....
33	....	623 ± 2	....	......	......	....
34	7.42 fr. oxal.; 6.55 fr. nit.	....	....	......	......	....
35	....	$-8H_2O$, 375	....	2.563^{20}	1.93^{40}	....
36	....	....	....	......	......	....
37	....	d.	....	s.	s.	s. al.
38	....	d.	....	s.	s.	s. al.; i. eth.
39	....	....	d. 130	∞	s.	∞ al.
40	1.69^{15} g/l; lq. 1.108^{-187}	−223	−188	d. to O_3 + HF	d.	....
41	d. 1.818^{25}_{4}	....	....	∞	......	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Fluorophosphoric acid, di-**	HPO_2F_2 (or $HOPOF_2$)	101.99	col. liq., fum
2	**Fluorophosphoric acid, hexa-**	HPF_6	145.99	col. liq., fum
3	**Fluosilicic acid**	H_2SiF_6	144.08	col. liq. fum. corros
4	**Fluosulfonic acid**	HSO_3F	100.07	col. liq
5	**Gadolinium**	Gd	157.26	
6	acetate	$Gd(C_2H_3O_2)_3 \cdot 4H_2O$	406.10	tricl
7	bromide	$GdBr_3 \cdot 6H_2O$	504.74	rhomb. pl
8	chloride	$GdCl_3$	263.27	monocl. pr. col
9	“	$GdCl_3 \cdot 6H_2O$	371.37	wh. pr., deliq
10	fluoride	GdF_3	213.90	wh. gelat
11	nitrate	$Gd(NO_3)_3 \cdot 5H_2O$	433.00	prisms
12	“	$Gd(NO_3)_3 \cdot 6H_2O$	451.02	tricl
13	oxalate	$Gd_2(C_2O_4)_3 \cdot 10H_2O$	758.02	monocl
14	oxide (gadolinia)	Gd_2O_3	361.80	wh. amor powd., hyg
15	selenate	$Gd_2(SeO_4)_3 \cdot 8H_2O$	886.81	monocl. pearly
16	sulfate	$Gd_2(SO_4)_3$	602.00	col
17	“	$Gd_2(SO_4)_3 \cdot 8H_2O$	746.13	monocl
18	sulfide	Gd_2S_3	410.00	yel. hyg. mass
19	**Gallium**	Ga	69.72	rhomb. pseudotetr. gray-bl
20	acetate, basic	$4Ga(C_2H_3O_2)_3 \cdot 2Ga_2O_3 \cdot 5H_2O$	1452.37	micr. cr., wh
21	bromide, tri-	$GaBr_3$	309.47	col. cr., deliq
22	“ , tri-, monammine	$GaBr_3 \cdot NH_3$	326.50	wh. powd
23	“ “ , hexammine	$GaBr_3 \cdot 6NH_3$	411.66	wh. powd
24	*per*chlorate	$Ga(ClO_4)_3 \cdot 6H_2O$	476.19	wh. deliq. cr
25	chloride, di-	$GaCl_2$	140.63	col. cr., deliq
26	“ , tri-	$GaCl_3$	176.09	col. cryst., deliq
27	“ , “, monammine	$GaCl_3 \cdot NH_3$	193.12	wh. powd
28	“ , “, hexammine	$GaCl_3 \cdot 6NH_3$	278.28	wh. powd
29	ferrocyanide	$Ga_4[Fe(CN)_6]_3$	914.75	gel wh. ppt
30	fluoride, tri-	GaF_3	126.72	wh. powd
31	“ , “	$GaF_3 \cdot 3H_2O$	180 77	wh. powd
32	“ , triammine	$GaF_3 \cdot 3NH_3$	177.82	wh. powd
33	hydride (digallane, gallo-ethane	Ga_2H_6	145.49	col. liq
34	hydroxyquinoline deriv.	$Ga(C_9H_6NO)_3$	502.16	grn.-yel. cr
35	iodide, tri-	GaI_3	450.48	col.-lem. yel. (need.) hyg
36	“ “ , monammine	$GaI_3 \cdot NH_3$	467.51	wh. powd
37	“ “ , hexammine	$GaI_3 \cdot 6NH_3$	552.67	wh. powd
38	nitrate	$Ga(NO_3)_3 \cdot xH_2O$	....	wh. cr. deliq
39	nitride	GaN	83.73	dk. gray powd. hex
40	oxalate	$Ga_2(C_2O_4)_3$	403.50	wh. powd
41	“	$Ga_2(C_2O_4)_3 \cdot 4H_2O$	475.56	micr. powd. wh., hyg
42	oxide, sub-	Ga_2O	155.44	br.-blk. powd
43	“ , sesqui-(α)	Ga_2O_3	187.44	trig., micr. cr. wh
44	“ , “ (β)	Ga_2O_3	187.44	β monocl. (?) wh. cr
45	“ , “	$Ga_2O_3 \cdot H_2O$	205.46	orthorhomb., micr. cr., wh
46	“ , (hydrated gallium oxide)	$Ga_2O_3 \cdot xH_2O$	....	gel ppt., indef. compos
47	oxychloride	$6GaOCl \cdot 14H_2O$	979.29	oct
48	2,4-pentanedione deriv. (acetylacetonate)	$Ga(C_5H_7O_2)_3$	367.04	α monocl. or. plates, β rhomb. or. pyramids, γ rhomb. pyramids
49	selenate	$Ga_2(SeO_4)_3 \cdot 16H_2O$	856.58	col. cr

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	d. $1.583\frac{25}{4}$	−75	116	s.	....	....
2	d. *ca.* 1.65 (65 %)	31 ($6H_2O$)	....	....	....	....
3	$1.29\text{–}.31^{15}$	....	d.	s.	s.	sl. s. alk.
4	1.743^{15}	−87.3	165.5	d.	....	....
5	....	....	....	....	....	....
6	1.611	....	....	11.6^{25}	....	....
7	2.844^{15}	....	....	s.	s.	s. HBr
8	4.52^{0}	628	....	s.	s.	....
9	2.424^{0}	....	....	s.	s.	....
10	....	....	....	i.	....	sl. s. hot HF
11	2.406^{15}	92	....	v. s.	v. s.	v. sl. s. conc. HNO_3
12	2.332	91	....	v. s.	v. s.	....
13	....	$-6H_2O$, 110	....	i.	....	s. HNO_3; sl. s. a.; 0.11 *n*—H_2SO_4
14	7.407^{15}	....	....	v. sl. s.	....	s. a.
15	3.309	$-8H_2O$, 130	....	s.	s.	....
16	$4.139^{14.6}$	....	....	3.98^{0}	$2.26^{34.4}$	....
17	$3.010^{14.6}$	....	....	3.28^{20}	2.54^{40}	....
18	3.8	....	....	d.	....	d. a.
19	s. $5.904^{29.6}$; liq. $6.095^{29.8}$	29.78	1983	i.	i.	s. a., alk.
20	....	d.>100	....	s.	d.	i. ac. a.
21	3.69^{25}	121.5 ± 0.6	278.8	s.	s.	sl. s. NH_3
22	3.112^{25}	124	....	d.	d.	sl. s. NH_3
23	....	....	....	d.	d.	sl. s. NH_3
24	....	d. 175	....	v. s.	....	v. s. al.
25	....	170.5	d. 200	d.	d.	s. bz.
26	2.47^{25}; lq. $2.36\frac{80}{80}$	77.9 ± 0.2	201.2	v. s.	v. s.	s. NH_3; sl. s. pet. eth.
27	2.189^{25}	124	....	d.	d.	s. NH_3
28	....	....	....	d.	d.	s. NH_3
29	....	....	d.	s.	s.	i. conc. HCl
30	4.47	>1000	subl. *ca.* 950	.002	....	s. H_2F_2; i. dil. HCl
31	....	>140	d.	i.	sl. s.	s. dil. HCl; sl. s. 50 % HF
32	....	$-NH_3$, 100	....	d.	d.	....
33	....	−21.4	139 (d.>130)	d.	d.	d. a., alk.
34	....	>150	subl. vac.	.0001	.0012	s. a., alk.; sl. s. al.
35	4.15^{25}	212 ± 1	345, subl.	....	d.	....
36	3.635^{25}	140	....	d.	d.	....
37	....	....	....	d.	d.	....
38	....	d. 110	$\rightarrow Ga_2O_3$, 200	v. s.	v. s.	s. abs. al.; i. eth.
39	6.1	....	subl.>800	i.	i.	d. h. a., alk.
40	....	....	d. 195–CO_2	....	....	....
41	....	d. 195	d.>160–H_2O	0.4	....	....
42	4.77	>660	subl.>500	i.	i.	s. a., alk.
43	6.48	tr. to β, 600	....	i.	i.	sl. s. h. a., alk.
44	5.88	1900 (1740)	....	i.	i.	v. sl. s. h. a., alk.
45	5.2	$-H_2O$, 400 tr. to α–Ga_2O_3	....	i.	i.	sl. s. a.; s. alk.
46	....	....	....	.00010	....	.0032 4.6 % NH_4OH; s. a. NaOH
47	....	....	....	i.	....	v. s. KOH; i. dil. HNO_3
48	α1.42; β1.41	194–5	subl. 140^{10}	s.	s.	s. acet.
49	....	....	....	v. s.	v. s.	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Gallium			
1	selenate	$Ga_2(SeO_4)_3 \cdot 22H_2O$	964.67	cr. monocl. or tricl., col
2	selenide, sub-	Ga_2Se	218.40	
3	" , mono-	$GaSe$	148.68	dk. red-br. greasy leaf
4	" , sesqui-	Ga_2Se_3	376.32	rdsh. blk., hard, brittle
5	sulfate	$Ga_2(SO_4)_3$	427.64	wh. powd
6	"	$Ga_2(SO_4)_3 \cdot 18H_2O$	751.93	col. cr
7	sulfide, sub-	Ga_2S	171.51	grn. cr. or blk. powd
8	" , mono-	GaS	101.79	sublimate, lt. yel
9	" , sesqui-	Ga_2S_3	235.64	yel. cr. or wh. amor
10	telluride, mono-	$GaTe$	197.33	soft blk. greasy leaves
11	" , sesqui-	Ga_2Te_3	522.27	hard, blk., brittle cr
	Germane			
12	bromo-	GeH_3Br	155.54	col. liq
13	chloro-	GeH_3Cl	111.08	col. liq
14	chlorotrifluoro-	GeF_3Cl	165.06	col. gas
15	dibromo-	GeH_2Br_2	234.45	col. liq
16	dichloro-	GeH_2Cl_2	145.53	col. liq
17	dichlorodifluoro-	$GeCl_2F_2$	181.51	col. gas
18	tribromo-(germanium bromoform)	$GeHBr_3$	313.36	col. liq
19	trichloro-(germanium chloroform)	$GeHCl_3$	179.98	col. liq
20	trichlorofluoro-	$GeCl_3F$	197.97	col. liq
21	**Germanium**	Ge	72.60	cub. gray-wh. met
22	bromide, di-	$GeBr_2$	232.43	col. need. or pl
23	" , tetra-	$GeBr_4$	392.26	gray-wh. oct
24	chloride, di-	$GeCl_2$	143.51	wh. powd
25	" , tetra-	$GeCl_4$	214.43	col. liq., 1.464
26	fluoride, di-	GeF_2	110.60	wh. cr., hyg
27	" , tetra-	GeF_4	148.60	col. gas or solid, not liq. at atm. press.
28	" "	$GeF_4 \cdot 3H_2O$	202.65	wh. cr., deliq
29	hydride, mono-	GeH	73.61	br. powd
30	" , tetra-(germane)	GeH_4	76.63	col. gas
31	" (digermane)	Ge_2H_6	151.25	liq
32	" (trigermane)	Ge_3H_8	225.86	col. liq
33	imide	$Ge(NH)_2$	102.63	wh. amor. powd
34	iodide, di-	GeI_2	326.44	yel. hex
35	" , tetra-	GeI_4	580.28	cub. yel
36	(tri-) nitride, di-	Ge_3N_2	245.82	blk. cr
37	" " , tetra-	Ge_3N_4	273.83	wh.-lt. br. powd
38	oxide, mono-	GeO	88.60	blk. cr. powd
39	" , di- (soluble)	GeO_2	104.60	hex., col
40	" " (insoluble)	GeO_2	104.60	tetr
41	oxychloride	$GeOCl_2$	159.51	col. liq
42	sulfide, mono-	GeS	104.67	yel.-red amor. or rhomb. bipyram. blk.

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	...	...	...	57.4^{25}	v. s.	...
2	5.02	...	...	...	...	...
3	5.03	960	...	...	...	...
4	4.92	1020	...	...	...	...
5	...	d.>600	d.>520	v. s.	v. s.	s. al.; i. eth.
6	...	...	...	v. s.	v. s.	s. 60% al.; i. al., eth.
7	4.18^{25}	d.>800	...	d.	d.	s. a., alk.
8	3.86^{25}	965 ± 10	...	i.	d.	s. a., alk.
9	3.65^{25}	1255 ± 10	...	d.	d.	s. a., alk.
10	5.44	824	...	...	...	...
11	5.57	790	...	...	...	...
12	$2.34^{29.5}$	−32.0	52.0	d.	d.	reacts like GeH_2Br_2; d. alk.; i. al.
13	1.75^{-52}	−52.0	28.0	d.	d.	d. alk.; i. al.
14	...	−66.2	−20.3	d.	...	s. abs. al.
15	2.80^{0}	−15.0	89.0	d.	d.	d. alk.; i. al.
16	1.90^{-68}	−68.0	69.5	d.	d.	d. alk.; i. al.
17	...	−51.8	−2.8	d.	...	s. abs. al.
18	...	−24.0	d.	d.	d.	d. alk.
19	1.93^{0}	−71.0	75.2	d.	d.	d. alk.
20	...	−49.8	37.5	d.	...	s. abs. al.
21	5.35^{20}_{20}	958.5	(2700)	i.	i.	s. h. H_2SO_4, aq. reg.; i. alk.
22	...	122.0	d.	d.	d.	s. a., $GeBr_4$, al.; i. bz.
23	3.132^{29}_{29}	26.1	186.5	d.	d.	s. abs. al., eth., bz.; i. conc. H_2SO_4
24	...	d. to Ge	+ $GeCl_4$	d.	d.	s. $GeCl_4$; i. al., chl.
25	1.879^{20}_{20}	−49.5	83.1	d.	d.	v. s. dil. HCl; s. al., eth.; i. conc. H_2SO_4, conc. HCl
26	...	d.>350	subl.	s.	v. s.	...
27	6.65 g/l	subl.	...	s. d. to	GeO_2 +	H_2GeF_6
28	...	d.	...	s.	s.	...
29	...	d. 165	sl. exp.	i.	i.	s. HNO_3, H_2O_2; i. NaOH
30	3.43 g/l; lq. 1.532^{-142}	−165.0	−90.0 (−126)	i.	i.	s. NaOCl; sl. s. h. HCl
31	g. 6.74^{20} g/l; lq. 1.98^{-109}	−109	29	d.	...	...
32	2.2	−105.6	110.5	i.	...	s. CCl_4
33	...	d. 150	...	d. to NH_3	+ GeO_2	...
34	...	subl., d.	...	s.	d.	s. dil. a., conc. HI; sl. s. chl., CCl_4
35	4.322^{26}_{26}	144.0	d.	s., with slow hydrolysis	d.	s. CS_2, CCl_4, bz.; sl. s. conc. HCl, KOH
36	...	...	subl.>650	...	...	...
37	...	d. 450	...	i.	i.	i. a., alk.
38	...	subl. 710	...	i.	i.	s. Cl_2 water or H_2O_2 with NH_4OH; i. a., alk.
39	4.703^{18}	1115.0	...	0.447^{25}	1.0^{100}	s. a., alk.; one form i. H_2O, HCl, HF, NaOH, NH_4OH
40	6.239	1086 ± 5	...	i.	...	sl. s. NaOH; i. HF, HCl
41	...	−56.0	d.>20	d.	d.	i. all solv.
42	(am.) 3.31; rhomb. 4.01^{14}_{14}	530	subl.>430	i.	i.	s. HCl, alk., or alk. sulfd.; sl. s. NH_4OH

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Germanium			
1	sulfide, di-	GeS_2	136.73	wh. powd. orthorhombic, white
2	**Glucinum**	See *Beryllium*		
3	**Gold**	Au	197.0	cub. yel. duct. met., coll. bl. vlt
4	bromide (ous)	$AuBr$	277.12	yelsh.-gray mass or cr. powd
5	" (ic)	$AuBr_3$ (or Au_2Br_6)	436.95	gray powd., cr. brown
6	chloride (ous)	$AuCl$	232.66	yel. cr
7	" (ic)	$AuCl_3$ (or Au_2Cl_6)	303.57	claret red, pr. cr
8	cyanide (ous)	$AuCN$	223.22	lt. yel. cr. powd
9	" (ic) (cyanoauric acid)	$Au(CN)_3 \cdot 3H_2O$ (or $HAu(CN)_4 \cdot 3H_2O$)	329.30	col. hyg. pl
10	iodide (ous)	AuI	324.12	grnsh.-yel. powd
11	" (ic)	AuI_3	577.96	dk. grn
12	nitrate, hydrogen, (ic) (nitratoauric acid)	$AuH(NO_3)_4 \cdot 3H_2O$ (or $H[Au(NO_3)_4] \cdot 3H_2O$)	500.29	tricl. oct. yel
13	oxide, (ous)	Au_2O	410.40	gray-violet (exist. quest.)
14	" "	$Au_2O \cdot xH_2O$		dk. vlt. (exist. quest.)
15	" (ic)	Au_2O_3	442.40	br.-blk. powd
16	" (ic)	$Au_2O_3 \cdot xH_2O$		yel.-br. powd
17	phosphide	Au_2P_3	487.34	gray
18	selenide	Au_2Se_3	631.28	
19	sulfide (ous)	Au_2S	426.47	br.-blk. powd
20	" (ic)	Au_2S_3	490.60	br.-blk. powd
21	telluride	Au_2Te	522.01	tricl. (exist. quest.)
22	" , di-	$AuTe_2$	452.42	(1) rhomb. (2) monocl. (3) tricl. yel., earthy to massive
23	**Hafnium**	Hf	178.60	gray
24	carbide	HfC	190.61	
25	oxide, (di-) (hafnia)	HfO_2	210.60	cubic (?) wh
26	oxychloride	$HfOCl_2 \cdot 8H_2O$	409.64	col
27	**Helium**	He	4.003	col. gas, inert, odorl
28	**Holmium**	Ho	164.94	salts yellow
29	**Hydrazine**	NH_2NH_2	32.05	col. liq. or wh. cr., 1.470^{22}
30	azide	$N_2H_4 \cdot HN_3$	75.08	deliq
31	fluogermanate	$2N_2H_4 \cdot H_2GeF_6$	252.71	monocl. pr., 1.452, 1.460, 1.464
32	fluosilicate	$N_2H_4 \cdot H_2SiF_6$	176.12	cryst
33	formate	$N_2H_4 \cdot 2CH_2O_2$	124.10	cub
34	hydrate	$N_2H_4 \cdot H_2O$	50.06	col. fum. liq. or cub. cr
35	hydrochloride, mono-	$N_2H_4 \cdot HCl$	68.51	wh. need
36	" , di-	$N_2H_4 \cdot 2HCl$	104.98	cub. col
37	nitrate, mono-	$N_2H_4 \cdot HNO_3$	95.06	col. dimorph. need
38	" , di-	$N_2H_4 \cdot 2HNO_3$	158.08	col. cr
39	oxalate	$2N_2H_4 \cdot H_2C_2O_4$	154.13	wh. need
40	*hypo*phosphate	$N_2H_4 \cdot 2H_2PO_3$	194.04	
41	*ortho*phosphate	$N_2H_4 \cdot H_3PO_4$	130.05	
42	*ortho*phosphite	$N_2H_4 \cdot H_3PO_3$	114.05	
43	*ortho*phosphite	$N_2H_4 \cdot 2H_3PO_3$	196.06	
44	picrate	$N_2H_4 \cdot HC_6H_2N_3O_7 \cdot \frac{1}{2}H_2O$	270.16	
45	selenate	$N_2H_4 \cdot H_2SeO_4$	177.02	col. cr. powd

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.94^{14}	*ca.* 800	subl. >600	sl. s.; d. sly.	d. to $GeO_2 + H_2S$	s. alk., alk. sulfd.; i. a., al., eth., etc.
2	...	...	...	...	...	...
3	19.3; lq. 17.0^{1063}	1063	2600	i.	i.	s. KCN, aq. reg., h. H_2SeO_4; i. a.
4	7.9	d. 115	...	i.	i.	d. a.
5	...	$-Br_2$, 160	...	sl. s.	...	s. eth.
6	7.4	d. to $AuCl_3$, 170	d. 289.5	d., v. sl. s.	d.	s. HCl, HBr
7	3.9	254 d.	subl. 265	68	v. s.	s. al., eth.; sl. s. NH_3; i. CS_2
8	7.12	d.	...	v. sl. s.	...	s. KCN, NH_4OH; i. al., eth.
9	...	d. 50	...	v. s.	d. v. s.	s. al., eth.
10	8.25	d. 120	...	v. sl. s.	sl. s. d.	s. KI
11	...	...	...	i.	d.	s. iodides
12	2.84	72 d.	...	s. d.	...	s. HNO_3
13	3.6	−O, 205	...	i.	i.	s. HCl; sl. s. KOH; i. H_2SO_4, HNO_3, al.
14	...	$-H_2O$, 200	...	s.	...	s. d. alk.
15	...	−O, 160	−3O, 250	i.	i.	s. HCl
16	...	$-1\frac{1}{2}H_2O$, 250	...	5.7×10^{-11} at 25	...	s. HCl, NaCN, conc. HNO_3
17	6.67	d.	...	...	...	i. HCl, dil. HNO_3
18	4.65^{22}	...	...	...	...	...
19	...	d. 240	...	i.; fresh soln.	ppt. coll.	i. a.; s. KCN, aq. reg.
20	8.754	d. 197	...	i.	...	s. Na_2S; i. a., eth.
21	9.04	...	...	...	...	...
22	8.2–9.3	472, d.	...	i.	i.	...
23	13.3	1700	Computed >3200	i.	...	...
24	...	3887	...	...	...	...
25	9.68	2810	...	i.	...	...
26	...	...	...	s.	...	...
27	0.1785^{0} g/l; lq. $0.147^{-270.8}$	-272.2^{26atm}	−268.9	0.94^{0} cm³; 0.94^{25} cm³	1.05^{50}cm³; 1.21^{75}cm³	abs. by Pt; i. al.
28	...	...	...	...	...	...
29	lq. 1.011^{15}	1.4	113.5	v. s.	...	s. al.
30	...	75.4	...	v. s.	v. s.	v. s. al.
31	$2.406\frac{25}{25}$	...	...	s.	...	...
32	...	d. 186	...	v. s.	...	sl. s. al.
33	...	128	...	s.	...	...
34	1.03^{21}	<-40	118.5^{740}	∞	∞	s. al.; i. eth., chl.
35	...	89	...	v. s.	...	sl. s. al.
36	1.42	198	...	270.4^{23}	v. s.	sl. s. al.
37	...	70.7	subl. 140	v. s.	...	sl. s. al.
38	...	104 d.	...	v. s.	...	...
39	...	148	...	200^{35}	...	$.0003^{22}$ al.; i. eth.
40	...	152	...	...	...	...
41	...	82	...	...	...	...
42	...	36	...	...	...	...
43	...	82	...	...	...	...
44	...	201.3	...	s.	s.	...
45	...	...	...	v. sl. s.	v. s.	...

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Hydrazine			
1	sulfate	$2N_2H_4 \cdot H_2SO_4$	162.18	col. cr
2	“	$N_2H_4 \cdot H_2SO_4$	130.13	rhomb. col
3	**Hydrazoic acid** (azoimide)	HN_3	43.03	col. liq
4	**Hydrogen**	H_2	2.016	col. gas, cub. solid
5	antimonide (stibine)	H_3Sb	124.78	col. gas
6	arsenide (solid)	H_2As_2 (or HAs)	151.84	brown powd
7	“ (arsine)	H_3As	77.93	col. gas
8	bismuthide (bismuthine)	H_3Bi	212.02	liq
9	bromide (hydrobromic acid) (Stibine)	HBr	80.92	col. gas or pa. yel. liq., 1.325 lq
10	bromide	$HBr \cdot H_2O$	98.94	col. liq
11	“ (const.-boiling mixt.)	$HBr\ (47\%) + H_2O$		col. liq
12	“	$HBr \cdot 2H_2O$	116.96	wh. cr. col. liq
13	chloride (hydrochloric acid)	HCl	36.47	col. gas or col. pois. fum. liq.; 1.256 lq.
14	“ (const.-boiling mixt.)	$HCl\ (20.24\%) + H_2O$		col. liq
15	“	$HCl \cdot H_2O$	54.48	col. liq
16	“	$HCl \cdot 2H_2O$	72.50	col. liq
17	“	$HCl \cdot 3H_2O$	90.51	col. liq
18	cyanide (hydrocyanic acid)	HCN	27.03	col. liq. or gas, pois., 1.2675^{10} liq
19	fluoride (hydrofluoric acid)	HF (or H_xF_x)	20.01	col. fum. corros. liq. or gas
20	“ (const.-boiling mixt.)	$HF\ (35.35\%) + H_2O$		col. liq
21	iodide (hydriodic acid)	HI	127.93	col. gas or pa. yel. liq., 1.466 liq
22	“ (const.-boiling mixt.)	$HI\ (57\%) + H_2O$		col. or pa. yel., fum. liq
23	“	$HI \cdot 2H_2O$	163.96	col. liq
24	“	$HI \cdot 3H_2O$	181.98	col. liq
25	“	$HI \cdot 4H_2O$	199.99	col. liq
26	oxide (water)	H_2O (or $(H_2O)_x$)	18.02	col. liq. or hex. col. cr., liq. 1.333, sld. 1.309, 1.313
27	“ , per-	H_2O_2	34.02	col. liq., 1.414^{22} liq
28	phosphide (phosphine)	H_3P	34.00	col. pois. spon. infl. gas or col. liq., 1.317 liq.
29	“	H_4P_2	65.99	col. liq
30	“	$(H_2P_4)_3$	377.81	yel. solid
31	selenide	H_2Se	80.98	col. gas
32	sulfide	H_2S	34.08	col. infl. gas, offen. odor 1.374 liq
33	“ , di-	H_2S_2	66.15	yel. oil, 1.885
34	“ , tri-	H_2S_3	98.21	bright yel. liq
35	“ , penta-	H_2S_5	162.35	clear yel. oil
36	telluride	H_2Te	129.63	col. gas or yel. need
37	**Hydroxylamine**	NH_2OH	33.03	wh. need. or col. liq., $1.440^{23.5}$ (lq.), deliq.
38	fluogermanate	$2NH_2OH \cdot H_2GeF_6 \cdot 2H_2O$	290.71	monocl. pr. 1.418, 1.438, 1.443

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	85	....	v. s.	....	i. al.
2	1.37	254	....	3.05^{32}	v. s.	i. al.
3	....	−80	37	∞	∞	s. al., alk.
4	.0899 g/l; lq. .070	−259.14	−252.8	2.14^{0} cm³, 1.91^{25} cm³	0.85^{80} cm³, 1.89^{50} cm³	6.925^{0} cm³ al.
5	liq. 2.26^{-25}; 5.30^{0} g/l	−88	−17	20 cm³	4 cm³	1500 cm³ al., 2500 cm³ CS_2
6	....	d. 200	....	i.	i.	s. KOH; i. al., eth., CS_2
7	3.484 g/l	−113.5	−55; d. 230	20 cm³	sl. s.	sl. s. al., alk.
8	....	....	22	....	....	....
9	3.50^{0} g/l; lq. 2.77^{-67}	−88.5	−67.0	221^{0}	130^{100}	s. al.
10	1.78	stable	−3.3 to −15.5 bet. 1 and 2.5 atm.			
11	1.49	−11	126	....	....	....
12	2.11^{-15}	−11	....	s.	s.	....
13	1.639^{0} g/l; lq. 1.194^{-86}	−112	−83.7	82.3^{0} g	56.1^{60} g	327 cm³ al.; s. eth., bz.
14	....	....	110	....	....	....
15	1.48	−15.35	....	∞	∞	s. al.
16	lq. $1.46^{18.3}$	−17.7	d.	∞	....	s. al.
17	....	−24.4	d.	∞	....	s. al.
18	.901 g/l; $.699^{20}$; 0.6884 lq.	−14	26	∞	∞	∞ al., s. eth.
19	.921 g/l; lq. .987	−92.3	19.4	∞	v. s.	....
20	....	....	120	....	....	....
21	5.66^{0} g/l; lq. $2.85^{-4.7}$	−50.8	-35.38^{4} atm.	42.500^{10} cm³	v. s.	s. al.
22	1.70^{15}	....	127^{774}	....	....	....
23	....	−43	....	∞	....	....
24	....	−48	....	∞	....	....
25	....	−36.5	....	∞	....	....
26	$1.000\frac{4}{4}$; s. 9168^{0}	0.000	100.000	....	....	∞ al.
27	$1.4649\frac{0}{4}$	−89	152.1	∞	....	s. al., eth.; i. pet. eth.
28	1.529^{0} g/l; lq. $.746^{-90}$	−133.5	−87.4	26^{17} cm³	i.	s. al., eth., Cu_2Cl_2
29	1.012	<−10	57.5^{735}	i.	i.	s. al., turp.
30	1.83^{19}	ign. 160	d.	i.	i.	i. al.; s. P, P_2H_4
31	3.614 g/l; lq. 2.12^{-42}	−64	−42	377^{4} cm³	$270^{22.5}$ cm³	s. CS_2, $COCl_2$
32	1.539^{0} g/l; lq. 96	−82.9	−61.80	437^{0} cm³	186^{40} cm³	9.54^{20} cm³ al.; s. CS_2
33	1.376	−88	74.5	d.	....	s. bz., CS_2; i. al.
34	1.496^{15}	−52	d. 90	....	....	....
35	1.67^{18}	d.	....	....	....	....
36	5.81 g/l; lq. 2.57^{-20}	−51	−4; 0	s. (unst.)	....	s. al., alk.
37	1.204	33.05	56.5^{22}	s.	d.	s. a., al., meth. al.; v. sl. s. eth., chl., bz., CS_2
38	$2.229\frac{25}{25}$	....	....	s.	....	s. abs. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Hydroxylamine			
1	fluosilicate	$2NH_2OH \cdot H_2SiF_6 \cdot 2H_2O$	246.17	scales
2	hydrochloride	$NH_2OH \cdot HCl$	69.50	monocl. col
3	nitrate	$NH_2OH \cdot HNO_3$	96.05	wh.
4	sulfate	$2NH_2OH \cdot H_2SO_4$	164.15	monocl. col
5	**Indium**	In	114.82	tetr. silv. wh. soft metal
6	bromide, mono-	$InBr$	194.68	red-br. solid
7	" , di-	$InBr_2$	274.59	pa. yel. solid
8	" , tri-	$InBr_3$	354.51	wh. to yel. need., deliq.
9	*per*chlorate	$In(ClO_4)_3 \cdot 8H_2O$	557.26	col. deliq. cr
10	chloride, mono-	$InCl$	150.22	(1) yel. or (2) dk. red, deliq
11	" , di-	$InCl_2$	185.67	wh. cr., deliq
12	" , tri-	$InCl_3$	221.13	wh. pl., deliq
13	cyanide	$In(CN)_3$	192.81	wh. ppt
14	fluoride	InF_3	171.76	
15	"	$InF_3 \cdot 3H_2O$	225.81	cr
16	"	$InF_3 \cdot 9H_2O$	333.90	wh. need
17	hydroxide	$In(OH)_3$	165.78	wh. ppt
18	iodate	$In(IO_3)_3$	639.52	wh. cr
19	iodide, mono-	InI	241.68	br.-red solid
20	" , di-	InI_2	368.60	
21	" , tri-	InI_3	495.52	yel. cr. deliq
22	nitrate	$In(NO_3)_3 \cdot 3H_2O$	354.83	deliq. pl
23	"	$In(NO_3)_3 \cdot 4\frac{1}{2}H_2O$	381.86	need., deliq
24	oxide, sub-	In_2O	245.52	blk. cr
25	" , mon-	InO	130.76	wh.-gray
26	" , sesqui-	In_2O_3	277.52	red-br., hot; pa. yel., cold; amor. and trig.
27	selenate	$In_2(SeO_4)_3 \cdot 10H_2O$	838.56	deliq. cr
28	sulfate	$In_2(SO_4)_3$	517.72	wh.-gray powd. monocl. pr., hyg.
29	"	$In_2(SO_4)_3 \cdot 9H_2O$	679.86	
30	" , di-H	$In_2(SO_4)_3 \cdot H_2SO_4 \cdot 7H_2O$	741.91	rhomb
31	sulfide, sub-	In_2S	261.59	yel. to blk. need
32	" , mono-	InS	146.83	dk.
33	" , sesqui-	In_2S_3	325.72	red cr. or yel. ppt
34	sulfite, basic	$2In_2O_3 \cdot 3SO_2 \cdot 8H_2O$	891.37	cr
35	**Iodic acid**	HIO_3	175.93	rhomb. col. or pa. yel. cr. powd
36	" " , metaper-	HIO_4	191.93	col
37	" " , *ortho*paraper-	H_5IO_6 (or $HIO_4 \cdot 2H_2O$)	227.96	monocl. wh., deliq
38	**Iodine**	I_2	253.82	rhomb. vlt.-blk., met. lust., 3.34
39	azide (iod(o)azide)	IN_3	168.94	yellow, exp
40	bromide, mono-	IBr	206.84	dk. gray cr
41	" , tri-	IBr_3	366.67	dr. br. liq
42	chloride, mono-(α-)	ICl	162.38	cub. need. dk. red; oily red-br. liq.
43	chloride, mono-(β-)	ICl	162.38	rhomb., 6 sided pl., brn.-red

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	v. s.	....	i. al.
2	1.67^{17}	151	d.	83^{17}	v. s.	s. al., meth. al., glyc.; i. eth.
3	....	48	d.<100	v. s.	d.	v. s. al.
4	....	170	d.	32.9^{0}	68.5^{90}	s. eth.; sl. s. al.
5	7.30	156.4	2000 ± 10	i.	i.	s. a.; v. sl. s. NaOH
6	4.96^{25}	220	662, subl.	d.	....	s. a.
7	4.22^{25}	235	632, subl.	d.	....	s. a.
8	4.74^{25}	436 ± 2	subl. easily	v. s.	....	....
9	....	*ca.* 80	d. 200	v. s.	d.	s. abs. al.; sl. s. eth.
10	4.19^{25} (yel.); 4.18^{25} (red)	225 ± 1	550 (608)	d.	d.	s. a.
11	3.655^{25}	235	550–70	d.	d.	....
12	4. (3.46)	586; subl. <400	volat. 600	v. s.	v. s.	sl. s. al., eth.
13	....	....	....	unst.	....	s. HCN; v. sl. s. NaOH; i. dil. a.
14	4.39^{25} ± 0.01	1170 ± 10	>1200	....	....	....
15	....	$-3H_2O$, 100	....	86.4	....	s. a.; i. al., eth.
16	....	d.	....	sl. s.	d.	s. HCl, HNO_3; i. al., eth.
17	....	$-H_2O$, <150	....	i.	....	s. a.; v. sl. s. NaOH; i. NH_4OH
18	....	....	d.	0.067^{20}	....	s. dil. H_2SO_4, HNO_3
19	5.31	351	711–15	....	slowly d.	s. dil. a.; i. al., eth., chl.
20	4.71^{25}	212	....	....	....	s. a.
21	4.69	210 ± 2(199)	....	s. unst.	s.	s. a., chl., bz., xylene
22	....	$-2H_2O$, 100	d.	v. s.	....	s. al.
23	....	$-4\frac{1}{2}H_2O$, 100	d.	v. s.	s.	s. al.
24	6.99^{25}	subl. in vac. 656–700	....	....	....	s. HCl
25	....	....	....	i.	....	s. a.
26	7.179	d. 850	volat.	i.	....	amor. s. a.; cr. i. a.
27	....	....	....	v. s.	....	....
28	3.438	....	....	s.	v. s.	....
29	....	....	d. 250	v. s.	....	....
30	....	$-H_2SO_4 + 7H_2O$ *ca.* 250	....	s.	....	....
31	5.87^{25}	653 ± 5	....	....	....	....
32	5.18^{25}	692 ± 5	subl. in vac. 850	....	....	s. HCl, HNO_3
33	4.90	1050	subl. *ca.* 850 in high vac.	i.	....	s. a.; sl. s. Na_2S
34	....	$-3H_2O$, 100	$-8H_2O$, 260	i.	....	s. a.
35	4.629^{0}	110	....	286^{0}	472^{80}	v. s. 87 % al.; sl. s. HNO_3; i. abs. al., eth., chl.
36	....	....	subl. 110	v. s.	....	....
37	....	d. 140	....	v. s.	v. s.	s. al., eth.
38	4.93	113.7	184.35	0.029^{20}	0.078^{50}	20.5^{15} al., 20.6^{17} eth.; s. chl., glyc., KI, CS_2
39	....	....	....	s. d.	....	s. $Na_2S_2O_3$
40	4.4157^{0}	(42); subl. 50	116	s. d.	....	s. al., eth., chl., CS_2
41	....	....	....	s.	....	s. al.
42	3.1822^{0}	27.2	97.4	d. to HIO_3 ± Cl		s. HCl, al., eth., CS_2
43	lq. 3.24^{34}	13.92	97.4	d.	....	s. HCl, al., eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Iodine			
1	chloride, tri-	ICl_3	233.29	rhomb. yel.-br. red, deliq
2	cyanide	ICN	152.94	wh. cr
3	fluoride, penta-	IF_5	221.92	col. liq
4	" , hepta-	IF_7	259.92	col. cr. or liq
5	oxide, di- (or tetr-)	IO_2 (or I_2O_4)	158.92	lem. yel. cr
6	" , pent-	I_2O_5	333.84	trim. wh
7	(tetra-) oxide, non-	I_4O_9	651.68	yel. powd., hyg
8	**Iodoplatinic acid**	$H_2PtI_6 \cdot 9H_2O$	1120.91	monocl. blk., deliq
9	**Iodous acid, hypo-** (iodine hydroxide)	HOI	143.93	only in soln., yel. to grnsh
10	**Iridium**	Ir	192.2	cub., silv. wh. met
11	bromide, tri-	$IrBr_3 \cdot 4H_2O$	504.91	olv. grn. cr
12	" , tetra-	$IrBr_4$	512.76	bl., deliq
13	chloride, di-	$IrCl_2$	264.01	blk.-grn. cr. (exist. quest.)
14	" , tri-	$IrCl_3$	299.47	olv. grn
15	" , tetra-	$IrCl_4$	334.93	dk.-br.-amor., hyg
16	fluoride, hexa-	IrF_6	307.10	yel. glass or tetr
17	iodide, tri-	IrI_3	573.86	grn
18	" , tetra-	IrI_4	700.78	blk
19	oxide, sesqui-	Ir_2O_3	434.20	bl.-blk. (exist. quest.)
20	" "	$Ir_2O_3 \cdot xH_2O$	......	olive grn
21	" , di-	IrO_2	225.10	tetr. blk
22	" , "	$IrO_2 \cdot 2H_2O$ (or $Ir(OH)_4$)	261.13	indigo-bl
23	sulfate	$Ir_2(SO_4)_3 \cdot xH_2O$	......	yel. pr
24	sulfide, mono-	IrS	225.17	bl.-blk
25	" , sesqui-	Ir_2S_3	482.40	br. blk
26	" , di-	IrS_2	257.22	br
27	" , hydro-	$Ir(HS)_3 \cdot 2H_2O$	328.35	choc. br
28	**Iron,** pure (*See under Alloys*)	Fe	55.85	cub. silv. metal
29	acetate (ous)	$Fe(C_2H_3O_2)_2 \cdot 4H_2O$	246.00	need
30	" , basic (ic)	$FeOH(C_2H_3O_2)_2$	190.95	br.-red powd
31	*ortho*arsenate (ous)	$Fe_3(AsO_4)_2 \cdot 6H_2O$	553.47	grn. amor. powd
32	" (ic) (scorodite)	$FeAsO_4 \cdot 2H_2O$	230.79	rhomb. grn. 1.765, 1.774, 1.797
33	arsenide	$FeAs$	130.76	wh
34	" , di- (arsenoferrite)	$FeAs_2$	205.67	cub. silv. gray
35	*ortho*arsenite, basic (ic)	$2FeAsO_3 \cdot Fe_2O_3 \cdot 5H_2O$	607.30	br.-yel. powd
36	*pyro*arsenite (ous)	$Fe_2As_2O_5$	341.52	grn.-wh
37	benzoate (ic)	$Fe(C_7H_5O_2)_3$	419.18	br. powd
38	boride	FeB	66.67	gray cr
39	bromide (ous)	$FeBr_2$	215.68	hex. grn.-yel
40	" (ic)	$FeBr_3$ (or Fe_2Br_6)	295.60	dk. red-br., deliq
41	" "	$FeBr_3 \cdot 6H_2O$	403.70	red
42	cacodylate (ic)	$Fe[(CH_3)_2AsO_2]_3$	466.78	yelsh. amor. powd
43	carbide	Fe_3C	179.56	cub. gray
44	carbonate (ous) (siderite)	$FeCO_3$	115.86	trig. gray, 1.875, 1.633
45	" "	$FeCO_3 \cdot H_2O$	133.88	amor
46	carbonyl, tetra-	$Fe(CO)_4$	167.89	dk. grn. lust. cr
47	" , nona-	$Fe_2(CO)_9$	363.79	or. hex. cr
48	" , penta-	$Fe(CO)_5$	195.90	visc. yel. liq
49	*per*chlorate (ous)	$Fe(ClO_4)_2 \cdot 6H_2O$	362.86	grn

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.117^{15}	$101^{16\text{ atm.}}$	77 d.	s. d.	...	s. bz., CCl_4, al., eth., ac. a.
2	...	...	...	sl. s.	sl. s.	s. al., eth.
3	3.5	−8	97	d.	d.	d. a., alk.
4	liq. 2.8^{6}	5.5	4.5 subl.	v. s., d.	d.	d. a., alk.
5	$4.2\frac{16}{10}$	d. sly. 75; rap. 130	...	d. to $HIO_3 \pm I_2$		s. H_2SO_4; sl. s. acet.; i. al., eth.
6	4.799^{25}	d. 300–50	...	187.4^{13}	...	sl. s. dil. al.; i. abs. al. eth., chl., CS_2
7	...	75 d.	...	...	...	...
8	...	<100	...	v. s. d.	...	...
9	...	...	...	...	...	...
10	22.421	2454	>4800	i.	i.	amor. s. aq. reg.; i. a., aq. reg.
11	...	$-3H_2O$, 100	...	v. s.	...	i. al.
12	...	d.	...	s. d.	...	s. al.
13	...	d. 773	...	s.	...	i. a., alk.
14	5.30	d. 763	...	i.	...	i. a., alk.
15	...	d.	...	s.	d.	s. al., dil. HCl
16	6.0	44.4 (30)	53	d.	d.	...
17	...	...	...	sl. s.	s.	sl. s. al.
18	...	d. 100	...	i.	i.	s. KI; i. al.
19	...	−O, 400	...	i.	...	s. H_2SO_4, h. HCl; i. alk.
20	...	d.	...	i.	...	s. a., alk.
21	3.15	d.	...	i.	i.	i. a., alk.
22	...	$-2H_2O$, 350	...	i.	i.	s. HCl
23	...	d.	...	s.	...	...
24	...	d.	...	i.	...	s. K_2S; i. a.
25	...	d.	...	sl. s.	...	s. HNO_3, K_2S
26	...	d. 300	...	i.	...	s. aq. reg.; i. a.
27	...	d.	...	i.	...	s. HNO_3
28	7.86	1535	3000	i.	i.	s. a.; i. al., alk., eth.
29	...	d.	...	v. s.	...	...
30	...	...	...	i.	...	s. a., al.
31	...	d.	...	i.	i.	s. dil. HCl; sl. s. NH_4OH
32	3.18	d.	...	i.	i.	s. HCl; i. HNO_3
33	7.83	1020	...	v. sl. s.	...	...
34	7.4	990	...	i.	...	sl. s. HNO_3; i. HCl
35	...	d.	...	sl. s.	...	s. a., alk.
36	...	...	...	i.	...	s. NH_4OH
37	...	...	...	i.	...	s. h. eth., al.
38	7.15^{18}	...	...	i.	...	s. HNO_3, h. conc. H_2SO_4
39	4.636^{25}	d.	...	109^{10}	170^{95}	s. al.
40	...	subl. d.	...	s.	s.	s. al., eth.; sl. s. NH_3
41	...	27	...	v. s.	v. s.	...
42	...	...	...	6.67	...	sl. s. al.
43	7.4	1837	...	i.	i.	s. a.
44	3.8	d.	...	0.0067^{25}	...	s. CO_2 soln.
45	...	d.	...	sl. s.	...	s. a., CO_2 soln.
46	1.996^{18}	d. 140–50	...	i.	...	s. org. solv.
47	2.085^{18}	d. 100	...	...	...	...
48	lq. 1.457	−21	102.8^{749}	i.	...	s. conc. H_2SO_4, alk. al., eth., bz.
49	...	d.>100	...	97.8^{0}	116.1^{60}	86.5^{20} al.; s. $HClO_4$

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Iron			
1	chloride (ous) (lawrencite)	$FeCl_2$	126.76	hex. grn. to yel., deliq
2	“ “	$FeCl_2\cdot 2H_2O$	162.80	
3	“ “	$FeCl_2\cdot 4H_2O$	198.83	monocl. bl. grn., deliq
4	“ (ic) (molysite)	$FeCl_3$ (or Fe_2Cl_6)	162.22	hex. blk.-br
5	“ “	$FeCl_3\cdot 6H_2O$	270.32	br. yel. v. deliq., cr. mass
6	chloroplatinate (ous)	$FePtCl_6\cdot 6H_2O$	571.92	yel. hex
7	*di*chromate (ic)	$Fe_2(Cr_2O_7)_3$	759.76	red-br. gran
8	citrate (ic)	$FeC_6H_5O_7\cdot 3H_2O$	299.00	red.-br. scales
9	ferricyanide (ous)	$Fe_3[Fe(CN)_6]_2$(?)	591.47	deep bl
10	“ (ic) (Berlin green)	$Fe[Fe(CN)_6]$	267.81	cub
11	ferrocyanide (ous)	$Fe_2Fe(CN)_6$	323.66	amor. bl.-wh
12	“ (ic)	$Fe_4[Fe(CN)_6]_3$	859.27	dk. bl. cr
13	fluoride (ous)	FeF_2	93.85	
14	“ “	$FeF_2\cdot 4H_2O$	165.91	
15	“ “	$FeF_2\cdot 8H_2O$	237.98	grn.-bl
16	“ (ic)	FeF_3 (or Fe_2F_6)	112.85	rhomb. grn
17	“ “	$FeF_3\cdot 4\frac{1}{2}H_2O$	193.92	yel. cr
18	fluosilicate (ous)	$FeSiF_6\cdot 6H_2O$	306.01	trig. col., 1.364, 1.385
19	“ (ic)	$Fe_2(SiF_6)_3$	537.88	gel. flesh color
20	formate (ic)	$Fe(CHO_2)_3$	190.90	cr., red powd
21	glycerophosphate (ic)	$Fe_3[C_3H_5(OH)_2PO_4]_3$	677.75	yelsh.-grn. scales or powd
22	hydroxide (ous)	$Fe(OH)_2$	89.87	hex. pa. grn. or wh. amor
23	“ (goethite)	$FeO(OH)$	88.86	rhomb., blksh. br
24	iodide (ous)	FeI_2	309.69	hex. gray
25	“ “	$FeI_2\cdot 4H_2O$	381.75	gray-blk. cr., deliq
26	lactate (ous)	$Fe(C_3H_5O_3)_2\cdot 3H_2O$	288.04	grn.-wh. cr. or powd
27	“ (ic)	$Fe(C_3H_5O_3)_3$	323.06	br. amor., deliq
28	malate (ic)	$Fe_2(C_4H_4O_5)_3$	507.92	br. hyg. scales
29	methanearsonate (ic)	$Fe_2(CH_3AsO_3)_3$	525.53	redsh.-br. lust. scales
30	nitrate (ous)	$Fe(NO_3)_2\cdot 6H_2O$	287.96	rhomb. gr
31	“ (ic)	$Fe(NO_3)_3\cdot 6H_2O$	349.97	cub
32	“ “	$Fe(NO_3)_3\cdot 9H_2O$	404.02	monocl. col.-pa. vlt., deliq
33	nitride	Fe_2N (or Fe_4N_2)	125.71	gray
34	“	Fe_4N	237.41	
35	oleate (ic)	$Fe(C_{18}H_{33}O_2)_3$	900.18	br.-red fatty lumps
36	oxalate (ous)	$FeC_2O_4\cdot 2H_2O$	179.90	rhomb. pa. yel
37	“ (ic)	$Fe_2(C_2O_4)_3\cdot 5H_2O$	465.84	yel. microcr. powd
38	oxide (ous)	FeO	71.84	blk
39	“ (ferrosoferric) (magnetite)	Fe_3O_4	231.55	cub. blk.; red-blk. powd
40	“ (ferrosoferric)	$Fe_3O_4\cdot xH_2O$		blk
41	“ (ic) (hematite)	Fe_2O_3	159.70	hex. red br. to blk., 3.01, 2.94 (Li)
42	“ “	$Fe_2O_3\cdot xH_2O$		red-br. amor. powd. or gelat
43	2,4-pentanedione deriv. (ic) (acetylacetonate)	$Fe(C_5H_7O_2)_3$	353.17	deep red rhomb
44	*ortho*phosphate (ous) (vivianite)	$Fe_3(PO_4)_2\cdot 8H_2O$	501.64	monocl. wh.-bl., 1.579, 1.603, 1.633
45	*ortho*phosphate (ic)	$FePO_4\cdot 2H_2O$	186.86	yel.-wh., dimorph
46	*pyro*phosphate (ic)	$Fe_4(P_2O_7)_3\cdot 9H_2O$	907.42	yel.-wh. powd
47	phosphide, mono-	FeP	86.83	rhomb
48	(di-) phosphide	Fe_2P	142.68	bl.-gray cr. or powd
49	(tri-) “	Fe_3P	198.53	gray
50	*hypo*phosphite (ic)	$Fe(H_2PO_2)_3$	250.84	wh. or gray-wh. powd
51	*meta*silicate (ous)	$FeSiO_3$	131.91	monocl

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of: Cold water	Hot water	Alcohol, acids, etc.
1	2.98	670–4	subl.	64.4^{10}	105.7^{100}	100 al.; s. acet.; i. eth.
2	2.358	......	......	......	......	......
3	1.93	......	......	160.1^{10}	415.5^{100}	s. al.
4	2.804^{11}	282	315	74.4^{0}	535.7^{100}	v. s. al., eth., 63^{18} acet.
5	......	37	280–5	91.9^{20}	∞	s. al., eth.
6	2.714	d.	......	v. s.	v. s.	......
7	......	......	......	s.	......	s. a.
8	......	......	......	s.	s.	i. al.
9	......	d.	......	i.	......	i. al., dil. a.
10	......	......	......	......	......	......
11	......	......	......	i.	......	......
12	......	d.	......	i.	i.	s. HCl, H_2SO_4; i. al., eth.
13	3.95–4.33	>1000 (?)	......	sl. s.	......	i. al., eth.
14	2.095	......	......	......	......	......
15	......	$-8H_2O$, 100	......	sl. s.	s.	s. a., HF; i. al., eth.
16	3.18	......	......	sl. s.	s.	s. a.; i. al., eth.
17	......	$-3H_2O$, 100	d.	sl. s.	s.	i. al.
18	1.961	......	......	128.2	......	......
19	......	......	......	s	s. d.	......
20	......	......	......	s.	......	v. sl. s. al.
21	......	......	......	50^{25}	......	i. al.
22	3.4	d.	......	0.00067	......	s. a., NH_4Cl; i. alk.
23	4.28	......	......	......	......	......
24	5.315	592	......	s.	......	......
25	2.87	90–8	......	v. s.	d.	s. al., eth.
26	......	d.	......	2.1^{10}	8.5^{100}	s. alk. citrate; v. sl. s. al.
27	......	......	......	s.	v. s.	i. eth.
28	......	......	......	s.	......	s. al.
29	......	......	......	50	......	i. al., eth.
30	......	60.5 d.	......	70.9^{0}; 83.5^{20}	166.7^{61}	......
31	......	35	......	s.	......	......
32	1.684	47.2	d.	s.	s.	s. al., acet.; sl. s. HNO_3
33	6.35	d. 200	......	i.	......	s. HCl, H_2SO_4
34	6.57 (?)	......	......	......	......	......
35	......	......	......	i.	......	s. a. al., eth.
36	2.28	d. 160	......	0.022	0.026	s. a.
37	......	d. 100	......	v. s.	v. s.	s. a.; i. al.
38	5.7	1420	......	i.	i.	s. a.; i. al., alk.
39	5.18	1538 d.	......	i.	i.	sl. s. a.; i. al., eth.
40	......	d.	......	i.	i.	s. a.
41	5.24	1565	......	i.	......	s. HCl
42	3.4–3.9	$-1\frac{1}{2}H_2O$, 500	......	i.	i.	s. a.; i. al., eth.
43	......	184	......	i.	......	s. al., bz., chl.; sl. s. eth.
44	2.58	......	......	i.	i.	s. a.; i. ac. a.
45	2.87	d.	......	v. sl. s.	0.67^{100}	s. HCl, H_2SO_4
46	......	......	......	i.	......	s. a., alk. citrates
47	6.07 (5.2^{20})	......	......	......	......	......
48	6.56	1290	......	i.	i.	s. aq. reg., $HNO_3 + HF$; i. dil. a.
49	6.74	1100	......	i.	......	......
50	......	d.	......	0.043^{25}	0.083^{100}	s. alk. citrate
51	3.5	1550	......	......	......	......

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Iron			
1	silicide	$FeSi$	83.91	yel.-gray; oct
2	sulfate (ous)	$FeSO_4 \cdot H_2O$	169.93	monocl
3	" "	$FeSO_4 \cdot 4H_2O$	223.98	grn. monocl. pr
4	" " (siderotil)	$FeSO_4 \cdot 5H_2O$	242.00	wh. tricl., $\alpha = 1.526$, $\beta = 1.536$, $\gamma = 1.542$
5	" " (melanterite)	$FeSO_4 \cdot 7H_2O$	278.03	monocl. bl.-grn., 1.471, 1.478, 1.486
6	" (ic)	$Fe_2(SO_4)_3$	399.90	rhomb. yel
7	" " (coquimbite)	$Fe_2(SO_4)_3 \cdot 9H_2O$	562.04	rhomb., deliq., 1.552, 1.558
8	sulfide (ous) (troilite)	FeS	87.92	hex. blk.-br
9	" (ferrosoferric)	Fe_3S_4	295.81	hex., (exist. quest.)
10	" (ic)	Fe_2S_3	207.90	yel.-grn
11	" , di- (marcasite)	FeS_2	119.98	rhomb. yel
12	" " (pyrite)	FeS_2	119.98	cub. yel
13	sulfite (ous)	$FeSO_3 \cdot 3H_2O$	189.96	grnsh. or wh. cr
14	*d*-tartrate (ous)	$FeC_4H_4O_6$	203.92	cr
15	thiocyanate (ous)	$Fe(SCN)_2 \cdot 3H_2O$	226.07	rhomb. grn
16	" (ic)	$Fe(SCN)_3$ (or $Fe_2(SCN)_6$)	230.10	cub. blk.-red. deliq
17	thiosulfate (ous)	$FeS_2O_3 \cdot 5H_2O$	258.06	grn. cr. deliq
18	*meta*vanadate (ic)	$Fe(VO_3)_3$	352.70	grayish-br. powd
19	**Krypton**	Kr	83.80	col. inert gas
20	**Lanthanum**	La	138.92	lead-gray met
21	acetate	$La(C_2H_3O_2)_3 \cdot 1\frac{1}{3}H_2O$	343.08	
22	boride, hexa-	LaB_6	203.84	cub. red. purple metallic
23	bromate	$La(BrO_3)_3 \cdot 9H_2O$	684.81	hex. pr
24	bromide	$LaBr_3 \cdot 7H_2O$	504.78	col. cr
25	carbide	LaC_2	162.94	yel. cryst
26	carbonate	$La_2(CO_3)_3 \cdot 8H_2O$	602.00	trimet. wh
27	chloride	$LaCl_3$	245.29	wh. deliq. cryst
28	"	$LaCl_3 \cdot 7H_2O$	371.40	tricl. wh., hyg
29	hexaantipyrine *per*chlorate	$[La(C_{11}H_{12}N_2O)_6] \cdot (ClO_4)_3$	1566.62	col. hex. cr
30	hydroxide	$La(OH)_3$	189.94	wh. powd
31	iodate	$La(IO_3)_3$	663.68	col
32	iodide	LaI_3	519.68	
33	molybdate	$La_2(MoO_4)_3$	757.69	tetr
34	nitrate	$La(NO_3)_3 \cdot 6H_2O$	433.04	col. deliq
35	oxalate	$La_2(C_2O_4)_3 \cdot 9H_2O$	704.04	wh
36	oxide (lanthana)	La_2O_3	325.84	amor. or rhomb. wh
37	sulfate	$La_2(SO_4)_3$	566.04	wh. powd., hyg
38	"	$La_2(SO_4)_3 \cdot 9H_2O$	728.18	hex. col
39	sulfide	La_2S_3	374.04	red-yel. cr
40	**Lead**	Pb	207.21	cub. silv. bl.-wh. soft met
41	acetate	$Pb(C_2H_3O_2)_2$	325.30	wh. cr
42	"	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	379.35	monocl. wh., β 1.576
43	"	$Pb(C_2H_3O_2)_2 \cdot 10H_2O$	505.46	rhomb. cr
44	" , basic	$Pb_2OH(C_2H_3O_2)_3$	608.56	wh
45	" "	$Pb(C_2H_3O_2)_2 \cdot Pb(OH)_2 \cdot 2H_2O$	602.56	monocl. wh
46	" "	$Pb(C_2H_3O_2)_2 \cdot 2Pb(OH)_2 \cdot 2H_2O$	843.78	wh. micr. need

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	6.1	....	....	i.	i.	i. aq. reg.
2	2.99–3.08	....	....	....	....	....
3	2.23–.29	....	....	....	....	....
4	2.2	$-5H_2O$, 300	....	s.	s.	i. al.
5	1.898	64; $-6H_2O$, 100	$-7H_2O$, 300	15.65	48.6^{50}	i. al.
6	3.097^{18}	d. 480	....	sl. s.	d.	i. H_2SO_4, NH_3
7	2.1	d.	....	440	d.	s. abs. al.
8	4.84	1193	d.	.00062^{18}	....	s. a., ev. H_2S; i. NH_3
9	4.55	....	....	i.	....	s. a.
10	4.3	d.	....	v. sl. s., d.	to FeS+S	d. a.
11	4.87	tr. 450	d.	0.00049	....	s. HNO_3; i. dil. a.
12	5.00	1171	d.	0.00049	....	s. HNO_3; i. dil. a.
13	....	d. 250	....	v. sl. s.	....	s. SO_2 soln.; i. al.
14	....	....	....	0.877^{16}	....	....
15	....	d.	....	v. s.	....	s. al., eth., acet.
16	....	d.	....	s.	v. s.	s. al., eth.
17	....	....	....	v. s.	d.	v. s. al.
18	....	....	....	i.	....	s. a.; i. al.
19	3.708^{0} g/l; lq. 2.155$^{-152.9}$	156.6	−152.9	11.0^{0} cm^3; 6.0^{25} cm^3	4.67^{50} cm^3	....
20	6.15	826	....	d. to $La(OH)_3$	d.	s. a.
21	....	....	....	16.88^{25}	....	....
22	2.61	2210	d.	i.	i.	i. HCl
23	....	37.5	$-7H_2O$, 100	28.5^{15}	....	i. al.
24	5.057^{25} anh.	anh. 783 ± 3	....	v. s.	....	v. s. al.; i. eth.
25	5.02	....	....	d.	d.	s. H_2SO_4; i. conc. HNO_3
26	....	....	....	i.	....	s. dil. a.; sl. s. aq. CO_2; i. acet.
27	3.842^{25}	872 (860)	....	v. s.	d.	v. s. al., pyr.; i. eth., bz.
28	....	d. 91	....	v. s.	v. s.	v. s. al.
29	....	290–5 d.	....	1.50^{20}	....	....
30	....	d.	....	i.	....	s. a.
31	....	....	....	1.7^{25}	....	....
32	5.057^{25}	761 ± 2	....	....	....	....
33	4.77^{16}	1181	....	sl. s.	....	....
34	....	40	d. 126	151.1^{25}	v. s.	v. s. al.; s. acet.
35	....	d.	....	.00008^{25}	....	....
36	6.51	2315	4200	0.0004^{29}	d.	s. a., NH_4Cl; i. acet.
37	3.60^{15}	d. 1150	....	3.0	0.69^{100}	sl. s. al.; i. acet.
38	2.821	d.	....	3.8^{0}	0.87^{100}	sl. s. HCl, al.
39	4.997^{0}_{0}; 4.911^{11}	2100–2150 vac.	....	d.	d.	s. a.
40	11.3437^{16} 11.288^{20}_{20} Ra Pb 11.2960^{16} U Pb	327.43	1620	i.	i.	s. HNO_3, h. conc. H_2SO_4
41	3.25	280	....	19.7^{0}	221^{50}	s. glyc.; v. sl. s. al.
42	2.55	75	....	45.61^{15}	200^{100}	i. al.
43	1.69	22	....	s.	....	i. al.
44	....	....	....	v. s.	....	sl. s. al.
45	....	....	....	v. s.	....	v. s. al.
46	....	....	....	5.55	18.2	s. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Lead			
1	acetate, tetra-	$Pb(C_2H_3O_2)_4$	443.39	monocl.
2	*di*antimonate	$Pb_2Sb_2O_7$	769.94	dk. yel. powd.
3	*ortho*arsenate	$Pb_3(AsO_4)_2$	899.45	wh. cr.; v. pois.
4	" , di-	$PbHAsO_4$	347.13	monocl. leaf, α 1.90, γ 1.97
5	" , mono-	$Pb(H_2AsO_4)_2$	489.06	tricl., 1.74, 1.82
6	*pyro*arsenate	$Pb_2As_2O_7$	676.24	rhomb., β 2.03
7	*meta*arsenate	$Pb(AsO_3)_2$	453.03	hex. tabl.
8	*ortho*arsenite	$Pb_3(AsO_3)_2 \cdot xH_2O$	....	wh. powd.
9	*meta*arsenite	$Pb(AsO_2)_2$	421.03	wh. powd.
10	azide	$Pb(N_3)_2$	291.26	col. need.
11	benzoate	$Pb(C_7H_5O_2)_2 \cdot H_2O$	467.45	wh. cr. powd.
12	*meta*borate	$Pb(BO_2)_2 \cdot H_2O$	310.87	cr. wh. powd.
13	bromate	$Pb(BrO_3)_2 \cdot H_2O$	481.06	monocl. col.
14	bromide	$PbBr_2$	367.04	rhomb. wh.
15	caprate	$Pb(C_{10}H_{19}O_2)_2$	549.71	
16	caproate	$Pb(C_6H_{11}O_2)_2$	437.51	
17	caprylate	$Pb(C_8H_{15}O_2)_2$	493.61	wh. leaf
18	carbonate (cerussite)	$PbCO_3$	267.22	rhomb. col., 1.804, 2.076, 2.078
19	" , basic (white lead, hydrocerussite)	$2PbCO_3 \cdot Pb(OH)_2$	775.67	wh. hex. or amor. powd., 2.09, 1.94.
20	cerotate	$Pb(C_{26}H_{51}O_2)_2$	998.55	wh. need. fr. bz.
21	chlorate	$Pb(ClO_3)_2$	374.12	monocl. wh.
22	"	$Pb(ClO_3)_2 \cdot H_2O$	392.14	monocl. wh., deliq.
23	*per*chlorate	$Pb(ClO_4)_2 \cdot 3H_2O$	460.17	rhomb.
24	chloride (cotunnite)	$PbCl_2$	278.12	rhomb. wh., 2.199, 2.217, 2.260
25	" , tetra-	$PbCl_4$	349.04	yel. oily liq.
26	" sulfide	$PbCl_2 \cdot 3PbS$	995.95	red
27	chlorite	$Pb(ClO_2)_2$	342.12	monocl. yel.
28	chromate (crocoite, chrome yellow)	$PbCrO_4$	323.22	monocl. yel., 2.31, 2.37 (Li), 2.66
29	chromate, basic	$Pb_2(OH)_2CrO_4$	564.45	red, amor. or cr.
30	" , " (chrome red)	$PbCrO_4 \cdot PbO$	546.43	red cr. powd.
31	*di*chromate	$PbCr_2O_7$	423.23	red cr.
32	citrate	$Pb_3(C_6H_5O_7)_2 \cdot 3H_2O$	1053.88	wh. cr. powd.
33	cyanate	$Pb(OCN)_2$	291.25	wh. need.
34	cyanide	$Pb(CN)_2$	259.25	yelsh.-wh. pois. powd.
35	enanthate	$Pb(C_7H_{13}O_2)_2$	465.56	wh. leaf
36	ferricyanide	$Pb_3[Fe(CN)_6]_2 \cdot 5H_2O$ (or $6H_2O$)	1135.65	blk.-brn. to red, monocl. pr.
37	ferrite	$PbFe_2O_4$	382.89	hexag.
38	ferrocyanide	$Pb_2Fe(CN)_6 \cdot 3H_2O$	680.43	yelsh.-wh. powd.
39	fluoride	PbF_2	245.21	col.
40	fluosilicate	$PbSiF_6 \cdot 2H_2O$	385.30	monocl. col.
41	"	$PbSiF_6 \cdot 4H_2O$	421.33	monocl.
42	formate	$Pb(CHO_2)_2$	297.25	rhomb. wh. lust, 1.789, 1.852, 1.877.
43	hydroxide	$Pb(OH)_2$ (indef.)	241.23	wh. amor.
44	"	$Pb_2O(OH)_2$ (or $2PbO \cdot H_2O$)	464.44	cub. or wh. amor. powd.
45	iodate	$Pb(IO_3)_2$	557.05	wh.
46	*paraper*iodate	$PbHIO_5$	415.14	cryst.
47	"	$PbHIO_5 \cdot H_2O$	433.15	amor.
48	iodide, mono-	PbI	334.13	pa. yel.
49	" , di-	PbI_2	461.05	hex. yel. powd.
50	isobutyrate	$Pb(C_4H_7O_2)_2$	381.40	wh. pr.
51	laurate	$Pb(C_{12}H_{23}O_2)_2$	605.82	chalky white powd.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.228^{17}	175	...	d.	...	d. al.; s. chl., hot ac. a.
2	6.72	...	...	i.	i.	v. sl. s. HCl
3	7.30	1042; sl. d. 1000	...	v. sl. s.	...	s. HNO_3
4	5.79	d.>200	$-H_2O$, 280	i.	sl. s.	s. HNO_3, caust. alk.
5	4.46^{15}	d. 140	...	d.	...	s. HNO_3
6	6.85	802	...	i.	d.	s. HCl, HNO_3; i. ac. a.
7	6.42^{15}	...	...	d.	d.	s. HNO_3
8	5.85	...	...	i.	...	s. HNO_3, alk.
9	5.85	...	...	i.	...	s. HNO_3
10	...	exp. 350	...	0.023^{18}	0.09^{70}	v. s. ac. a.; i. NH_4OH
11	...	$-H_2O$, 100	...	0.16^{20}	$0.31^{49.5}$	...
12	5.598 anh.	...	$-H_2O$, 160	i.	i.	s. a.; i. alk.
13	5.53	d. 180	...	1.38^{20}	...	...
14	6.66	373	916	0.4554^{0}; 0.8441^{20}	4.71^{100}	s. a., KBr; sl. s. NH_3; i. al.
15	...	103–4	...	i.	i.	0.00290^{20} eth.
16	...	73–4	...	...	...	1.09^{25} eth.
17	...	83.5–84.5	...	i.	i.	s. al.; 0.0938^{20} eth.
18	6.6	d. 315	...	0.00011^{20}	d.	s. a., alk.; i. al., NH_3
19	6.14	d. 400	...	i.	i.	sl. s. aq. CO_2
20	...	112.5–3.5	...	i.	...	i. al., eth.
21	3.89	d.	...	v. s.	...	s. al.
22	4.037	d. 110	...	151.3^{18}	171^{80}	s. al.
23	2.6	d. 100	...	499.7^{25}	...	s. al.
24	5.85	501	950	0.673^{0}; 0.99^{20}	3.34^{100}	sl. s. dil. HCl, NH_3; i. al.
25	3.18^{0}	−15	exp. 105	d. ev. Cl_2	d.	s. conc. HCl
26	...	...	...	i.	d.	d. a., alk.; i. dil. a.
27	...	exp. 126	...	0.095^{20}	0.42^{100}	s. KOH
28	6.3 (6.12^{15})	844	d.	$.0000058^{25}$	i.	s. a., alk.; i. ac. a., NH_3
29	...	920	...	i.	...	1.019 100 ml. 2 *N* KOH
30	...	...	...	i.	i.	s. a., alk.
31	...	...	...	d.	...	s. a., alk.
32	...	...	...	s.	...	...
33	...	d.	...	i.	sl. s.	...
34	...	...	...	sl. s.	s.	s. KCN
35	...	79–80	...	...	sl. s.	i. al.
36	1.037^{0} (satd.-soln.)	$-H_2O$, 110–120, d.	...	sl. s.	s., d. 100	s. HNO_3, alk.
37	...	1530; d.>725	...	...	...	...
38	...	$-H_2O$, 100	...	i.	...	sl. s. H_2SO_4
39	8.24	855	1290	0.064^{20}	...	s. HNO_3; i. acet., NH_3
40	...	d.	...	s.	v. s.	...
41	...	<100, d.	...	...	...	...
42	4.63	d. 190	...	1.6^{16}	20^{100}	i. al.
43	...	d. 145	...	0.0155^{20}	sl. s.	s. a., alk.; i. acet.
44	7.592	d. 145	...	.014	sl. s.	s. HNO_3, alk., ac. a.
45	...	d. 300	...	0.0012^{2}	0.003^{25}	sl. s. HNO_3; i. NH_3
46	...	d. 130	...	i.	i.	s. dil. HNO_3
47	...	$-H_2O$, 110	...	i.	i.	sl. s. dil. HNO_3
48	...	d. 300	...	.01	...	...
49	6.16	402 (393)	954 (900)	$.044^{0}$; 0.063^{20}	0.41^{100}	s. alk., KI; i. al.
50	...	<100	...	9.1^{16}	...	...
51	...	104.7	...	0.009^{35}	...	0.008^{25} al.; $0.007^{14.5}$ eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Lead			
1	lignocerate	$Pb(C_{24}H_{47}O_2)_2$	942.44	wh. powd
2	melissate	$Pb(C_{31}H_{61}O_2)_2$	1138.81	wh. powd
3	molybdate (wulfenite)	$PbMoO_4$	367.16	tetra pl
4	myristate	$Pb(C_{14}H_{27}O_2)_2$	661.92	wh. powd
5	2-naphthalenesulfonate	$Pb(C_{10}H_7SO_3)_2$	621.65	wh. cr. powd., pois
6	nitrate	$Pb(NO_3)_2$	331.23	cub. or monocl. col., 1.782
7	“ , basic	$Pb(OH)NO_3$	286.23	rhomb. cr
8	oleate	$Pb(C_{18}H_{33}O_2)_2$	770.10	wh. powd
9	oxalate	PbC_2O_4	295.23	heavy, wh. powd
10	oxide, sub-	Pb_2O	430.42	amor. blk
11	“ mono- (litharge)	PbO	223.21	tetr. yel., 2.665 (Li), 2.535 (Li)
12	“ “ (massicot)	PbO	223.21	rhomb. yel., 2.51, 2.61 (Li), 2.71
13	“ , red (minium)	Pb_3O_4	685.63	cr. sc. or red amor. powd
14	“ , sesqui-	Pb_2O_3	462.42	amor. or.-yel. powd
15	“ , di- (plattnerite)	PbO_2	239.21	tetr. br., ω 2.3 (Li)
16	oxychloride (matlockite)*	$PbCl_2\cdot Pb(OH)_2$	519.35	tetr. wh., 2.04, 2.15, 2.15
17	“ (laurionite)	$PbCl_2\cdot Pb(OH)_2$	519.35	rhomb
18	“ (paralaurionite)	$PbCl_2\cdot PbO\cdot H_2O$	519.35	monocl., pr., col. to wh., 2.146
19	“ (mendipite)	$PbCl_2\cdot 2PbO$	724.54	rhomb. yel., 2.24, 2.27, 2.31
20	“	$PbCl_2\cdot 3PbO$	947.75	yel
21	“ (Cassel yellow)	$PbCl_2\cdot 7PbO$	1840.59	yel. cr., or powd
22	palmitate	$Pb(C_{16}H_{31}O_2)_2$	718.03	chalky wh. powd
23	*ortho*phosphate	$Pb_3(PO_4)_2$	811.59	hex. col. or wh. powd., 1.970, 1.936
24	*ortho*phosphate, di-	$PbHPO_4$	303.20	rhomb. monocl. (?)
25	“ , mono-	$Pb(H_2PO_4)_2$	401.28	need
26	*pyro*phosphate	$Pb_2P_2O_7$	588.38	rhomb. wh
27	“	$Pb_2P_2O_7\cdot H_2O$	606.40	rhomb
28	*meta*phosphate	$Pb(PO_3)_2$	365.17	col. cr
29	*ortho*phosphite	$PbHPO_3$	287.20	wh. powd
30	picrate	$Pb(C_6H_2N_3O_7)_2\cdot H_2O$	681.43	yel. need
31	selenate	$PbSeO_4$	350.17	wh. rhomb
32	selenide (clausthalite)	$PbSe$	286.17	cub
33	*meta*silicate (alamosite)	$PbSiO_3$	283.27	monocl. col. or wh
34	sulfate (anglesite)	$PbSO_4$	303.28	monocl. or rhomb. wh., 1.877, 1.882
35	“ , basic (lanarkite)	$PbSO_4\cdot PbO$	526.49	monocl. wh., 1.93, 1.99, 2.02
36	*peroxydi*sulfate	$PbS_2O_8\cdot 3H_2O$	453.39	deliq
37	sulfate, hydrogen	$Pb(HSO_4)_2\cdot H_2O$	419.37	cr
38	sulfide (galena)	PbS	239.28	cub. bl. met. 3.912
39	sulfite	$PbSO_3$	287.28	wh. powd
40	stearate	$Pb(C_{18}H_{35}O_2)_2$	774.13	wh. powd
41	tartrate	$PbC_4H_4O_6$	355.28	wh. cr. powd
42	telluride (altaite)	$PbTe$	334.82	wh. cub
43	thiocyanate	$Pb(SCN)_2$	323.38	monocl. wh

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* PbFCl is also called matlockite.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	117	....	i.	....	v. s. boil. bz.; sl. s. al.; i. eth.
2	....	115–16	....	i.	i.	s. boil. tol., ac. a.; sl. s. h. bz., chl.; i. al., eth.
3	6.03–7.01	1060–70	....	i.	....	d. conc. H_2SO_4; s. a., KOH; i. al.
4	....	107	....	0.005^{35}	0.006^{50}	0.004^{25} al.; $0.010^{14.5}$ eth.
5	....	....	....	i.	....	s. al.
6	4.53^{20}	d. 470	....	37.65^{0}; 56.5^{20}	127^{100}	8.77^{22} 43 % al.; s. NH_3, alk.
7	5.93	180 d.	....	$19.4^{19.2}$	s.	s. a.
8	....	....	....	i.	....	6.46^{20} eth.; s. pet. eth.; sl. s. al.
9	5.28	d. 300	....	0.00016^{18}	....	s. HNO_3; i. al.
10	8.342	d.	....	i.	i.	s. a., alk.
11	9.53	888	....	0.0017^{20}	....	s. HNO_3, alk., lead acet., NH_4Cl, $CaCl_2$, $SrCl_2$
12	8.0	....	....	0.0023^{22}	i.	s. alk.
13	9.1	d. 500	....	i.	i.	s. ac. a., h. HCl; i. al.
14	....	d. 370	....	i.	d.	d. a. to Pb salts + PbO_2
15	9.375	d. 290	....	i.	i.	s. dil. HCl; sl. s. ac. a.; i. al.
16	7.21	d. 524	....	0.0095^{18}	....	s. alk.
17	6.24	d. 142	....	....	....	....
18	6.05^{15}	d. 150	....	....	....	....
19	7.08	693	....	i.	i.	s. alk.
20	....	....	....	0.0056^{18}	0.07^{74}	....
21	....	....	....	i.	....	....
22	....	112.3	....	0.005^{35}	0.007^{50}	s. al., 0.148^{20} eth.
23	6.9–7.3	1014	....	0.000014^{20}	i.	s. HNO_3, alk.; i. ac. a.
24	5.661^{15}	d.	....	....	....	s. HNO_3, KOH, NaOH, NH_4Cl
25	....	....	....	....	....	s. KOH, NaOH, dil. HNO_3, h. conc. HCl; i. 50 % acet. a.
26	5.8	824	....	i.	i.	s. HNO_3, KOH
27	....	806 anh.	....	i.	d.	s. HNO_3, KOH, $Na_4P_2O_7$
28	....	800 (?)	....	v. sl. s.	....	....
29	....	d.	....	i.	i.	s. HNO_3
30	2.831^{20}	$-H_2O$, 130	expl.	0.88^{15}	....	....
31	6.37	d.	....	i.	i.	s. conc. a.
32	8.10^{15}	1065	....	i.	....	s. HNO_3
33	6.49	766	....	i.	....	d. a.
34	6.2	d. 1000	....	0.00425^{25}	0.0056^{40}	s. NH_4 salts; sl. s. conc. H_2SO_4; i. al.
35	6.92	977	....	0.0044^{0}	v. sl. s.	sl. s. H_2SO_4
36	....	....	....	v. s.	....	....
37	....	d.	....	0.0001^{18}d.	....	sl. s. H_2SO_4
38	7.5	1114	....	0.01244^{20}	....	s. a.; i. KOH, al.
39	....	....	....	i.	i.	s. HNO_3
40	....	115.7	....	0.005^{35}	0.006^{50}	$0.005^{14.5}$ eth.; i. al.
41	2.53^{19}	....	....	0.0025^{20}	0.0074^{100}	s. HNO_3, KOH; i. al., ac. a., amm., acet.
42	8.16	917	....	....	....	....
43	3.82	....	....	0.05^{20}	d.	s. KCNS, HNO_3

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Lead			
1	*di*thionate	$PbS_2O_6 \cdot 4H_2O$	439.39	trig., 1.635, 1.653
2	thiosulfate	PbS_2O_3	319.33	wh. cr.
3	*meta*titanate	$PbTiO_3$	303.11	yel. rhomb. pyr.
4	tungstate (raspite)	$PbWO_4$	455.13	monocl. col., 2.27, 2.27, 2.30
5	" (stolzite)	$PbWO_4$	455.13	tetr., 2.269, 2.182
6	*meta*vanadate	$Pb(VO_3)_2$	405.11	yel. powd
7	**Lithium**	Li	6.94	cub. silv. wh. soft met., μ_c 3.16
8	acetate	$LiC_2H_3O_2 \cdot 2H_2O$	102.02	rhomb. wh., α 1.40, β 1.50
9	acetylsalicylate	$LiC_9H_7O_4$	186.09	sl. hyg. powd.; d. in moist air
10	*meta*aluminate	$LiAlO_2$ (or $Li_2Al_2O_4$)	65.91	wh. powd
11	aluminum hydride	$LiAlH_4$	37.94	wh.
12	amide	$LiNH_2$	22.96	cub. col
13	antimonide	Li_3Sb	142.58	
14	*ortho*arsenate	Li_3AsO_4	159.73	wh. powd. rhomb
15	benzoate	$LiC_7H_5O_2$	128.05	wh. cr. or powd
16	*meta*borate	$LiBO_2$	49.76	wh. powd., tricl
17	"	$LiBO_2 \cdot 8H_2O$	193.89	trig
18	*tetra*borate	$Li_2B_4O_7 \cdot 5H_2O$	259.24	
19	bromide	LiBr	86.86	cub. wh. deliq
20	"	$LiBr \cdot 2H_2O$	122.89	wh. pr
21	carbide	Li_2C_2	37.90	cr. or wh. powd
22	carbonate	Li_2CO_3	73.89	monocl. col., 1.428, 1.567, 1.572
23	" , acid (bicarbonate)	$LiHCO_3$	67.96	wh.
24	chlorate	$LiClO_3$	90.40	rhomb. need
25	"	$LiClO_3 \cdot \frac{1}{2}H_2O$ (or $\frac{1}{3}H_2O$)	99.41	tetr., deliq
26	*per*chlorate	$LiClO_4$	106.40	col. deliq
27	"	$LiClO_4 \cdot 3H_2O$	160.45	hex. col
28	chloride	LiCl	42.40	cub. wh., deliq
29	"	$LiCl \cdot H_2O$	60.41	
30	chloroplatinate	$Li_2PtCl_6 \cdot 6H_2O$	529.95	hex. or red, deliq
31	chromate	$Li_2CrO_4 \cdot 2H_2O$	165.92	rhomb. or.-yel., deliq
32	*di*chromate	$Li_2Cr_2O_7 \cdot 2H_2O$	265.93	blk.-br., deliq
33	citrate	$Li_3C_6H_5O_7 \cdot 4H_2O$	281.98	col. cr. or wh. powd., deliq
34	fluoride	LiF	25.94	cub. col
35	fluosilicate	$Li_2SiF_6 \cdot 2H_2O$	191.97	monocl. wh., 1,300, 1.296
36	fluosulfonate	$LiSO_3F$	106.01	wh. powd
37	formate	$LiCHO_2 \cdot H_2O$	69.97	rhomb. col
38	gallium hydride	$LiGaH_4$	80.69	wh. cr
39	" nitride	Li_3GaN_2	118.56	lt. gr. powd
40	*meta*germanate	Li_2GeO_3	134.48	monocl., 1.7
41	hydride	LiH	7.95	col
42	hydroxide	LiOH	23.95	wh. cr. or powd. tetr
43	"	$LiOH \cdot H_2O$	41.96	monocl. col
44	iodate	$LiIO_3$	181.86	hex. wh
45	iodide	LiI	133.86	cub. wh., deliq
46	"	$LiI \cdot 3H_2O$	187.91	hex. col.-yelsh
47	laurate	$LiC_{12}H_{23}O_2$	206.25	wh. powd
48	*per*manganate	$LiMnO_4 \cdot 3H_2O$	179.92	cub
49	molybdate	Li_2MoO_4	173.83	tetra pr

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.22	d.	....	115.0$^{20.5}$	....	....
2	5.18	d.	....	0.03	....	s. a., $Na_2S_2O_3$
3	7.52	....	....	i.	i.	....
4	....	1123	....	0.03	....	d. a.; i. al.
5	8.23	....	....	i.	....	s. KOH; i. HNO_3
6	....	....	....	sl. s.	....	d. HCl, s. dil. HNO_3
7	0.534	186	1336 ± 5	d. to LiO	H + H_2	d. al.; s. a.
8	....	70	d.	300^{15}	v. s.	21.5 al.
9	....	....	....	100	....	25 al.
10	$2.55\frac{25}{4}$	>1625	....	i.	....	....
11	0.917	stable to about 125^{0}	....	d.	....	25–30 eth.
12	1.178	373–375	430	d.	d.	....
13	3.2^{17}	>950	....	....	....	....
14	3.07^{15}	....	....	v. sl. s.	....	s. dil. ac. a.; i. pyr.
15	....	....	....	33^{25}	40^{100}	7.7^{25}, 10^{78} al.
16	....	840–5	....	sl. s.	....	....
17	1.38$^{14.7}$	47	....	....	....	....
18	....	$-2H_2O$, 200	....	v. s.	....	i. al.
19	3.464^{25}	547	1265	142.7^{0}	243.6^{82}	s. al., eth.
20	....	44	....	246^{20}	....	s. al.
21	1.65^{18}	....	....	d.	d.	s. a.
22	2.111$^{17.5}$	618	d.	1.54^{0}; 1.33^{20}	0.72^{100}	s. a.; i. acet., NH_3, al.
23	....	....	....	5.5^{13}	....	....
24	....	124–9	d. 270	313.5^{18}	v. s.	....
25	....	(50) 65	$-\frac{1}{2}H_2O$, 90; d. 290	313.5^{18}	∞	v. s. al.
26	2.429	236	d. 380	59.7^{25}	....	s. al.
27	1.841	95	$-2H_2O$, 100; $-3H_2O$, 150	s.	s.	v. s. al.
28	2.068^{25}	613	1353	45.4^{25}	127.5^{100}	3.80^{20} al., 34.7^{30} meth. al.; 3.94^{25} acet.; s. eth.
29	1.78	$-H_2O$, >98	....	....	....	....
30	....	....	$-6H_2O$, 180	s.	s.	s. al.; i. eth.
31	....	....	$-2H_2O$, 150	141^{18}	128^{30}	....
32	....	$-2H_2O$, 130	d.	151^{30}	....	....
33	....	d.	....	74.5^{25}	66.7^{100}	sl. s. al., eth.
34	2.601	870	1676	0.27^{18}	....	s. a., HF; i. al., acet.
35	2.33^{12}	$-2H_2O$, 100	d.	52.6^{17}	....	s. al.; i. eth., acet.
36	....	360	....	v. s.	s.	v. s. al., eth. acet.; i. ligroin
37	1.46	d.	....	24.42^{0}	57.64^{104}	s. form. a.
38	....	....	....	d.	d.	s. eth.
39	3.35	d. 800^{0}	....	d.	d.	s. a., alk.
40	3.53^{21}	1239	....	0.85^{25}	....	s. a.
41	0.78	689	d.	d. to LiO	H + H_2	....
42	1.43	450	d.	12.7^{0}	17.5^{100}	sl. s. al.
43	....	....	....	22.3^{10}	26.8^{80}	sl. s. al.
44	....	....	....	125^{15}	....	....
45	4.061^{25}	446	1190	s.	s.	251^{25} al.; v. s. NH_3
46	3.48	73; $-H_2O$, 73	$-2H_2O$, 80; $-3H_2O$, 300	151^{0}	201.2^{60}	s. abs. al., acet.
47	....	229.2–.8	....	0.154$^{16.3}$; 0.187^{25}	....	0.322^{25} al.; 0.008$^{15.8}$ eth.; 0.240^{15} acet.
48	2.06	d. 190	....	....	....	....
49	....	705	....	hyg.	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Lithium			
1	myristate	$LiC_{14}H_{27}O_2$	234.30	
2	nitrate	$LiNO_3$	68.95	trig. col. deliq., 1.735, 1.435
3	"	$LiNO_3{\cdot}3H_2O$	123.00	col.
4	nitride	Li_3N	34.83	red.-brn. amor. or blk. to gray cub. cr.
5	nitrite	$LiNO_2{\cdot}H_2O$	70.96	flat need
6	oxalate	$Li_2C_2O_4$	101.90	col. cr
7	" acid	$LiHC_2O_4{\cdot}H_2O$	113.98	
8	oxide	Li_2O	29.88	cub. wh. cr
9	palmitate	$LiC_{16}H_{31}O_2$	262.35	wh. powd
10	*ortho*phosphate	Li_3PO_4	115.80	rhomb. col
11	"	$2Li_3PO_4{\cdot}H_2O$	249.62	wh. cr. powd
12	" , di-H	LiH_2PO_4	103.94	col
13	potassium *dl*-tartrate	$LiKC_4H_4O_6{\cdot}H_2O$	212.12	monocl., β 1.523 (red)
14	salicylate	$LiC_7H_5O_3$	144.05	wh. powd., deliq
15	selenide	$Li_2Se{\cdot}9H_2O$	254.98	rhomb. col. deliq
16	*ortho*silicate	Li_4SiO_4	119.82	rhomb. col., α 1.594, γ 1.614
17	*meta*silicate	Li_2SiO_3	89.94	rhomb. col., lq. 1.548^{25}, α 1.584, γ 1.604
18	silicide	Li_6Si_2	97.76	bl. cr. hyg
19	sodium fluoaluminate	$Li_3Na_3(AlF_6)_2$	371.75	cub. cr. 1.3395
20	stearate	$LiC_{18}H_{35}O_2$	290.40	wh. cr
21	sulfate	Li_2SO_4	109.95	col. α monocl., β hex. or rhomb. → γ cub. 500°C; β 1.465
22	"	$Li_2SO_4{\cdot}H_2O$	127.96	monocl. col., 1.460, 1.477, 1.488
23	" , hydrogen	$LiHSO_4$	104.01	pr
24	sulfide	Li_2S	45.95	cub. wh.-yel
25	" , hydro-	$LiHS$	40.01	wh. powd. hyg
26	sulfite	$Li_2SO_3{\cdot}H_2O$	111.96	need
27	tartrate	$Li_2C_4H_4O_6{\cdot}H_2O$	179.97	wh. cr. powd
28	thallium *dl*-tartrate	$LiTlC_4H_4O_6{\cdot}2H_2O$	395.43	tricl
29	thiocyanate	$LiSCN$	65.02	deliq., wh. cr
30	tungstate	Li_2WO_4	261.80	trig. col
31	urate, acid	$LiHC_5H_2N_4O_3$	174.05	wh. powd
32	*meta*vanadate	$LiVO_3{\cdot}2H_2O$	141.92	yelsh. powd
33	*di*thionate	$Li_2S_2O_6{\cdot}2H_2O$	210.04	rhomb., 1.5602
34	**Lutetium** (cassiopeium)	Lu	174.99	
35	chloride	$LuCl_3$	281.36	col
36	sulfate	$Lu_2(SO_4)_3{\cdot}8H_2O$	782.31	col
37	**Magnesium**	Mg	24.32	hex. silv. wh. met
38	acetate	$Mg(C_2H_3O_2)_2$	142.41	wh
39	acetate	$Mg(C_2H_3O_2)_2{\cdot}4H_2O$	214.47	monocl. col., β 1.491
40	aluminate (spinel)	$MgAl_2O_4$	142.26	cub. col., 1.723
41	antimonide	Mg_3Sb_2	316.48	metallic
42	*ortho*arsenate (hoernesite)	$Mg_3(AsO_4)_2{\cdot}8H_2O$	494.91	monocl. wh
43	"	$Mg_3(AsO_4)_2{\cdot}22H_2O$	747.13	
44	" , mono-H (roesslerite)	$MgHAsO_4{\cdot}7H_2O$	290.35	monocl
45	*ortho*arsenite	$Mg_3(AsO_3)_2$	318.78	

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	223.6–4.2	......	$0.027^{16.3}$; 0.036^{25}	0.062^{50}	$0.010^{15.8}$ eth.; 0.331^{15} acet.; 0.155^{20} al.
2	2.38	255	......	52.2	$66.1^{70.9}$	s. al., acet.
3	......	29.88; $-2\frac{1}{2}H_2O$, 29.9	$-3H_2O$, 61.1	$34.8^{0.1}$	$57.48^{29.6}$	......
4	......	840–5	......	......	......	......
5	1.615^{0}	<100	d.	125^{0}	459^{50}	v. s. abs. al.
6	$2.121^{17.5}$	d.	......	$8^{19.5}$	......	......
7	......	d.	......	8^{17}	......	......
8	$2.013^{25.2}$	>1700	......	6.67^{0} d.	10.02^{100}	......
9	......	224.5	......	0.01^{18}	0.015^{35}	0.347^{15} acet., 0.077^{20} al., $0.005^{15.8}$ eth.
10	$2.537^{17.5}$	837	......	0.039^{18}	......	s. a., NH_4OH; i. acet.
11	2.41	......	......	0.04	......	s. a.
12	2.461	>100	......	......	......	......
13	1.610	......	......	s.	......	......
14	......	d.	......	133.3	......	50 al.
15	......	......	......	d.	......	......
16	2.28	1256	......	i.	d.	......
17	2.52^{25}	1201	......	i.	s. d.	s. dil. HCl
18	*ca.* 1.12	d.	......	d.	d.	d. a.; i. NH_3, turp.
19	2.774–8	710	......	0.074^{18}	......	......
20	......	220.5–1.5	......	0.010^{18}	......	0.010^{25} al., 0.040^{18} eth., 0.457^{15} acet.
21	2.221	860	......	26.1^{0}	23^{100}	i. abs. al., acet.
22	2.06	$-H_2O$, 130	......	34.6^{20}	29.5^{100}	i. abs. al.
23	2.123^{13}	120	......	d.	......	......
24	1.66	......	......	v. s.	v. s.	v. s. al.
25	......	......	......	s.	s.	s. al.
26	......	455 sl. d.	$-H_2O$, 180–200	s.	s.	i. al.
27	......	......	......	s.	......	......
28	3.144	......	......	......	......	......
29	......	......	......	v. s.	......	s. methyl acetate
30	......	742	......	v. s.	v. s.	d. a.; i. al.
31	......	......	......	$.27^{20}$	2.5^{100}	sl. s. al.
32	......	......	......	s.	......	......
33	2.158	d.	......	v. s.	......	......
34	......	......	......	......	......	......
35	3.98	892	......	......	......	......
36	......	......	......	66^{20}	22^{40}	......
37	1.74^{5}	651	1107	i.	sl. s. d. to $Mg(OH)_2$	s. min. a. except CrO_3 conc. HF, NH_4 salts; i. alk.
38	1.42	323 d.	......	v. s.	v. s.	5.25^{15} meth. al.
39	1.454	80	......	36.2^{0}; 61.1^{15}	66.4^{68}	v. s. al.
40	3.6	2135	......	......	......	v. sl. s. dil. HCl; i. dil. HNO_3
41	......	961	......	i.	......	......
42	2.60–.61	......	......	......	......	......
43	1.788	......	......	i.	i.	s. a., NH_4Cl
44	3.155^{15}	$-5H_2O$, 100	......	d.	......	......
45	......	......	......	s.	v. s.	s. a., NH_4Cl; i. NH_4OH

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Magnesium			
1	benzoate	$Mg(C_7H_5O_2)_2{\cdot}3H_2O$	320.59	wh. powd
2	bismuthide	Mg_3Bi_2	490.96	met
3	*ortho*borate	$Mg_3(BO_3)_2$	190.60	rhomb. col
4	*di*borate (ascharite)	$Mg_2B_2O_5{\cdot}H_2O$	168.30	orthorhomb
5	*meta*borate (pinnoite)	$Mg(BO_2)_2{\cdot}3H_2O$	164.01	yel. tetr. pyram., 1.565, 1.575
6	*meta*borate	$Mg(BO_2)_2{\cdot}8H_2O$	254.09	tetr., 1.565, 1.575
7	bromate	$Mg(BrO_3)_2{\cdot}6H_2O$	388.25	cub. col., 1.514
8	bromide	$MgBr_2$	184.15	lg. lust. wh. cr., deliq
9	“	$MgBr_2{\cdot}6H_2O$	292.25	hex. col. pr. & need., fluo. in X-Rays.
10	bromoplatinate	$MgPtBr_6{\cdot}12H_2O$	915.24	trig
11	carbonate (magnesite)	$MgCO_3$	84.33	trig. wh., 1.717, 1.515
12	“ (nesquehonite)	$MgCO_3{\cdot}3H_2O$	138.38	rhomb. col. need., 1.495, 1.501, 1.526
13	“ (lansfordite)	$MgCO_3{\cdot}5H_2O$	174.41	monocl. 1.456, 1.468, 1.507
14	“ , basic (artinite)	$MgCO_3{\cdot}Mg(OH)_2{\cdot}3H_2O$	196.71	rhomb., 1.489, 1.534, 1.557
15	“ “ (hydromagnesite)	$3MgCO_3{\cdot}Mg(OH)_2{\cdot}3H_2O$	365.37	rhomb. wh., 1.527, 1.530, 1.540
16	“ “	$4MgCO_3{\cdot}MgO{\cdot}5$-(or 6)$H_2O$	....	thin flakes
17	chlorate	$Mg(ClO_3)_2{\cdot}6H_2O$	299.33	wh. cr. or powd. deliq
18	*per*chlorate	$Mg(ClO_4)_2$	223.23	
19	“	$Mg(ClO_4)_2{\cdot}6H_2O$	331.33	
20	chloride	$MgCl_2$	95.23	wh. lust. hex. cr., 1.675, 1.59
21	“ (bischofite)	$MgCl_2{\cdot}6H_2O$	203.33	monocl. col. deliq., 1.495, 1.507, 1.528
22	chloropalladate	$MgPdCl_6{\cdot}6H_2O$	451.86	hex
23	chloroplatinate	$MgPtCl_6{\cdot}6H_2O$	540.39	trig
24	chlorostannate	$MgSnCl_6{\cdot}6H_2O$	463.86	tri
25	chromate	$MgCrO_4{\cdot}7H_2O$	266.44	rhomb. yel., 1.521, 1.550, 1.568
26	citrate, mono-H-	$MgHC_6H_5O_7{\cdot}5H_2O$	304.51	wh. gran. powd
27	ferrite (magnesioferrite)	$MgFe_2O_4$	200.02	oct. blk., 2.35
28	ferrocyanide	$Mg_2Fe(CN)_6{\cdot}12H_2O$	476.79	pa. yel. cr
29	fluoride (sellaite)	MgF_2	62.32	tetr. col. faint vlt. lumin., 1.378, 1.390
30	fluosilicate	$MgSiF_6$	166.38	wh. cr. or powd
31	“	$MgSiF_6{\cdot}6H_2O$	274.48	trig. wh
32	formate	$Mg(CHO_2)_2{\cdot}2H_2O$	150.39	rhomb. col
33	*ortho*germanate	Mg_2GeO_4	185.24	wh. ppt
34	hydroxide (brucite)	$Mg(OH)_2$	58.34	trig. col., 1.559, 1.580
35	iodate	$Mg(IO_3)_2{\cdot}4H_2O$	446.22	monocl
36	iodide	MgI_2	278.16	wh. cr., deliq
37	“	$MgI_2{\cdot}8H_2O$	422.29	wh. deliq. powd
38	lactate	$Mg(C_3H_5O_3)_2{\cdot}3H_2O$	256.51	wh. cr. powd.; v. bitter taste
39	laurate	$Mg(C_{12}H_{23}O_2)_2{\cdot}2H_2O$	458.96	wh. lumps
40	*per*manganate	$Mg(MnO_4)_2{\cdot}6H_2O$	370.28	dk. purp. need. deliq
41	molybdate	$MgMoO_4$	184.27	rhomb. tricl
42	myristate	$Mg(C_{14}H_{27}O_2)_2$	479.03	wh. powd
43	nitrate	$Mg(NO_3)_2{\cdot}2H_2O$	184.37	pr
44	“	$Mg(NO_3)_2{\cdot}6H_2O$	256.43	monocl. col. deliq
45	nitride	Mg_3N_2	100.98	grn. yel. cr
46	oleate	$Mg(C_{18}H_{33}O_2)_2$	587.21	yel. powd. or mass
47	oxalate	$MgC_2O_4{\cdot}2H_2O$	148.37	wh. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	...	d. 200 (?); $-3H_2O$, 110	...	6.16^{15}	19.6^{100}	s. al.
2	...	715	...	...	...	...
3	2.99^{21}	...	...	s.	s.	s. min. a.; i. ac. a.
4	2.60–.70	...	...	...	...	...
5	2.27–.30	...	...	...	...	...
6	2.30	...	...	i.	i. (v. sl. s.)	s. a.
7	2.29	$-6H_2O$, 200	d.	42^{18}	v. s.	i. al.
8	3.72	700 (695)	...	101.5^{20}	125.6^{100}	6.9^{0} al.; 21.8^{20} meth. al.
9	2.00?	165 d.	...	316^{0}	v. s.	s. al., acet.; sl. s. NH_3
10	2.802	...	...	...	...	...
11	3.037	d. 350	$-CO_2$, 900	0.0106	...	s. a., aq. CO_2; i. acet., NH_3
12	1.850	165	...	0.129^{25}	d.	s. a.; 1.4 aq. CO_2
13	1.69–.73	...	...	...	...	...
14	2.02^{20}	...	...	...	...	...
15	2.16	d.	...	0.04	0.011	s. a., NH_4 salts
16	0.08–.13	...	...	...	...	0.57^{100}
17	1.80^{25}	35	d. 120	56.5^{18}	73.7^{93}	s. al.
18	2.60^{25}	251 d.	...	49.90^{25}	v. s.	...
19	1.970^{25}	147	...	...	...	...
20	2.316	708	1412	54.25^{20}	72.7^{100}	50 al.
21	1.56	d. 116–8	d.	167	367	50 al.
22	2.12	d.	...	...	...	...
23	2.437	d.	...	...	...	...
24	2.08	d. 100	...	...	...	...
25	1.695	...	...	211.5^{18}	v. s.	...
26	...	...	...	sl. s.	...	s. a.
27	4.44–60	1750 ± 25	...	...	...	s. conc. HCl; i. h. HNO_3 al., dil. a.
28	...	d. *ca.* 200	...	33	...	...
29	2.9–3.2	1396	2239	$.0076^{18}$	i.	s. HNO_3; sl. s. a.; i. al.
30	...	...	...	65	...	...
31	1.788	...	...	...	...	...
32	...	...	...	7.7	...	i. al., eth.
33	...	...	...	0.0016^{26}	...	s. a.; i. alk.
34	2.38–.39	$-H_2O$, 350	...	0.0009^{18}	0.004^{100}	s. a., NH_4 salts
35	$3.3^{13.5}$	$-4H_2O$, 210	d.	10.2^{20}	19.3^{100}	...
36	4.244	>700 d.	...	100^{0}; 148^{18}	164.9^{110}	s. al., eth., NH_3, methyl
37	...	d. 41	...	81^{20}	90.3^{80}	s. al., eth.
38	...	...	...	3.3	16.7^{100}	i. al., eth.
39	...	150.4	...	0.007^{25}	0.041^{100}	0.415^{15} al., 0.012^{25} eth.
40	2.18 ?	d.	...	v. s.	d.	s. ac. a., meth. al.
41	...	...	...	13.7^{25}	...	...
42	...	131.6	...	0.006^{15}	0.014^{50}	0.189^{25} al., 0.126^{15} al., 0.007^{25} eth.
43	2.0256^{25}	129.0–.5	...	...	...	...
44	1.464	95	$-5H_2O$, 330	42.33^{18}	57.81^{90}	s. al., liq. NH_3
45	...	d. 1500	...	i.	d.	s. a.; d. al.
46	...	...	...	0.024^{25}	...	6.64^{20} al.; s. linseed oil; sl. s. ether
47	2.45 $\left(2\frac{1}{2}H_2O\right)$	d.	...	0.07^{16}	0.08^{100}	s. a., alk. oxal.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Magnesium			
1	oxide (periclase)	MgO	40.32	cub. col. 1.736
2	“ per-	MgO_2	56.32	wh. powd
3	palmitate	$Mg(C_{16}H_{31}O_2)_2$	535.14	cr. need. or wh. lumps
4	*ortho*phosphate	$Mg_3(PO_4)_2 \cdot 4H_2O$	334.98	monocl
5	“ (bobierrite)	$Mg_3(PO_4)_2 \cdot 8H_2O$	407.05	monocl. pl., 1.510, 1.520, 1.543
6	“ , mono-H (newberyite)	$MgHPO_4 \cdot 3H_2O$	174.36	rhomb. wh., 1.514, 1.518, 1.533
7	“ , mono-H	$MgHPO_4 \cdot 7H_2O$	246.42	hex
8	*pyro*phosphate	$Mg_2P_2O_7$	222.60	tabular monocl. col., 1.602, 1.604, 1.615
9	“	$Mg_2P_2O_7 \cdot 3H_2O$	276.65	wh. amor
10	*hypo*phosphite	$Mg(H_2PO_2)_2 \cdot 6H_2O$	262.41	wh. cr
11	*ortho*phosphite	$MgHPO_3 \cdot 3H_2O$	158.36	
12	salicylate	$Mg(C_7H_5O_3)_2 \cdot 4H_2O$	370.60	col. or sl. redsh. effl. cr. powd
13	selenate	$MgSeO_4 \cdot 6H_2O$	275.38	monocl. col., 1.486, 1.489, 1.491
14	silicate (clinoenstatite)	$MgSiO_3$	100.38	monocl
15	(di-) silicide	Mg_2Si	76.70	oct
16	(penta-) silicide, tri-	Mg_5Si_3	205.78	
17	stearate	$Mg(C_{18}H_{35}O_2)_2$	591.24	wh. powd. or lumps
18	sulfate	$MgSO_4$	120.39	col. cr
19	“ (kieserite)	$MgSO_4 \cdot H_2O$	138.49	monocl. col. pr., 1.523, 1.535, 1.586.
20	“ (epsom salt, epsomite)	$MgSO_4 \cdot 7H_2O$	246.50	rhomb. (monocl.) col., 1.433, 1.455, 1.461
21	sulfide	MgS	56.39	cub. pa. red-redsh. br., phos
22	sulfite	$MgSO_3 \cdot 6H_2O$	212.48	wh. cr. powd
23	*d*-tartrate	$MgC_4H_4O_6 \cdot 5H_2O$	262.47	monocl
24	“ , hydrogen	$Mg(HC_4H_4O_6)_2 \cdot 4H_2O$	394.54	rhomb
25	thiosulfate	$MgS_2O_3 \cdot 6H_2O$	244.55	col. pr
26	thiotellurite	Mg_3TeS_5	360.90	cr. mass pa. yel
27	tungstate	$MgWO_4$	272.24	col. monocl
28	**Manganese**	Mn	54.94	cub. or tetr. gray-pink met
29	acetate (ous)	$Mn(C_2H_3O_2)_2$	173.02	
30	“ “	$Mn(C_2H_3O_2)_2 \cdot 4H_2O$	245.08	monocl. pa. red
31	(di-) arsenide	Mn_2As	184.77	
32	(tri-) “ , di-	Mn_3As_2	314.61	magnetic (exist quest.)
33	arsenide, mono-	$MnAs$	129.84	blk. hex
34	benzoate (ous)	$Mn(C_7H_5O_2)_2 \cdot 3H_2O$	351.20	flat pr
35	boride, mono-	MnB	65.75	cr. powd
36	“ , di-	MnB_2	76.57	gray-vlt. cr
37	bromide, di-	$MnBr_2$	214.76	rose-red
38	“ “	$MnBr_2 \cdot 4H_2O$	286.83	α stable, monocl. rose-red, deliq.. β- or labile, col., rhomb.
39	carbide	Mn_3C	176.80	tetrah
40	carbonate (ous) (rhodochrosite)	$MnCO_3$	114.94	rhbdr. or trig. rose pink or amor. lt. br. powd., 1.817, 1.597
41	chloride, di- (scacchite)	$MnCl_2$	125.84	cub. pink, deliq
42	“ “	$MnCl_2 \cdot 4H_2O$	197.91	monocl. rose, deliq
43	“ , tri-	$MnCl_3$	161.30	grnsh. blk. solid or brn. cr
44	chloroplatinate (ous)	$MnPtCl_6 \cdot 6H_2O$	571.0	trig
45	citrate (ous)	$Mn_3(C_6H_5O_7)_2$	542.99	wh.-redsh. powd
46	ferrocyanide (ous)	$Mn_2Fe(CN)_6 \cdot 7H_2O$	447.93	grnsh. wh. powd
47	fluogallate (ous)	$[Mn(H_2O)_6][GaF_5 \cdot H_2O]$	345.76	orthorhomb., pink cr. n 1.45
48	fluoride, di-	MnF_2	92.93	red tetrag. or redsh. powd
49	“ , tri-	MnF_3	111.93	red

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.58	2800	....	0.00062	0.0086^{30}	s. a., NH_4 salts; i. al.
2	....	....	....	i.	i.	s. a.
3	....	121.5	....	0.008^{25}	0.009^{50}	0.003^{25} eth.; 0.047^{25} al.
4	1.64^{15}	....	....	0.0205	....	s. a.; i. NH_4 salts, NH_3
5	2.41	....	....	....	....	s. NH_4 citrate
6	2.10	....	....	sl. s.	....	s. a.
7	....	$-4H_2O$, 100	....	0.3	0.2	s. a.; i. al.
8	2.559	1383	....	i.	i.	s. a.; i. al.
9	2.56	d. 150	....	i.	sl. s.	s. a.; i. al.
10	....	....	....	20	....	i. al., eth.
11	....	....	....	0.25	....	s. a.
12	....	....	....	s.	....	s. al.
13	1.928	....	....	v. s.	v. s.	....
14	3.28	1557 d.	....	....	....	....
15	....	1102	....	i.	d.	s. a., NH_4Cl, HCl
16	....	1102	....	i.	d.	s. a., NH_4Cl
17	....	88.5	....	0.003^{15}; 0.004^{25}	0.008^{50}	0.020^{25} al., 0.003^{25} eth.
18	2.66	1124 d.	....	26^{0}	73.8^{100}	s. al., glyc., 1.16^{18} eth., i. acet.
19	2.517 (2.57)	....	....	....	68.4^{100}	....
20	1.636 (1.68)	$-6H_2O$, 150	$-7H_2O$, 200	71^{20}	91^{40}	s. al., glyc.
21	2.79–.85	d.	....	d.	d.	s. a., PCl_3
22	1.725	$-6H_2O$, 200	d.	1.25	0.83	i. al., NH_3
23	1.67	d.	d.	0.8^{18}	1.44^{90}	i. al., NH_3
24	1.72	....	....	....	....	....
25	1.818^{24}	$-3H_2O$, 170	d.	v. s.	v. s.	s. al.
26	....	....	....	s.	s.	s. al.
27	5.66	....	....	i.	....	d. a.; i. al.
28	7.20	1260	1900	d.	d.	s. dil. a.
29	1.74	....	....	s.	s.	....
30	1.589	....	....	s.	....	s. al.
31	....	1400	....	i.	i.	s. aq. reg.
32	....	....	....	i.	i.	s. aq. reg.
33	6.17–.20 (5.55)	d. 400	....	i.	i.	s. HCl, aq. reg.
34	....	....	....	6.55^{15}	....	....
35	6.2^{15}	....	....	....	....	....
36	6.9	....	....	d.	d.	s. a.
37	4.385^{25}	d.	....	127.3^{0}	228^{100}	i. NH_3
38	....	64.3 d.	d.	296.7^{0}	....	....
39	6.89^{17}	....	....	d.	d.	s. a.
40	3.125	d.	....	$.0065^{25}$	....	s. dil. a., .026 aq. CO_2; i. NH_3, al.
41	2.977^{25}	650	1190	62.2^{10}	123.8^{100}	s. al.; i. eth., NH_3
42	2.01	58; $-H_2O$, 106	$-4H_2O$, 198	151^{8}	656^{100}	s. al.; i. eth.
43	....	d. sl.	....	....	....	s. abs. al.
44	2.692	d.	....	....	....	....
45	....	....	....	v. sl. s.	....	s. soln. sod. cit., dil.
46	....	....	....	i.	....	s. HCl; i. NH_4 salts
47	2.22	d. 230	....	v. s.	....	s. HF
48	3.98	856	....	i.	d.	s. a.; i. al., eth.
49	3.54	d.	....	d.	d.	s. a.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Manganese			
1	fluosilicate (ous)	$MnSiF_6\cdot 6H_2O$	305.09	hex. pr., rose red, 1.357, 1.374
2	formate (ous)	$Mn(CHO_2)_2\cdot 2H_2O$	181.00	rhomb
3	glycerophosphate (ous)	$MnC_3H_7O_6P$	225.00	wh. or sl. redsh. odorl. powd
4	hydroxide (ous) (pyrochroite)	$Mn(OH)_2$	88.95	trig. wh.-pink, 1.723, 1.681
5	“ (ic)	$MnO(OH)$	87.94	br
6	“ “ (manganite)	$MnO(OH)$	87.94	rhomb. br.-blk., 2.24, 2.24 (Li) 2.53
7	“	$MnO(OH)_2$	104.95	blk.-br. amor. (exist. quest.)
8	iodide, di-	MnI_2	308.77	yelsh.-br. or pink, deliq., cr. mass or wh. powd
9	“ “	$MnI_2\cdot 4H_2O$	380.83	monocl. rose-red, deliq
10	iodoplatinate	$MnPtI_6\cdot 9H_2O$	1173.82	trig
11	lactate (ous)	$Mn(C_3H_5O_3)_2\cdot 3H_2O$	287.12	monocl. pa. red
12	nitrate (ous)	$Mn(NO_3)_2\cdot 6H_2O$	287.04	monocl. rose-wh. or col
13	oxalate (ous)	MnC_2O_4	142.95	
14	“ “	$MnC_2O_4\cdot 2H_2O$	178.98	redsh.-wh. cr. powd., oct
15	“ “	$MnC_2O_4\cdot 3H_2O$	197.00	prismatic, pink
16	oxide, mon- (ous) (manganosite)	MnO	70.93	cub. grn., 2.16
17	“ (ous, ic), (hausmannite)	Mn_3O_4	228.79	tetr. (rhomb.) blk., 2.46 (Li), 2.15 (Li)
18	“ , sesqui- (ic)	Mn_2O_3	157.86	cub. (tetr.) blk
19	“ , di-	MnO_2	86.93	rhomb. blk. or br.-blk. powd
20	“ , tri-	MnO_3	102.93	redsh., deliq. (exist. quest.)
21	“ , hept-	Mn_2O_7	221.86	dk. red oil
22	*ortho*phosphate (ous) (reddingite)	$Mn_3(PO_4)_2\cdot 3H_2O$	408.80	rhomb., also gran. pa. rose-pink or ylsh. wh., 1.651, 1.656, 1.683
23	“ (ous)	$Mn_3(PO_4)_2\cdot 7H_2O$	480.86	wh.-redsh. amor. powd
24	“ , mono-H (ous)	$MnHPO_4\cdot 3H_2O$	204.97	rhomb. red or pink powd
25	“ , di-H (ous)	$Mn(H_2PO_4)_2\cdot 2H_2O$	284.95	pr
26	*ortho*phosphate (ic)	$MnPO_4\cdot H_2O$	167.93	grnsh.-gray cr. powd
27	*pyro*phosphate (ous)	$Mn_2P_2O_7$	283.82	monocl. br.-pink, 1.695, 1.704, 1.710
28	“ “	$Mn_2P_2O_7\cdot 3H_2O$	337.87	amor. wh. powd
29	*meta*phosphate (ic)	$Mn_2(PO_3)_6\cdot 2H_2O$	619.77	pink
30	phosphide, mono-	MnP	85.91	dk. gray
31	(tri-) phosphide, di-	Mn_3P_2	226.75	dk. gray
32	*hypo*phosphite (ous)	$Mn(H_2PO_2)_2\cdot H_2O$	202.94	rose-red cr. or powd
33	*ortho*phosphite (ous)	$MnHPO_3\cdot H_2O$	152.93	redsh
34	selenate	$MnSeO_4\cdot 2H_2O$	233.92	rhomb
35	“	$MnSeO_4\cdot 5H_2O$	287.97	
36	selenide	$MnSe$	133.89	gray, cubic
37	selenite (ous)	$MnSeO_3\cdot 2H_2O$	217.92	cr
38	*ortho*silicate (ous) (tephroite)	Mn_2SiO_4	201.92	rhomb. flesh-red to gray, 1.759, 1.786, 1.797
39	*meta*silicate (ous) (rhodonite)	$MnSiO_3$	130.99	tricl. red., 1.733, 1.740, 1.744
40	(di-) silicide	Mn_2Si	137.92	quad. pr
41	silicide, mono-	$MnSi$	82.99	tetrah
42	“ , di-	$MnSi_2$	111.05	gray oct
43	sulfate (ous)	$MnSO_4$	151.00	reddish
44	“ “ (szmikite)	$MnSO_4\cdot H_2O$	169.01	monocl. pa. pink, 1.562, 1.595, 1.632
45	“ “	$MnSO_4\cdot 2H_2O$	187.03	(exist. quest)
46	“ “	$MnSO_4\cdot 3H_2O$	205.05	(exist. quest.)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.903	d.	....	140^{18}	v. s.	s. al.
2	1.953	d.	....	s.	s.	....
3	....	....	....	sl. s.	....	s. a., cit. a.; i. al.
4	3.258^{13}	d.	....	$.0002^{18}$	....	s. a., NH_4 salts; i. alk.
5	3.26	d.	....	v. sl. s.	....	....
6	4.2–4.4	d.	....	i.	i.	s. h. H_2SO_4, HCl
7	2.58	....	....	v. sl. s.	....	v. sl. s. al.
8	5.01	d. *ca.* 80	....	s.	....	....
9	....	d.	....	s.	v. s.	....
10	3.60	d.	....	....	....	....
11	....	d.	....	s.	v. s.	s. al.
12	1.82	25.8	129.4	426.4^{0}	∞	v. s. al.
13	$2.43^{21.7}$	d.	....	i.	i.	s. a., NH_4Cl
14	....	$-2H_2O$, 100	d.	0.0312^{25}	0.037^{36}	....
15	....	$-H_2O$, 25	....	....	....	....
16	5.43–.46 (3.7–3.9)	1650	....	i.	i.	s. a., NH_4Cl
17	4.856	1705	....	i.	i.	s. HCl
18	4.50	−O, 1080	....	i.	i.	s. a.; i. ac. a.
19	5.026	−O, 535	....	i.	i.	s. HCl; i. HNO_3, acet.
20	....	d.	....	s.	d.	s. H_2SO_4, alk.
21	>1.84	<-20	exp. 70	v. s.	d.	s. H_2SO_4
22	3.102	....	....	....	....	....
23	....	....	....	v. sl. s.	....	s. a., ac. a.; i. al.
24	....	....	....	sl. s.	d.	s. a.; i. al.
25	....	$-H_2O>100$	....	s.	....	i. al.
26	....	....	....	....	....	s. boil. conc. H_2SO_4, conc. HCl, molten H_3PO_4
27	3.707^{25}	(1196)	....	i.	....	s. a.
28	....	....	....	i.	....	s. aq. $K_4P_2O_7$, H_2SO_3; i. acet.
29	....	....	....	sl. s.	s.	....
30	5.39^{21}	1190	....	i.	i.	sl. s. HNO_3
31	5.12^{18}	1095	....	i.	i.	sl. s. dil. HNO_3
32	....	$-H_2O>150$	....	12.5	16.7	i. al.
33	....	$-H_2O$, 200	....	sl. s.	....	s. $MnCl_2$, $MnSO_4$
34	2.95–3.01	....	....	s.	s.	....
35	2.33–.39	....	....	....	....	....
36	5.59^{15}	....	....	i.	i.	d. dil. a.
37	....	....	....	v. sl. s.	v. sl. s.	....
38	4.043^{25}	1300	....	....	....	....
39	3.72^{25}	1323	....	i.	i.	i. HCl
40	6.20^{15}	1316	....	i.	i.	s. HCl, NaOH; i. HNO_3
41	5.90^{15}	1280	....	i.	i.	s. HF; v. sl. s. a.
42	5.24^{13}	....	....	i.	i.	s. HF, alk.; i. HNO_3 H_2SO_3
43	3.25	700	d. 850	52^{5}	70^{70}	s. al.; i. eth.
44	2.95	stab. 57–117	....	98.47^{48}	79.8^{100}	....
45	2.526^{15}	stab. 40–57	....	85.27^{35}	106.8^{55}	....
46	2.356^{15}	stab. 30–40	....	74.22^{5}	99.31^{57}	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Manganese			
1	sulfate (ous) (common form)	$MnSO_4 \cdot 4H_2O$	223.06	monocl. or rhomb. pink effl.
2	" "	$MnSO_4 \cdot 5H_2O$	241.08	tricl. rose
3	" "	$MnSO_4 \cdot 6H_2O$	259.10	(exist. quest.)
4	" "	$MnSO_4 \cdot 7H_2O$	277.11	rhomb. or monocl. red
5	" (ic)	$Mn_2(SO_4)_3$	398.06	grn. cr., deliq
6	sulfide (ous) (alabandite)	MnS	87.00	cub. grn. or amor. pink, 2.70 (Li)
7	" "	$3MnS \cdot H_2O$	279.00	gray-pink
8	" (ic) (hauerite)	MnS_2	119.06	cub. blk., 2.69 (Li)
9	tartrate (ous)	$MnC_4H_4O_6$	203.00	wh. powd
10	thiocyanate (ous)	$Mn(SCN)_2 \cdot 3H_2O$	225.15	deliq
11	*di*thionate (ous)	MnS_2O_6	215.06	tricl.
12	valerate	$Mn(C_5H_9O_2)_2 \cdot 2H_2O$	293.21	br. powd
13	**Manganic acid,** per-	$HMnO_4$	119.94	in soln. only
14	**Manganocyanic acid**	$H_4Mn(CN)_6$	215.07	
15	**Mercury**	Hg	200.61	silv. liq., hex. met
16	acetate (ous)	$Hg_2(C_2H_3O_2)_2$	519.31	micaceous scales
17	" (ic)	$Hg(C_2H_3O_2)_2$	318.70	wh. sc. or powd
18	acetylide (ic)	$3HgC_2 \cdot H_2O$	691.91	wh. powd
19	orthoarsenate, mono-H (ous)	Hg_2HAsO_4	541.14	yel.-red
20	" (ic)	$Hg_3(AsO_4)_2$	879.65	yel
21	azide (ous)	$Hg_2(N_3)_2$	485.27	wh. cr
22	benzoate (ic)	$Hg(C_7H_5O_2)_2$	442.83	wh. cr. powd
23	bromate (ous)	$Hg_2(BrO_3)_2$	657.06	cr
24	" (ic)	$Hg(BrO_3)_2 \cdot 2H_2O$	492.47	cr
25	bromide (ous)	Hg_2Br_2	561.07	tetr. wh.-yel
26	" (ic)	$HgBr_2$	360.44	rhomb. col
27	" iodide (ic)	$HgBrI$	407.45	rhomb. yel
28	carbonate (ous)	Hg_2CO_3	461.23	yel.-br
29	" , basic (ic)	$HgCO_3 \cdot 2HgO$	693.84	br.-red
30	chlorate (ous)	$Hg_2(ClO_3)_2$	568.14	rhomb. wh
31	" (ic)	$Hg(ClO_3)_2$	367.52	need
32	chloride (ous) (calomel)	Hg_2Cl_2	472.14	tetr. wh., 1.973, 2.656
33	" (ic) (corrosive sublimate)	$HgCl_2$	271.52	rhomb. col. or wh. powd., pois
34	" iodide (ic)	$HgClI$	362.99	rhomb. red
35	chromate (ous)	Hg_2CrO_4	517.23	red need. or powd
36	" (ic)	$HgCrO_4$	316.62	rhomb. red
37	cyanide (ic)	$Hg(CN)_2$	252.65	tetr. col. or wh. powd., pois
38	fluoride (ous)	Hg_2F_2	439.22	cub. yel
39	" (ic)	HgF_2	238.61	cub
40	fluosilicate (ous)	$Hg_2SiF_6 \cdot 2H_2O$	579.31	col. pr
41	" (ic)	$HgSiF_6 \cdot 6H_2O$	450.77	rhbdr. col., deliq
42	formate (ous)	$Hg_2(CHO_2)_2$	491.26	glist. scales
43	fulminate (ic)	$HgC_2N_2O_2$	284.65	cub. wh
44	iodate (ous)	$Hg_2(IO_3)_2$	751.06	yelsh
45	" (ic)	$Hg(IO_3)_2$	550.45	wh. amor. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Cold water	Hot water	Alcohol, acids, etc.
1	2.107	stab. 18–30	....	105.3^{0}	111.2^{54}	i. al.
2	2.103	stab. 8–18	....	124^{0}	142^{54}	....
3	....	stab. −5 to +8	....	147.4^{0}	134.5^{38}	....
4	2.093	$-7H_2O$, 280	stab. −10 to −5	172^{0}	118^{13}	i. al.
5	....	d. 160	....	d.	d.	s. HCl, dil. H_2SO_4; i. conc. H_2SO_4, HNO_3
6	3.99	d.	....	$.00047^{18}$	....	s. dil. a., al.; i. $(NH_4)_2S$
7	....	d.	....	0.0006	i.	s. dil. a.; i. $(NH_4)_2S$
8	3.463	d.	....	i.	i.	d. HCl
9	....	....	....	v. sl. s.	....	....
10	....	$-3H_2O$, 160–70	....	s.	v. s.	v. s. al.
11	1.757	....	....	s.	v. s.	....
12	....	....	....	s.	....	....
13	....	....	....	v. s.	d.	....
14	....	d.	....	i.	....	v. s. al.; i. eth.
15	13.546	−38.87	356.58	i.	i.	s. HNO_3; i. dil. HCl, HBr, HI
16	....	d.	....	0.75^{12}	....	s. H_2SO_4, HNO_3
17	3.270	d.	....	25^{10}	100^{100}	s. al., ac. a.
18	5.3	exp.	....	i.	i.	i. al.
19	....	i.	....	i.	....	s. HNO_3; i. NH_4OH, ac. a.
20	....	....	....	v. sl. s.	....	s. HCl, HNO_3
21	....	exp. d. by light	....	0.025	....	....
22	....	165	....	1.2^{15}	2.5^{100}	s. al., NaCl, $NH_4C_7H_5O_2$
23	....	d.	....	d.	....	sl. s. HNO_3
24	....	d. 130–40	....	0.15	1.6	s. HNO_3, HCl, $Hg(NO_3)_2$
25	7.307	subl. 345	....	$.000004^{25}$	....	s. a.; i. al., acet.
26	6.109^{25}; l. 5.12^{240}	236	322	$.61^{25}$	$20–25^{100}$	15^{0} al.; s. meth. al.; v. sl. s. eth.
27	....	229	360	....	....	s. al., eth.
28	5.07^{218} g/l	d. 130	....	.0000045	d.	s. NH_4Cl; i. al.
29	....	....	....	i.	....	s. H_2CO_3, NH_4Cl
30	6.409	d. 250	....	s.	d.	s. al., ac. a.
31	4.998	d.	....	25	....	....
32	7.150	subl. 400	....	$.0002^{18}$; $.0002^{25}$	$.001^{43}$	s. $Hg(NO_3)_2$, aq. reg.; sl. s. h. HNO_3, HCl; i. al., eth.
33	5.44^{25}; l. 4.44^{280}	276	302	3.6^{0}; 6.9^{20}	61.3^{100}	33^{25} al., 25 eth.; s. ac. a., pyr.
34	....	153	315	i.	sl. s.	s. al.
35	....	d.	....	v. sl. s.	sl. s.	s. HNO_3, KCN; i. al., acet.
36	....	d.	....	sl. s. d.	d.	d. a.; s. NH_4Cl; i. acet.
37	3.996	d.	....	9.3^{14}	53.9^{100}	10^{20} al.; $44.1^{19.5}$ meth. al.; s. NH_3, glyc.; i. bz.
38	8.73	570	....	s. d. to Hg_2O	....	....
39	8.95^{15}	645 d.	650	d.	....	s. dil. HNO_3, HF
40	....	....	....	sl. s.	....	i. HCl
41	....	....	....	d. easily	....	....
42	....	d.	....	0.4^{17}	d.	i. al.
43	4.42	exp.	....	sl. s.	s.	s. al., NH_4OH
44	....	d.	....	i.	i.	s. dil. HCl; i. cold HNO_3
45	....	....	....	i.	....	s. HCl, NH_4Cl, NaCl, KI; i. HNO_3

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Mercury			
1	iodide (ous)	Hg_2I_2	655.06	tetr. or amor. powd., yel
2	“ (ic)	HgI_2	454.45	rhomb. yel., cr. or powd
3	“ “	HgI_2	454.45	tetr. red, cr. or powd
4	nitrate (ous)	$Hg_2(NO_3)_2 \cdot 2H_2O$	561.26	monocl. col. effl
5	“ (ic)	$Hg(NO_3)_2 \cdot \frac{1}{2}H_2O$	333.63	wh.-yel. deliq. powd. or tr. cr
6	“ “	$Hg(NO_3)_2 \cdot H_2O$	342.64	col. cr. or wh. deliq. powd., pois
7	nitride	Hg_3N_2	629.85	br. powd
8	nitrite (ous)	$Hg_2(NO_2)_2$	493.24	yel
9	oxalate (ous)	$Hg_2C_2O_4$	489.24	
10	“ (ic)	HgC_2O_4	288.63	
11	oxide (ic) (montroydite)	HgO	216.61	rhomb. yel. or red, 2.37, 2.5, 2.65
12	oxybromide (ic)	$HgBr_2 \cdot 3HgO$	1010.27	yel. cr
13	oxychloride (ic)	$HgCl_2 \cdot 2HgO$	704.74	hex. red or monocl. blk
14	“ “	$HgCl_2 \cdot 3HgO$	921.35	hex. yel
15	oxycyanide (ic)	$Hg(CN)_2 \cdot HgO$	469.26	need. or wh. cr. powd
16	oxyfluoride (ic)	$HgF_2 \cdot HgO \cdot H_2O$	473.24	yel. cr
17	oxyiodide (ic)	$HgI_2 \cdot 3HgO$	1104.28	yel. br
18	*ortho*phosphate (ic)	$Hg_3(PO_4)_2$	791.79	wh.-yelsh. powd
19	selenide (ic) (tiemannite)	$HgSe$	279.57	gray plates
20	sulfate (ous)	Hg_2SO_4	497.29	monocl. col., wh.-yelsh. powd
21	“ (ic)	$HgSO_4$	296.67	rhomb. col. or wh. powd
22	“ , basic (ic)	$HgSO_4 \cdot 2HgO$	729.90	lem. yel. powd
23	sulfide (ous)	Hg_2S	433.29	blk
24	“ (ic) (α-) (cinnabar, vermilion)	HgS	232.68	hex. red cr. or powd., 2.854, 3.201
25	“ (ic) (β-) (metacinnabarite)	HgS	232.68	cub. blk. or amor. powd
26	tartrate (ous)	$Hg_2C_4H_4O_6$	549.29	yelsh.-wh. cr. powd
27	*ortho*tellurate (ic)	Hg_3TeO_6	825.44	cub. duodecahedron trans. amber
28	*ortho*tellurate	HgH_4TeO_6	428.25	ortho. rhomb., trans., floc
29	thiocyanate (ous)	$Hg_2(SCN)_2$	517.38	
30	“ (ic)	$Hg(SCN)_2$	316.78	wh. powd. pois
31	tungstate (ous)	Hg_2WO_4	649.14	yel. amor
32	“ (ic)	$HgWO_4$	448.53	yel
	Mercury-nitrogen compounds:			
	Mercury			
33	bromide (ic), ammonobasic	$Hg(NH_2)Br$	296.55	wh. powd
34	“ (ic), diammine	$Hg(NH_3)_2Br_2$	394.51	wh. powd
35	chloride (ic), ammonobasic (infusible white ppt.)	$Hg(NH_2)Cl$	252.09	wh. powd. or small pr
36	chloride (ic), aquobasic ammonobasic (chloride of Millon's base)	OHg_2NH_2Cl	468.70	pa. yel. or wh. powd
37	chloride (ic), diammine (fusible white ppt.)	$Hg(NH_3)_2Cl_2$	305.59	rhbdr
38	iodide (ic), ammonobasic	$Hg(NH_2)I$	343.55	dirty wh. cr
39	iodide (ic), aquobasic ammonobasic (iodide of Millon's base)	OHg_2NH_2I	560.16	yel. to br

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	7.70	subl. 140; 290 d.	310 d.	v. sl. s.	....	s. KI, NH_4OH; i. al., eth.
2	6.271; l. 5.24^{255}	259	354	v. sl. s.	sl. s.	v. sl. s. al.; s. eth., $Na_2S_2O_3$, KI
3	6.283	tr. 126–7; 259	354	$.0061^{25}$	sl. s.	1.8^{25} abs. al.; s. eth., acet., $Na_2S_2O_3$, alk. salts
4	4.79^4	70	....	d.	s. d.	s. dil. HNO_3; i. NH_4OH
5	4.39	79	d.	v. s.	d.	s. HNO_3, NH_3, acet.; i. al.
6	....	....	....	s.	....	s. HNO_3; i. al.
7	....	exp.	....	d.	....	d. a.; s. NH_4OH, NH_4 salts
8	7.33	d. 100	....	d.	....	....
9	....	....	....	i.	i.	sl. s. HNO_3
10	....	d.	....	$.0107^{20}$	....	s. HCl; sl. s. HNO_3
11	11.1^4	d. 500	....	$.0052^{25}$	$.0395^{100}$	s. a.; i. al., eth., acet., alk., NH_3
12	....	....	....	i.	sl. s.	v. s. al.
13	red 8.16–.43; blk. 8.53	....	....	....	....	....
14	7.93	d. 260	....	i.	d.	....
15	4.437^{19}	exp.	....	1.25	s.	....
16	....	d. 100	....	d.	....	s. dil. HNO_3
17	....	....	....	d.	....	s. HI
18	....	....	....	i.	sl. s.	s. a., NH_4Cl; i. al.
19	7.1–8.9	subl.	....	i.	....	s. aq. reg.
20	7.56	d.	d.	$.06^{25}$	$.09^{100}$	s. H_2SO_4, HNO_3
21	6.47	d.	....	d.	....	s. a., NaCl; i. al., acet., NH_3
22	6.44	....	volat.	$.003^{16}$	sl. s.	s. a.; i. al.
23	....	d. 0	....	i.	....	i. a., $(NH_4)_2S$
24	8.10	subl. 583.5	....	$.00001^{18}$	....	s. Na_2S, aq. reg.; i. HNO_3 al.
25	7.73	583.5	....	i.	....	s. Na_2S, aq. reg. alk.; i. HNO_3, al.
26	....	....	....	i.	....	i. a.
27	....	unalt. at 140	....	i.	i.	s. HNO_3, HCl
28	....	d. 20	....	slow d.	rapid d.	....
29	....	d.	....	i.	....	s. HCl, KCNS
30	....	d.	....	$.07^{25}$	s.	s. NH_4 salts, NH_3, HCl, KCN; sl. s. al., eth.
31	....	d.	....	i.	i.	d. a.; i. al.
32	....	d.	....	i.	d.	d. a.; i. al.
33	....	d.	....	i.-d.	....	i. al.; s. NH_4OH
34	....	180	....	d.	....	s. NH_4Br, NH_4Cl, NH_4I
35	5.70	infus.	....	0.14	d.^{100}	d. a.; i. al.
36	....	d.>120	....	sl. s.	....	s. HCl, HNO_3
37	....	300	....	i.	d.	s. a., KI
38	....	....	....	....	....	i. eth.
39	....	>128	exp.	i.	....	s. d. HCl, KI soln.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Mercury			
1	iodide (ic), diammine	$Hg(NH_3)_2I_2$	488.51	col. or pa. yel. powd. or need.
2	**Millon's base**	$(HO)_2Hg_2NH_2OH$	468.27	
3	**Molybdenum**	Mo	95.95	cub. silv.-wh. met. or gray-blk. powd.
4	boride (mono-)	MoB	106.77	tetragonal
5	" , (di-)	MoB_2	117.59	rhombohedral
6	(di-) boride	Mo_2B	202.72	tetragonal
7	bromide, di-	$MoBr_2$ (or Mo_3Br_6)	255.78	yel.-red
8	" , tri-	$MoBr_3$	335.70	dk. grn. need.
9	" , tetra-	$MoBr_4$	415.61	blk. need., deliq.
10	carbide, mono-	MoC	107.96	hex. blk.
11	(di-) carbide	Mo_2C	203.91	hex. blk.
12	carbonyl	$Mo(CO)_6$	264.01	cr. diamagnetic
13	chloride, di-	$MoCl_2$ (or Mo_3Cl_6)	166.86	amor. yel.
14	" , tri-	$MoCl_3$	202.32	dk. red need. or powd.
15	" , tetra-	$MoCl_4$	237.78	br. cr. or powd., deliq.
16	" , penta-	$MoCl_5$	273.24	gr.-blk. cr., deliq.
17	fluoride, hexa-	MoF_6	209.95	col. cr.
18	hydroxide	$Mo(OH)_3$ (or $Mo_2O_3{\cdot}3H_2O$)	146.97	blk. powd.
19	"	$MoO(OH)_3$ (or $Mo_2O_5{\cdot}3H_2O$)	162.97	br. to blk. powd.
20	hydroxy*tetra*bromide, di-	$Mo_3Br_4(OH)_2$	641.53	red powd.
21	" "	$Mo_3Br_4(OH)_2{\cdot}8H_2O$	785.66	golden-yel. cr.
22	hydroxy*tetra*chloride, di-	$Mo_3Cl_4(OH)_2{\cdot}2H_2O$	499.73	amor. pa. yel.
23	oxide, sesqui-	Mo_2O_3	239.90	blk. opaque (exist. quest.)
24	" , di-	MoO_2	127.95	tetr. or monocl. lead-gray
25	" , tri- (molybdic anhydride, molybdite)	MoO_3	143.95	rhomb. wh.-yelsh. or col.
26	oxide, pent-	Mo_2O_5	271.90	vlt.-bl. powd. (exist. quest.)
27	" ("molyb. blue")	$MoO_{2.5-3}{\cdot}xH_2O$		dk. blue coll.
28	oxy*di*bromide, di-	MoO_2Br_2	287.78	tabl. yel.-red, deliq.
29	oxy*tri*chloride	$MoOCl_3$	218.32	grn. cr.
30	oxy*tetra*chloride	$MoOCl_4$	253.78	grn. cr. deliq.
31	oxy*di*chloride, di-	MoO_2Cl_2	198.86	yelsh. wh. scaly cr.
32	oxy*penta*chloride, tri-	$Mo_2O_3Cl_5$	417.19	dk. br.-blk. cr., deliq.
33	oxy*hexa*chloride, tri-	$Mo_2O_3Cl_6$	452.64	ruby-red cr. or dp. vlt.
34	oxy*tetra*fluoride	$MoOF_4$	187.95	col.-wh. deliq.
35	*meta*phosphate	$Mo(PO_3)_3$	332.89	
36	phosphide	MoP (or Mo_2P_2)	126.93	gray-grn. cr. powd.
37	"	MoP_2	157.99	blk. powd.
38	sulfide, sesqui-	Mo_2S_3	288.10	steel gray need.
39	" , di- (molybdenite)	MoS_2	160.08	hex. blk. luster
40	" , penta-	Mo_2S_5	352.23	dk. br. powd.
41	" , tri-	MoS_3	192.13	red dk.-br.

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	d.	....	s. NH_4OH
2	4.083^{18}	....	....	....	....	....
3	10.2	2620 ± 10	4800	i.	i.	s. h. conc. HNO_3, H_2SO_4; sl. s. HCl; i. HF, dil. H_2SO_4, NH_3
4	8.65	....	....	....	....	....
5	7.12	....	....	....	....	....
6	9.26	....	....	....	....	....
7	$4.88^{17.5}$	....	....	i.	i.	s. alk.; i. a., aq. reg.
8	....	d.	....	i.	i.	d. alk., NH_3; i. a.
9	....	d.	volat.	v. s.	....	d. alk.
10	8.78	2692	....	i.	i.	sl. s. HNO_3, HF, h. H_2SO_4, HCl; i. alk. hyd.
11	9.18	2687	....	i.	....	sl. s. HNO_3, HF, h. H_2SO_4, HCl; i. alk.
12	1.96	d. 150	....	....	....	....
13	3.714^{25}	d.	....	i.	i.	s. HCl, H_2SO_4, NH_4OH, al., eth.
14	3.578^{25}	d.	....	i.	d. sl.	d. alk.; s. conc. H_2SO_4, HNO_3; v. sl. s. al., eth.; i. HCl
15	....	d.	....	d.	d.	d. al., eth.; s. conc. HNO_3, H_2SO_4, HCl
16	2.928	194	268	d.	d.	s. d. al., eth.; s. CCl_4, chl.; s. conc. HCl, conc. H_2SO_4, HNO_3
17	lq. 2.55	17	35	s. d.	d.	d. NH_3; s. NH_4OH, alk.
18	....	d.	....	....	....	sl. s. H_2SO_4, HCl; s. 30% H_2O_2
19	....	....	....	0.2 (coll.)	....	s. alk. carb.; s. a.; i. alk. hydroxides
20	....	....	....	....	....	s. alk.
21	....	d.	d.	....	....	d. HNO_3, alk.; s. HCl
22	....	....	....	i.	....	s. conc. a.; i. al.
23	....	....	....	i.	i.	i. a., alk., NH_4OH
24	6.47	....	....	i.	i.	sl. s. h. conc. H_2SO_4; i. $KHC_4H_4O_6$; i. alk., HCl, HF
25	$4.50^{19.5}$; 4.692 gm/cm³ at 21°C	795	subl.	0.1066^{18}	2.055^{70}	s. a., NH_4OH, alk. sulf.
26	....	....	....	....	....	s. h. H_2SO_4, HCl
27	....	....	....	s.	....	s. a., CH_3OH; i. $(CH_3)_2O$, chl., C_6H_6, CS_2, acet.
28	....	....	....	s.	....	....
29	....	....	subl. 100	d.	....	....
30	....	subl.	....	s.	....	....
31	3.31^{17}	subl.	....	s.	s.	s. al., eth.
32	....	melts eas.	subl.	s.	s.	....
33	....	d.	....	d.	....	s. eth.
34	3.0	98	180	s.	....	s. CCl_4, al., eth.; s. d. H_2SO_4
35	3.28	....	....	....	....	....
36	6.167	....	....	....	....	s. h. HNO_3
37	5.35^{25}	....	....	....	....	s. HNO_3, h. conc. H_2SO_4, aq. reg.; i. conc. HCl
38	5.91^{15}	d. 1100	volat. 1200	....	....	i. conc. HCl
39	4.80^{14}	1185	d. in air	i.	i.	s. h. H_2SO_4, aq. reg., HNO_3; i. dil. a., c. H_2SO_4
40	....	....	....	i.	i.	s. NH_4OH, alk., sulfides
41	....	d.	d.	sl. s.	s.	s. alk. sulfd., conc. KOH

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Molybdenum			
1	" , tetra-	MoS_4	224.19	brown powd
2	**Molybdic acid**	H_2MoO_4 (or $MoO_3 \cdot H_2O$)	161.97	hex.-wh. or sl. yelsh
3	" "	$H_2MoO_4 \cdot H_2O$ (or $MoO_3 \cdot 2H_2O$)	179.98	monocl. yel
4	**Neodymium**	Nd	144.27	yelsh. met
5	acetate	$Nd(C_2H_3O_2)_3 \cdot H_2O$	339.42	
6	bromate	$Nd(BrO_3)_3 \cdot 9H_2O$	690.16	hex. red
7	bromide	$NdBr_3$	384.02	grn. cr
8	carbide	NdC_2	168.29	hex. leaf. yel
9	chloride	$NdCl_3$	250.64	rose-vlt. pr
10	"	$NdCl_3 \cdot 6H_2O$	358.74	rhomb. red
11	hexaantipyrine *per*chlorate	$[Nd(C_{11}H_{12}N_2O)_6](ClO_4)_3$	1571.98	rose hex. cr
12	iodide	NdI_3	525.03	blk. cr. powd
13	molybdate	$Nd_2(MoO_4)_3$	768.39	tetr. 2.005
14	nitrate	$Nd(NO_3)_3 \cdot 6H_2O$	438.39	tricl
15	nitride	NdN	158.28	blk. powd
16	oxalate	$Nd_2(C_2O_4)_3 \cdot 10H_2O$	732.76	rose cr
17	oxide (neodymia)	Nd_2O_3	336.54	lt. bl. powd. red fluores
18	sulfate	$Nd_2(SO_4)_3 \cdot 8H_2O$	720.85	monocl. red, 1.541, 1.551, 1.562
19	sulfide	Nd_2S_3	384.72	olive grn. powd
20	**Neon**	Ne	20.18	col., wholly inert gas
21	**Nickel**	Ni	58.71	cub. silvery metal
22	acetate	$Ni(C_2H_3O_2)_2$	176.78	grn. pr
23	"	$Ni(C_2H_3O_2)_2 \cdot 4H_2O$	248.84	grn
24	antimonide (breithauptite)	$NiSb$	180.45	hex. lt. copper-red
25	*ortho*arsenate	$Ni_3(AsO_4)_2$	453.89	yelsh-grn. powd
26	arsenide (niccolite)	$NiAs$	133.60	hex
27	*ortho*arsenite, acid	$Ni_3H_6(AsO_3)_4 \cdot H_2O$	691.77	grn.-wh
28	benzenesulfonate	$Ni(C_6H_5SO_3)_2 \cdot 6H_2O$	481.11	green monocl
29	boride	NiB	69.51	pr
30	bromate	$Ni(BrO_3)_2 \cdot 6H_2O$	422.62	monocl
31	bromide	$NiBr_2$	218.52	yel.-br., deliq
32	"	$NiBr_2 \cdot 3H_2O$	272.57	yelsh-grn. need., deliq
33	bromoplatinate	$NiPtBr_6 \cdot 6H_2O$	841.51	trig
34	carbide	Ni_3C	188.08	
35	carbonate	$NiCO_3$	118.70	rhomb. lt. grn
36	" , basic (zaratite)	$NiCO_3 \cdot 2Ni(OH)_2 \cdot 4H_2O(?)$	376.18	cub. emerald grn., 1.56–1.61
37	" , basic	$2NiCO_3 \cdot 3Ni(OH)_2 \cdot 4H_2O$	587.58	lt. grn. cr. or br. powd
38	carbonyl	$Ni(CO)_4$	170.73	col. volat. inflamm. liq. or need
39	chlorate	$Ni(ClO_3)_2 \cdot 6H_2O$	333.70	dk. red
40	*per*chlorate	$Ni(ClO_4)_2 \cdot 6H_2O$	365.70	hex. need. grn., 1.55 av
41	chloride	$NiCl_2$	129.60	yel. sc. deliq
42	"	$NiCl_2 \cdot 6H_2O$	237.70	monocl. grn., deliq
43	chloropalladate	$NiPdCl_6 \cdot 6H_2O$	486.23	hex
44	chloroplatinate	$NiPtCl_6 \cdot 6H_2O$	574.76	trig
45	cyanide	$Ni(CN)_2$	110.73	
46	"	$Ni(CN)_2 \cdot 4H_2O$	182.79	lt. grn. pl. or powd., pois
47	di-*n*-butyldithiocarbamate (N B C)	$Ni[(C_4H_9)_2NCSS]_2$	467.44	dk. olive-gr. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	...	d.	...	i.	i.	s. alk. sulfd., h. H_2SO_4 i. a.
2	3.112	d. 115	...	sl. s.	sl. s.	s. alk., NH_4OH, H_2SO_4; i. NH_3
3	3.124^{15}	$-H_2O$, 70	d.	0.133^{18}	2.568^{70}	s. alk. hydx., alk. carb.; sl. s. acids
4	6.9	840	...	d.	...	...
5	...	...	...	26.2	...	...
6	...	66.7	$-9H_2O$, 150	151^{25}	...	...
7	...	...	...	sl. s.	...	...
8	5.15	d.	...	d.	d.	s. dil. a., H_2SO_4; i. conc. HNO_3
9	4.134^{25}	784	...	96.7^{13}	140^{100}	44.5 al.; i. eth., chl.
10	$2.282^{16.5}$	124	$-6H_2O$, 160	246^{13}	511^{100}	v. s. al.
11	...	285–9 d.	...	0.99^{20}	...	...
12	...	775 ± 3	...	...	...	...
13	5.14^{18}	1176	...	...	...	...
14	...	...	...	152.9^{25}	...	s. al., acet.
15	...	...	...	d.	...	...
16	...	...	...	$.000074^{25}$	...	...
17	7.24	...	...	$.00019^{29}$	...	s. a.
18	2.85	...	...	$8.^{20}$	5.4^{40}	...
19	5.179^{11}	d.	...	i.	d.	s. dil. a.
20	$.9002^{0}$ g/l; lq. $1.204^{-245.9}$	−248.67	−245.9	1.23^{0} cm^3; 1.16^{25} cm^3	1.08^{50} cm^3	s. liq. O_2
21	8.90	1455	2900	i.	i.	s. dil. HNO_3; sl. s. HCl, H_2SO_4; i. NH_3
22	1.798	d.	...	16.6	...	i. al.
23	1.744	d.	...	s.	...	s. al., i. abs. al.
24	7.54	1158	d. 1400	...	...	...
25	4.98	...	...	i.	...	s. a.
26	7.57^{0}	968	...	i.	i.	s. aq. reg.
27	...	d.	...	i.	...	s. a., alk.
28	1.628^{25}	$-H_2O$	d.	14.3^{18}	51.5^{82}	5.9 al.; 4.5 eth.
29	7.39^{18}	...	...	d.	d.	s. HNO_3, aq. reg.
30	2.575	d.	...	28	...	...
31	4.64^{28}	963	...	112.8^{0}	155.1^{100}	s. al., eth., NH_4OH
32	...	$-3H_2O$. 200	...	199^{0}	315.7^{100}	s. al., eth., NH_4OH
33	3.715	...	...	...	...	...
34	7.957^{25}	...	...	...	...	...
35	...	d.	...	0.0093^{25}	i.	s. a.
36	2.6	...	...	...	...	s. h. dil. HCl
37	...	d.	...	i.	d.	s. a., NH_4 salts
38	1.32^{17}	−25	43	$.018^{9.8}$	...	s. HNO_3, aq. reg., al., eth., chl., bz.; i. dil. a., alk.
39	2.07	d. 80	...	0.9^{27}	...	...
40	...	140	...	222.5^{0}	273.7^{45}	s. al., acet.; i. chl.
41	3.55	1001	973	64.2^{20}	87.6^{100}	s. al., NH_4OH; i. NH_3
42	...	...	...	254^{20}	599^{100}	v. s. al.
43	2.353	...	...	...	...	...
44	2.798	...	...	...	...	...
45	...	...	...	i.	i.	s. KCN
46	...	$-4H_2O$, 200	d.	i.	i.	s. KCN, NH_4OH, alk.; sl. s. dil. a.
47	1.29	89–90	...	...	...	i. H_2O, al.; sl. s. bz., pet., compounds

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Nickel			
1	dimethylglyoxime deriv., acid	$Ni(HC_4H_6N_2O_2)_2$	288.91	scarlet-red cr
2	ferrocyanide	$Ni_2Fe(CN)_6 \cdot xH_2O$		grn.-wh
3	fluogallate	$[Ni(H_2O)_6][GaF_5 \cdot H_2O]$	349.52	monocl. (?), pa. grn., n 1.45
4	fluoride	NiF_2	96.69	grn. quad
5	fluosilicate	$NiSiF_6 \cdot 6H_2O$	308.85	trig. grn., 1.391, 1.407
6	formate	$Ni(CHO_2)_2 \cdot 2H_2O$	184.76	grn. cr
7	hydroxide (ous)	$Ni(OH)_2$ (or $NiO \cdot xH_2O$	92.71	grn. amor. or. cr
8	iodate	$Ni(IO_3)_2$	408.53	yel. need
9	"	$Ni(IO_3)_2 \cdot 4H_2O$	480.59	hex
10	iodide	NiI_2	312.53	blk. deliq
11	nitrate	$Ni(NO_3)_2 \cdot 6H_2O$	290.80	monocl. grn., deliq
12	oleate	$Ni(C_{18}H_{33}O_2)_2$	621.58	grn. oil
13	oxalate	$NiC_2O_4 \cdot 2H_2O$	182.74	lt.-grn. powd
14	oxide, mon- (bunsenite)	NiO	74.69	cub. grn.-blk., 2.18 (red)
15	" , sesqui- (nickelic hydroxide)	$Ni_2O_3 \cdot xH_2O$		gray-blk. powd
16	*ortho*phosphate	$Ni_3(PO_4)_2 \cdot 8H_2O$	510.16	apple grn. pl. or emerald cr. gran
17	*pyro*phosphate	$Ni_2P_2O_7 \cdot xH_2O$		grn
18	(di-) phosphide	Ni_2P	148.36	gray cr
19	(tri-) phosphide, di-	Ni_3P_2	238.03	dk. grn.-blk
20	(penta-) phosphide, di-	Ni_5P_2	355.41	need. or tabl. cr
21	*hypo*phosphite	$Ni(H_2PO_2)_2 \cdot 6H_2O$	296.78	grn
22	selenate	$NiSeO_4 \cdot 6H_2O$	341.75	grn. tetr. ov. monocl., 1.539
23	selenide	$NiSe$	137.65	cub. wh. or gray
24	silicide	Ni_2Si	145.44	
25	stearate	$Ni(C_{18}H_{35}O_2)_2$	625.61	grn. powd
26	sulfate	$NiSO_4$	154.76	cub. yel
27	" (single nickel salt)	$NiSO_4 \cdot 6H_2O$	262.85	α tetr. blue; β monocl. grn., 1.511, 1.487
28	" (morenosite)	$NiSO_4 \cdot 7H_2O$	280.87	rhomb. grn., 1.467, 1.489, 1.492
29	sulfide, sub- (heazlewoodite)	Ni_3S_2	240.19	pa. yelsh. bronze, met. lust
30	" , mono- (millerite)	NiS	90.76	trig. or amor. blk
31	" (ous, ic) (polydymite)	Ni_3S_4	304.33	cub. gray-blk
32	sulfite	$NiSO_3 \cdot 6H_2O$	246.85	tetrah. grn
33	*di*thionate	$NiS_2O_6 \cdot 6H_2O$	326.92	grn. tricl
	Nickel complexes:			
34	Diaquotetramminenickel (II) nitrate	$[Ni(NH_3)_4(H_2O)_2(NO_3)_2]$	286.87	grn. cr
35	Tetrapyridinenickel (II) fluosilicate	$[Ni(C_5H_5N)_4]SiF_6$	517.14	rhomb. bl.-grn
36	Hexamminenickel (II) bromide	$[Ni(NH_3)_6]Br_2$	320.71	violet powd
37	Hexamminenickel (II) chlorate	$[Ni(NH_3)_6](ClO_3)_2$	327.80	
38	Hexamminenickel (II) chloride	$[Ni(NH_3)_6]Cl_2$	231.80	cub. bluish
39	Hexamminenickel (II) iodide	$[Ni(NH_3)_6]I_2$	414.72	cub. pa. blue
40	Hexamminenickel (II) nitrate	$[Ni(NH_3)_6](NO_3)_2$	284.90	oct. or cub. bl

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	subl. 250	....	i.	i.	s. abs. al., a.; i. ac. a., NH_4OH
2	1.892 (?)	....	....	i.	....	s. NH_4OH, KCN; i. HCl
3	2.45	$-5H_2O$, 110	....	sl. s.	....	s. HF
4	4.63	....	....	0.02	....	i. a., al., eth., NH_3
5	2.134	d.	....	v. s.	....	....
6	2.154	d.	....	s.	....	....
7	4.1	....	....	0.0013	....	s. a., NH_4OH
8	5.07	....	....	1.1^{30}	1.0^{90}	....
9	....	d. 100	....	1.4^{30}	1.1^{90}	....
10	5.834	797	....	124.2^{0}	188.2^{100}	s. al.
11	2.05	56.7	136.7	238.5^{0}	∞	s. al., NH_4OH
12	....	18–20	....	....	....	....
13	....	....	....	i.	....	s. a., NH_4 salts; v. sl. s. oxal. a.
14	7.45	1990	....	i.	i.	s. a., NH_4OH
15	4.83	$-O_2$, 600	to Ni_2O_3, 400	i.	i.	s. a., NH_4OH, KCN
16	....	d.	....	i.	i.	s. a., NH_4 salts; i. methyl and ethyl acetates
17	anh. 3.93^{25}	....	....	i.	....	s. a., NH_4OH
18	6.31^{15}	1112	....	i.	....	s. $HNO_3 + HF$; i. a.
19	5.99	....	....	i.	i.	s. HNO_3; i. HCl
20	....	1185	....	....	....	....
21	$1.82^{19.8}$	d. 100	....	s.	....	....
22	2.314	....	....	s.	....	....
23	8.46	....	....	i.	....	s. HNO_3, aq. req.; i. HCl
24	7.2^{17}	1309	....	i.	....	i. a.
25	....	100	....	i.	....	s. CCl_4, pyr. sl. s. acet.; i. CH_3OH, eth.
26	3.68	$-SO_3$, 840	....	29.3^{0}	83.7^{100}	i. al., eth. acet.
27	2.07	tr. 53.3	$-6H_2O$, 280	62.52^{0}	340.7^{100}	v. s. al., NH_4OH; 12.5 meth. al.
28	1.948	$-H_2O$, 31.5; 99	$-6H_2O$, 103	$75.6^{15.5}$	475.8^{100}	s. al.
29	5.82	....	....	i.	....	s. HNO_3
30	5.3–5.65	797	....	$.00036^{18}$	d.	s. HNO_3, KHS, aq. reg.; sl. s. a.
31	4.7	....	....	i.	....	s. HNO_3
32	....	....	....	i.	....	s. HCl, H_2SO_4
33	1.908	d.	....	....	....	....
34	....	....	....	s.	....	i. al.
35	2.307	....	....	....	....	....
36	1.837	....	....	v. s.	d.	....
37	1.52	180	....	giv. $Ni(NH_3)_4$	....	....
38	1.468^{25}	....	....	s.	d.	s. NH_4OH; i. al.
39	2.101	d.	....	d.	....	s. NH_4OH
40	....	....	....	4.46	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Niobium**	Nb	92.91	rhomb. steel gray lust. met., 1.80
2	boride, di-	NbB_2	114.55	hex
3	bromide, penta-	$NbBr_5$	492.49	purp. red
4	carbide	NbC	104.91	cub. blk. or lavender-gray powd
5	chloride, penta-	$NbCl_5$	270.20	yel.-wh., deliq
6	fluoride, penta-	NbF_5	187.91	monocl. pr., col
7	hydride	NbH	93.92	gray powd
8	nitride	NbN	106.92	cub. black
9	oxalate, hydrogen	$Nb(HC_2O_4)_5$	538.05	monocl. col
10	oxide, mon- (or di-)	NbO (or Nb_2O_2)	108.91	cub. blk
11	“ , di-	NbO_2	124.91	blk
12	“ , tri- (sesqui)	Nb_2O_3	233.82	bl.-blk
13	“ , pent-	Nb_2O_5	265.82	rhomb. wh
14	“ “ (niobicacid)	$Nb_2O_5 \cdot xH_2O$	....	wh. amor
15	oxybromide	$NbOBr_3$	348.66	yel. cr
16	oxychloride	$NbOCl_3$	215.28	need. col
17	**Nitric acid**	HNO_3	63.02	col. corros. pois. liq., $1.397^{16.4}$
18	**Nitrogen**	N_2	28.02	col. gas; col. liq. or cub. cr. at low temp.
19	chloride, tri-	NCl_3	120.38	yel. oil or rhomb. cr
20	fluoride, tri-	NF_3	71.01	col. gas
21	iodide, tri-	NI_3	394.77	blk
22	“ “ , monoammine	$NI_3 \cdot NH_3$	411.80	rhomb. dk. red
23	oxide (ous)	N_2O	44.02	col. gas. or liq. or cub. cr., 1.193^{16} lq.
24	“ (ic)	NO	30.01	col. gas; blue liq. and solid, liq. 1.330^{-90}
25	(di-) oxide, tri- (nitrous anhydride)	N_2O_3	76.02	red br. gas; bl. solid or liq
26	oxide, di- or tetr-	NO_2 (or N_2O_4)	46.01	col. solid (N_2O_4), yel. liq. or red-br. gas
27	“ , pent- (nitric anhydride)	N_2O_5	108.02	hex. (rhomb.) wh
28	“ , tri-	NO_3	62.01	bluish gas
29	**Nitrosyl** bromide	NOBr	109.92	br. gas or dk. br. liq
30	chloride	NOCl	65.47	yel. gas or yel.-red liq. or cr
31	fluoride	NOF	49.01	col. gas
32	**Nitrosylsulfuric acid** (chamber crystals)	$NOHSO_4$	127.08	rhomb. col
33	**Nitrosylsulfuric anhydride**	$(NOSO_3)_2O$	236.15	tetr
34	**Nitrous acid**	HNO_2	47.02	known only in solution (pa. blue)
35	“ “ , hypo-	$H_2N_2O_2$	62.03	wh. sld
36	**Nitryl** chloride	NO_2Cl	81.47	pa. yel. br. gas
37	fluoride	NO_2F	65.01	col. gas and solid
38	**Osmium**	Os	190.20	hex. gray-bl. met
39	chloride, di-	$OsCl_2$	261.11	dk. br., deliq
40	“ , tri-	$OsCl_3$	296.57	cub. br
41	“ “	$OsCl_3 \cdot 3H_2O$	350.62	dk. grn. cr

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	8.55	2500 ± 50	3700	i.	i.	s. h. H_2SO_4; sl. s. HF; i. HCl, HNO_3
2	6.97	2900 (?)	....	....	....	....
3	....	150	270	d.	....	s. al., ethyl bromide
4	7.82	*ca.* 3900	....	i.	....	i. a. exc. Hf and HNO_3
5	2.75	194	240.5	d.	....	s. HCl_4, CCl_4, al.
6	3.92	72	220 (approx.)	s. d.	....	s. al.; sl. s. CS_2, chl., H_2SO_4,
7	6.6	infus.	....	....	....	s. HF, conc. H_2SO_4; i. HCl HNO_3, alk.
8	8.4	2573	....	i.	....	s. HF + HNO_3; i. HNO_3
9	....	....	....	d.	d.	s. $H_2C_2O_4$; d. al.
10	6.27	....	....	i.	i.	s. a., alk.; i. al., HNO_3
11	....	....	....	i.	i.	sl. s. alk.; i. a.
12	....	1780	....	....	....	....
13	4.47	1520	....	i.	i.	s. HF, alk.; i. other acids
14	....	d.	....	i.	....	s. conc. H_2SO_4, conc. HCl, HF, alk.; i. NH_3
15	....	subl.	....	d.	....	s. a.
16	10.19^{100} g/l	subl. 400	....	s. d.	d.	s. H_2SO_4, al.; i. HCl
17	1.502	−42	86	∞	∞	d. al. viol.; s. eth.
18	1.2506^{0} g/l; lq. 0.808$^{-195.8}$; s. 1.026$^{-252.5}$	−209.86	−195.8	2.33^{0} cm^3	1.42^{40} cm^3; 1.32^{60} cm^3	sl. s. al.
19	1.653	<−40	<71, exp. 95	i.	d.	s. chl., bz., CCl_4, CS_2, PCl_3
20	liq. 1.537^{-129}	−216.6	−120	v. sl. s.	....	....
21	....	exp.	subl. vac.	i.	d.	s. $Na_2S_2O_3$, KCNS
22	3.5	d.>20	exp.	i.	d.	s. HCl, KCN, $Na_2S_2O_3$; i. abs. al.
23	1.977 g/l; lq. 1.226^{-89}	−102.4	−88.49	130.0^{0} cm^3; 87.4^{10} cm^3	56.7^{25} cm^3	s. al., eth., H_2SO_4
24	1.3402 g/l; lq. 1.269$^{-150.2}$	−163.6	−151.8	7.34^{0} cm^3	2.37^{60} cm^3	3.5 cm^3 H_2SO_4, 26.6 cm^3 al.; s. $FeSO_4$, CS_2
25	1.447^{2}	−102	3.5 d.	s.	d.	s. alk., a., eth.
26	1.491^{0}	−9.3	21.3 d.	s. d.	....	s. alk., CS_2, chl.
27	1.642^{18}	30	47 d.	s.	d. to HNO_3	s. chl.
28	....	d. sly. at ord.	temp.	....	....	s. eth.
29	>1.0	−55.5	−2	i. d.	d.	s. alk.
30	2.99 g/l; lq. 1.417^{-12}	−64.5	−5.5	d.	d.	s. fuming H_2SO_4
31	2.176 g/l	−134	−56	s. d. to H	NO_2+HF	....
32	....	73	....	d.	....	s. H_2SO_4
33	....	217	360	d.	....	s. H_2SO_4
34	....	....	....	....	....	....
35	....	exp.	....	s.	....	....
36	2.57 g/l; lq. 1.32^{14}	<−31	5	d.	....	....
37	2.90 g/l	−139	−63.5	d.	....	d. al., eth., chl.
38	22.48	2700	>5300	i.	i.	sl. s. HNO_3, aq. reg.; i. NH_3
39	....	d.	....	i.	sl. d.	s. al., eth., HNO_3; sl. s. alk.
40	....	d. 560–600	....	v. s.	....	s. a., alk., al.; sl. s. eth.
41	....	d.	....	v. s.	....	s. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Osmium			
1	chloride, tetra-	$OsCl_4$	332.03	red br. need
2	fluoride, tetra-	OsF_4	266.20	br. powd
3	" , hexa-	OsF_6	304.20	grn. cr
4	" , octa-	OsF_8	342.20	citron yel. cr
5	oxide, mon-	OsO	206.20	blk
6	" , sesqui-	Os_2O_3	428.40	dk. br
7	" , di-	OsO_2	222.20	cub. or hex. red-br
8	" , tetra-	OsO_4	254.20	(a) monocl. col (b) yel. mass
9	sulfide, di-	OsS_2	254.33	cub. blk
10	" , tetra-	OsS_4	318.44	br. blk
11	sulfite	$OsSO_3$	270.26	bl. blk
12	**Oxygen**	O_2	32.00	col. gas or liq. or hex. cr
13	fluoride	OF_2	54.00	col. gas unst
14	**Ozone**	O_3	48.00	col. gas or dk. bl. liq
15	**Palladium**	Pd	106.70	cub. silv.-wh. met
16	bromide	$PdBr_2$	266.53	red-br
17	chloride	$PdCl_2$	177.61	cub. need., dk. red, deliq
18	"	$PdCl_2\cdot 2H_2O$	213.65	br. prisms, deliq
19	cyanide	$Pd(CN)_2$	158.74	yelsh.-wh
20	fluoride, di-	PdF_2	144.70	br
21	" , tri-	PdF_3	163.70	rhomb. blk
22	hydride	Pd_2H (or Pd_4H_2)	428.82	silv. metallic (exist. quest)
23	iodide	PdI_2	360.54	blk. powd
24	nitrate	$Pd(NO_3)_2$	230.72	rhomb. br.-yel., deliq
25	oxide, mon-	PdO	122.70	blk.-grn. or amber mass or blk. powd
26	" , mon-	$PdO\cdot xH_2O$		yel. to br
27	" , di-	$PdO_2\cdot xH_2O$		dull red
28	selenide	$PdSe$	185.66	dk. gray
29	silicide	$PdSi$	134.76	cr
30	sulfate	$PdSO_4\cdot 2H_2O$	238.80	red-br. cr., deliq
31	sulfide, sub-	Pd_2S	245.47	grn. gray (exist. quest.)
32	" , mono-	PdS	138.77	brn. blk
33	" , di-	PdS_2	170.82	dk.-br
34	**Palladium complexes:** Diamminepalladium (II) hydroxide	$[Pd(NH_3)_2(OH)_2]$	174.78	micr.-cr. yel
35	Dichlorodiamminepalladium (II), *trans*- (or α-)	$[Pd(NH_3)_2Cl_2]$	211.68	tetr. yel
36	Tetramminepalladium (II) chloride	$[Pd(NH_3)_4]Cl_2\cdot H_2O$	263.76	tetrag. col
37	**Phospham**	PN_2H	60.00	wh. amor
38	**Phosphomolybdic acid**	$H_3PMo_{12}O_{40}\cdot 14H_2O$	2077.63	yelsh. cr
39	" "	$H_3PMo_{12}O_{40}\cdot 30H_2O$	2365.89	oct. yel
	Phosphonium			
40	bromide	PH_4Br	114.93	cub. col
41	chloride	PH_4Cl	70.47	cub. col

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	subl.	....	sl. s. d.	....	i. al.
2	....	....	....	d.	d.	....
3	....	>50	205	d.	d.	....
4	....	34.4	47.3	s. d.	s. d.	s. KF aq.
5	....	....	....	i.	i.	i. a.
6	....	d.	....	i.	i.	i. a.
7	7.91^{22}	d. 650	....	i.	i.	i. a.
8	4.906^{22}	(a) 39.5 (b) 41	130	5.07^{0}	6.23^{25}	v. s. CCl_4; s. al., eth., NH_4OH, $POCl_3$
9	....	d.	....	i.	i.	i. alk.
10	....	d.	....	i.	....	s. dil. HNO_3; i. $(NH_4)_2S$
11	....	d.	....	i.	....	s. dil. HCl, alk.
12	1.429^{0} g/l; lq. 1.14^{-183}; s. $1.426^{-252.5}$	−218.4	−182.96	4.89^{0} cm^3; 3.16^{25} cm^3	2.46^{50} cm^3; 2.30^{100} cm^3	2.78^{25} cm^3 al.; s. fus. Ag
13	lq. $1.90^{-223.8}$	−223.8	−144.8	sl. s. d.	i.	sl. s. a. alk.
14	2.144 g/l (g); 1.571^{-183} g/ml (lq.)	$-192.1 \pm .1$°C	−111.9	49^{0} cm^3	....	s. alk. solns., oils
15	11.97^{0}; $11.40^{22.5}$	1549.4	*ca.* 2200	i.	i.	s. aq. reg., h. HNO_3. H_2SO_4; sl. s. HCl
16	....	d.	....	i.	i.	s. HBr
17	....	500 d.	....	s.	s.	s. HCl, acet.
18	....	d.	....	v. s.	v. s.	s. HCl, acet.
19	....	d.	....	i.	i.	s. KCN, NH_4OH; i. dil. a.
20	....	volat.	d. red heat	sl. s.	....	s. HF
21	5.06	d.	d.	d.	d.	s. HF
22	10.76	d.	....	....	....	....
23	....	d. 350	....	i.	i.	s. KI; i. al., eth., dil. HCl
24	....	d.	....	s. d.	....	s. HNO_3
25	8.31	d. 750	....	i.	i.	sl. s. h. a.
26	....	d.	....	i.	i.	s. a., NH_3, NH_4Cl
27	....	d. $-H_2O$, $-O$	....	i.	i.	s. a., alk.
28	....	<960	....	i.	....	....
29	7.31^{15}	....	....	i.	....	....
30	....	d.	....	v. s.	d.	....
31	7.303^{15}	d. 800	....	i.	i.	sl. s. a., aq. reg.
32	....	950 d.	....	i.	i.	s. HNO_3, aq. reg.; i. HCl, $(NH_4)_2S$
33	....	d.	....	i.	i.	s. aq. reg., $(NH_4)_2S$
34	....	>105	....	v. s.	d.	....
35	2.5	d.	....	0.304^{10}	s. d.	s. a. (dec.), NH_4OH
36	1.91^{18}	d. 120	....	v. s.	....	....
37	....	infus.	....	i.	d.	s. conc. H_2SO_4; i. a. alk.
38	....	....	....	s.	....	s. al., eth.
39	....	$-H_2O$, 104; 78	....	....	....	....
40	g. 2.464 g/l	....	38.8^{794}; subl. *ca.* 30	d.	d.	....
41	....	$28^{46\ \text{atm.}}$	subl.	d.	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Phosphonium			
1	iodide	PH_4I	161.93	tetr. col. deliq
2	sulfate	$(PH_4)_2SO_4$	166.09	cr. col. deliq
	Phosphoric acid,			
3	" " ortho-	H_3PO_4	98.00	col. liq. or rhombic cr. deliq
4	" " "	$2H_3PO_4 \cdot H_2O$	214.02	hex. pointed pr. col., deliq
5	" " , pyro-	$H_4P_2O_7$	177.99	col. need. or liq., hyg
6	" " meta-	HPO_3	79.99	vitreous col. deliq
7	" " hypo-	$H_4P_2O_6$	161.99	cr
	Phosphorous acid,			
8	ortho-	$H_2(HPO_3)$	82.00	col.-yel., deliq. cr
9	" " , pyro-	$H_4P_2O_5$	145.99	need
10	" " , meta-	HPO_2	63.99	feather like cr
11	" " , hypo-	$H(H_2PO_2)$	66.00	col. oily liq. or deliq. cr
12	**Phosphorus,** yellow	P_4	123.92	cub. col.-yelsh. wax-like solid, 2.144.
13	" , red	P_4	123.92	cub. redsh.-br. or amor. red br. powd. (mixt. of col. and violet?)
14	" , violet	P_4	123.92	monocl. violet
15	" , black	P_4	123.92	blk. incombust
16	bromide, tri-	PBr_3	270.73	col. fum. liq., $1.697^{26.6}$
17	" , penta-	PBr_5	430.56	rhomb. yel
18	" (mono-) chloride, tetra-	$PBrCl_4$	252.72	yel. cr
19	" (di-) chloride, tri-	PBr_2Cl_3	297.18	or. cr
20	" (hepta-) chloride, di-	PBr_7Cl_2	661.31	pr
21	" (octa-) chloride, tri-	PBr_8Cl_3	776.68	br. need
22	" (di-) fluoride, tri-	PBr_2F_3	247.81	pa. yel
23	" " nitride	$(PNBr_2)_3$	614.46	rhomb. col
24	chloride, di-	PCl_2 (or P_2Cl_4?)	101.89	col
25	" , tri-	PCl_3	137.35	col. fum. liq., 1.516^{14}
26	" , penta-	PCl_5	208.27	tetr. yelsh.-wh., fum
27	" (di-) fluoride, tri-	PCl_2F_3	158.89	
28	" (tri-) iodide, di-	PCl_3I_2	391.19	hex. red
29	" (di-) nitride	$(PNCl_2)_3$	347.71	rhomb
30	" " "	$(PNCl_2)_4$	463.61	
31	" " "	$(PNCl_2)_5$	579.51	
32	" " "	$(PNCl_2)_6$	695.41	
33	" nitride	$P_6N_7Cl_9$	603.05	tr. rhomb. pr
34	cyanide	$P(CN)_3$	109.03	wh. need
35	fluoride, tri-	PF_3	87.98	col. gas
36	, penta-	PF_5	125.98	col. gas

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.86	subl. 61.8	80	d.	....	s. d. a., alk.
2	....	....	....	d.	....	....
3	1.834^{18}	42.35	$-\frac{1}{2}H_2O$, 213	548	v. s.	s. al.
4	....	29.32	d.	v. s.	....	....
5	....	61	....	709^{23}	d. to H_3PO_4	v. s. al., eth.
6	2.2–.5	subl.	....	d. to H_3PO_4	d.	s. al.; i. liq. CO_2
7	....	55	d. 100	s.; d. sly. to H_3PO_3 + HPO_3	d.>30	....
8	$1.651^{21.2}$	73.6	d. 200	309^{0}	694^{40}	s. al.
9	....	38	d. 130	d.	....	....
10	....	....	....	d.	....	....
11	1.493^{19}	26.5	d.	s.	v. s.	v. s. al., eth.
12	1.82	44.1; ign. 34	280	$.0003^{15}$	sl. s.	0.3 al., 880^{10} CS_2, s. bz. NH_3, alk., eth., chl.
13	2.20	590^{43} atm.	ign. >200; 280	i. (v. sl. s.)	i.	s. abs. al.; i. CS_2, eth., NH_3
14	2.36	593	....	i.	....	i. a., org. solv.
15	2.70	....	....	....	....	i. CS_2, c. H_2SO_4
16	2.852^{15}	−40	172.9	d.	....	d. al.; s. eth., chl., CS_2, CCl_4
17	....	<100 d.	106 d.	d.	....	s. CS_2, CCl_4, bz.
18	....	....	....	d.	....	....
19	....	35 d.	....	d.	....	....
20	....	....	....	d.	....	s. PCl_3, PCl_5
21	....	25	....	d.	....	....
22	....	−20	d. 15	d.	....	d. glass
23	....	190	subl. 150 vac.	i.	....	s. eth.; sl. s. CS_2, chl.
24	....	−28	180	hydr.	....	....
25	1.574^{21}	−91 (−111.8)	75.5^{749}	d.	d.	s. eth., bz., chl., CS_2, CCl_4
26	g. 4.65^{296} g/l	166.8 (press) sl. d.	subl. 162	d.	....	d. a.; s. CCl_4, CS_2
27	....	....	−8; d. 200	....	....	....
28	....	....	....	d.	....	s. CS_2
29	1.98	114	256.5	i.	d.	s. al., eth., chl., CS_2, bz. ac. a.
30	$2.18\frac{24}{24}$	123.5	328.5	....	....	....
31	....	41	224^{13}; polymer. >250	....	....	....
32	....	90	262^{13}; polymer. >250	....	....	....
33	....	237.5	$251–261^{13}$	....	....	....
34	....	subl. 130	....	d.	....	v. s. eth.; sl. s. h. bz.
35	3.907 g/l	−160	−95	d.	....	d. alk.; s. al.
36	5.805 g/l	−93.7	−84.5	d.	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Phosphorus			
1	iodide, di-	P_2I_4	569.64	tricl. or
2	" , tri-	PI_3	411.74	hex. red, deliq
3	nitride	P_3N_5	162.98	amor. wh
4	oxide, tri-	P_2O_3 (or P_4O_6)	109.96	monocl. col. or wh. powd., deliq
5	" , tetra-	P_2O_4	125.96	rhomb. col., deliq
6	" , pent- (phosphoric anhydride)	P_2O_5 (or P_4O_{10})	141.96	monocl. or wh. powd., v. deliq
7	oxybromide	$POBr_3$	286.73	col. pl
8	" chloride, di-	$POBrCl_2$	197.81	tabl. or liq
9	oxychloride	$POCl_3$	153.35	col. fum. liq., $1.460^{25\,1}$
10	"	$P_2O_3Cl_4$	251.79	col. fum. liq
11	oxy*di*bromide chloride	$POBr_2Cl$	242.27	
12	oxyfluoride	POF_3	103.98	col. gas
13	oxynitride	PON	60.99	amor. wh
14	oxysulfide	$P_4O_6S_4$	348.18	tetr., deliq
15	(tetra-) selenide, tri-	P_4Se_3	360.80	or.-red cr
16	selenide, penta-	P_2Se_5	456.76	dk. red-blk. need
17	(tetra-) sulfide, tri- ("sesquisulfide")	P_4S_3	220.12	rhomb. yel
18	(tetra-) sulfide, hepta	P_4S_7	348.39	lt. yel. cr
19	" , penta-	P_2S_5 (or P_4S_{10})	222.29	gray-yel. cr. deliq
20	thiocyanate	$P(SCN)_3$	205.23	liq
21	**Phosphoramide** (phosphoryl amide)	$PO(NH_2)_3$	95.05	amor. wh
22	**Phosphotungstic acid**	$H_3PW_{12}O_{40}\cdot 14H_2O$	3133.27	tricl. yel.-grn. cr
23	" "	$H_3PW_{12}O_{40}\cdot 24H_2O$	3313.43	trig
24	**Platinum**	Pt	195.09	cub. silv. metal
25	arsenide (sperrylite)	$PtAs_2$	345.05	cub. tin wh
26	bromide, di- (ous)	$PtBr_2$	355.06	br
27	" , tetra- (ic)	$PtBr_4$	514.89	dk. br
28	chloride, di- (ous)	$PtCl_2$	266.14	olive-grn
29	" , tri-	$PtCl_3$	301.60	grnsh.-blk
30	" , tetra (ic)	$PtCl_4$	337.06	br.-red cr
31	" " "	$PtCl_4\cdot 5H_2O$	427.14	monocl. red
32	cyanide (ous)	$Pt(CN)_2$	247.27	yel. br. cr
33	fluoride, di- (ous)	PtF_2	233.23	yelsh.-grn
34	" , tetra- (ic)	PtF_4	271.23	deep red, fused mass or yel.-lt. br. cr., deliq
35	hydroxide (ous)	$Pt(OH)_2$	229.25	blk
36	" "	$Pt(OH)_2\cdot 2H_2O$	265.28	
37	iodide, di- (ous)	PtI_2	449.07	blk
38	" , tetra- (ic)	PtI_4	702.91	amor. br. or blk. cr
39	oxide, mon- (ous)	PtO	211.23	vlt. blk
40	" " "	$PtO\cdot 2H_2O$	247.26	
41	" (ous, ic)	Pt_3O_4	649.69	blk
42	" , sesqui	$Pt_2O_3\cdot xH_2O$		br
43	" , di- (ic)	PtO_2	227.23	blk
44	" " "	$PtO_2\cdot H_2O$	245.25	blk

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	124.5	d.	d.	....	s. CS_2
2	....	61	d.	d.	d.	v. s. CS_2
3	2.51^{18}	....	d. 800	i.	v. sl. s. d.	i. any solv.
4	2.135^{21}	23.8	173	d. to H_3PO_3	d.	s. CS_2, eth., chl., bz.
5	2.54^{23}	>100	subl. 180	v. s. to H_3PO_3	d.	....
6	2.39	563	subl. 347	d. to H_3PO_4	d.	s. H_2SO_4; i. acet., NH_3
7	2.822	56	193	d.	....	s. H_2SO_4, CS_2, eth., bz., chl.
8	liq. 2104^{14}	13	137.6	d.	....	....
9	1.675	2	105.3	d.	d.	d. al., a.
10	lq. 1.58^{7}	<−50	212	d.	....	....
11	lq. 2.45^{50}	30	165	d.	....	....
12	4.69 g/l	−68	−39.8	d.	....	d. al.
13	....	red heat	....	i.	i.	i. a., alk.
14	....	102	295	d.	....	$50CS_2$
15	1.31	242	360–400	....	....	....
16	....	d.	....	d.	....	s. CCl_4; i. CS_2
17	2.03	172.5	407.5	i.	d.	$60CS_2$; s. bz., PCl_3, HNO_3; i. HCl, H_2SO_4
18	2.19^{17}	310	523	....	....	sl. s. CS_2; i. most solv.
19	2.03	276	514	d.	....	$0.22CS_2$; s. alk.
20	1.625^{18}	*ca.* −4	265	d.	....	s. al., eth., CS_2, bz.
21	....	d.	....	i.	i.	s. al.; i. a.
22	....	....	....	s.	....	s. al., eth.
23	....	89	....	s.	....	....
24	21.45	1773.5	4300	i.	i.	s. aq. reg., fus. alk.
25	10.602	>800 d.	....	i.	....	i.
26	6.65	d. 250	....	i. (v. sl. s.)	i.	s. HBr, KBr, Br aq.
27	5.69	d. 180	....	0.41^{20}	sl. s.	v. s. al., eth., HBr
28	5.87^{11} (6.05)	d. 581	....	i. (v. sl. s.)	i.	s. HCl, NH_4OH; sl. s. NH_3; i. al., eth.
29	5.256^{25}	435	....	sl. s.	s.	v. sl. s. conc. HCl; s. h. HCl
30	....	d. 370	....	v. s.	v. s.	s. acet.; sl. s. al., NH_3; i. eth.
31	2.43 ($8H_2O$)	$-H_2O$, 100	....	v. s.	v. s.	s. al., eth.
32	....	....	....	i.	i.	s. KCN; i. a., alk., al.
33	....	....	....	i.	i.	....
34	....	d.	....	s. d.	v. s.	s. a., alk.
35	....	d.	....	i.	i.	s. HCl, HBr, alk.; i. H_2SO_4, dil. HNO_3
36	....	$-2H_2O$, 100	....	i.	i.	s. conc. a.
37	6.4	d. 300–350	....	i.	i.	s. HI; sl. s. Na_2SO_3; i. a.
38	6.064^{25}	d. 370	....	s. d.	....	s. al., alk., acet., HI, KI, NH_3
39	14.9^{15}	d. 550	....	i.	i.	s. HCl, H_2SO_3; i. a., aq. reg.
40	....	....	....	....	....	s. conc. HCl, H_2SO_4, HNO_3
41	....	d.	....	i.	....	i. a., aq. reg.
42	....	....	....	i.	i.	s. conc. H_2SO_4, caust. alk.
43	....	450	....	i.	i.	i. a., aq. reg.
44	....	....	....	i.	i.	sl. s. NaOH; i. ac. a., aq. reg., HCl

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Platinum			
1	oxide, di-, (ic) (platinic hydroxide)	$PtO_2\cdot 2H_2O$ (or $Pt(OH)_4$)	263.26	yel.-br.-rose
2	oxide, di- (ic)	$PtO_2\cdot 3H_2O$	281.28	ochre
3	" " " (hydroxoplatinic acid)	$PtO_2\cdot 4H_2O$ (or $H_2Pt(OH)_6$)	299.29	yel. need
4	oxide, tri-	PtO_3	243.23	rdsh.-brn. powd
5	*pyro*phosphate	PtP_2O_7	369.27	grn.-yel
6	sulfate	$Pt(SO_4)_2\cdot 4H_2O$	459.41	yel. pl
7	sulfide, mono- (ous)	PtS	227.29	blk
8	" , sesqui-	Pt_2S_3	486.66	gray (exist. quest.)
9	" , di- (ic)	PtS_2	259.36	blk.-br. powd
	Platinum complexes:			
10	Tetrammineplatinum (II) chloride	$[Pt(NH_3)_4]Cl_2\cdot H_2O$	352.29	tetrag. col., 1.672, 1.667
11	Tetrammineplatinum (II) chloroplatinite (Magnus' salt)	$[Pt(NH_3)_4]PtCl_4$	600.42	tetrag. grn. or red
12	Tetrachlorodiammineplatinum (IV), *cis-*	$[Pt(NH_3)_2Cl_4]$	371.12	rhomb. or hex. pl. or need. or.-yel
13	Tetrachlorodiammineplatinum (IV), *trans-*	$[Pt(NH_3)_2Cl_4]$	371.12	oct. or quad. yel. pl
14	**Plumbous, Plumbic**	See *Lead*		
15	**Potassium**	K	39.10	cub. silv. metal
16	acetate	$KC_2H_3O_2$	98.14	lust. wh. powd., deliq
17	" , acid	$KC_2H_3O_2\cdot HC_2H_3O_2$	158.19	need. or pl
18	acetylsalicylate	$KC_9H_7O_4\cdot 2H_2O$	254.27	
19	*meta*aluminate	$KAlO_2\cdot 1\frac{1}{2}H_2O$	125.09	col. cr
20	aluminosilicate (microcline)	$KAlSi_3O_8$ (or $K_2O\cdot Al_2O_3\cdot 6SiO_2$)	278.25	tricl. 1.522, 1.526, 1.530
21	" (muscovite, white mica)	$KAl_3Si_3O_{10}(OH)_2$ (or $K_2O\cdot 3Al_2O_3\cdot 6SiO_2\cdot 2H_2O$)	398.20	col. monocl.; 1.551, 1.587, 1.581
22	" (orthoclase)	$KAlSi_3O_8$ (or $K_2O\cdot Al_2O_3\cdot 6SiO_2$)	278.25	monocl. 1.518, 1.524, 1.526
23	aluminum borate, basic	$K(AlO)_2(BO_2)_3$	253.50	cub. wh., 1.6935
24	" sulfate (kalinite)	$KAl(SO_4)_2\cdot 12H_2O$	474.39	cub. or monocl. col., 1.4562, 1.430, 1.452, 1.458
25	amide, (potassamide)	KNH_2	55.12	col.-wh. or yel.-grn
26	ammonium tartrate	$KNH_4C_4H_4O_6$	205.21	wh. cr. powd
27	antimonate, hydroxo- ("*pyro-*"antimonate)	$KSb(OH)_6\cdot\frac{1}{2}H_2O$	271.91	gran., wh. cr. powd
28	antimonide	K_3Sb	239.05	yel.-grn
29	antimony tartrate (tartar emetic)	$KSbC_4H_4O_7\cdot\frac{1}{2}H_2O$	333.94	rhomb. col., 1.620, 1.636, 1.638
30	*ortho*arsenate	K_3AsO_4	256.20	col. deliq. need
31	" , mono-H	K_2HAsO_4	218.11	col. cr
32	" , di-H	KH_2AsO_4	180.02	tetr. col., 1.567, 1.518
33	*ortho*arsenite	K_3AsO_3	240.20	col. need
34	*meta*arsenite	$KAsO_2$	146.01	wh. powd, hyg
35	" , acid	$KH(AsO_2)_2\cdot H_2O$	271.94	
36	aurate	$KAuO_2\cdot 3H_2O$ (or $2H_2O$)	322.34	lt. yel. need
37	azide	KN_3	81.12	col
38	benzoate	$KC_7H_5O_2\cdot 3H_2O$	214.25	wh. cr. powd
39	*di*borane (diboranide)	$K_2B_2H_6$	105.88	wh. cubical cr., 1.493

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Cold water	Hot water	Alcohol, acids, etc.
1	....	$-2H_2O$, 100	....	i.	i.	s. HCl, aq. reg., KOH
2	....	d.	....	i.	i.	i. HCl, aq. reg.
3	....	$-2H_2O$, 100; $-3H_2O$, 120	....	i.	i.	s. a., dil. caust. alk.
4	....	....	....	....	....	s. HCl, H_2SO_3; sl. s. HNO_3 H_2SO_4
5	4.85	d. 600	....	v. sl. s.	....	....
6	....	....	....	s.	d.	s. a., al., eth.
7	8.847	d.	....	i.	i.	s. $(NH_4)_2S$; i. a., alk.
8	5.52	d.	....	i.	i.	slowly s. aq. reg.; i. a.
9	7.22	d. 225–250	....	i.	i.	s. HCl, HNO_3; i. $(NH_4)_2S$
10	2.737	250; $-H_2O$, 100	....	....	....	....
11	<4.1	d.	....	sl. s.	sl. s.	....
12	....	240	....	....	....	....
13	3.3	200–216	....	....	....	....
14	....	....	....	....	....	....
15	0.86^{20}; 0.83^{62}	62.3	760	d. to $KOH + H_2$	d.	d. al.; s. a., Hg, NH_3
16	1.8	292	....	253^{20}; 286.3^{31}	492^{62}	33 al.; i. eth.
17	....	148	d. 200	d.	d.	s. al., acet.
18	....	65	....	....	....	....
19	....	....	....	v. s., d.	v. s., d.	s. alk.; i. al.
20	2.54–.57	....	....	....	....	....
21	2.76–.80	d.	....	i.	....	....
22	2.56	....	....	....	....	....
23	3.415	<1800	....	i.	i.	sl. s. HCl
24	1.75	92 (84.5)	$-9H_2O$, 64.5	11.4^{20}	∞	s. dil. a.; i. al.
25	....	335	subl. 400	d.	d.	d. al.
26	....	....	....	v. s.	....	....
27	....	....	....	2.82^{20}	s.	....
28	....	812	....	d.	....	d. in air
29	2.607	$-\frac{1}{2}H_2O$, 100	....	$5.26^{8.7}$	35.7^{100}	i. al.; 6.67^{25} glyc.
30	....	....	....	18.87	v. s.	4 al.
31	....	....	....	18.86^{6}	s.	i. al.
32	2.867	288	....	19^{6}	v. s.	i. al.
33	....	....	....	v. s.	....	s. al.
34	....	....	....	s.	s.	sl. s. al.
35	....	....	....	s.	....	sl. s. al.
36	....	d.	....	s.	d.	s. al.
37	2.04	350	....	s.	s.	s. al.; i. eth.
38	....	$-3H_2O$, 110	d.	52^{25}	112^{100}	s. al.
39	1.18	....	300^{1} d.	d.	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	*di*borane, dihydroxy-	$K_2B_2H_6O_2$	137.88	col. cubical cr
2	*penta*borane (pentaboranide)	$K_2B_5H_9$	141.36	wh. powd
3	*meta*borate	KBO_2 (or $K_2B_2O_4$)	81.92	monocl. col
4	*tetra*borate	$K_2B_4O_7 \cdot 8H_2O$	377.60	monocl. col
5	*penta*borate	$KB_5O_8 \cdot 4H_2O$	293.26	col
6	*peroxy*borate	$KBO_3 \cdot \frac{1}{2}H_2O$	106.92	wh
7	borotartrate (sol. cream of tartar)	$KC_4H_4BO_7$(?)	213.99	wh. cr. powd
8	bromate	$KBrO_3$	167.01	trig. col
9	bromide	KBr	119.01	cub. col. sl. hyg., 1.559
10	bromoaurate	$KAuBr_4$	555.96	rhomb. red-br
11	“	$KAuBr_4 \cdot 2H_2O$	591.99	vlt. cr. monocl
12	bromoiodide, di-	$KIBr_2$	325.85	rhomb
13	bromoplatinate	K_2PtBr_6	752.92	cub. dk. red-br
14	bromoplatinite	K_2PtBr_4	593.09	rhomb. br
15	“	$K_2PtBr_4 \cdot 2H_2O$	629.12	rhomb. blk
16	bromostannate	K_2SnBr_6	676.39	cr
17	cacodylate	$K[(CH_3)_2AsO_2] \cdot H_2O$	194.09	wh. cr
18	cadmium iodide	$2KI \cdot CdI_2 \cdot 2H_2O$	734.31	wh.-yelsh. cr. powd., deliq
19	calcium chloride (chlorocalcite)	$KCl \cdot CaCl_2$	185.55	cub. β 1.52
20	“ magnesium sulfate (krugite)	$K_2Ca_4Mg(SO_4)_6 \cdot 2H_2O$	875.26	gray
21	“ magnesium sulfate (polyhalite)	$K_2Ca_2Mg(SO_4)_4 \cdot 2H_2O$	602.97	tri., wh., 1.548, 1.562, 1.567
22	“ sulfate, (kaluszite, syngenite)	$K_2Ca(SO_4)_2 \cdot H_2O$	328.42	monocl., 1.500, 1.517, 1.518
23	d-camphorate	$K_2C_{10}H_{14}O_4 \cdot 5H_2O$	366.48	need. clusters, hyg
24	carbonate	K_2CO_3	138.20	monocl. col., hyg
25	“	$K_2CO_3 \cdot 2H_2O$	174.23	rhomb
26	“	$2K_2CO_3 \cdot 3H_2O$	330.45	monocl. col
27	“ , hydrogen	$KHCO_3$	100.11	monocl. col
28	*peroxy*carbonate	$K_2C_2O_6$	198.21	bl
29	carbonyl	$(KCO)_6$	402.64	gray-red
30	chlorate	$KClO_3$	122.55	monocl. col., 1.409, 1.517, 1.524
31	*per*chlorate	$KClO_4$	138.55	rhomb. col
32	chloride (sylvite)	KCl	74.55	cub. col. 1.490
33	*hypo*chlorite	$KClO$	90.55	in soln. only
34	chloroaquoruthenate, (III) penta-	$K_2Ru(H_2O)Cl_5$	375.19	rose prisms
35	chloroaurate	$KAuCl_4$	378.12	monocl. yel
36	“	$KAuCl_4 \cdot 2H_2O$	414.16	rhomb. pl., yel
37	chlorochromate (Peligot's salt)	$KCrO_3Cl$	174.56	monocl. red
38	chlorohydroxoruthenate (IV), penta-	$K_2Ru(OH)Cl_5$	374.19	brn.-red cr
39	chloroiodate (III)	$KICl_4$	307.84	rhomb. yel
40	chloroiodide, di-	$KICl_2$	236.93	monocl
41	chloroiridate	K_2IrCl_6	484.03	cub. blk
42	chloronitrosylruthenate (III), penta-	$K_2Ru(NO)Cl_5$	387.19	rhomb. dk. red
43	chloroösmate (IV)	K_2OSCl_6	481.13	cub. red
44	“ (III)	$K_3OSCl_6 \cdot 3H_2O$	574.28	cr. dk. red
45	chloropalladate	K_2PdCl_6	397.63	cub. red
46	chloropalladite	K_2PdCl_4	326.72	tetr. red-br. (cub. yel.)
47	chloroplatinate	K_2PtCl_6	486.16	cub. yel

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.39	d.→K	....	s.	....	s. al.
2	....	d.<180	....	d.	d.	....
3	....	947–50	....	71^{30}	v. s.	....
4	(anh.) 1.74	d.	....	26.7^{30}	v. s.	....
5	....	780	....	$.007^{0}$	....	....
6	....	....	....	1.22^{0}; 2.15^{15}	....	i. al., eth.
7	1.832	....	....	v. s.	....	i. al., eth., chl.
8	$3.27^{17.5}$	434; d. 370	....	3.1^{0}; 13.3^{40}	49.75^{100}	sl. s. al.; i. acet.
9	2.75^{25}	730	1380 (1435)	53.48^{0}	102^{100}	0.5 al.; s. glyc.; sl. s. eth.
10	....	d.	....	sl. s.	....	s. al.
11	....	....	....	19.5^{15}	204^{67}	d. eth.; s. al., KBr
12	....	60	d. 180	d.	....	....
13	4.66^{24}	d.>400	....	2.02^{20}	10^{100}	i. al.
14	....	....	....	v. s.	v. s.	....
15	....	$-H_2O$ vac.	....	v. s.	v. s.	....
16	3.783	....	....	....	....	....
17	....	....	....	s.	....	sl. s. al.; i. eth.
18	3.359	....	....	137^{15}	....	s. a., al., eth.
19	....	754	....	s.	....	....
20	2.801	....	....	....	....	....
21	2.775	....	....	....	....	....
22	2.60	1004	....	0.25	d.	s. a.; i. al.
23	....	$-5H_2O$, 110	....	260^{14}	....	s. al.
24	2.428^{19}	891	d.	112^{20}	156^{100}	i. al., acet.
25	....	....	....	146.9	331^{100}	....
26	2.043	....	....	129.4	268.3^{100}	i. conc. NH_4OH, al.
27	2.17	d. 100–200	....	22.4	60^{60}	i. al.
28	....	200–300	....	s.	....	....
29	....	exp.	....	exp.	....	d. al.
30	2.32	368.4	d. 400	7.1^{20}	57^{100}	0.83 al.; s. alk.
31	2.52^{10}	610 ± 10; (525–30)	....	0.75^{0}	21.8^{100}	i. al., eth.
32	1.984	776	subl. 1500	34.7^{20}	56.7^{100}	sl. s. al.; s. alk., eth., glyc.
33	....	d.	....	v. s.	v. s.	....
34	....	$-H_2O$, 200	....	s.	s.	sl. s. al.
35	....	d. 357	....	61.8^{20}	80.2^{60}	s. a.; 25 al.
36	....	....	....	s.	s.	s. al., eth.
37	2.497	d.	....	s. d.	....	s. a.
38	....	d.	....	s. d.	d.	i. al.
39	1.76^{45}	d.	....	d.	....	d. eth.
40	....	60	d. 215	d.	....	....
41	3.546	d.	....	125^{19}	6.67	i. al., KCl, NH_4OH
42	....	d.	....	12^{25}	80^{60}	i. al.
43	....	d.	....	sl. s.	s.	s. dil. HCl; i. al.
44	....	$-3H_2O$, 150	....	v. s.	....	s. al.; i. eth.
45	2.738	d.	....	sl. s. d.	d.	sl. s. HCl; i. al.
46	2.67	d. 105	....	s.	v. s.	s. KCl, NH_4OH; i. al.
47	3.499^{24}	d. 250	....	0.481^{2}	5.22^{100}	i. al., eth.

No	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	chloroplatinite	K_2PtCl_4	415.25	tetr. red-br
2	chloroplumbate	K_2PbCl_6	498.14	cub
3	chlororhenate (IV)	K_2ReCl_6	477.24	yel.-grn. oct
4	" (V)	K_2ReOCl_5	457.79	grn. hex. pl
5	chlororhodite, penta-	K_2RhCl_5	358.39	rhomb. red
6	" , hexa-	$K_3RhCl_6\cdot 3H_2O$	486.99	tricl. red
7	chlororuthenate (IV)	K_2RuCl_6	392.63	cub. blk
8	chlorostannate	K_2SnCl_6	409.63	cub. col., 1.657
9	chlorotellurate	K_2TeCl_6	418.54	pale yel. octahedral
10	chromate (tarapacaite)	K_2CrO_4	194.20	rhomb. yel., β 1.74
11	*di*chromate	$K_2Cr_2O_7$	294.21	monocl. or tricl. red
12	*peroxy*chromate	K_3CrO_8	297.30	cub. br.-red
13	chromium chromate, basic	$K_2CrO_4\cdot 2Cr(OH)\text{-}CrO_4$	564.26	vlt.-br. amor. powd
14	chromium sulfate (ic)	$KCr(SO_4)_2\cdot 12H_2O$	499.42	cub. oct., red or grn., 1.4814
15	citrate	$K_3C_6H_5O_7\cdot H_2O$	324.40	col
16	" , monobasic	$KH_2C_6H_5O_7$	230.21	wh. cr. powd
17	cobalt carbonate, hydrogen (ous)	$KHCO_3\cdot CoCO_3\cdot 4H_2O$	291.13	rose need
18	cobaltinitrite (Fischer's salt)	$K_3Co(NO_2)_6$	452.28	pr. yel
19	"	$K_3Co(NO_2)_6\cdot H_2O$	470.29	yel. cr. powd
20	"	$K_3Co(NO_2)_6\cdot 1\frac{1}{2}H_2O$	479.30	tetr. yel
21	cobalt malonate (ous)	$K_2Co(C_3H_2O_4)_2$	341.22	
22	" sulfate (ous)	$K_2SO_4\cdot CoSO_4\cdot 6H_2O$	437.36	monocl. pr. red, 1.481, 1.487, 1.500
23	copper chloride	$KCl\cdot CuCl_2$	209.01	red need
24	cyanate	$KOCN$	81.11	need. col
25	cyanide	KCN	65.11	cub. col., wh. gran., deliq., extr. pois.
26	cyanoargentate (I), (argentocyanide)	$KAg(CN)_2$	199.01	cub., 1.625
27	cyanoaurate (III)	$KAu(CN)_4\cdot 1\frac{1}{2}H_2O$	367.39	col. tabl
28	cyanoaurate (I)	$KAu(CN)_2$	288.33	col. rhomb
29	cyanocadmate	$K_2Cd(CN)_4$	294.67	cub. col
30	cyanochromate (III)	$K_3Cr(CN)_6$	325.41	rhomb. yel
31	cyanocobaltate (III)	$K_3Co(CN)_6$	332.34	monocl. yel
32	" (II)	$K_4Co(CN)_6$	371.43	vlt. need
33	cyanocuprate (I)	$K_3Cu(CN)_4$	284.90	rhbdr. col
34	cyanomanganate (III)	$K_3Mn(CN)_6$	328.33	rhomb. red, 1.553, 1.555 (Li), 1.571
35	" (II)	$K_4Mn(CN)_6\cdot 3H_2O$	421.47	tetr. deep blue
36	cyanomercurate	$K_2Hg(CN)_4$	382.87	col. cr. pois
37	cyanonickelate (II)	$K_2Ni(CN)_4\cdot H_2O$	258.97	monocl. cr. or powd., red-yel
38	cyanoösmite	$K_4Os(CN)_6\cdot 3H_2O$	556.74	monocl. col.-yel., β 1.607
39	cyanoplatinite	$K_2Pt(CN)_4\cdot 3H_2O$	431.54	rhomb. col. yel., blue fluores., deliq
40	ethyl sulfate	$KC_2H_5SO_4$	164.22	monocl. wh
41	ferricyanide	$K_3Fe(CN)_6$	329.25	monocl. red., 1.566, 1.569, 1.583
42	ferrocyanide	$K_4Fe(CN)_6\cdot 3H_2O$	422.39	monocl. lem. yel., β 1.577
43	fluoberyllate	K_2BeF_4	163.21	rhomb. col
44	fluoborate (avogadrite)	KBF_4	125.92	rhomb. or cub. col
45	fluogermanate	K_2GeF_6	264.79	hex. wh
46	fluomanganate (IV)	K_2MnF_6	247.12	hex. tab., yel
47	fluoniobate, penta- (oxyniobate)	$K_2NbOF_5\cdot H_2O$	300.12	monocl. pl. or leaf col
48	fluorescein deriv	$K_2C_{20}H_{10}O_5$	408.47	yelsh.-red powd
49	*hexa*fluorophosphate	KPF_6	184.1	
50	fluoride	KF	58.10	cub. col., deliq
51	"	$KF\cdot 2H_2O$	94.13	monocl. pr., deliq
52	" , acid	KHF_2	78.10	cub. col
53	fluosilicate (hieratite)	K_2SiF_6	220.25	hex. or cub. col

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.30	d.	...	0.93^{16}	5.3^{100}	i. al.
2	...	d. 190	...	...	...	s. h. HCl
3	3.34	...	...	0.8	d.	sl. s. HCl; d. alk.
4	...	...	...	d.	d.	s. a.; i. al. eth.
5	...	d.	...	sl. s.	d.	i. al.
6	3.291	d.	...	d.	...	sl. s. al., KCl
7	...	d.	...	s. d.	...	i. al.
8	2.71	...	...	s.	s.	...
9	...	...	...	d.	d.	s. HCl
10	2.732^{18}	968.3	...	62.9^{20}	79.2^{100}	i. al.
11	2.69	tr. 2.36; 398	d. 500	4.9^{0}	102^{100}	i. al.
12	...	d. 170	...	sl. s.	...	i. al., eth.
13	2.28^{14}	300	...	i.	...	i. al., acet. a.
14	1.83	89	$-12H_2O$, 400	24.39^{25}	50	s. dil. a.; i. al.
15	1.98	d. 230	...	167^{15}	199.7^{31}	s. glyc.; sl. s. al.
16	...	...	...	s.	...	...
17	...	...	...	d.	...	...
18	...	...	...	sl. s.	sl. s.	i. al.
19	...	...	...	i.	s. d.	s. min. a.; sl. s. ac. a.; i. al., eth.
20	...	d. 200	...	0.089^{17}	sl. s.	i. al., meth.
21	2.234	...	...	...	...	...
22	2.218	...	...	25.5^{0}	108.4^{49}	...
23	2.86	...	...	...	...	...
24	2.048^{16}; 2.056^{20}	d. 700–900	...	s.	s.	i. al.
25	1.52^{16}	634.5; (601–621)	...	v. s.	v. s.	s. glyc., meth. al.; sl. s. al.
26	2.36	...	...	25^{20}	100	4.85 % al.; i. a.
27	...	d. 200	...	s.	v. s.	s. al.
28	3.45	...	...	14.3	200	sl. s. al.; i. eth.
29	1.85	...	...	33	100^{100}	sl. s. al.
30	1.71	...	...	30.9^{20}	...	i. al.
31	1.906	d.	...	s.	s.	i. al.
32	...	...	...	s.	s.	i. al., eth.
33	...	d.	...	v. s.	...	...
34	...	...	...	s.	...	...
35	...	...	...	s.	d.	...
36	...	...	...	s.	...	s. al.
37	1.875^{11}	$-H_2O$, 100	...	s.	...	d. a.
38	...	d.	...	sl. s.	s.	i. al., eth.
39	2.455^{16}	d. 400–600	...	sl. s.	v. s.	s. al., eth., H_2SO_4
40	1.843	...	...	s.	...	s. al.
41	1.894^{17}	d.	...	33^{4}	77.5^{100}	s. acet.; i. al.
42	1.85^{17}	$-3H_2O$, 70	d.	27.8^{12}	$90.6^{96.3}$	s. acet.; i. al., NH_3
43	...	red ht.	...	2^{20}	5.26^{100}	...
44	2.498	530	...	$.44^{20}$	6.27^{100}	s. al.; sl. s. eth.
45	...	730	*ca.* 835	$.542^{18}$	2.58^{100}	...
46	...	d.	...	d.	d.	s. c. HCl
47	...	...	...	7.69	s.	s. conc. HF d.
48	...	...	...	s.	...	...
49	...	*ca.* 575	d.	5.5^{0}; 9.3^{25}	20.6^{50}	...
50	2.48	880	1500	92.3^{18}	v. s.	s. HF, NH_3; i. al.
51	2.454	41	...	349.3^{18}	v. s.	s. HF; i. al.
52	...	d.	...	$41.^{21}$	v. s.	s. $KC_2H_3O_2$; i. al.
53	hex. 3.08; cub. 2.665^{17}	d.	...	$0.12^{17.5}$	0.954^{100}	s. HCl; i. NH_3, al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	fluostannate	$K_2SnF_6 \cdot H_2O$	328.91	monocl. pr
2	fluosulfonate	$KFSO_3$	138.16	short, thick pr
3	fluotantalate	K_2TaF_7	392.07	rhomb. col
4	fluotellurate, di-	$K_2TeO_3F_2 \cdot 3H_2O$	345.85	micros., oct., monocl
5	fluothorate	$K_2ThF_6 \cdot 4H_2O$	496.38	col
6	fluotitanate	$K_2TiF_6 \cdot H_2O$	258.11	col. monocl. sm. lust. leaf
7	fluozirconate	K_2ZrF_6	283.41	monocl. col., 1.466, 1.455
8	formate	$KCHO_2$	84.11	rhomb. col., deliq
9	gadolinium sulfate	$K_2SO_4 \cdot Gd_2(SO_4)_3 \cdot 2H_2O$	812.29	cryst
10	gallium sulfate	$KGa(SO_4)_2 \cdot 12H_2O$	517.14	col. cr., 1.46528
11	*meta*germanate	K_2GeO_3	198.79	wh. cryst
12	*di*germanate	$K_2Ge_2O_5$	303.39	wh. cryst
13	*tetra*germanate	$K_2Ge_4O_9$	512.59	wh. cryst
14	glycerophosphate	$K_2C_3H_7PO_6$	248.26	col. to sl. yelsh. mass, hyg
15	hydride	KH	40.11	wh. need
16	hydroxide	KOH	56.10	rhomb. deliq., wh
17	iodate	KIO_3	214.02	monocl. col
18	iodate, acid	$KIO_3 \cdot HIO_3$	389.94	monocl
19	" "	$KIO_3 \cdot 2HIO_3$	565.87	col. tricl
20	*metaper*iodate	KIO_4	230.02	tetr. col
21	iodide	KI	166.02	cub. col. or wh. gran., 1.677
22	" , tri-	KI_3	419.86	monocl. dk. bl., deliq
23	iodoaurate	$KAuI_4$	743.98	lust. blk. cr
24	iodoiridite	K_3IrI_6	1071.91	grn. cr
25	iodomercurate(II), tri- (potassium mercury iodide)	$KHgI_3$ or $(KI \cdot HgI_2)$	620.47	yel. deliq. pr
26	iodomercurate(II), tetra-	K_2HgI_4 or $(2KI \cdot HgI_2)$	786.48	yel. cr. deliq
27	iodoplatinate	K_2PtI_6	1034.94	blk. rect
28	iron chloride (ic) (erythrosiderite)	$2KCl \cdot FeCl_3 \cdot H_2O$	329.34	orthorhomb. red
29	iron sulfate (ous)	$K_2SO_4 \cdot FeSO_4 \cdot 6H_2O$	434.27	grn. monocl. pr
30	" " (ic) (krausite)	$K_2SO_4 \cdot Fe_2(SO_4)_3 \cdot 2H_2O$	610.19	monocl. pale yel. grn
31	" " "	$KFe(SO_4)_3 \cdot 12H_2O$	503.27	cub. oct. col. or vlt., 1.482
32	" sulfide (ic)	$KFeS_2$	159.08	purp. hex
33	lactate	$KC_3H_5O_3 \cdot xH_2O$		col. to yelsh. syrupy liq
34	laurate	$KC_{12}H_{23}O_2$	238.40	amor
35	" , acid (mixt.)	$KC_{12}H_{23}O_2 \cdot C_{12}H_{24}O_2$	438.71	wh. wax-like solid
36	lead chloride (pseudocotunnite)	$2KCl \cdot PbCl_2$	427.23	yel
37	magnesium carbonate, hydrogen	$KHCO_3 \cdot MgCO_3 \cdot 4H_2O$	256.51	tricl. or rhombic col
38	" chloride (carnallite)	$KCl \cdot MgCl_2 \cdot 6H_2O$	277.88	rhomb. col., deliq., 1.466, 1.475, 1.494
39	" chloride sulfate (kainite)	$K_2SO_4 \cdot MgSO_4 \cdot MgCl_2 \cdot 6H_2O$ (or $KMgClSO_4 \cdot 3H_2O$)	497.97	col. monocl
40	magnesium chromate	$K_2CrO_4 \cdot MgCrO_4 \cdot 2H_2O$	370.56	tricl
41	" sulfate (langbeinite)	$K_2SO_4 \cdot 2MgSO_4$	415.03	tetrah., 1.5329
42	" sulfate (leonite)	$K_2SO_4 \cdot MgSO_4 \cdot 4H_2O$	366.71	col. monocl. 1.483, 1.487, 1.490
43	" " (picromerite, schönite)	$K_2SO_4 \cdot MgSO_4 \cdot 6H_2O$	402.74	monocl. col., 1.461, 1.463, 1.476

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.053	......	......	3.7^{18}	33.3^{100}	i. al., NH_3
2	......	311	......	6.9^{19}	......	......
3	4.56; 5.24	......	......	sl. s., d.	......	sl. s. HF
4	......	d.	......	sl. s.	sl. s.	s. HF
5	......	d.	......	2.15	6.6	d. a.; i. al
6	......	$-H_2O$, 32; 780	d.	$.556^{0}$; 1.3^{20}	1.27^{21}	2. min. a.; i. NH_3
7	3.48	......	......	$.781^{2}$	25^{100}	i. NH_3
8	1.91	167.5	d.	331^{18}	657^{90}	s. al.; i. eth.
9	3.503^{16}	......	......	s.	s.	s. K_2SO_4
10	1.895	......	......	s.	......	......
11	$3.40^{21.5}$	823	......	s.	......	s. a.
12	$4.31^{21.5}$	>83	......	s.	......	s. a.
13	$4.12^{21.5}$	1033	......	s.	......	s. a.
14	......	......	......	v. s.	v. s.	s. al.
15	1.43–.47	d.	......	d.	d.	i. CS_2, eth., bz.
16	2.044	360.4 ± 0.7	1320–4	97^{0}; 107^{15}	178^{100}	v. s. al.; i. eth., NH_3
17	3.89	560	d.>100	4.74^{0}	32.3^{100}	s. KI; i. al., NH_3
18	......	......	......	1.33^{15}	......	......
19	......	......	......	4^{15}	......	......
20	3.618^{15}	582	−O, 300	0.66^{13}	s.	v. sl. s. KOH
21	3.13	723	1420 (1330)	127.5^{0}	208^{100}	14.3 al; s. NH_3; sl. s. eth.
22	3.498	31 (45)	d. 225	v. s.	......	s. al., KI
23	......	......	......	s., d.	......	s. dil. soln. KI
24	......	d.	......	v.s. (i).	......	i. al.
25	......	......	......	d.	......	s. al., eth., KI, ac. a.
26	......	......	......	v. s.	......	i. al.
27	5.176 (4.96–5.03)	......	......	s.	s. d.	i. al.
28	2.320	......	......	......	......	......
29	2.169	......	......	......	......	......
30	2.840	......	......	......	......	......
31	1.83	33	......	$20^{12.5}$	v. s.	i. al.
32	2.563	......	......	d.	......	......
33	......	......	......	s.	......	s. al.; i. eth.
34	......	......	......	......	......	4.5^{15} al.
35	......	160	......	......	......	$0.904^{13.5}$ al.
36	......	490	......	s.	......	......
37	2.98	......	......	s. d. gives	$MgCO_2 \cdot 3$	H_2O
38	1.61	265	......	64.5^{19} d.	d.	d. al.
39	2.131	......	......	79.56^{18}	......	i. eth., al.
40	2.59	......	......	......	......	......
41	2.829	927	......	......	......	......
42	2.201^{20}	......	......	v. s.	......	......
43	2.15	d. 72	......	19.26^{0}; 25^{20}	59.8^{75}	......

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	malate	$K_2C_4H_4O_5$	210.26	col., viscid mass
2	manganate	K_2MnO_4	197.12	rhomb. grn
3	*per*manganate	$KMnO_4$	158.03	rhomb. purple, ω 1.59
4	manganese chloride (ous) (chloromanganokalite)	$4KCl \cdot MnCl_2$	424.06	trig. 1.59
5	manganese sulfate (ous) (manganolangbeinite)	$K_2SO_4 \cdot 2MnSO_4$	476.23	tetrah., rose-red, 1.572
6	manganese sulfate (ic)	$KMn(SO_4)_2 \cdot 12H_2O$	502.35	cub. (oct.,) vlt
7	mercury tartrate (ous)	$KHgC_4H_4O_6$	387.78	wh. cr. powd
8	methionate (methanedisulfonate)	$K_2CH_2(SO_3)_2$	252.35	monocl. β 1.539
9	methyl sulfate	$2KCH_3SO_4 \cdot H_2O$	318.41	wh. cr
10	molybdate	$K_2MoO_4 \cdot xH_2O$		wh. del. powd. or 4 sided pr
11	myristate, acid (mixt)	$KC_{14}H_{27}O_2 \cdot C_{14}H_{28}O_2$	494.82	wh. wax-like solid
12	naphthalene-1,5-disulfonate	$K_2C_{10}H_6(SO_3)_2 \cdot 2H_2O$	400.50	monocl., 1.485, 1.669, 1.697
13	nickel sulfate	$K_2SO_4 \cdot NiSO_4 \cdot 6H_2O$	437.11	monocl. bl. 1.484, 1.492, 1.505
14	nitrate (saltpeter)	KNO_3	101.10	rhomb. or trig. col., 1.335, 1.5056, 1.5064
15	nitride	K_3N	131.30	grnsh blk
16	nitrite	KNO_2	85.10	col. prism. deliq
17	nitroplatinite	$K_2Pt(NO_2)_4$	457.45	monocl. col
18	*m*-nitrophenoxide	$KOC_6H_4NO_2 \cdot 2H_2O$	213.23	flat or. need
19	*p*- “	$KOC_6H_4NO_2 \cdot 2H_2O$	213.23	yel. leaf
20	nitroprusside	$K_2[Fe(NO)(CN)_5] \cdot 2H_2O$	330.17	monocl. red hyg
21	oleate	$KC_{18}H_{33}O_2$	320.54	cr. or yelsh. or brnsh. soft mass, 1.452
22	“ , acid, (mixt.)	$KC_{18}H_{33}O_2C_{18}H_{34}O_2$	602.99	wh. wax-like solid
23	osmate	$K_2OsO_4 \cdot 2H_2O$	368.42	cub. vlt. hyg
24	oxalate	$K_2C_2O_4 \cdot H_2O$	181.23	monocl. wh., 1.440, 1.485, 1.550
25	oxalate, hydrogen	KHC_2O_4	128.12	monocl. col., 1.415, 1.545
26	“ , “	$KHC_2O_4 \cdot \frac{1}{2}H_2O$	137.13	trim
27	“ , “	$KHC_2O_4 \cdot H_2O$	146.14	rhomb
28	“ , tetra-	$KHC_2O_4 \cdot H_2C_2O_4 \cdot 2H_2O$	254.19	tricl. col
29	oxalatoferrate (II)	$K_2[Fe(C_2O_4)_2] \cdot 2H_2O$	346.11	gold need
30	“ (II)	$K[Fe(C_2O_4)_2] \cdot 2\frac{1}{2}H_2O$	316.03	br. cr
31	“ (III)	$K_3[Fe(C_2O_4)_3] \cdot 3H_2O$	491.24	monocl. grn
32	oxalatouranate (IV)	$K_4[U(C_2O_4)_4] \cdot 5H_2O$	836.61	monocl. yel
33	oxide, mon-	K_2O	94.19	cub. col.-gray
34	“ , per	K_2O_2	110.19	wh
35	“ , tri-(sesqui)	K_2O_3	126.19	red (probably a mixt.)
36	“ , super-	KO_2	71.10	yel. leaf
37	palmitate, acid (mixt.)	$KC_{16}H_{31}O_2 \cdot C_{16}H_{32}O_2$	550.92	wh. fatty sld
38	1-phenol-2-sulfonate (*o*-)	$KC_6H_4(OH)SO_3 \cdot H_2O$	230.28	rhomb., 1.527, 1.568, 1.647
39	“ -4- “ (*p*-)	$KC_6H_4(OH)SO_3$	212.26	rhomb., 1.571, 1.608, 1.694
40	phenyl sulfate	$KC_6H_5SO_4$	212.26	rhomb. leaf
41	*ortho*phosphate	K_3PO_4	212.27	rhomb. col. deliq
42	“ , mono-H	K_2HPO_4	174.18	amor. wh., deliq
43	“ , di-H	KH_2PO_4	136.09	tetr. col., deliq., 1.510, 1.4684
44	*pyro*phosphate	$K_4P_2O_7 \cdot 3H_2O$	381.39	col. deliq
45	*meta*phosphate	KPO_3	118.08	col. 1.458 1.487

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	s.	......	....
2	....	d. 190	....	d.	d.	s. KOH
3	2.703	d. < 240	....	2.83^{0}; 6.38^{20}	25^{65}	d. al.; s. H_2SO_4; v. s. meth. al., acet.
4	2.31	....	....	s.	s.	....
5	3.02	850	....	......	......	....
6	....	....	....	d.	......	....
7	....	....	....	i.	......	i. al.
8	2.376	....	....	s.	......	....
9	....	....	....	s.	......	s. al.
10	lq. 2.342^{964}	919	....	184.6^{25}	v. s.	i. al.
11	....	153	....	......	......	$.453^{13.5}$ al.
12	1.797	....	....	s.	......	....
13	2.124	d. < 100	....	7^{0}	60.8^{75}	....
14	2.109^{16}	tr.-trig. 129 m.p. 334	d. 400	13.3^{0}; 31.6^{20}	247^{100}	i. al., eth.
15	....	d.	....	d.	......	....
16	1.915	387 (419)	....	281^{0}; 313^{25}	413^{100}	v. s NH_3; al. s. al.; i. 94 % al.
17	....	d.	....	3.8^{15}	s.	....
18	1.691^{20}	$-2H_2O$, 130	d.	16.3^{15}	......	s. al.
19	1.652^{20}	$-2H_2O$, 130	d.	7.5^{15}	......	sl. s. al.
20	....	....	....	100^{16}	......	s. al.
21	....	....	....	25	s.	s. $4.315^{13.5}$ 100^{50} al.; 3.5^{35} eth.
22	....	95	....	s.	s.	$5.2^{13.5}$ al.
23	....	$-H_2O, > 100$	....	sl. s.	s. d.	i. al., eth.
24	2.127^{39}; 2.08	d.	....	33^{16}	......	....
25	2.0	d.	....	2.5	16.7^{100}	sl. s. al.
26	....	d.	....	2.2	51.5^{100}	....
27	2.044	....	....	......	......	....
28	1.836	d.	....	1.8^{13}	......	....
29	....	d.	....	s.	s.	....
30	....	d.	....	92^{21}	d.	i. al.
31	....	$-3H_2O$, 100	d. 230	4.7^{0}	117.7^{100}	s. acet.; i. al., NH_3
32	2.563	....	....	......	......	....
33	2.32^{0}	....	....	v. s.	v. s.	s. al., eth.
34	....	490	....	......	......	....
35	....	430	....	......	......	....
36	....	*ca.* 400	d.	v. s. d.	......	d. al.
37	....	138	....	......	......	0.198^{13} al.
38	1.734	400	....	s.	......	s. al.
39	1.87	> 260	....	......	......	....
40	....	150–60 d.	d.	14^{15}	......	v. sl. s. al.
41	$D^{17} = 2.564$	1340	....	90^{20}	s.	i. al.
42	....	d.	....	167^{20}	v. s.	v. s. al.
43	2.338	252.6	....	33^{25}	s.	i. al.
44	2.33	$-2H_2O$, 180	$-3H_2O$, 300	s.	v. s.	i. al.
45	2.393^{25}	807	....	i.	v. s.	i.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	*ortho*phosphite, mono-H.	K_2HPO_3	158.18	wh. powd. deliq
2	“ , di-H.	KH_2PO_3	120.09	deliq. wh
3	*hypo*phosphite	KH_2PO_2	104.09	hex. wh. deliq
4	phthalate, hydrogen	$KHC_8H_4O_4$	204.22	rhomb. col
5	picrate	$KC_6H_2N_3O_7$	267.20	yel. redsh. or grnsh. rhomb., 1.527, 1.903, 1.952 ′
6	piperate	$KC_{12}H_9O_4$	256.29	lt.-yel. cr. powd
7	platinate, hydroxo-	$K_2Pt(OH)_6$	375.47	rhomb. yel
8	thioplatinate	$K_2Pt_4S_6$	1051.51	bl. gray cr
9	plumbate, hydroxo-	$K_2Pb(OH)_6$	387.45	rhomb. col
10	praseodymium sulfate	$3K_2SO_4 \cdot Pr_2(SO_4)_3 \cdot H_2O$	1110.83	cr
11	propionate	$KC_3H_5O_2 \cdot H_2O$	130.18	wh. hyg. cr., leaf, deliq
12	propyl sulfate	$KC_3H_7SO_4$	178.25	wh. cr. powd
13	*per*rhenate	$KReO_4$	289.41	wh. tetr. 1.643
14	rhodium sulfate	$KRh(SO_4)_3 \cdot 12H_2O$	550.33	yel. cub
15	ruthenate	$K_2RuO_4 \cdot H_2O$	261.91	tetr. blk
16	*per*ruthenate	$KRuO_4$	204.80	tetr. blk
17	*d*-saccharate, acid	$KHC_6H_8O_8$	248.23	rhomb. need
18	salicylate	$KC_7H_5O_3$	176.21	wh. powd
19	santoninate	$KC_{15}H_{19}O_4$	302.40	wh. deliq. cr. powd
20	selenate	K_2SeO_4	221.15	rhomb. col., 1.535, 1.539, 1.545
21	selenide	K_2Se	157.15	wh., cr. reddens on exposure to air
22	selenite	K_2SeO_3	205.15	wh. deliq
23	selenocyanate	$KSeCN$	144.07	need. deliq
24	selenocyanoplatinate	$K_2Pt(SeCN)_6$	903.29	rhomb
25	*meta*silicate	K_2SiO_3	154.25	amor. col
26	*di*silicate	$K_2Si_2O_5$	214.31	β, 1.500
27	“ , hydrogen	$KHSi_2O_5$	176.22	rhomb
28	*tetra*silicate	$K_2Si_4O_9 \cdot H_2O$	352.45	rhomb. α 1.495, β 1.535
29	silicotungstate (normal)	$K_4SiW_{12}O_{40} \cdot 18H_2O$	3355.77	col. hex
30	silver carbonate	$KAgCO_3$	206.99	rect. pl
31	“ nitrate	$KNO_3 \cdot AgNO_3$	270.99	monocl
32	sodium antimony tartrate	$KNaSbC_4H_3O_7$	346.92	wh. scales or powd
33	“ carbonate	$KNaCO_3 \cdot 6H_2O$	230.20	monocl. hyg, efflor
34	“ ferricyanide	$K_2NaFe(CN)_6$	313.1	or.-red cr. monocl
35	“ ironchloride (ous) (rinneite)	$3KCl \cdot NaCl \cdot FeCl_2$	408.88	rhbdr., 1.589, 1.590
36	“ nitrocobaltate (III)	$K_2NaCo(NO_2)_6 \cdot H_2O$	454.19	yel. cr
37	“ sulfate	$3K_2SO_4 \cdot Na_2SO_4$	664.83	rhbdr
38	“ tartrate (rochelle salt, seignette salt)	$KNaC_4H_4O_6 \cdot 4H_2O$	282.23	rhomb. col., 1.492, 1.493, 1.496
39	stannate, hydroxo-	$K_2Sn(OH)_6$	298.94	trig. col
40	stearate	$KC_{18}H_{35}O_2$	322.56	wh. cr. powd
41	“ , acid (mixt.)	$KC_{18}H_{35}O_2 \cdot C_{18}H_{36}O_2$	607.02	wh. powd
42	strontium chromium oxalate (ic)	$KSrCr(C_2O_4)_3 \cdot 6H_2O$	550.89	grnsh. blk
43	styphnate	$KC_6H_2N_3O_8 \cdot H_2O$	301.21	yel. monocl. pr
44	succinate	$K_2C_4H_4O_4 \cdot 3H_2O$	248.31	rhomb
45	“ , hydrogen	$KHC_4H_4O_4$	156.18	monocl
46	“ , “	$KHC_4H_4O_4 \cdot 2H_2O$	192.21	rhomb. 1.417, 1.530, 1.533

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	...	d.	...	170^{20}	v. s.	i. al.
2	...	d.	...	220^{20}	v. s.	i. al.
3	...	d.	...	v. s.	v. s.	11.1^{25} chl.; v. sl. s. abs. al., NH_3; i. eth.
4	1.636	...	...	10^{25}	33^{100}	...
5	1.852	...	exp. 310	0.5^{15}	25^{100}	0.184^{25} al.
6	...	...	...	sl. s.	v. s.	...
7	...	d.	...	s.	...	i. al.
8	6.44^{15}	d. ign.	...	i.	...	d. HCl
9	...	...	...	d.	d.	s. KOH
10	3.275^{16}	...	...	sl. s.	...	s. HNO_3, HCl
11	...	$-H_2O$, 120	...	207^{16}	359	22.2^{13} 95 % al.
12	...	...	...	v. s.	...	...
13	4.887	350	...	1.21^{20}	14^{100}	v. sl. s. al.
14	2.23	...	...	s.	...	...
15	...	$-H_2O$, 200	d. $400^{vac.}$	v. s.	d.	d. a., al.
16	...	d. 440	...	sl. s.	s. d.	...
17	...	...	...	1.1^{6}	s.	...
18	...	...	...	s.	...	s. al.
19	...	...	...	s.	...	s. al.
20	3.066	...	...	110.5^{0}	122.2^{100}	...
21	2.851^{15}	...	...	s. d.	s.	...
22	...	...	...	s.	...	sl. s. al.
23	2.347	d. 100	...	s.	s.	d. a.; s. al.
24	$3.378^{12.5}$	d. 80	...	...	...	...
25	...	976	...	s.	s.	i. al.
26	$2.456\frac{25}{4}$	1015 ± 10	...	...	...	...
27	$2.417\frac{15}{4}$	515	...	...	...	...
28	2.417; anh. 2.335^{25}	d. 400; anh. 770	...	s.	s.	i. al.
29	...	$-17H_2O$, 100	...	33.3^{20}	v. s.	v. s. acet.; s. meth. al.; sl. s. al.; i. eth., bz.
30	3.769	d.	...	d.	d.	...
31	3.219	125	...	v. s.	v. s.	...
32	...	...	...	s.	...	...
33	$1.61–1.63^{14}$	$-6H_2O$, 100	...	185.2^{15}	...	...
34	...	d.	...	50^{25}	80^{80}	...
35	2.3	...	...	...	...	...
36	1.633	135	...	0.07^{25}	...	i. al.
37	2.7	...	...	s.	s.	...
38	1.790	70–80	$-4H_2O$, 215	26^{0}	66^{26}	v. sl. s. al.
39	3.197	...	...	85^{10}	110.5^{20}	sl. s. KOH; i. al., acet.
40	...	...	...	...	s.	$0.145^{13.5}$ al.; i. eth., CS_2, chl.
41	...	153	...	s.	s.	$0.091^{13.5}$ al.
42	2.155^{13}	...	...	...	...	...
43	...	$-H_2O$, 120	expl.	1.54^{30}	...	v. sl. s. al.
44	1.564	...	...	...	...	...
45	1.767	242 d.	...	...	...	...
46	1.616	...	...	s.	...	s. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Potassium			
1	succinate, hydrogen	$KHC_4H_4O_4 \cdot C_4H_6O_4$	274.26	monocl
2	sulfate (arcanite)	K_2SO_4	174.26	rhomb. or hex. col., 1.494, 1.495, 1.497
3	" , hydrogen (mercallite, misenite)	$KHSO_4$	136.17	monocl. or rhomb. col., deliq
4	*pyro*sulfate	$K_2S_2O_7$	254.32	col. need
5	*peroxydi*sulfate	$K_2S_2O_8$	270.32	tricl. col., 1.461, 1.467, 1.566
6	sulfide, mono-	K_2S	110.26	yel. br. deliq
7	" "	$K_2S \cdot 5H_2O$	200.34	rhomb. col
8	" , hydro-	KHS	72.17	rhomb. yel. deliq
9	" , di-	K_2S_2	142.32	red yel. cr
10	" "	$K_2S_2 \cdot 3H_2O$	196.37	yel
11	" , tri-	K_2S_3	174.39	br. yel. cr
12	" , tetra-	K_2S_4	206.46	red-br. cr
13	" "	$K_2S_2 \cdot 2H_2O$	242.49	yel
14	" , penta-	K_2S_5	238.52	orange cr
15	sulfite	$K_2SO_3 \cdot 2H_2O$	194.29	monocl. wh.-yelsh
16	" , hydrogen	$KHSO_3$	120.17	col. cr
17	*pyro*sulfite (*meta*bisulfite)	$K_2S_2O_5$	222.32	monocl. pl
...				
19	*d*-tartrate	$K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$	235.27	monocl. col., β 1.526
20	*dl*- "	$K_2C_4H_4O_6$	226.26	monocl. col
21	*d*- " , hydrogen	$KHC_4H_4O_6$	188.18	rhomb. col
22	*dl*- " , "	$KHC_4H_4O_6$	188.18	monocl. col
23	*ortho*tellurate	$K_2H_4TeO_6 \cdot 3H_2O$	359.88	rhomb. col. deliq
24	*meta*tellurate	K_2TeO_4	269.80	soft glutinous mass
25	telluride	K_2Te	205.80	col
26	tellurite	K_2TeO_3	253.80	wh. deliq. cr
27	thioantimonate	$2K_3SbS_4 \cdot 9H_2O$	896.77	yel. cr
28	thioarsenate	K_3AsS_4	320.46	deliq. cr
29	thioarsenite	K_3AsS_3	288.40	
30	thiocarbonate, tri-	K_2CS_3	186.40	yel.-red-br. cr., deliq
31	thiocyanate	$KSCN$	97.18	col. pr., deliq
32	*di*thionate	$K_2S_2O_6$	238.32	trig. col., 1.455, 1.515
33	*tri*thionate	$K_2S_3O_6$	270.39	rhomb., 1.475, 1.480, 1.487
34	*tetra*thionate	$K_2S_4O_6$	302.46	monocl
35	*penta*thionate	$2K_2S_5O_6 \cdot 3H_2O$	723.09	rhomb. col
36	*meta*thiostannate	$K_2SnS_3 \cdot 3H_2O$	347.12	dk. br. oil
37	thiosulfate	$3K_2S_2O_3 \cdot H_2O$	588.99	monocl. deliq
38	"	$3K_2S_2O_3 \cdot 5H_2O$	661.05	col. rhomb
40	tungstate	$K_2WO_4 \cdot 2H_2O$	362.14	monocl. col., deliq
41	*para*tungstate	$K_6W_7O_{24} \cdot 6H_2O$	2014.11	rhomb
42	*meta*tungstate	$K_6[H_2W_{12}O_{40}] \cdot 18H_2O$	3407.92	cub
43	*meta*uranate	K_2UO_4	380.26	or.-yel., rhomb
45	uranyl acetate	$KUO_2(C_2H_3O_2)_3 \cdot H_2O$	504.31	tetr
46	" carbonate	$2K_2CO_3 \cdot UO_2CO_3$	606.48	hex. yel
47	" sulfate	$K_2SO_4 \cdot UO_2SO_4 \cdot 2H_2O$	576.43	monocl. yel
48	urate, acid	$KHC_5H_2N_4O_3$	206.20	wh. powd
49	*meta*vanadate	KVO_3	138.05	col. cr
50	*ethyl*xanthate	KC_2H_5OCSS	160.30	col. lt. yel. pr
51	**Praseodymium**	Pr	140.92	pa. yel. met
52	acetate	$Pr(C_2H_3O_2)_3 \cdot 3H_2O$	372.10	grn. need
53	bromate	$Pr(BrO_3)_3 \cdot 9H_2O$	686.81	hex. grn

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.56	162	......	......	......	......
2	2.662	tr. 588; 1076	......	6.85^{0}; 12^{25}	24.1^{100}	i. al., acet., CS_2
3	2.24–2.61	210	d.	36.3^{0}	121.6^{100}	i. al. acet.
4	2.27	>300	d.	s.	d.	......
5	2.477	d.<100	......	1.75^{0}	5.3^{20}	i. al.
6	1.805^{14}	840	......	s.	v. s.	s. al., glyc.; i. eth.
7	......	60	$-3H_2O$, 150	s.	......	s. al., glyc.; i. eth.
8	2.0 (1.68–.70)	455	......	d.	d.	s. al.
9	......	470	......	s.	d.	s. al.
10	......	......	......	v. s.	v. s.	s. al.
11	......	252	......	s.	d.	s. al.
12	......	145	d. 850	s.	......	s. al.
13	......	......	......	s.	s.	sl. s. al.
14	......	206	......	v. s.	v. s.	sl. s. al.
15	......	d.	......	100	<100	sl. s. al.; i. NH_3
16	......	d. 190	......	s.	s.	i. al.
17	2.3	d.	......	sl. s.	......	sl. s. al.: i. eth.
19	1.97	......	......	150^{14}	278^{100}	sl. s. al.
20	1.984	......	......	......	......	......
21	1.956	......	......	0.37	6.1^{100}	s. a., alk.; i. al., ac. a.
22	1.954	......	......	$.42^{25}$	......	s. min. a.; i. al.
23	......	......	......	sl. s.	s.	sl. s. KOH; i. al.
24	......	200 d.	......	hydrolyzes	......	......
25	2.51	......	......	s.	s.	......
26	......	460–470 d.	......	v. s.	v. s.	s. h. K_2CO_3, KOH
27	......	......	......	s.	......	i. al.
28	......	d.	......	v. s.	......	i. al.
29	......	d.	......	s.	......	i. al.
30	......	d.	......	v. s.	s.	s. NH_3; sl. s. al.; i. eth.
31	1.886	173.2	d. 500	177.2^{0}	217^{20}	s. al., 20.75^{22} acet.; 0.18^{13} amyl. al.
32	2.278	d.	......	6	66^{100}	i. al.
33	2.304	......	......	v. s.	d.	i. al.
34	2.296	......	......	v. s.	......	i. al.
35	2.112	d.	......	50	d.	i. al.
36	1.847^{18}	$-3H_2O$, 100	......	s.	......	i. al.
37	2.23; (anh.) 2.590	$-H_2O$, 180	d.	96.1^{0}	312^{90}	i. al.
38	......	d.	......	$150.2^{17.2}$	......	......
40	3.113	tr. 388; 921	......	51.5	151.5	d. a.; i. al.
41	......	d.	......	2.15	6.6	d. a.; i. al.
42	......	*ca.* 930	......	s.	v. s.	d. a.
43	......	......	......	i.	i.	v. s. a.
45	2.396^{15} ($\frac{1}{2}H_2O$)	$-H_2O$, 275	......	s.	......	......
46	......	$-CO_2$, 300	......	7.4^{15}	d.	s. aq. K_2CO_3; i. al.
47	$3.363^{19.1}$	$-2H_2O$, 120	......	s.	......	......
48	......	......	......	sl. s.	......	......
49	......	......	......	sl. s.	s.	sl. s. KOH; i. al.
50	$1.558^{21.5}$	d.>200	......	v. s.	d.	20 al.; i. eth.
51	6.5	940	......	d.	......	s. a.
52	......	......	......	v. s.	......	......
53	......	56.5	$-7H_2O$, 100	196^{25}	......	......

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Praseodymium			
1	bromide	$PrBr_3$	380.67	grn. cr. powd
2	carbide	PrC_2	164.94	yel. cr
3	carbonate	$Pr_2(CO_3)_3 \cdot 8H_2O$	606.00	grn. silky pl
4	chloride	$PrCl_3$	247.29	bl. grn. need
5	"	$PrCl_3 \cdot 7H_2O$	373.40	tricl. grn
6	hexaantipyrine *per*chlorate	$[Pr(C_{11}H_{12}N_2O)_6](ClO_4)_3$	1568.63	grn. hex. leaf
7	molybdate	$Pr_2(MoO_4)_3$	761.69	tetr
8	oxalate	$Pr_2(C_2O_4)_3 \cdot 10H_2O$	726.06	lt. grn. cr
9	oxide, sesqui- (praseodymia)	Pr_2O_3	329.84	yel.-grn. amor
10	oxide, di-	PrO_2	172.92	br.-bl. powd
12	2, 4-pentanedione deriv. (acetylacetonate)	$Pr(C_5H_7O_2)_3$	438.24	cr. ppt
13	selenate	$Pr_2(SeO_4)_3$	710.72	
14	sulfate	$Pr_2(SO_4)_3$	570.04	lt. grn. powd
15	"	$Pr_2(SO_4)_3 \cdot 5H_2O$	660.12	monocl. pr
16	"	$Pr_2(SO_4)_3 \cdot 8H_2O$	714.17	monocl. grn., 1.540, 1.549, 1.561
17	sulfide	Pr_2S_3	378.04	br. powd
18	**Radium**	Ra	226.05	silv.-wh. met
19	bromide	$RaBr_2$	385.88	monocl. col.-yelsh
20	"	$RaBr_2 \cdot 2H_2O$	421.91	
21	carbonate	$RaCO_3$	286.06	wh. or sl. brnsh
22	chloride	$RaCl_2$	296.96	monocl. col.-yelsh
23	"	$RaCl_2 \cdot 2H_2O$	333.00	
24	iodate	$Ra(IO_3)_2$	575.89	
25	sulfate	$RaSO_4$	322.12	col
26	**Radon** (niton) (radium emanation)	Rn	222.00	col. gas, opaque cr
27	**Rhenium**	Re	186.22	hex. met. lust
28	chloride, tri-	$ReCl_3$	292.68	hex. dk. red
29	" , tetra-	$ReCl_4$	328.14	blk. (exist. quest.)
30	" , penta-	$ReCl_5$	363.60	dk. grn. to blk
31	" , hexa-	$ReCl_6$	399.05	yelsh. red (exist. quest.)
32	fluoride, tetra-	ReF_4	262.31	
33	" , hexa-	ReF_6	300.31	pa. yel
34	oxide, sesqui-	Re_2O_3	420.62	blk
35	" di-	ReO_2	218.31	blk
36	" tri-	ReO_3	234.31	
37	" hept-	Re_2O_7	484.62	br.-yel. pl. or powd
38	oxybromide, tri-	ReO_3Br	314.23	wh
39	oxy*tetra*chloride	$ReOCl_4$	344.14	
40	oxychloride, tri-	ReO_3Cl	269.77	col. liq
41	oxy*tetra*fluoride	$ReOF_4$	278.31	col
42	oxy*di*fluoride, di-	ReO_2F_2	256.31	col
43	sulfide, di-	ReS_2	250.44	blk. hex. on tri. leaf
44	" , hepta-	Re_2S_7	597.08	blk
45	**Rhodium**	Rh	102.91	cub. gray-wh
46	chloride, tri-	$RhCl_3$	209.28	br. red powd. deliq
47	" "	$RhCl_3 \cdot xH_2O$		dk. red
48	fluoride, tri-	RhF_3	159.91	rhomb. red
49	nitrate	$Rh(NO_3)_3$	288.93	br.-yel
50	"	$Rh(NO_3)_3 \cdot 2H_2O$	324.97	red. deliq

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	...	...	...	sl. s. d.	...	...
2	5.10	d.	...	d.	d.	s. dil. a.
3	...	$-6H_2O$, 100	...	i.	...	s. a.
4	4.02^{25}	818 (769–82)	>1000	103.9^{13}	∞^{100}	v. s. al.; 2.4 pyr.; i. eth., chl.
5	2.25^{17}	115	...	334^{13}	∞^{100}	s. al., HCl
6	...	286–91 d.	...	...	...	...
7	4.84	1030	...	...	...	...
8	...	...	...	i.	...	s. a.; 0.098^{25} n-H_2SO_4
9	6.88	d.	...	$.000020^{29}$	...	s. a.
10	...	...	...	...	...	...
12	...	146	...	...	...	s. CS_2
13	4.30^{15}	...	...	36^{0}	3^{92}	...
14	3.72^{16}	...	...	23.7^{0}; 17.7^{20}	1.02^{95}	...
15	3.176^{16}	...	...	...	1.85^{85}	...
16	$2.827^{13.8}$	...	...	17.4^{20}	sl. s.	...
17	5.042^{11}	d.	...	i.	d.	s. dil. a.
18	5?	700	1140	d. ev. H_2	...	d. a.
19	5.79	728	...	s.	s.	s. al.
20	...	$-2H_2O$, 100	...	...	...	...
21	...	...	...	i.	...	d. a.
22	4.91	1000	...	s.	s.	s. al.
23	...	$-2H_2O$, 100	...	...	...	...
24	...	...	...	$.0175^{0}$	$.170^{100}$	...
25	...	...	...	$.000002^{25}$	$.000005^{45}$	i. a.
26	9.73 g/l; lq. 4.4^{-62}; sld. 4	−71	−61.8	51.0^{0} cm³; 22.4^{25} cm³	13.0^{50} cm³	...
27	20.53	3167 ± 60	...	...	...	s. conc. HNO_3, H_2O_2
28	...	...	>550	s.	s.	s. a. alk.
29	...	...	500	s. d.	s. d.	s. HCl
30	4.9	...	d.	d.	d.	s. HCl; alk.
31	...	...	<40	s. d.	s. d.	s. HCl
32	...	124.5	...	...	...	...
33	lq. 6.1573; sld. 4.251	25.6	47.6	s. d.	s. d.	...
34	...	...	...	i.	i.	s. HNO_3; i. HCl
35	...	...	...	i.	i.	s. conc. HCl, H_2O_2
36	6.9–7.4	...	d. 400	i.	i.	s. alk. H_2O_2, HNO_3
37	8.2	*ca.* 220	450 subl.	v. s.	v. s.	v. s. al.; s. a., alk.
38	...	39.5	163	...	...	...
39	...	29	223	d.	d.	...
40	...	4.5	131	d.	d.	...
41	lq. 5.314; sld. 4.032	39.7	62.7	...	...	...
42	...	156	...	...	...	...
43	7.5	...	d.	i.	i.	s. HNO_3; i. al., alk.
44	$4.87^{24.5}$	...	d.	i.	i.	s. HNO_3, alk. H_2O_2
45	12.4	1966 ± 3	>2500	i.	i.	s. H_2SO_4 + HCl, h. conc H_2SO_4; sl. s. a., aq. reg.
46	...	d. 450–500	subl. 800	i.	i.	i. a., aq. reg.
47	...	d.	...	v. s.	...	s. al., HCl; i. eth.
48	5.38	...	>600 subl.	i.	i.	i. a., alk.
49	...	d.	...	v. s.	s.	i. al.
50	...	...	...	s.	s.	i. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Rhodium			
1	oxide, mon-	RhO	118.91	gray (exist. quest.)
2	“ , sesqui-	Rh_2O_3	253.82	gray cr. or amor
3	“ , “	$Rh_2O_3{\cdot}5H_2O$	343.90	yel. ppt
4	“ , di-	RhO_2	134.91	br
5	“ , di-	$RhO_2{\cdot}xH_2O$		olive-grn
6	sulfate	$Rh_2(SO_4)_3{\cdot}4H_2O$	566.08	red
7	“	$Rh_2(SO_4)_3{\cdot}12H_2O$	710.21	lt. yel. cr
8	“	$Rh_2(SO_4)_3{\cdot}15H_2O$	764.26	pa. yel. cr
9	sulfide, mono-	RhS	134.98	gray-blk. cr
10	“ , sesqui-	Rh_2S_3	302.02	blk
11	“ , hydro-	$Rh(HS)_3$	202.13	blk
12	sulfite	$Rh_2(SO_3)_3{\cdot}6H_2O$	544.11	yel. cr
13	**Rubidium**	Rb	85.48	soft, silv.-wh. met
14	acetate	$RbC_2H_3O_2$	144.52	col. nacreous leaf
15	aluminum sulfate	$RbAl(SO_4)_2{\cdot}12H_2O$	520.77	cub. oct. col., 1.457, 1.45232, 1.46618
16	bromate	$RbBrO_3$	213.40	
17	bromide	$RbBr$	165.40	cub. col., 1.5530
18	“ , tri-	$RbBr_3$	325.23	rhomb
19	bromochloroiodide	$RbIBrCl$	327.77	rhomb
20	bromoiodide, di-	$RbIBr_2$	372.23	rhomb
21	chlorobromide, di-	$RbBrCl_2$	236.31	rhomb
22	chloro*di*bromide	$RbBr_2Cl$	280.77	rhomb
23	carbonate	Rb_2CO_3	230.97	col. cr., deliq
24	“ , acid	$RbHCO_3$	146.50	rhomb
25	chlorate	$RbClO_3$	168.94	trim
26	*per*chlorate	$RbClO_4$	184.94	rhomb
27	chloride	$RbCl$	120.94	cub. col., 1.493
28	chloroiodide, di-	$RbICl_2$	283.31	rhomb
29	chloroplatinate	Rb_2PtCl_6	578.93	cub. yel
30	chromate	Rb_2CrO_4	286.97	rhomb. yel
31	*di*chromate	$Rb_2Cr_2O_7$	386.98	tricl. or monocl
32	chromium sulfate	$RbCr(SO_4)_2{\cdot}12H_2O$	545.81	cub., vlt., 1.482
33	copper sulfate	$Rb_2SO_4{\cdot}CuSO_4{\cdot}6H_2O$	534.73	monocl., 1.489, 1.491, 1.504
34	fluogermanate	Rb_2GeF_6	357.56	wh. cr
35	fluoride	RbF	104.48	col
36	fluosilicate	Rb_2SiF_6	313.02	cub. oct
37	fluosulfonate	$RbFSO_3$	184.55	need
38	gallium sulfate	$RbGa(SO_4)_2{\cdot}12H_2O$	563.52	col. cr., 1.46579
39	hydride	RbH	86.49	col. need
40	hydroxide	$RbOH$	102.49	gray-wh., deliq
41	iodate	$RbIO_3$	260.40	monocl. or cub
42	*metaper*iodate	$RbIO_4$	276.40	tetr
43	iodide	RbI	212.40	cub. col., 1.6474
44	“ , tri-	RbI_3	466.24	rhomb. blk
45	“ , compd. with SO_2	$RbI{\cdot}4SO_2$	468.66	lemon yel
46	iron selenate (ous)	$Rb_2SeO_4{\cdot}FeSeO_4{\cdot}6H_2O$	620.83	bl. grn. monocl. pr
47	“ “ (ic)	$RbFe(SeO_4)_2{\cdot}12H_2O$	643.44	cub., 1.507^{18}
48	“ sulfate (ous)	$Rb_2SO_4{\cdot}FeSO_4{\cdot}6H_2O$	527.04	gr. monocl. pr. 1.4815, 1.4874, 1.4977
49	“ “ (ic)	$RbFe(SO_4)_2{\cdot}12H_2O$	549.65	cub. 1.4823
50	*per*manganate	$RbMnO_4$	204.41	cr
51	neodymium nitrate	$2(?)RbNO_3{\cdot}Nd(NO_3){\cdot}4H_2O$	697.33	redsh. vlt. pl
52	nitrate	$RbNO_3$	147.49	hex. cub. rhomb. or tricl. col., 1.51, 1.52, 1.524

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	i.	i.	i. a.
2	....	d. 1100–1150	....	i.	i.	i. a. aq. reg., KOH
3	....	d.	....	i.	s	s. a.
4	....	....	....	i.	i.	i. a. alk.
5	....	d.	....	i.	....	s. HCl
6	....	d.	....	s.	s.	....
7	....	....	....	v. s.	d.	i. al.
8	....	d.	....	v. s.	d.	i. al., eth.
9	....	d.	....	i.	i.	i. a., aq. reg.
10	....	d.	....	i.	i.	i. a., aq. reg., aq. Br
11	....	d.	....	i.	d.	s. aq. reg., aq. Br; i. Na_2S
12	....	d.	....	s.	....	i. al.
13	1.532; lq. 1.475$^{38.5}$	38.5	700	d.	d.	s. a.; d. al.
14	....	246	....	s.	....	....
15	1.867^{0}	99	....	2.59^{20}	43.25^{80}	....
16	3.68	430	....	2.93^{25}	5.08^{40}	....
17	3.35; lq. 2.79^{730}	682	1340	98^{5}	205.2$^{113.5}$	sl. s. acet.; i. al.
18	....	d. 140	....	....	....	....
19	....	205	d. 200	....	....	....
20	....	225	d. 265	....	....	....
21	....	d. 110	....	....	....	....
22	....	76	....	....	....	....
23	....	837	d. 740	450^{20}	s.	0.7 abs. al.
24	....	d. 175	....	v. s.	....	s. al.
25	3.19	....	....	5^{19}	62.8^{100}	....
26	2.9	fus.	d.	0.5^{0}	18^{100}	i. al.
27	2.76; lq. 2.088^{750}	715	1390	77^{0}; 91.2^{20}	138.9^{100}	0.08^{25} al.; v. sl. s. NH_3; i. al.
28	....	180–200	d. 265	....	....	....
29	3.94$^{17.5}$	d.	....	.184^{0}; .141^{20}	.634^{100}	i. al.
30	3.518	....	....	62^{0}	95.7^{60}	....
31	3.02–.13	....	tricl. moncl.	4.96^{18} 5.42^{18}	27.3^{60} 28.1^{60}	....
32	1.946	107	....	....	....	....
33	2.57	....	....	10.28^{25}	....	....
34	....	....	....	sl .s.	v. s.	....
35	lq. 2.88^{820}	760	1410	130.6^{18}	....	s. dil. HF; i. al., eth., NH_3
36	3.332	....	....	0.16^{20}	1.35^{100}	s. a.; i. al.
37	....	304	....	....	....	....
38	1.962	....	....	s.	....	....
39	2.60	d. 300	....	d.	d.	d. a.
40	3.203^{11}	300	....	180^{15}	v. s.	s. al.
41	4.33$^{19.5}$	d.	....	2.1^{23}	....	v. s. HCl
42	3.918^{16}	....	....	0.65^{13}	....	....
43	3.55; lq. 2.87^{825}	642	1300	152^{17}	v. s.	0.674^{25} acet.
44	4.03	190	....	s.	....	....
45	....	13.5	....	....	....	....
46	2.819	....	....	....	....	....
47	2.131^{11}	45	....	....	....	....
48	2.516	....	....	....	....	....
49	1.91–.95	48–53	....	....	....	....
50	3.235$^{10.4}$	....	....	0.5^{0}	4.7^{60}	....
51	2.56	47	$-4H_2O$, 60	....	....	....
52	3.11; lq. 2.395^{400}	tr. cub. 161.4, m.p. 310	tr. rhomb. 219	3.48^{20}	452^{100}	v. s. HNO_3; s. acet.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Rubidium			
1	nitrate, hydrogen	$RbNO_3 \cdot HNO_3$	210.50	tetr
2	" "	$RbNO_3 \cdot 2HNO_3$	273.52	col. need
3	oxide, mon-	Rb_2O	186.96	cub. col.-yel.
4	" , per-	Rb_2O_2	202.96	cub. yel
5	" , tri- (sesqui)	Rb_2O_3 (or Rb_4O_6)	218.96	cub. blk
6	" , super-	RbO_2	117.48	yel
7	praseodymium nitrate	$2RbNO_3 \cdot Pr(NO_3)_3 \cdot 4H_2O$	693.98	grnsh. monocl. need., hyg
8	selenate	Rb_2SeO_4	313.92	col. rhomb
9	sulfate	Rb_2SO_4	267.03	rhomb. hex. col., 1.513, 1.513, 1.514.
10	sulfate, hydrogen	$RbHSO_4$	182.55	rhomb
11	sulfide, mono-	Rb_2S	203.03	col
12	" "	$Rb_2S \cdot 4H_2O$	275.09	cr. deliq
13	" , di-	Rb_2S_2	235.09	dk. red
14	" , tri-	Rb_2S_3	267.16	redsh. yel
15	" , penta-	Rb_2S_5	331.29	rhomb. red, deliq
16	" , hexa-	Rb_2S_6	363.36	brn.-red
17	*dl*-tartrate, hydrogen	$RbHC_4H_4O_6$	234.56	trim. pr
18	**Ruthenium**	Ru	101.1	blk. porous
19	"	Ru	101.1	hex. gray-wh. brittle met
20	chloride, tri-	$RuCl_3$	208.07	cr. br., deliq
21	" , tetra-	$RuCl_4 \cdot 5H_2O$	333.61	rdsh.-brn. cr. hygro
22	fluoride, penta-	RuF_5	196.70	dk.-grn. cr
23	hydroxide	$Ru(OH)_3$	152.72	blk. powd
24	oxide, di-	RuO_2	133.70	tetr. dk. bl
25	" "	$RuO_2 \cdot xH_2O$		blk
26	" , tetr-	RuO_4	165.70	rhomb. yel
27	silicide	$RuSi$	129.76	met. pr
28	sulfide (laurite)	RuS_2	165.83	cub. gray-blk
29	**Samarium**	Sm (or Sa)	150.35	hex. gray-wh. met
30	acetate	$Sm(C_2H_3O_2)_3 \cdot 3H_2O$	381.61	
31	bromate	$Sm(BrO_3)_3 \cdot 9H_2O$	696.32	hex. yel
32	bromide	$SmBr_3 \cdot 6H_2O$	498.27	yel. cr., deliq
33	carbide	SmC_2	174.45	hex. yel
34	chloride (ous)	$SmCl_2$	221.34	red-br. cr
35	"	$SmCl_3$	256.80	yelsh.-wh. cr., hyg
36	"	$SmCl_3 \cdot 6H_2O$	364.90	tricl. grn.-yel., deliq
37	hydroxide	$Sm(OH)_3$	201.45	pa. yel. powd
38	iodide	SmI_3	531.19	or.-yel. cr
39	molybdate	$Sm_2(MoO_4)_3$	780.71	rhomb. oct. vlt
40	nitrate	$Sm(NO_3)_3 \cdot 6H_2O$	444.55	tricl. pa. yel
41	oxalate	$Sm_2(C_2O_4)_3 \cdot 10H_2O$	745.08	cryst
42	oxide (samaria)	Sm_2O_3	348.86	wh.-yelsh. powd
43	2,4-pentanedione deriv. (acetylacetonate)	$Sm(C_5H_7O_2)_3$	447.75	cr. mass
44	sulfate	$Sm_2(SO_4)_3 \cdot 8H_2O$	733.19	monocl. lt. yel., 1.543, 1.552, 1.563.
45	" , basic	$Sm_2O_2SO_4$	428.93	yel. powd
46	sulfide	Sm_2S_3	397.06	yelsh.-pink
47	**Scandium**	Sc	44.96	silv
48	bromide	$ScBr_3$	284.85	
49	chloride	$ScCl_3$	151.47	col. cr
50	hydroxide	$Sc(OH)_3$	96.12	col. amor
51	nitrate	$Sc(NO_3)_3$	231.12	col
52	"	$Sc(NO_3)_3 \cdot 4H_2O$	303.19	pr., deliq
53	oxalate	$Sc_2(C_2O_4)_3 \cdot 5H_2O$	444.34	cr
54	oxide (scandia)	Sc_2O_3	138.20	wh. powd
55	2,4-pentanedione deriv. (acetylacetonate)	$Sc(C_5H_7O_2)_3$	342.42	col. pl

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	62	......	......	......	......
2	......	45	......	......	......	......
3	3.72	d. 400	......	s. d.	s. d.	......
4	3.65^{0}	600	......	d. to RbO	$H + H_2O_2$	......
5	3.53	<500	......	s. d.	......	......
6	3.05^{0}	280	......	d. to RbO	$H + H_2O_2$	$+ O_2$
7	2.50	63.5	$-4H_2O$, 60	......	......	......
8	3.90	......	......	159^{12}	......	......
9	3.613; lq. 2.53^{1100}	1060; tr. 653	......	42.4^{10}	81.8^{100}	......
10	2.892^{16}	<red heat	......	......	......	......
11	2.912	530 d.	......	v. s.	v. s.	......
12	......	......	......	v. s.	v. s.	......
13	......	420	volat.>850	......	......	......
14	......	213	......	......	......	......
15	2.618^{15}	225	......	d.	......	s. 70% al.; i. eth., chl.
16	......	201	......	......	......	......
17	2.282	d.	......	1.18^{25}	11.7^{100}	......
18	12.6	>1950	......	i.	i.	sl. s. a., aq. reg.; i. al., eth.
19	12.063	2450	>2700	i.	i.	s. fus. alk.; sl. s. aq. reg.; i. a.
20	3.11	d.>500	......	i.	d.	s. HCl; sl. s. al.; i. CS_2
21	......	......	......	s.	......	s. al.
22	$2.963^{16.5}$	101	270	d.	d.	......
23	......	......	......	v. sl. s.	......	s. a.; i. alk.
24	6.97	d.	......	i.	i.	i. a.; s. fus. alk.
25	......	d.	......	i.	i.	s. a.; i. alk.
26	3.29^{21}	25.5	*ca.* 100 d.	2.033^{20}	2.249^{74}	s. a., alk., al.
27	5.40^{4}	......	......	i.	i.	s. $HNO_3 + HF$
28	6.99	......	......	i.	i.	s. fus. alk.; i. a.
29	7.7	>1300	......	......	......	......
30	$4H_2O$, 1.94	......	......	15^{25}	......	......
31	......	75	$-9H_2O$, 150	114^{25}	......	v. sl. s. al.
32	2.971^{22}	......	......	......	......	......
33	5.86	......	......	d.	d.	s. a. d.
34	3.687^{22}	740	......	s. d.	......	i. al., CS_2
35	4.46^{18}	678 ± 2	......	92.4^{10}	99.9^{50}	v. s. al.; 6.4^{25} pyr.
36	2.383	$-5H_2O$, 110	......	......	......	......
37	......	......	......	i.	......	s. a.; i. alk.
38	......	816–24	d. 800	......	......	......
39	5.36	......	......	......	......	......
40	2.375	78–9	......	v. s.	......	......
41	......	......	......	0.000054	......	s. H_2SO_4
42	7.43	......	......	i.	......	v. s. a.
43	......	146–7	......	i.	......	......
44	2.930	$-8H_2O$, 450	......	2.67^{20}; 4.4^{25}	1.99^{40}	......
45	......	......	d. 1100	i.	......	i. dil. H_2SO_4
46	5.729	1900	......	......	d.	d. dil. a.
47	2.5	1200	2400	d. ev. H_2	......	......
48	3.914	subl.>1000	......	......	......	......
49	......	939	subl. 800–50	v. s.	v. s.	i. abs. al.
50	......	......	......	i.	......	s. dil. a.
51	......	150	......	s.	......	......
52	......	$-4H_2O$, 100	......	v. s.	......	......
53	......	$-4H_2O$, 140	......	......	......	......
54	3.86	......	......	i.	i.	s. h. a.
55	......	187.5	subl. 210–15	i.	......	s. al., bz., chl.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Scandium			
1	sulfate	$Sc_2(SO_4)_3$	378.40	col. cr
2	"	$Sc_2(SO_4)_3 \cdot 5H_2O$	468.48	
3	"	$Sc_2(SO_4)_3 \cdot 6H_2O$	486.49	
4	**Selenic acid**	H_2SeO_4	144.98	col. hex. pr.
5	" "	$H_2SeO_4 \cdot H_2O$	162.99	col. liq. or need. or rect. pl.
6	" "	$H_2SeO_4 \cdot 4H_2O$	217.04	col. liq.
7	**Selenious acid**	H_2SeO_3	128.98	hex. col.
8	**Selenium**	Se_8	631.68	amor. red powd
9	"	Se_8	631.68	colloidal dk. red powd
10	"	Se_8	631.68	vitreous, dk. brnsh. blk
11	"	Se_8	631.68	monocl. red, 2.9^{220} lq
12	"	$Se_8 < 500$ (Se_2 at 900)	631.68	trig. gray met
13	bromide, "mono-"	Se_2Br_2	317.75	dk. red liq
14	" , tetra-	$SeBr_4$	398.62	or. red-br. cr
15	" (mono)- chloride, tri-	$SeBrCl_3$	265.25	yel. br. cr
16	" (tri-) chloride	$SeBr_3Cl$	354.17	orange cr., hyg
17	chloride, "mono-"	Se_2Cl_2	228.83	br.-red liq., 1.596
18	" , tetra-	$SeCl_4$	220.79	cub. wh.-yel., deliq., 1.807
19	fluoride, tetra-	SeF_4	154.96	col. liq. or wh. cr
20	" , hexa-	SeF_6	192.96	gas, col., 1.895
21	iodide, "mono-"	Se_2I_2(?)	411.76	steel gray cr. (exist. quest)
22	nitride	Se_4N_4	371.87	amor. or.-yel. to brk. red hyg
23	oxide, di-	SeO_2	110.96	wh. monocl. (tetr.) col
24	" , tri-	SeO_3	126.96	amor. pa. yel. hyg
25	oxybromide	$SeOBr_2$	254.79	red-yel. cr
26	oxychloride	$SeOCl_2$	165.87	col.-yel. liq., 1.651^{20}
27	oxyfluoride	$SeOF_2$	132.96	col. liq
28	sulfide, "mono"	SeS	111.03	or. yel. tabl. or powd
29	" di-	SeS_2	143.09	br. red-yel
30	sulfur oxide	$SeSO_3$	159.03	grn. pr. or yel. powd
31	sulfur oxy*tetra*chloride	$SeSO_3Cl_4$	300.85	hex. pr
32	**Silane**, bromo-	SiH_3Br	111.00	
33	" , bromotrichloro-	$SiBrCl_3$	214.35	col. liq
34	" , chloro-	SiH_3Cl	66.54	
35	" , dibromo-	SiH_2Br_2	189.91	
36	" , dibromodichloro-	$SiBr_2Cl_2$	258.81	col. liq
37	" , dichloro-	SiH_2Cl_2	100.99	
38	" , tribromo- (silicobromoform)	$SiHBr_3$	268.82	col. liq
39	" , tribromochloro-	$SiBr_3Cl$	303.27	col. liq
40	" , trichloro- (silicochloroform)	$SiHCl_3$	135.44	col. liq
41	" , trichloroiodo	$SiCl_3I$	261.35	col. liq
42	" , trifluoro- (silicofluoroform)	$SiHF_3$	86.07	col. gas

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.579	d.	....	10.3^{25}	v. s.	....
2	....	....	....	39.9^{25}	....	....
3	....	$-4H_2O$, 100; $-6H_2O$, 250	....	v. s.	....	....
4	sld. 2.951^{15}; lq. 2.608^{15}	58; eas. undercools	260 d.	v. s.	v. s.	s. H_2SO_4; i. NH_3; d. al. & org. solv.
5	2.627^{15}; lq. 2.356^{15}	25–6; eas. undercools	205	v. s.	v. s.	d. org. solv.; v. s. al.; i. NH_3
6	....	−51.7; eas. undercools	172^{85}; $-H_2O$	∞	....	d. org. solv.; s. H_2SO_4
7	3.004^{15}	d.	$-H_2O$	167^{20}	v. s.	v. s. al.; i. NH_3
8	4.82	−met. 220	688	i.	i.	s. H_2SO_4, CS_2, bz.; i. al.
9	....	....	....	s.	....	s. CS_2
10	4.28 (4.14^{22})	indef.	688	i.	i.	s. H_2SO_4, HNO_3, CS_2
11	4.46^{25} (4.50)	170–180	688	i.	i.	s. H_2SO_4, HNO_3, CS_2
12	4.79^{15}	217	688	i.	i.	s. H_2SO_4, HNO_3; i. CS_2
13	3.604^{15}	....	227 d.	d.	d.	d. al.; s. CS_2, chl., C_2H_5Br
14	....	d. 75	....	d.	d.	s. CS_2, chl., C_2H_5Br, HCl
15	....	190	....	....	....	i. CS_2
16	....	d.	....	....	....	v. sl. s. CS_2
17	2.91^{17}; 2.77^{23}	−85	130 d.	d.	d.	d. al., eth.; s. CS_2 CCl_4, chl., bz.
18	$3.78\text{–}.85^{360}$	305; subl. 170–196	d. 288	d.	d.	d. a., alk.; s. $POCl_3$; v. sl. s. CS_2
19	....	m.p. −13.5; frz. −90	>100 (93)	d.	d.	....
20	3.25^{-28} g/l	−39; subl. −46.6	−34.5	s. d.	....	....
21	....	68–70	d. 100	d.	d.	....
22	....	exp. 160–200	d.	i.	i.	v. sl. s. bz., ac. a., CS_2; i. al., eth.
23	$3.95\frac{15}{15}$	340–350	subl. 315–7	38.4^{14}	82.5^{65}	6.67^{14} al., $4.35^{15.3}$ acet.; $1.11^{13.9}$ ac. a.; s. bz.
24	3.6	d. 120	....	v. s. d.	v. s. d.	s. al., conc. H_2SO_4; i. eth., bz., chl., CCl_4
25	lq. 3.38^{50}	41.6	217^{740} d.	d.	....	s. CS_2, CCl_4, chl., H_2SO_4, bz.
26	2.42^{22}	8.5 (10.9)	176.4	d.	....	s. CS_2, CCl_4, chl., bz.
27	2.67	4.6	124	d.	....	s. al., CCl_4
28	3.056^{0}	d. 118–9	....	i.	i.	s. CS_2; i. eth.
29	....	<100	d.	i.	....	d. aq. reg., HNO_3; s. $(NH_4)_2S$
30	....	$-SO_2$, 40	....	d.	....	s. H_2SO_4; i. SO_3
31	....	165	183	d.	....	....
32	1.72^{-80}; 1.533^{20}	−94	1.9	....	....	....
33	....	<−60	80	d.	d.	....
34	1.145^{-113}	−118.1	−30.4	....	....	....
35	2.17^{0}	−77	66	....	....	....
36	....	<−60	104	d.	d.	....
37	1.42^{-122}	−122	8.3	....	....	....
38	2.7^{17}	<−60	109	d.	d.	d. NH_3
39	2.434	−39	140.5	d.	d.	....
40	1.34	−134	33	d.	d.	s. CS_2, CCl_4, chl., bz.
41	....	<−60	113.5	d.	....	....
42	3.86^{0} g/l	*ca.* −110	−80.2	d.	d.	d. alk., al., eth.; s. tol.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Silane			
1	“ , triiodo- (silicoiodoform)	$SiHI_3$	409.83	red liq
2	**Silicic acid,** meta-	$(H_2SiO_3)_x$ (or $[SiO_2 \cdot H_2O_x]$)	....	amor. col. (exist. quest.)
3	“ “ , di-	$H_2Si_2O_5$ (or $2SiO_2 \cdot H_2O$)	138.14	amor. col. (exist. quest.)
4	**Silicon,** adamantine	Si	28.09	cub. steel gray
5	“ amorphous	Si	28.09	amor. br
6	“ graphitoidal	Si	28.09	blk. pl
7	acetate, tetra-	$Si(C_2H_3O_2)_4$	264.24	hyg. cr
8	(di-) bromide, hexa- (hexabromodisilane)	Si_2Br_6	535.62	rhomb. wh
9	bromide (di-) sulfide	$SiSBr_2$	219.95	col. pl
10	“ , tetra- (tetrabromosilane)	$SiBr_4$	347.72	col. fum. liq., 1.579^{16} (F)
11	carbide	SiC	40.07	hex. or cub. col. or blk., 2.654, 2.697
12	(di-) carbide	Si_2C	68.13	gray cr
13	(di-) chloride, hexa- (hexachlorodisilane)	Si_2Cl_6	268.86	col. liq
14	chloride (di-) sulfide	$SiSCl_2$	131.04	col. pr
15	“ tetra- (tetrachlorosilane)	$SiCl_4$	169.89	col. fum. liq., 1.412 (C)
16	“ , (tri-) sulfide, hydro-	$SiCl_3HS$	167.51	col. liq
17	fluoride, tetra- (tetrafluorosilane)	SiF_4	104.06	col. gas
18	(di-) fluoride, hexa- hexa-fluorodisilane)	Si_2F_6	170.12	gas
19	hydride (silane, silicane)	SiH_4	32.09	col. gas
20	“ (disilane, disilicane)	Si_2H_6	62.17	col. gas
21	“ (trisilane, trisilanepropane)	Si_3H_8	92.24	col. liq
22	“ (tetrasilane, tetrasilane butane)	Si_4H_{10}	122.32	col. liq
23	iodide, tetra- (tetraiodosilane)	SiI_4	535.74	cub. col
24	(di-) iodide, tetra- (tetraiododisilane-ethylene)	Si_2I_4	563.80	orange-red
25	(di-) iodide, hexa- (hexaiododisilane)	Si_2I_6	817.64	hex. col
26	nitride	Si_3N_4	140.21	amor. grayish-wh. powd
27	oxide, di- (cristobalite)	SiO_2	60.06	cub. or tetr. col., 1.487, 1.484
28	“ “ (lechatelierite)	SiO_2	60.06	col. 1.46
29	“ “ (quartz)	SiO_2	60.06	hex. col., 1.544, 1.553
30	“ “ (tridymite)	SiO_2	60.06	rhomb. col., 1.469, 1.470, 1.471
31	“ “ (amor., opal)	$SiO_2(+xH_2O)$	....	col. amor., 1.41–1.46
32 *	oxychloride	Si_2OCl_6	284.86	col. liq
33	sulfide, mono-	SiS	60.13	yel. need. or blk. sld
34	“ , di-	SiS_2	92.19	wh. need
35	thiocyanate, tetra-	$Si(SCN)_4$	260.40	small trim. pr
36	**Silicotungstic acid**	$H_4SiW_{12}O_{40} \cdot 14H_2O$	3131.36	trig. col
37	**Silicotungstic acid**	$H_4SiW_{12}O_{40} \cdot 31H_2O$	3437.64	col. or yelsh. tetrag

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* See silicon monoxide, oxyhydride, and sesquioxide at end of table.

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.314	8	220	d.	d.	s. CS_2, bz.
2	2.1–.3	d. 15	....	i.	i.	s. alk.; i. NH_4Cl
3	1.57^{17}	d. 150	....	sl. s.	sl. s.	s. alk.; i. NH_2Cl
4	2.42	1420	2355	i.	i.	s. $HF + HNO_3$; i. a., HF
5	2.00	....	2355	i.	i.	s. HF, KOH
6	*ca.* 2.4	....	2355	i.	i.	s. $HF + HNO_3$; i. HF
7	....	110, subl.	148	....	d. 160–170	d. al.
8	....	95	240	d.	d.	d. KOH; s. CS_2
9	....	93	$150^{18.3}$	d.	d.	s. bz., CS_2
10	2.814	5	153	d.	d.	d. H_2SO_4
11	3.217	2600 (subl. d.)	subl.>2000 d. 2210	i.	i.	d. fused KOH; i. a.
12	2.5	....	....	d.	....	s. HNO_3, H_2SO_4; i. al., eth.
13	lq. 1.58^0	−1	139 (145)	d.	d.	d. al.
14	....	75	$92^{22.5}$	d.	d.	s. CCl_4, CS_2
15	1.483	−70	57.57	d.	d.	d. al.
16	1.45	....	96–100	d.	d.	d. al.
17	4.67 g/l	−77 (−97)	-65^{181}	d.	d.	s. abs. al., eth., HF
18	....	−18.7	−19.1 (subl.)	d.	d.	....
19	lq. 0.68^{-185}; 1.44 g/l	−185	−111.8	i.	....	d. KOH
20	lq. 0.0686^{-25}	−132.5	−14.5	slow d., sl. s.	....	s. bz., al., CS_2
21	.725; 0.743^0	−117.4	52.9	d.	d.	d. CCl_4
22	0.79^0	−93.5	80	d.	....	....
23	....	120.5	290	d.	....	2.2^{27} CS_2
24	....	....	....	d.	....	i. CS_2, chl., bz.
25	....	250	d.	d.	d.	19^{19} CS_2
26	3.44	1900 press; subl.	....	....	....	s. HF
27	2.32	1710	2230 (2590)	i.	i.	s. HF; v. sl. s. alk.
28	2.20	....	2230 (2590)	i.	i.	s. HF; v. sl. s. alk.
29	2.653–2.660	<1470	2230 (2590)	i.	i.	s. HF; v. sl. s. alk.
30	2.28–2.33	1670	2230 (2590)	i.	i.	s. HF; v. sl. s. alk.
31	2.1–2.3	>1600	....	i.	i.	s. HF, hot alk.
32*	....	−33	137	d.	d.	d. al.; ∞ CS_2, CCl_4, chl., eth.
33	1.853^{15}	....	subl. 940^{20}	d.	d.	d. alk., al.
34	....	subl.	white heat	d.	....	d. al.; s. dil. alk.; i. bz.
35	....	143.8	314.2	....	....	s. bz.; sl. s., CS_2, chl.
36	....	$-18H_2O$, 100	....	v. s.	v. s.	v. s. al., eth.
37	....	$-6H_2O$ *ca.* 28.5; 36–53	....	v. s.	....	s. al.

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* See compounds at end of table.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Silicylamine,** tri- (nitrilotrissilane)	$(SiH_3)_3N$	107.26	inflam. liq
2	**Silicyl oxide** (disiloxane)	$(SiH_3)_2O$	78.17	col. gas
3	**Silver**	Ag	107.88	cub. wh. met., 0.54
4	acetate	$AgC_2H_3O_2$	166.92	wh. pl
5	acetylide	Ag_2C_2	239.78	wh. ppt
6	*ortho*arsenate	Ag_3AsO_4	462.55	cub. dk. red
7	*ortho*arsenite	Ag_3AsO_3	446.55	yel. powd
8	azide	AgN_3	149.90	wh. prisms
9	benzoate	$AgC_7H_5O_2$	228.99	wh. powd
10	*tetra*borate	$Ag_2B_4O_7 \cdot 2H_2O$	407.07	white
11	bromate	$AgBrO_3$	235.80	tetr. col., 1.847, 1.920
12	bromide (bromyrite)	AgBr	187.80	cub. pa. yel., 2.253
13	carbonate	Ag_2CO_3	275.77	yel. powd
14	chlorate	$AgClO_3$	191.34	tetr. wh
15	*per*chlorate	$AgClO_4$	207.34	wh. cr., deliq
16	chloride (cerargyrite)	AgCl	143.34	cub. wh., 2.071
17	chromate	Ag_2CrO_4	331.77	monocl. red
18	*di*chromate	$Ag_2Cr_2O_7$	431.78	tricl. red
19	citrate	$Ag_3C_6H_5O_7$	512.74	wh. need
20	cyanate	AgOCN	149.90	col
21	cyanide	AgCN	133.90	hex. wh
22	ferricyanide	$Ag_3Fe(CN)_6$	535.60	orange
23	ferrocyanide	$Ag_4Fe(CN)_6 \cdot H_2O$	661.49	wh
24	fluogallate	$Ag_3[GaF_6] \cdot 10H_2O$	687.52	orthorh., col. cr. n 1.493
25	(di-) fluoride	Ag_2F	234.76	hex. yel
26	fluoride	AgF	126.88	cub. yel., deliq
27	“ , di-	AgF_2	145.88	br. powd
28	fluosilicate	$Ag_2SiF_6 \cdot 4H_2O$	429.88	col. cr. or wh. powd., deliq
29	fulminate	$Ag_2C_2N_2O_2$	299.80	sm. need
30	iodate	$AgIO_3$	282.80	rhomb. col
31	iodide (iodyrite)	AgI	234.80	hex. yel., 2.21, 2.22
32	lactate	$AgC_3H_5O_3 \cdot H_2O$	214.97	wh. or sl. gray cr. powd
33	laurate	$AgC_{12}H_{23}O_2$	307.18	wh. greasy powd
34	levulinate	$AgC_5H_7O_3$	222.99	leaf
35	*per*manganate	$AgMnO_4$	226.81	monocl. dk. vlt
36	iodomercurate (II)	Ag_2HgI_4	924.05	deep yel. powd
37	myristate	$AgC_{14}H_{27}O_2$	335.24	
38	nitrate	$AgNO_3$	169.89	rhomb. col., α 1.729, γ 1.788
39	nitrite	$AgNO_2$	153.89	rhomb. wh
40	*hypo*nitrite	$Ag_2N_2O_2$	275.77	yel
41	nitroprusside	$Ag_2[FeNO(CN)_5]$	431.71	lt. pink
42	oxalate	$Ag_2C_2O_4$	303.78	col. cr
43	oxide	Ag_2O	231.76	cub. br.-blk
44	“ , per (?)	Ag_2O_2 (or AgO)	247.76	cub. gray-blk
45	palmitate	$AgC_{16}H_{31}O_2$	363.29	wh. greasy powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	0.895^{-106}	−105.6	52	…….	…….	…….
2	0.881^{-80}	−144	−15.2	v. sl. s.	sl. d.	…….
3	10.5	960.8	1950	i.	i.	s. HNO_3, h. H_2SO_4, KCN; i. alk.
4	3.259^{15}	d.	…….	0.72^{0}; 1.02^{20}	2.52^{80}	…….
5	…….	exp.	…….	i.	…….	s. a.; sl. s. al.
6	6.657^{25}	…….	…….	0.00085^{20}	…….	s. ac. a., NH_4OH
7	…….	150 d.	…….	0.00115^{20}	i.	s. ac. a., NH_4OH, HNO_3; i. al.
8	…….	2.50	exp. 297	i.	0.01^{100}	s. KCN, dil. HNO_3; sl. s. NH_4OH
9	…….	…….	…….	0.262^{25}	s.	.017 al.
10	…….	…….	…….	sl. s.	…….	s. a.
11	5.206	d.	…….	$.196^{25}$	1.33^{90}	s. NH_4OH; sl. s. HNO_3
12	6.473^{25}	434	d. 700	8.4×10^{-6}	$.00037^{100}$	s. KCN, $Na_2S_2O_3$; sl. s. NH_4OH; i. al.
13	6.077	218 d.	…….	0.0032^{20}	0.05^{100}	s. NH_4OH, $Na_2S_2O_3$; i. al.
14	4.430	230	d. 270	10^{15}	50^{80}	sl. s. al.
15	2.806^{25}	d. 486	…….	525^{25}	s.	s. al., tol.
16	5.56	455	1550	$.00008^{910}$	$.0021^{100}$	s. NH_4OH, $Na_2S_2O_3$, KCN
17	5.625	…….	…….	0.0014^{0}	0.008^{70}	s. a., NH_4OH, KCN
18	4.770	d.	…….	0.0083^{15}	d.	s. a., NH_4OH, KCN
19	…….	d.	…….	0.028^{18}	…….	s. a., NH_4OH, KCN, $Na_2S_2O_3$
20	4.00	d.	…….	sl. s.	s.	s. HNO_3, NH_4OH, KCN
21	3.95	320 d.	…….	$.00002^{320}$	…….	s. HNO_3, NH_4OH, KCN, $Na_2S_2O_3$
22	…….	…….	…….	$.00006^{620}$	…….	s. NH_4OH, h. $(NH_4)_2CO_3$; i. a.
23	…….	…….	…….	i.	i.	s. KCN; i. a., NH_4OH, NH_4 salts
24	2.90	…….	…….	v. s.	…….	i. al.
25	8.57	90 d.	…….	d.	…….	…….
26	$5.852^{15.5}$	435	…….	$182^{15.5}$	205^{108}	sl. s. NH_4OH
27	4.57–4.78	690	…….	d.	d.	…….
28	…….	<100	d.	v. s.	…….	…….
29	…….	exp.	…….	0.075^{13}	s.	v. s. NH_4OH; i. HNO_3
30	5.525	>200	d.	0.003^{10}	0.019^{60}	s. NH_4OH, HNO_3, KI
31	5.67	d. 552	…….	3×10^{-7}	3×10^{-6}	s. KCN, $Na_2S_2O_3$; sl. s. NH_4OH
32	…….	…….	…….	*ca.* 7.7	…….	…….
33	…….	212.5	…….	…….	…….	0.007^{25} al., 0.008^{15} eth.
34	…….	…….	…….	0.67^{17}	d.	…….
35	…….	d.	…….	0.55^{0}	$1.69^{28.5}$	d. al.
36	…….	…….	…….	i.	…….	s. KI, KCN; i. dil. a.
37	…….	211	…….	0.007^{25}	…….	0.006^{25} al., 0.007^{15} eth.
38	4.352^{19}	212	444 d.	122^{0}	952^{100}	s. eth., glyc.; v. sl. s. abs. al.
39	4.453^{26}	d. 140	…….	0.155^{0}	1.363^{60}	s. ac. a., NH_4OH; i. al.
40	5.75^{30}	d. 110	…….	v. sl. s.	…….	d. HNO_3, H_2SO_4
41	…….	…….	…….	i.	…….	s. NH_4OH; i. al., HNO_3
42	5.029^{4}	exp. 140	…….	0.00339^{18}	…….	s. a., NH_4OH, KCN
43	$7.143^{16.6}$	d. 300	…….	0.0013^{20}	0.0053^{80}	s. a., NH_4OH, KCN; i. al.
44	7.44	d.>100	…….	i.	…….	s. H_2SO_4, conc. HNO_3, NH_4OH
45	…….	209	…….	0.0012^{20}; 0.004^{25}	0.006^{50}	0.007^{15} eth.; 0.006^{25} al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Silver			
1	*ortho*phosphate	Ag_3PO_4	418.62	cub. yel
2	" , mono-H	Ag_2PO_4	311.75	wh. trig., 1.8036
3	*pyro*phosphate	$Ag_4P_2O_7$	605.48	wh.
4	*meta*phosphate	$AgPO_3$	186.86	wh. amor
5	propionate	$AgC_3H_5O_2$	180.95	wh. leaf. or need
6	*per*rhenate	$AgReO_4$	358.19	wh. tetr. or rhomb
7	salicylate	$AgC_7H_5O_3$	244.99	wh. to redsh. wh. cr
8	selenide	Ag_2Se	294.72	cub. thin gray pl
9	stearate	$AgC_{18}H_{35}O_2$	391.34	wh. powd., amor
10	sulfate	Ag_2SO_4	311.82	rhomb. wh
11	sulfide (acanthite)	Ag_2S	247.82	rhomb. gray-blk
12	" (argentite)	Ag_2S	247.82	cub. blk
13	sulfite	Ag_2SO_3	295.82	wh. cr
14	*d*-tartrate	$Ag_2C_4H_4O_6$	363.83	scales
15	*ortho*tellurate, tetra-H	$Ag_2H_4TeO_6$	443.40	rhomb. bipyr. straw yel
16	telluride (hessite)	Ag_2Te	343.37	cub. gray
17	tellurite	Ag_2TeO_3	391.37	yel. wh. ppt
18	thioantimonite (pyrargyrite)	Ag_3SbS_3	541.58	trig., 3.084, 2.881 (Li)
19	thioarsenite (proustite)	Ag_3AsS_3	494.73	trig., 3.088, 2.792
20	thiocyanate	$AgSCN$	165.96	col. cr. or wh. curd
21	*di*thionate	$Ag_2S_2O_6 \cdot 2H_2O$	411.92	rhomb. 1.662
22	thiosulfate	$Ag_2S_2O_3$	327.89	wh.
23	tungstate	Ag_2WO_4	463.68	pa.-yel. cr
24	**Silver complex:** Diamminesilver *per*rhenate	$[Ag(NH_3)_2]ReO_4$	392.25	col. monocl. cr
25	**Sodium**	Na	22.991	cub. silv. met., 4.22
26	acetate	$NaC_2H_3O_2$	82.04	wh.-gr. powd
27	"	$NaC_2H_3O_2 \cdot 3H_2O$	136.09	monocl. pr. col., effl., β 1.464
28	aluminasilicate (albite)	$NaAlSi_3O_8$ (or $Na_2O \cdot Al_2O_3 \cdot 6SiO_2$)	262.15	tri. col., 1.525, 1.529, 1.536
29	*meta*aluminate	$NaAlO_2$	81.97	amor. wh. powd. hyg
30	aluminum chloride	$NaCl \cdot AlCl_3$	191.80	wh.-yelsh. cr. powd., deliq
31	" sulfate	$NaAl(SO_4)_2 \cdot 12H_2O$	458.29	cub. oct. col., 1.4388
32	amide (sodamide)	$NaNH_2$	39.02	olive grn. fr. impurities or wh. conchoidal fract.
33	ammonium phosphate (microcosmic salt; stercorite)	$NaNH_4HPO_4 \cdot 4H_2O$	209.09	monocl. col., 1.439, 1.441, 1.469
34	antimonate, hydroxo- ("pyroantimonate")	$NaSb(OH)_6$	246.81	pseudo-cub
35	antimonide	Na_3Sb	190.75	bl
36	*meta*antimonite	$NaSbO_2 \cdot 3H_2O$	230.81	col. rhomb
37	*ortho*arsenate	$Na_3AsO_4 \cdot 12H_2O$	424.09	trig. col., 1.457, 1.466, hex. pr
38	" , mono-H	$Na_2HAsO_4 \cdot 7H_2O$	312.02	monocl. col., 1.462, 1.466, 1.478
39	" , "	$Na_2HAsO_4 \cdot 12H_2O$	402.10	monocl. col. eff., 1.445, 1.450, 1.451
40	" , di-H	$NaH_2AsO_4 \cdot H_2O$	181.94	rhomb. or monocl. col., 1.5382, 1.5535, 1.507

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Cold water	Hot water	Alcohol, acids, etc.
1	6.370^{25}	849	....	$.00065^{19.5}$	....	s. a., NH_4OH, KCN; i. NH_3
2	....	d. 110	....	....	....	....
3	$5.306^{7.5}$	585	....	i.	i.	s. a., NH_4OH, KCN; i. ac. a.
4	6.37	*ca.* 482	....	i.	....	s. HNO_3, NH_4OH
5	$2.687\frac{25}{4}$	....	....	0.842^{20}	2.03^{80}	....
6	7.05	430	....	0.32^{20}	....	....
7	....	....	....	s.	....	s. al.
8	8.0	880	d.	i.	....	s. h. HNO_3, NH_4OH
9	....	205	....	0.006^{20}	....	0.006^{25} al.; 0.006^{25} eth.
10	$5.45^{29.2}$	652	d. 1085	0.57^{0}	1.41^{100}	s. a., NH_4OH; i. al.
11	7.326	tr. 175	d.	.00002	....	s. HNO_3, KCN, conc. H_2SO_4
12	7.317	825	d.	$.000014^{20}$	....	s. a., KCN
13	....	d. 100	....	v. sl. s.	....	s. a., NH_4OH, KCN; i. HNO_3
14	3.432^{15}	d.	....	0.2^{18}	0.203^{25}	s. a., NH_4OH, KCN
15	....	d.>200	....	i.	i.	s. NH_4OH, KCN
16	8.5	955	....	i.	....	s. HNO_3, KCN
17	....	250-bl.; 450-pa. yel.	....	i.	i.	s. NH_3, KCN
18	5.76	>175	....	i.	i.	s. HNO_3
19	5.49	>175	....	i.	i.	s. HNO_3
20	....	d.	....	$.000021^{25}$	$.00064^{100}$	s. NH_4OH; i. a.
21	3.61	....	....	....	....	....
22	....	d.	....	sl. s.	....	s. NH_4OH, $Na_2S_2O_3$
23	....	....	....	0.05^{15}	....	s. HNO_3, NH_4OH, KCN
24	3.901	....	....	....	....	1.618 conc. NH_4OH
25	0.97	97.5	880	d. to NaO	H + H_2	d. al.; i. bz., eth.
26	1.528	324	....	119^{0}	170.15^{100}	2.1^{18} al.
27	1.45	58; 78	$-3H_2O$, 120	76.2^{0}	138.8^{50}	2.1^{18} al.; s. eth.
28	2.61	1100	....	....	....	....
29	....	1650	....	s.	v. s.	i. al.
30	....	185	....	s.	s.	....
31	1.675	61	....	anh. 110^{15}	anh. 146.3^{30}; d.>30	s. dil. a.; i. al.
32	....	210	400	d.	d.	d. hot al.; s. 0.1 g in liq. NH_3
33	1.554	79 d.	....	16.7	100	i. al.
34	....	....	....	$.03^{12.3}$	0.3^{100}	sl. s. al.
35	....	856	....	d.	....	....
36	2.864	d.	....	d.	....	....
37	1.762–1.804	86.3	....	$38.9^{15.5}$	....	1.67 al.
38	1.88	120–130	$-H_2O$, 180	5.46^{0}	35.09^{34}; 100^{100}	sl. s. al.
39	1.736–59	28	$-12H_2O$, 100	17.2^{0}; 56^{14}	140.7^{30}	sl. s. al.; i. liq. Cl
40	2.53; 2.67	$-H_2O$, 100–130	d. 200–280	s.	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	*meta*arsenate	$NaAsO_3$	145.91	rhomb. effl., 1.479, 1.502, 1.5265
2	arsenite (*meta*arsenite (?)) (com'l)	$NaAsO_2$ (or mixt. with Na_3AsO_3	129.91	gray-wh. powd
3	auride	$NaAu_2$	417.40	cub. yel
4	azide	NaN_3	65.02	col. hex
5	barbital	$NaC_8H_{11}N_2O_3$	206.18	wh. powd
6	benzenesulfonate	$NaC_6H_5SO_3$	180.16	wh. cr
7	benzoate	$NaC_7H_5O_2$	144.11	col. cr. or wh. amor., or gran. powd
8	*meta*bismuthate	$NaBiO_3$	280.00	yel.-br. powd. (com'l); yel. (pure)
9	bismuthide	Na_3Bi	277.99	blue vlt
10	*meta*borate	$NaBO_2$	65.82	hex. pr., col
11	"	$NaBO_2 \cdot 4H_2O$	137.88	monocl. col
12	*tetra*borate	$Na_2B_4O_7$	201.27	
13	"	$Na_2B_4O_7 \cdot 5H_2O$	291.35	cub. or hex. deliq
14	" (borax)	$Na_2B_4O_7 \cdot 10H_2O$	381.43	monocl. col., 1.447, 1.469, 1.472, effl.
15	"*per*borate" (com'l) (*meta*borate peroxyhydrate)	$NaBO_3 \cdot H_2O$ (or $NaBO_2 \cdot H_2O_2$)	99.83	
16	"perborate" (com'l) (*meta*borate peroxyhydrate)	$NaBO_3 \cdot 4H_2O$ (or $NaBO_2 \cdot H_2O_2 \cdot 3H_2O$)	153.88	monocl. col
17	borohydride	$NaBH_4$	37.84	
18	bromate	$NaBrO_3$	150.91	cub. col., 1.594
19	bromide	$NaBr$	102.91	cub. col
20	"	$NaBr \cdot 2H_2O$	138.95	monocl. col. pr
21	bromoaurate	$NaAuBr_4 \cdot 2H_2O$	575.89	br.-blk. cr
22	bromoiridite	$Na_3IrBr_6 \cdot 12H_2O$	957.78	olive gr. rhomb. effl
23	bromoplatinate	$Na_2PtBr_6 \cdot 6H_2O$	828.82	tricl. dk. red
24	cacodylate	$Na[(CH_3)_2AsO_2] \cdot 3H_2O$	214.02	wh. amor. powd. pois
25	calcium sulfate	$Na_2Ca(SO_4)_2 \cdot 2H_2O$	314.24	monocl. need
26	*d*-camphorate	$Na_2C_{10}H_{14}O_4 \cdot 3H_2O$	298.25	hygr. need
27	carbide	Na_2C_2	70.01	wh. powd
28	carbonate	Na_2CO_3	106.00	wh. powd., hyg
29	" (crystal carbonate, thermonatrite)	$Na_2CO_3 \cdot H_2O$	124.02	rhomb. col. deliq
30	carbonate	$Na_2CO_3 \cdot 7H_2O$	232.12	rhomb. bipyr. effl
31	" (washing soda)	$Na_2CO_3 \cdot 10H_2O$	286.16	monocl. wh. 1.405, 1.425, 1.440
32	", sesqui-	$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$	226.05	monocl. 1.5073
33	", hydrogen (baking soda)	$NaHCO_3$	84.02	monocl. wh. pr
34	cerium carbonate	$Na_6Ce(CO_3)_5 \cdot 12H_2O$	794.35	
35	chlorate	$NaClO_3$	106.45	cub. or trig. col., 1.513
36	*per*chlorate	$NaClO_4$	122.45	rhomb. deliq
37	"	$NaClO_4 \cdot H_2O$	140.47	rhombdr. col., deliq
38	chloride (common salt) (halite)	$NaCl$	58.45	cub. col., 1.5442
39	*hypo*chlorite	$NaClO$	74.45	in solution only
40	"	$NaClO \cdot 2\frac{1}{2}H_2O$	119.49	col. hyg
41	"	$NaClO \cdot 5H_2O$	164.53	col
42	chloroaurate	$NaAuCl_4 \cdot 2H_2O$	398.06	rhomb. yel
43	chloroiridate	$Na_2IrCl_6 \cdot 6H_2O$	559.93	tricl. dull red-blk
44	chloroiridite	$Na_3IrCl_6 \cdot 12H_2O$	691.03	dk. grn. cr

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.301	......	......	......	......	......
2	1.87	......	......	v. s.	v. s.	sl. s. al.
3	......	d. 700	......	......	......	......
4	1.846	......	d. in vac.	40.16^{10}; 41.7^{17}	......	0.314^{16} al.; s. liq. NH_3; i. eth.
5	......	......	......	20^{25}	40^{100}	sl. s. al.; i. eth.
6	......	......	......	35.8^{30}	v. s.	......
7	......	......	......	62.8^{0}; 66^{20}	74.2^{100}	$.81^{15}$, 1.64^{25}, 8.3^{78} al.
8	......	......	......	i.	d.	d. a.
9	......	775	......	d.	......	......
10	2.464	966	1434	s.	v. s.	......
11	......	57	$-H_2O$, 120	v. s.	v. s.	......
12	2.367	741	1575 d.	1.49^{0}	8.79^{40}	i. al.
13	1.815	120, H_2O	......	22^{65} anh.	52.3^{100}	......
14	1.73	75; $-8H_2O$, 60	$-10H_2O$, 200	1.3^{0}; 1.6^{10}	22^{62}; 14.2^{55}; 201^{100}	s. glyc.; v. sl. s. al.; i. a.
15	......	d. 40	......	sl. s.	d.	s. glyc., alk.
16	......	63	$-H_2O$, 130–150	2.55^{15}	3.75^{32}	s. a. al., glyc.
17	1.074	>400	......	d.	d.	d. a.
18	$3.339^{17.5}$	381	......	27.5^{0}	90.9^{100}	i. al.
19	3.203^{25}	755	1390	79.5^{0}; 116^{50}	121^{100}	sl. s. al.
20	2.176	$-2H_2O$, 51	......	79.5^{0}	116^{50}; $118.6^{80.5}$	sl. s. al.
21	......	......	......	s.	......	......
22	......	100	$-H_2O$, 150	......	......	s. NH_4OH
23	3.323	d. 150	......	v. s.	v. s.	v. s. al.
24	......	*ca.* 60	......	200^{15-20}; *ca.* 200^{25}	......	*ca.* 40^{25} al.; 100^{15-20} 90% al.
25	2.64	$-2H_2O$, 80	......	d.	d.	......
26	......	$-3H_2O$, 100	......	122^{14}	......	s. al.
27	1.575^{15}	......	700	d.	d.	d. al.; s. a.
28	2.509^{0}	851	d.	7.1^{0}	45.5^{100}	sl. s. abs. al.; i. acet.
29	2.25	$-H_2O$, 100	......	33	52.08	14^{25} glyc.; i. al., eth.
30	1.51	$-H_2O$, 32	......	16.90	33.9^{35}	......
31	1.44^{16}	32.5–34.5	$-H_2O$, 33.5	21.52^{0}	421^{104}	i. al.
32	1.777 (2.112)	d.	......	13^{0}	42^{100}	......
33	2.159–2.22	$-CO_2$, 270	......	6.9^{0}	16.4^{60}	sl. s. al.
34	1.47	$-H_2O$, 100	d. 200	d.	d.	s. ac. a., Na_2CO_3 soln.
35	2.490^{15}	248–261	d.	79^{0}	230^{100}	s. al. glyc.
36	......	482 d.	d.	s.	v. s.	s. al.
37	2.021	130	......	209^{15}	284^{50}	s. al.
38	2.165	801	1413	35.7^{0}	39.12^{100}	s. glyc.; sl. s. al., liq. NH_3; i. HCl
39	......	d.	d.	s.	d.	......
40	......	57.5	......	v. s.	......	......
41	......	24.5	......	29.3^{0}	94.2^{23}	......
42	......	d.	......	150^{10}	990^{60}	v. s. al., eth.
43	......	d. 600	......	v. s.	v. s.	sl. s. al.
44	......	$-H_2O$, 50	......	31.46^{15}	307.26^{85}	......

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	chloroösmate (IV)	$Na_2OsCl_6 \cdot 2H_2O$	484.97	or. red rhomb. pr
2	chloropalladite	$Na_2PdCl_4 \cdot 3H_2O$	348.57	br.-red cr., deliq
3	chloroplatinate	Na_2PtCl_6	453.97	or. yel. powd
4	"	$Na_2PtCl_6 \cdot 6H_2O$	562.06	tricl. yel.-red
5	chloroplatinite	$Na_2PtCl_6 \cdot 4H_2O$	455.12	red pr
6	chlororhodite, hexa-	Na_3RhCl_6	384.64	tricl. red
7	" "	$Na_3RhCl_6 \cdot 18H_2O$	708.93	oct. garnet-red effl
8	chromate	Na_2CrO_4	162.00	yel. rhomb. bipyr
9	"	$Na_2CrO_4 \cdot 10H_2O$	342.16	monocl. yel., deliq
10	*di*chromate	$Na_2Cr_2O_7 \cdot 2H_2O$	298.05	monocl. pr. red, deliq., 1.661, 1.699, 1.751
11	*peroxy*chromate	Na_3CrO_8	249.00	or. pl
12	cinnamate	$NaC_9H_7O_2$	170.14	wh. cr. powd
13	citrate	$Na_3C_6H_5O_7 \cdot 2H_2O$	294.12	wh. cr. gran. or powd
14	"	$Na_3C_6H_5O_7 \cdot 5(\text{or } 5\frac{1}{2})H_2O$	348.17	rhomb. wh.
15	cyanate	$NaOCN$	65.92	col. need
16	cyanide	$NaCN$	49.02	cub. col. deliq
17	cyanoaurite (aurocyanide)	$NaAu(CN)_2$	272.23	wh. cr. powd
18	cyanocuprate (I)	$NaCu(CN)_2$	138.57	col
19	enanthate (heptanoate)	$NaC_7H_{13}O_2$	152.17	wh. cr. powd. or leaf
20	ethyl acetoacetate deriv.	$NaC_6H_9O_3$	152.13	need
21	" sulfate	$NaC_2H_5SO_4 \cdot H_2O$	166.14	wh. hex. pl. deliq
22	ferrate (III) (ferrite)	$Na_2Fe_2O_4$	221.69	br. hex. pl. or need
23	ferricyanide	$Na_3Fe(CN)_6 \cdot H_2O$	298.97	red deliq
24	ferrocyanide (yellow prussiate of soda)	$Na_4Fe(CN)_6 \cdot 10H_2O$	484.11	monocl. pa. yel., 1.519, 1.530, 1.544.
25	fluoaluminate	Na_3AlF_6	209.96	monocl. col., β 1.364
26	fluoantimonate	$NaSbF_6$	258.76	
27	fluoberyllate	Na_2BeF_4	131.01	rhomb. or monocl. wh
28	fluoborate	$NaBF_4$	109.82	wh. rhomb
29	fluoride (villiaumite)	NaF	42.00	tetr. or cub. col., 1.336
30	" hydrogen	$NaF \cdot HF$	62.01	rhbdr. col. or wh. cr. powd
31	" *ortho*phosphate	$NaF \cdot Na_3PO_4 \cdot 12H_2O$	422.16	
32	fluoroacetate, mono-	$NaC_2H_2FO_2$	100.04	wh. powd
33	fluorophosphate, mono-	Na_2PO_3F	143.97	col
34	" , hexa-	$NaPF_6 \cdot H_2O$	185.99	
35	fluosilicate	Na_2SiF_6	188.05	hex. col., 1.312, 1.309
36	fluosulfonate	$NaSO_3F$	122.07	shiny leaf. hyg
37	formaldehydesulfoxylate	$NaHSO_2 \cdot CH_2O \cdot 2H_2O$	154.13	rhomb. pr. hygr
38	formate	$NaCHO_2$	68.02	monocl. col., deliq. wh
39	2-furanacrylate	$NaC_7H_5O_3$	160.11	lt. br. powd
40	*meta*germanate	Na_2GeO_3	166.59	monocl., wh., deliq., 1.59
41	"	$Na_2GeO_3 \cdot 7H_2O$	292.71	rhomb. col
42	(mono-) *d*-glutamate	$NaC_5H_8NO_4$	169.12	wh. cr. not deliq
43	glycerophosphate	$Na_2C_3H_7O_6P \cdot H_2O$	234.08	yelsh. viscid liq.; wh. cr. or powd
44	"	$Na_2C_3H_7O_6P \cdot 5\frac{1}{2}H_2O$	315.15	wh. odorl. pl., sc., or powd
45	gold sulfide	$NaAuS \cdot 4H_2O$	324.33	monocl. col
46	hydride	NaH	24.00	silver need
47	hydroxide	$NaOH$	40.01	wh. deliq., 1.3576

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	v. s.	....	s. al.
2	....	....	....	v. s.	....	s. al.
3	....	tr. 150–160	....	s.	v. s.	s. al.
4	2.50	$-6H_2O$, 100	....	66^{15}	v. s.	11.9 al.; s. aq. Cl; i. eth.
5	....	100 d.	....	s.	....	s. al.
6	....	d.>650	....	v. s.	....	....
7	....	904 d. effl.	....	v. s.	....	i. al.
8	2.710–36	....	....	87.3^{30}	....	s. meth. al.; sl. s. al.
9	1.483	19.92	....	31.7^{0}; 50^{10}	126^{100}	sl. s. al.; i. ac. a.
10	2.52^{18}	$-2H_2O$, 100; anh. 320	d. 400	238^{0}; anh 180^{20}	508^{80}; anh. 433^{98}	i. al.
11	....	d. 115	....	sl. s.	....	i. al., eth.
12	....	....	....	9.1	5^{100}	s. glyc.; 0.625 90% al.
13	....	$-2H_2O$, 150	....	72^{25}	167^{100}	i. al.
14	$1.857^{23.5}$	$-5H_2O$, 150	d.	92.6^{25}	250^{100}	sl. s. al.
15	1.937^{20}	....	....	s.	s.	i. al., eth.
16	....	563.7	1496	s.	v. s.	sl. s. al.; s. NH_3
17	....	....	....	s.	....	....
18	1.013^{20}	d. 100	....	s.	....	....
19	....	240–350	....	s.	....	s. al.
20	....	d.	....	d.	....	s. eth.
21	....	....	d.	164^{17}	....	d. alk., H_2SO_4; 142 al.
22	....	....	....	d.	....	v. s. dil. HCl
23	....	....	....	18.9^{0}	67^{100}	i. al.
24	1.458	....	....	31.85^{20}	156.5^{98}	i. al.
25	2.90	1000	....	sl. s.	....	d. alk.; i. HCl
26	3.375	....	....	128.6^{20}	....	s. al., acet.
27	....	d.	....	1.47^{18}	2.94^{100}	....
28	2.47^{20}	384 sl. d.	d.	108^{26}	210^{100}	sl. s. al.; d. H_2SO_4
29	2.79; 2.558^{41}	980–997 (1040)	1700	4.22^{18}	....	s. HF; v. sl. s. al.
30	....	....	....	s.	s.	....
31	2.2165	....	....	12^{25}	57.5^{70}	....
32	....	200–202 d. sl. above m.p.	....	111^{25}	....	1.4^{25} al.; 5^{25} CH_3OH; $.04^{25}$ acet.; $.0049^{25}$ CCl_4
33	....	*ca.* 625	....	25	....	....
34	2.369^{19}	....	....	103.2^{0}	....	....
35	2.679	d.	....	0.652^{17}	2.46^{100}	i. al.
36	....	d. red heat	....	s.	....	s. al., acet.; i. eth.
37	....	64	d.	v. s.	....	d. a.; s. al., alk.
38	1.92^{20}	253	....	44^{0}; 97.2^{20}	160^{100}	s. al.; i. eth.
39	1.919	d.	....	s.	s.	sl. s. al.; i. eth.
40	3.31^{22}	1083	....	....	d.	s. a.
41	....	83	....	24.6^{0}; 45.5^{25}	....	s. a.
42	....	d.	....	v. s.	....	....
43	....	....	....	s.	....	s. al.
44	....	....	d.>130	v. s.	....	i. al.
45	....	d.	....	s.	....	s. al.
46	1.396	800 m.p. d.	....	d.	d.	s. molten metals; i. CS_2, CCl_4, bz., NH_3
47	2.130	318.4	1390	42^{0}	347^{100}	v. s. al., glyc.; i. acet., eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	iodate	$NaIO_3$	197.92	rhomb. wh
2	*metaper*iodate	$NaIO_4$	213.92	tetr
3	“	$NaIO_4 \cdot 3H_2O$	267.97	trig. effl
4	iodide	NaI	149.92	cub. col
5	“	$NaI \cdot 2H_2O$	185.95	monocl. col. cr
6	iodoplatinate	$Na_2PtI_6 \cdot 6H_2O$	1110.84	tri
7	lactate	$NaC_3H_5O_3$	112.07	col. or yelsh. liq. very hyg
8	magnesium sulfate (bloedite)	$Na_2SO_4 \cdot MgSO_4 \cdot 4H_2O$	334.51	monocl. col., 1.486, 1.488, 1.489
9	“ tartrate	$Na_2Mg(C_4H_4O_6)_2 \cdot 10H_2O$	546.62	wh. powd. or monocl. pr
10	manganate	$Na_2MnO_4 \cdot 10H_2O$	345.08	monocl. grn
11	*per*manganate	$NaMnO_4$	141.93	red
12	“	$NaMnO_4 \cdot 3H_2O$	195.98	purp. deliq. cr
13	methanearsenate	$Na_2CH_3AsO_3 \cdot 6H_2O$	292.03	wh. cr. powd
14	methoxide	$CH_3ONa \cdot 2CH_3OH$	118.12	wh. powd
15	methyl sulfate	$NaCH_3SO_4 \cdot H_2O$	152.11	col. hyg. cr
16	molybdate	Na_2MoO_4	205.94	opaque wh
17	“	$Na_2MoO_4 \cdot 2H_2O$	241.98	rhbdr. wh
18	*di*molybdate	$Na_2Mo_2O_7$	349.89	need. wh
19	*tri*molybdate	$Na_2Mo_3O_{10} \cdot 7H_2O$	619.96	need. acicular
20	*tetra*molybdate	$Na_2Mo_4O_{13} \cdot 6H_2O$	745.89	need; yel. soln
21	*para*molybdate	$Na_6Mo_7O_{24} \cdot 22H_2O$	1589.98	monocl. col., effl
22	*octa*molybdate	$Na_2Mo_8O_{25} \cdot 17H_2O$	1519.97	monocl. cr
23	*deca*molybdate	$Na_2Mo_{10}O_{31} \cdot 21H_2O$	1879.83	wh. pr
24	*meta*niobate	$Na_2Nb_2O_6 \cdot 7H_2O$	453.93	pseudo-cub
25	nitrate (soda niter)	$NaNO_3$	85.01	trig. or rhbdr. col., 1.587, 1.336
26	nitride	Na_3N	83.00	dk. gray
27	*hypo*nitrite	$Na_2N_2O_2$	106.01	
28	nitrite	$NaNO_2$	69.01	rhomb. col.-yel. pr. hyg
29	nitrocobaltate III (cobaltinitrite)	$Na_3Co(NO_2)_6$	403.98	yel. to br. powd
30	nitroplatinite	$Na_2Pt(NO_2)_4$	425.26	pa. yel. rhomb. or monocl. pr. effl
31	*p*-nitrophenoxide	$NaOC_6H_4NO_2 \cdot 4H_2O$	233.16	yel. monocl. pr
32	nitroprusside	$Na_2[Fe(NO)(CN)_5] \cdot 2H_2O$	297.97	rhomb. red
33	oleate	$NaC_{18}H_{33}O_2$	304.44	wh. cr. or yel. amor. gran
34	oxalate	$Na_2C_2O_4$	134.01	col. cr.; wh. powd
35	“ , hydrogen	$NaHC_2O_4 \cdot H_2O$	130.04	monocl. wh
36	oxalatoferrate III	$Na_2[Fe(C_2O_4)_3] \cdot xH_2O$		grn. monocl
37	oxide, mon-	Na_2O	61.99	wh.-gray, deliq
38	“ , per-	Na_2O_2	77.99	yel.-wh. powd
39	“ , “	$Na_2O_2 \cdot 8H_2O$	222.12	hex
40	palmitate	$NaC_{16}H_{31}O_2$	278.41	cr
41	pentobarbital	$NaC_{11}H_{17}N_2O_3$	248.26	
42	phenobarbital	$NaC_{12}H_{11}N_2O_3$	254.22	wh
43	1-phenol-4-sulfonate (*p*-)	$NaC_6H_4(OH)SO_3 \cdot 2H_2O$	232.20	col. monocl. or gran., sl. effl
44	phenoxide	$NaOC_6H_5$	116.10	wh. deliq. cr. need
45	*hypo*phosphate	$Na_4P_2O_6 \cdot 10H_2O$	430.11	monocl., 1.477, 1.482, 1.504
46	“ , di-H	$Na_2H_2P_2O_6 \cdot 6H_2O$	314.07	monocl. col., 1.486, 1.490, 1.504
47	*ortho*phosphate	$Na_3PO_4 \cdot 10H_2O$	344.13	col. oct

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	$4.277^{17.5}$	d.	...	2.5^{0}	34^{100}	s. ac. a.; i. al.
2	3.865^{16}	d. 300	...	s.	...	s. H_2SO_4, HNO_3, ac. a.
3	3.219^{18}	d. 175	...	8	...	...
4	3.667	651	1300	158.7^{0}	256.8^{60}	v. s. al.; s. glyc.
5	3.677^{0}; $2.448^{20.8}$	752	...	317.9^{0}	1550^{100}	v. s. NH_3
6	2.5	...	...	s.	...	s. al.
7	...	17, d. 140	...	v. s.	...	s. al.; i. eth.
8	2.23	...	...	s.	...	...
9	...	...	...	s.	s.	...
10	...	17	...	s.	d.	...
11	...	d.	...	deliq.	v. s.	...
12	2.47	d. 170	...	v. s.	v. s.	d. alk.; s. NH_3
13	...	130–140	...	*ca.* 100	...	sl. s. al.; i. bz., eth., pet. eth., oils
14	...	d. $-CH_3OH$	...	s. d.	...	s. CH_3OH
15	...	...	...	s.	...	s. al.
16	lq. 2.59	687	...	s.	84^{100}	...
17	3.28	687	...	56.2^{0}	115.5^{100}	i. meth. acet.
18	...	612	...	sl. s.	sl. s.	...
19	...	528; $-6H_2O$, 100–120	...	3.878^{20}	13.7^{100}	...
20	...	...	...	39.8^{21}	v. s.	...
21	...	700; $-H_2O$, 120–200	...	117.9^{30}	...	...
22	...	$-H_2O$, 20	...	v. s.	v. s.	...
23	...	...	...	sl. s.	0.842^{100}	...
24	4.512–59	$-H_2O$, 100	...	s.	...	...
25	2.261	306.8	d. 380	73^{0}	180^{100}	v. s. NH_3; sl. s. glyc., 0.036^{25}, v. sl. s. acet.
26	...	d. 300	...	d.	...	...
27	2.466^{4}; 1.728^{25}	d. 300	...	d.	...	i. al.
28	2.168	271	d. 320	72^{0}; 81.5^{15}	163^{100}	$.3^{20}$ eth.; 4.4^{20} meth. al.; 3 abs. al.; v. s. NH_3
29	...	...	...	s. d.	...	s. dil. ac. a.; i. al.
30	...	$-H_2O$, 100	...	s.	s.	...
31	...	$-2H_2O$, 36; $-4H_2O$, 120	d.	5.97^{25}	...	sl. s. al.
32	1.72	...	...	40^{16}	...	s. al.
33	...	232–5	...	10^{12}	...	10^{32} al.; sl. s. eth.
34	2.34	...	...	3.7^{20}	6.33^{100}	...
35	...	...	...	1.7^{15}	21^{100}	...
36	$1.973^{17.5}$	$-4H_2O$, 100	$-10H_2O$, 200	32.5	182^{100}	...
37	2.27	...	1275 subl.	d.	d.	d. al.
38	2.805	460 d.	d. 657	s.	d.	d. al., NH_3; s. dil. a.; i. alk.
39	...	d. 30	d.	s.	d.	i. al.
40	...	270	...	...	...	...
41	...	...	...	s.	s. d.	s. al.
42	...	...	...	v. s.	...	s. al.; i. eth., chl.
43	...	...	d.	23.8^{25}	125^{100}	0.71^{25}, 7.4^{100} al., 20^{25} glyc.
44	...	...	...	v. s.	...	d. a.; s. al., acet.
45	1.823	d.	...	1.49^{25}	5.46^{50}	...
46	1.849	250	$-6H_2O$, 100	2.25	25	s. dil. H_2SO_4, NH_4OH; i. al.
47	$2.536^{17.5}$ anh.	100	...	anh. 8.8	...	...

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	*ortho*phosphate	$Na_3PO_4 \cdot 12H_2O$	380.16	trig. col., 1.446, 1.452
2	" , mono-H	$Na_2HPO_4 \cdot 2H_2O$	178.01	rhombic-bi-sphenoidal, 1.4629
3	" " "	$Na_2HPO_4 \cdot 7H_2O$	268.09	monocl. pr., 1.4424
4	" " "	$Na_2HPO_4 \cdot 12H_2O$	358.22	rhomb. or monocl. col. effl., wh. powd., 1.432, 1.436, 1.437
5	" di-H	$NaH_2PO_4 \cdot H_2O$	138.01	rhomb. col., 1.456, 1.485, 1.487
6	*pyro*phosphate	$Na_4P_2O_7$	265.95	wh. cr., 1.425
7	"	$Na_4P_2O_7 \cdot 10H_2O$	446.11	monocl. col., 1.450, 1.453, 1.460
8	" , di-H	$Na_2H_2P_2O_7 \cdot 6H_2O$	330.15	monocl. 1.4599, 1.4645, 1.4649
9	*meta*phosphate (glass)	$NaPO_3$	101.98	col., hyg., amor., 1.485
10	*meta*phosphate (sol.)	$NaPO_3$	101.98	col., 1.474, 1.478, 1.480
11	*meta*phosphate (insol)	$NaPO_3$	101.98	col., 1.498, 1.510, 1.529
12	*tri*phosphate (tripoly- phosphate	$Na_5P_3O_{10}$	367.93	powd. and gran
13	phosphide	Na_3P	99.97	red
14	*hypo*phosphite	$NaH_2PO_2 \cdot H_2O$	106.01	monocl. col., deliq
15	*ortho*phosphite, mono-H	$Na_2HPO_3 \cdot 5H_2O$	216.06	rhomb. wh., deliq., β 1.443
16	" , di-H	$NaH_2PO_3 \cdot 2\frac{1}{2}H_2O$	149.03	monocl., 1.419, 1.431, 1.449
17	phthalate	$Na_2C_8H_4O_4$	210.11	wh. powd. pearly pl
	picrate	$NaC_6H_2O_7 \cdot H_2O$	269.12	need
18	platinate, hydroxo-	$Na_2Pt(OH)_6$	343.27	hex. red-br. or yel
19	plumbate, hydroxo-	$Na_2Pb(OH)_6$	355.25	lt. yel-wh. fused, hyg. lumps
20	propionate	$NaC_3H_5O_2$	96.07	wh. gran. powd
21	*pyrohypo*rhenate	$Na_4Re_2O_7 \cdot H_2O$	594.62	sandy yel. cr
22	*per*rhenate	$NaReO_4$	273.31	col. hex. pl
23	*per*ruthenate	$NaRuO_4 \cdot H_2O$	206.71	blk. cr. lamellar
24	salicylate	$NaC_7H_5O_3$	160.11	wh. cr. powd
25	selenate	Na_2SeO_4	188.95	rhomb. col
26	"	$Na_2SeO_4 \cdot 10H_2O$	369.11	monocl. col
27	selenide	Na_2Se	124.95	wh. to red, deliq. cr
28	selenite	$Na_2SeO_3 \cdot 5H_2O$	263.03	wh. cr., tetrag
29	*ortho*silicate	Na_4SiO_4	184.05	col. hex., .530
30	*di*silicate	$Na_2Si_2O_5$	182.11	rhomb. pearly luster, 1.500, 1.510, 1.515
31	*meta*silicate	Na_2SiO_3	122.05	monocl. col., α 1.518, γ 1.527
32	"	$Na_2SiO_3 \cdot 9H_2O$	284.20	effl. rhomb. bipyramids
33	silicate (water glass)	$Na_2O \cdot xSiO_2$ (x = 2–5 (?))	....	amor. col., deliq
34	silicotungstate (normal)	$Na_4SiW_{12}O_{40} \cdot 20H_2O$?	3327.41	col. tricl
35	stannate, hydroxo-	$Na_2Sn(OH)_6$	266.74	hex. col. trig. wh. powd. or lumps
36	stearate	$NaC_{18}H_{35}O_2$	306.46	wh. powd., fatty odor
37	succinate	$Na_2C_4H_4O_4 \cdot 6H_2O$	270.16	wh. gran. or powd
38	" , tetrahydroxy- (dihydroxytartrate)	$Na_2C_4H_4O_8 \cdot 3H_2O$	280.11	wh. ppt
39	sulfanilate	$NaC_6H_4(NH_2)SO_3$	231.21	wh. lust. cr. leaf
40	sulfate (thenardite)	Na_2SO_4	142.06	rhomb., 1.464, 1.474, 1.485
41	"	Na_2SO_4	142.06	monocl. col
42	"	Na_2SO_4	142.06	hex. col. (>500)
43	"	$Na_2SO_4 \cdot 7H_2O_4$	268.17	rhomb. or tetr. wh

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.645^{4}; 1.62^{20}	73.3–76.7 d.	$-12H_2O$, 100	1.5^{0}; 25.8^{20}	157^{70}	i. CS_2
2	2.066^{15}	$-2H_2O$, 95	......	100^{50}	117^{80}	......
3	1.6789	$-5H_2O$, 48.1	......	104^{40}	......	......
4	1.52	$-5H_2O$, 35.1	......	4.15	87.4^{34}	i. al.
5	2.040	$-H_2O$, 100; d. 204	$-2H_2O$, 200	59.9^{0}; 110.3^{20}	427^{100}	v. sl. s. chl., tol., eth.; i. al.
6	2.534	880	......	3.16^{0}	40.26^{100}	......
7	1.815–36	880; $-H_2O$, 93.8	......	5.41^{0}	93.11^{100}	i. al., NH_3
8	1.85	$-H_2O$, 220	......	s. d.	d.	......
9	2.484^{20}	cr. 300	......	v. s.	v. s.	i.
10	2.476	627.6	......	21	s.	i.
11	......	tr. 500	......	i.	i.	i.
12	......	......	......	14.5^{25}; 16.25^{40}	23.25^{80}; 32.5^{100}	......
13	......	d.	......	d. ev. PH_3	......	......
14	......	d. viol.	......	100	667^{100}	v. s. al.; s. glyc.; sl. s. NH_2, NH_4OH
15	......	53	200–250 d.	s.	v. s.	i. al., NH_4OH
16	......	42	$-2\frac{1}{2}H_2O$, 100	56^{0}	193^{42}	......
17	......	......	......	v. s.	......	......
	......	$-H_2O$, 150	Expl. 310	5.58^{30}	......	sl. s. al.
18	......	$-3H_2O$, 150–70	d.	s.	......	sl. s. HCl; i. al.
19	......	......	......	d. to PbO_2	......	d. acids; s. alk.; hyd. al.
20	......	......	......	s.	......	s. al.
21	......	......	......	.004	......	......
22	......	300 in O_2	......	25^{20}	......	s. al.
23	......	d. $440^{vac.}$	......	v. s.	d.	......
24	......	......	......	111^{15}	125^{25}	17^{15} al.; 25 glyc.
25	3.098	......	......	$.84^{35}$	72.8^{100}	......
26	1.603–1.620	*ca.* 32 trans.	......	43.5^{20}	78.7^{30}	......
27	2.625^{10}	>875	......	d.	......	i. NH_3
28	......	......	......	s.	s.	i. al.
29	......	1018	......	s.	s.	......
30	......	874	......	s.	s.	......
31	2.4	1088	......	s.	s. d.	i. al., Na and K salts
32	......	40–48	$-6H_2O$, 100	v. s.	v. s.	29^{18} $N/2NaOH$; i. al., a.
33	......	......	......	s.	s.	i. al., Na and K salts
34	......	$-7H_2O$, 100	d.	v. s.	v. s.	s. a.; sl. s. al.
35	......	$-3H_2O$, 140	......	$61.3^{15.5}$	50^{100}	i. al., acet.
36	......	......	......	s.	s.	s. h. al.
37	......	......	......	21.45^{0}	86.63^{75}	v. sl. s. al.
38	......	d.	......	0.032^{0}	d.	d. min. a.; i. al., eth.
39	......	......	......	s.	......	......
40	2.698	884, tr. −mel. 100	......	4.76^{0}	42.7^{100}	s. glyc.; i. al.
41	......	tr.-hex. 500; 884	......	48.8^{40}	42.5^{100}	d. HI
42	......	884	......	s.	s.	......
43	......	tr. to anh. 24.4	......	19.5^{0}	44^{20}	i. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	sulfate (Glauber's salt, mirabilite)	$Na_2SO_4 \cdot 10H_2O$	322.22	monocl. col. effl., 1.394, 1.396, 1.398
2	sulfate hydrogen	$NaHSO_4$	120.07	tricl. col
3	“ , “	$NaHSO_4 \cdot H_2O$	138.09	monocl. col., deliq
4	*pyro*sulfate	$Na_2S_2O_7$	222.13	wh. transluc. cr. deliq
5	*peroxydi*sulfate	$Na_2S_2O_8$	238.13	wh. cr. powd
6	sulfide, mono-	Na_2S	78.06	amor. yel.-pink or wh., deliq
7	“ “	$Na_2S \cdot 9H_2O$	240.20	tetr. col., deliq
8	“ , hydro-	$NaHS$	56.07	rhomb. col. or wh. gran. cr
9	“ “	$NaHS \cdot 2H_2O$	92.10	col. need., deliq
10	“ “	$NaHS \cdot 3H_2O$	110.12	col. lust. rhomb. cr
11	“ , tetra-	Na_2S_4	174.26	yel. cub. hyg. cr
12	“ , penta-	Na_2S_5	206.32	yel. (exist. quest.)
13	*hydro*sulfite (dithionite, hyposulfite)	$Na_2S_2O_4 \cdot 2H_2O$	210.16	monocl. (?) col. cr. or yel.-wh. powd.
14	sulfite	Na_2SO_3	126.06	hex. pr. or wh. powd
15	“	$Na_2SO_3 \cdot 7H_2O$	252.17	monocl. col., efflor
16	“ , hydrogen	$NaHSO_3$	104.07	monocl., wh., yel. in soln
17	*pyro*sulfite (metabisulfite)	$Na_2S_2O_5$	190.13	col. pr. wh
18	*d* (& *l*)-tartrate	$Na_2C_4H_4O_6 \cdot 2H_2O$	230.10	rhomb. col
19	*d*-tartrate, hydrogen	$NaHC_4H_4O_6 \cdot H_2O$	190.09	wh. cr. powd., rhomb
20	*dl*-tartrate, hydrogen	$NaHC_4H_4O_6 \cdot H_2O$	190.09	monocl. or tricl
21	*ortho*tellurate, tetra-H	$Na_2H_4TeO_6$	273.64	hex. pl
22	tellurite	Na_2TeO_3	221.60	wh. rhomb. pr
23	thioantimonate (Schlippe's salt)	$Na_3SbS_4 \cdot 9H_2O$	481.16	cub. pa. yel
24	thioarsenate	$Na_3AsS_4 \cdot 8H_2O$	416.29	monocl. yel., β 1.6802
25	thiocarbonate, tri-	$Na_2CS_3 \cdot H_2O$	172.22	yel. need. deliq
26	thiocyanate	$NaSCN$	81.08	rhomb. col. pois. deliq
27	*di*thionate	$Na_2S_2O_6 \cdot 2H_2O$	242.17	clear rhomb. 1.482, 1.495, 1.519
28	thiosulfate	$Na_2S_2O_3$	158.13	monocl
29	“ (“hypo”) (hyposulfite)	$Na_2S_2O_3 \cdot 5H_2O$	248.21	monocl. col., effl., 1.489, 1.508, 1.536
30	thiosulfatoaurate (I)	$Na_3[Au(S_2O_3)_2] \cdot 2H_2O$	526.49	wh. odorl. cr
31	*tri*titanate	$Na_2Ti_3O_7$	301.69	wh. need
32	tungstate	Na_2WO_4	293.91	wh. rhomb
33	“	$Na_2WO_4 \cdot 2H_2O$	329.95	rhomb. col. pl
34	*para*tungstate	$Na_6W_7O_{24} \cdot 16H_2O$	2097.68	col. tricl
35	*meta*uranate	Na_2UO_4	348.06	gr. yel. or red pl. or rhomb. pr., or powd.
36	uranyl acetate	$NaUO_2(C_2H_3O_2)_3$	470.20	tetr. yel. cr., 1.501
37	“ carbonate	$2Na_2CO_3 \cdot UO_2CO_3$	542.09	yel. cr
38	urate	$Na_2C_5H_2N_4O_3 \cdot H_2O$	230.11	hard, cr. nodules or wh. gran. powd.
39	“ , acid	$NaHC_5H_2N_4O_3$	190.10	wh. gran. powd
40	valerate	$NaC_5H_9O_2$	124.12	col. cr. or wh. deliq. mass
41	*ortho*vanadate	Na_3VO_4	183.94	col. hex. pr
42	“	$Na_3VO_4 \cdot 10H_2O$	364.10	wh. cubic or hex. cr. 1.5305; ω 1.5398, ϵ 1.5475
43	“	$Na_3VO_4 \cdot 16H_2O$	472.20	cr. col. need
44	*pyro*vanadate	$Na_4V_2O_7$	305.89	hex
45	*meta*vanadate	$NaVO_3$	121.95	col. monocl. pr

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.464	d. 32.384	....	11^{0}	92.7^{30}	i. al.
2	2.435^{13}; 2.742	>315; d. 240–50	d. to $Na_2S_2O_4$	28.6^{25}	100^{100}	d. al.; sl. s. al.; i. NH_3
3	....	58.54 ± .05	....	*ca*. 67, d.	v. s. d.	i. al.
4	2.658^{25}	400.9	d. 460	s.	....	s. fum. H_2SO_4
5	....	....	....	s. d.	....	i. al.
6	1.856^{14}	1180	....	15.4^{10}	57.2^{90}	d. a.; sl. s. al.; i. eth.
7	2.471	920 d.	....	47.5^{10}	96.7^{50}	d. a.; sl. s. al.
8	....	350	....	v. s.	....	s. al.
9	....	d.	....	s.	s.	d. a.; s. al.
10	....	22	d.	s.	s.	s. al.
11	....	275	d.	s.	....	s. al.
12	....	251.8	....	s.	s.	s. al.
13	....	d. 52	....	25.4^{20}	d.	d. a.; s. alk.; i. al.
14	$2.633^{15.4}$	....	d.	12.54^{0}	28.3^{80}	sl. s. al.; i. liq. Cl_2, NH_3
15	1.561; 1.539^{15}	$-7H_2O$, 150	d.	32.8^{0}	196^{40}	sl. s. al.
16	1.48	d.	....	v. s.	v. s.	sl. s. al.
17	1.48	d.>150	....	54^{20}	81.7^{100}	i. al.
18	1.818	....	....	29^{6}	66^{43}	i. al.
19	....	$-H_2O$, 100	d. 234	6.7^{18}	9.2^{30}	....
20	....	$-H_2O$, 100	d. 219	8.9^{19}	....	i. al.
21	....	d.	d.	0.77^{18}	2^{100}	s. h. dil. HNO_3; i. NaOH soln.
22	....	....	....	sl. s.	s.	....
23	1.839	d.	....	20.15^{0}; 33	100	i. al.
24	....	d.	....	v. s.	d.	i. al.
25	....	d.	....	s.	d.	s. al.; i. bz., eth.
26	....	287	....	$139.3^{21.3}$	v. s.	v. s. al.
27	2.189	$-H_2O$, 110; $-SO_2$, 267	....	6.05^{0}; 47.6^{16}	90.9^{100}	i. al., HCl
28	1.667	....	....	50	231^{100}	....
29	1.729^{17} (1.685)	45–50; d. 48.0	....	79.4^{0}	291.1^{45}; 301.5^{60}	s. NH_3; i. al.
30	....	....	....	50	....	i. al.
31	3.35–3.50	....	....	i.	....	i. h. HCl
32	4.179	698	....	....	....	....
33	3.23–.25	$-2H_2O$, 100 anh. 698	....	41^{0}; 82.5^{20}	123.5^{100}	sl. s. NH_3; i. a., al.
34	3.987	$-12H_2O$, 100; $-16H_2O$, 300	....	8	d.	....
35	....	....	....	i.	i.	s. dil. a., alk. carb.
36	2.56	....	....	....	....	....
37	....	d. 400	....	sl. s.	....	i. al.
38	....	....	....	....	1.3^{100}	v. sl. s. 90% al.
39	....	....	....	0.083	0.8^{100}	....
40	....	140	....	s.	....	s. al.
41	....	850–66	....	s.	....	i. al.
42	....	....	....	s.	s.	....
43	....	866 (anh.)	....	v. s.	d.	i. al.
44	....	632–54	....	s.	s.	i. al.
45	....	630	....	21.1^{25}	38.8^{75}	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sodium			
1	ethylxanthate	NaC_2H_5OCSS	144.19	yelsh. powd
2	zinc uranyl acetate	$NaZn(UO_2)_3(C_2H_3O_2)_9 \cdot 9H_2O$	1592.13	tab. monocl. cr. α 1.475, γ 1.480
3	**Stannous and Stannic**	See under *Tin*		
4	**Strontium**	Sr	87.63	cub. silv. wh.-pa. yel. met
5	acetate	$Sr(C_2H_3O_2)_2$	205.72	wh. cr
6	acetate	$Sr(C_2H_3O_2)_2 \cdot \frac{1}{2}H_2O$	214.73	wh. cr. powd
7	*ortho*arsenate, acid	$SrHAsO_4 \cdot H_2O$	245.56	rhomb. need
8	*ortho*arsenite	$Sr_3(AsO_3)_2 \cdot 4H_2O$	580.77	cr. or wh. powd
9	*tetra*borate	$SrB_4O_7 \cdot 4H_2O$	314.97	
10	boride, hexa-	SrB_6	152.55	blk. cr
11	bromate	$Sr(BrO_3)_2 \cdot H_2O$	361.48	monocl. col.-yelsh. hyg
12	bromide	$SrBr_2$	247.46	wh. need., hyg
13	"	$SrBr_2 \cdot 6H_2O$	355.56	hex. col., hyg
14	carbide	SrC_2	111.65	tetr. blk
15	carbonate	$SrCO_3$	147.64	rhomb. col. or wh. powd., 1.516, 1.664, 1.666
16	chlorate	$Sr(ClO_3)_2$	254.54	rhomb. col. or wh. powd., 1.516, 1.605, 1.626
17	"	$Sr(ClO_3)_2 \cdot 8H_2O$	398.67	wh. need
18	*per*chlorate	$Sr(ClO_4)_2$	286.54	col. cr
19	chloride	$SrCl_2$	158.54	cub. col., <1.6
20	"	$SrCl_2 \cdot 2H_2O$	194.58	transp. leaf
21	"	$SrCl_2 \cdot 6H_2O$	266.64	trig. col., 1.536, 1.487
22	" fluoride	$SrCl_2 \cdot SrF_2$	284.17	tetr. 1.651, 1.627
23	chromate	$SrCrO_4$	203.64	monocl. yel
24	cyanide	$Sr(CN)_2 \cdot 4H_2O$	211.73	wh. rhomb., deliq
25	ferrocyanide	$Sr_2Fe(CN)_6 \cdot 15H_2O$	657.45	monocl. yel
26	fluoride	SrF_2	125.63	cub. col. or wh. powd
27	fluosilicate	$SrSiF_6 \cdot 2H_2O$	265.72	monocl
28	formate	$Sr(CHO_2)_2$	177.67	rhomb., 1.559, 1.574, 1.598
29	"	$Sr(CHO_2)_2 \cdot 2H_2O$	213.70	rhomb. col., 1.484, 1.521, 1.538
30	glycerophosphate	$SrC_3H_7O_6P$	257.74	wh. powd
31	hydroxide	$Sr(OH)_2$	121.65	wh. deliq
32	"	$Sr(OH)_2 \cdot 8H_2O$	265.78	tetr. col., deliq., 1.499, 1.476
33	iodate	$Sr(IO_3)_2$	437.47	tricl
34	iodide	SrI_2	341.47	col. pl
35	"	$SrI_2 \cdot 6H_2O$	449.57	hex. col.-yelsh., deliq
36	lactate	$Sr(C_3H_5O_3)_2 \cdot 3H_2O$	319.82	wh. cr. or gran. powd
37	*per*manganate	$Sr(MnO_4)_2 \cdot 3H_2O$	379.54	cub. purp
38	molybdate	$SrMoO_4$	247.58	tetr
39	nitrate	$Sr(NO_3)_2$	211.65	cub. col., 1.567
40	"	$Sr(NO_3)_2 \cdot 4H_2O$	283.71	monocl. wh
41	nitrite	$Sr(NO_2)_2 \cdot H_2O$	197.66	hex
42	oxalate	$SrC_2O_4 \cdot H_2O$	193.67	col
43	oxide	SrO	103.63	cub. gray-wh
44	" , per-	SrO_2	119.63	wh. powd
45	" , "	$SrO_2 \cdot 8H_2O$	263.76	col. cr
46	*ortho*phosphate, di-	$SrHPO_4$	183.62	rhomb. col
47	salicylate	$Sr(C_7H_5O_3)_2 \cdot 2H_2O$	397.89	col. cr
48	selenate	$SrSeO_4$	230.59	rhomb

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	......	......	s.	......	s. al.
2	......	......	......	i.	......	......
3	......	......	......	......	......	......
4	2.6	774	1150	d.	d.	s. a., al., liq. NH_3
5	2.099	......	d.	36.9	36.4^{97}	0.26^{15} meth. al.
6	anh. 2.099	......	......	s.	......	sl. s. al.
7	3.606^{15}; anh. 4.035	$-H_2O$, 125	......	$0.284^{15.5}$	d.	s. a.
8	......	......	......	sl. s.	......	s. a.; sl. s. al.
9	......	......	......	......	77^{100}	s. HNO_3, NH_4 salts
10	3.3	2235	......	i.	i.	s. HNO_3 i. HCl
11	3.773	$-H_2O$, 120	d. 240	33^{16}	......	......
12	4.216^{24}	643	d.	85.2^0	222.5^{100}	s. al., amyl. al.
13	2.358^{18}	d. 20	$-6H_2O$, >180	204.2^0	∞	s. al.; i. eth.
14	3.2	......	......	d.	d.	d. a.
15	3.70	1497^{60} atm.	$-CO_2$, 1340	0.0011^{18}	0.065^{100}	0.12 aq. CO_2; s. a., NH_4 salts
16	3.152	120 d.	......	174.9^{18}	v. s.	s. al.; i. abs. al.
17	......	......	......	s.	v. s.	s. al.
18	......	......	......	310^{25}	v. s.	212 meth. al.; 1.81 al.; i. eth.
19	3.052	873	......	43.5^0	100.8^{100}	v. sl. s. abs. al., acet.; i. NH_3
20	2.6715^{25}	......	......	......	......	......
21	1.93	$-4H_2O$, 60	$-6H_2O$, 100	106.2^0	205.8^{40}	3.8^6 al.
22	4.18	962	......	d.	d.	s. conc. HCl, HNO_3; i. al.
23	3.895^{15}	......	......	0.12^{15}	3^{100}	s. ac. a., HCl, HNO_3, NH_4 salts
24	......	d.	......	v. s.	......	......
25	......	......	......	50	100	......
26	4.24	1190	......	0.011^0	0.012^{27}	s. h. HCl; i. HF
27	$2.99^{17.5}$ d.	d.	......	3.2^{15}	v. s.	$.065^{15}$ 50% al.; s. HCl
28	2.69	71.9	......	s.	s.	......
29	2.695	d.	......	s.	s.	......
30	......	......	......	sl. s.	......	i. al.
31	3.625	375	......	0.41^0	21.83^{100}	s. a., NH_4Cl
32	1.90	$-8H_2O$, 100	......	0.90^0	47.71^{100}	s. a., NH_4Cl; i. acet.
33	5.045^{15}	......	......	$.03^{15}$	$.8^{100}$	......
34	4.549^{25}	402	d.	165.3^0	383^{100}	3.1^{40}, 4.3^{390} abs. al.
35	4.415	......	......	448.9^0	∞	s. al.; i. eth.
36	......	......	......	25	200^{100}	sl. s. al.
37	2.75	d. 175	......	270^0	291^{18}	......
38	4.145	......	......	0.0104^{17}	......	s. a.
39	2.986	570	......	40.1^0	100^{90}	.012 abs. al.; v. s. NH_3; sl. s. acet.
40	2.2	......	......	60.43^0	206.5^{100}	v. sl. s. abs. al.; i. HNO_3
41	$2.408\frac{0}{0}$	$-H_2O$, >100	d. 240	58.9^0	182^{100}	$.42^{20}$ 90% al.
42	......	$-H_2O$, 150	......	0.0051^{18}	5^{100}	s. HCl, HNO_3
43	4.7	2430	......	d. $Sr(OH)_2$	......	sl. s. al.; i. eth., acet.
44	4.56	d.	......	0.008^{20}	d.	v. s. al., NH_4Cl; i. acet.
45	1.951	$-8H_2O$, 100	d.	0.018^{20}	d.	s. al., NH_4Cl; i. NH_4OH
46	3.544^{15}	......	......	i.	i.	s. a., NH_4 salts
47	......	d.	......	5.6^{25}	28.6^{100}	1.5^{25}, 9.5^{78} al.
48	4.23	......	......	i.	i.	s. h. HCl; i. HNO_3

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Strontium			
1	*meta*silicate	$SrSiO_3$	163.69	col. pr., 1.618
2	sulfate (celestite)	$SrSO_4$	183.70	rhomb. col., 1.622, 1.624, 1.631
3	“ , hydrogen	$Sr(HSO_4)_2$	281.78	col
4	sulfide, mono-	SrS	119.70	cub. lt. gray
5	“ , hydro-	$Sr(HS)_2$	153.78	cr
6	“ , tetra-	$SrS_4 \cdot 6H_2O$	323.99	redsh cr
7	sulfite	$SrSO_3$	167.70	col. cr
8	tartrate	$SrC_4H_4O_6 \cdot 4H_2O$	307.77	monocl
9	thiocyanate	$Sr(SCN)_2 \cdot 3H_2O$	257.85	deliq
10	*di*thionate	$SrS_2O_6 \cdot 4H_2O$	319.83	trig., 1.530, 1.525
11	thiosulfate	$SrS_2O_3 \cdot 5H_2O$	289.84	monocl. need
12	tungstate	$SrWO_4$	335.55	tetr
	Sulfamic acid			
13	(amidosulfuric, aminosulfonic acid)	NH_2SO_3H	97.10	col. rhomb
14	**Sulfamide** (sulfuryl amide)	$SO_2(NH_2)_2$	96.11	rhomb. pl
	Sulfur			
15	“ rhombic (α)	S_8	256.53	rhomb. yel., 1.957
16	“ monoclinic (β)	S_8	256.53	monocl. pa. yel., 2.038
17	“ amorphous (γ)	S_8	256.53	pa. yel. amor
18	bromide, “mono-”	S_2Br_2	223.96	red. liq., 1.730
19	chloride, “mono-”	S_2Cl_2	135.05	yelsh. red liq., 1.666^{14}
20	“ , di-	SCl_2	102.98	dk. red liq., 1.557^{11}
21	“ , tetra-	SCl_4	173.89	yel. br. liq
22	fluoride, “mono-”	S_2F_2	102.13	col. gas
23	“ , tetra-	SF_4	108.07	gas (exist. quest.)
24	(di-) fluoride, deca-	S_2F_{10}	254.12	col. liq
25	fluoride, hexa-	SF_6	146.07	col. gas
26	(tetra-) nitride, di-	S_4N_2	156.28	red liq. or gray solid
27	(tetra-) “ , tetra-	S_4N_4	184.30	monocl. or.-red
28	oxide, mon-	SO (or S_2O_2)	48.07	col. gas
29	“ , sesqui-	S_2O_3	112.13	bl.-grn. cr
30	“ , di-	SO_2	64.07	col. gas or liq., suffoc. odor, 1.410 liq.
31	“ , tri- (α)	SO_3	80.07	trim. col. cr. or liq. 1.4097
32	“ “ (β-)	$(SO_3)_2$	160.13	silky, fibrous need
33	“ , hept- (or per-)	S_2O_7	176.13	visc. liq. or need. (exist. quest.)
34	“ , tetra- (or per-)	SO_4	96.07	wh. sld
35	oxy*tetra*chloride, mono-	S_2OCl_4	221.96	dk. red liq
36	“ , tri-	$S_2O_3Cl_4$	253.96	rhomb. need. or pl., wh
37	**Sulfuric acid**	H_2SO_4	98.08	col. oily liq. or hex. cr., 1.429
38	“ “	$H_2SO_4 \cdot H_2O$	116.10	col. liq., or monocl. pr. 1.438
39	“ “	$H_2SO_4 \cdot 2H_2O$	134.11	col. liq., 1.405
40	“ “	$H_2SO_4 \cdot 4H_2O$	170.15	
41	“ “ , peroxymono- (permono-, Caro's acid)	H_2SO_5	114.08	wh. cr
43	**Sulfuric acid,** peroxydi- (per(di-)sulfuric)	$H_2S_2O_8$	194.15	hyg. cr
44	**Sulfuric acid,** pyro-	$H_2S_2O_7$	178.15	col. cr., hyg
45	**Sulfurous acid**	H_2SO_3	82.08	in solution only
46	**Sulfuryl** chloride	SO_2Cl_2	134.98	col. liq. 1.444

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.65	1580	....	i.	i.	....
2	3.96	1580 d.	d.	0.0113^{0}	0.0114^{30}	sl. s. a.; i. dil. H_2SO_4, al.
3	....	d.	....	d.	....	14^{70} H_2SO_4
4	3.70^{15}	....	....	s. d.	....	s. a., al.; i. acet.
5	....	d.	....	s.	d.	....
6	....	25	....	s.	....	s. al.
7	....	d.	....	0.0033^{17}	....	v. s. H_2SO_3; s. a.
8	1.966	....	....	0.112^{0}	0.755^{85}	....
9	....	$-3H_2O$, 100	d. 160–170	v. s.	....	v. s. al.
10	2.373	$-4H_2O$, 78	....	22^{16}	67^{100}	i. al.
11	2.17^{17}	$-4H_2O$, 100	....	25^{13}	57^{100}	i. al.
12	6.187	d.	....	0.14	....	d. a.; i. al.
13	2.126^{25}	200 d.	d.	14.68	47.08^{80}	v. sl. s. al., eth., acet.; i. CS_2, CCl_4
14	....	91.5	d. 250	s.	....	s. al.
15	2.07; liq. 1.803	112.8; tr. mel. 95.5	444.6	i.	i.	23^{0} CS_2; s. tol.; sl. s. al., bz., eth.
16	1.96	119.25	444.6	i.	i.	70 CS_2; s. al., bz.
17	1.92; 1.9556^{0}	*ca.* 120	444.6	i.	i.	i. CS_2
18	2.635	−40	$54^{0.2}$	d.	d.	s. CS_2
19	1.678	−80	135.6	d.	d.	s. CS_2, bz. eth.
20	$1.621\frac{15}{15}$	−78	59	d.	d.	d. al., eth.; s. bz., CCl_4
21	....	−30	d. −15	d.	d.	....
22	lq. 1.5^{-100}	−105.5	−99	d.	d.	d. KOH
23	....	−124	−40	d.	d.	....
24	d°_{4} 2.08	f. p. −92	29	....	....	d. fused caustic
25	6.50 g/l; lq. 1.91	−56	−63.8 subl.	v. sl. s.	sl. s.	s. KOH; sl. s. al.
26	1.901^{18}	11	d.	i.	....	s. eth.; sl. s. al., CS_2
27	2.22^{15}	179 subl.	exp. 160	d.	....	s. CS_2, chl., bz., NH_3; sl. s. al., eth.
28	....	d.	d.	d.	....	....
29	....	d. 70–95	....	d.	d.	s. fum. H_2SO_4
30	2.927 g/l; lq. 1.434	−75.46	−10.0	22.8^{0}	0.58^{90}	s. al., H_2SO_4, ac. a.
31	2.75; lq. 1.925^{13}	16.83	44.8	d.	d.	forms fuming sulfuric acid
32	lq. 1.97	62.2; 32.2^{398}	44.6 (subl. 50)	d.	d.	....
33	....	0	subl. 10	d.	d.	s. H_2SO_4
34	....	0–3 d.	....	s. d.	....	d. dil. H_2SO_4
35	1.656^{0}	....	60–1	d.	d.	d. viol. al.
36	....	57 d.	....	d.	d.	d. al.
37	1.834	10.49	330 (98.3 %) d.	∞ ev. ht.	∞	d. al.; misc. org. solv.
38	1.788	8.62	290	∞	∞	d. al.
39	1.650^{0}	−38.9	167	∞	∞	d. al., eth.
40	....	−24.5	....	∞	∞	d. al., eth.
41	....	45 d.	....	d.	d.	s. H_3PO_4
43	....	65 d.	d.	d.	d.	s. al., eth., H_2SO_4
44	1.9	35	d.	d.	d.	d. al.
45	....	....	....	s.	....	s. al., eth., ac. a.
46	1.6674	−54.1	69.1	d.	d.	s. ac. a., bz.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Sulfuryl			
1	“ , pyro-, chloride	$S_2O_5Cl_2$	215.05	col. liq. 1.449^{19}
2	“ chloride fluoride	SO_2ClF	118.52	col. gas
3	fluoride	SO_2F_2	102.07	col. gas
4	See also under **Thio**			
5	**Tantalum**	Ta	180.95	cub. gray-blk. met. or blk. powd
6	boride, di-	TaB_2	202.52	
7	bromide	$TaBr_5$	580.46	yel. cr
8	carbide	TaC	192.87	cub. blk
9	chloride	$TaCl_5$	358.17	lt-yel. cr. powd
10	fluoride	TaF_5	275.88	tetr. col
11	nitride	TaN	194.89	hex. br.-bronze or blk
12	oxide, tetr-	Ta_2O_4 (or TaO_2)	425.76	dk.-gray powd
13	“ , pent-	Ta_2O_5	441.76	rhomb. col
14	“ , pent- (tantalic acid)	$Ta_2O_5 \cdot xH_2O$		col. gel
15	sulfide	Ta_2S_4 (or TaS_2)	490.00	blk. powd. or cr
16	**Telluric acid,** ortho-	$H_6TeO_6 \cdot 4H_2O$ (or $HTeO_4 \cdot 6H_2O$)	301.72	hex. need
17	“ “ “	H_6TeO_6	229.66	monocl. or microcryst. α 1.573, β 1.578, γ 1.630
18	“ “ allo- (polymeta-) (?)	$(H_2TeO_4)_x$ (?)		wh. powd
19	**Tellurium**	Te_2	255.22	rhbdr. sil.-wh. met., 1.0025
20	“	Te_2	255.22	amor. br.-blk., 1.0025
21	bromide, di-	$TeBr_2$	287.44	steel gray-grn. need., unst
22	“ , tetra-	$TeBr_4$	447.27	or. cr
23	chloride, di-	$TeCl_2$	198.52	blk. cr. or amor., unst
24	“ , tetra-	$TeCl_4$	269.44	wh. to yel. cr., deliq
25	ethoxide	$Te(OC_2H_5)_4$	307.85	
26	fluoride, tetra-	TeF_4	203.61	cr. wh
27	“ , hexa-	TeF_6	241.61	col. gas, unpleas. odor, 1.0009
28	iodide, di-	TeI_2	381.45	blk. cr. (exist. quest.)
29	“ , tetra-	TeI_4	635.29	gray cr
30	methoxide	$Te(OCH_3)_4$	251.75	solid
31	oxide, mon-	TeO	143.61	amor., blk. (exist. quest.)
32	“ , di- (tellurite)	TeO_2	159.61	tetr. or rhomb. wh., 2.00, 2.18 (Li), 2.35
33	“ , tri- α-	TeO_3	175.61	α-yel. amor.; β gray cr
34	sulfide	TeS_2	191.73	red-blk. amor. powd. (exist. quest.)
35	sulfur oxide	$TeSO_3$	207.67	amor. deep red solid
36	**Tellurous acid**	H_2TeO_3 (?)	177.63	wh. flocks (indef.), never isolated
37	**Terbium**	Tb	158.93	
38	chloride	$TbCl_3$	265.57	wh. need
39	“	$TbCl_3 \cdot 6H_2O$	373.67	col. cr., hyg
40	nitrate	$Tb(NO_3)_3 \cdot 6H_2O$	453.32	monocl. need. col
41	oxide (terbia)	Tb_2O_3	366.40	wh. cr
42	sulfate	$Tb_2(SO_4)_3 \cdot 8H_2O$	750.73	cryst
43	**Thallium**	Tl	204.39	tetr. bl. wh. met

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	g. 9.6 g/l; lq. 1.818^{11}_{4}	−39 to −37	140	d.	d.	d. a.
2	....	−124.7	7.1	d.	....	....
3	3.72 g/l	−120	−52	10^{9}	....	s. al.; sl. s. alk.
4	....	....	....	....	....	....
5	met. 16.6; powd. 14.491	2996 ± 50	*ca.* 4100	i.	i.	s. HF, fused alk.; i. a.
6	12.38	3000 (?)	....	....	....	....
7	4.67	240	320	d.	d.	s. abs. al., eth.
8	14.65	3880	5500	i.	i.	sl. s. H_2SO_4, HF
9	3.68^{27}	221	242	d.	....	s. abs. al., H_2SO_4
10	4.74	96.8	229.5	s.	....	s. HF
11	16.30	3090	....	i.	i.	sl. s. aq. reg., HNO_3, HF
12	....	oxidizes	....	i.	....	i. a.
13	$8.735^{61.2}$	1470 d.	....	i.	i.	s. fus. $KHSO_4$; i. a.
14	....	....	....	s.	....	s. alk.; i. a.; s. exc. concd. nitric acid
15	....	d.>1300	....	i.	i.	sl. s. HF + HNO_3; i. HCl
16	....	$-4H_2O$, 100	....	13.92^{0}	....	s. alk., dil. a.; sl. s. strong a.; i. al.
17	reg. 3.053; monocl. 3.071	$-2H_2O$, 140	$-3H_2O$, 300	19.7^{0}	258.5^{100}	s. a., alk.; i. al.
18	$3.44^{19.2}$	d.>160	....	sl. s.	s.	s. al.; sl. s. KOH
19	6.25	452	1390	i.	i.	s. H_2SO_4, HNO_3, aq. reg., KCN, KOH; i. HCl, CS_2
20	6.00	452	1390	i.	i.	s. H_2SO_4, HNO_3, aq. reg., KCN, KOH; i. HCl, CS_2
21	....	210 (280)	339	d.	....	d. NaOH; sl. s. min. a. tart. a.
22	4.31^{15}_{4}	380 ± 6	421	sl. s. d.	d.	s. min. a., tart. a., NaOH
23	7.05	209 ± 5(175)	327	d.	d.	d. NaOH; sl. s. min. a., tart. a.
24	3.26; lq. 2.559^{232}	224 (214)	390	s. d.	s. d.	s. HCl, bz., al., chl., CCl_4; i. CS_2
25	....	20	$107\text{–}107.5^{5.5}$	....	....	....
26	....	subl.	....	d.	d.	....
27	$3.025^{-35.5}$	−36	−35.5	d.	d.	d. a., alk.
28	....	subl.	....	i.	i.	....
29	8.403^{15}	259	d.	sl. s.	d.	s. HI, alk., aq. NH_3
30	....	....	123–4	....	....	....
31	....	d.	d.	i.	i.	s. HCl, dil. a., H_2SO_4, NaOH
32	tetr. 5.67^{15}; rhomb. 5.91^{0}	dull red	subl. 450	0.00067	....	s. HCl, HNO_3, alk.; i. NH_4OH
33	α 5.075; β 6.21	d.	....	i.	i.	d. conc. HCl; s. h. KOH; i. a., al.
34	....	....	....	i.	....	s. alk., sulfides; i. a.
35	....	soft. 30 d.	d.	d.	rapid d.	s. H_2SO_4
36	....	d. 40	....	0.00067	d.	s. NaOH, a.; sl. s. NH_4OH; i. al.
37	....	327 ± 5	....	....	....	....
38	4.35	588	....	s.	....	s. al.
39	....	....	....	v. s.	....	....
40	....	89.3	....	s.	....	....
41	....	....	....	....	....	s. dil. a.
42	....	$-8H_2O$, 360	....	$3{,}561^{20}$	2.51^{40}	....
43	11.85	302	1457 ± 10	i.	i.	s. HNO_3, H_2SO_4; sl. s. HCl

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Thallium			
1	acetate	$TlC_2H_3O_2$	263.43	silk wh. cr., deliq
2	azide	TlN_3	246.41	yel
3	bromate	$TlBrO_3$	332.31	col
4	bromide, mono-	$TlBr$	284.31	cub. yelsh. wh
5	" , "di-" (bromothallate(ous))	Tl_2Br_4 (or $[Tl^{I}Tl^{III}Br_4]$)	728.44	yel. need
6	" , tri-	$TlBr_3$	444.14	yel. deliq. unstab
7	carbonate	Tl_2CO_3	468.79	monocl. col
8	chlorate	$TlClO_3$	287.85	
9	*per*chlorate	$TlClO_4$	303.85	col
10	chloride, mono-	$TlCl$	239.85	cub. col. or wh. powd
11	" , "sesqui" (chlorothallate (ous))	Tl_4Cl_6 (or $Tl_3{}^{I}[Tl^{III}Cl_6]$)	1030.30	hex. yel. or yel. powd
12	chloride, tri-	$TlCl_3$	310.76	hex. pl
13	" , "	$TlCl_3 \cdot H_2O$	328.78	
14	" , "	$TlCl_3 \cdot 4H_2O$	382.83	col. need
15	chloroplatinate	Tl_2PtCl_6	816.75	pa. orange cr
16	chromate	Tl_2CrO_4	524.79	yel
17	*di*chromate	$Tl_2Cr_2O_7$	624.80	red cr
18	cyanide	$TlCN$	230.41	tabl
19	ethoxide	$[TlOC_2H_5]_4$	997.80	col. liq
20	ferrocyanide	$Tl_4Fe(CN)_6 \cdot 2H_2O$	1065.55	tricl. yel
21	fluogallate	$Tl_2[GaF_5H_2O]$	591.52	orthorh. (?), col. cr. n 1.645
22	fluoride, mono-	TlF	223.39	cub. oct. col
23	" , tri-	TlF_3	261.39	olive grn
24	fluosilicate	$Tl_2SiF_6 \cdot 2H_2O$	586.87	hex. pl
25	hydroxide (ous)	$TlOH$	221.40	pa. yel. need
26	iodide, mono-	TlI	331.31	cub. red; rhomb. yel
27	" , tri-	TlI_3	585.15	br. need
28	methoxide	$TlOCH_3$	235.42	wh. cr. powd
29	myristate	$TlC_{14}H_{27}O_2$	431.75	wh. powd
30	nitrate (ous) (α)	$TlNO_3$	266.40	cubic
31	" " (β)	$TlNO_3$	266.40	trig
32	" " (γ)	$TlNO_3$	266.40	rhomb., α 1.817
33	" , (ic)	$Tl(NO_3)_3$	390.41	cryst
34	" , "	$Tl(NO_3)_3 \cdot 3H_2O$	444.46	rhomb. col., deliq
35	oleate	$TlC_{18}H_{33}O_2$	485.83	wh. cr. clusters
36	oxalate	$Tl_2C_2O_4$	496.80	monocl. pr
37	oxide (ous)	Tl_2O	424.78	blk., deliq
38	" (ic)	Tl_2O_3	456.78	hex. blk., amor. pr.
39	palmitate	$TlC_{16}H_{31}O_2$	459.80	cr. need
40	phenoxide	$TlOC_6H_5$	297.49	wh. cr
41	*ortho*phosphate	Tl_3PO_4	708.15	col. need
42	" , di-H	TlH_2PO_4	301.39	monocl
43	*pyro*phosphate	$Tl_4P_2O_7$	991.52	monocl. pr
44	picrate	$TlC_6H_2N_3O_7$	432.49	red monocl. or yel. tricl
45	selenate	Tl_2SeO_4	551.74	rhomb. need. 1.949, 1.959, 1.964
46	selenide	Tl_2Se	487.74	gray leaf
47	silver nitrate	$TlNO_3 \cdot AgNO_3$	436.29	wh. cr. powd
48	stearate	$TlC_{18}H_{35}O_2$	487.85	need
49	sulfate (ous)	Tl_2SO_4	504.85	rhomb. col., 1.860, 1.867, 1.885
50	" " , hydrogen	$TlHSO_4$	301.46	
51	" (ic)	$Tl_2(SO_4)_3 \cdot 7H_2O$	823.09	col. leaf
52	sulfide (ous)	Tl_2S	440.85	tetr. bl.-blk
53	" (ic)	Tl_2S_3	504.98	blk. amor

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	3.68	110	....	v. s.	....	v. s. al.
2	....	334	....	v. sl. s.	....	....
3	....	....	....	0.35^{20}	....	....
4	$7.557^{17.8}$	460	815	$.05^{25}$	$.25^{68}$	s. al.; i. HBr, acet.
5	....	....	....	d.	d.	....
6	....	d.	....	s.	v. s.	v. s. al.
7	7.11	273	....	$4.03^{15.5}$	27.2^{100}	i. abs. al., eth., acet.
8	5.047^{9}	....	....	2^{0}	57.31^{100}	....
9	4.89	501	d.	20.5^{30}	167^{100}	sl. s. al.
10	7.00	430	720 (806)	0.32^{20}	1.97^{100}	sl. s. HCl; i. a., NH_4OH, al.
11	5.9	400–500	d.	0.26^{15}	1.9^{100}	....
12	....	25	d.	v. s.	....	....
13	....	$-H_2O$, 60	d. 100	v. s.	d.	....
14	....	37	....	86.2^{17}	d.	s. al., eth.
15	5.76^{17}	....	....	0.0064^{15}	0.05^{100}	....
16	....	....	....	0.03^{60}	0.2^{100}	sl. s. a., alk.; i. ac. a.
17	....	....	....	i.	....	d. a.
18	....	d.	....	$16.8^{28.5}$	....	....
19	3.522	−3	d. 80	s. d.	....	9.11^{25} al.; s. bz.; i. liq. NH_3
20	4.641	....	....	0.37^{18}	3.93^{101}	....
21	6.44	....	....	s.	....	....
22	....	....	300	78.6^{15}	v. s.	sl. s. al.
23	....	....	....	d.	....	i. c. HCl
24	....	....	....	v. s.	....	....
25	....	....	d. 139	25.9^{0}	52^{40}; 148^{100}	s. al.
26	7.09	440	824	$.0064^{20}$	0.120^{100}	s. HNO_3, aq. reg.; sl. s. al.; i. KI
27	....	....	....	....	....	s. al., eth.
28	....	d.>120	....	s. d.	....	1.70^{25} CH_3OH; 3.16^{25} bz.
29	....	120–3	....	....	....	0.52^{25} 50% al.
30	....	206	430	9.55^{20}	413^{100}	s. acet.; i. al.
31	....	tr. 145 $-\alpha$	....	....	....	....
32	$5.556^{21.4}$	tr. 75 $-\beta$	....	3.91^{0}	414^{100}	s. acet.; i. al.
33	....	....	....	s.	....	....
34	....	d. 100	....	d.	d.	....
35	....	131–2	....	0.05^{15}	0.3^{80}	1.75^{15}, 3.0^{25} al.
36	6.31	....	....	1.48^{15}	9.02^{100}	....
37	....	300	1080^{600}; —O, 1865	v. s., d. t	o TlOH	s. a., al.
38	amor. 9.65^{21}; hex. 10.19^{22}	717 ± 5	—2O, 875	i.	i.	s. a.; i. alk.
39	....	115–7	....	0.01^{15}	0.07^{60}	0.20^{15}, 1.04^{45} al.
40	....	233–5	....	d.	....	s. h. bz., pyr.; sl. s. lgr.
41	6.89	....	....	0.5^{15}	0.67^{100}	s. NH_4 salts; i. al.
42	4.723	*ca.* 190	....	sl. s.	sl. s.	i. al.
43	6.786^{20}	>120	....	40	....	....
44	red 3.164^{17}; yel. 2.993^{17}	exp. 273–5	....	0.135^{0}	2.43^{70}	0.40 CH_3OH
45	6.875	>400	....	2.13^{10}	8.5^{80}	i. al. eth.
46	....	340	....	i.	....	i. a.
47	....	75	....	s.	....	....
48	....	119	....	0.005^{15}	0.095^{75}	0.18^{16}, 0.60^{60} al.
49	6.77	632	d.	4.87^{20}	$15.57^{99.7}$	....
50	....	120 d.	....	....	....	v. sl. s. aq. H_2SO_4
51	....	$-6H_2O$, 220	d.	d.	....	s. dil. H_2SO_4
52	8.0	443	d.	0.02^{20}	sl. s.	s. a.; i. alk., acet.
53	....	soft. 12; 260	d.	i.	i.	s. h. H_2SO_4

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Thallium			
1	sulfite	Tl_2SO_3	488.85	cr
2	*meta*tellurate	Tl_2TeO_4	600.39	heavy ppt. wh
3	thiocyanate	$TlSCN$	262.47	tetr. col
4	*di*thionate	$Tl_2S_2O_6$	568.91	monocl
5	*pyro*vanadate	$Tl_4V_2O_7$	1031.46	
6	*meta*vanadate	$TlVO_3$	303.34	gray cr
	Thio compounds:			
7	Thiocarbonyl chloride (thiophosgene)	$CSCl_2$	114.99	red-yel. liq., 1.5442
8	Thiocarbonyl chloride, tetra-	$CSCl_4$	185.90	yel
9	Thiocyanic acid (iso)	HSCN (HNCS)	59.09	col. gas
10	Thiocyanogen	$(SCN)_2$	116.17	liq. or yel. sld
11	Thionyl bromide	$SOBr_2$	207.90	cr. yel. liq
12	" chloride	$SOCl_2$	118.98	col. yel. liq. 1.527^{10}
13	" " fluoride	$SOClF$	102.52	gas
14	" fluoride	SOF_2	86.07	col. gas
15	Thiophosphoramide (Thiophosphoryl amide)	$PS(NH_2)_3$	111.12	amor. yel.-wh
16	Thiophosphoryl bromide	$PSBr_3$	302.79	cub. yel
17	" "	$PSBr_3 \cdot H_2O$	320.18	yel. cr
18	" " (mono-) chloride, di-	$PSBrCl_2$	213.88	yel. liq
19	Thiophosphoryl bromide (di-) chloride	$PSBr_2Cl$	258.34	pa. gr. fum. liq
20	Thiophosphoryl chloride	$PSCl_3$	169.42	col. liq. 1.563 (C)
21	" fluoride	PSF_3	120.05	gas
22	Thiosulfuric acid	$H_2S_2O_3$	114.15	in soln. only
23	**Thorium**	Th	232.05	cub. gray, radioactive
24	boride, tetra-	ThB_4	275.40	tetr. pr
25	" , hexa-	ThB_6	297.04	cub. blk. met
26	bromide	$ThBr_4$	551.78	col. cr
27	carbide	ThC_2	256.14	tetrag. yel
28	carbonate	$Th(CO_3)_2$	352.14	(exist. quest.)
29	chloride	$ThCl_4$	373.95	rhomb. wh., deliq
30	cyanoplatinite	$Th[Pt(CN)_4]_2 \cdot 16H_2O$	1118.98	rhomb. yel. grn
31	fluoride	ThF_4	308.12	wh. powd., cub
32	fluoride	$ThF_4 \cdot 4H_2O$	380.18	cr
33	hydroxide	$Th(OH)_4$	300.15	wh. gelat
34	iodide	ThI_4	739.80	
35	nitrate	$Th(NO_3)_4$	480.15	plates, deliq
36	"	$Th(NO_3)_4 \cdot 4H_2O$	552.22	col
37	"	$Th(NO_3)_4 \cdot 12H_2O$	696.34	col. leaf, deliq
38	oxalate	$Th(C_2O_4)_2$	408.16	wh. cr
39	"	$Th(C_2O_4)_2 \cdot 6H_2O$	516.26	wh. amor. powd
40	oxide, di- (thoria)	ThO_2	264.12	cubic, white, 2.20 (lq.)
41	oxysulfide	$ThOS$	280.19	yel. cr
42	2,4-pentanedione deriv. (acetylacetonate)	$Th(C_5H_7O_2)_4$	628.54	col. cr
43	*ortho*phosphate	$Th_3(PO_4)_4 \cdot 4H_2O$	1148.34	gelat. wh
44	*meta*phosphate	$Th(PO_3)_4$	548.04	col., rhomb. pl

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	6.427	....	....	3.34^{15}	v. s.	i. al.
2	5.712; $6.760^{17.6}$	red heat	....	sl. s.	sl. s.	....
3	....	....	....	0.315^{20}	0.727^{40}	i. al.
4	5.57	d.	....	41.8^{19}	....	....
5	8.21^{19}	454	....	$.2^{14}$	$.26^{100}$	....
6	6.09^{17}	424	....	$.087^{11}$	$.21^{100}$	....
7	1.509^{15}	....	73.5	d.	....	d. al.; s. eth.
8	1.712^{13}	....	146–7	....	d.	....
9	....	> -10 d.	....	v. s.	....	v. s. al., eth., bz.
10	....	-2 to -3 d.	....	d.	....	s. al., eth., CS_2, CCl_4
11	2.68^{18}	-52 to -50	138^{773}; 68^{40}	d.	d.	s. bz., chl., CS_2, CCl_4
12	$1.655^{10.4}$	-105	78.8^{746}	d.	d.	d. a., al., alk.; s. bz. chl.
13	....	-139.5	12.2	....	....	....
14	2.93	-110	-30	d.	d.	s. eth., bz., chl., acet., $AsCl_3$
15	1.7^{13}	d. 200	....	sl. s.	d.	....
16	2.85^{17}	38	d. 175	d.	....	s. CS_2, eth., PCl_3
17	2.794^{18}	35	....	....	....	....
18	liq. 2.12^{0}	-30	150 d.	d.	....	....
19	lq. 2.48^{0}	-60	95^{60}	d.	....	....
20	lq. 1.635	-35	125	d.	....	s. CS_2, CCl_4, bz.
21	....	$3.8^{7.6\text{ atm.}}$	d.	sl. s., sl. d.	....	s. eth.; i. CS_2, bz.
22	....	....	....	s.	....	....
23	11.2	1845	4500	i.	i.	s. HCl, H_2SO_4, aq. reg.; sl. s. HNO_3
24	8.45	....	....	i.	i.	s. HNO_3, HCl, h. H_2SO_4
25	6.4^{15}	2195	....	i.	i.	s. HNO_3; i. H_2SO_4, HCl HF, aq. alk.
26	5.67	....	subl. 610	s.	s.	....
27	8.96	2773; ign.	5000	d.	....	v. sl. s. conc. a.
28	....	....	....	i.	d.	s. conc. Na_2CO_3; i. aq. CO_2
29	4.59	820; subl. 720–50	d. 1100	v. s.	v. s.	s. KCl, al., eth., a.
30	2.460	....	....	sl. s.	s.	....
31	....	red ht.	....	....	....	sl. d. dil. H_2SO_4, HCl; i. conc. H_2SO_4
32	....	$-H_2O$, 100	$-2H_2O$, 140–200	$.017^{25}$	....	i. HF
33	....	d.	....	i.	i.	s. a.; i. alk., $H_2C_2O_4$, HF
34	....	d.	....	s.	....	....
35	....	d. 500	....	v. s.	....	s. al.
36	....	swells	....	v. s.	....	v. s. al.
37	....	d.	....	v. s.	....	v. s. al., a.
38	4.637^{16}	d.	....	i.	i.	s. h. aq. $(NH_4)_2C_2O_4$; sl. s. a.
39	....	....	....	i.	....	s. Na_2CO_3, $(NH_4)_2C_2O_4$ soln.; i. HNO_3
40	10.03	3050	4400	i.	i.	s. h. H_2SO_4; i. alk., dil. a.
41	6.44^{0}	d.	....	i.	....	s. aq. reg.; sl. s. HNO_3
42	....	171; subl. 160^{10}	$260\text{–}270^{10}$	sl. s.	....	v. s. al., chl.; s. eth.
43	....	....	....	i.	i.	s. 30 % HCl; i. a.
44	$4.08^{16.4}$	....	....	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Thorium			
1	*hypo*phosphate	$ThP_2O_6{\cdot}11H_2O$	588.26	amor. wh. ppt
2	picrate	$Th(C_6H_2N_3O_7)_4{\cdot}10H_2O$	1324.68	
3	*ortho*silicate (thorite)	$ThSiO_4$	324.18	col. tetr
4	sulfate	$Th(SO_4)_2$	424.25	wh., cryst
5	"	$Th(SO_4)_2{\cdot}4H_2O$	496.32	need. or wh. cr. powd
6	"	$Th(SO_4)_2{\cdot}6H_2O$	532.35	
7	"	$Th(SO_4)_2{\cdot}8H_2O$	532.38	monocl. pr
8	"	$Th(SO_4)_2{\cdot}9H_2O$	586.40	monocl. wh
9	sulfide	ThS_2	296.25	yel-br. cryst
10	*pyro*vanadate	$ThV_2O_7{\cdot}6H_2O$	554.12	yellow
11	**Thulium**	Tm	168.94	
12	chloride	$TmCl_3{\cdot}7H_2O$	401.88	grn. cr
13	oxalate	$Tm_2(C_2O_4)_3{\cdot}6H_2O$	710.96	grnsh. wh. ppt
14	oxide (thulia)	Tm_2O_3	386.80	grnsh. wh. powd
15	**Tin** gray (α)	Sn	118.70	cubic, gray
16	" , ordinary (β-)	Sn	118.70	tetr. wh. met
17	" , brittle (γ-)	Sn	118.70	rhomb. wh
18	**Tin** acetate (ous)	$Sn(C_2H_3O_2)_2$	236.79	yelsh. powd
19	*pyro*arsenate (ous)	$Sn_2As_2O_7$	499.22	flocculent ppt
20	bromide (ous)	$SnBr_2$	278.53	rhomb. pa. yel
21	" (ic)	$SnBr_4$	438.36	rhomb. pyramids, col., deliq
22	bromide (tri-) chloride	$SnBr_3Cl$	393.91	liq
23	bromide (di-) chloride, di-	$SnBr_2Cl_2$	349.45	
24	bromide chloride, tri-	$SnBrCl_3$	304.99	col. liq
25	bromide (di-) iodide, di-	$SnBr_2I_2$	532.37	or.-red hex. pl
26	chloride (ous)	$SnCl_2$	189.61	rhomb. wh
27	" "	$SnCl_2{\cdot}2H_2O$	225.65	wh. monocl
28	" (ic)	$SnCl_4$	260.53	col. liq
29	" "	$SnCl_4{\cdot}3H_2O$	314.58	monocl. cr
30	" "	$SnCl_4{\cdot}4H_2O$	332.59	opaque
31	" "	$SnCl_4{\cdot}5H_2O$	350.61	monocl. cr
32	" , diammine (ic)	$SnCl_4{\cdot}2NH_3$	294.59	cr
33	chloride (di-) iodide, di-	$SnCl_2I_2$	443.45	red mobile liq
34	chromate (ic)	$Sn(CrO_4)_2$	350.72	br.-yel. cr. powd
35	ferricyanide (ous)	$Sn_3[Fe(CN)_6]_2$	780.02	wh
36	ferrocyanide (ous)	$Sn_2Fe(CN)_6$	449.36	wh. gel
37	" (ic)	$SnFe(CN)_6$	330.66	grnsh wh. gel
38	fluoride (ous)	SnF_2	156.70	wh. monocl. cr
39	" (ic)	SnF_4	194.70	wh. cr. mass hyg
40	hydride (stannane)	SnH_4	122.73	gas
41	iodide (ous)	SnI_2	372.54	monocl. yel.-red
42	" (ic)	SnI_4	626.38	cub. yel
43	nitrate (ous)	$Sn(NO_3)_2{\cdot}20H_2O$	603.04	col. leaf
44	" , basic (ous)	$SnO{\cdot}Sn(NO_3)_2$	377.42	wh. cr. mass
45	" (ic)	$Sn(NO_3)_4$	366.73	silky need
46	oxalate (ous)	SnC_2O_4	206.72	wh. cr. or heavy wh. powd

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	i.	i.	i. a., alk.
2	....	....	....	0.305^{25}	....	....
3	5.3	....	....	v. sl. s.	....	....
4	4.225^{17}	....	....	v. s.	s.	v. s. $NH_4C_3H_3O_2$
5	....	....	....	9.41^{17} (anh.)	2.54^{50} (anh.)	....
6	....	....	....	1.5^{0}; 1.63^{15}	3.85^{45}; 6.64^{60}	....
7	....	$-4H_2O$, 42	....	1^{0}; 1.85^{25}	3.71^{44}	....
8	2.77	$-9H_2O$, 400	....	$.74^{0}$; 1.57^{20}	6.76^{55}	s. HCl, HNO_3
9	6.80	d.	....	i.	i.	s. h. aq. reg.; sl. s. a.
10	....	....	....	i.	i.	s. conc. a.
11	....	....	....	i.	i.	....
12	....	....	....	v. s.	....	v. s. al.
13	....	....	....	....	....	s. soln. alk. oxal.
14	....	....	....	....	....	s. min. a.
15	5.75	231.89, stab. <18	2260	i.	i.	d. HCl, H_2SO_4, dil. HNO_3 aq. reg., h. KOH, NaOH
16	7.28	231.9 stab. 18–170	2270	i.	i.	d. HCl, H_2SO_4, dil. HNO_3, aq. reg., h. KOH, NaOH
17	6.52–.56	231.9 stab. >161	2270	i.	i.	d. HCl, H_2SO_4, dil. HNO_3, aq. reg., h. KOH, NaOH
18	....	182	240	d.	....	s. dil. HCl
19	....	d. As_2O_3 +	SnO_2	i.	i.	i. conc. ac. a.
20	5.117^{17}	215.5	620	85.2^{0}	222.5^{100}	....
21	lq. 3.340^{35}	31	202^{734}	s. d.	d.	s. acet., $AsBr_3$, PCl_3
22	3.12^{13}	1	73^{30}	....	....	....
23	2.82^{13}	−20	65^{30}; d. 191	$d.^{6}$	d.	....
24	2.51^{13}	−1	50^{30}	....	....	....
25	3.631^{15}	d. 50	....	s.	d.<80	....
26	lq. 3.393^{245}	246.0	623	83.9^{0} d.	269.8^{15} d.	s. al., eth., acet., pyr., ethyl acetate, methyl acetate
27	$2.710^{15.6}$	37.7	d.	118.7 d.	∞ d.	s. al., eth. acet., glac. ac. a
28	2.232	−33	114.1	s.	d.	s. eth.
29	....	80	stab. 64–83	s.	....	....
30	....	....	stab. 56–63	s.	....	....
31	....	....	stab. 19–56	s.	....	....
32	....	....	....	s.	....	d. HCl
33	3.287^{15}	....	297	s. conc. sol.	d. dil. sol.	s. bz., CS_2, chl.
34	....	d.	....	s.	....	....
35	....	d.	....	i.	....	d. HCl
36	....	....	....	i.	i.	d. HCl
37	....	....	....	i.	i.	d. h. HCl
38	....	....	....	s.	....	....
39	4.780^{19}	....	705	v. s.	d. to SnO_2	....
40	....	−150; d.	−52	....	....	s. $AgNO_3$, $HgCl_2$, conc. H_2SO_4, conc. alk.
41	5.28^{25}	320	720	$1.32^{20.8}$	$3.55^{98.5}$	d. KOH, HCl; s. HF, CS_2
42	4.696^{11}	143.5	341; subl. 180	d.	d.	145^{15} CS_2; s. al., eth., chl., bz.
43	....	−20	....	d.	d.	d. HNO_3
44	....	d.<100 exp.	....	d.	d.	....
45	....	d. compl. 50	....	d.	....	....
46	3.56^{18}	....	....	....	....	d. HCl; sl. s. NH_4Cl, $(NH_4)_2C_2O_4$

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin			
1	oxide, mon- (ous)	SnO	134.70	tetr. (cub.) blk
2	" , "	$SnO\cdot xH_2O$		wh. powd. or yelsh.-br. cr
3	" , di- (ic) (cassiterite)	SnO_2	150.70	tetr. wh., 1.997, 2.093
4	" , " ("ordinary" or α-stannic acid)	$SnO_2\cdot xH_2O$		amor. or col. ppt., wh
5	oxide, di- ("meta-" or β-stannic acid)	$SnO_2\cdot xH_2O$		amor. or gel wh
6	*ortho*phosphate (ous)	$Sn_3(PO_4)_2$	546.06	wh. amor. solid
7	" , mono-H (ous)	$SnHPO_4$	214.69	cr
8	" , di-H (ous)	$Sn(H_2PO_4)_2$	312.69	rhomb. cr
9	*pyro*phosphate (ous)	$Sn_2P_2O_7$	411.36	amor. powd
10	*meta*phosphate "	$Sn(PO_3)_2$	276.66	amor. mass
11	phosphide, mono-	SnP	149.68	silv. wh
12	" , tri-	SnP_3	211.64	cr
13	(tetra-) phosphide, tri-	Sn_4P_3	567.74	wh. cr
14	phosphorus chloride (ic)	$SnCl_4\cdot PCl_5$	468.79	cr
15	phosphoryl chloride (ic)	$SnCl_4\cdot POCl_3$	413.88	cr
16	selenide (ous)	$SnSe$	197.66	steel-gray cr
17	" (ic)	$SnSe_2$	276.62	cr
18	sulfate (ous)	$SnSO_4$	214.77	wh.-yelsh. cr. powd
19	" (ic)	$Sn(SO_4)_2\cdot 2H_2O$	346.86	hex. pr. deliq
20	sulfide (ous)	SnS	150.77	rhomb. gray-blk
21	" (ic) (mosaic gold)	SnS_2	182.83	hex. gold-yel
22	sulfur chloride (ic)	$SnCl_4\cdot 2SCl_4$	608.32	yel. cr
23	tartrate (ous)	$SnC_4H_4O_6$	266.77	heavy wh. powd
24	telluride (ous)	$SnTe$	246.31	gray cr
25	" (ic)	$SnTe_2$	373.92	blk. floc. ppt
26	**Titanium**	Ti	47.90	α hex., tr. — β cub. 800°C., silv. gray
27	boride, di-	TiB_2	69.54	hex
28	bromide, di-	$TiBr_2$	207.73	blk. powd
29	" , tri-	$TiBr_3\cdot 6H_2O$	395.74	rdsh. vlt. cr., deliq
30	" , tetra-	$TiBr_4$	367.56	or.-yel., deliq
31	carbide	TiC	59.91	cub. gr. met
32	chloride, di-	$TiCl_2$	118.81	lt. br.-blk. deliq
33	" , tri-	$TiCl_3$	154.27	dk. vlt., deliq
34	" , tetra-	$TiCl_4$	189.73	col. lt. yel. liq., 1.61
35	fluoride, tri-	TiF_3	104.90	purp.-red or vlt
36	" , tetra-	TiF_4	123.90	wh. powd
37	iodide, di-	TiI_2	301.74	blk. hyg
38	" , tetra-	TiI_4	555.58	cub. red
39	nitride	TiN	61.91	cub. yel.-bronze
40	oxalate	$Ti_2(C_2O_4)_3\cdot 10H_2O$	540.02	yel. pr
41	oxide, mon-	TiO	63.90	pr. blk
42	" , sesqui-	$Ti\ O_3$	143.80	trig., vlt. blk
43	" , di-(brookite)	TiO_2	79.90	rhomb., 2.583, 2.586, 2.741
44	" , " (octahedrite, anatase)	TiO_2	79.90	br.-blk., tetr., 2.554, 2.493

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	6.446^{0}	d. 700–950	...	i.	i.	d. a., fixed alk. hydx.; sl. s. NH_4Cl
2	...	...	...	...	d. to SnO	d. a., alk.; s. alk. carb.; i. NH_4OH
3	6.95	1127 d.	...	i.	i.	d. KOH, NaOH; i. aq. a.
4	...	...	...	i.	i.	s. a., K_2CO_3, KOH, NaOH
5	...	...	...	i.	i.	i. a., K_2CO_3; s. KOH, NaOH
6	3.823^{17}	...	...	i.	i.	d. a. alk. hydx.
7	$3.476^{15.5}$	stab. <100	d.	i.	i.	...
8	$3.167^{22.8}$	...	...	...	...	...
9	$4.009^{16.4}$	...	...	...	...	...
10	$3.380^{22.8}$	...	...	...	...	...
11	6.56	...	...	i.	...	s. HCl; i. HNO_3
12	4.10^{0}	d. <415 to Sn_4P_3	...	i.	i.	d. HNO_3; i. HCl
13	5.181	d. <480	...	i.	i.	d. HCl, fixed alk. hydx.
14	...	subl. 200	...	d.	d.	...
15	...	58	180	d.	d.	...
16	6.179^{0}	861	...	i.	i.	d. HCl, HNO_3, aq. reg., alk. sulfd.
17	5.133	650	...	i.	i.	d. h. conc. a.; i. dil. a.
18	...	d. <360 to SO_2	...	33^{25}	...	s. H_2SO_4
19	...	...	...	v. s.	d.	s. eth., dil. H_2SO_4; reacts with HCl
20	5.080^{0}	882	1230	$.00002^{18}$	...	d. HCl, alk., $(NH_4)_2S_x$
21	4.5	d.	...	0.00002^{18}	...	d. alk., sulf., aq. reg., PCl_5, $SnCl_2$, alk. hydx.; i. HCl, HNO_3
22	...	37	d. <40	d.	d.	d. HNO_3; s. CS_2, eth., bz., ethyl acet.
23	...	...	...	s.	...	v. s. dil. HCl
24	6.48	780	...	i.	i.	d. alk. sulfd.
25	...	...	...	i.	i.	d. dil. a., alk. hydx., $(NH_4)_2S_x$
26	4.5^{20}	1800	>3000	i.	d.	s. dil. a.
27	4.50	2600 (?)	...	...	...	...
28	...	d. >500	...	s. ev. H_2	...	...
29	...	115^{0}; d. 400	...	v. s.	...	v. s. al., acet.
30	2.6	39	230	d.	...	s. abs. al., abs. eth.
31	4.93	3140 ± 90	4300	i.	i.	s. HNO_3; aq. reg.
32	...	subl. in H_2	...	d.	...	s. al.; i. eth., chl., CS_2
33	...	d. 440	...	s.	s.	v. s. al.; s. HCl; i. eth.
34	lq. 1.726	−30	136.4	s.	d.	s. dil. HCl, al.
35	...	...	...	red s.; vlt. i.	...	...
36	$2.798^{20.5}$	...	284	s., d.	...	s. H_2SO_4, al., C_5H_5N; i. eth.
37	4.3^{20}	...	...	d.	...	d. alk.; s. conc. HF, HCl
38	...	150	>360	v. s.	d.	...
39	5.43	2950	...	i.	i.	sl. s. h. aq. reg. + HF
40	...	...	...	s.	s.	i. al., eth.
41	4.93	1750	...	...	...	s. dil. H_2SO_4; i. HNO_3
42	4.6	2130; d.	...	i.	i.	s. H_2SO_4; i. HCl, HNO_3
43	4.17	...	...	i.	i.	s. H_2SO_4, alk.; i. a.
44	3.84	...	...	i.	i.	s. H_2SO_4, alk.; i. a.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Titanium			
1	oxide, di- (rutile)	TiO_2	79.90	tetr. bl., 2.616, 2.903
2	“ “ (ortho- or α titanic acid)	$TiO_2 \cdot xH_2O$ (or H_4TiO_4)		wh.
3	oxide, di- (meta- or β titanic acid)	$TiO_2 \cdot xH_2O$ (or H_2TiO_3?)		wh. amor. powd
4	phosphide	TiP	78.88	gray met
5	sulfate	$Ti_2(SO_4)_3$	384.00	cr. grn. deliq
6	“ , basic	$TiOSO_4$	159.97	wh. or sl. yelsh. powd
7	sulfide, mono-	TiS	79.97	rdsh sld
8	“ , sesqui-	Ti_2S_3	192.00	grayish blk. cr
9	“ , di-	TiS_2	112.03	yel. sc
10	**Tungsten** (Wolfram)	W	183.86	cub. gray-blk
11	arsenide	WAs_2	333.74	blk. cr
12	(di-) boride	W_2B	378.66	tetr
13	boride	WB	194.74	tetr
14	boride, di-	WB_2	205.55	hex
15	bromide, di-	WBr_2	343.75	bl.-blk. need
16	“ , penta-	WBr_5	583.50	vlt.-br. need
17	“ , hexa-	WBr_6	663.42	bl.-blk. need
18	carbide	WC	195.93	hex. blk
19	(di-) carbide	W_2C	379.85	hex. blk
20	carbonyl	$W(CO)_6$	351.98	col. rhomb
21	chloride, di-	WCl_2	254.83	gray amor
22	“ , tetra-	WCl_4	325.75	gray deliq
23	“ , penta-	WCl_5	361.21	blk., deliq
24	“ , hexa-	WCl_6	396.66	cub. dk. bl
25	fluoride, hexa-	WF_6	297.92	lt. yel. liq., or col. gas
26	iodide, di-	WI_2	437.76	br.-grn. amor
27	“ , tetra-	WI_4	691.60	blk. cr
28	oxide, di-	WO_2	215.92	cub. br
29	“ , tri-	WO_3	231.92	rhomb. yel. or yel.-or. powd
30	oxy*tetra*bromide	$WOBr_4$	519.58	blk. deliq
31	oxy*di*bromide, di-	WO_2Br_2	375.75	red pr
32	oxy*tetra*chloride	$WOCl_4$	341.75	red need
33	oxy*di*chloride, di-	WO_2Cl_2	286.82	lt. yel. tabl
34	oxy*tetra*fluoride	WOF_4	275.92	col. pl., hyg
35	phosphide	W_2P	398.82	dk. gray. pr
36	“	WP	214.90	gray pr
37	“	WP_2	245.88	blk. cr
38	sulfide, di-	WS_2	248.05	dk. gray cr
39	“ , tri-	WS_3	280.12	choc. br. powd
40	**Tungstic acid,** ortho-	H_2WO_4	249.94	yel
41	“ “ “	$H_2WO_4 \cdot H_2O$	267.95	wh
42	“ “ , meta-	$H_6[H_2W_{12}O_{40}] \cdot 24H_2O$	3287.49	cub. yel

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	4.26	1640 d.	....	i.	i.	s. H_2SO_4, alk.; i. a.
2	....	d.	....	v. sl. s.; sl. d.	....	s. dil. HCl, H_2SO_4, conc. alk.
3	....	....	....	i.	i.	s. conc. H_2SO_4; i. in other acids, al. conc. alk.
4	3.95^{25}	....	....	i.	i.	i. a.
5	....	....	....	i.	i.	s. dil. a.; i. al., eth., conc. H_2SO_4
6	....	....	....	d.	....	....
7	....	....	....	i.	....	s. conc. H_2SO_4; i. HCl, HF, dil. H_2SO_4
8	....	....	....	i.	i.	s. conc. H_2SO_4, HNO_3; i. dil. HCl, dil. H_2SO_4
9	....	....	....	hyd. sl.	d. in steam	d. HCl; s. dil. HNO_3, H_2SO_4
10	19.3	3370	5900	i.	i.	s. HF + HNO_3; v. sl. s. HNO_3, H_2SO_4; aq. reg.; i. HF, KOH
11	6.9^{18}	....	....	i.	i.	d. h. HNO_3, h. H_2SO_4
12	17.17	....	....	....	....	....
13	15.73	2920	....	....	....	....
14	12.75	*ca.* 2900	....	i.	i.	s. aq. reg.
15	....	d. 400	....	d.	....	....
16	....	276	333	d.	....	s. alk., abs. al., chl., eth.
17	6.9	....	....	i.	d.	s. NH_4OH
18	15.63	2870 ± 50	6000	i.	....	s. HNO_3 + HF aq. reg.
19	17.15	2860	6000	i.	....	s. HNO_3 + HCl
20	2.65	subl. 50°	175	....	....	d. fum. HNO_3
21	5.436	....	....	d.	....	....
22	4.624	d.	d.	d.	....	....
23	3.875	248	275.6	d. to W_2O_5	....	v. sl. s. CS_2
24	3.52	275	346.7	....	$d.^{60}$	v. s. CS_2, $POCl_3$; s. al., eth., bz.
25	g. 12.9 g/l; lq. 3.44	2.5	19.5	d.	d.	s. alk.
26	6.9	....	....	i.	d.	s. KOH, alk.; i. CS_2, al.
27	5.2^{18}	d.	d.	i.	d.	s. abs. al.; i. eth., chl., turp
28	12.11	....	....	i.	i.	s. a. KOH
29	7.16	1473	....	i.	i.	s. h. alk., HF; i. a.
30	....	277	327	d.	d.	....
31	....	d.	d.	....	....	....
32	....	211	227.5	d.	d.	s. CS_2, S_2Cl_2, bz.
33	....	266	....	s.	d.	s. alk., NH_4OH; i. al.
34	....	110	187.5	d.	....	sl. s. CS_2; i. CCl_4
35	5.21	....	....	....	....	s. fus. Na_2CO_3 + $NaNO_3$; i. a., aq. reg.
36	8.5	....	....	i.	....	s. HNO_3 + HF; i. alk., HCl
37	5.8	d.	....	i.	i.	s. HNO_3 + HF, aq. reg. i. al., eth.
38	7.5^{10}	....	....	i.	....	s. HNO_3 + HF, fus. alk.; i. al.
39	....	....	....	sl. s.	s.	s. alk.
40	5.5	$-\frac{1}{2}H_2O$, 100	....	i.	sl. s.	s. alk., HF, NH_3; i. most a.
41	....	$H_2W_2O_7$ at 100	....	sl. s.	....	s. alk.
42	....	....	....	s.	....	s. alk.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Uranic acid,** meta- (uranyl hydroxide)	H_2UO_4 (or $UO_2(OH)_2$)	304.09	rhomb. or yel. powd
2	**Uranium**	U	238.07	cub. silv. wh. or blk. radioact
3	boride (di-)	UB_2	248.89	hex
4	bromide, tri	UBr_3	477.82	dk.-br. need., hyg
5	“ , tetra-	UBr_4	557.73	br. leaf., deliq
6	carbide	UC_2	262.09	gray cr
7	chloride, tri-	UCl_3	344.44	need. dk. red, hyg
8	“ , tetra-	UCl_4	379.90	cub. oct. dk. grn.-gray, deliq
9	“ , penta-	UCl_5	415.36	dk. grn.-gray need., red by trans. light, deliq.
10	fluoride, tetra-	UF_4	314.07	grn. amor. powd
11	“ , hexa-	UF_6	352.07	monocl. col.-pa. yel., deliq
12	iodide, tetra-	UI_4	745.75	blk. need
13	nitride	U_3N_4	770.24	brn.-blk
14	oxide, di-	UO_2	270.07	rhomb. or cub., br.-blk
15	“ , (tri-), oct-	U_3O_8	842.21	olive-grn. to blk
16	“ , tri- (uranyl oxide)	UO_3	286.07	yel.-red powd
17	“ , per-	$UO_4{\cdot}2H_2O$	338.10	pa.-yel. cr. hyg
18	sulfate (ous)	$U(SO_4)_2{\cdot}4H_2O$	502.27	rhomb. grn
19	“ “	$U(SO_4)_2{\cdot}8H_2O$	574.33	monocl. grn
20	“ “	$U(SO_4)_2{\cdot}9H_2O$	592.35	monocl. grnsh
21	sulfide, sesqui-	U_2S_3	572.34	gray-blk. need
22	“ , di-	US_2	302.20	tetr. gray-blk
23	**Uranyl** acetate	$UO_2(C_2H_3O_2)_2{\cdot}2H_2O$	424.19	rhomb. yel
24	benzoate	$UO_2(C_7H_5O_2)_2$	512.29	yel. powd
25	bromide	UO_2Br_2	429.90	grn.-yel. need. hyg
26	*per*chlorate	$UO_2(ClO_4)_2{\cdot}6H_2O$	545.07	yel. cr. deliq
27	chloride	UO_2Cl_2	340.98	yel., deliq
28	formate	$UO_2(CHO_2)_2{\cdot}H_2O$	378.12	oct. yel
29	iodate	$UO_2(IO_3)_2$	619.91	rhomb. yel
30	“	$UO_2(IO_3)_2{\cdot}H_2O$	637.93	α prismatic, stable; β pyramidal
31	iodide	UO_2I_2	523.91	red, deliq
32	nitrate	$UO_2(NO_3)_2{\cdot}6H_2O$	502.18	rhomb. yel., deliq., β 1.4967
33	oxalate	$UO_2C_2O_4{\cdot}3H_2O$	412.14	yel. cr
34	phosphate, mono-H	$UO_2HPO_4{\cdot}4H_2O$	438.12	tetr. yel. pl
35	sulfate	$UO_2SO_4{\cdot}3H_2O$	420.18	yel.-grn. cr
36	“	$2UO_2SO_4{\cdot}7H_2O$	858.38	yel
37	sulfide	UO_2S	302.14	br.-blk. tetr
38	sulfite	$UO_2SO_3{\cdot}4H_2O$	422.20	pa. grn. cr
39	**Vanadic acid,** tetra-	$H_2V_4O_{11}$	381.40	amor. br
40	“ “ , meta	HVO_3	99.96	yel. sc
41	**Vanadium**	V	50.95	cub. lt. gray met., 3.03
42	boride, di-	VB_2	72.59	hex
43	bromide, tri-	VBr_3	290.79	grn. blk., deliq

INORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	5.926	$-H_2O$, 250–300	....	i.	i.	s. a. alk. carb.; i. alk.
2	18.7	*ca.* 1133	ign.	i.	i.	s. a.; i. alk., al.
3	12.70	2365	....	....	....	....
4	....	....	volat.	s.	....	....
5	$4.84\frac{21}{4}$	....	volat.	s.	s.	s. acet.; i. al., eth.
6	11.28^{18}	2260	4100	d.	d.	s. a.
7	$5.44\frac{25}{4}$	....	....	v. s.	d.	s. HCl, NH_4Cl, acet. a.
8	$4.725\frac{25}{4}$	subl.	618	v. s.	d.	s. al., acet., C_6H_5COOH, ac. a., NH_4Cl; i. eth.
9	....	d. 120	....	d.	....	s. abs. al., ac. a., acet., NH_4Cl; i. eth., bz.
10	....	*ca.* 1000	....	i.	....	s. conc. a., alk.; i. dil. a., alk.
11	$4.68^{20.7}$	$69.2^{2\text{ atm.}}$	$56.2^{764.6}$	s.	....	d. al., eth.; v. s. $C_2H_2Cl_4$; s. CCl_4, chl.; i. CS_2
12	5.6^{15}	500	....	s.	s., d.	....
13	10.09	....	....	d.	....	s. HNO_3; i. conc. HCl, H_2SO_4
14	10.9	2176	....	i.	i.	s. HNO_3, conc. H_2SO_4
15	8.30	d.	....	i.	i.	s. HNO_3, H_2SO_4
16	7.29	d.	....	i.	....	s. min. a.; i. $K_2C_4H_4O_6$
17	....	d. 115	....	$.0006^{20}$	$.008^{90}$	d. HCl
18	....	$-4H_2O$, 300	....	d.	....	s. dil. a.
19	....	d. 90	....	s. d.	....	s. dil. a.; i. al.
20	....	$-7H_2O$, 230	$-9H_2O$, red heat	....	....	s. dil. H_2SO_4
21	....	ign.	....	....	....	+O aq. reg. conc. HNO_3; i. dil. a.
22	....	>1100	oxidizes	sl. d.	....	d. HNO_3; s. conc. HCl
23	2.893^{15}	$-2H_2O$, 110	d. 275	7.694^{15}	d.	v. s. al.
24	....	....	....	sl. s.	....	sl. s. al.
25	....	....	....	s.	....	s. al., eth.; s. H_2O dec.
26	....	90°; d. 110	....	....	....	....
27	....	<red ht.	d.	320^{18}	v. s.	s. al., eth., amyl. al.
28	3.695^{19}	$-H_2O$, 110	....	420^{15}	....	sl. s. form. a.
29	5.2	d. 250	....	....	....	i. HNO_3
30	$\alpha 5.220^{18}$; β 5.052^{18}	....	....	α $.1049^{18}$; β $.1214^{18}$	....	sl. s. dil. HNO_3
31	....	d. in air	....	....	....	s. al., eth., bz.
32	2.807^{13}	60.2 d. 100	....	170.3^{0}	∞^{60}	v. s. al., eth., ac. a., acet., meth. al.
33	....	$-H_2O$, 110	....	0.8^{14}	3.3^{100}	s. min. a., alk. oxal.
34	....	....	....	i.	i.	s. aq. Na_2CO_3, HNO_3; i. ac. a.
35	$3.28^{16.5}$	d. 100	....	$20.5^{15.5}$	22.2^{100}	4 al.; s. H_2SO_4
36	....	anh. 300	....	v. s.	v. s.	s. H_2SO_4
37	....	d. 40–50	....	sl. s.	....	s. dil. a., al., $(NH_4)_2CO_3$; i. abs. al.
38	....	....	....	i.	....	s. H_2SO_3
39	....	....	....	i.	....	s. a., alk., NH_4OH
40	....	....	....	i.	....	s. a., alk.; i. NH_3
41	5.96	1710	3000	i.	i.	s. HNO_3, H_2SO_4, HF, aq. reg.; i. HCl, alk.
42	5.10	....	....	....	....	....
43	....	d.	....	s.	....	s. al., eth.; i. HBr

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Vanadium			
1	carbide	VC	62.96	cub. blk
2	chloride, di-	VCl_2	121.86	hex. grn., deliq
3	" , tri-	VCl_3	157.32	pink, deliq. cr
4	" , tetra	VCl_4	192.78	red-br., liq
5	fluoride, tri-	VF_3	107.95	rhomb. grn
6	" "	$VF_3 \cdot 3H_2O$	162.00	rhomb
7	" , tetra-	VF_4	126.95	br.-yel
8	" , penta-	VF_5	145.95	
9	iodide	$VI_3 \cdot 6H_2O$	539.81	grn. cr., deliq
10	nitride	VN	64.96	cub. blk
11	oxide, mono- (or di)	VO (or V_2O_2)	66.95	lt.-gray cr
12	" , sesqui- (or tri-)	V_2O_3	149.90	blk. cr
13	" , di- (or tetr-)	VO_2 (or V_2O_4)	82.95	bl. cr
14	" , pent-	V_2O_5	181.90	rhomb. yel.-red
15	oxybromide	$VOBr$	146.87	oct., vlt
16	oxy*di*bromide	$VOBr_2$	226.78	br., deliq., powd
17	oxy*tri*bromide	$VOBr_3$	306.70	red liq
18	oxychloride	$VOCl$	102.41	yel.-brn. powd
19	oxy*di*chloride	$VOCl_2$	137.86	grn., deliq
20	oxy*tri*chloride	$VOCl_3$	173.32	yel. liq., deliq
21	oxy*di*fluoride	VOF_2	104.95	yel. solid
22	oxy*tri*fluoride	VOF_3	123.95	yel.-wh., hyg
23	(di-) silicide	V_2Si	129.96	silv. wh. pr
24	silicide, di-	VSi_2	107.07	met. pr
25	sulfate (hypovanadous)	$VSO_4 \cdot 7H_2O$	273.13	monocl. vlt
26	sulfide, mono- (or di-)	VS (or V_2S_2)	83.02	blk., pl. (exist. quest.)
27	" , sesqui- (or tri-)	V_2S_3	198.10	grn.-blk. pl. or powd
28	" , penta-	V_2S_5	262.23	blk.-grn. powd
29	**Vanadyl** sulfate	$VOSO_4$	163.02	bl.
30	**Water**	H_2O	18.016	col. liq. or hex. col. cr., lq. 1.333, sld 1.309, 1.313
31	**Water,** heavy or **Deuterium** oxide	D_2O	20.029	col. liq., 1.32844^{20}
32	**Wolfram**	see Tungsten		
33	**Xenon**	Xe	131.30	col. inert. gas
34	**Ytterbium**	Yb	173.04	
35	acetate	$Yb(C_2H_3O_2)_3 \cdot 4H_2O$	422.24	hex. pl
36	chloride	$YbCl_3 \cdot 6H_2O$	387.51	rhomb. grn., deliq
37	oxalate	$Yb_2(C_2O_4)_3 \cdot 10H_2O$	790.30	col. cr
38	oxide (ytterbia)	Yb_2O_3	394.08	col
39	selenate	$Yb_2(SeO_4)_3 \cdot 8H_2O$	919.09	hex. pl
40	selenite	$Yb_2(SeO_3)_3$	726.96	
41	sulfate	$Yb_2(SO_4)_3$	634.28	col
42	"	$Yb_2(SO_4)_3 \cdot 8H_2O$	778.41	prisms
43	**Yttrium**	Y	88.92	hex. gray-blk. met
44	acetate	$Y(C_2H_3O_2)_3 \cdot 4H_2O$	338.12	col. tricl
45	bromate	$Y(BrO_3)_3 \cdot 9H_2O$	634.81	hex. pr
46	bromide	YBr_3	328.67	deliq
47	bromide	$YBr_3 \cdot 9H_2O$	490.81	col. tabl., deliq
48	carbide	YC_2	112.94	micro-cr. yel

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	5.77	2810	3900	i.	......	s. HNO_3, fus. KNO_3; i. HCl, H_2SO_4
2	3.23^{18}	......	......	s. d.	s. d.	s. al., eth.
3	3.00^{18}	d.	......	s. d.	s. d.	s. abs. al., eth.
4	1.816^{30}	-28 ± 2	148.5^{755}	s. d.	......	s. abs. al., eth., chl., ac. a.
5	3.363^{19}	>800	subl.	i.	......	i. al., chl., CS_2
6	......	$-3H_2O$, 130	......	s.	v. s. d.	i. abs. al.
7	2.975^{23}	d. 325	......	s.	......	s. acet.; sl. s. al., chl.
8	2.177^{19}	......	111.2	s.	......	s. al., chl.; i. CS_2
9	......	......	......	......	......	s. al.
10	6.13	2050 (?)	......	i.	......	sl. s. aq. reg.
11	5.758^{14}	ign.	......	i.	i.	s. a.
12	4.87^{18}	1970	......	sl. s.	s.	s. HNO_3, HF, alk.
13	4.339	1967	......	i.	i.	s. a., alk.
14	3.357^{18}	690	d. 1750	0.8^{20}	......	s. a., alk.; i. abs. al.
15	4.00^{18}	d. 480	......	v. sl. s.	......	s. acet. anhyd., eth. ac., acet.
16	......	d. 180	......	s.	......	......
17	$2.933^{14.5}$	d. 180	130^{100}	s.	......	......
18	2.824; 3.64^{20}	......	127	i.	......	v. s. HNO_3
19	2.88^{13}	......	......	d.	......	s. dil. HNO_3
20	1.829	-77 ± 2	126.7	s. d.	......	s. al., eth., ac. a.
21	3.396^{19}	d.	......	......	......	sl. s. acet.
22	2.459^{19}	300	480	......	......	......
23	5.48^{17}	......	......	i.	i.	s. HF; i. a., al., eth.
24	4.42	......	......	i.	i.	s. HF; i. a. al., eth.
25	......	d. in air	......	......	......	......
26	4.20	d.	......	......	......	s. h. H_2SO_4, HNO_3; sl. s. KSH; i. alk., HCl
27	4.7^{21}	d.	......	i.	......	s. alk. sulf.; sl. s. alk., HCl, HNO_3, H_2SO_4
28	3.00	d.	......	i.	......	s. dil. HNO_3, alk. sulf., alk.
29	......	......	......	v. s.	......	......
30	lq. 1.000^4_4; sld. $.9168^0$	0.000	100.000	......	......	∞ al.
31	$1.105\frac{20}{4}$	3.82	101.42	∞	∞	∞ al.; sl. s. eth.
32	......	......	......	......	......	......
33	5.851 g/l; lq. 3.52^{-109}; s. 2.7^{-140}	−112	−107.1	24.1^0 cm^3; 11.9^{25} cm^3	8.4^{50} cm^3; 7.12^{80} cm^3	......
34	......	1800	......	d. ev. H_2	......	......
35	2.09	$-4H_2O$, 100	......	v. s.	v. s.	......
36	2.575	150-5	$-6H_2O$, 180	v. s.	v. s.	s. abs. al.
37	2.644	......	......	$.00033^{25}$	......	sl. s. dil. a.
38	9.17	......	......	i.	i.	s. h. dil. a.
39	3.30	......	......	s. d.	s.	......
40	......	......	......	i.	......	......
41	3.793	d. 900	......	44.2^0	4.7^{100}	......
42	3.286	......	......	35.9^{20}	21.1^{40}	......
43	5.51	1490	2500	sl. d.	d.	v. s. dil. a., h. KOH
44	......	......	......	9.03^{25}	......	......
45	......	74	$-6H_2O$, 100	168^{25}	......	sl. s. al.; i. eth.
46	......	......	......	v. s.	......	s. al.; i. eth.
47	......	......	......	v. s.	......	sl. s. al.; i. eth.
48	4.13^{18}	......	......	d.	......	......

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Yttrium			
1	carbonate	$Y_2(CO_3)_3 \cdot 3H_2O$	411.92	wh.-redsh. powd
2	chloride	YCl_3	195.29	shin. wh. leaf
3	"	$YCl_3 \cdot H_2O$	213.31	col
4	"	$YCl_3 \cdot 6H_2O$	303.39	rhomb. redsh.-wh., deliq
5	fluoride	$YF_3 \cdot \frac{1}{2}H_2O$	154.93	gelat
6	hydroxide	$Y(OH)_3$	139.94	wh.-yel., gelat. or powd
7	iodide	YI_3	469.68	deliq
8	molybdate	$Y_2(MoO_4)_3 \cdot 4H_2O$	729.75	grayish or yelsh. tetr. pl. 2.03
9	nitrate	$Y(NO)_3 \cdot 4H_2O$	347.01	redsh. wh. pr.
10	"	$Y(NO_3)_3 \cdot 6H_2O$	383.04	redsh.-col., deliq. cr
11	oxalate	$Y_2(C_2O_4)_3 \cdot 9H_2O$	604.04	wh. cr. powd
12	oxide (yttria)	Y_2O_3	225.84	col.-yelsh. cr. or powd
13	sulfate	$Y_2(SO_4)_3$	466.04	wh. powd
14	"	$Y_2(SO_4)_3 \cdot 8H_2O$	610.17	monocl. col.-redsh., 1.543, 1.549, 1.576
15	sulfide	Y_2S_3	274.04	yel.-gray powd
	Yttrium complexes:			
16	Hexaantipyrineyttrium *per*chlorate	$[Y(C_{11}H_{12}N_2O)_6](ClO_4)_3$	1516.63	col. hex. cr
17	Hexaantipyrineyttrium iodide	$[Y(C_{11}H_{12}N_2O)_6]I_3$	1599.02	col. cr
18	**Zinc**	Zn	65.38	hex. bluish-wh. met
19	acetate	$Zn(C_2H_3O_2)_2$	183.47	monocl
20	"	$Zn(C_2H_3O_2)_2 \cdot 2H_2O$	219.50	monocl. col. β 1.494
21	aluminate (gahnite)	$ZnAl_2O_4$	183.32	1.78
22	amide	$Zn(NH_2)_2$	97.43	amor., wh. powd
23	*ortho*arsenate (köttigite)	$Zn_3(AsO_4)_2 \cdot 8H_2O$	618.09	monocl. 1.662, 1.683, 1.717
24	arsenide	Zn_3As_2	345.96	cub
25	benzoate	$Zn(C_7H_5O_2)_2$	307.60	wh. powd
26	borate	$3ZnO \cdot 2B_2O_3$	383.42	wh. amor. powd., or tricl. cr
27	bromate	$Zn(BrO_3)_2 \cdot 6H_2O$	429.31	cub. wh
28	bromide	$ZnBr_2$	225.21	rhomb. col., hyg
29	butyrate	$Zn(C_4H_7O_2)_2 \cdot 2H_2O$	275.60	wh. pr
30	caproate	$Zn(C_6H_{11}O_2)_2$	295.68	wh. need
31	carbonate (smithsonite)	$ZnCO_3$	125.39	trig. col., 1.818, 1.618
32	chlorate	$Zn(ClO_3)_2 \cdot 4H_2O$	304.36	cub. col.-yelsh., deliq
33	chloride	$ZnCl_2$	136.29	cubic wh., deliq
34	chromate	$ZnCrO_4$	181.39	lem. yel., pr
35	*di*chromate	$ZnCr_2O_7 \cdot 3H_2O$	335.45	or.-yel. powd., or redsh. br. cr., hyg.
36	citrate	$Zn_3(C_6H_5O_7)_2 \cdot 2H_2O$	610.37	wh. amor. powd
37	cyanide	$Zn(CN)_2$	117.42	rhomb. col
38	ferrate (III) (ferrite)	$ZnFe_2O_4$	241.08	oct. blk
39	ferrocyanide	$Zn_2Fe(CN)_6$	342.72	wh. powd
40	"	$Zn_2Fe(CN)_6 \cdot 3H_2O$	396.77	wh. powd
41	fluogallate	$[Zn(H_2O)_6][GaF_55H_2O]$	356.21	orthorh., col. cr., n. 1.45
42	fluoride	ZnF_2	103.38	col., monocl. or tricl
43	"	$ZnF_2 \cdot 4H_2O$	175.44	rhomb
44	fluosilicate	$ZnSiF_6 \cdot 6H_2O$	315.54	hex. pr., col
45	formaldehydesulfoxylate	$Zn(HSO_2 \cdot CH_2O)_2$	255.58	rhomb. pr
46	" , basic	$Zn(OH)HSO_2 \cdot CH_2O$	177.49	rhomb. pr
47	formate	$Zn(CHO_2)_2$	155.42	

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	......	......	i.	......	sl. s. aq. CO_2; s. $(NH_4)_2CO_3$, dil. min. a.; i. al., eth.
2	2.8^{18}	680	......	78^{10}	82^{50}	60.1^{15} al., 60.6^{15} pyr.
3	......	$-H_2O$, 160	......	v. s.	......	......
4	2.18^{18}	$-5H_2O$, 100	......	217^{20}	233^{50}	s. al.; i. eth.
5	......	......	......	i.	......	v. sl. s. dil. a.
6	......	d.	......	i.	i.	s. a., NH_4Cl; i. alk.
7	......	......	......	v. s.	......	s. al.; sl. s. eth.
8	$4.79\frac{16}{16}$	1347	......	......	......	......
9	2.682	......	......	s.	......	s. al., HNO_3
10	2.68	$-3H_2O$, 100	......	$134.7^{22.5}$	......	v. s. al., eth., HNO_3
11	......	d.	......	0.0001	......	sl. s. HCl
12	4.84; 5.046	2410	......	$.0018^{29}$	......	s. a.; i. alk.
13	2.52	d. 1000	......	5.38^{25}	s.	s. satd. aq. K_2SO_4
14	2.558	$-8H_2O$, 120	d. 700	9.763^{20}	4.90^{40}	s. conc. H_2SO_4; i. al., alk.
15	......	......	......	d.	......	d. a.
16	......	293–6 d.	......	0.55^{20}	......	......
17	......	280–2	......	4.65^{20}	......	......
18	7.14	419.47	907	i.	i.	s. a., alk., ac. a.
19	1.84	242	subl. vac.	30^{20}	44.6^{100}	2.8^{25}, 166^{79} al.
20	1.735	237	$-2H_2O$, 100	31.1^{20}	66.6^{100}	2 al.
21	4.58	......	......	i.	i.	sl. s. alk.; i. a.
22	2.13^{25}	d. 200	......	d.	d.	i. eth., al.
23	3.309^{15}	d. 100	......	i.	i.	s. HNO_3, H_3AsO_4, alk.
24	......	1015	......	i.	......	......
25	......	......	......	$2.61^{15.9}$; 2.46^{20}	1.44^{60}	......
26	amor. 3.64; cr. 4.22	980	......	s.	......	amor. s. HCl; cr. i. HCl
27	2.566	100	$-6H_2O$, 200	100	v. s.	......
28	4.219^{4}	394	650	447^{20}; 471^{25}	675^{100}	v. s. al., eth., NH_4OH
29	......	......	......	10.7^{16}	d.	......
30	......	......	......	$1.03^{24.5}$	......	......
31	4.44	$-CO_2$, 300	......	0.001^{15}	......	s. a., alk., NH_4 salts; i. NH_3, acet., pyr.
32	2.15	d. 60	d.	262^{20}	v. s.	167 al.; s. glyc., eth.
33	2.91^{25}	262	732	432^{25}	615^{100}	$100^{12.5}$ al.; v. s. eth.; i. NH_3
34	......	......	......	i.	d.	s. a.; i. acet., liq. NH_3
35	......	......	......	v. s.	d.	s. a.; i. al., eth.
36	......	......	......	sl. s.	......	......
37	......	d. 800	......	0.0005^{20}	......	s. alk., KCN, NH_3; i. al.
38	5.33^{20}	1590	......	......	......	s. conc. HCl; i. alk., dil. a.
39	......	......	......	i.	......	s. excess alk.; i. dil. a.
40	......	d.	......	i.	i.	d. NaOH; s. NH_4OH; v. sl. s. NH_3; i. HCl, al.
41	2.33	$-5H_2O$, 110	......	v. s.	......	......
42	4.84^{15}	872	......	sl. s.	s.	s. h. a., NH_4OH; i. al., NH_3
43	2.535^{12}	$-4H_2O$, 100	......	1.6^{18}	s.	s. NH_4OH, a., alk.
44	2.104	......	......	v. s.	......	......
45	......	d.	......	v. s.	v. s.	d. a.; trans. by alk.; i. al.
46	......	d.	......	i.	i.	d. a.; trans. by alk.; i. al.
47	2.36	......	d.	......	......	......

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Zinc			
1	formate	$Zn(CHO_2)_2{\cdot}2H_2O$	191.45	monocl. wh., 1.513, 1.526, 1.566
2	gallate	$ZnGa_2O_4$	268.82	fine wh. cr., 1.74
3	glycerophosphate	$ZnC_3H_7O_6P$	235.45	wh. amor. powd
4	hydroxide (ε)	$Zn(OH)_2$	99.40	rhomb. col
5	iodate	$Zn(IO_3)_2$	415.22	wh. cr. powd
6	"	$Zn(IO_3)_2{\cdot}2H_2O$	451.25	
7	iodide	ZnI_2	319.22	cub. col. or wh. powd., deliq
8	*dl*-lactate	$Zn(C_3H_5O_3)_2{\cdot}3H_2O$	297.57	wh. rhomb. cr
9	*d*-lactate	$Zn(C_3H_5O_3)_2{\cdot}2H_2O$	279.55	wh. need
10	laurate	$Zn(C_{12}H_{23}O_2)_2$	463.99	wh. powd
11	*per*manganate	$Zn(MnO_4)_2{\cdot}6H_2O$	411.34	vlt. br. or blk., deliq
12	nitrate	$Zn(NO_3)_2{\cdot}3H_2O$	243.44	need
13	"	$Zn(NO_3)_2{\cdot}6H_2O$	297.49	tetr. col
14	nitride	Zn_3N_2	224.16	gray
15	oleate	$Zn(C_{18}H_{33}O_2)_2$	628.27	wax-like solid
16	oxalate	$ZnC_2O_4{\cdot}2H_2O$	189.43	wh. powd
17	oxide	ZnO	81.38	wh. or yelsh., amor. powd
18	" (zincite)	ZnO	81.38	hex. wh., 2.008, 2.029
19	" , per- com'l	$ZnO_2 + ZnO$	178.76	wh.-yel. powd
20	2,4-pentanedione deriv. (acetylacetonate)	$Zn(C_5H_7O_2)_2$	263.59	need
21	1-phenol-4-sulfonate (*p*-,	$Zn(C_6H_5SO_4)_2{\cdot}8H_2O$	555.84	clear, col. cr. or fine wh. powd., effl
22	*ortho* phosphate	$Zn_3(PO_4)_2$	386.10	rhomb. col
23	" (α-hopeite)	$Zn_3(PO_4)_2{\cdot}4H_2O$	458.16	rhomb. col., 1.572, 1.591, 1.59
24	*ortho*phosphate (β-hopeite)	$Zn_3(PO_4)_2{\cdot}4H_2O$	458.16	rhomb. col., 1.574, 1.582, 1.582
25	*ortho*phosphate (parahopeite)	$Zn_3(PO_4)_2{\cdot}4H_2O$	458.16	tricl. col., 1.614, 1.625, 1.665
26	*ortho*phosphate	$Zn_3(PO_4)_2{\cdot}8H_2O$	530.23	rhomb. pl
27	" , di-H	$Zn(H_2PO_4)_2{\cdot}2H_2O$	295.40	tricl
28	*pyro*phosphate	$Zn_2P_2O_7$	304.72	wh. powd
29	phosphide	Zn_3P_2	258.10	cub. dk. gray
30	*hypo*phosphite	$Zn(H_2PO_2)_2{\cdot}H_2O$	213.39	col. hyg. cr. powd
31	picrate	$Zn(C_6H_2N_3O_7)_2{\cdot}8H_2O$	665.71	yel. cr. powd., exp
32	salicylate	$Zn(C_7H_5O_3)_2{\cdot}3H_2O$	393.65	need
33	selenate	$ZnSeO_4{\cdot}5H_2O$	298.42	tricl
34	selenide	$ZnSe$	144.34	cub. 2.89
35	*ortho*silicate (willemite)	Zn_2SiO_4 (or $2ZnO{\cdot}SiO_2$)	222.82	trig., 1.694, 1.723
36	silicate (hemimorphite)	$Zn_4Si_2O_7(OH)_2{\cdot}H_2O$ (or $4ZnO{\cdot}2SiO_2{\cdot}2H_2O$	417.68	rhomb., 1.614, 1.617, 1.636
37	*meta*silicate	$ZnSiO_3$	141.44	hex. col
38	stearate	$Zn(C_{18}H_{35}O_2)_2$	632.30	light powd
39	sulfate (zinkosite)	$ZnSO_4$	161.44	rhomb. col., 1.658, 1.669, 1.670
40	"	$ZnSO_4{\cdot}6H_2O$	269.54	monocl. or tetr. col
41	" (goslarite)	$ZnSO_4{\cdot}7H_2O$	287.56	rhomb. col. effl. 1.457, 1.480, 1.484
42	sulfide (α) (wurtzite)	ZnS	97.45	hex. col., 2.356, 2.378
43	" (β-) (sphalerite)	ZnS	97.45	cub. col., 2.368
44	"	$ZnS{\cdot}H_2O$	115.46	yelsh.-wh. powd
45	sulfite	$ZnSO_3{\cdot}2(\text{or }2\tfrac{1}{2})H_2O$	181.48	wh. cr. powd

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.207^{20}	...	d.	5.2^{20}	38^{100}	i. al.
2	6.15 calc.	<800	...	...	...	...
3	...	...	...	s.	...	i. al., eth.
4	3.053	d. 125	...	$.00000026^{18}$	...	s. a., alk.
5	4.98	d.	...	sl. s.	...	s. HNO_3, alk.
6	...	...	...	0.877	1.32	s. HNO_3, NH_4OH
7	$4.666^{14.2}$	446	624	430^0; 437.7^{30}	510^{100}	s. a., al., eth., NH_3 $(NH_4)_2CO_3$
8	...	...	...	1.67^{15}	16.7^{100}	v. sl. s. al.
9	...	...	...	5.7^{15}	9^{33}	.104 h. 98 % al.
10	...	128	...	0.01^{15}	0.019^{100}	0.010^{15} al.
11	2.47	$-5H_2O$, 100	...	v. s.	v. s.	d. al., a.
12	...	45.5	...	327.3^{40}	...	...
13	2.065^{14}	36.4	$-6H_2O$, 105–131	184.3^{20}	∞	v. s. al.
14	...	...	...	d.	...	s. HCl
15	...	70	...	i.	...	sl. s. acet.
16	$2.562^{24.5}$	s. 100	...	$.0007^{918}$	...	s. a., alk.
17	5.47	>1800	...	$.00016^{29}$	...	s. min. a., dil. ac. a., NH_4OH
18	5.606	>1800	subl. 1800	$.00016^{29}$	...	s. a., alk., NH_4Cl; i. NH_3, al.
19	1.571	...	...	0.0022	...	d. a.
20	...	138	subl.	...	v. s. d.	v. s. bz., acet.; s. al.
21	...	$-8H_2O$, 125	...	62.5	250^{100}	55.6^{25} al.
22	3.998^{15}	900	...	i.	i.	s. a., NH_4OH; i. al.
23	3.04	tr. >105	...	i.	i.	v. s. a., NH_4OH, NH_4 salts
24	3.03	tr. >140	...	i.	i.	v. s. a., NH_4OH, NH_4 salts
25	3.75	tr. >163	...	i.	i.	v. s. a., NH_4OH, NH_4 salts
26	3.109^{15}	...	...	i.	...	s. alk.
27	...	100 d.	...	d.	...	...
28	3.75^{23}	...	...	i.	i.	s. a., alk., NH_4OH
29	4.55^{13}	>420	1100	i.	...	d. H_2SO_4 ev. H_3P, HNO_3 viol. s. dil. a.; i. al.
30	...	...	...	s.	...	s. alk.
31	...	exp.	...	s.	...	...
32	...	...	...	5^{20}	...	s. al.
33	2.591	d.>50	...	s.	...	...
34	5.42^{15}	...	...	i.	...	s. a.
35	3.9	1509	...	...	i.	...
36	3.45	...	...	i.	i.	...
37	3.52	1437	...	i.	...	...
38	...	130	...	i.	...	i. al., eth.
39	3.74^{15}; (3.4)	d. 740	...	86.5^{80}	80.8^{100}	sl. s. al.
40	2.072^{15}	tr. 70	...	s.	117.5^{40}	...
41	1.97	tr. 39	$-7H_2O$, 280	96.5^{20}	663.6^{100}	sl. s. al.
42	4.087	$1850^{150 \text{ atm.}}$	subl. 1185	$.0006^{918}$	...	v. s. a.; i. ac. a.
43	4.102^{25}	tr. 1020	...	$.00065^{18}$	...	v. s. a.
44	3.98	1049	...	i.	...	s. a.
45	...	...	...	0.16	d.	s. H_2SO_3; i. al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Zinc			
1	tartrate	$ZnC_4H_4O_6 \cdot H_2O$ (or $2H_2O$)	231.47	wh. powd
2	tellurate	Zn_3TeO_6	419.75	heavy granular ppt. wh
3	telluride	$ZnTe$	192.99	cub. red. 3.56
4	thiocyanate	$Zn(SCN)_2$	181.55	wh. powd
5	valerate	$Zn(C_5H_9O_2)_2 \cdot 2H_2O$	303.66	wh. glist. sc. or powd., disag. odor
	Zinc complexes:			
6	Diamminezinc chloride	$[Zn(NH_3)_2]Cl_2$	170.36	col
7	Tetramminezinc perrhenate	$[Zn(NH_3)_4](ReO_4)_2$	634.13	wh. cub. cr
8	Tetrapyridinezinc fluosilicate	$[Zn(C_5H_5N_4)]SiF_6$	523.83	rhomb. wh
9	**Zirconium**	Zr	91.22	cub. silv. wh.-gray
10	boride, di-	ZrB_2	112.86	hex
11	bromide, di-	$ZrBr_2$	251.05	blk. powd. ign. in air
12	" , tri-	$ZrBr_3$	330.97	bl.-blk. powd
13	" , tetra-	$ZrBr_4$	410.88	wh. cr. powd., hyg
14	carbide	ZrC	103.23	cub. gray met
15	chloride, di-	$ZrCl_2$	162.13	blk
16	" , tri-	$ZrCl_3$	197.59	brn
17	" , tetra-	$ZrCl_4$	233.05	wh. lust. cr
18	fluoride	ZrF_4	167.29	hex. col
19	iodide	ZrI_4	598.90	wh. or yel. cr
20	nitride	ZrN	105.23	cub. br.-bronze
21	oxide, di- (baddeleyite)	ZrO_2	123.22	col.-yel. or br., monocl., 2.13, 2.19, 2.20
22	" " (zirconia) ($HfO_2 < 2\%$)	ZrO_2	123.22	monocl. below 1000°C cub. above col.
23	oxide (zirconium hydroxide, zirconic acid)	$ZrO_2 \cdot xH_2O$	....	gelat. or wh. amor. powd
24	phosphide	ZrP_2	153.18	gray
25	selenate	$Zr(SeO_4)_2 \cdot 4H_2O$	449.20	hex. transp. cr
26	*ortho*silicate (zircon, hyacinth)	$ZrSiO_4$	183.28	tetr. col.-red or var. color, 1.92–96, 1.97–2.02
27	silicide	$ZrSi_2$	147.34	steel-gray rhomb. lust. met
28	sulfate	$Zr(SO_4)_2 \cdot 4H_2O$	355.42	rhomb. col. or wh. cr. powd
29	sulfide	ZrS_2	155.35	steel-gray cr
30	**Zirconyl** bromide	$ZrOBr_2 \cdot xH_2O$	....	brill. need., deliq
31	chloride	$ZrOCl_2 \cdot 8H_2O$	322.26	tetr. need. wh., effl., 1.552, 1.563
32	iodide	$ZrOI_2 \cdot 8H_2O$	505.19	col. need., hyg
33	sulfide	$ZrOS$	139.29	yel. powd

	Silicon monoxide	SiO	44.09	
	oxyhydride	$(SiHO_{\frac{3}{2}})x$	....	amorph. white
	sesquioxide	$(Si_2O_3)x$	....	amorph. tan

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	....	....	0.055^{30}	....	....
2	....	....	....	i.	i.	s. a.
3	6.34^{15}; 5.54^{18}	1238.5	....	i.	i.	s. a.
4	....	....	....	s.	....	s. al., NH_4OH
5	....	....	....	2.6^{24-25}	s.	*ca.* 2.5 al.; v. sl. s. eth.
6	....	210.8	d. 271	d.	....	....
7	$3.608\frac{25}{4}$	....	....	....	....	0.1852 conc. NH_4OH
8	2.197	....	....	....	....	....
9	6.4	1857	>2900	i.	i.	s. HF, aq. reg.; sl. s. a.
10	6.085	*ca.* 3000	....	....	....	....
11	....	d.>350	....	d. ev. H_2	....	....
12	....	d. 350	....	d. ev. H_2	....	....
13	....	volat.	....	d.	....	s. al., eth.
14	6.73	3540	5100	i.	....	s. a., dil. HF
15	....	d.>350	....	d. ev. H_2	....	....
16	....	d. 350—$ZrCl_2$	....	d. ev. H_2	....	....
17	2.80	subl. 300	....	d. to $ZrOCl_2$	....	s. al., eth., conc. HCl
18	4.43	subl.	d.	1.39	d.	s. HF; i. a.
19	....	....	....	s. d.	s.	d. al.; s. a., eth.; sl. s. bz., CS_2
20	7.09	2980	....	i.	i.	sl. s. aq. reg., $HNO_3 + HF$
21	5.49	2700	(4300)	i.	i.	s. H_2SO_4, HF
22	5.6	2715	....	i.	i.	s. H_2SO_4, HF
23	3.25	$-2H_2O$, 550	....	0.02	....	s. a.; i. alk., al.
24	$4.77\frac{25}{4}$	....	....	i.	....	....
25	....	$-3H_2O$, 100	$-4H_2O$, 130	s.	....	sl. s. al., conc. a.
26	4.56	2550	....	i.	....	i. a., aq. reg., alk.
27	4.88^{22}	....	....	....	....	....
28	....	$-3H_2O$, 120	....	$146^{39.5}$	....	s. H_2SO_4; i. al.
29	3.87	....	....	....	....	....
30	....	$-H_2O$, 120	....	s.	....	s. h. conc. HBr
31	....	$-6H_2O$, 150	$-8H_2O$, 210	s.	d.	s. al., eth.; sl. s. HCl
32	....	d.	....	v. s.	v. s.	v. s. eth.; s. al.
33	4.87	ign. in air	....	....	....	....
	2.2	<1702	1880	none	none	s. alk. and HF
	1.6	350 d.	....	i.	i.	s. with d. in alk. and HF
	....	1635	....	i.	i.	s. with d. in alk. and HF

PHYSICAL CONSTANTS OF

Metallic salts of organic acids will be

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Aluminum:			
1	Diethylaluminum malonate	$Al(C_7H_{11}O_4)_3$	504.45	wh. need. or pr
2	Triethylaluminum	$Al(C_2H_5)_3$	114.15	col. liq., ign. in air, $1.480^{6.5}$
3	Triethylaluminum etherate	$4Al(C_2H_5)_3 \cdot 3(C_2H_5)_2O$	678.97	col. liq
4	Trimethylaluminum	$Al(CH_3)_3$	72.07	col. liq., ign. in air, 1.432^{12}
5	Triphenylaluminum	$Al(C_6H_5)_3$	258.27	wh. need
	Antimony:			
6	Antimony ethoxide(ous) (triethyl antimonite)	$Sb(C_2H_5O)_3$	256.94	col. liq
7	Pentamethylantimony	$Sb(CH_3)_5$	196.93	existence doubtful
8	Triethylantimony	$Sb(C_2H_5)_3$	208.94	liq
9	Trimethylantimony	$Sb(CH_3)_3$	166.86	liq
10	Triphenylantimony, (triphenylstibine)	$Sb(C_6H_5)_3$	353.06	col. tricl. pl
	Arsenic:			
11	Arsanilic acid (*p*) (*p*-aminophenylarsinic acid)	$H_2NC_6H_4AsO(OH)_2$	217.04	wh. need
12	Arsenoacetic acid	$(AsCH_2COOH)_2$	267.91	sm. yel. need
13	Arsenobenzene	$C_6H_5As{:}AsC_6H_5$	304.02	wh. need
14	Cacodyl oxide (dicacodyl oxide)	$[(CH_3)_2As]_2O$	225.96	col. liq
15	Cacodyl sulfide (dicacodyl sulfide)	$[(CH_3)_2As]_2S$	242.02	oil
16	Dimethylarsine (cacodyl hydride)	$(CH_3)_2AsH$	105.99	col. liq., ign. in air
17	Dimethylarsinic acid (cacodylic acid)	$As(CH_3)_2O \cdot OH$	137.99	odorl., col. pr
18	Dimethylbromarsine (cacodyl bromide)	$(CH_3)_2AsBr$	184.89	yel. oil
19	Dimethylchlorarsine (cacodyl chloride)	$(CH_3)_2AsCl$	140.44	col. liq., infl
20	Methylarsine	CH_3AsH_2	91.96	col. liq
21	Phenylarsonic acid (benzene arsonic acid)	$C_6H_5AsO_3H_2$	202.03	col. pr
22	Tetraethyldiarsine (ethyl cacodyl)	$[(C_2H_5)_2As]_2$	266.06	oil
23	Tetraethyldiarsyl	$[As(C_2H_5)_2]_2$	266.06	liq
24	Tetramethyldiarsyl	$[As(CH_3)_2]_2$	209.96	col.-yel. oily liq., highly poisonous
25	Triethylarsine (arsenic triethyl)	$As(C_2H_5)_3$	162.09	col. liq
26	Trimethylarsine (arsenic trimethyl)	$As(CH_3)_3$	120.01	col. liq
27	Triphenylarsine (arsenic triphenyl)	$As(C_6H_5)_3$	306.21	wh. need. or rhomb. pl., 1.6139^{43}
	Beryllium:			
28	Di-*n*-butylberyllium	$Be(C_4H_9)_2$	123.25	col. liq
29	Diethylberyllium	$Be(C_2H_5)_2$	67.14	col. liq
30	Dimethylberyllium	$Be(CH_3)_2$	39.09	wh. need
31	Dipropylberyllium	$Be(C_3H_7)_2$	95.19	liq
	Bismuth:			
32	Methylbismuthine	$CH_3 \cdot BiH_2$	226.05	liq. (exist. quest.)
33	Triethylbismuthine (bismuth triethyl)	$Bi(C_2H_5)_3$	296.18	liq
34	Trimethylbismuthine (bismuth trimethyl)	$Bi(CH_3)_3$	254.10	liq

METAL-ORGANIC COMPOUNDS

found in the preceding section of the table.

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.084^{100}	98	....	i.	....	s. org. solv.
2	....	<−18	194	exp.; d. to Al(OH)$_3$	+C_2H_6	....
3	....	....	112^{16}	exp.	....	d. al; s. bz., eth.
4	....	0	130	d. to Al(OH)$_3$	+CH_4	s. eth.
5	....	196-200	....	d.	....	d. al., chl., CCl_4; s. bz.
6	1.524^{17}	....	95^{11}	d.	....	s. org. liqs.
7	....	96–100	....	i.	i.	....
8	1.324^{16}	<−29	159.5	i.	i.	s. al., eth.
9	1.523^{15}	....	80.6	sl. s.	sl. s.	s. eth.; i. al.
10	1.4343^{25} (1.4998)	50, (46-53)	>220^{1}; >360^{760}	i.	i.	s. org. solv.; sl. s. al.
11	....	232	....	....	....	s. eth., MeOH; sl. s. al., acet.; i. bz., chl.
12	....	>260, d. 205	....	i.	....	s. pyr., alks., alk. carb; i. al., eth., chl.
13	....	212	....	i.	....	s. bz., chl., CS_2; sl. s. al.; i. eth.
14	1.486^{15}	−25	149–51	sl. s.	....	s. al., eth.
15	....	....	211	sl. s.	....	s. al., eth.
16	1.213^{29}	....	35.6^{747}	....	....	s. al., eth., chl., bz., CS_2
17	....	200	....	82.9^{22}	v. s.	s. al.; i. eth.
18	....	....	130	....	....	....
19	>1	<−45	106.5–107, (109)	i.	....	v. s. al.; i. eth.
20	....	....	2	0.00085	....	s. al., eth.
21	1.760	158-62 d.	....	3.36^{28}	31.6^{84}	18.4^{26} 95 % al
22	....	....	185–90	i.	....	s. al., eth.
23	1.+	....	186	i.	....	s. al., eth.
24	1.15	−6	170	sl. s.	....	s. al., eth.
25	1.152	....	140^{736}	i.	....	....
26	1.124	....	70	sl. s.	....	s. eth.
27	1.2225^{48}	60–60.5 (57)	>360 (In CO_2)	i.	....	v. s. eth., bz.; sl. s. cold. al
28	....	....	170^{25}	d.	d.	....
29	....	12	110^{15}	d. to C_2H_6	....	....
30	....	....	subl. 200	d. to CH_4	....	....
31	....	<−17	245	....	....	....
32	2.30^{18}	....	110	i.	i.	s. al., eth.
33	1.82	....	107^{79}	i.	....	s. al., eth.
34	2.300^{18}	....	110	i.	i.	s. al., eth

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Bismuth:			
1	Triphenylbismuthine (bismuth triphenyl)	$Bi(C_6H_5)_3$	440.30	monocl
	Boron:			
2	Aminophenylboric acid (*m*)	$(NH_2C_6H_4)B(OH)_2$	136.95	wh. hex. pl
3	Amylboric acid (*n*)	$(C_5H_{11})B(OH)_2$	115.98	col. fl
4	Anisylboric acids, *o,m,p* (methoxyphenylboric acids)	$CH_3OC_6H_4B(OH)_2$	151.96	wh. cr
5	Borine carbonyl	BH_3CO	41.85	col. unst. gas
6	Butylboric acid (*n*)	$C_4H_9B(OH)_2$	101.95	col. cr
7	Butylboric acid (*tert*)	$C_4H_9B(OH)_2$	101.95	wh. cr
8	Diethoxyboron chloride	$(C_2H_5O)_2BCl$	136.40	col. liq
9	Diisoamyloxyboron chloride	$(C_5H_{11}O)_2BCl$	188.56	col. liq
10	Dimethoxyborine	$(CH_3O)_2BH$	73.90	col. liq., unst
11	Dimethoxyboron chloride	$(CH_3O)_2BCl$	108.35	col. liq
12	Dimethylboric acid (dimethylhydroxyborine)	$(CH_3)_2BOH$	57.90	col. liq
13	Dimethylboric anhydride	$(CH_3)_2BOB(CH_3)_2$	97.78	col
14	Dimethylborine trimethylammine	$(CH_3)_3NBH(CH_3)_2$	101.01	col. liq
15	Dimethylboron bromide	$(CH_3)_2BBr$	120.80	col. liq. or gas
16	Dimethylboron iodide	$(CH_3)_2BI$	167.81	col. liq
17	Dimethyldiborane (1,1) (unsym.)	$B_2H_4(CH_3)_2$	55.74	col. gas
18	Dimethyldiborane (1,2) (sym.)	$B_2H_4(CH_3)_2$	55.74	col. unst. gas
19	Dimethyltriborine triamine (*B*)	$(CH_3)_2B_3N_3H_4$	108.59	col. liq
20	Dimethyltriborine triamine (*N*)	$(CH_3)_2B_3N_3H_4$	108.59	col. liq
21	Dimethyltriborine triamine (*N-B*)	$(CH_3)_2B_3N_3H_4$	108.59	col. liq
22	Diphenylboric acid (diphenylhydroxyborine)	$(C_6H_5)_2BOH$	182.03	col. radiating cr
23	Diphenylboron bromide	$(C_6H_5)_2BBr$	244.93	col. visc. liq. or cr
24	Diphenylboron chloride	$(C_6H_5)_2BCl$	200.48	col. visc. liq
25	Di-*p*-tolylboric anhydride	$(C_7H_7)_2BOB(C_7H_7)_2$	402.15	wh. powd
26	Ethoxyboron dichloride	$C_2H_5OBCl_2$	126.79	col. liq
27	Ethyl boric acid	$(C_2H_5)B(OH)_2$	73.90	wh. cr
28	Furanylboric acid (*β*)	$(C_4H_3O)B(OH)_2$	111.90	wh. cr
29	Hexylboric acid (*n*)	$C_6H_{13}B(OH)_2$	130.00	wh. cr
30	Isobutylboric acid	$C_4H_9B(OH)_2$	101.95	col. cr
31	Methoxyboron dichloride	CH_3OBCl_2	112.77	col. liq
32	Methoxyboron difluoride	CH_3OBF_2	79.85	col. liq
33	Methylboric acid	$CH_3B(OH)_2$	59.87	wh. pl
34	Methylborine trimethylammine	$(CH_3)_3NBH_2CH_3$	86.98	col. liq
35	Methyldiborane	$B_2H_5CH_3$	41.71	col. very unst. gas
36	Methyltriborine triamine (*B*)	$CH_3B_3N_3H_5$	94.56	col. liq

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Cold water	Hot water	Alcohol, acids, etc.
1	1.585	78	....	....	....	v. s. chl.; s. eth., acet.; sl. s. al.
2	....	d.	d.	sl. s.	....	s. al.; sl. s. eth.
3	....	93–4, d.	d.	s.	s.	s. eth., dichloroethane
4	....	d.	d.	sl. s.	....	s. al., eth., bz.
5	....	−137.0	−63	d.	d.	....
6	....	92–4	d.	s.	s.	v. s. al., eth., chl., acet., acet. a. and esters; sl. s. bz., CCl$_4$, pet. eth.
7	....	105 d.	d.	s.	....	s. eth.
8	....	....	112.3	d.	d.	....
9	....	....	110–15^{14}	d.	d.	....
10	....	−130.6	25.9	d.	d.	....
11	....	−87.5	74.7	d.	d.	....
12	....	....	0^{36}	v. s.	....	....
13	....	−37.3	43	hyd.	hyd.	....
14	....	−18.0	d. 172	d.	d.	s. eth.
15	....	−123.4	22	d.	d.	....
16	....	−110.7	65	d.	d.	....
17	....	−150.2	−2.6	d.	d.	....
18	....	−125	4.9	d.	d.	....
19	....	−48	107	hyd.	hyd.	....
20	....	....	108	hyd.	hyd.	....
21	....	....	124	hyd.	hyd.	....
22	....	264–67	215–35^{17}	i.	i.	s. eth., al., pet. eth.
23	....	25	150–60^{8}	d.	d.	s. bz.
24	....	....	271	d.	d.	s. bz., pet. eth.
25	....	78	....	i.	....	s. al., eth., bz.
26	....	....	77.9	d.	d.	....
27	....	subl. 40	....	s.	s.	s. al., eth.
28	....	110 d.	d.	s.	....	v. s. eth., al., acet.; sl. s. bz., tol.
29	....	88–90, d.	d.	sl. s.	....	s. eth.
30	....	106–12, d.	d.	s.	....	s. eth., dichloroethane
31	....	−15	58.0	d.	d.	....
32	1.417$^{35.5}$; 1.354$^{76.5}$	....	86	d.	d.	....
33	....	d.	d.	sl. s.	....	s. al., eth.
34	....	0.8	177	d.	d.	s. eth.
35	....	....	−80^{50}; d. appr. −20	d.	d.	....
36	....	−59	87	hyd.	hyd.	....

No.	Name	Formula	Mol wt.	Crystalline form, color and index of refraction
	Boron:			
1	Methyltriborine triamine (*N*)	$CH_3B_3N_3H_5$	94.56	col. liq
2	Nitrophenylboric acids *o, m, p*	$NO_2C_6H_4B(OH)_2$	166.94	yel. need. or pr
3	Phenylboron dibromide	$C_6H_5BBr_2$	247.75	col. cr
4	Phenylboron dichloride	$C_6H_5BCl_2$	158.83	col. liq
5	Sodium tri-α-naphthyl boride	$Na_2B(C_{10}H_7)_3$	438.28	bl. cr. (purple in dil. soln.)
6	Tetramethoxydiborine	$(CH_3O)_4B_2$	145.78	col. liq
7	Tetramethyldiborane (1,1,2,2)	$B_2H_2(CH_3)_4$	83.79	col. liq
8	Tetramethyltriborine triamine (*N-B-B′B″*)	$(CH_3)_4B_3N_3H_2$	136.64	col. liq
9	Thiophenylboric acid (α) ("thienylboric" acid)	$(C_4H_3S)B(OH)_2$	127.96	col. star-formed need
10	Tribenzylborine	$B(C_6H_5CH_2)_3$	284.20	prismatic need. or col. oily liq
11	Tri-*n*-butylborine	$B(C_4H_9)_3$	182.16	col. mobile liq
12	Tri-*tert*-butylborine	$B(C_4H_9)_3$	182.16	col. mobile liq
13	Tri-*n*-butyltriborine trioxane (*n*-butyl boron oxide)	$(C_4H_9)_3B_3O_3$	251.80	col. liq
14	Tri-*tert*-butyltriborine trioxane (tert-butyl boric oxide)	$(C_4H_9)_3B_3O_3$	251.80	col. liq
15	Trichloroborine dimethyletherate	$(CH_3)_2OBCl_3$	163.26	col. cr
16	Trichloroborine trimethylammine	$(CH_3)_3NBCl_3$	176.30	col. cr
17	Tricyclohexylborine (boron tricyclohexyl)	$B(C_6H_{11})_3$	260.27	col. interlocking cr
18	Triethyl borate (triethoxyborine)	$B(OC_2H_5)_3$	146.00	col. liq., 1.381
19	Triethylboron (triethylborine)	$B(C_2H_5)_3$	98.00	col. liq
20	Tri-*n*-hexyltriborine trioxane (hexylboric oxide)	$(C_6H_{13})_3B_3O_3$	335.96	col. liq., 1.4323^{20}
21	Triisoamyl borate (triisoamyloxyborine)	$B(OC_5H_{11})_3$	272.24	liq., 1.421
22	Triisoamylborine	$B(C_5H_{11})_3$	224.24	col. mobile liq., $1.43207^{22.6}$
23	Tri-*p*-anisylborine	$B(CH_3OC_6H_4)_3$	332.20	wh. need
24	Triisobutyl borate (triisobutoxyborine)	$B(OC_4H_9)_3$	230.16	liq., 1.408
25	Triisobutylborine	$B(C_4H_9)_3$	182.16	col., mobile liq., $1.41882^{22.8}$
26	Trimethylamminoborine	$(CH_3)_3NBH_3$	72.96	col. hex., columns or need
27	Trimethyl borate (trimethoxyborine)	$B(OCH_3)_3$	103.92	col. liq
28	Trimethylboron (trimethylborine)	$B(CH_3)_3$	55.92	col. gas
29	Trimethyldiborane (1,1,2)	$B_2H_3(CH_3)_3$	69.77	col. liq
30	Trimethyltriborine triamine (*B*)	$(CH_3)_3B_3N_3H_3$	122.61	col. cr. or liq
31	Trimethyltriborine triamine (*N*)	$(CH_3)_3B_3N_3H_3$	122.61	col. liq
32	Trimethyltriborine triamine (*N-B-B′*)	$(CH_3)_3B_3N_3H_3$	122.61	col. liq
33	Trimethyl triborine trioxane (methylboric anhydride or anide)	$(CH_3)_3B_3O_3$	125.56	col. mobile liq

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids. etc.
1	....	....	84	hyd.	hyd.	....
2	....	d.	d.	sl. s.	s.	s. al., eth.
3	....	34	100^{20}	d.	d.	s. bz.
4	....	0	175	d.	d.	s. bz.
5	....	....	d.	d.	....	s. eth.; sl. s. lgr.
6	....	−24	d. 93; 21^{44}	d.	d.	....
7	....	−72.5	68.6	d.	d.	....
8	....	....	158	hyd.	hyd.	....
9	....	134	d.	s.	....	s. eth., al., acet., bz., CCl_4
10	....	47	230^{13}	i.	....	v. s. al., bz.; sl. s. eth.
11	....	....	$90-1^{9}$; $108-10^{20}$	i.	i.	v. s eth., al.
12	....	glass at low temp.	71^{12}	i.	....	s. eth.
13	....	....	154^{30}	hyd.	hyd.	v. s. eth.
14	....	20	$66-8^{5}$	hyd.	hyd.	s. eth.
15	....	d. 76	d.	d.	....	....
16	....	243	....	....	s.	s. al.
17	....	100	194^{15}	i.	....	s. eth.
18	0.8746^{10}; $0.864^{26.5}$	....	117.4, (120)	d.	....	....
19	0.6961^{23}	−92.9	$0^{12.5}$	i.	i.	s. al., eth.
20	0.8876	....	$178-82^{24}$	hyd.	hyd.	s. org. solv.
21	0.872^{0}	....	255	....	....	....
22	0.76	....	119^{14}	i.	....	s. eth.
23	....	128	....	i.	i.	s al., eth., bz.
24	0.864^{0}	....	212	....	....	....
25	0.74	....	188. 86^{20}	i.	i.	s. eth.
26	....	94	172	d.	d.	s. eth.
27	0.915; $0.9205^{24.3}$	−29	68.7, (65)	d.	....	s. al., eth.
28	1.9108 g/l, 0.625^{-100}	−161.5	−20.2	v. sl. s.	....	v. s. al., eth.
29	....	−123	45.5	d.	....	....
30	....	31.5	129	hyd.	hyd.	....
31	....	....	134	hyd.	hyd.	....
32	....	....	139	hyd.	hyd.	....
33	....	−37	79	hyd.	hyd.	s. eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Boron:			
1	Tri-*β*-naphthyl borate	$B(C_{10}H_7O)_3$	440.29	col. leaflets
2	Tri-*α*-naphthylborine	$B(C_{10}H_7)_3$	392.29	col. need
3	Triphenyl borate (triphenoxyborine)	$(C_6H_5O)_3B$	290.12	col. cr
4	Triphenylborine ammine*	$(C_6H_5)_3BNH_3$	259.15	col. cr
5	Triphenylboron	$B(C_6H_5)_3$	242.12	hex. need
6	Tripropyl borate (tripropoxyboron)	$B(OC_3H_7)_3$	188.08	liq
7	Tri-*n*-propylborine	$B(C_3H_7)_3$	140.08	col., mobile liq., $1.41352^{22.8}$
8	Tri-*sec*-propylborine	$B(C_3H_7)_3$	140.08	col. mobile liq
9	Tri-*p*-tolylborine	$B(CH_3C_6H_4)_3$	284.20	separate wh. cr.
10	Tri-*p*-xylylborine	$B(CH_3C_6H_3CH_3)_3$	326.28	col. bushed need
	Cadmium:			
11	Dibutylcadmium	$Cd(C_4H_9)_2$	226.64	oil
12	Diethylcadmium	$Cd(C_2H_5)_2$	170.53	oil
13	Diisoamylcadmium	$Cd(C_5H_{11})_2$	254.69	oil
14	Diisobutylcadmium	$Cd(C_4H_9)_2$	226.64	oil
15	Dimethylcadmium	$Cd(CH_3)_2$	142.48	oil
16	Dipropylcadmium	$Cd(C_3H_7)_2$	198.58	oil
	Calcium:			
17	Dianilinecalcium	$Ca(NHC_6H_5)_2$	224.31	wh. cr
18	Ethylcalcium iodide	C_2H_5CaI	196.06	amor. powd
19	Glycocollcalcium	$(CH_2NHCOO)Ca$	113.13	cr
	Cobalt:			
20	Bis-dimethylglyoxime cobalto chloride	$HON{:}CCH_3CCH_3NOH{\cdot}Co\,HON{:}CCH_3CCH_3{:}NOCl_2$	361.09	lt. grn. cr
21	Cobalt(ous) hexamethylenetetramine	$CoCl_2C_6H_{12}N_4$	270.04	ultramarine blue
22	Cobalt(ous) hydroxyquinone	$Co(C_{10}H_5O_3)_2$	405.22	ruby red
	Copper			
23	diazoaminobenzene(ous)	$CuN_3(C_6H_5)_2$	259.80	or. cr
	Gallium:			
24	Dimethylgallium amide	$Ga(CH_3)_2NH_2$	115.81	wh. cr
25	Dimethylgallium chloride monammine	$Ga(CH_3)_2Cl{\cdot}NH_3$	152.28	wh. cr
26	Dimethylgallium chloride diammine	$Ga(CH_3)_2Cl{\cdot}2NH_3$	169.31	wh. cr
27	Methylgallium dichloride	$Ga(CH_3)Cl_2$	155.67	wh. cr
28	Methylgallium dichloride monammine	$Ga(CH_3)Cl_2{\cdot}NH_3$	172.70	wh. cr
29	Methylgallium dichloride pentammine	$Ga(CH_3)Cl_2{\cdot}5NH_3$	240.83	wh. cr
30	Triethylgallium	$Ga(C_2H_5)_3$	156.90	col. liq
31	Triethylgallium monammine	$Ga(C_2H_5)_3{\cdot}NH_3$	173.93	col. liq
32	Triethylgallium monoetherate	$Ga(C_2H_5)_3{\cdot}(C_2H_5)_2O$	231.02	col. liq
33	Trimethylgallium	$Ga(CH_3)_3$	114.82	col. liq
34	Trimethylgallium monammine	$Ga(CH_3)_3{\cdot}NH_3$	131.86	wh. cr
35	Trimethylgallium monoetherate	$Ga(CH_3)_3{\cdot}(C_2H_5)_2O$	188.94	col. liq

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* This compound is the prototype of numerous stable complex compounds formed from organic

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	115	....	d.	....	s. bz.
2	....	203	d.	i.	....	sl. s. eth., al.; v. s. bz., CCl_4, chl., CS_2
3	....	*ca.* 35	>360	d.	....	s. eth., bz.
4	....	d. 216	d.	....	....	s. al.; sl. s. bz.
5	....	136	203^{15}	d.	....	d. al.; s. bz.
6	liq. 0.867^{16}	....	175	....	....	....
7	0.725	....	156, 60^{20}	i.	....	s. eth.
8	....	....	148–54, $33–5^{12}$	i.	....	s. eth.
9	....	175	233^{12}	i.	....	v. s. bz.; sl. s. eth.
10	....	147	221^{12}	i.	....	v. s. bz., chl., CCl_4; sl. s. eth.
11	$1.3056^{19.5}$	−48	$103.5^{12.5}$	d.	d.	....
12	$1.6564^{18.1}$	−21	64	d.	d.	....
13	1.2210^{19}	−115	121.5^{15}	....	....	....
14	1.2693^{18}	−37	90.5^{20}	d.	d.	....
15	$1.9846^{17.9}$	−4.5	105.5^{758}	d.	d.	....
16	$1.4201^{17.6}$	−83	$84^{21.5}$	d.	d.	....
17	....	d.	....	d.	....	i. eth., bz., lgr.
18	....	....	....	d.	....	sl. s.
19	....	....	....	s.	....	....
20	....	....	....	s.	....	s. al.
21	....	....	....	s.	....	....
22	....	d. 210–15	....	....		....
23	....	d. 270	....	i.	....	s. bz.; i. al., lgr.
24	....	....	subl. 60 vac.	....	....	....
25	....	54	....	d.	d.	v. s. NH_3; s. eth.
26	....	112	....	d.	d.	v. s. NH_3; i. eth.
27	....	75	....	d.	....	v. s. eth.
28	....	....	....	d.	....	i. eth.
29	....	d. > 80	....	d.	....	i. NH_3
30	1.0576^{30}	−82.3	142.6	d.	....	s. eth.
31	....	....	....	d.	....	....
32	....	....	....	d.	....	s. eth.
33	....	−19	$55.7 \pm .2^{762}$	d.	....	s. eth., NH_3
34	....	31	subl. vac.	d.	....	s. eth., NH_3; i. pet. eth.
35	....	<−76	99	d.	....	s. NH_3, eth.

amines and tri-aryl-borines.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Germanium:			
1	Amyltriphenylgermanium (*n*)	$Ge(C_5H_{11})(C_6H_5)_3$	375.04	col. pl
2	Benzyltriphenylgermanium	$Ge(CH_2C_6H_5)(C_6H_5)_3$	395.03	col. pl
3	Bis-acetylacetone germanium dibromide	$[CH(CCH_3O)_2]_2GeBr_2$	430.65	col. micr. cr.
4	Bis-acetylacetone germanium dichloride	$[CH(CCH_3O)_2]_2GeCl_2$	341.73	col. pr
5	Bis-(5-oxy-2, 8 dithio octane) germanium	$[SCH_2CH_2)_2O]_2Ge$	345.05	col. cr
6	Bis-propionylacetone germanium dichloride	$[CHC_2(C_2H_5)(CH_3)O_2]_2GeCl_2$	369.78	wh. cr. powd
7	Bis-tribenzyl germanyl sulfide	$[(C_6H_5CH_2)_3Ge]_2S$	724.02	col. cr
8	Bis-tribiphenylyl germanyl sulfide	$[(C_6H_5 \cdot C_6H_4)_3Ge]_2S$	1096.42	col. cr
9	Bis-trichlorogermanyl methane	$CH_2(GeCl_3)_2$	371.97	col. liq
10	Bis-tricyclohexylgermanium disulfide	$[(C_6H_{11})_3Ge]_2S_2$	708.21	col. cr
11	Bis-triethylgermanyl sulfide	$[(C_2H_5)_3Ge]_2S$	351.62	col. oily liq
12	Bis-triphenylgermanyl sulfide	$[(C_6H_5)_3Ge]_2S$	639.86	col. cr
13	Bis-tri-tolylgermanyl sulfide	$[(C_6H_4CH_3)_3Ge]_2S$	724.02	col. cr
14	Butyltriphenylgermanium (*n*)	$Ge(C_4H_9)(C_6H_5)_3$	361.01	col. need
15	Cyclopentamethylene germanium dichloride	$(CH_2)_5GeCl_2$	213.65	col. liq
16	Diethylcyclopentamethylenegermanium (1,1)	$(CH_2)_5Ge(C_2H_5)_2$	200.85	col. liq
17	Diethyldiphenylgermanium	$Ge(C_2H_5)_2(C_6H_5)_2$	284.92	col. liq
18	Diethylgermanium bromide	$(C_2H_5)_2GeBr_2$	290.55	col. liq
19	Diethylgermanium chloride	$(C_2H_5)_2GeCl_2$	201.64	col. liq
20	Diethylgermanium imine	$(C_2H_5)_2GeNH$	145.74	col. liq
21	Diethylgermanium iodide	$(C_2H_5)_2GeI_2$	384.56	col. liq
22	Diethylgermanium oxide(α)	$[(C_2H_5)_2GeO]_x$	146.72_x	stable wh. amor. solid
23	Diethylgermanium oxide(β)	$[(C_2H_5)_2GeO]_3$	440.16	unst. col. liq
24	Diphenylgermanium	$[(C_6H_5)_2Ge]_4$	907.20	wh. cr.
25	Diphenylgermanium dibromide	$(C_6H_5)_2GeBr_2$	386.63	col. liq
26	Diphenylgermanium dichloride	$(C_6H_5)_2GeCl_2$	297.72	col. liq
27	Diphenylgermanium difluoride	$(C_6H_5)_2GeF_2$	264.80	col. liq
28	Diphenyl-*sec*-propylgermanium bromide	$(C_6H_5)_2(C_3H_7)GeBr$	349.80	col. liq
29	Di-*p*-tolylgermanium dibromide	$(CH_3C_6H_4)_2GeBr_2$	414.69	lt. yel. liq

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	42–3	......	i.	i.	v. s. bz., pet. eth.; sl. s. me. al.
2	......	82.5–3.5	......	i.	i.	v. s. bz., pet. eth., chl.; sl. s. isopropyl al.; i. me. al.
3	......	226	......	......	......	sl. s. h. acetyl acet.; i. org. solv.
4	......	240 d.	......	......	......	sl. s. org. solv.
5	......	159.0–.5	......	......	......	s. bz., abs. al.
6	......	128–9	......	......	......	s. c. chl.; i. pet. eth.
7	......	124	......	......	......	s. al., me. al. bz.; i. alk.
8	......	238	......	......	......	s. org. solv.; i. alk.
9	......	......	110^{18}	hyd.	hyd.	s. org. solv.
10	......	87–8	......	i.	......	s. abs. al.
11	......	......	$148–50^{12}$	......	......	s. org. solv.; i. alk.
12	......	138	......	......	......	s. org. solv.; i. alk.
13	......	156–7	......	......	......	s. org. solv.; i. alk.
14	......	84.5–5.5	......	i.	i.	v. s. pet. eth., bz., chl., eth.; sl. s. isopropyl al.; i. me. al.
15	......	......	$55–60^{12}$	......	......	......
16	......	......	52^{13}	......	......	......
17	......	......	316	i.	i.	v. s. org. solv.
18	......	<−33	202	d.	d.	d. liq. NH_3; s. org. solv.
19	......	−39 to −37	175	d.	d.	d. liq. NH_3; s. org. solv.
20	......	......	$100^{0.01}$	......	......	......
21	......	−2 to −1	252	d.	d.	d. liq. NH_3; s. org. solv.
22	......	175	......	i.	i.	i. org. solv., liq. NH_3
23	......	18	......	i.	i.	s. org. solv.; i. liq. NH_3
24	......	294–5	......	i.	i.	sl. s. bz., tol., chl.; i. pet. eth.
25	......	......	$120^{.007}$, $205–7^{512}$	hyd.	hyd.	s. org. solv.
26	.71	9	223^{12}	hyd.	hyd.	s. org. solv.
27	......	......	$100^{0.007}$	hyd.	hyd.	s. org. solv.
28	......	......	$215–50^{13}$	......	......	......
29	......	......	$230–33^{13}$	hyd.	hyd.	s. org. solv.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Germanium:			
1	Di-*p*-tolylphenylgermanium bromide	$(CH_3C_6H_4)_2(C_6H_5)GeBr$	411.87	col. pr
2	Di-triphenylgermanyl methane	$[(C_6H_5)_3Ge]_2CH_2$	621.83	lg. col. pr
3	Ethyl-*tris*-*p*-biphenylylgermanium	$Ge(C_2H_5)(C_6H_4C_6H_5)_3$	561.24	col. cr
4	Ethylgermanium oxide	$(C_2H_5GeO)_2O$	251.32	wh. powd
5	Ethylgermanium tribromide	$(C_2H_5)GeBr_3$	341.41	col. liq
6	Ethylgermanium trichloride	$C_2H_5GeCl_3$	208.03	col. liq
7	Ethylgermanium trifluoride	$C_2H_5GeF_3$	158.66	col. liq
8	Ethylgermanium triiodide	$C_2H_5GeI_3$	482.42	yel. liq
9	Ethylphenyldi-*p*-tolylgermanium	$Ge(C_2H_5)(C_6H_5)(C_6H_4CH_3)_2$	361.01	wh. cr
10	Ethyl-*sec*-propyldiphenylgermanium	$Ge(C_2H_5)(C_3H_7)(C_6H_5)_2$	298.95	liq
11	Ethyltribenzylgermanium	$Ge(C_2H_5)(CH_2C_6H_5)_3$	375.04	col. cr
12	Ethyltriphenylgermanium	$Ge(C_2H_5)(C_6H_5)_3$	332.96	col. sld
13	Hexabenzyldigermane	$(C_6H_5CH_2)_6Ge_2$	691.96	col. cr
14	Hexaethyldigermane	$[(C_2H_5)_3Ge]_2$	319.56	col. liq
15	Hexaphenyldigermane	$[(C_6H_5)_3Ge]_2$	607.80	wh. cr
16	Hexaphenyldigermane (tribenzene)	$[(C_6H_5)_3Ge]_2\cdot 3C_6H_6$	842.13	col. cr
17	Hexa-*p*-tolyldigermane	$(CH_3C_6H_4)_6Ge_2$	691.96	col. cr
18	Methyltriphenylgermanium	$Ge(CH_3)(C_6H_5)_3$	318.94	trans. col. cr
19	Octaphenyltrigermane	$(C_6H_5)_8Ge_3$	834.60	wh. cr
20	Phenylethyl-*sec*-propylgermanium bromide	$(C_6H_5)(C_2H_5)[CH(CH_3)_2]GeBr$	301.76	col. oil; opt. act., *d.* & *l.* forms
21	Phenylgermanium tribromide	$(C_6H_5)GeBr_3$	389.45	col. liq
22	Phenylgermanium trichloride	$(C_6H_5)GeCl_3$	256.07	col. liq
23	Phenylgermanium triiodide	$C_6H_5GeI_3$	530.46	wh. sol., dec. by light
24	Phenyltri-*p*-tolylgermanium	$Ge(C_6H_5)(C_6H_4CH_3)_3$	423.08	wh. pr
25	Propyltriphenylgermanium (*n*)	$Ge(C_3H_7)(C_6H_5)_3$	346.99	col. need
26	Tetra-*i*-amylgermanium	$Ge(C_5H_{11})_4$	357.16	col. oily liq., $1.457^{17.5}$
27	Tetra-*n*-amylthiogermanium	$Ge[S(CH_2)_4CH_3]_4$	485.40	col. liq., 1.5336^{25}
28	Tetraanhydro-tetrakis-diphenylgermanediol (*cyclo*)	$[Ge(C_6H_5)_2O]_4$	971.20	monocl. pr. & cubes
29	Tetrabenzylgermanium	$Ge(CH_2C_6H_5)_4$	437.11	col. sol
30	Tetra-*p*-biphenylylgermanium	$Ge(C_6H_4C_6H_5)_4$	685.37	wh. need
31	Tetra-*p*-bromophenylthiogermanium	$Ge(SC_6H_4Br)_4$	824.87	col. cr
32	Tetra-*n*-butylgermanium	$Ge(C_4H_9)_4$	301.05	col. oily liq

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	119	....	....	....	....
2	....	132–33	....	i.	....	v. s. bz., eth., pet. eth., chl; i. liq. NH_3, al.
3	....	154–6	....	....	....	....
4	....	>300	d.	s.	s.	s. HCl, al.; i. pet. eth.
5	....	<-33	200^{763}	d.	d.	d. liq. NH_3; s. bz., eth.
6	....	<-33	144^{762}	d.	d.	d. liq. NH_3; s. bz., eth.
7	....	-16.5 to -15.5	112^{750}	d.	d.	d. liq. NH_3; s. bz., eth.
8	....	-2.5 to -1.5	281^{755}, d.>350	d.	d.	d. liq. NH_3; s. bz., eth.
9	....	55	....	....	....	....
10	....	175–90	....	....	....	....
11	....	56–7	....	....	....	s. meth. al.
12	....	78.0–.5	....	i.	i.	s. eth., pet. eth., bz., chl., acet.; i. meth. al.
13	....	183–4	....	....	....	s. glac. acet. a.
14	....	<-60	265^{758}	i.	i.	s. bz., eth.
15	....	340	....	i.	i.	sl. s. h. bz., h. chl.; i. liq. NH_3, lgr.
16	....	d. $-C_6H_6$	....	i.	....	s. bz.
17	....	226–7	....	....	....	....
18	....	70.5–1.0	....	i.	i.	v. s. bz., eth., acet., chl. pet. eth.; i. c. meth. al., liq. NH_3
19	....	247–8	....	i.	i.	s. h. bz., h. chl.
20	....	....	$130–5^{13}$	....	....	....
21	....	....	$120–2^{13}$	hyd.	hyd.	d. liq. NH_3; s. org. solv.
22	....	....	$105–6^{12}$	hyd.	hyd.	d. liq. NH_3; s. org. solv.
23	....	55–6	....	hyd.	hyd.	d. liq. NH_3; s. glac. acet. a.; org. solv.
24	....	191	....	i.	i.	s. org. solv.
25	....	86.0–.5	....	i.	i.	v. s. chl., bz., pet. eth.; sl. s. isopropyl al.; i. meth. al., liq. NH_3
26	$0.9147\frac{20}{20}$	....	163–4	....	....	....
27	1.0697^{25}	....	$240–1^{3-4}$	....	....	s. bz., abs. al.
28	....	218	....	....	....	s. ethyl acetate, pet. eth., eth.
29	....	107–8	....	....	....	....
30	....	270–2	....	i.	i.	s. bz.
31	....	196.0–.5	....	....	....	s. bz., abs. al.
32	....	....	$178–80^{733}$?	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Germanium:			
1	Tetra-*p*-*tert*-butylphenylthiogermanium	$Ge[SC_6H_4C(CH_3)_3]_4$	733.66	col. tetrag
2	Tetra-*n*-butylthiogermanium	$Ge[S(CH_2)_3CH_3]_4$	429.29	liq., 1.5439^{25}
3	Tetra-*sec*-butylthiogermanium	$Ge[SCH(CH_3)(C_2H_5)]_4$	429.29	liq., 1.5497^{25}
4	Tetra-*tert*-butylthiogermanium	$Ge[SC(CH_3)_3]_4$	161.77	tetrag. columns
5	Tetracetylthiogermanium	$Ge[SCH_2(CH_2)_{14}CH_3]_4$	1102.55	wh. cr
6	Tetracyclohexylthiogermanium	$Ge(SC_6H_{11})_4$	533.44	2 cr. mod α (stab.) tetrag.; β (metastab) monocl.
7	Tetraethoxylgermanium (tetraethyl germanate)	$Ge(OC_2H_5)_4$	252.84	col. liq
8	Tetraethylgermanium	$Ge(C_2H_5)_4$	188.84	col. oil, $1.443^{17.5}$; 1.554^{0}; 1.439^{30}
9	Tetraethylthiogermanium	$Ge(SC_2H_5)_4$	317.08	liq., 1.5886^{25}
10	Tetra-iso-butylthiogermanium	$Ge[SCH_2CH(CH_3)_2]_4$	429.29	liq., 1.5381^{25}
11	Tetraisopropylthiogermanium	$Ge[SCH(CH_3)_2]_4$	373.19	liq., 1.5535^{25}
12	Tetramethylgermanium	$Ge(CH_3)_4$	132.74	col. liq
13	Tetramethylthiogermanium	$Ge(SCH_3)_4$	260.98	liq., 1.6379^{25}
14	Tetraphenoxygermanium	$Ge(OC_6H_5)_4$	445.00	col. oil
15	Tetraphenylgermanium	$Ge(C_6H_5)_4$	381.00	tetr., col
16	Tetra(2-phenylethyl)-germanium	$Ge(C_6H_5C_2H_4)_4$	493.21	col. cr
17	Tetraphenylthiogermanium	$Ge(SC_6H_5)_4$	509.24	col., rhomb. cr., 1.7348, 1.7821 (H green)
18	Tetra-*n*-propylgermanium	$Ge(C_3H_7)_4$	244.95	col mob. liq., $1.451^{17.5}$
19	Tetrapropylthiogermanium	$Ge(SC_3H_7)_4$	373.19	liq., 1.5612^{25}
20	Tetra-*N*-pyrrylgermanium	$Ge(C_4H_4N)_4$	336.92	lt. yel. cr
21	Tetra-α-thienylgermanium	$Ge(C_4H_3S)_4$	405.10	wh. need., doubly refract
22	Tetra-*o*-tolylgermanium	$Ge(C_6H_4CH_3)_4$	437.11	wh. hex. cr
23	Tetra-*m*-tolylgermanium	$Ge(C_6H_4CH_3)_4$	437.11	wh. need
24	Tetra-*p*-tolylgermanium	$Ge(C_6H_4CH_3)_4$	437.11	wh. rhbdr. tab
25	Tetra-*p*-tolylthiogermanium	$Ge(SC_6H_4CH_3)_4$	565.35	col., rhomb. cr., 1.726, 1.7716 (H green)
26	Tolylgermanium tribromide(*p*)	$(CH_3C_6H_4)GeBr_3$	403.47	col. liq
27	Tolylgermanium trichloride(*p*)	$(CH_3C_6H_4)GeCl_3$	270.10	col. liq
28	Tolylgermanium triiodide(*p*)	$(CH_3C_6H_4)GeI_3$	544.49	col. cr., sensit. to light
29	Trianhydrotetrakisdiphenylgermanediol	$[HO\text{-}Ge(C_6H_5)_2\text{-}O\text{-}Ge(C_6H_5)_2]_2O$	989.22	
30	Tribenzylgermanium bromide	$(C_6H_5CH_2)_3GeBr$	425.90	col. cr

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	155-6	....	....	....	sl. s. al., glac. acet. a.; s. pet. eth., eth., acet.; v. s. chl., bz.
2	1.1072^{25}	....	$222.5^{4.5}$	....	....	s. abs. al.
3	1.1119^{25}	....	200.5^{4}	....	....	s. bz.
4	....	172-73	subl. 170^{4}	....	....	s. abs. al.
5	....	50-1	....	....	....	v. s. chl., bz.; s. pet eth., eth.; sl. s. acet., al., glac. acet. a.
6	$\alpha 1.270^{15}$ $\beta 1.259^{15}$	84 88	....	i. i.	....	s. abs. al., pet. eth. s. abs. al ,pet. eth.
7	....	−81	185-7	....	....	....
8	1.198^{0} $0.991\frac{24.5}{24.5}$	−90	162.5-3.0	d.	d.	s. bz., eth., HCl
9	1.2574^{25}	....	$164.5\text{-}5.0^{5}$	....	....	s. bz.
10	1.0984^{25}	....	$199\text{-}200^{4-5}$	....	....	s. al.
11	1.1478^{25}	15	$162\text{-}64^{4}$	....	....	s. abs. al.
12	1.006^{0}	−88	43.4	....	....	s. al., eth., bz.
13	1.4364^{25}	−3	$138\text{-}40^{4}$	....	....	s. al., bz.
14	....	....	$210\text{-}20^{0.3}$	....	....	s. bz.
15	....	235.7	>400	i.	i.	s. chl., bz., tol.; sl. s. eth., acet., lgr.
16	....	56-7	....	....	....	s. eth., al.
17	....	101.5	....	....	....	s. bz., abs. al., meth. al.
18	$0.9539\frac{20}{20}$	−73	225^{716}	....	....	....
19	1.1662^{25}	....	$191\text{-}92^{5}$	....	....	s. abs. al.
20	....	202	....	....	....	s. pet. eth., chl.
21	....	149-50	....	i.	i.	s. bz., tol., acet., chl., CCl_4; sl. s. al., meth. al.; i. pet. eth.
22	....	175-6	....	i.	i.	s. CCl_4, bz., xylene; sl. s. h. al.; i. pet. eth., al.
23	....	146	....	i.	i.	s. bz., tol., CCl_4; sl. s. meth. al.
24	....	227	....	i.	i.	s. bz.
25	....	110-11	....	....	....	s. bz., abs. al.
26	....	$155\text{-}6^{13}$	....	hyd.	hyd.	d. liq. NH_3; s. org. solv.
27	....	....	$115\text{-}6^{12}$	hyd.	hyd.	d. liq. NH_3; s. org. solv.
28	....	72	....	hyd.	hyd.	d. liq. NH_3; s. org. solv.
29	....	149	....	....	....	s. eth. acetate
30	....	145	....	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Germanium:			
1	Tribenzylgermanium chloride	$(C_6H_5CH_2)_3GeCl$	381.44	col. cr
2	Tribenzylgermanium fluoride	$(C_6H_5CH_2)_3GeF$	364.98	col. need
3	Tribenzylgermanium iodide	$(C_6H_5CH_2)_3GeI$	472.90	col. cr
4	Tribenzylgermanium oxide	$[(C_6H_5CH_2)_3Ge]_2O$	707.96	
5	Tri-*p*-biphenylylgermanium bromide	$(C_6H_5C_6H_4)_3GeBr$	612.09	wh. cr
6	Tri-*tert*-butylthiogermanium chloride	$Ge[SC(CH_3)_3]_3Cl$	375.58	col. cr
7	Tricyclohexylgermanium bromide	$(C_6H_{11})_3GeBr$	401.96	col. cr
8	Tricyclohexylgermanium chloride	$(C_6H_{11})_3GeCl$	357.50	col. cr
9	Tricyclohexylgermanium fluoride	$(C_6H_{11})_3GeF$	341.05	col. need
10	Tricyclohexylgermanium hydroxide	$(C_6H_{11})_3GeOH$	339.06	
11	Tricyclohexylgermanium iodide	$(C_6H_{11})_3GeI$	448.97	col. cr
12	Triethylgermanium bromide	$(C_2H_5)_3GeBr$	239.70	col. liq
13	Triethylgermanium chloride	$(C_2H_5)_3GeCl$	195.24	col. liq
14	Triethylgermanium fluoride	$(C_2H_5)_3GeF$	178.78	col. liq
15	Triethylgermanium hydride	$(C_2H_5)_3GeH$	160.79	col. liq
16	Triethylgermanium imine	$[(C_2H_5)_3Ge]_2NH$	334.58	col. liq
17	Triethylgermanium iodide	$(C_2H_5)_3GeI$	286.70	col. liq
18	Triethylgermanium oxide	$[(C_2H_5)_3Ge]_2O$	335.56	col. liq
19	Triethylphenylgermanium	$Ge(C_2H_5)_3(C_6H_5)$	236.88	col. liq
20	Triethyl-*p*-tolyl-germanium	$Ge(C_2H_5)_3CH_3C_6H_4$	250.91	col. liq
21	Triethyl-2,2,2, triphenyl-digermane (1,1,1)	$(C_2H_5)_3Ge-Ge(C_6H_5)_3$	463.68	rhomb. cr
22	Trimethylgermanium bromide	$Ge(CH_3)_3Br$	197.62	col. oily liq., 1.4705
23	Trimethylphenylgermanium	$Ge(CH_3)_3(C_6H_5)$	194.80	col. liq
24	Trimethylstannyl-triphenylgermanium	$(CH_3)_3Sn-Ge(C_6H_5)_3$	467.70	wh. cr
25	Triphenylanisylgermanium	$Ge(C_6H_5)_3(CH_3OC_6H_4)$	411.03	wh. sld
26	Triphenyldimethylaminophenylgermanium	$Ge(C_6H_5)_3C_6H_4N(CH_3)_2$	424.07	wh. need
27	Triphenylgermanium amide	$(C_6H_5)_3GeNH_2$	319.93	wh. ppt
28	Triphenylgermanium bromide	$(C_6H_5)_3GeBr$	383.82	hex. col
29	Triphenylgermanium chloride	$(C_6H_5)_3GeCl$	339.36	wh. cr
30	Triphenylgermanium fluoride	$(C_6H_5)_3GeF$	322.90	wh. cr

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of: Cold water	Hot water	Alcohol, acids, etc.
1	......	155	......	......	......	......
2	......	96	......	......	......	......
3	......	141	......	......	......	......
4	......	135	......	......	......	s. pet. eth.
5	......	242	......	......	......	s. bz.
6	......	66–7	$156\text{–}7^{3-4}$	......	......	s. al., org. solv.
7	......	110	......	hyd.	hyd.	s. al.
8	......	102	......	hyd.	hyd.	s. meth. al.
9	......	92	......	hyd.	hyd.	s. meth. al.
10	......	176–7	......	......	......	s. al., bz., pet. eth.
11	......	99–100	......	hyd.	hyd.	s. meth. al.
12	......	−33	190.9	hyd.	hyd.	s. bz., eth., chl., CCl_4
13	......	<−50	175.9	hyd.	hyd.	s. bz., eth., chl., CCl_4
14	......	......	149.0^{751}	hyd.	hyd.	s. bz., eth., chl., CCl_4
15	......	......	124.4^{761}	i.	i.	s. bz., eth.; i. liq. NH_3
16	......	......	$100^{0.1}$	hyd.	hyd.	s. bz., eth., CCl_4, chl.; i. liq. NH_3
17	......	<−50	212.3	hyd.	hyd.	s. bz., eth., chl., CCl_4; i. liq. NH_3
18	......	<−50	253.9	i.	i.	s. $C_2H_5NH_2$, bz., eth., org. solv.; i. liq. NH_3
19	......	......	$116\text{–}7^{13}$	i.	......	s. org. solv.
20	......	......	$125\text{–}6^{12}$	i.	......	s. org. solv.
21	......	89.5–90.5	......	i.	......	v. s. bz., chl.; s. pet. eth., al.; sl. s. meth. al.
22	$1.544\frac{18}{40}$	−25	113.7	d.	d.	s. org. solv.
23	......	......	182–3	i.	......	s. org. solv.
24	......	88	......	i.	......	s. pet. eth., CCl_4, chl., bz., sl. s. al.; i. liq. NH_3
25	......	158–9	......	......	......	s. al., glac. acet. a.
26	......	140–1	......	......	......	......
27	......	d. $-NH_3$	......	d.	d.	i. liq. NH_3
28	......	138.7	......	i.	hyd.	s. bz., chl.; sl. s. lgr.
29	......	117–8	285^{12}	i.	hyd.	s. bz., eth.
30	......	76.6	......	i.	hyd.	v. s. bz., eth., lgr., chl.; i. liq. NH_3

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Germanium:			
1	Triphenylgermanium hydride	$(C_6H_5)_3GeH$	304.91	wh. cr. (two forms)
2	Triphenylgermanium hydroxide	$(C_6H_5)_3GeOH$	320.91	wh. cr
3	Triphenylgermanium iodide	$(C_6H_5)_3GeI$	430.82	wh. cr
4	Triphenylgermanium oxide	$[(C_6H_5)_3Ge]_2O$	623.80	col. pl
5	Triphenylgermanium sodium	$Ge(C_6H_5)_3Na$	326.90	lt. yel
6	Triphenylgermanium sodiumoxide	$Ge(C_6H_5)_3ONa$	342.90	wh. sld
7	Triphenylgermanium sodiumtriammine	$Ge(C_6H_5)_3Na \cdot 3NH_3$	378.00	yel. sld
8	Triphenyl-*m*-tolyl germanium	$Ge(C_6H_5)_3(C_6H_4\text{-}CH_3)$	395.03	wh. anisotropic need
9	Triphenyl-*p*-tolyl germanium	$Ge(C_6H_5)_3(C_6H_4\text{-}CH_3)$	395.03	wh. sld
10	Tri-*o*-tolylgermanium bromide	$(CH_3C_6H_4)_3GeBr$	425.90	col. oil, (blue fluores.)
11	Tri-*m*-tolylgermanium bromide	$(CH_3C_6H_4)_3GeBr$	425.90	wh. need., anisotropic
12	Tri-*p*-tolylgermanium bromide	$(CH_3C_6H_4)_3GeBr$	425.90	col. cr
13	Tri-*o*-tolylgermanium chloride	$(CH_3C_6H_4)_3GeCl$	381.44	col. oil
14	Tri-*m*-tolylgermanium chloride	$(CH_3C_6H_4)_3GeCl$	381.44	sm. silky need.; opt. act
15	Tri-*p*-tolylgermanium chloride	$(CH_3C_6H_4)_3GeCl$	381.44	wh. cr
16	Tri-*o*-tolylgermanium hydroxide	$(CH_3C_6H_4)_3GeOH$	362.99	amor. powd
17	Tri-*m*-tolylgermanium oxide	$[(CH_3C_6H_4)_3Ge]_2O$	707.97	wh. cr
18	Tri-*p*-tolylgermanium oxide	$[(CH_3C_6H_4)_3Ge]_2O$	707.97	wh. pr. anisotropic
19	Tri-*m*-tolyl-*p*-tolyl germanium	$Ge(C_6H_4CH_3)_3 \cdot (C_6H_4CH_3)$	437.11	wh. sld
20	Tri-*p*-tolyl-*o*-tolyl germanium	$Ge(C_6H_4CH_3)_3 \cdot (C_6H_4CH_3)$	437.11	wh. cr
21	Tri-triphenylgermanium nitride	$[(C_6H_5)_3Ge]_3N$	925.71	col. need
22	Tris-acetylacetonegermanium cupribromide	$[(C_5H_7O_2)_3Ge]CuBr_3$	673.24	gr. -blk. cr
23	Tris-acetylacetonegermanium cuprobromide	$[(C_5H_7O_2)_3Ge]CuBr_2$	593.32	col. rect. pr
24	Tris-acetylacetonegermanium cuprochloride	$[(C_5H_7O_2)_3Ge]CuCl_2$	504.40	col. pr
25	Tris-acetylacetonegermanium dicuprobromide	$[(C_5H_7O_2)_3Ge]Cu_2Br_3$	736.81	col. pr
	Gold:			
26	Aminopyridinotribromogold (2)	$H_2NC_5H_4NAuBr_3$	531.06	blk. pr
27	Ethylenediaminodibutylgold bromide	$(CH_2NH_2)_2Au(C_4H_9)_2Br$	451.44	col. need
28	Ethylenediaminodipropylgold bromide	$(CH_2NH_2)_2Au(C_3H_7)_2Br$	423.39	col. cr
29	Pyridinotribromogold	$C_5H_5NAuBr_3$	516.05	red need
30	Quinolinotribromogold	$C_9H_7NBr_3Au$	566.10	deep red lust. pr
	Indium			
31	trimethyl	$In(CH_3)_3$	159.86	col. cr

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1		α, 47, β, 27		i.	i.	v. s. bz., tol., eth., chl., CCl_4; sl. s. liq. NH_3
2		134.2		i.	i.	s. bz., chl.; sl. s. lgr.
3		157		hyd.	hyd.	s. bz., eth.
4		183–4		i.	i.	s. bz., lgr., eth.
5		v. high		d.	d.	v. s. liq. NH_3; sl. s. eth., bz.
6		high		d.	d.	i. liq. NH_3
7		d.		d.	d.	v. s. liq. NH_3
8		136.5–8.5		i.	i.	s. bz., h. pet. eth.; i. meth. al.
9		123–4				s. org. solv.
10			205–10[1]			
11		78.0–.9	222–3[1]			s. CCl_4, bz., eth.
12		128–9				s. pet. eth.
13			216–22[1]			
14		84–5	221–4[1]			s. pet. eth., bz.; i. c. CH_3OH
15		121				s. pet. eth.
16			212–4[1]			
17		125.0–.2		i.	i.	s. al., bz., pet. eth.
18		148–50		i.	i.	s. h. lgr., c. bz.; sl. s. eth. al., meth. al.
19		98.5–100.5				s. meth. al.
20		164–6				
21		163–4		hyd.	hyd.	s. lgr., eth., bz.
22		139				i. chl.
23		165–6				s. chl.
24		147–8				s. chl.
25		195 d.				s. h. acet. acet.; i. chl.
26		160 d.		s.		s. chl.
27		d. 190		s.		s. al.
28		volat. 130	d. 190			
29		d. 150		s.		s. al., act.
30		d.>200				s. chl.
31	$1.568\frac{19}{19}$	89.0–.8	subl.	d.		s. eth.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Lanthanum** hexaantipyrine iodide	$La(COC_{10}H_{12}N_2)_6I_3$	1649.01	yel. cr
	Lead:			
2	Hexaethyldilead (triethyllead)	$Pb_2(C_2H_5)_6$	588.78	liq
3	Tetraethyllead	$Pb(C_2H_5)_4$	323.45	col. liq.; or. flame, grn. marg., 1.5195^{20}
4	Tetraisobutyllead	$Pb[CH_2CH(CH_3)_2]_4$	435.66	pl., 1.5042
5	Tetraisopropyllead	$Pb[CH(CH_3)_2]_4$	379.56	col. liq., dec. in air, 1.5223
6	Tetramethyllead	$Pb(CH_3)_4$	267.35	liq., 1.5120^{20}
7	Tetraphenyllead	$Pb(C_6H_5)_4$	515.61	wh. need
8	Tetra-*n*-propyllead	$Pb(C_3H_7)_4$	379.56	col. liq., 1.5094
	Lithium:			
9	Ethyllithium	LiC_2H_5	36.00	hex. transp. pl
	Mercury:			
10	Aminophenylmercuric acetate (*p*)	$C_6H_4(NH_2)HgO_2C_2H_3$	351.77	col. pr
11	Biphenylmercury	$Hg(C_6H_5C_6H_4)_2$	507.00	sm. scales
12	Chloromercuriphenol (*o*)	$C_6H_4OHHgCl$	329.17	
13	Di-*n*-amylmercury	$Hg(C_5H_{11})_2$	342.89	1.4998
14	Di-(*dl*)-amylmercury	$Hg(C_5H_{11})_2$	342.89	1.5014
15	Dibenzylmercury	$Hg(C_7H_7)_2$	382.86	long brittle col. need
16	Di-*n*-butylmercury	$Hg(C_4H_9)_2$	314.84	1.5057
17	Diethylmercury	$Hg(C_2H_5)_2$	258.73	col. liq. of hazel odor
18	Di-*n*-hexylmercury	$Hg(C_6H_{13})_2$	370.94	1.4973
19	Diisoamylmercury	$Hg(C_5H_{11})_2$	342.89	1.4989
20	Diisobutylmercury	$Hg(C_4H_9)_2$	314.84	col. liq., 1.4965
21	Diisopropylmercury	$Hg(C_3H_7)_2$	286.78	1.5263
22	Dimethylaminophenylmercuric acetate (*p*)	$C_6H_4N(CH_3)_2HgO_2C_2H_3$	379.82	long. col. need
23	Dimethylanilinemercury (*p*)	$Hg[C_6H_4N(CH_3)_2]_2$	440.95	lust. need
24	Dimethylmercury	$Hg(CH_3)_2$	230.68	col. liq., sweet odor
25	Dinaphthylmercury (*α*)	$Hg(C_{10}H_7)_2$	454.92	rhomb. wh
26	Dinaphthylmercury (*β*)	$Hg(C_{10}H_7)_2$	454.92	cryst. from bz
27	Diphenylmercury	$Hg(C_6H_5)_2$	354.81	wh. glassy need
28	Dipropylmercury	$Hg(C_3H_7)_2$	286.78	col. mobile liq., 1.5170
29	Ditolylmercury (*o*)	$Hg(C_7H_7)_2$	382.86	wh. tabl
30	Ditolylmercury (*m*)	$Hg(C_7H_7)_2$	382.86	col. or lt. yel. need
31	Ditolylmercury (*p*)	$Hg(C_7H_7)_2$	382.86	need
32	Ethane hexamercarbide	$C_2Hg_6O_2(OH)_2$	1293.70	yelsh.-wh. powd
33	Ethylmercuric chloride	C_2H_5HgCl	265.13	silv. irid. leaf
34	Ethylmercuric hydroxide	C_2H_5HgOH	246.68	silv. irid. leaf
35	Ethylmercuric iodide	C_2H_5HgI	356.59	cr. from EtOH
36	Mercury ethylmercaptide (ic)	$Hg(SC_2H_5)_2$	322.85	leaf
37	Mercury phenylmercaptide (ic)	$Hg(SC_6H_5)_2$	418.93	yelsh. need
38	Methylmercuric chloride	CH_3HgCl	251.10	wh. cr., disg. odor
39	Methylmercuric iodide	CH_3HgI	342.56	col. pearly leaf
40	Naphthylmercuric acetate (*α*)	$C_{10}H_7HgO_2C_2H_3$	386.81	fine need
41	Naphthylmercuric chloride (*α*)	$C_{10}H_7HgCl$	363.22	silk quad. tabl

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	...	268–9 d.	...	41.8^{20}	...	...
2	1.471	...	d.	i.	...	...
3	1.659^{18}	...	200 d.; 91^{19}	i.	...	s. bz., pet., al., eth.
4	1.324	−23	...	...	...	...
5	1.4504	−53.5	120^{14}; $133\text{–}8^{27}$	i.	...	s. bz., pet. eth.
6	1.995	−27.5	110	i.	...	s. bz., pet. eth., al.
7	...	227.7	...	...	...	s. bz.
8	1.44	...	126^{13}	...	...	s. bz., pet. eth.; sl. s. al.
9	...	95	...	d.	...	d. eth.; s. bz., lgr.
10	...	167	...	i.	i.	s. dil. a.; sl. s. chl., al.; i. eth.
11	...	216	...	difficultly	soluble in	common solv.
12	...	152.5^{0}	...	...	...	s. NaOH
13	1.6369	...	133^{10}	...	...	...
14	1.6700	...	93^{1}	...	...	...
15	...	...	...	...	...	s. al., eth., chl., CS_2, ac. a., bz., eth. acet.; sl. s. lgr.
16	1.7779	...	105^{10}	...	...	...
17	liq. 2.444	...	159	i.	i.	v. s. eth.; sl. s. al.
18	1.5361	...	158^{10}	...	...	...
19	1.6397	...	125^{10}	...	...	...
20	1.835^{15}; 1.7678	volat. 100	205–7; 86^{10}	v. sl. s.	...	s. eth., al.
21	2.0024	...	63^{10}	...	...	...
22	...	165	...	i.	i.	s. bz., chl., al., dil. a.
23	...	169	...	...	...	s. chl.; sl. s. al., eth., dil. HCl
24	3.069	...	96	...	...	s. al., eth.
25	1.929	188 (243)	249	i.	sl. s.	s. h. CS_2., chl.; sl. s. bz., eth.; v. sl. s. h. bz.
26	...	247–8	...	i.	...	sl. s. al., eth.
27	2.318	121.8, subl.	$204^{10.5}$; >306 d.	i.	i.	s. chl., CS_2, bz.; sl. s. eth., h. al.
28	2.0208	...	189–91; 73^{10}	i.	...	v. s. eth.; s. al.
29	...	107	219^{14}	...	...	s. h. bz.
30	...	102	...	i.	...	s. bz., chl., acet., eth. acet.
31	...	238	...	i.	...	s. h. bz., chl., CS_2; sl. s. c. al.
32	...	exp. 230	...	i.	i.	i.
33	3.482	193	...	i.	...	v. s. h. al.; sl. s. eth.
34	...	37	...	i.	i.	v. s. h. al.; s. eth.; sl. s. c. al.
35	...	186	...	...	...	s. al.
36	...	76–7	d.	i.	...	d. a.
37	...	153 d.	d.	i.	...	sl. s. h. al.; v. s. bz., pyr.
38	4.063	170	volat. 100	...	...	...
39	...	143	...	i.	...	v. s. meth. al.; s. eth., al.
40	...	154	...	i.	i.	s. al., ac. a., bz., CS_2, fats; sl. s. eth.
41	...	188–9	...	i.	i.	sl. s. bz., al.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Mercury:			
1	Phenylmercuric acetate	$C_6H_5HgO_2C_2H_3$	336.75	rhomb. sm. wh. lust. pr
2	Phenylmercuric bromide	C_6H_5HgBr	357.63	rhomb. wh. lust. tabl
3	Phenylmercuric chloride	C_6H_5HgCl	313.17	wh. satiny leaf
4	Phenylmercuric cyanide	C_6H_5HgCN	303.73	rhomb. long pr
5	Phenylmercuric iodide	C_6H_5HgI	404.63	rhomb. satiny tabl
6	Phenylmercuric nitrate	$C_6H_5HgNO_3$	339.72	rhomb. tabl
7	Tolylmercuric bromide (*p*)	C_7H_7HgBr	371.65	thin lust. gray sc
8	Tolylmercuric chloride (*p*)	C_7H_7HgCl	327.19	rhomb. silky tabl
	Neodymium:			
9	Neodymium hexaantipyrine iodide	$[Nd(COC_{10}H_{12}N_2)_6I_3]$	1654.398	rose cr
	Potassium:			
10	Potassium saccharate, acid (*d*)	$KHC_6H_8O_8$	248.23	rhomb. need
11	Potassium-*m*-nitrophenoxide	$KOC_6H_4NO_2 \cdot 2H_2O$	213.23	flat or. need
12	Potassium-*p*-nitrophenoxide	$KOC_6H_4NO_2 \cdot 2H_2O$	213.23	yel. leaf
	Rhenium:			
13	Bis-2:2′-dipyridyl rhenichloride	$(C_{10}H_9N_2)_2ReCl_6$	713.43	pa. grn. cr
14	Dipyridyl *per*-rhenate (2:2′)	$(C_5H_4N_2)HReO_4$	343.42	col. need
15	Dipyridyl rhenichloride (2:2′)	$(C_5H_5N)_2ReCl_6$	557.25	yel. need
16	Trimethylrhenium	$Re(CH_3)_3$	231.41	col. oil
17	Tripyridyl rhenichloride (2:2′:2″)	$(C_5H_4N)_3HReCl_6$	634.33	pa. grn. cr
	Silicon:			
18	Chloromethylsilicane	SiH_2ClCH_3	80.57	
19	Di-*p*-aminoazobenzene fluosilicate	$(NH_2C_6H_4N_2C_6H_5)_2 \cdot H_2SiF_6$	538.54	long cinnamon br. need
20	Di-*p*-aminobenzoic acid fluosilicate	$(NH_2C_6H_4COOH)_2 \cdot H_2SiF_6$	418.35	pr. wh. long, narrow
21	Dianiline fluosilicate	$(C_6H_5NH_2)_2 \cdot H_2SiF_6$	330.33	irreg. pl. wh
22	Dichloromethylsilicane	$SiHCl_2CH_3$	115.02	
23	Didiphenylamine fluosilicate	$[(C_6H_5)_2NH]_2 \cdot H_2SiF_6$	482.51	wh. rods forming rosettes
24	Diethylaniline fluosilicate	$(C_6H_5NHC_2H_5)_2 \cdot H_2SiF_6$	386.43	wh. pointed pr
25	Dimethylaniline fluosilicate	$(C_6H_5NHCH_3)_2 \cdot H_2SiF_6$	358.38	monocl. wh. need
26	Dimethylsilicane	$SiH_2(CH_3)_2$	60.14	
27	Di-α-naphthylamine fluosilicate	$(C_{10}H_7NH_2)_2 \cdot H_2SiF_6$	430.44	rosettes of wh. need
28	Di-β-naphthylamine fluosilicate	$(C_{10}H_7NH_2)_2 \cdot H_2SiF_6$	430.44	hex. wh. pl
29	Di-*m*-nitraniline fluosilicate	$(C_6H_4NH_2NO_2)_2 \cdot H_2SiF_6$	420.33	rhomb. wh. pl
30	Dinitrosodiphenylamine fluosilicate	$[(C_6H_5)_2N = NO]_2 \cdot H_2SiF_6$	540.51	butterfly shaped indigo cr
31	Di-*o*-toluidine fluosilicate	$(C_6H_4NH_2CH_3)_2 \cdot H_2SiF_6$	358.38	rhomb. wh
32	Di-*m*-toluidine fluosilicate	$(C_6H_4NH_2CH_3)_2 \cdot H_2SiF_6$	358.38	wh. rect. pr. pl
33	Di-*p*-toluidine fluosilicate	$(C_6H_4NH_2CH_3)_2 \cdot H_2SiF_6$	358.38	wh. need., unst. irreg. outline

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	....	149	....	sl. s.	sl. s.	s. glac. ac. a., bz., al.
2	....	276	....	i.	i.	s. al., bz., pyr.
3	....	251	....	....	....	sl. s. h. al., bz., pyr., eth.
4	....	204	....	....	sl. s.	s. h. al., bz.
5	....	266	....	i.	....	s. chl., CS$_2$; sl. s. al., eth., bz.
6	....	176–86	....	i.	sl. s.	s. h. al., bz.
7	....	228	....	....	....	s. chl., al., bz.; i. c. CS$_2$
8	....	233	....	i.	i.	sl. s. h. al., bz., chl., acet., pyr.; i. eth.
9	....	270–2	....	12.7^{20}	....	....
10	....	....	....	1.1^{16}	more sol.	....
11	1.691^{20}	$-2H_2O$, 130	d.	16.3^{15}	....	s. al.
12	1.652^{20}	$-2H_2O$, 130	d.	7.5^{15}	....	sl. s. al.
13	....	....	....	sl. s.	....	....
14	....	....	....	2.1	....	....
15	....	....	....	sl. s.	....	....
16	....	....	60	....	....	....
17	....	....	....	i.	....	....
18	0.935^{-80}	−134.1	7	....	....	....
19	....	220 d.	....	....	....	$.187^{25}$ 95 % al.
20	....	242	....	....	....	0.91^{25} 95 % al.
21	....	subl. 230	....	v.s.	....	s. h. al.
22	0.93^{0}	−93	....	....	....	....
23	....	169	....	....	....	2.4492^{25} 95 % al.
24	....	165.3	....	....	....	$.979^{25}$ 95 % al.
25	....	....	....	....	....	s. h. al.; i. c. al.
26	0.68^{-80}	−150	−20.1	....	....	....
27	....	218	....	....	....	$.1504^{25}$ 95 % al.
28	....	236.3	....	....	....	$.0816^{25}$; 1248^{35} 95 % al.
29	....	200	....	....	....	$.121^{25}$; $.4736^{35}$ 95 % al.
30	....	124.5	....	....	....	$.84^{25}$ 95 % al.
31	....	....	....	....	....	s. h. al.; i. c. al.
32	....	....	....	....	....	s. h. al.; i. c. al.
33	....	....	....	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Silicon:			
1	Ethyltriphenylsilicane	$(C_2H_5)(C_6H_5)_3Si$	288.42	rhomboidal pr
2	Hexamethyldisilicane	$Si_2(CH_3)_6$	146.33	
3	Methylsilicane	SiH_3CH_3	46.12	
4	Methyltriphenyl silicane	$(CH_3)(C_6H_5)_3Si$	274.40	
5	Phenylenediamine fluosilicate (*m*)	$C_6H_4(NH_2)_2 \cdot H_2SiF_6$	252.22	choc. br. need.-like pr
6	Phenylenediamine fluosilicate (*p*)	$C_6H_4(NH_2)_2 \cdot H_2SiF_6$	252.22	pink irreg. six-sided pl
7	Silico-benzoic acid	C_6H_5SiOOH	138.17	col. flaky resin
8	Tetrabenzylsilicane	$Si(C_6H_5CH_2)_4$	392.57	
9	Tetraethylsilicane	$Si(C_2H_5)_4$	144.30	liq., 1.4246
10	Tetramethylsilicane	$Si(CH_3)_4$	88.20	col. liq
11	Tetraphenylsilicane	$Si(C_6H_5)_4$	336.46	col. flocc. amor. part
12	Tolidine fluosilicate(*o*)	$(CH_3NH_2C_6H_3)_2 \cdot H_2SiF_6$	356.36	tiny, micr. wh. pr
13	Triethylphenylsilicane	$(C_2H_5)_3(C_6H_5)Si$	192.34	
	Sodium:			
14	Sodium acetamide	$NaNHCOCH_3$	81.06	wh. tabl
15	Sodium acetylide (ethinylsodium)	$NaHC_2$	48.03	wh. cr
16	Sodium anilide	$NaNHC_6H_5$	115.11	wh. cr., v. hygr
17	Sodium anthraquinone-*β*-sulfonate ("Silver salt")	$NaC_{14}H_7O_5S \cdot H_2O$	328.27	silvery leaf
18	Sodium arsanilate (atoxyl, soamim)	$NaC_6H_7O_3NAs \cdot 6H_2O$	347.13	wh. cr. powd., monocl
19	Sodium benzamide	$NaNHCOC_6H_5$	143.12	wh. powd
20	Sodium-*N*-chloro-*p*-toluenesulfonamide	$NaC_7H_7O_2NClS \cdot 3H_2O$	281.70	col. pr
21	Sodium ethoxide (sodium ethylate)	$NaOC_2H_5 \cdot 2C_2H_5OH$	160.19	wh. powd. or need
22	Sodium, ethyl-	NaC_2H_5	52.06	wh. cr., d. air
23	Sodium-*β*-naphthoxide	$NaOC_{10}H_7$	166.15	wh. powd., v. hygr
24	Sodium-*p*-nitrobenzene isodiazotate	$NaC_6H_4O_3N_3 \cdot 2H_2O$	225.15	gold. leaf. or need
25	Sodium-*p*-nitrophenoxide	$NaOC_6H_4NO_2 \cdot 4H_2O$	233.16	yel. moncol. pr
26	Sodium-*o*-sulfobenzoic imide (soluble saccharin)	$NaC_7H_4O_3NS \cdot 2H_2O$	241.20	wh. tabl
27	Triphenylborylsodium*	$NaB(C_6H_5)_3$	265.12	yel.-or. silky need
28	Triphenylmethylsodium	$NaC(C_6H_5)_3$	266.31	red. cr
	Tellurium:			
29	Di-*n*-butyl telluride	$(C_4H_9)_2Te$	241.84	yel. oil
30	Diethyl telluride	$(C_2H_5)_2Te$	185.73	
31	Dimethyl telluride	$(CH_3)_2Te$	157.68	pa. yel. oil; garlic-like odor
32	Dimethyltelluronium dibromide (*α*)	$C_2H_6Br_2Te$	317.51	or. leaf-like cr
33	Dimethyltelluronium dichloride (*α*)	$C_2H_6Cl_2Te$	228.59	leaf-like cr
34	Dimethyltelluronium dichloride (*β*)	$C_2H_6Cl_2Te$	228.59	leaf-like cr
35	Dimethyltelluronium diiodide (*α*)	$C_2H_6I_2Te$	411.52	red cr

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* All of the tri-arylborines form analogous addition-salts of the alkali metals.

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Cold water	Hot water	Alcohol, acids, etc.
1		76		i.		s. chl., bz., eth. acet.; sl. s. al.
2		12.5–14	112.5			
3	0.62^{-57}	−156.4	31			
4		67.3		i.		s. eth., chl., bz.; sl. s. al.
5		243–4				0.065^{25} 95% al.
6		d.				0.014^{25} 95% al.
7		40–50	215–6			s. eth., bz., chl.; sl. s. al., ac. a.
8			127.5	i.		s. eth., chl., bz.; sl. s. al.
9	$.762^{25}$		152.8–3.2			
10	$.651^{15}$		26.5			s. eth.; i. conc. H_2SO_4
11						s. acetic anh. and chlorosulphonic acid
12		268–9				$.013^{25}$, $.041^{35}$ 95% al.
13		148	230			
14		300–50 d.		d.		d. al.; sl. s. bz., liq. NH_3
15		d.>210		d.		d. a.; s. liq. NH_3
16		d.	d.	d.		d. a., al.; s. liq. NH_3
17		d.		0.84	27	v. sl. s. al.
18				$16^{1.7}$		sl. s. al.; s. CH_3OH
19		d.		d.		d. al.; i. eth., bz., chl.
20		expl. 175–180		s.	v.s.	
21		$-2C_2H_5OH$, 200	d.	d.	d.	v. s. al.; i. NH_3
22		d.		d.		d. al., eth.; s. diethylzinc; i. bz., lgr.
23		d.		s.		v. s. al., eth.; i. lgr.
24		$-H_2O$ over H_2SO_4	exp.	v. s.		
25		$-2H_2O$, 36; $-4H_2O$, 120	d.	5.97^{25}		sl. s. al.
26		$-H_2O$		v. s.		sl. s. h. al.
27			d.	d.	d.	0.08^{18} eth.
28				d.		s. eth., bz., liq. NH_3
29	1.334^{40}		132–5			
30			137–8	sl. s.		
31		sld. in liq. air	82, 94^{770}			
32		142 d.				s. al., eth.
33		92		s.	s.	s. al., eth.
34		134				s. al., eth.
35		127 d.		i.	v. sl. s.	s. chl., bz.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tellurium:			
1	Di-*p*-phenetyl ditelluride	$(C_2H_5OC_6H_4)_2Te_2$	497.53	or. brown need
2	Ditelluromethane	CH_2Te_2	269.25	dk. red amor. sld
3	Ethylmethyltellurophetone	$C_2H_5CTeCH_3$	183.71	dark yel. oil, 1.5055^{25}
	Thallium			
4	triethyl	$Tl(C_2H_5)_3$	291.57	yel. liq.
	Tin:			
5	Amyltetrathioorthostannate (*n*)	$Sn(SC_5H_{11})_4$	531.50	
6	Amyltetrathioorthostannate (*tert*)	$[CH_3CH_2C(CH_3)_2S]_4Sn$	531.50	
7	Bromobenzenetetrathioorthostannate (*p*)	$Sn(SC_6H_4Br)_4$	870.97	
8	Butylbenzenetetrathioorthostannate (*p*)	$Sn(SC_6H_4C_4H_9)_4$	779.76	
9	Butyltetrathioorthostannate (*n*)	$Sn(SC_4H_9)_4$	475.39	
10	Butyltetrathioorthostannate (*sec*)	$Sn(SC_4H_9)_4$	475.39	
11	Carbomethoxyphenyltrichlorostannane (*o*)	$(CH_3OCOC_6H_4)SnCl_3$	360.21	
12	Chlorobenzenetetrathioorthostannate (*p*)	$Sn(SC_6H_4Cl)_4$	693.14	
13	Cyclohexyltetrathioorthostannate	$Sn(SC_6H_{11})_4$	579.54	
14	Di-*o*-anisyldichlorostannane	$(CH_3OC_6H_4)_2SnCl_2$	403.87	
15	Dibenzyldiethylstannane	$(C_6H_5{\cdot}CH_2)_2Sn(C_2H_5)_2$	359.07	liq.
16	Dibenzylethylpropylstannane	$(C_6H_5{\cdot}CH_2)_2(C_2H_5)(C_3H_7)Sn$	373.10	liq.
17	Dibenzyltin acetate	$(C_6H_5CH_2)_2Sn(OCOCH_3)_2$	419.04	col. need. f. al
18	Dibenzyltin dibromide	$(C_6H_5{\cdot}CH_2)_2SnBr_2$	460.79	col. need. f. pet
19	Dibenzyltin dichloride	$(C_6H_5{\cdot}CH_2)_2SnCl_2$	371.87	col. need. f. acet.-HCl
20	Dibenzyltin diiodide	$(C_6H_5{\cdot}CH_2)_2SnI_2$	554.79	col. lng. silky yel. need. f. pet. eth.
21	Dibutyltin dibromide	$(C_4H_9)_2SnBr_2$	392.76	sm. need
22	Dibutyltin dichloride	$(C_4H_9)_2SnCl_2$	303.84	need
23	Dichlorodi-*m*-tolyl stannane	$(CH_3C_6H_4)_2SnCl_2$	371.87	
24	Diethyldibromodipyridinetin	$(C_2H_5)_2SnBr_2{\cdot}(C_5H_5N)_2$	494.85	
25	Diethyldiisoamyltin	$(C_2H_5)_2Sn(C_5H_{11})_2$	319.10	
26	Diethyldiisobutyltin	$(C_2H_5)_2Sn(C_4H_9)_2$	291.05	
27	Diethyldiphenyltin	$(C_2H_5)_2(C_6H_5)_2Sn$	331.02	
28	Diethylisoamyltin bromide	$(C_2H_5)_2(C_5H_{11})SnBr$	327.88	
29	Diethylisoamyltin chloride	$(C_2H_5)_2(C_5H_{11})SnCl$	283.42	
30	Diethylisobutyltin bromide	$(C_2H_5)_2(C_4H_9)SnBr$	313.85	
31	Diethyl-*n*-propyltin bromide	$(C_2H_5)_2(C_3H_7)SnBr$	299.82	
32	Diethyl-*n*-propyltin chloride	$(C_2H_5)_2(C_3H_7)SnCl$	255.36	
33	Diethyl-*n*-propyltin fluoride	$(C_2H_5)_2(C_3H_7)SnF$	238.91	
34	Diethyltin	$Sn(C_2H_5)_2$	176.82	sl. yel. oily liq.

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.666	108	d.>108	...	...	s. lgr.
2	...	d. 214	...	i.	i.	i.
3	1.8711	...	63–6	...	...	...
4	$1.957\frac{23}{23}$	−63	192	...	...	...
5	...	...	$162^{0.004}$	...	...	...
6	...	44	...	...	...	...
7	...	217	...	...	...	...
8	...	106	...	...	...	...
9	...	...	$136^{.001}$	...	...	...
10	...	...	$111^{.001}$	...	...	...
11	...	164	...	...	...	...
12	...	189	...	...	...	...
13	...	53–4	...	...	...	...
14	...	113	...	...	...	...
15	1.	<20	$223–4^{30}$	...	...	s. org. solv.
16	...	>0	$220–5^{15}$	...	...	misc. all org. solv.
17	...	136–7	...	...	...	s. acet., chl., bz.
18	...	130	...	...	...	s. acet., al., eth., chl., CCl_4
19	...	163–4	...	...	...	s. acet., al., eth., chl., CCl_4, h. ac. a.
20	...	86–7	...	...	...	s. acet., al., eth., chl., CCl_4
21	...	20	...	...	...	...
22	...	43	...	...	...	...
23	...	39–40	...	...	...	...
24	...	140	...	...	...	...
25	1.0725^{19}	...	$131^{13.5}$	...	...	...
26	1.1030	...	108.2^{13}	...	...	...
27	...	...	$154–6^{4}$	...	...	...
28	1.4881^{17}	...	137.5^{17}	...	...	...
29	$1.2994^{19.9}$	...	125.5^{13}	...	...	...
30	1.5108	...	122^{17}	...	...	...
31	1.5910^{21}	...	112.2^{16}	...	...	...
32	$1.3848^{15.7}$	...	108^{17}	...	...	...
33	...	271	...	...	...	6.93^{31} meth. al.; 3.78^{31} al.; $.05^{31}$ bz.
34	1.654	<−12	150 d.	i.	i.	s. bz., eth., lgr., chl., CCl_4

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Diethyltin dibromide	$(C_2H_5)_2SnBr_2$	336.65	col. need
2	Diethyltin dichloride	$(C_2H_5)_2SnCl_2$	247.74	wh. need
3	Diethyltin difluoride	$(C_2H_5)_2SnF_2$	214.82	sq. pl. or long rhomb. tab. f. meth. al.
4	Diethyltin diiodide	$(C_2H_5)_2SnI_2$	430.66	wh. need
5	Diethyltin oxide	$(C_2H_5)_2SnO$	192.82	wh. powd
6	Diisoamyltin dibromide	$(C_5H_{11})_2SnBr_2$	420.81	
7	Diisoamyltin dichloride	$(C_5H_{11})_2SnCl_2$	331.89	
8	Diisoamyltin diiodide	$(C_5H_{11})_2SnI_2$	514.82	oily liq
9	Diisobutyltin diiodide	$(C_4H_9)_2SnI_2$	486.76	
10	Diisopropyltin dibromide	$(C_3H_7)_2SnBr_2$	364.71	pale yel. hyg. cr
11	Diisopropyltin dichloride	$(C_3H_7)_2SnCl_2$	275.79	col. transp. cr
12	Diisopropyltin oxide	$(C_3H_7)_2SnO$	220.87	
13	Dimethyldibromodipyridinetin	$(CH_3)_2SnBr_2(C_5H_5N)_2$	466.80	
14	Dimethyldichlorodipyridinetin	$(CH_3)_2SnCl_2(C_5H_5N)_2$	377.88	
15	Dimethyldiethyltin	$(CH_3)_2Sn(C_2H_5)_2$	206.89	col. liq
16	Dimethyldiisobutyltin	$(CH_3)_2Sn(C_4H_9)_2$	262.99	
17	Dimethylethylpropyltin	$(CH_3)_2C_2H_5C_3H_7Sn$	220.92	
18	Dimethylethyltin iodide	$(CH_3)_2C_2H_5SnI$	304.75	1.5705^{18}
19	Dimethyltin	$[(CH_3)_2Sn]_x$	$(148.77)_x$	yel. sld
20	Dimethyltin dibromide	$(CH_3)_2SnBr_2$	308.60	col. pr
21	Dimethyltin dichloride	$(CH_3)_2SnCl_2$	219.68	
22	Dimethyltin difluoride	$(CH_3)_2SnF_2$	186.77	wh. fine pl
23	Dimethyltin diiodide	$(CH_3)_2SnI_2$	402.61	rhomb. wh
24	Dimethyltin oxide	$(CH_3)_2SnO$	164.77	wh. powd
25	Dimethyltin sulfide	$(CH_3)_2SnS$	180.83	
26	Di-α-naphthyltin	$Sn(C_{10}H_7)_2$	373.01	
27	Di (phenylthiol) diphenylstannane	$Sn(C_6H_5)_2(SC_6H_5)_2$	491.22	
28	Diphenyltin	$Sn(C_6H_5)_2$	272.90	yel. amor. powd
29	Diphenyltin dibromide	$(C_6H_5)_2SnBr_2$	432.73	col. cr
30	Diphenyltin dichloride	$(C_6H_5)_2SnCl_2$	343.82	col. cr
31	Diphenyltin difluoride	$(C_6H_5)_2SnF_2$	310.90	
32	Diphenyltin diiodide	$(C_6H_5)_2SnI_2$	526.74	col. cr
33	Diphenyltin hydroxychloride	$(C_6H_5)_2Sn(OH)Cl$	325.37	amor. wh. powd
34	Diphenyltin oxide	$(C_6H_5)_2SnO$	288.90	col. amor. powd
35	Di-*n*-propyldibromodipyridinetin	$(C_3H_7)_2SnBr_2(C_5H_5N)_2$	522.90	
36	Dipropyltin dibromide	$(C_3H_7)_2SnBr_2$	364.71	col. need
37	Dipropyltin dichloride	$(C_3H_7)_2SnCl_2$	275.79	col. cr
38	Dipropyltin difluoride	$(C_3H_7)_2SnF_2$	242.87	leaf
39	Dipropyltin diiodide	$(C_3H_7)_2SnI_2$	458.71	col. oily liq
40	Di-*m*-tolylstannane	$(CH_3C_6H_4)_2SnO$	316.95	wh. amor. infus
41	Di-*m*-tolyl thiostannane	$(CH_3C_6H_4)_2SnS$	333.01	
42	Di-*p*-tolyltin	$(CH_3C_6H_4)_2Sn$	300.95	or.-yel. amor. powd
43	Di-*o*-tolyltin dichloride	$(CH_3C_6H_4)_2SnCl_2$	371.87	
44	Di-*p*-tolyltin dichloride	$(CH_3C_6H_4)_2SnCl_2$	371.87	
45	Ditriphenylstannylmethane	$[(C_6H_5)_3Sn]_2CH_2$	714.03	wh. cr. sld
46	Di-*p*-xylyltin	$[(CH_3)_2C_6H_3]_2Sn$	329.01	
47	Dodecyltetrathioorthostannate (*n*)	$Sn(SC_{12}H_{25})_4$	924.23	

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	2.068^{74}	63	232–3	s.	s.	s. eth., org. solv.
2	....	84–5	220	s.	s.	s. HCl, org. solv.
3	....	229	....	....	....	$.45^{31}$ al.; 2.64^{31} meth. al.; $.047^{31}$ bz.
4	....	44.5–5.0	240–5 d.	v. sl. s.	sl. s.	s. org. solv.
5	....	infus.	....	i.	i.	s. HCl, dil. a., conc. alk.; i. org. solv.
6	....	−25 to −24	....	....	....	....
7	....	28	....	....	....	....
8	....	....	$202\text{–}5^{8}$	....	....	....
9	....	....	290–5	....	....	....
10	....	54	....	d.	d.	i. org. solv.
11	....	80–4	....	s.	s.	s. al., h. bz., glac. ac. a.
12	....	d.	....	i.	i.	s. h. HCl; i. org. solv., alk.
13	....	172	....	....	....	....
14	....	163	....	....	....	....
15	1.2319^{19}	<-13	144–6	i.	i.	s. org. solv.
16	$1.1179^{20.1}$	....	$85^{16.5}$	....	....	....
17	$1.2014\frac{20}{20}$	....	149–51	....	....	....
18	$2.0264\frac{20}{20}$	....	$77\text{–}8^{11}$; $185\text{–}7^{718}$	....	....	....
19	....	....	....	i.	i.	i. org. solv.
20	....	74–6	208–13	s.	s.	s. org. solv.
21	....	90 (107)	188–90	s.	....	s. org. solv.
22	....	....	d.<360	$4.66^{30.7}$	....	$.08^{31}$ al., 33^{31} meth. al.
23	2.872	43 (30)	228	sl. s.	s.	s. org. solv.
24	....	infus.	d.	i.	i.	s. a., NaOH; i. org. solv., NH_4OH
25	....	148	....	....	....	....
26	....	200	d. 255	....	....	....
27	....	65–65.5	....	....	....	....
28	....	225.7; (126–30)	....	i.	i.	s. chl., bz., eth.; i. abs. al.
29	....	38	230^{42}	....	....	s. al., eth.
30	....	42	333–7 d.	v. sl. s., d.	....	s. al., eth., lgr.
31	....	360	....	....	....	....
32	....	71–72	$176\text{–}82^{2}$	i.	i.	s. org. solv.
33	....	187	....	i.	i.	s. conc. a.; i. org. solv.
34	....	infus.	....	i.	i.	s. conc. a.; i. org. solv.
35	....	128	....	....	....	....
36	....	49	....	v. sl. s.	....	s. org. solv.
37	....	81	....	v. sl. s.	....	s. org. solv.
38	....	205	....	0.22^{32}	....	$.93^{32}$ al., 1.91^{32} meth. al.
39	....	<-15	270–3	i.	i.	s. org. solv.
40	....	....	....	i.	i.	s. min. a.; i. org. solv.
41	....	121.5–2	....	....	....	v. s. chl., bz., eth. acetate, pyr., eth.; s. HCl
42	....	111.5	d.<245	....	....	s. bz.
43	....	49–50	....	....	....	....
44	....	49–50	....	....	....	....
45	....	104.5	....	....	....	v. s. bz., eth., chl.; s. h. pet. eth.
46	....	157	d. 240	....	....	....
47	....	35.5	....	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Ethylchlorostannic acid	$H_2SnC_2H_5Cl_5$	327.06	col. deliq. pr
2	Ethyldiisoamyltin bromide	$(C_2H_5)(C_5H_{11})_2SnBr$	369.95	
3	Ethyldiisobutyltin bromide	$(C_2H_5)(C_4H_9)_2SnBr$	341.90	
4	Ethylmethylpropyltin iodide	$CH_3C_2H_5C_3H_7SnI$	332.80	1.5548^{17}
5	Ethyl-*n*-propyldiisoamyltin	$(C_2H_5)(C_3H_7)Sn(C_5H_{11})_2$	333.13	
6	Ethylpropyltin dichloride	$(C_2H_5)(C_3H_7)SnCl_2$	261.76	need. f. lt. pet
7	Ethyl stannic acid	$C_2H_5{\cdot}SnO{\cdot}OH$	180.77	wh. amor. gel or powd
8	Ethyltetrathioorthostannate	$Sn(SC_2H_5)_4$	363.18	
9	Ethyltin tribromide	$C_2H_5SnBr_3$	387.51	col. feath. cr
10	Ethyltin triiodide	$C_2H_5SnI_3$	528.52	
11	Ethyltri-*n*-butyltin	$C_2H_5(C_4H_9)_3Sn$	319.10	1.4732
12	Ethyltri-*n*-propyltin	$C_2H_5(C_3H_7)_3Sn$	277.02	
13	Hexadecyltetrathioorthostannate (*n*)	$Sn(SC_{16}H_{33})_4$	1148.65	
14	Hexaethyl distannane	$[Sn(C_2H_5)_3]_2$	411.76	
15	Hexaethylditin	$[(C_2H_5)_3Sn]_2$	411.76	liq
16	Hexaphenylditin	$[(C_6H_5)_3Sn]_2$	700.00	
17	Hexa-*p*-tolylditin	$[(C_6H_4CH_3)_3Sn]_2$	784.16	flat tabl. f. bz
18	Hexa-*p*-xylylditin	$[((CH_3)_2C_6H_3)_3Sn]_2$	868.32	flat rhomb. tabl. f. bz.-al
19	Isopropylstannic acid	$C_3H_7SnO{\cdot}OH$	194.79	wh. amor
20	Isopropyltetrathioorthostannate	$Sn(SC_3H_7)_4$	419.29	
21	Isopropyltin tribromide	$C_3H_7SnBr_3$	401.53	pa. yel. deliq., pr
22	Isopropyltin trichloride	$C_3H_7SnCl_3$	268.16	
23	Methylstannic acid	$(CH_3)SnOOH$	166.74	wh. amor. powd
24	Methyltetrathioorthostannate	$Sn(SCH_3)_4$	307.08	
25	Methyltin tribromide	CH_3SnBr_3	373.48	wh. need
26	Methyltin trichloride	CH_3SnCl_3	240.11	col. cr
27	Methyltin triiodide	CH_3SnI_3	514.49	lt. yel. need
28	Methyltribromodipyridinetin	$CH_3SnBr_3(C_5H_5N)_2$	531.68	
29	Methyltri-*n*-butyltin	$CH_3(C_4H_9)_3Sn$	305.07	1.4735
30	Methyltri-*n*-propyltin	$CH_3(C_3H_7)_3Sn$	262.99	
31	Phenylbenzyltin dichloride	$(C_6H_5)(C_6H_5CH_2)SnCl_2$	357.84	col. need. f. dil. HCl
32	Phenyltetrathioorthostannate	$Sn(SC_6H_5)_4$	555.34	
33	Phenyltin tribromide	$C_6H_5SnBr_3$	435.55	
34	Phenyltin trichloride	$C_6H_5SnCl_3$	302.17	
35	Phenyltribenzyltin	$(C_6H_5)Sn(C_6H_5CH_2)_3$	469.18	liq
36	Propyltetrathioorthostannate (*n*)	$Sn(SC_3H_7)_4$	419.29	
37	Propyltin triiodide	$C_3H_7SnI_3$	542.55	

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1		d.		d.		
2	1.3650		154–5^{16}			
3	1.4089$^{19.5}$		130.6^{13}			
4	1.8182$\frac{20}{20}$		108–11^{11}; 226–30^{720} sl. d.			
5	1.0654$^{21.9}$		141^{17}			
6		57–8		s.		s. eth., al.
7		d. below red heat		i.	i.	s. dil. min. a., KOH; i. al., eth., chl., xylene
8			105$^{.001}$			
9		310		s.		s. al.
10			181–4^{19}			
11	1.0783		129^{10}			
12			101^{10}			
13		53–54				
14			160^{23}			
15	1.412^{0}		d. 270			
16		232.5	d.$<$280			.029 eth.; 18.08 chl.; 7.82 bz.
17		143.5	d. 335			sl. s. bz., eth.; v. sl. s. abs. al.
18		192.5	d. 368			21$^{30.4}$ bz.
19		d.		i.		s. dil. min. a., KOH; i. org. solv.
20			92$^{.001}$			
21		112				s. glac. ac. a.; sl. s. h. bz., chl.; i. dry eth.
22			75^{16}			
23		infus.		i.	i.	s. a., alk.; i. org. solv.
24		31	81$^{.001}$			
25		53–5	210–11^{746}	s.		s. eth., al., bz., lgr., hyd. by alk.
26		43		s.		hyd. by alk.; s. org. solv.
27		86.5		s.	s.	s. eth., al., bz., chl., meth. al.
28		203				
29	1.0898$\frac{20}{4}$		121^{10}			
30			93^{10}			
31		83–4	80–100			
32		67				
33			182–3^{29}			
34			142–3^{25}	s.		
35			290^{5}			s. all ord. org. solv. except al.
36			123$^{.001}$			
37			d. 200^{16}			

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Propyltri-*n*-amyltin (*n*)	$C_3H_7(C_5H_{11})_3Sn$	375.20	1.4732
2	Stannic bisacetylacetone dibromide	$(C_5H_7O_2)_2SnBr_2$	476.75	col. six sided cr
3	Stannic bisacetylacetone dichloride	$(C_5H_7O_2)_2SnCl_2$	387.83	col. six sided cr
4	Stannic bisbenzoylacetone dibromide	$(C_{10}H_{16}O_2)_2SnBr_2$	614.99	pa. yel. powd
5	Stannic bisdibenzoylmethane dibromide	$(C_{15}H_{10}O_2)_2SnBr_2$	722.99	sulfur yel. cr
6	Stannic bis-3-ethylacetylacetone dibromide	$(C_7H_{11}O_2)_2SnBr_2$	532.85	col. six sided pr
7	Tetra-*dl*-amyltin	$Sn(C_5H_{11})_4$	403.26	1.4730
8	Tetra-*n*-amyltin	$Sn(C_5H_{11})_4$	403.26	col. stable liq., 1.4720
9	Tetraaquastannic bisacetylacetone stannibromide	$(C_5H_7O_2)_2Sn(OH_2)_4SnBr_6$	987.17	col. tab. pr
10	Tetrabenzyltin	$Sn(C_6H_5CH_2)_4$	483.21	col. pr. f. lt. pet
11	Tetra-*n*-butyltin	$Sn(C_4H_9)_4$	347.15	col. stable liq., 1.4730
12	Tetracyclohexyltin	$Sn(C_6H_{11})_4$	451.30	wh. micr. grains
13	Tetraethyltin	$Sn(C_2H_5)_4$	234.94	col. liq
14	Tetra-*n*-heptyltin	$Sn(C_7H_{15})_4$	515.47	1.4698
15	Tetra-*n*-hexyltin	$Sn(C_6H_{13})_4$	459.36	1.4706
16	Tetraisoamyltin	$Sn(C_5H_{11})_4$	403.26	liq
17	Tetraisobutyltin	$Sn(C_4H_9)_4$	347.15	col. liq
18	Tetramethyltin	$Sn(CH_3)_4$	178.84	col. liq
19	Tetra-*n*-octyltin	$Sn(C_8H_{17})_4$	571.57	1.4691
20	Tetraphenyltin	$Sn(C_6H_5)_4$	427.10	tetr. col. f. xylene
21	Tetrapropyltin	$Sn(C_3H_7)_4$	291.05	col. liq
22	Tetra-*o*-tolyltin	$Sn(C_6H_4CH_3)_4$	483.21	wh. cr. powd
23	Tetra-*m*-tolyltin	$Sn(C_6H_4CH_3)_4$	483.21	col. need
24	Tetra-*p*-tolyltin	$Sn(C_6H_4CH_3)_4$	483.21	col. need
25	Tetra-*m*-xylyltin	$[(CH_3)_2C_6H_3]_4Sn$	539.31	rhomb. need. f. bz.-al
26	Tetra-*p*-xylyltin	$[(CH_3)_2C_6H_3]_4Sn$	539.31	wh. quad. pr
27	Tolylstannonic acid (*o*)	$CH_3C_6H_4SnO_2H$	242.83	amor. powd
28	Tolylstannonic acid (*m*)	$CH_3C_6H_4SnO_2H$	242.83	
29	Tolyltetrathioorthostannate (*p*)	$Sn(SCH_3C_6H_4)_4$	611.45	
30	Tolyltin trichloride (*o*)	$CH_3C_6H_4SnCl_3$	316.20	
31	Tolyltin trichloride (*p*)	$CH_3C_6H_4SnCl_3$	316.20	
32	Tolyltrichlorostannane (*m*)	$CH_3C_6H_4SnCl_3$	316.20	col. liq
33	Tri-*n*-amyltin bromide	$(C_5H_{11})_3SnBr$	412.03	1.4963
34	Tribenzylethyltin	$(C_6H_5CH_2)_3(C_2H_5)Sn$	421.14	col. tabl. f. al.-lt. pet
35	Tribenzyltin chloride	$(C_6H_5CH_2)_3SnCl$	427.54	wh. need
36	Tribenzyltin hydroxide	$(C_6H_5CH_2)_3SnOH$	409.09	rhomb., col. tabl
37	Tribenzyltin iodide	$(C_6H_5CH_2)_3SnI$	519.00	need. like pr. f. glac. ac. a
38	Tri-*n*-butyltin bromide	$(C_4H_9)_3SnBr$	369.95	1.5000
39	Triethyl-*n*-amyltin	$(C_2H_5)_3C_5H_{11}Sn$	277.02	

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.0368	....	163^{10}	....	....	....
2	....	....	187	....	....	s. bz., chl., acet.; sl. s eth., CCl_4
3	....	....	202–3	s.	....	s. bz., acet.
4	....	....	213–4	....	....	sl. s. org. solv.
5	....	....	276–8	i.	....	sl. s. org. solv.
6	....	164–6	....	....	....	s. e. chl., bz.; sl. s. lt. pet.
7	1.0222	....	174^{10}	....	....	....
8	1.0206	....	181^{10}	....	....	....
9	....	105–7	....	....	....	s. bz.
10	....	42–3	....	i.	i.	s. common org. solv.; sl. s. lt. pet.
11	1.0572	....	145^{10}	....	....	....
12	....	263–4	....	i.	i.	6.25^{30} bz.; $.086^{30}$ al.; s. chl., CS_2
13	1.187^{23}	−112	181	i.	i.	s. org. solv.
14	0.9748	....	239^{10}	....	....	....
15	0.9959	....	209^{10}	....	....	....
16	$1.035^{19.6}$	....	188^{24}	....	....	....
17	1.054^{23}	−13	267; $143^{16.5}$	i.	i.	s. org. solv.
18	1.314^{0}	....	78	i.	i.	s. org. solv.
19	0.9605	....	268^{10}	....	....	....
20	1.490^{0}	226	>420	i.	i.	s. h. bz., pyr., CCl_4, chl., ac. a.; sl. s. al.
21	$1.1065^{20.2}$	....	222–5	i.	i.	s. org. solv.
22	....	158–9 (215)	....	i.	i.	s. bz., eth.; i. al.
23	....	128.5	....	i.	i.	s. bz., h. eth., h. al.
24	....	230–3	....	i.	i.	s. bz., chl., CS_2, pyr.; sl. s. al., eth.
25	....	219.5	d. 360	....	....	$.314^{30}$ al.; 5.28^{30} eth.; 35.1^{30} bz.; 43.2^{30} chl.
26	....	272–3	d. 360	i.	i.	$.015^{30}$ al.; 1.73^{30} bz.; 2.80^{30} chl., $.29^{30}$ eth.; $.017^{30}$ meth. al.
27	....	d. 295	....	....	....	....
28	....	....	d. 295	i.	i.	s. c. meth. al., al., eth., chl., eth. acet., pyr., a. and bases; i. pet. eth.
29	....	100	....	....	....	....
30	1.7619	....	$154–8^{20}$	....	....	....
31	1.7522	....	$156–7^{23}$	sl. d.	....	....
32	1.7516	<−20	$150–1^{23}$	....	....	....
33	1.2678	....	....	....	....	....
34	....	31–2	....	....	....	s. eth., bz., chl.; sl. s. al.
35	....	142–4	d.	i.	i.	s. ac. a., acet., bz., eth., chl., pyr.; i. al.
36	....	117–21	....	....	....	s. h. al., CS_2, bz.; sl. s eth., lgr.; i. KOH
37	....	102–3	....	....	....	....
38	1.3365	....	....	....	....	....
39	....	....	102^{10}	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Triethyl (*p*-dimethylaminophenyl) stannane	$(C_2H_5)_3(CH_3)_2NC_6H_4Sn$	326.05	1.5610^{22}
2	Triethyl-*o*-hydroxyphenyl stannane	$(C_2H_5)_3OHC_6H_4Sn$	298.98	1.5377^{25}
3	Triethylisoamyltin	$(C_2H_5)_3Sn(C_5H_{11})$	277.02	
4	Triethylisobutyltin	$(C_2H_5)_3Sn(C_4H_9)$	262.99	
5	Triethylphenyltin	$(C_2H_5)_3(C_6H_5)Sn$	282.98	col. liq
6	Triethyl-*n*-propyltin	$(C_2H_5)_3Sn(C_3H_7)$	248.97	
7	Triethyltin	$Sn(C_2H_5)_3$	205.88	col. liq
8	Triethyltin bromide	$(C_2H_5)_3SnBr$	285.80	col. liq
9	Triethyltin chloride	$(C_2H_5)_3SnCl$	241.34	col. liq
10	Triethyltin ethoxide	$(C_2H_5)_3Sn(OC_2H_5)$	250.94	col. liq
11	Triethyltin hydroxide	$(C_2H_5)_3SnOH$	222.89	col. cr
12	Triethyltin iodide	$(C_2H_5)_3SnI$	332.80	col. liq
13	Triisoamyltin bromide	$(C_5H_{11})_3SnBr$	412.03	
14	Triisoamyltin chloride	$(C_5H_{11})_3SnCl$	367.57	
15	Triisoamyltin fluoride	$(C_5H_{11})_3SnF$	351.12	need
16	Triisoamyltin iodide	$(C_5H_{11})_3SnI$	459.04	
17	Triisobutylethyltin	$(C_4H_9)_3Sn(C_2H_5)$	319.10	
18	Triisobutylisoamyltin	$(C_4H_9)_3Sn(C_5H_{11})$	361.18	
19	Triisobutyltin bromide	$(C_4H_9)_3SnBr$	369.95	
20	Triisobutyltin chloride	$(C_4H_9)_3SnCl$	325.50	
21	Triisobutyltin fluoride	$(C_4H_9)_3SnF$	309.04	fine long pr
22	Triisobutyltin iodide	$(C_4H_9)_3SnI$	416.96	col. liq
23	Triisopropyltin bromide	$(C_3H_7)_3SnBr$	327.88	
24	Triisopropyltin iodide	$(C_3H_7)_3SnI$	374.88	
25	Trimethylethyltin	$(CH_3)_3(C_2H_5)Sn$	192.86	col. liq
26	Trimethyltin	$Sn(CH_3)_3$	163.80	col. liq
27	Trimethyltin bromide	$(CH_3)_3SnBr$	243.72	col. cr. or liq
28	Trimethyltin chloride	$(CH_3)_3SnCl$	199.26	col. cr
29	Trimethyltin fluoride	$(CH_3)_3SnF$	182.80	wh. short. thick rect. pr
30	Trimethyltin hydride	$(CH_3)_3SnH$	164.81	col. oily liq
31	Trimethyltin hydroxide	$(CH_3)_3SnOH$	180.81	col. pr
32	Trimethyltin iodide	$(CH_3)_3SnI$	290.72	col. liq
33	Trimethyltin oxide	$[(CH_3)_3Sn]_2O$	343.61	wh. amor. powd
34	Trimethyltin sulfide	$[(CH_3)_3Sn]_2S$	359.67	lt. yel. oil
35	Triphenylbenzyltin	$(C_6H_5)_3Sn(C_6H_5CH_2)$	441.13	col. pl. f. al
36	Triphenylethyltin	$(C_6H_5)_3SnC_2H_5$	379.06	wh. pr. f. al
37	Triphenylmethyltin	$(C_6H_5)_3SnCH_3$	365.04	col. tetr. f. eth
38	Triphenyl-α-naphthyltin	$(C_6H_5)_3Sn(C_{10}H_7)$	477.16	col. pr
39	Triphenyltin	$Sn(C_6H_5)_3$	350.00	wh. powd
40	Triphenyltin bromide	$(C_6H_5)_3SnBr$	429.92	col. cr
41	Triphenyltin chloride	$(C_6H_5)_3SnCl$	385.46	col. cr
42	Triphenyltin fluoride	$(C_6H_5)_3SnF$	369.00	fine pr
43	Triphenyltin hydroxide	$(C_6H_5)_3SnOH$	367.01	
44	Triphenyltin iodide	$(C_6H_5)_3SnI$	476.92	4-sided monocl. wh
45	Triphenyl-*p*-tolyltin	$(C_6H_5)_3Sn(C_7H_7)$	441.13	need. f. eth
46	Triphenyl-*p*-xylyltin	$(C_6H_5)_3Sn[C_6H_3(CH_3)_2]_2$	560.31	col. lng. hex. sheets f. al
47	Tri-*n*-propyl-*n*-butyl tin	$(C_3H_7)_3C_4H_9Sn$	305.07	
48	Tri-*n*-propylethyltin	$(C_3H_7)_3Sn(C_2H_5)$	277.02	
49	Tri-*n*-propylisobutyltin	$(C_3H_7)_3Sn(C_4H_9)$	305.07	
50	Tripropyltin chloride	$(C_3H_7)_3SnCl$	283.42	col. liq
51	Tri-*n*-propyltin chloride	$(C_3H_7)_3SnCl$	283.42	

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	1.2425	....	$172\text{–}3^{3}$	....	....	....
2	1.3229^{25}	....	$197\text{–}200^{3}$	....	....	....
3	$1.1203^{20.1}$	....	$111^{18.5}$	....	....	....
4	$1.139^{20.3}$	....	96.5^{17}	....	....	....
5	1.2639	....	254	i.	i.	s. al., eth., org. solv.
6	$1.1680^{20.6}$	....	82^{13}	....	....	....
7	1.3774	<-75	161^{23}	i.	i.	s. al., org. solv.
8	1.630	−13.5	223–4	v. sl. s.	....	s. org. solv.
9	1.428^{8}	10 (15.5)	208–10	i.	....	s. org. solv.
10	1.2634	....	190	d.	....	s. org. solv.
11	....	43	271	s.	s.	s. org. solv.
12	1.833	−34.5	225 (231)	v. sl. s.	....	s. org. solv.
13	$1.2613^{20.7}$	21	177^{15}	....	....	....
14	$1.1290^{34.2}$	−30.2	174^{13}	....	....	....
15	....	288	....	....	....	1.03^{31} al.; $.967^{31}$ bz.; 1.22^{31} meth. al.
16	$1.3777^{25.5}$	−22	182^{13}	....	....	....
17	1.0779^{21}	....	125^{16}	....	....	....
18	$1.0356^{26.8}$	....	$152.9^{16.5}$	....	....	....
19	1.3523	−26.5	148^{13}	....	....	....
20	$1.1290^{34.2}$	+30.2	174^{13}	....	....	....
21	....	244	....	....	....	$.414^{32}$ al.; 0.614^{32} meth. al.; $.1^{32}$ bz.
22	$1.378^{25.5}$	−22	284–6	....	....	s. eth., org. solv.
23	$1.4263^{25.2}$	−49	133^{12}	....	....	s. org. solv.
24	$1.4378^{22.2}$	....	151^{13}	....	....	....
25	....	....	108.2	i.	i.	s. org. solv.
26	1.570^{25}	23	182	i.	i.	s. org. solv.
27	....	27	165	s.	s.	s. org. solv.
28	....	37	....	s.	s.	s. org. solv.
29	....	360 seal. tube	d. <375	....	....	2.45^{31} meth. al.; 1.08^{31} al.; 0.05^{31} bz.
30	....	....	60	v. sl. s.	....	s. org. solv.
31	....	118 d.	subl. > 80	s.	s.	s. a., al., bz., chl., CCl_4, alk.
32	2.1432	3.4	170	v. sl. s.	....	s. bz., al., eth., acet.
33	....	d.	....	i.	i.	s. a., alk.; i. org. solv.
34	1.649^{25}	6	233.5	i.	....	s. org. solv., HNO_3
35	....	90	250^{3}	....	....	s. org. solv. except al.
36	1.2953^{62}	56	....	....	....	....
37	$1.3113^{63.85}$	60–1	....	....	....	s. bz., chl., eth.
38	....	125	....	....	....	s. bz., chl., eth.
39	....	232.5	d. 280	i.	i.	$.079^{30}$ al.; 7.82^{30} bz.; $.92^{30}$ eth.; 18.1^{30} chl.
40	....	120.5	$249^{13.5}$	i.	i.	s. al., eth., org. solv.
41	....	106	$240^{13.5}$	i.	i.	s. org. solv.
42	....	357	....	sl. s.	....	sl. s. c. al., eth.
43	....	118	....	....	....	....
44	....	121	$253^{13.5}$	i.	i.	s. org. solv.
45	....	124	....	....	....	s. bz., chl., eth.
46	....	100.5	....	....	....	s. bz., eth., chl.
47	....	....	121^{10}	....	....	....
48	$1.1225^{21.8}$	....	$117.5^{23.3}$	....	....	....
49	$1.0841^{24.1}$	....	128^{18}	....	....	....
50	1.2678^{28}	−23.5	....	....	....	s. org. solv.
51	1.2678^{28}	−23.5	123^{13}	....	....	....

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
	Tin:			
1	Tri-*n*-propyltin fluoride	$(C_3H_7)_3SnF$	266.96	flat pr
2	Tri-*n*-propyltin iodide	$(C_3H_7)_3SnI$	374.88	col. liq
3	Tri-*o*-tolyltin bromide	$(C_6H_4CH_3)_3SnBr$	472.00	rhomb. tabl. f. al
4	Tri-*p*-tolyltin bromide	$(C_6H_4CH_3)_3SnBr$	472.00	rhbdr. f. al
5	Tri-*o*-tolyltin chloride	$(C_6H_4CH_3)_3SnCl$	427.54	short. thick pr. f. al
6	Tri-*m*-tolyltin chloride	$(CH_3C_6H_4)_3SnCl$	427.54	
7	Tri-*p*-tolyltin chloride	$(C_6H_4CH_3)_3SnCl$	427.54	rhomb. pl. f. al
8	Tri-*p*-tolyltin fluoride	$(C_6H_4CH_3)_3SnF$	411.08	hairlike felted need
9	Tri-*p*-tolyltin hydroxide	$(CH_3C_6H_4)_3SnOH$	409.09	
10	Tri-*o*-tolyltin iodide	$(C_6H_4CH_3)_3SnI$	519.00	rhomb. cr. fr. al.-eth
11	Tri-*p*-tolyltin iodide	$(C_6H_4CH_3)_3SnI$	519.00	rhomb. pl. fr. eth.-al
12	Tritriphenylstannylmethane	$[(C_6H_5)_3Sn]_3CH$	1063.02	wh. cr. sld
13	Tri-*p*-xylyltin bromide	$[(CH_3)_2C_6H_3]_3SnBr$	514.07	lng. hex. cr. f. al
14	Tri-*p*-xylyltin chloride	$[(CH_3)_2C_6H_3]_3SnCl$	469.62	6-cornered col. f. al
15	Tri-*m*-xylyltin fluoride	$[(CH_3)_2C_6H_3]_3SnF$	453.16	fine felted need
16	Tri-*p*-xylyltin fluoride	$[(CH_3)_2C_6H_3]_3SnF$	453.16	fine lng. need
17	Tri-*p*-xylyltin iodide	$[(CH_3)_2C_6H_3]_3SnI$	561.08	hex. tabl. f. al
	Zinc:			
18	Di-*n*-butylzinc	$Zn(CH_2CH_2CH_2CH_3)_2$	179.61	liq
19	Diethylzinc	$Zn(C_2H_5)_2$	123.50	col. liq. ign. in air or Cl
20	Dimethylzinc	$Zn(CH_3)_2$	95.45	col. liq
21	Diphenylzinc	$Zn(C_6H_5)_2$	219.58	wh. cr
22	Di-*n*-propylzinc	$Zn(CH_2CH_2CH_3)_2$	151.55	liq
23	Di-*o*-tolylzinc	$Zn(C_6H_4CH_3)_2$	247.63	wh. cr

METAL-ORGANIC COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	......	275	......	......	......	4.26^{31} meth. al.; 2.73^{31} al.; 0.118^{31} bz.
2	1.692^{16}	−53	260–2; 141^{13}	......	......	s. org. solv.
3	......	99.5	......	......	......	s. bz., eth.; sl. s. al.
4	......	98.5	......	......	......	s. bz., eth.; sl. s. al.
5	......	99.5	......	......	......	s. bz., eth.; sl. s. al.
6	......	108	......	......	......	......
7	......	97.5	......	......	......	sl. s. al., bz., eth.
8	......	305	......	......	......	s. al.
9	......	108–9	......	......	......	......
10	......	119.5	......	......	......	s. bz., eth.; sl. s. al.
11	......	120.5	......	......	......	s. bz.-eth.; sl. s. al.
12	......	128	......	i.	i.	v. s. bz., eth., chl.; s. h pet. eth.; sl. s. c. pet. eth., al.
13	......	151	......	......	......	s. bz., chl., eth.; i. c. al.
14	......	141.5	......	......	......	s. bz., chl., eth.; i. c. al.
15	......	205	......	......	......	s. bz., eth., al.
16	......	247	......	......	......	sl. s. bz., h. eth., al.
17	......	159.5	......	......	......	s. bz., chl., eth.; i. c. al.
18	......	......	81–2^{9}	d.	......	......
19	1.182^{18}	......	118	d.	......	......
20	1.386$^{10.5}$	−42.2	46	d.	......	d. al., a.; s. eth.
21	......	107	......	d.	......	s. xylene
22	......	......	146; 39–40^{9}	d.	......	......
23	......	207–10	......	......	......	s. xylene; v. sl. s. pet. eth.

PHYSICAL CONSTANTS OF

Compiled by Doctor Thomas R. P. Gibb, Jr.

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	Barium hydride	BaH_2	139.38	ortho., white
2	Cesium hydride	CsH	133.92	f. c. c., white
3	Cuprous hydride	CuH	64.55	yellow-brown hex
4	Hafnium hydride	HfH_2	180.60	tetrag. metallic
5	Lithium alumino hydride	$LiAlH_4$	34.32	
6	Lithium borohydride	$LiBH_4$	21.79	ortho white
7	Lithium hydride	LiH	7.95	f. c. c., white
8	Magnesium hydride	MgH_2	26.34	tetrag. white
9	Potassium borohydride	KBH_4	53.95	wh. cubic
10	Potassium hydride	KH	40.11	f. c. c. white
11	Rubidium hydride	RbH	86.49	f. c. c. white
12	Sodium borohydride	$NaBH_4$	37.84	cubic, white
13	Sodium hydride	NaH	24.00	cubic, white needles
14	Strontium hydride	SrH_2	89.65	ortho, white
15	Thorium dihydride	ThH_2	234.07	tetrag., black or metallic
16	Thorium tetrahydride	Th_4H_{15}	943.32	(ortho) black or metallic also cubic
17	Uranium trihydride(β)	UH_3	241.09	cubic, black or metallic

INORGANIC HYDRIDES

Compiled by Doctor Thomas R. P. Gibb, Jr.

No.	Sp. gr. or density	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
				Cold water	Hot water	Alcohol, acids, etc.
1	4.21 4.156 x-ray	dec. >300°C	....	reacts	reacts	....
2	3.41	dec.	....	reacts	reacts	....
3	6.29 (6.38)	dec. slowly 25°C	....	i.	dec.	....
4	11.48	dec. >400°C	....	i.	i.	....
5	0.917	150°C (dec)	....	reacts	reacts	ether v. sol.
6	0.67 0.666 x-ray	280	dec. 281	reacts slowly	reacts	s. ether, amines
7	0.78 0.776 x-ray	689	dec.	reacts	reacts	....
8	1.419	dec. >200°	....	reacts	reacts	....
9	1.177	dec. >400°	....	sol. (reacts)	reacts	isopropylamine v. s.
10	1.43	dec.	....	reacts	reacts	....
11	2.60	dec.	....	reacts	reacts	....
12	1.074	....	dec. ca. 400°	....	reacts	liq. NH_3 cellosolve ethers
13	1.396 1.364 x-ray	dec. >300°	....	reacts	reacts	....
14	3.27	dec. red hot	....	reacts	reacts	....
15	8.24	dec.	....	....	....	....
16	8.24	dec.	....	reacts	reacts	....
17	10.5 10.9 x-ray	dec. >300°	....	reacts	reacts	....

PHYSICAL AND CHEMICAL CONSTANTS OF THE RARE EARTH METALS (1956)

Table prepared by Ames Laboratory U. S. Atomic Energy Commission

	Element	M.P. °K	B.P. °K	Transition Temp. °K	ΔH vap. Kcal/mole	ΔH fusion Kcal/mole	Crystal Structure (Room Temp. Form)	Lattice Constants Å	
								a₀	c₀
1	Sc	1820–1870	2750	.....	73*	3.8*	h.c.p.	3.3090	5.2733
2	Y	~1820	3300	.....	80*	4.1*	h.c.p.	3.6474	5.7306
3	La	1193†	4500	573–623 1141†	81	2.4*	hex f.c.c.	3.770 5.302Å	12.159
4	Ce	1077†	3200	1027†	79	2.2*	f.c.c.	5.1612	....
5	Pr	1208†	3290	1071†	79	2.4*	hex	3.6725	11.835
6	Nd	1297†	3450	1141†	69	2.6*	hex	3.6579	11.799
7	Pm	1570*	3000*	.....	70*	3.0*	......	.....	....
8	Sm	1325†	1900*	1190†	46*	2.6*	Rhom	8.996	$\alpha = 23°13'$
9	Eu	<1170	1700*	.....	~40	2.5*	b.c.c.	4.606	....
10	Gd	~1520	3000*	.....	72*	3.7*	h.c.p.	3.6360	5.7826
11	Tb	1638†	2800*	1583†	70	3.9*	h.c.p.	3.6010	5.6936
12	Dy	~1670	2600	.....	67	4.1*	h.c.p.	3.5903	5.6475
13	Ho	~1770	2600*	.....	67*	4.1*	h.c.p.	3.5773	5.6158
14	Er	1770–1820	2900*	.....	70*	4.1*	h.c.p.	3.5588	5.5874
15	Tm	1820–1920	2400	.....	56*	4.4*	h.c.p.	3.5375	5.5546
16	Yb	1097†	1800*	1071†	40	2.2*	f.c.c.	5.4862	....
17	Lu	1920–2020	2200*	.....	59*	4.6*	h.c.p.	3.5031	5.5509

* Best estimated values from Ames Laboratory experience, and literature.
† Determined by thermal analysis.

PHYSICAL AND CHEMICAL CONSTANTS OF THE RARE EARTH METALS (1956) (Continued)

	Density g/cm³	Compressibility Room Temp. (3) cm²/Kg × 10⁶	Results from Sound Velocity Measurements				Spectrographic states for trivalent Ion	Experimental Entropy, 300°K
			Debye Temperature	Young's Modulus Kg/cm² × 10⁻⁵	Shear Modulus Kg/cm² × 10⁻⁵	Poisson's Ratio		
1	3.016	....	....	....	....	....	....	....
2	4.472	2.96	....	8.33	3.29	0.265	....	....
3	6.162 6.190	4.06	162	3.66	1.42	0.288	$^1S_0$	13.64
4	6.768	3.87	118	3.11	1.26	0.235	$^2F_{\frac{5}{2}}$	16.68
5	6.769	3.67	143	3.58	1.38	0.301	$^3H_4$	17.49
6	7.007	3.19	148	3.86	1.48	0.310	$^4I_{\frac{9}{2}}$	17.54
7	....	....	....	....	....	....	....	....
8	7.540	3.71	....	....	....	....	$^6H_{\frac{5}{2}}$	....
9	5.166	....	....	....	....	....	....	....
10	7.868	2.58	176	5.78	2.29	0.259	$^8S_{\frac{7}{2}}$	15.83
11	8.253	....	175	5.91	2.34	0.264	$^7F_6$	....
12	8.556	2.74	182	6.45	2.60	0.243	$^6H_{\frac{15}{2}}$	17.91
13	8.799	2.66	....	....	....	....	$^5I_8$	17.91
14	9.058	2.63	192	7.56	3.06	0.238	$^4I_{\frac{15}{2}}$	17.52
15	9.318	2.72	....	....	....	....	$^3H_6$	....
16	6.959	8.00	....	....	....	....	....	....
17	9.849	2.32	....	....	....	....	$^1S_0$	....

PHYSICAL CONSTANTS OF

Compiled by Wesley W. Wendlandt

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
1	**Lanthanum**	La	138.92	
2	bromide	$LaBr_3$	378.68	
3	chloride	$LaCl_3$	245.30	
4	fluoride	LaF_3	195.92	
5	iodide	LaI_3	519.61	
6	**Cerium (III)**	Ce	140.13	
7	bromide	$CeBr_3$	379.89	
8	chloride	$CeCl_3$	246.51	
9	fluoride	CeF_3	197.13	
10	iodide	CeI_3	520.86	
11	cerium (IV) fluoride	CeF_4	216.13	
12	**Praseodymium**	Pr	140.92	
13	bromide	$PrBr_3$	380.68	
14	chloride	$PrCl_3$	247.30	
15	fluoride	PrF_3	197.92	
16	iodide	PrI_3	521.65	
17	**Neodymium**	Nd	144.27	
18	acetylacetonate	$Nd[CH(COCH_3)_2]_3$	441.73	pink
19	bromide	$NdBr_3$	384.03	lavender
20	chloride	$NdCl_3$	250.65	lavender
21	chromate	$Nd(CrO_4)_3 \cdot 8H_2O$	780.73	yell
22	cobaltous nitrate	$Co_3[Nd(NO_3)_6] \cdot 24H_2O$	1641.96	wine red cryst
23	dimethylphosphate	$Nd[(CH_3)_2PO_4]_3$	519.38	pale-lilac hex. plates
24	fluoride	NdF_3	201.27	pale-lilac
25	iodide	NdI_3	525.00	
26	kojate	$Na(C_6H_5O_4)_3$	567.60	light choc
27	magnesium nitrate	$2Nd(NO_3)_3 \cdot 3Mg(NO_3)_2 \cdot 24H_2O$	1538.10	violet red
28	manganous nitrate	$2Nd(NO_3)_3 \cdot 3Mn(NO_3)_2 \cdot 24H_2O$	1629.93	violet red
29	nickel nitrate	$2Nd(NO_3)_3 \cdot 3Ni(NO_3)_2 \cdot 24H_2O$	1641.21	bluish-green
30	**Samarium (II)**	Sm	150.35	
31	bromide	$SmBr_2$	310.19	dk. brown
32	chloride	$SmCl_2$	221.27	dk. brown
33	fluoride	SmF_2	188.35	
34	iodide	SmI_2	404.17	dk. brown
	Samarium (III)			
35	benzoylacetonate	$Sm(C_{10}H_9O_2)_3 \cdot 2H_2O$	669.71	straw color
36	bromide	$SmBr_3$	390.11	
37	chloride	$SmCl_3$	256.73	
38	chromate	$Sm_2(CrO_4)_3 \cdot 8H_2O$	937.21	yell
39	dimethylphosphate	$Sm[(CH_3)_2PO_4]_3$	480.49	cream colored, hex. prisms
40	fluoride	SmF_3	207.35	
41	iodide	SmI_3	531.08	
42	kojate	$Sm(C_6H_5O_4)_3$	573.76	cream yell
43	oxide	Sm_2O_3	348.70	
44	**Europium (II)**	Eu	152.0	
45	bromide	$EuBr_2$	311.84	
46	chloride	$EuCl_2$	222.92	white amorph
47	fluoride	EuF_2	190.00	bright yellow
48	iodide	EuI_2	305.82	
49	sulfate	$EuSO_4$	248.07	colorless orthorhombic
	Europium (III)			
50	bromide	$EuBr_3$	391.76	
51	chloride	$EuCl_3$	258.38	colorless
52	fluoride	EuF_3	209.00	colorless
53	iodide	EuI_3	532.73	
54	nitrate	$Eu(NO_3)_3 \cdot 6H_2O$	338.03	colorless
55	sulfate-8-hydrate	$Eu_2(SO_4)_3 \cdot 8H_2O$	736.37	pale pink, monoclinic

No.	Sp. gr. or density	Melting point °C	Boiling point °C	Solubility in grams per 100 g		
				Cold water	Hot water	Alcohol, acids, etc.
1	6.162	920	4200	i.	i.	s. a.
2	...	783	1570	s.	s.	...
3	...	852	1750	s.	s.	...
4	...	1430	2330	i.	i.	...
5	...	761	1400	s.	s.	...
6	6.768	807	2900	i.	i.	s. a.
7	...	732	1550	s.	s.	...
8	...	802	1730	s.	s.	...
9	...	1460	2300	i.	i.	...
10	...	752	1390	s.	s.	...
11	...	977	dec.	i.	...	...
12	6.769	935	3020	i.	i.	s. a.
13	...	693	1550	s.	s.	...
14	...	776	1700	s.	s.	...
15	...	1370	2300	i.	i.	...
16	...	733	1380	s.	s.	...
17	7.007	1024	3180	i.	i.	s. a.
18	1.618	150–152	...	...	...	...
19	...	684	1540	s.	s.	...
20	...	760	1690	s.	s.	...
21	...	...	...	0.027	...	...
22	2.195	98.5	...	72.4^{30°	...	...
23	...	...	...	56.1^{25°	22.3^{100°	...
24	...	1410	2300	i.	i.	...
25	...	775	1370	s.	s.	...
26	...	275(d)	...	insol.	...	...
27	2.020	109	...	69.5^{30°	...	...
28	2.114	77	...	77.4^{30°	...	...
29	2.202	105.6	...	71.5^{30°	...	...
30	7.540	1052	1600	i.	i.	s. a.
31	5.1	700	1880	d.	...	...
32	...	740	>2000	d.	...	...
33	...	1377	>2400	...	...	...
34	...	527	1580	d.	...	...
35	...	103–5	...	iH_2O	...	solg. org. solv.
36	...	664	dec.	s.	s.	...
37	...	678	dec.	s.	s.	...
38	...	...	...	0.043^{25°	...	...
39	...	...	...	35.2^{25°	10.8^{95°	...
40	...	1397	>2300	i.	i.	...
41	...	820	dec.	s.	s.	...
42	...	275 (d)	...	insol.	...	...
43	...	2300 ± 50	...	...	...	...
44	5.166	<900	1400	...	...	...
45	...	677	1880	s.	s.	...
46	...	727	>2000	s.	s.	s. a.
47	6.495	1380	>2400	i.	i.	...
48	...	527	1580	s.	s.	...
49	4.989 (20°)	...	...	i.	i.	i. dil. a.
50	...	702	dec.	s.	s.	...
51	...	623	dec.	s.	s.	...
52	...	1390	2280	i.	i.	i. dil. a.
53	...	877	dec.	s.	s.	...
54	...	85 (sealed) tube)	...	v. s.	v. s.	...
55	...	...	...	2.563^{20°	1.93^{40°	...

No.	Name	Formula	Mol. wt.	Crystalline form, color and index of refraction
56	**Gadolinium**	Gd	157.26	
57	acetylacetonate 3-hydrate	$Gd[(CH(COCH_3)_2]_3 \cdot 3H_2O$	508.63	
58	bromide	$GdBr_3$	397.02	
59	chloride	$GdCl_3$	263.64	
60	cobaltous nitrate hydrate	$Co_3[Gd(NO_3)_6] \cdot 24H_2O$	1667.82	pale red
61	dimethylphosphate	$Gd[(CH_3)_2PO_4]_3$	532.37	
62	fluoride	GdF_3	214.26	
63	iodide	GdI_3	537.99	citron-yell
64	oxide	Gd_2O_3	362.52	
65	**Terbium**	Tb	158.93	
66	bromide	$TbBr_3$	398.69	
67	chloride	$TbCl_3$	265.31	colorless cryst
68	dimethylphosphate	$Tb[(CH_3)_2PO_4]_3$	534.04	
69	fluoride	TbF_3	215.93	colorless cryst
70	iodide	TbI_3	539.66	
71	oxalate	$Tb_2(C_2O_4)_3 \cdot 10H_2O$	762.05	white
72	oxide	Tb_4O_7	747.72	dark brown-black
73	**Dysprosium**	Dy	162.51	
74	bromide	$DyBr_3$	402.27	colorless
75	chloride	$DyCl_3$	268.89	colorless
76	chromate	$Dy_2(CrO_4)_3 \cdot 10H_2O$	853.21	greenish-yell
77	fluoride	DyF_3	219.51	colorless
78	iodide	DyI_3	543.24	yellowish-green
79	oxalate	$Dy_2(C_2O_4)_3 \cdot 10H_2O$	769.21	white
80	oxide	Dy_2O_3	373.02	
81	**Holmium**	Ho	164.94	
82	bromide	$HoBr_3$	404.69	light-yellow
83	chloride	$HoCl_3$	271.32	light-yellow
84	fluoride	HoF_3	221.94	light-yellow
85	iodide	HoI_3	545.67	light-yellow
86	oxalate	$Ho_2(C_2O_4)_3 \cdot 10H_2O$	774.10	pale tan
87	oxide	Ho_2O_3	377.88	tan
88	**Erbium**	Er	167.27	
89	bromide	$ErBr_3$	407.03	violet-rose
90	chloride	$ErCl_3$	273.65	pink
91	fluoride	ErF_3	224.27	rose
92	iodide	ErI_3	548.00	violet-red
93	oxalate	$Er_2(C_2O_4)_3 \cdot 6H_2O$	706.70	pink
94	**Thulium**	Tm	168.94	
95	bromide	$TmBr_3$	408.70	
96	chloride	$TmCl_3$	275.32	
97	fluoride	TmF_3	225.94	
98	iodide	TmI_3	549.67	
99	oxalate	$Tm_2(C_2O_4)_3 \cdot 5H_2O$	691.99	white
100	**Ytterbium (II)**	Yb	173.04	
101	bromide	$YbBr_2$	331.88	
102	chloride	$YbCl_2$	243.96	green-yell
103	fluoride	YbF_2	211.04	
104	iodide	YbI_2	426.86	
105	**Ytterbium (III)**			
106	bromide	$YbBr_3$	411.80	
107	chloride	$YbCl_3$	279.42	colorless cryst
108	fluoride	YbF_3	230.04	
109	iodide	YbI_3	553.77	gold-yellow
110	oxalate	$Yb_2(C_2O_4)_3 \cdot 5H_2O$	700.19	white
111	**Lutetium**	Lu	174.99	
112	bromide	$LuBr_3$	414.75	
113	chloride	$LuCl_3$	281.37	
114	fluoride	LuF_3	231.99	
115	iodide	LuI_3	555.72	
116	oxalate	$Lu_2(C_2O_4)_3 \cdot 6H_2O$	722.11	white

THE RARE EARTH COMPOUNDS (Continued)

No.	Sp. gr. or density	Melting point °C	Boiling point °C	Solubility in grams per 100 g		
				Cold water	Hot water	Alcohol, acids, etc.
56	7.868	1250	2700	i.	i.	s. a.
57	...	143.5–145	...	i.	i.	...
58	...	765	1490	s.	s.	...
59	...	609	1580	s.	s.	...
60	2.315	63.2	...	...	...	45.14 in HNO_3 (Sp. Gr. 1.325)
61	...	...	...	$23.0^{25°}$	$6.7^{100°}$	...
62	...	1380	2280	i.	i.	...
63	...	926	1340	s.	s.	...
64	...	2330 ± 20	...	...	...	...
65	8.253	1365	2500	i.	i.	s. a.
66	...	827	1490	s.	s.	...
67	...	588	1550	s.	s.	...
68	...	...	...	12.6	...	...
69	...	1370	2280	i.	i.	i. dil. a.
70	...	952	>1300	s.	s.	...
71	2.60	40 $(-H_2O)$	...	i.	i.	i. dil. a.
72	...	...	...	i.	i.	s. conc. a.
73	8.556	~1400	2300	i.	i.	s. a.
74	...	881	1480	s.	s.	...
75	...	654	>1500	s.	s.	...
76	...	...	...	1.00	...	...
77	...	1360	>2200	i.	i.	i. dil. a.
78	...	955	1320	s.	s.	...
79	...	40$(-H_2O)$	...	i.	i.	i. dil. a.
80	...	2340 ± 10	...	...	...	...
81	8.799	~1500	2300	i.	i.	s. a.
82	...	914	1470	s.	s.	...
83	...	718	1500	s.	s.	...
84	...	1360	>2200	i.	i.	i. dil. a.
85	...	1010	1300	s.	s.	...
86	...	$-H_2O$ at 40°	dec.	i.	i.	i. dil. a.
87	...	...	...	i.	i.	i. dil. a.
88	9.058	1500–1550	2600	i.	i.	s. a.
89	...	950	1460	s.	s.	...
90	...	774	1500	s.	s.	...
91	...	1350	2200	i.	i.	i. dil. a.
92	...	1020	1280	s.	s.	...
93	...	$-H_2O$ at 40°	dec.	i.	i.	i. dil. a.
94	9.318	1550–1650	2100	i.	i.	s. a.
95	...	952	1440	s.	s.	...
96	...	821	1490	s.	s.	...
97	...	1340	>2200	i.	i.	i. dil. a.
98	...	1015	1260	s.	s.	...
99	...	50 $(-H_2O)$	...	i.	i.	i. dil. a.
100	6.959	824	1500	i.	i.	s. a.
101	...	677	1800	s.	s.	s. dil. a.
102	5.08	727	1900	s.	s.	s. dil. a.
103	...	1380	2380	i.	i.	...
104	...	527	1300	s.	s.	s. dil. a.
105	...	...	...	...	...	...
106	...	940	dec.	s.	s.	...
107	...	854	dec.	s.	s.	...
108	...	1390	2200	i.	i.	i. dil. a.
109	...	1027	dec.	s.	s.	s. dil. a.
110	...	55 $(-H_2O)$	...	i.	i.	i. dil. a.
111	9.849	1650–1750	1900	i.	i.	s. a.
112	...	957	1400	s.	s.	...
113	...	892	1480	s.	s.	...
114	...	1320	2200	i.	i.	...
115	...	1045	1200	s.	s.	...
116	...	50 $(-H_2O)$	...	i.	i.	i. dil. a.

PHYSICAL CONSTANTS OF ORGANIC COMPOUNDS

The naming and arrangement of compunds, the preparation of the abridged form of the International Union Rules for the Naming of Organic Compounds and the Prefix Names of Organic Radicals have been in charge of

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INTERNATIONAL UNION RULES FOR THE NAMING OF ORGANIC COMPOUNDS

Editor's Note.—These rules are taken from the "Definitive Report of the Commission on the Reform of the Nomenclature of Organic Chemistry," which was unanimously adopted by the Commission and by the Council of the International Union of Chemistry at Liége in 1930. A translation of the report, with comments, appeared in the *Journal of the American Chemical Society*, **55**, 3905–25 (1933), and the reader is referred there for the full text and more extended comments. The comments here given in fine type are the editor's. A. M. P.

I. General

1. As few changes as possible will be made in terminology universally adopted.

2. For the present, only the nomenclature of compounds of known constitution will be dealt with; the question of substances of imperfectly known constitution is postponed.

3. The precise form of words, endings, etc., prescribed in the rules should be adapted to the genius of each language by the subcommittees.

II. Hydrocarbons

4. The ending *ane* is adopted for saturated hydrocarbons. Open-chain hydrocarbons will have the generic name *alkanes*.

5. The present names of the first four normal saturated hydrocarbons (methane, ethane, propane, butane) are retained. Names derived from the Greek or Latin numerals will be used for those having more than four atoms of carbon.

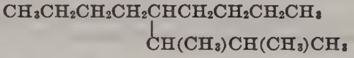
As the names in this series are also used in forming names of unsaturated hydrocarbons, of alcohols, aldehydes, acids, etc. a list of them is here given, with the numbers of carbon atoms:

1	Methane
2	Ethane
3	Propane
4	Butane
5	Pentane
6	Hexane
7	Heptane
8	Octane
9	Nonane
10	Decane
11	Hendecane (Undecane)
12	Dodecane
13	Tridecane
14	Tetradecane
15	Pentadecane
16	Hexadecane
17	Heptadecane
18	Octadecane
19	Nonadecane
20	Eicosane
21	Heneicosane
22	Docosane
23	Tricosane
24	Tetracosane
25	Pentacosane
26	Hexacosane
27	Heptacosane
28	Octacosane
29	Nonacosane
30	Triacontane
31	Hentriacontane
32	Dotriacontane
33	Tritriacontane
34	Tetratriacontane
35	Pentatriacontane
36	Hexatriacontane
37	Heptatriacontane
38	Octatriacontane
39	Nonatriacontane
40	Tetracontane
41	Hentetracontane
42	Dotetracontane
43	Tritetracontane
44	Tetratetracontane
45	Pentatetracontane
46	Hexatetracontane
47	Heptatetracontane
48	Octatetracontane
49	Nonatetracontane
50	Pentacontane
51	Henpentacontane
52	Dopentacontane
53	Tripentacontane

54 Tetrapentacontane
55 Pentapentacontane
56 Hexapentacontane
57 Heptapentacontane
58 Octapentacontane
59 Nonapentacontane
60 Hexacontane

6. Branched-chain hydrocarbons are regarded as derivatives of the normal hydrocarbons; their names will be referred to the longest normal chain present in the formula by adding to it the designations of the side chains. In case of ambiguity, or if a simpler name would result, that chain which admits of the maximum of substitutions will be selected as the fundamental chain.

A simple example is 2-methylbutane, $CH_3CH(CH_3)CH_2CH_3$. The principle of "maximum of substitutions" may be illustrated as follows: In the compound



$$\begin{array}{l} CH_3CH_2CH_2CH_2\overset{}{C}HCH_2CH_2CH_2CH_3 \\ \qquad\qquad\qquad\qquad\qquad | \\ \qquad\qquad\qquad\qquad\quad CH(CH_3)CH(CH_3)CH_3 \end{array}$$

the longest straight chain contains nine carbon atoms, which would lead to the name 5-(1, 2-dimethylpropyl)nonane; the number of substitutions in the main chain is only one, but the radical is a complicated one. By selecting a chain of eight we get three substitutions of simpler radicals and arrive at the name 4-butyl-2,3-dimethyloctane. Rules 6 and 7 apply to saturated hydrocarbons only.

7. In case there are several side chains, the order in which such chains are named will correspond to the order of their complexity. The chain having the greatest number of secondary and tertiary atoms will be considered the most complex. The alphabetic order may also be followed in such cases.

Two possible orders to be followed in arranging the names of substituting radicals in a compound are here referred to. In the "order of complexity" the radical of lowest weight comes first, then that of next lowest weight, and so on; of those having the same weight the least branched comes first and the most branched last, thus: methyl, ethyl, propyl, isopropyl, butyl, isobutyl, etc. The "alphabetic order" would of course be: butyl, ethyl, isobutyl, isopropyl, methyl, propyl (or else butyl, *iso*butyl, ethyl, methyl, propyl, *iso*propyl). (The alphabetic order is followed in the Organic Table in this handbook.)

8. In the names of open-chain unsaturated hydrocarbons having one double bond the ending *ane* of the corresponding saturated hydrocarbon will be replaced by the ending *ene;* if there are two double bonds, the ending will be *diene*, etc. These hydrocarbons will bear the generic names *alkenes*, *alkadienes*, *alkatrienes*, etc. Examples: propene, hexene, etc.

9. The names of triple-bond hydrocarbons will end in *yne*, *diyne*, etc. They will bear the generic name *alkynes.* Examples: propyne, heptyne, etc.

The ending *-yne* replaces *-ine* because the latter is reserved for bases (see Rule 33).

10. If there are both double and triple bonds in the fundamental chain the endings *enyne*, *dienyne*, etc., will be used. The generic names of these hydrocarbons will be *alkenynes*, *alkadienynes*, etc.

The double bonds are expressed first in the name (ene before yne) and take precedence in numbering (cf. Rule 64). Example: $CH_2:CHCH:CH\text{-}C:CH$, hexa-1,3-dien-5-yne, not hex-1-yne-3,5-diene. No provision is made for branched unsaturated hydrocarbons. It seems best, for general use, to select as the fundamental straight chain the longest one that contains the maximum of double and triple bonds. Example: $CH_2:C(C_2H_5)CH_2CH_3$, 2-ethyl-1-butene, not 3-methylenepentane.

11. Saturated monocyclic hydrocarbons will take the names of the corresponding open-chain saturated hydrocarbons, preceded by the prefix *cyclo*. They will bear the generic name *cycloalkanes*.

Examples: cyclopropane, cyclobutane, cycloheptane.

12. When they are unsaturated, rules 8–10 will be applied. However, in the case of partially saturated polycyclic aromatic compounds the prefix *hydro*, preceded by *di-*, *tetra-*, etc., will be used. Example: dihydroanthracene.

Further examples: cyclobutadiene, cyclohexene (not tetrahydrobenzene).

13. Aromatic hydrocarbons will be denoted by the ending *ene* and will otherwise retain their customary names. However, the name *phene* may be used instead of benzene.

Examples: benzene, toluene, xylene (not benzol, toluol, xylol).

III. Fundamental Heterocyclic Compounds

14. The endings of customary names, endings which do not correspond to the function of the substance, will undergo the following modifications, so far as they are in accord with the genius of each language: (a) The ending *ol* will be changed to *ole*. Example: pyrrole. (b) The ending *ane* will be changed to *an*. Example: pyran.

15. When nitrogenous heterocycles not having the ending *ine* give basic compounds on progressive hydrogenation, such derivation will be indicated by the successive endings *ine*, *idine*. Examples: pyrrole, pyrroline, pyrrolidine; oxazole, oxazoline.

16. The ending *a* is adopted for hetero atoms occurring in a ring. Oxygen will accordingly be indicated by *oxa*, sulfur by *thia*, nitrogen by *aza*, etc. The letter *a* may be elided before a vowel. Examples: thiadiazole, oxadiazole, thiazine, oxazine.

While the universally accepted names of heterocyclic compounds are retained, the names of other heterocyclic compounds are derived from that of the corresponding homocyclic compound by adding to it the names of the hetero atoms ending in *a*. Example: 2, 7, 9-triazaphenanthrene.

The custom of naming complex heterocyclic ring systems from the names of their component rings (as, anthrapyrrole, naphthopyridine) is so "universally accepted" that it will no doubt continue to be followed. The rule adds a useful new device for certain cases.

IV. Simple Functions

17. Substances of simple functions are defined as those containing a function of one kind only, which may be repeated several times in the same molecule.

That is, an alcohol may have one, two or more OH groups and still be a substance of simple function, while a hydroxy aldehyde or an amino acid is one of complex function.

18. When there is only one functional group, the fundamental chain will be selected so as to contain this group. When there are several functional groups the fundamental chain will be selected so as to contain the maximum number of these groups.

Example: $CH_3CH_2CH(COOH)_2$, 2-ethylpropanedioic acid (ethylmalonic acid). According to the original Geneva system it was butanoic-2-methyloic acid.

19. Halogen derivatives will be designated by the name of the hydrocarbon from which they are derived, preceded by a prefix indicating the nature and number of the halogen atoms.

Examples: C_2H_5Cl, chloroethane; CH_2BrCH_2Br, 1, 2-dibromoethane.

20. Alcohols and phenols will be given the name of the hydrocarbon from which they are derived, followed by the suffix *ol.* In accordance with rule 1 names universally adopted will be retained, as: phenol, cresol, naphthol, etc.

This nomenclature may also be applied to heterocycles. Example: quinolinol.

Further examples: $CH_3CHOHCH_3$, 2-propanol; $C_6H_{11}OH$, cyclohexanol.

21. In naming polyhydric alcohols or phenols, one of the forms *di, tri, tetra,* etc., will be inserted between the name of the parent hydrocarbon and the suffix *ol.*

Examples: CH_2OHCH_2OH, 1, 2-ethanediol; *p*-$C_6H_4(OH)_2$, 1, 4-benzenediol.

22. The name *mercaptan* as a suffix is abandoned; this function will be denoted by the suffix *thiol.*

Examples: CH_3SH, methanethiol; CH_2SHCH_2SH, 1, 2-ethanedithiol.

23. Ethers are considered as hydrocarbons in which one or several hydrogen atoms are replaced by alkoxy groups. However, for symmetrical ethers the present nomenclature may be retained. Examples: $CH_3OC_2H_5$, methoxyethane; CH_3OCH_3, methoxymethane or methyl ether.

24. Oxygen linked, in a chain of carbon atoms, to two of these atoms will be denoted by the prefix *epoxy* in all cases where it would be unprofitable to name the substance as a cyclic compound. Examples: ethylene oxide = epoxyethane; epichlorohydrin = 3-chloro-1,2-epoxypropane; tetramethylene oxide = 1,4-epoxybutane.

25. Sulfides, disulfides, sulfoxides and sulfones will be named like the ethers, *oxy* being replaced by *thio*, *dithio*, *sulfinyl* and

sulfonyl, respectively. Examples: $CH_3SO_2C_2H_5$, methylsulfonylethane; $CH_3SC_3H_7$, methylthiopropane; $CH_3CH_2CH_2$-$SOCH_2CH_2CH_2CH_3$, 1-(propylsulfinyl)butane.

26. Aldehydes are characterized by the suffix *al* added to the name of the hydrocarbon from which they are derived; thioaldehydes, by the suffix *thial.* Acetals will be named as 1,1-dialkoxyalkanes.

Examples: CH_3CHO, ethanal; CHOCHO, ethanedial; CH_3CH_2CHS, propanethial; $CH_2CH(OC_2H_5)_2$, 1,1-diethoxyethane; C_6H_5CHO, benzenecarbonal? (cf. rule 32, paragraph 2).

27. Ketones will receive the ending *one.* Diketones, triketones, thioketones will be designated by the suffixes *dione, trione, thione.*

Examples: CH_3COCH_3, 2-propanone; $CH_3COCOCH_3$, 2, 3-butanedione· $CH_3CSCH_2CH_3$, 2-butanethione; cyclohexanone.

28. The name *ketene* is retained.

Example: $(CH_3)_2C{:}CO$, dimethylketene.

29. For acids the rule of the Geneva nomenclature is retained. However, in cases where the use of that nomenclature would not be convenient the carboxyl group will be considered as a substituting group and the name of the acid will be formed by adding to the name of the hydrocarbon the suffix *carbonique* or *carboxylic,* according to the language.

Examples: CH_3CH_2COOH, propanoic acid; $HOOCCH_2COOH$, propanedioic acid; $HOOCCH_2CH(COOH)CH_2COOH$, 1, 2, 3-propanetricarboxylic acid. In the Geneva system the last-named compound would have been called pentanedioic-3-methyloic acid.

30. Acids in which an atom of sulfur replaces an atom of oxygen will be named according to the Geneva nomenclature. Example: ethanethioic, -thiolic, -thionic, -thionothiolic. If the carboxyl is considered as a substituent the compounds will be named *carbothioic* acids. The suffix *carbothiolic* will be used if it is certain that the oxygen of the OH group is replaced by sulfur; the suffix *carbothionic* if it is the oxygen of the CO group; the suffix *carbodithioic* will be used if both oxygen atoms are replaced.

Examples of the two systems of names: CH_3COSH or CH_3CSOH (either one), ethanethioic acid, methanecarbothioic acid; CH_3COSH, ethanethiolic acid, methanecarbothiolic acid; CH_3CSOH, ethanethionic acid, methanecarbothionic acid; CH_3CSSH, ethanethionothiolic acid, methanecarbodithioic acid.

31. The existing conventions will be retained for salts and esters.

Examples: Sodium butanoate or sodium salt of butanoic acid; diethyl 1,2-ethanedicarboxylate or diethyl ester of 1,2-ethanedicarboxylic acid; sodium acetate; methyl succinate.

32. Acid anhydrides will retain their present mode of designation according to the names of the corresponding acids. For names formed in accordance with the Geneva nomenclature,

the amides, amidoximes, amidines, imides and nitriles will be named like the acids by adding to the name of the corresponding hydrocarbon the endings *amide*, *amidine*, *amidoxime*, *imide*, and *nitrile*, respectively, while the halides will be named by combining *chloride*, etc., with the name of the radical. Examples: C_3H_7COCl, butanoyl chloride; $C_3H_7CONH_2$, butanamide; etc.

If the carboxyl is considered as a substituent the endings *carbonamide*, *carbonamidine*, *carbonamidoxime*, *carbonimide*, *carbonitrile* will be used. Examples: C_3H_7COCl, propanecarbonyl chloride; $C_3H_7CONH_2$, propanecarbonamide; etc.

33. The ending *ine* is reserved exclusively for nitrogenous bases. The present nomenclature of monoamines is retained. For polyamines, the name of the hydrocarbon will be followed by the suffixes *diamine*, *triamine*, etc.

For aliphatic compounds containing quinquevalent nitrogen the ending *ine* will be changed to *onium*. For cyclic substances containing quinquevalent nitrogen in the ring the ending *ine* will be changed to *inium;* for those with the ending *ole*, this will be changed to *olium*. Examples: pyridine, pyridinium; imidazole, imidazolium.

Further examples: CH_3NH_2, methylamine; $(CH_3)_2NH$, dimethylamine; $(CH_3)_3N$, trimethylamine; $NH_2CH_2CH_2NH_2$, 1,2-ethanediamine; dextrin (not dextrine); glycerol (not glycerine).

34. (revised 1938) (a) Derivatives of hydrogen arsenide, AsH_3, will be named like the amines and their derivatives, with the ending *arsine*. The univalent radical $-AsH_2$ will be designated by the prefix *arsino*.

Examples: CH_3AsH_2, methylarsine; $(CH_3)_3As$, trimethylarsine; $(CH_3)_2AsCl$, chlorodimethylarsine; $(CH_3)_3AsO$, trimethylarsine oxide; $H_2AsCH_2CH_2AsH_2$, 1, 2-diarsinoethane or ethane-1, 2-diarsine; $(C_2H_5)_4AsOH$, tetraethylarsonium hydroxide; $(CH_3)_2AsAs(CH_3)_2$, tetramethylbiarsine.

(b) Acids of the types $RHAs(:O)OH$ and $RR'As(:O)OH$ will be named *arsinic* acids; those of the type $RAs(:O)(OH)_2$ will be named *arsonic acids*. The radical $>AsO_2H$ will be designated by the prefix *arsinico*, the radical $-AsO_3H_2$ by the prefix *arsono*.

Examples: $(CH_3)_2AsO_2H$, dimethylarsinic acid; $C_6H_5AsO_3H_2$, benzenearsonic acid.

(c) Rules *a* and *b* are applicable to the analogous compounds of phosphorus and antimony, the syllable "ars" being replaced respectively by *phosph* or *stib*.

(d) The following list includes the prefixes and suffixes applicable to the most common compounds of phosphorus, arsenic and antimony:

Radical	*Prefix*	*Suffix*
$-AsH_2$	arsino	arsine
$-AsO$	arsenoso	
$-AsO_2$	arso	
$>As(:O)OH$	arsinico	arsinic
$-As(:O)(OH)_2$	arsono	arsonic
$-As = As-$	arseno	
$-PH_2$	phosphino	phosphine
$-PO$	phosphoroso	
$-PO_2$	phospho	
$>P(:O)OH$	phosphinico	phosphinic
$-P(:O)(OH)_2$	phosphono	phosphonic
$-P = P-$	phosphoro	
$-P = N-$	phosphazo	
$-P = As-$	phospharseno	
$-SbH_2$	stibino	stibine
$-SbO$	stiboso	
$-SbO_2$	stibo	
$>Sb(:O)OH$	stibinico	stibinic
$-Sb(:O)(OH)_2$	stibono	stibonic
$-Sb = Sb-$	antimono	
$-Sb = As-$	stibarseno	

(e) Derivatives of bismuthine, BiH_3, will be named like the arsines.

(f) Compounds of arsenic, phosphorus, antimony and bismuth which cannot be named clearly by the preceding rules will be named as derivatives of arsines, phosphines, stibines or bismuthines or (if possible) as organometallic derivatives (rule 48).

Examples: CH_3BiO, methylbismuth oxide; CH_3SbCl_4, methylantimony tetrachloride; $(C_6H_5)_2AsOC_2H_5$, ethoxydiphenylarsine; $(CH_3)_2AsOH$, hydroxydimethylarsine or dimethylarsenic hydroxide, CH_3SbS, methylantimony sulfide; $[(CH_3)_2As]_2O$, bis(dimethylarsenic) oxide or cacodyl oxide.

35. Compounds derived from hydroxylamine by replacement of the hydrogen of the hydroxyl will be regarded as alkoxy derivatives; those in which an atom of hydrogen of the NH_2 group is replaced, as alkylhydroxylamines. Oximes will be named by adding the suffix *oxime* to the name of the corresponding aldehyde, ketone or quinone. Examples: $C_2H_5ONH_2$ ethoxyamine; C_2H_5NHOH, ethylhydroxylamine.

Further examples: $CH_3CH_2CH:NOH$, propanal oxime; $CH_3C(:NOH)CH_3$, propanone oxime.

36. The generic term *urea* is retained; it will be used as a suffix for the alkyl and acyl derivatives of urea. Examples: butylurea, $C_4H_9NHCONH_2$; butyrylurea, $C_3H_7CONHCONH_2$. The bivalent radical -NHCONH- will be named *ureylene.*

37. The generic name *guanidine* is retained.

38. The name *carbylamine* is retained.

Example: C_2H_5NC, ethylcarbylamine (or ethyl isocyanide).

RULES FOR NAMING ORGANIC COMPOUNDS (Continued)

39. Isocyanic and isothiocyanic esters (RNCO, RNCS) will be named *isocyanates* and *isothiocyanates*.

40. The name *cyanate* is reserved for true esters which on saponification yield cyanic acid or its hydration products. The name *sulfocyanate* will be replaced by *thiocyanate*.

41. Nitro derivatives: no change in the present nomenclature.

Examples: C_6H_5NO, nitrosobenzene; $(NO_2)_3C_6H_2OH$, trinitrophenol.

42. Azo derivatives: the forms *azo*, *azoxy* are retained.

43. (a) Diazonium compounds, RN_2X, are named by addition of the suffix *diazonium* to the name of the parent substance (benzenediazonium chloride).

(b) Compounds having the same empirical formula but containing trivalent nitrogen will be named by replacing diazonium with *diazo* (benzenediazohydroxide).

(c) Substances of the type RN_2OM will be named *diazoates*.

(d) Compounds in which the two nitrogen atoms are united to a single carbon atom will be designated by the prefix *diazo* (diazomethane, diazoacetic acid).

(e) The term *diazoamino* is retained; however, these compounds may also be regarded as derivatives of triazene.

(f) Derivatives of the substances $H_2NNHNHNH_2$; $NH{:}NNHNH_2$; $NH{:}NNHN{:}NH$ will be named *tetrazanes*, *tetrazenes*, *pentazdienes*, etc.

Examples: (a) $C_6H_5N({:}N)Cl$, benzenediazonium chloride; (b) $C_6H_5N{:}NOH$, benzenediazohydroxide; (c) $C_6H_5N{:}NONa$, sodium benzenediazoate; (d) N_2CH_2, diazomethane; N_2CH_2COOH, diazoacetic acid, diazoethanoic acid or diazomethanecarboxylic acid; (e) $C_6H_5N{:}NNHC_6H_5$, diazoaminobenzene or 1,3-diphenyltriazene, (f) $C_6H_5NHNHNHNHC_6H_5$, 1,4-diphenyltetrazane; $C_6H_5N{:}NNHNH_2$, 1-phenyl-1-tetrazene

44. Hydrazines are designated by the name of the alkyl radicals from which they are derived, followed by the suffix *hydrazine*. In cases where the amino group of carbonamides is replaced by the hydrazino group, the suffix *hydrazide* will be used. Hydrazo derivatives are regarded as derivatives of hydrazine. Examples: CH_3NHNH_2, methylhydrazine; $C_2H_5NHNHC_3H_7$, 1-ethyl-2-propylhydrazine; $C_3H_7CONHNH_2$, butyrohydrazide or propanecarbohydrazide.

45. Hydrazones and semicarbazones are named like the oximes. The term *osazone* is retained.

Examples: $CH_3CH{:}NNHC_6H_5$, ethanal (or acetaldehyde) phenylhydrazone: $(CH_3)_2C{:}NNHCONH_2$, propanone (or acetone) semicarbazone.

46. The name *quinone* is retained.

Examples: *p*-benzoquinone or *p*-quinone, 1,2-naphthoquinone or 1,2-naphthaquinone, phenanthrenequinone or phenanthraquinone

47. Sulfonic and sulfinic acids will be designated by adding the suffixes *sulfonic* and *sulfinic* to the name of the hydrocarbon.

The analogous acids of selenium and tellurium will bear the names *alkaneselenonic* and *-seleninic* acids; *alkanetelluronic* and *-tellurinic* acids.

RULES FOR NAMING ORGANIC COMPOUNDS
(Continued)

Examples: $C_2H_5SO_3H$, ethanesulfonic acid; $C_{10}H_6(SO_2H)_2$, naphthalenedisulfinic acid, CH_3SeO_3H, methaneselenonic acid; $C_6H_5TeO_2H$. benzenetellurinic acid.

48. Organometallic compounds will be designated by the names of the organic radicals united to the metal which they contain, followed by the name of the metal. Examples: dimethylzinc, tetraethyllead, methylmagnesium chloride.

However, if the metal is united in a complex manner it may be considered as a substituent Example: $ClHgC_6H_4CO_2H$, chloromercuribenzoic acid.

49*a* (revised 1938)

I. Cyclic hydrocarbons with aliphatic side chains are to be named according to one of the two following methods: (α) The radical names denoting the side chains are prefixed to the name of the cyclic hydrocarbon. (β) The cyclic hydrocarbon residue, if it can be named as a radical, is considered a substituent of the aliphatic chain. Naming according to (α) is in general preferable when the side chain is short or when several side chains are present. Naming according to (β) is more convenient when the side chain is long, and particularly when the cyclic hydrocarbon residue is not at the end of this chain.

Examples: (α) $C_6H_5C_2H_3$, ethylbenzene; $CH_3C_6H_4C_2H_5$, methylethylbenzene; $C_{10}H_7CH{:}CH_2$, ethenylnaphthalene.
(β) $CH_3CH(C_6H_5)(CH_2)_5CH_3$, 2-phenyloctane; p-$(CH_3)_2CHC_6H_4CH(CH_3)CH(CH_3)(CH_2)_3CH_3$, 3-methyl-2-(4-isopropylphenyl)heptane.

For naming cyclic hydrocarbons with side chains according to (α), it is advisable in many cases to use the common names of simple aromatic hydrocarbons.

Examples: *o*-$CH_3C_6H_4C_2H_5$, 2-ethyltoluene; $(CH_3)_2C_6H_4CH{:}CH_2$(1,3,2), 2-ethenyl-*m*-xylene; $CH_3C_6H_3(C_2H_5)CH(CH_3)_2$(1,2,4), 2-ethyl-*p*-cymene.

II. When several cyclic hydrocarbon residues are united by an aliphatic chain the name of the compound will be derived from that of the aliphatic hydrocarbon, provided radical names are available for the cyclic hydrocarbon residues.

Examples: $C_6H_5CH_2C_6H_5$, diphenylmethane; $C_6H_5CH_2CH(C_6H_5)(CH_2)_2CH_3$, 1,2-diphenylpentane.

If this is not the case, or if the possibility of using a convenient radical name makes it desirable, the name of the compound will be derived from that of one of the cyclic hydrocarbons, on the principle of substitution.

Examples: $C_{11}H_9CH_2C_6H_5$(2), 2-benzylanthracene (better than phenyl-(2-anthryl) methane); $C_{16}H_9CH_2CH_2C_6H_5$, (β-phenylethyl) pyrene.

49*b* (revised 1938). When the cyclic hydrocarbons treated of in rule 49*a* carry functions which can be expressed only by a prefix, the same possibilities for names exist as those indicated in rule 49*a*.

Examples: $C_6H_5CHClCH_2Cl$, 1,2-dichloro-1-phenylethane or (α, β-dichloroethyl) benzene; $C_6H_5CH_2CHCH_3CH_2Cl$, 3-chloro-2-methyl-1-phenylpropane or (γ-chloroisobutyl) benzene; *p*-$ClC_6H_4CH_2CH_2Cl$, 4-chloro-1-(β-chloroethyl) benzene or 2-chloro-1-(4-chlorophenyl) ethane.

For naming derivatives of monocyclic hydrocarbons which have common names, it will be of advantage to employ these names.

RULES FOR NAMING ORGANIC COMPOUNDS
(**Continued**)

Examples: *p*-$ClC_6H_4CH_3$, 4-chlorotoluene (4-chloro-1-methylbenzene); *p*-$ClC_6H_4CH_2Cl$, 4, ω dichlorotoluene (4-chloro-1-(chloromethyl) benzene, 4-chlorobenzyl chloride); $CH_3C_6H_4(NO_2)CH(CH_3)_2$(1,2,4), 2-nitro-*p*-cymene (2-nitro-1-methyl-4-isopropylbenzene)

50. If it is necessary to avoid ambiguity, the names of complex radicals will be placed in parentheses. Examples: (dimethylphenyl)amine = $(CH_3)_2C_6H_3NH_2$; dimethylphenylamine = $C_6H_5N(CH_3)_2$.

V. Complex Functions

51. For compounds of complex function, that is to say, for compounds possessing different functions, only one kind of function (the principal function) will be expressed by the ending of the name. The other functions will be designated by appropriate prefixes.

Example: 2-aminoethanol (not ethanolamine). By rule 1 very commonly used names like phenolsulfonic acid, naphthylaminesulfonic acid might still be used.

52. The following prefixes and suffixes will be used for designating the functions.

Function	Prefix	Suffix
Acid and derivatives	carboxy	carboxylic, carbonyl, carbonamide, etc., or oic, oyl, etc.
Alcohol	hydroxy	ol
Aldehyde	oxo, aldo (for aldehyde O) or formyl (for CHO)	al
Amine	amino	amine
Azo derivative	azo	. . .
Azoxy derivative	azoxy	. . .
Carbonitrile (nitrile)	cyano	carbonitrile or nitrile
Double bond	. . .	ene
Ether	alkoxy	. . .
Ethylene oxide, etc.	epoxy	. . .
Halide	halogeno (halo)	. . .
Hydrazine	hydrazino	hydrazine
Ketone	oxo or keto	one
Mercaptan	mercapto	thiol
Nitro derivative	nitro	. . .
Nitroso derivative	nitroso	. . .
Quinquevalent nitrogen	. . .	onium, inium (olium)
Sulfide	alkylthio	. . .
Sulfinic derivative	sulfino	sulfinic
Sulfone	sulfonyl	. . .
Sulfonic derivative	sulfo	sulfonic
Sulfoxide	sulfinyl	. . .
Triple bond	. . .	yne
Urea	ureido	urea

RULES FOR NAMING ORGANIC COMPOUNDS
(Continued)

The order in which the functions are here listed has no significance; the rules do not establish any general order of precedence (cf. rules 7, 63).

53. The names of derivatives of fundamental heterocyclic substances will be formed according to the preceding rules.

Example: Hydroxyquinolinecarbonamide, not quinolinolcarbonamide.

VI. Radicals

54. Univalent radicals derived from saturated aliphatic hydrocarbons by removal of one atom of hydrogen will be named by replacing the ending *ane* of the hydrocarbon by the ending *yl*.

Examples: methyl, ethyl, pentyl (or amyl), etc. Since isopropylidene is recognized (rule 56) it was no doubt the intention of the Committee to recognize isopropyl similarly.

55. The names of univalent radicals derived from unsaturated aliphatic hydrocarbons will have the endings *enyl*, *ynyl*, *dienyl*, etc., the positions of the double or triple bonds being indicated by numerals or letters where necessary.

Examples: $CH_2{:}CH—$, ethenyl (or vinyl); $CH\vdots C—$, ethynyl; $CH_3—CH{:}CH—CH_2—$, 2-butenyl; $CH_2{:}CH—CH{:}CH—$, 1, 3-butadienyl.

56. Bivalent or trivalent radicals derived from saturated hydrocarbons by removal of 2 or 3 hydrogen atoms from the same carbon atom will be named by replacing the ending *ane* of the hydrocarbon by the endings *ylidene* or *ylidyne*. For radicals derived from unsaturated hydrocarbons, these endings will be added to the name of the hydrocarbon. The names isopropylidene and methylene are retained.

Examples: $CH_2<$, methylene; $CH_3CH<$, ethylidene; $CH_3CH_2CH<$, propylidene; $(CH_3)_2C<$, (1-methylethylidene) or isopropylidene; $CH_3C\vdots$, ethylidyne; $CH_2{:}CH—CH_2CH<$, 3-butenylidene.

57. The names of bivalent radicals derived from aliphatic hydrocarbons by removal of a hydrogen atom from each of the two terminal carbon atoms of the chain will be ethylene, trimethylene, tetramethylene, etc.

Only saturated radicals are provided for: $—CH_2CH_2—$, ethylene; $—CH_2CH_2CH_2—$, trimethylene, etc.

58. Radicals derived from acids by removal of OH will be named by changing the ending carboxylic to *carbonyl* or, if the Geneva nomenclature is used, oic to *oyl*.

Examples: CH_3CO, ethanoyl or methanecarbonyl (or acetyl).

59. Univalent radicals derived from aromatic hydrocarbons by removal of a hydrogen atom from the ring will in principle be named by changing the ending *ene* to *yl*. However, the radicals C_6H_5 and $C_6H_5CH_2$ will continue provisionally to be named phenyl and benzyl respectively. Moreover, certain abbreviations sanctioned by usage are authorized, as *naphthyl* instead of *naphthalyl*.

Examples: $CH_3C_6H_4—$, tolyl (instead of toluyl), anthryl (instead of anthracyl), phenanthryl, fluoryl.

60. Univalent radicals derived from heterocyclic compounds by removal of hydrogen from the ring will be named by changing their endings to *yl*. In cases where this would give rise to ambiguity, merely the final *e* will be changed to *yl*. Examples: pyridine, pyridyl; indole, indolyl; pyrroline, pyrrolinyl; triazole, triazolyl; triazine, triazinyl.

61. Radicals formed by removal of a hydrogen atom from a side chain of a cyclic compound will be regarded as substituted aliphatic radicals.

Examples: $C_6H_5CH_2CH_2$—, (2-phenylethyl); $C_6H_5CH:CHCH_2$—, (3-phenyl-2-propenyl). (For $C_6H_5CH_2$, see rule 59.)

62. In general, special names will not be given to multivalent radicals derived from cyclic compounds by removal of several hydrogen atoms from the ring. In this case prefixes or suffixes will be used. Examples: triaminobenzene or benzenetriamine; dihydroxypyrrole or pyrrolediol.

Comparison with rules 21, 33 and 51 will show that of the names given as examples, "benzenetriamine" and "pyrrolediol" are the ones ordinarily to be preferred (according to the rule of expressing the principal function in the ending of the name where there is a suffix denoting it).

63. The order in which prefixes or radicals are stated (alphabetic order or conventional order) remains optional.

See the comments on rule 7. There is no generally accepted "conventional order" for all prefixes.

VII. Numbering

64. In aliphatic compounds the carbon atoms of the fundamental chain will be numbered from one end to the other with the use of arabic numerals. In case of ambiguity the lowest numbers will be given (1) to the principal function, (2) to double bonds, (3) to triple bonds, (4) to atoms or radicals designated by prefixes. The expression "lowest numbers" signifies those that include the lowest individual number or numbers. Thus, 1, 3, 5 is lower than 2, 4, 6; 1, 5, 5 lower than 2, 6, 6; 1, 2, 5 lower than 1, 4, 5; 1, 1, 3, 4 lower than 1, 2, 2, 4.

Examples: $CH_2:CHCH_2CH_3$, 1-butene (not 3-butene); $CH_2:CHC\vdots CH$, 1-buten-3-yne (not 3-buten-1-yne); $CH_2:CH—CH_2OH$, 2-propen-1-ol (not 1-propen-3-ol; the name allyl alcohol may also be used); $CHCl_2—CH_2CH:CH_2$, 4, 4-dichloro-1-butene. The principle of "low numbers" also applies to cyclic compounds, with due regard to their different structures (e.g., bridges and hetero atoms are usually given preferred positions). Examples: 1, 3-cyclohexadiene; 3-cyclohexen-1-one or simply 3-cyclohexenone; 4, 4-dichlorocyclohexene.

Position of Numbers.—Where shall position numbers be placed, *before* or *after* the parts of the name to which they refer? Usage varies; some chemists place them before, some place them after, some use a combination. The Committee has left full latitude on this point. The examples in the French version usually show the numbers placed after; the examples in these comments follow the practice of *Chemical Abstracts* in being placed before. Each method has certain advantages. In Beilstein numbers placed after are in parentheses, those placed before are not, e.g., "2-methyl-butanol-(4)."

65. Positions in a side chain will be designated by numerals or letters, starting from the point of attachment. The numerals or letters will be in parentheses with the name of the chain.

Examples: $(CH_3)_2CH—$, (1-methylethyl) or isopropyl; $CH_3CHClCH_2—$, (2-chloropropyl). The rule equally permits Greek letters, ordinary letters, primed numbers (1′, 2′), numbers with indices (4^1, 4^2) or other designations.

66. In case of ambiguity in the numbering of atoms or radicals designated by prefixes, the order will be that chosen for the prefixes before the name of the fundamental compound or side chain of which they are substituents.

Example: $CH_2BrCH_2CH_2Cl$, 1-bromo-3-chloropropane (alphabetic order), or 1-chloro-3-bromopropane (order of increasing radical weight). The purpose of the rule is to decide which prefixes shall have which numbers, when the set of numbers (in the above example 1, 3) for the prefixes has been determined.

67. The prefixes, *di*, *tri*, *tetra*, etc. will be used before simple expressions (for example, diethylbutanetriol) and the prefixes *bis*, *tris*, *tetrakis*, etc., before complex expressions. Examples: bis(methylamino)propane, $CH_3NH(CH_2)_3NHCH_3$; bis(dimethylamino)ethane, $(CH_3)_2NCH_2CH_2N(CH_3)_2$. The prefix *bi* will be used only to denote the doubling of a radical or compound; for example, biphenyl.

Additional example of the use of *bi:* *p*-$(C_6H_4CO_2H)_2$, 4, 4′-bibenzoic acid or biphenyl-4, 4′-dicarboxylic acid.

68. A catalog of cyclic systems, with their numberings according both to the existing system and to that of Mr. Patterson, is in preparation under the auspices of the National Research Council of the United States and of the American Chemical Society.

This catalog appeared in 1940 as American Chemical Society Monograph No. 84, "The Ring Index" by Austin M. Patterson and Leonard T. Capell.

In order to avoid all confusion the Commission recommends placing a scheme of numbering at the head of each article.

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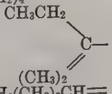
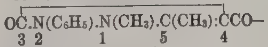
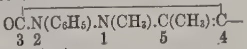
PREFIX NAMES OF ORGANIC RADICALS

This list is taken, by permission, from the Introduction to the Subject Index of *Chemical Abstracts*, Volumes 39 and 41, and represents the latest practice of that journal.

acenaphthenyl $C_{12}H_9$— (*from acenaphthene*)
acetamido CH_3CONH—
acetenyl = ethynyl
acetimido $CH_3C(:NH)$—
acetonyl CH_3COCH_2—
acetonylidene CH_3COCH=
acetoxy CH_3COO—
acetyl CH_3CO—
acetylene =CHCH=
acridyl $C_{13}H_8N$— (*from acridine*)
acrylyl $CH_2:CHCO$—
adipyl —$OC(CH_2)_4CO$—
alanyl CH_3CHNH_2CO—
alkoxy RO—(*R = any alkyl radical*)
allyl $CH_2:CHCH_2$—
β-allyl = isopropenyl
amido H_2N— (*properly, in acid groups only; by some used synonymously with amino*)
amidoxalyl = oxamyl
amino H_2N—
amoxy $CH_3(CH_2)_4O$—
amyl $CH_3(CH_2)_4$—
tert-amyl 
$(CH_3CH_2)(CH_3)_2C$—
amylidene $CH_3(CH_2)_3CH$=
anilino C_6H_5NH—
anisal = anisylidene
anisoyl *p*-$CH_3OC_6H_4CO$—
anisyl = methoxyphenyl or methoxybenzyl
anisylidene *p*-$CH_3OC_6H_4CH$=
anthranoyl *o*-$H_2NC_6H_4CO$—
anthraquinonyl $C_{14}H_7O_2$— (*from anthraquinone, 2 isomers*)
anthryl $C_{14}H_9$— (*from anthracene, 3 isomers*)
anthrylene —$C_{14}H_8$— (*from anthracene, 14 isomers*)
antimono —Sb:Sb—
antipyroyl (*from antipyric acid*)

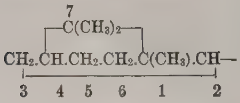

$OC.N(C_6H_5).N(CH_3).C(CH_3):CCO$—

antipyryl (*from antipyrine*)


$OC.N(C_6H_5).N(CH_3).C(CH_3):C$—

arseno —As:As—
arsenoso O:As—
arsinico (*from arsinic acid*) (HO)OAs=
arsino H_2As—
arso O_2As—
arsono (*from arsonic acid*) $(HO)_2OAs$—
arsylene HAs=
asaryl 2,4,5-$(CH_3O)_3C_6H_2$—
asparagyl $H_2NCOCH_2CHNH_2CO$—
aspartyl —$COCH_2CHNH_2CO$—
auro Au—
azido N_3—
azino = NN=.
azo —N:N— (*as connective*)
azoxy —N(O)N—
benzal = benzylidene
benzamido C_6H_5CONH—
benzenyl = benzylidyne
benzidino $H_2NC_6H_4C_6H_4NH$— (*from benzidine*)

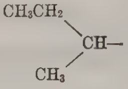
benziloyl $(C_6H_5)_2C(OH)CO—$
benzimidazolyl $C_7H_5N_2—$ (*from benzimidazole*)
benzimido $C_6H_5C(:NH)—$
benzofuryl $C_8H_5O—$ (*from benzofuran*)
benzhydryl $(C_6H_5)_2CH—$
benzhydrylidene $(C_6H_5)_2C=$
benzopyranyl $C_9H_7O—$ (2-α-, etc.) (*from benzopyran*)
benzoxazolyl $C_7H_4NO—$ (*from benzoxazole*)
benzoxy $C_6H_5COO—$
benzoyl $C_6H_5CO—$
benzoylene $—C_6H_4CO—$
benzyl $C_6H_5CH_2—$
benzylidene $C_6H_5CH=$
benzylidyne $C_6H_5C\equiv$
biphenylene $—C_6H_4C_6H_4—$
biphenylenebisazo $—N:NC_6H_4C_6H_4N:N—$
biphenylyl (2-, 3- or 4-) $C_6H_5C_6H_4—$ (*from biphenyl*)
biphenylylcarbonyl $C_6H_5C_6H_4CO—$
biphenylyloxy $C_6H_5C_6H_4O—$
bornyl (*from borneol*)



$$CH_2.CH.CH_2.CH_2.C(CH_3).CH—$$

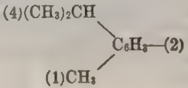
boryl $O:B—$
bromo $Br—$
1-butenyl $CH_3CH_2CH:CH—$
2-butenyl $CH_3CH:CHCH_2—$
3-butenyl $CH_2:CH(CH_2)_2—$
butoxy $CH_3(CH_2)_3O—$
butyl $CH_3(CH_2)_3—$

sec-butyl



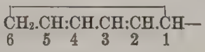
$$(CH_3CH_2)(CH_3)CH—$$

tert-butyl $(CH_3)_3C—$
butylene (1,4) = tetramethylene
butylidene $CH_3(CH_2)_2CH=$
butyryl $CH_3(CH_2)_2CO—$
camphanyl $C_{10}H_{17}—$ (*from camphane, 3 isomers*)
camphoroyl $C_{10}H_{14}O_2=$ (*from camphoric acid*)
camphoryl $C_{10}H_{15}O—$ (*from camphor*)
camphorylidene $C_{10}H_{14}O=$ (*from camphor*)
caproyl $CH_3(CH_2)_4CO—$
capryl $CH_3(CH_2)_8CO—$
caprylyl $CH_3(CH_2)_6CO—$
carbamido = ureido
carbamyl $H_2NCO—$
carbanilino = phenylcarbamyl
carbazolyl $C_{12}H_8N—$ (*from carbazole, 5 isomers*)
carbethoxy $C_2H_5OOC—$
carbomethoxy $CH_3OOC—$
carbonyl $OC=$
carbonyldioxy $—OCOO—$
carboxy $HOOC—$
carbyl $—C—$
carvacryl



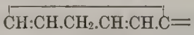
$$(4)(CH_3)_2CH—C_6H_3—(2),\ (1)CH_3$$

cetyl = hexadecyl
chaulmoogroyl $(C_5H_7(CH_2)_{12}CO—$ (*from chaulmoogric acid*)
chaulmoogryl $C_5H_7(CH_2)_{12}CH_2—$ (*from chaulmoogryl alcohol*)
chloro $Cl—$
chloromercuri $ClHg—$
chrysenyl $C_{18}H_{11}—$ (*from chrysene*)
cinnamal = cinnamylidene
cinnamenyl = styryl
cinnamoyl $C_6H_5CH:CHCO—$
cinnamyl $C_6H_5CH:CHCH_2—$
cinnamylidene $C_6H_5CH:CHCH=$
cresotyl 2,3-$HO(CH_3)C_6H_3CO—$ (*from cresotic acid*) (*2,3-shown*)
cresoxy = toloxy
cresyl = *ar*-hydroxytolyl; = tolyl
cresylene = tolylene
crotonyl $CH_3CH:CHCO—$
crotyl = 2-butenyl
cumal = *p*-cuminylidene
cumidino $(CH_3)_2CHC_6H_4NH—$
cuminal = *p*-cuminylidene
cuminyl *p*-$(CH_3)_2CHC_6H_4CH_2—$
cuminylidene *p*-$(CH_3)_2CHC_6H_4CH=$
cumoyl (*from cumic acid*) *p*-$(CH_3)_2CHC_6H_4.CO$
cumyl $(CH_3)_2CHC_6H_4—$
cyanato $NCO—$
cyano $NC—$
cyclobutyl (*from cyclobutane*) $C_4H_7—$
cyclohexadienyl (2,4- shown)



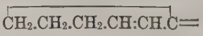
$$CH_2.CH:CH.CH:CH.CH—$$

cyclohexadienylidene (*2,4- or 2,5-; 2,5-shown*)



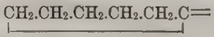
$$CH:CH.CH_2.CH:CH.C=$$

cyclohexenyl $C_6H_9—$ (*from cyclohexene, 3 isomers*)
cyclohexenylidene (2- shown)



$$CH_2.CH_2.CH_2.CH:CH.C=$$

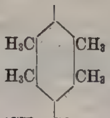
cyclohexyl $C_6H_{11}—$ (*from cyclohexane*)
cyclohexylidene



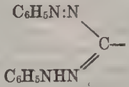
$$CH_2.CH_2.CH_2.CH_2.CH_2.C=$$

cyclopentenyl $C_5H_7—$ (*from cyclopentene*)
cyclopentyl $C_5H_9—$ (*from cyclopentane*)
cyclopropyl $C_3H_5—$ (*from cyclopropane*)
cymyl $C_{10}H_{13}—$ (*from cymene*)
2-*p*-cymyl = carvacryl
3-*p*-cymyl = thymyl
decyl $CH_3(CH_2)_9—$
desyl $C_6H_5COCH(C_6H_5)—$
diazo $—N:N—$ or $N:N=$
diazoamino $—N:NNH—$
disilanoxy $H_3SiSiH_2O—$
disilanyl $H_3SiSiH_2—$
disilanylamino $H_3SiSiH_2NH—$
disilanylene $—SiH_2SiH_2—$
disilazanoxy $H_3SiNHSiH_2O—$
disilazanyl $H_3SiNHSiH_2—$
disilazanylamino $H_3SiNHSiH_2NH—$
disiloxanoxy $H_3SiOSiH_2O—$
disiloxanyl $H_3SiOSiH_2—$
disiloxanylamino $H_3SiOSiH_2NH—$
dodecyl $CH_3(CH_2)_{10}CH_2—$
duryl 2,3,5,6-$(CH_3)_4C_6H—$

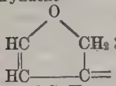
durylene



enanthyl $CH_3(CH_2)_5CO$—
epoxy —O— (*to different atoms already united in some other way*)
ethene = ethylene
ethenyl = ethylidyne; = vinyl
ethinyl = ethynyl
ethoxalyl C_2H_5OOCCO—
ethoxy C_2H_5O—
ethyl CH_3CH_2—
ethylene —CH_2CH_2—
ethylenedioxy —$O(CH_2)_2O$—
ethylidene $CH_3CH=$
ethylidyne $CH_3C\equiv$
ethynyl $CH\vdots C$—
ethynylene —$C\vdots C$—
fenchyl $C_{10}H_{17}$— (*from fenchane*)
fluorenyl $C_{13}H_9$— (*from fluorene, 5 isomers*)
fluorenylidene $C_{13}H_8=$ (*from fluorene*)
fluoro F—
formamido HCONH—
formazyl

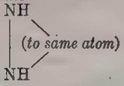


formyl OCH—
furfural = furfurylidene
furfuryl $O.CH{:}CH.CH{:}CCH_2$—
furfurylidene
$O.CH{:}CH.CH{:}CCH=$
2-furoyl $O.CH{:}CH.CH{:}CCO$—
3-furoyl $CH{:}CH.O.CH{:}CCO$—
furyl (*2 isomers, 2-shown*)
$O.CH{:}CH.CH{:}C$—
furylidene

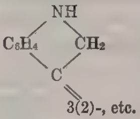


3(2)— (also a 2(3)-form)

geranyl $C_{10}H_{17}$— (*from geraniol*)
glutamyl —$OCCHNH_2(CH_2)_2CO$—
glutaryl —$OC(CH_2)_3CO$—
glyceroyl $CH_2OHCHOHCO$—
glyceryl —CH_2CHCH_2—
glycolyl $HOCH_2CO$—
glycyl H_2NCH_2CO—
glyoxylyl OCHCO—
guaiacyl = *o*-methoxyphenyl
guanidino $H_2NC({:}NH)NH$—
guanyl $H_2NC({:}NH)$—
hendecyl $CH_3(CH_2)_{10}$—
heptyl $CH_3(CH_2)_6$—
hexadecyl $CH_3(CH_2)_{14}CH_2$—
hexyl $CH_3(CH_2)_5$—
hippuryl $C_6H_5CONHCH_2CO$—
homopiperonyl 3,4-$(CH_2O_2)C_6H_3CH_2CH_2$—
hydnocarpoyl $C_5H_7(CH_2)_{10}CO$— (*from hydnocarpic acid*)
hydnocarpyl $C_5H_7(CH_2)_{10}CH_2$— (*from hydnocarpylalcohol*)
hydrazi



hydrazino H_2NNH—
hydrazo —HNNH— (*to different atoms*)
hydrazono $H_2NN=$
hydrocinnamoyl $C_6H_5CH_2CH_2CO$—
hydroxamino HONH—
hydroximino = isonitroso
hydroxy (hydroxyl) HO—
-idene *added to any radical usually means a double bond at point of attachment*
imidazolidyl $C_3H_7N_2$— (*from imidazolidine*)
imidazolyl $C_3H_3N_2$— (*from imidazole, 4 isomers*)
imido NH= (*property, in acid groups only;* by some used synonymously with imino)
imino NH=
indanyl C_9H_9— (*from indan, 4 isomers*)
indenyl C_9H_7— (*from indene, 7 isomers*)
indolyl C_8H_6N— (*from indole, 7 isomers*)
indolylidene

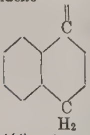


indyl = indolyl
iodo I—
iodoso OI—
iodoxy O_2I—
isoallyl = propenyl
isoamoxy $(CH_3)_2CHCH_2CH_2O$—
isoamyl $(CH_3)_2CHCH_2CH_2$—
isoamylidene $(CH_3)_2CHCH_2CH=$
isobutenyl = 2-methylpropenyl
isobutoxy $(CH_3)_2CHCH_2O$—
isobutyl $(CH_3)_2CHCH_2$—
isobutyryl $(CH_3)_2CHCO$—
isocyanato OCN—
isocyano $C{:}N$—
isohexyl $(CH_3)_2CH(CH_2)_3$—
isoindolyl C_8H_6N— (*from isoindole, 4 isomers*)
isoleucyl $CH_3CH_2CH(CH_3)CHNH_2CO$—
isonitro HOON=
isonitroso HON=
1-isopentenyl = 3-methyl-1-butenyl
isophthalal = isophthalylidene
isophthaloyl —OCC_6H_4CO— (*m*)
isophthalylidene $=HCC_6H_4CH=$ (*m*)
isopropenyl $CH_2{:}C(CH_3)$—
isopropoxy $(CH_3)_2CHO$—
isopropyl $(CH_3)_2CH$—
isopropylidene $(CH_3)_2C=$
isoquinolyl C_9H_6N— (*from isoquinoline, 7 isomers*)
isothiocyano $S{:}C{:}N$—
isovaleryl $(CH_3)_2CHCH_2CO$—
isoxazolyl C_3H_2NO— (*from isoxazole, 5 isomers*)
keto = oxo
lauroyl (*from lauric acid*) $CH_3(CH_2)_{10}CO$—
leucyl (*from leucine*) $(CH_3)_2CHCH_2CHNH_2CO$—
malonyl —$OCCH_2CO$—

menthyl CH_3.-

$\underset{1}{CH}.(CH_2)_2.\underset{4}{CH}(CH(CH_3)_2).\underset{3}{CH_2}.\underset{2}{CH}$—

—(*from menthane; 2-p- shown*)
mercapto HS—
mercuri —Hg—
mesityl 2,4,6-$(CH_3)_3C_6H_2$—
α-mesityl 3,5-$(CH_3)_2C_6H_3CH_2$—
mesyl = methylsulfonyl
methene = methylene
methenyl = methylidyne
methionyl $CH_2(SO_2)_{22}=$
methoxy CH_3O—
methyl CH_3—
methylene $CH_2=$
methylenedioxy —OCH_2O—
methylidyne $CH\equiv$
methylol = (hydroxymethyl)
morpholinyl (*from morpholine*) = C_4H_8NO—
myristoyl (*from myristic acid*) $CH_3(CH_2)_{12}CO$—
naphthal = naphthylmethylene
naphthalimido (*from naphthalimide*) $C_{10}H_6(CO)_2N$—
naphthenyl = naphthylmethylidyne
naphthoxy $C_{10}H_7O$—
naphthoyl $C_{10}H_7CO$—
naphthyl (1- or 2-) $C_{10}H_7$—
naphthylene $C_{10}H_6=$
naphthylidene



1(4)-, etc.
nitramino $O_2.NNH$—
nitrilo $N\equiv$
nitro O_2N—
aci-nitro = isonitro
nitroso ON—
nonyl $CH_3(CH_2)_8$—
norcamphanyl C_7H_{11}— (*from norcamphane*)
octyl $CH_3(CH_2)_7$—
oleoyl (*from oleic acid*) $C_{17}H_{33}CO$—
oxalyl —$OCCO$—
oxamido $H_2NCOCONH$—
oxamyl H_2NCOCO—
oxazolyl C_3H_2NO— (*from oxazole*)
oximido = isonitroso
oxo $O=$ (*to same atom*)
oxy —O— (*used as a connective; cf.* epoxy *and* oxo)
palmitoyl $CH_3(CH_2)_{14}CO$— (*from palmitic acid*)
pelargonyl $CH_3(CH_2)_7CO$— (*from pelargonic acid*)
pentamethylene —$CH_2(CH_2)_3CH_2$—

pentazolyl $N{=}N{-}N{=}N{-}N$—
pentenyl (*like butenyl*) C_5H_9—
pentyl = amyl
perimidyl $C_{11}H_7N_2$— (*from perimidine, 8 isomers*)
perseleno $Se{:}Se=$
perthio (*replacing O only*) $S{=}S=$
phenacyl $C_6H_5COCH_2$—
phenacylidene $C_6H_5COCH=$

phenanthryl $C_{14}H_9$— (*from phenanthrene 5 isomers*)
phenanthrylene—$C_{14}H_8$— (*several isomers*)
phenenyl $C_6H_3\equiv$ (*s*-, *as*-, *v*-)
phenethyl $C_6H_5CH_2CH_2$—
phenetidino $C_2H_5OC_6H_4NH$—
phenetyl (*o*, *m*, or *p*) $C_2H_5OC_6H_4$—
phenoxy C_6H_5O—
phenyl C_6H_5—
phenylacetyl $C_6H_5CH_2CO$—
phenylazo $C_6H_5N{:}N$—
phenylcarbamido = phenylureido
phenylene $C_6H_4=$ (*o*, *m* or *p*)
phenylenebisazo —$N{:}NC_6H_4N{:}N$— (*o*, *m*, *p*)
phenylidene = cyclohexadienylidene
phenylsulfamyl $C_6H_5NHSO_2$—
phenylsulfonamido $C_6H_5SO_2NH$—
phenylureido $C_6H_5NHCONH$—
phospharseno —$P{:}As$—
phosphazo —$P{:}N$—
phosphinico $HOOP=$ (*from phosphinic acid*)
phosphino H_2P—
phospho O_2P—
phosphono $(HO)_2OP$—
phosphoro —$P{:}P$—
phosphoroso OP—
phthalal = phthalylidene

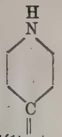
phthalidyl $C_6H_4.CO.O.CH$—
(*from phthalide*)

phthalidylidene $C_6H_4.CO.O.C=$
(*from phthalide*)
phthalimido $C_6H_4(CO)_2N$— (*o*)
phthaloyl —OCC_6H_4CO— (*o*)
phthalylidene $=HCC_6H_4CH=$ (*o*)
phytyl $(CH_3)_2CH(CH_2)_3CH(CH_3)(CH_2)_3$—$CH(CH_3)(CH_2)_3C(CH_3){:}CHCH_2$—
picryl 2,4,6- $(NO_2)_3C_6H_2$—
piperidyl $C_5H_{10}N$— (*from piperidine, 4 isomers*)
piperonyl 3,4-$(CH_2O_2)C_6H_3CH_2$—
piperonylidene 3,4-$(CH_2O_2)C_6H_3CH=$
pivalyl $(CH_3)_3CCO$— (*from pivalic acid*)
prolyl (*from proline*)

$NH.CH_2.CH_2.CH_2.CH.CO$—

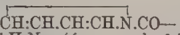
propargyl = 2-propynyl
propenyl $CH_3CH{:}CH$—
propenylidene $CH_3CH{:}C=$
propiolyl $HC\vdots CCO$—
propionyl CH_3CH_2CO—
propoxy $CH_3CH_2CH_2O$—
propyl $CH_3CH_2CH_2$—
propylene —$CH(CH_3)CH_2$—
propylidene $CH_3CH_2CH=$
1-propynyl $CH_3C\vdots C$—
2-propynyl $CH\vdots CCH_2$—
pseudoallyl = isopropenyl
as-pseudocumyl 2,3,5-$(CH_3)_3C_6H_2$—
s-pseudocumyl (2,4,5-)
v-pseudocumyl (2,3,6-)
pseudoindolyl C_8H_6N— (*from pseudoindole, 7 isomers*)
pyranyl C_5H_5O— (2-α, 2-γ, 3-α-, etc.)
pyrazinyl $C_4H_3N_2$— (*from pyrazine*)
pyrazolidyl $C_3H_7N_2$— (*from pyrazolidine*)
pyrazolyl $C_3H_3N_2$— (*from pyrazole, 4 isomers*)
pyrenyl $C_{16}H_9$— (*from pyrene*)
pyridyl C_5H_4N— (*from pyridine, 3 isomers*)

pyridylidene

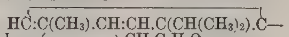


4(1), etc.

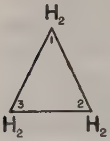
pyrimidyl $C_4H_3N_2—$ (*from pyrimidine*)
pyromucyl = 2-furcyl
pyrrolidyl $C_4H_8N—$ (*from pyrrolidine, 3 isomers*)

pyrroyl 
$\overline{CH:CH.CH:CH.N}.CO—$

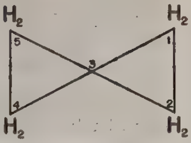
pyrryl $C_4H_4N—$ (*from pyrrole, 3 isomers*)
quinazolyl $C_8H_5N_2—$ (*from quinazoline*)
quinolyl $C_9H_6N—$ (*from quinoline, 7 isomers*)
quinonyl $C_6H_3O_2—$ (*from quinone*)
quinoxalyl $C_8H_5N_2—$(*from quinoxaline*)
salicyl = *o*-hydroxyphenyl; = *o*-hydroxybenzyl
salicylidene $HOC_6H_4CH=$ (*o*)
salicyloyl $HOC_6H_4CO—$ (*o*)
selenino $(HO)OSe—$
seleninyl $OSe=$
seleno $Se=$
selenocyano $NCSe—$
selenono $HO_3Se—$
selenonyl $—SeO_2—$
selenyl $HSe—$
semicarbazido $NH_2CONHNH—$
senecioyl $(CH_3)_2C:CHCO—$ (*from senecioic acid*)
siloxy $H_3SiO—$
silyl $H_3S—$
silylamino $H_3SiNH—$
1-silyldisilanyl $(H_3Si)_2SiH—$
silylene $H_2Si=$
silylidene $HSi\equiv$
stannyl $H_3Sn—$
stearoyl $CH_3(CH_2)_{16}CO—$
stibarseno $—Sb:As—$
stibinico $HOOSb=$
stibino $H_2Sb—$
stibo $O_2Sb—$
stibono $(HO)_2OSb—$
stiboso $O:Sb—$
stibyl = stibino
stibylene $HSb=$
styrene $—CH(C_6H_5)CH_2—$
styrolene = styrene
styryl $C_6H_5CH:CH—$
succinamyl $H_2NCOCH_2CH_2CO—$
succinimido $(CH_2CO)_2N—$
succinyl $—OCCH_2CH_2CO—$
sulfamino $HO_3SNH—$
sulfamyl $H_2NO_2S—$
sulfanilamido *p*-$H_2NC_6H_4SO_2NH—$ (*from sulfanilamide*)
sulfanilyl *p*-$H_2NC_6H_4SO_2—$ (*from sulfanilic acid*)
sulfhydryl = mercapto
sulfino $HO_2S—$
sulfinyl $OS=$
sulfo $HO_3S—$
sulfonamido $—SO_2NH—$
sulfonyl $—SO_2—$
sulfuryl = sulfonyl
tauryl $H_2NCH_2CH_2SO_2—$
telluro $Te=$
terephthalal = terephthalylidene
terephthaloyl $—OCC_6H_4CO—$(*p*)
terephthalylidene $=HCC_6H_4CH=$ (*p*)
tetramethylene $—CH_2CH_2CH_2CH_2—$
tetrazolyl $CHN_4—$ (*from tetrazole, 2 isomers*)
thenoyl $C_4H_3SCO—$ (*from thiophenecarboxylic acid, 2 isomers*)
thenyl (*2 isomers*) $C_4H_3SCH_2—$
thenylidene (*2 isomers*) $C_4H_3SCH=$
thiazolidyl $C_3H_6NS—$ (*from thiazolidine*)
thiazolyl $C_3H_2NS—$ (*from thiazole, 3 isomers*)
thienyl $C_4H_3S—$ (*from thiophene, 2 isomers*)
thio $—S—$
thiocarbamyl $H_2NCS—$
thiocarbonyl $SC=$
thiocyano $NCS—$
thiohydroxy = mercapto
thiol (S replacing O in OH)
Used in place of "thio" when required for distinction
thiono (S replacing O in CO)
Used in place of "thio" when required for distinction)
thionyl = sulfinyl
thioxo (S replacing 2H in $>CH_2$)
thiuram = thiocarbamyl
thujyl $C_{10}H_{17}—$ (*from sabinane, attached at 2-position*)
thymyl (*from thymol*)


$\overline{HC:C(CH_3).CH:CH.C(CH(CH_3)_2).C}—$

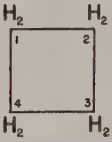
toloxy (*o, m,* or *p*) $CH_3C_6H_4O—$
toluidino (*o, m* or *p*) $CH_3C_6H_4ONH—$
toluyl (*o, m* or *p*) $CH_3C_6H_4CO—$
α-toluyl = phenylacetyl
tolyl (*o, m* or *p*) $CH_3C_6H_4—$
α-tolyl = benzyl
tolylene (*6 isomers*) $CH_3C_6H_3=$
α-tolylene = benzylidene
tosyl = tolylsulfonyl
triazeno $NH_2N:N—$
triazinyl $C_3H_2N_3—$ (*from triazine*)
triazo = azido
triazolyl $C_2H_2N_3—$ (*from triazole*)
trimethylene $—CH_2CH_2CH_2—$
trisilanyl $H_3SiSiH_2SiH_2—$
trisilanylene $—SiH_2SiH_2SiH_2—$
trityl = triphenylmethyl
tryptophyl $C_{11}H_{11}N_2O—$ (*from tryptophan*)
tyrosyl *p*-$HOC_6H_4CH_2CHNH_2CO—$ (*from tyrosine*)
undecyl = hendecyl (in sense $C_{11}H_{23}—$)
uramino = ureido
ureido $H_2NCONH—$ (*by some used synonymously with ureylene*)
ureylene $—HNCONH—$
valeryl $CH_3(CH_2)_3CO—$
valyl $(CH_3)_2CHCHNH_2CO—$ (*from valine*)
vanillal = vanillylidene
vanilloyl 3,4-$(CH_3O)(HO)(C_6H_3CO—$
vanillyl 3,4-$(CH_3O)(HO)C_6H_3CH_2—$
vanillylidene 3,4-$(CH_3O)(HO)C_6H_3CH=$
veratral = veratrylidene
veratroyl 3,4-$(CH_3O)_2C_6H_3CO—$
veratryl 3,4-$(CH_3O)_2C_6H_3CH_2—$
veratrylidene 3,4-$(CH_3O)_2C_6H_3CH=$
vinyl $H_2C:CH—$
vinylene $—CH:CH—$
vinylidene $H_2C:C=$
xanthyl $C_{13}H_9O—$ (*from xanthene, 6 isomers*)
xenyl = biphenylyl
xyloyl $(CH_3)_2C_6H_3CO—$ (*from xylic acid 7 isomers*)
xylyl $(CH_3)_2C_6H_3—$
xylylene $—H_2CC_6H_4CH_2—$



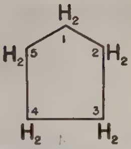
Cyclopropane



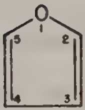
Spiropentane



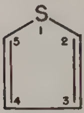
Cyclobutane



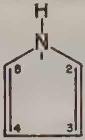
Cyclopentane



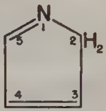
Furan



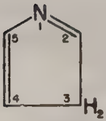
Thiophene
(Thiofuran)



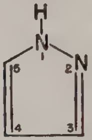
Pyrrole
(Azole)



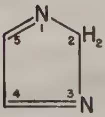
Isopyrrole
(Isoazole)
(α-Pyrrolenine)



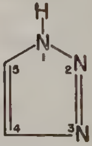
3-Isopyrrole
(Isoazole)
(β-Pyrrolenine)



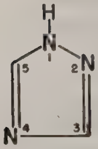
Pyrazole
(1, 2-Diazole)



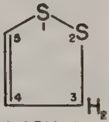
2-Isoimidazole
(1, 3-Isodiazole)



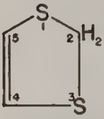
1, 2, 3-Triazole



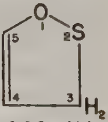
1, 2, 4-Triazole



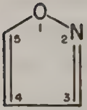
1, 2-Dithiole



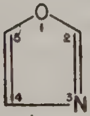
1, 3-Dithiole



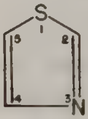
1, 2, 3-Oxathiole



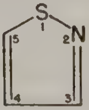
Isoxazole
(Furo [α] monazole)



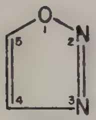
Oxazole
(Furo [β] monazole)

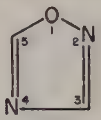


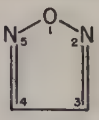
Thiazole

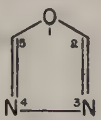


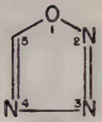
Isothiazole

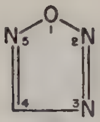

1, 2, 3-Oxadiazole

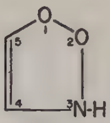

1, 2, 4-Oxadiazole
(Azoxime)

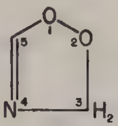

1, 2, 5-Oxadiazole
(Furazan)

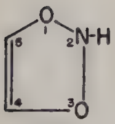

1, 3, 4-Oxadiazole

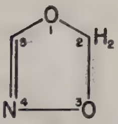

1, 2, 3, 4-Oxatriazole

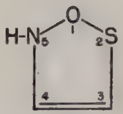

1, 2, 3, 5-Oxatriazole

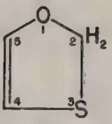

1, 2, 3-Dioxazole

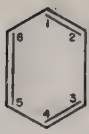

1, 2, 4-Dioxazole

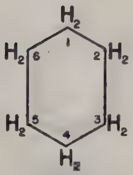

1, 3, 2-Diexazole

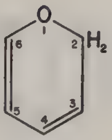

1, 3, 4-Dioxazole

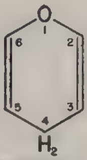

1, 2, 5-Oxathiazole

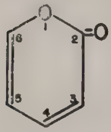

1, 3-Oxathiole


Benzene

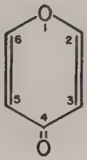

Cyclohexane


1, 2-Pyran

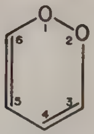

1, 4-Pyran



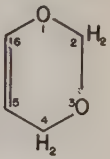
1, 2-Pyrone
(α-Pyrone)



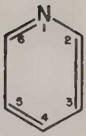
1, 4-Pyrone
(γ-Pyrone)



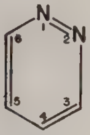
1, 2-Dioxin



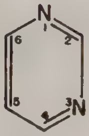
1, 3-Dioxin,
Dihydro form



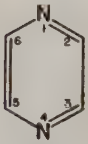
Pyridine
(Azine)



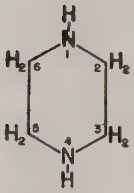
Pyridazine
(1, 2-Diazine)



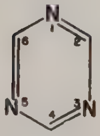
Pyrimidine
(1, 3-Diazine)



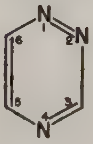
Pyrazine
(1, 4-Diazine)



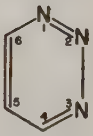
Piperazine



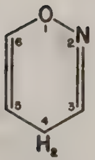
s-Triazine
(1, 3, 5-Triazine)



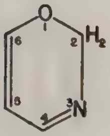
as-Triazine
(1, 2, 4-Triazine)



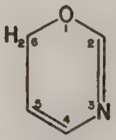
v-Triazine
(1, 2, 3-Triazine)



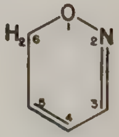
1, 2, 4-Oxazine



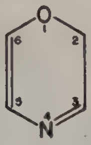
1, 3, 2-Oxazine



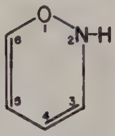
1, 3, 6-Oxazine
(Pentoxazole)



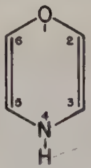
1, 2, 6,-Oxazine



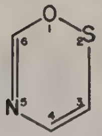
1, 4-Oxazine



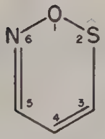
o-Isoxazine



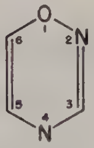
p-Isoxazine



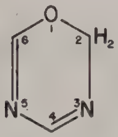
1, 2, 5-Oxathiazine



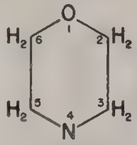
1, 2, 6-Oxathiazine



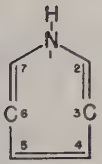
1, 4, 2-Oxadiazine



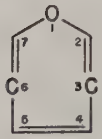
1, 3, 5, 2-Oxadiazine



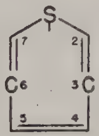
Morpholine (Tetrahydro-p-isoxazine)



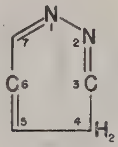
Azepine



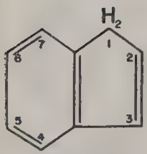
Oxepin



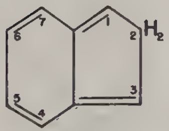
Thiepin



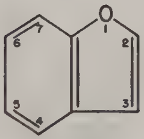
1, 2, 4-Diazepine



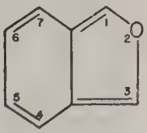
Indene



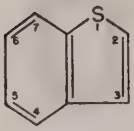
Isoindene



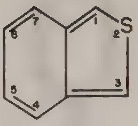
Benzofuran (Coumarone)



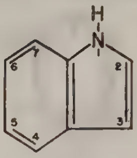
Isobenzofuran



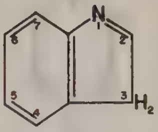
Thionaphthene
(Benzothiofuran)



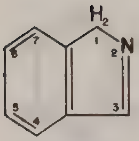
Isothionaphthene
(Isobenzothiofuran)



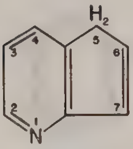
Indole



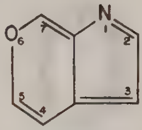
Indolenine
(3-Pseudoindole)



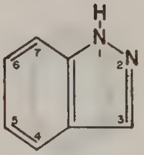
2-Isobenzazole
(Pseudoisoindole)



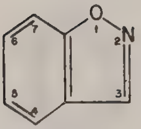
1, 5-Pyrindine
(4-Pyrindine)



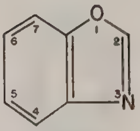
Pyrano [3, 4-b]-
pyrrole



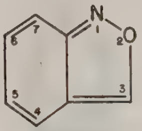
Isoindazole
(Benzpyrazole)



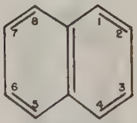
Indoxazine
(Benzisoxazole)



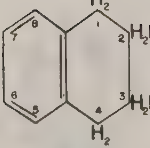
Benzoxazole



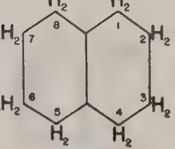
Anthranil



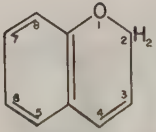
Naphthalene



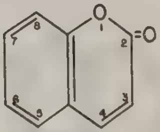
Tetralin



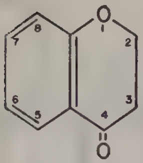
Decalin
(Bicyclo [4, 4, 0]
decane



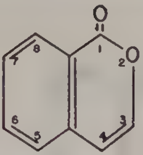
1, 2-Benzopyran
(1, 2-Chromene)



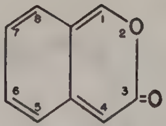
Coumarin
(1, 2-Benzopyrone)



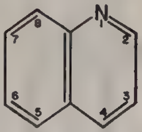
Chromone
(1, 4-Benzopyrone)



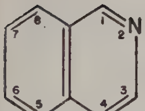
Isocoumarin
(2, 1-Benzopyrone)



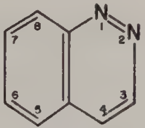
2, 3-Benzopyrone



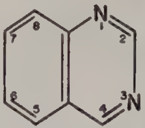
Quinoline
(1-Benzazine)



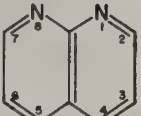
Isoquinoline
(2-Benzazine)



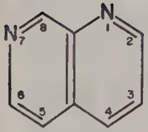
Cinnoline
(1, 2-Benzodiazine)



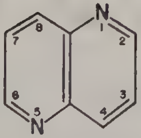
Quinazoline
(1, 3-Benzodiazine)



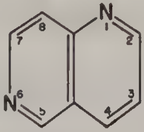
Naphthyridine



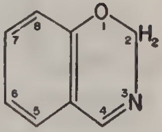
Pyrido [3, 4-b]-
pyridine



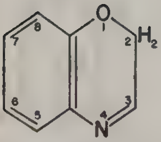
Pyrido [3, 2-b]-
pyridine



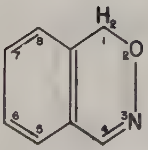
Pyrido [4, 3-b]-
pyridine



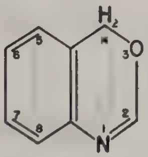
1, 3, 2-Benzoxazine



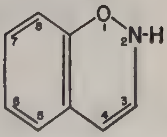
1, 4, 2-Benzoxazine



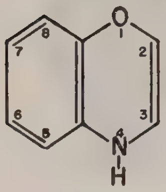
2, 3, 1-Benzoxazine



3, 1, 4-Benzoxazine



1, 2-Benzisoxazine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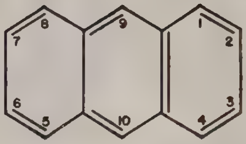
1, 4-Benzisoxazine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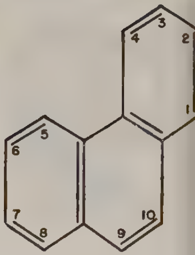
Anthracene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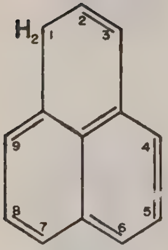
Phenanthrene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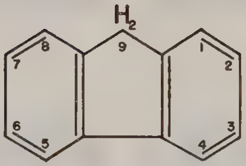
Benzonaphthene
(Phenalene)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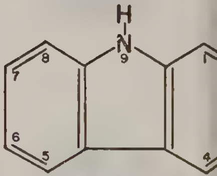
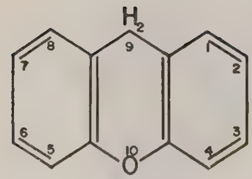
Fluorene



Carbazole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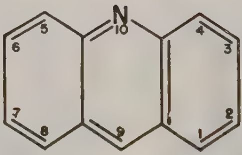
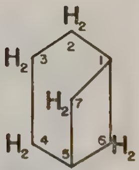
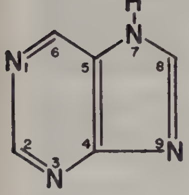
Xanthene


N
10
4
3
2
1
9
8
7
6
5

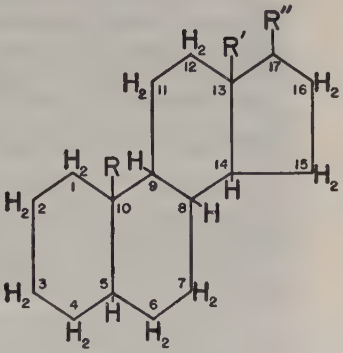
Acridine


H2
2
1
H2
3
H2
7
H2
4
5
6
H2

Norpinane


H
N
7
N
1
6
5
8
2
4
9
N
3
N

Purine


R″
H2
R′
12
17
H2
11
13
16
H2
H2
R
H
14
15
H2
1
9
H
H2
2
10
8
H
H2
3
5
7
H2
4
H
6
H2
H2

Steroid ring system

R; nearly always methyl
R′; usually methyl
R″; various groups

A more extensive listing of ring compounds and systems may be found in the following:

- Chemical Abstracts, annual subject index.
- The Ring Index, Patterson and Capell, Reinhold Publishing Company, 1940.
- Lexikon der Kohlenstoffverbindungen, Richter, Leopold Voss, 1910.

The numbering system for the compounds listed above is that used in The Ring Index.

EXPLANATION OF TABLE

The table presents data for over 5000 compounds. They have been selected to include those of general or commercial importance as well as those commonly met with in the laboratory.

Arrangement. The entries are arranged alphabetically by *parent compounds*, substituting atoms and groups like bromo-, chloro-, ethyl-, methyl-, nitro-, etc. being placed after the rest of the name instead of before it; e.g., Acetic acid, dichloro- (and not Dichloroacetic acid). This practice, which is followed in some of the indexes to journals, makes it possible to bring many derivatives of the same parent together. Radicals such as propyl, butyl and amyl, and also compounds such as butyric acid and valeraldehyde, are assumed to be of normal structure unless otherwise stated.

Nomenclature. Compounds are indexed under their common names wherever these are acceptable, but a large number of *synonyms* and *cross references* are included. In particular, many names formed according to the International Union Rules (see preceding pages) are given and are distinguished by the symbol (*). Trade mark names are in quotations.

An **alphabetic order of substituting radicals** is employed in each name; e.g., Ether, ethyl methyl (not Ether, methyl ethyl). For a table of radicals, see preceding pages.

Acids are entered under their "trivial" names where these exist. Systematic names are derived from trivial names where this is feasible; as, Valeric acid, α-bromo-.

Alcohols. Important alcohols having common names, as Amyl alcohol, Isoamyl alcohol, Propyl alcohol, are so entered. For others the International Union names are used; as, 3-Buten-1-ol.

Aldehydes and **amides** are usually entered under names derived from the acid name; as, Propionaldehyde, Propionamide (from propionic acid).

Amines will be found under their usual names; as, Ethylamine, Triethylamine, Ethylenediamine.

Carbylamines are entered as Ethyl isocyanide, Phenyl isocyanide, etc.

Cyanides. See Nitriles, below.

Esters of organic acids will in general be found under the names of the corresponding acids, but those of glycerol and glycol are under the names of the alcohols. Esters of inorganic acids have independent entries; as, Ethyl sulphate, Ethylsulfuric acid.

Ethers. Simple, unsubstituted ethers occur under their own names; as, Ethyl ether, Phenyl ether. Most other monoethers are under *Ether*; as, Ether, isoamyl phenyl.

Halogen derivatives of hydrocarbons, when simple, are entered under their common names (as, Propyl chloride) or, when more complex, under their International Union names (as, 1-Pentane, 2-chloro-).

Hydrazine derivatives are found under *Hydrazine* or, if monoacyl derivatives, under the name of the corresponding acid (as, Benzoic acid, hydrazide). But **hydrazones** are placed under the corresponding carbonyl compound (as, Acetone, phenylhydrazone).

Hydrocarbons of the aliphatic series are entered under their Geneva (International Union) names; other hydrocarbons, under their commonly accepted names.

Isocyanides (Isonitriles) are named as Ethyl isocyanide, Phenyl isocyanide, etc.

Ketones having simple names are so entered (e.g., Acetone, Acetophenone); others are given International Union names if possible (as, 2-Butanone). Those familiar with "ketone" names will find a number of cross references under *Ketone.*

Mercaptans are named, according to the International Union rule, as Ethanethiol (C_2H_5SH), Benzenethiol (C_6H_5SH), etc.

Metallic salts of organic acids will be found in the preceding table, "Physical Constants of Inorganic Compounds."

Metal-organic compounds should be looked for under the name of the metal; as, Lead, tetraethyl-.

Nitriles (cyanides) are given names derived from the corresponding acid; as, Acetonitrile.

EXPLANATION OF TABLE (Continued)

Oximes are entered under the corresponding carbonyl compound; as, Formaldehyde, oxime.

Phenols will be found under their usual names; as, Phenol, Resorcinol.

Salts of bases are entered under the names of the bases; as, Aniline, hydrochloride. For metal salts of organic acids see the preceding table, "Physical Constants of Inorganic Compounds."

Semicarbazones are placed under the corresponding carbonyl compound; as, Acetone, semicarbazone.

Sulfides, sulfones and **sulfoxides** are treated like ethers (see Ethers, above); as, Ethyl sulfide; Sulfone, ethyl phenyl.

Sulfonic acids are named as Ethanesulfonic acid, Naphthalenedisulfonic acid, etc.

Boldface type is used to distinguish the parent compounds and their substituting radicals. When a parent compound is followed by derivatives its name is not repeated but is replaced in each succeeding entry by a dash.

Formulas. Structural formulas have been given in most cases, and the structure has been indicated as fully as is feasible without taking undue space.

Numbers have been assigned to all compounds to facilitate identification of data on the right hand page and for use in connection with the formula, melting point and boiling point indexes which immediately follow the table. Since the original numbering, some items have been deleted and many others added resulting in occasional breaks in the succession and the occurrence of letters in combination with the numbers.

Crystalline form and **color** are stated in easily interpreted abbreviations. Other important characteristics are often added. The **index of refraction,** follows. For crystals of two or three indices they are invariably given in the order ω, ϵ or α, β, γ. The **specific rotation,** $[\alpha]$, is given for certain compounds. Temperature and wavelength are indicated by the superior and inferior figures and letters following the numerical value. When not otherwise indicated the index of refraction and specific rotation are understood to be at 20°C. and for sodium light.

For example: 1.5236^{20}_{D} indicates an index of refraction of 1.5236 for sodium light ($\lambda = 589.3$ mμ) at 20°C; $[\alpha] - 65.6^{\circ 20}_{D}$ indicates a negative specific rotation of 65.6° for sodium light and a temperature of 20°C.

Density, is normally given in grams per milliliter, at 20°C, numerically equivalent to the specific gravity at 20° referred to water at 4°C. Specific gravity at other temperatures is shown with superior and inferior figures indicating, respectively, the temperature of the substance and that of water to which it is referred. The density of gases is given in grams per liter at 0°C and 760 mm Hg pressure unless otherwise indicated.

Example: 1.536 indicates a density in grams per milliliter at 20°C; 1.634^{25}_{4} indicates a specific gravity of 1.634 at 25°C referred to water at 4°. 2.143g/l indicates the density of a gas at standard conditions, 0°C and 760 mm pressure, as 2.143 grams per liter.

Melting point and **boiling point** are given in °C. Other effects of temperature elevation such as dehydration, sublimation, decomposition explosion are recorded in connection with the melting or boiling points. Decomposition on heating is indicated by the abbreviation d. If decomposition occurs at a definite temperature, the form d. 120 is used, while 120 d. indicates melting or boiling at 120°C with decomposition. Loss of water of crystallization is indicated by — H_2O. The boiling point is stated at normal atmospheric pressure (760 mm of Hg) unless otherwise indicated by a superior figure which shows the pressure in millimeters under which the compound boils at the temperature given.

Example: 125^{720} indicates a boiling point of 125°C at a pressure of 720 mm.

Solubility is stated in grams of substance dissolving in 100 ml of the solvent. Normal room temperatures, 20°C, is assumed unless the temperature is indicated by a superior figure. The term insoluble (i.) must usually be interpreted to mean that a negligible quantity of the compound dissolves. Many compounds commonly regarded as insoluble really dissolve to a slight extent. The terms very soluble (v.s.), soluble (s.), slightly soluble

EXPLANATION OF TABLE (Continued)

(sl.s.) are used for lack of definite figures. Conflicting statements are very common in the literature. Quantitative statements of solubility are likewise subject to uncertainty due to inexact statement of conditions. Values may be variously stated as parts by weight of solute in parts by weight or volume of the solvent or of the solution, and values are often given and quoted in the literature without proper designation. In the large number of values given there are many which are uncertain in this respect.

The form s. d. indicates solubility with more or less decomposition. The occurrence of d. alone in the statement of solubility indicates that decomposition is the primary action. The statement of solubility in acids or alkalis is usually understood to be accompanied by decomposition.

The policy has been followed of giving the solubility in water, ethyl alcohol and ethyl ether first, followed by statements in regard to other solvents.

As examples:

23.4^{20} indicates a solubility of 23.4 grams of the substance in 100 ml of solvent at 20°C.

250 cm^3 al. indicates the solubility of a gas in ethyl alcohol as 250 cm^3 or ml of the gas in 100 ml of alcohol.

∞^{35} indicates that the substance is miscible with the solvent above 35°C.

Molecular weights have been computed to the nearest hundredth according to the atomic weights of 1939.

ABBREVIATIONS

$[\alpha]$	specific rotation
a	acid
abs	absolute
abt	about
ac. a	acetic acid
acet	acetone
al	alcohol
alk	alkali
amor	amorphous
anh	anhydrous
arom	aromatic
art	artificial
asym., as	asymmetric
bi-py	bipyramidal
bl	blue
blk	black
boil	boiling
br	brown
bz	benzene
brnsh	brownish
c	cold
ca	about
carb	carbonates
caust	caustic
chl	chloroform
col	colorless
comp	compound
conc	concentrated
cr., cryst	crystals
d	decomposes
d	dextrorotatory
deliq	deliquescent
dil	dilute
dist	distillable
dk	dark
dl	racemic
efflor	efflorescent
et	ethyl
et. ac	ethyl acetate
eth	ether
exp	explodes
f	from
feath	feathery
fl	flakes
fluores	fluorescent
frz	freezes
fum	fuming
gel	gelatinous
gen	generally
glac	glacial
glit	glittering
glyc	glycerin
gran	granular
grn	green
grnsh	greenish
h	hot
hex	hexagonal
hyd	hydrate or hydrolyses
hyg., hygr	hygroscopic
i	inactive
i	insoluble
ign	ignites
inflam	inflammable
infus	infuses
irid	iridescent
l	levorotatory
leaf. or lf	leaflets
lg	large
lgr	ligroin
liq	liquid
lng	long
lt	light
lust	lustrous
lvs	leaves
m	meta-
me., meth	methyl
met	metallic
micr	microscopic
min	mineral
mixt	mixture
mod	modification
monocl	monoclinic
need., nd	needles
o	ortho-
octahdr	octahedral
or	orange
ord	ordinary
org	organic
orth	orthorombic
p	para-
pa	pale
pet	petroleum
pet. eth	petroleum ether
ph	phenyl
$\mathrm{PHNO_2}$	nitrobenzene
pl	plates
pois	poison, poisonous
powd	powder
pr	prisms
purp	purple
pyr	pyridine
pyram	pyramids
quad	quadrilateral
rac	racemic
rect	rectangular
redsh	reddish
resin	resinous
rhomb	rhombic
rhbdr	rhombohedral
s	soluble
sc	scales
sec	secondary
sb	short
sl	slightly
sld	solid
slend	slender
sm	small
soft	softens
sol., soln	solutions
solv	solvents
st	steel
stab	stable
subl	sublimes
sym	symmetrical
tab., tabl	tablets
tert	tertiary
tetr	tetragonal
tol	toluene
trans	transparent
thk	thick
tricl	triclinic
trim	trimetric
uns	unsymmetrical
unst	unstable
v	very
var	variable
vic	vicinal
visc	viscous
volat	volatile or volatilizes
vlt	violet
w	water
wh	white
yel	yellow
yelsh., ylsh	yellowish
>	above
<	below
∞	soluble in all proportions

No.	Name	Synonyms	Formula	Mol. Wt.
1	**Abietic Acid** (obsolete)	abietinic acid; sylvic acid	$C_{20}H_{30}O_2$	302.44
2	**Acenaphthene**	naphthyleneethylene	$C_{10}H_6(CH_2)_2$	154.20
2H	**Acenaphthenequinone**	1, 2-acenaphthenedione	$C_{10}H_6(CO)_2$	182.17
2M	**Acenaphthylene**		$C_{10}H_6(CH)_2$	152.18
3	**Acetal**	1, 1-diethoxyethane*; acetaldehyde diethyl acetal; ethylidene diethyl ether.	$CH_3CH(OC_2H_5)_2$	118.17
4	——, **amino-.**	See *Ethylamine, β, β-diethoxy-.**		
5	——, **dichloro-**	1, 1-dichloro-2, 2-diethoxyethane*	$CHCl_2CH(OC_2H_5)_2$	187.07
6	——, **diethylamino-.**	See *Triethylamine, β, β-diethoxy-.*		
7	——, **dimethyl.**	See *Ethane,* 1, 1-*dimethoxy-**.		
8	——, **dimethylamino-.**	See *Ethylamine, β, β-diethoxy-N, N-dimethyl-.*		
9	——, **trichloro-.**	See *Ethane,* 1, 1, 1-*trichloro-*2, 2-*diethoxy-**.		
10	**Acetaldehyde**	ethanal*; acetic aldehyde; aldehyde.	CH_3CHO	44.05
11	——, cyanohydrin.	See *Lactonitrile.*		
12	——, diethyl acetal.	See *Acetal.*		
13	——, dimethyl acetal.	See *Ethane,* 1, 1-*dimethoxy-**.		
13M	——, 2, 4-dinitrophenylhydrazone		$CH_3CH{:}NNHC_6H_3(NO_2)_2$	224.18
14	——, oxime	ethanal oxime*; acetaldoxime.	$CH_3CH{:}NOH$	59.07
15	——, phenylhydrazone	*N*-ethylidene-*N′*-phenylhydrazine	$CH_3CH{:}NNHC_6H_5$	134.18
16	——, semicarbazone	ethanal semicarbazone*	$CH_3CH{:}NNHCONH_2$.	101.11
17	——, **butylethyl-.**	See *Caproaldehyde, α-ethyl-.*		
18	——, **dichloro-**	dichloroethanal*; dichloroaldehyde	$CHCl_2CHO$	112.95
19	——, **methyl-.**	See *Propionaldehyde.*		
20	——, **phenyl-.**	See *α-Tolualdehyde.*		
21	——, **thio-**, trimer.	See *s-Trithiane,* 2, 4, 6-*trimethyl-.*		
22	——, **tribromo-.**	See *Bromal.*		
23	——, **trichloro-.**	See *Chloral.*		
24	——, **trimethyl-.**	See *Pivaldehyde.*		
25	——, *α* or *β*-**trithio-.**	See *s-Trithiane,* 2, 4, 6-*trimethyl-.*		
26	——, *γ*-**trithio-**		$(CH_3CHS)_3$	180.34
27	**Acetaldehyde-ammonia.**	1-aminoethanol*; α-aminoethyl alcohol; aldehyde-ammonia.	$CH_3CH(NH_2)OH$	61.08
28	**Acetaldoxime.**	See *Acetaldehyde, oxime.*		
29	——, **trimethyl-.**	See *Pivalaldehyde, oxime.*		
30	**Acetalylamine.**	See *Ethylamine, β, β-diethoxy-**.		
31	**Acetamide**	ethanamide*	CH_3CONH_2	59.07

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1	Varies with solvent, usually plates or prisms	....	172–75°C	....	i.	v. s.	v. s. eth.; s. glac. ac. a., acet., bz., CS_2, me. al.
2	wh. lng. need., 1.407, 1.468, 1.620; liq. 1.6048^{100}	$1.024\frac{99}{4}$	95	277.5	i.	4.2^{20}, 66.7^{70}	s. h. eth.; 36.9^{20} chl.; 76^{20}, 284.6^{60} tol.; s. h. bz.
2H	yel. need......	....	261	subl.	i.	sl. s.	....
2M	rhomb.-yel. pl. f. al.	$0.899\frac{16}{4}$	92–93	265–75, sl. d.	i.	v. s.	v. s. eth.
3	col. volat. liq., 1.38193	$0.8254\frac{20}{4}$; $0.8461\frac{0}{4}$	....	102–4	4.58^{25}	∞	∞ eth.
4							
5	liq............	1.138^{14}	....	184	......	......	....
6							
7							
8							
9							
10	col. fum. inflam. liq., 1.3316	$0.7834\frac{18}{4}$	−123.5	21	∞	∞	∞ eth., bz.
11							
12							
13							
13M	sm. yel. sc.....	....	167	....	......	s.	s. eth.
14	need. or col. liq.; liq. $1.42567^{20.4}$	$0.9656\frac{20}{4}$	47; frz. 13	114–5	s.	∞	∞ eth.
15	col. need......	....	98–101 (57)	$236–7^{20}$	......	......	s. pet. eth.
16	need. f. w. or al.	$1.0300\frac{0}{4}$	162–3	....	3^{17}	s.	....
17							
18	col. liq........	....	....	90.5	......	......	....
19							
20							
21							
22							
23							
24							
25							
26	....	....	81	100	......	......	....
27	col. rhomb.....	....	97 (70–80)	100 sl. d.	v. s.	v. s.	sl. s. eth.
28							
29							
30							
31	col. hex., or rhbdr., deliq. need. f. chl.; 1.54, 1.46 (stable mod.), 1.370, 1.485, 1.585 (metastable mod.); liq. $1.427^{78.3}$	$1.159\frac{20}{4}$	81 (69.4)	222	97.5^{20}, 178^{60}	25.0^{20}, 257.1^{60}	sl. s. eth.; v. s. glyc.; s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
32	**Acetamide, *N*-benzyl-**	*N*-acetylbenzylamine; acetobenzylamide	$C_6H_5CH_2NHCOCH_3$	149.19
33	**——, *N*-bromo-**	acetobromamide	$CH_3CONHBr$	137.98
34	**——, *α*-chloro-**	2-chloroethanamide*	$ClCH_2CONH_2$	93.52
35	**——, cyanonitro-**	See *Fulminuric acid.*		
36	**——, *α, α*-dichloro-**	2, 2-dichloroethanamide*	$CHCl_2CONH_2$	127.97
37	**——, *N, N*-diphenyl-**	*N*-acetyldiphenylamine; *N*-phenylacetanilide	$(C_6H_5)_2NCOCH_3$	211.25
38	**——, *N*-ethyl-**	acetoethylamide	$CH_3CONHC_2H_5$	87.12
39	**——, hydroxy-.**	See *Glycolamide.*		
40	**——, *N*-(2-hydroxy-1-naphthyl)-.**	See 2-*Naphthol, 1-acetamido-.*		
41	**——, *N*-(4-hydroxy-1-naphthyl)-.**	See 1-*Naphthol, 4-acetamido-.*		
42	**——, isopropyl-.**	See *Isovaleramide.*		
43	**——, *N*-methyl-*N*-1-naphthyl-.**	See 1-*Naphthylamine, N-acetyl-N-methyl-.*		
44	**——, *N*-naphthyl-.**	See *Naphthylamine, N-acetyl-.*		
45	**——, *N*-phenyl-.**	See *Acetanilide.*		
46	**——, *N*-2-thienyl-**	*N*-acetyl-2-thiophenine; 2-acetothiophenide	$CH_3CONHC_4H_3S$	141.18
47	**——, thio-**	ethanethionamide*; acetothioamide	CH_3CSNH_2	75.13
48	**——, *N*-(thiocarbamyl)-.**	See *Urea, acetyl-thio-.*		
49	**——, trichloro-**	2, 2, 2-trichloroethanamide*	CCl_3CONH_2	162.42
50	**Acetamidine**	ethanamidine*	$CH_3C(:NH)NH_2$	58.08
51	**——, *N, N′*-diphenyl-**	ethenyldiphenylamidine	$CH_3C(:NC_6H_5)-NHC_6H_5$	210.27
52	**Acetanilide**	*N*-phenylacetamide; antifebrin	$CH_3CONHC_6H_5$	135.16
53	**——, *α*-acetyl-.**	See *Acetoacetanilide.*		
54	**——, *o*-amino-**	*N*-acetyl-*o*-phenylenediamine	$CH_3CONHC_6H_4-NH_2$	150.18
55	**——, *m*-amino-**	*N*-acetyl-*m*-phenylenediamine	$CH_3CONHC_6H_4-NH_2$	150.18
56	**——, *p*-amino-**	*N*-acetyl-*p*-phenylenediamine	$CH_3CONHC_6H_4-NH_2$	150.18
57	**——, *o*-bromo-**	*N*-acetyl-*o*-bromoaniline	$BrC_6H_4NHCOCH_3$	214.07
58	**——, *m*-bromo-**		$CH_3CONHC_6H_4Br$	214.07
59	**——, *p*-bromo-**	*N*-acetyl-*p*-bromoaniline, antisepsin, asepsin, bromanilid	$BrC_6H_4NHCOCH_3$	214.07
60	**——, *o*-chloro-**	*N*-acetyl-*o*-chloroaniline	$CH_3CONHC_6H_4Cl$	169.61
61	**——, *m*-chloro-**	*N*-acetyl-*m*-chloroaniline	$CH_3CONHC_6H_4Cl$	169.61
62	**——, *p*-chloro-**	*N*-acetyl-*p*-chloroaniline	$CH_3CONHC_6H_4Cl$	169.61
63	**——, 2,4-dimethyl-.**	See 2, 4-*Acetoxylide.*		
64	**——, 2,4-dinitro-**		$CH_3CONHC_6H_3-(NO_2)_2$	225.16
65	**——, *p*-ethoxy-.**	See *p-Acetophenetide.*		
66	**——, *o*-hydroxy-**	*o*-acetamidophenol; *o*-acetylaminophenol	$CH_3CONHC_6H_4-OH$	151.16
67	**——, *m*-hydroxy-**	*m*-acetamidophenol	$CH_3CONHC_6H_4-OH$	151.16
68	**——, *p*-hydroxy-**	*p*-acetamidophenol	$CH_3CONHC_6H_4-OH$	151.16

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
32	leaf. f. eth.....	....	61	>300	i.	s.	s. eth., lgr.
33	$+1H_2O$, lg. pl.	....	$+H_2O$, 70-80; anh. 108	....	s., d.^{100}	s.	s. eth.
34	monocl. need..	....	119.5	225.6	10^{24}	s.	v. sl. s. eth.
35							
36	monocl. pr.....	....	98	234.6	v. s. h.	v. s.	v. s. eth.
37	ng. need. or rhomb. f. w.	....	103 (99-100)	subl.	sl. s.	s.	sl. s. eth.
38	liq...........	$0.942\frac{4.5}{4}$	....	205	∞	∞	s. a.; i. dil. alk.
39							
40							
41							
42							
43							
44							
45							
46	wh. pl........	....	160-1	....	sl. s.	s.	sl. s. eth.
47	yel. monocl. tab. f. eth.	....	108.5	....	v. s.	s.	s. eth.
48							
49	monocl. tab. f. w.	....	141	239-40	v. sl. s.	v. s.	v. s. eth.
50	unstable......	....	166-7 d.	....	s., d. h.	s.	s. a.
51	need. f. al.....	....	131-2	....		sl. s. c., v. s. h.	v. s. eth.; s. a.
52	rhomb., wh. leaf. f. w.	$1.21\frac{4}{4}$	114	305	0.563^{25}, 3.5^{80}	36.9^{20}	s. eth., glyc.; 13.6^{20}, 44.9^{50} chl.; 69.5^{20} me. al.
53							
54	sm. lust. pl....	....	132 (145)	....	s.	.....	sl. s. eth.
55	col. need. f. bz.	....	70	d. 86.5-7.5	v. s.	s.	sl. s. eth.
56	col. need. f. w..	....	161-2	267	sl. s.	v. s.	v. s. eth.
57	need. f. al.....	....	99	....	i.	s.	s. eth.
58	need. f. dil. al..	....	87.5	....	......	s.	s. eth.
59	need. or monocl. pr.	....	168 (165-7)	....	v. sl. s. h.	sl. s.	sl. s. eth.; s. chl., bz.
60	need. f. dil. ac. a.	....	88	....	sl. s.	s.	v. s. eth.; s. bz.
61	need. f. dil. ac. a.	....	72.5	....	sl. s.	s.	v. s. eth.; s. CS_2, bz.
62	rhomb. need. or pl.	$1.385\frac{22}{4}$	178.4 (176-7)	....	sl. s.	3.28^{10}; 4.37^{20}	s. eth., CS_2
63							
64	need. f. al.....	....	120	....	i. c.	v. s. h.	s. eth.
65							
66	col. leaf. f. dil. al.	....	203	....	sl. s.	s.	s. eth., KOH
67	col. need. f. w..	....	149	....	s.	s.	sl. s. eth., chl., bz.
68	col. monocl. f. al.	$1.293\frac{21}{4}$	168	....	v. sl. s.	v. s.	sl. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
69	**Acetanilide, o-hydroxy-*N*-methyl-**	*o*-(acetylmethylamino)-phenol	$CH_3CON(CH_3)C_6H_4OH$	165.19
70	**——, *p*-hydroxy-*N*-methyl-**	....	$CH_3CON(CH_3)C_6H_4OH$	165.19
71	**——, *p*-iodo-**..........	....	$CH_3CONHC_6H_4I$..	261.07
72	**——, *p*-methoxy-.**	See *p-Acetaniside.*		
73	**——, *N*-methyl-**.......	exalgin..................	$CH_3CON(CH_3)C_6H_5$	149.19
74	**——, *o*-methyl-.**	See *o-Acetotoluide.*		
75	**——, *N*-methyl-*p*-nitro-**	....	$CH_3CON(CH_3)C_6H_4NO_2$	194.19
76	**——, *o*-nitro-**.........	....	$CH_3CONHC_6H_4NO_2$	180.16
77	**——, *m*-nitro-**.........	....	$CH_3CONHC_6H_4NO_2$	180.16
78	**——, *p*-nitro-**.........	....	$CH_3CONHC_6H_4NO_2$	180.16
80	**——, *N*-phenyl-.**	See *Acetamide, N, N-diphenyl*-.		
81	**——, *α*-phenyl-.**	See *α-Toluanilide.*		
82	**——, *p*-phenylazo-.**	See *Azobenzene, p-acetamido-.*		
83	**——, thio-**.............	....	$CH_3CSNHC_6H_5$...	151.22
84	***o*-Acetaniside**.........	*N*-acetyl-*o*-anisidine; *o*-acetanisidide	$CH_3CONHC_6H_4OCH_3$	165.19
85	***p*-Acetaniside**.........	*p*-methoxyacetanilide; *p*-acetamidoanisole; *N*-acetyl-*p*-anisidine; methacetin; *p*-acetanisidide	$CH_3CONHC_6H_4OCH_3$	165.19
86	**Acetic acid**............	ethanoic acid*.............	CH_3COOH.......	60.05
87	——, esters.	For esters other than those listed below see also "acetate"		
88	——, allyl ester............	allyl acetate, 2-propenyl ethanoate*	$CH_3COOCH_2CH{:}CH_2$	100.11
89	——, amyl ester...........	amyl acetate; 1-pentanol acetate; amyl acetic ester	$CH_3COO(CH_2)_4CH_3$	130.18
90	——, benzyl ester..........	benzyl acetate; benzyl ethanoate*	$CH_3COOCH_2C_6H_5$.	150.17
91	——, butyl ester...........	butyl acetate; butyl ethanoate*	$CH_3COO(CH_2)_3CH_3$	116.16
92	——, *sec*-butyl ester.........	2-butanol acetate; *α*-methylpropyl ethanoate*	$CH_3COOCH(CH_3)C_2H_5$	116.16
93	——, cetyl ester...........	cetyl acetate; hexadecylethanoate*; *n*-hexadecylacetate	$CH_3COO(CH_2)_{15}CH_3$	284.47
94	——, ethyl ester...........	ethyl ethanoate*; acetic ester.	$CH_3COOC_2H_5$....	88.10
95	——, ethylene ester.	See *Glycol, diacetate.*		
96	——, furfuryl ester.	See *Furfuryl alcohol, acetate.*		
97	——, heptyl ester..........	*n*-heptyl acetate...........	$CH_3COOC_7H_{15}$....	158.24
98	——, hexyl ester...........	*n*-hexyl acetate.............	$CH_3COO(CH_2)_5CH_3$	144.21
99	——, isoamyl ester.........	isoamyl acetate; 3-methyl-1-butanol acetate; *γ*-methylbutyl ethanoate*	$CH_3COO(CH_2)_2CH(CH_3)_2$	130.18
100	——, isobutyl ester.........	isobutyl acetate; *β*-methylpropyl ethanoate*.........	$CH_3COOCH_2CH(CH_3)_2$	116.16

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* Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
69	need.	....	150	....	sl. s.	v. s.	s. eth.
70	cr.	....	240	....	v. sl. s.	v. s.	s. eth.
71	monocl.	1.989^{15-20}_{4}	183–4	....	s. h.	5.05^{21}	i. eth.; v. s. ac. a.
72							
73	col. rhomb. pr. f. al. 1.560, 1.576, 1.647	0.977^{120}_{4}	101–4 (97–99)	254.7 (253^{712})	i.(sl. s.)	s.	....
74							
75	leaf. f. w......	....	152–3	....	......	s.	s. eth.
76	yel. monocl. leaf.	1.419^{15}_{4}	93 (90–1)	....	s. h.	s.	v. s. eth., KOH
77	col.-yel. leaf. ..	....	155 (150.5)	....	s. h.	s.	i. eth.; s. chl., KOH
78	yel. rhomb. pr.	....	215	....	v. sl. s.	s.	s. eth., KOH
80							
81							
82							
83	need. f. w.....	....	75	d.	i.	......	i. eth.; s. alk., NaOH
84	pearly, wh. cr. f. w.	....	87–8 (84)	303–5	v. s. h.	55.3^{21}	s. eth.; v. s. ac. a.
85	wh. powd., pr. or pl. f. w.	....	137–38	....	0.2^{15}, 8.3^{100}	12.7^{21}	sl. s. eth.; s. chl., acet.
86	col. liq., 1.37182	1.049^{20}_{4}	16.6	118.1	∞	∞	∞ eth.; i. CS_2
87	under *o-Cresol,*	*Cyclohexano*	*l, etc.*				
88	col. liq., 1.40448	0.928	....	103–4	sl. s.	∞	∞ eth.
89	col. liq., 1.4012	0.879^{20}_{20}	....	148^{737} (145–7)	0.18^{20}	∞	∞ eth.
90	col. liq., 1.5232	1.057^{16}_{4}	-51.5	213.5^{756}	v. sl. s.	∞	∞ eth.
91	col. inflam. liq., 1.3951	0.882^{20}_{4} 0.9016^{0}_{0}	-76.8	126.5 (124–6)	0.5^{25}	∞	∞ eth.
92	col. liq., 1.3866^{25}	0.8648^{25}_{4}	....	112–3	i.	s.	s. eth.
93	need., $1.4358^{33.9}$	0.858^{20}_{4}	18.5 (16–9)	200.5^{15}	i.	v. sl. s.	v. s. eth.
94	col. inflam. liq., $1.37216^{18.9}$	0.901^{20}_{4}; 0.90657^{15}_{4}	-83.6	77.15	8.6^{20}, 7.4^{35}	∞	∞ eth., chl., oils
95							
96							
97	col. liq., 1.4153	0.874^{16}_{16}	....	191.5	i.	s.	s. eth.
98	col. liq........	0.8902^{0}_{0}	....	169.2	i.	v. s.	v. s. eth.
99	col. liq., $1.40170^{17.9}$	0.8699^{25}_{4}	-78.5	142.5 (138–40)	0.16^{25}	∞	∞ eth.; s. amyl al.
100	col. liq., $1.39114^{17.8}$	0.8712	-98.9	116.5 (115–7)	0.63^{25}	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
101	**Acetic acid,** isopropyl ester	isopropyl acetate	$CH_3COOCH(CH_3)_2$	102.13
102	——, methylene diester	methylene acetate; methylene diacetate; methanediol diacetate	$(CH_3COO)_2CH_2$	132.11
103	——, methyl ester	methyl acetate	CH_3COOCH_3	74.08
104	——, β-phenylhydrazide.	See *Hydrazine, 1-acetyl- 2-phenyl-*.		
105	——, piperazinium salt		$C_4H_{10}N_2.2C_2H_4O_2$	206.24
106	——, piperidide.	See *Piperidine, 1-acetyl-*.		
107	——, propyl ester	*n*-propyl acetate	$CH_3COOC_3H_7$	102.13
108	——, **acetamido-.**	See *Aceturic acid.*		
109	——, **(*p*-acetamidoanilino)-.**	See *Glycine, N-(p-acetamidophenyl)-.*		
109M	——, **acetyl-.**	See *Acetoacetic acid.*		
110	——, **allyl-.**	See 4-*Pentenoic acid**.		
111	——, **amino-.**	See *Glycine.*		
112	——, **(*p*-aminoanilino)-.**	See *Glycine, N-(p-aminophenyl)-.*		
113	——, **anilino-.**	See *Glycine, N-phenyl-.*		
114	——, **anthranilido-.**	See *Anthranilic acid, N-(carboxymethyl)-.*		
115	——, **benzamido-.**	See *Hippuric acid.*		
116	——, **benzoyl-**	β-ketohydrocinnamic acid; 3-oxo-3-phenylpropanoic acid	$C_6H_5COCH_2COOH$	164.15
117	——, ——, ethyl ester	ethyl-β-ketohydrocinnamate; benzoylacetic ester	$C_6H_5COCH_2\text{-}COOC_2H_5$	192.21
118	——, ——, methyl ester		$C_6H_5COCH_2\text{-}COOCH_3$	178.18
119	——, **bromo-**	bromoethanoic acid*	$CH_2BrCOOH$	138.96
120	——, ——, ethyl ester	ethyl bromoethanoate*	$CH_2BrCOOC_2H_5$	167.01
121	——, **sec-butyl-.**	See *Valeric acid, β-methyl-.*		
122	——, **butylethyl-.**	See *Caproic acid, α-ethyl-.*		
123	——, **chloro-**	chloroethanoic acid*	$CH_2ClCOOH$	94.50
124	——, ——, butyl ester	butyl 2-chloroethanoate*	$CH_2ClCOOC_4H_9$	150.61
125	——, ——, ethyl ester	ethyl chloroacetate; ethyl chloroethanoate*	$CH_2ClCOOC_2H_5$	122.55
126	——, ——, methyl ester	methyl chloroethanoate*	$CH_2ClCOOCH_3$	108.53
127	——, ——, *p*-phenylphenacyl ester		$CH_2ClCOOCH_2COC_6H_4C_6H_5$	288.72
128	——, ——, piperazinium salt		$C_4H_{10}N_2.2CH_2\text{-}ClCOOH$	275.14
129	——, **cyano-**	cyanoethanoic acid*; malonic mononitrile	$CNCH_2COOH$	85.06
130	——, ——, ethyl ester		$CH_2(CN)COOC_2H_5$	113.11
131	——, ——, methyl ester	methyl cyanoethanoate*	$CNCH_2COOCH_3$	99.09
132	——, **diazo-,** ethyl ester	ethyl diazoethanoate*	$N_2CHCOOC_2H_5$	114.10
133	——, **dibromo-**	dibromoethanoic acid*	$CHBr_2COOH$	217.87
134	——, ——, ethyl ester	ethyl dibromoethanoate*	$CHBr_2COOC_2H_5$	245.92

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
101	col. liq.	$0.877\frac{16}{4}$; $0.8690\frac{25}{4}$	–73.4	89	3.09^{20}	∞	∞ eth.
102	col. liq.	$1.136\frac{20}{4}$	. . . .	170	sl. s.	∞	∞ eth.
103	col. liq., 1.35935	$0.92740\frac{25}{4}$	–98.1	57.1	31.9^{20}	∞	∞ eth.
104							
105	wh. cr.	. . . .	208.5–209	. . . .	s.	s.	i. eth ; s. h. *n*-butanol
106							
107	col. liq., 1.38438	$0.887\frac{20}{4}$	–92.5	101.6	1.89^{20}	∞	∞ eth.
108							
109							
109M							
110							
111							
112							
113							
114							
115							
116	col. need. f. bz.	. . . .	103–4 d.	. . . .	sl. s.	s.	s. eth.; sl. s. lgr.
117	col. liq., 1.53115^{16}	$1.122\frac{20}{4}$	<0	265–70 d.	v. v. sl. s.	∞	∞ eth.
118	col.-yel. liq., $1.53654^{24.7}$	$1.158\frac{20}{4}$	. . . .	265 d.	i.	∞	∞ eth.
119	col. hex. or rhomb.	$1.934\frac{20}{4}$	50	208	∞, deliq.	∞	∞ eth.
120	col. liq., 1.451	$1.514\frac{13}{4}$	. . . .	159; $57\text{–}9^{15}$	i.	∞	∞ eth.
121							
122							
123	col. rhomb., 1.4297^{65}	$1.58\frac{20}{20}$	α 63, β 55–6, γ 50	189	v. s.	s.	s. eth., chl., CS_2, bz.
124	liq.	$1.103\frac{0}{4}$	. . . .	175 (181–3)	. . . . . .	. . . . . .	. . . .
125	col. liq., 1.42274	$1.159\frac{20}{4}$	–26.0	144.2	i.	∞	∞ eth.
126	col. liq.	$1.227\frac{25}{4}$	–32.7	131.5	v. sl. s.	∞	∞ eth.
127	. . . .	. . . .	116	. . . .	. . . . . .	. . . . . .	. . . .
128	wh. cr.	. . . .	145–6	. . . .	s.	s. h.	i. eth.
129	deliq. col. cr.	. . . .	66 (69–70)	108^{15}, d. 160	s.	s.	s. eth.; sl. s. bz., chl.
130	col. liq., $1.41793^{20.5}$	$1.063\frac{20}{4}$	–22.5	206	i.	∞	∞ eth.
131	col. liq.	1.123^{15}	–22.5	200	i.	∞	∞ eth.
132	yel. oil, $1.4588^{17.6}$	$1.0852\frac{17.6}{4}$; 1.073^{22}	–22	$140\text{–}41^{720}$	sl. s.	s.	s. eth., bz., lgr.
133	col. deliq. cr.	. . . .	48	232; $195\text{–}7^{250}$	sl. s.	s.	s. eth.
134	oil, 1.498	$1.903\frac{20}{20}$	. . . .	194	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
135	**Acetic acid, dichloro-**	dichloroethanoic acid*	$CHCl_2COOH$	128.95
136	——, ——, ethyl ester	ethyl dichloroethanoate*	$CHCl_2COOC_2H_5$	157.00
137	——, **diethyl-.**	See *Butyric acid, α-ethyl-.*		
138	——, **diethylmethyl-.**	See *Butyric acid, α-ethyl-α-methyl-.*		
138M	——, **difluoro-**	difluoroethanoic acid*	CHF_2COOH	96.04
139	——, **diiodo-**	diiodoethanoic acid*	CHI_2COOH	311.88
140	——, **dimethyl-.**	See *Isobutyric acid.*		
141	——, **di-*n*-octyl-.**	See *Capric acid, α-octyl-.*		
142	——, **diphenyl-**	diphenylmethane-α-carboxylic acid	$(C_6H_5)_2CHCOOH$	212.24
142M	——, **diureido-.**	See *Allantoic acid.*		
143	——, **ethoxy-**	ethoxyethanoic acid*; ethyloglycolic acid; glycolic acid ethyl ether	$C_2H_5OCH_2COOH$	104.10
144	——, **ethyl-.**	See *Butyric acid.*		
145	——, **(ethylamino)-.**	See *Glycine, N-ethyl-.*		
146	——, **ethyldimethyl-.**	See *Butyric acid. α, α-dimethyl-.*		
147	——, **ethylene-.**	See *Cyclopropanecarboxylic acid*.*		
148	——, **ethylmethyl-.**	See *Butyric acid, α-methyl-.*		
149	——, **ethylpropyl-.**	See *Valeric acid, α-ethyl-.*		
149M	——, **fluoro-**	fluoroethanoic acid*	CH_2FCOOH	78.04
150	——, **2-fural-.**	See 2-*Furanacrylic acid.*		
150M	——, **2-furoyl-** ethyl ester	ethyl pyromucylacetate	$C_4H_3OCOCH_2\text{-}COOC_2H_5$	182.17
151	——, **guanido-.**	See *Glycocyamine.*		
152	——, **hydroxy-.**	See *Glycolic acid.*		
153	——, **iminodi-**	diglycolamidic acid; iminoacetic acid (incorrect)	$NH(CH_2COOH)_2$	133.10
154	——, **iodo-**	iodoethanoic acid*	CH_2ICOOH	185.96
155	——, **isoamyl-.**	See *Caproic acid, δ-methyl-.*		
156	——, **isobutyl-.**	See *Isocaproic acid.*		
157	——, **isopropyl-.**	See *Isovaleric acid.*		
158	——, **isopropylmethyl-.**	See *Butyric acid, α, β-dimethyl-.*		
159	——, **isothiocyano-**	mustard oil acetic acid	$SCNCH_2COOH$	117.12
160	——, **mercapto-**	2-mercaptoethanoic acid*; thioglycolic acid	$HSCH_2COOH$	92.11
161	——, **methoxy-**	methoxyethanoic acid*; methyloglycolic acid	CH_3OCH_2COOH	90.08
162	——, **methyl-.**	See *Propionic acid.*		
163	——, **(α-methylguanido)-**	See *Creatine.*		
164	——, **methylpropyl-.**	See *Valeric acid, α-methyl-.*		
165	——, **oxydi-.**	See *Diglycolic acid.*		
166	——, **phenoxy-**	glycolic acid phenyl ether	$C_6H_5OCH_2COOH$	152.14
167	——, **phenyl-.**	See *α-Toluic acid.*		
168	——, **pyromucyl-.**	See *Acetic acid, 2-furoyl-.*		
169	——, **salicyl-.**	See *Benzoic acid, o-(carboxymethoxy)-.*		
170	——, **silico-.**	See *Methanesiliconic acid.*		
171	——, **sulfo-**	sulfoethanoic acid*	HO_3SCH_2COOH	140.11
172	——, **2-thienyl-.**	See 2-*Thiopheneacetic acid.*		
173	——, **thiol-**	ethanethiolic acid*; methanecarbothiolic acid; thioacetic acid	CH_3COSH	76.11
174	——, ——, ethyl ester		$CH_3COSC_2H_5$	104.16
175	——, **tolyl-.**	See *α-Toluic acid, methyl-.*		
176	——, **tribromo-**	tribromoethanoic acid*	CBr_3COOH	296.78
177	——, **trichloro-**		CCl_3COOH	163.40

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* Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
135	col. liq., 1.4659^{22}	1.5634^{20}_{4}	5–6; frz. 11	194	8.63	s.	s. eth.
136	col. liq., 1.43860	1.2821^{20}_{4}	....	158.2	v. sl. s.	∞	∞ eth.
137							
138							
138M	col. liq.........	1.5359^{10}	0.35	134.2^{766}	v. s.	s.	s. eth.
139	yel. cr.	....	110 (95–6)	....	sl. s.	s.	s. eth., bz.
140							
141							
142	col. need. f. w. or lf. f. al.	....	148	subl.	v. s. h.	v. s.	v. s. eth.; s. chl.
142M							
143	col. liq.........	1.102^{20}_{4}	....	206	v. s.	v. s.	v. s. eth.
144							
145							
146							
147							
148							
149							
149M	col. sld.	....	33	165	s.	s.	....
150							
150M	liq.	....	....	$142–3^{10}$	i.	s.	s. eth.
151							
152							
153	col. rhomb.	....	*ca.* 225	....	2.43^{5}	i.	i. eth.
154	col. rhomb. pl.	....	82	d.	s.	s.	s. eth.
155							
156							
157							
158							
159	rhomb. pl.....	....	125–6	subl.	s. h.	......	....
160	liq.	1.3253^{20}_{4}	−16.5	$104–6^{11}$	s.	s.	s. eth.
161	col. hyg. liq.	1.1768^{20}_{4}	....	$89–91^{7}$	s.	s.	s. eth.
162							
163							
164							
165							
166	col. pl. or need. f. w.	....	99	285 sl. d.	1.2^{10}	s.	s. eth., ac. a., bz.
167							
168							
169							
170							
171	hyg. tab. f. w.	....	86	*ca.* 245 d.	s.	v. s.	i. eth.
172							
173	col. liq.........	1.074^{10}_{4}	<−17	93	s.	∞	∞ eth.
174	liq.	0.9739^{25}_{4}	....	115–16	i.	v. s.	v. s. eth.
175							
176	col. monocl. tab.	....	135	245 d.	v. s.	v. s.	v. s. eth.; sl. s. c. lgr.
177	col. rhomb. deliq.	1.6298^{61}_{4}	57.5	197.5	120^{25}	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
178	**Acetic acid, trichloro-** ethyl ester	....	$CCl_3COOC_2H_5$....	191.45
179	——, ——, methyl ester.	....	CCl_3COOCH_3.....	177.43
180	——, ——, piperazinium salt	....	$C_4H_{10}N_2.2CCl_3$-COOH	412.94
180M	——, **trifluoro-**........	trifluoroethanoic acid*.......	CF_3COOH.......	114.03
181	——, **triiodo-**..........	triiodoethanoic acid*........	CI_3COOH........	437.79
182	——, **trimethyl-.**	See *Pivalic acid.*		
183	——, **triphenyl-**........	....	$(C_6H_5)_3CCOOH$...	288.33
184	——, **ureido-.**	See *Hydantoic acid.*		
185	——, **vinyl-.**	See 3-*Butenoic acid**.		
186	**Acetic aldehyde.**	See *Acetaldehyde.*		
187	**Acetic anhydride......**	ethanoic anhydride*..........	$(CH_3CO)_2O$........	102.09
188	**Acetic ester.**	See *Acetic acid, ethyl ester.*		
189	**Acetin.**	See *diacetate, monoacetate, triacetate,* under *Glycerol.*		
190	**Acetoacetanilide......**	β-ketobutyranilide; α-acetylacetanilide	CH_3COCH_2-$CONHC_6H_5$	177.20
191	——, **α-bromo-.......**	2-bromo-3-oxo-*N*-phenylbutanamide	$CH_3COCHBr$-$CONHC_6H_5$	256.11
191M	**Acetoacetic acid......**	acetylacetic acid; 3-oxobutanoic acid*	CH_3COCH_2COOH.	102.09
192	——, ethyl ester...........	ethylacetoacetate; acetoacetic ester; ethyl 3-oxobutanoate*	CH_3COCH_2-$COOC_2H_5$	130.14
193	——, methyl ester.........	methyl acetoacetate.........	CH_3COCH_2-$COOCH_3$	116.11
194	——, **γ-chloro-**, ethyl ester	ethyl 4-chloro-3-oxobutanoate*	$CH_2ClCOCH_2$-$COOC_2H_5$	164.59
195	——, **α, α-diethyl-,** ethyl ester	ethyl 2,2-diethyl-3-oxobutanoate*	$CH_3COC(C_2H_5)_2$-$COOC_2H_5$	186.25
197	——, **α-isopropyl-,** ethyl ester	ethyl 2-isopropyl-3-oxobutanoate*	$CH_3COCH(C_3H_7)$-$COOC_2H_5$	172.22
198	——, **α-methyl-**, ethyl ester	ethyl 2-methyl-3-oxobutanoate*; methylacetoacetic ester	$CH_3COCH(CH_3)$-$COOC_2H_5$	144.17
199	**Acetoacetic ester.**	See *Acetoacetic acid, ethyl ester.*		
200	**Acetobenzylamide.**	See *Acetamide, N-benzyl-.*		
201	**Acetobromamide.**	See *Acetamide, N-bromo-.*		
202	**Acetocinnamone.**	See *Acetone, benzylidene-.*		
203	**Acetoethylamide.**	See *Acetamide, N-ethyl-.*		
204	**Acetoethyl nitrate....**	....	C_2H_4O-$(C_2H_5NO_3)_2$?	226.19
205	**Acetoglyceral.........**	glycerol ethylidene ether.....	$C_3H_5(OH)O_2C_2H_4$.	118.13
206	**Acetoin..............**	3-hydroxy-2-butanone*; acetylmethylcarbinol	$CH_3COCHOHCH_3$	88.10
207	**Acetol...............**	1-hydroxy-2-propanone*; hydroxyacetone; acetylcarbinol	CH_3COCH_2OH...	74.08
207M	——, **fluoro-.**	See *Propane, 2,2-difluoro-*.*		
208	**Acetonaphthalide.**	See *Naphthylamine, N-acetyl-.*		
208M	**1-Acetonaphthone....**	methyl 1-naphthyl ketone....	$CH_3COC_{10}H_7$.....	170.20
209	——, **α-phenyl-.**	See *Ketone, benzyl 1-naphthyl.*		
209M	**2-Acetonaphthone....**	methyl 2-naphthyl ketone....	$CH_3COC_{10}H_7$.....	170.20
210	——, **4-bromo-1-hydroxy-**	2-acetyl-4-bromo-1-naphthol..	$CH_3COC_{10}H_5$-BrOH	265.11
211	——, **1-hydroxy-.......**	1-hydroxy-2-naphthyl methyl ketone; 2-acetyl-1-naphthol	$CH_3COC_{10}H_6OH$..	186.20

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
178	col. liq., 1.45068	$1.383\frac{20}{4}$	....	168	i.	∞	∞ eth.
179	col.	$1.4868\frac{19.2}{4}$	-17.5	153.8	d.	d.	s. eth.
180	wh. cr.	....	121–1.5	....	s.	s. h.	i. eth.
180M	col. liq.	1.53514^{0}	-15.25	72.4	v. s.	......	....
181	yel. leaf.	....	150 d.	....	s.	s.	s. eth.
182							
183	monocl. pr. ...	....	265	....	sl. s.	s.	sl. s. eth.; s. bz.
184							
185							
186							
187	col. liq., 1.39038	$1.08712\frac{15}{4}$; $1.0820\frac{20}{4}$	-73.1	140.0	13.6 c., d.	∞	∞ eth.; s. chl., bz.
188							
189							
190	leaf.	....	85	....	sl. s.	s.	s. eth., a., alk., h. bz.
191	col. need.....	....	138 d.	d.	i.	s.	s. eth.
191M	col. syrup	....	....	<100, d.	∞	s.	s. eth.
192	col. liq., $1.42092^{16.6}$	$1.025\frac{20}{4}$	<-80	180	$14.3^{16.5}$	s.	s. eth., bz., chl.
193	col. liq., $1.41837^{20.5}$	1.077	....	170	38.0	∞	∞ eth.
194	col. liq.	$1.176\frac{25}{4}$	....	200	v. sl. s.	∞	∞ eth.
195	wh.-yel. liq., $1.43266^{17.2}$	$0.960\frac{25}{4}$	....	211–6 d.	i.	∞	∞ eth.
197	col. liq.	$0.957\frac{25}{4}$	....	205 d.	v. sl. s.	∞	∞ eth.
198	col. liq., $1.42066^{17.8}$	$1.019\frac{20}{4}$	....	186.8	v. sl. s.	s.	s. eth.
199							
200							
201							
202							
203							
204	liq.	$1.045\frac{19}{4}$	....	89 exp.	i.	s.	....
205	liq. (mixt.?) ..	$1.081\frac{0}{4}$	....	184–8	sl. s.	s.	....
206	1.4194^{15}	$1.002\frac{15}{4}$	15	148 (144)	s.	v. s.	i. eth., lgr.
207	col. liq., 1.4295	$1.082\frac{20}{20}$	-17	146, d.	∞	∞	∞ eth.
207M							
208							
208M	cr.	1.1336	34	296; $166\text{–}7^{12}$	......	s.	s. eth.
209							
209M	need.	....	53 (51.5)	300; 172^{11}	......	s.	....
210	yel. need.....	....	127	....	i.	s.	s. eth.
211	yel. need.....	....	99–101 (103)	325 d.	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
212	**2-Acetonaphthone, 1-hydroxy-4-nitro-**	....	$CH_3COC_{10}H_5(NO_2)OH$	231.20
213	**Acetone**.........	2-propanone*; dimethyl ketone	CH_3COCH_3..... ..	58.08
	For derivatives see also 2-_Propanone_			
215	——, azine..	dimethylketazine; diisopropylidenehydrazine	$(CH_3)_2C:NN:C(CH_3)_2$	112.17
216	——, cyanohydrin	See _Isobutyronitrile, α-hydroxy-_.		
217	——, dichloride	See _Propane, 2,2-dichloro-_*.		
218	——, oxime	See _Acetoxime._		
219	——, phenylhydrazone......	2-propanone phenylhydrazone*	$(CH_3)_2C:NNHC_6H_5$	148.20
220	——, semicarbazone...	2-propanone semicarbazone*.	$(CH_3)_2C:NNHCONH_2$	115.14
221	——, sodium bisulfite compound	....	$(CH_3)_2C(OH)SO_3Na$	162.14
222	——, **acetonyl-.**	See 2,5-_Hexanedione_*.		
223	——, **acetyl-.**	See 2,4-_Pentanedione_*.		
224	——, **allyl-.**	See 5-_Hexen-2-one_*.		
225	——, **anisal-.**	See 3-_Buten-2-one, 4-p-methoxyphenyl-_.		
226	——, **benzal-.**	See _Acetone, benzylidene-_.		
227	——, **benzoyl-.**	1-phenyl-1,3-butanedione*; α-acetylacetophenone; methyl phenacyl ketone; acetylbenzoylmethane	$C_6H_5COCH_2COCH_3$	162.18
228	——, **benzyl-.**	See 2-_Butanone, 4-phenyl-_*.		
229	——, **benzylidene-.** ..	benzalacetone; methyl styryl ketone; 4-phenyl-3-buten-2-one*; cinnamyl methyl ketone; acetocinnamone	$C_6H_5CH:CHCOCH_3$	146.18
230	——, **dibenzal-.**	See _Styryl ketone._		
231	——, _sym_-**diisopropyl-.**	See 4-_Heptanone, 2,6-dimethyl-_*.		
232	——, **diisopropylidene-.**	See _Phorone._		
233	——, _sym_-**dimethyl-.**	See 3-_Pentanone_*.		
234	——, **diphenyl-.**	See 2-_Propanone, 1,3-diphenyl-_*.		
235	——, **ethylidene-.**	See 3-_Penten-2-one_*.		
236	——, _unsym_-**ethylmethyl-.**	See 2-_Pentanone, 3-methyl-_*.		
237	——, **2-fural-.**	See _Acetone, furfurylidene-_.		
238	——, **furfurylidene-.**	furfural acetone; 4-(2-furyl)-3-butene-2-one*	$C_4H_3OCH:CHCOCH_3$	136.14
239	——, **hydroxy-.**	See _Acetol._		
240	——, **isonitroso-.**	See _Pyruvaldehyde, aldoxime._		
241	——, **isopropylidene-.**	See _Mesityl oxide._		
242	——, _p_-**methoxybenzal-.**	See 3-_Buten-2-one, 4-p-methoxyphenyl-_.		
243	——, **phenacyl-.**	See _Valerophenone, γ-oxo-_.		
244	——, **chloride.**	See _Propane, 2,2-dichloro-_*.		
245	**Acetone-chloroform.**	See _Chloretone._		
246	**Acetonediacetic acid.** .	γ-ketopimelic acid; 4-oxoheptanedioic acid*	$CO(CH_2CH_2COOH)_2$	174.15
247	**Acetonedicarboxylic acid**	β-ketoglutaric acid; 3-oxopentanedioic acid*	$CO(CH_2COOH)_2$.	146.10
248	**Acetone diethylsulfone.**	See _Propane, 2,2-bis(ethylsulfonyl)-_*.		
248M	——, **fluoride.**	See _Propane, 2, 2-difluoro-_*.		
249	**Acetonic acid.**	See _Isobutyric acid, α-hydroxy-_.		
250	**Acetonitrile**...........	ethanenitrile*; methyl cyanide	CH_3CN..........	41.05
251	——, **allyl-.**	See 4-_Pentenenitrile_*.		
252	——, **benzoyl-.**	β-ketohydrocinnamonitrile; 3-oxo-3-phenylpropanenitrile; α-cyanoacetophenone	$C_6H_5COCH_2CN$...	145.15
253	——, **diethyl-.**	See _Butyronitrile, α-ethyl-_.		
254	——, **ethylmethyl-.**	See _Butyronitrile, α-methyl-_.		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
212	yel. need......	....	....	....	i.	sl. s.	s. eth.
213	col. inflam. liq., $1.35886^{19.4}$	$0.792\frac{20}{4}$; $0.8186\frac{0}{4}$	-95	56.5	∞	∞	∞ eth.; s. chl.
215	col. liq., 1.45102^{25}	$0.8381\frac{25}{4}$	....	131	s.	∞	∞ eth.
216							
217							
218							
219	rhomb. cr. or oil	....	42 (27)	163^{50}	s.	s.	s. eth., dil. min. a.
220	col. need. f. w.	....	187-8	....	sl. s.	s.	s. eth.
221	wh. leaf.......	....	d.	....	v. s.	sl. s.	i. eth.
222							
223							
224							
225							
226							
227	col. pr., $1.56775^{77.8}$	$1.090\frac{60}{4}$	61 (57-8)	261-2 (132^{14})	sl. s. c.	s.	s. eth., conc. alk.
228							
229	col. lustr. pl. . .	$1.0377\frac{15}{15}$	42	260-2	i.	v. s.	s. eth., chl., bz.
230							
231							
232							
233							
234							
235							
236							
237							
238	wh. nd.	....	39-40	229 d.	i.	s.	s. eth.
239							
240							
241							
242							
243							
244							
245							
246	rhomb. f. w. . .	....	143	....	s. h.	s.	sl. s. eth.; i. bz.
247	need. f. eth....	....	135 d.	d.	v. s.	s.	v. sl. s. eth.; i. bz., chl., lgr.
248							
248M							
249							
250	col. liq., $1.34596^{16.5}$	$0.7828\frac{20}{4}$	-41 to -44	82	∞	∞	∞ eth.
251							
252	leaf.	....	80-1	....	sl. s. c.	s.	s. eth., chl., bz., alk., KCN
253							
254							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
255	**Acetonitrile, 2-furyl-.**	See 2-*Furanacetonitrile.*		
256	**——, iminodi-**	α,α′-dicyanodimethylamine; iminoacetonitrile (incorrect)	$NH(CH_2CN)_2$	95.10
257	**——, isobutyl-.**	See *Isocapronitrile.*		
258	**——, phenyl-.**	See *α-Tolunitrile.*		
259	**——, trimethyl-.**	See *Propionitrile, α, α-dimethyl-.*		
260	**——, trinitro-**	trinitroethanenitrile*	$(NO_2)_3CCN$	176.05
261	**——, vinyl-.**	See *Allyl cyanide.*		
262	**Acetonitrolic acid**	ethylnitrolic acid	$CH_3(NO_2)C:NOH$	104.07
263	**Acetonylamine.**	See 2-*Propanone, 1-amino-.*		
264	**o-Acetophenetide**	o-ethoxyacetanilide; N-acetyl-o-phenetidine	$CH_3CONHC_6H_4\text{-}OC_2H_5$	179.21
265	***p*-Acetophenetide**	p-ethoxyacetanilide; p-acetphenetidine; phenacetin	$CH_3CONHC_6H_4\text{-}OC_2H_5$	179.21
266	**——, α-amino-.**	See *Phenocoll.*		
267	**Acetophenone**	methyl phenyl ketone; hypnone; acetylbenzene	$CH_3COC_6H_5$	120.14
268	——, oxime		$C_6H_5C(:NOH)\text{-}CH_3$	135.16
269	**——, α-acetonyl-.**	See *Valerophenone, γ-oxo-.*		
270	**——, α-acetyl-.**	See *Acetone, benzoyl-.*		
271	**——, o-amino-**	o-aminophenyl methyl ketone: o-acetylaniline	$CH_3COC_6H_4NH_2$	135.16
272	**——, *m*-amino-**	m-aminophenyl methyl ketone	$CH_3COC_6H_4NH_2$	135.16
273	**——, *p*-amino-**	p-aminophenyl methyl ketone.	$CH_3COC_6H_4NH_2$	135.16
274	**——, benzal-.**	See *Chalcone.*		
274M	**——, o-bromo-**		$CH_3COC_6H_4Br$	199.05
275	**——, *p*-bromo-**		$BrC_6H_4COCH_3$	199.05
276	**——, α-bromo-**	phenacyl bromide	$BrCH_2COC_6H_5$	199.05
277	**——, α-bromo-*p*-methyl-**	p-methylphenacyl bromide	$CH_3C_6H_4COCH_2\text{-}Br$	213.08
278	**——, α-bromo-*p*-phenyl-**	p-phenylphenacyl bromide	$BrCH_2COC_6H_4\text{-}C_6H_5$	275.15
279	**——, 4-*tert*-butyl-2-methyl-3, 6-dinitro-**	musk ketone; musk C	$CH_3COC_6H(C_4H_9)\text{-}(CH_3)(NO_2)_2$	280.28
279M	**——, o-chloro-**		$CH_3COC_6H_4Cl$	154.59
280	**——, *p*-chloro-**	methyl p-chlorophenyl ketone	$CH_3COC_6H_4Cl$	154.59
281	**——, α-chloro-**	phenacyl chloride	$ClCH_2COC_6H_5$	154.59
282	**——, α-cyano-.**	See *Acetonitrile, benzoyl-.*		
283	**——, *p*, α-dibromo-**	p-bromophenacyl bromide	$BrCH_2COC_6H_4Br$	277.96
284	**——, 2,4-dihydroxy-.**	See *Resacetophenone.*		
285	**——, 2,5-dihydroxy-**	2-acetylhydroquinone; quinacetophenone	$CH_3COC_6H_3(OH)_2$	152.14
286	**——, α-ethoxy-α-phenyl-.**	See *Benzoin, ethyl ether.*		
287	**——, α-hydroxy-**	benzoylcarbinol; phenacyl alcohol; acetophenone alcohol	$C_6H_5COCH_2OH$	136.14
288	**——, 2-hydroxy-4-methoxy-.**	See *Peonol.*		
289	**——, α-hydroxy-*p*-phenyl-.**	See also "*p-phenylphenacyl ester*" under *Acetic Acid.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
255							
256	col. leaf. f. eth.	....	75	....	s.	s.	sl. s. eth.
257							
258							
259							
260	waxy	....	41.5	exp. 220	d.	d.	s. eth.
261							
262	yel. rhomb. f. w. or eth.	....	88	d.	s.	s.	s. eth.
263							
264	leaf.	....	79	>250	i.	s.	s. eth.
265	wh. powd. or monocl. pr. or leaf.; 1.54, 1.571, 1.59	....	137–138	d.	.0055^{14}; .11^{25}	7.45^{25}	1.56^{25} eth.; 7.1 chl.
266							
267	col. liq. or pl., 1.53418^{19}	$1.026\frac{20}{4}$	19.7	202.3	i.	s.	s. eth., bz. chl., conc. H_2SO_4
268	col. need. f. w.	....	58	....	sl. s.	s.	s. eth.
269							
270							
271	yel. oil	....	....	252 sl. d.	i.	......	s. eth.
272	yel. leaf. f. dil. al.	....	99.5 (96.5)	290	......	......	....
273	yel. need. f. w.	....	106	295	v. sl. s.	s.	s. eth., HCl, bz.; sl. s. lgr.
274							
274M	col. liq.	....	....	117–118^{12}	......	......	s. eth.
275	wh. leaf. f. al.	1.647	50	255.5; 129–30^{15}	v. sl. s.	s.	s. eth., ac. a., bz., lgr.
276	trim. (rhomb.) pr. f. al.	$1.647\frac{20}{4}$	50	140^{12}	i.	v. s.	v. s. eth.
277	col. need. or leaf. f. al.	....	49–51	....	i., d.	d.	s. eth.
278	lng. col. need.	....	125.5	....	......	1.3^{25}, 6.7^{78}	....
279	....	....	136	....	i.	s.	s. eth.
279M	col. oil, 1.685^{25}	1.1884	....	227–8^{738}; 113^{18}	v. sl. s.	......	s. eth.
280	cr............	$1.188\frac{20}{4}$	20 (14–15)	232	i.	∞	∞ eth.
281	col. rhomb. ...	$1.324\frac{15}{4}$	59	247	i.	s.	s. eth.; 31.4 CS_2
282							
283	fine need......	....	109.7	....	i.	sl. s.	s. eth.
284							
285	yel. need......	....	202	....	i.	s.	sl. s. eth.
286							
287	hex. pl.	1.013	95 (83–84)	119^{11}	v. s. h.	s.	s. eth.
288							
289	*chloro-; Butyric*	*acid; Caproi*	*c acid; etc.*				

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
290	**Acetophenone, α-hydroxy-*p*-phenyl-,** acetate	*p*-phenylphenacyl acetate....	CH_3COOCH_2-$COC_6H_4C_6H_5$	254.27
291	——, ——, benzoate........	*p*-phenylphenacyl benzoate...	$C_6H_5COOCH_2$-$COC_6H_4C_6H_5$	316.34
292	**——, α-hydroxy-α-phenyl-.**	See *Benzoin.*		
293	**——, 5-isopropyl-2-methyl-**	carvacryl methyl ketone; 2-acetyl-*p*-cymene	$CH_3COC_6H_3$-$(CH_3)CH(CH_3)_2$	176.25
294	**——, *p*-methoxy-.....**	*p*-anisyl methyl ketone; *p*-acetylanisole	$CH_3OC_6H_4COCH_3$	150.17
295	**——, *p*-methyl-.......**	methyl *p*-tolyl ketone.......	$CH_3COC_6H_4CH_3$..	134.17
296	**——, *m*-nitro-........**	....	$CH_3COC_6H_4NO_2$..	165.14
297	**——, α-phenyl-.**	See *Desoxybenzoin.*		
298	**——, 2,3,4-trihydroxy-.**	See *Gallacetophenone.*		
299	**——, α-triphenyl-.**	See *β-Benzopinacolin.*		
300	**o-Acetophenonecarboxylic acid.**	See *Benzoic acid, o-acetyl-.*		
301	**Acetophenone pinacol.**	See 2,3-*Butanediol, 2,3-diphenyl-.*		
302	**Acetophenone pinacolin.**	See 2-*Butanone,* 3,3-*diphenyl-.*		
303	**Acetopropionic acid.**	See *Levulinic acid.*		
304	**α-Acetothienone.**	See *Ketone, methyl 2-thienyl.*		
305	**Acetothioamide.**	See *Acetamide, thio-.*		
306	**2-Acetothiophenide.**	See *Acetamide, N-2-thienyl-.*		
307	**o-Acetotoluide........**	*o*-methylacetanilide; *N*-acetyl-*o*-toluidine; acet-*o*-toluidide	$CH_3CONHC_6H_4$-CH_3	149.19
308	**——, *N*-methyl-.......**	*N*-acetyl-*N*-methyl-*o*-toluidine	$(CH_3)(CH_3CO)$-$NC_6H_4CH_3$	163.21
309	***m*-Acetotoluide ......**	*N*-acetyl-*m*-toluidine; acet-*m*-toluidide	$CH_3CONHC_6H_4$-CH_3	149.19
310	**——, *N*-methyl-......**	....	$(CH_3)(CH_3CO)$-$NC_6H_4CH_3$	163.21
311	***p*-Acetotoluide........**	*N*-acetyl-*p*-toluidine; acet-*p*-toluidide	$CH_3CONHC_6H_4$-CH_3	149.19
312	**——, *N*-methyl-.......**	....	$(CH_3)(CH_3CO)$-$NC_6H_4CH_3$	163.21
313	**Acetoxime............**	2-propanone oxime*; acetone oxime	$(CH_3)_2C{:}NOH$....	73.09
314	**2,4-Acetoxylide........**	aceto-*as*-*m*-xylidide; 2,4-dimethylacetanilide	$CH_3CONHC_6H_3$-$(CH_3)_2$	163.21
315	**Acetphenetidine.**	See *Acetophenetide.*		
316	**Acettoluidide.**	See *Acetotoluide.*		
317	**Aceturic acid.........**	*N*-acetylglycine; acetamidoacetic acid	$CH_3CONHCH_2$-$COOH$	117.10
318	**——, *N*-phenyl-.......**	*N*-acetyl-*N*-phenylglycine....	$C_6H_5N(CH_3CO)$-CH_2COOH	193.20
	Acetyl-. For acetyl derivatives, see the parent compounds (e.g., for acetylbenzoic acid			
319	**Acetyl bromide.......**	ethanoyl bromide*..........	CH_3COBr........	122.96
320	**——, bromo-..........**	bromoethanoyl bromide*....	$CH_2BrCOBr$......	201.87
321	**Acetyl chloride ....**	ethanoyl chloride*..........	CH_3COCl........	78.50

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
290	....	....	111	....	......	......	....
291	....	....	167	....	......	......	....
292							
293	liq.	$0.956\frac{20}{4}$	....	240; 130–134^{13}	......	......	....
294	pl. f. eth., 1.54684$^{41.3}$	$1.0493\frac{80}{4}$; $1.0818\frac{41}{4}$	38–9	258; 138–9^{15}	sl. s.	s.	s. eth.
295	col. need. or pa. yel. liq., 1.53533$^{17.4}$	$0.9891\frac{22}{4}$; $1.013\frac{13}{4}$	28	222	i.	v. s.	v. s. eth.
296	need.	....	81 (74–76)	202	i.	s.	v. s. eth.
297							
298							
299							
300							
301							
302							
303							
304							
305							
306							
307	col. monocl., 1.556, 1.587, 1.700	$1.168\frac{15}{4}$	110.4	296	0.86	8.08	s. eth., bz., glyc., v. s. chl., glac. ac. a.
308	cr.	....	56	260	......	s.	....
309	monocl. f. w.	$1.141\frac{15}{4}$	65.5	303	0.44^{13}	s.	s. eth.
310	cr.	....	66 (60–61)	....	......	s.	....
311	col. monocl. or tricl., 1.495, 1.625, 1.807	$1.212\frac{15}{4}$	146-7	307	0.09	8.05c., v.s.h.	s. h. eth., glac. ac. a.; sl. s. bz., glyc.
312	leaf.	....	80	283	......	s.	s. h. lgr.
313	col. pr., 1.4156	$0.97\frac{20}{20}$	61	136.3	v. s.	v. s.	v. s. eth., s. lgr.
314	need.	....	129–30	....	v. sl. s.	v. s.	....
315							
316							
317	need. f. w.	....	206	....	2.17^{15}	s.	i. eth.; sl. s. ac. a., acet., chl.; i. bz.
318	....	....	172–3.5	....	......	......	....
	see *Benzoic acid, acetyl-*.) See also "acetate" under the names of alcohols and phenols						
319	col. fum. liq.	$1.663\frac{16}{4}$	–96.5	76.7	d.	d.	v. sl. s. eth.
320	liq.	$2.317\frac{21.5}{21.5}$	....	147–50	d.	d.	....
321	col. inflam. liq., 1.38976	$1.1051\frac{20}{4}$	–112	51–2	d.	d.	∞ eth., bz., chl., acet., glac. ac. a.

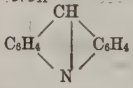
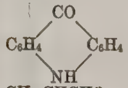
For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
322	**Acetyl chloride, chloro-**	chloroethanoyl chloride*	$CH_2ClCOCl$	112.95
323	**——, dichloro-**	dichloroethanoyl chloride*	$CHCl_2COCl$	147.40
324	**——, phenyl-.**	See *α-Toluyl chloride.*		
325	**——, trichloro-**		CCl_3COCl	181.85
326	**Acetyl cyanide.**	See *Pyruvonitrile.*		
327	**Acetyl disulfide**	diacetyl disulfide	$(CH_3CO)_2S_2$	150.21
328	**Acetylene**	ethyne*; ethine	$CH\vdots CH$	26.04
329	——, dibromide.	See *Ethylene, 1,2-dibromo-.*		
330	——, tetrabromide.	See *Ethane, 1,1,2,2-tetrabromo-**.		
331	——, tetrachloride.	See *Ethane, 1,1,2,2-tetrachloro-**.		
332	**——, amyl-.**	See *1-Heptyne**.		
332M	**——, amylmethyl-.**	See *2-Octyne**.		
333	**——, bromo-**	bromoethyne*; ethynyl bromide	$CH\vdots CBr$	104.94
334	**——, butyl-.**	See *1-Hexyne**.		
334M	**——, butylethyl-.**	See *3-Octyne**.		
335	**——, butylmethyl-.**	See *2-Heptyne**.		
336	**——, chloro-**	chloroethyne*	$CH\vdots CCl$	60.49
336D	**——, decylmethyl-.**	See *2-Dodecyne**.		
336F	**——, di-*n*-amyl-.**	See *6-Dodecyne**.		
336H	**——, dibromo-**	dibromoethyne	$BrC\vdots CBr$	183.85
336M	**——, dibutyl-.**	See *5-Decyne.*		
336R	**——, diiodo-**	diiodoethyne	$IC\vdots CI$	277.86
336T	**——, diethyl-.**	See *3-Hexyne**.		
337	**——, dimethyl-.**	See *2-Butyne**.		
338	**——, diphenyl-**	diphenylethyne; tolan	$C_6H_5C\vdots CC_6H_5$	178.22
338M	**——, dipropyl-.**	See *4-Octyne**.		
339	**——, divinyl-.**	See *1,5-Hexadien-3-yne**.		
340	**——, ethyl-.**	See *1-Butyne**.		
341	**——, ethylmethyl-.**	See *2-Pentyne**.		
342	**——, ethylphenyl-.**	See *Benzene, 1-butynyl-.*		
342M	**——, ethylpropyl-.**	See *3-Heptyne**.		
343	**——, *n*-heptyl-.**	See *1-Nonyne**.		
343M	**——, hexadecyl-.**	See *1-Octadecyne.**		
344	**——, *n*-hexyl-.**	See *1-Octyne**.		
345	**——, isopropyl-.**	See *1-Butyne, 3-methyl-**		
346	**——, methyl-.**	See *Propyne**.		
347	**——, methylphenyl-.**	See *Propyne, 1-phenyl-.*		
348	**——, methylpropyl-.**	See *2-Hexyne**.		
349	**——, *n*-octyl-.**	See *1-Decyne**.		
350	**——, phenyl-.**	See *Benzene, ethynyl-.*		
351	**——, *n*-propyl-.**	See *1-Pentyne**.		
352	**——, vinyl-.**	See *3-Buten-1-yne**.		
353	**Acetylenecarboxylic acid. ethyl-.**	See *2-Pentynoic acid**.		
354	**Acetylenedicarboxylic acid**	butynedioic acid*	$COOHC\vdots CCOOH$	114.06
355	**Acetylenediurein.**	See *Glycoluril.*		
356	**Acetyl fluoride**	ethanoyl fluoride*	CH_3COF	62.04
357	**Acetyl iodide**	ethanoyl iodide*	CH_3COI	169.96

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
322	col. liq.	$1.495\frac{0}{4}$	....	108–10 (105–106)	d.	d.	∞ eth.
323	col. liq.	....	....	108	d.	d.	∞ eth.
324							
325	col. liq.	1.629	....	118	d.	d.	∞ eth.
326							
327	col. cr.	....	20	d.	i.	s.	v. s. eth.; s. CS_2
328	col. inflam. gas	liq. $0.6208\frac{-84}{4}$; solid 0.73^{-85}; gas 1.173^{0} g/l	-81.8	-83.6 subl.	100^{18} cm^3	600^{18} cm^3	2500^{15} cm^3 acet.; s. bz., chl.
329							
330							
331							
332							
332M							
333	pois. gas	$4.684\frac{0}{760}$g/l	....	-2	sl. s.	......	s. eth., dil. HNO_3
334							
334M							
335							
336	unst. spon. inflam. gas	2	....	-32 to -30 exp.	s.	s.	....
336D							
336F							
336H	liq. (poison) ..	*ca.* 2	explodes w. trace of O_2	*ca.* 76	i.	s.	s. eth.
336M							
336R	col. rhomb. ...	....	78–82	80–100 d.	......	......	sl. s. sol. c. lgr
336T							
337							
338	col. monocl. leaf. f. al.	....	62.5 (60)	300	i.	v. s. h.	v. s. eth.
338M							
339							
340							
341							
342							
342M							
343							
343M							
344							
345							
346							
347							
348							
349							
350							
351							
352							
353							
354	lng. pr.	....	179	....	v. s.	v. s.	v. s. eth.
355							
356	col. liq. or gas	$0.993\frac{20}{4}$	<-60	20.5	5, d.	d.	∞ eth.; s. bz., ac. a., chl.; v. sl. s. CS_2
357	col.-br. fum. liq.	2.067	....	104–6	d.	d.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
358	**Acetyl peroxide**	ethanoyl peroxide*; diacetyl peroxide	$(CH_3CO)_2O_2$	118.09
358M	**Acetylsalicylic acid.**	See *Aspirin.*		
359	**Achroödextrin**		$C_{36}H_{62}O_{31}$?	990.86
360	**Aconic acid**	4,5-dihydro-5-keto-3-furancarboxylic acid; formylsuccinic acid lactone	$OCH{:}C(COOH)\text{-}$ CH_2CO	128.08
361	**Aconine**		$C_{26}H_{21}NO_{11}$	523.44
362	**——, acetylbenzoyl-.**	See *Aconitine.*		
363	**——, benzoyl-.**	See *Benzaconine.*		
364	**Aconitic acid**	1,2,3-propenetricarboxylic acid*	$C_3H_3(COOH)_3$	174.11
365	**Aconitine**	acetylbenzoylaconine	$C_{34}H_{49}NO_{11}$	647.74
366	——, hydrobromide		$C_{34}H_{49}NO_{11}.HBr.\frac{1}{2}H_2O$	737.68
367	——, hydrochloride (*l*)		$C_{34}H_{49}O_{11}N.HCl.3H_2O$	738.26
368	——, nitrate (*l*)		$C_{34}H_{49}NO_{11}.HNO_3.5H_2O$	800.84
369	——, sulfate (*l*)		$(C_{34}H_{49}NO_{11})_2.H_2SO_4$	1393.57
370	**——, diacetyl-**	aconitine *O*-diacetate	$C_{34}H_{47}(C_2H_3O)_2NO_{11}$	731.82
371	**Acridine**			179.21
372	**——, 2-amino-5-*p*-aminophenyl-.**	See *Chrysaniline.*		
373	**——, 5, 10-dihydro-**	*ms*-dihydroacridine	$C_6H_4CH_2C_6H_4NH$	181.23
374	**——, dihydroketo-.**	See *ms-Acridone.*		
375	**——, 3-methyl-**		$C_{13}H_8N.CH_3$	193.24
376	**——, 5-phenyl-**	*ms*-phenylacridine	$C_6H_5C_{13}H_8N$	255.30
377	***ms*-Acridone**	dihydroketoacridine		195.21
378	**Acrolein**	acrylaldehyde; propenal*; acrylic aldehyde	$CH_2{:}CHCHO$	56.06
379	**——, α, β-dimethyl-.**	See *Tiglaldehyde.*		
380	**——, α-ethyl- β-propyl-.**	See *2-Hexenal, 2-ethyl-.*		
381	**——, β-2-furyl-**	3-(2-furyl) propenal*; furacrolein	$C_4H_3OCH{:}CHCHO$	122.12
381M	**——, α-methyl-**	2-methylpropenal*; methacrolein	$CH_2{:}C(CH_3)CHO$	70.09
382	**——, β-methyl-.**	See *Crotonaldehyde.*		
383	**——, β-phenyl-.**	See *Cinnamaldehyde.*		
384	**Acrylaldehyde.**	See *Acrolein.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
358	col. leaf......	....	30	63^{21}	sl. s.	......	v. s. eth.; d. NaOH
358M							
359	amor. wh......	....	....	....	s.	i.	col. with I_2
360	rhomb. f. w., α 1.385, γ 1.530	....	164	d.	18^{15}	......	s. me. al.
361	*d.* (salts *l.*) amor. hyg.	....	132	....	v. s.	v. s.	v. sl. s. eth; s. chl.
362							
363							
364	col. leaf. or need. f. w.	....	194–5 (191) d.	....	18^{13}	50^{12}	sl. s. eth.
365	rhomb. pr. f. chl., $[\alpha]+11^{\circ 23}_{D}$ 3% al.	....	188–97.8 (204)	....	$.031^{25}$	4.54^{25}	2.27^{25} eth.; 14.3^{25} bz.; s. chl.
366	wh. to ylsh. hex. tab. f. w., $[\alpha]$ —30.47°_{D} in w.	....	163; anh. 176–80	....	s.	s.	s. eth.
367	wh. cr.	....	149	....	s.	s.	s. eth.
368	....	....	....	....	s.	s.	....
369	ylsh. amor. powd.	....	....	....	s.	s.	....
370	cr............	....	158	....	s.	......	....
371	col. leaf. or need., rhomb. f. al.	$1.1005\frac{19.7}{4}$	108; subl. 100	346	v. sl. s.	v. s.	v. s. eth.; s. bz., CS_2
372							
373	col. cr. f. al.	....	169	subl.; d. 300	i.	s. h.	s. eth.
374							
375	yel. need. f. dil. al.	....	134	....	......	v. s.	v. s. eth., bz.
376	yel. monocl. need. f. al.	....	181	404	i.	sl. s.	s. eth.; v. s. bz.
377	yei. need......	....	354	....	i.	sl. s.	sl. s. eth.; s. h. ac. a., KOH; i. bz., chl.
378	col. inflam. liq., unst. 1.39975	$0.841\frac{20}{4}$	-87.7	52.5	40	s.	s. eth.
379							
380							
381	yel. cr........	....	51	200	i.	∞	s. eth.
381M	col. liq., 1.4191^{20}	$0.830\frac{20}{4}$	....	73.5	s.	∞	∞ eth.
382							
383							
384							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
384M	**Acrylamide**	propenamide*; acrylic amide	$CH_2{:}CHCONH_2$	71.08
385	**Acrylic acid**	propenoic acid*; ethylenecarboxylic acid	$CH_2{:}CHCOOH$	72.06
385F	——, benzyl ester	benzyl acrylate	$CH_2{:}CHCOOCH_2C_6H_5$	162.18
385K	——, butyl ester	*n*-butyl acrylate	$CH_2{:}CHCOOC_4H_9$	128.17
385P	——, cyclohexyl ester	cyclohexyl acrylate	$CH_2{:}CHCOOC_6H_{11}$	154.20
386	——, ethyl ester	ethyl acrylate; ethyl propenoate*	$CH_2{:}CHCOOC_2H_5$	100.11
387	——, methyl ester	methyl acrylate	$CH_2{:}CHCOOCH_3$	86.09
388	**——, β-benzoyl-**	4-oxo-4-phenyl-2-butenoic acid	$C_6H_5COCH{:}CHCOOH$	176.16
389	**——, α-chloro-**	2-chloropropenoic acid*	$CH_2{:}CClCOOH$	106.51
390	**——, β-chloro-**	3-chloropropenoic acid*	$CHCl{:}CHCOOH$	106.51
391	**——, α, β-dimethyl-.**	See *Tiglic acid.*		
392	**——, α, β-diphenyl-.**	See *Cinnamic acid, α-phenyl-.*		
393	**——, β-2-furyl-.**	See 2-*Furanacrylic acid.*		
394	**——, β-hydroxy-**	3-hydroxypropenoic acid*	$HOCH{:}CHCOOH$	88.06
395	**——, β-isopropyl-.**	See 2-*Pentenoic acid, 4-methyl-**.		
396	**——, α-methyl-.**	See *Methacrylic acid.*		
397	**——, *cis*(?)-β-methyl-.**	See *Isocrotonic acid.*		
398	**——, *trans*(?)-β-methyl-.**	See *Crotonic acid (α or solid)*		
399	**——, β-(3,4-methylenedioxystyryl)-.**	See *Piperic acid.*		
400	**——, α-phenyl-.**	See *Atropic acid.*		
401	**——, β-phenyl-.**	See *Cinnamic acid.*		
402	**——, β-propyl-.**	See 2-*Hexenoic acid**.		
403	**——, β-vinyl-.**	See 2,4-*Pentadienoic acid**.		
404	**Acrylic aldehyde.**	See *Acrolein.*		
404M	**Acrylic amide.**	See *Acrylamide.*		
405	**2-Acrylonaphthone, 1-hydroxy-β-phenyl-.**	1-hydroxy-2-naphthyl styryl ketone; 2-cinnamyl-1-naphthol	$C_6H_5CH{:}CHCOC_{10}H_6OH$	274.30
406	**Acrylonitrile**	propenenitrile*; vinyl cyanide	$CH_2{:}CHCN$	53.06
406H	**Acrylyl chloride**	propenoyl chloride*	$CH_2{:}CHCOCl$	90.51
406R	**Adalin**	uradal; (α-bromo-α-ethylbutyryl) urea	$(C_2H_5)_2CBrCONHCONH_2$	237.11
407	**Adenine**	6-aminopurine	$C_5H_3N_4{\cdot}NH_2$	135.13
407M	**Adermin.**	See *Vitamin B₆.*		
408	**Adipaldehyde**	hexanedial*; adipic dialdehyde	$CHO(CH_2)_4CHO$	114.14
408M	**Adipamic acid**	adipic acid monoamide	$NH_2OC(CH_2)_4COOH$	145.16
409	**Adipamide**	hexanediamide*; adipic diamide	$(CH_2CH_2CONH_2)_2$	144.17
410	**Adipic acid**	hexanedioic acid*; 1,4-butanedicarboxylic acid	$COOH(CH_2)_4COOH$	146.14
411	——, dibutyl ester	....	$(CH_2CH_2COOC_4H_9)_2$	258.35
412	——, diethyl ester	ethyl adipate	$(CH_2CH_2COOC_2H_5)_2$	202.25
412M	——, monoamide.	See *Adipamic acid.*		
413	——, piperazinium salt	....	$C_4H_{10}N_2.C_6H_{10}O_4$	232.28

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
384M	col.	....	84–5	....	......	......	....
385	col. liq., 1.4224	1.062^{16}	12.3	141.9	∞	∞	∞ eth.
385F	col. liq., 1.513^{24}	$1.068\frac{20}{4}$	....	$113\text{–}14^{19}$	i.	∞	∞ eth.
385K	col. liq., 1.4185^{20}	$0.898\frac{20}{4}$	....	145–6	i.	∞	∞ eth.
385P	col. liq., 1.456^{24}	$0.975\frac{20}{4}$	....	88^{20}	i.	∞	∞ eth.
386	col. liq., 1.405^{20}	$0.924\frac{20}{4}$	....	99.8	v. sl. s.	∞	∞ eth.
387	col. liq., 1.3984	$0.953\frac{20}{4}$	....	80.5	v. sl. s.	s.	s. eth.
388	leaf. (+1H_2O)	....	+1H_2O, 64, anh. 99	....	s.	s.	s. eth.
389	need.	....	65	subl.; 176–81 d.	s.	s.	s. eth.
390	leaf.	....	85	....	s.	s.	s. eth.
391							
392							
393							
394	liq.	....	....	....	v. s.	v. s.	v. s. eth.
395							
396							
397							
398							
399							
400							
401							
402							
403							
404							
404M							
405	or. leaf.	....	126	....	i.	s.	s. eth.
406	col. liq., 1.393^{20}	$0.797\frac{20}{4}$	–82	78–9	s.	∞	∞ eth.
406H	col. liq.	1.14	....	75–76	d.	......	....
406R	col. cr.	....	115–116	....	s. h.	s.	s. bz., acet.
407	+3H_2O, need. f. c. w.	....	365	....	0.09 c.	sl. s.	i. eth., chl.; s. h. NH_4OH
407M							
408	oil.	....	....	$92\text{–}94^{9}$	sl. s.	v. s.	v. s. eth.; s. bz.
408M	need. f. w. ...	....	125–130	....	......	......	....
409	col. pl.	....	220 (226–227)	....	0.44^{12}	v. s.	v. sl. s. eth.
410	col. monocl. pr.	1.366	151–3	265^{100}	1.5^{15}	v. s.	0.6^{15} eth.; s. HNO_3
411	....	$0.9652\frac{20}{4}$	–37.5	183^{14}	i.	∞	∞ eth.
412	col. liq.	$1.009\frac{20}{4}$	–21	$239\text{-}41^{761}$	0.423^{20}	s.	s. eth.
412M							
413	wh. cr.	....	244–5 d.	....	s.	v. sl. s. h.	i. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
414	**Adipic dialdehyde.**	See *Adipaldehyde.*		
415	**Adipic diamide.**	See *Adipamide.*		
416	**Adipic ketone.**	See *Cyclopentanone*.*		
416M	**Adipoin**	2-hydroxycyclohexanone	$C_6H_{10}O_2$	114.14
417	**Adipyl chloride**	hexanedioyl chloride*	$ClCO(CH_2)_4COCl$	183.04
417M	**Adonitol, Adonite**		$C_5H_{12}O_5$	152.15
418	**Adrenaline**	3,4-dihydroxy- α-(methylaminomethyl) benzyl alcohol; suprarenine; epinephrine	$(HO)_2C_6H_3$-$CH(CH_2NHCH_3)$-OH	183.20
419	**Aesculetin, Aesculin.**	See *Esculetin, Esculin.*		
420	**Alanine, β, β′-dithiodi-**	See *Cystine.*		
421	**——, β-hydroxy-.**	See *Serine.*		
422	**——, β-p-hydroxyphenyl-.**	See *Tyrosine.*		
423	**——, β-(3-indyl)-.**	See *Tryptophan.*		
424	**——, β-mercapto-.**	See *Cysteine.*		
425	**——, *N*-methyl-**		$CH_3CH(NHCH_3)$-$COOH$	103.12
426	**DL-Alanine**	*dl*-2-aminopropanoic acid*; *dl*-α-aminopropionic acid	$CH_3CH(NH_2)$-$COOH$	89.09
427	——, ethyl ester hydrochloride	ethyl α-aminopropionate hydrochloride	CH_3CHNH_2-$COOC_2H_5.HCl$	153.61
428	**——, *N*-benzoyl-**	α-benzamidopropionic acid	$CH_3CH(NHCOC_6$-$H_5)COOH$	193.20
429	**——, β-phenyl-**		$C_6H_5CH_2CH$-$(NH_2)COOH$	165.19
430	**L-Alanine**	*d*-α-aminopropionic acid; *d*-2-aminopropanoic acid*	$CH_3CH(NH_2)$-$COOH$	89.09
431	**——, β-[(3,5-diiodo-4-hydroxy-phenoxy)-3,5-diiodophenyl]-.** See L-*Thyr*			
432	**——, β-phenyl-**	*d*-α-amino- β-phenylpropionic acid	$C_6H_5CH_2$-$CH(NH_2)COOH$	165.19
433	**D-Alanine**	*l*-α-aminopropionic acid; *l*-2-aminopropanoic acid*	$CH_3CH(NH_2)$-$COOH$	89.09
434	**——, β-phenyl-**	*l*-α-aminohydrocinnamic acid	$C_6H_5CH_2CH$-$(NH_2)COOH$	165.19
435	**β-Alanine**	3-aminopropanoic acid*; β-aminopropionic acid	$NH_2CH_2CH_2COOH$	89.09
435M	**——,(*N*-α,γ-dihydroxy-β,β-dimethylbutyryl)-.**		See *Pantothenic acid.*	
436	**Alantolactone.**	See *Helenin.*		
437	**Alcohol.**	See *Ethyl alcohol.*		
438	**Aldehyde.**	See *Acetaldehyde.*		
439	**Aldehyde-ammonia.**	See *Acetaldehyde-ammonia.*		
440	**Aldehydine**	5-ethyl-2-methylpyridine	$(C_2H_5)(CH_3)C_5H_3N$	121.18
441	**Aldol**	3-hydroxybutanal*; β-hydroxybutyraldehyde	$CH_3CHOHCH_2$-CHO	88.10
442	**Alizarin**	1,2-dihydroxyanthraquinone	$C_6H_4(CO)_2C_6H_2$-$(OH)_2$	240.20
443	**——, 3-methyl-**		$C_6H_4(CO)_2C_6$-$HCH_3(OH)_2$	254.23
444	**——, 3-nitro-**	alizarin orange; β-nitroalizarin	$C_6H_4(CO)_2C_6$-$H(OH)_2NO_2$	285.20
445	**——, 4-nitro-**	α-nitroalizarin	$C_6H_4(CO)_2C_6H$-$(OH)_2NO_2$	285.20

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction.	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
414							
415							
416							
416M	cr. f. al.	....	113 (92)	....	sl. s. h.	s. h.	i. eth., bz., pet. eth.
417	col. liq.	....	....	$112–15^{10}$ (sl. d.)	d. h.	d. h.	....
417M	pr. f. w.	....	102	....	s.	s. h.	i. eth., lgr.
418	wh.-brnsh. powd.	....	216 d.	....	0.027^{20}	sl. s.	i. eth., chl., acet., oils; s. a., alk.
419							
420							
421							
422							
423							
424							
425	col. rhomb. f. al.	....	260 d.	subl. 292 sl. d.	s.	v. sl. s. c.	....
426	need. or pr. f. w.	....	295	subl. 200	16.6^{25}, 32.2^{75}	0.57^{75} 75%, 0.084^{25} 90%	i. eth.
427	col. need.	....	64–8 (85–7)	d.	v. s.	v. s.	v. s. eth.
428	col. pl. or pr.	....	163–5	d.	s.	sl. s.	sl. s. eth.
429	monocl. f. w. or leaf. f. al.	....	318–20 d.	subl.	1.42^{25}, 3.70^{75}	sl. s. c.	v. v. sl. s. eth.
430	rhomb. f. w.	....	297 d.	....	16.65^{25}, 28.5^{75}	0.16	i. eth., acet.
431	*oxine.*						
432	leaf. f. w., $[\alpha]$ $+35.08^{16}_{D}$ in. w.	....	283–4 d.	....	2.83^{16}	i.	i. eth.
433	pr. f. al.	....	295 d.	subl.	2.2^{17}	0.2 c. 80%	i. eth.
434	leaf., 1.600, 1.610, 1.675	....	283 d.	....	3^{25}	sl. s. h.	i. eth.
435	rhomb. pr. f. al.	....	196 d.	....	v. s.	v. sl. s.	i. eth., acet.
435M							
436							
437							
438							
439							
440	liq.	$0.9184\frac{23}{4}$	....	174	i.	s.	s. eth., H_2SO_4
441	col. syrupy liq.	$1.103\frac{20}{4}$	....	83^{20}	∞	∞	∞ eth.
442	or. or red tri-cl. or rhomb.	....	290	430	0.034^{100}	v. s.	v. s. eth.; s. me. al., bz., ac. a., CS_2, alk.
443	or. need.	....	229	subl. 200	......	[illegible]	s. eth., acet.
444	or. need. f. bz.	....	244 d.	subl. d.	sl. s.	s.	s. chl., bz.
445	yel. need. f. al.	....	289 d.	subl. d.	sl. s.	s.	s. chl., bz., dil. alk., H_2SO_4

For explanations and abbreviations see beginning of table.

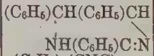
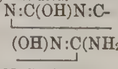
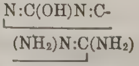
No.	Name	Synonyms	Formula	Mol. Wt.
446	**β-Alizarin amide.**	See *Anthraquinone, 2-amino-1-hydroxy-.*		
447	**Alizarin bordeaux.**	See *Quinalizarin.*		
448	**6 (or 7)-Alizarincarboxylic acid**	5,6 (or 7,8)-dihydroxy-2-anthraquinonecarboxylic acid	$(OH)_2C_6H_2(CO)_2$-C_6H_3COOH	284.21
449	**Alizarin orange.**	See *Alizarin, 3-nitro-.*		
450	**Alizarin yellow A.**	See *Benzophenone, 2,3,4-trihydroxy-.*		
451	**Alkannin**	....	$C_{16}H_{16}O_5$	288.29
452	**Alkargen.**	See *Cacodylic acid.*		
453	**Alkarsin, Alkarsine.**	See *Cacodyl oxide.*		
453M	**Allantoic acid**	diureidoacetic acid	$C_4H_8O_4N_4$	176.14
454	**Allantoin**	5-ureidohydantoin; glyoxyldiureide	$C_4H_6N_4O_3$	158.12
455	**Allanturic acid**	5-hydroxy-2,4-imidazoledione; glyoxalylurea	NHCONHCOCHOH	116.08
456	**Allene.**	See *Propadiene*.*		
456M	**——, *unsym*-dimethyl-.**	See *1,2-Butadiene, 3-methyl-.*		
457	**——, ethyl-.**	See *1,2-Pentadiene*.*		
458	**——, methyl-.**	See *1,2-Butadiene*.*		
459	**Allocinnamic acid.**	See allo-*Cinnamic acid.*		
460	**Allocrotonic acid.**	See *Isocrotonic acid.*		
460M	**Allomucic acid**	....	$C_6H_{10}O_8$	210.14
461	**Allophanamide.**	See *Biuret.*		
462	**Allophanic acid,** ethyl ester	ethyl allophanate; ethyl ureacarboxylate	$NH_2CONHCOOC_2H_5$	132.12
462M	***L*-Allose**	....	$C_6H_{12}O_6$	180.16
463	**Alloxan**	pyrimidinetetrone; mesoxalyurea	NHCONHCOCOCO	142.07
464	——, 5-oxime.	See *Violuric acid.*		
465	**Alloxanic acid**	tetrahydro-4-hydroxy-2,5-diketo-4-imidazolecarboxylic acid	NHCONHCOC- (OH)COOH	160.09
466	**Alloxantin**	....	$C_8H_6N_4O_8$	286.16
467	**——, tetramethyl-.**	See *Amalic acid.*		
	Allyl. For allyl derivatives	see the parent compounds (e.g.,	for allylaniline see	*Aniline,*
468	**Allyl alcohol**	2-propen-l-ol*	$CH_2{:}CH.CH_2OH$ ..	58.08
469	**Allyl alcohol**	(For derivatives see also *2-Propen-1-ol.**)		
470	——, dibromide.	See *1-Propanol, 2,3-dibromo-*.*		
471	——, dichloride.	See *1-Propanol, 2,3-dichloro-*.*		
472	——, γ-methyl-.	See *2-Buten-1-ol*.*		
473	——, γ-phenyl-.	See *Cinnamic alcohol.*		
474	**Allylamine**	2-propenylamine*	$CH_2{:}CHCH_2NH_2$ ..	57.09
475	**——, *N*-methyl-**	....	$CH_2{:}CHCH_2$-$NHCH_3$	71.12
476	**Allyl bromide**	3-bromopropene*	$CH_2{:}CHCH_2Br$ ...	120.99
477	**Allyl bromide, α-bromo-.**	See *Propene, 2,3-dibromo-*.*		
478	**Allyl chloride**	3-chloropropene*	$CH_2{:}CHCH_2Cl$	76.53
479	**Allyl chloride, α-chloro-.**	See *Propene 2,3-dichloro-*.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
446							
447							
448	red. need.	....	305	subl.	v. sl. s.	s.	sl. s. eth.
449							
450							
451	br. red spears f. bz. $[\alpha]^{20}_{Cd}-157°$ (C_6H_6)	....	148	....	i.	sl. s.	v. sl. s. eth.; sl. s. chl.; s. glac. ac. a., alk.
452							
453							
453M	lf. f. me. al....	....	173 d.	....	sl. s. c.	......	sl. s. org. solv.
454	wh. monocl. f h. w	....	235	d.	0.06^{20}	v. sl. s.	i. eth.; s. NaOH
455	hyg. gum.....	....	....	....	s.	i.	d. h. alk.
456							
456M							
457							
458							
459							
460							
460M	need. f. w.....	....	166–71d.	....	8^{100}	sl. s.	....
461							
462	need. f. w.....	....	192	d.	s. h., i. c.	0.5^{21}	0.1^{20} eth.
462M	pr. f. al. $[\alpha]^{20-25}_{D}$ (H_2O) initial–1.90°; final 13.88°.	....	128–9	....	s.	sl. s.	....
463	anh. dk. yel.; hyd., col. rhomb. pr.	....	170 d.	....	v. s.	s.	....
464							
465	tricl.........	....	d.	....	v. s.	15.8	sl. s. eth.
466	rhomb. pr. f. w. with $2H_2O$	....	170 d.	253–5 d.	sl. s. c.	v. sl. s.	v. sl. s. eth.
467							
	allyl-). For allyl esters of organic acids see the acids.						
468	col. mobile liq.; pungent odor; 1.41345	0.855^{20}_{4}	–129	96–97	∞	∞	∞ eth.
469							
470							
471							
472							
473							
474	col. liq., 1.41943^{22}	0.761^{20}_{4}	....	53.2	∞	∞	∞ eth.; s. chl.
475	col. liq.......	....	....	65	∞	......	....
476	col. liq., 1.46545	1.398^{20}_{4}	–119.4	71.3	i.	∞	∞ eth.; s. chl., CS_2, CCl_4
477							
478	liq., 1.41538...	0.938^{20}_{4}	–136.4	44.6	i.	s.	∞ eth.
479							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
480	**Allyl cyanide**	3-butenenitrile*; vinylacetonitrile; β-butenonitrile	$CH_2{:}CHCH_2CN$	67.09
481	**Allylene.**	See *Propyne**.		
482	**——, γ-bromo-.**	See *Propyne, 3-bromo-**.		
483	**Allylene dichloride.**	See *Propene, 1,2-dichloro-**.		
484	**Allylene oxide.**	See *Propene, 1,2-epoxy-**.		
485	**Allyl ether**	3-(2-propenoxy)propene*; diallyl ether	$(CH_2{:}CHCH_2)_2O$	98.14
486	**——, thio-.**	See *Allyl sulfide.*		
487	**Allyl fluoride**	3-fluoropropene*	$CH_2{:}CHCH_2F$	60.07
488	**Allyl iodide**	3-iodopropene*	$CH_2{:}CHCH_2I$	167.99
489	**Allyl isocyanide**		$CH_2{:}CHCH_2NC$	67.09
490	**Allyl mercaptan.**	See *2-Propene-1-thiol**.		
491	**Allyl mustard oil.**	See *Isothiocyanic acid, allyl ester.*		
492	**Allyl sulfide**	3-(2-propenylthio)propene*; thioallyl ether; diallyl sulfide; allyl thioether; 2-propenyl sulfide*	$(CH_2{:}CHCH_2)_2S$	114.20
493	**Allyl sulfocyanide.**	See *Thiocyanic acid, allyl ester.*		
494	**Allyl tribromide.**	See *Propane,1,2,3-tribromo-**.		
495	**Allyl trichloride.**	See *Propane, 1,2,3-trichloro-**.		
496	**Allyl trisufide**	diallyl trisulfide	$(C_3H_5)_2S_3$	178.32
497	**Aloïn**		$C_{20}H_{18}O_9$	402.35
498	**Alstonine**	chlorogenine	$C_{21}H_{20}N_2O_4 \cdot 3\frac{1}{2}H_2O$	427.44
498M	**Altrose**		$C_6H_{12}O_6$	180.16
499	**Aluminum,triethoxy-***	aluminum ethoxide	$Al(OC_2H_5)_3$	162.15
500	**——, triethyl-***	aluminum ethyl	$Al(C_2H_5)_3$	114.15
501	**——, trimethyl-***	aluminum methyl	$Al(CH_3)_3$	72.07
502	**Amalic acid**	tetramethylalloxantin	$C_8(CH_3)_4N_4O_7$	324.25
503	**Amanitine.**	See *Choline.*		
504	**Amarine**	4,5-dihydro-2,4,5-triphenylimidazole	 $(C_6H_5)CH(C_6H_5)CH \diagdown NH(C_6H_5)C{:}N$	298.37
505	**Amaron**	tetraphenylpyrazine; benzoin imide; ditolan azotide	$(C_6H_5)_2(CNC)_2(C_6H_5)_2$	384.46
506	**Amidine, benzenylnaphthyl-.**	See *Benzamidine, N-1-naphthyl-.*		
507	**——, ethenyldiphenyl-.**	See *Acetamidine, N,N'-diphenyl-.*		
508	**Amidol.**	See *Phenol, 2,4-diamino-, dihydrochloride.*		
	Amino-. See the parent compounds	(e.g., for aminoacetophenone see *Acetophenone,*		
510	**Amino G acid**	See *2-Naphthylamine-6,8-disulfonic acid.*		
511	**Ammelide**	6-amino-s-triazine-2,4-diol; cyanuramide	 $N{:}C(OH)N{:}C\text{-}(OH)N{:}C(NH_2)$	128.09
512	**Ammeline**	4,6-diamino-s-triazin-2-ol; cyanurodiamide	 $N{:}C(OH)N{:}C\text{-}(NH_2)N{:}C(NH_2)$	127.11
513	**Ammonium bromide, (β-acetoxyethyl) trimethyl-.**	See *Choline, O-acetyl-,*		
514	**——, ethyl-*.**	See *Ethylamine, hydrobromide.*		
515	**——, tetraethyl-***		$(C_2H_5)_4NBr$	210.17
516	**Ammonium chloride,**	derivatives of. See also "*hydrochloride*" under the various		
517	**——, tetramethyl-***		$(CH_3)_4NCl$	109.60
518	**Ammonium hydroxide, (carboxymethyl)trimethyl-,**	anhydride. See		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
480	col. liq., 1.40602	0.8318^{20}_{4}	....	116–9	v. sl. s.	∞	∞ eth.
481							
482							
483							
484							
485	liq...........	0.805	....	94.3	sl. s.	∞	∞ eth.
486							
487	col. gas.......	....	....	–10	2.8^{13} cm^3	60^{13} cm^3	90 cm^3 eth.
488	yel. liq.......	1.848^{12}_{12}	–99.3	103.1	i.	s.	s. eth., chl.
489	liq...........	0.794^{17}_{4}	....	106	sl. s.	∞	∞ eth.
490							
491							
492	col. oil w. garlic odor, 1.4877^{27}	0.88765^{27}_{4}	–83	*ca.* 138; 138.6^{758} (140–2)	sl. s.	∞	∞ eth.; s. chl., CCl_4, CS_2
493							
494							
495							
496	liq...........	1.085^{15}	....	140	i.	i.	∞ eth.
497	yel. need......	....	147.9	....	sl. s. c.	sl. s. c.	i. eth.; s. acet., KOH; i. chl.
498	br. amor......	....	<100; 195 anh.	....	sl. s.	s.	v. sl. s. eth.; s. chl.
498M	β-*l*, th. pointed pr.; $[\alpha]^{20}_{D}$-28.75°	....	*l* 107–9.5 *d* 103–5	....	s.	s.	s. me. al.
499	....	1.1422^{20}_{4}	150–60	320	d.	......	....
500	col. liq., ign. in air, $1.480^{6.5}$	....	<–18	194	exp.	......	s. eth.
501	col. liq., ign. in air, 1.432^{12}	....	0	130	d.	......	s. eth.
502	cr............	....	245 d.	....	sl. s. h.	v. sl. s.	s. KOH
503							
504	pr...........	....	129	d.198 (anh.)	i.	s.	s. eth.
505	sm. need. f. acet.	....	246	subl.	i.	s.	s. eth., chl., h. bz.
506							
507							
508							
	amino-).						
510							
511	wh. cr. powd..	....	d.	....	v. sl. s.	......	s. eth., alk., min. a.
512	wh. minute need. dendritic groups	....	d.	....	0.021^{23}	i.	i. eth.; s. KOH, alk., min. a.
513	*bromide.*						
514							
515	cr. f. al.......	1.397^{20}_{4}	....	....	......	v. s.	s. chl.
516	amines.						
517	col. cr........	1.169^{20}_{4}	....	....	s.	s.	i. eth.
518	*Betaine.*						

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
519	**Ammonium hydroxide, tetraethyl-*.**		$(C_2H_5)_4NOH$	147.26
520	**——, tetramethyl-*.**		$(CH_3)_4NOH{\cdot}5H_2O$.	181.23
521	**——, trimethylvinyl-.**	See *Neurine.*		
522	**Ammonium purpurate.**	See *Murexide.*		
523	**Amygdalic acid**	amygdalinic acid; mandelic acid gentiobioside	$C_{19}H_{27}O_{11}.COOH$	476.43
524	**Amygdalin**	mandelonitrile gentiobioside; amygdaloside	$C_{20}H_{27}NO_{11}$	457.43
524M	**Amygdalose.**	See *Gentiobiose.*		
	Amyl. For (normal) amyl derivatives see the parent compounds (e.g., for amylbenzene			
525	***pri-act*-Amyl alcohol.**	See 1-*Butanol, 2-methyl-*.*		
526	***pri-n*-Amyl alcohol.**	See 1-*Pentanol*.*		
527	***sec-act*-Amyl alcohol.**	See 2-*Pentanol*.*		
528	***tert*-Amyl alcohol.**	See 2-*Butanol, 2-methyl-*.*		
529	***n*-Amyl aldehyde.**	See *Valeraldehyde.*		
530	**Amylamine**	*n*-amylamine; pentylamine*; 1-aminopentane	$CH_3(CH_2)_4NH_2$.	87.16
530M	**——, *N, N*-dimethyl.**		$CH_3(CH_2)_4N(CH_3)_2$	115.22
531	**——, *α*-methyl-**	2-aminohexane	$CH_3(CH_2)_3CH(CH_3)NH_2$	101.19
532	**——, 4-methyl-.**	See *Isohexylamine.*		
533	***sec-n*-Amylamine.**	See *Butylamine, α-methyl-*; *Propylamine, α-methyl-*.		
534	***tert*-Amylamine**	(*α*, *α*-dimethylpropyl) amine; dimethylethylcarbinylamine	$CH_3CH_2C(CH_3)_2NH_2$	87.16
535	**Amyl bromide**	1-bromopentane*; *n*-amyl bromide	$CH_3(CH_2)_3CH_2Br$.	151.06
536	***pri-act*-Amyl bromide.**	See *Butane, 1-bromo-2-methyl-**.		
537	**Amyl chloride**	1-chloropentane*; *n*-amyl chloride	$CH_3(CH_2)_3CH_2Cl$	106.60
538	***pri-act*-Amyl chloride.**	See *Butane, 1-chloro-2-methyl-**.		
539	***tert*-Amyl chloride.**	See *Butane, 2-chloro-2-methyl-**.		
540	***n*-Amyl cyanide.**	See *Capronitrile.*		
541	***α-n*-Amylene.**	See 1-*Pentene*.*		
542	***β-n*-Amylene.**	See 2-*Pentene*.*		
543	***α-n*-Amylene glycol.**	See 1,2-*Pentanediol*.*		
544	***β-n*-Amylene glycol.**	See 2,3-*Pentanediol*.*		
545	**Amyl ether**	pentyloxypentane*; di-*n*-amyl ether	$[CH_3(CH_2)_3CH_2]_2O$	158.28
545M	**Amyl fluoride (*n*)**	1-fluoropentane*	$CH_3(CH_2)_3CH_2F$	90.14
546	**Amylin.**	See *Dextrin.*		
547	**Amyl iodide**	1-iodopentane*; *n*-amyl iodide	$CH_3(CH_2)_3CH_2I$	198.06
548	***pri-act*-Amyl iodide.**	See *Butane, 1-iodo-2-methyl-*.*		
549	***tert*-Amyl iodide.**	See *Butane,2-iodo-2-methyl-*.*		
550	**Amyl isocyanide.**	*n*-amylcarbylamine*	$CH_3(CH_2)_4NC$	97.16
551	**Amyl mercaptan.**	See 1-*Pentanethiol*.*		
552	***pri-act*-Amyl mercaptan.**	See 1-*Butanethiol, 2-methyl-**.		
553	***tert*-Amyl mercaptan.**	See 2-*Butanethiol,2-methyl-*.*		
554	***n*-Amyl mustard oil.**	See *Isothiocyanic acid, amyl ester.*		
555	**Amyl nitrite (*n*)**	pentyl nitrite*	$CH_3(CH_2)_4NO_2$	117.15
556	**Amyl sulfate**	di-*n*-amyl sulfate; pentyl sulfate	$[CH_3(CH_2)_4]_2SO_4$	238.34
557	**Amytal.**	See *Barbituric acid, 5-ethyl-5-isoamyl-.*		
558	***l*-Anabasine**	*l*-2-(3-pyridyl)piperidine	$C_{10}H_{14}N_2$	162.23
559	**Anacardic acid**		$C_{22}H_{32}O_3$	344.48

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
519	deliq. need....	....	190 d.	....	s.	s.	....
520	hyg. need.....	....	anh. 63	d.	∞^{63}	v. s.	i. eth.
521							
522							
523	col. cr........	....	118	....	deliq.	i.	i. eth.
524	rhomb. f. w...	....	214–6	....	8.3^{10}, ∞^{100}	0.11^{10}, 9^{78}	i. eth.
524M	see *Benzene, amyl-*). For amyl esters of organic acids see the acids.						
525							
526							
527							
528							
529							
530	col. liq........	$0.7614\frac{20}{4}$	–55	104	s.	s.	∞ eth.
530M	col. liq., 1.4083^{20}	$0.743\frac{20}{4}$	....	122–3	sl. s.	......	∞ eth.
531	....	$0.767\frac{20.4}{4}$	–19	130^{742}	......	......	....
532							
533							
534	col. liq.......	$0.7611\frac{0}{4}$	–105	78.5	∞	∞	∞ eth.
535	col. liq., 1.444	$1.246\frac{0}{4}$; $1.218\frac{20}{4}$	–88.0	$128–9^{740}$	i.	s.	∞ eth.
536							
537	col. liq., 1.4119^{18}	$0.883\frac{20}{4}$	–99	108.2 (107^{740})	i.	∞	∞ eth.
538							
539							
540							
541							
542							
543							
544							
545	ylsh. liq......	$0.774\frac{20}{4}$	–69.3	190	i.	∞	∞ eth.
545M	col. liq., 1.35622	0.7880	<–80	62.8	i.	v. s.	v.s. eth.
546							
547	col. liq., 1.4955	$1.517\frac{20}{4}$	–85.6	156	i.	s.	∞ eth.
548							
549							
550	liq...........	$0.806\frac{20}{4}$	–51.1	155.5	i.	s.	....
551							
552							
553							
554							
555	pa. yel. liq., 1.38506	$0.8528\frac{20}{4}$	....	104	sl. s.	∞	∞ eth.
556	1.4270^{25}......	$1.0265\frac{25}{25}$	....	$117.0^{2.5}$	......	......	....
557							
558	col. liq., 1.5430 $[\alpha]-82.20°^{20}_{D}$	$1.0481\frac{20}{20}$	....	28.09	∞	s.	s. eth., bz.
559	cr..........	....	26	....	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
560	**Anaesthesin.**	See *Benzocaine.*		
561	**Analgen (1)**	5-benzamido-8-ethoxyquinoline; quinalgen; chinalgen; labordin; benzanalgen	$C_9H_5N(NHCO-C_6H_5)OC_2H_5$	292.33
	Analgen (2).	Formerly, 5-acetamido-8-ethoxyquinoline.		
562	**Analgesine.**	See *Antipyrine.*		
563	**Anethole**	*p*-propenylanisole; anise camphor; 1-methoxy-4-propenylbenzene	$CH_3CH{:}CHC_6H_4-OCH_3$	148.20
564	**Angelic acid**	*cis*-2-methyl-2-butenoic acid*; *α*-methylisocrotonic acid	$CH_3CH{:}C(CH_3)-COOH$	100.11
565	**Anhalonidine**		$C_{12}H_{17}NO_3$	223.27
566	**Anhalonine**	1,2,3,4-tetrahydro-6-methoxy-1-methyl-7,8-methylene-dioxyisoquinoline	$C_{12}H_{15}NO_3$	221.25
567	——, hydrochloride		$C_{12}H_{15}NO_3 \cdot HCl$	257.71
568	***dl*-Anhydroecgonine**	ecgonidine	$C_9H_{13}NO_2$	167.20
569	——, hydrochloride		$C_9H_{13}NO_2 \cdot HCl$	203.67
570	**Anhydroformaldehyde aniline.**	See *s-Triazine, hexahydro-1,3,5-triphenyl-.*		
571	**Aniline**	phenylamine; aminobenzene	$C_6H_5NH_2$	93.12
572	——, hydrochloride		$C_6H_5NH_2 \cdot HCl$	129.59
572F	——, nitrate		$C_6H_5NH_3NO_3$	156.14
572M	——, oxalate		$(C_6H_5NH_3)_2C_2O_4$	276.29
572T	——, picrate		$C_6H_5NH_3OC_6H_2-(NO_2)_3$	322.23
573	——, sulfate		$(C_6H_5NH_2)_2H_2SO_4$	284.33
574	——, ***o*-acetyl-.**	See *Acetophenone, o-amino-.*		
575	——, ***N*-acetyl-.**	See *Acetanilide.*		
576	——, ***N*-allyl-**	*N*-(2-propenyl)aniline	$CH_2{:}CHCH_2-NHC_6H_5$	133.19
577	——, ***o*-amino-.**	See *o-Phenylenediamine.*		
578	——, ***m*-amino-.**	See *m-Phenylenediamine.*		
579	——, ***p*-amino-.**	See *p-Phenylenediamine.*		
580	——, **azodi-.**	See *Azobenzene, diamino-.*		
581	——, ***N*-benzal-.**	See *Aniline, N-benzylidene-.*		
582	——, ***p,p'*-benzalbis-*N,N*-dimethyl-.**	See *Aniline, p,p'-benzylidenebis-N,N-*		
583	——, ***p,p'*-benzaldi-.**	See *Methane, p,p'-diaminotriphenyl-.*		
584	——, ***N*-benzal-*p*-hydroxy-.**	See *Phenol, p-benzylideneamino-.*		
585	——, ***m*-benzohydryl-.**	*m*-aminotriphenylmethane; *m*-aminotritan	$(C_6H_5)_2CHC_6H_4-NH_2$	259.34
586	——, ***p*-benzohydryl-.**	*p*-aminotriphenylmethane	$(C_6H_5)_2CHC_6H_4-NH_2$	259.34
587	——, **o, *m*, or *p*-benzoyl-.**	See *Benzophenone, amino-.*		
588	——, ***N*-benzoyl-.**	See *Benzanilide.*		
589	——, ***m*-benzyl-**	*m*-aminodiphenylmethane	$NH_2C_6H_4CH_2C_6H_5$	183.24
590	——, ***p*-benzyl-**	*p*-aminodiphenylmethane	$NH_2C_6H_4CH_2C_6H_5$	183.24
591	——, ***N*-benzyl-.**	See *Benzylamine, N-phenyl-.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
560							
561	col.-yel. need. .	....	210	....	i.	v. sl. s.	v. sl. s. eth.; s. a.
562							
563	col. leaf. f. al., 1.5624^{12}	$0.9936\frac{15}{15}$	22.5, frz. 20–1	235.3	v. sl. s.	20 96%	s. eth., chl., bz., acet., CS_2
564	col. monocl. pr., 1.4434^{47} liq.	liq. $0.983\frac{47}{4}$	45	185	sl. s.	s.	v. s. eth.
565	....	....	160	....	s.	s.	sl. s. eth.; s. chl.
566	need.........	....	85	....	s.	s.	s. eth., chl.
567	wh. cr. powd. $[\alpha]-41.9^{\circ 17}_{D}$ in w.	....	>230 d.	....	sl. s. c., v. s. h.	sl. s.	sl. s. eth., chl.
568	wh. cr. f. w. . .	....	226–30 d.; (*l*, 235 d.)	....	s.	sl. s. c.	v. sl. s. eth.
569	rhomb. need. f. al., $[\alpha]$ −61.50°D	....	240–1	....	s.	s.	....
570							
571	col. oily liq., 1.5863^{20}	$1.022\frac{20}{4}$	−6.2	184.4	3.4^{20}, 6.4^{90}	∞	∞ eth., bz.
572	wh. leaf. or need........	$1.222\frac{4}{4}$	198	245	18^{15}, 107^{25}	s.	i. eth.
572F	rhomb........	1.356	d. >190	....	v. s.	v. s.	v. s. eth.
572M	tricl. pr.......	....	175 d.	....	v. s. c.	sl. s.	i. eth.
572T	yel. or red monocl. pr.	1.558	181 d.	....	$.374^{18}$ (c.) d. h.	8.4^{15} 95%	0.078^{20} bz.
573	leaf. f. al. . . .	$1.377\frac{4}{4}$	d.	....	6.6^{15}	sl. s.	i. eth.
574							
575							
576	yel. oil.......	$0.982\frac{25}{4}$	....	$217–8^{736}$ (209)	sl. s.	s.	∞ eth.
577							
578							
579							
580							
581							
582	*dimethyl-*.						
583							
584							
585	need. f. eth....	....	120	....	......	......	....
586	pr. f. eth.....	....	84	248^{13}	i.	......	s. eth., bz., lgr.
587							
588							
589	cr...........	....	46	....	......	......	s. lgr.
590	col. monocl. f. lgr.	1.038^{55}	34–5 (37)	300	i.	v. s.	v. s. eth.; s. lgr.
591							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
592	**Aniline, *N*-benzylidene-**	benzalaniline	$C_6H_5CH:NC_6H_5$	181.23
592M	**——,*p*,*p*′-benzylidene-bis-*N*,*N*-dimethyl-**	4,4′-bisdimethylaminotriphenylmethane; leucomalachite green	$C_6H_5CH[C_6H_4N(CH_3)_2]_2$	330.46
593	**——, *o*-bromo-**	1-amino-2-bromobenzene	$BrC_6H_4NH_2$	172.03
594	**——, *m*-bromo-**	1-amino-3-bromobenzene	$BrC_6H_4NH_2$	172.03
595	**——, *p*-bromo-**	1-amino-4-bromobenzene	$BrC_6H_4NH_2$	172.03
596	**——, *p*-bromo-*N*,*N*-diethyl-**		$BrC_6H_4N(C_2H_5)_2$	228.14
597	**——, *p*-bromo-*N*,*N*-dimethyl-**		$BrC_6H_4N(CH_3)_2$	200.09
598	**——, *N*-butyl-**		$C_6H_5NHC_4H_9$	149.23
599	**——, *p*-*tert*-butyl-**	1-amino-4-*tert*-butylbenzene	$(CH_3)_3CC_6H_4NH_2$	149.23
600	**——, *o*-chloro-**	2-chlorophenylamine	$ClC_6H_4NH_2$	127.57
601	**——, *m*-chloro-**	3-chlorophenylamine	$ClC_6H_4NH_2$	127.57
602	**——, *p*-chloro-**	4-chlorophenylamine	$ClC_6H_4NH_2$	127.57
603	**——, *N*-cyano-.**	See *Cyananilide.*		
604	**——, *N*, *N*-diacetyl-.**	See *Diacetanilide.*		
605	**——, *N*, *N*-dibenzyl-.**	See *Dibenzylamine,N-phenyl-.*		
606	**——, 2, 4-dibromo-6-nitro-**		$Br_2(NO_2)C_6H_2NH_2$	295.94
607	**——, 2, 6-dibromo-4-nitro-**		$Br_2(NO_2)C_6H_2NH_2$	295.94
608	**——, *N*,*N*-dibutyl-**	*N*-phenyldibutylamine	$C_6H_5N(C_4H_9)_2$	205.33
609	**——, 2, 3-dichloro-**		$Cl_2C_6H_3NH_2$	162.02
610	**——, 2, 4-dichloro-**		$Cl_2C_6H_3NH_2$	162.02
611	**——, 2, 5-dichloro-**		$Cl_2C_6H_3NH_2$	162.02
612	**——, 3, 4-dichloro-**		$Cl_2C_6H_3NH_2$	162.02
613	**——, 3, 5-dichloro-**		$Cl_2C_6H_3NH_2$	162.02
614	**——, *N*-(dichloromethylene)-**	phenyliminophosgene; phenylcarbylamine chloride	$C_6H_5NCCl_2$	174.03
615	**——, 2, 6-dichloro-4-nitro-**		$Cl_2(NO_2)C_6H_2NH_2$	207.02
616	**——,*N*, *N*-diethyl.-**	*N*-phenyldiethylamine	$C_6H_5N(C_2H_5)_2$	149.23
617	**——*N*, *N*-diethyl-*m*-nitro-**		$NO_2C_6H_4N(C_2H_5)_2$	194.23
618	**——,*N*, *N*-diethyl-*p*-nitro-**		$NO_2C_6H_4N(C_2H_5)_2$	194.23
619	**——,*N*, *N*-diethyl-*p*-nitroso-**		$NOC_6H_4N(C_2H_5)_2$	178.23
620	**——, *ar*-dimethyl-.**	See *Xylidine.*		
621	**——, *N*, *N*-dimethyl-**		$C_6H_5N(CH_3)_2$	121.18
621M	——, ——, hydrochloride		$C_6H_5N(CH_3)_2HCl$	157.64

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
592	yel. need. f. CS_2	1.07^{50}	54 (51–2)	300	i.	s.	s. eth.
592M	monocl. need. f. bz.	....	93; 102	d.	i.	s.	v. s. eth.; s. bz.; sl. s. lgr.
593	cr............	....	32,frz. 28.7	229	sl. s.	s.	s. eth.
594	$1.62604^{20.4}$....	$1.5793\frac{20.4}{4}$	18.5; frz. 16.7	251	v. sl. s.	s.	s. eth.
595	rhomb........	1.799	66.4	d.	i.	v. s.	v. s. eth.
596	need. or pr....	....	33	270	i.	v. s.	v. s. eth.
597	....	....	55	264	i.	v. s.	v. s. eth.
598	col. liq.......	....	....	240.9	sl. s.	v. s.	v. s. eth.
599	oil..........	$0.9525\frac{15}{4}$	17	240.9	i.	∞	∞ eth.
600	liq., 1.5895....	$1.213\frac{20}{4}$	α −14; β −3.5; mixt. 0	208.8	i.	∞	s. eth., most org. solv., a.
601	liq., $1.59424^{20.7}$	$1.216\frac{20}{4}$	−10.4	229.8 ($99–100^{10}$)	......	∞	∞ eth.; s. most org. solv., a.
602	rhomb. pr.....	$1.427\frac{19}{4}$; liq. $1.170\frac{70}{4}$	70–2	231	s. h.	s.	s. eth., a., most org. solv.
603							
604							
605							
606	yel. cr........	....	127	....	......	......	....
607	yel. need......	....	203	....	sl. s.	......	....
608	col. liq........	0.907	....	262.8 (271)	i.	s.	s. eth.
609	need. f. lgr....	....	24	252	......	s.	v. sl. s. eth.; sl. s. bz., lgr.
610	need. f. dil. me. al.	$1.567\frac{20}{4}$	63	245	sl. s.	s.	s. eth.
611	need. f. lgr....	....	50	251	sl. s.	s.	s. eth., bz., CS_2; sl. s. lgr.
612	need. f. lgr....	....	71.5	272	......	s.	s. eth.; sl. s. lgr.
613	need..........	....	50.5	260	i.	s.	s. eth.
614	col. oil........	....	....	209	......	......	....
615	yel. need. f. al.	....	189–90 (195)	....	......	s.	....
616	col.-yel. or brn. inflam. oil, $1.54105^{22.3}$	$.93507\frac{20}{4}$	−38.8	215.5	1.44^{12}	v. s.	v. s. eth., $CHCl_3$
617	yel. oil.......	....	....	288–90	......	......	....
618	yel. monocl. need. f. al.	1.225	77–8	....	......	v. s. h.	sl. s. lgr.
619	grn. monocl...	1.24^{15}	84	....	sl. s.	v. s.	v. s. eth.
620							
621	yel. liq., 1.55819	$0.9557\frac{20}{4}$	2.5	192.5–3.5	v. sl. s.	s.	s. eth., most ord. org. solv.
621M	hyg. pl.......	$1.1156\frac{18.5}{4}$	90	....	s. c.	s.	i. eth.; s. chl.; sl. s. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
622	**Aniline, *N, N*-dimethyl-*o*-nitro-**		$NO_2C_6H_4N(CH_3)_2$	166.18
623	**——, *N, N*-dimethyl-*m*-nitro-**		$NO_2C_6H_4N(CH_3)_2$	166.18
624	**——, *N, N*-dimethyl-*p*-nitro-**		$NO_2C_6H_4N(CH_3)_2$	166.18
625	**——, *N, N*-dimethyl-*p*-nitroso-**		$NOC_6H_4N(CH_3)_2$	150.18
626	**——, *N, N*-dimethyl-*p*-phenylazo-.**	See *Azobenzene, p-dimethylamino-.*		
627	**——, 2, 4-dinitro-**	2,4-dinitrophenylamine	$(NO_2)_2C_6H_3NH_2$	183.12
628	**——, 2, 6-dinitro-**	2,6-dinitrophenylamine	$(NO_2)_2C_6H_3NH_2$	183.12
629	**——, *N, N*-dipropyl-**		$C_6H_5N(C_3H_7)_2$	177.28
630	**——, ethoxy-.**	See *Phenetidine.*		
631	**——, ethoxyl-.**	See *Ethanol, 2-anilino-.*		
632	**——, *o*-ethyl-**	*o*-aminoethylbenzene	$C_2H_5C_6H_4NH_2$	121.18
633	**——, *m*-ethyl-**	*m*-aminoethylbenzene	$C_2H_5C_6H_4NH_2$	121.18
634	**——, *p*-ethyl-**	*p*-aminoethylbenzene	$C_2H_5C_6H_4NH_2$	121.18
635	**——, *N*-ethyl-**	*N*-ethylphenylamine	$C_6H_5NHC_2H_5$	121.18
636	**——, *N*-ethyl-*o*, *m* or *p*-hydroxy-**	See *Phenol, ethylamino-.*		
637	**——, *N*-ethyl-*N*-methyl-**		$C_6H_5N(CH_3)C_2H_5$	135.20
637K	**——, *o*-fluoro-**	1-amino-2-fluorobenzene	$FC_6H_4NH_2$	111.12
637M	**——, *m*-fluoro-**	1-amino-3-fluorobenzene	$FC_6H_4NH_2$	111.12
637P	**——, *p*-fluoro-**	1-amino-4-fluorobenzene	$FC_6H_4NH_2$	111.12
638	**——, hexahydro-.**	See *Cyclohexylamine*.*		
639	**——, *p, p′*-hydrazodi-.**	See *Hydrazobenzene, 4, 4′-diamino-.*		
640	**——, hydroxy-.**	See *Phenol, amino-.*		
641	**——, *m*-hydroxy-*N, N*-dimethyl-.**	See *Phenol, m-dimethylamino-*.*		
642	**——, β-hydroxethyl-.**	See *Ethanol, 2-anilino-.*		
643	**——, *p, p′*-iminodi-.**	See *Diphenylamine, 4,4′-diamino-.*		
644	**——, *o*-iodo-**		$IC_6H_4NH_2$	219.04
645	**——, *m*-iodo-**		$IC_6H_4NH_2$	219.04
646	**——, *p*-iodo-**		$IC_6H_4NH_2$	219.04
647	**——, *N*-isoamyl-**	*N*-isoamylphenylamine	$C_5H_{11}NHC_6H_5$	163.26
647H	**——, *p*-isobutyl-**		$C_4H_9C_6H_4NH_2$	149.23
647M	**——, *N*-isobutyl-**	*N*-phenylisobutylamine	$C_6H_5NHCH_2CH(CH_3)_2$	149.23
648	**——, *p*-isopropyl-.**	See *Cumidine.*		
649	**——, 2-isopropyl-5-methyl-.**	See *Thymylamine.*		
650	**——, 5-isopropyl-2-methyl-.**	See *Carvacrylamine.*		
651	**——, mercapto-.**	See *Phenol, aminothio-.*		
652	**——, methenyltri-.**	See *Leucaniline.*		
653	**——, methoxy-.**	See *Anisidine.*		
654	**——, *o*. *m* or *p*-methyl-.**	See *Toluidine.*		
655	**——, *N*-methyl-**		$C_6H_5NHCH_3$	107.15

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*Name approved by the International Union of Chemistry

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
622	red. monocl...	1.179	-20	154^{24}	sl. s.	s.	s. eth.
623	red. monocl. pr. f. eth.	1.313^{17}	66 (59–60)	285	i.	s.	s. eth.
624	yel. fluores. need. f. al.	....	163	....	i.	s.	s. conc. HCl, h. ac. a.
625	grn. tricl. leaf.	....	85	....	i.	s.	s. eth.
626							
627	yel. monocl. f. dil. acet.	1.615	176 (188)	....	sl. s. h.	0.7^{21}	sl. s. h. HCl
628	yel.need. f.al.	....	138 (141–2)	....	i.	0. 40 c.	s. eth., h. bz.; i. lgr.
629	yel. oil.......	$0.9104\frac{20}{4}$	....	245–6 (238–41)	i.	s.	s. eth.
630							
631							
632	liq..........	$0.983\frac{22}{4}$	-43	215–6	sl. s.	v. s.	v. s. eth.
633	col. liq......	$0.990\frac{0}{4}$; $0.9631\frac{20}{4}$	-64	214–5(205)	sl. s.	v. s.	v. s. eth.
634	glit.leaf.or col. oil	$0.975\frac{22}{4}$	-5	216.5	sl. s.	v. s.	v. s. eth.
635	col. liq., $1.55558^{20.3}$	$0.9631\frac{20}{4}$	-63.5	204.72	i. (v. sl. s.)	∞	∞ eth.
636							
637	col. liq......	0.9193^{55}	....	201	i.	∞	∞ eth.
637 K	pa. yel. liq., 1.54672^{18}	1.1437^{18}	-28.95	175	i.	s.	s. eth.
637M	pa. yel. liq., $1.54528^{18.5}$	$1.1561^{18.5}$	....	186.1	i.	s.	s. eth.
637 P	pa. yel. liq., 1.53945	1.1725	-0.82	187.6	......	......	....
638							
639							
640							
641							
642							
643							
644	need........	....	56.5	....	v. sl. s.	v. s.	v. s. eth.
645	leaf. or need..	....	33 (27)	....	i.	s.	s. chl.
646	need. f. w....	....	62.75 (67–8)	....	i.	s.	s. eth., chl
647	liq..........	$0.928\frac{15}{4}$	....	254.5	i.	∞	∞ eth.
647 H	pa. yel. liq...	....	....	235^{762}	i.	∞	∞ eth.
647M	....	$0.940\frac{18}{4}$	....	225–7	......	......	....
648							
649							
650							
651							
652							
653							
654							
655	yel. liq., $1.57021^{21.2}$	$0.986\frac{20}{4}$	-57.0	195.7	v. sl. s.	s.	∞ eth.; s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
655M	**Aniline, *N*-methyl-, hydrochloride**		$C_6H_5NHCH_3 \cdot HCl$	143.62
656	**——, *p*-methylamino-.**	See *p-Phenylenediamine, N-methyl-.*		
657	**——, *N*-methyl-*o*-nitro-**		$NO_2C_6H_4NHCH_3$	152.15
658	**——, *N*-methyl-*m*-nitro-**		$NO_2C_6H_4NHCH_3$	152.15
659	**——, *N*-methyl-*p*-nitro-**		$NO_2C_6H_4NHCH_3$	152.15
660	**——, *N*-methyl-*p*-nitroso-**		$NOC_6H_4NHCH_3$	136.15
661	**——, *N*-methyl-*N*-nitroso-**	methylphenylnitrosamine	$C_6H_5N(CH_3)NO$	136.15
662	**——, *N*-methyl-*N*, 2, 4, 6-tetranitro-.**	See *Tetryl.*		
663	**——, methylene-.**	See *s-Triazine, hexahydro*-1,3,5-*triphenyl-.*		
664	**——, *p*,*p*′-methylenebis-*N*,*N*-dimethyl-**	*p*,*p*′-tetramethyldiaminodiphenylmethane	$CH_2[C_6H_4N(CH_3)_2]_2$	254.36
666	**——, *p*, *p*′-methylenedi-**	4,4′-diaminodiphenylmethane	$NH_2C_6H_4CH_2C_6H_4NH_2$	198.26
667	**——, *N*-methyl-*N*-nitroso-**	methylphenylnitrosamine	$C_6H_5N(CH_3)NO$	136.15
668	**——, *o*-nitro-**	1-amino-2-nitrobenzene	$NO_2C_6H_4NH_2$	138.12
669	**——, *m*-nitro-**	1-amino-3-nitrobenzene	$NO_2C_6H_4NH_2$	138.12
670	**——, *p*-nitro-**	1-amino-4-nitrobenzene	$NO_2C_6H_4NH_2$	138.12
671	**——, *N*-nitro-**	phenylnitramine; nitranilide; diazobenzolic acid	$C_6H_5NHNO_2$	138.12
672	**——, *p*-nitroso-**		$NOC_6H_4NH_2$	122.12
673	**——, *ar*-pentabromo-.**		$C_6Br_5NH_2$	487.66
674	**——, *ar*-pentachloro-.**		$C_6Cl_5NH_2$	265.37
675	**——, *ar*-pentamethyl-**	aminopentamethylbenzene	$C_6(CH_3)_5NH_2$	163.26
676	**——, *p*-phenyl-.**	See *Xenylamine.*		
677	**——, *N*-phenyl-.**	See *Diphenylamine**.		
678	**——, phenylazo-.**	See *Azobenzene, amino-.*		
679	**——, *N*-(2-propenyl)-.**	See *Aniline, N-allyl-.*		
680	**——, *o*-propyl-**	1-amino-2-propylbenzene	$CH_3CH_2CH_2C_6H_4NH_2$	135.20
681	**——, *p*-propyl-**	1-amino-4-propylbenzene	$CH_3CH_2CH_2C_6H_4NH_2$	135.20
682	**——, *N*-propyl-**		$C_6H_5NHC_3H_7$	135.20
683	**——, 2, 3, 4, 5-tetrachloro-**		$C_6HCl_4NH_2$	230.92
684	**——, 2, 3, 5, 6-tetrachloro-**		$C_6HCl_4NH_2$	230.92
685	**——, 2, 3, 4, 5-tetramethyl-**		$(CH_3)_4C_6HNH_2$	149.23
686	**——, 2, 3, 4, 6-tetramethyl-.**	See *Isoduridine.*		
687	**——, *p*, *p*′-thiodi-**	4,4′-diaminodiphenyl sulfide; thioaniline	$S(C_6H_4NH_2)_2$	216.29
688	**——, 2, 4, 6-tribromo-.**		$Br_3C_6H_2NH_2$	329.85
689	**——, 3, 4, 5-tribromo-.**		$Br_3C_6H_2NH_2$	329.85
690	**——, 2, 3, 4-trichloro-.**		$Cl_3C_6H_2NH_2$	196.47
691	**——, 2, 4, 5-trichloro-.**		$Cl_3C_6H_2NH_2$	196.47

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
655M	need........	....	121–122	....	378.8^{25}	v. s.	i. eth., bz.; v. s. chl.
656							
657	red need. f. pet. eth.	....	36–7 (34)	d.	sl. s. h.	s.	s. eth.
658	red.-yel. need. f. al.	....	66.0	....	i.	s.	s. eth.
659	yel. need. f. al.	1.201^{155}	152	d.	i.	sl. s.	sl. s. eth.; s bz.; v. sl. s lgr.
660	bl. fl........	....	118	....	......	......	....
661	yel. liq., $1.57602^{22.7}$	$1.1277\frac{20}{4}$	15	225 d.	i. (sl. s.)	s.	s. eth.
662							
663							
664	leaf. or tab...	....	91–2	....	i.	sl. s. c., s. h.	v. s. eth., bz., CS_2
666	pearly leaf. f. bz.	....	93 (77–84)	232^{11}	sl. s.	v. s.	v. s. eth.; s. bz.
667	yel. oil......	$1.124\frac{20}{4}$	12–5	225; 121^{13}	......	s.	s. eth.
668	or. rhomb. need. f. al.	$1.442\frac{20}{4}$	71.5	284.11 (270 d.)	0.126^{25}	15.8^{15}, 27.87^{25}	v. s. eth.
669	yel. rhomb. need. f. al.	$1.430\frac{20}{4}$	111.8	286; 306.35 (270 d.)	0.089^{25}	6.10^{25}	5.67^{20} eth.
670	yel. monocl. need. f. al.	1.424	147.5	331.73 (260 d.)	0.08^{19}, 2.2^{100}	4.61^{20}	4.39^{20} eth.
671	leaf. f. lgr....	....	46	exp. 98	s.	v. s.	sl. s. lgr.
672	steel bl. need. f. bz.	....	174	....	s.	s.	s. bz.
673	need........	....	222	261–2	......	s.	....
674	need. f. al....	....	232	....	......	v. s.	v. s. eth.; sl. s. lgr.
675	monocl. f. al..	....	152	278	i.	s.	s. eth.
676							
677							
678							
679							
680	liq..........	0.949^{18}	....	222–4	i.	s.	s. eth.
681	liq..........	....	....	224–6	sl. s.	......	....
682	pa. yel. oil...	$0.949\frac{18}{4}$	....	222	i.	v. s.	v. s. eth.
683	need. f. al....	....	118	....	......	v. s.	v. s. eth.; s. bz., ac. a.
684	cr. f. lgr.....	....	90	....	i.	s.	v. s. eth.
685	leaf. f. w.....	....	64–6	259–60	s. h.	v. s.	v. s. eth.; s. pet. eth.
686							
687	need. f. w....	....	108–9 (105)	....	v. sl. s.	s.	s. eth., h. bz.
688	col. rhomb. bi-pyr. need. f. bz.	$2.35\frac{20}{20}$	119	300	i.	sl. s.	s. eth., chl.
689	need........	....	118–9	....	i.	s.	s. eth.
690	need. f. lgr...	....	67.5	291.5	......	v. s.	s. lgr.
691	need. f. lgr...	....	96	270	......	v. s.	s. CS_2; sl. s lgr.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
692	**Aniline, 2, 4, 6-trichloro-**	*sym*-trichloroaniline	$Cl_3C_6H_2NH_2$	196.47
693	**——, 2, 4, 5-trimethyl-.**	See *Pseudocumidine.*		
694	**——, 2, 4, 6-trimethyl-.**	See *Mesidine.*		
695	**——, 2, 4, 6-trinitro-**	picramide; "T.N.A."	$(NO_2)_3C_6H_2NH_2$	228.12
695M	***p*-Anilinesulfonamide.**	See *Sulfanilamide.*		
696	***o*-Anilinesulfonic acid.**	See *Orthanilic acid.*		
697	***m*-Anilinesulfonic acid**	. See *Metanilic acid.*		
698	***p*-Anilinesulfonic acid.**	See *Sulfanilic acid.*		
699	**Animal starch.**	See *Glycogen.*		
700	**Anisalcohol.**	See *Anisyl alcohol.*		
701	**Anisaldehyde**	anisic aldehyde; *p*-methoxybenzaldehyde; *p*-anisaldehyde; aubepine	$CH_3OC_6H_4CHO$	136.14
702	**——, 3-hydroxy-.**	See *Isovanillin.*		
703	***o*-Anisaldehyde.**	See *Benzaldehyde, o-methoxy-.*		
703M	**Anisamide**	*p*-methoxybenzamide	p-$CH_3OC_6H_4$-$CONH_2$	151.16
704	**Anise camphor**	See *Anethole.*		
705	**Anisic acid**	*p*-methoxybenzoic acid; *p*-anisic acid	$CH_3OC_6H_4COOH$	152.14
706	——, ethyl ester		$CH_3OC_6H_4COOC_2H_5$	180.20
707	——, methyl ester	methyl anisate	$CH_3OC_6H_4$-$COOCH_3$	166.17
708	——, piperazinium salt		$C_4H_{10}N_2.2C_8H_8O_3$	390.43
709	**——, 2-hydroxy-6-methyl-.**	See *Everninic acid.*		
710	**Anisic aldehyde.**	See *Anisaldehyde.*		
711	**Anisidine, *N*-acetyl-.**	See *Acetaniside.*		
712	***o*-Anisidine**	*o*-methoxyaniline	$CH_3OC_6H_4NH_2$	123.15
713	***m*-Anisidine**	*m*-methoxyaniline	$CH_3OC_6H_4NH_2$	123.15
714	***p*-Anisidine**	*p*-methoxyaniline	$CH_3OC_6H_4NH_2$	123.15
714M	**Anisoin**	*p, p'*-dimethoxybenzoin	$C_{16}H_{16}O_4$	272.29
715	**Anisole**	methoxybenzene*; methyl phenyl ether	$C_6H_5OCH_3$	108.13
716	**——, *p*-acetamido-.**	See *p-Acetaniside.*		
717	**——, *p*-acetyl-.**	See *Acetophenone, p-methoxy-.*		
718	**——, *p*-allyl-.**	See *Estragole.*		
719	**——, *o*-bromo-**	1-bromo-2-methoxybenzene*; *o*-bromophenyl methyl ether	$BrC_6H_4OCH_3$	187.04
720	**——, *p*-bromo-**	1-bromo-4-methoxybenzene*; *p*-bromophenyl methyl ether	$BrC_6H_4OCH_3$	187.04
721	**——, 2,4-dinitro-**	2,4-dinitrophenyl methyl ether	$(NO_2)_2C_6H_3OCH_3$	198.13
722	**——, *o*-hydroxy-.**	See *Guaiacol.*		
723	**——, *o*-nitro-**	1-methoxy-2-nitrobenzene	$NO_2C_6H_4OCH_3$	153.13
724	**——, *m*-nitro-**	1-methoxy-3-nitrobenzene	$NO_2C_6H_4OCH_3$	153.13

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
692	lng. need. f. lgr.	....	77.5	262.4	i.	v. s.	s. eth.; v. s. lgr.
693							
694							
695	yel. monocl. need. f. ac. a.	1.762	188	exp.	0.106	0.127	0.121^{17} eth., s. ac. a.
695M							
696							
697							
698							
699							
700							
701	col. liq., $1.57641^{12.7}$	$1.123\frac{20}{4}$	2.5	247	0.2 c.	∞	∞ eth.
702							
703							
703M	col. need. or tab.	....	166.5–7.5	....	s.	v. s.	....
704							
705	col. monocl. need. or pr.	$1.385\frac{4}{4}$	184.2	280	0.04^{18}	89^{25}	s. eth., chl., et. ac.
706		$1.1028\frac{15}{15}$	7	269; $134\text{–}5^{20}$	i.	s.	s. eth.
707	col. sc. f. al...	....	48	256	i.	s.	s. eth.
708	wh. cr.........	....	172–4	....	sl. s.	s. h.	i. eth.
709							
710							
711							
712	col. liq., 1.57536^{20}	1.108^{26}; $1.0923\frac{20}{4}$	5.2 (3–4)	225 (218)	sl. s.	s.	s. eth., dil. min. a.
713	col. liq......	$1.096\frac{20}{4}$	<–12	251	sl. s.	s.	s. eth.
714	rhomb. pl., 1.55592^{67}	$1.071\frac{55}{4}$ 1.0605^{67}	59 (57.7)	240 (245)	v. sl. s.	v. s.	v. s. eth.
714M	pr..........	....	113	....	sl. s. h.	s. h.	sl. s. eth.
715	col. liq., 1.51791^{20}	$0.9988\frac{15}{15}$; $0.9954\frac{20}{4}$	–37.3	155, 42.8^{10}	i.	s.	s. eth.
716							
717							
718							
719	oil, 1.57245....	$1.5018\frac{20}{4}$	....	221–3	i.	v. s.	v. s. eth.
720	cr. f. eth., 1.56051^{20}	$1.4569\frac{20}{4}$	11–12	215, 100^{16}	7.1	v. s.	v. s. eth., $CHCl_3$
721	col.-yel. monocl. need. f. w. or al.	$1.341\frac{20}{4}$	88–9 (95.2)	subl.	sl. s. h.	1.5^{20} s. h.	s. eth.
722							
723	col. liq., 1.56188^{20}	$1.2527\frac{20}{4}$	9.4 (10)	277 (272)	i. c.; 0.169^{30}	∞	∞ eth.
724	need. f. al.....	1.373^{18}	38	258	i.	s.	v. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
725	**Anisole, *p*-nitro-**	1-methoxy-4-nitrobenzene	$NO_2C_6H_4OCH_3$	153.13
726	**——, *p*-propenyl-.**	See *Anethole.*		
727	**——, 2,4,6-trinitro-**	picric acid methyl ether; methyl picrate	$(NO_2)_3C_6H_2OCH_3$	243.13
728	**——, *o*-vinyl**	*o*-methoxystyrene	$CH_2{:}CHC_6H_4OCH_3$	134.17
729	**——, *m*-vinyl-**	*m*-methoxystyrene	$CH_2{:}CHC_6H_4OCH_3$	134.17
730	**——, *p*-vinyl-**	*p*-methoxystyrene	$CH_2{:}CHC_6H_4OCH_3$	134.17
731	**Anisoyl chloride**	*p*-methoxybenzoyl chloride; anisyl chloride	$CH_3OC_6H_4COCl$	170.59
732	**Anisyl alcohol**	*p*-methoxybenzyl alcohol; anisalcohol	$CH_3OC_6H_4CH_2OH$	138.16
732M	**Anisylamine.**	See *Benzylamine, p-methoxy-.*		
733	**Anisyl chloride.**	See *Anisoyl chloride.*		
734	**Anol**	*p*-propenylphenol	$CH_3CH{:}CHC_6H_4OH$	134.17
735	**Anthracene**		$C_6H_4{:}(CH)_2{:}C_6H_4$	178.22
736	——, α-hexahydride.	See *Anthracene, α-hexahydro-.*		
737	**——, amino-.**	See *Anthrylamine.*		
738	**——, diamino-.**	See *Anthradiamine.*		
739	**——, 9,10-dibromo-***		$C_6H_4(CBr)_2C_6H_4$	336.04
740	**——, 9,10-dichloro-***	*ms*-dichloroanthracene	$C_6H_4(CCl)_2C_6H_4$	247.12
741	**——, 9,10-dihydro-***	anthracene 9, 10-dihydride	$C_6H_4{:}(CH_2)_2{:}C_6H_4$	180.24
742	**——, 9,10-dihydro-9-keto-.**	See *Anthrone.*		
743	**——, dihydroxy-.**	See *Anthracenediol.*		
744	**——, 9,10-dihydro-9,10-diketo-.**	See *Anthraquinone.*		
744M	**——, 1,3-dimethyl-***		$C_{14}H_8(CH_3)_2$	206.27
745	**——, 2,3-dimethyl-***		$C_{14}H_8(CH_3)_2$	206.27
746	**——, 2,4-dimethyl-***		$C_{14}H_8(CH_3)_2$	206.27
747	**——, 9-ethyl-***		$C_6H_4CHC(C_2H_5)C_6H_4$	206.27
748	**——, 9-ethyl-9,10-dihydro-**		$C_6H_4C_2H_3(C_2H_5)C_6H_4$	208.29
749	**——, α-hexahydro-**	anthracene α-hexahydride	$C_{14}H_{16}$	184.27
750	**——, hydroxy-.**	See *Anthrol.*		
751	**——, 9-hydroxy-.**	See *Anthranol.*		
752	**——, 1-methyl-**	α-methylanthracene	$C_6H_4(CH)_2C_6H_3CH_3$	192.25
753	**——, 2-methyl-**	β-methylanthracene	$C_6H_4(CH)_2C_6H_3CH_3$	192.25
754	**——, 9-methyl-**		$C_6H_4C(CH_3)CHC_6H_4$	192.25
755	**——, 9-nitro-**		$C_{14}H_9NO_2$	223.22
756	**——, 9-phenyl-**		$C_{14}H_9C_6H_5$	254.31
756M	**Anthracenecarboxylic acid.**	See *Anthroic acid.*		
757	**Anthracenediamine.***	See *Anthradiamine.*		
758	**1,2-Anthracenediol***	1,2-anthradiol; 1,2-dihydroxyanthracene	$C_6H_4(CH)_2C_6H_2(OH)_2$	210.22
759	**1,5-Anthracenediol*.**	See *Rufol.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
725	col. monocl. pr. f. al., 1.57072^{60}	1.233^{20}_{4}; 1.2192^{60}_{4}	54	260 (274)	0.007^{15}; 0.0589^{30}	s.	v. s. eth.; sl. s. c. pet. eth.
726							
727	col.monocl.pl. f. al.	1.408^{20}_{4}	68.4	....	i.	s.	s. eth., bz., ac. a.
728	arom. liq., 1.556	1.0095^{15}_{4}	....	195–200, $83\text{–}4^{12}$	i.	s.	s. eth.
729	oil...........	....	....	$89\text{–}90^{14}$	i.	s.	s. eth.
730	arom. liq.....	1.0029^{15}_{4}	....	204^{756}; $90\text{–}1^{13}$	i.	s.	s. eth.
731	need.........	....	27 (22–3)	145^{14}	i.	s. d.	s. eth., acet.
732	need.........	1.109^{26}_{4}	25 (19–21)	258.8	i.	v. s.	v. s. eth.
732M							
733							
734	col. leaf. f. h. w.	....	93	250 d.	sl. s. h.	s.	s. eth., alk., ord. org. solv.
735	col. monocl....	1.25^{27}_{4}	217 (213)	354–5	i.	0.076^{16} 0.83^{78}	1.189 eth.; 1.767 chl.; 1.500 CS_2; 7.5^{80} bz.
736							
737							
738							
739	yel. need. f. xylene or tol.	....	221 (226)	subl.	i.	sl. s.	sl. s. eth., c. bz.; s. chl., h. bz., h. tol.
740	yel. need. f. CCl_4	....	209–10	....	......	sl. s.	sl. s. eth.; s. bz.
741	col. tricl. or monocl. f. al.	0.8976^{11}_{4}	108.5	305 (313) subl.	i.	v. s.	v. s. eth.; s. bz.
742							
743							
744							
744M	pl...........	....	202–203	....	i.	v. s.	v. s. eth.
745	col. fluores. leaf. f. bz.	....	252 (246)	....	......	s.	v. s. bz.
746	need. f. al.....	....	71	....	......	s.	v. s. bz.
747	leaf. f. al., $1.6762^{99.2}$	1.041^{99}_{4}	59	....	i.	s.	s. eth.
748	oil...........	1.049^{18}_{4}	....	320 sl. d.	i.	s.	s. eth.; ∞ bz.
749	col. leaf.......	....	63	290	i.	v. s.	v. s. eth., bz.
750							
751							
752	col. leaf. f. al., $1.6803^{99.4}$	1.047^{99}_{4}	86	200	i.	sl. s.	sl. s. eth.; s. bz., CS_2
753	col. sc........	....	207	subl.	i.	sl. s.	sl. s. eth.; s. bz., CS_2
754	....	1.066^{99}_{4}	80	....	......	......	....
755	yel. need. f. al.	....	146	>360	......	sl. s.	v. s. bz., CS_2
756	leaf. f. al......	....	153	417	......	v. s.	v.s.eth.;s.h.bz.
756M							
757							
758	grnsh. leaf....	....	160–2 (131 d.)	....	......	v. s.	v. s. eth.; s. ac. a., alk.
759							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
760	**1,8-Anthracenediol*.**	See *Chrysazol.*		
761	**2,6-Anthracenediol*.**	See *Flavol.*		
762	**9,10-Anthracenediol*.**	See *Oxanthranol.*		
763	**Anthrachrysazin.**	See *Anthrachrysone.*		
764	**Anthrachrysone**	1,3,5,7-tetrahydroxyanthraquinone; anthrachrysazin	$C_{14}H_4O_2.(OH)_4$	272.20
765	**9,10-Anthradiamine**	9,10-anthracenediamine*; 9,10-diaminoanthracene	$C_{14}H_8(NH_2)_2$	208.25
766	**Anthradiol.**	See *Anthracenediol.*		
767	**Anthraflavic acid**	2,6-dihydroxyanthraquinone	$HOC_6H_3(CO)_2$-C_6H_3OH	240.20
768	**Anthragallol**	1,2,3-trihydroxyanthraquinone	$C_6H_4(CO)_2C_6H$-$(OH)_3$	256.20
769	**Anthrahydroquinone.**	See *Oxanthranol.*		
770	**Anthramine.**	See *Anthrylamine.*		
771	**Anthranil**		C_7H_5NO	119.12
772	**Anthranilaldehyde**	*o*-aminobenzaldehyde	$NH_2C_6H_4CHO$	121.13
773	**Anthranilic acid**	*o*-aminobenzoic acid	$NH_2C_6H_4COOH$	137.13
774	——, ethyl ester	ethyl anthranilate; ethyl *o*-aminobenzoate	$NH_2C_6H_4COOC_2H_5$	165.19
775	——, methyl ester	methyl anthranilate	$NH_2C_6H_4COOCH_3$	151.16
776	——, ***N*-acetyl-**	*o*-acetamidobenzoic acid	$CH_3CONHC_6H_4$-$COOH$	179.17
777	——, ***N*-benzoyl-**	*o*-benzamidobenzoic acid	$C_6H_5CONHC_6H_4$-$COOH$	241.24
778	——, ***N*-carboxy-**, anhydride.	See *Isatoic anhydride.*		
779	——, ***N*-(carboxymethyl)-**	phenylglycine-*o*-carboxylic acid; anthranilidoacetic acid	$HOOCCH_2NHC_6$-H_4COOH	195.17
780	——, ***N*-ethyl-**	*o*-ethylaminobenzoic acid; 2-ethylaminobenzenecarboxylic acid	$C_2H_5NHC_6H_4$-$COOH$	165.19
781	——, ***N*-methyl-**, methyl ester		$CH_3NHC_6H_4$-$COOCH_3$	165.19
782	——, **3-nitro-**	2-amino-3-nitrobenzoic acid	$NO_2(NH_2)C_6H_3$-$COOH$	182.13
783	——, **4-nitro-**	2-amino-4-nitrobenzoic acid	$NO_2(NH_2)C_6H_3$-$COOH$	182.13
784	——, **5-nitro-**	2-amino-5-nitrobenzoic acid	$NO_2(NH_2)C_6H_3$-$COOH$	182.13
785	——, **6-nitro-**	2-amino-6-nitrobenzoic acid	$NO_2(NH_2)C_6H_3$-$COOH$	182.13
786	——, ***N*-phenyl-**	*o*-anilinobenzoic acid	$C_6H_5NHC_6H_4$-$COOH$	213.23
787	**Anthranilonitrile**	*o*-aminobenzonitrile; *o*-aminophenyl cyanide	$NH_2C_6H_4CN$	118.13
788	**Anthranol**	9-anthrol; 9-hydroxyanthracene	$C_{14}H_9{\cdot}OH$	194.22
789	——, **9,10-dihydro-**	hydroanthranol	$C_6H_4CHOHC_6H_4C$-H_2	196.24
790	**Anthranylamine.**	See 9-*Anthrylamine.*		
791	**Anthrapurpurin**	1,2,7-trihydroxyanthraquinone; isopurpurin	$HOC_6H_3(CO)_2$-$C_6H_2(OH)_2$	256.20

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
760							
761							
762							
763							
764	silky yel. need. (+$2H_2O$)	....	>360	$-H_2O$, 150, subl.	i.	s.	v. sl. s. eth.; s. ac. a., acet., chl., CS_2, bz., lgr.
765	pa. yel. leaf...	....	160–6	....	i.	......	....
766							
767	yel. need. f. al.	....	330	subl.	i.	1.10^{17}	i. eth.; s. conc. H_2SO_4; sl. s. ac. a.; i. bz., chl.
768	or. red need. f. dil. ac. a.	....	310 d.	subl. 290	v. sl. s.	s.	s. eth., ac. a.; sl. s. chl., CS_2
769							
770							
771	col. oil, 1.5861.	$1.187\frac{15}{4}$	<-18	215	sl. s. h.	s.	s. ord. org. solv.
772	silv. leaf......	....	39–40	d.	sl. s.	v. s.	v. s. eth.; s. chl., bz.; i. lgr.
773	col. trim. rhomb. leaf.	....	145	subl.	0.35^{14}	$10.7^{9.6}$	16.0^{7} eth.
774	cr............	1.1174	13	260 (266–8); $135–6^{12}$	v. sl. s.	s.	s. eth.
775	col. liq.......	$1.168\frac{15}{4}$	8.2; 24.5	135.5^{15}	s.	v. s.	v. s. eth.
776	rhomb. f. ac. a.	....	185	....	sl. s. c.; s. h.	s. h.	s. eth., bz., h. ac. a.
777	lng. need. f. al.	....	181	....	i.	s.	s. eth.
778							
779	need. f. me. al.	....	215 (218–20)	....	sl. s.	s.	s. eth.; i. bz.
780	pr............	....	152–3	....	......	s.	s. eth.
781	....	....	....	256	i.	s.	s. eth.
782	yel. need. f. w.	$1.558\frac{15}{4}$	204	....	i.	v. s.	v. s. eth.
783	red need......	....	264 (269.5)	....	sl. s. h.	v. s.	v. s. eth.; s. xylene
784	yel. need......	....	263 (270–80d.)	....	s. h.	s.	s. eth.
785	yel. leaf. f. w..	....	183–4 d.	....	s. h.	v. s.	v. s. eth.
786	need. f. al.....	....	181 (182–3)	>184 d.	v. sl. s. h.	v. s. h.	s. eth.
787	col.-ylsh. pr...	....	50	264–6	......	s.	s. eth.
788	pa. yel. need..	....	170 d. (120)	....	i.	s.	v. s. h. bz.; s. alk., ac. a.
789	need. f. pet. eth.	....	76	....	s. h.	s.	s. eth.
790							
791	or. need. f. al.	....	369	462 d.	sl. s. h.	v. s.	sl. s. eth.; s. h. ac. a.; v. sl. s. chl., bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
792	**α-Anthraquinoline.**	See *Naphtho-*[2, 3-*f*] *quinoline.*		
793	**Anthraquinonazine, *N*, *N*′-dihydro-.**	See *Indanthrene.*		
794	**Anthraquinone**	9,10-dihydro-9 10-diketo-anthracene	$C_6H_4{:}(CO)_2{:}C_6H_4$	208.20
795	**——, 1-amino-**	α-anthraquinonylamine	$C_6H_4(CO)_2C_6H_3$-NH_2	223.22
796	**——, 2-amino-**	β-anthraquinonylamine	$NH_2C_6H_3(CO)_2$-C_6H_4	223.22
797	**——, 2-amino-1-hydroxy-**	β-alizarin amide	$C_{14}H_6O_2.(OH)NH_2$	239.22
798	**——, 1-bromo-**		$C_6H_4(CO)_2C_6H_3Br$	287.11
799	**——, 2-bromo-**		$C_6H_4(CO)_2C_6H_3Br$	287.11
800	**——, 1-chloro-**		$C_6H_4(CO)_2C_6H_3Cl$	242.65
801	**——, 2-chloro-**		$C_6H_4(CO)_2C_6H_3Cl$	242.65
805	**——, 1, 2-diamino-**		$C_6H_4(CO)_2C_6H_2$-$(NH_2)_2$	238.24
806	**——, 1, 3-diamino-**		$C_6H_4(CO)_2C_6H_2$-$(NH_2)_2$	238.24
807	**——, 1, 4-diamino-**		$C_6H_4(CO)_2C_6H_2$-$(NH_2)_2$	238.24
808	**——, 1, 5-diamino-**		$NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$	238.24
809	**——, 1, 6-diamino-**		$NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$	238.24
810	**——, 1, 7-diamino-**		$NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$	238.24
811	**——, 1, 8-diamino-**		$NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$	238.24
812	**——, 2, 3-diamino-**		$C_6H_4(CO)_2C_6H_2$-$(NH_2)_2$	238.24
813	**——, 2, 6-diamino-**		$NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$	238.24
814	**——, 2, 7-diamino-**		$NH_2C_6H_3(CO)_2$-$C_6H_3NH_2$	238.24
815	**——, 2, 3-dibromo-**	β-dibromoanthraquinone	$C_6H_4(CO)_2C_6H_2Br_2$	366.02
816	**——, 2, 7-dibromo-**		$C_6H_3Br(CO)_2$-C_6H_3Br	366.02
817	**——, 1, 2-dihydroxy-.**	See *Alizarin.*		
818	**——, 1, 3-dihydroxy-.**	See *Purpuroxanthin.*		
819	**——, 1, 4-dihydroxy-.**	See *Quinizarin.*		
820	**——, 1, 5-dihydroxy-.**	See *Anthrarufin.*		
821	**——, 1, 8-dihydroxy-.**	See *Chrysazin.*		
822	**——, 2, 3-dihydroxy-.**	See *Hystazarin.*		
823	**——, 2, 6-dihydroxy-.**	See *Anthraflavic acid.*		
824	**——, 2, 7-dihydroxy-.**	See *Isoanthraflavic acid.*		
825	**——, 1, 3-dinitro-.**		$C_6H_4(CO)_2C_6H_2$-$(NO_2)_2$	298.20

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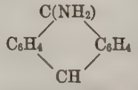
*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
792							
793							
794	ylsh. rhomb...	1.419^{-20}_{4}	286 subl.	379–81	i.	0.05^{10}; 2.3^{70}	v. sl. s. eth.; 6.4^{100} tol.; sl. s. bz.
795	red need......	....	252 (243)	subl.	i.	s.	s. eth., chl., bz., acet.
796	red need. f. al.	....	302	subl.	i.	s.	sl. s. eth.; s. chl., bz., acet.
797	br. need. f. al.	....	226–7	subl.	i.	s.	s. eth.; sl. s. NH_4OH
798	yel. need. f. bz.	....	188	subl.	......	s.	s. conc. H_2SO_4
799	yel. need. f. amyl al.	....	204–5	subl.	......	sl. s.	s. h. bz.
800	yel. need......	....	162	subl.	i.	sl. s.	i. eth.; s. ac. a., nitro-bz., amyl al., h. bz.
801	pa. yel. need. f. ac. a. or al.	....	211(203–5)	subl.	i.	sl. s.	i. eth.; s. h. bz., nitro-bz., conc. H_2SO_4
805	vlt. cr., grn. cast	....	303 (242–4)	....	......	......	s. pyr., aniline; sl. s. chl., xylene
806	brick red cr. f. $PhNO_2$	....	290	....	......	......	s. h. $PhNO_2$
807	dk. vlt. cr. f. al.	....	268	....	sl. s. h.	v. s.	s. bz., pyr., nitro-bz., aniline
808	red need. f. al. or ac. a.	....	319	subl.	v. sl. s.	sl. s.	sl. s. eth.; s. h. nitro-bz.; sl. s. bz., chl., acet.
809	red cr........	....	292	....	......	......	s. h. $PhNO_2$
810	red cr	....	290	....	......	......	s. h. $PhNO_2$
811	red cr. f. al ...	....	262	....	i.	v. s.	sl. s. eth.; s. ac. a., nitro-bz., pyr.
812	red cr	....	>320	....	......	......	s. nitro-bz., pyr., H_2SO_4; sl. s. chl.
813	redsh.-br. pr. f. h. pyr.	....	310–20 d.	....	......	s. h.	i. chl., xylene
814	or. cr. f. al. or nitro-bz.	....	>330	subl.	i.	sl. s.	sl. s. eth.; s. conc. a.
815	yel. need......	....	281 (269–70)	subl.	......	v. sl. s.	s. chl., bz.
816	yel. need. or pl.	....	236.5	subl.	......	v. sl. s. h.	s. bz., h. ac. a.
817							
818							
819							
820							
821							
822							
823							
824							
825	yel. need......	....	240 (246–50)	....	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
826	**Anthraquinone, 1, 5-dinitro-**	....	$NO_2C_6H_3(CO)_2C_6H_3NO_2$	298.20
827	**——, 1,2,3,5,6,7-hexahydroxy-.** See *Rufigallic acid*			
828	**——, 1(or α)-hydroxy-..**	erythrohydroxyanthraquinone	$C_6H_4(CO)_2C_6H_3OH$	224.20
829	**——, 2(or β)-hydroxy-..**	....	$C_6H_4(CO)_2C_6H_3OH$	224.20
830	**——, 2-methyl-.......**	....	$C_6H_4(CO)_2C_6H_3CH_3$	222.23
831	**——, 1-nitro-........**	....	$NO_2C_6H_3(CO)_2C_6H_4$	253.20
832	**——, 2-nitro-........**	....	$NO_2C_6H_3(CO)_2C_6H_4$	253.20
833	**——, 1,2,5,6-tetrahydroxy-.** See *Rufiopin.*			
834	**——, 1,2,5,8-tetrahydroxy-.** See *Quinalizarin.*			
835	**——, 1,3,5,7-tetrahydroxy-.** See *Anthrachrysone.*			
836	**——, 1,2,3-trihydroxy-.**	See *Anthragallol.*		
837	**——, 1,2,4-trihydroxy-.**	See *Purpurin.*		
838	**——, 1,2,5-trihydroxy-.**	2-hydroxyanthrarufin........	$HOC_6H_3(CO)_2C_6H_2(OH)_2$	256.20
839	**——, 1,2,6-trihydroxy-.**	See *Flavopurpurin.*		
840	**——, 1,2,7-trihydroxy-.**	See *Anthrapurpurin.*		
841	**——, 1,2,8-trihydroxy-.**	2-hydroxychrysazin.........	$HOC_6H_3(CO)_2C_6H_2(OH)_2$	256.20
842	**——, 1,3,8-trihydroxy-6-methyl-.** See *Emodin.*			
843	**2-Anthraquinonecarboxylic acid, 5,6 (or 7,8)-dihydroxy-.** See 6 (or 7)-			
844	**α-Anthraquinonylamine.** See *Anthraquinone, 1-amino-.*			
845	**β-Anthraquinonylamine.** See *Anthraquinone, 2-amino-.*			
846	**Anthrarufin..........**	1,5-dihydroxyanthraquinone..	$HOC_6H_3(CO)_2C_6H_3OH$	240.20
847	**——, 2-hydroxy-.**	See *Anthraquinone, 1,2,5-trihydroxy-.*		
848	**1-Anthroic acid.......**	1-anthracenecarboxylic acid*; α-anthroic acid	$C_{14}H_9COOH$......	222.23
849	**2-Anthroic acid.......**	2-anthracenecarboxylic acid*; β-anthroic acid	$C_{14}H_9COOH$......	222.23
850	**9-Anthroic acid.......**	9-anthracenecarboxylic acid*; *ms*-anthroic acid	$C_{14}H_9COOH$......	222.23
851	**1-Anthrol............**	1-hydroxyanthracene........	$C_{14}H_9.OH$........	194.22
852	**2-Anthrol............**	2-hydroxyanthracene........	$C_{14}H_9.OH$........	194.22
853	**9-Anthrol.**	See *Anthranol.*		
854	**Anthrone............**	9,10-dihydro-9-ketoanthracene	$C_{14}H_{10}O$..........	194.22
855	**——, 10-hydroxy-.**	See *Oxanthranol.*		
856	**1-Anthrylamine.......**	α-anthramine; 1-aminoanthracene	$C_{14}H_{11}N$..........	193.24
856M	**2-Anthrylamine.......**	β-anthramine; 2-aminoanthracene	$C_{14}H_{11}N$..........	193.24
856T	**9-Anthrylamine.......**	9-aminoanthracene; *meso*-anthramine; anthranylamine	 	193.24
857	**Antifebrin.**	See *Acetanilide.*		
858	**Antimony, pentamethyl-***	....	$Sb(CH_3)_5$.........	196.93

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
826	pa. yel. need. f. nitro-bz. or xylene	....	384–5	subl.	i.	v. sl. s.	v. sl. s. eth., bz.; s. h. nitro-bz., h. xylene; sl. s. ac. a.
827							
828	or. cr. f. al....	....	190	subl.	i.	s.	s. eth.
829	yel. leaf. or need. f. al.	....	302	subl.	v. sl. s.	s.	s. eth.
830	col-ylsh.need. f. al.	....	175–7	subl.	....	v. sl. s.	s. eth., conc. H_2SO_4; v. s. bz.
831	yel. need. f. ac. a.	....	230	270^7 subl.	i.	sl. s.	sl. s. eth.
832	yel. need. f. al.	....	181	subl.	i.	sl. s.	sl. s. eth.; v. s. chl.; s. H_2SO_4
833							
834							
835							
836							
837							
838	red need......	....	273–4	subl.	i.	....	s. eth.
839							
840							
841	or. need......	....	230	subl.	i.	v. sl. s.	....
842							
843	*Alizarincarboxylic acid.*						
844							
845							
846	pa. yel. leaf. f. ac. a.	....	280	subl.	v. sl. s.	sl. s.	sl. s. eth., acet.; s. bz., alk.
847							
848	yel. need......	....	245	subl.	i.	sl. s.	sl. s. eth., bz., chl.
849	yel. leaf......	....	281	subl.	i.	sl. s.	sl. s. eth., chl.; s. ac. a.; i. bz., CS_2
850	pa. yel. need. f. al.	....	217 d. (206)	d.	sl. s. h.	s.	....
851	br. need. or leaf. f. a.	....	d. 150–3	200 d.	i.	v. s.	v. s. eth.; s. NaOH, org. solv.
852	brnsh. need....	....	d. 200	....	i.	v. s.	v. s. eth.; s. acet.
853							
854	col. need......	....	154–5	....	i.	s.	s. bz., h. NaOH
855							
856	....	....	119 (130)	....	......	......	....
856M	yel. need......	....	236–7	....	i.	sl. s.	sl. s. eth.
856T	yel. cr........	....	145–50	....	......	s.	s. eth., chl., bz.
857							
858	....	....	....	96–100	i.	s.	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
859	**Antimony, triethyl-*.**	See *Stibine, triethyl-.*		
860	——, **trimethyl-***	See *Stibine, trimethyl-.*		
860M	**Antineuritic vitamin.**	See *Vitamin* B_1.		
861	**Antipyrine**	1,5-dimethyl-2-phenyl-3-pyrazolone; analgesine; phenazone	$N(CH_3)N(C_6H_5)$- $COCH{:}C(CH_3)$	188.22
862	——, salicylate.	See *Salipyrine.*		
863	**Antipyrine chloral hydrate.**	See *Hypnal.*		
864	**Antiscorbutin.**	See *l-Ascorbic acid.*		
865	**Antisepsin.**	See *Acetanilide, p-bromo-.*		
866	**Aphrodine.**	See *Yohimbine.*		
867	**Apiole**	2,5-dimethoxysafrole; apiol; parsley camphor	$CH_2{:}CHCH_2C_6H$-$(OCH_3)_2(CH_2O_2)$	222.23
868	**Apoatropine**	atropamine	$C_{17}H_{21}NO_2$	271.35
869	——, hydrochloride		$C_{17}H_{21}NO_2.HCl$	307.81
870	**Apocodeine**		$C_{18}H_{19}NO_2$	281.34
871	**Apomorphine**		$C_{17}H_{17}NO_2$	267.32
872	——, hydrochloride		$C_{17}H_{17}NO_2.HCl$	303.78
873	**Apoquinine**		$C_{19}H_{22}N_2O_2.2H_2O$	346.42
874	**Aposafranone**	10-phenyl-2(10)-phenazinone; benzeneindone	$C_6H_4(NC_6H_5)$-$(N)C_6H_3{:}O$	272.29
876	**Arabinose,** diphenylhydrazone		$C_5H_{10}O_4NN(C_6H_5)_2$	316.35
877	*dl*-**Arabinose**	pectinose	$C_5H_{10}O_5$	150.13
878	*c*-**Arabinose (*d* or *l*)**		$C_5H_{10}O_5$	150.13
879	*d*-**Arabitol**	arabite; 1,2,3,4,5-pentanepentol* (one form)	$C_5H_7(OH)_5$	152.15
880	**Arabonic acid**	α, β, γ, δ-tetrahydroxyvaleric acid (one form)	$CH_2OH(CHOH)_3$-$COOH$	166.13
881	**Arachic alcohol.**	See 1-*Eicosanol*.*		
882	**Arachidic acid**	eicosanoic acid*; arachic acid; *n*-eicosoic acid	$CH_3(CH_2)_{18}COOH$	312.52
883	——, ethyl ester		$C_{19}H_{39}COOC_2H_5$	340.58
884	——, methyl ester		$C_{19}H_{39}COOCH_3$	326.55
885	**Arbutin**	arbutoside	$C_{12}H_{16}O_7$	272.25
886	**Arecaidine, arecaine**	1-methylguvacine; 1,2,5,6-tetrahydro-1-methylnicotinic acid	$C_7H_{11}NO_2.H_2O$	159.18
887	——, methyl ester.	See *Arecoline.*		
888	**Arecoline**	arecaidine methyl ester; methyl 1, 2, 5, 6-tetrahydro-1-methylnicotinate	$C_8H_{13}NO_2$	155.19
889	——, hydrobromide		$C_8H_{13}NO_2.HBr$	236.12
890	——, hydrochloride		$C_8H_{13}NO_2.HCl$	191.66

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
859							
860							
860M							
861	leaf. or sc. f. eth., bz. or w., 1.5697, 1.6935, 1.7324	1.19_{4}^{20}	114 (109)	319^{174}	100	100	2.6 eth.; sl. s. lgr.
862							
863							
864							
865							
866							
867	col. need., 1.5380^{14} liq.; α1.583, β1.73 sol.	1.015_{4}^{20}	29.5	294	v. sl. s.	s.	s. eth.
868	wh. pr........	....	62	....	sl. s.	v. s.	v. s. eth.; s. chl., CS_2, bz.
869	col. cr........	....	237–9	....	s.	s.	s. eth.
870	pl. f. al.......	....	100–10 d.	....	v. sl. s.	s.	s. eth.
871	wh. pr. f. eth., turns grn. in air	....	170 d.	....	sl. s.	s.	s. eth., bz.; v. s. chl., sl. s. HCl
872	monocl. pr., grn. on expos. to lt.	....	200–10 d.	....	2^{25}	2.47^{25}	0.0536^{25} eth.; v. sl. s. chl.
873	need. f. eth....	....	210 d.	....	s. h.	s.	v. s. eth.; s. chl., bz., CS_2, KOH
874	dk. red met. cr.	....	242 (248–9)	....	sl. s.	s.	s. bz.; i. alk.
876	col. need., [α] $+18.5_{D}^{\circ 20}$ in pyr.	....	197–204	....	v. sl. s.	s. h.	....
877	col. rhomb....	1.585_{4}^{20}	164.5	....	16.9^{10}	0.35 h.	i. eth.
878	rhomb. pr.; *l*, [α] $+105_{D}^{\circ 20}$ in w.	1.585_{4}^{20}	159.5	....	58.9^{10}	0.5 90%	i. eth.
879	col. warts or pr.	....	103	....	v. s.	2.08^{12} 90%	i. eth.
880	cr. or syrup...	....	89	d., $-H_2O$	v. v. s.	......	....
881							
882	lust. sc.......	0.824_{4}^{100}	76.3	328	i.	0.45^{20}	v. s. eth.
883	cr............	....	50	$295–7^{100}$	i.	s.	s. eth.
884	cr............	....	54.5	286^{100}	i.	s.	s. eth.
885	col. silky need.	....	195	....	12.5	6.67	i. eth., chl., CS_2
886	....	....	224 d.	....	v. s.	i.	i. eth.
887							
888	oily alk. liq...	....	....	220	∞	∞	∞ eth.; s. chl.
889	pr. f. al.......	....	168	....	s.	s. h.	sl. s. eth., chl.
890	wh. cr.......	....	158	....	s.	s.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
891	**DL-Arginine**	*dl*-α-amino-δ-guanidovaleric acid; *dl*-$N^δ$-guanylornithine	$NH_2C(:NH)NH(CH_2)_3CH(NH_2)COOH$	174.21
892	**L-Arginine**	*d*-α-amino-δ-guanidovaleric acid	$NH_2C(:NH)NH(CH_2)_3CH(NH_2)COOH$	174.21
893	——, flavianate		$C_6H_{14}N_4O_2.C_{10}H_6N_2O_8S$	488.43
893M	——, diflavianate		$C_6H_{14}N_4O_2.(C_{10}H_6N_2O_8S)_2$	802.65
894	——, picrate		$C_6H_{14}N_4O_2 \cdot C_6H_3N_3O_7 \cdot 2H_2O$	439.35
895	**Arsanilic acid**	*p*-aminobenzenarsonic acid; *p*-aminophenylarsinic acid	$NH_2C_6H_4AsO(OH)_2$	217.04
897	**Arsenic, bisdiethyl-.**	See *Biarsine, tetraethyl-.*		
898	**——, dimethyl-.**	See *Cacodyl.*		
899	**——, triethyl-.**	See *Arsine, triethyl-.*		
900	**Arsenic dichloride, methyl-.**	See *Arsine, dichloromethyl-.*		
901	**Arsenic oxide, bisdimethyl-.**	See *Cacodyl oxide.*		
902	**——, methyl**	methyl arsinoxide	CH_3AsO	105.94
903	**Arsenic sulfide, bisdimethyl-.**	See *Cacodyl sulfide.*		
904	**Arsenic trichloride, dimethyl-.**	See *Cacodyl trichloride.*		
905	**Arsenious chloride, diphenyl-.**	See *Arsine, chlorodiphenyl-.*		
906	**Arsenobenzene, 3,3′-diamino-4,4′-dihydroxy-,**	dihydrochloride. See		
907	**Arsenobenzol.**	See *Arsphenamine.*		
908	**Arsine, chlorodimethyl-*.**	See *Cacodyl chloride.*		
909	**——, chlorodiphenyl-*.**	diphenylchloroarsine; diphenylarsenious chloride; blue cross; sneezing gas	$(C_6H_5)_2AsCl$	264.57
910	**——, dichloromethyl-***	methylarsenic dichloride; methyldichloroarsine	CH_3AsCl_2	160.86
910M	**——, diethyl-***		$(C_2H_5)_2AsH$	134.04
911	**——, dimethyl-***	cacodyl hydride	$(CH_3)_2AsH$	105.99
912	**——, ethyl-***	arsinoethane	$C_2H_5AsH_2$	105.99
913	**——, methyl-***		CH_3AsH_2	91.96
914	**——, methyldichloro-***	See *Arsine,dichloromethyl-.*		
915	**——, triethyl-***	arsenic triethyl	$(C_2H_5)_3As$	162.09
916	**——, trimethyl-***		$(CH_3)_3As$	120.01
917	**Arsinic acid, *p*-aminophenyl-.**	See *Arsanilic acid.*		
918	**——, dimethyl-.**	See *Cacodylic acid.*		
919	**——, methyl-.**	See *Methanearsonic acid.*		
920	**Arsinoxide, methyl .**	See *Arsenic oxide, methyl-.*		
921	**Arsphenamine**	3,3′-diamino-4,4′-dihydroxyarsenobenzene dihydrochloride; salvarsan; arsenobenzol; "606"	$C_{12}H_{12}As_2N_2O_2.2HCl.2H_2O.$	475.02
922	**Asaron.**	See *Benzene,* 1,2,4-*trimethoxy*-5-*propenyl-.*		
923	**Asaronic acid**	2,4,5-trimethoxybenzoic acid	$(CH_3O)_3C_6H_2COOH$	212.20
924	***l*-Ascorbic acid**	vitamin C; cevitamic acid; antiscorbutin	$C_6H_8C_6$	176.12
925	**Asepsin.**	See *Acetanilide, p-bromo-.*		
926	**Aseptol.**	See 1-*Phenol-2-sulfonic acid.*		
927	**Asparacemic acid.**	See DL-*Aspartic acid.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
891	....	....	217–8 d.	....	......	......	....
892	pr. f. w.; pl. f. al.	....	238 d.	....	15^{21}	i.	i. eth.
893	or. pl.........	....	258–60 d.	....	0.0177^{19}	0.002	i. eth.
893M	yel. need......	....	soft. 160; d. 228	....	d.	d.	i. a.
894	yel. need......	....	217–8 d.	....	0.5^{16}	i.	i. eth.
895	wh. need......	....	232	....	sl. s.	sl. s.	s. eth.; sl. s. ac. a.; i. bz., chl., acet.
897							
898							
899							
900							
901							
902	pr. f. CS_2.....	....	95	d.	......	s.	s. bz.
903							
904							
905							
906	*Arsphenamine.*						
907							
908							
909	rhomb. pl.....	1.583^{40}	44 (39)	333 d.	0.2	20	v. s. eth.; s. bz.
910	col. liq........	$1.838\frac{20}{4}$	–59	133–6	sl. s.	s.	s. eth.
910M	liq., 1.4709, ign. in air	$1.1338\frac{23}{4}$	....	105 (96.5–97)	......	......	....
911	col. liq., ign. in air	$1.213\frac{29}{4}$	....	36	......	∞	∞ eth., chl., bz., CS_2
912	col. liq........	$1.217\frac{22}{4}$	....	36	0.00013^{19}	s.	s. eth.
913	col. liq. or gas.	....	....	2	0.0085	v. s.	v. s. eth.
914							
915	col. liq., 1.467.	$1.150\frac{20}{4}$	....	141 d.	i.	s.	s. eth.
916	col. liq.......	$1.124\frac{22}{4}$	....	52.8	sl. s.	s.	∞ eth.
917							
918							
919							
920							
921	hyg. yel. powd.	....	....	....	v. v. s.	sl. s.	v. sl. s. eth.
922							
923	need. f. al.....	....	144	*ca.* 300	sl. s. c., s. h.	s.	s. bz., lgr.
924	wh. cr. powd., $[\alpha]^{20}_{D}+21\text{–}2°$, w.	....	190–2	....	33.3	2;4 95%	i. eth., chl., bz.; 1 g. per 100 glyc.
925							
926							
927							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
928	**L-Asparagine**	*l*-α-aminosuccinamic acid; *l*-β-asparagine	$NH_2COCH_2CH(NH_2)COOH$	132.12
929	**DL-Aspartic acid**	*dl*-aminosuccinic acid; asparacemic acid	$COOHCH_2CH(NH_2)COOH$	133.10
930	**L-Aspartic acid**	*d*-aminosuccinic acid	$COOHCH_2CH(NH_2)COOH$	133.10
931	**D-Aspartic acid**	*l*-aminosuccinic acid	$COOHCH_2CH(NH_2)COOH$	133.10
932	**Aspidospermine**		$C_{22}H_{30}N_2O_2$	354.48
933	**Aspirin**	acetylsalicylic acid; salicylic acid acetate; *o*-acetoxybenzoic acid	$CH_3COOC_6H_4COOH$	180.15
934	**Atisine**		$C_{22}H_{31}NO_2$	341.48
935	——, hydrochloride		$C_{22}H_{31}NO_2.HCl$	377.94
936	***dl*-Atrolactic acid**	*dl*-α-phenyllactic acid; *dl*-α-hydroxyhydratropic acid; *dl*-atrolactinic acid	$CH_3C(C_6H_5)(OH)COOH$	166.17
937	**Atropamine.**	See *Apoatropine.*		
938	**Atropic acid**	α-phenylacrylic acid; α-methylene-α-toluic acid	$CH_2{:}C(C_6H_5)COOH$	148.15
939	**Atropine**	*dl*-hyoscyamine; *dl*-daturine; tropic acid tropine ester	$C_{17}H_{23}NO_3$	289.36
940	——, chloroaurate		$C_{17}H_{23}NO_3H.AuCl_4$	629.40
941	——, sulfate		$(C_{17}H_{23}NO_3)_2.H_2SO_4$	676.80
942	——, valerate		$C_{17}H_{23}NO_3.C_5H_{10}O_2.H_2O$	409.51
943	**Atroscine.**	See *i-Scopolamine.*		
944	**Aubepine.**	See *Anisaldehyde.*		
945	**Auramine (base)**	bis(*p*-dimethylaminophenyl)-methylenimine	$[(CH_3)_2NC_6H_4]_2C{:}NH$	267.36
946	——, hydrochloride.	See *Auramine (dye).*		
947	**——, *N*-methyl-**		$[(CH_3)_2NC_6H_4]_2C{:}NCH_3$	281.39
948	**Auramine (dye)**	auramine (base) hydrochloride	$[(CH_3)_2NC_6H_4]_2C{:}NH_2Cl.H_2O$	321.85
949	**Aurin, Aurine**	rosolic acid; pararosolic acid	$C_{19}H_{14}O_3$	290.30
950	**——, hexamethoxy-.**	See *Eupittone.*		
950M	**Axerophthol.**	See *Vitamin A.*		
951	**Azelaic acid**	nonanedioic acid*; 1,7-heptanedicarboxylic acid	$COOH(CH_2)_7COOH$	188.22
952	——, diethyl ester	ethyl azelate	$CH_2[(CH_2)_3COOC_2H_5]_2$	244.32
953	**Azete, tetrahydro-.**	See *Trimethylenimine.*		
954	**Azetidine.**	See *Trimethylenimine.*		
955	**Azimethylene.**	See *Methane, diazo-*.*		
956	**Azirine, dihydro-.**	See *Ethylenimine.*		
957	**Azoaniline.**	See *Azobenzene, diamino-.*		
958	**Azobenzene**	diphenyldiimide; azobenzide	$C_6H_5N{:}NC_6H_5$	182.22
959	**——, *p*-acetamido-**	*p*-phenylazoacetanilide	$CH_3CONHC_6H_4N{:}NC_6H_5$	239.27
960	**——, *o*-amino-**	*o*-phenylazoaniline; 2-benzeneazoaniline	$NH_2C_6H_4N{:}NC_6H_5$	197.23

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
928	col. rhomb., 1.549, 1.583, 1.625	$1.543\frac{15}{4}$	236 d. cl. tube (226)	235 d.	2.46^{25} 86.6^{100}	0.0003^{25}	i. eth.; s. NH_3
929	monocl. pr....	$1.663\frac{12}{12}$	278–80 d.	....	0.82^{25}, 4.79^{75}	0.032^{25} 75%	....
930			251				
931	col. rhomb. leaf.	$1.6613\frac{12}{12}$	269–71	....	0.39^{10}, 0.54^{25}, 2.71^{75}	i.	i. eth.; s. dil. HCl
932	need. f. al. or pet. eth.	....	208	.....	1.7^{25}	2.1^{25}	0.95^{25} eth.; s. chl., bz.
933	col. need. f. w., 1.505, 1.645, 1.655	....	143	d. 140	0.25	20 90%	3.57 eth.; 5.9 chl, v. sl. s. bz.
934	col. varnish...	....	85	....	sl. s.	v. s.	v.s. eth.; s. chl.
935	pr...........	....	296	....	v. s.	v. s.	i. eth.
936	rhomb......	....	$\frac{1}{2}H_2O$ 90; anh. 93	....	s.	......	....
937							
938	col. monocl....	....	106–7	2.7 d.	0.14^{19}	s.	s. eth., bz.. chl., CS_2, glac. ac. a.
939	col. rhomb. pr. or need.	....	115.5; 118, subl.	....	0.11^{25}	68.5	5.6 eth.; 64 chl.; 3.7 glyc.
940	leaf. or glist. powd.	....	135–7	....	sl. s.	......	....
941	col. need. or wh. cr. powd.	....	183-4.5 anh.	....	260	27	0.05 eth.; 0.16 chl.; s. glyc.
942	wh. crusts....	....	42	....	v. s.	sl. s.	sl. s. eth.
943							
944							
945	yel. leaf. f. al.	....	136	....	i.	7^{20} 96%	2.31^{20} eth.
946							
947	yel. cr. f. al...	....	130–3	....	v. sl. s.	v. s.	v. s. ac. a.
948	yel. fl........	....	....	....	s.	s.	....
949	red rhomb. need.	....	308–10 d.	....	0.12^{25}	s.	s. eth., ac. a., alk.; sl. s. chl.; i. bz., CS_2
950							
950M							
951	col. leaf. or need, $1.4303^{110.6}$	$1.029\frac{20}{4}$	106.5	360 d.; 226^{10}	0.24^{20}, 2.2^{65}	v. s.	2.7 eth..
952	....	....	....	291; $151\text{-}3^{14}$	i.	s.	s. eth.
953							
954							
955							
956							
957							
958	or.–red monocl. leaf.	$1.203\frac{20}{4}$	68	297.4	i.	8.5^{16}	s. eth.; 8.57^{20} lgr.; 3.95^{10} me. al.
959	....	....	144	....	......	......	....
960	golden need...	....	123	....	i.	v. s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
961	**Azobenzene, *m*-amino-**	*m*-phenylazoaniline; 3-benzeneazoaniline	$NH_2C_6H_4N:NC_6H_5$	197.23
962	**——, *p*-amino-**	*p*-phenylazoaniline; 4-benzeneazoaniline	$NH_2C_6H_4N:NC_6H_5$	197.23
963	**——, 4-amino-2,3′-dimethyl-.**	See *m-Toluidine*, 4-*m-tolylazo-*.		
964	**——, 4-amino-3,4′-dimethyl-.**	See *o-Toluidine*, 4-*p-tolylazo-*.		
965	**——, 4′-amino-2, 3′-dimethyl-.**	See *o-Toluidine*, 4-*o-tolylazo-*.		
966	**——, 2, 2′-diamino-**	2, 2′-azodianiline	$H_2NC_6H_4N:NC_6H_4NH_2$	212.25
967	**——, 2,4-diamino-.**	See *Chrysoidine (base).*		
968	**——, 4,4′-diamino-**	4,4′-azodianiline	$H_2NC_6H_4N_2C_6H_4NH_2$	212.25
969	**——, diethoxy-.**	See *o-Azophenetole.*		
970	**——, dihydroxy-.**	See *Azophenol.*		
971	**——, dimethyl.**	See *Azotoluene.*		
972	**——, *p*-dimethylamino-**	*N*, *N*-dimethyl-*p*-phenylazoaniline	$(CH_3)_2NC_6H_4N:NC_6H_5$	225.29
973	**——, 4,4′-diphenyl-.**	See *p,p′-Azobiphenyl.*		
974	**——, *o*-hydroxy-**	*o*-phenylazophenol	$HOC_6H_4N:NC_6H_5$	198.22
975	**——, *m*-hydroxy-**	*m*-phenylazophenol	$HOC_6H_4N:NC_6H_5$	198.22
976	**——, *p*-hydroxy-**	*p*-phenylazophenol	$HOC_6H_4N:NC_6H_5$	198.22
977	**——, *p*-nitro-**		$NO_2C_6H_4N:NC_6H_5$	227.22
978	**——, 2,4,3′-triamino-.**	See *m-Phenylenediamine*, 4-(3-*aminophenylazo*)-.		
979	**Azobenzenedicarboxylic acid.**	See *Azobenzoic acid.*		
980	**Azobenzil.**	See *Oxazole, triphenyl-.*		
981	***o*-Azobenzoic acid**	*o,o′*-azobenzenedicarboxylic acid	$COOHC_6H_4N:NC_6H_4COOH$	270.24
982	***m*-Azobenzoic acid**	*m,m′*-azobenzenedicarboxylic acid	$COOHC_6H_4N:NC_6H_4COOH$	270.24
983	***p*-Azobenzoic acid**	*p,p′*-azobenzenedicarboxylic acid	$COOHC_6H_4N:NC_6H_4COOH$	270.24
984	***p,p′*-Azobiphenyl**	4,4′-diphenylazobenzene; *p*-azodiphenyl; di-*p*-xenyldiimide	$C_6H_5C_6H_4N:NC_6H_4C_6H_5$	334.40
985	**Azodicarbonamide**	azoformamide	$NH_2CON:NCONH_2$	116.08
986	***p*-Azodiphenyl.**	See *p,p′-Azobiphenyl.*		
987	**Azoformamide.**	See *Azodicarbonamide.*		
988	**Azoimide, phenyl-.**	See *Benzene, triazo-.*		
989	**Azole.**	See *Pyrrole.*		
990	**1,1′-Azonaphthalene**	di-1-naphthyldiimide; α, α′-azonaphthalene	$C_{10}H_7N:NC_{10}H_7$	282.33
991	**——, 4-amino-.**	See 1-*Naphthylamine*, 4-(1-*naphthylazo*)-.		
992	**1,2′-Azonaphthalene**	α-naphthyl-β-naphthyldiimide	$C_{10}H_7N:NC_{10}H_7$	282.33
993	**2,2′-Azonaphthalene**	di-β-naphthyldiimide	$C_{10}H_7N:NC_{10}H_7$	282.33
994	***o*-Azophenetole**	*o,o′*-azodiphenetole; *o,o′*-diethoxyazobenzene	$(C_2H_5OC_6H_4)_2N_2$	270.32
995	***p*-Azophenetole**	*p,p′*-azodiphenetole; *p,p′*-diethoxyazobenzene	$(C_2H_5OC_6H_4)_2N_2$	270.32
996	***o*-Azophenol**	*o,o′*-azodiphenol; 2,2′-dihydroxyazobenzene	$HOC_6H_4N:NC_6H_4OH$	214.22
997	***m*-Azophenol**	*m,m′*-azodiphenol; 3,3′-dihydroxyazobenzene	$HOC_6H_4N:NC_6H_4OH$	214.22

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
961	or. need.	....	57	....	i.	s.	s. eth., bz., chl.
962	yel. monocl.	....	126 (122–3)	>360	sl. s. h.	s. h.	s. eth., bz., chl.
963							
964							
965							
966	redsh. pl. f. al. or bz.	....	134	....	v. sl. s.	s.	s. eth.; v. s. acet.
967							
968	yel. need. f. al.	....	241	....	sl. s.	s.	s. eth., bz., chl.; sl. s. lgr.
969							
970							
971							
972	yel. leaf. f. al.	....	117 (115)	d.	i.	v. s.	s. eth., conc. min. a.
973							
974	or. need. f. eth.	....	82.5–3.0	....	sl. s.	s.	s. eth., alk.
975	yel. pr. f. bz.	....	114–7	....	0.08 h.	s.	s. eth.
976	rhomb. pr. f. al.	....	152 (155–6)	220–30^{20} sl. d.	0.002^{25}	v. s.	v. s. eth.
977	or. red. leaf. or need.	....	134	....	......	v. sl. s. h.	....
978							
979							
980							
981	dk. yel. need. f. al.	....	245 d. (237)	....	v. sl. s.	s.	v. s. eth.; i. bz.
982	amor. powd. or yel. need.	....	340	d.	sl. s.	0.24^{78} 88%	sl. s. eth.
983	red. need.	....	*ca.* 330	d.	v. sl. s.	v. sl. s.	v. sl. s. eth.
984	or.-red pl. f. bz.	....	249–50	....	i.	i.	s. eth.
985	or.-red cr.	....	180 d.	....	s. h.	i.	sl. s. eth.; d. h. HCl
986							
987							
988							
989							
990	red need. f. ac. a.	....	190	subl.	i.	sl. s.	s. bz., ac. a., acet.
991							
992	br. leaf. f. ac. a.	....	136	....	i.	s.	s. bz., ac. a., conc. H_2SO_4
993	red. leaf. f. bz. or chl.	....	208	subl.	i.	sl. s.	sl. s. eth., me. al.; s. bz., chl.
994	red pr. f. al.	....	131	240 d.	i.	s.	s. eth., HCl
995	yel. leaf.	....	160.2	d.	i.	s. h.	v. s. eth.
996	yel. leaf. f. bz. or al.	....	172	subl.	i.	0.33	v. s. eth.; 1.67 bz.; s. conc. alk.
997	yel. leaf. f. dil. al.	....	205	....	v. sl. s.	s. h.	sl. s. eth.; s. h. alk.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
998	**p-Azophenol**	*p,p'*-azodiphenol; 4,4'-dihydroxyazobenzene	$HOC_6H_4\text{-}N{:}NC_6H_4OH$	214.22
999	**o-Azotoluene**	2,2'-dimethylazobenzene; di-*o*-tolyldiimide	$CH_3C_6H_4N{:}NC_6H_4CH_3$	210.27
1000	***m*-Azotoluene**	3,3'-dimethylazobenzene; di-*m*-tolyldiimide	$CH_3C_6H_4\text{-}N{:}NC_6H_4CH_3$	210.27
1001	***p*-Azotoluene**	4,4'-dimethylazobenzene; di-*p*-tolyldiimide	$CH_3C_6H_4\text{-}N{:}NC_6H_4CH_3$	210.27
1002	**Azoxybenzene** (ordinary)	azoxybenzide	$C_6H_5(NON)C_6H_5$	198.22
1003	**Azoxybenzenedicarboxylic acid.** See *Azoxybenzoic acid.*			
1004	**o-Azoxybenzoic acid**	*o,o'*-azoxydibenzoic acid; azoxybenzene-2,2'-dicarboxylic acid	$C_6H_4COOH\text{-}(NON)C_6H_4\text{-}COOH$	286.24
1005	***m*-Azoxybenzoic acid**	*m,m'*-azoxydibenzoic acid	$C_6H_4COOH\text{-}(NON)C_6H_4\text{-}COOH$	286.24
1006	***p*-Azoxybenzoic acid**	*p,p'*-azoxydibenzoic acid	$C_6H_4COOH\text{-}(NON)C_6H_4\text{-}COOH$	286.24
1007	**1,1'-Azoxynaphthalene**	1,1'-azoxydinaphthalene; α, α'-azoxynaphthalene	$C_{10}H_7(NON)C_{10}H_7$	298.33
1008	**2,2'-Azoxynaphthalene**	β, β'-azoxynaphthalene	$C_{10}H_7(NON)C_{10}H_7$	298.33
1009	**Baeyer's acid.**	See *Croceic acid.*		
1010	**Baphiïn**		$C_{12}H_{10}O_4$ or $C_{24}H_{20}O_8$	218.20 (436.40)
1011	**Baptitoxine.**	See *Cytisine.*		
1012	**Barbital**	5,5-diethylbarbituric acid; veronal; barbitone; malourea	$NHCONHCOC\text{-}$ $(C_2H_5)_2CO$	184.19
1013	**Barbituric acid**	malonylurea; pyrimidinetrione	$NHCONHCO\text{-}$ CH_2CO	128.09
1014	**——, 5-amino-.**	See *Uramil.*		
1015	**——, 5,5-diallyl-**	dial	$NHCONHCOC\text{-}$ $(C_3H_5)_2CO$	208.21
1016	**——, 5,5-diethyl-.**	See *Barbital.*		
1017	**——, 5,5-dipropyl-**	proponal; propytal	$NHCONHCOC\text{-}$ $(C_3H_7)_2CO$	212.25
1018	**——, 5-ethyl-5-isoamyl-**	amytal	$NHCONHCOC\text{-}$ $(C_2H_5)(C_5H_{11})CO$	226.27
1019	**——, 5-ethyl-5-α-methylbutyl-**		$NHCONHCOC\text{-}$ $(C_2H_5)(C_5H_{11})CO$	226.27
1020	**——, 5-ethyl-5-phenyl-.** See *Phenobarbital.*			

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
998	cr. (+1H_2O) f. dil. al.; α anh. grn. powd.; β anh. dk. red powd.	....	216	....	sl. s.	v. s.	v. s. eth.; s. bz.
999	red monocl. pr. f. eth.	....	55	....	i.	$6^{14.5}$	$147.7^{18.5}$ eth.; s. bz.
1000	or. red rhomb. cr.	....	54–5	....	i.	v. s.	v. s. eth.
1001	or. yel. monocl. need. f. lgr.	....	144	....	i	s.	v. s. eth.; s. lgr.
1002	yel. rhomb. need. f. h. al., 1.6644^{26}	$1.246\frac{20}{4}$	36	d.	i.	17.5^{16}	v. s. eth.; 43^{15} lgr.
1003							
1004	pa. yel. tricl. leaf. f. al.	....	250 d.	d.	i.	sl. s.	sl. s. eth.
1005	pa. yel. need. or leaf.	....	345 d.(320)	....	i.	sl. s.	sl. s. eth.
1006	yel. amor......	....	240 d.	d.	i.	i.	i. eth.; s. pyr.
1007	yel.-red rhomb. f. al.	....	127	....	i.	s.	sl. s. eth.; s. conc. H_2SO_4
1008	yel. rhomb. need. f. al.	....	167–8	....	i.	s. h.	sl. s. eth.; s. bz., chl.
1009							
1010	leaf..........	....	d.	....	i.	s.	s. eth.
1011							
1012	wh. cr. powd..	....	191	....	0.69^{20}, 8.3^{100}	s.	v. s. eth.; s. acet., alk., pet. eth., ac. a.; sl. s. chl.
1013	wh. rhomb. pr.	....	245	260 d.	sl. s.	sl. s.	s. eth.
1014							
1015	col. sc........	....	170	....	sl. s.	s.	s. eth.
1016							
1017	col. cr........	....	145	....	0.06c., 1.4^{100}	v. s.	v. s. eth.; s. dil. alk.
1018	col..........	....	135	....	sl. s.	s.	s. eth.
1019	col..........	....	128.5–130	....	sl. s.	s.	s. eth.
1020							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1021	**Barbituric acid, 5-(2-furfurylidene)-2-thio-**	furfuralmalonylthiourea	$C_4H_3OCH{:}\underline{CCONHCSNHCO}$	222.21
1022	**——, 5-hydroxy-.**	See *Dialuric acid.*		
1023	**——, 5-isonitroso-.**	See *Violuric acid.*		
1025	**Bassorin**	tragacanthin	$C_{16}H_{10}O_5$ (?)	282.24
1026	**Bebeerine**		$C_{18}H_{19}NO_3$	297.34
1027	——, hydrochloride		$C_{18}H_{19}NO_3 \cdot HCl$	333.81
1028	**Behenic acid**	docosanoic acid*; *n*-docosoic acid	$CH_3(CH_2)_{20}COOH$	340.58
1029	——, ethyl ester		$C_{21}H_{43}COOC_2H_5$	368.63
1030	——, methyl ester		$C_{21}H_{43}COOCH_3$	354.60
1031	**Behenolic acid**	13-docosynoic acid*	$CH_3(CH_2)_7C{:}C(CH_2)_{11}COOH$	336.54
1032	**Belladonnine**		$C_{17}H_{21}NO_2$	271.35
1033	**Benzaconine**	benzoylaconine; pelline; picraconitine	$C_{32}H_{43}NO_{10}$	601.68
1033M	**Benzal.**	See *Benzylidene.*		
1034	**Benzalazine.**	See *Benzaldehyde, azine.*		
1035	**Benzal bromide.**	See *Benzylidene bromide.*		
1036	**Benzal chloride.**	See *Benzylidene chloride.*		
1037	**Benzaldehyde**	benzenecarbonal*	C_6H_5CHO	106.12
1038	——, azine	benzalazine; benzylideneazine; dibenzalhydrazine	$C_6H_5CH{:}NN{:}CHC_6H_5$	208.25
1039	——, cyanohydrin.	See *Mandelonitrile.*		
1040	——, hydrazone	benzalhydrazine; benzylidenehydrazine	$C_6H_5CH{:}NNH_2$	120.15
1041	——, α-, or *syn*-oxime	*syn*-benzaldoxime	$C_6H_5CH{:}NOH$	121.13
1042	——, β-, or *anti*-oxime	*anti*-benzaldoxime	$C_6H_5CH{:}NOH$	121.13
1043	——, phenylhydrazone	benzalphenylhydrazine; benzylidenephenylhydrazine	$C_6H_5CH{:}NNHC_6H_5$	196.24
1044	**——, 4-acetoxy-3-methoxy-.**	See *Vanillin, acetate.*		
1045	**——, *o*-amino-.**	See *Anthranilaldehyde.*		
1046	**——, *m*-amino-**		$NH_2C_6H_4CHO$	121.13
1047	**——, *p*-amino-**		$NH_2C_6H_4CHO$	121.13
1048	**——, *o*-chloro-**	2-chlorobenzenecarbonal*	ClC_6H_4CHO	140.57
1049	**——, *m*-chloro-**	3-chlorobenzenecarbonal*	ClC_6H_4CHO	140.57
1050	**——, *p*-chloro-**	4-chlorobenzenecarbonal*	ClC_6H_4CHO	140.57
1051	**——, diacetyl-.**	See *Benzal diacetate.*		
1052	**——, 2,4-dihydroxy-.**	See *β-Resorcylaldehyde.*		
1053	**——, 3,4-dihydroxy-.**	See *Protocatechualdehyde.*		
1054	**——, 2,4-dimethoxy-**	2,4-dimethoxybenzenecarbonal*; β-resorcylaldehyde dimethyl ether	$(CH_3O)_2C_6H_3CHO$	166.17
1055	**——, 3,4-dimethoxy-.**	See *Veratraldehyde.*		
1056	**——, *p*-dimethylamino-**	4-dimethylaminobenzenecarbonal*	$(CH_3)_2NC_6H_4CHO$	149.19
1057	**——, 2,4-dinitro-**	2,4-dinitrobenzenecarbonal*	$(NO_2)_2C_6H_3CHO$	196.12

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1021	yel. flocks.....	....	....	....	i.	......	....
1022							
1023							
1025	amor., a mucilage	....	....	....	sl. s.	i.	s. alk.; d. h. a.
1026	mixture (?), pr. f. me. al., $[\alpha]$–298°D	....	214	....	0.016 c.	20	s. eth., chl., a.
1027	hyg. need. or sc.	....	259–60	....	s.	s.	....
1028	col. need......	....	80.7 (84)	306^{60}	0.10c.	0.10^{17}	1.92^{16} eth.
1029	need. f. al.....	....	54–4.5	$230–1^{5}$	i.	s.	s. eth.
1030	cr............	....	54–4.5	$224–5^{15}$	i.	s.	s. eth.
1031	col. need. f. al.	....	57.5	....	i.	v. s.	v.s. eth.; s. chl.
1032	amor. resin....	....	....	....	v. sl. s.	v. s.	v.s. eth.; s. chl.
1033	amor.........	....	130	....	......	......	....
1033M							
1034							
1035							
1036							
1037	col. liq., $1.54629^{17.6}$	$1.0504\frac{15}{4}$	–26; frz.–56	179.5; $112.5–13^{100}$	0.33	∞	∞ eth., fixed and vol. oils
1038	lng. yel. lust. pr.	....	93	d.	i.	v. s. h.	v. s. eth.; s. chl., bz.
1039							
1040	col. leaf. or liq.	....	16	140^{14}	d.	s.	d. a., alk.
1041	col. leaf., $1.5637^{21.4}$	$1.111\frac{20}{4}$	35	200, 134^{20}	sl. s.	v. s.	v. s. eth., bz.
1042	col. rhomb. tab. or need.	....	130	....	s. h.	15.5^{20}, 53.6^{70}	v. s. eth.; sl. s. bz.
1043	col.-pink monocl. pr.	....	156	....	......	s. h.	sl. s. eth.; s. bz.
1044							
1045							
1046	in solution only						
1047	pl. or leaf. f. w.	....	71	....	v. sl. s.	s.	s. eth.
1048	liq., $1.56564^{21.7}$	$1.252\frac{20}{4}$	11 (8–9)	208^{748}	sl. s.	v. s.	v. s. eth.; s. bz.
1049	liq. or pr., $1.56500^{20.2}$	$1.2497\frac{15}{4}$	17–8	213–4 (204)	sl. s.	v. s.	v. s. eth.; s. bz.
1050	leaf., 1.55525^{61}	$1.196\frac{61}{4}$	47.5	214 $(144–4.5^{100})$	sl. s.	v. s.	v. s. eth.; s. CS_2, ac. a., bz.
1051							
1052							
1053							
1054	need. f. dil. al.	....	69–70	165^{10}	i.	v. s.	v. s. eth.
1055							
1056	leaf. f. w......	....	74	$176–7^{17}$	sl. s.	s.	s. eth., ac. a., ord. org. solv.
1057	pa. yel. cr. f. al.	....	72	$190–210^{10-20}$	sl. s.	v. s.	v. s. eth.; s. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1058	**Benzaldehyde, 2,6-dinitro-**	2,6-dinitrobenzenecarbonal*	$(NO_2)_2C_6H_3CHO$	196.12
1059	**——, 4-ethoxy-3-methoxy-**	vanillin ethyl ether; protocatechualdehyde 4-ethyl-3-methyl ether	$C_2H_5O(CH_3O)C_6H_3CHO$	180.20
1060	**——, *o*-hydroxy-.**	See *Salicylaldehyde.*		
1061	**——, *m*-hydroxy-**		HOC_6H_4CHO	122.12
1062	**——, *p*-hydroxy-**		HOC_6H_4CHO	122.12
1063	**——, 4-hydroxy-3-methoxy-.**	See *Vanillin.*		
1064	**——, *p*-isopropyl-.**	See *Cumaldehyde.*		
1065	**——, *o*-methoxy-**	salicylaldehyde methyl ether; *o*-anisaldehyde	$CH_3OC_6H_4CHO$	136.14
1066	**——, *p*-methoxy-.**	See *Anisaldehyde.*		
1067	**——, methyl-.**	See *Tolualdehyde.*		
1068	**——, 3,4-methylenedioxy-.**	See *Piperonal.*		
1069	**——, *o*-nitro-**		$NO_2C_6H_4CHO$	151.12
1070	**——, *m*-nitro-**		$NO_2C_6H_4CHO$	151.12
1071	**——, *p*-nitro-**		$NO_2C_6H_4CHO$	151.12
1072	**——, 2,4,6-trinitro-**		$(NO_2)_3C_6H_2CHO$	241.12
1073	**——, trithio-.**	See *s-Trithiane, triphenyl-.*		
1074	**o-Benzaldehydesulfonic acid.**	See *Benzenesulfonic acid,o-formyl-.*		
1075	**Benzal diacetate**	benzylidene diacetate; diacetylbenzaldehyde; α, α-diacetoxytoluene	$C_6H_5CH(OOCCH_3)_2$	208.21
1075M	**Benzaldoxime.**	See *Benzaldehyde, oxime.*		
1076	**Benzaldoximecarboxylic anhydride.**	See 2,3,1-*Benzoxaz-1-one.*		
1076M	**Benzal fluoride**	α,α-difluorotoluene; benzylidene fluoride	$C_6H_5CHF_2$	128.12
1077	**Benzalimine, *N*-ethyl-.**	See *Ethylamine, N-Benzylidene.*		
1078	**Benzamarone**	1,2,3,4,5-pentaphenyl-1, 5-pentanedione (one form); α, α′-benzalbisdesoxybenzoin	$C_6H_5CH[CH(C_6H_5)COC_6H_5]_2$	480.58
1079	**Benzamide**	benzenecarbonamide; benzoic amide	$C_6H_5CONH_2$	121.13
1080	——, oxime	benzamidoxime; benzenylaminoxide	$C_6H_5C(:NOH)NH_2$	136.15
1081	**——, *o*-amino-**		$NH_2C_6H_4CONH_2$	136.15
1082	**——, *m*-amino-**		$NH_2C_6H_4CONH_2$	136.15
1083	**——, *p*-amino-**		$NH_2C_6H_4CONH_2$	136.15
1084	**——, *o*-chloro-**	2-chlorobenzenecarbonamide*	$ClC_6H_4CONH_2$	155.58
1085	**——, *m*-chloro-**	3-chlorobenzenecarbonamide*	$ClC_6H_4CONH_2$	155.58
1086	**——, *p*-chloro-**	4-chlorobenzenecarbonamide*	$ClC_6H_4CONH_2$	155.58
1087	**——, *o*-hydroxy-.**	See *Salicylamide.*		
1088	**——, *m*-hydroxy-**		$HOC_6H_4CONH_2$	137.13
1089	**——, *p*-hydroxy-**		$HOC_6H_4CONH_2$	137.13
1089M	**——, *p*-methoxy-.**	See *Anisamide.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1058	leaf. f. dil. ac. a.	....	123	....	s. h.	s.	s. eth., bz., ac. a., chl.; sl. s. CS$_2$, lgr.
1059	monocl. pr....	....	64–5 (73–4)	subl.	sl. s. h.	sl. s.	s. eth.
1060							
1061	col. need. f. w.	....	106 (101–3)	240	2.78^{43}	v. s.	s. eth.; 6.31^{67} bz.
1062	col. need. f. w.	$1.129\frac{130}{4}$	116	subl.	$1.38^{30.5}$	v. s.	v. s. eth.; 3.68^{65} bz.
1063							
1064							
1065	pr., 1.5597....	$1.133\frac{20}{4}$	35	243	i.	s.	v. s. eth.
1066							
1067							
1068							
1069	yel. need. f. w.	....	α40; β37.9	156^{15}	0.23^{25}, 1.53^{103}	v. s.	v. s. eth.; s. bz.
1070	lt. yel. need. f. w.	....	58	164^{23}	0.16^{25}, 1.95^{112}	s.	v.s. eth.; s. chl.
1071	col. pr. f. w...	$1.496\frac{0}{4}$	106.5	subl.	0.97^{90}	v. s.	sl. s. eth.; 5.01^{13} bz.
1072	pl. f. bz.......	....	119	....	i.	s.	s. eth.
1073							
1074							
1075	....	$1.11\frac{20}{4}$	44–6	220; 154^{20}	......	s.	s. eth.
1075M							
1076							
1076M	col. liq.......	1.13696^{19}	....	132	i.	s.	....
1077							
1078	col. cr........	....	217–8	....	0.63 h.	sl. s.	1.6^{12} bz.
1079	col. monocl....	$1.341\frac{4}{4}$	130 (125–6)	290	0.58^{12}, 1.35^{25}	17^{25}	v. s. eth.
1080	monocl. pr. f. w.	....	79–80	....	sl. s. c.	v. s.	v. s. eth.; s. chl., bz.; i. lgr.
1081	leaf. f. chl.....	....	109–11.5 (108)	300 d.	s. h.	v. s.	sl. s. eth., bz.
1082	yel. need. (+1H$_2$O) f. w.	....	113–4 anh.; +H$_2$O 79	d. 300; –H$_2$O, 100–20	sl. s.	s.	s. eth.; sl. s. c. chl., c. bz.
1083	yel. cr........	....	183 (anh.)	....	sl. s.	s.	sl. s. eth.
1084	lng. rhomb. need. f. w.	$1.34\frac{18}{4}$	142 (139)	....	sl. s.	v. s.	v. s. eth.
1085	need.........	....	134.5	....	sl. s.	v. s.	s. eth.
1086	need. f. eth....	....	179 (170)	....	v. sl. s.	v. s.	v. s. eth.
1087							
1088	col. leaf. f. w..	....	170.5	....	sl. s. c., s. h.	v. s.	v. s. eth.; i. chl., CS$_2$
1089	need. f. w.....	....	162 anh.	–H$_2$O, 100	sl. s.	v. s.	sl. s. eth.; i. chl., CS$_2$
1089M							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1090	**Benzamide, *o*, *m* or *p*-methyl-.**	*See Toluamide.*		
1091	**——, *o*-nitro-**		$NO_2C_6H_4CONH_2$	166.13
1092	**——, *m*-nitro-**		$NO_2C_6H_4CONH_2$	166.13
1093	**——, *p*-nitro-**		$NO_2C_6H_4CONH_2$	166.13
1094	**——, *N*-phenyl-.**	See *Benzanilide.*		
1095	**Benzamidine**	benzenecarbonamidine*; benzenylamidine	$C_6H_5C(:NH)NH_2$	120.15
1096	**——, *N*-1-naphthyl-**	benzenylnaphthylamidine	$C_6H_5C(:NH)\text{-}NHC_{10}H_7$	246.30
1097	**Benzamidoxime.**	See *Benzamide, oxime.*		
1098	**Benzamine.**	See *β-Eucaine.*		
1099	**Benzanalgen.**	See *Analgen.*		
1100	**Benzanilide**	*N*-phenylbenzamide; *N*-benzoylaniline	$C_6H_5CONHC_6H_5$	197.23
1100M	**——, *p*-amino-**		$p\text{-}H_2NC_6H_4\text{-}CONHC_6H_5$	212.24
1101	**——, *o*-nitro-**		$NO_2C_6H_4\text{-}CONHC_6H_5$	242.23
1102	**——, *o′*-nitro-**		$C_6H_5CONHC_6H_4\text{-}NO_2$	242.23
1103	**——, *m*-nitro-**		$NO_2C_6H_4\text{-}CONHC_6H_5$	242.23
1104	**——, *m′*-nitro-**		$C_6H_5CONHC_6H_4\text{-}NO_2$	242.23
1105	**——, *p*-nitro-**		$NO_2C_6H_4CONHC_6\text{-}H_5$	242.23
1106	**——, *p′*-nitro-**		$C_6H_5CONHC_6H_4\text{-}NO_2$	242.23
1107	**——, thio-**		$C_6H_5CSNHC_6H_5$	213.29
1108	**——, 3,4,5-trihydroxy-.**	See *Gallanilide.*		
1109	**Benzaurin**	*p,p′*-dihydroxytriphenylcarbinol	$C_6H_5(C_6H_4OH)_2COH$ or $C_6H_5(OHC_6H_4)\text{-}C{:}C_6H_4{:}O$	292.32 (274.30)
1110	**Benzazide.**	See *Benzoyl azide.*		
1111	**1-Benzazine.**	See *Quinoline.*		
1112	**2-Benzazine.**	See *Isoquinoline.*		
1113	**Benzene***	benzol; benzole; phene*	C_6H_6	78.11
1114	——, hexabromide.	See *Cyclohexane, 1,2,3,4,5,6-hexabromo-*.*		
1115	——, hexachloride.	See *Cyclohexane, 1,2,3,4,5,6-hexachloro-*.*		
1116	**——, acetyl-.**	See *Acetophenone.*		
1117	**——, acetylenyl-.**	See *Benzene, ethynyl-.*		
1118	**——, 1-allyl-3,4-methylenedioxy-.**	See *Safrole.*		
1119	**——, amino-.**	See *Aniline.*		
1120	**——, aminodimethylamino-.**	See *Phenylenediamine, N, N-dimethyl-.*		
1121	**——, amoxy-.**	See *Ether, amyl phenyl.*		
1122	**——, amyl-**	1-phenylpentane	$C_6H_5(CH_2)_4CH_3$	148.24
1123	**——, sec-*n*-amyl-.**	See *Benzene, (α-methylbutyl)-.*		
1124	**——, *tert*-amyl-**	2-methyl-2-phenylbutane	$C_6H_5C(CH_3)_2C_2H_5$	148.24
1125	**——, 1-amyl-2,4-dihydroxy-.**	See *Resorcinol, 4-amyl-.*		
1126	**——, anilino-.**	See *Diphenylamine*.*		
1127	**——, azimino-.**	See *1,2,3-Benzotriazole.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
1090							
1091	need. f. dil. al.	$1.462\frac{32}{4}$	176.6	317	s. h.	s.	s. eth.
1092	yel. monocl. need. f. w.	....	142.7	315	s. h.	s.	s. eth.
1093	need. f. w.	....	201.4	....	v. sl. s.	s.	s. eth.
1094							
1095	col. cr.	....	80	d.	s.	v. s.	sl. s. eth.
1096	pl. f. al.	....	141	....	i.	s.	s. eth.
1097							
1098							
1099							
1100	col. leaf. f. al.	$1.321\frac{4}{4}$	161	$117–9^{10}$	v. sl. s.	3.16^{30}	sl. s. eth.
1100M	col. cr.	....	135–6	....	....	s.	....
1101	wh. need. f. al.	....	155	....	v. sl. s.	v. s.	sl. s. eth.
1102	yel. need. f. al.	....	94–8	....	sl. s. h.	s.	v. s. eth.
1103	leaf. f. w. or al.	....	153–4	subl.	v. sl. s. c.	s.	s. eth., bz.
1104	leaf. f. amyl al.	....	157	....	i.	sl. s.	v. s. chl.
1105	leaf. f. eth.	....	210–11	....	v. sl. s.	s.	s. eth.
1106	yel. need.	....	199	....	i.	sl. s. h.	....
1107	yel. pr. f. al.	....	100–2	d.	i.	s.	v. s. eth.
1108							
1109	brick red powd.	....	100	....	v. sl. s.	s.	s. eth.; sl. s. h. bz.
1110							
1111							
1112							
1113	col. rhomb. pr. or inflam. liq.; 1.50112^{20}	0.87901^{20}	5.51; 5.48–.49	80.099	0.082^{22}	∞	∞ eth., ac. a., acet., tol.; s. chl.
1114							
1115							
1116							
1117							
1118							
1119							
1120							
1121							
1122	col. liq., 1.4751^{15}	$0.860\frac{22}{4}$	−78.25	202.1	i.	s.	∞ eth.
1123							
1124	liq., 1.49154^{23}	0.8736^{15}	....	189–91	i.	∞	∞ eth.
1125							
1126							
1127							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1128	**Benzene, benzoyl-.**	See *Benzophenone.*		
1229	**——, benzyl-.**	See *Methane, diphenyl-.*		
1130	**——, 1-benzyl-4-ethyl-**	*p*-ethyldiphenylmethane	$C_6H_5CH_2C_6H_4C_2H_5$	196.28
1130M	**——, 1-benzyloxy-2-methoxy-4-propenyl-.** See *Isoeugenol, benzyl ether.*			
1131	**——, benzylphenyl-.**	See *Biphenyl, benzyl-.*		
1132	**——, bromo-***	phenyl bromide	C_6H_5Br	157.02
1133	**——, 1-bromo-4-(4-bromophenoxy)-.** See *Ether, bis-p-bromophenyl.*			
1134	**——, 1-bromo-3-chloro-***	*m*-bromochlorobenzene	BrC_6H_4Cl	191.47
1135	**——, 1-bromo-4-chloro-***	*p*-bromochlorobenzene	BrC_6H_4Cl	191.47
1136	**——, (α-bromoethyl-)**	1-bromo-1-phenylethane	$CH_3CHBrC_6H_5$	185.07
1137	**——, 1-bromo-4-fluoro-***		BrC_6H_4F	175.01
1138	**——, 1-bromo-2-iodo-***		BrC_6H_4I	282.93
1139	**——, 1-bromo-3-iodo-***		BrC_6H_4I	282.93
1140	**——, 1-bromo-4-iodo-***		BrC_6H_4I	282.93
1141	**——, 1-bromo-2-nitro-***		$BrC_6H_4NO_2$	202.02
1142	**——, 1-bromo-3-nitro-***		$BrC_6H_4NO_2$	202.02
1143	**——, 1-bromo-4-nitro-***		$BrC_6H_4NO_2$	202.02
1144	**——, (β-bromovinyl)-.**	See *Styrene, β-bromo-.*		
1145	**——, butoxy-*.**	See *Ether, butyl phenyl.*		
1146	**——, butyl-**	1-phenylbutane	$C_6H_5CH_2CH_2CH_2$-CH_3	134.21
1147	**——, *sec*-butyl-**	2-phenylbutane	$C_6H_5CH(CH_3)C_2H_5$	134.21
1148	**——, *tert*-butyl-**	2-methyl-2-phenylpropane	$C_6H_5C(CH_3)_3$	134.21
1149	**——, 1-*tert*-butyl-3,5-dimethyl-2,4,6-trinitro-**	musk xylene	$(NO_2)_3C_6C(CH_3)_3$-$(CH_3)_2$	297.27
1150	**——, butylmethyl-.**	See *Toluene, butyl-.*		
1151	**——, 1-butynyl-**	1-phenyl-1-butyne; ethylphenylacetylene	$C_6H_5C\vdots CCH_2CH_3$	130.18
1151H	**——, butyryl-.**	See *Butyrophenone.*		
1152	**——, chloro-***	phenyl chloride	C_6H_5Cl	112.56
1153	**——, 1-chloro-2,4-dinitro-***	4-chloro-1,3-dinitrobenzene	$(NO_2)_2C_6H_3Cl$	202.56
1154	**——, 1-chloro-3,5-dinitro-***	5-chloro-1,3-dinitrobenzene	$(NO_2)_2C_6H_3Cl$	202.56
1155	**——, 2-chloro-1,3-dinitro-***		$(NO_2)_2C_6H_3Cl$	202.56
1156	**——, 3-chloro-1,2-dinitro-***		$(NO_2)_2C_6H_3Cl$	202.56
1157	**——, 4-chloro-1,2-dinitro-***		$(NO_2)_2C_6H_3Cl$	202.56
1157M	**——, 1-chloro-4-fluoro-***		ClC_6H_4F	130.55
1158	**——, 1-chloro-4-iodo-***		ClC_6H_4I	238.47

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1128							
1129							
1130	liq..........	0.985^{19}	....	294.5	......	s.	s. eth., chl.
1130M							
1131							
1132	col. oily liq., 1.55977	$1.4991\frac{15}{15}$	-30.6	155-6	0.0446^{30}	10.4^{25}	71.3 eth.; s. bz.
1133							
1134	....	$1.6302\frac{20}{4}$	-21.2	196	i.	v. s.	v. s. eth.
1135	col. rhomb. or monocl. pr.	....	67.4	196.3	i.	s.	s. eth.
1136	liq..........	$1.3108\frac{23}{4}$	....	200-10 d.; $105\text{-}7^{30}$	i.	s.	s. eth.
1137	col. liq., 1.5310^{15}	1.593^{15}	-17.4	151.6	i.	s.	s. eth.
1138	col. liq.......	$2.257\frac{25}{4}$	2.1	257^{754} $(124\text{-}7^{17})$	i.	v. sl. s.	v. sl. s. ac. a.
1139	col. oily liq....	....	-9.3	252^{754}	i.	v. sl. s.	v. sl. s. ac. a.
1140	col. need. or pl.	....	92	251.5^{754}	i.	sl. s.	s. eth.
1141	pa. yel. cr. f. al.	$1.6245\frac{80}{4}$	42 (36-9)	261	i.	v. s.	s. eth., bz.
1142	rhomb. cr., 1.5979	$1.7036\frac{20}{4}$	56	256.5	v. sl. s.	s.	s. eth., bz.
1143	col. rhomb. pr.	$1.934\frac{22}{4}$	127	256	i.	1.38 c.	s. eth., bz.
1144							
1145							
1146	col. liq., 1.48979^{20}	0.86013^{20}	-81.2	183.270	i.	∞	∞ eth.
1147	col. liq., 1.49020^{20}	0.86207^{20}	-82.7	173.305	i.	∞	∞ eth.
1148	col. liq., 1.49266^{20}	0.86650^{20}	-58.1	169.119	i.	v. s.	v. s. eth.
1149	....	....	113	....	i.	sl. s.	s. eth.
1150							
1151	....	0.923^{21}	....	203	i.	s.	s. eth.
1151H							
1152	col. liq., 1.52479	$1.1066\frac{20}{4}$	-45, frz. -55	132	0.0488^{30}	∞	∞ eth.; s. chl., CS_2, bz.
1153	yel. rhomb. f. eth.	$\alpha 1.697^{22}$; $\beta 1.680\frac{20}{4}$	α 53.4 (51); β43; γ27	315	i.	s.	s. eth.
1154	col. need. f. al.	....	55 (59)	volat. in steam	i.	s.	s. eth.
1155	yel. need. f. al.	$1.6867^{16.5}$	87	315	i.	v. s.	s. eth.
1156	pr. f. et. al....	....	78 (86.8)	....	i.	s.	s. eth.
1157	yel. monocl. rhomb. f. eth.	$\alpha 1.697\frac{20}{4}$; $\beta 1.6867\frac{20}{4}$	α36.3; β37.1; γ38.8; δ28	315 d.	i.	s.	v. s. eth.; s. bz., CS_2
1157M	col. liq., 1.4990^{15}	....	-27.7	130.1	i.	s.	s. eth.
1158	col. leaf. f. al.	....	57	226-7	i.	s.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1159	**Benzene, chloromercuri-.** See *Mercury chloride, phenyl-**.			
1160	**——, 1-chloro-2-nitro-***	*o*-chloronitrobenzene........	$ClC_6H_4NO_2$......	157.56
1161	**——, 1-chloro-3-nitro-***	*m*-chloronitrobenzene........	$ClC_6H_4NO_2$......	157.56
1162	**——, 1-chloro-4-nitro-***	*p*-chloronitrobenzene........	$ClC_6H_4NO_2$......	157.56
1163	**——, 1-chloro-2,4,5-trinitro-***	....	$(NO_2)_3C_6H_2Cl$...	247.56
1164	**——, 1-chloro-2,4,6-trinitro-*.** See *Picryl chloride.*			
1165	**——, 2-chloro-1,3,5-trinitro-*.** See *Picryl chloride.*			
1166	**——, cyclohexyl-.**	See *Cyclohexane, phenyl-.*		
1167	**——, 1,4-diacetamido-.**	See *o-Phenylenediamine, N, N′-diacetyl-.*		
1168	**——, diamino-.**	See *Phenylenediamine.*		
1169	**——, diazoamino-.**	See *Diazoaminobenzene.*		
1170	**——, 1,2-dibromo-***	*o*-dibromobenzene.........	$C_6H_4Br_2$..........	235.92
1171	**——, 1,3-dibromo-*...**	*m*-dibromobenzene..........	$C_6H_4Br_2$..........	235.92
1172	**——, 1,4-dibromo-*...**	*p*-dibromobenzene..........	$C_6H_4Br_2$..........	235.92
1173	**——, 1,2-dibutoxy-*...**	pyrocatechol dibutyl ether...	$C_6H_4[O(CH_2)_3CH_3]_2$..........	222.32
1173M	**——, 1,4-di-*tert*-butyl-**	....	$C_6H_4[C(CH_3)_3]_2(p)$	190.32
1174	**——, 1,2-dichloro-*....**	*o*-dichlorobenzene..........	$C_6H_4Cl_2$..........	147.01
1175	**——, 1,3-dichloro-* ...**	*m*-dichlorobenzene..........	$C_6H_4Cl_2$..........	147.01
1176	**——, 1,4-dichloro-* ...**	*p*-dichlorobenzene.........	$C_6H_4Cl_2$..........	147.01
1177	**——, 1,3-dicyano-.**	See *Isophthalonitrile.*		
1178	**——, 1,2-diethoxy-*...**	pyrocatechol diethyl ether; catechol diethyl ether	$C_6H_4(OC_2H_5)_2$....	166.21
1179	**——, 1,3-diethoxy-*...**	resorcinol diethyl ether......	$C_6H_4(OC_2H_5)_2$....	166.21
1180	**——, 1,4-diethoxy-*...**	hydroquinone diethyl ether ..	$C_6H_4(OC_2H_5)_2$....	166.21
1181	**——, 1,2-diethyl-*.....**	*o*-diethylbenzene	$C_6H_4(C_2H_5)_2$......	134.21
1182	**——, 1,3-diethyl-*.....**	*m*-diethylbenzene..........	$C_6H_4(C_2H_5)_2$......	134.21
1183	**——, 1,4-diethyl-*.....**	*p*-diethylbenzene............	$C_6H_4(C_2H_5)_2$......	134.21
1184	**——, (diethylamino)methyl-.** See *Toluidine, N, N-diethyl-.*			
1185	**——, 1,3-diethyl-5-methyl-*.** See *Toluene, 3,5-diethyl-.*			
1186	**——, dihydro-.**	See *Cyclohexadiene.**		
1187	**——, 1,2-dihydroxy-.**	See *Pyrocatechol.*		
1188	**——, 1,3-dihydroxy-.**	See *Resorcinol.*		
1189	**——, 1,4-dihydroxy-.**	See *Hydroquinone.*		
1190	**——, 1,2-diiodo-*.....**	*o*-diiodobenzene............	$C_6H_4I_2$...........	329.93
1191	**——, 1,3-diiodo-*.....**	*m*-diiodobenzene...........	$C_6H_4I_2$...........	329.93
1192	**——, 1,4-diiodo-*.....**	*p*-diiodobenzene............	$C_6H_4I_2$...........	329.93
1193	**——, 1,3-diisoamoxy- .**	resorcinol diisoamyl ether....	$C_6H_4[OCH_2CH_2CH(CH_3)_2]_2$	250.37

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1159							
1160	monocl. need..	$1.368\frac{22}{4}$; $1.305\frac{80}{4}$	32.5	245.7	i.	s.	s. eth., bz.
1161	pa. yel. rhomb. pr. f. al.	$1.534\frac{20}{4}$	unst. 23.7; stab. 44.4 (46)	235-6	i.	v. s. h.	s. eth., bz., ac. a., chl., CS_2
1162	monocl. pr....	$1.520\frac{18}{4}$	83.5	242	i.	s.	s. eth., CS_2
1163	yel. cr. f. al...	....	116	....	i.	v. s. h.	s. h. bz.
1164							
1165							
1166							
1167							
1168							
1169							
1170	col. liq., $1.6117^{17.5}$	$1.9557\frac{20.5}{4}$	1.8 (5.6); frz. 6-7	221 (224)	i.	s.	∞ eth.
1171	col. liq., $1.6083^{17.5}$	$1.9523\frac{20.5}{4}$	-6.9	219.5 (217)	i.	s.	s. eth.
1172	col. monocl. f. al., 1.57425	$2.261\frac{17}{4}$; liq. 1.841^{89}	86.9	218-19	i.	10^{25}	71^{25} eth.; $90CS_2$; s. acet., lgr.
1173	pa. yel. liq....	....	....	$135\text{-}8^{12}$	......	......	....
1173M	wh. cr........	....	75	236.5	i.	v. s.	s. eth.
1174	col. liq., 1.5518^{22}	$1.3048\frac{20}{4}$	-17.5	180-3	0.0145^{25}	s.	s. eth.
1175	col. liq., $1.54570^{20.9}$	$1.288\frac{20}{4}$	-24.8	172	0.0123^{25}	s.	s. eth., bz.
1176	monocl. lf. f. al., $1.52104^{80.3}$	$1.4581\frac{20.5}{4}$	53	173.4	0.0079^{25}	sl. s. c., v. s. h.	v. s. eth.; s. bz., chl., CS_2
1177							
1178	cr. f. pet. eth	....	43-5	....	......	......	....
1179	pr..........	....	12.4	234-5	i.	s.	s. eth.
1180	leaf.........	....	71-2	246	......	v. s.	v. s. eth., chl.
1181	col. liq., 1.50346^{20}	0.87996^{20}	<-20	183.423	i.	s.	s. eth.
1182	col. liq., 1.49552^{20}	0.86394^{20}	<-20	181.102	i.	s.	s. eth.
1183	col. liq., 1.49832^{20}	0.86196^{20}	-35	183.752	i.	s.	s. eth.
1184							
1185							
1186							
1187							
1188							
1189							
1190	monocl. pl. or pr. f. lgr.	....	27; frz. 23.4	286-7	v. sl. s.	s.	v. s. eth.
1191	rhomb. pl. f. al.-eth.	....	40; frz. 34.2	284.8	i.	s.	s. eth., chl.
1192	rhomb. lf. f. al.	....	129.4	285, subl.	i.	s.	v. s. eth.
1193	cr. f. w.......	....	47	....	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1194	**Benzene, 1,2-dimethoxy-***.	See *Veratrole.*		
1195	**——, 1,3-dimethoxy-***.	resorcinol dimethyl ether	$C_6H_4(OCH_3)_2$	138.16
1196	**——, 1,4-dimethoxy-***	hydroquinone dimethyl ether	$C_6H_4(OCH_3)_2$	138.16
1197	**——, 1,2-dimethyl-*.**	See *o-Xylene.*		
1198	**——, 1,3-dimethyl-*.**	See *m-Xylene.*		
1199	**——, 1,4-dimethyl-*.**	See *p-Xylene.*		
1200	**——, 1,2-dinitro-***	*o*-dinitrobenzene	$C_6H_4(NO_2)_2$	168.11
1201	**——, 1,3-dinitro-***	*m*-dinitrobenzene	$C_6H_4(NO_2)_2$	168.11
1202	**——, 1,4-dinitro-***	*p*-dinitrobenzene	$C_6H_4(NO_2)_2$	168 11
1203	**——, 1,3-diphenyl-**	*m*-phenylbiphenyl; *m*-terphenyl	$(C_6H_5)_2C_6H_4$	230.29
1204	**——, 1,4-diphenyl-.**	See *Terphenyl.*		
1205	**——, 1,2-dipropoxy-***	pyrocatechol dipropyl ether	$C_6H_4(OCH_2CH_2CH_3)_2$	194.27
1206	**——, 1,3-dipropoxy-***	resorcinol dipropyl ether	$C_6H_4(OCH_2CH_2CH_3)_2$	194.27
1207	**——, ethenoxy-*.**	See *Ether, phenyl vinyl.*		
1208	**——, ethoxy-*.**	See *Phenetole.*		
1209	**——, 1-ethoxy-2-methoxy-4-propenyl-.**	See *Isoeugenol, ethyl ether.*		
1210	**——, ethyl-**	phenylethane	$C_2H_5C_6H_5$	106.16
1211	**——, 1-ethyl-4-isobutyl-**		$C_2H_5C_6H_4CH_2CH(CH_3)_2$	162.27
1212	**——, 1-ethyl-3-isopropyl-**		$C_2H_5C_6H_4CH(CH_3)_2$	148.24
1213	**——, 1-ethyl-4-isopropyl-**		$C_2H_5C_6H_4CH(CH_3)_2$	148.24
1214	**——, ethylmethyl-.**	See *Toluene, ethyl-.*		
1215	**——, 1-ethyl-2-nitro-**		$NO_2C_6H_4C_2H_5$	151.16
1216	**——, 1-ethyl-3-nitro-**		$NO_2C_6H_4C_2H_5$	151.16
1217	**——, 1-ethyl-4-nitro-**		$NO_2C_6H_4C_2H_5$	151.16
1218	**——, 1-ethyl-4-propyl-**		$C_2H_5C_6H_4(CH_2)_2CH_3$	148.24
1219	**——, ethylsulfonyl-*.**	See *Sulfone, ethyl phenyl.*		
1220	**——, ethynyl-**	phenylacetylene; acetylenylbenzene	$C_6H_5C\vdots CH$	102.13
1221	**——, fluoro-***	phenyl fluoride	C_6H_5F	96.10
1222	**——, *p*-fluorobromo-.**	See *Benzene, 1-bromo-4-fluoro-**.		
1223	**——, 1-fluoro-4-iodo-***		FC_6H_4I	222 01
1223H	**——, 1-fluoro-2-nitro-***		$FC_6H_4NO_2$	141.10
1223K	**——, 1-fluoro-3-nitro-***		$FC_6H_4NO_2$	141.10
1223M	**——, 1-fluoro-4-nitro-***		$FC_6H_4NO_2$	141.10
1224	**——, hexabromo-***	perbromobenzene	C_6Br_6	551.56

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1194							
1195	col. liq.......	1.0803^{0}_{4}	-52	216 5-217.7	v. sl. s.	s.	s. eth.
1196	col. leaf. f. w.	$1\ 053^{55}_{55}$	56	212.6; 109^{20}	i.	v. s.	v. s. eth.; s. bz.
1197							
1198							
1199							
1200	col.-yel. monocl. pl. f. al.	1.565^{17}_{4}	118 (116-7)	319^{773}	0.01 c., 0.38^{100}	3.8^{25}	27.1^{18} chl.; 5.0^{18} bz.; s. me. al.
1201	col.-yelsh. rhomb. need. or pl. f. al.	1.571^{0}_{4}; 1.5656^{30}_{4}	89.57	302.8^{770} (291)	0.0469^{15}, 0.32^{100}	2.60^{20}	$6\ 7^{15}$ eth.; 34.7^{18} bz.; s. tol., chl., ethyl acet.
1202	col.-yel. monocl. need. f. al.	1.625^{20}_{4}	173-4	299^{777}, subl.	0.18^{100}	0.4^{20}	1.82^{18} chl.; 2.3^{18} bz.; s. ac. a.
1203	need. f. al.....	....	86-7	363	i.	s.	s. eth., ac. a., bz.
1204							
1205	....	....	....	$117\text{-}20^{12}$	......	......	....
1206	liq., 1.5138^{33}...	1.035^{20}_{21}	....	251; $127\text{-}8^{12}$	......	......	....
1207							
1208							
1209							
1210	col. liq., $1.49828^{14.5}$	0.8669^{20}_{4}	-93.9 (-92.8)	136.15 (134-6)	0.014^{15}	∞	∞ eth.
1211	liq...........	....	....	209-13	i.	......	s. eth.
1212	liq...........	....	<-20	190-2	i.	......	s. eth.
1213	liq...........	0.8606^{16}_{4}	<-20	197-8	i.	......	s. eth.
1214							
1215	col. liq.......	$1.126^{24.5}_{4}$	-23	223-4	i.	v. s.	v. s. eth.
1216	col. liq.......	1.135^{20}_{4}	....	242-3	i.	v. s.	v. s. eth.
1217	col. liq.......	1.124^{25}_{4}	-32	241-2	i.	v. s.	v. s. eth.
1218	liq...........	0.867^{14}_{4}	....	$202\text{-}5^{765}$	i.	......	s. eth.
1219							
1220	col. liq., $1.5524^{12.5}$	0.9295^{20}_{4}	-40 to -48 (-56)	143	i.	∞	∞ eth.
1221	col. liq., $1.4646^{22.8}$	1.024^{20}_{4}	-41.9	84.85	0.154^{30}	∞	∞ eth.
1222							
1223	col. liq.......	....	-27.2; (-19.3)	183.2	i.	s.	s. eth.
1223 H	yel. liq., 1.54886	$1.3375^{17.2}$	-6	214.8	i.	s.	s. eth.
1223 K	yel. liq., 1.53622^{19}	1.3254^{19}	3.6	200.15	i.	s.	s. eth.
1223M	sld., 1.53156...	1.330	27	205.3	i.	s.	s. eth.
1224	monocl. need. f. bz.	....	306	....	i.	i.	i. eth.; sl. s. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1225	**Benzene, hexachloro-***	perchlorobenzene	C_6Cl_6	284.80
1226	——, **hexaethyl-**		$C_6(C_2H_5)_6$	246.42
1227	——, **hexahydro-.**	See *Cyclohexane.*		
1228	——, **hexahydroxy-**	benzenehexol	$C_6(OH)_6$	174.11
1229	——, **hexaiodo-***	periodobenzene	C_6I_6	833.58
1230	——, **hexamethyl-**		$C_6(CH_3)_6$	162.27
1231	——, **hexyloxy-.**	See *Ether, hexyl phenyl.*		
1232	——, **hydroxy-.**	See *Phenol.*		
1233	——, **iodo-***	phenyl iodide	C_6H_5I	204.02
1234	——, **1-iodo-2-nitro-***		$NO_2C_6H_4I$	249.02
1235	——, **1-iodo-3-nitro-***		$NO_2C_6H_4I$	249.02
1236	——, **1-iodo-4-nitro-***		$NO_2C_6H_4I$	249.02
1237	——, **iodoso-**		C_6H_5IO	220.02
1238	——, **iodoxy-**		$C_6H_5IO_2$	236.02
1239	——, **isoallyl-.**	See *Benzene, propenyl-.*		
1240	——, **isoamoxy-.**	See *Ether, isoamyl phenyl.*		
1241	——, **isoamyl-**	3-methyl-1-phenylbutane	$C_6H_5(CH_2)_2CH(CH_3)_2$	148.24
1242	——, **isobutoxy-.**	See *Ether, isobutyl phenyl.*		
1243	——, **isobutyl-**	2-methyl-1-phenylpropane	$C_6H_5CH_2CH(CH_3)_2$	134.21
1244	——, **isohexyl-**	4-methyl-1-phenylpentane	$C_6H_5(CH_2)_3CH(CH_3)_2$	162.27
1245	——, **isopropenyl-**	2-phenylpropene; *uns*-methylphenylethylene	$CH_3C(C_6H_5){:}CH_2$	118.17
1246	——, **isopropoxy-*.**	See *Ether, isopropyl phenyl.*		
1247	——, **isopropyl-.**	See *Cumene.*		
1248	——, **isopropylmethyl-.**	See *Cymene.*		
1249	——, **methoxy-*.**	See *Anisole.*		
1250	——, **1-methoxy-4-propenyl-.**	See *Anethole.*		
1251	——, **methyl-.**	See *Toluene.*		
1252	——, **(α-methylbutyl)-**	2-phenylpentane; *sec-n*-amylbenzene	$C_6H_5CH(CH_3)CH_2CH_2CH_3$	148.24
1253	——, **3,4-methylenedioxy-1-propenyl-.**	See *Isosafrole.*		
1254	——, **(β-methylpropoxy)-*.**	See *Ether, isobutyl phenyl.*		
1255	——, **methylpropyl-.**	See *Toluene, propyl-.*		
1256	——, **nitro-***		$C_6H_5NO_2$	123.11
1257	——, **nitroso-***		C_6H_5NO	107.11
1258	——, **pentaamino-.**	See *Benzenepentamine*.*		
1259	——, **pentabromo-***		C_6HBr_5	472.65
1260	——, **pentachloro-***		C_6HCl_5	250.35
1261	——, **pentaethyl-***		$(C_2H_5)_5C_6H$	218.37

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1225	monocl. or rhomb. pr.	1.569^{236}; 2.044^{23}	227 (224–6)	326	i.	i. c., v. sl. s. h.	v. sl. s. eth.; s. h. bz.
1226	col. monocl. f. al., $1.480^{130.4}$	0.831^{130}	129	298	i.	s.	v. s. eth., bz.
1227							
1228	need. f. HCl...	....	d. 200		sl. s.	sl. s.	sl. s. eth., bz.
1229	red-br. need. f. bz.	....	350 d.	....	i.	i.	i. eth.
1230	col. rhomb. pl. f. al., 1.8012, 1.745, 1.5032 (587 m μ)	....	166 (159–62)	265	i.	0.16^{6}	v. s. bz.
1231							
1232							
1233	col. liq., $1.62145^{18.5}$	$1.832\frac{20}{4}$	-31.4	188.6	0.034^{30}	s.	∞ eth.; s. chl.
1234	yel. rhomb. need.	$1.810\frac{16}{4}$	49.4	290	i.	sl. s.	sl. s. eth.
1235	col. cr........	$1.804\frac{16}{4}$	36	280	i.	sl. s.	sl. s. eth.
1236	col. need.....	$1.8090\frac{15.5}{4}$	171.5	288 1	i.	sl. s.	sl. s. eth.
1237	yel. powd.....	....	exp. abt. 210	....	s.	s.	i. c., s. h. eth.; s. h. chl.
1238	need. f. w.....	....	exp. 236–7	....	v. sl. s.	i.	v. s. bz., chl.; s. h. ac. a.
1239							
1240							
1241	col. liq.......	$0.885\frac{20}{4}$	....	194 (198–9)	i.	∞	∞ eth.
1242							
1243	col. liq., 1.48646^{20}	0.85321^{20}	....	172.759	i.	∞	∞ eth.
1244	liq...........	0.857	....	214–5	i.	sl. s.	s. eth.
1245	col. liq..	$0.9139\frac{20}{4}$	....	160.5–1.5	i.	s.	s. eth.
1246							
1247							
1248							
1249							
1250							
1251							
1252	liq...........	$0.874\frac{15}{4}$	....	189.3 (191–3)	i.	s.	s. eth.
1253							
1254							
1255							
1256	yel. liq., 1.55291	$1.19867\frac{25}{4}$	5.7	210.9	0.19^{20}; 0.8^{80}	v. s. c.	v. s. eth.; s. bz., oils
1257	col. rhomb. or monocl. f. eth.	....	68	59^{18}	i.	s.	s. eth., chl.; sl. s. lgr.
1258							
1259	need. f. al.....	....	293	subl.	......	sl. s.	sl. s. eth.; s. bz.
1260	need. f. al.....	$1.8342\frac{16}{4}$	86	277	i.	v. sl. s.	v. s. eth.; s. bz., CS_2
1261	col. liq., 1.516.	0.896	<-20	277	i.	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1262	**Benzene, pentaiodo-*.**		C_6HI_5	707.67
1263	**——, pentamethyl-***		$(CH_3)_5C_6H$	148 24
1264	**——, perbromo-.**	See *Benzene, hexabromo-*.*		
1265	**——, perchloro-.**	See *Benzene, hexachloro-*.*		
1266	**——, periodo-.**	See *Benzene, hexaiodo-*.*		
1267	**——, phenoxy-*.**	See *Phenyl ether.*		
1268	**——, phenyl-.**	See *Biphenyl.*		
1269	**——, phenyldithio-*.**	See *Phenyl disulfide.*		
1270	**——, phenylsulfonyl-*.**	See *Phenyl sulfone.*		
1271	**——, phenylthio-*.**	See *Phenyl sulfide.*		
1272	**——, (2-propenoxy)-*.**	See *Ether, allyl phenyl.*		
1273	**——, propenyl-**	1-phenylpropene; 1-propenylbenzene; iosallylbenzene	$CH_3CH{:}CHC_6H_5$	118.17
1275	**——, propoxy-*.**	See *Ether, phenyl propyl.*		
1276	**——, propyl-**	1-phenylpropane	$C_6H_5CH_2CH_2CH_3$	120.19
1277	**——, 1-propynyl-.**	See *Propyne, 1-phenyl-.*		
1278	**——, 1,2,3,5-tetrabromo-***		$C_6H_2Br_4$	393.74
1279	**——, 1,2,4,5-tetrabromo-***		$C_6H_2Br_4$	393.74
1280	**——, 1,2,3,4-tetrachloro-***		$C_6H_2Cl_4$	215.90
1281	**——, 1,2,3,5-tetrachloro-***		$C_6H_2Cl_4$	215.90
1282	**——, 1,2,4,5-tetrachloro-***		$C_6H_2Cl_4$	215.90
1283	**——, 1,2,3,4-tetraethyl-**		$(C_2H_5)_4C_6H_2$	190.32
1284	**——, 1,2,4,5-tetraethyl-**		$(C_2H_5)_4C_6H_2$	190.32
1285	**——, tetrahydro-.**	See *Cyclohexene.*		
1286	**——, tetrahydroxy-.**	See *Benzenetetrol.*		
1287	**——, 1,2,3,4-tetraiodo-***		$C_6H_2I_4$	581.76
1288	**——, 1,2,3,5-tetraiodo-***		$C_6H_2I_4$	581.76
1289	**——, 1,2,4,5-tetraiodo-***		$C_6H_2I_4$	581.76
1290	**——, 1,2,3,4-tetramethyl-.**	See *Prehnitene.*		
1291	**——, 1,2,3,5-tetramethyl-.**	See *Isodurene.*		
1292	**——, 1,2,4,5-tetramethyl-.**	See *Durene.*		
1293	**——, triamino-.**	See *Benzenetriamine.*		
1294	**——, triazo-**	diazobenzene imide; phenyl azoimide	$C_6H_5N_3$	119.12
1295	**——, 1,2,3-tribromo-*.**	*v*-tribromobenzene	$C_6H_3Br_3$	314.83
1296	**——, 1,2,4-tribromo-*.**	*as*-tribromobenzene	$C_6H_3Br_3$	314.83
1297	**——, 1,3,5-tribromo-*.**	*sym*-tribromobenzene	$C_6H_3Br_3$	314.83
1298	**——, 1,2,3-trichloro-***	*v*-trichlorobenzene	$C_6H_3Cl_3$	181.46
1299	**——, 1,2,4-trichloro-***	*as*-trichlorobenzene	$C_6H_3Cl_3$	181.46
1300	**——, 1,3,5-trichloro-***	*sym*-trichlorobenzene	$C_6H_3Cl_3$	181.46
1301	**——, 1,3,5-triethoxy-*.**	phloroglucinol triethyl ether	$C_6H_3(OC_2H_5)_3$	210.27

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1262	need. f. al.....	....	172	subl.	i.	v. sl. s.	v. sl. s. eth.; s. chl., h. ac. a.
1263	col. pr. f. dil. al., $1.50489^{72.8}$	liq. 0.847^{167}	53	230	i.	v. s.	....
1264							
1265							
1266							
1267							
1268							
1269							
1270							
1271							
1272							
1273	col. liq.......	$0.914\frac{20}{4}$; $0.924\frac{16}{4}$	....	175, (176–7)	i.	s.	∞ eth.
1275							
1276	col. liq., 1.49202^{20}	0.86204^{20}	-101.6	159.218	0.006^{15}	s.	s. eth.
1277							
1278	need. f. al.....	....	98.5	329	i.	v. sl. s.	v. s. eth., bz.
1279	monocl. pr. f. CS_2	$3.027\frac{20}{4}$	178	....	i.	v. sl. s.	v. s. eth.
1280	need.........	....	47.5	254	i.	sl. s.	v. s. eth., CS_2
1281	need. f. al.....	....	51	246	sl. s. c., s. h.	v. sl. s.	s. eth.; v. s. CS_2
1282	monocl. need. f. eth.	$1.734\frac{10}{4}$; $1.858\frac{21}{4}$	138	246	i.	sl. s. h.	s. eth., bz., CS_2
1283	liq., 1.5083....	0.887	....	254	i.	sl. s.	s. eth.
1284	col. liq. or cr., 1.5025	$0.888\frac{16}{4}$	13	250	i.	v. s.	v. s. eth.
1285							
1286							
1287	pr. f. CS_2.....	....	136	subl.	......	v. s.	v. s. eth.; s. chl.
1288	pr. f. eth......	....	148	subl.	i.	v. sl. s.	v. sl. s. eth.; v. s. h. ac. a.
1289	need. f. eth....	....	254	subl.	i.	v. sl. s.	v. sl. s. eth.; v. s. CS_2
1290							
1291							
1292							
1293							
1294	yel. oil, $1.56421^{22.5}$	$1.078^{22.5}$	....	59^{12}; exp.	i.	sl. s.	sl. s. eth.
1295	col. monocl. pr. f. al.	2.658	87.4	....	i.	sl. s. h.	v. s. eth.
1296	need. f. al.....	....	44	276	i.	sl. s.	s. eth., CS_2; v s. bz.
1297	need. f. al.....	....	119–21	278	i.	sl. s. h.	s. eth., bz., chl.
1298	pl. f. al.......	....	52	219	i.	sl. s.	v. s. eth.
1299	col. rhomb., 1.5671	$1.574\frac{10}{4}$	17	213	i.	sl. s.	v. s. eth.
1300	lng. need.....	....	63	208.5	i.	s.	v. s. eth.
1301	col. cr........	....	43	175^{24}	i.	v. s.	v. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1302	**Benzene, 1,2,4-triethyl-**	*as*-triethylbenzene	$(C_2H_5)_3C_6H_3$	162.27
1303	**——, 1,3,5-triethyl-**	*sym*-triethylbenzene	$(C_2H_5)_3C_6H_3$	162.27
1304	**——, 1,3,5-trihydroxamino-.**	See 1,3,5-*Cyclohexanetrione, trioxime.*		
1305	**——, 1,2,3-trihydroxy-.**	See *Pyrogallol.*		
1306	**——, 1,2,4-trihydroxy-.**	See 1,2,4-*Benzenetriol.*		
1307	**——, 1,3,5-trihydroxy-.**	See *Phloroglucinol.*		
1308	**——, 1,2,3-triiodo-***	*v*-triiodobenzene	$C_6H_3I_3$	455.84
1309	**——, 1,2,4-triiodo-***	*as*-triiodobenzene	$C_6H_3I_3$	455.84
1310	**——, 1,3,5-triiodo-***	*sym*-triiodobenzene	$C_6H_3I_3$	455.84
1311	**——, 1,2,3-trimethoxy-***	pyrogallol trimethyl ether	$C_6H_3(OCH_3)_3$	168.19
1312	**——, 1,3,5-trimethoxy-***	phloroglucinol trimethyl ether	$C_6H_3(OCH_3)_3$	168.19
1313	**——, 1,2,4-trimethoxy-5-propenyl-**	asaron	$CH_3CH:CHC_6H_2(OCH_3)_3$	208.25
1314	**——, 1,2,3-trimethyl-.**	See *Hemimellitene.*		
1315	**——, 1,2,4-trimethyl-.**	See *Pseudocumene.*		
1316	**——, 1,3,5-trimethyl-.**	See *Mesitylene.*		
1317	**——, 1,2,3-trinitro-***	*v*-trinitrobenzene	$C_6H_3(NO_2)_3$	213.11
1318	**——, 1,2,4-trinitro-***	*as*-trinitrobenzene	$C_6H_3(NO_2)_3$	213.11
1319	**——, 1,3,5-trinitro-***	*sym*-trinitrobenzene	$C_6H_3(NO_2)_3$	213.11
1320	**——, 1,3,5-triphenyl-**	*sym*-triphenylbenzene	$(C_6H_5)_3C_6H_3$	306.39
1321	**——, vinyl-.**	See *Styrene.*		
1322	**Benzenearsonic acid, *p*-amino-.**	See *Arsanilic acid.*		
1323	**Benzene azimide.**	See 1,2,3-*Benzotriazole.*		
1324	**Benzeneazoaniline.**	See *Azobenzene, amino-.*		
1325	**Benzeneazoethane**	ethaneazobenzene; ethylphenyldiimide	$C_6H_5N:NC_2H_5$	134.18
1326	**Benzeneazomethane**	methaneazobenzene; methylphenyldiimide	$C_6H_5N:NCH_3$	120.15
1327	**Benzeneazo-β-naphthol, *p*-nitro-.**	See 2-*Naphthol, 1-p-phenylazo-.*		
1328	**4-Benzeneazo-α-naphthylamine.**	See 1-*Naphthylamine, 4-phenylazo-.*		
1328H	**Benzeneboronic acid.**	See *Boric acid, phenyl-.*		
1328R	**Benzeneboronic acid, *o* and *m*-chloro.**	See *Boric acid, o* (and *m*)*-chlorophenyl-.*		
1329	**Benzenecarbonal.***	See *Benzaldehyde.*		
1330	**Benzenecarbonamide.**	See *Benzamide.*		
1331	**Benzenecarbonamidine.***	See *Benzamidine.*		
1332	**Benzenecarbonitrile.***	See *Benzonitrile.*		
1333	**Benzenecarbonyl bromide***, etc.	See *Benzoyl bromide,* etc.		
1334	**Benzenecarbothioic acid***.	See *Benzoic acid, thio-.*		
1335	**Benzenecarboxylic acid***.	See *Benzoic acid.*		
1336	**1,2-Benzenediacetonitrile**	*o*-xylylene cyanide	$C_6H_4(CH_2CN)_2$	156.18
1337	**1,3-Benzenediacetonitrile**	*m*-xylylene cyanide	$C_6H_4(CH_2CN)_2$	156.18
1338	**1,4-Benzenediacetonitrile**	*p*-xylylene cyanide	$C_6H_4(CH_2CN)_2$	156.18
1339	**Benzenediamine.**	See *Phenylenediamine.*		
1340	**Benzenediazoanilide.**	See *Diazoaminobenzene**		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1302	arom. liq., 1.4972	0.8819^{17}_{4}	....	218	i.	s.	s. eth.
1303	col. liq., 1.4939	0.863^{20}_{4}	....	218	i.	v. s.	v. s. eth.
1304							
1305							
1306							
1307							
1308	need. f. al.....	....	116	subl.	i.	v. s.	v. s. eth.
1309	need. f. al.....	....	91 (84)	subl.	i.	s.	s. eth., chl.
1310	need. f. ac. a..	....	184 (180)	subl.	i.	v. sl. s.	v. sl. s. eth.; s. ac. a.
1311	col. rhomb. need. f. dil. al.	1.0987^{75}_{75}	47	241 (235)	......	v. s.	v. s. eth., bz.
1312	col. pr. f. al...	....	54–5 (52)	255.5	i.	v. s.	v. s. eth., bz.
1313	monocl. need. f. w., 1.5719^{11}	1.165	67	296, subl. d.	sl. s. h.	v. s.	v. s. eth.; s. ac. a., chl., CCl_4
1314							
1315							
1316							
1317	lt. grn. pr. f. al.	....	127.5	....	i.	10 h.	....
1318	col.-yel. cr....	1.73^{16}_{4}	61.0	....	sl. s.	5.45^{15}	7.13^{15} eth.
1319	col.-yel. rhomb. pl. f. bz.	1.688^{20}_{4}	61, 121	d.	0.04^{16}	1.9^{16}	$1.07^{17.5}$ eth.; v. s. bz.
1320	rhomb. tab. f. eth.; 1.524, 1.867, 1.873	1.206^{20}_{4}	170	....	......	sl. s.	sl. s. eth.; s. bz.
1321							
1322							
1323							
1324							
1325	lt. yel. oil, $N^{21.9}_{\alpha}$ 1.53133	$0.9628^{21.9}$	....	175–85 d.	sl. s.	v. s.	v. s. eth.
1326	yel. oil.......	....	....	150	......	s.	s. eth.
1327							
1328							
1328 H							
1328 R							
1329							
1330							
1331							
1332							
1333							
1334							
1335							
1336	col. cr. f. eth..	....	59–60	....	......	s.	s. eth.
1337	cr...........	....	28–9	$305–10^{300}$ sl. d.	i.	s.	s. eth., chl.
1338	lng. pr. f. eth. or need. f. w.	....	98	....	sl. s. h.	s.	s. eth., chl.
1339							
1340							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1341	**Benzenediazonium chloride***	diazobenzene chloride	$C_6H_5N(\vdots N)Cl$	140.57
1342	**Benzenediazonium cyanide***	diazobenzene cyanide	$C_6H_5N(\vdots N)CN$	131.13
1343	**Benzenediazonium nitrate***	diazobenzene nitrate	$C_6H_5N(\vdots N)NO_3$	167.12
1344	**Benzenediazonium tribromide***	diazobenzene perbromide	$C_6H_5N(\vdots N)Br_3$	344.86
1345	**Benzenedicarbinol.**	See *Xylylene glycol.*		
1346	**1,2-Benzenedicarbonal*.**	See *Phthalaldehyde.*		
1347	**1,3-Benzenedicarbonal*.**	See *Isophthalaldehyde.*		
1348	**1,4-Benzenedicarbonal*.**	See *Terephthalaldehyde.*		
1349	**1,3-Benzenedicarbonitrile*.**	See *Isophthalonitrile.*		
1350	**1,4-Benzenedicarbonitrile*.**	See *Terephthalonitrile.*		
1351	**1,2-Benzenedicarbonyl chloride*.**	See *Phthalyl chloride.*		
1352	**1,3-Benzenedicarbonyl chloride*.**	See *Isophthalyl chloride.*		
1353	**1,4-Benzenedicarbonyl chloride*.**	See *Terephthalyl chloride.*		
1354	**1,2-Benzenedicarboxylic acid*.**	See *Phthalic acid.*		
1355	**1,3-Benzenedicarboxylic acid*.**	See *Isophthalic acid.*		
1356	**1,4-Benzenedicarboxylic acid*.**	See *Terephthalic acid.*		
1357	**1,2-Benzenediol*.**	See *Pyrocatechol.*		
1358	**1,3-Benzenediol*.**	See *Resorcinol.*		
1359	**1,4-Benzenediol*.**	See *Hydroquinone.*		
1360	**1,3-Benzenedithiol*.**	See *Resorcinol, dithio-.*		
1361	**1,4-Benzenedithiol*.**	See *Hydroquinone, dithio-*		
1362	**Benzenehexacarboxylic acid*.**	See *Mellitic acid.*		
1363	**Benzenehexol*.**	See *Benzene, hexahydroxy-.*		
1364	**Benzeneindone.**	See *Aposafranone.*		
1365	**Benzenepentacarboxylic acid***		$C_6H(COOH)_5$	298.16
1366	**Benzenepentamine***	pentaaminobenzene	$C_6H(NH_2)_5$	153.19
1367	**Benzenepropionic acid.**	See *Hydrocinnamic acid.*		
1368	**Benzenesiliconic acid**	silicobenzoic acid	C_6H_5SiOOH	138.17
1369	**Benzenesulfanilide.**	See *Benzenesulfonanilide.*		
1370	**Benzene sulfide.**	See *Phenyl sulfide.*		
1371	**Benzenesulfinic acid***		$C_6H_5SO_2H$	142.17
1372	**Benzenesulfonamide**	benzenesulfonic amide	$C_6H_5SO_2NH_2$	157.18
1372M	**Benzenesulfonamide,**	***p*-amino-.** See *Sulfanilamide.*		
1372T	**Benzenesulfonamide,**	***p*-amino-*N*-2-pyridyl-.** See *Sulfapyridine.*		
1373	**Benzenesulfonanilide**	benzenesulfanilide	$C_6H_5SO_2NHC_6H_5$	233.28
1374	**Benzene sulfone.**	See *Phenyl sulfone.*		
1375	**Benzenesulfone chloride.**	See *Benzenesulfonyl chloride**.		
1376	**Benzenesulfonic acid*.**		$C_6H_5SO_3H$	158.17
1377	——, sodium salt		$C_6H_5SO_3Na$	180.16
1378	——, ***o*-amino-.**	See *Orthanilic acid.*		
1379	——, ***m*-amino-.**	See *Metanilic acid.*		
1380	——, ***p*-amino-.**	See *Sulfanilic acid.*		
1381	——, ***p*-(4-amino-1-naphthylazo)-**		$SO_3HC_6H_4N:NC_{10}H_6NH_2$	327.35
1382	——, ***o*-bromo-**		$BrC_6H_4SO_3H$	237.08
1383	——, ***p*-bromo-**		$BrC_6H_4SO_3H$	237.08
1384	——, ***p*-chloro-**		$ClC_6H_4SO_3H$	192.62
1385	——, ***p*-(*p*-dimethylaminophenylazo)-, sodium salt.**	See *Methyl orange.*		
1386	——, ***o*-formyl-**	*o*-benzaldehydesulfonic acid	$C_6H_4(CHO)SO_3H$	186.18
1387	——, **methyl-.**	See *Toluenesulfonic acid.*		
1388	——, ***o*-nitro-**		$NO_2C_6H_4SO_3H$	203.17

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1341	col. need......	....	d.	exp.	v. s.	s.	i. eth., bz., lgr.; s. acet.
1342	yel. pr........	....	69	....	sl. s.	......	....
1343	col. need......	1.37^{20}_{4}	exp. at 90	....	v. s.	s.	i. eth., chl., bz.
1344	or. yel. tab. f. al.	....	63.5 d.	....	i.	sl. s.	i. eth.
1345							
1346							
1347							
1348							
1349							
1350							
1351							
1352							
1353							
1354							
1355							
1356							
1357							
1358							
1359							
1360							
1361							
1362							
1363							
1364							
1365	rhomb........	....	238; $+5H_2O$ d. 238	....	s.	s.	sl. s. eth.; i. bz.
1366	need.........	....	....	....	v. s.	i.	i. eth.
1367							
1368	glassy f. eth...	....	92	....	i.	......	v. s. eth.; s. KOH
1369							
1370							
1371	pr. f. w.......	....	84	100 d.	sl. s.	v. s.	v. s. eth.
1372	monocl. need. f. w. or pl. f. al.	....	156	....	0.43^{16}	v. s. h.	v. s. eth.
1372M							
1372 T							
1373	tetr. pr., 1.600, 1.649	....	110	....	4.3^{16}	v. s.	v. s. eth.
1374							
1375							
1376	col. leaf. or need.	....	$+1.5H_2O$ 43–4; anh. 50–1	d.	v. s.	v. s.	i. eth.; sl. s. bz.
1377	need. f. w.....	....	450 d.	....	47	sl. s. h.	....
1378							
1379							
1380							
1381	vlt. need......	....	....	....	i.	v. sl. s.	....
1382	deliq. need....	....	....	....	v. s.	s.	....
1383	deliq. need ...	....	102-3	155^{25}	s.	s.	....
1384	deliq. need....	....	68	$147–8^{25}$	s.	s.	i. eth., bz.
1385							
1386	....	....	114	....	s.	......	....
1387							
1388	leaf..........	....	70	d.	v. s.	s.	i. eth.; s. alk.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1389	**Benzenesulfonic amide.** See *Benzenesulfonamide**.			
1390	**Benzenesulfonyl chloride***	benzenesulfonic chloride; benzenesulfone chloride	$C_6H_5SO_2Cl$	176.62
1391	——, *p*-**bromo-**		$BrC_6H_4SO_2Cl$	255.53
1392	**1,2,3,4-Benzenetetracarboxylic acid*.** See *Mellophanic acid.*			
1393	**1,2,3,5-Benzenetetracarboxylic acid*.** See *Prehnitic acid*			
1394	**1,2,4,5-Benzenetetracarboxylic acid*.** See *Pyromellitic acid.*			
1395	**1,2,3,5-Benzenetetrol***	1,2,3,5-tetrahydroxybenzene	$C_6H_2(OH)_4$	142.11
1396	**1,2,4,5-Benzenetetrol***		$C_6H_2(OH)_4$	142.11
1397	**Benzenethiol*.**	See *Phenol, thio-.*		
1398	**1,2,3-Benzenetriamine***	*vic*-triaminobenzene	$C_6H_3(NH_2)_3$	123.16
1399	**1,2,4-Benzenetriamine***	*asym*-triaminobenzene	$C_6H_3(NH_2)_3$	123.16
1400	**1,2,3-Benzenetricarboxylic acid*.** See *Hemimellitic acid.*			
1401	**1,2,4-Benzenetricarboxylic acid*.** See *Trimellitic acid.*			
1402	**1,3,5-Benzenetricarboxylic acid*.** See *Trimesic acid*.			
1403	**1,2,3-Benzenetriol*.**	See *Pyrogallol.*		
1404	**1,2,4-Benzenetriol***	hydroxyquinol; hydroxyhydroquinone	$C_6H_3(OH)_3$	126.11
1405	**1,3,5-Benzenetriol*.**	See *Phloroglucinol.*		
1406	**1,3,5-Benzenetrisulfonic acid***		$C_6H_3(SO_3H)_3$	318.29
1407	**Benzenyl amidine.**	See *Benzamidine.*		
1408	**Benzenyl aminoxime.**	See *Benzamide oxime.*		
1409	**Benzenylphenyleneamidine.** See *Benzimidazole, 2-phenyl-.*			
1410	**Benzhydrol.**	See *Benzohydrol.*		
1411	**Benzidine**	*p,p′*-bianiline; 4,4′-diaminobiphenyl	$NH_2C_6H_4C_6H_4NH_2$	184.23
1412	——, **2-amino-**	*o*-amino-*p,p′*-diaminobiphenyl	$(NH_2)_2C_6H_3C_6H_4NH_2$	199.25
1413	——, ***N,N′*-diacetyl-**	*p,p′*-biacetanilide	$(CH_3CONHC_6H_4)_2$	268.31
1415	——, **3,3′-dimethyl-.**	See *o-Tolidine.*		
1416	——, ***N,N′*-diphenyl-**		$[C_6H_4NHC_6H_5]_2$	336.42
1417	——, **3-ethoxy-**	4,4′-diamino-3-ethoxybiphenyl	$NH_2C_6H_4C_6H_3(OC_2H_5)NH_2$	228.29
1418	**2,2′-Benzidinedisulfonic acid** ($NH_2=1$)	4,4′-diamino-2,2′-biphenyldisulfonic acid	$(NH_2)_2C_{12}H_6(SO_3H)_2$	344.35
1419	**Benzidine sulfone**	dibenzothiophene-2,7-diamine 9-dioxide; 2,7-diaminobiphenylene sulfone	$(NH_2C_6H_3)_2SO_2$	246.28
1420	**Benzil**	diphenylglyoxal; bibenzoyl; dibenzoyl; diphenyl diketone	$C_6H_5COCOC_6H_5$	210.22
1421	——, *α*-dioxime		$(C_6H_5C{:}NOH)_2$	240.25
1422	——, *β*-dioxime		$(C_6H_5C{:}NOH)_2$	240.25
1423	——, *γ*-dioxime		$(C_6H_5C{:}NOH)_2$	240.25

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
1389							
1390	rhomb. cr. or col. oily liq.	1.378^{23}	14.5; frz. 0	246–7d.	i.	v. s.	s. eth.
1391	tricl. or monocl. f. eth.	....	75	153^{15}	i.	d.	v. s. eth.
1392							
1393							
1394							
1395	need. f. w.	....	165	....	v. s.	v. s.	i. chl., bz.
1396	leaf. f. ac. a. ...	....	220	....	v. s.	v. s.	v. s. eth.; sl. s. HCl
1397							
1398	cr.	....	103	336	v. s.	v. s.	v. s. eth.
1399	leaf. f. chl.	....	100	340	v. s.	v. s.	v. sl. s. eth.; s. chl.
1400							
1401							
1402							
1403							
1404	col. monocl. leaf. f. w. or eth.	....	140.5	....	v. s.	v. s.	v. s. eth.; sl. s. bz.
1405							
1406	deliq. cr. $+3H_2O$	....	d. >100	....	s.	......	....
1407							
1408							
1409							
1410							
1411	wh. or sltly. redsh. cr. powd. or leaf. f. H_2O	1.250^{20}_{4}	116.5–117, 120.5–121, 125, 129	401.7	0.04^{12}, 0.94^{100}	s.	2.2 eth.
1412	need.	....	134	....	......	......	....
1413	need. f. ac. a. ..	....	331 (314–6)	subl. d.	i.	v. sl. s.	v. sl. s. eth.
1415							
1416	leaf. f. tol.	....	242	....	i.	sl. s.	s. h. tol.; sl. s. bz., acet.
1417	glit. flat need. f. w.	....	134 (139)	....	v. sl. s.	v. s. h.	v. sl. s. eth.
1418	monocl. pr. f. w.	....	d. >175	....	0.0791^{22}	v. sl. s.	v. sl. s. eth.
1419	yel. pl.	....	327–8 (>350)	....	i.	i.	i. eth., h. bz.
1420	yel. rhomb. need. f. al.	$1.521^{13.3}_{4}$	95	346–8 d.	i.	v. s.	v. s. eth.
1421	leaf	....	237 d.	....	i.	0.05^{17}	v. sl. s. eth., ac. a.; s. conc. NaOH
1422	need. $(+C_2H_6O)$ f. al.	....	206–7 d.	....	sl. s. h.	15.26^{17}	s. eth., ac. a., NH_3, conc. NaOH
1423	need. (+al.) f. al.	....	-al. 100; 164–5	....	i.	$>15.3^{17}$	s. conc. alk.; i. lgr.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1424	**Benzil, α-mono-oxime**.....	....	$C_6H_5COC(:NOH)-C_6H_5$	225.24
1425	——, β-mono-oxime	....	$C_6H_5COC(:NOH)-C_6H_5$	225.24
1426	——, *syn* (or α)-osazone.....	benzil *syn*-bisphenylhydrazone	$(C_6H_5C:NNHC_6H_5)_2$	390.47
1427	——, *anti* (or β)-osazone.....	benzil bisphenylhydrazone...	$(C_6H_5C:NNHC_6H_5)_2$	390.47
1428	**Benzilam.**	See *Oxazole, triphenyl-.*		
1429	**Benzilic acid**..........	diphenylglycolic acid........	$(C_6H_5)_2COHCOOH$	228.24
1430	**Benzimidazole**........	benzoglyoxaline.............	$\underbrace{C_6H_4NHCH:N}$....	118.13
1431	——, **2-phenyl-**........	2-phenylbenzoglyoxaline; benzenylphenyleneamidine	$\underbrace{C_6H_4NHC(C_6H_5):N}$	194.23
1432	**2(3)-Benzimidazolone.**	phenyleneurea.............	$\underbrace{C_6H_4NHCONH}$...	134.13
1433	**Benzocaine**...........	ethyl *p*-aminobenzoate; anaesthesin	$NH_2C_6H_4COOC_2-H_5$	165.19
1434	**1,3-Benzodiazine.**	See *Quinazoline.*		
1435	**1,4-Benzodiazine.**	See *Quinoxaline.*		
1436	**Benzodifluorochloride.**	See *Toluene, α-chloro-α, α-difl*	*uoro-.*	
1436M	**Benzofluoride dichlori**	**de.** See *Toluene, α, α-dichloro-*	*α-fluoro-.*	
1437	**Benzofuran**...........	coumarone; benzfuran.	$\underbrace{C_6H_4OCH:CH}$....	118.13
1438	**2-Benzofurancarboxyli**	**c acid.** See *Coumarilic acid.*		
1439	**Benzoglyoxaline.**	See *Benzimidazole.*		
1440	**Benzohydrazide.**	See *Benzoic acid, hydrazide.*		
1441	**Benzohydrol**..........	diphenylcarbinol; benzhydrol	$(C_6H_5)_2CHOH$....	184.23
1442	——, ***p*-amino-**........	*p*-aminodiphenylcarbinol.....	$C_6H_5CHOHC_6H_4-NH_2$	199.24
1443	——, ***p,p′*-bisdimethylamino-**	Michler's hydrol; tetramethyl-4,4′-diaminobenzohydrol	$HOCH[C_6H_4N-(CH_3)_2]_2$	270.36
1444	***p*-Benzohydrolcarboxy**	**lic acid.** See *Benzoic acid, p-*	*(α-hydroxybenzyl)-.*	
1445	**Benzohydrol ether.**	See *Benzohydryl ether.*		
1446	**Benzohydroxamic acid**	....	$C_6H_5C(:NOH)OH$	137.13
1447	**Benzohydrylamine**....	α-aminodiphenylmethane....	$(C_6H_5)_2CHNH_2$...	183.24
1448	**Benzohydryl ether**....	benzohydrol ether	$[(C_6H_5)_2CH]_2O$ ..	350.44
1449	**Benzoic acid**..........	benzenecarboxylic acid*; phenylformic acid	C_6H_5COOH.......	122.12
1450	——, allyl ester.............	allyl benzoate..............	$C_6H_5COOC_3H_5$...	162.18
1451	——, anhydride.	See *Benzoic anhydride.*		
1452	——, benzyl ester..........	benzyl benzoate; benzyl benzenecarboxylate	$C_6H_5COOCH_2C_6H_5$	212.24
1453	——, butyl ester...........	butyl benzoate; butyl benzenecarboxylate*	$C_6H_5COOC_4H_9$....	178 22
1454	——, ethyl ester...........	ethyl benzoate; ethyl benzenecarboxylate*	$C_6H_5COOC_2H_5$....	150 17
1455	——, ethylene ester.	See *Glycol, dibenzoate.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
1424	lust. pl. f. al...	....	137–8	d. 200	sl. s.	v. s.	v. s. eth.; s. chl., ac. a.; sl. s. c. bz., lgr.
1425	need. f. bz....	....	113–4	....	sl. s.	v. s.	v. s. eth.; s most org. solv.; i. lgr.
1426	yel. need......	....	208	....	......	sl. s. c.	s. eth.; 1.7^{19} acet.
1427	need........	....	225	d.	i.	sl. s.	sl. s. eth.; 2.4^{19} acet.; v. s. h. chl., bz.
1428							
1429	monocl. need. f. w.	....	150	d. 180	v. s. h.	v. s.	v. s. eth.; s. H_2SO_4
1430	rhomb. pl. f. al.	....	170	>360	s.	s.	s. eth., a., alk.
1431	tab. f. ac. a.; need. f. w.	....	280 (291)	....	sl. s.	v. s.	sl. s. bz., chl.
1432	plates........	....	305	....	sl. s.	s.	sl. s. bz.; i. dil. a.
1433	col. pr.f.al.or rhomb. f. eth.	....	91–2 (88–90)	....	0.04	20	14.3 eth.; s. chl.
1434							
1435							
1436							
1436M							
1437	liq., $1.56450^{22.7}$	$1.0776\frac{15}{15}$	<-18	174 (169)	i.	s.	s. eth.; i. alk.
1438							
1439							
1440							
1441	silky need. f. lgr.	....	68–69	298.5	0.05 c.	v. s.	v. s. eth.; s. ac. a., chl., CCl_4
1442	need. f. bz. or h. w.	....	121	....	s.	v. s.	sl. s. eth., pet. eth., lgr.; s. me. al., acet., glac. ac. a.
1443	col. tricl. pr. f. bz.	....	96	....	i.	s.	s. eth., bz.
1444							
1445							
1446	rhomb. lvs.....	....	131–132	exp.	2.25^{6}	s.	sl. s. eth.; i. bz.
1447	hex. pl. or liq., 1.5963^{22}	$1.0635\frac{22}{0}$	34	288 (301^{746})	sl. s.	......	....
1448	monocl. f. bz..	....	109–11	315^{745} d.	......	sl. s.	sl. s. eth.; s. bz.
1449	col. monocl. leaf. or need., 1.53974^{15}	$1.2659\frac{15}{4}$	122	249	0.18^{4}, 0.27^{18}, 2.2^{75}	47.1^{15}	40^{15} eth.; s. chl., CCl_4, acet., me. al., bz., CS_2
1450	yel. liq........	$1.058\frac{15}{15}$	....	230	i.	s.	∞ eth.
1451							
1452	col. oily liq., or need. or leaf., 1.5681^{21}	1.114^{18}	21 (18.5)	323–4 (316–7)	i.	s.	s. eth., chl.; i. glyc.
1453	thick col. oil..	$1.000\frac{20}{4}$	-22.4	250.3	i.	∞	∞ eth.
1454	col. liq., $1.50682^{17.3}$	$1.0509\frac{15}{4}$, $1.047\frac{20}{4}$	-34.6	212.6	0.08^{20}	s.	∞ eth.; s. chl., pet. eth.
1455							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1456	**Benzoic acid**, hydrazide	benz(o)hydrazide; benzoylhydrazine	$C_6H_5CONHNH_2$	136.15
1457	——, isoamyl ester	3-methyl-1-butanol benzoate	$C_6H_5COOC_5H_{11}$	192.25
1458	——, isobutyl ester	isobutyl benzoate; β-methylpropyl benzenecarboxylate*	$C_6H_5COOCH_2CH(CH_3)_2$	178.22
1459	——, isopropyl ester		$C_6H_5COOCH(CH_3)_2$	164.20
1460	——, methylene diester	methylene dibenzoate; methylene benzoate; methanediol dibenzoate	$(C_6H_5COO)_2CH_2$	256.25
1461	——, methyl ester	methyl benzoate; niobe oil	$C_6H_5COOCH_3$	136.14
1462	——, phenyl ester	phenyl benzoate	$C_6H_5COOC_6H_5$	198.21
1463	——, phenylhydrazide	1-benzoyl-2-phenylhydrazine	$C_6H_5CONHNHC_6H_5$	212.24
1464	——, propyl ester	*n*-propyl benzoate	$C_6H_5COOC_3H_7$	164.20
1465	——, **o-acetamido-**.	See *Anthranilic acid, N-acetyl-*.		
1466	——, ***m*-acetamido-**		$CH_3CONHC_6H_4COOH$	179.17
1467	——, ***p*-acetamido-**		$CH_3CONHC_6H_4COOH$	179.17
1468	——, **o-acetoxy-**.	See *Aspirin.*		
1469	——, **o-acetyl-**	*o*-acetophenonecarboxylic acid	$CH_3COC_6H_4COOH$	164.15
1470	——, ***p*-acetyl-**		$CH_3COC_6H_4COOH$	164.15
1471	——, **o-amino-**.	See *Anthranilic acid.*		
1472	——, ***m*-amino-**		$NH_2C_6H_4COOH$	137.13
1473	——, ***p*-amino-**		$NH_2C_6H_4COOH$	137.13
1474	——, ——, butyl ester.	See *Butesin.*		
1475	——, ——, β-diethylaminoethyl ester, hydrochloride. See *Procaine hydrochloride*.			
1476	——, ——, ethyl ester.	See *Benzocaine.*		
1477	——, ——, methyl ester		$NH_2C_6H_4COOCH_3$	151.16
1478	——, **3-amino-2-nitro-**		$NH_2(NO_2)C_6H_3COOH$	182.13
1479	——, **3-amino-4-nitro-**		$NH_2(NO_2)C_6H_3COOH$	182.13
1480	——, **3-amino-5-nitro-**		$NH_2(NO_2)C_6H_3COOH$	182.13
1481	——, **4-amino-2-nitro-**		$NH_2(NO_2)C_6H_3COOH$	182.13
1482	——, **4-amino-3-nitro-**		$NH_2(NO_2)C_6H_3COOH$	182.13
1483	——, **5-amino-2-nitro-**	3-amino-6-nitrobenzoic acid	$NH_2(NO_2)C_6H_3COOH$	182.13
1484	——, **o-anilino-**.	See *Anthranilic acid, N-phenyl*-.		
1485	——, **azodi-**.	See *Azobenzoic acid.*		
1486	——, **azoxydi-**.	See *Azoxybenzoic acid.*		
1487	——, **o-benzamido-**.	See *Anthranilic acid, N-benzoyl*-.		
1488	——, ***m*-benzamido-**	*m*-benzoylaminobenzoic acid	$C_6H_5CONHC_6H_4COOH$	241.24
1489	——, ***p*-benzamido-**	*p*-benzoylaminobenzoic acid	$C_6H_5CONHC_6H_4COOH$	241.24
1490	——, **o-benzohydryl-**	triphenylmethane-*o*-carboxylic acid	$(C_6H_5)_2CHC_6H_4COOH$	288.33

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1456	pl. f. w........	....	112.5	267 d.	s.	s.	sl. s. eth., chl., bz.
1457	col. liq........	0.9925^{19}	....	262	i.	s.	∞ eth.
1458	col. liq........	$1.002\frac{15}{4}$	....	237	i.	∞	∞ eth.
1459	col. liq........	$1.0162\frac{15}{4}$	....	218.5	i.	s.	s. eth.
1460	need..........	....	97.8	....	sl. s.	s.	s. eth.
1461	col. liq., 1.51810^{16}	$1.0937\frac{15}{4}$; $1.088\frac{20}{4}$	-12.5	199.6	0.0157^{30}	∞	∞ eth.
1462	col. monocl....	$1.235\frac{31}{4}$	70	314	v. sl. s.	s.	s. eth.
1463	col. pl. f. al...	....	168	....	sl. s. h.	s. h.	sl. s. eth.
1464	col. liq........	$1.0274\frac{15}{4}$	-51.6	231.2	v. sl. s.	∞	∞ eth.
1465							
1466	need. f. al.....	....	249-50	subl.	v. sl. s.	sl. s. h.	sl. s. eth.
1467	need..........	....	250-2	....	sl. s.	s.	sl. s. eth.
1468							
1469	cr. f. w........	....	114-15	....	s. h.	......	....
1470	need. f. h. w...	....	200	subl.	sl. s.	sl. s.	sl. s. eth.; i. lgr.
1471							
1472	yel. need......	$1.511\frac{20}{4}$	174 (179.5)	subl.	0.59^{15}	2.2^{16}	$1.81^{5.6}$ eth.
1473	yelsh.-red monocl.	....	187	....	$0.34^{9.6}$	$11.3^{9.6}$	$8.21^{5.8}$ eth.
1474							
1475							
1476							
1477	col. leaf.......	....	112	....	......	......	....
1478	yel. need. f. w.	....	156-7	195 d.	v. s. h.	v. s.	v. s. eth.
1479	red leaf. f. al	....	298 d.	....	sl. s.	s.	s. eth.
1480	yel. pr. f. w...	....	208	....	sl. s.	v. s. h.	s. ac. a.
1481	red need. f. w.	....	239.5 d.	....	s. h.	v. s.	....
1482	red-yel. need. f. al.	....	284	....	i.	sl. s. h.	....
1483	yel. need. or pr.	....	235 d.	....	sl. s. h.	s. h.	sl. s. eth.
1484							
1485							
1486							
1487							
1488	red. pr. f. al...	$1.5105\frac{4}{4}$	248 (174)	subl.	sl. s.	s.	s. eth.
1489	sm. need. f. al.	....	278	....	sl. s.	s.	s. eth., ac. a.
1490	need. f. al.....	....	161-2	subl.	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1491	**Benzoic acid, *o*-benzoyl-**	benzophenone-*o*-carboxylic acid	$C_6H_5COC_6H_4$-$COOH$	226.22
1492	**——, *m*-benzoyl-**	benzophenone-*m*-carboxylic acid	$C_6H_5COC_6H_4$-$COOH$	226.22
1493	**——, *p*-benzoyl-**	benzophenone-*p*-carboxylic acid	$C_6H_5COC_6H_4$-$COOH$	226.22
1494	**——, benzoylamino-.**	See *Benzoic acid, benzamido-.*		
1495	**——, *o*-benzyl-**	diphenylmethane-*o*-carboxylic acid	$C_6H_5CH_2C_6H_4$-$COOH$	212.24
1496	**——, *m*-benzyl-**		$C_6H_5CH_2C_6H_4$-$COOH$	212.24
1497	**——, *p*-benzyl-**		$C_6H_5CH_2C_6H_4$-$COOH$	212.24
1498	**——, *o*-bromo-**		BrC_6H_4COOH	201.03
1499	**——, *m*-bromo-**		BrC_6H_4COOH	201.03
1500	**——, *p*-bromo-**		BrC_6H_4COOH	201.03
1501	**——, *p,p'*-carbonyldi-**	*p,p'*-benzophenonedicarboxylic acid	$CO(C_6H_4COOH)_2$	270.23
1502	**——, *o*-(carboxymethoxy)-**	salicylic-*O*-acetic acid; salicylacetic acid	$HOOCCH_2OC_6H_4$-$COOH$	196.15
1503	**——, *o*-chloro-**		ClC_6H_4COOH	156.57
1504	**——, *m*-chloro-**		ClC_6H_4COOH	156.57
1505	**——, *p*-chloro-**		ClC_6H_4COOH	156.57
1506	**——, *p*-cyano-**	terephthalic mononitrile	CNC_6H_4COOH	147.13
1507	**——, 2,3-diamino-**		$C_6H_3(NH_2)_2COOH$	152.15
1508	**——, 2,4-diamino-**		$C_6H_3(NH_2)_2COOH$	152.15
1509	**——, 2,5-diamino-**		$C_6H_3(NH_2)_2COOH$	152.15
1510	**——, 3,4-diamino-**		$C_6H_3(NH_2)_2COOH$	152.15
1511	**——, 3,5-diamino-**		$C_6H_3(NH_2)_2COOH$	152.15
1512	**——, 2,3-dibromo-**		$C_6H_3Br_2COOH$	279.93
1513	**——, 2,4-dibromo-**		$C_6H_3Br_2COOH$	279.93
1514	**——, 2,5-dibromo-**		$C_6H_3Br_2COOH$	279.93
1515	**——, 2,6-dibromo-**		$C_6H_3Br_2COOH$	279.93
1516	**——, 3,4-dibromo-**		$C_6H_3Br_2COOH$	279.93
1517	**——, 2,3-dichloro-**		$Cl_2C_6H_3COOH$	191.02
1518	**——, 2,4-dichloro-**		$Cl_2C_6H_3COOH$	191.02
1519	**——, 2,5-dichloro-**		$Cl_2C_6H_3COOH$	191.02
1520	**——, 2,6-dichloro-**		$Cl_2C_6H_3COOH$	191.02
1521	**——, 3,4-dichloro-**		$Cl_2C_6H_3COOH$	191.02
1522	**——, 3,5-dichloro-**		$Cl_2C_6H_3COOH$	191.02
1523	**——, 2,3-dihydroxy-**	*o*-pyrocatechuic acid; pyrocatechol-*o*-acid	$(HO)_2C_6H_3COOH$	154.12
1524	**——, 2,4-dihydroxy-**	See *β-Resorcylic acid.*		
1525	**——, 2,5-dihydroxy-.**	See *Gentisic acid.*		
1526	**——, 2,6-dihydroxy-.**	See *γ-Resorcylic acid.*		
1527	**——, 3,4-dihydroxy-.**	See *Protocatechuic acid.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
1491	tricl. need. ($+1H_2O$) f. h. w.	....	$+H_2O$, 93; anh. 127	....	s. h.	v. s.	v. s. eth.
1492	need. f. dil. al.	....	161–2	subl.	sl. s.	s.	s. eth.
1493	monocl. leaf. f. w.	....	194	subl.	sl. s.	s.	s. eth., ac. a.; sl. s. chl., bz.
1494							
1495	need. f. dil. al.	....	114	subl.	sl. s.	s.	s. eth., chl., bz.
1496	need. or leaf. f. dil. al.	....	107–8	subl.	v. sl. s.	s.	s. eth., chl.
1497	need. f. w. or leaf. f. dil. al.	....	157–8	subl.	sl. s.	s.	s. eth., chl., bz.
1498	col. monocl. need. f. w.	$1.929\frac{25}{4}$	147–50	subl.	0.18^{25}	s.	s. eth., chl.
1499	col. monocl. need.	$1.845\frac{25}{4}$	155	280	0.04^{25}	s.	s. eth.
1500	col. monocl. need. or leaf. f. w.	$1.894\frac{25}{4}$	251–3	....	0.0056^{25}	s.	s. eth.
1501	gel.........	....	subl. <360	....	i.	sl. s.	sl. s. eth., bz., acet.; s. ac. a.
1502	need. f. w.....	....	190	....	s.	s.	s. eth., ac. a., acet.
1503	col. monocl...	$1.544\frac{20}{4}$	142	subl.	0.21^{25}	v. s.	v. s. eth.
1504	col. pr.......	$1.496\frac{25}{4}$	158 (154–5)	subl.	0.04^{0}	s.	s. eth.
1505	col. tricl......	$1.541\frac{24}{4}$	243 (235)	subl.	0.0077^{25}	v. s.	v. s. eth.
1506	leaf. f. w......	....	213–4 (219)	....	v. sl. s. c., s. h.	v. s.	v. s. eth.; s. h. ac. a.
1507	lng. need.....	....	190–1	d.	sl. s.	v. v. s.	v. s. ac. a.
1508	cr...........	....	*ca.* 140	....	s. h.	s.	v. s. ac. a.
1509	sm. pr........	....	....	d.	v. sl. s.	v. sl. s.	v. sl. s. eth.
1510	leaf..........	....	210–1 d.	....	sl. s. c., s. h.	......	....
1511	need. ($+1H_2O$) f. w.	....	($-H_2O$, 110) anh. 228–36	d.	1.1^{8}	v. s.	v. s. eth.
1512	need. f. w.....	....	149–50	....	sl. s. h.	......	s. h. lgr.
1513	leaf. f. w......	....	172–3	subl.	sl. s. h.	s.	s. eth.
1514	need. f. w. or al.	....	153	....	0.084^{11}	s.	s. eth., ac. a.
1515	need. f. w.....	....	146.5 (151–2)	$209\text{–}10^{16}$	s. h.	s.	s. eth., chl.
1516	need. f. w.....	....	232–3	subl.	sl. s. h.	s.	s. eth.
1517	need.........	....	164 (160)	....	sl. s. h.	s.	s. eth.
1518	need. f. w. or bz.	....	164 (160, 158)	subl.	s. h.	s.	s. eth., chl., bz.
1519	col. need. f. w.	....	154.4	301	0.084^{11}	s.	s. eth., alk.
1520	col. need. f. al.	....	139 (132)	subl.	i.	s.	s. eth., bz., alk.
1521	col. need. f. w., al. or bz.	....	208–9 (201–2)	subl.	sl. s.	s.	s. eth., alk.
1522	need. f. al.....	....	182–3	subl.	sl. s. c.	v. s.	s. eth.; sl. s. lgr.
1523	col. need. f. w.	....	anh. 204	d.	s.	s.	s. eth.
1524							
1525							
1526							
1527							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1528	**Benzoic acid, 3,5-dihydroxy-.**	See *α-Resorcylic acid.*		
1529	**——, 3,4-dimethoxy-.**	See *Veratric acid.*		
1530	**——, 2,3-dimethyl-.**	See *Hemellitic acid.*		
1531	**——, 2,4-dimethyl-.**	See 2,4-*Xylic acid.*		
1532	**——, 2,5-dimethyl-.**	See *Isoxylic acid.*		
1533	**——, 2,6-dimethyl-.**	See 2,6-*Xylic acid.*		
1534	**——, 3,4-dimethyl-.**	See 3,4-*Xylic acid.*		
1535	**——, 3,5-dimethyl-.**	See *Mesitylenic acid.*		
1536	**——, 2,4-dinitro-......**	....	$(NO_2)_2C_6H_3COOH$	212.12
1537	**——, 2,5-dinitro-......**	....	$(NO_2)_2C_6H_3COOH$	212.12
1538	**——, 2,6-dinitro-......**	....	$(NO_2)_2C_6H_3COOH$	212.12
1539	**——, 3,4-dinitro-......**	....	$(NO_2)_2C_6H_3COOH$	212.12
1540	**——, 3,5-dinitro-......**	....	$(NO_2)_2C_6H_3COOH$	212.12
1540M	——, ——, isobutyl ester....	....	$(NO_2)_2C_6H_3CO_2$-$CH_2CH(CH_3)_2$	268.22
1541	**——, o-ethoxy-........**	salicylic acid ethyl ether... ..	$C_2H_5OC_6H_4COOH$	166.17
1542	**——, *m*-ethoxy-.......**	....	$C_2H_5OC_6H_4COOH$	166.17
1543	**——, *p*-ethoxy-.......**	....	$C_2H_5OC_6H_4COOH$	166.17
1544	**——, *o*-ethyl- ....**	....	$C_2H_5C_6H_4COOH$..	150.17
1545	**——, *m*-ethyl-........**	....	$C_2H_5C_6H_4COOH$..	150.17
1546	**——, *p*-ethyl-.........**	....	$C_2H_5C_6H_4COOH$..	150.17
1547	**——, *o*-ethylamino-.**	See *Anthranilic acid, N-ethyl-.*		
1548	**——, *m*-ethylamino-..**	....	$C_2H_5NHC_6H_4$-$COOH$	165.19
1549	**——, *p*-ethylamino-...**	....	$C_2H_5NHC_6H_4$-$COOH$	165.19
1550	**——, *o*-fluoro-........**	....	FC_6H_4COOH.....	140.11
1551	**——, *m*-fluoro-.......**	....	FC_6H_4COOH	140.11
1552	**——, *p*-fluoro-........**	....	FC_6H_4COOH.....	140.11
1553	**——, *o*-formyl-.**	See *Phthalaldehydic acid.*		
1554	**——, *m*-formyl-.**	See *Isophthalaldehydic acid.*		
1555	**——, *p*-formyl-.**	See *Terephthalaldehydic acid.*		
1556	**——, hexahydro-.**	See *Cyclohexanecarboxylic acid.**		
1557	**——, hydrazodi-.**	See *Hydrazobenzoic acid.*		
1558	**——, *o*-hydroxy-.**	See *Salicylic acid.*		
1559	**——, *m*-hydroxy-.....**	....	HOC_6H_4COOH....	138.12
1560	**——, *p*-hydroxy-......**	....	HOC_6H_4COOH....	138.12
1561	**——, *p*-(α-hydroxybenzyl)-**	*p*-benzohydrolcarboxylic acid	$C_6H_5CH(OH)C_6$-H_4COOH	228.24
1562	**——, 4-hydroxy-3-methoxy-.**	See *Vanillic acid.*		
1563	**——, *o*-β-hydroxyvinyl-**, lactone.	See *Isocoumarin.*		
1564	**——, *o*-iodo-.........**	....	IC_6H_4COOH......	248.03
1565	**——, *m*-iodo-........**	....	IC_6H_4COOH......	248.03

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1528							
1529							
1530							
1531							
1532							
1533							
1534							
1535							
1536	col. rhomb. pr. f. w.	....	182–3; frz. 180.9	subl.	1.85^{25}	v. s.	0.71^{30} bz.
1537	col. need. or monocl. pr. f. w.	....	177	....	sl. s. h.	s.	s. eth.
1538	col. need. f. w.	....	202–3	d.	s. h.	s.	s. eth.
1539	col. need......	....	163	165 subl.	0.67^{25}	v. s.	v. s. eth.
1540	yel. monocl. tab. f. w.	....	204–5	subl.	1.9^{100}	v. s.	sl. s. eth., bz., CS$_2$; s. ac. a.
1540M	monocl. pl. or need.	....	87	....	......	......	....
1541	col. oil.......	....	19.3–.5 (22)	d. *ca.* 300	sl. s. c.; s. h.	......	....
1542	col. need. f. w.	....	137	subl.	sl. s. h.	s.	s. eth.
1543	col. need......	....	195	....	v. sl. s. h.	......	....
1544	col. need. f. h. w., $1.51012^{99.6}$	....	68	259	v. sl. s.	v. s.	v. s. eth.
1545	col. need. f. dil. al., 1.5345^{100}	1.042^{100}	47	....	v. sl. s.	s.	v. s. eth.
1546	col. leaf. or pr. f. al.	....	113	....	s. h.	v. s.	v. s. eth.
1547							
1548	pr...........	....	101	subl.	v. sl. s.	s.	s. eth.
1549	....	....	178	....	......	s.	s. eth.
1550	need. f. w.....	$1.460\frac{25}{4}$	122	....	0.722^{25}	v. s.	v. s. eth.
1551	leaf. f. w......	$1.474\frac{25}{4}$	124	....	0.150^{25}	......	....
1552	monocl. pr. f. w.	$1.479\frac{25}{4}$	182 (184–6)	....	0.127^{25}	s.	s. eth.
1553							
1554							
1555							
1556							
1557							
1558							
1559	col. rhomb. f. w. or al.	$1.473\frac{4}{4}$	201.3 (199–200)	....	0.92^{18}	s. h.	9.7^{17} eth.; 0.01^{25} bz.
1560	col. monocl. f. w.	$1.443\frac{20}{4}$	213 (214.5–5.5)	subl. 76	0.79^{15}, 2.6^{75}	39.34^{15}	$9\ 4^{17}$ eth.; 0.01^{11} bz.
1561	need. f. w.....	....	164-5	d.	s. h.	s.	s. eth.; sl. s. chl.
1562							
1563							
1564	col. need. f. w.	$2.249\frac{25}{4}$	162	....	0.095^{25}	sl. s.	sl. s. eth.
1565	need. f. acet...	$2.171\frac{25}{4}$	185–7	subl. d.	0.0117^{25}	sl. s.	sl. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1566	**Benzoic acid, *p*-iodo-.**		IC_6H_4COOH	248.03
1567	**——, *o*-isopropyl-**		$(CH_3)_2CHC_6H_4$-$COOH$	164.20
1568	**——, *p*-isopropyl-.**	See *Cumic acid.*		
1569	**——, *o*-mercapto-**	thiosalicylic acid; *o*-sulfhydrylbenzoic acid	HSC_6H_4COOH	154 18
1570	**——, *o*-methoxy-**	salicylic acid methyl ether	$CH_3OC_6H_4COOH$	152.14
1571	**——, *m*-methoxy-**		$CH_3OC_6H_4COOH$	152.14
1572	**——, *p*-methoxy-.**	See *Anisic acid.*		
1573	**——, methyl-.**	See *Toluic acid.*		
1574	**——, 3,4-methylenedioxy-.**	See *Piperonylic acid.*		
1575	**——, *o*-nitro-**		$NO_2C_6H_4COOH$	167.12
1576	——, ——, ethyl ester		$NO_2C_6H_4COOC_2H_5$	195.17
1577	——, ——, methyl ester		$NO_2C_6H_4COOCH_3$	181.14
1578	**——, *m*-nitro-**		$NO_2C_6H_4COOH$	167.12
1579	——, ——, ethyl ester		$NO_2C_6H_4COOC_2H_5$	195.17
1580	——, ——, methyl ester		$NO_2C_6H_4COOCH_3$	181.14
1581	**——, *p*-nitro-**		$NO_2C_6H_4COOH$	167.12
1582	——, ——, ethyl ester		$NO_2C_6H_4COOC_2H_5$	195.17
1583	——, ——, methyl ester		$NO_2C_6H_4COOCH_3$	181.14
1584	**——, *o*-nitroso-**		NOC_6H_4COOH	151 12
1585	**——, *m*-nitroso-**		NOC_6H_4COOH	151.12
1586	**——, *p*-nitroso-**		NOC_6H_4COOH	151.12
1587	**——, pentamethyl-**		$(CH_3)_5C_6COOH$	192.25
1588	**——, *o*-phenoxy-**	salicylic acid phenyl ether	$C_6H_5OC_6H_4COOH$	214.21
1589	**——, *o*-phenyl-**	*o*-biphenylcarboxylic acid	$C_6H_5C_6H_4COOH$	198.21
1590	**——, *m*-phenyl-**	*m*-biphenylcarboxylic acid	$C_6H_5C_6H_4COOH$	198.21
1591	**——, *p*-phenyl-**	*p*-biphenylcarboxylic acid	$C_6H_5C_6H_4COOH$	198.21
1592	**——, *p*-phosphono-**	*p*-benzophosphinic acid	$(HO)_2POC_6H_4$-$COOH$	202.11
1593	**——, *o*-propyl-**		$C_3H_7C_6H_4COOH$	164.20
1594	**——, *p*-propyl-**		$C_3H_7C_6H_4COOH$	164.20
1595	**——, silico-.**	See *Benzenesiliconic acid.*		
1596	**——, *o*-sulfamyl-**	*o*-sulfamidobenzoic acid	$NH_2O_2SC_6H_4$-$COOH$	201.19
1597	**——, *m*-sulfamyl-**		$NH_2O_2SC_6H_4$-$COOH$	201.19
1598	**——, *p*-sulfamyl-**		$NH_2O_2SC_6H_4$-$COOH$	201.19

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1566	pl. or leaf.....	$2.184\frac{25}{4}$	269–70	subl. d.	0.0035^{25}	sl. s.	sl. s. eth.
1567	col. pr. f. w...	....	51	....	s. h.	s.	s. eth., bz.
1568							
1569	lt. yel. need. f. al.	....	164	subl.	v. sl. s.	v. s.	s. eth., ac. a.
1570	monocl. tab. f. w.	1.180	98 (100–1)	200	0.5^{30}	v. s.	v. s. eth.
1571	col. need. f. w.	....	107–8	$170–2^{10}$ subl.	sl. s. c., v. s. h.	v. s.	v. s. eth.
1572							
1573							
1574							
1575	tricl. need. f. w.	$1.575\frac{4}{4}$	147.5 (144–5)	....	0.68^{20}	28^{10}	21.6^{11} eth.; s. alk.; v. sl. s. bz., chl.; i. lgr.
1576	col. tricl......	....	30	$148–50^{10}$	i.	s.	s. eth.
1577	yel. oil.......	$1.286\frac{20}{4}$; $1.284\frac{25}{25}$	–8	275 (269)	i.	∞	∞ eth.; i. pet. eth.
1578	monocl. leaf. f. w.	$1.494\frac{4}{4}$	141.4	....	0.31^{20}	33^{10}	25.1^{11} eth.; s. alk.; v. sl. s. bz., chl.; i. lgr.
1579	monocl. pr....	....	47 (40–1)	298; 171^{25}	i.	v. s.	v. s. eth.
1580	col. need......	....	78.5 (70)	279	i.	sl. s.	s. eth.; sl. s. me. al.
1581	monocl. leaf. f. w.	$1.550\frac{32}{4}$	242.4	subl.	0.024^{25}	0.9^{10}	2.2^{11} eth.; s. acet., alk.; v. sl. s. c. bz., chl.; i. lgr.
1582	col. tricl. leaf. f. al.	....	57	....	i.	s.	s. eth.
1583	yel. monocl. leaf.	....	96	....	i.	s.	s. eth.
1584	col. f. al......	....	210 d.	....	......	s.	v. sl. s. eth., bz.; s. ac. a.
1585	col. cr........	....	230 d.	....	......	s.	v. sl. s.eth., bz.
1586	yel. powd.....	....	250 d.	....	......	s.	v. sl. s. eth., bz.; sl.s. ac. a.
1587	need. f. w.....	....	210.5	subl.	v. sl. s.	s.	....
1588	rhomb. leaf. f. dil. al.	....	114.5	355 d.	0.01	v. s.	v. s. eth.; s. chl., glyc.
1589	col. monocl. need. f. al.	$1.458\frac{20}{4}$	114 (111)	343–4	sl. s. h., i. c.	v. s.	v. s. bz.; s. ac. a.
1590	col. leaf. f. al..	....	160–2	....	i. (sl. s.)	v. s.	v. s. eth., bz., ac. a., lgr.
1591	col. need. f. al. or bz.	....	219 (224)	subl.	v. sl. s. h.	v. s.	v. s. eth.
1592	need. f. w.....	....	>300	....	s.	s.	sl. s. HCl
1593	leaf. f. al......	....	58	273	s.	v. s.	v. s. eth.
1594	col. leaf. f. w..	....	141	....	sl. s. h.	v. s.	v. s. eth.; s. bz.
1595							
1596	rhomb. f. al...	....	165–7	....	v. s.	v. s.	v. s. eth.
1597	need. or pl. f.w.	....	238	....	v. sl. s.	v. s.	v. s. eth.
1598	need. or pr. f. w.	....	280 d.	....	v. v. sl. s.	v. s.	sl. s. eth.; v. sl. s. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1599	**Benzoic acid, o-sulfhydryl-.** See *Benzoic acid, o-mercapto-.*			
1600	——, **o-sulfo-**		$HO_3SC_6H_4COOH\cdot 3H_2O$	256.23
1601	——, ——, imide.	See *Saccharin.*		
1602	——, ***m*-sulfo-**		$HO_3SC_6H_4COOH\cdot 2H_2O$	238.21
1603	——, ***p*-sulfo-**		$HO_3SC_6H_4COOH\cdot 3H_2O$	256.23
1604	——, **2,3,4,5-tetrahydro-.** See 1-*Cyclohexene*-1-*carboxylic acid**.			
1605	——, **2,3,4,5-tetrahydroxy-**		$(HO)_4C_6HCOOH$	186.12
1606	——, **thio-**	benzenecarbothioic acid*	C_6H_5COSH	138.18
1607	——, ***p*-(*p*-toluyl)-**		$CH_3C_6H_4COC_6H_4COOH$	240.25
1608	——, **2,3,5-triamino-**		$(NH_2)_3C_6H_2COOH$	167.17
1609	——, **3,4,5-triamino-**		$(NH_2)_3C_6H_2COOH$	167.17
1609M	——, **3,4,5-tribromo-**		$Br_3C_6H_2COOH$	358.84
1610	——, **2,3,4-trichloro-**		$Cl_3C_6H_2COOH$	225.47
1611	——, **2,4,5-trichloro-**		$Cl_3C_6H_2COOH$	225.47
1612	——, **3,4,5-trichloro-**		$Cl_3C_6H_2COOH$	225.47
1613	——, **2,3,4-trihydroxy-**	4-pyrogallolcarboxylic acid	$(HO)_3C_6H_2COOH$	170.12
1614	——, **2,4,5-trihydroxy-**	4-hydroxygentisic acid	$(HO)_3C_6H_2COOH$	170.12
1615	——, **2,4,6-trihydroxy-**	phloroglucinolcarboxylic acid	$(HO)_3C_6H_2COOH$	170.12
1616	——, **3,4,5-trihydroxy-.**	See *Gallic acid.*		
1617	——, **2,3,4-trimethoxy-**		$(CH_3O)_3C_6H_2COOH$	212.20
1618	——, **2,4,5-trimethoxy-**	See *Asaronic acid.*		
1619	——, **3,4,5-trimethoxy-**	gallic acid trimethyl ether	$(CH_3O)_3C_6H_2COOH$	212.20
1620	——, **2,3,4-trimethyl-.**	See *Prehnitylic acid.*		
1621	——, **2,3,5-trimethyl-.**	See *γ-Isodurylic acid.*		
1622	——, **2,3,6-trimethyl-**		$(CH_3)_3C_6H_2COOH$	164.20
1623	——, **2,4,5-trimethyl-.**	See *Durylic acid.*		
1624	——, **2,4,6-trimethyl-.**	See *β-Isodurylic acid.*		
1625	——, **3,4,5-trimethyl-.**	See *α-Isodurylic acid.*		
1626	——, **2,4,6-trinitro-**	*sym*-trinitrobenzoic acid	$(NO_2)_3C_6H_2COOH$	257.12
1627	**Benzoic amide.**	See *Benzamide.*		
1628	**Benzoic anhydride**	benzoic acid anhydride	$(C_6H_5CO)_2O$	226.22
1629	**Benzoic sulfimide.**	See *Saccharin.*		
1630	**Benzoin**	benzoylphenylcarbinol; α-hydroxy-α-phenylacetophenone	$C_6H_5CHOHCOC_6H_5$	212.24
1631	——, ethyl ether	α-ethoxy-α-phenylacetophenone, 2-ethoxy-1,2-diphenyl-1-ethanone	$C_6H_5CH(OC_2H_5)COC_6H_5$	240.29
1632	——, imide.	See *Amaron.*		
1633	——, *l*-oxime		$C_6H_5CH(OH)C(:NOH)C_6H_5$	227.25
1633M	——, ***p,p'*-dimethoxy-.**	See *Anisoin.*		
1634	**Benzol, Benzole.**	See *Benzene**.		
1635	**Benzonitrile**	benzenecarbonitrile*; phenyl cyanide	C_6H_5CN	103.12
1636	——, **o-amino-.**	See *Anthranilonitrile.*		
1637	——, ***m*-amino-**	*m*-aminophenyl cyanide	$NH_2C_6H_4CN$	118.13
1638	——, ***p*-amino-**	*p*-aminophenyl cyanide	$NH_2C_6H_4CN$	118.13

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1599							
1600	rhomb. need. f. w.	....	68–9; $-3H_2O$, 105; anh. 141	....	50	v. s.	i. eth.
1601							
1602	deliq. cr.	....	98; anh. 141	....	s.	s.	v. s. eth.; i. bz
1603	need. f. w.	....	94; anh. 260	....	v. s.	v. s.	v. s. eth.
1604							
1605	cr.	....	148	....	v. s.	....	i. lgr.
1606	yel. oil or cr.	....	24	d.	i.	∞	∞ eth.
1607	need. f. acet.	....	130 (224)	....	v. sl. s.	v. s.	v. s. acet.; sl. s. bz.
1608	cr. f. w.	....	....	....	v. s. h.	v.sl.s.h.	i. eth.
1609	need. f. w.	....	$-H_2O$, >100	d.	s. h.	i.	i. eth.
1609M	col. need.	....	240	....	i.	s.	s. h. bz.
1610	need. f. al.	....	186–7 (129)	....	sl. s.	s.	s. eth.
1611	sm. need. f. w.	....	163	subl.	s. h.	s.	s. eth.
1612	need. f. al.	....	203	subl.	s. h.	v. s.	v. s. eth.
1613	need. f. w.	....	200 d.	subl.	0.13^{12}	s.	v. s. eth.
1614	need. f. w.	....	217–8	....	v. s. h.	v. s.	....
1615	cr. f. w.	....	100 d.	....	s. h.	s.	v. s. eth.; i. bz.
1616							
1617	cr. f. eth.	....	97–9	....	s.	s.	s. eth.
1618							
1619	monocl. need. f. w.	....	168	$225–7^{10}$	v. sl. s.	v. s.	v. s. eth., chl.
1620							
1621							
1622	need. f. w.	....	84; 105–6	....	s.	s.	s. eth.
1623							
1624							
1625							
1626	yel. rhomb. need. f. w.	....	228.7 (220-3)	subl. d.	2.05^{23}	26.6^{25}	14.7^{25} eth.
1627							
1628	col. rhomb. pr., 1.57665^{15}	$1.1989\frac{16}{4}$	42	360	i.	s.	s. eth.
1629							
1630	col. hex. pr. f. al.	$1.310\frac{20}{4}$	137	344; 194^{12}	0.03^{25}	s.	sl. s. eth.
1631	need. f. lgr.	....	62	184–6	....	s.	s. eth.; v. s. bz.
1632							
1633	wh. amor. powd. or pr. f. bz.	....	163–4 (149–51)	....	i.	s.	s. eth., acet.
1633M							
1634							
1635	col. liq., 1.52892	$1.0102\frac{15}{15}$	-13	190.7	1^{100}	∞	∞ eth.
1636							
1637	need.	....	53–4	288–90	sl. s.	s.	s. eth.
1638	col. monocl. pr.	....	86	d.	v. s. h.	v. s.	v. s. eth.; i. HCl

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1639	**Benzonitrile, *p*-bromo-**	*p*-bromophenyl cyanide	BrC_6H_4CN	182.03
1640	**——, *p*-chloro-**	4-chlorobenzenecarbonitrile*; *p*-chlorophenyl cyanide	ClC_6H_4CN	137.57
1641	**——, methyl-.**	See *Tolunitrile.*		
1642	**——, *o*-nitro-**	2-nitrobenzenecarbonitrile*; *o*-nitrophenyl cyanide	$NO_2C_6H_4CN$	148.12
1643	**——, *m*-nitro-**		$NO_2C_6H_4CN$	148.12
1644	**——, *p*-nitro-**		$NO_2C_6H_4CN$	148.12
1645	**Benzo[*a*]phenanthrene.**	See *Chrysene.*		
1646	**Benzo[*def*]phenanthrene.** See *Pyrene.*			
1647	**Benzo[*l*]phenanthrene.**	See *Triphenylene.*		
1648	**Benzo[*a*]phenazine**	α-benzophenazine; αβ-naphthophenazine	$C_{10}H_6{:}N_2{:}C_6H_4$	230.26
1649	**Benzo[*b*]phenazine, 5,8-dihydro-8-imino-5-phenyl-.** See *Rosinduline*			
1650	**Benzophenone**	phenyl ketone; diphenyl ketone; benzoylbenzene; α-oxodiphenylmethane	$(C_6H_5)_2CO$	182.21
1651	——, oxime		$(C_6H_5)_2C{:}NOH$	197.23
1652	——, phenylhydrazone		$(C_6H_5)_2C{:}NNHC_6H_5$	272.34
1653	**——, 2-amino-**	*o*-aminodiphenylketone; *o*-benzoylaniline	$C_6H_5COC_6H_4NH_2$	197.23
1654	**——, 3-amino-**	*m*-aminophenyl phenyl ketone; *m*-benzoylaniline	$C_6H_5COC_6H_4NH_2$	197.23
1655	**——, 4-amino-**	*p*-aminophenyl phenyl ketone; *p*-benzoylaniline	$C_6H_5COC_6H_4NH_2$	197.23
1656	**——, 4,4′-bisdimethylamino-**	Michler's ketone; tetramethyl-4,4′-diaminobenzophenone	$CO[C_6H_4N(CH_3)_2]_2$	268.35
1657	**——, 2,2′-diamino-**	bis-*o*-aminophenyl ketone	$NH_2C_6H_4COC_6H_4NH_2$	212.24
1658	**——, 3,3′-diamino-**	bis-*m*-aminophenyl ketone	$NH_2C_6H_4COC_6H_4NH_2$	212.24
1659	**——, 4,4′-diamino-**	bis-*p*-aminophenyl ketone	$NH_2C_6H_4COC_6H_4NH_2$	212.24
1660	**——, 2,2′-dihydroxy-**	bis-*o*-hydroxyphenyl ketone	$HOC_6H_4COC_6H_4OH$	214.21
1661	**——, 2,3′-dihydroxy-**	*m*-hydroxyphenyl *o*-hydroxyphenyl ketone	$HOC_6H_4COC_6H_4OH$	214.21
1662	**——, 2,4-dihydroxy-**	4-benzoylresorcinol; 4-benzoresorcin	$C_6H_5COC_6H_3(OH)_2$	214.21
1663	**——, 2,4′-dihydroxy-**	*o*-hydroxyphenyl *p*-hydroxyphenyl ketone; *p*-salicyloylphenol	$HOC_6H_4COC_6H_4OH$	214.21
1664	**——, 2,5-dihydroxy-**	2,5-dihydroxyphenyl phenyl ketone	$(HO)_2C_6H_3COC_6H_5$	214.21
1665	**——, 3,3′-dihydroxy-**	bis-*m*-hydroxyphenyl ketone	$HOC_6H_4COC_6H_4OH$	214.21
1666	**——, 3,4′-dihydroxy-**	*m*-hydroxyphenyl *p*-hydroxyphenyl ketone	$HOC_6H_4COC_6H_4OH$	214.21
1667	**——, 4,4′-dihydroxy-**	bis-*p*-hydroxyphenyl ketone	$HOC_6H_4COC_6H_4OH$	214.21
1668	**——, 2,4-dihydroxy-6-methoxy-.** See *Isocotoin.*			
1669	**——, 2,6-dihydroxy-4-methoxy-.** See *Cotoin.*			
1670	**——, 4,4′-dimethyl-**	di-*p*-tolyl ketone	$CH_3C_6H_4COC_6H_4CH_3$	210.26

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1639	need. f. w......	....	113	235–7	s. h.	s.	v. s. eth.
1640	need. f. al......	....	92 (93–4)	223	sl. s.	s.	s. eth., bz.
1641							
1642	silky need. f. w.	....	109	....	s. h.	s.	s. eth., ac. a.
1643	need. f. w......	....	118 (115–6)	subl.	sl. s.	s.	s. eth.
1644	yel. leaf. f. al...	....	147	....	sl. s. c.	sl. s. c., s. h.	s. chl., ac. a.
1645							
1646							
1647							
1648	yel. need. f. bz.	....	142.5	>360	i.	v. sl. s.	v. sl. s. eth.; sl. s. c. bz.
1649							
1650	α(stab.) col. rhomb. pr.; β col. monocl. pr.	$\alpha 1.0976\frac{50}{50}$; $\beta 1.108\frac{23}{4}$	α49; β 26; γ45–8; δ–51	306	i.	13 5^{18}	17.5^{13} eth.; s. chl.
1651	need.........	....	144 (141–2.5)	....	v. sl. s.	s.	v.s. eth., acet.; s. alk.
1652	need.........	....	137 (105)	....	......	......	....
1653	pa. yel. leaf....	....	108	....	......	s.	s. eth.
1654	yel. need......	....	86	....	sl. s. w.	s.	s. eth.
1655	leaf. f. dil. al...	....	124 (110–5)	....	sl. s.	s.	s. eth.
1656	glit. leaf. f. al.	....	174	>360 sl. d.	0.04^{25}	v. s.	v. s. eth., bz.
1657	pa. yel. leaf. f. dil. al.	....	132–3	....	i.	s.	....
1658	yel. need. f. al.	....	173–4 (171)	285^{11}	s. h.	s.	s. eth.
1659	hex. or rhomb. need. f. dil. al.	....	244 (237)	....	s. h., d. by boil.	s.	s. eth.
1660	leaf. or pr. f. lgr.	....	59–60	340	i.	s.	s. eth., chl.
1661	need. f. w......	....	126	....	......	s.	s. eth.
1662	....	....	144	....	i.	s.	s. eth.
1663	yel. pyram. f. bz. or pl. f. h. w.	....	150–1 (147–8)	....	s. h.	s. h.	v. s. eth.; s. bz., alk.
1664	yel. need. f. dil. al.	....	125	....	s. h.	s.	s. eth., bz.
1665	sm. need. f. w..	....	170 (162–3)	....	s.	s.	s. alk.
1666	need. f. w......	....	206 (197–200)	....	s. h.	s.	s. eth.
1667	yel. need. f. lgr.	....	210	subl.	v. s. h.	v. s.	v. s. eth.; s. me. al., acet.; i. bz., chl., CS_2
1668							
1669							
1670	rhomb. f. al....	....	95 (91–2)	333–4^{725}	i.	v. s.	v. s. eth.; s. chl., CS_2

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1671	**Benzophenone, *p*-hydroxy-**	....	$HOC_6H_4COC_6H_5$..	198.21
1672	**——, *o*-nitro-**.........	*o*-nitrophenyl phenyl ketone	$NO_2C_6H_4COC_6H_5$	227.21
1673	**——, *m*-nitro-**........	....	$NO_2C_6H_4COC_6H_5$	227.21
1674	**——, *p*-nitro-**........	....	$NO_2C_6H_4COC_6H_5$	227.21
1675	**——, 2,4,6,3′,4′-pentahydroxy-.** See *Maclurin.*			
1676	**——, 2,2′,6-trihydroxy-**	2-salicylylresorcinol.........	$(HO)_2C_6H_3COC_6H_4OH$	230.21
1677	**——, 2,3,4-trihydroxy-**	4-benzoylpyrogallol; alizarin yellow A	$C_6H_5COC_6H_2(OH)_3$	230.21
1678	**Benzophenonecarboxylic acid.** See *Benzoic acid, benzoyl-.*			
1679	***p,p′*-Benzophenonedicarboxylic acid.** See *Benzoic acid, p,p′-carbonyldi-.*			
1680	**2,3-Benzophenonedicarboxylic acid.** See *Phthalic acid, 3-benzoyl-.*			
1681	**2,5-Benzophenonedicarboxylic acid.** See *Terephthalic acid. benzoyl-.*			
1682	**3,4-Benzophenonedicarboxylic acid.** See *Phthalic acid, 4-benzoyl-.*			
1683	***p*-Benzophosphinic acid.** See *Benzoic acid, p-phosphono-.*			
1684	**Benzopinacol**.........	1,1,2,2-tetraphenyl-1,2-ethanediol*; tetraphenylethylene glycol; benz(o)pinacone	$(C_6H_5)_2COHCOH(C_6H_5)_2$	366.44
1685	**β-Benzopinacolin**.....	α-triphenylacetophenone; benzoyltriphenylmethane; phenyl trityl ketone	$(C_6H_5)_3CCOC_6H_5$..	348.42
1686	**Benzopinacone.**	See *Benzopinacol.*		
1687	**Benzopyrazine.**	See *Quinoxaline.*		
1688	**Benzo[*b*]pyridine.**	See *Quinoline.*		
1689	**Benzo[c]pyridine.**	See *Isoquinoline.*		
1690	**Benzo[*a*]pyrimidine.**	See *Quinazoline.*		
1691	**1,2-Benzopyrone.**	See *Coumarin.*		
1692	**1,4-Benzopyrone, γ-Benzopyrone.** See *Chromone.*			
1693	**2,1-Benzopyrone.**	See *Isocoumarin.*		
1694	**Benzo[*b*]pyrrole**	See *Indole.*		
1695	**Benzoquinhydrone.**	See *Quinhydrone.*		
1696	**Benzo[*f*]quinoline**	5,6-benzoquinoline; β-naphthoquinoline	$C_{13}H_9N$..........	179.21
1697	**——, 3-methyl-**.......	3-methyl-5,6-benzoquinoline; β-naphthoquinaldine	$C_{13}H_8NCH_3$......	193.24
1698	**Benzo[*h*]quinoline**.....	7,8-benzoquinoline; α-naphthoquinoline	$C_{13}H_9N$..........	179.21
1699	**——, 2-methyl-**.......	2-methyl-7,8-benzoquinoline; α-naphthoquinaldine	$C_{13}H_8NCH_3$......	193.24
1700	***p*-Benzoquinone.**	See *Quinone.*		
1701	**4-Benzoresorcin.** See *Benzophenone, 2,4-dihydroxy-.*			
	Benzothiazole. (Numbered beginning S=1).			
1702	**Benzothiazole, 2-(2,4-dinitrophenylthio)-**	2-benzothiazyl 2,4-dinitrophenyl sulfide	C_6H_4SC- $[SC_6H_3(NO_2)_2]:N$	333.33
1703	**——, 2,2′-dithiobis-**...	2,2′-dibenzothiazyl disulfide..	$C_{14}H_8N_2S_4$........	332.46
1704	**——, mercapto-.**	See *Benzothiazolethiol.*		
1705	**——, 2-methyl-**.......	μ-methylbenzothiazole; ethenylaminothiophenol	$SC(CH_3):NC_6H_4$..	149.20
1706	**——, 2-phenyl-**.......	benzenylaminothiophenol....	$C_6H_4SC(C_6H_5):N$..	211.27
1707	**2-Benzothiazolethiol**..	2-mercaptobenzothiazole; *o*-thiocarbamidothiophenol	$C_6H_4SC(SH):N$	167.24
1708	——, benzoate...........	....	$C_{14}H_9NOS_2$.......	271.34

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1671	rhomb. leaf. f. dil. al.	....	134	....	s. h.	v. s.	v. s. eth.
1672	col. monocl. f. al.	....	105	....	......	sl. s.	....
1673	col. need. f. al.	....	94–5	234^{18}	......	s.	....
1674	col. leaf. f. al.	....	138	....	v. sl. s.	s.	sl. s. bz., CS_2
1675							
1676	yel. leaf. f. al.	....	133	....	sl. s. h.	s. h.	s. eth., bz., alk.
1677	yel. need. f. dil. al.	....	140	....	sl. s.	s.	s. eth., alk., H_2SO_4; sl. s. bz.
1678							
1679							
1680							
1681							
1682							
1683							
1684	pr	....	186 d.	....	......	2.02 h.	s. eth.
1685	need	....	182.5	....	i.	v. sl. s. c., s. h.	s. eth.; v. s. bz., chl., CS_2
1686							
1687							
1688							
1689							
1690							
1691							
1692							
1693							
1694							
1695							
1696	sm. leaf. f. h. w.	....	93	351	s. h.	v. s.	v. s. eth., bz.
1697	need. f. dil. al	....	82	>300	sl. s.	s.	s. eth.
1698	monocl. f. eth.	....	52	351 (223^{47})	v. sl. s.	v. s.	v. s. eth.; s. bz.
1699	liq	....	....	>300	i.	s.	....
1700							
1701							
1702	yel. cr.	$1.24\frac{20}{4}$	160–2	....	i.	sl. s. c., s. h.	sl. s. eth.
1703	lt. yel. cr	$1.50\frac{28}{4}$	180.0	d.	i.	v. sl. s. h.	v. sl. s. chl.
1704							
1705	liq	....	....	238	i.	s.	....
1706	need. f. al.	....	115	360	i.	s.	s. eth., CS_2, dil. HCl
1707	wh.-yel. cr	$1.42\frac{20}{4}$	179.5	d.	i.	s. h.	v. sl. s. eth.; s. alk.
1708	yel. cr.	....	132	....	i.	sl. s. c., s. h.	sl. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1709	**2-Benzothiazolethiol,** mercaptide with α, β-diphenylguanidine	....	$C_{20}H_{18}N_4S_2$	378.50
1710	——, **6-nitro-**, diethylthiolthionocarbamic ester		$C_{12}H_{13}N_3O_2S_3$	327.43
1711	**Benzothiofuran.**	See *Thionaphthene.*		
1712	**Benzothiophene.**	See *Thionaphthene.*		
1713	**o-Benzotoluide**	*N*-benzoyl-*o*-toluidine	$C_6H_5CONHC_6H_4CH_3$	211.25
1714	**m-Benzotoluide**	*N*-benzoyl-*m*-toluidine; *m*-benzotoluidide	$C_6H_5CONHC_6H_4CH_3$	211.25
1715	**p-Benzotoluide**	*N*-benzoyl-*p*-toluidine	$C_6H_5CONHC_6H_4CH_3$	211.25
1716	**1,2,3-Benzotriazole**	aziminobenzene; benzene azimide	$C_6H_4NHN{:}N$	119.12
1717	**Benzotrichloride.**	See *Toluene, α-trichloro-.*		
1718	**Benzotrifluoride.**	See *Toluene, α-trifluoro-.*		
1719	**Benzoxazole, 2-methyl-**(O=1)	μ-methylbenzoxazole; ethenylaminophenol	$OC(CH_3){:}NC_6H_4$	133.14
1720	**2(3)Benzoxazolone** (O=1)	*o*-hydroxycarbanilic acid lactone	C_6H_4OCONH	135.12
1721	**2,3,1-Benzoxaz-1-one**	benzaldoximecarboxylic anhydride	$C_6H_4COON{:}CH$	147.13
	Benzoyl-. For benzoyl derivatives see the parent compounds (e.g., for benzoylacetic			
1722	**Benzoyl azide**	benzazide	$C_6H_5CON_3$	147.13
1723	**Benzoyl bromide**	benzenecarbonyl bromide*	C_6H_5COBr	185.03
1724	**Benzoyl chloride**	benzenecarbonyl chloride*	C_6H_5COCl	140.57
1725	——, **p-bromo-**	....	BrC_6H_4COCl	219.48
1726	——, **3,5-dinitro-**	....	$(NO_2)_2C_6H_3COCl$	230.57
1727	——, **p-methoxy-.**	See *Anisoyl chloride.*		
1728	——, **m-nitro-**	....	$NO_2C_6H_4COCl$	185.57
1729	——, **p-nitro-**	....	$NO_2C_6H_4COCl$	185.57
1730	**Benzoyl cyanide**	α-keto-α-tolunitrile; 2-oxo-2-phenylethanenitrile	C_6H_5COCN	131.13
1731	**Benzoyl disulfide**	dibenzoyl disulfide	$(C_6H_5CO)_2S_2$	274.34
1732	**Benzoyl fluoride**	benzenecarbonyl fluoride*	C_6H_5COF	124.11
1734	**Benzoyl hydroperoxide**	See *Perbenzoic acid.*		
1735	**Benzoyl iodide**	benzenecarbonyl iodide*	C_6H_5COI	232.03
1736	**Benzoyl peroxide**	dibenzoyl peroxide	$(C_6H_5CO)_2O_2$	242.22
1737	**Benzpinacone.**	See *Benzopinacol.*		
	Benzyl-. For benzyl derivatives see the parent compounds (e.g., for benzylbenzoic acid			
1738	**Benzyl alcohol**	phenylcarbinol; α-hydroxytoluene	$C_6H_5CH_2OH$	108.13
1739	——, esters.	See "benzyl ester" under the corresponding acids.		
1740	——, **o-chloro-**	....	$ClC_6H_4CH_2OH$	142.58
1741	——, **3,4-dihydroxy-α-(methylaminomethyl)-.**		See *Adrenaline.*	
1742	——, **α,α-dimethyl-.**	See *2-Propanol, 2-phenyl-.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1709	yel. cr........	1.00	173	....	i.	s.	i. eth.
1710	fine yel. cr....	....	122	....	i.	s. h.	s. eth., bz.
1711							
1712							
1713	rhomb. need., 1.621, 1.654, 1.691	$1.205\frac{15}{4}$	146 (135–6.5)	....	sl. s. h.	s.	s. eth.
1714	monocl. pr. f. dil. al.	$1.170\frac{15}{4}$	125	....	......	10.02^{15}	....
1715	rhomb. need. f. al.	$1.202\frac{15}{4}$	158	232	i.	3.3^{18}	s. eth.
1716	need. f. bz....	....	100	$201\text{–}4^{15}$ mm.	i.	s.	s. bz.
1717							
1718							
1719	liq...........	$1.136\frac{0}{4}$	....	201	i.	s.	∞ eth.
1720	col. need. f. h. dil. HCl	....	141–2 (138)	....	sl. s. c.	v. s.	v. s. eth.
1721	cr. f. bz.......	....	d. 120	....	......	......	....
	acid see *Acetic acid, benzoyl-*). See also "benzoate" under names of alcohols and phenols.						
1722	col. pl. f. acet.	....	32	exp.	i.	s.	s. eth.
1723	col. fum. liq...	$1.570\frac{15}{4}$	0; frz., -24	218–19	d.	s. d.	∞ eth.
1724	col. fum. liq., 1.55369	$1.2187\frac{15}{15}$	-1	$197\ (194^{742})$	d.	s. d.	∞ eth.; s. bz., CS_2, oils
1725	col. need......	....	42	245–7 sl. d.	d.	v. s.	v. s. eth.; s. bz., lgr.
1726	yel. need. f. bz.	....	68–9	196^{12}	d.	d.	s. eth.
1727							
1728	yel. pr.........	....	34	278	d.	d.	s. eth.
1729	yel. need. f. lgr.	....	72	154^{15}	d.	d.	s. eth.
1730	col. tab.......	....	32–3	206–8	i.	v. s.	v. s. eth.
1731	pr. f. h. al., eth. or CS_2	....	133 (128)	d.	i.	sl. s.	sl. s. eth.; s. CS_2; i. NH_4OH
1732	col. fum. liq...	>1	....	159 (156)	hyd. h.	v. s.	v. s. eth.
1734							
1735	need. or leaf...	....	3	135^{25}	d.	s.	∞ eth.
1736	col. rhomb. f. eth.; 1.545, 1.546, 1.837	....	103.5 (106–8)	exp.	sl. s.	s.	s. eth., bz., olive oil; 2.53^{15} CS_2
1737							
	see *Benzoic acid, benzyl-*).						
1738	col. liq., 1.53955	$1.050\frac{15}{15}$	-15.3	$205.2;\ 93^{10}$	4^{17}	66.7 50%, ∞ abs.	∞ eth., chl., me. al.; s. acet.
1739							
1740	need. or leaf. f. dil. al.	....	72	230	sl. s.	s.	s. eth.
1741							
1742							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1743	**Benzyl alcohol, *o*-hydroxy-.**	See *Saligenin.*		
1744	**——, *m*-hydroxy-**	α,3-toluenediol	$HOC_6H_4CH_2OH$	124.13
1745	**——, *p*-hydroxy-**	α,4-toluenediol	$HOC_6H_4CH_2OH$	124.13
1746	**——, 4-hydroxy-3-methoxy-.**	See *Vanillyl alcohol.*		
1747	**——, *p*-isopropyl-.**	See *Cumic alcohol.*		
1748	**——, *o*-methoxy-**	saligenin 2-methyl ether	$CH_3OC_6H_4CH_2OH$	138.16
1749	**——, *p*-methoxy-.**	See *Anisyl alcohol.*		
1750	**——, *o*, *m* or *p*-methyl-.**	See *Carbinol, tolyl-.*		
1751	**——, α-methyl-**	methylphenylcarbinol; 1-phenylethanol	$C_6H_5CH(CH_3)OH$	122.16
1752	**——, 3,4-methylenedioxy-.**	See *Piperonyl alcohol.*		
1753	**——, *o*-nitro-**		$NO_2C_6H_4CH_2OH$	153.13
1754	**——, *m*-nitro-**		$NO_2C_6H_4CH_2OH$	153.13
1755	——, ——, benzoate	*m*-nitrobenzyl benzoate	$C_6H_5COOCH_2$-$C_6H_4NO_2$	257.24
1756	**——, *p*-nitro-**		$NO_2C_6H_4CH_2OH$	153.13
1757	**——, thio-.**	See *α-Toluenethiol.*		
1758	**Benzylamine**	α-aminotoluene	$C_6H_5CH_2NH_2$	107.15
1759	**——, *N*-acetyl-.**	See *Acetamide, N-benzyl-.*		
1760	**——, *N*,*N*-diphenyl-.**	See *Diphenylamine, N-benzyl-.*		
1760M	**——, *p*-methoxy-**	anisylamine, acc. to some	*p*-$CH_3OC_6H_4CH_2$-NH_2	137.18
1761	**——, α-methyl-**	α-phenylethylamine; 1-amino-1-phenylethane	$C_6H_5CH(CH_3)NH_2$	121.18
1762	**——, *N*-methyl-*N*-phenyl-**	*N*-benzyl-*N*-methylaniline	$C_6H_5CH_2N(CH_3)$-C_6H_5	197.27
1763	**——, *N*-nitroso-*N*-phenyl-**	*N*-phenylbenzylnitrosamine	$C_6H_5CH_2N(NO)$-C_6H_5	212.24
1764	**——, *N*-phenyl-**	*N*-benzylaniline	$C_6H_5CH_2NHC_6H_5$	183.24
1765	**Benzyl azide.**	See *Toluene, α-triazo-.*		
1766	**Benzyl bromide**	α-bromotoluene	$C_6H_5CH_2Br$	171.04
1767	**Benzyl chloride**	α-chlorotoluene	$C_6H_5CH_2Cl$	126.58
1768	**——, *o*-bromo-**	*o*-bromo-α-chlorotoluene	$BrC_6H_4CH_2Cl$	205.49
1769	**——, *p*-bromo-**	*p*-bromo-α-chlorotoluene	$BrC_6H_4CH_2Cl$	205.49
1770	**——, *p*-chloro-**	α,4-dichlorotoluene	$ClC_6H_4CH_2Cl$	161.03
1771	**Benzyl cyanide.**	See *α-Tolunitrile.*		
1772	**Benzyl disulfide**	dibenzyl disulfide; α-(benzyldithio) toluene	$(C_6H_5CH_2)_2S_2$	246.37
1773	**Benzyl ether**	dibenzyl ether	$(C_6H_5CH_2)_2O$	198.25
1773M	**Benzyl fluoride**	α-fluorotoluene	$C_6H_5CH_2F$	110.13
1774	**Benzyl hydrosulfide.**	See *α-Toluenethiol.*		
	Benzylidene-.	For benzylidene derivatives see the parent compounds (e.g. for		
1774H	**Benzylidene bromide**	benzal bromide; α, α-dibromotoluene	$C_6H_5CHBr_2$	249.95
1774R	**Benzylidene chloride**	benzal chloride; α, α-dichlorotoluene	$C_6H_5CHCl_2$	161.03
1775	**Benzyl iodide**	α-iodotoluene	$C_6H_5CH_2I$	218.05
1776	**Benzyl mercaptan.**	See *α-Toluenethiol.*		
1777	**Benzyl mustard oil.**	See *Isothiocyanic acid, benzyl ester.*		
1778	**Benzylnitrosamine, *N*-phenyl-.**	See *Benzylamine, N-nitroso-N-phenyl-.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1743							
1744	need. f. bz....	....	67	300 d.	v. s. h.	v. s.	v. s. eth.
1745	col. need. f. w.	....	124 (110)	252	s.	v. s.	v. s. eth.
1746							
1747							
1748	liq., 1.549^{17}....	$1.0495\frac{15}{15}$	....	248–50; $131\text{–}2^{15}$	v. sl. s.	s.	∞ eth.
1749							
1750							
1751	col. liq........	$1.013\frac{20}{4}$; $1.000\frac{25}{4}$	....	205 $(105\text{–}7^{12})$	i.	∞	∞ eth.
1752							
1753	need. f. w......	....	74	168^{20}	sl. s. c.	s.	s. eth.
1754	rhomb........	....	27	180^{3}	sl. s.	s.	v. s. eth.
1755	....	....	69.0–.5	....	i.	s.	s. eth.
1756	need. f. w.....	....	93	185^{12}	sl. s. c., s. h.	v. s.	v. s. eth.
1757							
1758	col. liq., 1.5401	$0.9826\frac{19}{4}$	....	185	∞	∞	∞ eth.
1759							
1760							
1760M	col. liq.......	1.050^{15}	....	236–237; $122\text{–}4^{14}$	s.	∞	∞ eth.
1761	arom. oil......	0.9395^{15}	....	187.4	4.2^{20}	∞	∞ eth.
1762	liq...........	....	9.2	306	i.	v. s.	v. s. eth.
1763	yel. need. f. al.	....	57–8	....	i.	s.	s. eth., chl., lgr.
1764	col. monocl. pr. f. al.	$1.0618\frac{25}{4}$; $1.038\frac{56}{4}$	37–8 (32)	306–7	i.	s.	s. eth., h. meth. al.
1765							
1766	col. pois. liq...	$1.438\frac{22}{0}$	-4.0	198	i.	∞	∞ eth.
1767	col. liq., 1.5415^{15}	$1.1026\frac{18}{4}$	-43 (-48)	179	i. c., d. h.	∞	∞ eth.
1768	....	....	....	$124\text{–}6^{20}$	i.	v. s.	v. s. eth.
1769	need. f. al. or pet. eth.	....	41	236	i.	v. s. h.	v. s. eth.
1770	need.........	....	29	222 (214) d.	i.	s. c., v. s. h.	s. eth., ac. a., CS_2, bz.
1771							
1772	leaf. f. al......	....	(1) 71–2; (2) 69–70	....	v. sl. s.	s. h.	s. eth., bz., h. me. al.
1773	col. oil........	$1.0428\frac{20}{4}$	4–5	295–8 $(157\text{–}60^{15})$	i.	v. s. h.	s. eth.
1773M	col. liq.......	$1.02278^{25.3}$	-35	139.9	d.	....	....
1774	benzylidenemalonic acid see *Malonic acid. benzylidene.*						
1774H	fum. oily liq., 1.541	1.51^{15}	....	140^{20}	i.	∞	∞ eth.
1774R	col. oily liq., 1.5502^{20}	1.2557^{14}	-16; frz. -17	207 (203.5^{756})	i.	∞	∞ eth.
1775	col. cr........	$1.733\frac{25}{4}$	24	93^{10}	i.	s.	s. eth., CS_2
1776							
1777							
1778							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1779	**Benzyloxyamine***	α (or *O*)-benzylhydroxylamine	$C_6H_5CH_2NHOH$	123.15
1780	**Benzyl sulfide**	dibenzyl sulfide	$(C_6H_5CH_2)_2S$	214.31
1781	**Benzyl sulfone**	dibenzyl sulfone	$(C_6H_5CH_2)_2SO_2$	246.31
1782	**Benzyl sulfoxide**	dibenzyl sulfoxide	$(C_6H_5CH_2)_2SO$	230.31
1783	**Berbamine**		$C_{18}H_{19}NO_3 \cdot 2H_2O$	333.37
1784	**Berberine**		$C_{20}H_{17}NO_4 \cdot 6H_2O$	443.44
1785	——, compd. with chloroform		$C_{20}H_{19}NO_5 \cdot CHCl_3$	472.75
1786	——, hydrochloride		$C_{20}H_{19}NO_5 \cdot HCl \cdot 2H_2O$	425.86
1787	——, nitrate		$C_{20}H_{19}NO_5 \cdot HNO_3$	416.38
1788	——, sulfate		$C_{20}H_{19}NO_5 \cdot H_2SO_4$	451.44
1789	**——, tetrahydro-.**	See *Canadine; Hydroberberine.*		
1790	**Berberonic acid**	2,4,5-pyridinetricarboxylic acid*	$C_5H_2N(COOH)_3 \cdot 1\frac{1}{2}H_2O$	238.15
1791	**Betacaine.**	See *β-Eucaine.*		
1792	**Betaine**	lycine;oxyneurine; trimethylglycocoll; (carboxymethyl)-trimethylammonium hydroxide anhydride	$\underline{COCH_2N(CH_3)_3O}$	117.15
1793	**Betel phenol.**	See *Chavibetol.*		
1794	**Betol**	2-naphthyl salicylate; β-naphthyl salicylate	$HOC_6H_4COOC_{10}H_7$	264.27
1795	**Betorcinol.**	See *Resorcinol, 2,5-dimethyl-.*		
1796	**Betulinic acid**		$C_{36}H_{54}O_6$	582.80
1797	**Betulinol**	betulin; betula camphor; birch camphor	$C_{36}H_{60}O_3$(?)	540.85
1798	***p,p'*-Biacetanilide.**	See *Benzidine, N,N'-diacetyl-.*		
1799	**Biacetyl.**	See 2,3-*Butanedione**.		
1800	**Biacetylene.**	See *Butadiyne.*		
1801	**Biallyl.**	See 1,5-*Hexadiene**.		
1802	***o,p'*-Bianiline.**	See 2,4'-*Biphenyldiamine.*		
1803	***p,p'*-Bianiline.**	See *Benzidine.*		
1803M	**Bianisal.**	See *Stilbene, 4,4'-dimethoxy-.*		
1804	**4,4'-Bi-*o*-anisidine**	4,4'-diamino-3,3'-dimethoxybiphenyl	$[CH_3O(NH_2)C_6H_3]_2$	244.29
1805	**Biarsine, tetraethyl-**	ethyl cacodyl; bis(diethylarsenic)	$(C_2H_5)_2AsAs(C_2H_5)_2$	266.06
1806	**——, tetramethyl-.**	See *Cacodyl.*		
1807	***o,o'*-Bibenzoic acid.**	See *Diphenic acid.*		
1808	**Bibenzoyl.**	See *Benzil.*		
1809	**Bibenzyl**	*sym*-or 1,2-diphenylethane; dibenzyl	$C_6H_5CH_2CH_2C_6H_5$	182.25
1810	**——, 4,4'-diamino-.**	See *α, α'-Bi-p-toluidine.*		
1811	**Bi-sec-butyl.**	See *Hexane, 3,4-dimethyl-**.		
1812	**Bi-*tert*-butyl.**	See *Butane,* 2,2,3,3-*tetramethyl*	-*	
1813	**2,2'-Bicamphane-2,2'-**	**diol.** See *Camphor pinacol.*		
1814	**Bicyclo [4,4,0] decane.**	See *Naphthalene, decahydro-**.		
1815	**Bicyclo [2,2,1] heptane.**	See *Norcamphane.*		
1816	**Bicyclo-[2,2,1]hept-2-e**	**ne, 1,7,7-trimethyl-.** See	*Bornylene.*	

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1779	oil..........	....	....	118–9^{30}	s.	......	....
1780	col.rhomb.pl. f. eth. or chl.	$1.0712\frac{50}{50}$	49	....	i.	s.	s. eth.
1781	need. f. al. +bz.	....	151	290 sl. d.	s. h.	sl. s.	v. s. acet.; s. bz., ac. a.
1782	leaf. f. al. or w.	....	134 (130)	d. 210	i. c., s. h.	s.	s. eth.
1783	leaf. f. al., $[\alpha]\ 108.6^{25}_{D}$	....	anh. 200	....	......	s.	s. eth.
1784	yel. anh.need. f. eth.; cr. (+$6H_2O$) f. w.	....	anh. 145	....	22^{21}	1 c.	v. sl. s. eth.; sl. s. chl., bz.
1785	tricl. tab. f. chl.	....	179	....	......	......	....
1786	or. need. or yel. powd.	....	....	....	s.	s.	....
1787	yel. need......	....	....	....	sl. s.	......	....
1788	yel. need......	....	....	....	1^{21}	sl. s.	....
1789							
1790	tricl. pr.......	....	235; anh. 243	....	v. sl. s.	v. sl. s.	i. eth., bz., chl.; s. dil. a.
1791							
1792	col. monocl. pr. or leaf.	....	293 d.	....	157^{19}	8.6^{18}	v. sl. s. eth.
1793							
1794	cr. f. al.......	....	95	....	i.	s.	s. h. eth., h. bz.
1795							
1796	wh. powd.....	....	195	....	sl. s.	v. s.	....
1797	need. f. al. $[\alpha]+19.96^{15}_{D}$ in pyr.	....	258	subl., d.	i.	0.85 c., 4.27 h.	0.4 c., 3.07 h. eth.
1798							
1799							
1800							
1801							
1802							
1803							
1803M							
1804	col. need. or leaf.	....	131.5	....	sl. s. h.	s.	v. s. eth.; s. acet., chl. bz.
1805	liq., ign. in air, 1.4709	$1.1388\frac{28.7}{4}$	....	185–90	i.	s.	s. eth.
1806							
1807							
1808							
1809	col. monocl. need. f. al.	$0.995\frac{20}{4}$; $0.942\frac{80}{4}$	52.5	284	i.	s.	v. s. eth.; s. CS_2
1810							
1811							
1812							
1813							
1814							
1815							
1816							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1817	**Bicyclo[3,1,1]hept-2-en**	**e, 2,6,6-trimethyl-.** See	*Pinene.*	
1818	**Bicyclo[3,1,0]hexane, 1**	**-isopropyl-4-methylene**	**-.** See *Sabinene.*	
1819	**Biethylene.**	See 1,3-*Butadiene**.		
1820	**Biformyl.**	See *Glyoxal.*		
1821	**Biguanide**	guanylguanidine; diguanide	$NH_2C(:NH)NHC(:NH)NH_2$	101.12
1822	——, *α-o*-**tolyl-**		$C_7H_7NHC(:NH)NHC(:NH)NH_2 \cdot \frac{1}{2}H_2O$	200.24
1823	**Bihexyl.**	See *Dodecane**.		
1824	**Biisoamyl.**	See *Octane*, 2,7-*dimethyl*-*.		
1825	**Biisobutyl.**	See *Hexane*, 2,5-*dimethyl*-*.		
1826	**Biisopropenyl.**	See 1,3-*Butadiene*, 2,3-*dimethy*	*l*-*.	
1827	**Biisopropyl.**	See *Butane*, 2,3-*dimethyl*-*.		
1828	**Bikhaconine, acetylver**	**atryl-.** See *Bikhaconitine.*		
1829	**Bikhaconitine**	acetylveratrylbikhaconine	$C_{36}H_{61}NO_{11}$	673 78
1830	**Bilifuscin**		$C_{16}H_{20}N_2O_4$	304.34
1831	**Bilineurine.**	See *Choline.*		
1832	**Bilirubin**		$C_{32}H_{36}N_4O_6$	572.64
1833	**Biliverdin**		$C_{32}H_{36}N_4O_8$	604.64
1834	**1,1′-Bi-2-naphthol**	*β*-dinaphthol; 2,2′-dihydroxy-1,1′-binaphthyl	$HOC_{10}H_6C_{10}H_6OH$	286.31
1835	**4,4′-Bi-1-naphthol**	*α*-dinaphthol; 4,4′-dihydroxy-1,1′-binaphthyl	$HOC_{10}H_6C_{10}H_6OH$	286 31
1836	**1,1′-Binaphthyl***	*α, α*′-dinaphthyl	$C_{10}H_7C_{10}H_7$	254.31
1837	——, **2,2′-dihydroxy-.**	See 1,1′-*Bi-2-naphthol.*		
1838	——, **4,4′-dihydroxy-.**	See 4,4′-*Bi-1-naphthol.*		
1839	**2,2′-Binaphthyl***	*β, β*′-dinaphthyl	$C_{10}H_7C_{10}H_7$	254 31
1840	**Bindschedler green,** leu	co base. See *Diphenylamine, p,*	*p′-bisdimethylamino-*	.
1841	**Bioctyl.**	See *Hexadecane**.		
1842	**Bioxirane.**	See *i-Erythritol, anhydride.*		
1843	*o,o*′-**Biphenol**	2,2′-dihydroxybiphenyl	$HOC_6H_4C_6H_4OH$	186.20
1844	*o,p*′-**Biphenol**	2,4′-dihydroxybiphenyl	$HOC_6H_4C_6H_4OH$	186.20
1845	*m,m*′-**Biphenol**	3,3′-dihydroxybiphenyl	$HOC_6H_4C_6H_4OH$	186.20
1846	*p,p*′-**Biphenol**	4,4′-dihydroxybiphenyl	$HOC_6H_4C_6H_4OH$	186.20
1847	*p,p*′-**Biphenol, 2,2′,6,6′**	**-tetramethoxy-.** See *Hydr*	*ocerulignone.*	
1848	*p,p*′-**Biphenol, 3,3′, 5,5′-tetranitro-**		$[C_6H_2(NO_2)_2OH]_2$	366.20
1849	**Biphenyl**	diphenyl; phenylbenzene	$C_6H_5C_6H_5$	154.20
1850	——, **2-amino-.**	See *o-Biphenylamine.*		
1851	——, **3-amino-.**	See *m-Biphenylamine.*		
1852	——, **4-amino-.**	See *Xenylamine.*		
1853	——, **2-amino-4,4′-dia**	**mino-.** See *Benzidine, 3-amin*	*o-*.	
1854	——, **2-benzyl-**	1-benzyl-2-phenylbenzene	$C_6H_5CH_2C_6H_4C_6H_5$	244.32

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1817							
1818							
1819							
1820							
1821	amor. or pr. f. al.	....	130	....	s.	s.	....
1822	wh. cr.........	....	$\frac{1}{2}H_2O$ 140–4; anh. 145–6	....	s. h.	s.	s. eth.
1823							
1824							
1825							
1826							
1827							
1828							
1829	cr............	....	113	....	......	s.	s. eth.
1830	br. powd......	....	183	....	sl. s.	s.	sl. s. eth.; s. glac. ac. a., alk.
1831							
1832	br. rhomb. cr..	....	192–2.5	....	i.	sl. s.	v. sl. s. eth.; s. CS_2, chl., bz., a., alk.
1833	grn.-blk. powd.	....	....	....	i.	s.	sl. s. eth.; s. bz., alk.; i. chl.
1834	need. f. al. or tol.	....	218	subl.	i.	s.	v. s. eth.; sl. s. chl.
1835	rhomb. f. al....	....	300	subl.	i.	s.	v. s. eth.; s. alk.; sl. s. chl., bz.
1836	col. rhomb. leaf. f. al.	....	160.5 (156)	*ca.* 360; 240–4^{12}	i.	s. h.	s. eth., bz., CS_2
1837							
1838							
1839	col. pl..........	....	187–8 (181)	452	i.	sl. s.	sl. s. eth.; s. h. bz., CS_2
1840							
1841							
1842							
1843	pr. f. tol.; leaf. (hyd.) f. w.	....	hyd. 73–5; anh. 109–10	326	s. h.	s.	s. eth., ac. a., bz., alk.
1844	monocl. pr. or need.	....	162–3	342	sl. s. h.	s.	s. eth.
1845	need. f. w.....	....	123–4	247^{18}	v. sl. s.	s.	s. eth., chl., bz., alk.
1846	rhomb. need. or pl. f. al.	$1.25\frac{20}{4}$	274–5 (270–2)	subl.	sl. s.	s.	s. eth.; sl. s. bz.
1847							
1848	yel. need.......	....	222–5	....	i.	s.	....
1849	col. monocl., α1.56841, β1.59441, γ1.61158; 1.58822$^{77.1}$	$1.180\frac{0}{4}$; $0.9919\frac{73}{4}$	69–71	254–5	i.	10 c.	s. eth.; 6.57$^{19.5}$ me. al.
1850							
1851							
1852							
1853							
1854	monocl. need..	....	54	283–7^{110}	i.	s.	s. eth.; v. s. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1855	**Biphenyl, 4-benzyl-**	1-benzyl-4-phenylbenzene	$C_6H_5CH_2C_6H_4C_6H_5$	244.32
1856	**——, 2-bromo-***	2-bromodiphenyl	$C_6H_5C_6H_4Br$	233.11
1857	**——, 4-bromo-***	4-bromodiphenyl	$C_6H_5C_6H_4Br$	233.11
1858	**——, 2-chloro-***	*o*-chlorodiphenyl	$ClC_6H_4C_6H_5$	188.65
1859	**——, 3-chloro-***	*m*-chlorodiphenyl	$ClC_6H_4C_6H_5$	188.65
1860	**——, 4-chloro-***	*p*-chlorodiphenyl	$ClC_6H_4C_6H_5$	188.65
1861	**——, 2,4′-diamino-.**	See 2,4′-*Biphenyldiamine.*		
1862	**——, 4,4′-diamino-.**	See *Benzidine.*		
1862M	**——, 4,4′-diamino-3,3′-dimethoxy-.**	See 4,4′-*Bi-o-anisidine.*		
1863	**——, 4,4′-dibromo-***	*p,p′*-dibromodiphenyl	$BrC_6H_4C_6H_4Br$	312.02
1864	**——, 4,4′-dichloro-***	4,4′-dichlorodiphenyl	$ClC_6H_4C_6H_4Cl$	223.10
1865	**——, 4,4′-dichloro-2,2′-dinitro-***		$Cl(NO_2)C_6H_3C_6H_3(NO_2)Cl$	313.10
1866	**——, 2,2′-dihydroxy-.**	See *o,o′-Biphenol.*		
1867	**——, 2,4′-dihydroxy-.**	See *o,p′-Biphenol.*		
1868	**——, 3,3′-dihydroxy-.**	See *m,m′-Biphenol.*		
1869	**——, 4,4′-dihydroxy-.**	See *p,p′-Biphenol.*		
1870	**——, 2,2′-dimethyl-.**	See *o,o′-Bitolyl.*		
1871	**——, 2,3′-dimethyl-.**	See *o,m′-Bitolyl.*		
1872	**——, 3,3′-dimethyl-.**	See *m,m′-Bitolyl.*		
1873	**——, 4,4′-dimethyl-.**	See *p,p′-Bitolyl.*		
1874	**——, 2,2′-dinitro-***	*o,o′*-dinitrodiphenyl	$NO_2C_6H_4C_6H_4NO_2$	244.20
1875	**——, 2,4′-dinitro-***	*o,p′*-dinitrodiphenyl	$NO_2C_6H_4C_6H_4NO_2$	244.20
1876	**——, 3,3′-dinitro-***	*m,m′*-dinitrodiphenyl	$NO_2C_6H_4C_6H_4NO_2$	244.20
1877	**——, 4,4′-dinitro-***	*p,p′*-dinitrodiphenyl	$NO_2C_6H_4C_6H_4NO_2$	244.20
1878	**——, 2-ethoxy-***		$C_6H_5C_6H_4OC_2H_5$	198.25
1879	**——, 3-ethoxy-***		$C_6H_5C_6H_4OC_2H_5$	198.25
1880	**——, 1,2,3,4,5,6-hexahydro-.**	See *Cyclohexane, phenyl-.*		
1881	**——, hydroxy-.**	See *Phenol, phenyl-.*		
1882	**——, 4-iodo-***		$C_6H_5C_6H_4I$	280.11
1883	**——, 2-methoxy-***		$C_6H_5C_6H_4OCH_3$	184.23
1884	**——, 4-methoxy-***		$C_6H_5C_6H_4OCH_3$	184.23
1885	**——, 2-methyl-**	*o*-phenyltoluene	$C_6H_5C_6H_4CH_3$	168.23
1886	**——, 3-methyl-**	*m*-phenyltoluene	$C_6H_5C_6H_4CH_3$	168.23
1887	**——, 4-methyl-**	*p*-phenyltoluene	$C_6H_5C_6H_4CH_3$	168.23
1888	**——, 2-nitro-***		$C_6H_5C_6H_4NO_2$	199.20
1889	**——, 3-nitro-***		$C_6H_5C_6H_4NO_2$	199.20
1890	**——, 4-nitro-***		$C_6H_5C_6H_4NO_2$	199.20
1891	**——, 3-phenyl-.**	See *Benzene, 1,3-diphenyl-.*		
1892	**——, 4-phenyl-.**	See *Terphenyl.*		
1893	**——, 3,3′,5,5′-tetrahydroxy-.**	See 5,5′-*Biresorcinol.*		
1894	**——, 2,2′,4,4′-tetranitro-***		$(NO_2)_2C_6H_3C_6H_3(NO_2)_2$	334.20

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1855	leaf..........	....	85	285–6^{100}	i.	s.	s. eth.; v. s. bz.
1856	liq...........	....	<-20	296–8	i.	s.	s. eth.
1857	col. pl. f. al...	....	89–90	310	i.	s.	s. eth.
1858	monocl.......	....	32	273–4	i.	s.	v. s. ẽth.; s. lgr., CCl_4
1859	cr............	....	89	284–5	i.	s.	s. eth.
1860	leaf. f. lgr. or al.	....	77 (66–75)	291.2^{745} (282)	i.	s.	s. eth., lgr.
1861							
1862							
1862M							
1863	monocl. pr....	$1.897\frac{20}{4}$	164	355–60	i.	v. sl. s. h.	s. bz.
1864	monocl. pr. or need. f. tol.	$1.439\frac{20}{4}$	148–9 (130–43)	315–9	i.	......	....
1865	yel. need. f. al.	....	138	....	i.	sl. s. c., s. h.	....
1866							
1867							
1868							
1869							
1870							
1871							
1872							
1873							
1874	yelsh. monocl. need.	$1.45\frac{20}{4}$	124	....	i.	s. h.	s. eth., h. ac. a., h. bz.; sl. s. lgr.
1875	col. monocl. need. or pr.	$1.474\frac{20}{4}$	93.5	....	i.	s. h.	s. eth., h. ac. a., h. bz.
1876	or.-yel. need...	....	200	....	i.	sl. s.	sl. s. eth.; s. h. ac. a., h. bz.
1877	need. f. al.....	$1.445\frac{20}{4}$	233 (237–43)	....	i.	v. sl. s. c., s. h.	v. s. eth.; s. h. bz., h. ac. a.
1878	pr...........	....	34	276	......	v. s.	v. s. eth.
1879	cr............	....	34	305	......	s.	s. eth.
1880							
1881							
1882	col. cr. f. ac. a.	....	113–4 (109–11)	320 d.	i.	s. h.	s. eth., bz., ac. a.
1883	pr...........	....	29	274; 159–60^{18}	......	......	....
1884	leaf..........	....	90 (84–5)	....	......	s. h.	....
1885	col. liq.......	$1.010\frac{20}{4}$	....	260	i.	s.	s. eth.
1886	col. liq.......	$1.031\frac{0}{4}$	....	277	i	s.	s. eth.
1887	col. pl. from lgr.	1.015^{27}	47–48.5	267	i.	s.	s. eth.
1888	rhomb. bi-py. leaf. f. al.	$1.44\frac{20}{4}$	37 (31–3)	320	i.	v. s.	v. s. eth.
1889	yel. leaf. f. w. +al.	....	58.5–61	....	i.	v. s.	v. s. ac. a.; s. lgr.
1890	col. rhomb. bi-py. need. f. al.	$1.328\frac{20}{4}$	113	340	i.	sl. s. c.	s. eth.; v.s. chl.
1891							
1892							
1893							
1894	yel. pr. f. bz...	....	164–5	d.	i.	sl. s.	sl. s. eth.; s. bz., ac. a.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1895	***o*-Biphenylamine**	2-aminobiphenyl	$NH_2C_6H_4C_6H_5$	169.22
1896	***m*-Biphenylamine**	3-aminobiphenyl	$NH_2C_6H_4C_6H_5$	169.22
1897	***p*-Biphenylamine.**	See *Xenylamine.*		
1898	**Biphenylcarboxylic acid.** See *Benzoic acid, phenyl-.*			
1899	**2,4′-Biphenyldiamine**	*o,p′*-bianiline; diphenyline; 2,4′-diaminobiphenyl	$NH_2C_6H_4C_6H_4NH_2$	184.23
1900	**2,2′-Biphenyldicarbonyl chloride.** See *Diphenoyl chloride.*			
1901	**2,2′-Biphenyldicarboxylic acid.** See *Diphenic acid.*			
1902	**2,2′-Biphenyldisulfonic acid, 4,4′-diamino-.** See *2,2′-Benzidinedisulfonic*			
1903	**Biphenylene oxide.**	See *Dibenzofuran.*		
1904	**Biphenylene sulfone, 2,7-diamino-.** See *Benzidine sulfone.*			
1905	***p*-Biphenylyl mustard oil.** See *Isothiocyanic acid, xenyl ester.*			
1906	**Bipropargyl.**	See 1,5-*Hexadiyne.**		
1907	**Bipropenyl.**	See 2,4-*Hexadiene**.		
1908	**4,4′-Bipyridine**	4,4′- or γ,γ′-dipyridyl	$(C_5H_4N)_2$	156.18
1909	**Bipyromucyl.**	See *Furil.*		
1910	**2,3′-Biquinoline**	2,3′-biquinolyl; 2,3′-diquinolyl	$(C_9H_6N)_2$	256.29
1911	**2,7′-Biquinoline**	2,7′-diquinolyl	$(C_9H_6N)_2$	256.29
1912	**6,6′-Biquinoline**	6,6′-diquinolyl	$(C_9H_6N)_2$	256.29
1913	**Birch camphor.**	See *Betulinol.*		
1914	**5,5′-Biresorcinol**	3,3′,5,5′-tetrahydroxybiphenyl	$(HO)_2C_6H_3C_6H_3(OH)_2\cdot 2H_2O$	254.23
1915	**Bismuth, triethyl-***	triethylbismuthine; bismuth triethyl	$Bi(C_2H_5)_3$	296.18
1916	**——, trimethyl-***	trimethylbismuthine	$(CH_3)_3Bi$	254.10
1917	**——, triphenyl-***	triphenylbismuthine	$(C_6H_5)_3Bi$	440.30
	Bismuthine. For derivatives see under *Bismuth.*			
1918	**2,2′-Bithienyl.**	See 2,2′-*Bithiophene.*		
1919	**2,2′-Bithiophene**	2,2′-bithienyl; α, α-dithienyl	$(C_4H_3S)_2$	166.25
1920	**——, hexabromo-**	perbromo-α, α-dithienyl	$(C_4Br_3S)_2$	639.70
1921	**4,4′-Bi-*o*-toluidine**	($NH_2=1$). See *o-Tolidine.*		
1922	**α,α′-Bi-*p*-toluidine**	4,4′-diaminobibenzyl; 4,4′-diamino-*s*-diphenylethane	$H_2NC_6H_4C_2H_4C_6H_4NH_2$	212.29
1923	***o,o′*-Bitolyl**	2,2′-dimethylbiphenyl	$CH_3C_6H_4C_6H_4CH_3$	182.25
1924	***o,m′*-Bitolyl**	2,3′-dimethylbiphenyl	$CH_3C_6H_4C_6H_4CH_3$	182.25
1925	***m,m′*-Bitolyl**	3,3′-dimethylbiphenyl; *m,m′*-ditolyl	$CH_3C_6H_4C_6H_4CH_3$	182.25
1926	***p,p′*-Bitolyl**	4,4′-dimethylbiphenyl	$CH_3C_6H_4C_6H_4CH_3$	182.25
1927	**Biuret**	allophanamide; carbamylurea; ureidoformamide	$NH_2CONHCONH_2\cdot H_2O$	121.10
1928	**——, acetyl-**	acetylallophanamide	$CH_3CONHCONHCONH_2$	145.12
1929	**Bivinyl.**	See 1,3-*Butadiene**.		
1930	**——, α-methyl-.**	See 1,3-*Pentadiene**.		
1931	**——, β-methyl-.**	See *Isoprene.*		
1932	**Blue cross.**	See *Arsine, chlorodiphenyl-.*		
1933	**Boric acid, benzyl-**	benzylboron dihydroxide; α-tolueneboronic acid	$C_6H_5CH_2B(OH)_2$	135.96

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1895	col. leaf......	....	49.3 (45.5)	299	i.	s.	....
1896	col. leaf. or need.	....	30	254^{135}	sl. s.	s.	s. eth.
1897							
1898							
1899	need. f. dil. al.	....	45	363	v. sl. s.	s.	s. eth.
1900							
1901							
1902	*acid*						
1903							
1904							
1905							
1906							
1907							
1908	need. (+$2H_2O$) f. w.	....	$2H_2O$, 73; anh. 114	304.8	v. sl. s.	v. s.	v. s. eth.; s. chl., bz.
1909							
1910	yel. pl. or need. f. bz.	....	176–7	>400	i.	v. s.	s. eth., h. chl., h. bz.
1911	monocl. pl. f. al.	....	193	subl.	i.	v. sl. s.	sl. s. eth.; s. chl., h. bz.
1912	monocl. leaf. f. al.	....	181 (178)	dist.	v. sl. s. h.	v. sl. s.	s. eth., bz.
1913							
1914	pl., need. or wh.cr.powd.	....	anh. 310	....	s. h.	s.	s. eth.; i. ac. a., acet.
1915	col. liq.......	$1.82\frac{20}{4}$	....	107^{79} exp.	i.	s.	s. eth.
1916	....	$2.300\frac{18}{4}$	....	110	......	......	....
1917	monocl.......	$1.585\frac{20}{4}$	77–8	242^{14}	i.	sl. s.	s. eth.; v. s. chl., acet.
1918							
1919	col. leaf.......	....	33	260	i.	v. s.	v. s. eth.; s. ac. a.
1920	need.........	....	255	....	....	i.	s. h. bz.
1921							
1922	lust. pl. f. w...	....	134–5 (132)	subl.	s. h.	v. s.	....
1923	col. liq. or cr. f. al.	$0.955\frac{10}{4}$	17.8	272; 258^{738}	i.	s.	s. eth., bz.
1924	col. liq.......	....	....	270 (287 5)	i.	v. s.	v. s. eth.; s. bz.
1925	col. visc. liq...	$0.9993\frac{16}{4}$	5–7	286–7^{718}	i.	s.	s. eth., bz.
1926	col. monocl. pr. f. eth.	$1.102\frac{20}{4}$; liq. 0.917^{121}	121	273–6 (295)	i.	s.	s. eth., bz., CS_2
1927	col. need. (+$1H_2O$); anh. f. al.	....	190 (193) d.	....	1.54^{15}; 45.5^{100}	v. s.	v. sl. s. eth.
1928	col. need.......	....	193	....	s.	v. s.	sl. s. eth.; s. bz.
1929							
1930							
1931							
1932							
1933	wh. cr........	....	–H_2O, 104; anh. 140	d.	sl. s. c.	......	s. eth., bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1934	**Boric acid, *p*-bromophenyl-**		$BrC_6H_4B(OH)_2$	200.84
1934M	**——, *o*(and *m*)-chlorophenyl-**	*o*-and *m*-chlorobenzeneboronic acid	$ClC_6H_4B(OH)_2$	156.39
1935	**——, *p*-chlorophenyl-**		$ClC_6H_4B(OH)_2$	156.39
1936	**——, ethyl-**	ethaneboronic acid	$C_2H_5B(OH)_2$	73.90
1937	**——, isoamyl-**	3-methyl-1-butaneboronic acid	$(iso\text{-}C_5H_{11})B(OH)_2$	115.98
1938	**——, isobutyl-**		$(CH_3)_2CHCH_2B(OH)_2$	101.95
1939	**——, phenyl-**	phenylboron dihydroxide; benzeneboronic acid	$C_6H_5B(OH)_2$	121.94
1940	**——, propyl-**	1-propaneboronic acid	$n\text{-}C_3H_7B(OH)_2$	87.92
1940M	**——, *o*-(and *m*)-tolyl-**	*o*-and *m*-tolueneboronic acid	$CH_3C_6H_4B(OH)_2$	135.96
1941	**——, *p*-tolyl-**	*p*-tolylboron dihydroxide	$CH_3C_6H_4B(OH)_2$	135.96
1942	**Borine, difluorophenyl-**	boron phenyl difluoride; phenylboron difluoride	$C_6H_5BF_2$	125.92
1943	**——, difluoro-*p*-tolyl-**	boron *p*-tolyl difluoride	$CH_3C_6H_4BF_2$	139.95
1944	**——, triethyl-**	triethylboron; boron triethyl	$(C_2H_5)_3B$	98.00
1945	**——, triisoamyl-**	triisoamylboron	$(C_5H_{11})_3B$	224.24
1946	**——, triisobutyl-**	triisobutylboron	$(C_4H_9)_3B$	182.16
1947	**——, trimethyl-**	trimethylboron; boron trimethyl	$(CH_3)_3B$	55.92
1948	**——, triphenyl-**	boron triphenyl; triphenylboron	$(C_6H_5)_3B$	242.12
1949	**——, tripropyl-**	tripropylboron	$(C_3H_7)_3B$	140.08
1950	**Borneo camphor.**	See *d-Borneol.*		
1951	***dl*-Borneol**	*dl-exo*-2-camphanol; *dl*-bornyl alcohol; *dl*-α-camphol	$C_{10}H_{17}OH$	154.25
1952	——, acetate	*dl*-bornyl acetate	$C_{10}H_{17}OOCCH_3$	196.28
1953	***d*-Borneol**	*d*-exo-2-camphanol; *d*-bornyl alcohol; Borneo camphor; Malay camphor; Sumatra camphor; *d*-α-camphol	$C_{10}H_{17}OH$	154.25
1954	——, acetate		$CH_3COOC_{10}H_{17}$	196.28
1955	***l*-Borneol**	*l-exo*-2-camphanol; ngai camphor	$C_{10}H_{17}OH$	154.25
1956	——, acetate	*l*-bornyl acetate	$C_{10}H_{17}OOCCH_3$	196.28
1957	**Bornyl acetate.**	See *Borneol, acetate.*		
1958	**Bornyl alcohol.**	See *Borneol.*		
1959	**Bornylamine**		$C_{10}H_{17}NH_2$	153.26

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1934	need.	....	266	....	......	......	s. eth.
1934M	wh. cr.	....	indef. (dehyd.)	d.	sl. s.	s.	s. eth., bz., lgr.
1935	need. or sheafs.	....	275	....	......	......	s. eth.
1936	wh. leaf. or pl.	....	subl. 40 (?); indef.; (d.)	d.	s.	s.	s. eth.
1937	col. sq. tab. doub. refractive	....	169 (101) d.	d.	s. c.; v. s. h.	s.	s. eth., all org. solv.
1938	lng. pointed doubly refracting pl.	....	112 (104)	....	s.	s.	s. eth.
1939	wh. need.	....	214–6 (d.)	d.	sl. s.	s.	s. eth., bz.
1940	wh. thick rect. pl.	....	107 (74–5) d.	d.	s.	s.	s. eth., dichloroethane
1940M	wh. need. or pl.	....	indef. (d.)	d.	sl. s.	s.	s. eth., bz.
1941	need	....	240	....	......	......	s. eth.
1942	col. oil	....	....	70–5	d.	......	s. eth., bz.
1943	col. oil	....	....	95–7	d.	......	s. eth., bz.
1944	col. fum. liq.	0.6961^{23}_{4}	....	95	v. sl. s.	s.	s. eth.
1945	liq., 1.43207	$0.7600^{23.4}_{4}$	....	119^{14}	......	......	s. eth.
1946	liq., $1.42445^{22.8}$	0.7380^{25}_{4}	....	188; 86^{20}	......	......	s. eth.
1947	col. gas	1.9108 g/l	−161.5	−20	v. sl. s.	v. s.	v. s. eth.
1948	hex. columns, d. in air	....	136	245–50; (203^{15})	i.	d.	s. eth., bz.
1949	liq., $1.42354^{22.5}$	$0.7204^{24.7}_{4}$	....	156 (60^{20})	......	......	s. eth.
1950							
1951	col. hex. leaf. f. lgr., $[\alpha]-44.2^{\circ}_{D}$	1.011^{20}_{4}	210.5	subl.	v. sl. s.	v. s.	v. s. eth.; 25^{20} bz.
1952	col., 1.4630	0.985^{20}_{4}	27–8	114^{22}	......	......	....
1953	col. hex. leaf., $[\alpha]\ +37.44^{\circ 20}_{D}$ in al.	1.011^{20}_{4}	208	212 subl.	0.074^{25}	s.	s. eth., lgr.; 22.2^{20} bz.
1954	col. rhomb., 1.46635^{15}, liq. $[\alpha]\ +44.45^{\circ 20}_{D}$	liq. 0.9855^{20}_{4}	29	223–4 (225–6)	v. sl. s.	v. s.	s.eth.
1955	col. hex. pl., $[\alpha]\ 37.74^{\circ 20}_{D}$ in al.	1.011^{20}_{4}	208.6	210^{799} subl.	0.0740^{25}	s.	v. s. eth.; 22.2^{20} bz.
1956	col., 1.46635^{15}	0.9855^{20}_{4}	29	223–4	......	......	....
1957							
1958							
1959	col. cr., $[\alpha]\ +47.2^{\circ 30}_{D}$ in al.	....	163	200 subl.	v. sl. s.	v. s.	v. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1960	**Bornyl chloride**	2-chlorocamphane (one form); pinene hydrochloride; artificial camphor	$C_{10}H_{17}Cl$	172.69
1961		See also *Isobornyl chloride.*		
1962	*l*-**Bornylene**	*l*-1,7,7-trimethylbicyclo-[2,2,1]-2-heptene	$C_{10}H_{16}$	136.23
1963	**Bornyl esters.**	See under *Borneol.*		
1964	**Boron.** (For other derivatives see under *Boric acid* and *Borine.*)			
1965	——, **triethoxy-.**	See *Ethyl borate.*		
1966	——, **trimethoxy-.**	See *Methyl borate.*		
1967	——, **tripropoxy-.**	See *Propyl borate.*		
1968	**Brasileïn.**	See *Brazileïn.*		
1969	**Brasilin.**	See *Brazilin.*		
1970	**Brassidic acid, Brassic acid**	*trans*-13-docosenoic acid*; isoerucic acid; *trans*-erucic acid	$C_8H_{17}CH{:}CHC_{11}H_{22}COOH$	338.56
1971	**Brassidic anhydride**		$(C_{21}H_{41}CO)_2O$	659.10
1972	**Brazileïn**	brasileïn	$C_{16}H_{12}O_5$	284.26
1973	**Brazilin**	brasilin	$C_{16}H_{14}O_5 \cdot 1\frac{1}{2}H_2O$	313.30
1974	**British gum.**	See *Dextrin.*		
1975	**Bromacetol.**	See *Propane, 2,2-dibromo-*.*		
1976	**Bromal**	2,2,2-tribromoethanal*; tribromoacetaldehyde; tribromoaldehyde	CBr_3CHO	280.78
1977	——, hydrate	2,2,2-tribromo-1,1-ethanediol*; tribromoethylidene glycol	$CBr_3CH(OH)_2$	298.79
1978	**Bromanilid.**	See *Acetanilide, p-bromo-.*		
1979	**Bromelia.**	See *Ether, ethyl 2-naphthyl.*		
1980	**Bromine cyanide.**	See *Cyanogen bromide.*		
	Bromo- See the parent compounds (e.g., for bromoacetic acid see *Acetic acid, bromo-.*)			
1981	**Bromoform**	tribromomethane	$CHBr_3$	252.77
1982	——, **nitro-.**	See *Bromopicrin.*		
1983	**Bromopicrin**	tribromonitromethane*; nitrobromoform	NO_2CBr_3	297.77
1984	**Brönner's acid.**	See 2-*Naphthylamine-6-sulfonic acid.*		
1985	**Brucine**		$C_{23}H_{26}N_2O_4 \cdot 4H_2O$	466.52
1986	——, hydrochloride		$C_{23}H_{26}N_2O_4 \cdot HCl$	430.92
1987	——, nitrate		$C_{23}H_{26}N_2O_4 \cdot HNO_3 \cdot 2H_2O$	493.51
1988	——, sulfate		$(C_{23}H_{26}N_2O_4)_2 \cdot H_2SO_4 \cdot 7H_2O$	1013.10
1989	**Bulbocapnine**		$C_{19}H_{19}NO_4$	325.35
1990	**1,2-Butadiene***	methylallene	$CH_2{:}C{:}CHCH_3$	54.09
1990M	——, **3-methyl-**	*unsym*-dimethylallene	$CH_2{:}C{:}C(CH_3)_2$	68.11
1991	**1,3-Butadiene***	bivinyl; erythrene; pyrrolylene; vinylethylene; divinyl; biethylene	$CH_2{:}CHCH{:}CH_2$	54.09

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1960	col. cr........	....	131–2 (128)	207.4	i.	26.04	s. eth.
1961							
1962	col. cr. f. me. al., $[\alpha]$ $-22.27^{\circ 20}_{D}$ in bz.	....	113	146^{750}	i.	s.	s. eth., tol., me. al.
1963							
1964							
1965							
1966							
1967							
1968							
1969							
1970	col. leaf. f. al., 1.4347^{100}	$0.8585\frac{57}{4}$	61 5	282^{30}	0.74^{24}	v. sl. s. c.	s. eth.
1971	need..........	$0.835\frac{70}{4}$	64	....	i.	sl. s.	s. eth.
1972	dk. red rhomb. leaf.	....	....	....	sl. s. h.	s.	s. eth., alk.
1973	wh. or pa. yel. rhomb. need. f. al.	....	250	....	sl. s.	s.	s. eth., alk.
1974							
1975							
1976	yel. liq.......	2.30^{15}	....	174	d	s.	s. eth.
1977	col. monocl. pr.	$2.566\frac{40}{4}$	53.5	d.	s.	s.	s. eth.
1978							
1979							
1980							
1981	col. liq. or hex. cr., $1.5980^{19.0}$	$2.890\frac{20}{4}$	6–7	149.5	0.319^{20}	∞	∞ eth.; s bz., chl., pet. eth. and oils
1982							
1983	pr., 1.5831^{13}...	$2.811\frac{12.5}{4}$	10	127^{118}	i.	s.	s. eth.
1984							
1985	monocl. pr. f. al. $[\alpha]$–119°D	....	$4H_2O$, 105; anh. 178	....	0.1 c., 0.67^{100}	81.8^{25}	0.75 eth.; 13 1^{25} chl.; s. bz.; i. alk.
1986	wh. need......	....	....	....	s.	s.	....
1987	wh. pr........	....	anh. 230 d.	....	s.	s.	....
1988	lng. need.....	....	....	....	s.	s.	....
1989	rhomb. pr. f. eth., $[\alpha]$ +237.1°D	....	199	....	i.	s.	s. eth., chl.
1990	col. liq.......	....	136.3	10.3	i.	∞	∞ eth.
1990M	liq...........	$0.683\frac{20}{4}$	–120	40.5–41.5	......	......	....
1991	gas..........	$0.650\frac{-6}{4}$	–108.92	–3	i.	v. s.	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1992	**1, 3-Butadiene, 2-chlo**	ro-*. See *Chloroprene.*		
1993	**——, 2,3-dimethyl-***	biisopropenyl	$CH_2{:}C(CH_3)$- $C(CH_3){:}CH_2$	82.14
1994	**——, 2-methyl-*.**	See *Isoprene.*		
1995	**Butadiyne***	butadiine; biacetylene	$CH\vdots CC\vdots CH$	50.06
1996	**Butanal*.**	See *Butyraldehyde.*		
1997	**Butanamide*.**	See *Butyramide.*		
1998	**Butane**	*n*-butane; methylethylmethane	$CH_3(CH_2)_2CH_3$	58.12
1999	**——, 1-amino-.**	See *Butylamine (n).*		
2000	**——, 2-amino-.**	See *sec-Butylamine.*		
2000H	**——, 2-amino-2,3-dim**	ethyl-. See *Propylamine, α, α*	*, β-trimethyl-.*	
2000R	**——, 1-amino-2-ethyl-**	. See *Butylamine, β-ethyl-.*		
2001	**——, 1-amino-3-meth**	yl-. See *Isoamylamine.*		
2001F	**——, 3-amino-2-meth**	yl-. See *Propylamine, α, β-dim*	*ethyl-.*	
2002	**——, 1-benzyloxy-.**	See *Ether, benzyl butyl.*		
2003	**——, 2,2-bis(ethylsulf**	onyl)-*. See *Trional.*		
2004	**——, 1-bromo-*.**	See *Butyl bromide(n).*		
2005	**——, 2-bromo-*.**	See *sec-Butyl bromide.*		
2006	**——, 1-bromo-2-methyl-* (*d*)**	*d-pri-act*-amyl bromide	$CH_3CH_2CH(CH_3)$- CH_2Br	151.06
2007	**——, 1-bromo-3-methyl-*.**	See *Isoamyl bromide.*		
2008	**——, 1-butoxy-*.**	See *Butyl ether.*		
2009	**——, 1-butyldithio-*.**	See *Butyl disulfide.*		
2009H	**——, 1-(butylsulfinyl)***	-. See *Butyl sulfoxide.*		
2009R	**——, 1-(butylsulfonyl)**	-*. See *Butyl sulfone.*		
2010	**——, butylthio-*.**	See *Butyl sulfide (n).*		
2011	**——, 1-chloro-*.**	See *Butyl chloride (n).*		
2012	**——, 2-chloro-*.**	See *sec-Butyl chloride.*		
2013	**——, 1-chloro-2-methyl-***	*pri-act*-amyl chloride	$CH_3CH_2CH(CH_3)$- CH_2Cl	106.60
2014	**——, 1-chloro-3-methy**	l-*. See *Isoamyl chloride.*		
2015	**——, 2-chloro-2-methyl-***	*tert*-amyl chloride	$CH_3CH_2CCl(CH_3)$- CH_3	106.60
2016	**——, 1,2,3,4-diepoxy-.**	See *i-Erythritol, anhydride.*		
2017	**——, 1,4-dihydroxy-.**	See 1,4-*Butanediol*.*		
2018	**——, 2,2-dimethyl-***	ethyltrimethylmethane; neohexane	$(CH_3)_3CCH_2CH_3$	86.17
2019	**——, 2,3-dimethyl-***	isopropyldimethylmethane; biisopropyl	$(CH_3)_2CHCH$- $(CH_3)_2$	86.17
2020	**——, 1-ethoxy-*.**	See *Ether, butyl ethyl.*		
2021	**——, 1-ethoxy-3-meth**	yl-*. See *Ether, ethyl isoamyl.*		
2021M	**——, 1-fluoro-*.**	See *Butyl fluoride (n).*		
2022	**——, 1-iodo-*.**	See *Butyl iodide.*		
2023	**——, 2-iodo-*.**	See *sec-Butyl iodide.*		
2024	**——, 1-iodo-2-methyl-***	*pri-act*-amyl iodide	$CH_3CH_2CH(CH_3)$- CH_2I	198.06
2025	**——, 1-iodo-3-methyl-**	*. See *Isoamyl iodide.*		
2026	**——, 2-iodo-2-methyl-**	* *tert*-amyl iodide	$CH_3CH_2CI(CH_3)$- CH_3	198.06
2027	**——, 1-methoxy-*.**	See *Ether, butyl methyl.*		
2028	**——, 2-methyl-***	ethyldimethylmethane; isopentane	$(CH_3)_2CHCH_2CH_3$	72.15
2029	**——, 3-methyl-1-(γ-m**	ethylbutoxy)-*. See *Isoam*	*yl ether.*	
2030	**——, 2-methyl-1-(β-m**	ethylbutylthio)-*. See *Su*	*lfide, bis(β-methylbut*	*yl).*
2031	**——, 3-methyl-1-(γ-m**	ethylbutylthio)-*. See *Is*	*oamyl sulfide.*	
2032	**——, 3-methyl-1-phen**	oxy-. See *Ether, isoamyl phen*	*yl.*	
2033	**——, 2-methyl-2-phen**	yl-. See *Benzene, tert-amyl-.*		
2034	**——, 3-methyl-1-phen**	yl-. See *Benzene, isoamyl-.*		
2035	**——, 3-methyl-1-(2-pr**	openoxy)-*. See *Ether, allyl i*	*soamyl.*	

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1992							
1993	col. liq., 1.4377^{17}	$0.7446\frac{0}{0}$; $0.727\frac{20}{20}$	−76.01	69.6	......	......	....
1994							
1995	gas..........	2.233	−36.4	10.3	460 cm^3	s.	v. s. eth.
1996							
1997							
1998	col. gas or hex.	liq. $0.60\frac{0}{4}$	−135	−0.6 to −0.3	$15\frac{17}{772}$ cm^3	$1813\frac{17}{775}$ cm^3	$2980\frac{18}{778}$ cm^3 eth.
1999							
2000							
2000 H							
2000 R							
2001							
2001 F							
2002							
2003							
2004							
2005							
2006	liq..........	$1.221\frac{20}{4}$	....	120–1	i.	s.	s. eth.
2007							
2008							
2009							
2009 H							
2009 R							
2010							
2011							
2012							
2013	liq..........	$0.881\frac{18}{4}$	....	97–9	i.	s.	s. eth.
2014							
2015	liq., 1.407^{18}....	$0.871\frac{20}{4}$	−73	86	i.	s.	s. eth.
2016							
2017							
2018	liq., 1.3675....	$0.6487\frac{20}{4}$	−98.2	49.7	i.	s.	s. eth.
2019	liq., 1.3783....	$0.668\frac{17}{4}$	−135.1	58.1	i.	s.	s. eth.
2020							
2021							
2021 M							
2022							
2023							
2024	liq., 1.4981^{15}...	1.524	....	148	i.	s.	s. eth.
2025							
2026	liq..........	1.497^{19}	....	125–8	i.	∞	∞ eth.
2027							
2028	col. liq., 1.355.	0.621^{19}	−160.5	28 (27–31)	i.	∞	∞ eth.
2029							
2030							
2031							
2032							
2033							
2034							
2035							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2036	**Butane, (α-methylpropoxy)-*.**	See *sec-Butyl ether.*		
2037	**——, 1-nitro-***		$CH_3CH_2CH_2CH_2NO_2$	103.12
2038	**——, 1-phenyl-.**	See *Benzene, butyl-.*		
2039	**——, 2-phenyl-.**	See *Benzene, sec-butyl-.*		
2040	**——, 2,2,3,3-tetramethyl-***	*tert*-butyltrimethylmethane; bi-*tert*-butyl; hexamethylethane	$CH_3C(CH_3)_2C(CH_3)_2CH_3$	114.23
2041	**——, 2,2,3-trimethyl-***	isopropyltrimethylmethane	$CH_3C(CH_3)_2CH(CH_3)CH_3$	100.20
2042	**1-Butanearsonic acid**	*n*-butylarsonic acid	$CH_3(CH_2)_3AsO(OH)_2$	182.04
2042M	**1-Butaneboronic acid, 3-methyl-.**	See *Boric acid, isoamyl-.*		
2043	**Butanedial*.**	See *Succinaldehyde.*		
2044	**Butanediamide*.**	See *Succinamide.*		
2045	**——, 2-hydroxy-*.**	See *Malamide.*		
2046	**1,4-Butanediamine*.**	See *Putrescine.*		
2047	**1,1-Butanedicarboxylic acid*.**	See *Malonic acid, propyl-.*		
2048	**1,2-Butanedicarboxylic acid.**	See *Succinic acid, ethyl-.*		
2049	**1,4-Butanedicarboxylic acid.**	See *Adipic acid.*		
2050	**2,3-Butanedicarboxylic acid, 2,3-dimethyl-.**	See *Succinic acid, tetramethyl-.*		
2051	**Butanedinitrile*.**	See *Succinonitrile.*		
2052	**Butanedioic acid*.**	See *Succinic acid.*		
2053	**Butanedioic anhydride*.**	See *Succinic anhydride.*		
2054	**1,1-Butanediol, 2,2,3-trichloro-*.**	See *Butyraldehyde, α, α, β-trichloro-*,		
2055	**1,2-Butanediol***	α-butylene glycol; ethylethylene glycol	$CH_3CH_2CH(OH)CH_2OH$	90.12
2056	**——, 3-methyl-***	isopropylethylene glycol; α-isoamylene glycol	$(CH_3)_2CHCH(OH)CH_2OH$	104.15
2057	**1,3-Butanediol***	β-butylene glycol; α-methyltrimethylene glycol	$CH_3CH(OH)CH_2CH_2OH$	90.12
2058	**——, 3-methyl-***	γ-isoamylene glycol	$(CH_3)_2COHCH_2CH_2OH$	104.15
2059	**1,4-Butanediol***	tetramethylene glycol; 1,4-dihydroxybutane	$CH_2OH(CH_2)_2CH_2OH$	90.12
2060	**2,3-Butanediol***	pseudobutylene glycol; *sym*-dimethylethylene glycol	$CH_3CH(OH)CH(OH)CH_3$	90.12
2061	**——, 2,3-dimethyl-*.**	See *Pinacol.*		
2062	**——, 2,3-diphenyl-**	α, α′-dimethylhydrobenzoin; acetophenone pinacol	$CH_3COH(C_6H_5)COH(C_6H_5)CH_3$	242.31
2063	**——, 2-methyl-***	trimethylethylene glycol; β-isoamylene glycol	$(CH_3)_2C(OH)CH(OH)CH_3$	104.15
2064	**1,3-Butanedione, 1-phenyl-*.**	See *Acetone, benzoyl-.*		
2065	**2,3-Butanedione***	dimethylglyoxal; biacetyl; dimethyl diketone; diacetyl	$CH_3COCOCH_3$	86.09
2066	——, dioxime*.	See *Glyoxime, dimethyl-.*		
2067	——, mono-oxime	biacetyl mono-oxime; α-isonitrosoethyl methyl ketone	$CH_3COC(:NOH)CH_3$	101.10
2068	**Butanedioyl chloride*.**	See *Succinyl chloride.*		
2069	**Butanenitrile*.**	See *Butyronitrile.*		
2070	**——, 3-methyl-*.**	See *Isovaleronitrile.*		
2071	**1,2,3,4-Butanetetrol***	(*anti*). See *i-Erythritol.*		
2072	**1-Butanethiol***	butyl mercaptan	$CH_3(CH_2)_2CH_2SH$	90.18
2073	**——, 2-methyl-***	*pri-act*-amyl mercaptan	$CH_3CH_2CH(CH_3)CH_2SH$	104.21
2074	**——, 3-methyl-***	isoamyl mercaptan	$(CH_3)_2CH(CH_2)_2SH$	104.21
2075	**2-Butanethiol, 2-methyl-***	*tert*-amyl mercaptan	$CH_3CH_2C(CH_3)_2SH$	104.21

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2036							
2037	liq..........	....	....	151–2	v. sl. s.	∞	∞ eth.
2038							
2039							
2040	leaf. f. eth....	....	104 (98–9)	106.8	i.	......	s. eth.
2041	col. liq., 1.38944^{20}	0.69011^{20}	−25.0	80.882	i.	s.	s. eth.
2042	....	....	158–9	....	v. s.	s.	s. eth.
2042M							
2043							
2044							
2045							
2046							
2047							
2048							
2049							
2050							
2051							
2052							
2053							
2054	*hydrate.*						
2055	liq..........	$1.019\frac{0}{4}$	....	192	sl. s.	∞	....
2056	liq..........	$0.9987\frac{0}{4}$	....	206	......	s.	s. eth.
2057	visc. liq.......	1.005	....	204	s.	s.	i. eth.
2058	thick syrup...	$0.9892\frac{20}{4}$	....	202–3	s.	s.	....
2059	need. or oil....	$1.020\frac{20}{4}$	16	230	∞	s.	sl. s. eth.
2060	liq..........	$1.048\frac{0}{4}$	....	184	∞	s.	∞ eth.
2061							
2062	need........	....	121–2; 116–7	....	i.	v. s.	v.s.eth.; sl. s. pet. eth.
2063	thick oil......	$0.9893\frac{0}{0}$	....	177	∞	∞	∞ eth.
2064							
2065	grnsh. yel. liq., 1.39331^{18}	$0.9904\frac{15}{15}$	....	88	25^{15}	∞	∞ eth.
2066							
2067	pr. f.chl.; leaf. f. w.	....	74–5	186	sl. s.	v. s.	v. s. eth.; s. alk.
2068							
2069							
2070							
2071							
2072	col. liq.......	$0.858\frac{0}{4}$; $0.8365\frac{25}{4}$	−115.9	98	sl. s.	v. s.	v. s. eth.
2073	liq..........	$0.8415\frac{23}{4}$	....	119–21	......	......	....
2074	col. liq., 1.44118	$0.835\frac{20}{4}$	....	119	i.	∞	∞ eth.
2075							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2076	**1,2,3-Butanetricarboxylic acid, 1,2,3-dimethyl-***. See *l-Camphoronic acid.*			
2077	**Butanimide*.**	See *Succinimide.*		
2078	**Butanoic acid*.**	See *Butyric acid.*		
2079	**——, 3-methyl-*.**	See *Isovaleric acid.*		
2079M	**——, 3-oxo-*.**	See *Acetoacetic acid.*		
2080	**Butanoic anhydride*.**	See *Butyric anhydride.*		
2081	**1-Butanol*.**	See *Butyl alcohol* (*n*).		
2081M	**——, 2-amino-**		$CH_3CH_2CH(NH_2)$-CH_2OH	**89.14**
2082	**——, 2-ethyl-***	3-methylolpentane; pseudohexyl alcohol	$(C_2H_5)_2CHCH_2OH$	**102.17**
2083	——, ——, acetate	*β*-ethylbutyl acetate	$(C_2H_5)_2CHCH_2$-$OOCCH_3$	**144.21**
2084	**——, 2-methyl-*(*d*)**	*d-sec*-butylcarbinol; *d-pri-act*-amyl alcohol	$CH_3CH_2CH(CH_3)$-CH_2OH	**88.15**
2085	**——, 3-methyl-*.**	See *Isoamyl alcohol.*		
2086	**——, 3-methyl-1-phenyl-***	isobutylphenylcarbinol	$(CH_3)_2CHCH_2$-$CHOHC_6H_5$	**164.24**
2086M	**——, 2-nitro-***		$CH_3CH_2CH(NO_2)$-CH_2OH	**119.12**
2086R	**——, 2-nitro-2-methylol-.** See 1,3-*Propanediol, 2-ethyl-2-nitro-*.*			
2087	**2-Butanol*.**	See *sec-Butyl alcohol.*		
2088	**——, 2,3-dimethyl-***	isopropyldimethylcarbinol	$(CH_3)_2COHCH$-$(CH_3)_2$	**102.17**
2089	**——, 3,3-dimethyl-*.**	See *Pinacolyl alcohol.*		
2090	**——, 2-methyl-***	dimethylethylcarbinol; *tert*-amyl alcohol	$CH_3CH_2C(CH_3)$-$OHCH_3$	**88.15**
2091	**——, 3-methyl-***	methylisopropylcarbinol; *sec*-isoamyl alcohol	$(CH_3)_2$-$CHCHOHCH_3$	**88.15**
2092	**——, 2,3,3-trimethyl-***	*tert*-butyldimethylcarbinol; pentamethylethyl alcohol	$(CH_3)_3CC(CH_3)_2$-OH	**116.20**
2093	**Butanolide.**	See *Butyrolactone.*		
2094	**1-Butanone, 3-methyl-1-phenyl-.** See *Isovalerophenone.*			
2095	**2-Butanone***	ethyl methyl ketone	$CH_3COC_2H_5$	**72.10**
2096	——, oxime	methyl ethyl ketoxime	$CH_3C{:}NOH(C_2H_5)$	**87.12**
2097	**——, 3,3-dimethyl-*.**	See *Pinacolin.*		
2098	**——, 3,3-diphenyl-**	acetophenone pinacolin	$CH_3COC(C_6H_5)_2$-CH_3	**224.29**
2098M	**——, 1-hydroxy-**	ethylketol	$CH_3CH_2CO{\cdot}CH_2OH$	**88.10**
2099	**——, 3-hydroxy-*.**	See *Acetoin.*		
2100	**——, 3-methyl-***	isopropyl methyl ketone	$CH_3COCH(CH_3)_2$	**86.13**
2101	——, ——, oxime	methyl isopropyl ketoxime	$CH_3C{:}NOHCH$-$(CH_3)_2$	**101.15**
2102	**——, 1-phenyl-**	benzyl ethyl ketone	$C_2H_5COCH_2C_6H_5$	**148.20**
2103	**——, 4-phenyl-**	benzylacetone	$C_6H_5CH_2CH_2$-$COCH_3$	**148.20**
2105	**Butanoyl bromide*.**	See *Butyryl bromide.*		
2106	**Butanoyl chloride*.**	See *Butyryl chloride.*		
2107	**——, 3-methyl-*.**	See *Isovaleryl chloride.*		
2108	**2-Butenal*.**	See *Crotonaldehyde.*		
2109	**——, 2-methyl-*.**	See *Tiglaldehyde.*		
2109M	**2-Butenamide*.**	See *Crotonamide.*		
2110	**1-Butene***	*α*-butylene; ethylethylene	$CH_3CH_2CH{:}CH_2$	**56.10**
2111	**——, 4-bromo-***	*δ*-bromo-*α*-butylene; vinylethyl bromide	$CH_2BrCH_2CH{:}CH_2$	**135.01**

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2076							
2077							
2078							
2079							
2079M							
2080							
2081							
2081M	1.453^{20}.......	0.944	-2	178; $79\text{–}80^{10}$	∞	......	....
2082	col. liq., 1.421.	$0.8328\frac{20}{20}$	....	149.5	0.63^{24}, 0.43^{20}	s.	s. eth.
2083	col. liq., 1.410.	$0.879\frac{20}{4}$	<-100	162.4	0.06	......	....
2084	col. liq., [α] $-5.90^{\circ 20}_{D}$	$0.816\frac{20}{4}$	....	128	sl. s.	∞	∞ eth.
2085							
2086	thick oil......	$0.9537\frac{19}{4}$	....	$235\text{–}6^{746}$	i.	s.	s. eth.
2086M	....	....	-47 to -48	105^{10}	20^{20}	......	....
2086 R							
2087							
2088	col. liq. w. odor of camphor	$0.8232\frac{19}{4}$	-14	120–1	v. sl. s.	s.	∞ eth.
2089							
2090	col. liq., 1.4052	0.809	-11.9	101.8	12.5; 14^{30}	∞	∞ eth.; s. bz., chl., glyc., oils
2091	col. liq.......	$0.819\frac{20}{4}$	....	114 (112)	sl. s.	∞	∞ eth.
2092	col. liq.; $+1H_2O$ need.	....	17; frz. 15	131–2	i.	s.	s. eth.
2093							
2094							
2095	col. liq., $1.38071^{15.9}$	$0.805\frac{20}{4}$	-86.4	79.6	35.3^{10} 19^{90}	∞	s. eth.
2096	col. liq., 1.4428	$0.923\frac{20}{4}$	-29.5	152	10	∞	∞ eth.
2097							
2098	pr...........	....	41–1.5	310–1	i.	s. c., v. s. h.	v. s. eth., bz., chl.
2098M	1.4250^{21}......	$1.020\frac{21}{4}$	....	51.5^{12}, 48^{9}	......	......	....
2099							
2100	col. liq., 1.38788^{16}	$0.815\frac{15}{4}$	-92	93	v. sl. s.	∞	∞ eth.
2101	col. liq.......	....	....	157–8	s.	∞	∞ eth.
2102	col. liq.......	$1.002\frac{0}{4}$	....	230.2	i.	∞	∞ eth.
2103	liq...........	$0.989\frac{23}{17}$	....	235; 115^{13}	......	s.	s. eth.
2105							
2106							
2107							
2108							
2109							
2109M							
2110	gas...........	$0.668\frac{0}{4}$	-130	-5	i.	v. s.	v. s. eth.
2111	....	$1.33\frac{17}{4}$	....	165–6 (99)	......	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2112	**1-Butene, 2,3-dimethyl-***	1-isopropyl-1-methylethylene	$CH_2:C(CH_3)CH(CH_3)_2$	84.16
2113	**——, 3,3-dimethyl-***	*tert*-butylethylene; pseudobutylethylene	$CH_2:CHC(CH_3)_3$	84.16
2114	**——, 2-ethyl-***	3-methylenepentane; *uns*-diethylethylene	$CH_2:C(C_2H_5)CH_2CH_3$	84.16
2115	**——, 2-ethyl-3-methyl-***	1-ethyl-1-isobutylethylene; 2-methyl-3-methylene-pentane*	$CH_2:C(C_2H_5)CH(CH_3)_2$	98.18
2116	**——, 2-methyl-***	*uns*-ethylmethylethylene	$CH_2:C(CH_3)CH_2CH_3$	70.13
2117	**——, 3-methyl-***	isopropylethylene; α-isoamylene	$(CH_3)_2CHCH:CH_2$	70.13
2118	**2-Butene***	*sym*-dimethylethylene; β-butylene; pseudobutylene	$CH_3CH:CHCH_3$	56.10
2119	**——, 2,3-dimethyl-***	tetramethylethylene	$(CH_3)_2C:C(CH_3)_2$	84.16
2120	**——, 2-methyl-***	trimethylethylene; β-isoamylene	$(CH_3)_2C:CHCH_3$	70.13
2121	**3-Butene-1, 1-dicarboxylic acid.**	See *Malonic acid, allyl-.*		
2122	***cis*-Butenedioic acid*.**	See *Maleic acid.*		
2123	***trans*-Butenedioic acid*.**	See *Fumaric acid.*		
2123M	**3-Butene-1,2-diol*.**	See *Erythrol.*		
2123X	**2-Butenenitrile*.**	See *Crotononitrile.*		
2124	**3-Butenenitrile*.**	See *Allyl cyanide.*		
2125	**2-Butenoic acid, *cis*(?)-*.**	See *Isocrotonic acid.*		
2126	**——, *trans*(?)-*.**	See *Crotonic acid.*		
2127	**——, 2-methyl-*.**	See *Tiglic acid.*		
2128	**——, 4-oxo-4-phenyl-.**	See *Acrylic acid, β-benzoyl.*		
2129	**3-Butenoic acid***	vinylacetic acid; β-butenic acid	$CH_2:CHCH_2COOH$	86.09
2130	**——, 2-hydroxy-4-phenyl-**	benzallactic acid; styrylglycolic acid	$C_6H_5CH:CHCHOHCOOH$	178.18
2131	**——, 4-phenyl-**	β-benzalpropionic acid	$C_6H_5CH:CHCH_2COOH$	162.18
2132	**2-Buten-1-ol***	propenylcarbinol; crotyl alcohol; crotonyl alcohol; γ-methylallyl alcohol	$CH_3CH:CHCH_2OH$	72.10
2133	——, acetate	2-butenyl ethanoate*; crotyl acetate; crotonyl acetate	$CH_3COOC_4H_7$	114.14
2134	**3-Buten-1-ol***	allylcarbinol; 1-buten-4-ol	$CH_2:CHCH_2CH_2OH$	72.10
2135	**3-Buten-2-ol***	methylvinylcarbinol	$CH_2:CHCHOHCH_3$	72.10
2136	**3-Buten-2-one, 4-*p*-anisyl-**	See *3-Buten-2-one, 4-p-methoxyphenyl-.*		
2137	**——, 4-(2-furyl)-***	See *Acetone, furfurylidene-.*		
2137M	**——, 4-*p*-methoxyphenyl-**	anisylideneacetone; *p*-methoxybenzylideneacetone	$CH_3OC_6H_4CH:CHCOCH_3$	176.21
2138	**——, 4-phenyl-*.**	See *Acetone, benzylidene-.*		
2139	**——, 4-(2,6,6-trimethyl-1-cyclohexenyl)-.**	See *β-Ionone.*		
2140	**——, 4-(2,6,6-trimethyl-2-cyclohexenyl)-.**	See *α-Ionone.*		
2141	**——, 4-(2,2,6-trimethyl-3-cyclohexenyl)-.**	See *β-Irone.*		
2142	**β-Butenonitrile.**	See *Allyl cyanide.*		
2143	**3-Buten-1-yne***	vinylacetylene	$CH:CCH:CH_2$	52.07
2144	**Butesin**	butyl *p*-aminobenzoate	$H_2NC_6H_4COO(CH_2)_3CH_3$	193.24
2145	——, picrate		$(H_2NC_6H_4COOC_4H_9)_2C_6H_2(NO_2)_3OH$	615.59

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2112	....	$0.6803\frac{20}{4}$	....	56.0–6.5	......	......	....
2113	....	$0.6549\frac{15}{4}$	....	41.2	......	......	....
2114	....	$0.6914\frac{20}{4}$	....	66.2–6.7	......	......	....
2115	....	$0.7186\frac{20}{4}$	....	88.7–9.1	......	......	....
2116	col. liq.......	....	....	31.0	......	......	....
2117	col. liq.......	$0.648\frac{20}{4}$	–135	25 (21)	i.	∞	∞ eth.
2118	col. gas.......	0.635	....	(*cis*) 1 (*trans*) 2.5	i.	v. s.	v. s. eth.; i. H_2SO_4
2119	liq., 1.4128....	$0.712\frac{20}{4}$	....	73	......	......	....
2120	col. inflam. liq.	$0.668\frac{13}{4}$	–124	38.4	v. sl. s.	s.	∞ eth.
2121							
2122							
2123							
2123M							
2123 X							
2124							
2125							
2126							
2127							
2128							
2129	col. liq., 1.4257^{15}	$1.013\frac{15}{15}$	–39	163	s.	∞	∞ eth.
2130	need. f. w.....	....	46	98	s. h.	......	sl. s. eth.; bz., CS_2, lgr.
2131	need. f. w.....	....	88 (83–4)	302 sl. d.	sl. s. h.	v. s.	v. s. eth.
2132	col. liq., 1.4240	$0.8726\frac{0}{4}$; $0.854\frac{20}{4}$	<–30	118 (117–20)	16.6	∞	∞ eth.
2133	col. liq.......	$0.934\frac{0}{4}$	....	129	sl. s.	s.	s. eth.
2134	col. liq., $1.4146^{17.5}$	$0.864\frac{0}{4}$; $0.848\frac{17}{0}$	....	113	s.	∞	∞ eth.
2135	col. liq.......	....	....	96–7	......	......	....
2136							
2137							
2137M	leaf..........	....	72–4	....	i.	v. s.	v. s. eth.
2138							
2139							
2140							
2141							
2142							
2143	col. liq.......	$0.6867\frac{20}{0}$	....	5^{757}	......	......	....
2144	wh. cr. powd..	....	55–7	147^{2}	0.00014	s.	s. eth., bz., chl., dil a.
2145	yel. amor. powd.	....	109–10	....	0.07	s.	s. eth., bz., chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2146	**Butine.**	See _Butyne_*.		
	Butyl-. For butyl derivatives see the parent compounds (e.g., for butylbenzene see			
2147	**Butyl acetate, α,γ-dimethyl-.**	See _2-Pentanol, 4-methyl-_*, _acetate._		
2148	**——, β-ethyl-.**	See _1-Butanol, 2-ethyl-_*, _acetate._		
2149	**Butyl alcohol (_n_)**	1-butanol*; propylcarbinol	$CH_3(CH_2)_2CH_2OH$	74.12
2150	**sec-Butyl alcohol**	2-butanol*; ethylmethylcarbinol	$CH_3CH_2CHOHCH_3$	74.12
2151	**_tert_-Butyl alcohol**	2-methyl-2-propanol*; trimethylcarbinol	$(CH_3)_3COH$	74.12
2152	**——, trichloro-.**	See _Chloretone._		
2153	**Butylamine (_n_)**	1-aminobutane	$CH_3(CH_2)_2CH_2NH_2$	73.14
2153H	**——, _N_-ethyl-**		$CH_3(CH_2)_3NHC_2H_5$	101.19
2153R	**——, β-ethyl-**	1-amino-2-ethyl-_n_-butane	$(C_2H_5)_2CHCH_2NH_2$	101.19
2154	**——, _N_-methyl-**		$CH_3NHC_4H_9$	87.16
2155	**——, α-methyl-**	methylpropylcarbinylamine; 2-_sec_-amylamine; 2-aminopentane	$CH_3(CH_2)_2CH(CH_3)NH_2$	87.16
2156	**——, γ-methyl-.**	See _Isoamylamine._		
2157	**sec-Butylamine**	(α-methylpropyl)amine; 2-aminobutane	$CH_3CH(NH_2)CH_2CH_3$	73.14
2157M	**——, _N_-ethyl-**		$CH_3CH_2CH(CH_3)NHC_2H_5$	101.19
2158	**_tert_-Butylamine**	(α, α-dimethylethyl) amine; trimethylcarbinylamine	$(CH_3)_3CNH_2$	73.14
2159	**_n_-Butylarsonic acid.**	See _1-Butanearsonic acid._		
2160	**Butyl bromide (_n_)**	1-bromobutane*	$CH_3(CH_2)_2CH_2Br$	137.03
2161	**sec-Butyl bromide**	2-bromobutane*; methylethylbromomethane	$C_2H_5CH(CH_3)Br$	137.03
2162	**_tert_-Butyl bromide**	2-bromo-2-methylpropane*; trimethylbromomethane	$(CH_3)_3CBr$	137.03
2163	**Butyl carbitol.**	See _Diethylene glycol, monobutyl ether._		
2164	**Butyl cellosolve.**	See _Ethanol, 2-butoxy-_*.		
2165	**Butyl chloral.**	See _Butyraldehyde, α, α, β-trichloro-._		
2166	**Butyl chloride (_n_)**	1-chlorobutane*	$CH_3(CH_2)_2CH_2Cl$	92.57
2167	**sec-Butyl chloride**	2-chlorobutane*; methylethylchloromethane	$C_2H_5CH(CH_3)Cl$	92.57
2168	**_tert_-Butyl chloride**	2-chloro-2-methylpropane*; trimethylchloromethane	$(CH_3)_3CCl$	92.57
2169	**Butyl cyanide (_n_).**	See _Valeronitrile._		
2170	**sec-Butyl cyanide.**	See _Butyronitrile, α-methyl-._		
2171	**_tert_-Butyl cyanide.**	See _Propionitrile, α, α-dimethyl-._		
2172	**Butyl disulfide (_n_)**	1-butyldithiobutane*	$[CH_3(CH_2)_3]_2S_2$	178.35
2173	**α-Butylene.**	See _1-Butene_*.		
2174	**β-Butylene.**	See _2-Butene_*.		
2175	**γ-Butylene.**	See _Propene, 2-methyl-_*.		
2176	**α-Butylene glycol.**	See _1, 2-Butanediol_*.		
2177	**β-Butylene glycol.**	See _1,3-Butanediol_*.		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2146							
	Benzene, butyl-). For butyl esters of organic acids see the acids.						
2147							
2148							
2149	col. liq., 1.39931	$0.80978\frac{20}{4}$	−89.2 to −89.8 (−79.9)	117.71	7.9^{20}	∞	∞ eth.
2150	col. liq., 1.397.	$0.808\frac{20}{4}$	−89	99.5–100	12.5^{20}	∞	∞ eth.
2151	col. liq. or rhomb. pr. or pl., 1.38779	$0.7887\frac{20}{4}$	25.5	82.8	∞	∞	∞ eth.
2152							
2153	col. liq., 1.401.	$0.7401\frac{20}{4}$	−50.5	77.8 (76–8)	∞	s.	s. eth.
2153 H	....	....	....	108–109	......	......	....
2153 R	....	....	....	125	......	......	....
2154	col. liq., $1.40180^{18.1}$	$0.737\frac{20}{4}$	....	91	......	......	....
2155	col. liq.......	$0.73839\frac{20}{0}$	....	92	∞	∞	∞ eth.
2156							
2157	col. liq., $1.39501^{16.7}$ $[\alpha]\ 7.4^{20}_{D}$	$0.724\frac{20}{4}$ $(0.718\frac{20}{4})$	−104.5	63	∞	∞	∞ eth.
2157M	....	$0.7358\frac{20}{0}$	....	$97\text{–}98^{741}$	......	......	....
2158	col. liq., 1.37940^{18}	$0.696\frac{20}{4}$	−67.5	46.4 (43.8)	∞	∞	∞ eth.
2159							
2160	col. liq., 1.4398	$1.299\frac{20}{4}$	−112.4	101.6	i.	∞	∞ eth.
2161	col. liq., 1.4344^{25}	$1.2580\frac{20}{4}$	....	91.3	i.	......	....
2162	col. liq., 1.428.	$1.222\frac{20}{4}$	−20	73.3	i.	......	....
2163							
2164							
2165							
2166	col. liq., 1.4015	0.884; $0.9074\frac{0}{4}$	−123.1	78	$0.066^{12.5}$	[illegible]	∞ eth.
2167	col. liq., 1.3953^{25}	$0.8707\frac{20}{4}$	−131.3	68	v. sl. s.	∞	∞ eth.
2168	col. liq., 1.38686^{18}	$0.847\frac{15}{4}$	−28.5	51–2	v. sl. s.	∞	∞ eth.
2169							
2170							
2171							
2172	....	....	....	$100\text{–}3^{15}$	i.	∞	∞ eth.
2173							
2174							
2175							
2176							
2177							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2178	**Butyl ether (*n*)**	1-butoxybutane*; di-*n*-butyl ether	$CH_3(CH_2)_3$-$O(CH_2)_3CH_3$	130.23
2179	**sec-Butyl ether**	2-(α-methylpropoxy)butane*; di-*sec*-butyl ether	$[CH_3CH_2CH$-$(CH_3)]_2O$	130.23
2179M	**Butyl fluoride (*n*)**	1-fluorobutane*	$CH_3(CH_2)_3F$	76.11
2180	**Butyl hydrogen sulfate**	See *Butylsulfuric acid.*		
2181	**Butyl iodide (*n*)**	1-iodobutane*	$CH_3(CH_2)_2CH_2I$	184.03
2182	**sec-Butyl iodide**	2-iodobutane*; methylethyliodomethane	$C_2H_5CH(CH_3)I$	184.03
2183	***tert*-Butyl iodide**	2-iodo-2-methylpropane*; trimethyliodomethane	$(CH_3)_3CI$	184.03
2184	**Butyl isocyanide (*n*)**	butylcarbylamine*	$CH_3(CH_2)_3NC$	83.13
2185	**Butyl isocyanide, γ-methyl-.**	See *Isoamyl isocyanide.*		
2186	***tert*-Butyl isocyanide**	(α, α-dimethylethyl)carbylamine*	$(CH_3)_3CNC$	83.13
2186M	***n*-Butyl ketone.**	See 5-*Nonanone**.		
2187	**Butyl mercaptan (*n*).**	See 1-*Butanethiol**.		
2187M	***n*-Butylmercuric chloride.**	See *Mercury chloride, n-butyl-.*		
2188	**Butyl mustard oils.**	See the butyl esters under *Isothiocyanic acid.*		
2189	**Butyl nitrate* (*n*)**		$CH_3(CH_2)_3ONO_2$	119.12
2190	**sec-Butyl nitrate**	α-methylpropyl nitrate*	$C_2H_5CH(CH_3)$-ONO_2	119.12
2191	**Butyl nitrite* (*n*)**		$CH_3(CH_2)_3ONO$	103.12
2192	**sec-Butyl nitrite**	α-methylpropyl nitrite*	$C_2H_5CH(CH_3)$-ONO	103.12
2193	***tert*-Butyl nitrite**	α, α-dimethylethyl nitrite*	$(CH_3)_3CONO$	103.12
2194	**Butyl sulfate (*n*)**	di-*n*-butyl sulfate	$(CH_3CH_2CH_2$-$CH_2)_2SO_4$	210.29
2195	**Butyl sulfide (*n*)**	dibutyl sulfide; butylthiobutane*	$(CH_3CH_2CH_2$-$CH_2)_2S$	146.29
2196	**sec-Butyl sulfide**	di-*sec*-butyl sulfide; 1-methyl-1-(α-methylpropylthio)-propane*	$[C_2H_5CH(CH_3)]_2S$	146.29
2196H	**Butyl sulfone**	1-(butylsulfonyl)butane*; di-*n*-butyl sulfone	$[CH_3(CH_2)_3]_2SO_2$	178.29
2196R	**Butyl sulfoxide**	1-(butylsulfinyl)butane*; di-*n*-butyl sulfoxide	$[CH_3(CH_2)_3]_2SO$	162.29
2197	**Butylsulfuric acid (*n*)**	butyl hydrogen sulfate	$C_4H_9OSO_2OH$	154.18
2198	**1-Butyne***	1-butine; ethylacetylene	$CH\vdots CCH_2CH_3$	54.09
2199	**——, 3-methyl-***	isopropylacetylene	$(CH_3)_2CHC\vdots CH$	68.11
2200	**1-Butyne, 1-phenyl-.**	See *Benzene, 1-butynyl-.*		
2201	**2-Butyne***	2-butine; dimethylacetylene; crotonylene	$CH_3C\vdots CCH_3$	54.09
2202	**Butynedioic acid*.**	See *Acetylenedicarboxylic acid.*		
2203	**2-Butynoic acid*.**	See *Tetrolic acid.*		
2204	**Butyraldehyde**	butanal*; butyric aldehyde	$CH_3(CH_2)_2CHO$	72.10
2205	——, oxime	butanal oxime*; butyraldoxime	$CH_3(CH_2)_2$-$CH{:}NOH$	87.12
2206	——, phenylhydrazone	*N*-butylidene-*N′*-phenylhydrazine	$CH_3(CH_2)_2CH{:}$-$NNHC_6H_5$	162.23

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2178	col. liq	$0.7841\frac{0}{4}$; $0.769\frac{20}{20}$	−95.2 (−98)	142	sl. s.	∞	∞ eth.
2179	....	$0.756\frac{21}{4}$	....	121	sl. s.	∞	∞ eth.
2179M	col. liq., 1.3419^{15}	0.7761	....	31.95	i.	v. s.	....
2180							
2181	liq., 1.50006...	$1.617\frac{20}{4}$	−103.5	131	$0.0202^{17.5}$	∞	∞ eth
2182	col. liq	$1.595\frac{20}{4}$	−104.0	117.5 (119–22)	i.	s.	∞ eth.
2183	liq	$1.571\frac{0}{4}$	−33.65	100 d.	i., d.	∞	∞ eth.
2184	liq	....	....	118	i.	∞	∞ eth.
2185							
2186	lt. oil.........	....	....	$91^{37.5}$	......	s.	....
2186M							
2187							
2187M							
2188							
2189	liq., $1.40130^{23.2}$	$1.048\frac{0}{4}$	....	136	i.	s.	s. eth.
2190	liq	$1.0382\frac{0}{4}$	....	124	......	∞	∞ eth.
2191	liq	$0.9114\frac{0}{4}$	....	75 (77–9)	......	∞	∞ eth.
2192	liq	$0.8981\frac{0}{4}$	....	68	......	∞	∞ eth.
2193	lt. yel. liq.....	$0.8941\frac{0}{4}$	....	63	sl. s.	v. s.	v. s. eth.; s. chl., CS_2
2194	col. liq., 1.4210^{25}	$1.0591\frac{25}{25}$	....	97.4^{4}	i.	......	....
2195	liq	$0.852\frac{0}{4}$; $0.839\frac{16}{0}$	−79.7	182 (186–9)	i.	v. s.	v. s. eth.
2196	liq	$0.8317\frac{23}{4}$	....	165	i.	v. s.	v. s. eth.
2196H	pl............	....	43	....	i.	s.	s. eth.
2196R	need.........	....	32	d.	i.	s.	s. eth.
2197	syrup.........	....	....	d.	v. s.	s.	s. eth.
2198	col. liq., 1.3962	$0.668\frac{0}{4}$	−130	8.6	i.	s.	s. eth.
2199	col. liq	$0.6854\frac{0}{4}$	....	29.3	i.	∞	∞ eth.
2200							
2201	liq., 1.3893^{25}...	0.688^{25}	....	27.2 (28.9)	i.	s.	s. eth.
2202							
2203							
2204	col. liq., 1.38433	$0.817\frac{20}{4}$	−99.0	75.7	3.7	∞	∞ eth.
2205	col. liq	$0.923\frac{20}{4}$	−29.5	152^{715}	10.8	∞	∞ eth.
2206							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2207	**Butyraldehyde**, sodium bisulfite compound		$C_3H_7CHOHSO_3Na$	176.17
2208	——, **α-ethyl-**	2-ethylbutanal*	$CH_3CH_2CH(C_2H_5)CHO$	100.16
2209	——, **β-hydroxy-.**	See *Aldol.*		
2210	——, **β-methyl-.**	See *Isovaleraldehyde.*		
2211	——, **α,α,β-trichloro-**	2, 2, 3-trichlorobutanal*; butyl chloral	$CH_3CHClCCl_2CHO$	175.45
2212	——, ——, hydrate	2,2,3-trichloro-1,1-butanediol*; butyl chloral hydrate	$CH_3CHClCCl_2CH(OH)_2$	193.47
2213	**Butyraldoxime.**	See *Butyraldehyde, oxime.*		
2214	**Butyramide**	butanamide*; butyric amide.	$CH_3CH_2CH_2CONH_2$	87.12
2215	——, **β-bromo-γ-oxo-N-phenyl-.**	See *Acetoacetanilide, α-bromo-.*		
2216	——, **β-methyl-.**	See *Isovaleramide.*		
2217	——, ***N*-phenyl-.**	See *Butyranilide.*		
2218	**Butyranilide**	*N*-phenylbutyramide	$CH_3(CH_2)_2CONHC_6H_5$	163.21
2219	——, **β-keto-.**	See *Acetoacetanilide.*		
2220	**Butyric acid**	butanoic acid*; ethylacetic acid	$CH_3CH_2CH_2COOH$	88.10
2221	——, allyl ester	allyl butyrate; 2-propenyl butanoate*	$C_3H_7COOCH_2CH{:}CH_2$	128.17
2222	——, amyl ester	amyl butyrate; pentyl butanoate*	$C_3H_7COO(CH_2)_4CH_3$	158.24
2223	——, benzyl ester		$CH_3(CH_2)_2CO_2CH_2C_6H_5$	178.22
2224	——, butyl ester	butyl butyrate; butyl butanoate*	$CH_3CH_2CH_2COOC_4H_9$	144.21
2225	——, ethyl ester	ethyl butyrate; ethyl butanoate*	$CH_3CH_2CH_2COOC_2H_5$	116.16
2226	——, ethylene ester.	See *Glycol, dibutyrate.*		
2227	——, furfuryl ester.	See *Furfuryl alcohol, butyrate.*		
2228	——, geranyl ester.	See *Geraniol, butyrate.*		
2229	——, glyceryl ester.	See *Glycerol, tributyrate.*		
2230	——, isoamyl ester	γ-methylbutyl butanoate*	$CH_3(CH_2)_2COOC_5H_{11}$	158.24
2231	——, isobutyl ester	β-methylpropyl butanoate*	$CH_3(CH_2)_2COOCH_2CH(CH_3)_2$	144.21
2232	——, methyl ester	methyl *n*-butyrate	$CH_3CH_2CH_2COOCH_3$	102.13
2233	——, α-methylisoamyl ester.	See *2-Pentanol, 4-methyl-, butyrate.*		
2234	——, *p*-phenylphenacyl ester		$CH_3(CH_2)_2COOCH_2COC_6H_4C_6H_5$	282.33
2235	——, propyl ester	*n*-propyl butyrate	$CH_3CH_2CH_2COOC_3H_7$	130.18
2236	——, piperazinium salt		$C_4H_{10}N_2{\cdot}2C_3H_7COOH$	262.35
2237	——, **α-amino-**	2-aminobutanoic acid*	$CH_3CH_2CH(NH_2)COOH$	103.12
2238	——, **β-amino-**	3-aminobutanoic acid*	$CH_3CH(NH_2)CH_2COOH$	103.12
2239	——, **γ-amino-**	4-aminobutanoic acid*; piperidic acid	$NH_2CH_2CH_2CH_2COOH$	103.12
2240	——, **α-amino-α-methyl-.**	See *Isovaline.*		
2241	——, **α-amino-γ-methylmercapto-.**	See *Methionine.*		
2242	——, **α-bromo-**	2-bromobutanoic acid*	$CH_3CH_2CHBrCOOH$	167.01

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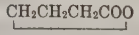
*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2207	leaf.........	....	d.	....	v. s.	sl. s.	i. eth.
2208	col. liq.......	$0.814\frac{20}{4}$	....	116–7	sl. s.	∞	∞ eth.
2209							
2210							
2211	col. oily liq., 1.47554	$1.3956\frac{20}{4}$	....	$164\text{–}5^{750}$	s.	s.	s. eth.
2212	rhomb. leaf. f. w.	$1.693\frac{20}{4}$	78	d.	sl. s.	v. s.	s. eth.
2213							
2214	rhomb. f. bz...	$1.032\frac{20}{4}$	116 (108–10)	216	16.28^{15}	s.	sl. s. eth.
2215							
2216							
2217							
2218	monocl. leaf...	$1.134\frac{20}{4}$	91–2	189^{15}	i.	v. s.	v. s. eth.
2219							
2220	col. liq., 1.39906	$0.9587\frac{20}{4}$	–7.9; frz. –19	163.5^{757}	$5.62^{-1.1}$	∞	∞ eth.
2221	liq..........	....	....	143	i.	∞	∞ eth.
2222	liq., 1.4110....	$0.8713\frac{15}{4}$	–73.2	185	0.054^{50}	v. s.	v. s. eth.
2223	....	$1.016^{17.5}$	....	240	i.	v. s.	v. s. eth.
2224	col. liq., 1.4049	$0.8721\frac{20}{20}$	–91.5	166.4	sl. s.	∞	∞ eth.
2225	col. liq., 1.39302^{18}	$0.879\frac{20}{4}$	–93.3	121.3 (119–21)	0.68^{25}	s.	s. eth.
2226							
2227							
2228							
2229							
2230	col. liq.......	$0.882\frac{0}{4}$; $0.860\frac{15}{4}$	–73.2	159–79 (184.8)	0.054^{50}	v. s.	v. s. eth.
2231	col. liq., 1.4035	$0.8606\frac{25}{4}$	....	156.9	v. sl. s.	∞	∞ eth.
2232	col. liq., 1.3879	0.898	<–95	102.3	1.56^{21}	∞	∞ eth.
2233							
2234	....	....	97	....	....	.....	....
2235	col. liq., 1.4005	$0.879\frac{15}{4}$; $0.8710\frac{25}{4}$	–95.2	143	0.167^{17}	∞	∞ eth.
2236	wh. cr........	....	89.5–90	....	s.	s.	i. eth.; s. h. dioxane
2237	col. leaf.......	....	d. 285	subl.	28	0.182^{78}	i. eth.
2238	need.........	....	184	....	100	i.	i. eth.
2239	leaf. or need. f. dil. al.	....	193 (183–4, 202 d.)	....	v. s.	i.	i. eth., bz.
2240							
2241							
2242	col. oily liq....	$1.567\frac{20}{20}$	–4	212–7 d.; $181\text{–}2^{250}$	6.7 c.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2243	**Butyric acid, α-bromo-**, ethyl ester	ethyl 2-bromobutanoate*	$CH_3CH_2CHBr-COOC_2H_5$	195.07
2244	——, **α,β-dibromo-**	2,3-dibromobutanoic acid*	$CH_3CHBrCHBr-COOH$	245.92
2245	——, **α,α-dimethyl-**	2,2-dimethylbutanoic acid*; ethyldimethylacetic acid	$CH_3CH_2C(CH_3)_2-COOH$	116.16
2246	——, **α,β-dimethyl-**	2,3-dimethylbutanoic acid*; isopropylmethylacetic acid	$CH_3CH(CH_3)CH-(CH_3)COOH$	116.16
2247	——, **α-ethyl-**	2-ethylbutanoic acid*; 3-pentane carboxylic acid; diethylacetic acid	$(C_2H_5)_2CHCOOH$	116.16
2248	——, **α-ethyl-α-methyl-**	diethylmethylacetic acid	$CH_3CH_2C(C_2H_5)-(CH_3)COOH$	130.18
2249	——, **α-hydroxy-**	2-hydroxybutanoic acid*	$CH_3CH_2CHOH-COOH$	104.10
2250	——, **β-hydroxy-**	3-hydroxybutanoic acid*	$CH_3CHOHCH_2-COOH$	104.10
2251	——, **γ-hydroxy-**	4-hydroxybutanoic acid*	$CH_2OHCH_2CH_2-COOH$	104.10
2252	——, **γ-hydroxy-**, lactone.	See *Butyrolactone.*		
2253	——, **α-isonitroso-.**	See *Butyric acid, α-oxo-, oxime.*		
2254	——, **α-keto-.**	See *Butyric acid, α-oxo-.*		
2256	——, **γ-keto-γ-phenyl-.**	See *Propionic acid, β-benzoyl-.*		
2257	——, **α-methyl-**	2-methylbutanoic acid*; ethylmethylacetic acid; active valeric acid	$CH_3CH_2CH(CH_3)-COOH$	102.13
2257M	——, **α-oxo-**	2-oxobutanoic acid*; α-ketobutyric acid	$CH_3CH_2COCOOH$	102.09
2257 R	—— ——, oxime	α-isonitrosobutyric acid	$C_2H_5C(:NOH)-COOH$	117.10
2258	**Butyric aldehyde.**	See *Butyraldehyde.*		
2259	**Butyric amide.**	See *Butyramide.*		
2260	**Butyric anhydride**	butanoic anhydride*	$(CH_3CH_2CH_2-CO)_2O$	158.19
2261	**Butyrin.**	See *Glycerol, tributyrate.*		
2262	**Butyrolactone**	4-hydroxybutanoic acid lactone*; γ-hydroxybutyric acid lactone; butanolide	 $CH_2CH_2CH_2COO$	86.09
2263	**2-Butyronaphthone, 1-hydroxy-**	1-hydroxy-2-naphthyl propyl ketone; 2-butyryl-1-naphthol	$CH_3(CH_2)_2COC_{10}-H_6OH$	214.25
2264	**Butyrone.**	See 4-*Heptanone**.		
2266	**Butyronitrile**	butanenitrile*; *n*-propyl cyanide	$CH_3(CH_2)_2CN$	69.10
2267	——, **β,γ-epoxy-.**	See *Epicyanohydrin.*		
2268	——, **α-ethyl-**	3-cyanopentane; 2-ethylbutanenitrile*; diethylacetonitrile	$(C_2H_5)_2CHCN$	97.16
2269	——, **α-methyl-**	2-methylbutanenitrile*; *sec*-butyl cyanide; methylethylacetonitrile	$CH_3CH_2CH(CH_3)-CN$	83.13
2270	**Butyrophenone**	butyrylbenzene; phenyl propyl ketone	$CH_3CH_2CH_2-COC_6H_5$	148.20
2271	**Butyryl bromide**	butanoyl bromide*	$CH_3(CH_2)_2COBr$	151.01
2272	**Butyryl chloride**	butanoyl chloride*	$CH_3(CH_2)_2COCl$	106.55
2273	**C acid.**	See 2-*Naphthylamine-4, 8-disulfonic acid.*		

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ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2243	col. liq........	1.321^{25}_{4}	....	179 d. ($58–62^{10}$)	i.	s.	s. eth.
2244	(1) long need. f. eth.	....	87	....	sl. s.	v. s.	v. s. eth.
	(2) sm. need. f. lgr.	....	59	....	sl. s.	v. s.	v. s. eth.
2245	col. liq........	....	-14	187	v. sl. s.	s.	s. eth.
2246	liq............	0.928^{15}_{4}	....	189–91	s.	s.	s. eth.
2247	col. liq., 1.41788^{10}	0.9195^{18}_{4}; 0.9331^{10}_{4}	<-15	190 (195–7)	sl. s.	∞	∞ eth.
2248	arom. oil.......	....	<-20	203–4	i.	s.	....
2249	col. hyg. cr....	....	42.5	260 d., subl. 60–70	s.	s.	s. eth.
2250	monocl.; syrup	....	48–50	130^{12}	v. s.	v. s.	v. s. eth.; i. bz.
2251	liq............	....	-17	sl. d. ord. temp.	......	......	....
2252							
2253							
2254							
2256							
2257	col. liq., 1.4051	0.941^{20}_{4}	<-80	174	sl. s.	∞	∞ eth.
2257M	hyg. pl. or oil..	1.200^{17}_{4}	32	85^{21}	v. s.	v. s.	sl. s. eth.
2257R	need. f. w.....	....	151 (169–70)	....	v. sl. s.	v. s.	v. sl. s. eth.
2258							
2259							
2260	col. liq.......	0.9946^{20}_{4}	-75.0 (-56.1)	198	d.	d.	∞ eth.
2261							
2262	oil............	1.1286^{15}_{0}	....	206	∞	s.	s. eth.
2263	yel-grn. need..	....	78	....	i.	s.	s. eth.
2264							
2266	col. liq., 1.3816^{24}	0.796^{15}	-112.6	118	sl. s.	∞	∞ eth.
2267							
2268	oil............	....	....	144–6	......	∞	∞ eth.
2269	liq............	0.8061^{0}_{4}	....	125	......	s.	s. eth.
2270	col. liq., $1.52016^{18.25}$	0.988^{20}_{4}	11	232.3	i.	∞	∞ eth.
2271	liq............	1.4162^{17}_{4}	....	128	......	......	....
2272	col. liq., 1.41209	1.028^{20}_{4}	-89.0	102 (99–102)	d.	d.	∞ eth.
2273							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2274	**Cacodyl**	tetramethylbiarsine; diarsenic tetramethyl; arsenic dimethyl	$(CH_3)_2AsAs(CH_3)_2$	209.96
2275	**——, ethyl-.**	See *Biarsine, tetraethyl-.*		
2276	**Cacodyl chloride**	dimethylarsenic monochloride; chlorodimethylarsine	$(CH_3)_2AsCl$	140.44
2277	**Cacodyl hydride.**	See *Arsine, dimethyl-.*		
2278	**Cacodylic acid**	dimethylarsinic acid; alkargen	$(CH_3)_2AsOOH$	137.99
2279	**Cacodyl oxide**	bisdimethylarsenic oxide; alkarsin, alkarsine	$[(CH_3)_2As]_2O$	225.96
2280	**Cacodyl sulfide**	bisdimethylarsenic sulfide	$[(CH_3)_2As]_2S$	242.02
2281	**Cacodyl trichloride**	dimethylarsenic trichloride	$(CH_3)_2AsCl_3$	211.35
2282	**Cadaverine**	1,5-pentanediamine*; pentamethylenediamine	$H_2N(CH_2)_5NH_2$	102.18
2283	**Cadmium, diethyl-***	cadmium ethyl	$(C_2H_5)_2Cd$	170.53
2284	**——, dimethyl-***		$(CH_3)_2Cd$	142.48
2285	**Caffeic acid**	3,4-dihydroxycinnamic acid	$(HO)_2C_6H_3CH:CHCOOH$	180.15
2286	**Caffeine**	1,3,7-trimethylxanthine; theine	$C_8H_{10}N_4O_2$	194.19
2287	——, benzoate		$C_8H_{10}N_4O_2 \cdot C_7H_6O_2$	316.31
2288	——, citrate		$C_8H_{10}N_4O_2 \cdot C_6H_8O_7$	386.32
2289	——, hydriodide diiodide		$C_8H_{10}N_4O_2 \cdot HI \cdot I_2 \cdot 1\frac{1}{2}H_2O$	602.99
2290	——, hydrobromide		$C_8H_{10}N_4O_2 \cdot HBr \cdot 2H_2O$	311.15
2291	——, hydrochloride		$C_8H_{10}N_4O_2 \cdot HCl \cdot 2H_2O$	266.69
2292	——, isovalerate		$C_8H_{10}N_4O_2 \cdot C_5H_{10}O_2$	296.32
2293	——, mercurichloride		$C_8H_{10}N_4O_2 \cdot HgCl_2$	465.72
2294	——, salicylate		$C_8H_{10}N_4O_2 \cdot C_7H_6O_3$	332.31
2295	——, sulfate		$C_8H_{10}N_4O_2 \cdot H_2SO_4$	292.27
2296	**Cajeputole.**	See *Cineole.*		
2296M	**Calciferol**	vitamin D_2, irradiated ergosterol	$C_{28}H_{43}OH$	396.64
2296T	**Calcium pantothenate**		$[C_9H_{16}NO_5]_2Ca$	476.54
2297	**Camphane**	1,7,7-trimethylnorcamphane; hydrocamphene; 1,7,7-trimethylbicyclo(2,2,1)heptane	$C_{10}H_{18}$	138.25
2298	**——, 2-chloro-.**	See *Bornyl chloride*; *Isobornyl chloride.*		
2299	**2-Camphanol.**	See *Borneol.*		
2300	**2-Camphanone.**	See *Camphor.*		
2301	***dl*-Camphene**	*dl*-2,2-dimethyl-3-methylenenorcamphane	$C_{10}H_{16}$	136.23
2302	***d* or *l*-Camphene**		$C_{10}H_{16}$	136.23
2303	**α-Camphol.**	See *Borneol.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2274	col. oil........	>1	-6	170	sl. s.	s.	s. eth.
2275							
2276	col. liq.......	>1	<-45	106.5	i.	∞	i. eth.
2277							
2278	col. tricl......	....	200	....	83^{22}	28.5^{15} 90%	i. eth.
2279	col. liq.......	1.486^{15}	-25	149–51	sl. s.	s.	s. eth.
2280	oil...........	....	<-40 d.	211	sl. s.	s.	s. eth.
2281	cr. f. eth......	....	d. 50	....	d.	d.	s. eth., CS_2
2282	syrupy fum. liq.	$0.9174\frac{0}{4}$	9	178–80	s.	s.	sl. s. eth.
2283	col. liq.......	$1.653\frac{22}{\text{[illegible]}}$	-21	$64^{19.5}$	......	......	∞ eth.
2284	col. liq.......	$1.9846^{17.9}$	-4.5	105.5^{758}	d.	......	s. eth.
2285	yel. monocl. f. w.	....	195	d.	s.	v. s.	sl. s. eth.
2286	wh. need. f. al.; cr. (+1H_2O) f.w.	$1.23\frac{19}{4}$	anh. 235–7	subl. 180	1.35^{16} 45.5^{65}	2.3^{16} 85%	0.044^{16} eth.; 14.2 chl.; s acet., bz.
2287	wh. cr........	....	....	....	s.	s.	....
2288	monocl.......	....	....	....	s.	s. d.	....
2289	dk. grn. pr....	....	182–4	....	i.	s.	sl. s. chl.
2290	col. trans. cr...	....	....	....	s.	s. d.	....
2291	monocl. col....	....	....	....	s. d.	s. d.	....
2292	fatty glist. need.	....	....	....	s.	......	....
2293	col. need......	....	246	....	s.	......	....
2294	cr. masses.....	....	....	....	s.	s.	....
2295	wh. need......	....	....	....	s. d.	s. d.	....
2296							
2296M	col. lng. pr....	....	115–17	....	i.	s.	v. s. eth.
2296T	wh. odorless cryst. powd.	....	198–200	....	14.4^{25}	i. 95%	....
2297	hex. pl. or pr..	....	152–4	160 subl.	i.	s. h.	s. eth., et. acetate, h. me. al.
2298							
2299							
2300							
2301	feathery need., 1.4402^{80}	$0.879\frac{20}{4}$; 0.822^{78}	50	159–60	i.	v. s.	v. s. eth.
2302	*d*: featn. need., $[\alpha]^{17}_{D}$ +103.9° in eth.	....	51 (48)	160–2; 52^{17}	i.	sl. s.	s. eth.
	l: cr., 1.45514^{45}, $[\alpha]$-52°$_D$	....	42–52	158–60	......	......	s. eth.
2303							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2304	***dl*-Campholic acid**	*dl*-1,2,2,3-tetramethylcyclopentanecarboxylic acid*	$C_5H_5(CH_3)_4COOH$	170.25
2305	**Camphor, 3-amino-**	α-aminocamphor; 3-camphorylamine	$C_{10}H_{15}O\cdot NH_2$	167.25
2306	**——, artificial.**	See *Bornyl chloride.*		
2307	**——, Borneo.**	See *d-Borneol.*		
2308	**——, parsley.**	See *Apiole.*		
2309	***d*-Camphor**	*d*-2-camphanone; Japan camphor; laurel camphor; Formosa camphor; *d*-2-keto-1,7,7-trimethylnorcamphane	$C_{10}H_{16}O$	152.23
2310	——, oxime		$C_{10}H_{16}NOH$	167.25
2311	**——, α-bromo-**	3-bromo-*d*-camphor (one form)	$C_{10}H_{15}BrO$	231.14
2312	**——, α′ (or β)-bromo-**	3-bromo-*d*-camphor (one form)	$C_{10}H_{15}BrO$	231.14
2313	**——, α-chloro-**	3-chloro-*d*-camphor (one form)	$C_{10}H_{15}ClO$	186.68
2314	**——, 3-nitro-**	α-nitrocamphor	$C_{10}H_{15}O\cdot NO_2$	197.23
2315	**α-Camphoramic acid**	α-camphoramidic acid; 3-carbamyl-1,2,2-trimethylcyclopentanecarboxylic acid; camphoric acid 3-monoamide	$C_5H_5(CH_3)_3(CONH_2)COOH$	199.24
2316	**β-Camphoramic acid**	β-camphoramidic acid; 3-carbamyl-2,2,3-trimethylcyclopentanecarboxylic acid; camphoric acid 1-monoamide	$C_5H_5(CH_3)_3(CONH_2)COOH$	199.24
2317	**Camphoric acid,** 1-monoamide.	See *β-Camphoramic acid.*		
2318	——, 3-monoamide.	See *α-Camphoramic acid.*		
2319	***dl*-Camphoric acid**	*dl-cis*-1,2,2-trimethyl-1,3-cyclopentanedicarboxylic acid*; paracamphoric acid	$C_8H_{14}(COOH)_2$	200.23
2320	***d*-Camphoric acid**		$C_8H_{14}(COOH)_2$	200.23
2321	***l*-Camphoric acid**	*l-cis*-1,2,2-trimethyl-1,3-cyclopentanedicarboxylic acid*	$C_8H_{14}(COOH)_2$	200.23
2322	***dl*-Camphoric anhydride**	*dl-cis*-1,2,2-trimethyl-1,3-cyclopentanedicarboxylic anhydride*	$C_8H_{14}(CO)_2O$	182.21
2323	***d*-Camphoric anhydride**		$C_{10}H_{14}O_3$	182.21

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
04	*dl*: col. tricl. pr.	....	109	....	0.016^{19}	51.29 c.	s. eth.
	d: [α] +49.8$^{\circ 15}_{D}$ in al.	....	106	255	......	......	....
	l: [α] −49.1$^{\circ 15}_{D}$ in al.	....	106–7	250	......	......	....
305	waxy.........	....	110	244	i.	s.	s. eth., a.
306							
307							
308							
309	col. trig., hex., 1.532 (1.5462), [α] 44.26$^{\circ 20}_{D}$ in al.	$1.000\frac{0}{0}$; $0.990\frac{25}{4}$	176–7	204 subl.	0.1	100	173 etb.; 300 chl.; s. CS_2, bz., me. al., ac. a., acet.
310	monocl. need. or pr. f. dil. al., [α] +42.4$^{20}_{D}$ in al.	$1.01\frac{116}{4}$	118 (114–6)	249–54 d.	i.	v. s.	s. eth., min. a.
311	col. monocl., 1.5535, 1.5787, 1.5912, $[\alpha]_{5461}$+165°	$1.449\frac{20}{4}$	78	274 sl. d.	i.	12.1^{15}, 130^{50}	s. eth., chl., CCl_4, bz.
312	....	....	61	130^{10}	i.	s.	s. eth.
313	(α) leaf. [α] +97$^{\circ 20}_{D}$ in al.	....	93–4	244–7 part. d.	s. h.	s. h.	s. eth., chl., CS_2, bz.
314	monocl. pr. f. bz.	....	100–1	....	i.	s.	s. eth., chl.; v. s. bz.
315	....	....	176–7	....	s. h.	s. h.	s. eth., h. me. al.
316	....	....	182–3	....	s. h.	s.	s. eth., acet.; sl. s. bz.
317							
318							
319	col. monocl. need.	$1.228\frac{20}{4}$	202 (208)	....	0.76^{25}, 10^{100}	s.	v. s. eth.
320	col. monocl. pr. or leaf. [α] 47.7$^{\circ 20}_{D}$ in al.	$1.186\frac{20}{4}$	187	....	0.62^{12}, 8.3^{100}	112	91.4^{25} eth.; s. acet.; i. chl.
2321	....	....	187	....	sl. s.	s.	s. eth., me. al.
2322	rhomb. f. al...	$1.194\frac{20}{4}$	221 (216–7)	270	v. sl. s.	0.63 c.	1.00 eth.; v. s. chl., et. ac.; s. bz., CS_2
2323	rhomb.pr.f.al.	$1.194\frac{20}{4}$	221	270 d.	v. sl. s.	v. s.	37.5^{5} bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2324	***l*-Camphoronic acid**...	*l*-2,3-dimethyl-1,2,3-butanetricarboxylic acid*; *l*-α, α, β-trimethyltricarballylic acid	$(CH_3)_2C(COOH)$-$C(CH_3)(COOH)$-CH_2COOH	218.2
2325	**Camphor pinacol (*l*)** ..	*l*-2,2′-bicamphane-2,2′-diol...	$C_9H_{16}COHCO$-HC_9H_{16}	306.4
2326	**3-Camphorylamine.**	See *Camphor, 3-amino-.*		
2327	**β-Camphylamine**.....	2,3,3-trimethyl-1-cyclopentene-1-ethylamine	$C_8H_{13}CH_2CH_2NH_2$	153.2
2328	**Canadine**.............	*l*-tetrahydroberberine........	$C_{20}H_{21}NO_4$.......	339.
2329	**Cane sugar.**	See *Sucrose.*		
2330	**Cantharene**...........	dihydro-*o*-xylene............	$C_6H_6(CH_3)_2$.......	108.1
2331	**Cantharidin**..........	2,3-dimethyl-7-oxabicyclo-(2,2,1) heptane-2,3-dicarboxylic anhydride	$C_{10}H_{12}O_4$.........	196.20
2332	**Capraldehyde**.........	decanal*; capric aldehyde; caprinaldehyde; *n*-decyl aldehyde	$CH_3(CH_2)_8CHO$...	156.26
2333	——, oxime................	decanal oxime*; caprinaldoxime	$CH_3(CH_2)_8CH:NOH$	171.28
2334	**Capramide**............	decanamide*; *n*-decylic amide; capric amide	$CH_3(CH_2)_8CONH_2$	171.28
2335	**Capric acid**...........	decanoic acid*; *n*-capric acid; *n*-decoic acid; *n*-decylic acid	$CH_3(CH_2)_8COOH$	172.26
2336	——, ethyl ester...........	ethyl caprate; ethyl decanoate*	$CH_3(CH_2)_8COOC_2H_5$	200.3
2337	——, methyl ester..........	methyl decanoate*; methyl caprate	$CH_3(CH_2)_8$-$COOCH_3$	186.2
2338	——, **α-octyl-**	2-octyldecanoic acid*; 9-heptadecanecarboxylic acid*; di-*n*-octylacetic acid	$[CH_3(CH_2)_7]_2$-$CHCOOH$	284.4
2339	**Capric aldehyde.**	See *Capraldehyde.*		
2340	**Capric amide.**	See *Capramide.*		
2341	**Capric anhydride**.....	decanoic anhydride*; *n*-decylic anhydride	$[CH_3(CH_2)_8CO]_2O$	326.5
2342	**Caprinaldehyde.**	See *Capraldehyde.*		
2343	**Caprinaldoxime.**	See *Capraldehyde, oxime.*		
2344	**Caprinitrile**...........	decanenitrile*; capric nitrile; *n*-nonyl cyanide	$CH_3(CH_2)_8CN$....	153.2
2345	**Caproaldehyde**........	hexanal*; *n*-caproic aldehyde; *n*-hexoic aldehyde	$CH_3(CH_2)_4CHO$...	100.1
2346	——, oxime................	hexanal oxime*; capronaldoxime	$CH_3(CH_2)_4$-$CH:NOH$	115.1
2347	——, **α-ethyl-**.........	2-ethylhexanal*; butylethylacetaldehyde	$C_4H_9CH(C_2H_5)$-CHO	128.2
2348	——, **α, β, γ, δ-tetrahydroxy-*.**	See *Fucose.*		
2349	**Caproamide**...........	hexanamide*..............	$CH_3(CH_2)_4CONH_2$	115.1
2350	**Caproic acid (*n*)**.......	hexanoic acid*; *n*-hexoic acid	$CH_3(CH_2)_4COOH$	116.1
2351	——, amyl ester...........	amyl caproate; pentyl hexanoate*	$CH_3(CH_2)_4$-$COOC_5H_{11}$	186.2

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2324	hyg. need. f. w., [α] $-26.9^{\circ 19}_{D}$ in w.	....	164–5 (158)	$195–210^{13}$	12.5^{16}	59.8^{16}	5.28^{16} eth.; 42.9 chl.; s. acet.; v. sl. s. bz., CS_2
2325	rhomb. bisphenoidal	....	157.8	....	i.	s.	s. eth.
2326							
2327	liq., 1.47284^{18} [α] +6 °D	$0.8736\frac{18}{4}$	....	194–6	......	......	....
2328	silky need. f. al., [α] −299 °D in chl.	....	133–4	....	i.	s.	v. s. eth., chl., bz.
2329							
2330	col. oily liq., 1.4895	$0.8521\frac{20}{4}$	....	135	i.	∞	s. eth.
2331	col. rhomb. pl.	....	218 (212)	subl. at 84	0.0033	0.02^{18}	0.09 eth.; s. ac. a., conc. H_2SO_4, alk.; sl. s. chl., acet.
2332	liq., 1.42977^{15}..	$0.828\frac{15}{4}$	....	208–9	i.	s.	s. eth.
2333	leaf. f. dil. me. al.	....	69	....	......	s.	s. eth.
2334	cr...........	$0.999\frac{20}{4}$	108 (98)	....	i.	s.	s. eth.
2335	col. need., 1.42855^{40}	$0.8858\frac{40}{4}$	31.5	268–70	sl. s.	s.	s. eth.
2336	col. liq., 1.42575^{20}	$0.8650\frac{20}{4}$	−19.96	224.5 $(110–2^{10})$	∞	∞	∞ eth., chl.
2337	col. liq.......	....	−18	224	i.	v. s.	v. s. eth.
2338	need. or leaf. f. al.	....	38.5	$270–5^{100}$	i.	s.	....
2339							
2340							
2341	cr...........	....	23.9	....	i.	s.	s. eth.
2342							
2343							
2344	col. liq.......	$0.8295\frac{15}{4}$	−17.9	243.7 (236–7)	i.	v. sl. s.	s. eth.
2345	col. liq.......	$0.8335\frac{20}{4}$	....	131	i.	v. s.	v. s. eth.
2346	cr...........	....	51	....	......	s.	s. eth.
2347	col. liq., 1.416.	$0.823\frac{20}{4}$	<−100	163.4	0.04^{28}	......	....
2348							
2349	cr...........	$0.999\frac{20}{4}$	101.0	255	v. sl. s.	v. s.	s. eth., bz.
2350	col. oily liq., 1.41635	$0.945\frac{0}{0}$; $0.929\frac{20}{4}$	−1.5 to −2.0 (−9.5)	205 (202)	0.4	s.	s. eth.
2351	col. liq.......	....	....	222.2	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2352	**Caproic acid**, butyl ester	butyl caproate; butyl hexanoate*	$CH_3(CH_2)_4COOC_4H_9$	172.26
2353	——, ethyl ester	ethyl caproate; ethyl hexanoate*	$CH_3(CH_2)_4COOC_2H_5$	144.21
2354	——, isoamyl ester	γ-methylbutyl hexanoate*	$CH_3(CH_2)_4COOC_5H_{11}$	186.29
2355	——, methyl ester	methyl hexanoate*; methyl caproate	$CH_3(CH_2)_4COOCH_3$	130.18
2356	——, *p*-phenylphenacyl ester		$CH_3(CH_2)_4COOCH_2COC_6H_4C_6H_5$	310.38
2357	——, piperazinium salt		$C_4H_{10}N_2\cdot 2C_5H_{11}COOH$	318.45
2358	**——, α-amino-.**	See *Norleucine.*		
2359	**——, α-bromo-**	2-bromohexanoic acid*	$CH_3(CH_2)_3CHBrCOOH$	195.07
2360	**——, α,ε-diamino-.**	See *Lysine.*		
2361	**——, α-ethyl-**	butylethylacetic acid; 3-heptanecarboxylic acid; 2-ethylhexanoic acid*	$CH_3(CH_2)_3CH(C_2H_5)COOH$	144.21
2362	**——, α-hydroxy-**	2-hydroxyhexanoic acid*	$CH_3(CH_2)_3CHOHCOOH$	132.16
2363	**——, γ-hydroxy-, lactone**	4-hydroxyhexanoic acid lactone*	$CH_3CH_2\underbrace{CH(CH_2)_2COO}$	114.14
2364	**——, α-methyl-**	2-methylhexanoic acid*	$CH_3(CH_2)_3CH(CH_3)COOH$	130.18
2365	**——, δ-methyl-**	5-methylhexanoic acid*; isoamylacetic acid; isoheptylic acid	$(CH_3)_2CH(CH_2)_3COOH$	130.18
2366	**Caproic aldehyde.**	See *Caproaldehyde.*		
2367	**Caproic anhydride**	hexanoic anhydride*	$[CH_3(CH_2)_4CO]_2O$	214.30
2368	**Caproic nitrile.**	See *Capronitrile.*		
2369	**Caprokol.**	See *Resorcinol, 4-hexyl-.*		
2370	**Capronaldoxime.**	See *Caproaldehyde, oxime.*		
2371	**Caprone.**	See 6-*Hendecanone**.		
2372	**Capronitrile**	hexanenitrile*; caproic nitrile; *n*-amyl cyanide	$CH_3(CH_2)_4CN$	97.16
2373	**Caprophenone, 2,4-dihydroxy-**	4-caproylresorcinol	$CH_3(CH_2)_4COC_6H_3(OH)_2$	208.25
2374	**Caproyl chloride**	hexanoyl chloride*	$CH_3(CH_2)_4COCl$	134.61
2375	**Caprylaldehyde**	octanal*; caprylic aldehyde; *n*-octylaldehyde	$CH_3(CH_2)_6CHO$	128.21
2376	——, oxime	octanal oxime*; caprylaldoxime	$CH_3(CH_2)_6CH:NOH$	143.23
2377	**Caprylamide**	octanamide*	$CH_3(CH_2)_6CONH_2$	143.23
2378	***sec-n*-Caprylamine.**	See *Heptylamine, α-methyl-**.		
2379	**Capryl chloride**	decanoyl chloride*	$CH_3(CH_2)_8COCl$	190.71
2380	**Caprylene.**	See *Octylene.*		
2381	**Caprylic acid**	octanoic acid*; *n*-octoic acid; *n*-octylic acid	$CH_3(CH_2)_6COOH$	144.21
2382	——, ethyl ester	ethyl caprylate; ethyl octanoate*	$CH_3(CH_2)_6COOC_2H_5$	172.26
2383	——, isoamyl ester	γ-methylbutyl octanoate*	$CH_3(CH_2)_6COOC_5H_{11}$	214.34
2384	——, methyl ester	methyl octanoate*; methyl caprylate	$CH_3(CH_2)_6COOCH_3$	158.24
2385	——, *p*-phenylphenacyl ester		$CH_3(CH_2)_6COOCH_2COC_6H_4C_6H_5$	338.43

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2352	col. liq	$0.8843\frac{0}{4}$	...	204.3	v. sl. s.	∞	∞ eth.
2353	col. to yelsh. liq., 1.40727^{20}	$0.8710\frac{20}{4}$	−67.5	168	0.0015^{20}	s.	s. eth.
2354	col. liq	...	...	$94–6^{10}$	i.	s.	...
2355	col. liq	$0.9038\frac{0}{4}$	...	149.5	i.	v. s.	v. s. eth.
2356	...	...	65	...	...	...	...
2357	wh. cr	...	111–1.5	...	s.	s.	i. eth.; s. h. acet.
2358							
2359	liq	...	...	240 ($128–31^{10}$)	...	s.	s. eth.
2360							
2361	col. liq	$0.903\frac{20}{4}$	<0	223–5	0.2	...	...
2362	col. need	...	62	subl. 100	s.	s.	s. eth.
2363	col. liq	...	<−18	220	s.	s.	...
2364	liq	...	...	209.6	∞	∞	∞ eth.
2365	col. liq	$0.926\frac{15}{4}$; $0.9138\frac{21}{4}$	<−25	211.5 (216.5)	sl. s.	s.	s. eth.
2366							
2367	col. oil	$0.9279\frac{17}{4}$	−40.6	241–3 sl. d.	d.	s.	∞ eth.
2368							
2369							
2370							
2371							
2372	col. liq., $1.40851^{14.3}$	$0.809\frac{20}{4}$	−79.4	163	v. sl. s.	s.	s. eth.
2373	...	...	56	$196–8^{7}$	i.	s.	s. eth., chl., acet., pet. eth.; v. s. bz.
2374	col. liq., 1.4867	$0.9704\frac{25}{4}$	−87.3	153	d.	d.	s. eth.
2375	col. liq., 1.4217	$0.821\frac{20}{4}$	...	163.4 (81^{32})	v. sl. s.	∞	∞ eth.
2376	cr	...	58–9	$120–5^{10}$	...	...	...
2377	col. leaf	...	110 (104)	>200 d.	0.45^{100}	s.	s. eth.
2378							
2379	col. liq	$0.973\frac{8}{4}$	−34.5	232.3 (195–6)	d.	d.	s. eth.
2380							
2381	col. leaf. or oily liq., 1.4285	$0.910\frac{20}{4}$	16	237.5	0.25^{100}	∞	∞ eth.; s. bz., chl., CS_2, glac. ac. a.
2382	col. liq., 1.41775^{20}	$0.8667\frac{20}{4}$	−44.8 (−43.1)	208	0.063^{20}	s.	s. eth.
2383	col. liq	...	...	136^{10}	i.	s.	...
2384	col. liq	$0.887\frac{20}{4}$	−41	192.9	i.	v. s.	v. s. eth.
2385	...	...	67	...	...	...	...

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2386	**Caprylic acid, α-amino-,*dl*-**	*dl*-2-aminooctanoic acid*	$CH_3(CH_2)_5CH(NH_2)COOH$	159.23
2387	——, **α-hydroxy-**	2-hydroxyoctanoic acid*	$CH_3(CH_2)_5CHOHCOOH$	160.21
2388	**Caprylic anhydride**	octanoic anhydride*; *n*-octoic anhydride	$[CH_3(CH_2)_6CO]_2O$	270.40
2389	**Caprylidene.**	See 1-*Octyne**.		
2390	**Caprylone.**	See 8-*Pentadecanone**.		
2391	**Caprylonitrile**	octanenitrile*; *n*-heptyl cyanide	$CH_3(CH_2)_6CN$	125.21
2392	**Caprylyl chloride**	octanoyl chloride*	$CH_3(CH_2)_6COCl$	162.66
2393	**Carbamamidine.**	See *Guanidine.*		
2394	**Carbamic acid,** benzyl ester	benzyl carbamate; benzyl aminomethanoate*	$NH_2COOCH_2C_6H_5$	151.16
2395	——, ethyl ester	ethyl carbamate; urethan	$NH_2COOC_2H_5$	89.09
2396	——, isoamyl ester	isoamyl carbamate; isoamyl urethan	$NH_2COOC_5H_{11}$	131.17
2397	——, isobutyl ester	β-methylpropyl aminomethanoate*	$NH_2COOCH_2CH(CH_3)_2$	117.15
2398	——, methyl ester	methyl urethan	NH_2COOCH_3	75.07
2400	——, propyl ester	*n*-propyl carbamate	$NH_2COOC_3H_7$	103.12
2401	——, **cyclohexylethylthiolthiono-,** cyclohexylethylammonium salt		$C_6H_{11}(C_2H_5)NCSSNH_2(C_2H_5)C_6H_{11}$	330.58
2402	——, **cyclopentamethylenedithio-,** salts. See under 1-*Piperidinecarbodithioic*			
2403	——, **dibenzyldithio,** dibenzylammonium salt		$(C_6H_5CH_2)_2NCSSNH_2(CH_2C_6H_5)_2$	470.67
2404	——, ——, zinc salt		$[(C_6H_5CH_2)_2NCSS]_2Zn$	610.16
2405	——, **dibutylthiolthiono-,** zinc salt		$[(C_4H_9)_2NCSS]_2Zn$	474.11
2405M	——, **diethyl-**		$(C_2H_5)_2NCOOH$	117.15
2406	——, **diethylthiolthiono-,** benzal diester		$[(C_2H_5)_2NCSS]_2CHC_6H_5$	386.64
2407	——, ——, diethylammonium salt		$(C_2H_5)_2NCSSNH_2(C_2H_5)_2$	222.40
2408	——, **diethylthiolthiono-,** 6-nitrobenzothiazyl ester. See 2-*Benzothiazolethiol*, 6-*ni*			
2409	——, ——, zinc salt		$[(C_2H_5)_2NCSS]_2Zn$	361.90
2410	——, **dimethylthiolthiono-,** dimethylammonium salt		$(CH_3)_2NCSSNH_2(CH_3)_2$	166.30
2411	——, ——, 2,4-dinitrophenyl ester		$(CH_3)_2NCSSC_6H_3(NO_2)_2$	287.31
2412	——, ——, selenium tetrasalt		$[(CH_3)_2NCSS]_4Se$	559.79
2413	——, ——, zinc salt		$[(CH_3)_2NCSS]_2Zn$	305.79

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2386	waxy pl......	....	263–4	d., subl.	0.6^{100}	v. sl. s.	v. sl. s. eth.
2387	pl............	....	69.5	....	v. sl. s.	v. s.	v. s. eth.
2388	liq...........	$0.9021\frac{25}{4}$	–1	285	d.	s.	∞ eth.
2389							
2390							
2391	col. liq.......	$0.820\frac{18}{4}$; $0.8058\frac{30}{4}$	–45.6	205.2 (194–5)	i.	v. sl. s.	s. eth.
2392	liq...........	$0.9671\frac{0}{4}$	–6	195.55	d.	d.	s. eth.
2393							
2394	leaf..........	....	86	220 d.	sl. s.	s.	s. eth.
2395	col. need. f. lgr.	$0.9862\frac{21}{4}$; $1.11\frac{20}{20}$	50 (48)	180	$100+^{25}$	166^{25}	v. s. eth., bz.; s. chl., glyc.; sl. s. lgr.
2396	need. f. w.....	$0.944\frac{70.6}{4}$	63.5	220	s. h.	s.	s. eth.
2397	col. leaf.......	$0.943\frac{20}{4}$	55	206–7	i.	s.	s. eth.
2398	col. pl.......	$1.136\frac{56}{4}$	52	177	217^{11}	73^{15}	s. eth.
2400	col. pr.........	....	60–1 (53)	200	v. s.	v. s.	s. eth.
2401	pa. yel. cr.....	....	95–6	....	v. s.	v. s.	s. eth.
2402	*acid.*						
2403	yel. cr........	....	82.5	....	s.	v. s.	sl. s. eth.
2404	cream colored powd.	....	176–7	....	i.	i.	i. eth.; sl. s. chl.
2405	cream colored powd.	$1.26\frac{20}{4}$	108–9	....	i.	i.	sl. s. eth., chl.
2405M	need. f. eth ...	....	74 unst. >–15	....	v. s.	v. s.	2.6^{22} eth.
2406	yel. cr.........	....	178–9	....	i.	s. h.	....
2407	pa. yel. pl.....	....	81–2	....	v. s.	v. s.	v. sl. s. eth.
2408	*tro-, diethylthiolt*	*hionocarbami*	*c ester.*				
2409	wh. powd.......	$1.24\frac{20}{4}$	173–4	....	i.	i.	i. eth.; sl. s. chl.
2410	pa. yel. pl.....	....	129–30	....	v. s.	v. s.	v. sl. s. eth.
2411	yel. cr.........	$1.54\frac{20}{4}$	139	....	i.	s. h.	....
2412	dense or. cr...	....	179–80	....	i.	i.	i. eth.; sl. s. chl.
2413	wh. powd.....	$2.00\frac{20}{4}$	248–50	....	i.	i.	i. eth.; sl. s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2414	**Carbamic acid, diphenyl-,** ethyl ester	diphenylurethan	$(C_6H_5)_2NCOOC_2H_5$	241.28
2415	——, **dithio-**	aminodithioformic acid; aminomethanethionothiolic acid*	NH_2CS_2H	93.16
2416	——, **ethyl-,** ethyl ester	ethylurethan	$C_2H_5NHCOOC_2H_5$	117.15
2417	——, **ethylidenedi-,** diethyl ester	ethylidenediurethan	$CH_3CH(NHCOOC_2H_5)_2$	204.23
2418	——, **isobutyl-,** ethyl ester	ethyl isobutylcarbamate; isobutylurethan	$(CH_3)_2CHCH_2NHCOOC_2H_5$	145.20
2419	——, **methyl-,** ethyl ester	methylurethan	$CH_3NHCOOC_2H_5$	103.12
2420	——, **nitro-,** ethyl ester	nitrourethan	$NO_2NHCOOC_2H_5$	134.09
2421	——, **phenyl-,** esters. See	under *Carbanilic acid.*		
2422	——, **propyl-,** ethyl ester	*n*-propylurethan	$C_3H_7NHCOOC_2H_5$	131.17
2423	——, **thiol-,** ethyl ester	aminomethanethiolic acid ethyl ester; thiourethan	$NH_2COSC_2H_5$	105.15
2424	——, **thiono-,** ethyl ester	thiourethan; xanthogenamide	$NH_2CSOC_2H_5$	105.15
2425	**Carbamide.**	See *Urea.*		
2426	**Carbamide oxide.**	See *Urea, hydroxy-.*		
2427	**Carbamonitrile.**	See *Cyanamide.*		
2428	**Carbamyl chloride**	chloroformamide; urea chloride; carbamide chloride	H_2NCOCl	79.49
2428M	——, **diphenyl-**	*N*-chloroformyldiphenylamine	$(C_6H_5)_2NCOCl$	231.68
2429	**Carbanil.**	See *Isocyanic acid, phenyl ester.*		
2430	**Carbanilic acid,** ethyl ester	*N*-phenylurethan; ethyl phenylcarbamate	$C_6H_5NHCOOC_2H_5$	165.19
2431	——, isobutyl ester	isobutyl phenylcarbamate	$C_6H_5NHCOOCH_2CH(CH_3)_2$	193.24
2431M	——, propyl ester	*n*-propylphenylurethan; *n*-propyl carbanilate	$C_6H_5NHCO_2C_3H_7$	179.21
2432	——, **o-hydroxy-,** lacton	e. See 2(3)-*Benzoxazolone.*		
2433	**Carbanilide**	*N,N′*-diphenylurea; *sym*-diphenylurea	$C_6H_5NHCONHC_6H_5$	212.24
2434	——, ***N,N′*-diethyl-**	*N,N′*-diethyl-*N, N′*-diphenylurea*	$CO[N(C_2H_5)(C_6H_5)]_2$	268.35
2435	——, **2,2′-dimethylthio-**	di-*o*-tolylthiourea	$CS(NHC_6H_4CH_3)_2$	256.36
2436	——, **4,4′-dimethylthio-**	di-*p*-tolylthiourea	$CS(NHC_6H_4CH_3)_2$	256.36
2437	——, ***N,N′*-diphenyl-.**	See *Urea, tetraphenyl-.*		
2438	——, ***N*-methyl-**		$C_6H_5(CH_3)NCONHC_6H_5$	226.27
2439	——, **2,2′,4,4′-tetranitro-**		$[(NO_2)_2C_6H_3NH]_2CO$	392.24
2440	——, **thio-**	*N,N′*-diphenylthiourea; *sym*-diphenylthiourea	$(C_6H_5NH)_2CS$	228.30
2441	——, **thio-o,o′-dimethyl-**	*sym*-di-*o*-tolylthiourea	$(CH_3C_6H_4NH)_2CS$	256.36
2442	**Carbanilonitrile.**	See *Cyananilide.*		
2443	**Carbazide.**	See *Carbohydrazide.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2414	col. pr. f. lgr...	....	71–2	360	s.	v. s.	v. s. eth.
2415	col. need......	....	....	....	v. s. d.	s.	s. eth.
2416	col. liq........	$0.981\frac{20}{4}$	....	176	$63.2^{15.5}$	......	....
2417	need..........	....	125–6	$170–80^{20}$ d.	sl. s. c.	s.	s. eth.
2418	col. liq., 1.4288	$0.943\frac{20}{4}$	<–65	96^{17}	i.	......	....
2419	col. liq., $1.4200^{18.9}$	1.009^{19}	....	170	$94.7^{15.5}$	s.	....
2420	col. leaf. f. lgr.	....	64	....	v. s.	v. s.	v. s. eth.; sl. s. lgr.
2421							
2422	liq............	0.992^{15}	....	191.5–2.5^{758} (186)	$9.80^{15.5}$	......	....
2423	pl. or leaf.....	....	108 (102–9)	subl. d.	v. sl. s. c., s. h.	v. s. h.	v. s. h. eth.
2424	monocl. leaf. f. eth.	....	41–2	d.	i. (v. sl. s.)	s.	s. eth.
2425							
2426							
2427							
2428	col. liq.......	....	50	61–2	d.	d.	....
2428M	pl. f. al.......	....	85	....	......	......	....
2429							
2430	lgn. need. f. w.	$1.106\frac{30}{4}$; $1.079\frac{60}{4}$	52	238	v. sl. s.	v. s.	v. s. eth.; s. bz.
2431	cr............	....	85.5–86	216 d.	v. sl. s.	v. s.	v. s. eth.
2431M	wh. need......	....	50–51	....	......	......	....
2432							
2433	col. rhomb. f. al., 1.583	$1.239\frac{20}{4}$	238–9 (235;	260 subl.	0.015^{25}	s.	v. s. eth.
2434	col. cr. f. w....	....	72–3 (54)	....	s.	v. s.	....
2435	v. sm. col. need. f. al.	....	156–8	218	v. sl. s.	sl. s.	v. sl. s. eth.; s. ac. a., bz.
2436	v. sm. rhomb. need.	....	178–9 (176–7)	....	v. sl. s.	sl. s.	v. sl. s. eth.
2437							
2438	col. need......	....	104	203–5	i.	sl. s.	v. s. eth., bz.
2439	yel. need......	....	189	....	i.	v. s.	v. sl. s. eth.
2440	col. rhomb. leaf. f. al.	$1.321\frac{4}{4}$	154	d.	i. (v. sl. s.)	s.	s. eth.
2441	need. f. al.....	....	158	216–18	i.	s. h.	i. eth.; s. ac. a., bz.
2442							
2443							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2444	**Carbazole**	dibenzopyrrole; diphenylenimine	$C_6H_4NHC_6H_4$	167.20
2445	**——, *N*-acetyl-**		$CH_3CONC_{12}H_8$	209.24
2446	**——, *N*-ethyl-**		$C_{12}H_8NC_2H_5$	195.25
2447	**Carbinol.**	See *Methanol**.		
2448	**——, acetyl-.**	See *Acetol.*		
2449	**——, acetylenyl-.**	See *2-Propyn-1-ol**.		
2450	**——, acetylmethyl-.**	See *Acetoin.*		
2451	**——, allyl-.**	See *3-Buten-1-ol**.		
2452	**——, allyldiethyl-.**	See *5-Hexen-3-ol, 3-ethyl-**.		
2453	**——, allyldimethyl-.**	See *4-Penten-2-ol, 2-methyl-**.		
2454	**——, allylmethyl-.**	See *4-Penten-2-ol**.		
2454M	**——, allylmethylpropyl-.**	See *1-Hepten-4-ol, 4-methyl-**.		
2455	**——, *p*-aminodiphenyl-.**	See *Benzohydrol, p-amino-.*		
2456	**——, amyl-.**	See *1-Hexanol**.		
2457	**——, amyldiethyl-.**	See *3-Octanol, 3-ethyl-**.		
2458	**——, amyldimethyl-.**	See *2-Heptanol, 2-methyl-**.		
2459	**——, amylhexyl-.**	See *6-Dodecanol**.		
2460	**——, amylmethyl-.**	See *2-Heptanol**.		
2461	**——, amylpropyl-.**	See *4-Nonanol**.		
2462	**——, benzoyl-.**	See *Acetophenone, α-hydroxy-.*		
2463	**——, benzoylphenyl-.**	See *Benzoin.*		
2464	**——, benzyl-.**	See *Phenethyl alcohol.*		
2465	**——, benzylphenyl-.**	See *Ethanol, 1,2-diphenyl-.*		
2466	**——, bis-*p*-aminophenyl-4-amino-*m*-tolyl-.**	See *Rosaniline.*		
2467	**——, butyl-.**	See *1-Pentanol.**		
2468	**——, sec-butyl-.**	See *1-Butanol, 2-methyl-**.		
2469	**——, *tert*-butyl-.**	See *1-Propanol, 2,2-dimethyl-**.		
2470	**——, butyldimethyl-.**	See *2-Hexanol, 2-methyl-**.		
2471	**——, *tert*-butyldimethyl-.**	See *2-Butanol, 2,3,3-trimethyl-**.		
2472	**——, butylethylmethyl-.**	See *3-Heptanol, 3-methyl-**.		
2473	**——, butylmethyl-.**	See *2-Hexanol**.		
2473M	**——, 1-butynyldimethyl-.**	See *3-Hexyn-2-ol, 2-methyl-**.		
2474	**——, dibutyl-.**	See *5-Nonanol**.		
2475	**——, diethyl-.**	See *3-Pentanol**.		
2476	**——, diethylisobutyl-.**	See *3-Hexanol, 3-ethyl-5-methyl-**.		
2477	**——, diethylisopropyl-.**	See *3-Pentanol, 3-ethyl-2-methyl-**.		
2478	**——, diethylmethyl-.**	See *3-Pentanol, 3-methyl-**.		
2479	**——, diethylpropyl-.**	See *3-Hexanol, 3-ethyl-**.		
2480	**——, *p,p'*-dihydroxytriphenyl-.**	See *Benzaurin.*		
2481	**——, diisoamyl-.**	See *5-Nonanol, 2,8-dimethyl-**.		
2482	**——, diisobutyl-.**	See *4-Heptanol, 2,6-dimethyl-**.		
2483	**——, diisopropyl-.**	See *3-Pentanol, 2,4-dimethyl-**.		
2484	**——, dimethyl-.**	See *Isopropyl alcohol.*		
2485	**——, dimethylethyl-.**	See *2-Butanol, 2-methyl-**.		
2486	**——, dimethylphenyl-.**	See *2-Propanol, 2-phenyl-.*		
2487	**——, dimethylpropenyl-.**	See *3-Penten-2-ol**.		
2488	**——, dimethylpropyl-.**	See *2-Pentanol, 2-methyl-**.		
2489	**——, diphenyl-.**	See *Benzohydrol.*		
2490	**——, diphenylene-.**	See *9-Fluorenol**.		
2491	**——, dipropyl-.**	See *4-Heptanol**.		
2492	**——, ethyl-.**	See *Propyl alcohol.*		
2493	**——, ethyldipropyl-.**	See *4-Heptanol, 4-ethyl-**.		
2493M	**——, ethylethynylmethyl-.**	See *1-Pentyn-3-ol, 3-methyl-**		
2494	**——, ethylhexyl-.**	See *3-Nonanol**.		
2495	**——, ethylisobutyl-.**	See *3-Hexanol, 5-methyl-**.		
2496	**——, ethylisopropyl-.**	See *3-Pentanol, 2-methyl-**.		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2444	col. leaf.......	....	246 (243–5)	354.8	i.	$0.92^{1.4}$	3.1^{30} eth.; 5.3^{50} bz., 3.1^{80} tol.; 11.1^{30} acet.; sl. s. ac. a., chl., CS_2, CCl_4
2445	need. f. w.....	....	69	>360 d.	i. c., sl. s. h.	v. s.	v. s. eth., bz.
2446	leaf. f. eth....	....	67–8	....	......	s. h.	s. eth.
2447							
2448							
2449							
2450							
2451							
2452							
2453							
2454							
2454M							
2455							
2456							
2457							
2458							
2459							
2460							
2461							
2462							
2463							
2464							
2465							
2466							
2467							
2468							
2469							
2470							
2471							
2472							
2473							
2473M							
2474							
2475							
2476							
2477							
2478							
2479							
2480							
2481							
2482							
2483							
2484							
2485							
2486							
2487							
2488							
2489							
2490							
2491							
2492							
2493							
2493M							
2494							
2495							
2496							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2497	**Carbinol, ethylisoprop**	**ylmethyl-.** See 3-*Pentanol, 2*	*,3-dimethyl-**.	
2498	——, **ethylmethyl-.**	See *sec-Butyl alcohol.*		
2499	——, **ethylmethylprop**	**yl-.** See 3-*Hexanol, 3-methyl-**.		
2500	——, **ethylphenyl-.**	See 1-*Propanol, 1-phenyl-.*		
2501	——, **ethylpropyl-.**	See 3-*Hexanol**.		
2502	——, **ethylvinyl-.**	See 1-*Penten-3-ol**.		
2503	——, **ethynyl-.**	See 2-*Propyn-1-ol**.		
2503H	——, **ethynylisopropyl**	**methyl-.** See 1-*Pentyn-3-ol, 3*	*,4-dimethyl-**.	
2503R	——, **ethynylmethylpr**	**opyl-.** See 1-*Hexyn-3-ol, 3-me*	*thyl-**.	
2504	——, **α-furyl-.**	See *Furfuryl alcohol.*		
2505	——, **heptyl-.**	See 1-*Octanol**.		
2506	——, **heptylmethyl-.**	See 2-*Nonanol**.		
2507	——, **hexyldimethyl-.**	See 2-*Octanol, 2-methyl-**.		
2508	——, **hexylpropyl-.**	See 4-*Decanol**.		
2509	——, **isoamyl-.**	See 1-*Pentanol, 4-methyl-**.		
2510	——, **isoamylmethyl-.**	See 2-*Hexanol, 5-methyl-**.		
2511	——, **isobutyl-.**	See *Isoamyl alcohol.*		
2512	——, **isobutyldimethyl**	**-.** See 2-*Pentanol, 2,4-dimethy*	*l-**.	
2513	——, **isobutylmethyl-.**	See 2-*Pentanol, 4-methyl-**.		
2514	——, **isohexyl-.**	See 1-*Hexanol, 5-methyl-**.		
2515	——, **isopropyl-.**	See *Isobutyl alcohol.*		
2516	——, **isopropyldimethy**	**l-.** See 2-*Butanol, 2,3,-dimethyl*	*-**.	
2517	——, **methyl-.**	See *Ethyl alcohol.*		
2518	——, **methyl-*tert*-but**	**yl-.** See *Pinacolyl alcohol.*		
2519	——, **methyldipropyl-.**	See 4-*Heptanol, 4-methyl-**.		
2520	——, **methylhexyl-.**	See 2-*Octanol**.		
2521	——, **methylisopropyl-**	**.** See 2-*Butanol, 3-methyl-**.		
2522	——, **methylnonyl-.**	See 2-*Hendecanol**.		
2523	——, **methylphenyl-.**	See *Benzyl alcohol, α-methyl-.*		
2524	——, **methylpropyl-.**	See 2-*Pentanol**.		
2525	——, **methylvinyl-.**	See 3-*Buten-2-ol**.		
2526	——, **1-naphthyldi-phenyl-**	diphenyl-α-naphthylcarbinol	$(C_6H_5)_2(C_{10}H_7)$-COH	310.38
2527	——, **nonyl-.**	See 1-*Decanol**.		
2528	——, **phenyl-.**	See *Benzyl alcohol.*		
2529	——, **propenyl-.**	See 2-*Buten-1-ol**.		
2530	——, **propyl-.**	See *Butyl alcohol (n).*		
2531	——, **styryl-.**	See *Cinnamic alcohol.*		
2532	——, **α-thienyl-.**	See 2-*Thiophenecarbinol.*		
2533	——, ***o*-tolyl-**	*o*-methylbenzyl alcohol; *o*-tolubenzyl alcohol	$CH_3C_6H_4CH_2OH$	122.16
2534	——, ***m*-tolyl-**	*m*-methylbenzyl alcohol; *m*-tolubenzyl alcohol	$CH_3C_6H_4CH_2OH$	122.16
2535	——, ***p*-tolyl-**	*p*-methylbenzyl alcohol; *p*-tolubenzyl alcohol	$CH_3C_6H_4CH_2OH$	122.16
2536	——, ***p,p′,p″*-triaminot**	**riphenyl-.** See *Pararosaniline*	.	
2537	——, **triethyl-.**	See 3-*Pentanol, 3-ethyl-**.		
2538	——, **trimethyl-.**	See *tert-Butyl alcohol.*		
2539	——, **p_3-trinitrotriphe**	**nyl-.** See *Carbinol, tris (p-nitr*	*ophenyl)-.*	
2540	——, **triphenyl-**		$(C_6H_5)_3COH$	260.32
2541	——, **tripropyl-.**	See 4-*Heptanol, 4-propyl-**.		
2542	——, **tris(*p*-aminophe**	**nyl)-.** See *Pararosaniline.*		
2543	——, **tris(*p*-nitro-phenyl)-**	p_3-trinitrotriphenylcarbinol; 4,4′,4″-trinitrotritanol	$(NO_2C_6H_4)_3COH$	395.32
2544	**Carbinol *o*-carboxylic**	**anhydride, triphenyl-.**	See *Phthalide, 3,3-di*	*phenyl-.*
2545	**Carbinylamine, diethy**	**l-.** See *Propylamine, α-ethyl-.*		
2546	——, **dimethylethyl-.**	See *tert-Amylamine.*		
2547	——, **methylisopropyl-**	**.** See *Propylamine, α, β-dimeth*	*yl-.*	
2548	——, **methylpropyl-.**	See *Butylamine, α-methyl-.*		
2549	——, **trimethyl-.**	See *tert-Butylamine.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2497							
2498							
2499							
2500							
2501							
2502							
2503							
2503 H							
2503 R							
2504							
2505							
2506							
2507							
2508							
2509							
2510							
2511							
2512							
2513							
2514							
2515							
2516							
2517							
2518							
2519							
2520							
2521							
2522							
2523							
2524							
2525							
2526	cr. f. lgr......	....	136	d.	i.	s. h.	v. s. eth.; s. bz.; sl. s. i. lgr.
2527							
2528							
2529							
2530							
2531							
2532							
2533	col. need......	$1.023\frac{40}{4}$	34	219 (223.3)	1^{20}, 1.5^{100}	v. s.	v. s. eth.
2534	col. liq........	$1.036\frac{0}{4}$	<-20	217	5 c.	s.	s. eth.
2535	col. need......	....	59.5	217	sl. s. c.	v. s.	v. s. eth.
2536							
2537							
2538							
2539							
2540	hex. pr. f. bz..	$1.188\frac{20}{4}$	162.5	>360	i.	v. s.	v. s. eth., bz.
2541							
2542							
2543	monocl. or rhomb. cr. f. bz.	....	193 (171-2)	....	......	sl. s. h.	sl. s. eth.; s. bz., ac. a.
2544							
2545							
2546							
2547							
2548							
2549							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2550	**"Carbitol".**	See *Diethylene glycol, monoethyl ether.*		
2551	**——, butyl.**	See *Diethylene glycol, monobutyl ether.*		
2552	**——, diethyl.**	See *Ether, bis(β-ethoxyethyl).*		
2553	**——, methyl.**	See *Diethylene glycol, monomethyl ether.*		
2554	**Carbocinchomeronic acid**	2,3,4-pyridinetricarboxylic acid	$C_5H_2N(COOH)_3\cdot 1\frac{1}{2}H_2O$	238.15
2555	**β-Carbocinchomeronic acid.**	See *3,4,5-Pyridinetricarboxylic acid.*		
2556	**Carbodiimide, diphenyl-**	carbodiphenylimide	$C_6H_5N:C:NC_6H_5$	194.23
2556M	**Carbodinicotinic acid.**	See *2,3,5-Pyridinetricarboxylic acid.*		
2557	**Carbodiphenylimide.**	See *Carbodiimide, diphenyl-.*		
2558	**Carbohydrazide**	carbonic acid dihydrazide; carbazide	$CO(NHNH_2)_2$	90.09
2559	**——, 1,5-diphenyl-**	*sym*-diphenylcarbazide	$(C_6H_5NHNH)_2CO$	242.28
2560	**Carbolic acid.**	See *Phenol.*		
2561	**Carbomethene.**	See *Ketene.*		
2562	**Carbon bisulfide.**	See *Carbon disulfide.*		
2563	**Carbon dioxide**	carbonic anhydride; carbonic acid gas	CO_2	44.01
2564	**Carbon disulfethyl.**	See *Carbonic acid, dithiol-, diethyl ester.*		
2565	**Carbon disulfide**	carbon bisulfide	CS_2	76.13
2566	**Carbon hexachloride.**	See *Ethane, hexachloro-**.		
2566M	**Carbon hexafluoride.**	See *Ethane, hexafluoro-**.		
2567	**Carbonic acid,** dibutyl ester		$CO(OCH_2CH_2CH_2CH_3)_2$	174.24
2568	——, diethyl ester	ethyl carbonate	$(C_2H_5)_2CO_3$	118.13
2569	——, dihydrazide.	See *Carbohydrazide.*		
2570	——, diisoamyl ester	isoamyl carbonate	$CO(OC_5H_{11})_2$	202.29
2571	——, diisobutyl ester	isobutyl carbonate	$CO[OCH_2CH(CH_3)_2]_2$	174.24
2572	——, dimethyl ester	methyl carbonate	$CO(OCH_3)_2$	90.08
2573	——, diphenyl ester	phenyl carbonate; diphenyl carbonate	$(C_6H_5)_2CO_3$	214.21
2574	——, dipropyl ester		$CO(OCH_2CH_2CH_3)_2$	146.18
2575	——, ethyl methyl ester		$CH_3C_2H_5CO_3$	104.10
2576	——, **chloro-**, esters.	See under *Formic acid, chloro-.*		
2577	——, **dithiol-**, diethyl ester	ethyldithiolcarbonate; carbon disulfethyl	$CO(SC_2H_5)_2$	150.25
2578	——, **thiolthiono-**, *O*-ethyl ester.	See *Xanthogenic acid.*		
2579	——, **trithio-**		$CS(SH)_2$	110.21
2580	**Carbonic acid gas.**	See *Carbon dioxide.*		
2581	**Carbonic anhydride.**	See *Carbon dioxide.*		
2582	**Carbonimide,** esters.	See under *Isocyanic acid.*		

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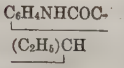
*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2550							
2551							
2552							
2553							
2554	rhomb. f. w....	....	(–H_2O, 115–20) anh. 250 d.	....	1.2^{15}	sl. s.	i. eth., bz.
2555							
2556	α: syrup......	....	....	330–1	......	d. h.	v.s. bz.; d. HCl
	β: cr.........	....	168–70	....	v. sl. s.	v. sl. s.	v. sl. s. eth.
2556M							
2557							
2558	need. f. dil. al.	....	152 exp.	....	v. v. s.	v. v. s.	v. v. s. eth.; i. bz., chl.
2559	leaf..........	....	172–3	d.	i.	s.	sl. s. eth.; s. bz.
2560							
2561							
2562							
2563	col. odorl. gas.	1.977 g/1; liq., 1.101^{-37}; solid 1.56^{-79}	$-56.6^{5.2 atm.}$	–78.5 subl.	179.7^0 cm^3, $.355^0$g, 90.1^{20} cm^3, $.097^{40}$g, $.058^{60}$g	31^{15} cm^3	....
2564							
2565	col. inflam. liq., 1.62950^{18}	$1.2628\frac{20}{4}$	–108.6; frz.–111	46.3	0.22^{23}	∞	∞ eth., bz.
2566							
2566M							
2567	col. liq.......	$0.9244\frac{20}{4}$	....	207^{720}	i.	s.	s. eth.
2568	col. inflam. liq., 1.38456^{20}	$0.9751\frac{20}{4}$	–43	125.8	i.	∞	∞ eth.
2569							
2570	liq...........	$0.912\frac{15}{4}$	....	228.7	......	......	....
2571	liq...........	$0.919\frac{15}{4}$	....	190.3	i.	∞	∞ eth.
2572	col. liq., 1.3687	$1.0694\frac{20}{4}$	0.5	90–1	i.	s.	s. eth.
2573	need. f. al.....	$1.1215\frac{87}{4}$	78; 81	306 (302)	i.	s.	s. eth., bz., CCl_4
2574	col. liq.......	$0.9411\frac{20}{4}$	....	168.2	v. sl. s.	∞	∞ eth.
2575	col. liq.......	$1.002\frac{27}{4}$	–14.5	109.2	i.	∞	∞ eth.
2576							
2577	yel. liq.......	1.085^{19}	....	196.7	i.	s.	s. eth.
2578							
2579	red brn. oil....	>1	d. 20–30	57 d.	i. d.	s.	s. eth., Na_2CO_3
2580							
2581							
2582							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2583	**Carbon monoxide**		CO	28.01
2584	**Carbon oxysulfide.**	See *Carbonyl sulfide.*		
2585	**Carbon suboxide**	malonic anhydride (so-called); dioxopropadiene*	$OC{:}C{:}CO$	68.03
2586	**Carbon tetrabromide**	tetrabromomethane*	CBr_4	331.67
2587	**Carbon tetrachloride**	tetrachloromethane*	CCl_4	153.84
2587M	**Carbon tetrafluoride**	tetrafluoromethane*	CF_4	88.01
2588	**Carbon tetraiodide**	tetraiodomethane*	CI_4	519.69
2589	**Carbonyl chloride.**	See *Phosgene.*		
2589M	**Carbonyl fluoride**	fluoroformyl fluoride	COF_2	66.01
2590	**Carbonyl sulfide**	carbon oxysulfide	COS	60.07
2591	**Carbostyril**	2-quinolinol or 2(1)-quinolone; *o*-aminocinnamic acid lactam	C_9H_7NO	145.15
2592	**——, 3-ethyl-**		 $C_6H_4NHCOC(C_2H_5)CH$	173.21
2593	**——, 4-methyl-**	2(1)-lepidone	$C_{10}H_9NO$	159.18
2594	**Carbothialdine**		$C_5H_{10}N_2S_2$	162.27
2595	**Carbylamine chloride, phenyl-.** See *Aniline, N-(dichloromethylene)-.*			
	Carbylamine derivatives. See *Amyl isocyanide, Butyl isocyanide, etc.*			
2596	**Carminic acid**		$C_{22}H_{20}O_{13}$	492.38
2597	**Carnaubyl alcohol**		$C_{24}H_{50}O$	354.65
2599	**α-Carotene**	α-carotin	$C_{40}H_{56}$	536.85
2600	**β-Carotene**	β-carotin; provitamin A	$C_{40}H_{56}$	536.85
2601	**Carotin.**	See *Carotene.*		
2602	***d*-Carpaine**		$C_{14}H_{25}NO_2$	239.35
2603	——, hydrochloride		$C_{14}H_{25}NO_2{\cdot}HCl$	275.82
2604	**Carubinose.**	See *d-Mannose.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2583	col. odorl. pois. gas	liq. $0.814\frac{-195}{4}$ $1.250\frac{0}{4}$g/1	−207 (−213)	−190 (−192)	0.0044^{0}g, 0.0028^{20} g, 0.0010^{80} g, 3.5^{0} cm^{3}	20^{20}cm^{3}	s. bz., ac. a., Cu_2Cl_2
2584							
2585	col. liq. or gas, 1.454	1.114^{0}	−111.3 (−107)	7	d.	......	s. eth.
2586	col. monocl. tab., $1.59998^{99.5}$ (He)	3.42	α48.4 β90.1	189.5 sl. d.	0.024^{30}	s.	s. eth., chl.
2587	col. liq., 1.46305^{15}	$1.595\frac{20}{4}$; $1.63195\frac{0}{4}$	−22.8; frz. to trimorph.; −28.6; −23.8; −21.2	76.8	0.08^{20}	∞	∞ eth., chl., bz.
2587M	col. gas.......	1.96^{-184}	−184	−128	sl. s.	......	....
2588	dk. red cub....	4.32	171 d.	subl. 90–100 vac.	i., d. h.	s., d. h.	s. eth.
2589							
2589M	col. gas.......	1.139^{-114}	−114	−83	d.	d.	....
2590	gas...........	liq. 1.24^{-87}; (A) 2.105; 2.721 g/1	−138	−50.2 (−47.5)	100 cm^{3}	800^{22} cm^{3}	4.4^{18} cm^{3} pyr.; 12^{13} cm^{3} nitro bz.; 1500^{22} cm^{3} tol.
2591	pr. f. al.......	....	200	subl.	v. sl. s.	v. s.	v. s. eth.; s. dil. HCl
2592	col. cr........	....	168	....	......	......	....
2593	col. need. f. w.	....	217.4	270^{17}	v. sl. s. c.	v. s. h.	v. sl. s. eth.; sl. s. bz.
2594	cr............	....	....	....	i.	sl. s.	i. eth., s. a.
2595							
2596	red monocl. pr.	....	136 d.	....	v. s.	s.	v. sl. s. eth.; s. conc. H_2SO_4, alk.; i. bz., chl.
2597	leaf..........	....	69	....	sl. s.	s.	....
2599	$[\alpha]+364^{20}_{\mathrm{Cd}}$ in bz.	....	175	....	......	......	....
2600	red-br. glist. cr.	....	181–2	....	i.	sl. s.	sl. s. eth., me. al., chl.; s. CS_2, bz., pet. eth.
2601							
2602	monocl. pr. f. al. $[\alpha]$ $+21°55'_{\mathrm{D}}$ in al.	....	121	....	i.	11	3 eth.; s. chl., bz., amyl al., CS_2
2603	lng. wh. rhomb. or monocl. need.	....	225 d.	....	11.6	s.	s. eth.
2604							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2605	**Carvacrol**	2-*p*-cymenol; cymophenol	$CH_3(C_3H_7)C_6H_3$-OH	150.21
2606	**——, hexahydro-.**	See *Carvomenthol.*		
2607	**Carvacrylamine**	2-*p*-cymylamine; 2-amino-*p*-cymene; 5-isopropyl-2-methylaniline; cymidine	$(CH_3)_2CH(CH_3)$-$C_6H_3NH_2$	149.23
2608	**Carvene.**	See *d-Limonene.*		
2609	**Carvenone**	3-*p*-menthen-2-one	$C_{10}H_{16}O$	152.23
2610	**Carveol, dihydro-**	*p*-menth-8(9)-en-2-ol	$C_{10}H_{17}OH$	154.25
2611	**Carvol.**	See *d-Carvone.*		
2612	**Carvomenthene**	1-*p*-menthene	$C_{10}H_{18}$	138.25
2613	**Carvomenthol**	2-*p*-menthanol; hexahydrocarvacrol	$C_{10}H_{19}OH$	156.26
2614	**Carvone, dihydro-**	*p*-menth-8(9)-en-2-one	$C_{10}H_{16}O$	152.23
2615	***dl*-Carvone,** oxime	*dl*-carvoxime	$C_{10}H_{14}$:NOH	165.23
2616	***d*-Carvone**	*d*-6,8(9)-*p*-menthadien-2-one; carvol	$C_{10}H_{14}O$	150.21
2617	***dl*-Carvoxime.**	See *dl-Carvone, oxime.*		
2618	**Caryophyllin**		$(C_{10}H_{16}O)_3$	456.69
2619	***d*-Catechin.**	See *d-Catechol.*		
2620	**Catechol.**	See also *Pyrocatechol.*		
2621	***d*-Catechol**	*d*-catechin; 3,5,7,3′,4′-flavanpentol (one form); 2-(3,4-dihydroxyphenyl)-3,5,7-chromantriol (one form)	$C_{15}H_{14}O_6$	290.26
2622	**Cedrarine.**	See *Quinazoline, 3,4-dihydro-3-phenyl-.*		
2623	**Cedrene** (artificial)		$C_{15}H_{24}$	204.34
2624	**Cedriret.**	See *Cerulignone.*		
2625	**Cellobiose**	cellose; glucose β-glucoside	$C_{12}H_{22}O_{11}$	342.30
2627	——, octaacetate (α)	octaacetylcellobiose	$C_{12}H_{14}O_3$-$(OOCCH_3)_8$	678.59
2628	**Cellose.**	See *Cellobiose.*		
2629	**"Cellosolve."**	See *Ethanol, 2-ethoxy-*.*		
2630	**——, benzyl.**	See *Ethanol, 2-benzyloxy-.*		
2631	**——, butyl.**	See *Ethanol, 2-butoxy-.*		
2632	**——, methyl.**	See *Ethanol, 2-methoxy-*.*		
2633	**Cellulose**		$(C_6H_{10}O_5)_x$	$(162.14)_x$

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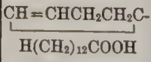
*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2605	col. oily liq., 1.52295	0.976	0.5 (1–2)	237.9	v. sl. s.	s.	s. eth., alk.
2606							
2607	oil, 1.543^{19}....	$0.9942\frac{20}{4}$	−16	241; 118^{12}	v. sl. s.	s.	s. eth.
2608							
2609	liq., 1.48377^{19}	$0.9263\frac{20}{4}$	....	233	i.	......	....
2610	liq., 1.48168...	0.927	....	225	......	......	....
2611							
2612	col. oily liq....	0.829^{20}	....	175	......	s.	....
2613	oil, 1.46296....	0.904^{20}	....	222 (220)	......	s.	s. eth.
2614	oily liq., 1.47174^{19}, [α]−19° (−16°)D.	$0.9253\frac{20}{4}$	....	220–1	......	......	....
2615	monocl. cr....	....	93–4 (70–71)	....	s.	s.	....
2616	col. liq., $1.49994^{18.2}$, [α]+62.07$_{D}$ (*l* [α] −39.34$^{\circ 18}_{D}$ in al.)	$0.9608\frac{20}{4}$	....	230 (227–8; 225)	v. sl. s.	∞	∞ eth.; s. chl.
2617							
2618	silky need. [α] +54.5°$_{D}$ in al.	....	310	subl. 285	i.	sl. s.	v. s. eth.; i. alk.
2619							
2620							
2621	wh. cr. powd. or need. f. w.	$1.344\frac{4}{4}$	175 (217)	240–5 d.	s.	s.	0.59 eth.; s. et. ac., alk.
2622							
2623	col. liq., 1.5001^{19}, [α] −52.6°$_{D}$.	0.929	....	262–3	......	......	....
2624							
2625	col. need., [α]+24.4°$_{D}$. in w.	....	225	....	s.	v. v. sl. s.	v. v. sl. s. eth.; i. acet.
2627	col. silky need., [α] +41.5°$_{D}$ in chl.	....	228–9	....	i.	s. h.	i. eth.
2628							
2629							
2630							
2631							
2632							
2633	wh. amorph...	1.27–1.61	....	....	i.	i.	i. eth., all ord. org. solv.; s. $Cu(NH_3)_4(OH)_2$

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2636	**Cellulose**, acetate, tri-		$C_6H_7O_2(OOCCH_3)_3$	288.25
2636M	——, ethyl ether	ethylcellulose; triethylcellulose	2,3, and 6 "OH" groups ethylated	indefinite
2637	——, hexanitrate	chief constituent of guncotton	$C_{12}H_{14}(ONO_2)_6O_4$	594.28
2638	——, pentanitrate		$C_{12}H_{15}(ONO_2)_5O_5$	549.28
2639	——, tetranitrate	constituent of collodion	$C_{12}H_{16}(ONO_2)_4O_6$	504.28
2640	——, trinitrate	constituent of collodion	$C_{12}H_{17}(ONO_2)_3O_7$	459.28
2640M	**——, ethyl-.**	See *Cellulose, ethyl ether.*		
2641	**Cerane**	isohexacosane	$C_{26}H_{54}$	366.70
2642	**Cerotic acid**	hexacosanoic acid*	$CH_3(CH_2)_{24}COOH$	396.68
2643	**Cerotin.**	See *Ceryl alcohol.*		
2644	**Cerulignone**	3,3′,5,5′-tetramethoxydiphenoquinone; coerulignone; cedriret	$C_{16}H_{16}O_6$	304.29
2645	**Ceryl alcohol**	1-hexacosanol*; cerotin; *n*-hexacosyl alcohol	$CH_3(CH_2)_{24}CH_2OH$	382.70
2646	**Cetane.**	See *Hexadecane**.		
2647	**Cetyl alcohol**	1-hexadecanol*; *n*-hexadecyl alcohol; ethal	$CH_3(CH_2)_{15}OH$	242.44
2648	——, acetate.	See *Acetic acid, cetyl ester.*		
2648M	**Cetylamine**	hexadecylamine* (*n*); 1-aminohexadecane	$CH_3(CH_2)_{15}NH_2$	241.45
2649	**Cetyl cyanide.**	See *Margaronitrile.*		
2650	**Cetylene.**	See 2-*Hexadecyne**.		
2651	**Cetyl ether**	1-hexadecyloxyhexadecane*; hexadecyl ether; dicetyl ether	$(C_{16}H_{33})_2O$	466.85
2652	**Cetyl iodide**	1-iodohexadecane*; *n*-hexadecyl iodide	$CH_3(CH_2)_{14}CH_2I$	352.35
2653	**Cetyl sulfate**	hexadecyl sulfate; di-*n*-hexadecyl sulfate	$[CH_3(CH_2)_{15}]_2SO_4$	546.91
2654	**Cevadine.**	See *Veratrine* (crystalline).		
2654M	**Cevitamic acid.**	See *l-Ascorbic acid.*		
2655	**Chalcone**	benzalacetophenone; benzylideneacetophenone; phenyl styryl ketone; 1,3-diphenyl-2-propen-1-one	$C_6H_5CH{:}CHCOC_6H_5$	208.25
2656	***d*-Chaulmoogric acid**	*d*-13-(2-cyclopentenyl) tridecanoic acid	 $\underbrace{CH{=}CHCH_2CH_2C}H(CH_2)_{12}COOH$	280.44
2657	**Chavibetol**	5-allylguaiacol; betel phenol	$CH_2{:}CHCH_2C_6H_3(OH)(OCH_3)$	164.20

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2636	ylsh. amor....	....	....	....	i.	i.	i. eth., acet.; s. chl., glac. ac. a., nitro-bz.
2636M	fine wh. need. f. 0.2% soln. in bz.	....	240–255	....	i.	sl. s.-s.	s. warm eth.
2637	wh. amor.....	1.66	ign. 160–70	....	i.	i.	i. eth., bz.; v. v. sl. s. eth. + al.; s. nitro-bz. ‡
2638	wh. amor.....	*ca.* 1.66	....	....	i.	i.	i. eth., bz.; s. eth. + al.
2639	wh. amor.....	1.66	....	....	i.	i.	i. eth., bz.; s. eth. + al., me. al.
2640	wh. amor.....	1.66	....	....	i.	s.	s. me. al., h. glac. ac. a.; i. bz.
2640M							
2641	cr. f. eth......	....	61	$207^{0.7}$	i.	s.	s. eth.
2642	col. need. f. al.	0.836^{79}	87.7 (80–2)	d.	i.	v. sl. s.	20^{35} eth.; s. acet., bz.
2643							
2644	bluish gr. need.	....	d.	....	i.	i.	s. H_2SO_4, phenol; i. ord. org. solv.
2645	col. rhomb. pl.	....	79.5–79.8	305^{20} d.	i.	s.	s. eth.
2646							
2647	leaf. f. al., $1.4283^{78.9}$	$0.8176\frac{50}{4}$	49.3	190^{15}; 344	i.	102	s. eth.; 97^{24} me. al.; s. bz.
2648							
2648M	col. cr..........	....	....	322.5; 143.9^{2}	i.	s.	s. eth.
2649							
2650							
2651	leaf...........	....	55	270 d.	sl. s.	s.	s. eth.
2652	leaf. f. al., 1.4806	1.123	22	211^{15}	i.	s.	s. eth.
2653	....	....	66.2–6.3	....	......	......	....
2654							
2654M							
2655	pa. yel. rhomb. pl.	$1.071\frac{62}{4}$	62 (55–7)	348	i.	sl. s.	s. eth., chl., bz., CS_2, conc. H_2SO_4; v. sl. s. lgr.
2656	col. leaf. f. al. $[\alpha]+62°_D$ in chl.	....	68.5	$247–8^{20}$	i.	v. sl. s.	s. eth., chl.
2657	liq., 1.5413^{20}...	$1.0690\frac{15}{15}$	8.5	254–5	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

‡All nitro celluloses are soluble in acet., et. ac., amyl acetate.

No.	Name	Synonyms	Formula	Mol. Wt.
2658	**Chavicol**	*p*-allylphenol	$CH_2{:}CHCH_2C_6H_4OH$	134.17
2659	——, methyl ether.	See *Estragole.*		
2660	**Chelerythrine,** alcoholate		$C_{21}H_{19}NO_5 \cdot C_2H_6O$	411.44
2661	**Chelidonine,** hydrochloride		$C_{20}H_{19}NO_5 \cdot HCl$	389.83
2662	*d*-**Chelidonine**		$C_{20}H_{19}NO_5 \cdot H_2O$	371.38
2663	**Chick antidermatitis factor.**	See *Pantothenic acid.*		
2664	**Chinalgen.**	See *Analgen.*		
2664M	**Chitosamine.**	See D-*Glucosamine.*		
2665	**Chloral**	trichloroethanal*; trichloroacetaldehyde	CCl_3CHO	147.40
2666	——, alcoholate	2,2,2-trichloro-1-ethoxyethanol*; chloral hydrate monoethyl acetal	$CCl_3CH(OH)OC_2H_5$	193.47
2667	——, diethyl acetal.	See *Ethane,* 1,1,1-*trichloro*-2,2-*diethoxy*-*.		
2668	——, hydrate	2,2,2-trichloro-1,1-ethanediol*; trichloroethylidene glycol	$CCl_3CH(OH)_2$	165.42
2669	**Chloral-antipyrine.**	See *Hypnal.*		
2670	**Chloranil**	tetrachloroquinone; tetrachloro-*p*-benzoquinone	$C_6Cl_4O_2$	245.89
2671	**Chloranilic acid**	2,5-dichloro-3,6-dihydroxyquinone	$C_6Cl_2(OH)_2O_2$	208.99
2672	**Chlorbutanol.**	See *Chloretone.*		
2673	**Chlorbutol.**	See *Chloretone.*		
2674	**Chloretone**	1,1,1-trichloro-2-methyl-2-propanol*; trichloro-*tert*-butyl alcohol; acetone-chloroform; chlorbutol; chlorbutanol	$(CH_3)_2C(OH)CCl_3$	177.47
2675	**Chlorhydrin.**	See 1,2-*Propanediol,* 3-*chloro*-*.		
2676	**Chlorine cyanide.**	See *Cyanogen chloride.*		
	Chloro-.	See the parent compounds (e.g., for chloroacetic acid see		
2677	**Chloroacetal**	2-chloro-1,1-diethoxyethane*; chloroacetaldehyde diethyl acetal	$CH_2ClCH(OC_2H_5)_2$	152.62
2678	**Chloroacetol.**	See *Propane,* 2,2-*dichloro*-*.		
2679	**Chloroform**	trichloromethane*	$CHCl_3$	119.39
2680	——, **methyl-.**	See *Ethane,* 1,1,1-*trichloro*-*.		
2681	——, **nitro-.**	See *Chloropicrin.*		
2682	——, **phenyl-.**	See *Toluene,* α-*trichloro*-.		
2683	**Chlorogenine.**	See *Alstonine.*		
2684	α-**Chlorohydrin.**	See 1,2-*Propanediol,* 3-*chloro*-*.		
2685	**Chlorophyll a**		$C_{55}H_{72}MgN_4O_5 \cdot \frac{1}{2}H_2O$	902.49
2686	**Chlorophyll b**		$C_{55}H_{70}MgN_4O_6$	907.47
2687	**Chloropicrin**	trichloronitromethane*; nitrochloroform	CCl_3NO_2	164.39

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
2658	liq., 1.5441^{18}...	$1.033\frac{18}{4}$	<-25	237	s.	∞	∞ eth., chl.
2659							
2660	rhbdr. leaf.; sol. bl. fluores.	....	207	....	sl. s.	sl. s.	v. s. eth.; s. chl., amyl al., bz.
2661	wh. fine cr....	....	....	....	0.31^{18}	sl. s.	....
2662	monocl. tab...	....	135–6	....	i.	v. s.	v. s. eth.; s. chl., amyl al.
2663							
2664							
2664M							
2665	col. liq., 1.45572	$1.512\frac{20}{4}$	-57.5	98	s. ...	∞	∞ eth.; s. chl.
2666	col. need......	$1.143\frac{40}{4}$	44–7 (55)	115	v. s.	s.	s. eth.
2667							
2668	col. monocl. tab., 1.538, 1.600, 1.602	$1.9081\frac{20}{4}$	51.7 (61–3)	96.3^{764} (98 d.)	470^{17}	77^{25}	66.7^{25} eth., s. chl.
2669							
2670	yel. monocl. pr. f. bz.	....	290 (in sealed tube)	subl.	i.	s. h.	s. eth., bz.; sl. s. chl., CS_2
2671	red leaf.......	....	283–4	....	v. sl. s.	......	....
2672							
2673							
2674	wh. cr. ($+1H_2O$) f. w.	....	$+1H_2O$ 80–1 (anh. 97)	167	i. c.	v. s.	v. s. eth.; 125 glyc.; s. chl., acet., bz., glac. ac. a.
2675							
2676							
	Acetic acid, chloro-).						
2677	liq...........	$1.026\frac{16}{4}$	....	156.8 ($62–4^{20}$)	sl. s.	∞	∞ eth.
2678							
2679	col. liq., 1.44643^{18}	$1.49845\frac{15}{4}$	-63.5	61.26 (58–61.5)	1.0^{15}	∞; const. boil. mixt. 7% et. al.	∞ eth.; s. bz., acet., CS_2
2680							
2681							
2682							
2683							
2684							
2685	hex. lancet shaped pl.	....	150–3	d.	i.	v. s.	v. s. eth.; s. pet. eth.
2686	pl...........	....	183–5	....	i.	v. s.	v. s. eth.; s. me. al.
2687	col. liq., 1.46075^{23}	$1.651\frac{20}{4}$; $1.69225\frac{0}{4}$	-64, frz. -69	112	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2688	**Chloroprene**	2-chloro-1,3-butadiene*	$CH_2:CHCCl:CH_2$	88.54
2689	**Cholalic acid.**	See *Cholic acid.*		
2690	**Cholanic acid, trihydroxy-.**	See *Cholic acid.*		
2691	**Cholesterol**	cholesterin	$C_{27}H_{45}OH$	386.64
2692	——, benzoate		$C_6H_5COOC_{27}H_{45}$	490.75
2693	**Cholestrophan**	dimethylparabanic acid	$N(CH_3)CON-$ $(CH_3)COCO$	142.11
2694	**Cholic acid**	cholalic acid; trihydroxycholanic acid; colalin	$C_{24}H_{40}O_5 \cdot H_2O$	426.58
2695	**Choline**	(*β*-hydroxyethyl)trimethylammonium hydroxide; bilineurine; sincaline; amanitine	$HOCH_2CH_2N(CH_3)_3OH$	121.18
2696	——, ***O*-acetyl-**, bromide	(*β*-acetoxyethyl) trimethylammonium bromide	$CH_3COOCH_2CH_2N(CH_3)_3Br$	226.12
2697	——, ***O*-acetyl-*β*-methyl-**, chloride	*β*-acetoxypropyltrimethylammonium chloride	$CH_3CH(OOCCH_3)CH_2N(CH_3)_3Cl$	195.69
2698	——, ***β*-methyl-**, chloride	*β*-hydroxypropyltrimethylammonium chloride	$CH_3CHOHCH_2N(CH_3)_3Cl$	153.65
2699	**3,5,7-Chromantriol.**	See *d-Catechol.*		
2700	**Chromone**	1,4-benzopyrone; *γ*-benzopyrone	$C_6H_4OCH:CHCO$	146.14
2701	**Chromone, 2-phenyl-.**	See *Flavone.*		
2702	**Chromotropic acid**	4,5-dihydroxy-2,7-naphthalenedisulfonic acid	$(HO)_2C_{10}H_4(SO_3H)_2$	320.28
2703	**Chrysammic acid**	2,4,5,7-tetranitrochrysazin; chrysamminic acid; 1,8-dihydroxy-2,4,5,7-tetranitroanthraquinone	$C_{14}H_2(NO_2)_4(OH)_2O_2$	420.20
2704	**Chrysaniline**	2-amino-5-*p*-aminophenylacridine	$C_{19}H_{15}N_3 \cdot 2H_2O$	321.37
2705	**Chrysarobin**		$C_{30}H_{36}O_7$	508.59
2706	**Chrysazin**	1,8-dihydroxyanthraquinone	$HOC_6H_3(CO)_2C_6H_3OH$	240.20
2707	——, **2-hydroxy-.**	See *Anthraquinone, 1,2,8-trihydroxy-.*		
2708	——, **3-methyl-.**	See *Chrysophanic acid.*		
2709	——, **2,4,5,7-tetranitro-.**	See *Chrysammic acid.*		
2710	**Chrysazol**	1,8-anthracenediol*; 1,8-anthradiol	$HOC_6H_3(CH)_2C_6H_3OH$	210.22
2711	**Chrysene**	benzo [*a*] phenanthrene	$C_{18}H_{12}$	228.28
2712	**Chrysenequinone.**	See *Chrysoquinone.*		
2713	**Chrysin**	5,7-dihydroxyflavone	$C_{15}H_{10}O_4$	254.23
2714	**Chrysoidine** (base)	2,4-diaminoazobenzene; 4-phenylazo-*m*-phenylenediamine	$C_6H_5N:NC_6H_3(NH_2)_2$	212.25
2715	——, hydrochloride		$C_6H_5N:NC_6H_3(NH_2)_2HCl$	248.71

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2688	col. liq., 1.4583	$0.9583\frac{20}{20}$	....	59.4	v. sl. s.	∞	∞ eth., s. most org. solv.
2689							
2690							
2691	monocl. pearly leaf.; cr. $+1H_2O$ f. dil. al.	$1.067\frac{20}{4}$	anh. 148.5	360 d.	0.26^{20}	1.08^{17}, 11^{78}	18 eth.; s. bz., chl., CS_2, pyr.; h. ac. a.
2692	pl............	....	150–1	....	......	i.	s. eth.
2693	pearly leaf....	....	145	275–7	sl. s.	sl. s.	....
2694	rhomb. cr. $+1H_2O$ f. w.	....	195 (anh.)	d. 160	0.025	4.27 70%	1.40 c. eth.; s. ac. a., acet., alk.
2695	col. visc. liq...	....	....	....	s.	s.	i. eth.
2696	col. need......	....	143	d.	v. s.	v. s.	s. eth.
2697	micro. need. f. al., eth.	....	172–3	d.	v. s.	v. s.	i. eth.
2698	wh. pr. cr. f. N. butanol	....	165–7	d.	v. s.	v. s.	i. eth.
2699							
2700	wh. need. f. pet. eth.	....	59	subl.	i.	s.	s. eth., chl., bz.
2701							
2702	need. or leaf. $(+2H_2O)$	....	....	....	v. s.	i.	i. eth.
2703	yel. monocl. pr.	....	exp.	....	i.	s.	s. eth., min. a.
2704	yel. need......	....	270	....	v. sl. s.	sl. s.	....
2705	yel. leaf........	....	205–10 (170–8)	....	i.	s.	s. eth., chl.; sl. s. c. bz., CS_2
2706	red or yel. need. or leaf. f. al.	....	193 (191)	....	sl. s.	s.	s. eth., caust. alk., chl., ac. a., nitro-bz.
2707							
2708							
2709							
2710	yel. need. f. dil. al.	....	225 d.	....	i.	s.	s. eth., alk., et. ac., bz.
2711	col. rhomb. pl. f. bz. or ac. a. with red-vlt. fluores.	....	254 (250)	448	v. sl. s.	0.08 c.	v. sl. s. eth., bz.; s. h. tol.; sl. s. CS_2
2712							
2713	pa. yel. pl.....	....	275	subl.	i.	0.43 c.	sl. s. eth., lgr., CS_2, bz., chl., alk.
2714	pa. yel. cr. f. w.	....	117.5	....	sl. s.	s.	s. eth.; v. s. chl.
2715	redsh.-br. cr. or powd.	....	....	....	v. s.	s.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt
2716	**Chrysophanic acid**	1,8-dihydroxy-3-methylanthraquinone; 3-methylchrysazin	$C_{14}H_5(OH)_2(CH_3)O_2$	254.23
2717	**Chrysoquinone**	chrysenequinone; 1,2-chrysenedione	$C_{18}H_{10}O_2$	258.26
2718	**Cinchamidine.**	See *Hydrocinchonidine.*		
2719	**Cinchomeronic acid**	3,4-pyridinedicarboxylic acid	$C_5H_3N(CO_2H)_2$	167.12
2720	**Cinchonamine**		$C_{19}H_{24}N_2O$	296.40
2721	**Cinchonicine**	cinchotoxine	$C_{19}H_{22}N_2O$	294.38
2722	**Cinchonidine**		$C_{19}H_{22}N_2O$	294.38
2723	——, bisulfate		$C_{19}H_{22}N_2O \cdot H_2SO_4 \cdot 5H_2O$	482.54
2724	——, hydrochloride		$C_{19}H_{22}N_2O \cdot HCl \cdot H_2O$	348.87
2725	——, sulfate		$(C_{19}H_{22}N_2O)_2 \cdot H_2SO_4 \cdot 3H_2O$	740.89
2726	**Cinchonine**		$C_{19}H_{22}N_2O$	294.38
2727	——, bisulfate		$C_{19}H_{22}N_2O \cdot H_2SO_4 \cdot 4H_2O$	464.53
2728	——, hydrochloride		$C_{19}H_{22}N_2O \cdot HCl \cdot 2H_2O$	366.88
2729	——, nitrate		$C_{19}H_{22}N_2O \cdot HNO_3 \cdot \frac{1}{2}H_2O$	366.41
2730	——, sulfate		$(C_{19}H_{22}N_2O)_2 \cdot H_2SO_4 \cdot 2H_2O$	722.88
2731	——, **hydroxy-.**	See *Cupreine.*		
2731M	**Cinchoninic acid**	4-quinolinecarboxylic acid	C_9H_6NCOOH	173.16 (anh.)
2732	**Cinchotine**	hydrocinchonine; pseudocinchonine	$C_{19}H_{24}N_2O$	296.40
2733	**Cinchotoxine.**	See *Cinchonicine.*		
2734	**Cineole**	1,8-epoxy-*p*-menthane; eucalyptole; cajeputole	$C_{10}H_{18}O$	154.25
2735	**1,4-Cineole**	*p*-cineole; 1,4-epoxy-*p*-menthane	$C_{10}H_{18}O$	154.25
2736	***l*-Cineolic acid**	*l*-tetrahydro-2,6,6-trimethyl-1,4-pyran-2,5-dicarboxylic acid*	$C_{10}H_{16}O_5$	216.23
2737	**Cinnamaldehyde**	3-phenylpropenal*; β-phenylacrolein; cinnamic aldehyde	$C_6H_5CH:CHCHO$	132.15
2737M	**Cinnamamide**	cinnamic amide	$C_6H_5CH:CHCONH_2$	147.17
2738	**Cinnamein.**	See *Cinnamic acid, benzyl ester.*		
2739	**Cinnamene.**	See *Styrene.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2716	hex. or monocl. yel. cr. f. al.	0.92	196	subl.	sl. s.	0.050^{15}, 0.44 h.	s. eth., chl., bz., sl. s. CS_2
2717	redsh. or. need. f. ac. a.	....	239.5 (235)	subl.	i.	s. h.	sl. s. eth., c. ac. a., tol.; s. H_2SO_4, h. bz.
2718							
2719	pr. f. w. or HCl	....	260 d. (266)	d.	v. sl. s.	sl. s.	v. sl. s. eth.; i. chl.
2720	rhomb. need. f. al.	....	194 (185)	....	i.	s.	s. eth., bz., chl.
2721	need. [α] $47.2^{\circ 15}_{D}$ in in al. or chl.	....	58–60	....	sl. s.	s.	s. eth., chl., bz.
2722	trim. pr. f. al.; 1.610, 1.625, 1.675, [α] $-107.9^{17.8}_{D}$	....	210.5 (202)	....	$0.019^{11.5}$	4.81 c.	0.41 c. eth.; s. chl.
2723	lng. monocl. pr.	....	....	....	v. s.	v. s.	....
2724	wh. cr. powd..	....	anh. 242	....	5^{20}	$25.6^{18.5}$	0.33^{25} eth.; v. s. chl.
2725	monocl. glist. need. efflor.	....	anh. 205	....	1.54	1.37	0.024 eth.; 0.16^{25} chl.
2726	col. need., col. monocl. f. al.; 1.570, 1.685, 1.690; [α] $229.6^{\circ 17}_{D}$ in al.	....	255 (264)	subl. 220	0.027^{20}	0.795^{20}	0.27^{10} eth.; s. chl.
2727	wh. rhomb. octah.	....	....	....	217^{14}	111^{14}	s. eth.
2728	col. monocl., [α] +165.5	....	anh. 217–8	....	4.5 c.	100	0.18 eth.; s. chl.
2729	col. monocl....	....	....	....	3.79^{12}	s.	....
2730	col. rhomb., [α] $+170.3^{\circ}{}_{D}$	....	anh. 198.5	....	1.55^{13}	17^{11}	0.043 eth.; 2.1 chl.
2731							
2731M	monocl. pr. or need. with $1H_2O$ f. w.	....	253–4	....	v. sl. s.	v. sl. s.	i. eth.
2732	pr., [α] $+204.5^{\circ 14}_{D}$ in et.al.	....	286	....	i. c.; s. h.	sl. s.	v. sl. s. eth.
2733							
2734	col. liq., 1.4584^{15}	$0.9239\frac{20}{4}$	+1.5	176–7	0.2 c.	∞	∞ eth.; s. chl., glac. ac. a., oils
2735	1.4479^{18}......	0.8997^{20}	+1	173.4	0.2 c.	∞	∞ eth.
2736	cr.; α 1.480, γ 1.522	....	196–7 d.	....	1.4 d.	0.79 h.	0.71 eth.; sl. s. chl.
2737	col. liq., 1.61949	$1.1119\frac{15}{4}$	−7.5	251	v. sl. s.	∞	∞ eth.
2737M	need..........	....	147	....	sl. s. h.	s.	s. eth., CS_2
2738							
2739							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2740	**Cinnamic acid** (ordinary or *trans*)	*trans*-β-phenylacrylic acid; *trans*-benzenepropenoic acid	$C_6H_5CH{:}CH\text{-}COOH$	148.15
2741	——, allyl ester.	allyl cinnamate.	$C_6H_5CH{:}CH\text{-}COOC_3H_5$	188.22
2742	——, benzyl ester.	cinnamein.	$C_6H_5CH{:}CHCO\text{-}OCH_2C_6H_5$	238.27
2743	——, dibromide.	See *Hydrocinnamic acid, α, β-dibromo-.*		
2744	——, ethyl ester.	ethyl *trans*-3-phenylpropenoate	$C_6H_5CH{:}CH\text{-}COOC_2H_5$	176.21
2745	——, methyl ester.	methyl cinnamate.	$C_6H_5CH{:}CH\text{-}COOCH_3$	162.18
2746	——, γ-phenylallyl ester.	See *Styracin.*		
2747	——, *p*-phenylphenacyl ester	. . . .	$C_6H_5CH{:}CHCOO\text{-}CH_2COC_6H_4C_6H_5$	342.38
2748	——, **α-acetyl-**, ethyl ester	ethyl α-benzalacetoacetate. . .	$C_6H_5CH{:}C(CO\text{-}CH_3)COOC_2H_5$	218.24
2749	——, **o-amino-**.	β-(*o*-aminophenyl) acrylic acid	$NH_2C_6H_4CH{:}CH\text{-}COOH$	163.17
2750	——, ——, lactam.	See *Carbostyril.*		
2751	——, ***m*-amino-**.	. . . .	$NH_2C_6H_4CH{:}CH\text{-}COOH$	163.17
2752	——, ***p*-amino-**.	. . . .	$NH_2C_6H_4CH{:}CH\text{-}COOH$	163.17
2753	——, **α-bromo-**.	2-bromo-3-phenylpropenoic acid; α-bromo-β-phenylacrylic acid	$C_6H_5CH{:}CBr\text{-}COOH$	227.06
2754	——, **β-bromo-**.	3-bromo-3-phenylpropenoic acid; β-bromo-β-phenylacrylic acid	$C_6H_5CBr{:}CH\text{-}COOH$	227.06
2755	——, **o-carboxy-**.	*o*, β-styrenedicarboxylic acid	$(COOH)C_6H_4CH{:}CHCOOH$	192.16
2756	——, ***p*-carboxy-**.	*p*, β-styrenedicarboxylic acid	$(COOH)C_6H_4CH{:}CHCOOH$	192.16
2757	——, **2,4-dihydroxy-.**	See *Umbellic acid.*		
2758	——, **2,5-dihydroxy-**. . .	3-(2,5-dihydroxyphenyl)-propenoic acid	$(HO)_2C_6H_3CH{:}\text{–}CHCOOH$	180.15
2759	——, **3,4-dihydroxy-.**	See *Caffeic acid.*		
2760	——, **α-ethyl-**.	. . . .	$C_6H_5CH{:}C\text{-}(C_2H_5)COOH$	176.21
2761	——, **o-hydroxy-.**	See *o-Coumaric acid.*		
2762	——, ***m*-hydroxy-.**	See *m-Coumaric acid.*		
2763	——, ***p*-hydroxy-.**	See *p-Coumaric acid.*		
2764	——, **3-hydroxy-4-methoxy-.**	See *Isoferulic acid.*		
2765	——, **4-hydroxy-3-methoxy-.**	See *Ferulic acid.*		
2766	——, **β-ketohydro-.**	See *Acetic acid, benzoyl-.*		
2767	——, **α-methyl-**.	α-benzalpropionic acid.	$C_6H_5CH{:}\text{-}C(CH_3)COOH$	162.18
2768	——, **o-nitro-**.	. . . .	$NO_2C_6H_4CH{:}\text{-}CHCOOH$	193.15
2769	——, ——, ethyl ester.	. . . .	$NO_2C_6H_4CH{:}CHCOOC_2H_5$	221.21
2770	——, ***m*-nitro-**.	. . . .	$NO_2C_6H_4CH{:}CHCOOH$	193.15
2771	——, ——, ethyl ester	. . . .	$NO_2C_6H_4CH{:}\text{-}CHCOOC_2H_5$	221.21
2772	——, ——, methyl ester. . . .	. . . .	$NO_2C_6H_4CH{:}\text{-}CHCOOCH_3$	207.18

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2740	col. monocl.....	$1.2475\frac{4}{4}$	133	300	0.1^{20} 0.588^{98}	23^{20}	v. s. eth.; s. bz., glac. ac. a., CS_2, 5.9^{15} chl.
2741	wh.-yel. cr....	$1.052\frac{25}{25}$	....	286 d.	i.	v. s.	∞ eth.
2742	col. pr........	....	39	244^{25}; $195–200^{5}$	......	s. h.	s. eth.
2743							
2744	col. liq., 1.55982	1.049	6.5 (12)	271; 141^{15}	i.	s.	v. s. eth.
2745	col. cr., $1.57661^{21.4}$	$1.0911\frac{20}{4}$; $1.042\frac{36}{0}$	36	261.9 (259.6)	i.	v. s.	s. eth.
2746							
2747	....	....	182.5	....	......	......	....
2748	....	....	59	181^{17}	......	s.	s. eth.
2749	yel. need......	....	159 d.	....	sl. s. c., s. h.	s.	s. eth.
2750							
2751	pa. yel. need..	....	181	....	sl. s.	s.	s. eth.
2752	pa. yel. need.	....	175–6 d.	....	sl. s.	s.	s. eth.
2753	(*cis*) rhomb. f. w.	....	120-1	$111^{0.6}$	s. h.	s.	s. CS_2, bz.
	(*trans*) need. f. w.	....	131–2	$121^{0.6}$	v. sl. s. h.	∞	∞ eth.
2754	(*cis*) monocl. f. al.	....	160	$111^{0.6}$	sl. s. h.	sl. s. c.	s. eth., chl., h. bz.
	(*trans*) need. f. w.	....	134–5	$122^{0.6}$	sl. s. h.	s.	s. h. bz.; sl. s. CS_2
2755	need. f. w.....	....	175	....	sl. s.	v. s.	sl. s. eth.; i. bz.
2756	infus. powd...	....	358 d.	subl. >350	i.	......	s. h. ac. a.
2757							
2758	cr. f. w.......	....	207 d.	....	......	s.	....
2759							
2760	need. f. w.....	....	104–5 (81)	....	0.01^{25}	s.	s. eth.; sl. s. pet. eth.
2761							
2762							
2763							
2764							
2765							
2766							
2767	need. or pr. f. bz.	....	74	288	0.12 h.	s.	s. eth., CS_2, bz
2768	sc. or need. f. al.	....	240	subl.	i. c.	0.21^{25}	....
2769	yel. rhomb. need.	....	44	....	......	v. s.	v. s. eth., bz.
2770	col. (yel.) need. f. al.	....	193 (199–200)	....	v. sl. s.	sl. s.	....
2771	....	....	74–76	....	i.	sl. s.	sl. s. eth.
2772	pa. yel. pr. f. al.	....	123–4	d.	i.	v. sl. s.	v. sl. s. eth.; v. s. chl., bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2773	**Cinnamic acid, *p*-nitro-**	....	$NO_2C_6H_4CH:CHCOOH$	193.15
2774	——, ——, ethyl ester.......	....	$NO_2C_6H_4CH:CHCOOC_2H_5$	221.21
2775	**——, *α*-phenyl-**.......	*trans-α,β*-diphenylacrylic acid	$C_6H_5CH:C(C_6H_5)COOH$	224.25
2776	***allo*-Cinnamic acid** ...	*cis*-cinnamic acid (68°)......	$C_6H_5CH:CHCOOH$	148.15
2777	**——, *α, β*-dibromo-** ...	*cis*-2,3-dibromo-3-phenylpropenoic acid*; *β*-dibromocinnamic acid	$C_6H_5CBr:CBrCOOH$	305.97
2778	**Cinnamic alcohol**.....	3-phenyl-2-propen-1-ol*; styrylcarbinol; *γ*-phenylallyl alcohol; cinnamyl alcohol; styrone	$C_6H_5CH:CHCH_2OH$	134.17
2779	**——, 4-hydroxy-3-methoxy-.**	See *Coniferyl alcohol.*		
2779M	**Cinnamic amide.**	See *Cinnamamide.*		
2780	**Cinnamic anhydride**..	*trans-β*-phenylacrylic anhydride	$(C_6H_5CH:CHCO)_2O$	278.29
2781	**Cinnamone.**	See *Styryl ketone.*		
2782	**Cinnamoyl chloride**...	cinnamyl chloride; *trans-β*-phenylacrylyl chloride; *trans*-benzenepropenoyl chloride	$C_6H_5CH:CHCOCl$	166.60
2783	**Cinnamyl alcohol.**	See *Cinnamic alcohol.*		
2784	**Cinnamyl chloride.**	See *Cinnamoyl chloride.*		
2785	**Cinnamyl chloride.**	See also *Propene, 3-chloro-1-phenyl-**.		
2786	**Citraconic acid**.......	*cis*-methylbutenedioic acid*; methylmaleic acid	$CH_3C(COOH):CHCOOH$	130.10
2787	**Citraconic anhydride** .	methylmaleic anhydride.....	$\underbrace{OCOC(CH_3):CHCO}$	112.08
2788	**Citral a**...............	geranial..................	$C_{10}H_{16}O$.........	152.23
2789	**Citral b**...............	neral.....................	$C_{10}H_{16}O$..........	152.23
2790	***dl*-Citramalic acid**....	*dl*-2-hydroxy-2-methylbutanedioic acid*; *dl-α*-hydroxypyrotartaric acid; *dl-α*-methylmalic acid	$CH_3C(OH)(COOH)CH_2COOH$	148.11
2790M	**Citramide**............	citric triamide.............	$C_6H_{11}N_3O_4$.......	189.17
2791	**Citrene.**	See *d-Limonene.*		
2792	**Citric acid**............	2-hydroxy-1,2,3-propanetricarboxylic acid*; *β*-hydroxytricarballylic acid	$(COOH)CH_2C(OH)(COOH)CH_2COOH$	192.12
2793	——, *p*-phenylphenacyl ester	....	$C_{48}H_{38}O_{10}$........	774.79
2794	——, trimethyl ester........	methyl citrate..............	$C_3H_4(OH)(COOCH_3)_3$	234.20
2795	**——, hydroxy-.**	See *Tricarballylic acid, α,β-dihydroxy-.*		
2795M	**Citric triamide.**	See *Citramide.*		
2796	***d*-Citronellal**	*d*-rhodinal.................	$CH_2:C(CH_3)(CH_2)_3CH(CH_3)CH_2CHO$	154.25
2797	***l*-Citronellal**..........	....	$C_{10}H_{18}O$..........	154.25

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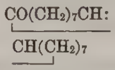
*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
2773	lt. yel. pr. f. al.	....	286	....	0.0265^{25}	sl. s. h.	v. sl. s. eth.; i. CS_2, lgr.
2774	yel. tricl. need.	....	141 (136–7)	....	i.	sl. s.	sl. s. eth.
2775	(*trans*) wh. need. f. dil. al.	....	172	subl.	sl. s. h.	s.	s. eth.
	(*cis*) need.....	....	137–8	....	......	......	....
2776	monocl. pr....	$1.284\frac{4}{4}$	68	125^{19}; 265 d.	0.937^{25}	v. s.	v. s. eth.
2777	yel pl. f. chl...	....	100	$124^{9.5}$	i.	s.	s. eth., chl., ac. a., lgr.; sl. s. pet. eth.
2778	need., 1.58190.	$1.0440\frac{20}{4}$	33	257.5	sl. s.	v. s.	v. s. eth.
2779							
2779M							
2780	need. f. al.....	....	135–6	....	i.	sl. s.	s. bz.
2781							
2782	cr., $1.61364^{42.5}$	....	36	257.5	i.	s.	s. eth., pet. eth., chl.
2783							
2784							
2785							
2786	monocl.......	1.617	91	....	238 c.	......	sl. s. eth., bz., chl.; i. CS_2
2787	....	$1.25\frac{15}{4}$	7–8	213–4	d.	v. s.	v. s. eth.
2788	col. liq., 1.48752	$0.8868\frac{20}{4}$	....	229 (224–9) d.	i.	∞	∞ eth.
2789	1.4900........	$0.888\frac{19}{4}$	....	103^{12}	......	......	....
2790	monocl. pr. (*d* $[\alpha]+34.7^{\circ 14}_{D}$ in w.)	....	119 (*d* 95; 109)	subl.	v. s.	s.	s. eth., acet., et. ac.; i. bz.
2790M	cr. f. w.......	....	210–215 d.	....	2.7^{18}	i.	i. eth.
2791							
2792	col. rhomb., (cr. $+1H_2O$ f. w.); 1.493, 1.498, 1.509 (hyd.)	$1.542\frac{18}{4}$	$-H_2O$ 70–5; 153	d.	133 c.	116^{25}	2.26 c. eth.
2793	....	....	146	....	......	......	....
2794	col. tricl......	....	79	287 d.	sl. s.	v. s.	v. s. eth.
2795							
2795M							
2796	col. liq., $1.4483^{17.5}$ $[\alpha]+13.09^{\circ 15}_{D}$	$0.855\frac{17}{4}$	....	205–8	v. sl. s.	∞	∞ eth.
2797	1.4570........	$0.8567\frac{15}{4}$	....	205–6	v. sl. s.	∞	∞ eth.

No.	Name	Synonyms	Formula	Mol. Wt.
2798	***dl*-Citronellol**	dihydrogeraniol	$C_{10}H_{20}O$	156.26
2799	***d*-Citronellol**		$C_{10}H_{19}OH$	156.26
2800	**Civetone**	9-cycloheptadecen-1-one*	 $CO(CH_2)_7CH{:}$ $CH(CH_2)_7$	250.41
2801	**Clupanodonic acid**		$C_{21}H_{33}COOH$	330.50
2802	***l*-Cocaine**	benzoylmethylecgonine	$C_8H_{13}N(OOCC_6H_5)(COOCH_3)$	303.35
2803	——, chromate		$C_{17}H_{21}NO_4\text{-}H_2CrO_4 \cdot H_2O$	439.39
2804	——, hydrochloride		$C_{17}H_{21}NO_4 \cdot HCl$	339.81
2805	**——, cinnamoyl-**	so called; ecgonine cinnamate methyl ester	$C_{19}H_{23}NO_4$	329.38
2806	**Codamine**		$C_{20}H_{25}NO_4$	343 41
2807	**Codeine**	morphine methyl ether	$C_{18}H_{21}NO_3 \cdot H_2O$	317.37
2808	——, hydrochloride		$C_{18}H_{21}NO_3\text{-}HCl \cdot 2H_2O$	371.86
2809	——, phosphate		$C_{18}H_{21}NO_3\text{-}H_3PO_4 \cdot 2H_2O$	433.39
2810	——, sulfate		$(C_{18}H_{21}NO_3)_2\text{-}H_2SO_4 \cdot 5H_2O$	786.87
2811	**Coerulignone.**	See *Cerulignone.*		
2812	**Colalin.**	See *Cholic acid.*		
2813	***l*-Colchicine**		$C_{22}H_{25}NO_6$	399.43
2814	——, compd. with chloroform		$C_{22}H_{25}NO_6 \cdot CHCl_3$	518.82
2815	***α*-Collidine**	4-ethyl-2-methylpyridine*	$CH_3C_5H_3NC_2H_5$	121.18
2816	***β*-Collidine**	3-ethyl-4-methylpyridine*	$CH_3 \cdot C_5H_3N \cdot C_2H_5$	121.18
2817	***γ*-Collidine**	2,4,6-trimethylpyridine*	$(CH_3)_3C_5H_2N$	121.18

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2798	......	0.8488^{19}_{4}	......	99^{10}	......	......	......
2799	col. liq., 1.45659, $[\alpha]+4^{\circ 17}_{D}$	0.8565^{17}_{4}	......	222	v. sl. s.	∞	∞ eth.
2800	......	......	32.5 (31)	342^{742}; $158\text{–}60^{2}$	......	......	......
2801	pa. yel. oil, 1.5057^{15}	0.9410^{15}_{4}	<-78	236^{5}	i.	......	s. eth.
2802	col. monocl. pr. f. al., liq. 1.50218; solid α 1.49, $[\alpha]-15.83^{\circ 20}_{D}$ in chl.	......	98	......	0.16^{25}, 0.38^{80}	20^{25}	26.3 eth.; s. bz., chl.
2803	or.-yel. leaf....	......	127	......	sl. s.	......	......
2804	col. monocl. pr. f. al. [α] -71.95°_{D} in w.	......	197	......	250^{25}	38.4^{25}	i. eth.; 8 chl.; s. glyc.
2805	need. f. bz....	......	121	......	i.	s.	s. eth., chl., bz.
2806	pr......	......	121	......	sl. s.	v. s.	s. eth.
2807	col. rhomb. octahdr. $(+1H_2O)$ f. w.; (anh.) 1.620, 1.630, 1.650; (hyd.) 1.543, 1.636, 1.684, [α] -137.75°_{D} in al.	1.315^{14}	anh. 155	......	0.83^{25}, 1.7^{80}	62.5^{25}	8^{25} eth.; s. chl., bz., tol.
2808	col. need., $[\alpha]-108.2^{\circ 22}_{D}$ in w.	......	anh. 264	......	3.84^{15}	s.	......
2809	col. need. or efflor. powd. [α] -134°_{D}	......	235 d.	......	44.5^{25}	0.38^{25}	0.07 eth.; s. chl.
2810	col. rhomb. $[\alpha]-101.2^{\circ 15}_{D}$ in w.	......	278 d.	......	3.3^{25}	0.1^{25}	i. eth., chl.
2811							
2812							
2813	yel. varnish; yel. need. f. et. ac.	......	anh. 143–7	......	4.54	v. s.	0.638 eth.; v.s. chl.; 1 bz.
2814	need. f. chl....	......	......	......	d. h.	......	......
2815	col. liq......	0.9268^{16}_{4}	......	179	s. c., less. s. h.	v. s.	v. s. eth.; s. bz.
2816	col. liq......	0.966^{0}_{4}; $0.9286^{16.8}_{4}$	......	195–6	i.	s.	s. eth., chl.
2817	col. liq......	0.917^{20}_{4}	......	172	20.8^{6}, 3.5^{20}	s.	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2819	**Conhydrine**	α-hydroxyconiine; 2-(α-hydroxypropyl)piperidine	$C_8H_{17}NO$	143.23
2820	**ψ-Conhydrine.**	See *Pseudoconhydrine.*		
2821	**α-Coniceine**		$C_8H_{15}N$	125.21
2822	**β-Coniceine**	2-allylpiperidine	$C_8H_{15}N$	125.21
2823	**γ-Coniceine**	1,2,3,4-tetrahydro-6-propylpyridine	$C_8H_{15}N$	125.21
2824	**δ-Coniceine.**	See *Piperolidine.*		
2825	**ε-Coniceine**	methylconidine	$C_8H_{15}N$	125.21
2826	**Conidine, methyl-.**	See *ε-Coniceine.*		
2827	**Coniferin**		$C_{16}H_{22}O_8{\cdot}2H_2O$	378.37
2828	**Coniferyl alcohol**	3-(4-hydroxy-3-methoxyphenyl)-2-propen-1-ol; 4-hydroxy-3-methoxycinnamic alcohol; γ-hydroxyisoeugenol	$(CH_3O)(OH)C_6H_3\text{-}CH{:}CHCH_2OH$	180.20
2829	**Coniine, α-hydroxy-.**	See *Conhydrine.*		
2830	***d*-Coniine**	*d*-2-propylpiperidine	$C_5H_{10}N{\cdot}C_3H_7$	127.23
2831	——, hydrochloride		$C_8H_{17}N{\cdot}HCl$	163.69
2832	——, picrate		$C_8H_{17}N{\cdot}C_6H_3N_3O_7$	356.33
2833	**Conquinamine**		$C_{19}H_{24}N_2O_2$	312.40
2834	**Conquinine.**	See *Quinidine.*		
2835	**Conylene**	octadiene (one form)	C_8H_{14}	110.19
2836	**Conyrine**	2-propylpyridine	$C_3H_7C_5H_4N$	121.18
2837	**Coriandrol.**	See *d-Linaloöl.*		
2839	**Corybulbine**		$C_{18}H_{15}N(OH)\text{-}(OCH_3)_3$	355.42
2840	**Corycavine**		$C_{23}H_{23}NO_6$	409.42
2841	***dl*-Corydaline**		$C_{18}H_{15}N(OCH_3)_4$	369.45
2842	**Corynine.**	See *Yohimbine.*		
2843	**Cotarnine**		$C_{12}H_{15}NO_4$	237.25
2844	——, hydrochloride	stypticin	$C_{12}H_{15}NO_4{\cdot}HCl$	273.71
2845	——, phthalate	styptol	$2C_{12}H_{15}NO_4{\cdot}C_6H_4\text{-}(COOH)_2$	640.63
2846	**Cotoin**	2,6-dihydroxy-4-methoxybenzophenone	$C_6H_2(OH)_2\text{-}(OCH_3)COC_6H_5$	244.24
2847	**Coumalic acid**	2-oxo-1,2-pyran-5-carboxylic acid*	$\underline{OCOCH{:}CHC\text{-}(COOH){:}CH}$	140.09

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2819	col. cr. f. eth., $[\alpha]+10^{\circ}{}_{D}$	....	121	226	v. s.	s.	s. eth., chl.
2820							
2821	col. liq. (mixt. ?)	$0.893\frac{15}{4}$	−16	158	sl. s.	......	....
2822	col. need. (l) $[\alpha]$ $-50.47^{\circ 45}_{D}$	$0.8519\frac{50}{4}$	39–41	168–9	sl. s.	s.	s. eth.
2823	col. liq., $1.46068^{18.4}$	$0.872\frac{20}{4}$, $0.8825\frac{23}{4}$	>−50	172	sl. s.	s.	....
2824							
2825	liq. (d) $[\alpha]$ $+67.4^{\circ 15}_{D}$	$0.8856\frac{15}{4}$	....	151–4	......	s.	s. eth.
	(l) $[\alpha]$ $-87.34^{\circ 15}_{D}$	$0.8624\frac{15}{4}$	....	143–5	......	......	....
	(dl)..........	$0.8836\frac{15}{4}$	....	150–1	......	......	....
2826							
2827	glit. need. $(+2H_2O)$, $[\alpha]-66.9^{\circ 20}_{D}$ in w.	....	anh. 185	....	0.51	sl. s.	i. eth.
2828	pr..........	....	73–4	....	sl. s. h.	s.	s. eth., alk.
2829							
2830	col. oily liq., $1.45119^{21.9}$, $[\alpha]+13.79^{\circ}$ $(+15.7^{\circ})_{D}$	0.845	−2.5	166.5	1.1 c.	∞	v. s. eth.; s. bz., chl., amyl al., acet.
2831	col. rhomb. f. w	....	220 (217)	....	50	s.	i. eth.; s. chl.
2832	yel. need. f. h. w.	....	75	....	......	s.	s. eth.
2833	yel. tetr......	....	123	....	......	s.	v. s. eth.
2834							
2835	liq..........	$0.770\frac{0}{4}$	....	126^{738}	......	s.	....
2836	liq..........	<1	2	165	sl. s.	∞	∞ eth.
2837							
2839	need.........	....	238	....	i.	sl. s.	sl. s. eth.; s. c. HCl
2840	rhomb. tab. f. al.	....	218–9	....	i.	i. c.	i. alk.
2841	col. pr. f. al. (d) $[\alpha]$ $+295^{\circ 25}_{D}$ in al.	....	*dl* 135; *dl*-meso, 158–9	....	i.	s. h.	s. eth., chl.
2842							
2843	col. need. f. bz.	....	132–3 d.	....	sl. s.	s.	s. eth., NH_4OH
2844	yel. cr. powd..	....	142–4	....	v. s.	v. s.	....
2845	yel. cr. or powd.	....	103	....	v. s.	......	....
2846	yelsh. cr. f. h. w.	....	130–1	....	sl. s.	s.	s. eth., bz., chl., CS_2, acet.
2847	pr..........	....	205–10 part. d.	218^{120}; subl. part. d.	sl. s. c.	s.	sl. s. eth.; s. ac. a., acet.; i. chl., bz., lgr.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2848	***o*-Coumaric acid**	*o*-hydroxycinnamic acid; *o*-cumaric acid	$HOC_6H_4CH{:}CH\text{-}COOH$	164.15
2849	——, lactone.	See *Coumarin.*		
2850	***m*-Coumaric acid**	*m*-hydroxycinnamic acid; *m*-cumaric acid	$HOC_6H_4CH{:}CH\text{-}COOH$	164.15
2851	***p*-Coumaric acid**	*p*-hydroxycinnamic acid; *p*-cumaric acid	$HOC_6H_4CH{:}CH\text{-}COOH$	164.15
2852	**——, α, β-dihydro-.**	See *Phloretic acid.*		
2854	**Coumarilic acid**	2-benzofurancarboxylic acid; coumarone-2-carboxylic acid	$C_8H_5O{\cdot}COOH$	162.14
2855	**Coumarin**	1,2-benzopyrone; *o*-coumaric acid lactone; coumarinic lactone	$C_6H_4OCOCH{:}CH$	146.14
2856	**——, 6,7-dihydroxy-.**	See *Esculetin.*		
2857	**——, 7,8-dihydroxy-.**	See *Daphnetin.*		
2858	**——, 7-hydroxy-.**	See *Umbelliferone.*		
2859	**——, 3-methyl-**	α-methylcoumarin	$C_6H_4OCOC\text{-}(CH_3){:}CH$	160.16
2860	**——, 4-methyl-**	β-methylcoumarin	$C_6H_4OCOCH{:}C\text{-}(CH_3)$	160.16
2861	**Coumarone.**	See *Benzofuran.*		
2862	**Creatine**	(α-methylguanido) acetic acid; methylglycocyamine	$NH_2C({:}NH)N\text{-}(CH_3)CH_2COOH$	131.14
2863	**Creatinine**	1-methylglycocyamidine	$CH_3NC({:}NH)NH\text{-}COCH_2$	113.12
2864	**Creosol**	2-methoxy-4-methylphenol; 4-methylguaiacol (OH=1); 2-methoxy-*p*-cresol (OH=1)	$CH_3OC_6H_3(CH_3)\text{-}OH$	138.16
	Cresol. (In numbering derivatives, (OH=1)			
2865	**Cresol, hexahydro-.**	See *Cyclohexanol, methyl-.*		
2866	***o*-Cresol**	*o*-methylphenol; *o*-hydroxytoluene; *o*-cresyl alcohol (incorrect)	$CH_3C_6H_4OH$	108.13
2867	——, acetate	*o*-tolyl acetate; *o*-cresyl acetate	$CH_3COOC_6H_4CH_3$	150.17
2868	**——, 3-amino-**	3-amino-2-methylphenol; 2-amino-6-hydroxytoluene	$CH_3(NH_2)C_6H_3OH$	123.15
2869	**——, 4-amino-**	4-amino-2-methylphenol; 5-amino-2-hydroxytoluene	$CH_3(NH_2)C_6H_3OH$	123.15
2870	**——, 5-amino-**	5-amino-2-methylphenol; 4-amino-2-hydroxytoluene	$CH_3(NH_2)C_6H_3OH$	123.15
2871	**——, 4,6-dinitro-**	2-methyl-4,6-dinitrophenol	$(NO_2)_2C_6H_2(CH_3)\text{-}OH$	198.13
2872	**——, 3-nitro-**	....	$NO_2(CH_3)C_6H_3OH$	153.13
2873	**——, 4-nitro-**	2-methyl-4-nitrophenol	$NO_2(CH_3)C_6H_3OH$	153.13
2874	**——, 5-nitro-**	2-methyl-5-nitrophenol	$NO_2(CH_3)C_6H_3OH$	153.13
2875	**——, 6-nitro-**	2-methyl-6-nitrophenol	$NO_2(CH_3)C_6H_3OH$	153.13
2876	**——, 3,4,5,6-tetrabromo-**	....	$CH_3C_6Br_4OH$	423.77
2877	**——, thio-**	2-toluenethiol*; *o*-tolyl mercaptan	$CH_3C_6H_4SH$	124.19
2878	***m*-Cresol**	*m*-methylphenol; *m*-hydroxytoluene	$CH_3C_6H_4OH$	108.13
2879	**——, 5-amino-**	5-amino-3-methylphenol; 3-amino-5-hydroxytoluene	$CH_3(NH_2)C_6H_3OH$	123.15

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2848	need. f. w.....	....	207–8 d.	d.	sl. s.	v. s.	v. sl. s. eth.; i. CS_2, chl.
2849							
2850	col. pr. f. w...	....	191	....	v. s. h.	s.	v. s. eth.; s. bz.
2851	col. need. (+1H_2O) f. c. w., anh. f. h. w.	....	210–3 (206)	....	v. sl. s.	v. s.	v. s. eth.; sl. s. bz.; i. lgr.
2852							
2854	need. f. w.....	....	192–3	310–15 sl. d.	s. h.	s.	sl. s. CS_2, chl.
2855	col. rhomb. f. eth.	$0.935\frac{20}{4}$	67–8 (70)	301.72 (290–1)	0.01^{25}	13.7^{16} 90%	v. s. eth.; s. chl., oils
2856							
2857							
2858							
2859	need.........	....	90	....	......	s.	....
2860	need. f. bz....	....	82	....	......	s.	s. bz.
2861							
2862	col. monocl. pr. (+1H_2O) f. w.	....	–H_2O, 100; anh. 295	....	1.35^{18}	0.0063 c.	i. eth.
2863	col. rhomb. pr. f. w.	....	260 d.	d.	8.7^{16}	0.98^{16}	....
2864	col. oil, 1.5353^{25}	$1.0919\frac{25}{4}$	5.5	221.8, 113.5^{22}	sl. s.	∞	∞ eth., bz.
2865							
2866	col. cr. or liq., 1.5453	$1.0465\frac{20}{4}$	30	191.5	3.1^{40}, 5.6^{100}	$\infty^{>30}$	$\infty^{>30}$ eth.; s. chl., ord. org. solv.
2867	....	....	....	208 ($83–5^{10}$)	v. sl. s.	v. s.	v. s. eth.
2868	need.........	....	129	....	sl. s.	......	sl. s. eth.
2869	need. f. bz.....	....	172–3	subl.	sl. s.	v. s.	v. s. eth.; sl. s. bz.
2870	col. pl. or need.	....	159–61	subl.	sl. s. c., s. h.	v. s.	v. s. eth.
2871	yel. pr. f. al....	....	85.8	....	v. sl. s.	10.82^{15}	v. s. eth.; s. acet.; sl. s. lgr.
2872	lt. yel. cr. f. w.	....	142–3	....	v. sl. s.	v. s.	v. s. eth.
2873	need. f. w.....	....	82–5; 79–80	....	v. sl. s.	v. s.	v. s. eth.
2874	yel. need. f. lgr.	....	118	....	v. sl. s.	v. s.	v. s. eth.
2875	yel. pr........	....	69.5	....	i.	v. sl. s.	v. sl. s. eth.
2876	yel. need. f. chl.	....	206–7	d.	i.	s.	v. s. eth.
2877	leaf.........	....	15	194.3	i.	s.	v. s. eth.
2878	col. liq., 1.5398	$1.034\frac{20}{4}$	11–2	202.8	2.35^{20}; 5.8^{100}	∞	∞ eth.; s. chl., ord. org. solv.
2879	....	....	79	345	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2880	***m*-Cresol, 6-amino-**	2-amino-5-methylphenol; 4-amino-3-hydroxytoluene	$CH_3(NH_2)C_6H_3OH$	123.15
2881	——, **4-nitro-**	3-methyl-4-nitrophenol	$NO_2(CH_3)C_6H_3OH$	153.13
2882	——, **5-nitro-**	3-methyl-5-nitrophenol	$NO_2(CH_3)C_6H_3OH$	153.13
2883	——, **6-nitro-**	3-methyl-6-nitrophenol	$NO_2(CH_3)C_6H_3OH$	153.13
2884	——, **thio-**	3-toluenethiol*; *m*-tolyl mercaptan	$CH_3C_6H_4SH$	124.19
2885	——, **2,4,6-trinitro-**		$(NO_2)_3C_6H(CH_3)OH$	243.13
2886	***p*-Cresol**	*p*-methylphenol; *p*-hydroxytoluene	$CH_3C_6H_4OH$	108.13
2887	——, **2-amino-**	2-amino-4-methylphenol; 3-amino-4-hydroxytoluene	$CH_3(NH_2)C_6H_3OH$	123.15
2888	——, **3-amino-**	3-amino-4-methylphenol; 2-amino-4-hydroxytoluene	$CH_3(NH_2)C_6H_3OH$	123.15
2889	——, **2,6-dinitro-**	4-methyl-2,6-dinitrophenol	$(NO_2)_2C_6H_2(CH_3)OH$	198.13
2890	——, **2-methoxy-**	See *Creosol.*		
2891	——, **2-nitro-**	4-methyl-2-nitrophenol	$NO_2(CH_3)C_6H_3OH$	153.13
2892	——, **3-nitro-**	4-methyl-3-nitrophenol	$NO_2(CH_3)C_6H_3OH$	153.13
2893	——, **thio-**	4-toluenethiol*; *p*-tolyl mercaptan	$CH_3C_6H_4SH$	124.19
2894	**Cresorcinol**	4-methylresorcinol; cresorcin; 2,4-dihydroxytoluene	$CH_3C_6H_3(OH)_2$	124.13
2895	**2,3-Cresotic acid**	2-hydroxy-3-methylbenzoic acid; 2-hydroxy-*m*-toluic acid; *o*-homosalicylic acid; *o*-cresotic acid; *β*-cresotic acid	$CH_3C_6H_3(OH)COOH$	152.14
2896	**2,4-Cresotic acid**	2-hydroxy-4-methylbenzoic acid; 2-hydroxy-*p*-toluic acid; *α*-*m*-homosalicylic acid; *m*-cresotic acid; *γ*-cresotic acid	$CH_3C_6H_3(OH)COOH$	152.14
2897	**2,5-Cresotic acid**	2-hydroxy-5-methylbenzoic acid; 6-hydroxy-*m*-toluic acid; *p*-homosalicylic acid; *p*-cresotic acid; *α*-cresotic acid	$CH_3C_6H_3(OH)COOH$	152.14
2898	**2,6-Cresotic acid**	2-hydroxy-6-methylbenzoic acid; 6-hydroxy-*o*-toluic acid; ***β*-*m*-homosalicylic** acid	$CH_3C_6H_3(OH)COOH$	152.14
2899	**3,2-Cresotic acid**	3-hydroxy-2-methylbenzoic acid; 3-hydroxy-*o*-toluic acid	$CH_3C_6H_3(OH)COOH$	152.14
2900	**3,4-Cresotic acid**	3-hydroxy-4-methylbenzoic acid; 3-hydroxy-*p*-toluic acid	$CH_3C_6H_3(OH)COOH$	152.14
2901	**3,5-Cresotic acid**	3-hydroxy-5-methylbenzoic acid; 5-hydroxy-*m*-toluic acid	$CH_3C_6H_3(OH)COOH$	152.14
2902	**3,6-Cresotic acid**	3-hydroxy-6-methylbenzoic acid; 5-hydroxy-*o*-toluic acid	$CH_3C_6H_3(OH)COOH$	152.14

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2880	col. need. f. bz.	....	157–9	....	......	......	....
2881	need. f. w.....	....	129	....	v. sl. s.	v. s.	v. s. eth.
2882	lt. yel. cr.....	....	90–1	....	v. sl. s.	v. s.	v. s. eth.
2883	yel. monocl. need. f. eth.	....	56	volat.	sl. s.	s.	v. s. eth.
2884	liq...........	$1.0625\frac{0}{4}$, $1.052\frac{12}{4}$	<−20	195–200	i.	s.	∞ eth.
2885	yel. need. f. w.	....	106	exp. 150	0.22^{20}, 0.81^{100}	v. s.	v. s. eth., s. bz.
2886	col. pr., 1.5395	$1.0347\frac{20}{4}$	36 (32–4)	202.5	2.4^{40}, 5.3^{100}	$\infty^{>36}$	$\infty^{>36}$ eth.; s. ord. org. solv.
2887	sc. f. eth., rhomb. f. bz.	....	135	subl.	v. sl. s.	v. s.	v. s. eth.; s. chl.; sl. s. bz.
2888	col. cr. f. w....	....	144.5	subl.	sl. s.	......	....
2889	lng. yel. pr....	....	81	....	sl. s.	s.	v. s. eth.
2890							
2891	yel. need. f. dil. al.	$1.2399\frac{38}{4}$	36.5 (32)	125^{25}	v. sl. s.	v. s.	v. s. eth.
2892	yel. pr. f. eth..	....	77	....	v. sl. s.	v. s.	v. s. eth.
2893	leaf. f. eth....	....	42–3	195	i.	s.	v. s. eth.
2894	col. cr. f. bz. +pet. eth.	....	104–5	267–70	s.	s.	s. eth.; sl. s. bz., lgr.
2895	lng. need. f. w.	....	163–4	....	0.14^{25}, 1.16^{100}	s.	s. eth., chl.
2896	sm. need. f. w.	....	178	subl.	4.36^{100}	v. s.	v.s.eth.; i.chl.
2897	lng. need. f. w.	....	152.5	....	v. sl. s.	v. s.	s. eth.; i. CS_2
2898	need. f. w.....	....	168	....	0.14^{25}	v. s.	v. s. eth.
2899	glit. need. f. w.	....	145–6	....	s.	v. s.	v. s. eth.
2900	lng. need.....	....	207	subl.	v. sl. s.	v. s.	s. eth.
2901	tab. f. w......	....	208	subl.	5.25^{100}	v. s.	v. s. eth.
2902	need. f. w.....	....	$-H_2O$ 100; 177–8 (183–4)	....	sl. s.	v. s.	v.s. eth.; i. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2903	**4,2-Cresotic acid**	4-hydroxy-2-methylbenzoic acid; 4-hydroxy-*o*-toluic acid	$CH_3C_6H_3(OH)COOH$	152.14
2904	**4,3-Cresotic acid**	4-hydroxy-3-methylbenzoic acid; 4-hydroxy-*m*-toluic acid	$CH_3C_6H_3(OH)COOH$	152.14
2905	**Cresyl alcohol.**	See *Cresol.*		
	Cresyl esters of organic acids. See "tolyl ester" under the names of the acids.			
2906	**Cresyl phosphate.**	See *Tolyl phosphate.*		
2907	**Croceic acid**	2-naphthol-8-sulfonic acid; β-naphthol-α-monosulfonic acid; Baeyer's acid	$HOC_{10}H_6SO_3H$	224.22
2908	**Croconic acid**	crocic acid	$C_5O_3(OH)_2 \cdot 3H_2O$	196.11
2909	**Crotonaldehyde**	2-butenal*; crotonic aldehyde; β-methylacrolein; propylene aldehyde	$CH_3CH:CHCHO$	70.09
2909M	**Crotonamide**	α-crotonic amide; 2-butenamide*	$CH_3CH:CHCONH_2$	85.10
2910	**Crotonic acid** (α or solid)	*trans*(?)-2-butenoic acid*; *trans*(?)-β-methylacrylic acid	$CH_3CH:CHCOOH$	86.09
2911	——, methyl ester	methyl α-crotonate	$C_3H_5COOCH_3$	100.11
2912	——, **β-bromo-**	3-bromo-*trans*-2-butenoic acid*	$CH_3CBr:CHCOOH$	165.00
2913	——, **α-chloro-**	2-chloro-2-butenoic acid* (one form)	$CH_3CH:CClCOOH$	120.54
2914	——, **α-ethyl-**	2-ethyl-*trans*(?)-2-butenoic acid*; 2-pentene-3-carboxylic acid*	$CH_3CH:C(C_2H_5)COOH$	114.14
2915	——, **β-hydroxy-**	3-hydroxy-2-butenoic acid*; desmotropic with acetoacetic acid	$CH_3COH:CHCOOH$	102.09
2916	**β-Crotonic acid** (liquid).	See *Isocrotonic acid.*		
2916M	**α-Crotonic amide.**	See *Crotonamide.*		
2917	**Crotonic anhydride**	2-butenoic anhydride*	$(CH_3CH:CHCO)_2O$	154.16
2917H	**Crotonic nitrile.**	See *Crotononitrile.*		
2917R	**Crotononitrile**	crotonic nitrile; 2-butenenitrile*; propenyl cyanide	$CH_3CH:CHCN$	67.09
2917V	**Crotonyl alcohol.**	See *2-Buten-1-ol.*		
2918	**Crotonylene.**	See *2-Butyne**.		
2919	**Crotyl alcohol** (and acetate).	See *2-Buten-1-ol**.		
2920	**Cryptopine**		$C_{21}H_{23}NO_5$	369.40
2921	**Crystal violet** (base)	hexamethylpararosaniline	$[(CH_3)_2NC_6H_4]_3COH$	389.53
2922	**Cubebin**		$C_{20}H_{20}O_6$	356.36
2923	**Cumaldehyde**	*p*-isopropylbenzaldehyde; *p*-cuminic aldehyde	$C_3H_7C_6H_4CHO$	148.20
2924	**Cumaric acid.**	See *Coumaric acid.*		
2925	**Cumene**	isopropylbenzene; 2-phenylpropane; cumol	$C_6H_5CH(CH_3)_2$	120.19
2926	——, **hexahydro-.**	See *Cyclohexane, isopropyl-.*		
2927	——, **α-nitro-**	2-nitro-2-phenylpropane; (α-nitroisopropyl) benzene	$C_6H_5C(NO_2)(CH_3)_2$	165.19
2928	**o-Cumenol.**	See *Phenol, o-isopropyl-.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2903	monocl. f. al. or w.	....	177.8	236–7, subl.	94^{100}	s.	s. eth.
2904	monocl. need. f. w.	....	172	subl. sl. d.	s. h.	v. s.	v. s. eth.; s. chl.
2905							
2906							
2907							
2908	yel. leaf......	....	$-3H_2O$, 100; anh. 180	subl.	156 c.	14.99 c.	....
2909	col. inflam. liq., $1.43838^{17.3}$	0.8575^{15}_{4}	−69; frz. −74	104–5 (102.4)	18	∞	∞ eth., bz., tol.
2909M	need.........	....	158	....	sl. s.	s.	v. sl. s. eth.; sl. s. bz.
2910	col. monocl. need. f. w. or lgr., $1.4228^{79.7}$	1.018^{20}_{4}; liq. 0.964^{80}	72	189	8.28^{15}	......	sl. s. lgr.
2911	col. liq.......	0.981^{4}_{4}	....	120.7	i.	v. s.	v. s. eth.
2912	leaf..........	....	97 (94–5)	....	sl. s.	v. s.	v. s. eth.; s. CS_2, bz.
2913	long need.....	....	99	212 subl.	2.12 c.	s.	s. eth.
2914	col. monocl. pr.	....	45	209	sl. s.	s.	v. s. eth.
2915	liq..........	....	....	d.	∞	......	....
2916							
2916M							
2917	col. liq., 1.47446	1.0397^{20}_{4}	....	246–8	d.	d.	∞ eth.
2917H							
2917R	col. liq.......	0.826^{23}_{4}	....	118–119	......	......	....
2917 V							
2918							
2919							
2920	pr. f. al., opt. i.	1.315^{20}_{4}	220–1 (218)	....	i.	sl. s.	sl. s. eth., chl., v. sl. s. bz.
2921	vlt. cr. f. bz...	....	195	....	i.	s.	s. eth.
2922	wh. need. f. al. or bz.	....	131–2 (125)	not volat.	v. sl. s.	1.03^{12}	2.68 eth.; s. chl.
2923	col. liq., 1.5301	0.978^{20}_{4}	....	235	i.	s.	s. eth.
2924							
2925	col. liq., 1.49145^{20}	0.86179^{20}	−96.9	152.392	i.	s.	s. eth., bz.
2926							
2927	liq..........	1.1025^{20}_{0}	−35	d. 224; $123–8^{12}$	i. c.	......	....
2928							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2929	**Cumic acid**...........	*p*-isopropylbenzoic acid; *p*-cuminic acid	$(CH_3)_2CHC_6H_4$-$COOH$	164.20
2930	**Cumic alcohol**.........	*p*-isopropylbenzyl alcohol; *p*-cuminic alcohol; cuminyl alcohol	$(CH_3)_2CHC_6H_4$-CH_2OH	150.21
2931	**α-Cumidic acid**.......	4,6-dimethylisophthalic acid; 4,6-dimethyl-1,3-benzenedicarboxylic acid*	$(CH_3)_2C_6H_2$-$(COOH)_2$	194.18
2932	**Cumidine**.............	*p*-isopropylaniline...........	$(CH_3)_2CHC_6H_4$-NH_2	135.20
2933	***p*-Cuminic acid.**	See *Cumic acid.*		
2934	***p*-Cuminic alcohol.**	See *Cumic alcohol.*		
2935	***p*-Cuminic aldehyde.**	See *Cumaldehyde.*		
2935M	**Cuminyl alcohol.**	See *Cumic alcohol.*		
2936	**Cumol.**	See *Cumene.*		
2937	**Cumylic acid.**	See *Durylic acid.*		
2938	**Cupreine**.............	hydroxycinchonine..........	$C_{19}H_{20}N_2(OH)_2$....	310.38
2939	**Curarine**.............	....	$C_{19}H_{25}N_2O\cdot OH$....	314.42
2940	**Curcumin**............	1,7-bis (4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione*	$[(CH_3O)(OH)C_6$-$H_3CH{:}CHCO]_2$-CH_2	368.37
2941	**Curine**..............	....	$C_{18}H_{19}NO_3$.......	297.34
2942	**Cuscohygrine** (anh.)	....	$C_{13}H_{24}N_2O$.......	224.34
2943	**Cuscohygrine** (hydrate)	....	$C_{13}H_{24}N_2O\cdot3\frac{1}{2}H_2O$.	287.40
2944	**Cuskhygrine.**	See *Cuscohygrine.*		
2945	**Cusparine**............	2-homopiperonyl-4-methoxyquinoline	$C_{19}H_{17}NO_3$.......	307.34
2946	**Cyamelide**............	*s*-trioxanetriimine; insoluble cyanic acid	$(HNCO)_3$.........	129.08
2947	**Cyanamide**...........	carbamonitrile.............	$CN\cdot NH_2$.........	42.04
2948	**——, benzyl-**..........	....	$C_6H_5CH_2NHCN$..	132.16
2949	**——, diethyl-**.........	*N*-cyanodiethylamine........	$CNN(C_2H_5)_2$......	98.15
2950	**——, phenyl-.**	See *Cyananilide.*		
2951	**Cyananilide**..........	carbanilonitrile; phenylcyanamide; *N*-cyanoaniline	C_6H_5NHCN......	118.13
2952	**Cyanic acid**..........	....	$HOCN$...........	43.03
2953	——, ethyl ester..........	....	C_2H_5OCN........	71.08
2954	——, insoluble.	See *Cyamelide.*		
2955	**——, thio-.**	See *Thiocyanic acid.*		
2956	**Cyanidine.**	See *s-Triazine.*		
2957	**——, trihydroxy-.**	See *Cyanuric acid.*		
	Cyano-. See the parent compounds (e.g., for cyanoacetic acid see *Acetic acid, cyano-*).			
2958	**Cyanogen** (gas)..........	ethanedinitrile*; oxalonitrile; prussite	$N\vdots CC\vdots N$	52.04
2959	**Cyanogen bromide**....	bromine cyanide...........	$CNBr$............	105.93

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2929	col. tricl. f. al..	$1.163\frac{4}{4}$	116.5	subl.	0.015^{25}	v. s.	v. s. eth.
2930	col.-yel. liq. (oil), 1.522^{24}	$0.978\frac{20}{20}$	....	248.4	sl. s.	∞	∞ eth.
2931	lng. pr. f. bz. +al. or need. f. w.	....	266 (>320), subl. without melting	....	sl. s.	s. h.	....
2932	col. liq.......	$0.957\frac{20}{4}$	−63	225	i.	s.	s. eth., bz., a.
2933							
2934							
2935							
2935M							
2936							
2937							
2938	concentric pr. f. eth., $[\alpha]^{16}_{D}-175.5°$ in al.	....	anh. 198 (202)	....	i.	s.	sl. s. eth.; v. sl. s. bz., chl.
2939	red-br. leaf....	....	161	....	i.	s.	....
2940	or.-yel. need. or powd.	....	183 (177)	....	i.	s.	sl. s. eth., CS_2; 0.05 bz.; s. alk.; i. lgr.
2941	col. cr........	....	212	....	......	......	....
2942	oil...........	$0.9782\frac{16}{4}$	....	215^{20}	∞	......	....
2943	need.........	....	40–1; d. 120–30	....	......	......	s. eth., bz. with sep. of H_2O
2944							
2945	lng. col. need..	....	91–2	....	......	s.	s. eth.
2946	wh. amor.....	$1.127\frac{15}{4}$	....	d.	0.01^{15}	i.	i. eth., ord. org. solv.; s. conc. H_2SO_4; sl. s. NH_4OH
2947	col. need., 1.4418^{48}	1.083	44	140^{19} d.	v. s.	v. s.	s. eth., chl., bz.
2948	pl. f. al.......	....	43 (33)	....	i.	s.	s. eth.
2949	liq., 1.4126^{48}...	0.854	....	190; 68^{10}	i.	s.	s. eth.
2950							
2951	need. f. eth....	....	47	....	sl. s.	s.	s. eth.
2952	col. gas.......	liq. $1.140\frac{0}{4}$	....	d.	sl. s.	......	s. eth., ac. a.
2953	liq...........	$1.127\frac{15}{5}$; $0.89\frac{20}{4}$	....	162 d.	i.	∞	∞ eth.
2954							
2955							
2956							
2957							
2958	col. **pois.** gas	liq. $0.866\frac{17}{4}$; 2.335 g/1	−34.4	−20.5	450^{20} cm³	2300^{20} cm³	500^{20} cm³ eth.
2959	col. need......	$2.015\frac{20}{4}$	52	61.6	s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2960	**Cyanogen chloride**	chlorine cyanide	$CNCl$	61.48
2961	——, trimer.	See *Cyanuric chloride.*		
2962	**Cyanogen iodide**	iodine cyanide	CNI	152.94
2963	**Cyanogen sulfide.**	See *Thiocyanic acid, cyanogen ester.*		
2964	**Cyanuramide.**	See *Ammelide.*		
2965	**Cyanuric acid (*n*)**	s-triazinetriol; trihydroxycyanidine; tricyanic acid	$N:C(OH)N:C(OH)N:C(OH)$	129.08
2966	——, tribenzyl ester	benzyl cyanurate	$(C_6H_5CH_2OC:N)_3$	399.43
2967	**——, trithio-.**	See *Thiocyanuric acid.*		
2968	**Cyanuric chloride**	trichloro-s-triazine; trichlorocyanidine; tricyanogen chloride	$C_3Cl_3N_3$	184.43
2969	**Cyanurodiamide.**	See *Ammeline.*		
2970	**Cyanurotriamide.**	See *Melamine.*		
2971	**Cyclobutane***	tetramethylene	$CH_2CH_2CH_2CH_2$	56.10
2972	**——, benzoyl-.**	See *Ketone, cyclobutyl phenyl.*		
2973	**——, methyl-**		$CH_3\text{-}CHCH_2CH_2CH_2$	70.13
2974	**1,2-Cyclobutanedicarboxylic acid***	ethylenesuccinic acid	$C_4H_6(COOH)_2$	144.12
2975	**1,3-Cyclobutanedicarboxylic acid***		$C_4H_6(COOH)_2$	144.12
2976	**Cyclobutene***	cyclobutylene	$CH:CHCH_2CH_2$	54.09
2977	**9-Cycloheptadecen-1-one*.**	See *Civetone.*		
2978	**Cycloheptane***	heptamethylene; suberane	$CH_2(CH_2)_5CH_2$	98.18
2979	**Cycloheptanol***	suberyl alcohol; suberol; hydroxyheptamethylene	$CH_2(CH_2)_5CHOH$	114.18
2980	**Cycloheptanone***	suberone; ketoheptamethylene	$CO(CH_2)_5CH_2$	112.17
2981	**Cycloheptene***	suberene; suberylene	$CH:CH(CH_2)_4CH_2$	96.17
2982	**1,3-Cyclohexadiene***	1,2-dihydrobenzene; $\Delta^{1,3}$-cyclohexadiene	$CH:CHCH:CH\text{-}CH_2CH_2$	80.12
2983	**——, 5-isopropyl-2-methyl-.**	See *α-Phellandrene.*		
2984	**1,4-Cyclohexadiene**	1,4-dihydrobenzene; $\Delta^{1,4}$-cyclohexadiene	$CH:CHCH_2\text{-}CH:CHCH_2$	80.12
2985	**Cyclohexadiene-1,2-dicarboxylic acid*.**	See *Phthalic acid, dihydro-.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2960	col. liq. or pois. gas	$1.218\frac{4}{4}$; liq. $1.186\frac{20}{4}$	−6	13.8	2500 cm^3	10,000 cm^3	5,000 cm^3 eth.
2961							
2962	col. need. f. eth. or al.	....	146.5, seal. tube	subl.	s.	s.	s. eth., volat. oils
2963							
2964							
2965	col. monocl. (+2H_2O) f. w., efflor.	$1.768\frac{0}{4}$	>360	d.	0.25^{17}	0.35^{22}	v. sl. s. eth.; s. conc. H_2SO_4
2966	need. f. al.....	....	157	>320	i. c.	s.	sl. s. eth.
2967							
2968	monocl. f. eth.	$1.32\frac{20}{4}$	146	190	sl. s.	v. s.	s. h. eth., ac. a.; v. s. chl.
2969							
2970							
2971	liq. or gas, 1.3752^0	$0.703\frac{0}{4}$	−50	13	i.	∞	∞ eth.; v. s. acet.
2972							
2973	col. liq., 1.3836^{20}	0.6931^{20}	....	35–36^{753}	i.	∞	∞ eth.
2974	(*cis*) pl. f. w...	....	138	....	s.	s.	s. eth., sl. s. bz.
	(*trans*) (*dl*) need. f. bz.	....	131	....	s.	......	....
	(*d*) [α] +123.3$^{\circ 30}_{D}$ in w.	....	105	....	......	......	....
	(*l*) [α] −124.3$^{\circ 0}_{D}$ in w.	....	105	....	......	......	....
2975	(*cis*) pr. f. w...	....	138–9 (135–6)	252	34.5	v. s.	v. sl. s. eth.
	(*trans*) pr...	....	171	subl.	3.8	v. s.	v. sl. s. eth.
2976	gas...........	$0.733\frac{0}{4}$	....	2 (−3 to 1)	......	......	s. acet.
2977							
2978	oil, 1.4440....	$0.8099\frac{20}{4}$	−12	118.1	i.	v. s.	v. s. eth.
2979	....	$0.9717\frac{0}{0}$; $0.9565\frac{20}{4}$	....	185.2 (184.5)	1.1	v. s.	v. s. eth.
2980	oil, 1.46027$^{21.9}$.	$0.9508\frac{20}{4}$	....	179.5	sl. s.	v. s.	s. eth.
2981	oil, 1.4552....	$0.8228\frac{20}{4}$	....	115	i.	s.	s. eth.
2982	col. liq., 1.4758, (1.4744)	$0.8404\frac{20}{4}$	−98	80.5 (83–4)	i.	s.	v. s. eth.
2983							
2984	col. liq., 1.46806^{19}	$0.8471\frac{20}{4}$	....	86–7 (81–2)	i.	∞	∞ eth.
2985							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
2986	**1,3-Cyclohexadiene-1, 4-dicarboxylic acid***	2,3-dihydroterephthalic acid	$C_6H_6(COOH)_2$	168.14
2987	**1,4-Cyclohexadienedione***. See *Quinone.*			
2988	**Cyclohexane***	hexahydrobenzene; hexamethylene	C_6H_{12}	84.16
2989	——, **amino-.**	See *Cyclohexylamine**.		
2990	——, **bromo-***	cyclohexyl bromide	$C_6H_{11}Br$	163.07
2991	——, **chloro-***	cyclohexyl chloride	$C_6H_{11}Cl$	118.61
2992	——, **1,3-dimethyl-**	hexahydro-*m*-xylene	$C_6H_{10}(CH_3)_2$	112.21
2993	——, **1,4-dimethyl-**	hexahydro-*p*-xylene	$C_6H_{10}(CH_3)_2$	112.21
2994	——, **1,2,3,4,5,6-hexabromo-** (α or *trans*)	benzene *trans*-hexabromide	$C_6H_6Br_6$	557.60
2995	——, ——, (β or *cis*)	benzene β-hexabromide	$C_6H_6Br_6$	557.60
2996	——, **1,2,3,4,5,6-hexachloro-** (α or *trans*)	benzene *trans*-hexachloride	$C_6H_6Cl_6$	290.85
2997	——, ——, (β or *cis*)	benzene *cis*-hexachloride	$C_6H_6Cl_6$	290.85
2998	——, ——, (γ)	benzene γ-hexachloride	$C_6H_6Cl_6$	290.85
2999	——, ——, (δ)	benzene δ-hexachloride	$C_6H_6Cl_6$	290.85
3000	——, **isopropyl-**	hexahydrocumene; normenthane	$C_3H_7{\cdot}C_6H_{11}$	126.24
3001	——, **4-isopropyl-1-methyl-**. See *p-Menthane.*			
3002	——, **methyl-**	hexahydrotoluene; cyclohexylmethane	$CH_3C_6H_{11}$	98.18
3003	——, **phenyl-**	cyclohexylbenzene; 1,2,3,4,-5,6-hexahydrobiphenyl	$C_6H_5C_6H_{11}$	160.25
3004	——, **1,3,5-trimethyl-**	hexahydromesitylene	$C_6H_9(CH_3)_3$	126.24
3005	**Cyclohexanecarboxylic acid***	hexahydrobenzoic acid	$C_6H_{11}COOH$	128.17
3006	——, **2-hydroxy-**	hexahydrosalicylic acid	$HOC_6H_{10}COOH$	144.17
3007	——, **1,2,4,5-tetrahydroxy-***. See *Quinic acid.*			
3008	**1,2-Cyclohexanedicarboxylic acid***	hexahydrophthalic acid	$C_6H_{10}(COOH)_2$	172.18
3009	**1,4-Cyclohexanedicarboxylic acid***	hexahydroterephthalic acid	$C_6H_{10}(COOH)_2$	172.18

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
2986	flocks........	....	....	....	i. c., s. h.	......	....
2987							
2988	col. liq., 1.42900^{15}	$0.7791\frac{20}{4}$	6.5	81.4	i.	∞	∞ eth.
2989							
2990	col. liq., 1.49564^{15}	$1.3290\frac{15}{15}$	....	163–5	i.	∞	∞ eth.
2991	col. liq., 1.46264	$1.0161\frac{0}{0}$; $1.000\frac{20}{4}$	−43.9	142.5	i.	∞	∞ eth., bz.
2992	col. liq. (*cis*) 1.4269	$0.7735\frac{20}{4}$	−85	121	i.	∞	∞ eth.
	(*trans*) 1.4254.	$0.772\frac{20}{4}$	....	119^{756}	......	......	....
2993	col. liq., 1.421.	(*cis*) $0.7671\frac{20}{4}$;	−86	120.5^{755}	......	......	....
		(*trans*) $0.7638\frac{20}{4}$	....	119	......	......	....
2994	col. monocl. pr.	....	212	....	i.	sl. s.	sl. s. eth.; s. $CHCl_3$
2995	cub. cr. f. bz..	....	253 d.	....	......	i.	i. eth.; sl. s. bz.
2996	col. monocl. pr.	$1.87\frac{20}{4}$	157	288 d.	i.	s. h.	4.35^{15} chl.; 6.5^{18} bz.; v. s. aniline
2997	col. cr........	$1.89\frac{19}{4}$	297	subl.	i.	sl. s.	0.13 $CHCl_3$, 1^{22} bz.; 0.289^{16} ac. a.
2998	need. f. al.....	....	112–3	....	i.	......	....
2999	pl............	....	129–32	....	......	......	....
3000	col. liq.......	$0.7902\frac{20}{4}$	....	154.7	i.	v. s.	v. s. eth.
3001							
3002	col. liq., 1.4235	$0.7864\frac{0}{4}$; $0.769\frac{20}{4}$	−126.4	100.3	i.	s.	s. eth.
3003	oil...........	$0.9440\frac{20}{4}$	7	237.5	i.	v. s.	v. s. eth.
3004	(*cis*) col. liq., 1.43010^{20}_{He}	0.773^{20}	....	140–140.5^{752}	......	......	....
	(*trans*) 1.42740^{20}_{He}	0.7720^{20}	....	138.5–139^{754}	......	......	....
3005	col. monocl. pr., $1.4561^{33.8}$	$1.048\frac{15}{4}$	31	233	0.201^{15}	v. s.	v. s. eth.
3006	cr. f. w.......	....	111	....	v. s.	v. s.	v. s. eth.; sl. s. bz.
3007							
3008	(*cis*) tricl. pr. f. w.	....	192; d. $-H_2O$ >192	....	0.2	s.	s. acet.
	(*trans*) monocl. leaf. f. w.	....	221	....	......	......	....
3009	(*cis*) leaflets f. w.	....	168–9	....	v. s. h.	s.	s. eth., $CHCl_3$
	(*trans*) pr. f. w.	....	300 subl.	....	1.34 h.	v. s.	sl. s. eth.; s. acet.; i. $CHCl_3$

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3010	**1,3-Cyclohexanedione***	3-hydroxy-2-cyclohexen-1-one* (tautomeric form); dihydroresorcinol; hydroresorcinol	$COCH_2COCH_2CH_2C$ H_2	112.12
3011	**1,4-Cyclohexanedione***	tetrahydroquinone; *p*-quinone tetrahydride	$CO(CH_2)_2$- $COCH_2CH_2$	112.12
3012	**1,2,3,4,5,6-Cyclohexanehexacarboxylic acid***	hexahydromellitic acid	$C_6H_6(COOH)_6$	348.22
3013	**1,2,3,4,5,6-Cyclohexane**	**hexol*.** See *i-Inositol.*		
3014	**Cyclohexanehexone***, hydrate	triquinoyl hydrate	$C_6O_6{\cdot}8H_2O$	312.19
3015	**Cyclohexanepentol*.**	See *d-Quercitol.*		
3016	**1,3,5-Cyclohexanetrione***, trioxime	1,3,5-trihydroxaminobenzene; phloroglucinol trioxime	$C_6H_6(NOH)_3$	171.16
3017	**Cyclohexanol***	hexahydrophenol; **"Hexalin"**.	$C_6H_{11}OH$	100.16
3018	——, acetate	cyclohexyl acetate	$CH_3COOC_6H_{11}$	142.19
3019	——, benzoate	cyclohexyl benzoate; cyclohexyl benzenecarboxylate	$C_6H_5COOC_6H_{11}$	204.26
3020	——, **2-methyl-**	hexahydro-*o*-cresol	$CH_3C_6H_{10}OH$	114.18
3021	——, **3-methyl-(*l*)**	*l*-hexahydro-*m*-cresol	$CH_3C_6H_{10}OH$	114.18
3022	——, **4-methyl-**	hexahydro-*p*-cresol	$CH_3C_6H_{10}OH$	114.18
3023	**Cyclohexanone***	ketohexamethylene; pimelic ketone	$CO(CH_2)_4CH_2$	98.14
3024	——, **2,5-dimethyl-** (*d*)		$COCH(CH_3)CH_2$- $CH_2CH(CH_3)CH_2$	126.19
3024M	——, **2-hydroxy-.**	See *Adipoin.*		
3025	——, **2-methyl-**		$COCH(CH_3)CH_2$- $CH_2CH_2CH_2$	112.17
3026	——, **3-methyl-**		$COCH_2CH(CH_3)$- $CH_2CH_2CH_2$	112.17
3027	——, **4-methyl-**		$COCH_2CH_2CH$- $(CH_3)CH_2CH_2$	112.17
3028	**Cyclohexanone pinacol**	. See 1,2-*Ethanediol*, 1,2-*dicyclo*	*hexyl-*.	

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3010	pr. f. bz. or ethyl acetate	....	105–6	....	s.	s.	v. sl. s. eth., CS_2, lgr.; s. chl.
3011	monocl. f. w...	....	78	subl. 100	s.	s.	s. eth.
3012	cr..........	....	d.	....	v. s.	v. s.	v. s. eth.
3013							
3014	micr. need. f. dil. HNO_3	....	95	....	s. h.	i.	i. eth., s. alk.
3015							
3016	cr. powd......	....	exp. 155	....	v. sl. s.	v. sl. s.	s. chl., ac. a.
3017	col. need., hyg., $1.46560^{22.6}$	$0.9449\frac{25}{4}$; $0.9624\frac{20}{4}$	24 (22–25)	161.5	5.67^{15}	s.	s. eth.; ∞ bz., CS_2, turpentine
3018	....	....	....	177 (171–6)	i.	∞	∞ eth.
3019	....	....	....	160^{18}	i.	s.	s. eth.
3020	(*cis*) col. liq., 1.4640^{20}	0.937^{20}	−9.5 to −9.2	165	v. sl. s.	∞	s. eth.
	(*trans*) col. liq., 1.4611^{20}	0.9238^{26}	−21.2 to −20.5	166.5	v. sl. s.	∞	s. eth.
3021	(*cis*) syrup, $1.45497^{21.8}$	$0.9145\frac{21.8}{4}$	−47	173–4	1.03	∞	∞ eth.
	(*trans*) syrup, $1.45497^{21.8}$	$0.9145\frac{21.8}{4}$	....	$174–5^{762}$	......	......	....
3022	(*cis*) aromatic liq., $1.45327^{21.5}$	0.9129	....	$173–4^{750}$	v. sl. s.	∞	s. eth.
	(*trans*) aromatic liq., $1.45307^{20.7}$	0.9118	....	$173–4.5^{745}$	v. sl. s.	∞	s. eth.
3023	col. liq., 1.4507	$0.9478\frac{20}{4}$	frz. −45	156.7 (155)	2.4^{31}	s.	s. eth.
3024	oil, 1.44807^{20}; $[\alpha]^{20}+11.6$	0.8985^{20}	....	$172–174^{750}$	i.	s.	s. eth.
3024M							
3025	liq., $1.45049^{14.6}$	0.9248^{18}	....	163	i.	s.	s. eth.
3026	liq., (*d*) 1.4456^{21}; $[\alpha]^{15}+13.38$;	0.915	....	169	i.	s.	s. eth
	(*dl*) 1.4430^{20}	0.9136_{24}	....	168	i.	s.	s. eth.
3027	liq., $1.44322^{24.4}$	$0.912\frac{24}{4}$	....	169	i.	s.	s. eth.
3028							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3029	**Cyclohexene***	1,2,3,4-tetrahydrobenzene	$CH_2CH_2CH_2CH_2$- CH:CH	82.14
3030	**——, 4-isopropyl-1-methyl-3-.** See *Menthene.*			
3031	**——, 3-isopropyl-6-methylene-.** See *β-Phellandrene.*			
3032	**——, 4-methyl-**	1,2,3,6-tetrahydrotoluene	$CH:CHCH_2CH$- $(CH_3)CH_2CH_2$	96.17
3033	**1-Cyclohexene-1-carboxylic acid***	2,3,4,5-tetrahydrobenzoic acid	$CH_2(CH_2)_3CH:C$- COOH	126.15
3034	**1-Cyclohexene-1,2-dicarboxylic acid***	Δ^1-tetrahydrophthalic acid	$C_6H_8(COOH)_2$	170.16
3035	**2-Cyclohexen-1-one, 3-hydroxy-*.** See 1,3-*Cyclohexanedione**.			
3036	**Cyclohexyl acetate.** See *Cyclohexanol, acetate.*			
3037	**Cyclohexylamine***	hexahydroaniline; aminocyclohexane	$C_6H_{11}NH_2$	99.17
3038	**——, *N*-butyl-**		$C_6H_{11}NH(CH_2)_3CH_3$	155.28
3039	**——, *N*-ethyl-**		$C_6H_{11}NHC_2H_5$	127.23
3040	——, ——, cyclohexylethylthiolthionocarbamate. See under *Carbamic acid, cyclohexyl-*			
3041	**——, *N*-methyl-**		$C_6H_{11}NHCH_3$	113.20
3042	**Cyclohexyl benzoate.** See *Cyclohexanol, benzoate.*			
3043	**Cyclohexyl bromide.** See *Cyclohexane, bromo-**.			
3044	**Cyclohexyl chloride.** See *Cyclohexane, chloro-**.			
3045	**1,3-Cyclopentadiene***		$CH:CHCH:CHCH_2$	66.10
3046	**Cyclopentane***	pentamethylene	$CH_2CH_2CH_2$- CH_2CH_2	70.13
3047	**——, bromo-***	cyclopentyl bromide	C_5H_9Br	149.04
3048	**Cyclopentanecarboxylic acid, 3-carbamyl-1,2,2-trimethyl-.** See *α-Cam-*			
3049	**——, 3-carbamyl-2,2,3-trimethyl-.** See *β-Camphoramic acid.*			
3050	**——, 1,2,2,3-tetramethyl-*.** See *Campholic acid.*			
3051	**1,2-Cyclopentanedicarboxylic acid***		$C_5H_8(COOH)_2$	158.15
3052	**1,3-Cyclopentanedicarboxylic acid***		$C_5H_8(COOH)_2$	158.15
3053	**——, 1,2,2-trimethyl-(*cis*).** See *Camphoric acid.*			
3054	**——, 1,2,2-trimethyl-(*trans*).** See *Isocamphoric acid.*			
3055	**1,3-Cyclopentanedicarboxylic anhydride*.** See *Camphoric anhydride*.			
3056	**Cyclopentanol***		$CH_2CH_2CH_2CH_2C$- HOH	86.13
3057	**Cyclopentanone***	ketopentamethylene; adipic ketone	$COCH_2CH_2CH_2CH_2$	84.11
3058	**Cyclopentene***		$CH:CHCH_2CH_2CH_2$	68.11
3059	**——, 2-acetyl-1,3,3,4,4-pentamethyl-.** See *Desoxymesityl oxide.*			
3060	**1-Cyclopentene-1-ethylamine, 2,3,3-trimethyl-.** See *β-Camphylamine.*			
3061	**Cyclopentyl bromide.** See *Cyclopentane, bromo-**.			

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
3029	col. liq., 1.44507^{22}	$0.8102\frac{20}{4}$	−103.7	83	i.	s.	v. s. eth.
3030							
3031							
3032	liq..........	$0.841\frac{15}{4}$; $0.801\frac{20}{4}$	....	102–3	i.	s.	s. eth.
3033	pl., 1.4903....	$1.109\frac{20}{4}$; $1.072\frac{47}{4}$	38	243	0.7^{20}	......	....
3034	monocl. leaf. f. w.	....	120	....	v. s.	......	....
3035							
3036							
3037	col. liq., 1.43716	$0.8191\frac{20}{4}$ (0.8678)	....	134	sl. s.	s.	s. eth.
3038	col. liq.......	....	....	200–4	sl. s.	v. s.	v. s. eth.
3039	col. liq.......	$0.868\frac{0}{0}$	....	164	sl. s.	∞	∞ eth.
3040	*ethylthiolthiono*	-.					
3041	col. liq.......	....	....	145–7	sl. s.	v. s.	∞ eth.
3042							
3043							
3044							
3045	col. liq., 1.4446^{19}	$0.80475\frac{19}{4}$	....	42.5	i.	∞	∞ eth., bz.
3046	col. liq., 1.4039	$0.7510\frac{20}{4}$	−93.3	49.5	i.	∞	∞ eth.
3047	1.4875^{19}......	$1.3692\frac{15}{15}$	....	137–9	......	......	....
3048	*phoramic acid.*						
3049							
3050							
3051	(*cis*): need. f.w.	....	139	anh. 150–60	v. s.	s.	....
	(*trans*): warts f. w.		161		v. s. h.	v. s.	v. sl. s. eth.; s. et. ac.; sl. s. bz., chl.
3052	(*cis*) pr. f. w...	....	121	300 d.	v. s. h.	v. s.	v. s. eth.; s. chl., acet., h. bz.
	(*trans*) pr. f. CCl_4	....	88	....	v. s. c.	......	....
3053							
3054							
3055							
3056	oil, 1.4530....	$0.9488\frac{20}{4}$	....	139–40	sl. s.	s.	....
3057	oil, 1.4366.....	$0.9480\frac{20}{4}$	−58.2	130.6	s.	∞	∞ eth.
3058	liq., 1.42246^{20}.	0.7719^{20}	−93.3	44.242	i.	s.	s. eth.
3059							
3060							
3061							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3062	**Cyclopropane***	trimethylene	$CH_2CH_2CH_2$	42.08
3063	**——, 1,1-dimethyl-**	1,1-dimethyltrimethylene	$(CH_3)_2CCH_2CH_2$	70.13
3064	**——, methyl-**		$CH_3CHCH_2CH_2$	56.10
3065	**Cyclopropanecarboxylic acid***	ethyleneacetic acid	$CH_2CH_2CHCOOH$	86.09
3066	**1,1-Cyclopropanedicarboxylic acid.***	See *Vinaconic acid.*		
3067	**1,2,3-Cyclopropanetricarboxylic acid***		$C_3H_3(COOH)_3$	174.11
3068	***o*-Cymene**	*o*-isopropyltoluene; 2-isopropyl-1-methylbenzene	$CH_3C_6H_4CH(CH_3)_2$	134.21
3069	***m*-Cymene**	*m*-isopropyltoluene; 3-isopropyl-1-methylbenzene; isocymene	$CH_3C_6H_4CH(CH_3)_2$	134.21
3070	***p*-Cymene**	cymene; *p*-isopropyltoluene; 4-isopropyl-1-methylbenzene	$CH_3C_6H_4CH(CH_3)_2$	134.21
3071	**——, 2-acetyl-.**	See *Acetophenone, 5-isopropyl-2-methyl-.*		
3072	**——, 2-amino-.**	See *Carvacrylamine.*		
3073	**——, 2-bromo-**	2-bromo-4-isopropyl-1-methylbenzene	$CH_3C_6H_3BrC_3H_7$	213.12
3074	**——, hexahydro-.**	See *p-Menthane.*		
3075	**——, 2-nitro-**	4-isopropyl-1-methyl-2-nitrobenzene	$C_{10}H_{13}NO_2$	179.21
3076	**2-*p*-Cymenecarboxylic acid, 3-hydroxy-.**	See *o-Thymotic acid.*		
3077	**2,5-*p*-Cymenediol.**	See *Thymohydroquinone.*		
3078	**2-*p*-Cymenol.**	See *Carvacrol.*		
3079	**3-*p*-Cymenol.**	See *Thymol.*		
3080	**Cymidine.**	See *Carvacrylamine.*		
3081	**Cymophenol.**	See *Carvacrol.*		
3082	**2-*p*-Cymylamine.**	See *Carvacrylamine.*		
3083	**3-*p*-Cymylamine.**	See *Thymylamine.*		
3084	**L-Cysteine**	*l*-2-amino-3-mercaptopropanoic acid*; *l*-β-mercaptoalanine	$HSCH_2CH(NH_2)COOH$	121.15
3085	**DL-Cystine**		$[SCH_2CH(NH_2)COOH]_2$	240.29
3086	**D-Cystine**		$[SCH_2CH(NH_2)COOH]_2$	240.29
3087	**L-Cystine**	*l*-3,3′-dithiobis (2-aminopropanoic acid*); *l*-β, β′-dithiodialanine; dicysteine	$[SCH_2CH(NH_2)COOH]_2$	240.29
3088	***meso*-Cystine**		$[SCH_2CH(NH_2)COOH]_2$	240.29
3089	**Cytisine**	ulexine; sophorine; baptitoxine	$C_{11}H_{14}N_2O$	190.24
3090	**β-Cytisolidine.**	See *Quinoline, 6,8-dimethyl-*.*		
3091	**Dambose.**	See *i-Inositol.*		
3092	**Daphnetin**	7,8-dihydroxycoumarin	$OCOCH{:}CHC_6H_2(OH)_2$	178.14
3093	**Daturine.**	See *Hyoscyamine.*		
3094	***dl*-Daturine.**	See *Atropine.*		

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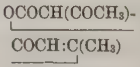
*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3062	col. gas........	0.720^{-79}	−126.6	−34.4	i.	v. s.	v. s. eth.
3063	1.366.........	0.6604	....	21	i.	s.	s. eth., H_2SO_4
3064	col. gas........	0.691^{-20}	....	5	sl. s.	v. s.	v. s. eth.
3065	1.43901^{20}......	$1.0885\frac{20}{4}$	18–19	182–4 (181)	sl. s.	s.	s. eth.
3066							
3067	col. cr........	....	220	....	s.	s.	....
3068	col. liq., $1.50206^{16.15}$	$0.876\frac{20}{4}$	−73.5	175 (175–8)	i.	s.	s. eth., chl.
3069	col. liq., $1.49385^{17.05}$	$0.8696\frac{20}{4}$	<−25	175.7	i.	s.	s. eth., chl.
3070	col. liq., $1.49474^{15.0}$	$0.8570\frac{20}{4}$	−73.5 (−68.9)	176	i.	v. s.	s. eth., chl.
3071							
3072							
3073	liq............	$1.269\frac{17}{4}$	....	233–5	i.	v. s.	s. eth.
3074							
3075	aromatic oil, 1.53093^{20}	$1.0774\frac{20}{4}$	....	$130–5^{15}$	i.	v. s.	v s. eth.
3076							
3077							
3078							
3079							
3080							
3081							
3082							
3083							
3084	cr. powd......	....	....	....	v. s.	......	s. ac. a., NH_4OH
3085	need..........	....	260 (225–7)	....	0.006^{25}	......	....
3086	wh. hex. pl....	....	247–9	....	0.011^{25}	i.	s. min. a., alk.
3087	hex. pl. f. dil. HCl, 1.700, 1.640, $[\alpha]$ $-206^{\circ 20}_{D}$ in dil. HCl	....	258–61 d.	....	0.011^{25}, 0.052^{75}	i.	i. eth., chl., bz.; s. min. a.; caustic alk., NH_4OH
3088	....	....	....	....	0.006^{25}	......	....
3089	col. lg. rhomb. cr. $[\alpha]-119.1^{\circ 17}_{D}$ in w.	....	152–3	....	78^{16}	30.1^{8}	i. eth., CS_2, CCl_4; s. chl., bz.
3090							
3091							
3092	pa. yel. need...	....	256	....	v. s. h.	s. h. dil.	v. sl. s. eth.; i. chl., bz.
3093							
3094							

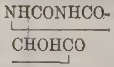
For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3094M	**1,3-Decadiene***		$(CH_3)(CH_2)_5$- $CH{:}CHCH{:}CH_2$	138.25
3095	**"Decalin".**	See *Naphthalene, decahydro-*.*		
3096	**Decamethylene glycol.**	See 1,10-*Decanediol*.*		
3097	**Decanal*.**	See *Capraldehyde.*		
3098	**Decanamide*.**	See *Capramide.*		
3099	**Decane***	*n*-decane	$CH_3(CH_2)_8CH_3$	142.28
3100	**——, 1-amino-.**	See *Decylamine*.*		
3101	**——, 1-iodo-***	*prim-n*-decyl iodide	$CH_3(CH_2)_9I$	268.19
3102	**Decanedioic acid*.**	See *Sebacic acid.*		
3103	**1,10-Decanediol***	decamethylene glycol	$CH_2OH(CH_2)_8$- CH_2OH	174.28
3104	**Decanenitrile*.**	See *Caprinitrile.*		
3105	**Decanoic acid*.**	See *Capric acid.*		
3106	**Decanoic anhydride*.**	See *Capric anhydride.*		
3107	**1-Decanol***	*n*-decyl alcohol; nonylcarbinol	$CH_3(CH_2)_8CH_2OH$	158.28
3108	——, acetate	*n*-decyl acetate	$CH_3COO(CH_2)_9$- CH_3	200.31
3109	——, nitrate	*n*-decyl nitrate	$CH_3(CH_2)_9ONO_2$	203.28
3110	——, nitrite	*n*-decyl nitrite	$CH_3(CH_2)_9ONO$	187.28
3111	——, sulfate		$[CH_3(CH_2)_9]_2SO_4$	378.60
3112	**4-Decanol***	hexylpropylcarbinol; *sec*-decyl alcohol	$CH_3(CH_2)_2CH$- $OH(CH_2)_5CH_3$.	158.28
3113	**2-Decanone***	methyl octyl ketone	$CH_3COC_8H_{17}$	156.26
3114	**3-Decanone***	ethyl heptyl ketone	$C_2H_5CO(CH_2)_6$- CH_3	156.26
3115	**4-Decanone***	hexyl propyl ketone	$CH_3(CH_2)_2CO$- $(CH_2)_5CH_3$	156.26
3116	**Decanoyl chloride*.**	See *Capryl chloride.*		
3117	**1-Decene***	*n*-decylene	$CH_2{:}CH(CH_2)_7$- CH_3	140.26
3118	**Decine.**	See *Decyne*.*		
3119	***n*-Decoic acid.**	See *Capric acid.*		
3120	***n*-Decyl alcohol.**	See 1-*Decanol*.*		
3121	**sec-Decyl alcohol.**	See 4-*Decanol*.*		
3122	***tert*-Decyl alcohol.**	See 4-*Heptanol, 4-propyl-**; 3-*Octanol, 3-ethyl-*.*		
3123	***n*-Decyl aldehyde.**	See *Capraldehyde.*		
3124	***n*-Decylamide.**	See *Capramide.*		
3125	**Decylamine*(*n*)**	1-aminodecane	$CH_3(CH_2)_9NH_2$	157.29
3126	***n*-Decylene.**	See 1-*Decene*.*		
	***n*-Decyl esters.**	See under 1-*Decanol.*		
3127	***n*-Decylic acid.**	See *Capric acid.*		
3128	***n*-Decylic amide.**	See *Capramide.*		
3129	***n*-Decylic anhydride.**	See *Capric anhydride.*		
3130	***prim-n*-Decyl iodide.**	See *Decane, 1-iodo-*.*		
3131	**1-Decyne***	1-decine; *n*-octylacetylene	$CH\vdots C(CH_2)_7CH_3$	138.25
3131H	**5-Decyne***	5-decine; dibutylacetylene	$C_4H_9C\vdots C{\cdot}C_4H_9$	138.25
3132	**Dehydroacetic acid**	3-acetyl-6-methyl-2,4-pyrandione	 $OCOCH(COCH_3)$- $COCH{:}C(CH_3)$	168.14
3133	**Dehydromucic acid**	2,5-furandicarboxylic acid	$C_4H_2O(COOH)_2$	156.09
3134	——, dimethyl ester		$C_4H_2O(COOCH_3)_2$	184.14
3135	**——, tetrahydro-3, 4-dihydroxy-.**	See *Isosaccharic acid.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3094M	liq..........	0.750^{20}	....	168–70	......	......	....
3095							
3096							
3097							
3098							
3099	col. liq., 1.41203	$0.73014\frac{20}{4}$	-30 to -32	174	i.	∞	∞ eth.
3100							
3101	liq., 1.48269...	$1.2567\frac{20}{4}$	....	132^{15}	......	......	....
3102							
3103	....	....	71.5	179^{11}	v. sl. s.	s.	i. eth.
3104							
3105							
3106							
3107	col. visc. liq., 1.43682^{20}	$0.8292\frac{20}{4}$	+6	231	i.	s.	∞ eth.
3108	col. liq.......	....	-15.05	244; 125^{15}	i.	s.	s. eth., bz.
3109	liq..........	$0.951\frac{0}{4}$	....	$127\text{–}8^{11}$	......	......	....
3110	liq..........	....	....	$105\text{–}8^{12}$	......	......	....
3111	....	....	37.6–37.8	....	......	......	....
3112	thk. col. oil...	$0.826\frac{20}{4}$	....	210–1	i.	s.	....
3113	liq. or need., 1.4263^{22}	0.825	14 (2.5)	211	i.	s.	s. eth.
3114	liq..........	....	....	211	......	s.	s. eth.
3115	col. liq.......	$0.824\frac{20}{4}$	-9	207	v. sl. s.	∞	∞ eth.
3116							
3117	col. liq., 1.42146^{20}	0.74081^{20}	−66.31	170.670	i.	∞	∞ eth.
3118							
3119							
3120							
3121							
3122							
3123							
3124							
3125	col. liq. or leaf.	$0.951\frac{6}{4}$	17	220.5	sl. s.	s.	s. eth.
3126							
3127							
3128							
3129							
3130							
3131	col. liq.......	0.791	-40	$80\text{–}2^{32}$	i.	s.	s. eth.
3131 H	col. liq., 1.4311	0.7673^{25}	....	78.8^{25}; 116^{115}	i.	s.	s. eth.
3132	rhomb. need. or pl.	....	109	270	1^{6}	s. h.	s. eth.
3133	pl. f. h. al.; need. f. w.	....	>320	....	i. c.	......	....
3134	need. f. w.....	....	109–10	$154\text{–}6^{15}$	i. c.	s.	s. eth.
3135							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3136	**Dehydromucyl chloride**	2,5-furandicarbonyl chloride.	$C_4H_2O(COCl)_2$....	192.99
3137	**Delphinine**..........	....	$C_{34}H_{47}NO_9$.......	613.73
3138	**Derritol**..............	....	$C_{21}H_{22}O_6$.........	370.39
3139	**Desoxalic acid**.........	1,2-dihydroxy-1,1,2-ethanetricarboxylic acid	$(COOH)CH(OH)$-$C(OH)(COOH)_2$	194.10
3140	**Desoxybenzoin**........	α-phenylacetophenone; benzyl phenyl ketone	$C_6H_5CH_2COC_6H_5$..	196.24
3141	**——, α,α′-benzalbis-.**	See *Benzamarone; Isobenzamarone.*		
3142	**Desoxymesityl oxide** ..	2-acetyl-1,3,3,4,4-pentamethylcyclopentene	$C_{12}H_{20}O$..........	180.28
3143	**Dextrin**..............	starch gum; British gum; amylin; gommelin	$(C_6H_{10}O_5)_x$........	..$(162.14)_x$
3144	**Dextronic acid.**	See *D-Gluconic acid.*		
3145	**Dextrose.**	See *D-Glucose.*		
	Di-. For dibromo, diethyl, etc. derivatives see the parent compounds (e.g., *Acetic*			
3146	**Diacetamide**..........	....	$(CH_3CO)_2NH$.....	101.10
3147	**——, *N*-phenyl-.**	See *Diacetanilide.*		
3148	**Diacetanilide**.........	*N*-phenyldiacetamide; *N,N*-diacetylaniline	$(CH_3CO)_2NC_6H_5$..	177.20
3149	**——, *p*-ethoxy-**	*N,N*-diacetyl-*p*-phenetidine...	$(CH_3CO)_2NC_6H_4$-OC_2H_5	221.25
3150	**Diacetin.**	See *Glycerol, diacetate.*		
3151	**Diacetoacetic acid,** ethyl ester	ethyl 2-acetyl-3-oxobutanoate*; ethyl α-acetylacetoacetate	$(CH_3CO)_2CH$-$COOC_2H_5$	172.18
3152	**Diacetone alcohol.**	See *2-Pentanone, 4-hydroxy-4-methyl-**.		
3153	**Diacetonealkamine, benzoylvinyl-.** See *β-Eucaine.*			
3154	**Diacetosuccinic acid,** diethyl ester	diethyl 2,3-diacetylbutanedioate*; ethyl α,β-diacetylsuccinate	$(CH_3COCHCOO$-$C_2H_5)_2$	258.27
3155	**Diacetyl.**	See 2,3-*Butanedione**.		
3156	**Diacetyl dioxime.**	See *Glyoxime, dimethyl-.*		
3157	**Diacetyl peroxide.**	See *Acetyl peroxide.*		
3158	**Dial.**	See *Barbituric acid, 5,5-diallyl-.*		
3159	**Diallyl.**	See 1,5-*Hexadiene**.		
3160	**Diallylamine**..........	di-2-propenylamine*........	$(CH_2{:}CHCH_2)_2NH$	97.16
3161	**Diallyl sulfide.**	See *Allyl sulfide.*		
3162	**Dialuramide.**	See *Uramil.*		
3163	**Dialuric acid**..........	5-hydroxybarbituric acid; tartronylurea	 $NHCONHCO$-$CHOHCO$	144.09
	Diamino-. See the parent compounds (e.g., for diaminophenol see *Phenol, diamino-;*			
3164	**Diamylamine**.........	di-*n*-amylamine............	$[CH_3(CH_2)_4]_2NH$..	157.29
3165	**Diamyl ketone.**	See 6-*Hendecanone**.		
3166	**Di-*n*-amyl sulfate.**	See *Amyl sulfate.*		
3167	**Diarsenic tetramethyl.**	See *Cacodyl.*		
3168	**1,2-Diazine.**	See *Pyridazine.*		
3169	**1,3-Diazine.**	See *Pyrimidine.*		
3170	**1,4-Diazine.**	See *Pyrazine.*		
3171	**Diazoacetic acid,** ethyl ester. See under *Acetic acid, diazo-.*			
3172	**Diazoaminobenzene***	1,3-diphenyltriazene*; benzenediazoanilide	$C_6H_5N{:}NNHC_6H_5$	197.23
3173	——, (isomeric form).......	....	$C_6H_5N{:}NNHC_6H_5$	197.23

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3136	yel. pl.........	....	80	*ca.* 245	v. s.	......	v. s. eth.
3137	rhomb. pl......	....	191 d.	....	0.002^{20}	4.8^{20}	9^{20} eth.; v. s. chl.
3138	yel. need. f. me. al.	....	161	....	......	......	....
3139	hyg. cr........	....	....	d. 50	v. s.	v. s.	sl. s. eth.
3140	wh. pl. f. al....	....	60 (55–6)	322	sl. s. h.	s.	s. eth.
3141							
3142	liq............	....	....	218–20	i.	......	....
3143	col. amor., [α] gen. >+200°D	$1.0384\frac{20}{4}$	d.	....	s.	i.	i. eth.
3144							
3145							
	acid, dibromo-;	*Benzene, diet*	*hyl-).*				
3146	col. need. f. eth.	....	78	223.5	s.	s.	s. eth., lgr.
3147							
3148	col. pl. f. lgr....	....	37–8	142^{11}	s.	s.	s. bz., lgr., tol.
3149	col. need. f. lgr.	....	53.5–54 (55–56)	182^{13}	0.25	v. s.	v. sl. s. eth.
3150							
3151	col. liq., $1.46950^{18.3}$	$1.104\frac{15}{4}$; $1.089\frac{25}{25}$	....	211 sl. d.	sl. s.	v. s.	v. s. eth.
3152							
3153							
3154	α_1 oil.........	....	....	....	v. sl. s.	s.	s. eth.; 10 lgr.
	α_2 cr.........	....	20–2	....	......	v. s.	v. s. eth.
	α_3 pr.........	....	31–2	....	i.	v. s.	v. s. eth.
	α_4 rhomb.....	$1.209\frac{20}{4}$	89–90	....	......	15	20 eth.
3155							
3156							
3157							
3158							
3159							
3160	liq............	....	....	111–2	......	......	....
3161							
3162							
3163	col. tetr.......	....	214–5 d.	....	sl. s.	......	....
	for diaminonaph	thalene see	*Naphthalene*	*diamine).*			
3164	col. liq........	....	....	$202\text{–}3^{745}$	v. sl. s.	v. s.	∞ eth.
3165							
3166							
3167							
3168							
3169							
3170							
3171							
3172	(1) golden-yel. leaf. or pr. f. al.	....	98–9	d. w. sl. exp.	i.	s. h.	s. eth., bz.
	(2) yel. pr.....	....	80–1	....	......	......	....
3173	yel. pr........	....	80–1	exp.	i.	s. h.	s. eth., bz., lgr.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3174	**Diazoaminobenzene, 4,4′-dinitro-***	1,3-*bis*(*p*-nitrophenyl)triazene*	$NO_2C_6H_4NNN-HC_6H_4NO_2$	287.23
3175	**——, 4-methyl-.**	See *Triazene-1-phenyl-3-p-tolyl-*.		
3176	**1,1′-Diazoaminonaphthalene***	1,3-di-1-naphthyltriazene*	$C_{10}H_7N:NNH-C_{10}H_7$	297.35
3177	**2,2′-Diazoaminonaphthalene***	1,3-di-2-naphthyltriazene*	$C_{10}H_7N:NNH-C_{10}H_7$	297.35
3178	**Diazobenzene chloride**	, etc. See *Benzenediazonium chloride*, etc.*		
3179	**Diazobenzene imide.**	See *Benzene, triazo-*.		
3180	**Diazobenzene perbromide.**	See *Benzenediazonium tribromide**.		
3181	**Diazobenzolic acid.**	See *Aniline, N-nitro-*.		
3182	**1,2-Diazole.**	See *Pyrazole.*		
3183	**Diazomethane.**	See *Methane, diazo-*.		
3184	**Dibenzanthracene**		$C_{22}H_{14}$	278.33
3185	**Dibenzo-*p*-dithiin.**	See *Thianthrene.*		
3186	**Dibenzofuran**	diphenylene oxide; biphenylene oxide	$\underbrace{C_6H_4OC_6H_4}$	168.18
3187	**——, 3-amino-**		$C_{12}H_7O\cdot NH_2$	183.20
3188	**——, 2-bromo-**		$C_{12}H_7BrO$	247.09
3189	**——, 3-nitro-**		$O_2NC_{12}H_7O$	213.18
3190	**2-Dibenzofurancarboxylic acid**		$C_{12}H_7O\cdot COOH$	212.19
3191	**Dibenzo(*a,i*)phenanthrene.**	See *Picene.*		
3192	**Dibenzo-1,4-pyran.**	See *Xanthene.*		
3193	**Dibenzopyrrole.**	See *Carbazole.*		
3194	**Dibenzothiophene-2,7-diamine,** 9-dioxide.	See *Benzidine sulfone.*		
3195	**Dibenzoyl.**	See *Benzil.*		
3196	**Dibenzyl.**	See *Bibenzyl.*		
3197	**Dibenzylamine***		$(C_6H_5CH_2)_2NH$	197.27
3198	——, dibenzylthiolthionocarbamate.	See under *Carbamic acid, dibenzylthiolthiono-*.		
3199	**——, *N*-phenyl-**	*N,N*-dibenzylaniline	$(C_6H_5CH_2)_2N-C_6H_5$	273.36
3200	**Dibenzyl disulfide.**	See *Benzyl disulfide.*		
	Dibromo-. See the parent compounds (e.g., for dibromobenzene see *Benzene, dibromo-*).			
3201	**β-Dibromohydrin.**	See 1-*Propanol, 2,3-dibromo-**.		
3202	**Dibutylamine***	di-*n*-butylamine	$(C_4H_9)_2NH$	129.24
3203	**——, *N*-phenyl-.**	See *Aniline, N,N-dibutyl-*.		
3204	**Di-*n*-butyl sulfate.**	See *Butyl sulfate.*		
3205	**Dichloramine(T)**	*N,N*-dichloro-*p*-toluenesulfonamide	$CH_3C_6H_4SO_2NCl_2$	240.11
	Dichloro-. See the parent compounds (e.g., for dichlorobenzene see *Benzene, dichloro-*).			
3206	**α-Dichlorohydrin.**	See 2-*Propanol, 1,3-dichloro-**.		
3207	**β-Dichlorohydrin.**	See 1-*Propanol, 2,3-dichloro-**.		
3208	**Dichloronitrohydrin.**	See 2-*Propanol, 1,3-dichloro-, nitrate**.		
3209	**Dicyan(o)diamide.**	See *Guanidine, 1-cyano-*.		
3210	**Dicyan(o)diamidine.**	See *Urea, guanyl-*.		
3211	**Dicyclohexylamine***		$(C_6H_{11})_2NH$	181.31
3211M	**Dicyclopentadiene**		$C_{10}H_{12}$	132.20
3212	**Dicysteine.**	See *l-Cystine.*		
3213	**Di-*n*-decyl sulfate.**	See 1-*Decanol, sulfate.*		
3214	**Di-*n*-dodecyl sulfate.**	See *Dodecyl sulfate.*		
3215	**Diethanolamine**	diethylolamine; 2,2′-iminodiethanol; β,β′-dihydroxydiethylamine; iminoethyl alcohol (incorrect)	$HN(CH_2CH_2OH)_2$	105.14
	Diethyl. For diethyl derivatives see the parent compounds (e.g., for diethylbenzene see			

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3174	yel. cr.........	....	233 d. (224–6)	....	i.	v. sl. s. h.	s. eth.
3175							
3176	yel. leaf. f. al..	....	exp.	....	......	......	....
3177	red need. f. xylene	....	156	....	......	......	....
3178							
3179							
3180							
3181							
3182							
3183							
3184	or. tab. f. bz. or brnsh. need. f. ac. a.	....	267.5	....	i.	i.	i. eth., ac. a., c. bz.
3185							
3186	col. leaf. f. al., bl. fluor.	....	87	288	i.	sl. s.	v. s. eth.; s. bz.
3187	need.........	....	99–99.5	....	i.	v. s. h.	v. s. eth.
3188	leaf..........	....	110	220^{40}	i.	s. h.	s. eth.
3189	yel. need......	....	181–3	....	i.	sl. s.	sl. s. eth.; s. h. glac. ac. a.
3190	amor.........	....	246–7	....	v. sl. s.	s. h.	s. eth.
3191							
3192							
3193							
3194							
3195							
3196							
3197	col. liq., 1.57432^{22}	1.026^{22}	–26	300 (268 -71^{250})	i.	v. s.	v. s. eth.
3198							
3199	need. or pr. f. al., 1.60647^{80}	$1.04436\frac{80}{4}$	71–2 (69.5)	>300 d.	i.	sl. s.	s. eth., bz.
3200							
3201							
3202	col. liq.......	$0.767\frac{20}{4}$	....	159–61	s.	v. s.	v. s. eth.
3203							
3204							
3205	pa. yelsh. cr. or powd.	....	83	....	sl. s.	s.	s. eth., bz., chl., CCl_4, ac. a.
3206							
3207							
3208							
3209							
3210							
3211	col. liq.......	....	....	$254-6^{745}$	sl. s.	v. s.	∞ eth.
3211M	col. cr.........	0.976^{35}	32.9	170 sl. d.	......	v. s.	v. s. eth.
3212							
3213							
3214							
3215	liq. or col. pr., 1.4776^{20}	$1.0966\frac{20}{4}$	28	268	∞	∞	v. sl. s. eth., sl. s. bz.
	Benzene, diethyl –). For diethyl esters of organic acids see the acids.						

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3216	**Diethylamine***		$(C_2H_5)_2NH$	73.14
3217	——, diethylthiolthionocarbamate. See under *Carbamic acid, diethylthiolthiono-.*			
3218	——, hydrochloride	diethylammonium chloride*	$(C_2H_5)NH\cdot HCl$	109.60
3219	——, ***N*-cyano-.**	See *Cyanamide, diethyl-.*		
3219M	——, **2,2′-diamino-.**	See *Diethylenetriamine.*		
3220	——, **β,β′-dihydroxy-.**	See *Diethanolamine.*		
3221	——, **β,β′-dihydroxy-*N*-methyl-.** See *Ethanol, 2,2′-methyliminodi-.*			
3222	——, ***N*-formyl-.**	See *Formamide, N,N-diethyl-.*		
3223	——, **β-hydroxy-.**	See *Ethanol, 2-ethylamino-*.*		
3224	——, ***N*-methyl-**		$(C_2H_5)_2NCH_3$	87.16
3225	——, ***N*-nitro-**	diethylnitramine; nitric diethylamide	$(C_2H_5)_2NNO_2$	118.14
3226	——, ***N*-nitroso-**	diethylnitrosamine; nitrous diethylamide	$(C_2H_5)_2NNO$	102.14
3227	——, ***N*-phenyl-.**	See *Aniline, N,N-diethyl-.*		
3228	**Diethylenediamine.**	See *Piperazine.*		
3229	**Diethylene dioxide.**	See *p-Dioxane.*		
3230	**Diethylene disulfide.**	See *p-Dithiane.*		
3231	**Diethylene glycol**	2,2′-oxydiethanol; 2,2′-dihydroxyethyl ether	$O(CH_2CH_2OH)_2$	106.12
3232	——, diethyl ether.	See *Ether, bis (β-ethoxyethyl).*		
3233	——, dioleate		$(C_{17}H_{33}COOC_2H_4)_2O$	635.00
3234	——, distearate	glycosterin	$(C_{17}H_{35}COOC_2H_4)_2O$	639.03
3235	——, monobutyl ether	2-(β-butoxyethoxy)ethanol*; butyl "Carbitol"	$C_4H_9OCH_2CH_2OCH_2CH_2OH$	162.23
3236	——, monobutyl ether acetate		$C_4H_9O(CH_2)_2O(CH_2)_2OOCCH_3$	204.26
3237	——, monoethyl ether	2-(β-ethoxyethoxy)ethanol*; "Carbitol"	$C_2H_5OCH_2CH_2OCH_2CH_2OH$	134.17
3238	——, monoethyl ether acetate		$C_2H_5O(CH_2)_2O(CH_2)_2OOCCH_3$	176.21
3238M	——, monolaurate	"Glaurin"	$C_{11}H_{23}COOC_2H_4–OC_2H_4OH$	288.42
3239	——, monomethyl ether	2-(β-methoxyethoxy)ethanol*; methyl "Carbitol"	$CH_3OCH_2CH_2OCH_2CH_2OH$	120.15
3240	**Diethylene oxide 2-iminoethyl alcohol.** See *4-Morpholinëthanol.*			
3240M	**Diethylenetriamine**	2,2′-diaminodiethylamine	$(NH_2C_2H_4)_2NH$	103.17
3241	**Diethylenimide oxide.**	See *Morpholine.*		
3242	**Diethyl ether.**	See *Ethyl ether.*		
3242H	**Diethyl formal.**	See *Methane, diethoxy-.*		
3242R	**Diethylolamine.**	See *Diethanolamine.*		
3243	**Diethylphosphoric acid**	diethyl hydrogen phosphate	$PO(OC_2H_5)_2OH$	154.11
3244	**Diethyl sulfate.**	See *Ethyl sulfate.*		
3245	**Diethyl sulfite.**	See *Ethyl sulfite.*		
3246	**Difurfurylamine**	α,α′-di-2-furyldimethylamine	$(C_4H_3OCH_2)_2NH$	177.20
3247	***m*-Digallic acid**	gallic acid 3-monogallate	$C_{14}H_{10}O_9$	322.22
3249	**Diglycolamidic acid.**	See *Acetic acid, iminodi-.*		
3250	**Diglycolic acid**	oxydiethanoic acid*; oxydiacetic acid	$O(CH_2COOH)_2$	134.09
3251	**Diglycolide.**	See *Glycolide.*		
3252	**Diglycolyl diamide.**	See *Glycine anhydride.*		
3253	**Diguanide.**	See *Biguanide.*		
3254	**Di-*n*-heptyl sulfate.**	See *Heptyl sulfate.*		
3255	**Di-*n*-hexadecyl sulfate.**	See *Cetyl sulfate.*		
3256	**Dihexyl.**	See *Dodecane*.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3216	col. inflam. liq., 1.38730^{18}	$.7108\frac{18}{4}$	−50 (−39)	55.5	81.5^{144}	s.	s. eth.
3217							
3218	leaf. f. et. al...	$1.048\frac{21}{4}$	219–20	330	232^{25}	sl. s. c.	i. eth.
3219							
3219M							
3220							
3221							
3222							
3223							
3224	col. liq........	....	....	63–5	v. s.	s.	s. eth.
3225	liq...........	....	....	206^{757}	sl. s.	∞	∞ eth.
3226	yel. liq., $1.43864^{19.9}$	$0.9422\frac{20}{4}$	....	177 (175.4)	s.	∞	∞ eth.
3227							
3228							
3229							
3230							
3231	col. liq.......	1.132^{0}; 1.1177^{20}	−10.45 (−6.5)	244.5 (245–50)	s.	s.	s. eth.
3232							
3233	pa. yel. liq....	$0.9310\frac{20}{4}$	....	....	dispersible	∞	∞ eth.
3234	wh. wax-like solid	$0.9333\frac{20}{4}$	54–5	....	dispersible	i.	i. eth.
3235	col. liq.......	$0.9553\frac{20}{4}$	....	231.2	∞	v. s.	v. s. eth.
3236	col. liq.......	$0.985\frac{20}{4}$	....	245	......	......	....
3237	col. liq.......	$0.9902\frac{20}{4}$	....	201.9	∞	v. s.	s. eth.
3238	col. liq.......	$1.009\frac{20}{4}$	....	218	∞	......	....
3238M	straw-colored oily liq.	$0.960\frac{25}{25}$	17–18	>270	i.	s.	s. eth.
3239	col. liq., 1.4264^{27}	$1.0354\frac{20}{4}$	....	193.2	∞	......	....
3240							
3240M	col.-yel. liq....	$0.9586\frac{20}{20}$	....	207.1	∞	s.	i. eth.
3241							
3242							
3242 H							
3242 R							
3243	liq...........	1.175	....	203.3	i.	......	....
3244							
3245							
3246	col. liq.......	....	....	$102–3^{1}$	i.	......	s. eth.
3247	need. $(+1H_2O)$ f. al. +w.	....	268–70 d.	....	......	......	....
[illegible]							
3249							
3250	rhomb. or monocl. pr. $(+1H_2O)$ f. w.	....	148	d.	s.	s.	s. eth.
3251							
3252							
3253							
3254							
3255							
3256							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3257	**Di-*n*-hexyl sulfate.**	See *Hexyl sulfate.*		
	Dihydro-. See the parent compounds (e.g., for dihydronaphthalene see *Naphthalene,*			
	Dihydroxy-. See the parent compounds (e.g., for dihydroxyanthraquinone, see			
3258	**Diimide, dinaphthyl-.**	See *Azonaphthalene.*		
3259	**——, diphenyl-.**	See *Azobenzene.*		
3260	**——, dixenyl-.**	See *Azobiphenyl.*		
3261	**——, ethylphenyl-.**	See *Benzeneazoethane.*		
3262	**——, methylphenyl-.**	See *Benzeneazomethane.*		
3263	**——, α-naphthyl-β-naphthyl-.** See 1,2′-*Azonaphthalene.*			
3264	**Diisoamylamine......**	bis (γ-methylbutyl)amine* ...	$[(CH_3)_2CHCH_2-CH_2]_2NH$	157.29
3265	**Diisoamyl sulfate.**	See *Isoamyl sulfate.*		
3266	**Diisoamyl sulfide.**	See *Isoamyl sulfide.*		
3267	**Diisobutylamine......**	bis(β-methylpropyl)amine* ..	$[(CH_3)_2CHCH_2]_2-NH$	129.24
3268	**Diisobutylene.........**	....	$(CH_3)_2C:CHC-(CH_3)_3$	112.21
3269	**Diisobutyl sulfate.**	See *Isobutyl sulfate.*		
3270	**Diisocrotyl.**	See 2,4-*Hexadiene, 2,5-dimethyl-*.*		
3271	**Diisopropylamine*....**	....	$[(CH_3)_2CH]_2NH$...	101.19
3272	**——, *N*-nitroso-.......**	diisopropylnitrosamine; nitrous diisopropylamide	$[(CH_3)_2CH]_2NNO$	130.19
3273	**Diketone, dimethyl.**	See 2,3-*Butanedione*.*		
3274	**——, diphenyl.**	See *Benzil.*		
3275	**α,γ-Dilaurin.**	See *Glycerol, 1,3-dilaurate.*		
	Dimethyl. For dimethyl derivatives see the parent compounds (e.g., for dimethyl-			
3276	**Dimethylamine*......**	....	$(CH_3)_2NH$........	45.08
3277	——, dimethylthiolthionocarbamate. See under *Carbamic acid, dimethylthiolthiono-.*			
3278	——, hydrochloride.........	dimethylammonium chloride*	$(CH_3)_2NH\cdot HCl$...	81.55
3279	**——, α,α′-dicyano-.**	See *Acetonitrile, iminodi-.*		
3280	**——, α,α′-di-2-furyl-.**	See *Difurfurylamine.*		
3281	**——. *N*-nitro-.........**	dimethylnitramine; nitric dimethylamide	$(CH_3)_2NNO_2$......	90.08
3282	**——, *N*-nitroso-.......**	dimethylnitrosamine; nitrous dimethylamide	$(CH_3)_2NNO$......	74.08
3283	**Dimethylarsenic monochloride.** See *Cacodyl chloride.*			
3284	**Dimethylenimine.**	See *Ethylenimine.*		
3284M	**α,α-Dimethylpropyl.**	See *tert-Butyl.*		
3285	**Dimethyl sulfate.**	See *Methyl sulfate.*		
3286	**Dimethyl sulfite.**	See *Methyl sulfite.*		
3287	**1,2,7,8-Dinaphthanthracene.** See *Dibenzanthracene.*			
3288	**α-Dinaphthol.**	See 4,4′-*Bi-1-naphthol.*		
3289	**Dinaphthyl.**	See *Binaphthyl.*		
3290	**Di-2-naphthylamine*.**	....	$C_{10}H_7NHC_{10}H_7$...	269.33
3291	**Dinicotinic acid.......**	3,5-pyridinedicarboxylic acid*	$C_5H_3N(COOH)_2$...	167.12
	Dinitro-. See the parent compounds (e.g., for dinitrobenzene see *Benzene, dinitro-*).			
3292	**Di-*n*-nonyl sulfate.**	See *Nonyl sulfate.*		
3292M	**Dioctadecylamine*(*n*).**	....	$[CH_3(CH_2)_{17}]_2NH$..	521.98
3293	**Di-*n*-octadecyl sulfate.**	See *Octadecyl sulfate.*		
3294	**Di-*n*-octyl sulfate.**	See *Octyl sulfate.*		
3295	**Dionin.**	See *Morphine, ethyl-, hydrochloride.*		
3296	***m*-Dioxane............**	1,3-dioxane; trimethylene glycol methylene ether; trimethylene methylene dioxide	$\underline{OCH_2OCH_2CH_2CH_2}$	88.10

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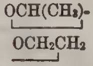
*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3257							
	dihydro-.)						
	Anthraquinone,	*dihydroxy-*; f	or dihydroxy	naphthalene	see *Naph*	*thalenedi*	*ol.)*
3258							
3259							
3260							
3261							
3262							
3263							
3264	col. liq., 1.42289^{21}	$0.7672\frac{21}{4}$	-44	190 (185-8)	sl. s. (i.)	s.	∞ etb
3265							
3266							
3267	col. liq., 1.40934	$0.7450\frac{20}{4}$	-70; frz. -77	139-40	v. sl. s.	s.	s. eth.
3268	col. liq.......	$0.715\frac{15}{4}$	....	102.6	......	......	....
3269							
3270							
3271	col. liq.......	$0.722\frac{22}{0}$	....	83-4	sl. s.	......	....
3272	cr. f. eth.	....	46	194.5	v. sl. s.	v. s.	s. eth., bz.
3273							
3274							
3275							
	benzoic acid see	*Benzoic acid,*	*dimethyl-*).F	or dimethyl	esters of o	rganic ac	ids see the acids.
3276	col. liq. or gas, liq. 1.350^{17}	$0.6804\frac{0}{4}$	-96.0	7.4	v. s.	s.	s. eth.
3277							
3278	need. f. al.....	....	171	....	369^{25}	v. s.	i. eth.; 25.16^{20} chl.
3279							
3280							
3281	....	....	57-8	187	s.	s.	s. eth.
3282	yel. oily liq., 1.43743^{18}	$1.0049\frac{18}{4}$	....	152-3	s.	s.	s. eth.
3283							
3284							
3284M							
3285							
3286							
3287							
3288							
3289							
3290	leaf. f. bz......	....	171	471	i.	sl. s.	s. eth., h. ac a., bz.; blue fluores.
3291	cr..........	....	323	d.	v. sl. s.	......	....
3292							
3292M	col. cr.......	....	73.5-74.5	....	i.	sl. s.	sl. s. eth.
3293							
3294							
3295							
3296	col. liq., 1.41652	$1.03422\frac{20}{4}$	....	105^{755}	∞	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3297	***p*-Dioxane**............	1,4-dioxane; diethylene dioxide; glycol ethylene ether	$OCH_2CH_2OCH_2CH_2$	88.10
3298	**2,5-*p*-Dioxanedione.**	See *Glycolide.*		
3299	**2,5-*p*-Dioxanedione, 3,6-dimethyl-.** See *Lactide.*			
3300	**Dioxindole.**	See *Oxindole, 3-hydroxy-.*		
3301	**1,3-Dioxolane, 2-methyl-**	ethylene ethylidene ether; glycol ethylidene diether...	 $OCH(CH_3)-OCH_2CH_2$	88.10
3302	**α,γ-Dipalmitin.**	See *Glycerol, 1,3-dipalmitate.*		
3303	**Dipentene.**	See *dl-Limonene.*		
3304	**Diphenic acid**.........	2,2′-biphenyldicarboxylic acid; *o,o*′-bibenzoic acid; 1,10-diphenic acid	$(COOH)C_6H_4-C_6H_4COOH$	242.22
3305	——, dimethyl ester........	methyl diphenate...........	$(C_6H_4COOCH_3)_2$..	270.27
3306	——, diphenyl ester........	ethyl diphenate.............	$(C_6H_4COOC_2H_5)_2$..	298.33
3307	**——, 4,4′,5,5′,6,6′-hexahydroxy-,** dilactone. See *Ellagic acid.*			
3308	**——, 3-nitro- (COOH=1)**	*o*-nitrodiphenic acid.........	$COOHC_6H_3NO_2C_6H_4COOH$	287.22
3309	**——, 4-nitro-**.........	*m*-nitrodiphenic acid........	$COOHC_6H_3NO_2-C_6H_4COOH$	287.22
3310	**——, 5-nitro-**.........	*p*-nitrodiphenic acid.........	$COOHC_6H_3NO_2-C_6H_4COOH$	287.22
3311	**Diphenic anhydride**...	....	$(C_6H_4CO)_2O$......	224.20
3312	**Diphenimide**.........	....	$(C_6H_4CO)_2NH$....	223.22
3313	**Diphenine.**	See *Hydrazobenzene,* 4,4′*-diamino-.*		
3314	**Diphenoquinone, 3,3′,5,5′-tetramethoxy-.** See *Cerulignone.*			
3315	**Diphenoyl chloride**....	2,2′-biphenyldicarbonyl chloride	$(C_6H_4COCl)_2$.....	279.12
3316	**Diphenyl.**	See *Biphenyl.*		
	Diphenyl-. For diphenyl derivatives see the parent compounds (e.g., for diphenylmeth			
3317	**Diphenylamine***......	*N*-phenylaniline; anilinobenzene	$(C_6H_5)_2NH$.......	169.22
3318	**——, *N*-acetyl-.**	See *Acetamide, N, N-diphenyl-.*		
3319	**——, *o*-amino-.**	See *o-Phenylenediamine, N-phenyl-.*		
3320	**——, *p*-amino-.**	See *p-Phenylenediamine, N-phenyl-.*		
3321	**——, *N*-benzyl-**.......	*N,N*-diphenylbenzylamine...	$C_6H_5CH_2N(C_6H_5)_2$	259.34
3322	**——, *p,p*′-bisdimethylamino-**	leuco base of Bindschedler green; tetramethyl-4,4′-diaminodiphenylamine	$NH[C_6H_4N(CH_3)_2]_2$	255.35
3322M	**——, *N*-chloroformyl-.**	See *Carbamyl chloride, diphenyl-.*		
3323	**——, 4,4′-diamino-**....	*p,p*′-iminodianiline..........	$NH_2C_6H_4NHC_6H_4NH_2$	199.25
3324	**——, 2,4′-dinitro-***....	....	$NO_2C_6H_4NHC_6H_4NO_2$	259.22
3325	**——, 4,4′-dinitro-***....	....	$NO_2C_6H_4NHC_6H_4NO_2$	259.22
3326	**——, *N*-ethyl-**........	....	$(C_6H_5)_2NC_2H_5$....	197.27
3327	**——, *N*-formyl-.**	See *Formamide, N, N-diphenyl-.*		
3328	**——, hydroxy-.** See *Phenol, anilino-.*			
3329	**——, *N*-methyl-**.......	....	$(C_6H_5)_2NCH_3$.....	183.24
3330	**——, *p*-nitro-**.........	....	$NO_2C_6H_4NHC_6H_5$.	214.22
3331	**——, *N*-nitroso-**.......	diphenylnitrosamine; nitrous diphenylamide	$(C_6H_5)_2NNO$.....	198.22
3332	**——, *p*-nitroso-**.......	....	$NOC_6H_4NHC_6H_5$..	198.22

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3297	col. liq., 1.4232	$1.0353\frac{20}{4}$ $(1.03034\frac{20}{4})$	11.7 (9–13)	101.5	∞	∞	∞ eth., most org. liq.
3298							
3299							
3300							
3301	....	$1.002\frac{0}{4}$	....	82.5	66.7	....	....
3302							
3303							
3304	monocl. leaf. f. w.	....	228-9	subl.	sl. s.	s.	s. eth., most org. solv.
3305	pr. f. me. al...	....	74	....	....	....	....
3306	....	....	42				
3307							
3308	....	....	248–50 d.	....	....	....	....
3309	....	....	268	....	....	....	....
3310	....	....	214–6	....	....	....	....
3311	....	....	219	subl.	i.	....	sl. s. eth.
3312	need.........	....	217.5(219)	....	i.	sl. s.	i. eth.; s. chl.
3313							
3314							
3315	....	....	94 (97)	....	....	....	sl. s. eth.; s.bz.
3316	ane see *Methane*	, *diphenyl-*.)					
3317	col. monocl. leaf.	$1.159\frac{20}{4}$	53	302	0.03^{25}	44 c.	v. s. eth.; 57.5 me. al.; s. bz., lgr.
3318							
3319							
3320							
3321	need.........	....	95 (88.5)	....	v. sl. s.	sl. s. c., s. h.	v. s. eth.
3322	tetr. pl. f. CS_2	....	119	....	v. sl. s.	s.	s. eth.
3322M							
3323	leaf. f. w......	....	158	d.	sl. s.	s.	s. eth.
3324	yelsh.-red need. f. bz.	....	222	....	i.	sl. s.	s. acet., chl., pyr.
3325	yel. need. f. al.	....	216 (214.5)	....	i.	sl. s.	5.66^{22} acet.; s. glac. ac. a.; sl. s. bz.
3326	liq.........	....	....	297	i.	s.	s. eth.
3327							
3328							
3329	col. liq.......	$1.048\frac{20}{4}$	−7.6	293.4	i.	s.	s. eth.
3330	yel. need......	....	132	211.0^{30}	i.	v. s.	v. s. ac. a.
3331	yel. monocl. pl. f. lgr.	....	66.5	....	....	sl. s. c., v. s. h.	s. h. bz.
3332	grn. pl. f. al. or bz.	....	143	....	sl. s.	s. c., v. s. h.	s. eth., bz.; v. s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3332M	**Diphenylamine, 2,2′,4,4′-tetrabromo-**	....	$(C_6H_3Br_2)_2NH$....	484.85
3333	**——, thio-.**	See *Phenothiazine.*		
3334	**Diphenyl carbonate.**	See *Carbonic acid, diphenyl ester.*		
3335	**Diphenylene ketone oxide.**	See *Xanthone.*		
3336	**Diphenylene oxide.**	See *Dibenzofuran.*		
3337	**Diphenylenimine.**	See *Carbazole.*		
3338	**Diphenyline.**	See *2,4′-Biphenyldiamine.*		
3339	**Diphosgene**...........	trichloromethyl chloroformate; superpalite; perchloromethyl formate	$ClCOOCCl_3$.......	197.85
3340	**Dipicolinic acid**.......	2,6-pyridinedicarboxylic acid*; α,α′-dipicolinic acid	$C_5H_3N(COOH)_2 \cdot 1\frac{1}{2}H_2O$	194.14
3341	**Diplumbane, hexaethyl-.**	See *Lead, hexaethyldi-.*		
3342	**Diplumbic hexaethyl.**	See *Lead, hexaethyldi-.*		
3343	**Dipropargyl.**	See *1,5-Hexadiyne*.*		
3344	**Di-2-propenylamine*.**	See *Diallylamine.*		
3345	**Dipropylamine***.......	di-*n*-propylamine...........	$(CH_3CH_2CH_2)_2NH$	101.19
3346	**——, *N*-nitroso-**........	dipropylnitrosamine; nitrous dipropylamide	$(CH_3CH_2CH_2)_2\text{-}NNO$	130.19
3347	**Dipropylene.**	See *2,4-Hexadiene*.*		
3348	**Di-*n*-propyl sulfate.**	See *Propyl sulfate.*		
3349	**Dipyridine.**	See *Nicotyrine.*		
3350	**Dipyridyl.**	See *Bipyridine.*		
3351	**5,10-Dipyrrolo[1,2-*a*,1,2-*d*] pyrazinedione.**	See *Pyrocoll.*		
3353	**Diquinolyl.**	See *Biquinoline.*		
3354	**α,γ-Distearin.**	See *Glycerol, 1,3-distearate.*		
3355	**Disulfide, bis(dibutylthiocarbamyl)**	tetrabutylthiuram disulfide. .	$[(C_4H_9)_2NCS]_2S_2$...	408.73
3356	**——, bis(diethylthiocarbamyl)**	tetraethylthiuram disulfide...	$[(C_2H_5)_2NCS]_2S_2$...	296.52
3357	**——, bis(dimethylthiocarbamyl)**	tetramethylthiuram disulfide.	$[(CH_3)_2NCS]_2S_2$...	240.41
3358	**——, bis(ethylmethylthiocarbamyl)**	diethyldimethylthiuram disulfide	$[(CH_3)C_2H_5NCS]_2\text{-}S_2$	268.47
3359	**——, bis(1-piperidylthiocarbonyl)**	dicyclopentamethylenethiuram disulfide	$(C_5H_{10}NCS)_2S_2$....	320.54
3360	**——, bis(tetrabenzylthiocarbamyl)**	tetrabenzylthiuram disulfide..	$[(C_6H_5CH_2)_2NCS]_2\text{-}S_2$	544.78
3361	**——, diacetyl.**	See *Acetyl disulfide.*		
3362	**——, 2,2′-dibenzothiazyl.**	See *Benzothiazole, 2,2′-dithiobis-(S=1).*		
3363	**——, dibenzoyl.**	See *Benzoyl disulfide.*		
3364	**——, diethyl.**	See *Ethyl disulfide.*		
3365	**——, diisoamyl.**	See *Isoamyl disulfide.*		
3366	**——, dimethyl.**	See *Methyl disulfide.*		
3367	**——, diphenyl.**	See *Phenyl disulfide.*		
3368	**——, diphenylene.**	See *Thianthrene.*		
3369	**Ditaine.**	See *Echitamine.*		
3370	**Ditan.**	See *Methane, diphenyl-.*		
3371	**——, α-methyl-.**	See *Ethane, 1,1-diphenyl-.*		
3372	**Di-*n*-tetradecyl sulfate.**	See *Tetradecyl sulfate.*		
3373	***p*-Dithiane**............	1,4-dithiane; diethylene disulfide; tetrahydro-*p*-dithiin	$SCH_2CH_2SCH_2\text{-}CH_2$	120.22
3374	**1,3,5-Dithiazine, 5,6-dihydro-2,4,6-trimethyl-.**		See *Thialdine.*	
3375	**α,α-Dithienyl.**	See *2,2′-Bithiophene.*		
3376	***p*-Dithiin, tetrahydro-.**	See *Di-p-thiane.*		
3377	**Ditolan azotide.**	See *Amaron.*		
3378	**Di-*o*-tolylamine**.......	....	$(CH_3C_6H_4)_2NH$...	197.27
3379	**Di-*m*-tolylamine**......	....	$(CH_3C_6H_4)_2NH$...	197.27

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3332M	need., silky luster or pr.	....	184	....	i.	sl. s. h.	....
3333							
3334							
3335							
3336							
3337							
3338							
3339	col. liq.......	1.653^{14}_{4}	-57	127.5	i.	v. s.	v. s. eth.
3340	col. need. $(+1\frac{1}{2}H_2O)$ f. w.	....	anh. 226 d.	....	v. sl. s.	v. sl. s.	....
3341							
3342							
3343							
3344							
3345	col. liq., $1.40455^{19.5}$	0.7384^{20}_{4}	-39.6	110.7	s.	s.	∞ eth.
3346	yel. liq.......	0.910^{25}_{4}	....	205	v. sl. s.	∞	∞ eth.
3347							
3348							
3349							
3350							
3351							
3353							
3354							
3355	yel. or. liq	....	....	....	i.	sl. s.	s. eth.
3356	yel. cr........	....	70	....	i.	sl. s.	sl. s. eth.; s. chl.
3357	yel. cr	1.29^{20}_{4}	155–6 (141–5)	....	i.	sl. s.	sl. s. eth.; s. chl.
3358	yel. cr	....	72	....	i.	sl. s.	sl. s. eth.; s. chl.
3359	yel. cr	....	129–30	....	i.	sl. s.	sl. s. eth.; s. chl.
3360	yel. cr	....	132–3	....	i.	sl. s.	sl. s. eth.; s. chl.
3361							
3362							
3363							
3364							
3365							
3366							
3367							
3368							
3369							
3370							
3371							
3372							
3373	wh. monocl. pr. f. eth.	....	112, subl.	200	v. sl. s.	s. h.	s. eth., CS_2
3374							
3375							
3376							
3377							
3378	bl. cr.........	....	52–3	313 4	v. sl. s.	......	....
3379	liq............	....	<–12	320	v. sl. s.	v. s.	v. s. eth

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3380	**Di-*p*-tolylamine**		$(CH_3C_6H_4)_2NH$	197.27
3381	**Diurea.**	See *p-Urazine.*		
3382	**Divinyl.**	See 1,3-*Butadiene*.*		
3383	**Docosane* (*n*)**		$CH_3(CH_2)_{20}CH_3$	310.59
3384	**Docosanoic acid*.**	See *Behenic acid.*		
3385	***cis*-13-Docosenoic acid*.**	See *Erucic acid.*		
3386	***trans*-13-Docosenoic acid*.**	See *Brassidic acid.*		
3387	***n*-Docosoic acid.**	See *Behenic acid.*		
3388	**13-Docosynoic acid*.**	See *Behenolic acid.*		
3389	**Dodecanal*.**	See *Lauraldehyde.*		
3390	**Dodecane***	*n*-dodecane; bihexyl; dihexyl.	$CH_3(CH_2)_{10}CH_3$	170.33
3391	**——, 1-amino-.**	See *Dodecylamine*.*		
3392	**——, 1-bromo-***	dodecyl bromide; lauryl bromide	$CH_3(CH_2)_{10}CH_2Br$	249.24
3393	**Dodecanenitrile*.**	See *Lauronitrile.*		
3394	**Dodecanoic acid*.**	See *Lauric acid.*		
3395	**1-Dodecanol***	*n*-dodecyl alcohol; lauryl alcohol	$CH_3(CH_2)_{11}OH$	186.33
3396	**6-Dodecanol***	amylhexylcarbinol	$CH_3(CH_2)_4CHOH(CH_2)_5CH_3$	186.33
3397	**Dodecanoyl chloride*.**	See *Lauroyl chloride.*		
3398	**1-Dodecene***	α-dodecylene	$C_{12}H_{24}$	168.31
3398M	**Dodecine.**	See *Dodecyne*.*		
3399	***n*-Dodecyl alcohol.**	See 1-*Dodecanol*.*		
3400	**Dodecylamine* (*n*)**	*pri-n*-dodecylamine; 1-aminododecane	$CH_3(CH_2)_{11}NH_2$	185.35
3401	**α-Dodecylene*.**	See 1-*Dodecene*.*		
3402	**Dodecyl sulfate**	di-*n*-dodecyl sulfate	$[CH_3(CH_2)_{11}]_2SO_4$	434.71
3402M	**2-Dodecyne***	decylmethylacetylene	$CH_3C\vdots C(CH_2)_8CH_3$	166.30
3402T	**6-Dodecyne***	6-dodecine; di-*n*-amylacetylene	$C_5H_{11}C\vdots C\cdot C_5H_{11}$	166.30
3403	**Dotriacontane***	*n*-dotriacontane	$CH_3(CH_2)_{30}CH_3$	450.85
3403M	**1-Dotriacontanol***		$n\text{-}C_{32}H_{65}OH$	466.85
3404	**Duboisine.**	See *Hyoscyamine.*		
3405	**Dulcin.**	See *Urea, p-phenetyl-.*		
3406	**Dulcitol**	1,2,3,4,5,6-hexanehexol* (one form); dulcite; melampyrin	$C_6H_8(OH)_6$	182.17
3407	**Durene**	1,2,4,5-tetramethylbenzene	$(CH_3)_4C_6H_2$	134.21
3408	**Durylic acid**	2,4,5-trimethylbenzoic acid; cumylic acid	$(CH_3)_3C_6H_2COOH$	164.20
3409	**Ecgonidine.**	See *dl-Anhydroecgonine.*		
3410	**Ecgonine, benzoyl-**		$C_{16}H_{19}NO_4\cdot 4H_2O$	361.39
3411	**——, benzoylmethyl-.**	See *Cocaine.*		
3412	***l*-Ecgonine**	tropinecarboxylic acid	$C_9H_{15}NO_3\cdot H_2O$	203.24
3412M	——, cinnamate methyl ester.	See *l-Cocaine, cinnamoyl-.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
3380	col. need. f. pet. eth.	....	79	330.5	v. sl. s.	......	....
3381							
3382							
3383	cr. f. al.......	$0.778\frac{44}{4}$	44.4	317.4 (224^{15})	i.	4^{78}	v. s. eth.
3384							
3385							
3386							
3387							
3388							
3389							
3390	col. liq.......	$0.766\frac{0}{4}$; $0.7511\frac{20}{4}$	-12	214.5; 145^{100}	i.	v. s.	v. s. eth.
3391							
3392	liq...........	....	....	$175\text{-}80^{45}$	i.	s.	s. eth.
3393							
3394							
3395	leaf. f. dil. al..	$0.8309\frac{24}{4}$	22.6 (24)	255	i.	s.	s. eth.
3396	cr.............	....	30	119^{9}	......	s.	s. eth.
3397							
3398	col. liq., 1.43002^{20}	0.75836^{20}	-31.5	213.357	i.	v. s.	v. s. eth.
3398M							
3399							
3400	col. cr.........	....	27-8	259.1; 93.5^{2}	sl. s.	s.	s. eth.
3401							
3402	....	....	48.4-8.5	....	......	......	....
3402M	liq............	$0.792\frac{15}{4}$	-9	105^{15}	......	......	....
3402 T	col. liq., 1.4374^{25}	0.7816^{25}	....	100^{14}; 115^{30}	i.	s.	s. eth.
3403	cr. pl. f. eth...	$0.775^{79.4}$	74-5 (70)	310^{15}	......	v. sl. s. c.	s. h. eth., h. ac. a.
3403M	....	....	89.3-89.5	....	......	......	....
3404							
3405							
3406	col. monocl. pr.	$1.466\frac{15}{4}$	188	$295^{3.5}$	3.2^{15}	0.0734^{15}	v. sl. s. eth.
3407	col. monocl. leaf., β 1.615	liq. $0.838\frac{81}{4}$	80 (78-9)	193-5 subl.	i.	s.	s. eth., bz.; v. s. ac. a.
3408	col. need. f. bz.	....	149.5	....	v. sl. s. h.	v. s.	v. s. eth.; s. bz.
3409							
3410	lust. need. f. w.	....	90.2; anh. 193-5	....	sl. s. c., s. h.	s.	i. eth.; s. dil. a., alk.
3411							
3412	col. monocl. pr. f. al.	$1.370\frac{12}{4}$; $0.777\frac{87}{4}$	198; anh. 205	....	21.7^{17}	1.5	v. sl. s. eth.
3412M							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3413	***l*-Ecgonine**, hydrochloride		$C_9H_{15}NO_3\ HCl$	221.68
3414	**Echitamine**	ditaine	$C_{22}H_{28}N_2O_4 \cdot 4H_2O$	456.53
3415	**Echitin**		$C_{32}H_{52}O_2$	468.74
3416	**Eglantine.**	See *α-Toluic acid, isobutyl ester.*		
3417	**Eicosane***	*n*-eicosane	$CH_3(CH_2)_{18}CH_3$	282.54
3418	**Eicosanoic acid***	See *Arachidic acid.*		
3419	**1-Eicosanol***	*pri-n*-eicosyl alcohol; arachic alcohol	$CH_3(CH_2)_{18}CH_2OH$	298.54
3420	***n*-Eicosoic acid.**	See *Arachidic acid.*		
3421	***pri-n*-Eicosyl alcohol.**	See 1-*Eicosanol*.*		
3422	**Eikonogen.**	See 2-*Naphthol-6-sulfonic acid, 1-amino-, sodium salt.*		
3423	**Elaidic acid**	*trans*-9-octadecenoic acid*	$C_8H_{17}CH{:}CH(CH_2)_7COOH$	282.46
3424	——, dibromide	θ, ι-dibromostearic acid (one form)	$C_{17}H_{33}Br_2COOH$	442.29
3425	——, ethyl ester		$C_{17}H_{33}COOC_2H_5$	310.51
3426	——, methyl ester		$C_{17}H_{33}COOCH_3$	296.48
3427	***β*-Elaterin**		$C_{20}H_{28}O_5$	348.43
3428	**Eleomargaric acid**	9,13-octadecadienoic acid* (?)	$C_{17}H_{31}COOH$	280.44
3429	***α*-Eleostearic acid**	*cis*-9,11,13-octadecatrienoic acid(?)	$C_{17}H_{29}COOH$	278.42
3430	***β*-Eleostearic acid**	*trans*-9,11,13-octadecatrienoic acid(?)	$C_{17}H_{29}COOH$	278.42
3431	**Ellagic acid**	4,4′,5,5′,6,6′-hexahydroxydiphenic acid dilactone	$C_{14}H_6O_8 \cdot 2H_2O$	338.22
3432	**Emetine** (*l*)		$C_{29}H_{40}N_2O_4$	480.63
3433	——, hydrochloride (*d*)		$C_{29}H_{40}N_2O_4 \cdot 2HCl \cdot 7H_2O$	679.67
3434	**Emodin**	1,3,8-trihydroxy-6-methylanthraquinone; rheum emodin; frangula emodin	$CH_3C_{14}H_4O_2(OH)_3$	270.23
3435	**Enanthaldehyde**	heptanal*; enanthal; heptyl aldehyde; enanthole; *n*-heptaldehyde	$CH_3(CH_2)_5CHO$	114.18
3436	——, oxime	heptanal oxime*; enanthaldoxime; *n*-heptaldoxime	$CH_3(CH_2)_5CH{:}NOH$	129.20
3437	**Enanthic acid**	heptanoic acid*; enanthylic acid; oenanthic acid; *n*-heptoic acid; *n*-heptylic acid	$CH_3(CH_2)_5COOH$	130.18
3438	——, ethyl ester	ethyl heptanoate*	$CH_3(CH_2)_5COOC_2H_5$	158.24
3439	——, heptyl ester	*n*-heptyl *n*-heptylate	$CH_3(CH_2)_5COOC_7H_{15}$	228.37
3440	——, methyl ester	methyl heptanoate*	$CH_3(CH_2)_5COOCH_3$	144.21
3441	——, *p*-phenylphenacyl ester		$CH_3(CH_2)_5COOCH_2COC_6H_4C_6H_5$	324.40
3442	——, piperazinium salt		$C_4H_{10}N_2 \cdot 2C_6H_{13}COOH$	346.50

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3413	rhomb. or tricl. tab., $[\alpha]-57\ {}^{\circ}_{D}$	....	246	....	s.	sl. s.	....
3414	col. cr., $[\alpha]-28.8^{\circ 15}_{D}$	....	206 d.	....	s.	v. s.	sl. s. eth., bz.; s. chl.
3415	leaf.........	....	170	....	......	0.06^{15} 80%	sl. s. eth.; v. s. chl.
3416							
3417	cr., $1.434^{42.9}$...	$0.778\frac{37}{4}$	38	205^{15}	i.	......	∞ eth.
3418							
3419	wh. waxy mass.	....	71	220^{8}	i.	v. sl. s.	s. h. bz.
3420							
3421							
3422							
3423	col. leaf. f. al..	$0.851\frac{79}{4}$	51.5 (44–5)	288^{100}	i.	s.	s. eth., bz., chl.
3424	....	....	27	....	i.	i.	s. eth.
3425	oil...........	$0.868\frac{18}{4}$	....	$217–8.5^{15}$	i.	s.	s. eth.
3426	liq...........	$0.872\frac{15}{4}$	....	213.5^{15}	i.	s.	s. eth.
3427	hex. pl.......	....	195 (216)	....	i.	s.	sl. s. eth., bz.; s. chl.
3428	rhomb. pl....	....	48	....	......	s.	s. eth.
3429	leaf. or need. f. al.	....	48–9	235^{12} sl. d.	i.	s.	v. s. eth., CS_2; s. h. ac. a.
3430	pl. or need. f. al.	....	72	....	i.	sl. s.	s. warm glac. ac. a.
3431	yel. cr........	$1.667\frac{18}{4}$	d.	....	v. sl. s. h.	sl. s.	i. eth.
3432	amor.........	....	68 (74)	....	v. sl. s.	v. s.	v. s. eth.; s. chl.; sl. s. bz.
3433	need. f. h. w...	....	235–55	....	13.1^{18}	s.	i. eth.
3434	or -red monocl. need. f. ac. a.	....	253 (250)	subl.	i.	s.	s. glac. ac. a.; i. amyl al., alk. sols.
3435	col. liq., 1.4131	$0.850\frac{20}{4}$	–45	155	sl. s.	s.	∞ eth.
3436	large pl. f. al., $1.421^{83.9}$	$0.8583\frac{20}{4}$; $0.834\frac{83}{4}$	55.5	195	v. sl. s.	s.	s. eth.
3437	col. oily liq., $1.42162^{19.8}$	$0.9127\frac{25}{4}$	–10	223.5 $(108–110^{9})$	0.241^{15}	s.	s. eth.
3438	col. liq., 1.41296^{20}	$0.8685\frac{20}{4}$	....	188	i.	s.	∞ eth.
3439	col. liq.......	$0.865\frac{19}{4}$	....	$273–4^{754}$ $(137–40^{10})$	i.	s.	s. eth.
3440	liq., 1.4114....	$0.881\frac{15}{5}$	....	172.1 (174–6)	......	......	....
3441	....	....	62	....	......	......	....
3442	wh. cr........	....	95–6	....	s.	s.	i. eth.; s. h acet.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3443	**Enanthic anhydride**	heptanoic anhydride*	$[CH_3(CH_2)_5CO]_2O$	242.35
3444	**Enanthole.**	See *Enanthaldehyde.*		
3445	**Enanthone.**	See 7-*Tridecanone*.*		
3446	**Enanthylic acid.**	See *Enanthic acid.*		
3447	**Enanthylidene.**	See 1-*Heptyne*.*		
3448	**Enneamethylene glycol.**	See 1,9-*Nonanediol*.*		
3449	**Eosin**	2,4,5,7-tetrabromofluorescein	$C_{20}H_8Br_4O_5$	647.93
3450	——, (dye)	alkali salt of eosin	$C_{20}H_6Br_4Na_2O_5$	691.91
3451	**Ephedrine**	2-methylamino-1-phenyl-1-propanol (one form)	$C_6H_5CHOHCH(NHCH_3)CH_3\cdot H_2O$	183.25
3452	——, hydrochloride (*l*)		$C_{10}H_{15}NO\cdot HCl$	201.69
3453	——, sulfate		$(C_{10}H_{15}NO)_2\cdot H_2SO_4$	428.54
3454	**Epichlorohydrin**	α-epichlorohydrin; 1-chloro-2,3-epoxypropane; γ-chloropropylene oxide; (chloromethyl)oxirane	$\underbracket{OCH_2CH}CH_2Cl$	92.53
3455	**Epicyanohydrin**	β, γ-epoxybutyronitrile; γ-cyanopropylene oxide; oxiraneacetonitrile	OCH_2CHCH_2CN	83.09
3456	**α-Epidibromohydrin.**	See *Propene, 2,3-dibromo-*.*		
3457	**α-Epidichlorohydrin.**	See *Propene, 2,3-dichloro-*.*		
3458	**Epihydric alcohol.**	See *Glycidol.*		
3459	**Epiiodohydrin**	α-epiiodohydrin; 1,2-epoxy-3-iodopropane; γ-iodopropylene oxide; (iodomethyl)oxirane	$\underbracket{OCH_2CH}CH_2I$	183.99
3460	**Epinephrine.**	See *Adrenaline.*		
3461	**Ergosterol**	ergosterin	$C_{28}H_{44}O$	396.64
3461M	——, irradiated.	See *Calciferol.*		
3462	**Ergotinine** (amorphous).	See *Ergotoxine.*		
3463	*d*-**Ergotinine**		$C_{35}H_{39}N_5O_5$	609.71
3464	**Ergotoxine**	ergotinine (amorphous)	$C_{35}H_{41}N_5O_6$	627.72
3465	**Erucic acid** (*cis*)	*cis*-13-docosenoic acid*	$CH_3(CH_2)_7CH{:}CH(CH_2)_{11}COOH$	338.56
3466	*trans*-**Erucic acid.**	See *Brassidic acid.*		
3467	**Erythrene.**	See 1,3-*Butadiene*.*		
3468	*i*-**Erythritol**	*anti*-1,2,3,4-butanetetrol*; ordinary erythrite; erythrol; erythroglucin; phycitol	$(CH_2OHCHOH)_2$	122.12
3469	——, anhydride	1,2,3,4-diepoxybutane* (one form); bioxirane	$\underbracket{OCH_2CH}\underbracket{CHCH_2O}$	86.09
3470	——, tetranitrate	erythrol tetranitrate; nitroerythrite	$(CHNO_3CH_2NO_3)_2$	302.12
3471	**Erythroglucin.**	See *i-Erythritol.*		
3472	**Erythrohydroxyanthraquinone.**	See *Anthraquinone, 1-hydroxy-.*		
3472M	**Erythrol**	3-butene-1,2-diol	$CH_2{:}CHCHOH\text{-}CH_2OH$	88.10
3473	**Erythrol.**	See *i-Erythritol.*		
3473M	**Erythrose**		$C_4H_8O_4$	120.10

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3443	liq., 1.4312....	$0.932\frac{20}{4}$	17	258 (170–3^{15})	i.	s.	s. eth.
3444							
3445							
3446							
3447							
3448							
3449	red monocl. need.	....	....	....	i.	s.	s. ac. a., alk.
3450	red-br. powd..	....	....	....	s.	s.	....
3451	col. cr. f. eth..	....	43 (40)	255 d.	s.	s.	s. eth., chl.
3452	wh. need......	....	216 d.	....	s.	s.	i. eth.
3453	wh. cr........	....	....	....	s.	s. h.	....
3454	col. liq., $1.44195^{11.55}$	$1.203\frac{0}{4}$; $1.1801\frac{20}{4}$	–25.6	117	i.	∞	∞ eth.
3455	pr...........	....	162	....	s. h.	s.	....
3456							
3457							
3458							
3459	liq...........	$2.03\frac{13}{4}$	....	160–80	i.	s.	s. eth.
3460							
3461	cr............	....	160–3	....	i.	s.	s. eth.
3461M							
3462							
3463	lng. need. f. al., sol. fluores. vlt., [α] 335°D in al.	....	229	....	i.	0.5^{20}	s. eth., chl., bz., acet.
3464	wh. amor. powd.	....	162–4	....	v. sl. s.	s. h.	sl. s. eth.; s. NaOH
3465	col. need. f. al.	$0.860\frac{55}{4}$	33.5 (31–2)	281^{30}	i.	173	v. s. eth.; 163^{21} me. al.
3466							
3467							
3468	wh. tetr. pr., 1.544, 1.521	$1.451\frac{20}{4}$	119–20 (126)	331	61.5	sl. s.	i. eth.
3469	col. liq......	$1.113\frac{18}{4}$	....	138	∞ d.	......	....
3470	leaf. f. al......	....	61	exp. by percussion	i.	s.	s. eth.
3471							
3472							
3472M	....	....	....	$94–95^{12}$	......	......	....
3473							
3473M	col. syrup; D–, [α] D –14.5, L+–, [α] D +21.5	....	....	....	v. s.	v. s.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3474	**Erythrosin**	2,4,5,7-tetraiodofluorescein	$C_{20}H_8I_4O_5$	835.94
3475	**Erythrosin** (dye)	alkali salt of erythrosin; iodeosin B	$C_{20}H_6I_4Na_2O_5$	879.92
3476	**Esculetin**	6,7-dihydroxycoumarin; aesculetin	$(HO)_2\text{-}\underbrace{C_6H_2OCOCH:CH}$	178.14
3477	**Esculin**	aesculin	$C_{15}H_{16}O_9 \cdot \frac{1}{2}H_2O$	349.29
3478	**Eserine.**	See *Physostigmine.*		
3479	**Estragole**	estragol; *p*-allylanisole; chavicol methyl ether	$CH_2:CHCH_2C_6H_4\text{-}OCH_3$	148.20
3480	**Ethal.**	See *Cetyl alcohol.*		
3481	**Ethanal*.**	See *Acetaldehyde.*		
3482	**——, hydroxy-*.**	See *Glycolaldehyde.*		
3483	**——, trichloro-*.**	See *Chloral.*		
3484	**Ethanamide*.**	See *Acetamide.*		
3485	**——, 2-cyano-2-nitro-*.**	See *Fulminuric acid.*		
3486	**——, 2-hydroxy-*.**	See *Glycolamide.*		
3487	**Ethanamidine*.**	See *Acetamidine.*		
3488	**Ethane***	bimethyl; methylmethane; dimethyl	CH_3CH_3	30.07
3489	**——, amino-.**	See *Ethylamine*.*		
3490	**——, 1-amino-1-phenyl-.**	See *Benzylamine, α-methyl-.*		
3491	**——, 1-amino-2-phenyl-.**	See *Phenethylamine.*		
3492	**——, arsino-.**	See *Arsine, ethyl-.*		
3493	**——, 1,2-bisphenylsulfonyl-***	ethylenebisphenylsulfone	$(CH_2SO_2C_6H_5)_2$	310.37
3494	**——, bromo-*.**	See *Ethyl bromide.*		
3495	**——, 1-bromo-2-chloro-***	ethylene chlorobromide	CH_2ClCH_2Br	143.43
3496	**——, 1-bromo-2-ethoxy-*.**	See *Ether, β-bromoethyl ethyl.*		
3497	**——, 1-bromo-1-phenyl-.**	See *Benzene, (α-bromoethyl)-.*		
3498	**——, chloro-*.**	See *Ethyl chloride.*		
3499	**——, 1-chloro-2-(β-chloroethoxy)-*.**	See *Ether, bis-β-chloroethyl.*		
3500	**——, 1-chloro-2-(β-chloroethylthio)-*.**	See *Sulfide, β, β'-dichloroethyl.*		
3501	**——, 1-chloro-1-ethoxy-*.**	See *Ether, α-chloroethyl ethyl.*		
3502	**——, 1-chloro-2-ethoxy-*.**	See *Ether, β-chloroethyl ethyl.*		
3502M	**——, 1-chloro-1,1,-2,2,2-pentafluoro-***		$CClF_2CF_3$	154.48
3503	**——, *sym*-diacetyl-.**	See *2,5-Hexanedione*.*		
3504	**——, 4,4′-diamino-*sym*-diphenyl-.**	See *α, α-Bi-p-toluidine.*		
3505	**——, 1,1-dibromo-***	ethylidene bromide; ethylidene dibromide	CH_3CHBr_2	187.88
3506	**——, 1,2-dibromo-*.**	See *Ethylene bromide.*		
3507	**——, 1,1-dichloro-***	ethylidene chloride; ethylidene dichloride	CH_3CHCl_2	98.97
3508	**——, 1,1-dichloro-2,2-diethoxy-*.**	See *Acetal, dichloro-.*		
3509	**——, 1,2-dichloro-*.**	See *Ethylene chloride.*		
3510	**——, 1,2-dichloro-1-ethoxy-*.**	See *Ether, α, β-dichloroethyl.*		
3510R	**——, 1,1-dichloro-1,-2,2,2-tetrafluoro-***		CCl_2FCF_3	170.93
3511	**——, 1,2-dichloro-1,1,2,2-tetrafluoro-***		$CClF_2CClF_2$	170.93
3512	**——, 1,1-diethoxy-*.**	See *Acetal.*		
3512I	**——, 1,1-difluoro-***	ethylidene fluoride	CH_3CHF_2	66.05
3512M	**——, 1,2-difluoro-*.**	See *Ethylene fluoride.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
3474	or. cr. f. eth. . .	. . . .	. . . .	. . . .	i.	s.	v. sl. s. eth.; i. bz.
3475	red-br. powd .				s.	s.	
3476	need	. . . .	270 d.	. . . .	sl. s. c.	s.	v. sl. s. eth.; s. dil. alk.
3477	wh. need., $[\alpha]$ $-14.6^{\circ 18}_{D}$ in me. al.	. . . .	160 d.; anh. 205	d. 230	0.16 c., 8 h.	4.58^{78}	v. sl. s. eth.; s. h. chl., ac. a., alk.
3478							
3479	oil, $1.5230^{17.5}_{D}$	0.9645^{21}_{4}	. . . .	215	i.	s.	s. eth.
3480							
3481							
3482							
3483							
3484							
3485							
3486							
3487							
3488	col. gas.	1.357^{0} g/l; 0.561^{-100}	−172	−88.3	4.7^{20} cm³	46^{4} cm³	. . . .
3489							
3490							
3491							
3492							
3493	need. or leaf. f. al.	. . . .	180	. . . .	sl. s. h.	sl. s. h.	s. glac. ac. a., bz.
3494							
3495	col. liq.	1.689^{19}_{4}	−16.6	107–8	0.688^{30}	∞	∞ eth.
3496							
3497							
3498							
3499							
3500							
3501							
3502							
3502M	col. gas.	. . . .	. . . .	−38	i.	s.	s. eth.
3503							
3504							
3505	liq., 1.51277. . .	$2.089^{20.5}_{4}$	. . . .	110 (108–10)	i.	v. s.	v. s. eth.
3506							
3507	col. liq., 1.41655	1.174^{20}_{4}	−96.7	57.3	0.55^{20}	v. s.	v. s. eth.
3508							
3509							
3510							
3510 R	col. gas.	. . . .	. . . .	−2	i.	s.	s. eth.
3511	col. gas, 1.3092^{0}	1.5312^{0}	. . . .	3.8	i.	s.	s. eth.
3512							
3512 L	col. gas.	. . . .	. . . .	−24.7	. . . . . .	. . . . . .	. . . .
3512M							

No.	Name	Synonyms	Formula	Mol. Wt.
3513	**Ethane, 1,1-diiodo-***	*uns*-diiodoethane; ethylidene iodide; ethylidene diiodide	CH_3CHI_2	281.89
3514	**——, 1,2-diiodo-*.**	See *Ethylene iodide.*		
3515	**——, 1,1-dimethoxy-***	acetaldehyde dimethyl acetal; dimethyl acetal; ethylidene dimethyl ether	$CH_3CH(OCH_3)_2$	90.12
3516	**——, 1,1-dinitro-***	*uns*-dinitroethane	$CH_3CH(NO_2)_2$	120.07
3517	**——, 1,2-diphenoxy-***	glycol diphenyl ether; ethylene diphenyl ether	$(CH_2OC_6H_5)_2$	214.25
3518	**——, 1,1-diphenyl-**	*uns*-diphenylethane; α-methylditan	$(C_6H_5)_2CHCH_3$	182.25
3519	**——, 1,2**(or *sym*)**-diphenyl-.**	See *Bibenzyl.*		
3520	**——, 1,2-epoxy-*.**	See *Ethylene oxide.*		
3521	**——, ethenyloxy-*.**	See *Ether, ethyl vinyl.*		
3522	**——, ethoxy-*.**	See *Ethyl ether.*		
3523	**——, 1-ethoxy-2-(β-ethoxyethoxy)-*.**	See *Ether, bis(β-ethoxyethyl).*		
3524	**——, ethyldithio-*.**	See *Ethyl disulfide.*		
3525	**——, ethylsulfinyl-*.**	See *Ethyl sulfoxide.*		
3526	**——, ethylsulfonyl-*.**	See *Ethyl sulfone.*		
3527	**——, ethylthio-*.**	See *Ethyl sulfide.*		
3528	**——, fluoro-*.**	See *Ethyl fluoride.*		
3529	**——, hexabromo-***	perbromoethane	CBr_3CBr_3	503.52
3530	**——, hexachloro-***	perchloroethane; carbon hexachloride	CCl_3CCl_3	236.76
3530M	**——, hexafluoro-***	perfluoroethane; carbon hexafluoride	CF_3CF_3	138.02
3531	**——, hexamethyl-.**	See *Butane, 2,2,3,3-tetramethyl-*.*		
3532	**——, hexaphenyl-**		$(C_6H_5)_3C\text{-}C(C_6H_5)_3$	486.62
3533	**——, iodo-*.**	See *Ethyl iodide.*		
3534	**——, methoxy-*.**	See *Ether, ethyl methyl.*		
3535	**——, methylthio-*.**	See *Sulfide, ethyl methyl.*		
3536	**——, naphthyl-.**	See *Naphthalene, ethyl-.*		
3537	**——, nitro-**		$C_2H_5NO_2$	75.07
3538	**——, pentabromo-***		$CHBr_2CBr_3$	424.61
3539	**——, pentachloro-***		$CHCl_2CCl_3$	202.31
3539M	**——, pentachlorofluoro-***		CCl_3CCl_2F	220.31
3540	**——, pentachloro(pentachloroethoxy)-*.**	See *Ether, bis(pentachloroethyl).*		
3541	**——, pentaiodo-***		CHI_2CI_3	659.63
3542	**——, perbromo-.**	See *Ethane, hexabromo-*.*		
3543	**——, perchloro-.**	See *Ethane, hexachloro-*.*		
3543M	**——, perfluoro-.**	See *Ethane, hexafluoro-*.*		
3544	**——, phenyl-.**	See *Benzene, ethyl-.*		
3545	**——, phosphino-.**	See *Phosphine, ethyl-.*		
3546	**——, 1,1,1,2-tetrabromo-***	*uns*-tetrabromoethane	CH_2BrCBr_3	345.70
3547	**——, 1,1,2,2-tetrabromo-***	*sym*-tetrabromoethane; acetylene tetrabromide	$CHBr_2CHBr_2$	345.70
3548	**——, 1,1,1,2-tetrachloro-***	*uns*-tetrachloroethane	CH_2ClCCl_3	167.86

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3513	liq.	2.84^{0}_{4}	....	179	i.	v. s.	v. s. eth.
3514							
3515	col. inflam. liq.	0.8476^{25}_{4}	....	64.5	s.	s.	s. eth., chl.
3516	liq.	$1.3503^{23.5}_{23.5}$	....	185–6	sl. s.	s.	s. eth.
3517	col. leaf. f. al.	....	98.5	....	v. sl. s. (i.)	s. h.	v. s. eth.; s. chl.
3518	col. oil, 1.5761	1.006^{21}_{4}; 0.9877^{25}_{4}	....	272 (268–86)	i.	s.	s. eth.
3519							
3520							
3521							
3522							
3523							
3524							
3525							
3526							
3527							
3528							
3529	rhomb. pr., 1.740, 1.847, 1.863	3.823^{20}_{4}	148–9 d.	d. 210	i.	sl. s.	s. CS_2; v. sl. s. al. eth.
3530	col. rhomb. tab. f. al. or eth.	2.091^{20}_{4}	subl. 187	....	i.	v. s.	v. s. eth.
3530M	col. gas	1.85^{-78}	−100.6	−78.2	i.	......	....
3531							
3532	col. cr.	....	145–7 d.	....	i.	v. sl. s.	s. chl.
3533							
3534							
3535							
3536							
3537	w. wh. liq., $1.39007^{24.3}$	1.052^{20}_{20}	<−50; frz. −90	114.8	4.5 cc	∞	∞ eth.; s. chl., dil. alk.
3538	monocl. pr.	3.312^{20}_{4}	57	210^{800} d.	i.	s.	v. s. eth.
3539	liq., $1.50250^{24.0}$	1.709^{0}_{4}; 1.6728^{25}_{4}	−29	162	i.	∞	∞ eth.
3539M	wh. sld	....	101.3	137.9	i.	s.	s. eth.
3540							
3541	col. monocl. pr. f. ac. a.	....	182–4	....	......	s.	s. ac. a., bz.
3542							
3543							
3543M							
3544							
3545							
3546	col. liq., 1.62772	2.875^{20}_{4}	0	$103.5^{13.5}$	......	s.	....
3547	col.-yel. liq., 1.63795	2.9638^{20}_{4}	0.1	151^{54}; d. 239–42	0.0651^{30}	∞	∞ eth., chl., aniline, ac. a.
3548	liq., $1.48162^{23.2}$	1.588^{20}_{4}	....	130.5	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3549	**Ethane, 1,1,2,2-tetrachloro-***	*sym*-tetrachloroethane; acetylene tetrachloride	$CHCl_2CHCl_2$	167.86
3549K	**——, 1,1,1,2-tetrachloro-2,2-difluoro-***		CCl_3CClF_2	203.85
3549P	**——, 1,1,2,2-tetrachloro-1,2-difluoro-***		CCl_2FCCl_2F	203.85
3550	**——, 1,1,1,2-tetraphenyl-**	*uns*-tetraphenylethane; triphenylbenzylmethane; α-benzyltritan	$(C_6H_5)_3CCH_2C_6H_5$	334.44
3551	**——, 1,1,2,2-tetraphenyl-**	*sym*-tetraphenylethane	$(C_6H_5)_2CHCH(C_6H_5)_2$	334.44
3552	**——, 1,1,2-tribromo-***	vinyl tribromide	$CH_2BrCHBr_2$	266.79
3553	**——, 1,1,1-trichloro-***	methylchloroform	CH_3CCl_3	133.42
3554	**——, 1,1,1-trichloro-2,2-diethoxy-***	chloral diethyl acetal; trichloroacetal	$CCl_3CH(OC_2H_5)_2$	221.52
3555	**——, 1,1,2-trichloro-***	vinyl trichloride	$CH_2ClCHCl_2$	133.42
3555R	**——, 1,1,1-trichloro-2,2,2-trifluoro-***		CCl_3CF_3	187.39
3556	**——, 1,1,2-trichloro-1,2,2-trifluoro-**		$C_2Cl_3F_3$	187.39
3557	**——, 1,1,1-triethoxy-*.**	See *Orthoacetic acid, triethyl ester.*		
3557M	**——, 1,1,1-trifluoro-***	methylfluoroform	CH_3CF_3	84.04
3558	**——, 1,1,1-triiodo-***	methyliodoform	CH_3CI_3	407.80
3559	**——, 1,1,1-triphenyl-**	α-methyltritan	$(C_6H_5)_3CCH_3$	258.35
3560	**——, 1,1,2-triphenyl-**		$(C_6H_5)_2CHCH_2C_6H_5$	258.35
3561	**Ethaneazobenzene.**	See *Benzeneazoethane.*		
3561M	**Ethaneboronic acid.**	See *Boric acid, ethyl-.*		
3562	**Ethanedial*.**	See *Glyoxal.*		
3563	**Ethanediamide*.**	See *Oxamide.*		
3564	**1,2-Ethanediamine*.**	See *Ethylenediamine.*		
3565	**1,1-Ethanedicarboxylic acid, 1-hydroxy-2-phenyl-.**	See *Tartronic acid,*		
3566	**Ethanedinitrile*.**	See *Cyanogen.*		
3567	**Ethanedioic acid*.**	See *Oxalic acid.*		
3568	**1,1-Ethanediol, 2,2,2-tribromo-*.**	See *Bromal, hydrate.*		
3569	**——, 2,2,2-trichloro-*.**	See *Chloral, hydrate.*		
3570	**1,2-Ethanediol*.**	See *Glycol.*		
3571	**——, 1,2-dicyclohexyl-**	dodecahydrohydrobenzoin; cyclohexanone pinacol	$C_{12}H_{22}O_2$	198.30
3572	**——, 1,2-diphenyl-.**	See *Hydrobenzoin; Isohydrobenzoin.*		
3573	**——, 1,1,2,2-tetraphenyl-*.**	See *Benzopinacol.*		
3574	**Ethanedioyl chloride*.**	See *Oxalyl chloride.*		
3575	**1,2-Ethanedisulfonic acid***	ethylenedisulfonic acid	$C_2H_4(SO_3H)_2$	190.19
3576	**1,2-Ethanedithiol***	dithioglycol; ethylene mercaptan; ethylene dimercaptan	$HSCH_2CH_2SH$	94.19
3577	**Ethanenitrile*.**	See *Acetonitrile.*		
3578	**——, 2-oxo-2-phenyl-.**	See *Benzoyl cyanide.*		
3579	**Ethanesulfinic acid***	ethylsulfinic acid	$C_2H_5SO_2H$	94.13
3580	**Ethanesulfonic acid***	ethylsulfonic acid	$C_2H_5SO_2OH$	110.13
3581	**——, 2-amino-.**	See *Taurine.*		
3582	**——, 2-hydroxy-.**	See *Isethionic acid.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3549	col. liq., 1.4942	1.600^{20}_{4}	–43.8 (–36)	146.3	i.	∞	∞ eth.
3549 K	col. sld.......	....	40.6	91.5	i.	s.	s. eth.
3549 P	col. liq., 1.41297^{25}	1.64470^{25}	24.65	92.8	i.	s.	s. eth.
3550	col. monocl. f. eth.	....	144	$277–80^{21}$	i.	sl. s.	sl. s. eth.
3551	col. rhomb. need. f. chl.	1.182^{20}_{4}	211 (209)	383	......	0.76^{78}	14 bz.; s. ac. a
3552	liq., 1.58902...	2.579^{20}_{4}	–26	188.4	......	s.	....
3553	col. liq., $1.43765^{21.6}$	1.3249^{26}_{4}	....	74.1	i.	∞	∞ eth.
3554	liq...........	1.266^{15}_{4}	....	197	0.5	∞	∞ eth., glyc.
3555	col. liq., 1.4711	1.443^{20}_{4}	–36.7	113.5	i.	∞	∞ eth.
3555 R	col. gas.......	1.5702	13.2	45.8	i.	s.	s. eth.
3556	col. liq., 1.35572^{25}	1.56354^{25}	–36.4	47.7	i.	s.	s. eth.; ∞ bz.
3557							
3557M	col. gas.......	3.784 g/1	–107	–46.8	......	......	....
3558	yel. octahdr...	....	95 d.	....	......	sl. s.	v. s. eth., CS_2, bz.; sl. s. lgr.
3559	need. f. al. or eth.	....	95	....	i.	sl. s. c., s. h.	v. s. eth.
3560	monocl. leaf. f. dil. al.	....	54–4.5	$348–9^{751}$	i.	v. s.	v. s. eth.
3561							
3561M							
3562							
3563							
3564							
3565	*benzyl-.*						
3566							
3567							
3568							
3569							
3570							
3571	need.........	....	129–30	....	......	......	v. s. bz.; s. pet. eth.
3572							
3573							
3574							
3575	cr. f. ac. a....	....	104	....	v. s.	v. s.	....
3576	liq...........	1.123	....	146	......	s.	v. s. alk.; s. NH_4OH
3577							
3578							
3579	syrup........	....	....	....	......	......	s. alk.
3580	hyg. cr.......	....	....	....	s., deliq.	s.	s. alk.
3581							
3582							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3583	**Ethanesulfonyl chloride***	ethylsulfonyl chloride	$C_2H_5SO_2Cl$	128.58
3584	**1,1,2,2-Ethanetetracarboxylic acid*,** tetraethyl ester	ethyl *sym*-ethanetetracarboxylate	$(COOC_2H_5)_2CH-CH(COOC_2H_5)_2$	318.32
3585	**Ethanethial***, trimer.	See *sym-Trithiane,* 2,4,6-*trimethyl-*.		
3586	**Ethanethiol***	ethyl mercaptan; ethyl hydrosulfide; ethyl thioalcohol	C_2H_5SH	62.13
3587	——, sodium derivative	sodium mercaptide; sodium thioethylate	C_2H_5SNa	84.12
3588	**Ethanethiolic acid*.**	See *Acetic acid, thiol-.*		
3589	**Ethanethionamide*.**	See *Acetamide, thio-.*		
3590	**1,1,1-Ethanetricarboxylic acid***	ethenyltricarboxylic acid	$CH_3C(COOH)_3$	162.10
3591	**1,1,2-Ethanetricarboxylic acid, 1,2-dihydroxy-***	. See *Desoxalic acid.*		
3592	**Ethanoic acid*.**	See *Acetic acid.*		
3593	**——, oxo-*.**	See *Glyoxylic acid.*		
3594	**Ethanoic anhydride*.**	See *Acetic anhydride.*		
3595	**Ethanol*.**	See *Ethyl alcohol.*		
3596	**——, 2-allyl-.**	See 4-*Penten-1-ol**.		
3597	**——, 1-amino-*.**	See *Acetaldehyde-ammonia.*		
3598	**——, 2-amino-***	β-aminoethyl alcohol; ethanolamine; ethylolamine; β-hydroxyethylamine	$NH_2CH_2CH_2OH$	61.08
3599	**——, 2-anilino-**	β-hydroxyethylaniline; ethoxylaniline	$C_6H_5NHCH_2-CH_2OH$	137.18
3600	**——, 2-benzyloxy-**	glycolmonobenzyl ether; benzyl cellosolve	$C_6H_5CH_2OCH_2-CH_2OH$	152.19
3601	**——, 2-bromo-***	β-bromoethyl alcohol; ethylene bromohydrin	CH_2BrCH_2OH	124.98
3602	——, ——, acetate.	β-bromoethyl acetate	$CH_3COOCH_2-CH_2Br$	167.01
3603	**——, 2-butoxy-***	glycol monobutyl ether; butyl cellosolve	$C_4H_9OCH_2CH_2-OH$	118.17
3604	**——, 2-(β-butoxyethoxy)-*.**	See *Diethylene glycol, monobutyl ether.*		
3604M	**——, 2-butylamino-***	*n*-butylethanolamine	$CH_3(CH_2)_3NH-CH_2CH_2OH$	117.19
3605	**——, 2-chloro-***	β-chloroethyl alcohol; ethylene chlorohydrin	CH_2ClCH_2OH	80.52
3606	——, ——, acetate	β-chloroethyl acetate; 2-chloroethyl ethanoate*	$CH_3COOCH_2-CH_2Cl$	122.55
3607	**——, 2,2-dichloro-***	β,β-dichloroethyl alcohol	$CHCl_2CH_2OH$	114.97
3608	**——, 2-diethylamino-***	β-diethylaminoethyl alcohol; 2-hydroxytriethylamine	$(C_2H_5)_2NCH_2-CH_2OH$	117.19
3609	——, ——, *p*-aminobenzoate hydrochloride.	See *Procaine, hydrochloride.*		
3610	**——, 2-dimethylamino-***	β-dimethylaminoethyl alcohol	$(CH_3)_2NCH_2-CH_2OH$	89.14
3611	**——, 1,2-diphenyl-**	benzylphenylcarbinol	$C_6H_5CH_2CHO-HC_6H_5$	198.25
3612	**——, 2-ethoxy-***	glycol monoethyl ether; "Cellosolve"	$C_2H_5OCH_2CH_2-OH$	90.12
3613	——, ——, acetate	β-ethoxyethyl acetate; "Cellosolve" acetate	$CH_3COOCH_2CH_2-OC_2H_5$	132.16
3614	**——, 2-(β-ethoxyethoxy)-.**	See *Diethylene glycol, monoethyl ether.*		
3615	**——, 2-ethylamino-***	β-hydroxydiethylamine	$C_2H_5HNCH_2CH_2-OH$	89.14
3616	**——, 2,2′-ethylenedioxydi-.**	See *Triethylene glycol.*		
3617	**——, 2,2′-ethyliminodi-**	β, β′-dihydroxytriethylamine	$C_2H_5N(CH_2CH_2-OH)_2$	133.19

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3583	liq..........	1.357^{20}_{4}	....	177.5	d.	d.	v. s. eth.
3584	pr...........	....	76 (72–4)	305 d.	......	s.	....
3585							
3586	liq., 1.43055...	0.840	–121 (–147.3)	34.7 (34.5–5.5)	1.5	s.	s. eth., alk.
3587	wh. cr........	....	....	....	s.	s.	....
3588							
3589							
3590	pr...........	....	159 d.	....	s.	s.	s. eth.
3591							
3592							
3593							
3594							
3595							
3596							
3597							
3598	col. liq., 1.4539	1.0180^{20}_{4}	10.5	172.2	∞	∞	0.72 eth.; s. chl.; sl. s. bz., lgr.
3599	col. liq........	1.110^{0}_{4}	....	286	v. sl. s.	s.	s. eth., chl.
3600	col. liq.......	1.068	<–75	256	0.4	......	....
3601	col. liq., 1.4915	1.7720^{20}_{4}	....	150.3	s.	∞	∞ eth.
3602	col. liq.......	1.514^{20}_{4}	–13.8	161.5–4.5	v. s.	∞	∞ eth.
3603	col. liq.......	0.9027^{20}_{4}	....	170.6	∞	∞	∞ eth.
3604							
3604M	1.4437^{20}......	0.8907^{20}_{4}	....	200	s.	s.	s. eth.
3605	col. liq.......	1.213^{20}_{4}	–69	128.8	∞	s.	2.3^{15} eth.
3606	col. liq., 1.4247	1.1783^{0}_{4}	....	145	i.	∞	∞ eth.
3607	liq...........	1.145^{15}_{4}	....	146	sl. s.	s.	s. eth.
3608	col. liq., 1.4400^{25}	0.8601^{25}_{25}; 0.884^{20}_{4}	....	163; $42–4^{8}$	s.	s.	s. eth., bz.
3609							
3610	col. liq., 1.43..	0.8866^{20}_{4}	....	135 (131–4)	∞	∞	∞ eth.
3611	need..........	....	66–8	$167–70^{10}$	v. sl. s.	s.	v. s. eth.
3612	col. liq.......	0.9311^{20}_{4}	....	135.1	∞	∞	∞ eth.
3613	col. liq.......	0.9749^{20}_{4}	....	156.2 (150–60)	22	∞	∞ eth.
3614							
3615	liq., 1.444.....	0.914^{20}_{4}	....	$167–9^{751}$	v. s.	v. s.	v. s. eth.
3616							
3617	yel. liq., 1.4663	1.0135^{20}_{4}	....	$251–2^{750}$	s.	s.	sl. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3617M	**Ethanol, 2-fluoro-***	β-fluoroethyl alcohol; ethylene fluorohydrin	CH_2FCH_2OH	64.06
3618	**——, 2-heptyl-2-methyl-.**	See 1-*Nonanol, 2-methyl-**.		
3619	**——, 2,2′-iminodi-.**	See *Diethanolamine.*		
3619M	**——, 2-isobutylamino-***	isobutylethanolamine	$(CH_3)_2CHCH_2NHCH_2CH_2OH$	117.19
3620	**——, 2-methoxy-***	glycol monomethyl ether; methyl cellosolve	$CH_3OCH_2CH_2OH$	76.09
3621	——, ——, acetate	glycol monomethyl ether acetate; methyl cellosolve acetate	$CH_3COOCH_2CH_2OCH_3$	118.13
3622	**——, 2-(β-methoxyethoxy)-.**	See *Diethylene glycol, monomethyl ether.*		
3623	**——, 2-methylamino-***	β-hydroxy-*N*-methylethylamine	$CH_3HNCH_2CH_2OH$	75.11
3624	**——, 2,2′-methyliminodi-**	β, β′-dihydroxy-*N*-methyldiethylamine	$CH_3N(CH_2CH_2OH)_2$	119.16
3625	**——, 2-methyl-2-propyl-.**	See 1-*Pentanol, 2-methyl-**.		
3626	**——, 2,2′,2″-nitrilotri-**	triethylolamine; 2,2′,2″-trihydroxytriethylamine. See *Triethanolamine*		
3627	**——, 2-nitro-**		$NO_2CH_2CH_2OH$	91.07
3628	**——, 2,2′-oxydi-.**	See *Diethylene glycol.*		
3629	**——, pentamethyl-.**	See 2-*Butanol, 2,3,3-trimethyl-**.		
3629M	**——, 2-phenoxy-**	β-hydroxyethyl phenyl ether; phenyl cellosolve	$C_6H_5OCH_2CH_2OH$	138.16
3630	**——, 1-phenyl-.**	See *Benzyl alcohol, α-methyl-.*		
3631	**——, 2-phenyl-.**	See *Phenethyl alcohol.*		
3632	**——, 2,2′-thiodi-**	thiodiglycol; bis-β-hydroxyethyl sulfide	$S(CH_2CH_2OH)_2$	122.18
3633	**——, 2,2,2-trichloro-***		CCl_3CH_2OH	149.42
3634	**——, 2,2,2-trichloro-1-ethoxy-*.**	See *Chloral, alcoholate.*		
3635	**Ethanolamine.**	See *Ethanol, 2-amino-*.*		
3636	**1-Ethanone, 2-ethoxy-1, 2-diphenyl-.**	See *Benzoin, ethyl ether.*		
3637	**Ethanoyl bromide*.**	See *Acetyl bromide.*		
3638	**Ethanoyl chloride*.**	See *Acetyl chloride.*		
3639	**Ethanoyl fluoride*.**	See *Acetyl fluoride.*		
3640	**Ethanoyl iodide*.**	See *Acetyl iodide.*		
3641	**Ethanoyl peroxide*.**	See *Acetyl peroxide.*		
3642	**Ethene*.**	See *Ethylene.*		
3643	**——, ethenyloxy-*.**	See *Vinyl ether.*		
3644	**——, ethenylthio-*.**	See *Vinyl sulfide.*		
3645	**Ethenol.**	See *Vinyl alcohol.*		
3646	**Ethenone.**	See *Ketene.*		
3647	**Ethenylamine*.**	See *Vinylamine.*		
3648	**Ethenyltricarboxylic acid.**	See 1,1,1-*Ethanetricarboxylic acid**.		
3649	**Ether.**	See *Ethyl ether.*		
3650	**——, allyl cresyl.**	See *Ether, allyl tolyl.*		
3651	**——, allyl ethyl**	3-ethoxypropene*	$C_2H_5OCH_2CH:CH_2$	86.13
3652	**——, allyl isoamyl**	3-methyl-1-(2-propenoxy)-butane*	$CH_2:CHCH_2OCH_2CH_2CH(CH_3)_2$	128.21
3653	**——, allyl methyl**	3-methoxypropene*	$CH_2:CHCH_2OCH_3$	72.10
3654	**——, allyl 2-naphthyl**	2-(2-propenoxy)naphthalene*	$C_{10}H_7OCH_2CH:CH_2$	184.23
3655	**——, allyl phenyl**	2-propenoxybenzene*	$CH_2:CHCH_2OC_6H_5$	134.17
3656	**——, allyl *o*-tolyl**	2-(2-propenoxy)toluene*; allyl *o*-cresyl ether	$CH_2:CHCH_2OC_6H_4CH_3$	148.20
3657	**——, allyl *m*-tolyl**	3-(2-propenoxy)toluene*	$CH_2:CHCH_2OC_6H_4CH_3$	148.20

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3617M	col. liq., $1.36470^{18.4}$	$1.11124^{18.3}$	-26.45	103.35	∞	∞	∞ eth.
3618							
3619							
3619M	1.4402^{20}......	0.8818^{20}_{4}	....	190	s.	s.	s. eth.
3620	col. liq.......	0.9660^{20}_{4}	....	124.3	∞	v. s.	s. eth.
3621	liq...........	1.0054^{20}_{20}	....	143	∞	......	....
3622							
3623	col. liq., 1.4385	0.937^{20}_{4}	....	159^{747}	∞	∞	∞ eth.
3624	liq., 1.4678....	1.0377^{20}_{4}	....	$246–8^{747}$	∞	∞	sl. s. eth.
3625							
3626							
3627	col. liq.......	1.270^{15}_{4}	<-80	193.8	v. s.	v. s.	v. s. eth.
3628							
3629							
3629M	col. liq.......	1.1094^{20}_{20}	....	245.2	2.6	s.	s. eth.
3630							
3631							
3632	col. liq., 1.519.	1.1824^{20}_{4}	-16	168^{14}	∞	∞	sl. s. eth.
3633	rhomb. tab....	1.550^{23}_{4}	17.8	152.2	sl. s.	∞	∞ eth.
3634							
3635							
3636							
3637							
3638							
3639							
3640							
3641							
3642							
3643							
3644							
3645							
3646							
3647							
3648							
3649							
3650							
3651	col. liq., 1.38810	0.765^{20}_{4}	....	67.6	i.	∞	∞ eth.
3652	liq...........	....	....	120	v. sl. s.	∞	∞ eth.
3653	col. liq.......	0.77^{11}_{4}	....	46	v. sl. s.	∞	∞ eth.
3654	oil...........	....	....	d. 210	i.	......	....
3655	col. oil........	0.9856^{15}_{15}	....	$192; 85^{19}$	i.	s.	∞ eth.
3656	oil...........	0.969^{15}_{4}	....	$205–8; 85^{12}$	......	......	....
3657	....	0.965^{15}_{4}	....	211–4; $92–4^{12}$	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3658	**Ether, allyl *p*-tolyl**	4-(2-propenoxy)toluene*	$CH_2:CHCH_2OC_6H_4CH_3$	148.20
3658R	**——, 2-aminodiethyl.**	See *Ethylamine, β-ethoxy-**.		
3659	**——, β-aminoethyl ethyl.**	See *Ethylamine, β-ethoxy-**.		
3660	**——, amyl ethyl**	1-ethoxypentane*	$C_2H_5O(CH_2)_4CH_3$	116.20
3661	**——, amyl methyl.**	See *Pentane, 1-methoxy-**.		
3662	**——, amyl phenyl**	amoxybenzene	$CH_3(CH_2)_4OC_6H_5$	164.24
3663	**——, benzyl butyl**	1-benzyloxybutane	$C_6H_5CH_2O(CH_2)_3CH_3$	164.24
3664	**——, benzyl ethyl**	α-ethoxytoluene	$C_2H_5OCH_2C_6H_5$	136.19
3665	**——, benzyl methyl**	α-methoxytoluene	$C_6H_5CH_2OCH_3$	122.16
3666	**——, benzyl 2-naphthyl**	2-benzyloxynaphthalene*	$C_6H_5CH_2OC_{10}H_7$	234.28
3667	**——, bis-*p*-bromophenyl**	4,4′-dibromodiphenyl ether; 1-bromo-4-(4-bromophenoxy)benzene*	$BrC_6H_4OC_6H_4Br$	328.02
3668	**——, bis-β-chloroethyl**	1-chloro-2-(β-chloroethoxy)ethane*; *sym*-dichloroethyl ether; β, β′-dichlorodiethyl ether	$(ClC_2H_4)_2O$	143.02
3669	**——, bis-β-chloroisopropyl**	1-chloro-2-(β-chloroisopropoxy)propane*; β, β′-dichloroisopropyl ether	$ClCH_2CH(CH_3)OCH(CH_3)CH_2Cl$	171.07
3670	**——, bischloromethyl**	chloro (chloromethoxy)methane*; *sym*-dichlorodimethyl ether	CH_2ClOCH_2Cl	114.97
3671	**——, bis(*p*-chlorophenyl)**	4,4′-dichlorodiphenyl ether	$(ClC_6H_4)_2O$	239.10
3672	**——, bis-β-ethoxyethyl**	1-ethoxy-2-(β-ethoxyethoxy)ethane*; diethylene glycol diethyl ether; diethyl carbitol	$(C_2H_5OCH_2CH_2)_2O$	162.23
3673	**——, bis-*p*-nitrophenyl**	1-nitro-4-(4-nitrophenoxy)benzene*; 4,4′-dinitrodiphenyl ether	$NO_2C_6H_4OC_6H_4NO_2$	260.20
3674	**——, bispentachloroethyl**	pentachloro (pentachloroethoxy)ethane*; perchloroether; decachlorodiethyl ether	$C_2Cl_5OC_2Cl_5$	418.61
3675	**——, β-bromoethyl ethyl**	1-bromo-2-ethoxyethane*; β-bromoethyl ether	$BrCH_2CH_2OC_2H_5$	153.03
3676	**——, bromophenyl methyl.**	See *Anisole, bromo-*.		
3677	**——, butyl cresyl.**	See *Ether, butyl tolyl*.		
3678	**——, butyl ethyl**	1-ethoxybutane*	$(C_2H_5)O(CH_2)_3CH_3$	102.17
3679	**——, *tert*-butyl ethyl**	2-ethoxy-2-methylpropane*	$C_2H_5OC(CH_3)_3$	102.17
3680	**——, butyl 2-furylmethyl**	butyl furfuryl ether	$C_4H_3OCH_2OC_4H_9$	154.20
3681	**——, butyl methyl**	1-methoxybutane*	$CH_3O(CH_2)_3CH_3$	88.15
3682	**——, butyl phenyl**	butoxybenzene*	$CH_3(CH_2)_3OC_6H_5$	150.21
3683	**——, *n*-butyl tetrahydrofurfuryl.**	See *Furan, 2-butoxymethyltetrahydro-*.		
3684	**——, butyl *o*-tolyl**	2-butoxytoluene*; butyl *o*-cresyl ether	$CH_3C_6H_4O(CH_2)_3CH_3$	164.24

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3658	....	0.9728^{15}_{15}	....	214.5; 91^{12}	......	......	....
3658 R							
3659							
3660	liq..........	0.759^{18}_{4}	....	119–20	sl. s.	∞	∞ eth.
3661							
3662	liq..........	....	....	111^{17}	......	......	....
3663	....	0.9310^{10}_{4}	....	$220–1^{744}$	i.	∞	∞ eth.
3664	col. liq.......	0.949^{20}_{4}	....	185	i.	∞	∞ eth.
3665	liq..........	0.987^{20}_{4}	....	174	i.	s.	s. eth.
3666	leaf. f. al......	....	99	....	i.	v. s.	v. s. eth.; s. chl., bz.
3667	leaf. f. al......	....	53–4 (54–6)	338–40	i.	v. s.	∞ eth.; v.s. bz.
3668	liq., 1.457.....	1.222^{20}_{4}	–50	178	1.02	s.	s. eth.
3669	col. liq.......	1.1127	....	187.1 ($93–5^{18}$)	0.19	......	....
3670	col. liq., 1.4346^{20}	1.315^{20}_{4}	....	105	d.	∞	∞ eth.
3671	1.611.........	1.3164^{11}_{4}	....	312–4	i.	......	....
3672	col. liq.......	0.907^{20}_{4}	....	188	∞	......	....
3673	yel. need. f. al.	....	142–3	....	i.	sl. s.	sl. s. eth.; s. ac. a., bz.
3674	tetr. scales....	1.900^{14}_{4}	69	d.	......	......	....
3675	....	1.370^{0}_{4}	....	126–9	sl. s.	∞	∞ eth.
3676							
3677							
3678	col. liq.......	0.752^{20}_{4}	–124	91.4 (90–3)	i.	∞	∞ eth.
3679	liq..........	0.7519^{20}_{4}	....	68–9	i.	s.	s. eth.
3680	col. liq.......	0.955^{20}_{4}	....	$189–90^{765}$	i.	s.	v. s. eth.
3681	col. liq.......	0.764^{0}_{4}; 0.744^{20}_{4}	–115.5	70.3	v. sl. s.	∞	∞ eth.
3682	col. liq., 1.5046^{20}	0.9515^{20}_{4}	....	210.3 ($98–9^{10}$)	......	......	....
3683							
3684	....	0.9437^{0}_{0}	....	223.0	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3685	**Ether, butyl *m*-tolyl**	3-butoxytoluene*	$CH_3C_6H_4OC_4H_9$	164.24
3686	**——, butyl *p*-tolyl**	4-butoxytoluene*	$CH_3C_6H_4OC_4H_9$	164.24
3687	**——, cetyl phenyl**	1-phenoxyhexadecane*	$C_6H_5OCH_2(CH_2)_{14}$-CH_3	318.53
3688	**——, chlorodiethyl.**	See *Ether, chloroethyl ethyl.*		
3689	**——, α-chloroethyl ethyl**	1-chloro-1-ethoxyethane*; α-chlorodiethyl ether	$CH_3CHClOC_2H_5$	108.57
3690	**——, β-chloroethyl ethyl**	1-chloro-2-ethoxyethane*; β-chlorodiethyl ether	$CH_2ClCH_2OC_2H_5$	108.57
3691	**——, chloromethyl methyl**	chloromethoxymethane*	$ClCH_2OCH_3$	80.52
3692	**——, chlorophenyl ethyl.**	See *Phenetole, chloro-.*		
3693	**——, cresyl ethyl.**	See *Ether, ethyl tolyl.*		
3694	**——, cresyl methyl.**	See *Ether, methyl tolyl.*		
3695	**——, cresyl propyl.**	See *Ether, propyl tolyl.*		
3696	**——, decachlorodiethyl.**	See *Ether, bis(pentachloroethyl).*		
3697	**——, diallyl.**	See *Allyl ether.*		
3698	**——, di-*n*-amyl.**	See *Amyl ether.*		
3699	**——, dibenzyl.**	See *Benzyl ether.*		
3700	**——, 4,4′-dibromodiphenyl.**	See *Ether, bis-p-bromophenyl.*		
3701	**——, dibutyl.**	See *Butyl ether.*		
3702	**——, dicetyl.**	See *Cetyl ether.*		
3703	**——, dichloro-.**	See *Ether, α, β-dichloroethyl ethyl.*		
3704	**——, β,β′-dichlorodiethyl.**	See *Ether, bis-β-chloroethyl.*		
3704M	**——, *sym*-dichlorodimethyl.**	See *Ether, bischloromethyl.*		
3705	**——, 4,4′-dichlorodiphenyl.**	See *Ether, bis-p-chlorophenyl.*		
3706	**——, *sym*-dichloroethyl.**	See *Ether, bis-β-chloroethyl.*		
3707	**——, α,β-dichloro-ethyl ethyl**	1,2-dichloro-1-ethoxyethane*; dichloroether; α, β-dichloroethyl ether	$CH_2ClCHClOC_2H_5$	143.02
3708	**——, β,β′-dichloroisopropyl.**	See *Ether, bis-β-chloroisopropyl.*		
3709	**——, diethyl.**	See *Ethyl ether.*		
3710	**——, di-*n*-heptyl.**	See *Heptyl ether.*		
3711	**——, 2,2′-dihydroxydiethyl.**	See *Diethylene glycol.*		
3711M	**——, β,β′-dihydroxydi-*n*-propyl.**	See 2-*Propanol, 1,1′-oxydi-.*		
3712	**——, 2,2′-dihydroxyethyl.**	See *Diethylene glycol.*		
3713	**——, diisoamyl.**	See *Isoamyl ether.*		
3714	**——, diisobutyl.**	See *Isobutyl ether.*		
3715	**——, diisopropyl.**	See *Isopropyl ether.*		
3716	**——, dimethyl.**	See *Methyl ether.*		
3717	**——, dinaphthyl.**	See *Naphthyl ether.*		
3718	**——, di-*n*-octyl.**	See *Octyl ether.*		
3719	**——, diphenyl.**	See *Phenyl ether.*		
3720	**——, di-*n*-propyl.**	See *Propyl ether.*		
3721	**——, divinyl.**	See *Vinyl ether.*		
3722	**——, ethylene diphenyl.**	See *Ethane, 1,2-diphenoxy-*.*		
3723	**——, ethyl 2-furyl-methyl**	ethyl furfuryl ether	$C_4H_3OCH_2OC_2H_5$	126.15
3724	**——, ethyl heptyl**	1-ethoxyheptane*	$C_2H_5O(CH_2)_6CH_3$	144.25
3725	**——, ethyl hexyl**	1-ethoxyhexane*	$C_2H_5O(CH_2)_5CH_3$	130.23
3725M	**——, ethylidene diethyl.**	See *Acetal.*		
3725T	**——, ethylidene dimethyl.**	See *Ethane, 1,1-dimethoxy-*.*		
3726	**——, ethyl isoamyl**	1-ethoxy-3-methylbutane*	$C_2H_5OCH_2CH_2$-$CH(CH_3)_2$	116.20
3727	**——, ethyl isobutyl**	1-ethoxy-2-methylpropane*	$C_2H_5OCH_2CH$-$(CH_3)_2$	102.17

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3685	....	0.9407^{0}_{0}	....	229.2	......	......	....
3686	....	0.9419^{0}_{0}	....	229.5	......	......	....
3687	leaf., $1.4556^{82.4}_{\alpha}$	$0.8434^{82.4}_{4}$	41.8	200^{1}	......	......	....
3688							
3689	....	....	....	98 part d.	......	......	....
3690	liq............	1.0572^{0}_{4}; 0.989^{20}_{4}	....	107–8	......	......	....
3691	liq., 1.3974....	1.0625^{10}_{4}	−103.5	59.5	d.	s.	s. eth.
3692							
3693							
3694							
3695							
3696							
3697							
3698							
3699							
3700							
3701							
3702							
3703							
3704							
3704M							
3705							
3706							
3707	col. inflam. liq.	1.174^{23}_{4}	....	140–5	......	v. s.	v. s. eth.
3708							
3709							
3710							
3711							
3711M							
3712							
3713							
3714							
3715							
3716							
3717							
3718							
3719							
3720							
3721							
3722							
3723	col. liq.......	0.9844^{20}_{4}	....	$149.5–50.5^{770}$	i.	s.	s. eth.
3724	....	0.790^{16}_{4}	....	166.6	i.	s.	s. eth.
3725	liq...........	0.8327^{0}_{4}	....	137	i.	v. s.	s. eth.
3725M							
3725 T							
3726	col. liq.......	0.764^{18}_{4}	....	112	i.	∞	∞ eth.
3727	col. liq.......	0.751^{20}_{4}	....	80 (78–80)	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3728	**Ether, ethyl isopropyl**	2-ethoxypropane*	$C_2H_5OCH(CH_3)_2$	88.15
3729	**——, ethyl methyl**	methoxyethane*	$CH_3OC_2H_5$	60.09
3730	**——, ethyl β-methylaminoethyl.**	See *Ethylamine, β-ethoxy-N-methyl-.*		
3731	**——, ethyl β-4-morpholylethyl.**	See *Morpholine, 4-(β-ethoxyethyl)-.*		
3732	**——, ethyl-1-naphthyl**	1-ethoxynaphthalene*	$C_{10}H_7OC_2H_5$	172.22
3733	**——, ethyl 2-naphthyl**	2-ethoxynaphthalene*; bromelia; nerolin (new)	$C_{10}H_7OC_2H_5$	172.22
3734	**——, ethyl octyl**	1-ethoxyoctane*	$C_2H_5O(CH_2)_7CH_3$	158.28
3735	**——, ethyl phenyl.**	See *Phenetole.*		
3736	**——, ethyl propargyl.**	See *Propyne, 3-ethoxy-*.*		
3737	**——, ethyl propyl**	1-ethoxypropane*	$C_2H_5OC_3H_7$	88.15
3738	**——, ethyl tetrahydrofurfuryl.**	See *Furan, 2-ethoxymethyltetrahydro-.*		
3739	**——, ethyl *o*-tolyl**	2-ethoxytoluene*; *o*-cresyl ethyl ether	$CH_3C_6H_4OC_2H_5$	136.19
3740	**——, ethyl *m*-tolyl**	3-ethoxytoluene*	$CH_3C_6H_4OC_2H_5$	136.19
3741	**——, ethyl *p*-tolyl**	4-ethoxytoluene	$CH_3C_6H_4OC_2H_5$	136.19
3742	**——, ethyl vinyl**	ethenoxyethane*	$CH{:}CH_2OC_2H_5$	72.10
3745	**——, 2-furylmethyl methyl**	furfuryl methyl ether	$C_4H_3OCH_2OCH_3$	112.12
3746	**——, heptyl methyl**	1-methoxyheptane*	$CH_3OC_7H_{15}$	130.23
3747	**——, heptyl phenyl**	1-phenoxyheptane*	$C_6H_5O(CH_2)_6CH_3$	192.29
3748	**——, hexyl phenyl**	hexyloxybenzene; 1-phenoxyhexane*	$CH_3(CH_2)_5OC_6H_5$	178.27
3748M	**——, β-hydroxyethyl phenyl.**	See *Ethanol, 2-phenoxy-.*		
3749	**——, isoamyl 1-naphthyl**	1-(γ-methylbutoxy)naphthalene*	$C_{10}H_7OCH_2CH_2\text{-}CH(CH_3)_2$	214.30
3750	**——, isoamyl 2-naphthyl**	2-(γ-methylbutoxy)naphthalene*	$C_{10}H_7OCH_2CH_2CH(CH_3)_2$	214.30
3751	**——, isoamyl phenyl**	isoamoxybenzene; 3-methyl-1-phenoxybutane	$C_6H_5O(CH_2)_2\text{-}CH(CH_3)_2$	164.24
3752	**——, isobutyl methyl**	1-methoxy-2-methylpropane*	$CH_3OCH_2CH\text{-}(CH_3)_2$	88.15
3753	**——, isobutyl phenyl**	isobutoxybenzene; 2-methyl-1-phenoxypropane	$(CH_3)_2CHCH_2O\text{-}C_6H_5$	150.21
3754	**——, isopropyl methyl**	2-methoxypropane*	$CH_3OCH(CH_3)_2$	74.12
3755	**——, isopropyl phenyl**	isopropoxybenzene; 2-phenoxypropane	$(CH_3)_2CHOC_6H_5$	136.19
3756	**——, methylene diethyl.**	See *Methane, diethoxy-*.*		
3757	**——, methylene dimethyl.**	See *Methane, dimethoxy-*.*		
3758	**——, o,o′-methylenediphenyl.**	See *Xanthene.*		
3759	**——, methylenedipropyl.**	See *Methane, dipropoxy-*.*		
3760	**——, methyl 1-naphthyl**	1-methoxynaphthalene*; methyl α-naphthyl ether	$C_{10}H_7OCH_3$	158.19
3761	**——, methyl 2-naphthyl**	2-methoxynaphthalene*; methyl β-naphthyl ether; nerolin (old); yara-yara	$C_{10}H_7OCH_3$	158.19
3762	**——, methyl phenyl.**	See *Anisole.*		
3763	**——, methyl propargyl.**	See *Propyne, 3-methoxy-*.*		
3764	**——, methyl propyl**	1-methoxypropane*	$CH_3OCH_2CH_2CH_3$	74.12
3765	**——, methyl 6-quinolyl.**	See *Quinoline, 6-methoxy-.*		
3766	**——, methyl *o*-tolyl**	2-methoxytoluene*; *o*-cresyl methyl ether	$CH_3C_6H_4OCH_3$	122.16

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3728	col. liq........	$0.745\frac{0}{4}$	....	54	s.	∞	∞ eth.
3729	col. liq. or gas.	$0.7260\frac{0}{4}$	....	7.9 (11–2)	s.	∞	∞ eth.
3730							
3731							
3732	liq., $1.59509^{32.8}$	$1.061\frac{20}{4}$	5.5	276.4; 160^{19}	i.	v. s.	v. s. eth.
3733	pl., $1.59752^{35.6}$. $1.5932^{47.8}$	$1.0606\frac{25}{4}$	37.5	282	i.	sl. s.	s. eth., pet. eth.
3734	liq...........	$0.794\frac{17}{4}$	....	182–4	i.	s.	s. eth.
3735							
3736							
3737	col. liq., 1.36948	0.747 $(0.732\frac{20}{4})$	<–79	64 (61.4)	s.	∞	∞ eth.
3738							
3739	liq., $1.508^{13.3}$..	$0.9592\frac{13.3}{4}$	....	180.1; $69.6–70.2^{12}$	......	......	....
3740	1.513.........	$0.9560\frac{0}{0}$	....	192; $73–5^{10}$	......	......	....
3741	liq., $1.5058^{17.6}$	$0.9662\frac{0}{0}$	....	189.9; $70–1^{15}$	......	......	....
3742	liq...........	$0.763\frac{15}{18}$	....	35.5	sl. s.	s.	∞ eth.
3745	col. liq.......	$1.0163\frac{20}{4}$	....	$134–5^{762}$	i.	s.	v. s. eth.
3746	col. liq.......	$0.795\frac{0}{0}$	....	149.8	i.	∞	∞ eth.
3747	....	$0.9319\frac{0}{0}$	....	266.8	......	......	....
3748	....	$0.9426\frac{0}{4}$	....	246	......	......	....
3748M							
3749	liq., $1.5705^{14.2}$	$1.0069^{14.2}$	....	$317–9^{742}$ d.	......	......	....
3750	leaf., 1.5768^{12}..	$1.0155\frac{12}{4}$	26.5	323–6 d.	i.	s.	s. eth.
3751	col. liq., 1.4872^{20}	$0.9198\frac{22}{4}$	....	225	......	......	....
3752	liq...........	$0.7507\frac{0}{4}$	....	59^{741}	i.	s.	s. eth.
3753	col. liq.......	$0.939\frac{16}{4}$	....	198	......	......	....
3754	col. liq.......	$0.7347\frac{20}{20}$	....	32.5^{777}	sl. s.	s.	s. eth.
3755	col. liq.......	$0.9464\frac{15}{15}$	....	177.2	......	......	....
3756							
3757							
3758							
3759							
3760	col. liq., $1.6232^{13.9}$	$1.0964\frac{13.9}{4}$	<–10	265–9 (258)	i.	v. s.	v. s. eth.; s. bz.
3761	col. leaf. f. eth.	....	72	274	sl. s.	sl. s.	v. s. eth.; s. CS_2, bz.
3762							
3763							
3764	col. liq., 1.3579	$0.738\frac{20}{4}$	....	38.9	3.05^{25}	∞	∞ eth.
3765							
3766	liq., $1.5199^{15.3}$	$0.9851\frac{15}{15}$	....	171.3	i.	v. s.	v. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3767	**Ether, methyl *m*-tolyl**	3-methoxytoluene*	$CH_3C_6H_4OCH_3$	122.16
3768	**——, methyl *p*-tolyl**	4-methoxytoluene*	$CH_3C_6H_4OCH_3$	122.16
3769	**——, 1-naphthyl propyl**	1-propoxynaphthalene*	$C_{10}H_7OCH_2CH_2$-CH_3	186.24
3770	**——, 2-naphthyl propyl**	2-propoxynaphthalene*	$C_{10}H_7OCH_2CH_2$-CH_3	186.24
3771	**——, octyl phenyl**	1-phenoxyoctane*	$C_6H_5O(CH_2)_7CH_3$	206.32
3772	**——, perchloro-.**	See *Ether, bis(pentachloroethyl)*.		
3773	**——, phenyl propyl**	propoxybenzene*	$C_3H_7OC_6H_5$	136.19
3774	**——, phenyl vinyl**	ethenoxybenzene*	$C_6H_5OCH{:}CH_2$	120.14
3775	**——, propyl *o*-tolyl**	2-propoxytoluene*; *o*-cresyl propyl ether	$CH_3C_6H_4O(CH_2)_2$-CH_3	150.21
3776	**——, propyl *m*-tolyl**	3-propoxytoluene*	$CH_3C_6H_4OC_3H_7$	150.21
3777	**——, propyl *p*-tolyl**	4-propoxytoluene*	$CH_3C_6H_4OC_3H_7$	150.21
3778	**Ethine.**	See *Acetylene.*		
3779	**Ethinyl tribromide.**	See *Ethylene, tribromo-.*		
3780	**Ethinyl trichloride.**	See *Ethylene, trichloro-.*		
3781	**Ethionic anhydride**	carbyl sulfate; 1,3,2,4-dioxadithiane 2,4-bisdioxide	$\underline{SO_2OCH_2CH_2SO_2O}$	188.17
3782	**Ethocain.**	See *Procaine, hydrochloride.*		
3783	**Ethoxyamine***	*α*-ethylhydroxylamine	$C_2H_5ONH_2$	61.08
	Ethyl. For ethyl derivatives see the parent compounds (e.g., for ethylbenzene see			
3784	**Ethyl acetate.**	See *Acetic acid, ethyl ester.*		
3784M	**Ethylal.**	See *Methane, diethoxy-.*		
3785	**Ethyl alcohol**	ethanol*; methylcarbinol; alcohol; spirit of wine	CH_3CH_2OH	46.07
	——. For other derivatives see *Ethanol.*			
3786	——, esters with organic acids. See "ethyl ester," under the names of the acids.			
3787	**Ethylamine***	aminoethane	$C_2H_5NH_2$	45.08
3788	——, hydrobromide	ethylammonium bromide*	$C_2H_5NH_2{\cdot}HBr$	126.01
3789	——, hydrochloride		$C_2H_5NH_2{\cdot}HCl$	81.55
3789M	——, hydroiodide		$C_2H_5NH_2{\cdot}HI$	173.01
3790	**——, *N*-benzylidene**	*N*-ethylbenzalimine; *N*-benzalethylamine	$C_6H_5CH{:}NC_2H_5$	133.19
3791	**——, *β,β*-diethoxy-**	aminoacetaldehyde; 2, 2-diethoxyethylamine; aminoacetal; acetalylamine	$(C_2H_5O)_2CH$-CH_2NH_2	133.19
3792	**——, *β,β*-diethoxy-*N,N*-dimethyl-**	dimethylaminoacetal	$(CH_3)_2NCH_2$-$CH(OC_2H_5)_2$	161.24
3793	**——, *α,α*-dimethyl-.**	See *tert-Butylamine.*		
3794	**——, *β*-ethoxy-***	2-aminodiethyl ether; *β*-aminoethyl ethyl ether	$C_2H_5OCH_2CH_2$-NH_2	89.14
3795	**——, *β*-ethoxy-*N*-methyl-**	ethyl *β*-methylaminoethyl ether	$CH_3NHCH_2CH_2$-OC_2H_5	103.16
3796	**——, *β*-hydroxy-.**	See *Ethanol, 2-amino-*.*		
3797	**——, *β*-hydroxy-*N,N*-dimethyl-.** See *Ethanol, 2-dimethylamino-*.*			
3798	**——, *β*-hydroxy-*N*-methyl-.** See *Ethanol, 2-methylamino-*.*			
3799	**——, *α*-phenyl-.**	See *Benzylamine, α-methyl-.*		
3800	**——, *β*-phenyl-.**	See *Phenethylamine.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
3767	liq., 1.506^{20}....	$0.9766\frac{15}{15}$	....	177.2; (172–3)	......	......	....
3768	liq., $1.51237^{19.3}$	$0.9709\frac{19.3}{4}$	....	176.5 (173–4)	......	......	....
3769	liq., $1.5928^{18.4}$	$1.0447^{18.4}$	....	298–9	......	......	....
3770	need.........	....	39.5–40	....	......	......	....
3771	col. liq.......	$0.9139\frac{15}{15}$	8	285.2	......	......	....
3772							
3773	col. liq.......	$0.9530\frac{15}{15}$	....	190.5	......	s.	s. eth.
3774	....	....	....	155–6	......	......	....
3775	....	$0.9517\frac{0}{0}$	....	204.1	......	......	....
3776	....	$0.9484\frac{0}{0}$	....	210.6	......	......	....
3777	....	$0.9497\frac{0}{0}$	....	210.4	......	......	....
3778							
3779							
3780							
3781	deliq. cr.....	....	80	....	d.	......	....
3782							
3783	col. liq.......	$0.883^{7.5}$	....	68	∞	∞	∞ eth.
	Benzene, ethyl–). For ethyl esters of organic acids see the acids.						
3784							
3784M							
3785	col. liq., $1.36242^{18.35}$	$0.7893\frac{20}{4}$; $0.78505\frac{25}{4}$	−117.3; −114.6	78.5 (78.37)	∞	......	∞ eth., chl.; s. me. al.
3786							
3787	col. liq.......	$0.7059\frac{0}{4}$; $0.689\frac{15}{15}$	−80.6	16.6	∞	∞	∞ eth.
3788	need. or pl. f. al.	$1.741\frac{20}{4}$	159.5	....	......	......	....
3789	monocl. deliq. pl. f. al.	$1.2045\frac{21}{4}$	108	d. 315	238^{17}	s.	i. eth.
3789M	need. f. w.....	....	188.5	....	......	sl. s.	....
3790	$1.541\frac{20}{He}$......	$0.937\frac{20}{4}$	....	195	i.	∞	∞ eth.
3791	liq., 1.4120	$0.9161\frac{25}{4}$	....	163	s.	s.	s. eth., $CHCl_3$
3792	yel. liq.......	$0.885\frac{7}{4}$	....	170–1	s.	s.	s. eth.
3793							
3794	liq., 1.4101^{20}...	$0.8512\frac{20}{4}$	....	108	∞	∞	∞ eth.
3795	liq., 1.4147....	$0.8363\frac{20}{4}$	....	$114–5^{744}$	......	......	....
3796							
3797							
3798							
3799							
3800							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3801	**Ethyl arsenate**	triethyl arsenate; ethyl orthoarsenate	$(C_2H_5)_3AsO_4$	226.09
3802	**Ethyl arsenite**	triethyl arsenite; ethyl orthoarsenite	$(C_2H_5)_3AsO_3$	210.09
3803	**Ethyl borate**	triethyl borate; triethoxyboron	$B(OC_2H_5)_3$	146.00
3804	**Ethyl bromide**	bromoethane*	CH_3CH_2Br	108.98
3805	——, **vinyl-.**	See 1-_Butene, 4-bromo-_*.		
3805M	**Ethylcellulose.**	See _Cellulose, ethyl ether._		
3806	**Ethyl chloride**	chloroethane*	CH_3CH_2Cl	64.52
3807	**Ethyl cyanide.**	See _Propionitrile._		
3808	**Ethyl disulfide**	ethyldithioethane*; diethyl disulfide	$(C_2H_5)_2S_2$	122.24
3809	**Ethylene**	ethene*; elayl	$CH_2:CH_2$	28.05
3810	——, esters.	See "diacetate", "dibenzoate", etc. under _Glycol._		
3811	——, **bromo-.**	See _Vinyl bromide._		
3812	——, **1-bromo-2-phenyl-.**	See _Styrene, β-bromo-._		
3813	——, **butyl-.**	See 1-_Hexene_*.		
3814	——, **_sec_-butyl-.**	See 1-_Pentene, 3-methyl-_*.		
3815	——, **_tert_-butyl-.**	See 1-_Butene, 3,3-dimethyl-_*.		
3816	——, **1-butyl-1-methyl-.**	See 1-_Hexene, 2-methyl-_*.		
3817	——, **1-butyl-2-methyl-.**	See 2-_Heptene_*.		
3818	——, **1-_sec_-butyl-1-methyl-.**	See 1-_Pentene, 2,3-dimethyl-_*.		
3819	——, **1-_sec_-butyl-2-methyl-.**	See 2-_Hexene, 4-methyl-_*.		
3820	——, **chloro-.**	See _Vinyl chloride._		
3821	——, **1,2-dibromo-**	acetylene dibromide; _sym_-dibromoethylene	$CHBr:CHBr$	185.87
3822	——, **1,1-dichloro-**	_uns_-dichloroethylene	$CH_2:CCl_2$	96.95
3823	——, **1,2 (or _sym_)-dichloro-(_cis_)**	acetylene dichloride	$CHCl:CHCl$	96.95
3823A	——, **1,2 (or _sym_)-dichloro-(_trans_)**	acetylene dichloride	$CHCl:CHCl$	96.95
3824	**Ethylene, 1,1 (or _uns_)-diethyl-.**	See 1-_Butene, 2-ethyl-_*.		
3825	——, **1,2(or _sym_)-diethyl-.**	See 3-_Hexene_*.		
3826	——, **1,1-diethyl-2-methyl-.**	See 2-_Pentene, 3-ethyl-_*.		
3826M	——, **1,1-difluoro-**	_uns_-difluoroethylene	$CH_2:CF_2$	64.04
3827	——, **1,2(or _sym_)-diisopropyl-.**	See 3-_Hexene, 2,5-dimethyl-_*.		
3828	——, **1,1(or _uns_)-dimethyl-.**	See _Propene, 2-methyl-_*.		
3829	——, **1,2(or _sym_)-dimethyl-.**	See 2-_Butene_*.		
3830	——, **1,1-dimethyl-2-propyl-.**	See 2-_Hexene, 2-methyl-_*.		
3831	——, **1,2-dimethyl-1-propyl-.**	See 2-_Hexene, 3-methyl-_*.		
3832	——, **1,1-diphenyl-**	_uns_-diphenylethylene	$(C_6H_5)_2C:CH_2$	180.24
3833	——, **_trans_-1,2-diphenyl-.**	See _Stilbene._		
3834	——, **ethyl-.**	See 1-_Butene_*.		
3835	——, **1-ethyl-1,2-dimethyl-.**	See 2-_Pentene, 3-methyl-_*.		
3836	——, **2-ethyl-1,1-dimethyl-.**	See 2-_Pentene, 2-methyl-_*.		
3837	——, **1-ethyl-1-isobutyl.**	See 1-_Butene, 2-ethyl-3-methyl-_*.		
3838	——, **1-ethyl-2-isopropyl-.**	See 3-_Hexene, 2-methyl-_*.		
3839	——, **1-ethyl-1-methyl-.**	See 1-_Butene, 2-methyl-_*.		
3840	——, **1-ethyl-2-methyl-.**	See 2-_Pentene_*.		
3841	——, **1-ethyl-1-propyl-.**	See 1-_Pentene, 2-ethyl-_*.		
3842	——, **1-ethyl-2-propyl-.**	See 3-_Heptene_*.		
3843	——, **ethyltrimethyl-.**	See 2-_Pentene, 2,3-dimethyl-_*.		
3843M	——, **fluoro-.**	See _Vinyl fluoride._		
3844	——, **iodo-.**	See _Vinyl iodide._		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3801	....	$1.3264\frac{0}{4}$	....	238	d. c.	......	....
3802	....	$1.224\frac{0}{4}$	....	166	d. c.	......	....
3803	col. liq., 1.381.	$0.864^{26.5}$	....	120	d.	∞	∞ eth.
3804	col. liq., 1.42386	$1.430\frac{20}{4}$; $1.4505\frac{25}{4}$	-119	38.0	1.08^{0}, $0.96^{17.5}$, 0.91^{20}	∞	∞ eth., chl.
3805							
3805M							
3806	col. liq. or gas.	$0.9214\frac{0}{4}$	-138.7	12.2	0.574^{20}	48.3^{21}	∞ eth.
3807							
3808	oil, 1.50633^{20}..	$0.99267\frac{20}{4}$	....	153-4	v. sl. s.	∞	∞ eth.
3809	col. gas, 1.363^{-100}	1.245^{0} g/1; $0.566\frac{-102}{4}$	-169.4; frz. -181	-103.9	25.6^{0} cm^{3}	360 cm^{3}	s. eth.
3810							
3811							
3812							
3813							
3814							
3815							
3816							
3817							
3818							
3819							
3820							
3821	col. liq., 1.5428	$2.271\frac{17.5}{4}$	(*cis*)-53; (*trans*)-6.5	110^{754} 108	i.	v. s.	v. s. eth.
3822	liq............	$1.250\frac{15}{4}$	....	37	i.	......	....
3823	liq., 1.4519^{15}...	$1.291\frac{15}{4}$	-80.5	60.1	i.	∞	∞ eth.
3823A	liq., 1.4490^{15}...	$1.265\frac{15}{4}$	-50	48.4	i.	∞	∞ eth.
3824							
3825							
3826							
3826M	col. gas.......	....	....	<-70	i.	s.	s. eth.
3827							
3828							
3829							
3830							
3831							
3832	col. liq., 1.610^{14}	$1.038\frac{14}{4}$; $1.0206\frac{22}{4}$	9	277	......	......	....
3833							
3834							
3835							
3836							
3837							
3838							
3839							
3840							
3841							
3842							
3843							
3843M							
3844							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3845	**Ethylene, isoamyl-.**	See 1-*Hexene, 5-methyl-**.		
3846	**——, isobutyl-.**	See 1-*Pentene, 4-methyl-**.		
3847	**——, 1-isobutyl-1-methyl-.**	See 1-*Pentene, 2,4-dimethyl-**.		
3848	**——, 1-isobutyl-2-methyl-.**	See 2-*Hexene, 5-methyl-**.		
3849	**——, isopropyl-.**	See 1-*Butene, 3-methyl-**.		
3850	**——, 1-isopropyl-1,2-dimethyl-.**	See 2-*Pentene, 3,4-dimethyl-**.		
3851	**——, 2-isopropyl-1,1-dimethyl-.**	See 2-*Pentene, 2,4-dimethyl-**.		
3852	**——, 1-isopropyl-1-methyl-.**	See 1-*Butene, 2,3-dimethyl-**.		
3853	**——, 1-isopropyl-2-methyl-.**	See 2-*Pentene, 4-methyl-**.		
3854	**——, methyl-.**	See *Propene**.		
3855	**——, 1-methyl-1-phenyl-.**	See *Benzene, isopropenyl-.*		
3856	**——, 1-methyl-1-propyl-.**	See 1-*Pentene, 2-methyl-**.		
3857	**——, 1-methyl-2-propyl-.**	See 2-*Hexene**.		
3858	**——, perchloro-.**	See *Ethylene, tetrachloro-.*		
3858M	**——, perfluoro-.**	See *Ethylene, tetrafluoro-.*		
3859	**——, phenyl-.**	See *Styrene.*		
3860	**——, propyl-.**	See 1-*Pentene**.		
3861	**——, pseudobutyl-.**	See 1-*Butene, 3,3-dimethyl-**.		
3862	**——, tetrachloro-**	perchloroethylene..........	$CCl_2{:}CCl_2$........	165.85
3862M	**——, tetrafluoro-**	perfluoroethylene..........	$CF_2{:}CF_2$.........	100.02
3863	**——, tetraiodo-.......**	....	$CI_2{:}CI_2$..........	531.70
3864	**——, tetramethyl-.**	See 2-*Butene, 2,3-dimethyl-**.		
3865	**——, tetraphenyl-.....**	....	$(C_6H_5)_2C{:}C(C_6H_5)_2$	332.42
3866	**——, tribromo-......**	ethinyl tribromide..........	$CHBr{:}CBr_2$.......	264.78
3867	**——, trichloro-.......**	ethinyl trichloride..........	$CHCl{:}CCl_2$.......	131.40
3868	**——, trimethyl-.**	See 2-*Butene, 3-methyl-**.		
3869	**——, triphenyl-.......**	α-phenylstilbene...........	$(C_6H_5)_2C{:}CH\text{-}C_6H_5$	256.33
3870	**——, vinyl-.**	See 1,3-*Butadiene**.		
3871	**Ethylene bromide.....**	1,2-dibromoethane*; ethylene dibromide; glycol dibromide	CH_2BrCH_2Br.....	187.88
3872	**Ethylene bromohydrin.**	See *Ethanol, 2-bromo-**.		
3873	**Ethylenecarboxylic acid.**	See *Acrylic acid.*		
3874	**Ethylene chloride.....**	1,2-dichloroethane*; ethylene dichloride; glycol dichloride	CH_2ClCH_2Cl.....	98.97
3875	**Ethylene chlorobromide.**	See *Ethane, 1-bromo-2-chloro-**.		
3876	**Ethylene chlorohydrin.**	See *Ethanol, 2-chloro-**.		
3877	**Ethylene cyanide.**	See *Succinonitrile.*		
3878	**Ethylene cyanohydrin.**	See *Hydracrylonitrile.*		
3879	**Ethylenediamine** (anh.).	1,2-ethanediamine*.........	$NH_2CH_2CH_2NH_2$	60.10
3880	**Ethylenediamine** (hydrate)	....	$NH_2CH_2CH_2NH_2 \cdot H_2O$	78.12
3880M	——, hexavanadate.......	....	$2C_2H_4(NH_2)_2 \cdot H_4V_6O_{17} \cdot 4H_2O$	774.00
3881	——, hydrochloride.........	ethylenediammonium chloride	$HCl \cdot NH_2CH_2CH_2NH_2 \cdot HCl$	133.03
3882	**——, *N,N′*-diphenyl-..**	*sym*-diphenylethylenediamine; ethylenediphenyldiamine	$C_6H_5NHCH_2CH_2NHC_6H_5$	212.29
3883	**1,1-Ethylenedicarboxylic acid, 2-phenyl-.**	See *Malonic acid, benzylidene-.*		
3884	***cis*-1,2-Ethylenedicarboxylic acid.**	See *Maleic acid.*		
3885	***trans*-1,2-Ethylenedicarboxylic acid.**	See *Fumaric acid.*		
3885M	**Ethylene difluoride.**	See *Ethylene fluoride.*		
3886	**Ethylene diiodide.**	See *Ethylene iodide.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3845							
3846							
3847							
3848							
3849							
3850							
3851							
3852							
3853							
3854							
3855							
3856							
3857							
3858							
3858M							
3859							
3860							
3861							
3862	col. liq., 1.50534	1.62272	-22.18	121.02	i.	∞	∞ eth.
3862M	col. gas.......	....	-142.5	-78.4	i.	......	....
3863	yel. monocl. pr.	$2.983\frac{20}{4}$	187	subl.	i.	sl. s.	sl. s. eth.; v. s. CS_2; s. bz., chl., tol., ac. a.
3864							
3865	col. monocl. or rhomb. f. bz.	....	227 (221)	425	i.	v. sl. s.	v. sl. s. eth.; v. s. bz.
3866	liq...........	$2.708^{20.5}$	....	163-4; $53\text{-}5^{9}$	......	......	....
3867	col. liq., 1.4777	$1.45560\frac{25}{4}$	-73 (-86)	87	0.1	∞	∞ eth.
3868							
3869	narrow leaf. f. al. or ac. a.	....	72-3	$220\text{-}1^{14}$	i.	v. s.	v. s. eth.
3870							
3871	col. liq., 1.53789	$2.1701\frac{25}{4}$	9.97 (10)	131.6	0.431^{30}	s.	∞ eth.
3872							
3873							
3874	col. liq., 1.44432	$1.257\frac{20}{4}$	-35.3	83.5-3.7	0.92^{0}, 0.869^{20}	s.	∞ eth.; s. ord. org. solv.
3875							
3876							
3877							
3878							
3879	col. liq., $1.45400^{26.1}$	$0.8994\frac{20}{4}$	8.5	116.1 (117)	s.	......	0.236 eth.; i. bz.
3880	col. liq., 1.4500	$0.963\frac{21}{4}$	10	118	......	......	....
3880M	brownish-yel...	....	....	....	sl. s.	i.	i. eth.
3881	1.633........	....	....	....	......	......	....
3882	col. leaf. f. dil. al.	....	65	....	i.	v. s.	v. s. eth.
3883							
3884							
3885							
3885M							
3886							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3887	**Ethylene dimercaptan.**	See 1,2-_Ethanedithiol_*.		
3888	**Ethylenediphenyldiamine.**	See _Ethylenediamine, N, N′-diphenyl-_*.		
3889	**Ethylene diphenyl ether.**	See _Ethane, 1,2-diphenoxy-_*.		
3890	**Ethylene disulfonic acid.**	See 1,2-_Ethanedisulfonic acid_*.		
3891	**Ethylene ethylidene ether.**	See 1,3-_Dioxolane, 2-methyl-_.		
3891H	**Ethylene fluoride**	1,2-difluoroethane*; ethylene difluoride; glycol difluoride	CH_2FCH_2F	66.05
3891R	**Ethylene fluorohydrin.**	See _Ethanol, 2-fluoro-_*.		
3892	**Ethylene glycol.**	See _Glycol._		
3893	**Ethylene imine.**	See _Ethylenimine._		
3894	**Ethylene iodide**	1,2-diiodoethane*; ethylene diiodide; glycol diiodide	CH_2ICH_2I	281.89
3895	**Ethylene lactic acid.**	See _Hydracrylic acid._		
3896	**Ethylene mercaptan.**	See 1,2-_Ethanedithiol_*.		
3897	**Ethylene nitrate.**	See _Glycol, dinitrate._		
3898	**Ethylene nitrite.**	See _Glycol, dinitrite._		
3899	**Ethylene oxide**	1,2-epoxyethane*; oxirane	$(CH_2)_2O$	44.05
3900	**——, α,α-dimethyl-**	1,2-epoxy-2-methylpropane; isobutylene oxide	$\underbracket{CH_2C(CH_3)_2O}$	72.10
3900M	**Ethylene sulfide**	thiirane	$(CH_2)_2S$	60.11
3901	**Ethylenimine**	dimethylenimine; dihydroazirine	$\underbracket{NHCH_2CH_2}$	43.07
3902	**Ethyl ether**	ethoxyethane*; diethyl ether; ether; ethyl oxide; sulfuric ether	$C_2H_5OC_2H_5$	74.12
3903	**Ethyl fluoride**	fluoroethane*	CH_3CH_2F	48.06
3904	**Ethyl hydrogen sulfate.**	See _Ethylsulfuric acid._		
3905	**Ethyl hydrosulfide.**	See _Ethanethiol_*.		
3906	**Ethylidene bromide.**	See _Ethane, 1,1-dibromo-_*.		
3907	**Ethylidene chloride.**	See _Ethane, 1,1-dichloro-_*.		
3908	**Ethylidene cyanohydrin.**	See _Lactonitrile._		
3908M	**Ethylidene fluoride.**	See _Ethane, 1,1-difluoro-_*.		
3909	**Ethylidene glycol, tribromo-.**	See _Bromal, hydrate._		
3910	**——, trichloro-.**	See _Chloral hydrate._		
3911	**Ethylidene iodide.**	See _Ethane, 1,1-diiodo-_*.		
3912	**Ethyl iodide**	iodoethane*	CH_3CH_2I	155.98
3913	**Ethyl isocyanide**	ethylcarbylamine*	C_2H_5NC	55.08
3914	**Ethyl ketone.**	See 3-_Pentanone_*.		
3915	**Ethyl mercaptan.**	See _Ethanethiol_*.		
3916	**Ethyl mustard oil.**	See _Isothiocyanic acid, ethyl ester._		
3917	**Ethyl nitrate**	nitric ether	$C_2H_5ONO_2$	91.07
3918	**Ethyl nitrite**	nitrous ether	C_2H_5ONO	75.07
3919	**Ethyloglycolic acid.**	See _Acetic acid, ethoxy-._		
3920	**Ethylolamine.**	See _Ethanol, 2-amino-_*.		
3921	**Ethyl orthoarsenate.**	See _Ethyl arsenate._		
3922	**Ethyl orthoarsenite.**	See _Ethyl arsenite._		
3923	**Ethyl orthosilicate**		$(C_2H_5)_4SiO_4$	208.30
3924	**Ethyl oxide.**	See _Ethyl ether._		
3925	**Ethyl phosphate**	triethyl phosphate	$(C_2H_5)_3PO_4$	182.16

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
3887							
3888							
3889							
3890							
3891							
3891 H	col. gas.	. . . .	. . . .	10–11	. . . . . .	. . . . . .	. . . .
3891 R							
3892							
3893							
3894	yel. monocl. pr. f. eth.	$2.132\frac{10}{4}$	81–2	d.	sl. s.	s.	s. eth.
3895							
3896							
3897							
3898							
3899	col. liq. or gas, $1.35988^{8.4}$	1.965^{0} g/1; $0.887\frac{7}{4}$	-111.3	10.7	∞	∞	∞ eth.
3900	liq	0.831	. . . .	51–2	. . . . . .	s.	s. eth.
3900M	col. liq., 1.4914^{18}	$1.0368\frac{0}{4}$	d.	55–56	. . . . . .	v. sl. s.	v. sl. s. eth.
3901	oil	$0.832\frac{20}{4}$	. . . .	55–6	∞	s.	. . . .
3902	col. liq. or rhomb., $1.3497^{24.8}$	$0.7135\frac{20}{4}$	α–116.3 β–123.3	34.6	7.5^{20}	∞	∞ chl., bz.; s. conc. H_2SO_4
3903	col. gas, 1.3057^{-40}	$0.8158^{-37.7}$; 2.198^{0} g/1	-143.2	-37.7	198^{14} cm^3	v. s.	v. s. eth.
3904							
3905							
3906							
3907							
3908							
3908M							
3909							
3910							
3911							
3912	col. liq., $1.5222^{7.0}$	$1.933\frac{20}{4}$; $1.9245\frac{25}{4}$	-108.5 (-105 to -111)	72.2	0.4^{20}	s.	s. eth., bz., chl.
3913	col. liq., 1.3659^{34}	$0.7402\frac{20}{4}$	<-66	79	v. s.	∞	∞ eth.
3914							
3915							
3916							
3917	col. inflam. liq., $1.38484^{21.5}$	$1.105\frac{20}{4}$	-102 (-112)	88.7	1.3^{55} (i.)	∞	∞ eth.
3918	col. or yelsh. liq.	$0.900^{15.5}$	. . . .	17	v. sl. s.	∞	s. eth.
3919							
3920							
3921							
3922							
3923	col. liq	$0.933\frac{20}{4}$	. . . .	165.5	d.	v. s.	∞ eth.
3924							
3925	liq., 1.40616^{10}	$1.0686\frac{25}{4}$	. . . .	216	100^{25} d.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3926	**Ethyl phosphite**	triethyl phosphite	$(C_2H_5)_3PO_3$	166.16
3927	**Ethyl selenide**	diethyl selenide	$(C_2H_5)_2Se$	137.08
3928	**Ethyl silicate.**	See *Ethyl orthosilicate.*		
3929	**Ethyl sulfate**	diethyl sulfate	$(C_2H_5)_2SO_4$	154.18
3930	**Ethyl sulfide**	ethylthioethane*; diethyl sulfide	$(C_2H_5)_2S$	90.18
3931	**Ethylsulfinic acid.**	See *Ethanesulfinic acid.**		
3932	**Ethyl sulfite**	diethyl sulfite	$(C_2H_5)_2SO_3$	138.18
3933	**Ethyl sulfone**	ethylsulfonylethane*; diethyl sulfone	$(C_2H_5)_2SO_2$	122.18
3934	**Ethylsulfonic acid.**	See *Ethanesulfonic acid**.		
3935	**Ethyl sulfoxide**	ethylsulfinylethane*; diethyl sulfoxide	$(C_2H_5)_2SO$	106.18
3936	**Ethylsulfuric acid**	ethyl hydrogen sulfate; acid ethyl sulfate	$C_2H_5OSO_3H$	126.13
3937	**Ethyl telluride**	tellurium ethyl; diethyl telluride	$(C_2H_5)_2Te$	185.73
3938	**Ethyl thioalcohol.**	See *Ethanethiol**.		
3939	**Ethyne*.**	See *Acetylene.*		
3940	**Ethynyl bromide.**	See *Acetylene, bromo-.*		
3941	**α-Eucaine**		$C_{19}H_{27}NO_4$	333.42
3942	——, hydrochloride		$C_{19}H_{27}NO_4 \cdot HCl \cdot H_2O$	387.90
3943	**β-Eucaine**	benzamine; betacaine	$C_{15}H_{21}NO_2$	247.33
3944	——, hydrochloride		$C_{15}H_{21}NO_2 \cdot HCl$	283.79
3945	——, lactate	4-benzoxy-2,2,6-trimethylpiperidine lactate; benzamine lactate; benzoylvinyldiacetonealkamine lactate	$C_{15}H_{21}NO_2 \cdot C_3H_6O_3$	337.41
3946	**Eucalyptole.**	See *Cineole.*		
3947	**Eugenic acid.**	See *Eugenol.*		
3948	**Eugenol**	4-allylguaiacol; eugenic acid	$CH_2{:}CHCH_2C_6H_3(OCH_3)OH$	164.20
3949	——, methyl ether	See *Veratrole, 4-allyl-.*		
3950	——, **methyl-.**	See *Veratrole, 4-allyl-.*		
3951	**Eugetic acid**	5-allyl-3-methoxysalicylic acid; eugetinic acid	$C_3H_5C_6H_2(OCH_3)(OH)COOH$	208.21
3952	**Eupittone**	hexamethoxyaurin; eupittonic acid	$C_{19}H_8(OCH_3)_6O_3$	470.46
3953	**Euxanthic acid**		$C_{19}H_{16}O_{10} \cdot 3H_2O$	458.37
3954	**Euxanthone**	1,7-dihydroxyxanthone	$HOC_6H_3(CO)(O)C_6H_3OH$	228.19
3955	——, **3-methoxy-.**	See *Gentisin.*		
3956	**Evernic acid**	orsellinic acid 4-everninate; lecanoric acid monomethyl ether	$C_{17}H_{16}O_7$	332.30
3957	**Everninic acid**	2-hydroxy-6-methylanisic acid; orsellinic acid 4-methyl ether	$CH_3OC_6H_2(OH)(CH_3)COOH$	182.17
3958	*d*-**Evodiamine**		$C_{19}H_{17}N_3O$	303 35
3959	*i*-**Evodiamine** (hydrate)		$C_{19}H_{17}N_3O \cdot H_2O$	321.37
3960	**Exalgin.**	See *Acetanilide, N-methyl-.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3926	col. liq., 1.4079	0.9687^{20}_{4}	....	156.5	i.	v. s.	v. s. eth.
3927	liq., 1.4768....	1.2300^{20}_{4}	....	108	i.	......	....
3928							
3929	col. oily liq., 1.4010^{18}	1.1842^{15}_{4}; 1.172^{25}_{4}	−24.5	208 sl. d.; 96^{15}	i., sl. d.; d. h.	∞, d. h.	∞ eth.
3930	col. liq., 1.44233	0.837^{20}_{4}	−102.1	92	0.313^{20}	s.	s. eth.
3931							
3932	col. liq., 1.4198^{11}	1.1062^{0}_{4}; 1.077^{20}_{4}	....	158 (161.3)	s. d.	s.	s. eth.
3933	rhomb. pl.....	1.357^{20}_{4}	73–4 (70)	248	15.6^{16}	......	s. h. eth.; v. s. bz.; i. pet. eth.
3934							
3935	syrupy liq.....	....	5	89^{15} d.	s.	s.	s. eth.
3936	col. oily liq....	1.316^{17}_{4}	....	280, d.	v. s.	s.	s. eth.
3937	red-yel. liq....	1.599^{15}_{4}	....	138	i.	s.	....
3938							
3939							
3940							
3941	shining pr. cr..	....	103–5	....	......	......	v. s. eth.
3942	rosettes f. sm. cr.	....	*ca.* 200 d.	....	10	117	sl. s. eth.
3943	wh. cr........	....	78 (91)	....	......	......	v. s. eth.
3944	wh. pl. or pr...	....	268 d.	....	3.33	3.53	s. eth., chl.
3945	col. cr........	....	....	....	s.	s.	....
3946							
3947							
3948	col. liq., $1.5416^{19.4}$	1.0664^{20}_{4}; 1.0620^{25}_{4}	10.3	252–3	v. sl. s.	∞	∞ eth.; s. chl., oils
3949							
3950							
3951	pr. f. w.......	....	124; anh. 127	d.	sl. s. c.; s. h.	s.	s. eth., $(NH_4)_2CO_3$
3952	or. need. f. al..	....	200 d.	....	......	sl. s. h.	s. glac. ac. a., alk., bl. color
3953	pa. yel. need..	....	155–8 d. (162)	d.	sl. s.	s. h.	v. sl. s. eth.; s. alk.
3954	yel. need......	....	240	subl. d.	i.	s. h.	sl. s. eth.; s. alk.
3955							
3956	need. or pr. f. al.	....	168–9 d. (164)	....	i. c., v. sl. s. h.	s.	s. eth.
3957	cr. f. w.......	....	170–1 d. (157)	....	s. h.	s.	s. eth., h. bz.
3958	yel. leaf......	....	278	....	......	......	i. dil. a.
3959	rhomb. leaf...	....	146–7	....	......	......	....
3960							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3962	**6-Fenchanol.**	See *Isofenchyl alcohol.*		
3963	**2-Fenchanone.**	See *Fenchone.*		
3964	***l*-α-Fenchene**	*l*-7,7-dimethyl-2-methylenenorcamphane	$C_{10}H_{16}$	136.23
3965	***d*-Fenchone**	*d*-2-fenchanone; *d*-1,3,3-trimethyl-2-norcamphanone; fenchone	$C_{10}H_{16}O$	152.23
3966	**Ferulic acid**	4-hydroxy-3-methoxycinnamic acid	$HO(OCH_3)C_6H_3\text{-}CH{:}CHCOOH$	194.18
3967	**Filixic acid**		$C_{35}H_{40}O_{12}$	652.67
3968	**Fisetin**	3,7,3′,4′-tetrahydroxyflavone	$HOC_6H_3OC\text{-}[C_6H_3(OH)_2]C\text{-}(OH)CO$	286.23
3969	**Flavaniline**	2-(*p*-aminophenyl)lepidine	$NH_2C_6H_4C_9H_5N\cdot CH_3$	234.29
3970	**3,5,7,3′,4′-Flavenpentol.**	See *d-Catechol.*		
3971	**Flavianic acid,** histidine salt.	See *Histidine, diflavianate.*		
3972	**Flavol**	2,6-anthracenediol*; 2,6-anthradiol	$HOC_6H_3(CH)_2\text{-}C_6H_3OH$	210.22
3973	**Flavone**	2-phenylchromone; 2-phenyl-1,4-benzopyrone	$C_6H_4OC(C_6H_5){:}CHCO$	222.23
3974	**——, 5,7-dihydroxy-.**	See *Chrysin.*		
3975	**——, 3,5,7,2′,4′-pentahydroxy-.**	See *Morin.*		
3976	**——, 3,5,7,3′,4′-pentahydroxy-.**	See *Quercetin.*		
3977	**——, 3,7,3′,4′-tetrahydroxy-.**	See *Fisetin.*		
3978	**Flavopurpurin**	1,2,6-trihydroxyanthraquinone	$HOC_6H_3(CO)_2\text{-}C_6H_2(OH)_2$	256.20
3979	**Fluoran**	9-hydroxy-9-xanthene-*o*-benzoic acid lactone	$C_{20}H_{12}O_3$	300.30
3980	**——,2,7-dihydroxy-.**	See *Hydroquinonephthalein.*		
3981	**Fluoranthene**	idryl	$C_{16}H_{10}$	202.24
3982	**Fluorene**	diphenylenemethane	$C_6H_4CH_2C_6H_4$	166.21
3983	**——, keto-.**	See 9-*Fluorenone**.		
3984	**——, 9-oxo-.**	See 9-*Fluorenone**.		
3985	**Fluorene alcohol.**	See 9-*Fluorenol**.		
3986	**9-Fluorenol***	fluorene alcohol; diphenylenecarbinol	$C_6H_4CHOHC_6H_4$	182.21
3987	**9-Fluorenone***	9-oxofluorene; ketofluorene; diphenylene ketone	$C_6H_4COC_6H_4$	180.19
3988	**Fluorescein**	resorcinolphthalein	$C_{20}H_{12}O_5$	332.30
3989	**——, dibromohydroxymercuri-,** disodium salt.	See *Mercurochrome* 220		
3990	**——, 4,5-dihydroxy-.**	See *Galleïn.*		
3991	**——, 2,4,5,7-tetrabromo-.**	See *Eosin.*		
3992	**——, 2,4,5,7-tetraiodo-.**	See *Erythrosin.*		
	Fluoro-. See the parent compounds (e.g., for fluorobenzene see *Benzene, fluoro-*).			
3993	**Fluoroform**	trifluoromethane*	CHF_3	70.02
3993M	**——, methyl-.**	See *Ethane, 1,1,1-trifluoro-**.		
3994	**Formal.**	See *Methane, dimethoxy-**.		
3995	**Formaldehyde**	methanal*; oxomethane	$HCHO$	30.03
3996	——, diethyl acetal.	See *Methane, diethoxy-**.		

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No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3962							
3963							
3964	liq., 1.4724^{19}...	0.864^{20}_{4}	....	158 (155–6)	i.	∞	∞ eth.
3965	oil, $1.4647^{14.5}$..	0.9460^{20}_{4}	6	193–5	i.	v. s.	v. s. eth.
3966	rhomb. need. f. w.	....	168 (169–70)	d.	s. h.	v. s.	sl. s. eth., bz.
3967	cr............	....	184 (160)	....	i.	i.	sl. s. eth.; s CS_2
3968	yel. need......	....	360	....	i.	s.	sl. s. eth., bz.
3969	col. pr. f. bz...	....	97	....	v. sl. s.	s.	s. bz.
3970							
3971							
3972	yel. cr. powd. f. al.	....	295–300 d. (270 d.)	....	i.	v. s.	v. s. eth.; s. ac. a.
3973	col. f. lgr.....	....	97	....	i.	s.	s. eth.
3974							
3975							
3976							
3977							
3978	yel. need. f. al.	....	>360	459	v. sl. s. h.	s. h.	sl. s. eth.
3979	flat need......	....	173–5	....	......	s.	s. H_2SO_4, HNO_3
3980							
3981	col. monocl. need. f. al.	....	110	251^{60}	i.	sl. s. c.	v. s. eth.; s. CS_2, ac. a.
3982	col. leaf. f. al..	....	116 (100–7)	295 (298)	i.	sl. s.	v. s. eth.; s. bz., CS_2
3983							
3984							
3985							
3986	hex. need. f. w.	....	153 (156)	....	......	s.	s. eth., bz.
3987	yel. rhomb. pr.	....	84	341.5	i.	v. s.	v. s. eth.
3988	or.-red cr. powd.	....	312–8 d. (d. 290)	....	i.	s.	sl. s. eth.; s. alk. sol., dil. a., h. glac. ac. a.; i. bz., chl.
3989	*soluble.*						
3990							
3991							
3992							
3993	col. gas.......	....	–163	–82.2; 20^{40} atm.	75 cm^3	394.5 cm^3	sl. s. $CHCl_3$
3993M							
3994							
3995	col. gas.......	0.815^{-20}_{4}	–92	–21	s.	s.	s. eth.
3996							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3997	**Formaldehyde**, dimethyl acetal. See *Methane, dimethoxy-**.			
3997M	——, 2,4-dinitrophenylhydrazone		$HCH:NNHC_6H_3(NO_2)_2$	210.15
3998	——, dipropyl acetal.	See *Methane, dipropoxy-**.		
3999	——, oxime	formoxime; formaldoxime	$HCH:NOH$	45.04
4000	——, **2-thienyl-.**	See 2-*Thiophenecarbonal.*		
4001	——, **thio-** (trimer)	*s*-trithiane; trimethylene trisulfide; trithioformaldehyde; methanethial* (trimer)	$SCH_2SCH_2SCH_2$	138.26
4002	**Formaldoxime.**	See *Formaldehyde, oxime.*		
4003	**Formamide**	methanamide*	$HCONH_2$	45.04
4004	——, oxime	methenyl amidoxime; isuretin	$HC(:NOH)NH_2$	60.06
4005	——, **chloro-.**	See *Carbamyl chloride.*		
4006	——, ***N,N*-diethyl-**	*N*-formyldiethylamine	$HCON(C_2H_5)_2$	101.15
4007	——, ***N,N*-diphenyl-**	*N*-formyldiphenylamine; *N*-phenylformanilide	$HCON(C_6H_5)_2$	197.23
4008	——, ***N*-ethyl-**	*N*-ethylmethanamide	$HCONHC_2H_5$	73.09
4009	——, ***N*-phenyl-.**	See *Formanilide.*		
4010	——, **ureido-.**	See *Biuret.*		
4011	**Formamidine, amino-.**	See *Guanidine.*		
4012	——, ***N,N*-diphenyl-**		$C_6H_5N:CHNHC_6H_5$	196.24
4013	**Formamine.**	See *Hexamethylenetetramine.*		
4014	**Formanilide**	*N*-phenylformamide.	$HCONHC_6H_5$	121.13
4015	——, ***N*-phenyl-.**	See *Formamide, N,N-diphenyl*-.		
4016	**Formic acid**	methanoic acid*	$HCOOH$	46.03
4017	——, allyl ester	allyl formate; 2-propenyl methanoate*	$HCOOCH_2CH:CH_2$	86.09
4018	——, amyl ester	amyl formate; pentyl methanoate*	$HCOO(CH_2)_4CH_3$	116.16
4019	——, benzyl ester	benzyl formate; benzyl methanoate*	$HCOOCH_2C_6H_5$	136.14
4020	——, butyl ester	butyl formate; butyl methanoate*	$HCOOC_4H_9$	102.13
4021	——, *sec*-butyl ester		$HCOOCH(CH_3)C_2H_5$	102.13
4022	——, ethyl ester	ethyl formate; ethyl methanoate*	$HCOOC_2H_5$	74.08
4023	——, ethylene ester.	See *Glycol, diformate.*		
4024	——, geranyl ester.	See *Geraniol, formate.*		
4025	——, heptyl ester	*n*-heptyl formate	$HCOOC_7H_{15}$	144.21
4026	——, hexyl ester	*n*-hexyl formate	$HCOO(CH_2)_5CH_3$	130.18
4027	——, isoamyl ester	γ-methylbutyl methanoate*	$HCOO(CH_2)_2CH(CH_3)_2$	116.16

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No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3997							
3997M	yel. cr.	....	167	....	......	s. h.	v. sl. s. eth.
3998							
3999	col. liq	....	....	84	*ca.* 10, d. h.	......	....
4000							
4001	tetr. pr	....	215–6	subl.	i. c.; sl. s. h.	sl. s.	sl. s. eth.
4002							
4003	col. liq., $1.44530^{22.7}$	$1.134\frac{20}{4}$; $1.1292\frac{25}{4}$	2.55	210.7 d. (92—5^{10})	∞	∞	sl. s. eth., bz.
4004	rhomb. f. acet. or al.	....	114	d.	s.	sl. s.	sl. s. eth.; i. bz.
4005							
4006	col. liq	0.908^{19}	....	177–8	∞	v. s.	v. s. eth.
4007	rhomb. f. al ...	$1.230\frac{20}{4}$	74 (70–1)	337.5^{762}	s. h.	s.	s. eth., bz.
4008	liq	$0.952\frac{21}{4}$	....	197–9	∞	∞	∞ eth.
4009							
4010							
4011							
4012	need. f. al	....	136	>250	sl. s.	s.	v. s. eth.; s. bz., acet., chl., CS_2; sl. s. pet. eth.
4013							
4014	col. monocl. pr.	$1.1437\frac{17}{4}$; $1.112\frac{60}{4}$	47.5	271	s.	v. s.	s. eth.
4015							
4016	col. liq., 1.37137	$1.22647\frac{15}{4}$; $1.220\frac{20}{4}$	8.40	100.7	∞	∞	∞ eth., glyc.
4017	liq	$0.948\frac{18}{4}$	....	83	sl. s.	s.	∞ eth.
4018	col. liq., $1.3951^{11.5}$	$0.8926\frac{15}{4}$	–73.5	130.4	sl. s.	∞	∞ eth.
4019	arom. liq	$1.081\frac{20}{4}$	....	203.4	i.	s.	∞ eth.
4020	col. liq., 1.3891	$0.9108\frac{0}{4}$; $0.8848\frac{25}{4}$	–90.0	106.8	sl. s.	∞	∞ eth.
4021	....	$0.882\frac{20}{4}$	....	97	sl. s.	∞	∞ eth.
4022	col. liq., 1.35975	$0.9236\frac{25}{4}$	–80.5	54.3	11.8^{25}	s.	s. eth.
4023							
4024							
4025	col. liq	$0.894\frac{0}{4}$	....	176.7	i.	s.	s. eth.
4026	col. liq	$0.898\frac{0}{4}$	....	153.6	v. s.	∞	∞ eth.
4027	col. liq., 1.391 .	$0.871\frac{20}{4}$	....	123.5	0.307^{22}	s.	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4028	**Formic acid**, isobutyl ester	isobutyl formate; β-methylpropyl methanoate*	$HCOOCH_2CH(CH_3)_2$	102.13
4029	——, isopropyl ester	isopropyl methanoate*	$HCOOCH(CH_3)_2$	88.10
4030	——, *l*-linalyl ester.	See *l-Linaloöl, formate.*		
4031	——, methyl ester	methyl methanoate*; methyl formate	$HCOOCH_3$	60.05
4032	——, octyl ester	*n*-octyl formate	$HCOO(CH_2)_7CH_3$	158.24
4033	——, *p*-phenylphenacyl ester		$HCOOCH_2COC_6H_4C_6H_5$	240.25
4034	——, propyl ester	*n*-propyl formate	$HCOOC_3H_7$	88.10
4035	——, **acetyl-.**	See *Pyruvic acid.*		
4036	——, **o-aminobenzoyl-.**	See *Isatic acid.*		
4037	——, **benzoyl-.**	See *Glyoxylic acid, phenyl-.*		
4038	——, **chloro-**, butyl ester	*n*-butyl chlorocarbonate	$ClCOO(CH_2)_3CH_3$	136.58
4039	——, ——, ethyl ester	ethyl chloromethanoate*; ethyl chlorocarbonate	$ClCOOC_2H_5$	108.53
4040	——, ——, isoamyl ester	γ-methylbutyl chloromethanoate*; isoamyl chlorocarbonate	$ClCOOC_5H_{11}$	150.61
4041	——, ——, isobutyl ester	β-methylpropyl chloromethanoate*; isobutyl chlorocarbonate	$ClCOOCH_2CH(CH_3)_2$	136.58
4042	——, ——, methyl ester	methyl chloromethanoate*; methyl chlorocarbonate	$ClCOOCH_3$	94.50
4043	——, ——, propyl ester	*n*-propyl chlorocarbonate	$ClCOOCH_2CH_2CH_3$	122.55
4044	——, ——, trichloromethyl ester.	See *Diphosgene.*		
4045	——, **cyano-**, ethyl ester	ethyl cyanomethanoate*; cyanoethyl carbonate	$CNCOOC_2H_5$	99.09
4046	——, **phenyl-.**	See *Benzoic acid.*		
4047	——, **2-thenoyl-.**	See 2-*Thiopheneacetic acid, α-oxo-.*		
4048	**Formohydrazide**	formylhydrazine	$HCONHNH_2$	60.06
4049	**Formonitrolic acid**	methylnitrolic acid	$HC(:NOH)NO_2$	90.04
4050	**Formosa camphor.**	See *d-Camphor.*		
4051	**Formoxime.**	See *Formaldehyde, oxime.*		
4052	**Formyl chloride, chloro-.**	See *Phosgene.*		
4052M	**Formyl fluoride, fluoro-.**	See *Carbonyl fluoride.*		
4053	**Frangula emodin.**	See *Emodin.*		
4054	**Frangulin**		$C_{20}H_{20}O_9$	404.36
4055	**Fraxin**		$C_{16}H_{18}O_{10}$	370.31
4056	D-**Fructosamine**	isoglucosamine; isodextrosamine	$CH_2OH(CHOH)_3COCH_2NH_2$	179.17
4057	D-**Fructose**	levulose; fruit sugar	$C_6H_{12}O_6$	180.16
4058	**Fructosin.**	See *Levulin (synthetic).*		
4059	**Fruit sugar.**	See D-*Fructose.*		
4061	**Fucose**	2,3,4,5-tetrahydroxyhexanal* (one form)	$C_6H_{12}O_5$	164.16
4062	**Fulminic acid**, silver salt	silver fulminate; fulminating silver	$AgCNO$	149.90
4063	**Fulminuric acid**	2-cyano-2-nitroethanamide*; cyanonitroacetamide; isocyanuric acid	$CNCH(NO_2)CONH_2$	129.08

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4028	col. liq., $1.38584^{19.9}$	$0.875\frac{20}{4}$	−95.3	98.2	1.01^{22}	∞	∞ eth.
4029	liq	$0.883\frac{0}{4}$; $0.873\frac{20}{4}$	....	71.3 (66.5–8.5)	2.1^{22}	∞	∞ eth.
4030							
4031	col. liq., 1.344	$0.98149\frac{15}{4}$; $0.975\frac{20}{4}$	−99.0	31.50	30.4^{20}	∞	s. eth., me. al.
4032	col. liq., 1.414	$0.872\frac{12.5}{4}$	....	198	i.	......	....
4033	....	....	74	....	......	......	....
4034	col. liq., 1.3771	$0.9006\frac{20}{4}$	−92.9	81.3	2.79^{20}	∞	∞ eth.
4035							
4036							
4037							
4038	....	$1.074\frac{25}{4}$	....	140–5	d.	d.	∞ eth.
4039	col. liq	$1.138\frac{20}{4}$	−80.6	94	d.	d.	s. eth., bz., chl.
4040	col. liq	$1.024\frac{25}{25}$	....	156	d.	∞	∞ eth.
4041	col. liq	$1.037\frac{25}{4}$	....	130	d.	s., d.	∞ eth.; s. bz., chl.
4042	col. liq	$1.236\frac{15}{4}$	....	71.4	d.	∞	∞ eth.; s. bz., chl.
4043	col. liq	$1.000\frac{20}{4}$	....	116	d.	∞	∞ eth.
4044							
4045	liq	$1.013\frac{20}{4}$	....	116	i.	s.	s. eth.
4046							
4047							
4048	yel. pl. or need	....	54	....	i.	s. h.	s. h. eth.; v. s. chl., bz.
4049	need. f. eth.	....	64	....	v. s.	s.	v. s. eth.
4050							
4051							
4052							
4052M							
4053							
4054	yel. need	....	226	....	v. sl. s.	s. h.	s. h. eth., h. bz.
4055	need. f. al.	....	190	....	s. h.	s.	i. eth.
4056	syrup	....	....	....	......	i.	i. eth.; s. dil. a.
4057	need. f. w.	$1.598\frac{20}{4}$; $1.669\frac{18}{4}$	105 (95)	....	v. s.	6.71^{18}	s. acet.
4058							
4059							
4061	need. f. al.	....	145	d.	v. s.	1.66^{22}	i. eth.
4062	sm. wh. need. f. w.	....	exp.	....	0.075^{13}	s.	s. NH_4OH; i. HNO_3
4063	col. pr. f. al	....	145 exp.	....	s.	s.	v. sl. s. eth.; i. chl., bz., lgr.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4064	**Fumaric acid**	*trans*-butenedioic acid*; *trans*-1,2-ethylenedicarboxylic acid	$HOOCCH{:}CH\text{-}COOH$	116.07
4065	——, diethyl ester	ethyl fumarate; diethyl fumarate	$({:}CHCOOC_2H_5)_2$	172.18
4066	——, dimethyl ester	methyl fumarate	$({:}CHCOOCH_3)_2$	144.12
4067	——, monoethyl ester	monoethyl fumarate	$HOOCCH{:}CH\text{-}COOC_2H_5$	144.12
4068	**——, bromo-**		$BrC(COOH){:}CH\text{-}COOH$	194.98
4069	**——, chloro-**		$ClC(COOH){:}CH\text{-}COOH$	150.52
4070	**——, methyl-.**	See *Mesaconic acid.*		
4071	**Furacrolein.**	See *Acrolein, β-2-furyl-.*		
4072	**Furacrylic acid.**	See 2-*Furanacrylic acid.*		
4073	**Fural.**	See *Furfural.*		
4074	**2-Furaldehyde.**	See *Furfural.*		
4075	**Furan**	furfuran	$\underbrace{OCH{:}CHCH{:}CH}$	68.07
4076	**——, 2-acetyl-.**	See *Ketone, 2-furyl methyl.*		
4077	**——, 2-benzoyl-.**	See *Ketone, 2-furyl phenyl.*		
4078	**——, 3-bromo-**	β-furyl bromide	C_4H_3OBr	146.98
4079	**——, 2-butoxymethyltetrahydro-**	tetrahydrofurfuryl *n*-butyl ether	$C_4H_7O\cdot CH_2OC_4H_9$	158.24
4080	**——, 2-chloro-**	α-furyl chloride; α-chlorofurfuran	C_4H_3OCl	102.52
4081	**——, 2-chloromercuri-**		C_4H_3OHgCl	303.13
4082	**——, 2-(chloromethyl)-**	furfuryl chloride	$C_4H_3OCH_2Cl$	116.55
4083	**——, 2-(chloromethyl)tetrahydro-**	tetrahydrofurfuryl chloride	$C_4H_7O\cdot CH_2Cl$	120.58
4084	**——, 2-(diethoxymethyl)-**	furfural diethyl acetal	$C_4H_3O\cdot CH\text{-}(OC_2H_5)_2$	170.20
4085	**——, 2,5-dimethyl-**		$C_4H_2O(CH_3)_2$	96.12
4086	**——, 2,5-dinitro-**		$C_4H_2O(NO_2)_2$	158.07
4087	**——, 2,5-diphenyl-**		$C_4H_2O(C_6H_5)_2$	220.26
4088	**——, 2-ethoxymethyltetrahydro-**	tetrahydrofurfuryl ethyl ether	$C_4H_7O\cdot CH_2OC_2H_5$	130.18
4089	**——, 2-iodo-**	α-furyl iodide	C_4H_3IO	193.98
4090	**——, 3-iodo-**	β-furyl iodide	C_4H_3IO	193.98
4091	**——, 2,2′-mercuridi-.**	See *Mercury, di-2-furyl-.*		
4092	**——, 2-methyl-.**	silvan; sylvan	$C_4H_3OCH_3$	82.10
4093	**——, 3-methyl-**		$C_4H_3O\cdot CH_3$	82.10
4094	**——, 2-nitro-**		$C_4H_3O\cdot NO_2$	113.07
4095	**——, tetrahydro-**	tetramethylene oxide	$\underbrace{OCH_2CH_2CH_2CH_2}$	72.10
4096	**——, thio-.**	See *Thiophene.*		
4097	**——, 2,3,4-trichloro-**		C_4HCl_3O	171.42

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4064	col. monocl. pr.	1.635^{20}_{4}	287 (293–5)	290; subl. 200	0.70^{25}, 9.8^{100}	$5.75^{29.7}$, 4.76^{76}	0.72^{25} eth.; v. sl. s. CCl_4, chl.
4065	col. liq.......	1.054^{20}_{20}	0.6	218	sl. s.	s.	s. eth.
4066	col. tricl. pr...	....	102	192	i.	sl. s.	sl. s. eth.; s. c. chl.
4067	pl...........	....	66	147^{16}	sl. s.	v. s.	v. s. eth.
4068	pl...........	....	185–6	d. 200	s.	s.	....
4069	pl. f. ac. a....	....	191–2	subl.	v. s.	v. s.	v. s. eth.; sl. s. bz.
4070							
4071							
4072							
4073							
4074							
4075	col. liq., 1.42157	0.9444^{15}; 0.9366^{20}_{4}	....	32^{758}	i.	v. s.	v. s. eth.
4076							
4077							
4078	liq., 1.4981....	1.650^{20}_{4}	....	$101.9–2.2^{744}$	i.	s.	....
4079	col. liq.......	0.9150^{20}_{4}	....	$194.5–6.0^{721}$	i.	s.	s. eth.
4080	col. liq., 1.4571	1.1923^{20}_{4}	....	$77.2–7.5^{744}$	i.	s.	
4081	col. cr. powd. f. al.	....	148	....	i.	s. h.	sl. s. eth.
4082	col. liq., 1.4941	1.1783^{20}_{4}	....	$49.1–9.4^{26}$	i.	s.	s. eth.
4083	col. liq.......	1.1102^{20}_{4}	....	$149.0–9.5^{721}$	......	......	....
4084	col. liq.......	....	....	$184–5^{740}$	i.	v. s.	....
4085	col. liq., 1.4363	$0.9026^{17.7}_{4}$	....	94	i.	s.	s. eth., chl., ac. a., bz.
4086	need. f. w., pr. f. al.	....	101	....	......	i. c.	s. eth.
4087	need. or leaf. f. dil. al.	....	91	343–5	i.	v. s.	v. s. eth.; s. most org. solv.
4088	col. liq.......	0.9386	....	$152–4^{726}$	......	......	....
4089	col. oil, 1.5661^{20}	2.024^{20}_{4}	....	$43–5^{15}$	......	......	s. eth.
4090	col. liq.......	2.045^{20}_{4}	....	132.2^{732}	i.	......	s. eth.
4091							
4092	col. liq........	0.916	....	$62.5–3.0^{737}$	i.	s.	s. eth.
4093	col. liq.......	0.923^{18}_{4}	....	65.5	......	s.	s. eth.
4094	lt. yel. monocl. f. pet. eth.	....	28.8–9.2	....	i.	......	s. eth., alk.
4095	liq., 1.4040^{25}...	....	....	64–66	v. s.	s.	....
4096							
4097	....	1.5471^{20}_{4}	....	$151.7–2.7^{734}$	......	......	....

No.	Name	Synonyms	Formula	Mol. Wt.
4098	**2-Furanacetonitrile**	2-furylacetonitrile; furfuryl cyanide	$C_4H_3O \cdot CH_2CN$	107.11
4099	**2-Furanacrylic acid**	β-2-furylacrylic acid; 2-furalacetic acid; furacrylic acid	$C_4H_3OCH{:}CH\text{-}COOH$	138.12
4100	——, amyl ester	*n*-amyl β-2-furylacrylate	$C_4H_3OCH{:}CH\text{-}COOC_5H_{11}$	208.25
4101	——, butyl ester	*n*-butyl β-2-furylacrylate	$C_4H_3OCH{:}CH\text{-}COOC_4H_9$	194.22
4102	——, ethyl ester	ethyl β-2-furylacrylate; ethyl furacrylate	$C_4H_3OCH{:}CH\text{-}COOC_2H_5$	166.17
4103	——, methyl ester	methyl β-2-furylacrylate	$C_4H_3OCH{:}CH\text{-}COOCH_3$	152.14
4104	——, propyl ester	*n*-propyl β-2-furylacrylate	$C_4H_3OCH{:}CH\text{-}COOC_3H_7$	180.20
4105	**2-Furancarbinol.**	See *Furfuryl alcohol.*		
4106	**2-Furancarbonal*.**	See *Furfural.*		
4107	**2-Furancarbonyl chloride.**	See *2-Furoyl chloride.*		
4108	**2-Furancarboxylic acid.**	See *Furoic acid.*		
4109	**3-Furancarboxylic acid**	3-furoic acid	$C_4H_3O \cdot COOH$	112.08
4110	**——, 4,5-dihydro-5-keto-.**	See *Aconic acid.*		
4111	**——, 2,5-dimethyl-.**	See *Pyrotritaric acid.*		
4112	**——, 2-methyl-**		$CH_3C_4H_2O \cdot COOH$	126.11
4113	——, ——, ethyl ester		$CH_3C_4H_2O \cdot COOC_2H_5$	154.16
4114	**——, tetrahydro-5-oxo-.**	See *Paraconic acid.*		
4115	**2,5-Furandicarbonyl chloride.**	See *Dehydromucyl chloride.*		
4116	**2,3-Furandicarboxylic acid**		$C_4H_2O(COOH)_2$	156.09
4117	——, dimethyl ester		$C_4H_2O(COOCH_3)_2$	184.14
4118	**2,5-Furandicarboxylic acid.**	See *Dehydromucic acid.*		
4119	**2,5-Furandione.**	See *Maleic anhydride.*		
4120	**2-Furanmethylamine.**	See *Furfurylamine.*		
4121	**Furfural**	2-furancarbonal*; 2-furaldehyde; fural; furfuraldehyde; furole; furfurole	C_4H_3OCHO	96.08
4122	——, diacetate	furfurylidene diacetate	$C_4H_3OCH\text{-}(OOCCH_3)_2$	198.17
4123	——, diethyl acetal.	See *Furan, 2-(diethoxymethyl)-.*		
4124	——, hydramide	See *Hydrofuramide.*		
4125	——, phenylhydrazone		$C_4H_3OCH{:}NNH\text{-}C_6H_5$	186.21
4126	**——, 5-methyl-**	-methylfurfurole	$CH_3C_4H_2O \cdot CHO$	110.11
4127	**——, 5-nitro-**		$NO_2C_4H_2O \cdot CHO$	141.08
4128	**——, tetrahydro-**	furfural tetrahydride	$C_4H_7O \cdot CHO$	100.11
4128T	**Furfural acetone.**	See *Acetone, furfurylidene-.*		
4129	**Furfuralcohol.**	See *Furfuryl alcohol.*		
4130	**Furfuramide.**	See *Hydrofuramide.*		
4131	**Furfuran.**	See *Furan.*		
4132	**Furfurine**		$C_{15}H_{12}N_2O_3$	268.26
4133	**Furfurole.**	See *Furfural.*		
4134	**Furfuryl alcohol**	2-furancarbinol; furfuralcohol; α-furylcarbinol.	$C_4H_3O \cdot CH_2OH$	98.10
4135	——, acetate		$C_4H_3OCH_2OOC\text{-}CH_3$	140 13
4136	——, butyrate		$C_4H_3OCH_2\text{-}OOCC_3H_7$	168.19

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4098	col. liq	$1.0854\frac{25}{4}$	78–80^{20}	....	sl. s.	v. s.	v. s. eth.
4099	wh. need. f. w., odorless, 1.5286^{20}	....	141	226; 117^{8}	i.	s.	s. eth.
4100	col. liq	$1.0322\frac{20}{4}$	....	119.4	i.	......	....
4101	col. liq	$1.0482\frac{20}{4}$	....	121.0^{5}	i.	s.	....
4102	col. liq., 1.5286^{20}	$1.0891\frac{25}{4}$	24.5	132–3^{18}; 117^{8}	i.	s.	....
4103	col. liq., 1.4447^{20}	....	27	114–5^{16}; 227–8^{744}	i.	s.	....
4104	col. liq., 1.5229^{20}	1.0744	....	119^{7}	i.	s.	....
4105							
4106							
4107							
4108							
4109	col. need. f. w.	....	120.5–1.5	105–10^{12}	i. c.	......	v. s. eth.
4110							
4111							
4112	col. cr. f. w.	....	102–3	....	....	s.	s. eth.
4113	col. liq	....	....	85–7^{20}	i.	......	s. eth.
4114							
4115							
4116	col. cr. powd	....	225	....	s.	s.	s. eth.
4117	col. gran. cr	....	37	....	i.	s.	v. s. eth.
4118							
4119							
4120							
4121	col.-yel. liq.; almond odor, 1.52608^{20}	$1.1598\frac{20}{4}$	−36.5	161.7	8.3^{20} 19.9^{90}	∞	∞ eth.
4122	col. cr. f. pet. eth.	....	52–3	220 (143–4^{20})	i.	s.	s. eth.
4123							
4124							
4125	....	....	97	....	i.	s.	s. eth.
4126	col. liq	$1.1072\frac{18}{4}$; $1.109\frac{18}{18}$	....	187; 106–7^{60}	3.3	v. s.	∞ eth.
4127	straw yel	....	36	....	......	......	s. eth.
4128	col. liq	$1.10947\frac{25}{4}$	....	144–5^{740}	i.	s.	....
4128T							
4129					......		
4130							
4131							
4132	lt. br. need	....	117	....	i.	s.	s. eth.
4133							
4134	col.-yel. liq., almost odorless, 1.4850^{25}	$1.1296\frac{20}{4}$	....	171^{750}	∞	∞	∞ eth.
4135	col. liq., 1.4603^{25}	$1.1175\frac{20}{4}$	....	175–7^{764}	i.	s.	s. eth.
4136	col. liq	$1.0530\frac{20}{4}$	....	212–3^{764} (69–70^{1})	v. sl. s.	s.	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4137	**Furfuryl alcohol**, propionate	....	$C_4H_3OCH_2OOCC_2H_5$	154.16
4138	——, 2-furoate..........	furfuryl furoate; furfuryl pyromucate	$C_4H_3OCO_2CH_2C_4H_3O$	192.16
4139	**——, 5-methyl-**.......	5-methyl-2-furancarbinol. ..	$CH_3C_4H_2O{\cdot}CH_2OH$	112.12
4140	**——, tetrahydro-**......	tetrahydro-2-furancarbinol...	$C_4H_7O{\cdot}CH_2OH$....	102.13
4141	**Furfurylamine**...	2-furanmethylamine.........	$C_4H_3OCH_2NH_2$...	97.11
4142	**——, tetrahydro-**......	tetrahydro-2-furanmethylamine	$C_4H_7OCH_2NH_2$...	101.15
4143	**Furfuryl chloride.**	See *Furan, 2-(chloromethyl)-.*		
	Furfuryl esters.	See under *Furfuryl alcohol.*		
4144	**Furfurylidene diacetate.**	See *Furfural, diacetate.*		
4145	**Furfuryl mercaptan**...	2-furylmethanethiol.........	$C_4H_3OCH_2SH$.....	114.16
4146	**Furil**.................	bipyromucyl; di-2-furylglyoxal	$C_4H_3OCOCOC_4H_3O$	190.15
4147	**2-Furoic acid, Furoic acid**	2-furancarboxylic acid; pyromucic acid	C_4H_3OCOOH.....	112.08
4147D	——, amyl ester..........	*n*-amyl furoate............	$C_4H_3O{\cdot}COOC_5H_{11}$	182.21
4147E	——, butyl ester..........	*n*-butyl furoate............	$C_4H_3O{\cdot}COOC_4H_9$..	168.19
4147F	——, *sec*-butyl ester........	*sec*-butyl furoate............	$C_4H_3O{\cdot}COOC_4H_9$..	168.19
4147G	——, ethyl ester..........	ethyl furoate............	$C_4H_3O{\cdot}COOC_2H_5$..	140.13
4147H	——, furfuryl ester.	See *Furfuryl alcohol, 2-furoate.*		
4147J	——, heptyl ester.........	*n*-heptyl furoate..........	$C_4H_3O{\cdot}COOC_7H_{15}$.	210.27
4147K	——, hexyl ester..........	*n*-hexyl furoate............	$C_4H_3O{\cdot}COOC_6H_{13}$.	196.24
4147L	——, isoamyl ester.........	isoamyl furoate............	$C_4H_3O{\cdot}COOC_5H_{11}$.	182.21
4147M	——, methyl ester..........	methyl furoate...........	$C_4H_3O{\cdot}COOCH_3$...	126.11
4147N	——, octyl ester..........	*n*-octyl furoate............	$C_4H_3O{\cdot}COOC_8H_{17}$.	224.29
4147P	——, propyl ester..........	*n*-propyl furoate...........	$C_4H_3O{\cdot}COOC_3H_7$..	154.16
4147Q	**——, 3-bromo-**........	β-bromopyromucic acid.....	$C_4H_2BrO{\cdot}COOH$..	190.99
4147R	**——, 5-bromo-**........	δ-bromopyromucic acid......	$BrC_4H_2O{\cdot}COOH$..	190.99
4147S	——, ——, ethyl ester	....	$BrC_4H_2O{\cdot}COOC_2H_5$	219.04
4147T	**——, 3-chloro-**........	β-chloropyromucic acid......	$ClC_4H_2O{\cdot}COOH$...	146.53
4147U	**——, 5-chloro-**........	δ-chloropyromucic acid.....	$ClC_4H_2O{\cdot}COOH$...	146.53
4147V	**——, 5-methyl-**.......	....	$CH_3C_4H_2O{\cdot}COOH$	126.11
4147W	——, ——, methyl ester	....	$CH_3C_4H_2O{\cdot}COOCH_3$	140.13
4147X	**——, 5-nitro-**.........	....	$NO_2C_4H_2O{\cdot}COOH$	157.08
4147Y	**——, tetrahydro-**......	tetrahydropyromucic acid....	$C_4H_7O{\cdot}COOH$.....	116.11
4148	**3-Furoic acid.**	See 3-*Furancarboxylic acid.*		
4149	**Furoin**...............	....	$C_4H_3OCHOHCOC_4H_3O$	192.16

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4137	col. liq	$1.1085\frac{20}{4}$	....	$195\text{–}6^{762}$	v. sl. s. (i.)	s.	∞ eth.
4138	dimorphous ...	1.395; (1.330)	27.5 (19.5)	122^{2}	i.	s.	s. eth.
4139	col. liq	$1.0769\frac{20}{4}$	....	$194\text{–}6^{744}$	s.	v. s.	v. s. eth.
4140	col., almost odorless liq., 1.4502^{19}	$1.0495\frac{20}{4}$	....	$177\text{–}78^{743}$	∞	∞	∞ eth.
4141	col. liq	<1	....	144–6	∞	s.	s. eth.
4142	col. liq	....	....	$151\text{–}2^{735}$	∞	∞	∞ eth.
4143							
4144							
4145	col. oily liq., 1.5329	$1.13186\frac{20}{4}$	....	$155; 84^{65}$	i.	......	....
4146	yel. need......	....	165–6	....	i.	s.	s. eth.
4147	wh. monocl. need., subl.	....	133	230–2; subl. 100	3.57^{15}	s.	v. s. eth.
4147 D	col. liq	1.0335	....	$95\text{–}7^{1}$	i.	∞	....
4147 E	col. oil, d. on standing	1.0555	....	$118\text{–}20^{25}$; $83\text{–}4^{1}$	i.	∞	∞ eth.
4147 F	col. liq	1.0465	....	$67\text{–}9^{1}$	i.	∞	∞ eth.
4147 G	wh. leaf. or pr., $1.4797^{20.8}$	$1.0974\frac{40}{4}$; $1.1774\frac{21}{4}$	34 (30–3)	195^{706}	i.	∞	∞ eth.
4147 H							
4147J	col. liq	$1.0005\frac{20}{4}$	....	$116\text{–}7^{1}$	i.	s.	....
4147 K	col. liq	$1.0170\frac{20}{4}$	....	$105\text{–}7^{1}$	i.	s.	....
4147L	col. liq	....	....	$135\text{–}7^{25}$	i.	∞	....
4147M	col. liq.; turns yel. in light, 1.4860^{20}	$1.1739\frac{15}{15}$	....	181.3	i. (sl. s.)	∞	∞ eth.
4147 N	col. liq	0.9885	....	$126\text{–}7^{1}$	i.	s.	....
4147P	col. liq........	1.075	....	211	i. (sl. s.)	s.	∞ eth.
4147Q	wh. need. f. w.	....	127–9	....	1.3^{20}	s.	s. eth.; v. sl. s. lgr., CS_2
4147R	wh. leaf. f. w..	....	186	....	v. sl. s. c.	s.	v. s. eth.
4147S	pr	1.528^{20}	17	235^{767}	i.	s.	s. eth.
4147T	wh. cr........	....	148.5–9.5	....	i.	s.	....
4147U	wh. leaf	....	179–80	....	0.3^{20}	s.	....
4147V	pl. or need. f. w.	....	108–9	....	v. s. h.	v. s.	v. s. eth.
4147W	col. liq	....	....	98^{15}	......	......	s. eth.
4147 X	wh. cr. f. w...	....	185.0–5.5	subl.	s. h.	s.	s. eth.
4147Y	wh. cr........	1.1933	21	$131\text{–}2^{14}$	......	......	....
4148							
4149	lt. br. need....	....	134–5	....	i.	sl. s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4150	**Furole.**	See *Furfural.*		
4151	**Furoyl chloride**	2-furoyl chloride; pyromucyl chloride	C_4H_3OCOCl	130.53
4152	**β-Furyl bromide.**	See *Furan, 3-bromo-.*		
4152H	**α-Furyl chloride.**	See *Furan, 2-chloro-.*		
4152M	**α-Furyl iodide.**	See *Furan, 2-iodo-.*		
4152S	**β-Furyl iodide.**	See *Furan, 3-iodo-.*		
4153	**G acid.**	See 2-*Naphthol*-6,8-*disulfonic acid.*		
4154	**D-Galactonic acid**	*d*-lactonic acid	$CH_2OH(CHOH)_4COOH$	196.16
4155	**D-Galactose**		$C_6H_{12}O_6$	180.16
4156	**D-Galacturonic acid**		$C_5H_9O_5COOH$	194.14
4157	**Gallacetophenone**	2,3,4-trihydroxyacetophenone; 4-acetylpyrogallol	$CH_3COC_6H_2(OH)_3$	168.14
4158	**Gallanilide**	gallanol; 3,4,5-trihydroxybenzanilide	$C_6H_5NHCOC_6H_2(OH)_3$	245.23
4159	**Gallein**	pyrogallolphthalein, 4,5-dihydroxyfluoresceïn	$C_{20}H_{12}O_7$	364.30
4160	**Gallic acid**	3,4,5-trihydroxybenzoic acid	$(HO)_3C_6H_2COOH$	170.12
4161	——, 3-monogallate.	See *m-Digallic acid.*		
4162	——, trimethyl ether.	See *Benzoic acid, 3,4,5-trimethoxy-.*		
4163	**Gallin**	3,4,5,6-tetrahydroxy-9-xanthene-*o*-benzoic acid	$C_{20}H_{14}O_7$	366.31
4164	**Gelsemine**, compd. with acetone		$C_{20}H_{22}N_2O_2\cdot(CH_3)_2CO$	380.47
4165	***d*-Gelsemine**		$C_{20}H_{22}N_2O_2$	322.39
4166	——, hydrochloride		$C_{20}H_{22}N_2O_2\cdot HCl$	358.86
4167	**Gentianin.**	See *Gentisin.*		
4167M	**Gentiobiose**	amygdalose	$C_{12}H_{22}O_{11}$	342.30
4168	**Gentisic acid**	2,5-dihydroxybenzoic acid; hydroquinonecarboxylic acid	$(HO)_2C_6H_3COOH\cdot 3H_2O$	208.17
4169	**——, 4-hydroxy-.**	See *Benzoic acid, 2,4,5-trihydroxy-.*		
4170	**Gentisin**	1,7-dihydroxy-3-methoxyxanthone; 3-methoxyeuxanthone; gentianin	$C_{14}H_{10}O_5$	258.22
4171	**Geranial.**	See *Citral a.*		
4172	**Geranic acid**	3,7-dimethyl-2,6(and 2,7)-octadienoic acid*	$C_{10}H_{16}O_2$	168.23
4173	**Geraniol**	3,7-dimethyl-2,6-octadien-1-ol*, one form	$C_{10}H_{17}OH$	154.25
4174	——, acetate	geranyl acetate	$C_{12}H_{20}O_2$	196.28
4175	——, butyrate	geranyl butyrate	$CH_3(CH_2)_2COOC_{10}H_{17}$	224.33
4176	——, formate		$HCOOC_{10}H_{17}$	182.26
4177	**——, dihydro-.**	See *dl-Citronellol.*		
4178	**——, tetrahydro-.**	See 1-*Octanol, 3,7-dimethyl-**.		
	Geranyl esters.	See under *Geraniol.*		
4179	**Germanium, tetraphenyl-***		$(C_6H_5)_4Ge$	381.00
4180	***d*-Glaucine**		$C_{21}H_{25}NO_4$	355.42
4180M	**Glaurin.**	See *Diethylene glycol, monolaurate.*		
4181	**Glonoin.**	See *Nitroglycerin.*		
4182	**Glucide.**	See *Saccharin.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4150							
4151	col. liq., lachrymatory	....	0	59.5–61.5^{7}; 176	d.	......	s. eth.
4152							
4152H							
4152M							
4152S							
4153							
4154	need. f. w.....	....	95–100	d. 140–1	s.	......	....
4155	hex. tab. f. al..	....	+1H_2O 118–20; anh. 165–8	....	10.3^{0}, 68.3^{25}	0.59^{38} 85%	v. sl. s. me. al.
4156	micro. need., [α]+53.59°$_D$	....	159–60 d.	....	s.	s. h.	i. eth.
4157	leaf.........	....	173	....	sl. s.	s.	s. eth.; v. sl. s. bz.
4158	col. cr. or powd.	....	205	....	s. h.	s.	s. eth.
4159	red cr. powd ..	....	d.	....	v. sl. s. h.	s.	sl. s. h. eth.; s. alk.
4160	col. monocl. need. f. w.	$1.694\frac{4}{4}$	220 d.	d.	1.16^{25}, 33^{100}	27.2^{25}	2.5^{15} eth.; s. glyc.
4161							
4162							
4163	need.........	....	....	....	s.	s.	s. eth.
4164	pr. f. acet.....	....	anh. at 120	....	......	......	....
4165	....	....	178	....	i.	s.	s. eth., chl., bz.
4166	pr. f. w.......	....	300	....	s.	sl. s.	....
4167							
4167M	two cr. forms: α and β	....	α189–95; β190–95	....	s.	......	s. h. me. al.
4168	col. need. f. w.	....	200	d.	v. s.	v. s.	v. s. eth.; i. CS_2, chl., bz.
4169							
4170	yel. need......	....	267	400 subl.	v. sl. s.	sl. s. h.	sl. s. h. eth.; s. alk.
4171							
4172	thin oil, 1.48695$^{20.2}$	$0.952\frac{20}{4}$	....	119^{20}	i.	s.	s. eth.
4173	col. liq., 1.4798	$0.8812\frac{16}{4}$	<−15	229; 120–2^{17}	i.	∞; 5.41 50%	∞ eth.
4174	col. liq., 1.4660	$0.917\frac{15}{4}$	....	242–5^{764} d.	v. sl. s.	v. s.	∞ eth.
4175	....	$0.9008\frac{17}{4}$	....	151–3^{18}	i.	s.	s. eth.
4176	liq...........	$0.927\frac{20}{4}$	....	113–4^{15}	i.	s.	s. eth.
4177							
4178							
4179	col. tetr......	....	235.7	>400	i.	......	sl. s. eth., acet., lgr.; s. chl., bz., tol.
4180	yel. rhomb. pr.	....	119–20	....	s. h.	v. s.	s. eth.; v. s. chl.; sl. s. bz.
4180M							
4181							
4182							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4184	D-**Gluco-α-heptose** . . .	. . . .	$CH_2OH(CHOH)_5$- CHO	210.18
4185	D-**Gluconic acid**	dextronic acid; *d*-glyconic acid; maltonic acid; glycogenic acid	$C_5H_6(OH)_5COOH$	196.16
4186	——, δ-lactone.	. . . .	$\underbrace{C_5H_6(OH)_4COO}$	178.14
4186M	D-**Glucosamine**	chitosamine; 2-amino-D-glucose	$C_6H_{13}NO_5$.	179.17
4187	D-**Glucosazone.**	See D-*Glucose, phenylosazone.*		
4188	**Glucose,** β-glucoside.	See *Cellobiose.*		
4188M	——, **tetraethyl-.**	See D-*Glucose, tetraethyl ether.*		
4189	D-**Glucose** (anh.)	dextrose; grape sugar.	$C_6H_{12}O_6$.	180.16
4190	——, (α)	. . . .	$C_6H_{12}O_6{\cdot}H_2O$.	198.17
4191	——, (β)	. . . .	$C_6H_{12}O_6.H_2O$.	198.17
4192	——, diacetate.	diacetyl-*d*-glucose.	$C_5H_6(OOCCH_3)_2$- $(OH)_3CHO$	264.23
4193	——, α-pentaacetate.	pentaacetyl-α-*d*-glucose.	$C_6H_7O(OOCCH_3)_5$	390.34
4194	——, β-pentaacetate.	β-pentaacetyl-*d*-glucose.	$C_6H_7O_6(OCCH_3)_5$. .	390.34
4195	——, μ-pentaacetate.	. . . .	$C_6H_7O(OOCCH_3)_5$	390.34
4197	——, α-phenylhydrazone. . . .	. . . .	$C_6H_{12}O_5NNHC_6H_5$	270.28
4198	——, β-phenylhydrazone. . . .	. . . .	$C_6H_{12}O_5NNHC_6H_5$	270.28
4199	——, phenylosazone.	*d*-glucosone bisphenylhydrazone; detxrosazone; *d*-glucosazone	$C_6H_{10}O_4$- $(:NNHC_6H_5)_2$	358.39
4199H	——, tetraethyl ether.	tetraethylglucose.	$C_{14}H_{28}O_6$.	292.37
4199R	——, **2-amino-.**	See D-*Glucosamine.*		
4200	——, **pentaacetyl-.**	See D-*Glucose, pentaacetate.*		
4202	D-**Glucoside, α-methyl-**	. . . .	$C_7H_{14}O_6$.	194.18
4203	——, **β-methyl-**.	. . . .	$C_7H_{14}O_6$.	194.18
4204	D-**Glucosone,** bisphenylhydrazone.	See D-*Glucose, phenylosazone.*		
4205	**Glutamic acid, β-hydroxy-(DL)**	*dl*-α-amino-β-hydroxyglutaric acid	$COOHCH_2CH$- $(OH)CH(NH_2)$- COOH	163.13
4206	**β-hydroxy-(L)**.	*d*-2-amino-3-hydroxypentanedioic acid	$COOHCH_2CHOH$- $CH(NH_2)COOH$	163.13
4207	DL-**Glutamic acid**.	*dl*-glutaminic acid; *dl*-α-aminoglutaric acid	$COOH(CH_2)_2CH$- $(NH_2)COOH$	147.13
4208	L-**Glutamic acid**.	*d*-glutaminic acid; *d*-α-aminoglutaric acid	$COOH(CH_2)_2CH$- $(NH_2)COOH$	147.13
4209	D-**Glutamic acid**.	*l*-glutaminic acid; *l*-α-aminoglutaric acid	$C_3H_5(NH_2)$- $(COOH)_2$	147.13

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4184	rhomb. pl. f. w.	....	215 d. (180–90)	....	9.5, v. s. h.	v. sl. s.	....
4185	cr.	....	125–6; (130–2)	....	s.	i.	i. eth.
4186	need	....	146 (130–5)	....	......	......	....
4186M	need. f. et. al.	....	110	....	s.	sl. s.	i. eth., $CHCl_3$
4187							
4188							
4188M							
4189	rhomb. need. f. al.	$1.544\frac{25}{4}$	(+1H_2O 118–20) anh. 146	....	$83^{17.5}$	$1.94^{17.5}$	i. eth.
4190	....	$1.544\frac{25}{4}$	146	....	32.3^{0}, 82.0^{25}	2 (initial), 4.5 (final) 80%	....
4191	need. f. al.	$1.5620\frac{18}{4}$	150	....	154^{15}	4.9 (initial), 9.1 (final) 80%	i. eth.
4192	col. cr. or lt. yel. amor.	....	<100	....	s.	s.	s. eth.; i. bz.
4193	fine need. f. lgr. or al.	....	113 (111–2)	subl.	$0.15^{18.5}$	1.32^{15}	2.7^{15} eth.
4194	need. f. al.	....	131	....	$0.09^{18.5}$	0.82^{19}	2.1^{15} eth.
4195	monocl. tab.	....	116–8	....	s. warm	s.	sl. s. eth.
4197	col. cr.	....	160	....	v. s.	v. s. h.	v. sl. s. eth.
4198	col. need.	....	141	....	sl. s.	s.	v. sl. s. c. eth.
4199	yel. need.	....	208 d.	....	v. sl. s.	s. h.	....
4199H	$[\alpha]_D^{20}$ 65.3°	....	61–4	$138–9^{0.5}$	......	......	....
4199R							
4200							
4202	rhomb. f. w.	....	165	....	63	1.6	i. eth.
4203	tetr. f. al.	....	104	....	58	4.2	i. eth.
4204							
4205	rhomb. pr. and need.	....	198 d.	....	v. s. h.	......	....
4206	pr. f. w.	....	soft. 100; hyd. 105; (rac. 198 d.)	d. >100	v. s.	i.	i. eth.; v. s. ac. a.
4207	tetr. pl.	$1.4601\frac{20}{4}$	225–7 d.	....	2.64^{25}, 8.16^{50}	v. sl. s.	v. sl. s. eth.
4208	tetr. pl.	1.538	208 d.	....	0.89^{25}, 2.23^{50}	0.037^{25} 75% 0.003^{25} 100%	0.007^{25} me. al.; 0.0004^{25} acet.
4209	col. rhomb. pl. f. w., 1.490, 1.605, 1.620	1.538 (1.460)	202 (198); *l* 213 d.	....	1.5^{20}	0.07^{15}	i. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4210	**L-Glutamic acid,** hydrochloride		$C_5H_9NO_4{\cdot}HCl$	183.60
4211	**L-Glutamine**	*d*-α-aminoglutaramic acid	$C_3H_5(NH_2)$-$(CONH_2)COOH$	146.15
4212	**Glutaramic acid, α-amino-.**	See *Glutamine.*		
4213	**Glutaric acid**	pentanedioic acid*	$COOH(CH_2)_3$-$COOH$	132.11
4214	——, diethyl ester	diethyl pentanedioate*; ethyl glutarate	$C_2H_5OOC(CH_2)_3$-$COOC_2H_5$	188.22
4215	——, piperazinium salt		$C_4H_{10}N_2{\cdot}2C_5H_8O_4$	350.37
4216	——, **α-amino-.**	See *Glutamic acid.*		
4218	——, **α-hydroxy-**	2-hydroxypentanedioic acid*	$COOHCHOH$-$(CH_2)_2COOH$	148.11
4219	——, **β-keto-.**	See *Acetonedicarboxylic acid.*		
4220	——, **α,β,γ-trihydroxy-(*dl*)**		$COOH(CHOH)_3$-$COOH$	180.11
4221	——, **α,β,γ-trihydroxy-(*d* or *l*)**	2,3,4-trihydroxypentanedioic acid*	$COOH(CHOH)_3$-$COOH$	180.11
4222	**Glutaronitrile**	pentanedinitrile*; trimethylene dicyanide; trimethylene cyanide	$CN(CH_2)_3CN$	94.11
4223	**Glyceraldehyde**	2,3-dihydroxypropanal*; α, β-dihydroxypropionaldehyde	$CH_2OHCHOH$-CHO	90.08
4224	**Glyceric acid**	2,3-dihydroxypropanoic acid*; α, β-dihydroxypropionic acid	$CH_2OHCHOH$-$COOH$	106.08
4225	——, ethyl ester	ethyl 2,3-dihydroxypropanoate*	$CH_2OHCHOH$-$COOC_2H_5$	134.13
4226	——, methyl ester	methyl glycerate	$CH_2OHCHOH$-$COOCH_3$	120.10
4227	**Glycerin.**	See *Glycerol.*		
4228	**Glycerol**	glycerin; 1,2,3-propanetriol*	$CH_2OHCHOH$-CH_2OH	92.09
4229	——, borate	glyceryl borate	$(C_3H_5BO_3)_x$	$(99.89)_x$
4230	——, α-chlorohydrin.	See 1,2-*Propanediol, 3-chloro-**.		
4231	——, diacetate	diacetin	$C_3H_5(OH)$-$(OOCCH_3)_2$	176.17
4232	——, *sym*-dichlorohydrin.	See 2-*Propanol,* 1,3-*dichloro-**.		
4233	——, *uns*-dichlorohydrin.	See 1-*Propanol,* 2,3-*dichloro-**.		
4234	——, 1,3-dilaurate	α, γ-dilaurin	$(C_{11}H_{23}COO)_2$-C_3H_5OH	456.69
4235	——, 1,3-dinitrate		$C_3H_5(OH)(NO_3)_2{\cdot}\frac{1}{2}H_2O$	191.10
4236	——, 1,3-dipalmitate	α, γ-dipalmitin	$(C_{15}H_{31}COO)_2$-C_3H_5OH	568.90
4237	——, 1,3-distearate	α, γ-distearin	$(C_{17}H_{35}COO)_2$-C_3H_5OH	625.01
4238	——, ethylidene ether.	See *Acetoglyceral.*		
4239	——, monoacetate	monoacetin	$CH_2OHCHOH$-CH_2OOCCH_3	134.13
4240	——, 1-monolaurate	α-monolaurin	$C_{11}H_{23}COOCH_2$-$CHOHCH_2OH$	274.39
4241	——, α-mononitrate		$CH_2OHCHOH$-CH_2ONO_2	137.09

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4210	tricl. pl., [α] 1.546°D; [β]1.559°D	....	d. 201	....	v. s., d.	s.	v. sl. s. conc. HCl
4211	need	....	185–6	....	4.25^{25}	$.00046^{25}$	i. eth.
4212							
4213	col. monocl., $1.4188^{106.4}$	$1.429\frac{15}{4}$; $1.192\frac{106}{4}$	97.5; 95–6	304 d.	64^{20}	v. s.	v. s. eth.; s. bz., chl.; sl. s. pet. eth.
4214	syrup 1.4241^{20}	$1.025\frac{20}{4}$	−24.1	237	0.88^{20}	v. s.	s. eth.
4215	wh. cr	....	152	....	s.	s. h.	i. eth.
4216							
4218	sm. col. cr	....	72–3	....	s.	s.	....
4219							
4220	col. tab. f. acet.	....	152 d.	....	v. s.	v. s. h.	s. acet.
4221	col. leaf. f. acet.	....	128	....	v. s.	v. s.	s. acet.
4222	col. liq., $1.4365^{23.2}$	$0.995\frac{15}{4}$	−29	287.4	s.	s.	i. eth.
4223	need. or pr. f. me. al.	$1.453\frac{18}{4}$	138	....	sl. s.	v. sl. s.	v. sl. s. eth.
4224	syrup	....	....	....	∞	∞	i. eth.; v. s. acet.
4225	liq	$1.191\frac{15}{15}$	....	230–40; 121^{14}	s.	v. s.	v. s. eth.
4226	liq	$1.279\frac{15}{4}$	....	239–44; 120^{14}	∞	∞	v. sl. s. eth.
4227							
4228	rhomb. or col. liq., 1.4729	$1.260\frac{20}{4}$	17.9, solidifies at a much lower temperature	290	∞	∞	i. eth., chl.
4229	glassy yel	....	....	....	d.	......	....
4230							
4231	col. liq	$1.184\frac{16}{4}$	40	176^{40}; 280 (250–3)	∞	v. s.	s. eth.; i. CS_2
4232							
4233							
4234	cr	....	56.6	....	......	s.	s. eth.
4235	liq	$1.47\frac{15}{4}$	<−30; anh. 26	148^{15}	7.7	v. s.	s. eth.
4236	cr. f. al. or chl.	....	70	....	......	sl. s. c., v. s. h.	sl. s. c., v. s. in eth.; s. chl.
4237	rhomb. pl. f. chl. or lgr.	....	79.1	....	......	sl. s. c., s. h.	sl. s. c., s. h eth.
4238							
4239	col. oil	$1.2060\frac{20}{4}$	....	158^{165}	v. s.	v. s.	sl. s. eth.; i. bz.
4240	wh. need	....	63.0	....	......	sl. s. c., s. h.	sl. s. c., s. h. eth.
4241	col. pr	$1.40\frac{15}{4}$	58	155–60	70	v. s.	v. sl. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4242	**Glycerol**, β-mononitrate		$CH_2OHCH(ONO_2)CH_2OH$	137.09
4243	——, 1-monoöleate	monoölein	$C_{17}H_{33}COOCH_2CHOHCH_2OH$	356.53
4244	——, 1-monopalmitate	α-monopalmitin	$C_{15}H_{31}COOCH_2CHOHCH_2OH$	330.50
4245	——, monoricinoleate		$C_{17}H_{32}(OH)COOC_3H_5(OH)_2$	372.53
4247	——, 1-monostearate	α-monostearin	$C_{17}H_{35}COOCH_2CHOHCH_2OH$	358.55
4248	——, 1-octadecyl ether.	See 1,2-*Propanediol, 3-octadecyloxy-**.		
4249	——, 1-sodium derivative	sodium glycerolate; sodium glycerate (so called)	$CH_2OHCHOHCH_2ONa$	114.08
4250	——, triacetate	triacetin	$C_3H_5(OOCCH_3)_3$	218.20
4251	——, tribenzoate	tribenzoin	$C_3H_5(OOCC_6H_5)_3$	404.40
4252	——, tribromohydrin.	See *Propane, 1,2,3-tribromo-**.		
4253	——, tributyrate	butyrin; tributyrin	$(CH_3CH_2CH_2CO)_3C_3H_5O_3$	302.36
4254	——, trichlorohydrin.	See *Propane, 1,2,3-trichloro-**.		
4255	——, trilaurate	trilaurin; laurin	$(C_{11}H_{23}COO)_3C_3H_5$	638.99
4256	——, trimyristate	myristin; trimyristin	$(C_{13}H_{27}COO)_3C_3H_5$	723.15
4257	——, trinitrate.	See *Nitroglycerin.*		
4258	——, trinitrite		$C_3H_5(ONO)_3$	179.09
4259	——, trioleate	triolein; olein; glyceryl oleate	$(C_{17}H_{33}COO)_3C_3H_5$	885.41
4260	——, tripalmitate	tripalmitin; palmitin	$(C_{15}H_{31}COO)_3C_3H_5$	807.30
4261	——, tristearate	stearin; tristearin	$(C_{17}H_{35}COO)_3C_3H_5$	891.46
4262	——, **1-thio-**	3-mercapto-1,2-propanediol*	$(HO)_2C_3H_5SH$	108.15
4263	**Glycerol ether** (of Berthelot and de Luca)	glyceryl ether	$C_6H_{10}O_3$	130.14
4264	**Glycerophosphoric acid**	glycerolphosphoric acid	$C_3H_5(OH)_2OPO_3H_2$	172.08
4265	**Glyceryl α-chlorohydrin.**	See 1,2-*Propanediol, 3-chloro-**.		
	Glyceryl esters.	See under *Glycerol.*		
4266	**Glyceryl ether.**	See *Glycerol ether (of Berthelot and de Luca).*		
4267	**Glyceryl nitrate.**	See *Nitroglycerin.*		
4268	**Glycidol**	2,3-epoxy-1-propanol*; epihydric alcohol; glycide	$\underbrace{OCH_2CH}CH_2OH$	74.08
4269	**Glycine**	aminoacetic acid; aminoethanoic acid*; glycocoll	NH_2CH_2COOH	75.07
4270	——, methyl ester	methyl aminoethanoate*	$NH_2CH_2COOCH_3$	89.09
4271	——, ***N*-(*p*-acetamidophenyl)-**	(*p*-acetamidoanilino)acetic acid	$CH_3CONHC_6H_4NHCH_2COOH$	208.21
4272	——, ***N*-acetyl-.**	See *Aceturic acid.*		
4273	——, ***N*-(*p*-aminophenyl)-**	(*p*-aminoanilino)acetic acid	$NH_2C_6H_4NHCH_2COOH$	166.18
4274	——, ***N*-benzoyl-.**	See *Hippuric acid.*		
4275	——, ***N*-carbamyl-.**	See *Hydantoic acid.*		
4276	——, ***N*-ethyl-**	(ethylamino)ethanoic acid*; (ethylamino)acetic acid; *N*-ethylglycocoll	$C_2H_5NHCH_2COOH$	103.12
4277	——, ***N*-DL-leucyl**		$(CH_3)_2CHCH_2CH(NH_2)CONHCH_2COOH$	188.23

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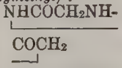
*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4242	leaf..........	1.40^{20}_{4}	54	160	s.	v. s.	sl. s. eth.
4243	....	0.947^{21}_{4}	35	....	i.	s.	v. s. eth.
4244	leaf..........	....	77.0	....	......	$5.306^{22.5}$	sl. s. c., s. h. eth.
4245	amber liq.....	1.0284^{20}_{4}	....	....	disper-sible	∞	∞ eth.
4247	need. or wax-like solid	0.9841^{20}_{4}	81.1 (57–8)	....	disper-sible	sl. s. c., v. s. h.	sl. s. c., v. s. h. eth.
4248							
4249	wh. powd.....	....	d. 245	....	d.	s.	....
4250	col. liq.......	1.161^{20}_{4}	−78	259	7.17	∞	∞ eth.
4251	need. f. me. al.	1.228^{12}_{4}	76.5	d.	i.	s. h.	v. s. eth.
4252							
4253	col. oily liq., 1.4359	1.0350^{20}_{4}	<−75	315 ($203–4^{25}$)	i.	v. s.	v. s. eth.
4254							
4255	col. need......	0.8944^{60}_{4}	46.4	....	i.	s.	s. eth.; v. s. bz.
4256	glit. need. f. eth., 1.4429^{60}	0.885^{60}_{4}	56.5	....	i.	s.	s. eth., bz.; v. s. chl.
4257							
4258	yel. liq.......	1.291^{10}_{16}	....	150 sl. d.	i.	d.	s. eth., chl., bz.; i. CS_2
4259	col. oil........	0.915^{20}_{4}	−17; frz.−6	240^{18}	i.	sl. s.	v.s. eth.; s. chl.
4260	col. need. f. eth., 1.4381^{80}	0.866^{80}_{4}	65.1; 46	310–20	i.	$.004^{21}$	v.s. eth.; s. chl.
4261	col. cr. f. eth., 1.4399^{80}	0.862^{80}_{4}	54.5; 70.8	....	i.	v. sl. s.	s. eth.
4262	thick liq......	1.295^{14}_{4}	....	d.	v. sl. s.	∞	i. eth.
4263	col. liq.......	1.091^{20}_{4}	....	173	∞	∞	∞ eth.
4264	col. oily liq....	1.59^{14}_{4}	−20	....	∞	∞	....
4265							
4266							
4267							
4268	col. liq.......	1.165^{0}_{4}	....	162 d.	∞	∞	∞ eth.
4269	wh. monocl., 1.495, 1.615, 1.650	1.601	233 d.; (225–30)	289–92 d.	25.3^{25}, 57.5^{75}	0.043^{25}, 90%	0.61^{20} pyr.
4270	col. liq.......	....	....	*ca.* 130 d.	......	......	....
4271	....	....	241–2	....	......	......	....
4272							
4273	leaf..........	....	222–3 d.	....	sl. s.	......	....
4274							
4275							
4276	leaf. f. al......	....	>160 d.	....	s.	s.	....
4277	cr. f. w.......	....	243 d.	....	6.6 h.	v. sl. s.	v. sl. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4278	**Glycine, *N*-methyl-.**	See *Sarcosine.*		
4279	**——, *N*-*o*-nitrophenyl-**	....	$NO_2C_6H_4NHCH_2$-COOH	196.16
4280	**——, *N*-phenyl-.......**	anilinoacetic acid..........	$C_6H_5NHCH_2$-COOH	151.16
4281	——, ——, *o*-carboxylic acid.	See *Anthranilic acid, N-(carboxymethyl)-.*		
4282	**Glycine anhydride....**	2,5-piperazinedione; α, γ-diacipiperazine, diglycolyl diamide	 $NHCOCH_2NH\text{-}COCH_2$	114.10
4283	**Glycocholic acid......**	....	$C_{24}H_{39}O_4NHCH_2$-COOH	465.62
4284	**Glycocoll.**	See *Glycine.*		
4285	**Glycocyamidine, 1-methyl-.**	See *Creatinine.*		
4286	**Glycocyamine........**	guanidoacetic acid..........	$NH_2C(:NH)$-$NHCH_2COOH$	117.11
4287	**——, methyl-.**	See *Creatine.*		
4288	**Glycogen.............**	animal starch..............	$(C_6H_{10}O_5)_x$.......	$(162.14)_x$
4289	**Glycogenic acid.**	See D-*Gluconic acid.*		
4290	**Glycol...............**	1,2-ethanediol*; ethylene glycol	CH_2OHCH_2OH...	62.07
4291	——, For derivatives see also	1,2-*Ethanediol.*		
4292	——, cyanohydrin.	See *Hydracrylonitrile.*		
4293	——, diacetate............	ethylene acetate...........	$(CH_2OOCCH_3)_2$...	146.14
4294	——, dibenzoate..........	ethylene benzoate; ethylene dibenzoate	$(C_6H_5COO)_2C_2H_4$..	270.27
4295	——, dibromide.	See *Ethylene bromide.*		
4296	——, dibutyrate...........	ethylene butyrate..........	$(CH_2OOCCH_2$-$CH_2CH_3)_2$	202.25
4297	——, dichloride.	See *Ethylene chloride.*		
4297M	——, difluoride.	See *Ethylene fluoride.*		
4298	——, diformate...........	ethylene formate...........	$HCOOCH_2CH_2$-OOCH	118.09
4299	——, diiodide.	See *Ethylene iodide.*		
4300	——, dilaurate............	ethylene laurate............	$(C_{11}H_{23}COOCH_2)_2$	426.67
4301	——, dimyristate..........	ethylene myristate..........	$(C_{13}H_{2}.COOCH_2)_2$	482.77
4302	——, dinitrate............	ethylene nitrate............	$C_2H_4(ONO_2)_2$.....	152.07
4303	——, dinitrite............	ethylene nitrite	$C_2H_4(ONO)_2$......	120.07
4304	——, dipalmitate..........	ethylene palmitate..........	$(C_{15}H_{31}COOCH_2)_2$	538.87
4305	——, diphenyl ether.	See *Ethane, 1,2-diphenoxy-*.*		
4306	——, dipropionate	ethylene propionate.........	$(CH_3CH_2$-$COOCH_2)_2$	174.19
4307	——, distearate...........	ethylene stearate..........	$[CH_3(CH_2)_{16}$-$COOCH_2\cdot]_2$	594.98
4308	——, dithiocyanate.........	ethylene (di)thiocyanate.....	$(CH_2SCN)_2$.......	144.21
4309	——, ethylene ether.	See *p-Dioxane.*		
4310	——, ethylidene diether.	See 1,3-*Dioxolane, 2-methyl-.*		
4311	——, monoacetate.........	....	CH_3COOCH_2-CH_2OH	104.10
4312	——, monobenzyl ether.	See *Ethanol, 2-benzyloxy-.*		
4313	——, monobutyl ether.	See *Ethanol, 2-butoxy-*.*		
4314	——, monoethyl ether.	See *Ethanol, 2-ethoxy-*.*		
4315	——, monoformate.........	β-hydroxyethyl formate.....	$HCOOCH_2CH_2OH$	90.08

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4278							
4279	dk. red cr. f. al.	....	192–3 d.	....	v. sl. s.	v. s. h.	sl. s. eth.
4280	col. cr.	....	127	....	s.	s.	sl. s. eth.
4281							
4282	tab.	....	275 d.	subl.	s. h.	v. s.	....
4283	col. need.	....	134	....	0.33 c.	v. s.	0.09^{20} eth.
4284							
4285							
4286	leaf. or need. f. w.	....	d.	....	0.45^{15}	v. sl. s.	v. sl. s. eth.
4287							
4288	wh. amor.	....	240	....	v. s.	i. c., s. h.	i. eth.
4289							
4290	col. liq., 1.4274	$1.1155\frac{20}{4}$	−17.4 (−12)	197.2 (198–200)	∞	∞	7.89 eth.
4291							
4292							
4293	col. liq., 1.415	$1.128\frac{0}{4}$; $1.104\frac{20}{4}$	−31	186 (190.5)	14.3	∞	∞ eth.
4294	rhomb. pr. f. eth.	....	73–4	d. 360	i.	......	s. eth.
4295							
4296	liq.	$1.024\frac{0}{4}$	....	240	i.	v. s.	v. s. eth.
4297							
4297M							
4298	1.35800	$1.193\frac{0}{4}$	....	174	sl. s.	s.	s. eth.
4299							
4300	....	....	50–2	188^{20}	i.	v. s.	v. s. eth.
4301	cr.	....	62–3	....	......	......	....
4302	yel. liq.	1.483^{8}	−20	exp. 114–6	i.	s.	d. alk.
4303	liq.	$1.2156\frac{0}{4}$	<−15	98	i.	s.	s. eth.; d. alk.
4304	leaf. or need.	$0.8594^{77.9}$	68.7 (69–72)	226	i.	0.31^{38}	s. h. eth.
4305							
4306	liq.	1.0544^{15}	....	211; $90–2^{8}$	sl. s.	∞	∞ eth.
4307	leaf.	0.8581^{78}	76–7	241^{20}	i.	0.122^{40}	v. s. eth.
4308	col. rhomb. pl. or need.	....	90	d.	s.	s.	s. eth.
4309							
4310							
4311	col. liq.	1.108^{15}	....	182	∞	∞	∞ eth.
4312							
4313							
4314							
4315	liq.	$1.199\frac{15}{4}$	....	180; 88^{25}	∞	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4316	**Glycol**, monomethyl ether.	See _Ethanol, 2-methoxy-*_.		
4317	——, monomethyl ether acetate.	See _Ethanol, 2-methoxy-*, acetate._		
4318	——, monopalmitate		$C_{15}H_{31}COOCH_2$-CH_2OH	300.47
4319	——, monostearate		$C_{17}H_{35}COOCH_2$-CH_2OH	328.52
4320	**——, decamethylene.**	See 1,10-_Decanediol*_.		
4321	**——, diethylene.**	See _Diethylene glycol._		
4322	**——, _sym_-dimethyl-.**	See 2,3-_Butanediol*_.		
4323	**——, _uns_-dimethyl-.**	See 1,2-_Propanediol, 2-methyl-*_.		
4323M	**——, dipropylene.**	See 2-_Propanol, 1,1′-oxydi-_.		
4324	**——, dithio-.**	See 1,2-_Ethanedithiol*_.		
4324M	**——, divinyl-.**	See 1,5-_Hexadiene-3,4-diol*_.		
4325	**——, ethyl-.**	See 1,2-_Butanediol*_.		
4326	**——, ethylene.**	See _Glycol._		
4327	**——, ethyl methyl.**	See 2,3-_Pentanediol*_.		
4328	**——, heptamethylene.**	See 1,7-_Heptanediol*_.		
4329	**——, isopropyl-.**	See 1,2-_Butanediol, 3-methyl-*_.		
4330	**——, nonamethylene.**	See 1,9-_Nonanediol*_.		
4331	**——, octamethylene.**	See 1,8-_Octanediol*_.		
4332	**——, octylene.**	See 4,5-_Octanediol*_.		
4333	**——, pentamethylene.**	See 1,5-_Pentanediol*_.		
4334	**——, γ-pentylene.**	See 1,4-_Pentanediol*_.		
4335	**——, tetraethyl-.**	See 3,4 _Hexanediol, 3,4-diethyl-*_.		
4336	**——, tetramethyl-.**	See _Pinacol._		
4337	**——, tetramethylene.**	See 1,4-_Butanediol*_.		
4338	**——, tetraphenyl-.**	See _Benzopinacol._		
4339	**——, thiodi-.**	See _Ethanol, 2,2′-thiodi-._		
4340	**——, triethylene.**	See _Triethylene glycol._		
4341	**——, trimethyl-.**	See 2,3-_Butanediol, 2-methyl-*_.		
4342	**——, xylylene.**	See _Xylylene glycol._		
4343	**Glycolaldehyde**	hydroxyethanal*; glycolic aldehyde	CH_2OHCHO	60.05
4344	**Glycolamide**	2-hydroxyethanamide*; hydroxyacetamide	$CH_2OHCONH_2$	75.07
4345	**Glycoleucine.**	See _Norleucine._		
4346	**Glycolic acid**	hydroxyethanoic acid*; hydroxyacetic acid	$HOCH_2COOH$	76.05
4347	——, ethyl ester	ethyl hydroxyethanoate*	$CH_2OHCOOC_2H_5$	104.10
4348	——, ethyl ether.	See _Acetic acid, ethoxy-._		
4349	——, methyl ester	methyl hydroxyethanoate*; methyl glycolate	$CH_2OHCOOCH_3$	90.08
4350	——, phenyl ether.	See _Acetic acid, phenoxy-._		
4351	**——, benzoyl-**	α-hydroxy-β-ketohydrocinnamic acid; 2-hydroxy-3-oxo-3-phenylpropanoic acid	$C_6H_5COCH(OH)$-$COOH$	180.15
4352	**——, diphenyl-.**	See _Benzilic acid._		
4353	**——, phenyl-.**	_See Mandelic acid._		
4354	**——, styryl-.**	See 3-_Butenoic acid, 2-hydroxy-4-phenyl-._		
4355	**——, thio-.**	See _Acetic acid, mercapto-._		
4356	**Glycolic aldehyde.**	See _Glycolaldehyde._		
4357	**Glycolic anhydride**		$(CH_2OHCO)_2O$	134.09
4358	**Glycolide**	2,5-_p_-dioxanedione; diglycolide	$\underbrace{OCOCH_2OCOCH_2}$	116.07
4359	**Glycoluric acid**	See _Hydantoic acid._		
4360	**Glycoluril**	acetylenediurein	$C_2H_2(CON_2H_2)_2$	142.12
4361	**Glyconic acid.**	See _Gluconic acid._		
4362	**Glycosterin.**	See _Diethylene glycol, distearate._		
4363	**Glyoxal**	ethanedial*; oxalaldehyde; biformyl	CHOCHO	58.04
4364	——, dioxime.	See _Glyoxime._		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
4316							
4317							
4318	cr.	$0.8786^{60.5}_{4}$	51.5	....	......	24.08^{25}	s. h. eth.
4319	cr.	0.8780^{60}_{4}	58.5	....	......	19.61^{29}	s. h. eth.
4320							
4321							
4322							
4323							
4323M							
4324							
4324M							
4325							
4326							
4327							
4328							
4329							
4330							
4331							
4332							
4333							
4334							
4335							
4336							
4337							
4338							
4339							
4340							
4341							
4342							
4343	col. pl.	....	97	....	v. s.	v. s. h.	sl. s. eth.
4344	col. rhomb.	....	120	....	v. s.	sl. s.	sl. s. eth.
4345							
4346	rhomb. leaf. f. eth.	....	α63; β79	d.	s.	s.	s. eth.
4347	col. liq.	1.0826^{23}_{4}	....	160	......	v. s.	v. s. eth.
4348							
4349	col. liq.	1.168^{18}_{4}	....	151.2	s.	∞	∞ eth.
4350							
4351	lng. pr.	....	125	....	sl. s. c.	s.	s. eth.
4352							
4353							
4354							
4355							
4356							
4357	cr. powd.	....	130	d.	i. c., s. h.	i.	i. eth.
4358	col. leaf. f. al.	....	86–7	....	s. h.	sl. s.	sl. s. eth.; s. ac. a., h. chl.
4359							
4360	wh. need. f. w.	....	....	....	1.333^{15}	s.	s. eth.
4361							
4362							
4363	yel. cr., 1.3828.	1.14^{20}_{4}	15	50.4	v. s.	s.	s. eth.
4364							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4365	**Glyoxal, di-2-furyl-.**	See *Furil.*		
4366	**——, dimethyl-.**	See 2,3-*Butanedione*.*		
4367	**——, diphenyl-.**	See *Benzil.*		
4368	**Glyoxalic acid.**	See *Glyoxylic acid.*		
4369	**Glyoxaline.**	See *Imidazole.*		
4370	**Glyoxime**	glyoxal dioxime	$HON:CHCH:NOH$	88.07
4371	**——, dimethyl-**	2,3-butanedione dioxime*; diacetyl dioxime	$CH_3C(:NOH)C$- $(:NOH)CH_3$	116.12
4372	**Glyoxyldiureide.**	See *Allantoin.*		
4373	**Glyoxylic acid**	oxoethanoic acid*; glyoxalic acid; oxalaldehydic acid	$HCOCOOH$	74.04
4374	**——, *o*-aminophenyl-.**	See *Isatic acid.*		
4375	**——, *o*-carboxyphenyl-.**	See *Phthalonic acid.*		
4376	**——, *o*-nitrophenyl-**	*o*-nitrobenzoylformic acid	$NO_2C_6H_4COCOOH$	195.13
4377	**——, phenyl-**	benzoylformic acid	$C_6H_5COCOOH$	150.13
4378	**——, 2-thienyl-.**	See 2-*Thiopheneacetic acid, α-oxo-.*		
4379	**Gnoscopine**	*dl*-narcotine	$C_{22}H_{23}NO_7$	413.41
4380	**Gommelin.**	See *Dextrin.*		
4381	**Granatonine, methyl-.**	See *Pseudopelletierine.*		
4382	**Grape sugar.**	See D-*Glucose.*		
4383	**Guaiacol**	*o*-methoxyphenol; pyrocatechol monomethyl ether; *o*-hydroxyanisole	$CH_3OC_6H_4OH$	124.13
4384	**——, 4-allyl-.**	See *Eugenol.*		
4385	**——, 5-allyl-.**	See *Chavibetol.*		
4386	**——, 4-methyl-.**	See *Creosol.*		
4387	**——, 4-propenyl-.**	See *Isoeugenol.*		
4388	**——, 5-vinyl-.**	See *Hesperetol.*		
4389	**Guaiene**	2,3-dimethylnaphthalene	$C_{10}H_6(CH_3)_2$	156.22
4390	**Guaiole.**	See *Tiglaldehyde.*		
4391	**Guanidine**	aminomethanamidine*; carbamamidine; aminoformamidine	$NH:C(NH_2)_2$	59.07
4391H	——, carbonate		$2CH_5N_3 \cdot H_2CO_3$	180.18
4391R	——, picrate		$CH_5N_3 \cdot C_6H_3O_7N_3$	288.18
4392	**——, 1-amino-**	guanylhydrazine	$NH_2NHC(:NH)$- NH_2	74.09
4393	**——, 1-carbamyl-.**	See *Urea, guanyl-.*		
4394	**——, 1-cyano-**	dicyan(o)diamide; param	$NH_2C(:NH)$- $NHCN$	84.08
4395	**——, diphenyl-**	melaniline	$NH:C[NHC_6H_5]_2$	211.26
4396	——, ——, mercaptide with 2-benzothiazolethiol. See under *2-Benzothiazolethiol.*			
4397	**——, di-*o*-tolyl-**		$C_{15}H_{17}N_3$	239.31
4398	**——, guanyl-.**	See *Biguanide.*		
4399	**——, nitro-***		$NH_2C(:NH)$- $NHNO_2(?)$	104.07
4400	**——, phenyl-*o*-tolyl-**		$C_{14}H_{15}N_3$	225.29
4401	**——, 1,1,3,3-tetraphenyl-***		$NH:C[N(C_6H_5)_2]_2$	363.44
4402	**——, 1,1,3-triphenyl-***	β-triphenylguanidine	$HN:C(NHC_6H_5)$- $N(C_6H_5)_2$	287.35
4403	**——, 1,2,3-triphenyl-***	α-triphenylguanidine	$C_6H_5N:C$- $(NHC_6H_5)_2$	287.35

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4365							
4366							
4367							
4368							
4369							
4370	rhomb. tab. f. w.	....	178	....	v. s. h.	s.	s. eth.
4371	col. cr. f. dil. al.	....	234.5 (246)	....	i.	v. s.	v. s. eth.
4372							
4373	col. rhomb.....	....	d.	....	v. s.	s.	....
4374							
4375							
4376	need. f. w.....	....	46–7	....	v. s. h.	......	....
4377	col. cr. f. CCl_4.	....	66	147–51^{12}	s.	s.	s. eth.; i. CS_2
4378							
4379	lng. need.....	....	229	....	......	.06	s. chl., bz.; i. alk.
4380							
4381							
4382							
4383	col. hex. pr., $1.53833^{21.4}_{\alpha}$	$1.1287\frac{21.4}{4}$	28.2 (32)	205; 106.5^{24}	1.6^{15}	s.	s. eth., chl., glac. ac. a.
4384							
4385							
4386							
4387							
4388							
4389	leaf. f. al......	$1.008\frac{20}{4}$	104–104.5	260–265	i.	s.	s. eth.
4390							
4391	col. cr........	....	....	....	v. s.	v. s.	....
4391 H	octahr. or tetr. columns	1.24	197	....	v. s. c.	i.	....
4391R	or.-yel. pl. or need.	....	333 d.	....	.037^{0}; .574^{80}	sl. s.	sl. s. eth.
4392	cr..........	....	d.	....	s.	s.	i. eth.
4393							
4394	rhomb. leaf...	$1.40\frac{14}{4}$	205 (207)	d.	2.26^{13}	1.26^{13}	0.01^{13} eth.; i. bz.
4395	monocl. need. f. al.	$1.13\frac{20}{4}$	147–8	d. >170	sl. s.	9.1^{20} 90%, 5^{16}	v. sl. s. eth.; s. CCl_4, chl., h. bz., h. tol., dil. min. a.
4396							
4397	wh. cr........	$1.10\frac{20}{4}$	179	....	v. sl. s.	sl. s. c., s. h.	sl. s. eth.
4398							
4399	yelsh. need. f. w.	....	246–7 (231)	....	0.26$^{18.3}$	sl. s.	i. eth.; s. sol. KOH
4400	wh. cr........	....	129.5–30	....	v. sl. s.	sl. s. c., s. h.	sl. s. eth.
4401	rhomb. f. lgr..	....	130	....	i.	s.	s. eth.; v. s. bz.
4402	regular tab....	....	131	....	v. sl. s.	v. s.	v. s. eth.; sl. s. bz.
4403	wh. need. or pr. f. al.	$1.13\frac{20}{4}$	145	d.	v. sl. s.	3.55 c.	s. eth., chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4404	**Guanine**	2-aminohypoxanthine	$C_6H_5N_5O$	151.13
4404M	D-**Gulose**	*l*-gulose, formerly	$C_6H_{12}O_6$	180.16
4405	**Guncotton.**	See *Cellulose, hexanitrate.*		
4406	**Guvacine**		$C_6H_9NO_2$	127.14
4407	**——, 1-methyl-.**	See *Arecaidine.*		
4408	**H acid.**	See 1-*Naphthol*-3,6-*disulfonic acid, 8-amino-.*		
	Haem-.	See *Hem-.*		
4409	**Harmaline**		$C_{13}H_{14}N_2O$	214.26
4410	**Harmine**		$C_{13}H_{12}N_2O$	212.24
4411	**Helenin**	alantolactone	$C_{15}H_{20}O_2$	232.31
4412	*l*-**Helicin**	salicylaldehyde glucoside	$C_6H_4(OC_6H_{11}O_5)$-CHO	284.26
4413	**Heliotropin.**	See *Piperonal.*		
4414	**Hematein**	haematin; hematin	$C_{16}H_{12}O_6$	300.26
4415	**Hematin**	haematin	$C_{34}H_{32}FeN_4O_4(OH)$	633.48
4416	**Hematoxylin**	haematoxylin	$C_{16}H_{14}O_6 \cdot 3H_2O$	356.32
4417	**Hemellitene.**	See *Hemimellitene.*		
4418	**Hemellitic acid**	2,3-dimethylbenzoic acid; 2,3-xylic acid; *vic-o*-xylic acid	$(CH_3)_2C_6H_3COOH$	150.17
4419	**Hemimellitene**	1,2,3-trimethylbenzene; *vic*-trimethylbenzene; hemellitene	$(CH_3)_3C_6H_3$	120.19
4420	**——, 4,5,6-trinitro-**		$(NO_2)_3C_6(CH_3)_3$	255.19
4421	**Hemimellitic acid**	1,2,3-benzenetricarboxylic acid*	$C_6H_3(COOH)_3$	210.14
4422	**Hemipic acid**	3,4-dimethoxyphthalic acid; hemipinic acid; narcotine hemipic acid	$(CH_3O)_2C_6H_2$-$(COOH)_2$	226.18
4423	**Hemiterpene.**	See *Isoprene.*		
4424	**Hendecanal***	undecanal*; *n*-undecylaldehyde	$CH_3(CH_2)_9CHO$	170.29
4425	——, oxime		$CH_3(CH_2)_9$-$CH{:}NOH$	185.30
4426	**Hendecane***	undecane*	$CH_3(CH_2)_9CH_3$	156.30
4427	**——, 1-amino-.**	See *Hendecylamine**.		
4428	**Hendecanoic acid***	undecanoic acid*; *n*-undecylic acid	$CH_3(CH_2)_9COOH$	186.29
4429	**1-Hendecanol***	1-undecanol*; *pri-n*-undecyl alcohol	$CH_3(CH_2)_9CH_2OH$	172.30
4430	**2-Hendecanol***	2-undecanol*; methylnonylcarbinol	$CH_3(CH_2)_8CH$-$OHCH_3$	172.30
4431	**2-Hendecanone***	2-undecanone*; methyl nonyl ketone	$CH_3CO(CH_2)_8$-CH_3	170.29
4432	**3-Hendecanone***	3-undecanone*; ethyl octyl ketone	$C_2H_5CO(CH_2)_7$-CH_3	170.29

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4404	col. need.		360 d.		i.	v. sl. s.	v. sl. s. eth., NH_4OH; s. KOH
4404M	col. syrup, $[\alpha]^{20}_{D}$ −20.4°				s.	sl. s.	
4405							
4406	lust. sc.		271–2 d.		s.	s.	i. eth.
4407							
4408							
4409	rhomb. pr. f. al.+bz.		250 d. (238)		v. sl. s.	sl. s.	sl. s. eth.
4410	monocl. or rhomb. pr. f. al.		257–9 d.		2.5^{20}	sl. s.	sl. s. eth.
4411	wh. need. f. al.+w.		76	275; 192^{10}	v. sl. s.	v. s.	v. s. eth.; s. bz., chl.
4412	fine need.		175		60 c., v. s. h.	s.	i. eth.
4413							
4414	br. pl.		250 d.		0.6^{20}	sl. s.	0.0093^{20} eth.; s. alk.; i. bz., chl.
4415	br. powd.		>200		i.	i. c., s. h.	i. eth., chl.; s. alk.
4416	col.-yelsh. tetr. cr. f. dil. $(NH_4)_2SO_3$		anh. 140	$-H_2O$, 100–20	v. sl. s.	s.	s. eth., NH_4OH, glyc., caustic alk.
4417							
4418	col. pr. f. al.		144		v. sl. s. h.	s.	s. eth.
4419	col. liq., 1.5139^{20}	0.89438^{20}	<−15	176.084	i.	s.	s. eth.
4420	pr. f. al.		209		i.	s.	
4421	col. need.		190	d.	3.15^{19}		s. eth.
4422	monocl. cr.		186–8; 159–60 anh.	subl.	sl. s.	sl. s.	0.7 eth.
4423							
4424	liq., 1.4334	$0.830\frac{20}{4}$	−4	117^{18}	i.	s.	s. eth.
4425	need. f. me. al.		72		s.	s.	s. eth.
4426	col. liq., 1.4184	$0.741\frac{20}{4}$	−26.5	195.84 (197)	i.	∞	∞ eth.
4427							
4428	col. sc. $1.4294^{45.2}$	0.8905; $0.8889\frac{30}{4}$	29.3	228^{160}	i.	sl. s.	s. eth.
4429	cr. or liq., 1.4404	$0.8334\frac{23}{4}$	11 (19)	131^{15}	i.	s.	v. s. eth.
4430	liq.	0.8363	12	225.4; 228–9	$.02^{20}$	s.	s. eth.
4431	col. arom. liq., $1.43002^{17.3}$	$0.826\frac{20}{4}$	15; (12.1); frz. 6	228 (226)	i.	s.	s. eth.
4432	liq.		4.5	104–6 (227)	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4433	**6-Hendecanone***	6-undecanone*; diamyl ketone; dipentyl ketone; (*n*)-caprone	$CH_3(CH_2)_4CO(CH_2)_4CH_3$	170.29
4434	**2-Hendecene***	2-undecene*; β-undecylene	$CH_3CH{:}CH(CH_2)_7CH_3$	154.29
4435	**10-Hendecenoic acid***	10-undecenoic acid*; ι-undecylenic acid	$CH_2{:}CH(CH_2)_8COOH$	184.27
4436	**Hendecylamine* (*n*)**	*pri-n*-undecylamine; 1-aminohendecane	$CH_3(CH_2)_{10}NH_2$	171.32
4436M	**1-Hendecyne***	1-undecyne*; rutylidene	$CH{\vdots}C(CH_2)_8CH_3$	152.27
4437	**Heneicosane***		$CH_3(CH_2)_{19}CH_3$	296.57
4438	**Hentriacontane***	*n*-hentriacontane	$CH_3(CH_2)_{29}CH_3$	436.83
4439	**16-Hentriacontanone***	dipentadecyl ketone; palmitone	$(C_{15}H_{31})_2CO$	450.81
4439M	**Hepatoflavin.**	See D-*Riboflavin.*		
4440	**Heptacosane***	*n*-heptacosane	$CH_3(CH_2)_{25}CH_3$	380.72
4440M	**1-Heptacosanol***	*n*-heptacosyl alcohol	$n\text{-}C_{27}H_{55}OH$	396.72
4440Q	***n*-Heptacosyl alcohol.**	See 1-*Heptacosanol.**		
4441	**Heptadecane***	*n*-heptadecane	$CH_3(CH_2)_{15}CH_3$	240.46
4441M	**——, 1-amino-.**	See *Heptadecylamine*(n).*		
4442	**9-Heptadecanecarboxylic acid*.**	See *Capric acid, α-octyl-.*		
4443	**Heptadecanenitrile*.**	See *Margaronitrile.*		
4444	**Heptadecanoic acid*.**	See *Margaric acid.*		
4445	**1-Heptadecanol***	*pri-n*-heptadecyl alcohol	$CH_3(CH_2)_{16}OH$	256.46
4446	**9-Heptadecanone***	di-*n*-octyl ketone; pelargone; nonylone	$(C_8H_{17})_2CO$	254.45
4447	***n*-Heptadecoic acid.**	See *Margaric acid.*		
4448	***pri-n*-Heptadecyl alcohol.**	See 1-*Heptadecanol**.		
4448M	**Heptadecylamine*(*n*)**	1-aminoheptadecane	$CH_3(CH_2)_{16}NH_2$	255.48
4449	***n*-Heptadecylic acid.**	See *Margaric acid.*		
4450	**2,4-Heptadiene***		$CH_3CH{:}CHCH{:}CHCH_2CH_3$	96.17
4450M	**1,3-Heptadiene, 2,6-dimethyl-***	isogeraniolene	$CH_2{:}C(CH_3)CH{:}CHCH_2CH(CH_3)_2$	124.22
4451	**1,6-Heptadiene-3,5-dione, 1,7-bis(4-hydroxy-3-methoxyphenyl)-*.**			
4452	**2,5-Heptadien-4-one, 2,6-dimethyl-*.**	See *Phorone.*		
4453	***n*-Heptaldehyde.**	See *Enanthaldehyde.*		
4454	***n*-Heptaldoxime.**	See *Enanthaldehyde, oxime.*		
4455	**Heptamethylene.**	See *Cycloheptane**.		
4456	**Heptamethylene glycol.**	See 1,7-*Heptanediol**.		
4457	**Heptanal*.**	See *Enanthaldehyde.*		
4458	**Heptane***	*n*-heptane	$CH_3(CH_2)_5CH_3$	100.20
4458M	***n*-Heptane, 2-amino-.**	See *Hexylamine, α-methyl-.*		
4459	**Heptane, 1-bromo-***	*n*-heptyl bromide	$CH_3(CH_2)_6Br$	179.11
4460	**——, 1-chloro-***	*n*-heptyl chloride	$CH_3(CH_2)_6Cl$	134.65
4461	**——, 2,6-dimethyl-***	diisobutylmethane; isobutylisoamyl	$(CH_3)_2CH(CH_2)_3CH(CH_3)_2$	128.25
4462	**Heptane, 1-ethoxy-*.**	See *Ether, ethyl heptyl.*		
4463	**——, 4-ethyl-***	ethyldipropylmethane	$CH_3(CH_2)_2CH(C_2H_5)(CH_2)_2CH_3$	128.25
4464	**——, 1-heptyloxy-*.**	See *Heptyl ether.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4433	leaf..........	$0.8262\frac{20}{4}$	14–5	226	i.	v. s.	v. s. eth.
4434	col. liq., 1.4333	$0.7729\frac{20}{4}$	....	193	i.	∞	∞ eth.
4435	wh. cr. mass or col. to yelsh. liq.	$0.9075\frac{25}{4}$	24.5	275	i.	∞	∞ eth.; s. chl.
4436	col. liq.......	....	16.5	241.6	sl. s.	s.	s. eth.
4436M	liq...........	$0.867\frac{25}{4}$	-33	210–5	i.	s.	s. eth.
4437	cr., $1.4344^{45.3}$..	$0.778\frac{40}{4}$	40	215^{15}	......	......	....
4438	cr............	$0.781\frac{68}{4}$	68.1	302^{15}	......	......	sl. s. eth.
4439	leaf. f. al., $1.4297^{93.5}$	liq. $0.795\frac{91}{4}$	82.8	....	i.	s.	s. eth.
4439M							
4440	cr............	$0.780\frac{60}{4}$	59.5	270^{15}	i.	v. s.	sl. s. eth.
4440M	....	....	81.2–81.6	....	......	......	....
4440Q							
4441	hex. leaf., 1.437	$0.778\frac{20}{4}$	22.5	303	i.	sl. s.	s. eth.
4441M							
4442							
4443							
4444							
4445	cr............	.8475	53.31 (54)	308.5	$.01+^{20}$	s.	s. eth.
4446	pl. f. me. al...	....	53 (50.5^0)	....	......	sl. s.	s. me. al.
4447							
4448							
4448M	col. cr..........	....	....	335.9; 155.0^2	i.	s.	s. eth.
4449							
4450	liq...........	$0.733\frac{21.5}{4}$	....	107 (104–6)	......	......	....
4450M	liq...........	$0.765\frac{10}{4}$	....	143–5^{755}	i.	......	....
4451	See *Curcumin.*						
4452							
4453							
4454							
4455							
4456							
4457							
4458	col. liq., 1.38764^{20}	0.68376^{20}	-90.5	98.427	$0.0052^{15.5}$	100	∞ eth., chl.
4458M							
4459	col. liq.......	$1.133\frac{18}{4}$	-58.86	178.8	i.	v. s.	v. s. eth.
4460	liq., 1.42844...	$0.8725\frac{20}{0}$	-69.5	159.5	i.	∞	∞ eth.
4461	col. liq.......	$0.7247\frac{0}{4}$; $0.712\frac{20}{0}$	....	132–3	i.	i.	s. eth.
4462							
4463	col. liq., 1.408.	$0.741\frac{20}{4}$	....	139	i.	i.	s. eth.
4464							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4465	**Heptane, 1-iodo-***	*n*-heptyl iodide............	$CH_3(CH_2)_5CH_2I$...	226.11
4466	**——, 1-methoxy-*.**	See *Ether, heptyl methyl.*		
4467	**——, 2-methyl-***......	amyldimethylmethane; isooctane	$(CH_3)_2CH(CH_2)_4CH_3$	114.23
4468	**——, 3-methyl-***......	butylethylmethylmethane....	$CH_3CH_2CH(CH_3)(CH_2)_3CH_3$	114.23
4469	**——, 4-methyl-***......	methyldipropylmethane.....	$CH_3(CH_2)_2CH(CH_3)(CH_2)_2CH_3$	114.23
4470	**——, 1-phenoxy-*.**	See *Ether, heptyl phenyl.*		
4471	**3-Heptanecarboxylic acid.**	See *Caproic acid, α-ethyl-.*		
4472	**1,7-Heptanedicarboxylic acid.**	See *Azelaic acid.*		
4473	**Heptanedioic acid.***	See *Pimelic acid.*		
4474	**——, 4-oxo-*.**	See *Acetonediacetic acid.*		
4475	**1,7-Heptanediol***......	heptamethylene glycol.......	$CH_2OH(CH_2)_5CH_2OH$	132.20
4476	**1-Heptanethiol***......	*n*-heptyl mercaptan.........	$CH_3(CH_2)_5CH_2SH$	132.26
4477	**Heptanoic acid*.**	See *Enanthic acid.*		
4478	**1-Heptanol***..........	*n*-heptyl alcohol............	$CH_3(CH_2)_5CH_2OH$	116.20
4479	——, esters of organic acids.	See "heptyl ester" under the names of the acids.		
4480	——, nitrite.	See *Heptyl nitrite.*		
4481	**2-Heptanol***..........	amylmethylcarbinol.........	$CH_3CHOH(CH_2)_4CH_3$	116.20
4482	**——, 2-methyl-***......	amyldimethylcarbinol.......	$(CH_3)_2COH(CH_2)_4CH_3$	130.23
4483	**3-Heptanol, 3-methyl-***	butylethylmethylcarbinol....	$CH_3CH_2COH(CH_3)(CH_2)_3CH_3$	130.23
4484	**4-Heptanol***..........	dipropylcarbinol............	$CH_3(CH_2)_2CHOH(CH_2)_2CH_3$	116.20
4485	**——, 2,6-dimethyl-***...	diisobutylcarbinol..........	$[(CH_3)_2CHCH_2]_2CHOH$	144.25
4486	**——, 4-ethyl-***........	ethyldipropylcarbinol.......	$CH_3CH_2COH(CH_2CH_2CH_3)_2$	144.25
4487	**——, 4-methyl-***......	methyldipropylcarbinol......	$CH_3(CH_2)_2COH(CH_3)(CH_2)_2CH_3$	130.23
4488	**——, 4-propyl-***.......	tripropylcarbinol; *tert*-decyl alcohol	$(C_3H_7)_3COH$......	158.28
4489	**2-Heptanone***.........	amyl methyl ketone.........	$CH_3CO(CH_2)_4CH_3$	114.18
4490	**3-Heptanone***.........	ethyl butyl ketone..........	$C_2H_5CO(CH_2)_3CH_3$	114.18
4491	**——, 6-methyl-***......	ethyl isoamyl ketone........	$C_2H_5COCH_2CH_2CH(CH_3)_2$	128.21
4492	**4-Heptanone***.........	dipropyl ketone; butyrone...	$C_3H_7COC_3H_7$.....	114.18
4493	**——, 2,6-dimethyl-***...	diisobutyl ketone; *s*-diisopropylacetone; isovalerone; valerone	$[(CH_3)_2CHCH_2]_2CO$	142.24
4494	**——, 2-methyl-***......	isobutyl propyl ketone.......	$CH_3CH_2CH_2COCH_2CH(CH_3)_2$	128.21
4495	**1-Heptene***...........	α-heptylene................	$CH_2{:}CH(CH_2)_4CH_3$	98.18
4496	**2-Heptene***...........	1-butyl-2-methylethylene; β-heptylene	$CH_3CH{:}CH(CH_2)_3CH_3$	98.18
4497	**3-Heptene***.........	1-ethyl-2-propylethylene; γ-heptylene	$CH_3CH_2CH{:}CHCH_2CH_2CH_3$	98.18

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4465	liq...........	$1.4034\frac{0}{4}$; $1.366\frac{21}{4}$	-48.2	203.95; 91-3^{20}	i.	s.	s. eth.
4466							
4467	col. liq., 1.3935	$0.7029\frac{20}{4}$	....	116.0	i.	sl. s.	s. eth.
4468	liq...........	0.7161	....	122.2	i.	sl. s.	s. eth.
4469	col. liq., 1.398^{15}	$0.7211\frac{20}{4}$	....	118.0	i.	sl. s.	s. eth.
4470							
4471							
4472							
4473							
4474							
4475	cr............	....	12	259; 143-6^{8}	s.	s.	i. eth.
4476	liq...........	$0.8389\frac{25}{4}$	-43.4	176.2 (174-5)	i.	∞	∞ eth.
4477							
4478	col. liq., 1.42410^{20}	$0.8219\frac{20}{4}$	-34.6	176	0.09^{18}; 0.28^{100}	∞	∞ eth.
4479							
4480							
4481	liq., 1.4213, 1.4190^{25}	.8187	....	160.4	.35^{20}	s.	s. eth.
4482	col. liq., 1.4303	$0.879\frac{20}{4}$	....	162	i.	s.	s. eth.
4483	col. liq., 1.4279^{20}	$0.8282\frac{20}{4}$	....	163.5; 65.2-65.8^{15}	v. sl. s.	s.	s. eth.
4484	liq., 1.4205....	$0.820\frac{20}{4}$	-41.5	155.4	i.	s.	s. eth.
4485	col. liq., 1.423^{21}	$0.8237\frac{0}{4}$; $0.8155\frac{12}{4}$	....	172-4^{750}	i.	s.	s. eth.
4486	liq...........	$0.8349\frac{20}{4}$	....	179.5	i.	s.	s. eth.
4487	col. liq., 1.427.	$0.8248\frac{20}{4}$	....	161.5	i.	s.	s. eth.
4488	col. oil........	$0.8338\frac{21}{0}$	....	190-2	i.	s.	....
4489	col. liq.......	$0.822\frac{15}{4}$	....	150	v. sl. s.	s.	s. eth.
4490	col. liq.......	$0.8183\frac{20}{4}$	-39.0	148.5	i.	∞	∞ eth.
4491	liq...........	....	....	163.5	i.	s.	s. eth.
4492	col. liq., 1.40732^{20}	$0.8174\frac{20}{4}$	-32.6; (-34)	144	i.	∞	∞ eth.
4493	col.oil, 1.412^{21}.	$0.806\frac{20}{4}$	....	168 (165-6)	i.	∞	∞ eth.
4494	liq...........	0.813	....	155	i.	s.	s. eth.
4495	col. liq., 1.39980^{20}	0.69698^{20}	-10	93.643	i.	s.	s. eth.
4496	....	$0.7034\frac{20}{4}$	....	98.1-8.4	......	......	....
4497	....	$0.7043\frac{20}{4}$	....	95.8-6.1	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4497M	**1-Hepten-4-ol, 4-methyl-***	allylmethylpropylcarbinol	$CH_2{:}CHCH_2C(CH_3)(C_3H_7)OH$	128.21
4498	**5-Hepten-2-one, 6-methyl-***		$(CH_3)_2C{:}CH(CH_2)_2COCH_3$	126.19
4499	**Heptine.**	See *Heptyne**.		
4500	***n*-Heptoic acid.**	See *Enanthic acid.*		
4501	***pri-n*-Heptyl alcohol.**	See *1-Heptanol**.		
4502	***n*-Heptyl aldehyde.**	See *Enanthaldehyde.*		
4503	**Heptylamine* (*n*)**		$CH_3(CH_2)_6NH_2$	115.22
4504	**——, α-methyl-**	2-aminoöctane; *sec-n*-octylamine; *sec-n*-caprylamine	$CH_3(CH_2)_5CH(CH_3)NH_2$	129.24
4505	***n*-Heptyl bromide.**	See *Heptane, 1-bromo-**.		
4506	***n*-Heptyl chloride.**	See *Heptane, 1-chloro-**.		
4507	***n*-Heptyl cyanide.**	See *Caprylonitrile.*		
4508	**Heptylene.**	See *Heptene**.		
	Heptyl esters of organic acids. See "heptyl ester," under the names of the acids.			
4509	**Heptyl ether**	1-heptyloxyheptane*; di-*n*-heptyl ether	$(C_7H_{15})_2O$	214.38
4510	***n*-Heptylic acid.**	See *Enanthic acid.*		
4511	***n*-Heptyl iodide.**	See *Heptane, 1-iodo-**.		
4512	***n*-Heptyl mercaptan.**	See *1-Heptanethiol**.		
4513	**Heptyl nitrite (*n*)**		$CH_3(CH_2)_6ONO$	145.20
4514	**Heptyl sulfate**	di-*n*-heptyl sulfate	$[CH_3(CH_2)_6]_2SO_4$	294.44
4515	**1-Heptyne***	1-heptine; *n*-amylacetylene; enanthylidene	$CH{\vdots}C(CH_2)_4CH_3$	96.17
4516	**2-Heptyne***	2-heptine; butylmethylacetylene	$CH_3C{\vdots}C(CH_2)_3CH_3$	96.17
4516F	**3-Heptyne***	3-heptine; ethylpropylacetylene	$C_2H_5C{\vdots}C(CH_2)_2CH_3$	96.17
4517	**Herapathite.**	See *Quinine, iodosulfate.*		
4518	**Heroin.**	See *Morphine, diacetyl-.*		
4519	**Hesperetic acid.**	See *Isoferulic acid.*		
4520	**Hesperetol**	5-vinylguaiacol; 3-hydroxy-4-methoxystyrene	$CH_2{:}CHC_6H_3(OCH_3)OH$	150.17
4521	**Hesperidene**	See *d-Limonene.*		
4522	**Hesperidin**		$C_{22}H_{26}O_{12}$	482.43
4523	**Hexacosanoic acid*.**	See *Cerotic acid.*		
4524	**1-Hexacosanol*.**	See *Ceryl alcohol.*		
4525	***n*-Hexacosyl alcohol.**	See *Ceryl alcohol.*		
4526	**Hexadecanal,** oxime*.	See *Palmitaldehyde, oxime.*		
4527	**Hexadecanamide*.**	See *Palmitamide.*		
4528	**Hexadecane***	*n*-hexadecane; cetane; bioctyl	$CH_3(CH_2)_{14}CH_3$	226.44
4528M	**——, 1-amino-.**	See *Cetylamine.*		
4529	**——, 1-hexadecyloxy-*.**	See *Cetyl ether.*		
4530	**——, 1-iodo-*.**	See *Cetyl iodide.*		
4531	**——, 1-phenoxy-*.**	See *Ether, cetyl phenyl.*		
4532	**Hexadecanenitrile*.**	See *Palmitonitrile.*		
4533	**Hexadecanoic acid*.**	See *Palmitic acid.*		
4534	**1-Hexadecanol*.**	See *Cetyl alcohol.*		
4535	**Hexadecanoyl chloride***.	See *Palmitoyl chloride.*		
4536	**7-Hexadecenoic acid*.**	See *Hypogeic acid (artificial).*		
4537	**2-Hexadecine.**	See *2-Hexadecyne**.		
4537M	***n*-Hexadecyl.**	See *Cetyl.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4497M	......	......	......	$159–160^{748}$	......	......	......
4498	col. liq	0.860^{20}_{4}	–67.3	174	i.	∞	∞ eth.
4499							
4500							
4501							
4502							
4503	col. liq., 1.424	0.777^{20}_{4}	–23	158.3	sl. s.	∞	∞ eth.
4504	liq., 1.4254	0.7721^{20}_{4}	......	164–6	i.	v. s.	v. s. eth.
4505							
4506							
4507							
4508							
4509	col. liq	0.815^{0}_{4}	......	260	i.	s.	s. eth.
4510							
4511							
4512							
4513	liq	0.8939^{0}_{4}	......	155	i.	......	s. eth.
4514	col. liq., 1.4362^{25}	0.9819^{25}_{25}	11.4	$146.6^{1.5}$	......	......	......
4515	col. liq	$0.738^{12.6}_{4}$; 0.7288^{25}_{4}	>–70	99.8; 26.5^{50}	i.	∞	∞ eth.
4516	col. liq., 1.4220^{25}	0.745^{25}; 0.750^{19}_{4}	......	112; 39.5^{50}	i.	∞	∞ eth.
4516F	col. liq., 1.415^{25}	0.7337^{25}	......	106–7	i.	∞	∞ eth.
4517							
4518							
4519							
4520	cr	......	57	......	v. sl. s.	v. s.	v. s. eth.
4521							
4522	yel. hyg. need.	......	171	251 d.	0.02 h.	0.5	i. eth., bz.; s.h. ac. a.
4523							
4524							
4525							
4526							
4527							
4528	col. leaf	0.7751^{20}_{4}	20 (16–7)	287.5	i.	∞	∞ eth.
4528M							
4529							
4530							
4531							
4532							
4533							
4534							
4535							
4536							
4537							
4537M							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4538	***n*-Hexadecylic acid.**	See *Palmitic acid.*		
4538X	**1-Hexadecyne***		$CH_3(CH_2)_{13}C\vdots CH$	222.40
4539	**2-Hexadecyne***	2-hexadecine; cetylene	$CH_3(CH_2)_{12}C\vdots CCH_3$	222.40
4540	**7-Hexadecynoic acid*.**	See *Palmitolic acid.*		
4541	**1,5-Hexadiene***	biallyl; diallyl	$CH_2:CHCH_2CH_2CH:CH_2$	82.14
4542	**2,4-Hexadiene***	bipropenyl; dipropylene	$CH_3CH:CHCH:CHCH_3$	82.14
4543	**——, 2,5-dimethyl-***	diisocrotyl	$(CH_3)_2C:CHCH:C(CH_3)_2$	110.19
4544	**2,4-Hexadienedioic acid*.**	See *Muconic acid.*		
4544M	**1,5-Hexadiene-3, 4-diol***	divinyl glycol	$CH_2:CH.CHOH.CHOH.CH:CH_2$	114.14
4545	**2,4-Hexadienoic acid*.**	See *Sorbic acid.*		
4546	**1,5-Hexadien-3-yne***	divinylacetylene	$CH_2:CHC\vdots CCH:CH_2$	78.11
4547	**1,5-Hexadiyne***	bipropargyl; 1,5-hexadiine; dipropargyl	$CH\vdots CCH_2CH_2C\vdots CH$	78.11
4548	**"Hexalin".**	See *Cyclohexanol*.*		
4549	**Hexamethylene.**	See *Cyclohexane*.*		
4550	**Hexamethylenediamine.**	See 1,6-*Hexanediamine*.*		
4551	**Hexamethylene glycol.**	See 1,6-*Hexanediol*.*		
4552	**Hexamethylenetetramine**	methenamine; formamine; hexamine; "Urotropin"	$(CH_2)_6N_4$	140.19
4553	**Hexamine.**	See *Hexamethylenetetramine.*		
4554	**Hexanal*.**	See *Caproaldehyde.*		
4555	**Hexanamide*.**	See *Caproamide.*		
4556	**Hexane***	*n*-hexane	$CH_3(CH_2)_4CH_3$	86.17
4557	**——, 1-amino-*.**	See *Hexylamine.*		
4558	**——, 2-amino-.**	See *Amylamine, α-methyl-.*		
4559	**——, 1-bromo-***	*n*-hexyl bromide	$CH_3(CH_2)_4CH_2Br$	165.08
4560	**——, 1-chloro-***	*n*-hexyl chloride	$CH_3(CH_2)_4CH_2Cl$	120.62
4561	**——, 2-chloro-***		$CH_3CHCl(CH_2)_3CH_3$	120.62
4562	**——, dihydroxy-.**	See *Hexanediol*.*		
4563	**——, 1,6-diiodo-***	1,6-hexylene iodide	$ICH_2(CH_2)_4CH_2I$	338.00
4564	**——, 2,3-dimethyl-***	isopropylmethylpropylmethane	$CH_3CH(CH_3)CH(CH_3)CH_2CH_2CH_3$	114.23
4565	**——, 2,4-dimethyl-***	ethylisobutylmethylmethane	$(CH_3)_2CHCH_2CH(CH_3)CH_2CH_3$	114.23
4566	**——, 2,5-dimethyl-***	biisobutyl	$(CH_3)_2CH(CH_2)_2CH(CH_3)_2$	114.23
4567	**——, 3,4-dimethyl-***	bi-*sec*-butyl; *sec*-butylethylmethylmethane	$CH_3CH_2CH(CH_3)CH(CH_3)CH_2CH_3$	114.23
4568	**——, 1-ethoxy-*.**	See *Ether, ethyl hexyl.*		
4569	**——, 3-ethyl-***	diethylpropylmethane	$(CH_3CH_2)_2CHCH_2CH_2CH_3$	114.23
4570	**——, 1-iodo-***	*n*-hexyl iodide	$CH_3(CH_2)_4CH_2I$	212.09
4571	**——, 2-methyl-***	ethylisobutylmethane	$(CH_3)_2CH(CH_2)_2CH_2CH_3$	100.20
4572	**——, 3-methyl-***	ethylmethylpropylmethane	$CH_3CH_2CH(CH_3)CH_2CH_2CH_3$	100.20
4573	**——, 3-methylene-*.**	See 1-*Pentene, 2-ethyl-*.*		
4574	**——, 1-phenoxy-*.**	See *Ether, hexyl phenyl.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4538							
4538 X	cr.	0.797^{20}	15	155^{15}	i.	. . . . . .	. . . .
4539	. . . .	. . . .	−25	280–5	. . . . . .	. . . . . .	. . . .
4540							
4541	liq., 1.4044. . . .	$0.6880\frac{20}{4}$	−140.68	59.6	i.	. . . . . .	s. eth.
4542	col. liq., 1.4384	$0.7108\frac{20}{4}$	. . . .	82	i.	. . . . . .	. . . .
4543	col. liq	$0.7158\frac{21}{4}$	−91.3	102.5^{756}	i.	s.	s. eth.
4544							
4544M	1.4745^{22}.	$1.006\frac{22}{4}$	. . . .	$100\text{–}2^{12}$	. . . . . .	. . . . . .	. . . .
4545							
4546	col. liq., 1.504.	$0.7851\frac{20}{4}$	. . . .	83.5	. . . . . .	. . . . . .	. . . .
4547	col. liq., $1.44132^{23.8}$	$0.8049\frac{20}{4}$	frz. −6	86 (85.4)	i.	s.	v. s. eth.; s. ord. org. solv.
4548							
4549							
4550							
4551							
4552	rhomb. f. al . . .	. . . .	263	subl. 263 d.	150^{20}	3	i. eth.; s. H_2SO_4
4553							
4554							
4555							
4556	col. liq., 1.37536	$0.6603\frac{20}{4}$	−94.3	69.0	$0.0138^{15.5}$	50^{33}	s. eth., chl.
4557							
4558							
4559	liq., 1.4478. . . .	$1.1705\frac{20}{4}$	−85.0	156.0	i.	∞	∞ eth.
4560	col. liq., 1.4194	$0.8719\frac{20}{4}$	−83	132.4	i:	. . . . . .	. . . .
4561	1.4142^{22}.	$0.876\frac{14}{4}$	. . . .	123 (125–6)	. . . . . .	. . . . . .	. . . .
4562							
4563	col. need. or liq., 1.5899^{15}	$2.05\frac{18}{4}$	9.5 (6–7)	163^{17} d.	i.	v. s.	v. s. eth.
4564	col. liq., 1.4093	$0.7240\frac{20}{4}$	. . . .	113.9	i.	sl. s.	s. eth.
4565	col. liq., 1.4026	$0.7077\frac{20}{4}$	. . . .	110.0	i.	sl. s.	s. eth.
4566	col. liq., 1.3929	$0.6985\frac{20}{4}$	−91	108.25	i.	sl. s.	s. eth.
4567	liq., 1.4058. . . .	$0.721\frac{20}{4}$	. . . .	116.5	i.	sl. s.	s. eth.
4568							
4569	col. liq., 1.4016	$0.7169\frac{20}{4}$	. . . .	118.9	i.	sl. s.	s. eth.
4570	col. liq., 1.4929	$1.441\frac{20}{4}$	. . . .	180	. . . . . .	. . . . . .	. . . .
4571	col. liq	$0.6789\frac{20}{4}$	−119.1	90.0	i.	s.	s. eth.
4572	col. liq., 1.38864^{20}	0.68713^{20} $(0.6870\frac{20}{4})$	−119.4	91.850	i.	s.	s. eth.
4573							
4574							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4575	**3-Hexanecarboxylic acid.**	See *Valeric acid, α-ethyl-.*		
4576	**Hexanedial*.**	See *Adipaldehyde.*		
4577	**Hexanediamide*.**	See *Adipamide.*		
4578	**1,6-Hexanediamine*...**	hexamethylenediamine......	$NH_2(CH_2)_6NH_2$...	116.21
4579	**Hexanedioic acid*.**	See *Adipic acid.*		
4580	**——, 2,3,4,5-tetrahydroxy-.**	See *Mucic acid*; *Saccharic acid.*		
4581	**1,6-Hexanediol*.......**	hexamethylene glycol........	$CH_2OH(CH_2)_4$-CH_2OH	118.17
4582	**2,3-Hexanediol*.......**	2,3-dihydroxyhexane........	$CH_3(CH_2)_2$-$(CHOH)_2CH_3$	118.17
4583	**3,4-Hexanediol, 3,4-diethyl-***	tetraethylethylene glycol.....	$(C_2H_5)_2COHCO$-$HC(C_2H_5)_2$	186.29
4584	**2,3-Hexanedione, 3-oxime***	α-isonitrosobutyl methyl ketone	$CH_3COC(:NOH)$-$(CH_2)_2CH_3$	129.16
4585	**2,5-Hexanedione*.....**	acetonylacetone; *sym*-diacetylethane	$CH_3CO(CH_2)_2$-$COCH_3$	114.14
4586	**Hexanedioyl chloride*.**	See *Adipyl chloride.*		
4587	**1,2,3,4,5,6-Hexanehexol*.**	See *Dulcitol*; *Sorbitol.*		
4588	**Hexanenitrile*.**	See *Capronitrile.*		
4589	**1,2,3,4,5-Hexanepentol*.**	See *Rhamnitol.*		
4590	**1-Hexanethiol*.......**	*pri-n*-hexyl mercaptan.......	$CH_3(CH_2)_5SH$.....	118.23
4591	**Hexanoic acid*.**	See *Caproic acid.*		
4592	**Hexanoic anhydride*.**	See *Caproic anhydride.*		
4593	**1-Hexanol*...........**	*n*-hexyl alcohol; amylcarbinol	$CH_3(CH_2)_4CH_2OH$	102.17
4594	——, esters of organic acids.	See "hexyl ester" under the names of the acids.		
4595	——, nitrite	See *Hexyl nitrite.*		
4596	**——, 2-ethyl-*........**	....	$C_4H_9CH(C_2H_5)$-CH_2OH	130.23
4597	——, ——, acetate.........	β-ethylhexyl acetate........	$C_4H_9CH(C_2H_5)$-CH_2OOCCH_3	172.26
4598	**——, 3-isopropyl-5-methyl-***	isocapric alcohol; β-isoamylisoamyl alcohol; diamyl alcohol	$(CH_3)_2CHCH$-$(CH_2OH)(CH_2)_2$-$CH(CH_3)_2$	158.28
4599	**——, 2-methyl-*......**	....	$CH_3(CH_2)_3CH$-$(CH_3)CH_2OH$	116.20
4600	**——, 5-methyl-*......**	isoheptyl alcohol; isohexylcarbinol	$(CH_3)_2CH(CH_2)_3$-CH_2OH	116.20
4601	**2-Hexanol*...........**	butylmethylcarbinol.........	CH_3CHOH-$(CH_2)_3CH_3$	102.17
4602	**——, 2-methyl-*......**	butyldimethylcarbinol.......	$CH_3COH(CH_3)$-$(CH_2)_3CH_3$	116.20
4603	**——, 5-methyl-*......**	isoamylmethylcarbinol.......	$CH_3CHOH(CH_2)_2$-$CH(CH_3)_2$	116.20
4604	**3-Hexanol*...........**	ethylpropylcarbinol.........	CH_3CH_2CHOH-$(CH_2)_2CH_3$	102.17
4605	**——, 3-ethyl-*........**	diethylpropylcarbinol........	CH_3CH_2COH-$(C_2H_5)(CH_2)_2CH_3$	130.23
4606	**——, 3-ethyl-5-methyl-***	diethylisobutylcarbinol......	$(C_2H_5)_2COHCH_2$-$CH(CH_3)_2$	144.25
4607	**——, 3-methyl-*......**	ethylmethylpropylcarbinol...	$CH_3(CH_2)_2COH$-$(CH_3)CH_2CH_3$	116.20

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4575							
4576							
4577							
4578	silk leaf	…	39–40	196; (204–5) subl.	v. s.	sl. s.	sl. s. bz.
4579							
4580							
4581	need. f. w.	…	42	250	s.	s.	sl. s. h. eth.
4582	…	$0.9669\frac{0}{4}$	…	207	∞	s.	s. eth.
4583	…	…	27–8	230; $116–9^{17}$	i.	v. s.	v. s. eth.
4584	leaf	…	49.5	…	…	…	…
4585	col. liq., 1.449	$0.970\frac{20}{4}$	–9	192–4	∞	∞	∞ eth.; i. KOH, K_2CO_3
4586							
4587							
4588							
4589							
4590	col. liq	$0.849\frac{20}{4}$	–81.03	$149–50^{768}$	i.	∞	∞ eth.
4591							
4592							
4593	col. liq., 1.41790^{20}	$0.8186\frac{20}{4}$	–51.6	157.2	0.59^{20}	s.	∞ eth.
4594							
4595							
4596	col. liq	0.8340	<–76	183.5	$.10^{20}$	s.	s. eth.
4597	col. liq., 1.420	$0.872\frac{20}{4}$	–93	199.3	0.01^{43}	…	…
4598	col. oil	$0.8569\frac{0}{4}$	…	211 (203.3^{764})	i.	s.	…
4599	liq	$0.831\frac{13}{4}$	…	$162–4^{750}$	i.	∞	∞ eth.
4600	liq., 1.4254	$0.8311\frac{0}{4}$; $0.825\frac{11.5}{4}$	…	167–9	v. sl. s.	s.	s. eth.
4601	col. liq., 1.4126	$0.8287\frac{0}{4}$; $0.80977\frac{20}{4}$; $0.8044\frac{25}{4}$	…	140–0.4 (136–9)	v. sl. s.	s.	∞ eth.
4602	col. liq., 1.4175^{20}	$0.8119\frac{20}{4}$	…	139.4–140.4^{735}; $53–53.5^{15}$	v. sl. s.	∞	∞ eth.
4603	liq	$0.8185\frac{17}{4}$	…	148–50	i.	s.	s. eth.
4604	col. liq	$0.8188\frac{20}{4}$	…	135	v. sl. s.	s.	∞ eth.
4605	col. liq., 1.433	$0.8379\frac{20}{0}$	…	160.5	i.	s.	s. eth.
4606	liq	$0.8396\frac{22}{4}$	…	172	i.	s.	s. eth.
4607	col. liq., 1.423	$0.8234\frac{20}{4}$	…	141	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4608	**3-Hexanol, 5-methyl-***	ethylisobutylcarbinol	$CH_3CH_2CHOHCH_2CH(CH_3)_2$	116.20
4609	**——, 2,2,5,5-tetramethyl-***		$(CH_3)_3CCH_2CHOHC(CH_3)_3$	158.28
4610	**2-Hexanone***	butyl methyl ketone	$CH_3CO(CH_2)_3CH_3$	100.16
4611	**——, 5-methyl-***	isoamyl methyl ketone	$CH_3COCH_2CH_2CH(CH_3)_2$	114.18
4612	**——, ——,** oxime		$CH_3C(:NOH)C_5H_{11}$	129.20
4613	**——, 1,3,4,5,6-pentahydroxy-*.** See *Sorbose.*			
4614	**3-Hexanone***	ethyl propyl ketone	$C_2H_5CO(CH_2)_2CH_3$	100.16
4614M	**——, 4-hydroxy-*.**	See *Propioin.*		
4615	**——, 5-methyl-***	ethyl isobutyl ketone	$C_2H_5COCH_2CH(CH_3)_2$	114.18
4616	**Hexanoyl chloride***	See *Caproyl chloride.*		
4617	**2-Hexenal, 2-ethyl-***	α-ethyl-β-propylacrolein	$CH_3(CH_2)_2CH:C(C_2H_5)CHO$	126.19
4618	**1-Hexene***	butylethylene	$CH_2:CH(CH_2)_3CH_3$	84.16
4618H	**——, 5-amino-4-methyl-.** See 4-*Pentenylamine,* 1, 2-*dimethyl-.*			
4619	**——, 2-methyl-***	1-butyl-1-methylethylene	$CH_2:C(CH_3)CH_2CH_2CH_2CH_3$	98.18
4620	**——, 3-methyl-***		$CH_2:CHCH(CH_3)CH_2CH_2CH_3$	98.18
4621	**——, 4-methyl-***		$CH_2:CHCH_2CH(CH_3)CH_2CH_3$	98.18
4622	**——, 5-methyl-***	isoamylethylene	$CH_2:CHCH_2CH_2CH(CH_3)_2$	98.18
4623	**2-Hexene***	β-hexylene; 1-methyl-2-propylethylene	$CH_3CH:CH(CH_2)_2CH_3$	84.16
4624	**——, 2-methyl-***	1,1-dimethyl-2-propylethylene	$(CH_3)_2C:CHCH_2CH_2CH_3$	98.18
4625	**——, 3-methyl-***	1,2-dimethyl-1-propylethylene	$CH_3CH:C(CH_3)CH_2CH_2CH_3$	98.18
4626	**——, 4-methyl-***	1-*sec*-butyl-2-methylethylene	$CH_3CH:CHCH(CH_3)CH_2CH_3$	98.18
4627	**——, 5-methyl-***	1-isobutyl-2-methylethylene	$CH_3CH:CHCH_2CH(CH_3)_2$	98.18
4628	**3-Hexene***	*sym*-diethylethylene; γ-hexylene	$CH_3CH_2CH:CHCH_2CH_3$	84.16
4629	**——, 2,5-dimethyl-***	*sym*-diisopropylethylene	$(CH_3)_2CHCH:CHCH(CH_3)_2$	112.21
4630	**——, 2-methyl-***	1-ethyl-2-isopropylethylene	$(CH_3)_2CHCH:CHCH_2CH_3$	98.18
4631	**2-Hexenoic acid***	β-propylacrylic acid	$CH_3CH_2CH_2CH:CHCOOH$	114.14
4632	**——, 5-methyl-***	α, β-isoheptenic acid	$(CH_3)_2CHCH_2CH:CHCOOH$	128.17
4633	**5-Hexen-3-ol, 3-ethyl-***	allyldiethylcarbinol	$CH_2:CHCH_2COH(C_2H_5)CH_2CH_3$	128.21
4634	**5-Hexen-2-one***	allylacetone	$CH_2:CHCH_2CH_2COCH_3$	98.14
4635	**Hexine.**	See *Hexyne*.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4608	liq..........	....	....	148.2	i.	s.	s. eth.
4609	cr............	....	52–3	173–4	i.	s.	s. eth.
4610	col. liq., 1.39694$^{17.4}$	$0.830\frac{0}{4}$	–56.9	127.2	v. sl. s.	∞	∞ eth.
4611	col. liq.......	$0.818\frac{17}{4}$	....	144	v. sl. s.	∞	∞ eth.
4612	col.-yel. oil....	$0.888\frac{20}{4}$	....	195–6 d.	......	......	....
4613							
4614	col. liq., 1.39899^{22}	$0.813\frac{21.8}{4}$	....	124	v. sl. s.	∞	∞ eth.
4614M							
4615	col. liq.......	$0.815\frac{17}{0}$	....	136	i.	∞	∞ eth.
4616							
4617	col. liq.......	$0.848\frac{20}{4}$	....	175	i.	s.	s. eth.
4618	col. liq., 1.3821^{20}	$0.6732\frac{20}{4}$	–98.5	63.485	i.	∞	∞ eth.
4618H							
4619	....	$0.7000\frac{20}{4}$	....	91.1–1.5	......	......	....
4620	....	$0.6953\frac{20}{4}$	....	84.0	......	......	....
4621	....	$0.6969\frac{20}{4}$	....	87.2–7.5	......	......	....
4622	....	$0.6936\frac{20}{4}$	....	84.7	......	......	....
4623	....	$0.6813\frac{20}{4}$	....	67.9–8.1	......	......	s. dil. H_2SO_4
4624	....	$0.7089\frac{20}{4}$	....	94.4–4.6	......	......	....
4625	....	$0.7120\frac{20}{4}$	....	93.1–3.3	......	......	....
4626	....	(1) $0.7007\frac{20}{4}$	....	87.1–7.6	......	......	....
		(2) $0.6981\frac{20}{4}$	....	85.1–5.6	......	......	....
4627	....	(1) $0.6990\frac{20}{4}$	....	91.1–1.6	......	......	....
		(2) $0.7020\frac{20}{4}$	....	85.6–6.1	......	......	....
4628	....	(1) $0.722\frac{15}{4}$	....	67.5	......	......	....
		(2) $0.693\frac{20}{20}$	....	70–1	......	......	....
4629	....	....	....	116–20	......	......	....
4630	....	$0.6942\frac{20}{4}$	....	86.4–6.9	......	......	....
4631	need. f. w., 1.4467^{40}	$0.965\frac{20}{4}$	32	217	sl. s.	s.	v. s. eth.
4632	1.4524.........	$0.942\frac{20}{4}$	16.5	227	......	s.	....
4633	....	....	....	156	......	......	....
4634	col. liq., 1.42126$^{15.4}$	$0.846\frac{20}{4}$	....	129.5	i.	∞	∞ eth.
4635							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4636	***n*-Hexoic acid.**	See *Caproic acid.*		
4637	***n*-Hexoic aldehyde.**	See *Caproaldehyde.*		
4638	**Hexoylene.**	See 2-*Hexyne**.		
4639	**Hexyl alcohol, active.**	See 1-*Pentanol, 3-methyl-**.		
4640	***n*-Hexyl alcohol.**	See 1-*Hexanol**.		
4641	**Hexylamine*(*n*)**		$CH_3(CH_2)_5NH_2$	101.19
4641M	——, **α-methyl-**	2-amino-*n*-heptane	$CH_3(CH_2)_4CH(CH_3)NH_2$	115.22
4642	***n*-Hexyl bromide.**	See *Hexane, 1-bromo-**.		
4643	***n*-Hexyl chloride.**	See *Hexane, 1-chloro-**.		
4644	**Hexylene.**	See *Hexene**.		
4645	**1,6-Hexylene iodide.**	See *Hexane, 1,6-diiodo-**.		
	Hexyl esters of organic acids.	See "hexyl ester" under the names of the acids.		
4646	***n*-Hexyl iodide.**	See *Hexane, 1-iodo-**.		
4647	***pri-n*-Hexyl mercaptan.**	See 1-*Hexanethiol**.		
4648	**Hexyl nitrite(*n*)**		$CH_3(CH_2)_5ONO$	131.17
4649	**Hexyl sulfate**	di-*n*-hexyl sulfate	$[CH_3(CH_2)_5]_2SO_4$	266.39
4650	**1-Hexyne***	butylacetylene; 1-hexine	$HC\vdots C(CH_2)_3CH_3$	82.14
4651	**2-Hexyne***	2-hexine; methylpropylacetylene; hexoylene	$CH_3C\vdots C(CH_2)_2CH_3$	82.14
4651F	**3-Hexyne***	3-hexine; diethylacetylene	$C_2H_5C\vdots C\cdot C_2H_5$	82.14
4651H	**1-Hexyn-3-ol, 3-methyl-***	ethynylmethylpropylcarbinol	$HC\vdots C\cdot C(OH)(CH_3)C_3H_7$	112.17
4651R	**3-Hexyn-2-ol, 2-methyl-***	1-butynyldimethylcarbinol	$(CH_3)_2C(OH)C\vdots C\cdot C_2H_5$	112.17
4652	**Hippuric acid**	*N*-benzoylglycine; benzamidoacetic acid	$C_6H_5CONHCH_2COOH$	179.17
4653	——, *p*-phenylphenacyl ester		$C_6H_5CONHCH_2COOCH_2COC_6H_4C_6H_5$	373.39
4653M	**Histamine**	4-imidazoleëthylamine; β-aminoethylglyoxaline	$C_3H_3N_2\cdot CH_2CH_2NH_2$	111.15
4654	**DL-Histidine**	*dl*-α-amino-5-imidazolepropionic acid	$C_3H_3N_2CH_2CH(NH_2)COOH$	155.16
4655	**D-Histidine**		$C_3H_3N_2CH_2CH(NH_2)COOH$	155.16
4656	**L-Histidine**		$C_3H_3N_2CH_2CH(NH_2)COOH$	155.16
4657	——, diflavianate		$C_6H_9N_3O_2(C_{10}H_6N_2O_8S)_2$	783.61
4658	——, dihydrochloride		$C_6H_9N_3O_2\cdot 2HCl$	228.09
4659	**Homatropine**	mandelyltropeine; homoatropine	$C_{16}H_{21}NO_3$	275.34
4660	——, hydrobromide		$C_{16}H_{21}NO_3\cdot HBr$	356.26
4661	——, hydrochloride		$C_{16}H_{21}NO_3\cdot HCl$	311.80
4662	**Homoanthranilonitrile.**	See *p-Tolunitrile, 2-amino-*.		
4663	**Homoatropine.**	See *Homatropine.*		
4664	**Homocinchonidine**		$C_{19}H_{22}N_2O$	294.38
4665	**Homohydroquinone.**	See *Toluhydroquinone.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4636							
4637							
4638							
4639							
4640							
4641	col. liq	....	−19	132.7	sl. s.	∞	∞ eth.
4641M	1.41997^{19}	$0.7665\frac{10}{4}$	....	142	sl. s.	s.	s. eth.
4642							
4643							
4644							
4645							
4646							
4647							
4648	yel. liq	$0.8851\frac{20}{4}$	....	129–30	i.	s.	s. eth.
4649	1.4344^{25}	$1.0039\frac{25}{25}$	....	125.3^{2}	......	......	....
4650	col. liq	$0.736\frac{0}{4}$; $0.7120\frac{25}{4}$	−150	71.5	i.	s.	s. eth.
4651	liq	0.7494^{5}; $0.7377\frac{18}{4}$	....	84	i.	∞	∞ eth.
4651F	col. liq., 1.4112^{25}	0.7263^{25}	....	....	i.	∞	∞ eth.
4561 H	col. liq., 1.4338^{20}	0.8620^{20}	....	58^{26}	s.	s.	s. eth.
4651R	col. liq., 1.4411^{0}	0.962^{0}	....	145–147	s.	s.	s. eth.
4652	col. rhomb., 1.535, 1.592, 1.760	$1.371\frac{20}{4}$	187.5 (189–90)	d.	0.33^{20}	sl. s.	sl. s. eth.; 0.11 chl.; i. bz., pet. eth.
4653	....	....	163	....	......	......	....
4653M	wh. cr	....	83–4	$209–10^{18}$	s.	sl. s.	....
4654	tetr. pr	....	285–6 d.	d.	s.	i.	i. eth., acet., chl.
4655	lng. pl	....	287–8	....	......	i.	i. eth., acet., chl.
4656	leaf. f. w	....	277 d.	d. 209^{18}	s.	v. sl. s.	i. eth.
4657	need	....	251–2 d.	....	sl. s.	i.	i. eth.
4658	rhomb. pl	....	245 d.	....	v. s., d.	s.	i. eth.; v. sl. s. conc. HCl
4659	deliq. pr. f. eth.; glist. pr. f. al.	....	95.5–8.5	....	v. sl. s.	s.	s. eth., acet., dil. a., bz., chl.
4660	col. rhomb. pr.	....	212 d.	....	17.5^{25}	3.3	i. eth.; s. chl.
4661	sm. wh. cr	....	216–7	....	s.	s.	....
4662							
4663							
4664	pr	....	207.6	....	i.	4.8	s. chl.
4665							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4666	**Homophthalic acid**	α-2-toluenedicarboxylic acid	$C_6H_4(CH_2COOH)$-$COOH$	180.15
4667	**4-Homopyrocatechol**	4-methylpyrocatechol	$CH_3C_6H_3(OH)_2$	124.13
4668	**o-Homosalicylic acid.**	See 2,3-*Cresotic acid.*		
4669	***m*-Homosalicylic acid**	(α). See 2,4-*Cresotic acid.*		
4670	***m*-Homosalicylic acid**	(β). See 2,6-*Cresotic acid.*		
4671	***p*-Homosalicylic acid.**	See 2,5-*Cresotic acid.*		
4672	**Hordenine**	*p*-hydroxy-*N*,*N*-dimethyl-phenethylamine	$C_{10}H_{15}NO$	165.23
4673	——, sulfate		$(C_{10}H_{15}NO)_2H_2$-$SO_4\cdot H_2O$	446.55
4674	**Hydantoic acid**	*N*-carbamylglycine; ureidoacetic acid; glycoluric acid; ureaacetic acid	$NH_2CONHCH_2$-$COOH$	118.09
4675	**Hydantoin**	glycolylurea	$NHCONHCOCH_2$	100.08
4676	**——, 1-methyl-**	β-methylhydantoin	$N(CH_3)CONH$-$COCH_2$	114.10
4677	**——, 5-methyl-**	α-lactylurea	$NHCONHCOCH$-(CH_3)	114.10
4678	**——, 2-thio-**	glycolylthiourea	$C_3H_4N_2OS$	116.14
4679	**——, 5-ureido-.**	See *Allantoin.*		
4680	**Hydracetin.**	See *Hydrazine, 1-acetyl-2-phenyl-.*		
4681	**Hydracrylic acid**	3-hydroxypropanoic acid*; β-hydroxypropionic acid; ethylene lactic acid	CH_2OHCH_2COOH	90.08
4682	**——, α-phenyl-.**	See *Tropic acid.*		
4683	**Hydracrylonitrile**	3-hydroxypropanenitrile*; ethylene cyanohydrin; glycol cyanohydrin; β-hydroxypropionitrile	$HOCH_2CH_2CN$	71.08
4684	**Hydrastine**		$C_{21}H_{21}NO_6$	383.39
4685	——, hydrochloride		$C_{21}H_{21}NO_6\cdot HCl$	419.85
4686	**Hydrastinine**		$C_{11}H_{13}NO_3$	207.22
4687	——, bisulfate		$C_{11}H_{11}NO_2\cdot H_2SO_4$	287.28
4688	——, hydrochloride (*i*)		$C_{11}H_{11}NO_2\cdot HCl$	225.67
4689	**Hydratropic acid**	α-methyl-α-toluic acid; α-phenylpropionic acid	$C_6H_5CH(CH_3)$-$COOH$	150.17
4690	**——, α-hydroxy-.**	See *Atrolactic acid.*		
4691	**Hydrazine, 1-acetyl-2-phenyl-**	acetic acid β-phenylhydrazide; hydracetin; pyrodin	$CH_3CONHNH$-C_6H_5	150.18
4692	**——, benzal-.**	See *Benzaldehyde, hydrazone.*		
4693	**——, benzalphenyl-.**	See *Benzaldehyde, phenylhydrazone.*		
4694	**——, benzoyl-.**	See *Benzoic acid, hydrazide.*		
4695	**——, 1-benzoyl-2-phenyl-.**	See *Benzoic acid, phenylhydrazide.*		
4696	**——, benzyl-**		$C_6H_5CH_2NHNH_2$	122.17
4697	**——, benzylidene-.**	See *Benzaldehyde, hydrazone.*		
4698	**——, benzylidenephenyl-.**	See *Benzaldehyde, phenylhydrazone.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4666	cr. f. w.	....	175	....	s. h.	v. s.	sl. s. eth.
4667	col., 1.5425^{74}	$1.129\frac{74}{4}$	65	252	v. s.	v. s.	v. s. eth.
4668							
4669							
4670							
4671							
4672	rhomb. pr.	....	117.8 subl.	140–50	s.	v. s.	v. s. eth.; s. chl.; sl. s. bz.
4673	col. cr.	....	208–10	....	s.	sl. s.	i. eth.
4674	monocl. pr.	....	171	....	3^{20}	0.39^{20}	v. sl. s. eth.
4675	need.	....	220	....	s. h.	s.	....
4676	pr.	....	157–8	subl.	s.	s.	....
4677	rhomb.	....	anh. 145	....	v. s.	v. s.	v. sl. s. eth.
4678	need. f. h. w.	....	d. 200	....	s. h.	i.	i. eth.
4679							
4680							
4681	syrup	....	....	d.	v. s.	s.	∞ eth.
4682							
4683	col. liq.	$1.059\frac{0}{4}$	....	$221^{728.5}$	∞	∞	1.64^{15} eth.
4684	col. rhomb. pr., $[\alpha]^{17}_{D}$ −678° in chl.	....	132	....	0.025^{80}	0.74^{25}	0.8^{25} eth.; s. chl.
4685	wh. hyg. pwd.	....	210 (116)	....	s.	s.	v. sl. s. eth.; sl. s. chl.
4686	wh.-yelsh. need. f. lgr.	....	116–7	....	sl. s.	s.	s. eth., chl., a. d. bz.
4687	grn. fluores. cr.	....	216 d.	....	s.	s.	....
4688	yel. need.; aq. sol. bl. fluores.	....	212 d.	....	v. s.	v. s.	0.077 eth.; s chl.
4689	col. liq.	$1.1\frac{0}{4}$	<−20	265	sl. s.	......	....
4690							
4691	col. hex.	....	128	....	v. sl. s. c., v. s. h.	s.	sl. s. eth.; s. bz., chl.
4692							
4693							
4694							
4695							
4696	col. oil	....	26	103^{41}	∞	∞	∞ eth.
4697							
4698							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4699	**Hydrazine, *p*-bromophenyl-.**		$BrC_6H_4NHNH_2$	187.05
4700	**——, 1-butylidene-2-phenyl-.**	See *Butyraldehyde, phenylhydrazone.*		
4701	**——, carbamyl-.**	See *Semicarbazide.*		
4702	**——, dibenzal-.**	See *Benzaldehyde, azine.*		
4703	**——, diisopropylidene-.**	See *Acetone, azine.*		
4704	**——,(dimethylphenyl)-.**	See *Hydrazine, xylyl-.*		
4705	**——, 1,2-di-1-naphthyl-**	1,1′-hydrazonaphthalene	$C_{10}H_7NHNHC_{10}H_7$	284.35
4706	**——, 1,2-di-2-naphthyl-**	2,2′-hydrazonaphthalene	$C_{10}H_7NHNHC_{10}H_7$	284.35
4707	**——, 2,4-dinitrophenyl-***		$(NO_2)_2C_6H_3$-$NHNH_2$	198.14
4708	**——, 1,1-diphenyl-***	*uns*-diphenylhydrazine	$(C_6H_5)_2NNH_2$	184.23
4709	**——, 1,2-diphenyl-***	hydrazobenzene; *sym*-diphenylhydrazine	$C_6H_5NHNHC_6H_5$	184.23
4710	**——, 1,2-di-*o*-tolyl-**	*o*-hydrazotoluene	$CH_3C_6H_4NHNH$-$C_6H_4CH_3$	212.29
4711	**——, 1,2-di-*m*-tolyl-**	*m*-hydrazotoluene	$CH_3C_6H_4NHNH$-$C_6H_4CH_3$	212.29
4712	**——, 1,2-di-*p*-tolyl-**	*p*-hydrazotoluene	$CH_3C_6H_4NHNH$-$C_6H_4CH_3$	212.29
4713	**——, ethyl-**		$NH_2NHC_2H_5$	60.10
4714	**——, 1-ethylidene-2-phenyl-.**	See *Acetaldehyde, phenylhydrazone.*		
4715	**——, 1-ethyl-1-phenyl-**		$C_6H_5(C_2H_5)NNH_2$	136.19
4716	**——, 1-ethyl-2-phenyl-**		$C_6H_5NHNHC_2H_5$	136.19
4717	**——, formyl-.**	See *Formohydrazide.*		
4718	**——, guanyl-.**	See *Guanidine, 1-amino-.*		
4719	**——, 1-isoamyl-1-phenyl-**		$C_6H_5N(C_5H_{11})NH_2$	178.27
4720	**——, 1-isobutyl-1-phenyl-**	1-(β-methylpropyl)-1-phenylhydrazine*	$C_4H_9(C_6H_5)NNH_2$	164.25
4721	**——, methyl-***		CH_3NHNH_2	46.07
4722	**——, 1-methyl-1-phenyl-**		$C_6H_5N(CH_3)NH_2$	122.17
4723	**——, 1-methyl-2-*m*-tolyl-**	*m*-methylhydrazobenzene	$CH_3C_6H_4NHNH$-C_6H_5	198.26
4724	**——, 1-methyl-2-*p*-tolyl-**	*p*-methylhydrazobenzene	$CH_3C_6H_4NHNH$-C_6H_5	198.26
4725	**——, (1-naphthyl)-**		$C_{10}H_7NHNH_2$	158.20
4726	**——, (2-naphthyl)-**		$C_{10}H_7NHNH_2$	158.20
4727	**——, *o*-nitrophenyl-**		$NO_2C_6H_4NHNH_2$	153.14
4728	**——, *m*-nitrophenyl-**		$NO_2C_6H_4NHNH_2$	153.14
4729	**——, *p*-nitrophenyl-**		$NO_2C_6H_4NHNH_2$	153.14
4730	**——, phenyl-***		$C_6H_5NHNH_2$	108.14
4731	——, ——, hydrochloride		$C_6H_5NHNH_2{\cdot}HCl$	144.60
4733	**——, 1-phenyl-2-*o*-tolyl-**	*o*-methylhydrazobenzene	$CH_3C_6H_4NHNH$-C_6H_5	198.26

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4699	need. or leaf. f. al. or lgr.	....	106	....	i.	s.	s. eth., bz.
4700							
4701							
4702							
4703							
4704							
4705	col. leaf. f. bz..	....	271; 274	....	i.	v. s.	v. s. eth.; s. bz.
4706	col. flocks.....	....	164	....	i.	sl. s.	v. s. eth.
4707	purp.-red pr. f. al.; vlt. fluores.	....	194 (198 d.)	exp.	i.	v. sl. s.	i. (sl. s.) eth.; s. aniline, h.; ethyl acetate; sl. s. chl., CS_2, bz.
4708	ylsh.-br. liq. or pl. f. lgr.	$1.190\frac{16}{4}$	34.5; 44	220^{50}	v. sl. s.	v. s.	v. s. eth.; s. conc. H_2SO_4
4709	col.-yelsh. rhomb. tab. f. al.	$1.158\frac{16}{4}$	131 (126)	d.	v. sl. s.	3.95^{16}	s. eth.
4710	col. leaf. f. al..	....	165	d.	v. sl. s.	s.	s. eth., bz.
4711	col. oil........	....	....	....	i.	s.	....
4712	col. monocl. pl. f. al.-eth.	$0.957\frac{20}{4}$	133–4 (126)	d.	i.	v. s.	v. s. eth.; s. bz.
4713	col. liq.......	....	....	101.5	v. s.	v. s.	v. s. eth.
4714							
4715	liq...........	$1.018\frac{15}{4}$	....	237	......	......	....
4716	liq., $1.57108\frac{20.8}{He}$	$1.004\frac{15}{15}$	....	240; 104^{10}	sl. s.	s.	s. eth.
4717							
4718							
4719	liq...........	....	....	$173–5^{50}$	......	......	....
4720	....	$0.9633\frac{20}{4}$	....	245	......	......	....
4721	col. hyg. liq...	....	....	87.5	v. s.	∞	∞ eth.
4722	yel. liq., 1.583.	$1.040\frac{20}{4}$	....	227.5	sl. s.	∞	∞ eth.
4723	col.-lt. yel. pr. f. lgr.	....	59–61	....	i.	v. s.	sl. s. eth.; s. bz.
4724	col. sc. f. lgr...	....	86–7	....	......	v. s.	v. s. eth., bz.
4725	col. leaf.......	....	116	203^{20}	v. sl. s. c.	v. s. h.	sl. s. eth.; v. s. chl.
4726	col. leaf. f. w..	....	124–5	....	sl. s. h.	v. s. h.	sl. s. eth.; s. chl., bz.
4727	brick red need.	....	90	....	i.	sl. s.	sl. s. eth.
4728	yel. need......	....	93	....	sl. s.	sl. s.	....
4729	or.-red. leaf. or need.	....	157	d.	sl. s.	s.	s. eth., chl., ethyl acetate; v. sl. s. bz.
4730	yel. monocl. or oil	$1.0978\frac{20}{4}$	19.6	sl. d.	12.6^{20}, 23^{50}	∞	∞ eth.
4731	leaf. f. al......	....	240–1	....	v. s.	s.	i. eth.
4733	col. leaf. f. al..	....	101–2	....	i.	sl. s. c.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4734	**Hydrazine, picryl-**	2,4,6-trinitrophenylhydrazine	$(NO_2)_3C_6H_2NHNH_2$	243.14
4735	**——, tetraphenyl-***		$(C_6H_5)_2NN(C_6H_5)_2$	336.42
4736	**——, *o*-tolyl-**		$CH_3C_6H_4NHNH_2$	122.17
4737	**——, *m*-tolyl-**		$CH_3C_6H_4NHNH_2$	122.17
4738	**——, *p*-tolyl-**		$CH_3C_6H_4NHNH_2$	122.17
4739	**——, 2,4,6-trinitrophenyl-.**	See *Hydrazine, picryl-.*		
4740	**——, triphenyl-***		$(C_6H_5)_2NNHC_6H_5$	260.33
4741	**——, 2,3-xylyl-**	(2,3-dimethylphenyl)hydrazine	$(CH_3)_2C_6H_3NHNH_2$	136.19
4742	**——, 2,5-xylyl-**	(2,5-dimethylphenyl)hydrazine	$(CH_3)_2C_6H_3NHNH_2$	136.19
4743	**Hydrazobenzene.**	See *Hydrazine, 1,2-diphenyl-*.*		
4744	**——, 4,4′-diamino-**	*p,p′*-hydrazodianiline; diphenine	$NH_2C_6H_4NHNHC_6H_4NH_2$	214.27
4745	**——, methyl-.**	See *Hydrazine, 1-phenyl-2-tolyl-.*		
4746	***o*-Hydrazobenzoic acid**	*o,o′*-hydrazodibenzoic acid	$(COOHC_6H_4NH)_2$	272.25
4747	***m*-Hydrazobenzoic acid**	*m,m′*-hydrazodibenzoic acid	$(COOHC_6H_4NH)_2$	272.25
4748	***p*-Hydrazobenzoic acid**	*p,p′*-hydrazodibenzoic acid	$(COOHC_6H_4NH)_2$	272.25
4749	**Hydrazonaphthalene.**	See *Hydrazine, dinaphthyl-.*		
4750	**Hydrazophenylene.**	See *Phenazine,* 5,10-*dihydro-.*		
4751	**Hydrazotoluene.**	See *Hydrazine, ditolyl-.*		
4752	**Hydrindene.**	See *Indan.*		
4753	**α-Hydrindone.**	See 1-*Indanone.*		
4754	**β-Hydrindone.**	See 2-*Indanone.*		
4754M	**Hydroanisoin**	*p,p′*-dimethoxyhydrobenzoin, one form	$[p\text{-}CH_3OC_6H_4\text{-}CHOH\cdot]_2$	274.31
4755	**Hydroanthranol.**	See *Anthranol,* 9,10-*dihydro-.*		
4756	**Hydrobenzamide**	tribenzaldiamine; *N,N′*-dibenzylidene-α,α-toluenediamine	$(C_6H_5CH)_3N_2$	298.37
4757	**Hydrobenzoin**	1,2-diphenyl-1,2-ethanediol (one form); tolylene glycol	$C_6H_5CHOHCHOHC_6H_5$	214.25
4757M	**——, *p,p′*-dimethoxy-.**	See *Hydroanisoin; Isohydroanisoin.*		
4758	**——, α,α′-dimethyl-.**	See 2,3-*Butanediol,* 2,3-*diphenyl-.*		
4759	**——, dodecahydro-.**	See 1,2-*Ethanediol,* 1,2-*dicyclohexyl-.*		
4760	**Hydroberberine**	tetrahydroberberine	$C_{20}H_{21}NO_4$	339.38
4761	**Hydrocarbostyril**	3,4-dihydro-2(1)-quinolone; *o*-aminohydrocinnamic acid lactam	$\underbrace{C_6H_4NHCOCH_2CH_2}$	147.17
4762	**Hydrocerulignone**	4,4′-dihydroxy-3,3′,5,5′-tetramethoxybiphenyl	$C_{12}H_4(OH)_2(OCH_3)_4$	306.31
4763	**Hydrocinchonidine**	cinchamidine	$C_{19}H_{24}N_2O$	296.40
4764	**Hydrocinchonine.**	See *Cinchotine.*		
4765	**Hydrocinnamaldehyde**	3-phenylpropanal	$C_6H_5CH_2CH_2CHO$	134.17
4766	**Hydrocinnamic acid**	β-phenylpropionic acid; benzenepropionic acid	$C_6H_5CH_2CH_2COOH$	150.17
4767	——, ethyl ester	ethyl benzenepropanoate; ethyl β-phenylpropionate	$C_6H_5CH_2CH_2COOC_2H_5$	178.22
4768	——, piperazinium salt		$C_4H_{10}N_2\cdot 2C_9H_{10}O_2$	386.48
4769	**——, α-acetyl-,** ethyl ester	ethyl α-benzylacetoacetate	$C_6H_5CH_2CH\text{-}(COCH_3)COOC_2H_5$	220.26

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4734	yel. need........	....	186–7	d.	i.	sl. s.	sl. s. eth.
4735	rhomb. pr. f. al.+chl.	....	147	....	i.	v. sl. s. h.	s. bz., chl., acet., H_2SO_4, blue color
4736	col. tab. f. lgr.	....	56	....	......	v. s.	v. s. eth., chl.; sl. s. lgr.
4737	liq...........	....	....	224	......	......	....
4738	col. rhomb. leaf	....	61	240–4 d.	sl. s.	v. s.	v. s. eth., bz.
4739							
4740	need. f. bz....	$0.869\frac{70}{4}$	142 d.	....	i.	s.	sl. s. eth.; v. s. bz.
4741	col. need......	....	149–50	....	......	s.	s. eth.
4742	need. f. eth....	....	85	d.	v. sl. s.	v. s.	s. eth.
4743							
4744	yel. cr........	....	145	....	s. h.	s.	s. eth.
4745							
4746	col. leaf. f. al..	....	205	....	i.	s.	s. alk.
4747	yel. cr. f. al...	....	....	....	i.	sl. s. h.	s. alk.
4748	sm. need. f. al.	....	....	....	i.	sl. s.	s. KOH
4749							
4750							
4751							
4752							
4753							
4754							
4754M	col. rhomb. tab.	....	168–170; 170–171	....	v. sl. s.	v. s. h.; s. c.	v. sl. s. eth.
4755							
4756	col. pr. f. al...	....	101 (110)	130	i.	v. s.	v. s. eth.
4757	monocl. leaf. f. al.	0.927^{134}	139	>300	0.25 c., 1.25 h.	v. s.	....
4757M							
4758							
4759							
4760	wh. need. or pa. yel. octahdr. cr.	....	167	....	i.	s.	s. chl., CS_2
4761	col. pr. f. al., 1.479, 1.710, 1.810	....	163	....	v. sl. s.	v. s.	v. s. eth.
4762	monocl. pr. f. al.	....	190	d.	sl. s.	s.	sl. s. eth.; i. CS_2
4763	leaf..........	....	230	....	i.	sl. s.	sl. s. eth.
4764							
4765	col. monocl. pr. f. al.	....	47	280	i.	17	∞ eth.
4766	col. monocl. need. f. al.	$1.071\frac{49}{4}$	48.6	279.8	0.59^{20}	372^{20}	s. eth.
4767	col. liq., 1.49542	$1.015\frac{20}{4}$	....	249	i.	s.	s. eth.
4768	wh. cr........	....	150.5–1.5	....	sl. s.	s. h.	i. eth.
4769	col. liq.......	$1.061\frac{25}{25}$	....	290 d.	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4770	**Hydrocinnamic acid, o-amino-,** lactam. See *Hydrocarbostyril.*			
4771	——, **α-amino-.**	See *Alanine, β-phenyl-.*		
4772	——, **β-amino-.**		$C_6H_5CH(NH_2)$-CH_2COOH	165.19
4773	——, **α-amino-p-hydroxy-.** See *Tyrosine.*			
4774	——, **α,β-dibromo-(*i*)**	*i*-cinnamic acid dibromide	$C_6H_5CHBrCH$-$BrCOOH$	307.99
4776	——, **o-hydroxy-.**	See *Melilotic acid.*		
4777	——, **p-hydroxy-.**	See *Phloretic acid.*		
4778	——, **α-hydroxy-β-keto-.** See *Glycolic acid, benzoyl-.*			
4779	**Hydrocinnamonitrile, β-keto-.** See *Acetonitrile, benzoyl-.*			
4780	**Hydrocinnamyl alcohol.** See 1-*Propanol, 3-phenyl-.*			
4781	**Hydrocotarnine**		$C_{12}H_{15}NO_3\cdot\frac{1}{2}H_2O$	230.26
4782	**o-Hydrocoumaric acid.**	See *Melilotic acid.*		
4783	**Hydrocyanic acid**	hydrogen cyanide; prussic acid	HCN	27.03
4784	**Hydrofuramide.**	furfural hydramide; trifuraldiamine; furfuramide	$(C_5H_4O)_3N_2$	268.26
4785	**Hydrogen cyanide.**	See *Hydrocyanic acid.*		
4786	**Hydrogen methyl sulfate.** See *Methylsulfuric acid.*			
4787	**Hydrohydrastinine**		$C_{11}H_{13}NO_2$	191.22
4788	**α-Hydronaphthoquinone.** See 1,4-*Naphthalenediol**.			
4789	**Hydrophlorone.**	See *Hydroquinone, 2,5-dimethyl-.*		
4790	**Hydroquinine**		$C_{20}H_{26}N_2O_2$	326.43
4791	**Hydroquinone**	1,4-benzenediol*; quinol; hydroquinol; p-dihydroxybenzene	$C_6H_4(OH)_2$	110.11
4792	——, diacetate	quinol diacetate; p-phenylene diacetate; diacetylhydroquinone	$C_6H_4(OOCCH_3)_2$	194.18
4793	——, diethyl ether.	See *Benzene, 1,4-diethoxy-**.		
4794	——, dimethyl ether	See *Benzene, 1,4-dimethoxy-**.		
4795	——, monoamyl ether.	See *Phenol, p-amoxy-.*		
4796	——, monobutyl ether.	See *Phenol, p-butoxy-.*		
4797	——, monoethyl ether.	See *Phenol, p-ethoxy-.*		
4798	——, monoheptyl ether.	See *Phenol, p-heptyloxy-.*		
4799	——, monohexyl ether.	See *Phenol, p-hexyloxy-.*		
4800	——, monomethyl ether.	See *Phenol, p-methoxy-.*		
4801	——, monoöctyl ether.	See *Phenol, p-octyloxy-.*		
4802	——, monopropyl ether.	See *Phenol, p-propoxy-.*		
4803	——, **2-acetyl-.**	See *Acetophenone, 2,5-dihydroxy-.*		
4804	——, **bromo-**	2-bromo-1,4-benzenediol*	$BrC_6H_3(OH)_2$	189.02
4805	——, **chloro-**	2-chloro-1,4-benzenediol*; chloroquinol	$ClC_6H_3(OH)_2$	144.56
4806	——, **2,3-dimethyl-**	2,3-dimethyl-1,4-benzenediol*; o-xylohydroquinone; 3,6-dihydroxy-o-xylene	$(CH_3)_2C_6H_2(OH)_2$	138.16
4807	——, **2,5-dimethyl-**	2,5-dimethyl-1,4-benzenediol*; p-xylohydroquinone; hydrophlorone; hydro-p-xyloquinone; 2,5-dihydroxy-p-xylene	$(CH_3)_2C_6H_2(OH)_2$	138.16
4808	——, **2,6-dimethyl-**	2,6-dimethyl-1,4-benzenediol*; 2,5-dihydroxy-m-xylene	$(CH_3)_2(OH)_2C_6H_2$	138.16
4809	——, **dithio-**	1,4-benzenedithiol*; p-phenylene dimercaptan	$C_6H_4(SH)_2$	142.23
4810	——, **hydroxy-.**	See 1,2,4-*Benzenetriol**.		
4811	——, **2-isopropyl-5-methyl-.** See *Thymoquinone.*			
4812	——, **2-methyl-.**	See *Toluhydroquinone.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4770							
4771							
4772	monocl. f. w. . .	....	231 d.	....	sl. s. c.	s.	sl. s. eth.
4773							
4774	monocl. pr. . . .	....	203–4	....	d. h.	s.	s. eth., CS_2
4776							
4777							
4778							
4779							
4780							
4781	monocl. pr. f. al.	....	55–6	....	....	v. s.	v. s. eth., chl., bz.; s. alk.
4782							
4783	col. pois. liq., 1.2675^{10}	$0.6876\frac{20}{4}$	–14	26	∞	∞	∞ eth.
4784	need. f. al.	....	117	250 d.	i.	s.	s. eth.
4785							
4786							
4787	wh. cr.	....	66	....	....	v. s.	v. s. eth.
4788							
4789							
4790	$+2H_2O$, need. f. chl. or eth.	....	168; 172 anh.	....	sl. s.	s.	s. eth., chl., acet., NH_4OH
4791	col. hex. pr. f. w., 1.633, 1.626	$1.358\frac{20}{4}$	170.5 (173.1)	286.2	5.9^{15}	v. s.	v. s. eth.
4792	pl. or leaf. f. al.	....	124	....	sl. s. h.	sl. s.	v. s. eth.; s. chl.
4793							
4794							
4795							
4796							
4797							
4798							
4799							
4800							
4801							
4802							
4803							
4804	leaf. f. pet. eth.	....	110–1 (113–5)	subl.	s.	s.	s. eth., bz., ac. a., chl., lgr.
4805	monocl. leaf. f. chl.	....	106	263	v. s.	v. s.	s. eth., h. chl.
4806	cr. f. w.	....	221 d.	....	s.	s.	s. eth.
4807	leaf. f. w.	....	217 (212)	subl.	sl. s.	s.	s. eth.; sl. s. CS_2, ac. a., chl.; v. sl. s. bz.
4808	need. f. xylene.	....	149–51	....	....	s.	s. eth.
4809	hex. leaf. f. dil. al.	....	98	....	sl. s.	s.	s. eth., bz., lgr.; v. s. ac. a.
4810							
4811							
4812							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4813	**Hydroquinone, tetra-chloro-**	tetrachloro-1,4-benzenediol*	$C_6Cl_4(OH)_2$	247.90
4813M	**——, 2,3,5-trimethyl-**		$(CH_3)_3C_6H(OH)_2$	152.19
4814	**——, trichloro-**		$Cl_3C_6H(OH)_2$	213.46
4815	**Hydroquinonecarboxylic acid.** See *Gentisic acid.*			
4816	**Hydroquinone-2-carboxylic acid, 5-hydroxy-.** See *Benzoic acid,2,4,5-trihy-*			
4817	**2,5-Hydroquinonedicarboxylic acid.** See *Terephthalic acid, 2,5-dihydroxy-.*			
4818	**Hydroquinone-phthalein**	2,7-dihydroxyfluoran	$C_{20}H_{12}O_5$	332.30
4819	**Hydroresorcinol.**	See 1,3-*Cyclohexanedione*.*		
4820	**Hydrotoluquinone.**	See *Toluhydroquinone.*		
	Hydroxy-. See the parent compounds (e.g., for hydroxybenzoic acid see *Benzoic acid, hy-*			
4821	**Hydroxylamine, benzyl-***	β (or *N*)-benzylhydroxyl-amine	$C_6H_5CH_2NHOH$	123.15
4822	**——, α(or *O*)-benzyl-.**	See *Benzyloxyamine*.*		
4823	**——, ethyl-***	β-ethylhydroxylamine	C_2H_5NHOH	61.08
4824	**——, α-ethyl-.**	See *Ethoxyamine*.*		
4825	**——, methyl-***	β-methylhydroxylamine	CH_3NHOH	47.06
4826	**——, α-methyl-.**	See *Methoxyamine*.*		
4827	**——, phenyl-***	β-phenylhydroxylamine	C_6H_5NHOH	109.12
4828	**——, propyl-***		$CH_3CH_2CH_2NH-OH$	75.11
4829	**——, *o*-tolyl-**	β (or *N*)-*o*-tolylhydroxyl-amine	$CH_3C_6H_4NHOH$	123.15
4830	**——, *m*-tolyl-**		$CH_3C_6H_4NHOH$	123.15
4831	**——, *p*-tolyl-**		$CH_3C_6H_4NHOH$	123.15
4832	**Hyenic acid**		$C_{24}H_{49}COOH$	382.66
4833	**Hyoscine**	*l*-scopolamine	$C_{17}H_{21}NO_4$	303.35
4834	——, hydrobromide		$C_{17}H_{21}NO_4 \cdot HBr \cdot 3H_2O$	438.32
4835	——, sulfate	*l*-scopolamine sulfate	$(C_{17}H_{21}NO_4)_2 \cdot H_2SO_4 \cdot 2H_2O$	740.80
4836	**Hyoscyamine**	*l*-hyoscyamine; daturine; duboisine	$C_{17}H_{23}NO_3$	289.36
4837	——, hydrobromide		$C_{17}H_{23}NO_3 \cdot HBr$	370.29
4838	——, hydrochloride		$C_{17}H_{23}NO_3 \cdot HCl$	325.83
4839	——, sulfate		$(C_{17}H_{23}O_3N)_2 \cdot H_2SO_4 \cdot 2H_2O$	712.84
4840	***dl*-Hyoscyamine.**	See *Atropine.*		
4841	***d*-Hyoscyamine**		$C_{17}H_{23}NO_3$	289.36
4842	***d*-Hypaphorine**		$C_{14}H_{18}N_2O_2 \cdot 2H_2O$	282.33
4844	**Hypnal**	antipyrine chloral hydrate; chloral-antipyrine	$C_{11}H_{12}N_2O \cdot CCl_3-CH(OH)_2$	353.64
4845	**Hypogeic acid** (artificial)	7-hexadecenoic acid	$CH_3(CH_2)_7CH:CH(CH_2)_5COOH$	254.40
4846	**Hypoxanthine**	6(1)-purinone; 6-oxypurine; sarcine	$C_5H_4N_4O$	136.11

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4813	col. monocl. f. bz.	....	232	subl. d.	i.	v. s.	v. s. eth.; s. bz.
4813M	wh. cr.	....	170–171	....	v. sl. s. c.; s. h.	s.	s. eth.
4814	col. pr. f. w ...	....	134 (138)	subl.	0.6^{15}	v. s.	v. s. eth.
4815							
4816	*droxy–.*						
4817							
4818	need. f. eth....	....	232–4	d.	v. sl. s. h.	s.	s. eth., alk.; i. lgr.
4819							
4820							
	droxy–; for hydr	oxypropane	see *Propano*	*l*).			
4821	need. f. lgr....	....	57	....	s.	......	....
4822							
4823	col. leaf. or need. f. lgr., $1.41519^{63.9}$	0.908^{20}_{4}	59 d.	....	v. s.	v. s.	sl. s. eth.
4824							
4825	hyg. pr., 1.41638	1.0003^{20}_{4}	42	62.5^{15}	v. s.	v. s.	sl. s. eth.
4826							
4827	col. need......	....	82	....	2 c., 10 h.	v. s.	v. s. eth.; v. sl. s. lgr.
4828	need. f. eth....	....	*ca.* 46	....	v. s.	s.	s. eth.; i. lgr.
4829	col. need. f. bz., eth.	....	44	....	i.	v. s.	v. s. eth.; sl. s. lgr.
4830	leaf. f. bz., eth.	....	68	....	sl. s. h.	s.	s. eth.; sl. s. lgr.
4831	col. leaf. f. bz.	....	94	....	1 c., 50 h., d.	v. s.	v. s. eth.; sl. s. bz.
4832	cr. f. eth......	....	78	....	i.	sl. s.	s. eth.
4833	col. syrup, $[\alpha]-33.1^{\circ}_{D}$	....	55	....	10.5^{15}	v. s.	v. s. eth.; s. chl.; sl. s. bz.
4834	col. rhomb. cr. f. w., $[\alpha]-32.9^{\circ 15}_{D}$	....	anh. 194	....	66.6^{25}	6.3^{25}	i. eth.; 0.13 chl.
4835	wh. micr. need. f. w.	....	....	....	v. s.	v. s.	....
4836	wh. need......	....	106–8	....	......	s.	s. eth., chl.
4837	wh. deliq. pr..	....	152	....	v. s.	50	0.06 eth.
4838	wh. cr.	....	149–51	....	s.	s.	....
4839	need. f. al., $[\alpha]-28.6^{\circ}_{D}$	....	anh. 206	....	v. s.	15.6	0.04 eth.; s. chl.
4840							
4841	silky need. f. w.+al., $[\alpha]-20.3^{\circ 15}_{D}$	....	106	....	5	v. s.	s. eth., chl., bz.
4842	lg. monocl. cr. f. w.	....	anh. 255	....	......	......	....
4844	rhomb. cr.....	....	68	....	12	sl. s.	sl. s. eth.
4845	col. need......	....	33	236^{15}	i.	v. s.	s. eth.
4846	need.........	....	d. 150	....	0.07^{19}, 1.4^{100}	sl. s.	s. eth., alk.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4847	**Hypoxanthine, 2-amino-.** See *Guanine.*			
4848	**Hystazarin**	2,3-dihydroxyanthraquinone; hystazin	$C_6H_4(CO)_2C_6H_2(OH)_2$	240.20
4848M	**Idose**		$C_6H_{12}O_6$	180.16
4849	**Idryl.**	See *Fluoranthene.*		
4850	**Imesatin**	3-iminoöxindole	$C_6H_4NHCOC{:}NH$	146.14
4851	**Imidazole**	glyoxaline; iminazole	$NHCH{:}NCH{:}CH$	68.08
4852	**——, 4,5-dihydro-2,4,5-triphenyl-.** See *Amarine.*			
4852M	**——, 2-ketotetrahydro-.** See *Urea, ethylene-.*			
4853	**——, 1-methyl-**	*N*-methylglyoxaline	$N(CH_3)CH{:}NCH{:}CH$	82.10
4854	**——, 2,4,5-triphenyl-.**	See *Lophine.*		
4855	**4-Imidazolecarboxylic acid, tetrahydro-4-hydroxy-2,5-diketo-.** See			
4856	**2,4-Imidazoledione, 5-hydroxy-.** See *Allanturic acid.*			
4856M	**4-Imidazoleëthylamine.** See *Histamine.*			
4857	**5-Imidazolepropionic acid, α-amino-.** See *Histidine.*			
4858	**2(3)-Imidazolone, dihydro-.** See *Urea, ethylene-.*			
4859	**Imidazolo[4,5-*d*]pyrimidine.** See *Purine.*			
4860	**Imperatorin.**	See *Peucedanin.*		
4861	**Indaconitine**	acetylbenzoylpseudaconine	$C_{34}H_{47}NO_{10}$	629.73
4862	**Indan**	hydrindene; 2,3-dihydroindene	$C_6H_4CH_2CH_2CH_2$	118.17
4863	**1-Indanone**	1-ketoindan; α-hydrindone	$C_6H_4COCH_2CH_2$	132.15
4864	**2-Indanone**	2-ketoindan; β-hydrindone	$C_6H_4CH_2COCH_2$	132.15
4865	**Indanthrene**	*N,N'*-dihydroanthraquinonazine	$C_{28}H_{14}N_2O_4$	442.41
4866	**Indene**		$C_6H_4CH_2CH{:}CH$	116.15
4867	**——, 2,3-dihydro-.**	See *Indan.*		
4868	**Indican** (of plants)		$C_{14}H_{17}NO_6{\cdot}3H_2O$	349.33
4869	**Indigo, Indigo blue.**	See *Indigotin.*		
4870	**——, soluble.**	See *5,5'-Indigotindisulfonic acid, disodium salt.*		
4871	**Indigo carmine.**	See *5,5'-Indigotindisulfonic acid, disodium salt.*		
4872	**Indigopurpurin.**	See *Indirubin.*		
4873	**Indigo red.**	See *Indirubin.*		
4874	**Indigotin**	indigo; indigo blue	$C_{16}H_{10}N_2O_2$	262.26
4876	**4,4'-Indigotindicarboxylic acid**		$C_{18}H_{10}N_2O_6$	350.28
4877	**5,5'-Indigotindisulfonic acid**		$C_{16}H_{10}N_2O_8S_2$	422.38
4878	——, disodium salt	indigo carmine; soluble indigo	$C_{16}H_8N_2Na_2O_8S_2$	466.35
4878M	**Indigotinsulfonic acid**		$C_{16}H_{10}N_2O_5S$	342.32
4879	**Indigo white**	leucoindigo	$C_{16}H_{12}N_2O_2$	264.27
4880	**Indirubin**	indigo red; indigopurpurin	$C_{16}H_{10}N_2O_2$	262.26

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4847							
4848	yel. need. f. ac. a.	....	260	....	......	sl. s.	sl. s. eth.; s. H_2SO_4
4848M	glassy brittle mass, L-idose, $[\alpha]^{22}_{D} + 63.2°$	....	osazone 168	....	......	......	....
4849							
4850	yel. pr.........	....	....	....	i.	s.	sl. s. eth.
4851	col. pr.........	....	90	256	v. s.	v. s.	s. eth.
4852							
4852M							
4853	....	1.036^{10}_{4}	−6	197–9	∞	......	....
4854							
4855	*Alloxanic acid.*						
4856							
4856M							
4857							
4858							
4859							
4860							
4861	cr..............	....	202–3 d.	....	i.	s.	s. eth.
4862	col. liq., $1.53877^{16.4}$	$0.9645\frac{20}{4}$	−51.40	176.5	i.	∞	∞ eth.
4863	rhomb. need. f. w., $1.56084^{44.75}$	$1.101\frac{45}{4}$	41	244	v. sl. s.	v. s.	s. eth.
4864	need. f. al., 1.5377^{66}	$1.071\frac{67}{4}$	61	225 d.	i.	v. s.	v. s. eth.
4865	bl. powd.........	....	470–500 d.	....	i.	i.	i. eth.; s. dil. alk. sol.
4866	col. liq., $1.57107^{12.7}$	$1.006\frac{20}{4}$	−2	182.4	i.	∞	∞ eth.; s. pyr., CCl_4, acet., CS_2, turpentine
4867							
4868	br. rhomb.........	....	51–7; anh. 100–2	d.	v. s.	v. s.	s. eth.; sl. s. bz.
4869							
4870							
4871							
4872							
4873							
4874	rhomb., purp..	$1.35\frac{20}{4}$	392 d.	subl.	i.	i.	i. eth.; s. h. chl., h. anil.
4876	blue powd.....	....	....	....	i.	i.	i. eth., chl.; s. H_2SO_4
4877	blue amor......	....	....	....	s.	s.	....
4878	blue powd.....	....	....	....	s.	sl. s.	....
4878M	purp..........	....	200 d.	....	s.	s.	....
4879	wh. powd......	....	....	....	i.	s.	s. eth., alk.
4880	br. need.......	....	....	subl.	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4881	**Indole**	benzo[b]pyrrole	$C_6H_4NHCH{:}CH$	117.14
4882	**——, 1-acetyl-**		$CH_3CONCH{:}CHC_6H_4$	159.18
4883	**——, 2-methyl-**	α-methylindole; methylketole	$CH_3NC_8H_6$	131.17
4884	**——, 3-methyl-.**	See *Skatole.*		
4885	**2-Indolecarboxylic acid, 3-hydroxy-.**	See *Indoxylic acid.*		
4886	**3-Indolepropionic acid, α-amino-.**	See *Tryptophan*.		
4887	**2,3-Indolinedione.**	See *Isatin.*		
4888	**3-Indolol.**	See *Indoxyl.*		
4889	**2(3)-Indolone.**	See *Oxindole.*		
4890	**Indophenin**		$(C_{12}H_7NOS)_x$	$(213.24)_x$
4891	**Indoxyl**	3-indolol	$C_6H_4NHCH{:}COH$	133.14
4892	**——, 1-nitroso-**	isatoxime	$C_6H_4N(NO)CH{:}COH$	162.14
4893	**Indoxylic acid**	3-hydroxy-2-indolecarboxylic acid	$C_6H_4NHC(COOH)COH$	177.15
4894	***i*-Inositol**	1,2,3,4,5,6-cyclohexanehexol*; *i*-inosite; phaseomannitol; dambose	$C_6H_6(OH)_6$	180.16
4895	**Inulin**		$(C_6H_{10}O_5)_6 \cdot H_2O$	990.86
4896	**Iodeosin B.**	See *Erythrosin (dye).*		
4897	**Iodine cyanide.**	See *Cyanogen iodide.*		
	Iodo-. See the parent compounds (e.g., for iodobenzene see *Benzene, iodo-*).			
4898	**Iodoform**	triiodomethane	CHI_3	393.78
4899	**——, methyl-.**	See *Ethane,* 1,1,1-*triiodo-**.		
4900	***dl*-Iodogorgoic acid**	3,5-*dl*-diiodotyrosine	$HOC_6H_2I_2CH_2CH(NH_2)COOH$	433.01
4901	***d*-Iodogorgoic acid**	*d*-3,5-diiodotyrosine	$C_9H_9I_2NO_3$	433.01
4902	**Iodol.**	See *Pyrrole,* 2,3,4,5-*tetraiodo-.*		
4903	**Iodonium iodide, diphenyl-**		$(C_6H_5)_2II$	408.04
4904	**Iodophen.**	See *Phenolphthalein,* 3′,3″,5′,5″-*tetraiodo-.*		
4905	**α-Ionone**	4-(2,6,6-trimethyl-2-cyclohexenyl)-3-buten-2-one	$C_{13}H_{20}O$	192.29
4906	——, semicarbazone		$C_{13}H_{20}{:}NNHCONH_2$	249.35
4907	**β-Ionone**	4-(2,6,6-trimethyl-1-cyclohexenyl)-3-buten-2-one	$C_{13}H_{20}O$	192.29
4908	——, semicarbazone		$C_{13}H_{20}{:}NNHCONH_2$	249.35
4909	**β-Irone**	4-(2,3,6,6-tetramethyl-1-cyclohexenyl)-3-buten-2-one	$C_{13}H_{20}O$	192.29
4910	**Isatic acid**	*o*-aminophenylglyoxylic acid; *o*-aminobenzoylformic acid; isatinic acid	$NH_2C_6H_4COCOOH$	165.14
4911	——, lactam.	See *Isatin.*		
4912	**Isatin**	2,3-indolinedione; isatic acid lactam	$C_6H_4NHCOCO$	147.13
4913	**——, acetyl-.**	See *Pseudoisatin,* 1-*acetyl-.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4881	col. leaf. f. w. .	....	52.5	254	s. h.	v. s.	v. s. eth.; s. bz., lgr.
4882	liq	....	....	$152-3^{14}$	......	......	....
4883	need. or leaf....	$1.07\frac{20}{4}$	59	272.3	v. sl. s.	v. s.	v. s. eth.; s. H_2SO_4
4884							
4885							
4886							
4887							
4888							
4889							
4890	bl. need	....	....	....	i.	sl. s.	sl. s. eth.; s. H_2SO_4; i. bz.
4891	oil	....	85	110	......	......	s. alk.
4892	yel. need......	....	202	....	sl. s.	s.	s. KOH
4893	tricl..........	....	....	subl. 123	sl. s., d. h.	......	....
4894	col. monocl. f. w.	$1.524\frac{15}{4}$	anh. 225	319^{15}, d.	4.5^{15}	i.	i. eth.
4895	col. hyg. cr....	anh. $1.35\frac{20}{4}$	178 d. (160)	....	0.01^{0}	0.02^{16}	....
4896							
4897							
4898	yel. hex., 1.800, 1.750	$4.008\frac{20}{4}$	119	subl.; 210 exp.	0.01^{25}	1.3^{18}, 7.8^{78}	13.6^{25} eth.; s. chl., glyc., CS_2
4899							
4900	rect. pr.......	....	204 d.	....	0.062^{25}, 0.56^{75}	......	....
4901	need	....	194 d.	....	......	......	....
4902							
4903	yel. need. f. al.	....	182	....	......	s. h.	....
4904							
4905	col. liq., $1.49842^{22.3}$	0.930	....	147.5^{28}	v. sl. s.	∞	∞ eth.; s. chl.
4906	col. cr. f. bz., lgr.	....	110	....	......	s.	....
4907	col. liq., $1.51977^{18.9}$	0.944	....	140^{18}	v. sl. s.	∞	∞ eth.
4908	need. f. al.....	....	148	....	i.	s.	s. eth., bz.
4909	col. liq., 1.5180	$0.9456\frac{20}{4}$	....	144^{16}	v. sl. s.	v. s.	v. s. eth.
4910	wh. powd.	....	d.	....	sl. s.	......	....
4911							
4912	red monocl. need. f. al.	....	201 (198–9)	subl.	v. sl. s. c., s. h.	s.	sl. s. eth.; s. alk.
4913							

No.	Name	Synonyms	Formula	Mol. Wt.
4914	**Isatin, 1-methyl-**	*N*-methylisatin	$C_6H_4N(CH_3)COCO$	161.15
4915	**——, 5-methyl-**	*p*-methylisatin	$CH_3C_6H_3NHCOCO$	161.15
4916	**——, nitro-**		$C_6H_3(NO_2)NH$- $COCO$	192.13
4917	**——, thio-.**	See *Thionaphthenequinone.*		
4918	**Isatin chloride**	2-chloro-3-pseudoindolone	$C_6H_4N{:}CClCO$	165.58
4919	**Isatoic anhydride**	*N*-carboxyanthranilic acid anhydride	$C_6H_4COOCONH$	163.13
4920	**Isatoxime.**	See *Indoxyl, 1-nitroso-.*		
4921	**α-Isatropic acid**	1,2,3,4-tetrahydro-1-phenyl-1,4-naphthalenedicarboxylic acid (one form)	$C_{18}H_{16}O_4$	296.31
4922	**Isethionic acid**	2-hydroxyethanesulfonic acid	$CH_2OHCH_2SO_3H$	126.13
4922M	**Isoalloxazine.**	See D-*Riboflavin.*		
	Isoamyl. For isoamyl derivatives see the parent compounds (e.g., for isoamylbenzene			
4923	**Isoamyl alcohol**	isobutylcarbinol; 3-methyl-1-butanol*	$(CH_3)_2CHCH_2$- CH_2OH	88.15
4924	**sec-Isoamyl alcohol.**	See 2-*Butanol, 3-methyl-*.*		
4925	**Isoamyl aldehyde.**	See *Isovaleraldehyde.*		
4926	**Isoamylamine**	1-amino-3-methylbutane	$(CH_3)_2CHCH_2$- CH_2NH_2	87.16
4927	**Isoamyl borate**	triisoamyl borate	$B(OC_5H_{11})_3$	272.24
4928	**Isoamyl bromide**	1-bromo-3-methylbutane*	$(CH_3)_2CHCH_2$- CH_2Br	151.06
4929	**Isoamyl chloride**	1-chloro-3-methylbutane*	$(CH_3)_2CHCH_2$- CH_2Cl	106.60
4930	**Isoamyl cyanide.**	See *Isocapronitrile.*		
4931	**Isoamyl disulfide**	diisoamyl disulfide	$C_5H_{11}S_2C_5H_{11}$	206.40
4932	**α-Isoamylene.**	See 1-*Butene, 3-methyl-*.*		
4933	**β-Isoamylene.**	See 2-*Butene, 3-methyl-*.*		
4934	**α-Isoamylene glycol.**	See 1,2-*Butanediol, 3-methyl-*.*		
4935	**β-Isoamylene glycol.**	See 2,3-*Butanediol, 2-methyl-*.*		
4936	**γ-Isoamylene glycol.**	See 1,3-*Butanediol, 3-methyl-*.*		
4937	**Isoamyl ether**	3-methyl-1-(γ-methylbutoxy)butane*; diisoamyl ether	$(CH_3)_2CH(CH_2)_2$- $O(CH_2)_2CH$- $(CH_3)_2$	158.28
4938	**Isoamyl iodide**	1-iodo-3-methylbutane*	$(CH_3)_2CHCH_2$- CH_2I	198.06
4939	**Isoamyl isocyanide**	γ-methylbutyl isocyanide; isoamylcarbylamine	$(CH_3)_2CH(CH_2)_2$- NC	97.16
4940	**Isoamyl mercaptan.**	See 1-*Butanethiol, 3-methyl-*.*		
4941	**Isoamyl nitrate**	γ-methylbutyl nitrate*	$(CH_3)_2CHCH_2$- CH_2ONO_2	133.15
4942	**Isoamyl nitrite**	γ-methylbutyl nitrite*	$(CH_3)_2CHCH_2$- CH_2ONO	117.15
4943	**Isoamyl sulfate**	diisoamyl sulfate	$[(CH_3)_2CH_2CH_2$- $CH_2]_2SO_4$	240.35
4944	**Isoamyl sulfide**	diisoamyl sulfide; 3-methyl-1-(γ-methylbutylthio)butane*	$[(CH_3)_2CH$- $(CH_2)_2]_2S$	174.34
4945	**Isoamyl urethan.**	See *Carbamic acid, isoamyl ester.*		
4946	**Isoanthraflavic acid**	2,7-dihydroxyanthraquinone	$HOC_6H_3(CO)_2$- C_6H_3OH	240.20

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4914	red need......	....	134	....	......	......	....
4915	red leaf. f. w..	....	187	....	sl. s. c.	sl. s.	sl. s. eth.; s. alk., h. HCl
4916	need. f. al.....	....	230	....	sl. s.	v. s.	s. alk.
4917							
4918	br. need......	....	180 d.	....	i.	s.	v. s. eth.
4919	monocl. f. acet.	....	240 d.	....	0.7^{100}	3^{78}	sl. s. eth.; 1.3 h. acet.
4920							
4921	cr............	....	237	....	v. sl. s.	sl. s.	i. eth., bz., CS_2
4922	....	....	....	100 d.	v. s.	i.	....
4922M	see *Benzene, isoamyl–*). For isoamyl esters of organic acids see the acids.						
4923	col. liq., $1.4084^{17.8}$	0.812	−117.2	130.5 (130–2)	2.672^{22}	∞	∞ eth.
4924							
4925							
4926	col. liq.......	$0.7505\frac{20}{4}$	....	95	s.	∞	∞ eth.; s. chl.
4927	col. liq., 1.421.	$0.872\frac{0}{4}$	....	255	d.	∞	∞ eth.
4928	col. liq., 1.4412	1.215	−111.9	120.65	$0.02^{16.5}$	s.	s. eth.
4929	col. liq.......	0.893	....	98.9	i.	∞	∞ eth.
4930							
4931	liq...........	0.918^{19}	....	250;122–5^{10}	d.	......	....
4932							
4933							
4934							
4935							
4936							
4937	col. liq., 1.408.	$0.78073\frac{15}{15}$	....	172.5–3.0	i.	∞	∞ eth.
4938	col. liq.......	1.510	....	148	i.	s.	∞ eth.
4939	liq...........	....	....	137	i.	s.	s. eth.
4940							
4941	col. liq., $1.41219^{21.7}$	0.996^{23}	....	148	v. sl. s.	s.	v. s. eth.
4942	ylsh. inflam. liq., $1.38708^{20.7}$	0.872	....	99	v. sl. s.	∞	∞ eth.
4943	....	....	....	149–51^{12}	......	......	....
4944	col. liq., 1.45238	$0.84314\frac{20}{4}$	....	209–11 (216)	i.	v. s.	v. s. eth.
4945							
4946	lng. yel. need. f. dil. al.	....	330 subl.	d.–H_2O, 100	......	s.	v. sl. s. eth.; s. alk., H_2SO_4

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4947	**Isobenzamarone**	α,α′-benzalbisdesoxybenzoin; 1,2,3,4,5-pentaphenyl-1,5-pentanedione (one form)	$C_6H_5CH[CH(C_6H_5)COC_6H_5]_2$	480.58
4948	**1(3)-Isobenzofuranone**	See *Phthalide.*		
4949	**Isobornyl chloride**	2-chlorocamphane (one form); camphene hydrochloride; bornyl chloride (incorrect)	$C_{10}H_{17}Cl$	172.69
4950	**Isobutane**	2-methylpropane*; trimethylmethane	$(CH_3)_3CH$	58.12
	Isobutyl. For isobutyl derivatives see the parent compounds (e.g., for isobutyl benzene			
4951	**Isobutyl alcohol**	2-methyl-1-propanol*; isopropylcarbinol	$(CH_3)_2CHCH_2OH$	74.12
4952	**Isobutyl aldehyde.**	See *Isobutyraldehyde.*		
4953	**Isobutylamine**	1-amino-2-methylpropane	$(CH_3)_2CHCH_2NH_2$	73.14
4954	**——, *N*-methyl-**		$CH_3NHCH_2CH(CH_3)_2$	87.16
4954M	**——, *N*-phenyl-.**	See *Aniline, N-isobutyl-.*		
4955	**Isobutyl arsenite**	triisobutyl (ortho)arsenite	$As[OCH_2CH(CH_3)_2]_3$	294.25
4956	**Isobutyl borate**	triisobutyl borate	$B(OC_4H_9)_3$	230.16
4957	**Isobutyl bromide**	1-bromo-2-methylpropane*	$(CH_3)_2CHCH_2Br$	137.03
4958	**Isobutyl chloride**	1-chloro-2-methylpropane*	$(CH_3)_2CHCH_2Cl$	92.57
4959	**Isobutyl cyanide.**	See *Isovaleronitrile.*		
4960	**Isobutylene.**	See *Propene, 2-methyl-*.*		
4960M	**Isobutylene bromide**	See *Propane, 1,2-dibromo-2-methyl-**		
4961	**Isobutylene glycol.**	See 1,2-*Propanediol, 2-methyl-**.		
4962	**Isobutylene oxide.**	See *Ethylene oxide, α, α-dimethyl-.*		
4963	**Isobutyl ether**	(2-methyl-1-β-methylpropoxy)propane*; diisobutyl ether	$[(CH_3)_2CHCH_2]_2O$	130.23
4964	**Isobutyl fluoride**	1-fluoro-2-methylpropane*	$(CH_3)_2CHCH_2F$	76.11
4966	**Isobutyl iodide**	1-iodo-2-methylpropane*	$(CH_3)_2CHCH_2I$	184.03
4967	**Isobutyl isocyanide**	β-methylpropylcarbylamine*	$(CH_3)_2CHCH_2NC$	83.13
4968	**Isobutyl mercaptan.**	See 1-*Propanethiol, 2-methyl-*.*		
4969	**Isobutyl mustard oil.**	See *Isothiocyanic acid, isobutyl ester.*		
4970	**Isobutyl nitrate**	β-methylpropyl nitrate*	$(CH_3)_2CHCH_2ONO_2$	119.12
4971	**Isobutyl nitrite**	β-methylpropyl nitrite*	$(CH_3)_2CHCH_2ONO$	103.12
4972	**Isobutyl sulfate**	diisobutyl sulfate	$[(CH_3)_2CHCH_2]_2SO_4$	210.29
4973	**Isobutyl sulfide**	diisobutyl sulfide; 2-methyl-1-(β-methylpropylthio)propane*	$[(CH_3)_2CHCH_2]_2S$	146.29
4974	**Isobutyraldehyde**	2-methylpropanal*; isobutyl aldehyde	$(CH_3)_2CHCHO$	72.10
4975	——, oxime	2-methylpropanal oxime; isobutyraldoxime	$(CH_3)_2CHCH{:}NOH$	87.12
4976	**Isobutyraldoxime.**	See *Isobutyraldehyde, oxime.*		
4977	**Isobutyramide**	2-methylpropanamide*; isobutyric amide	$(CH_3)_2CHCONH_2$	87.12
4978	**Isobutyric acid**	2-methylpropanoic acid*; dimethylacetic acid; α-methylpropionic acid	$(CH_3)_2CHCOOH$	88.10

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
4947	cr.	. . . .	179–80	. . . .	. . . . . .	. . . . . .	4.1^{12} bz.
4948							
4949	col. feath. cr. . .	. . . .	148–50 (157)	. . . .	i.	s.	s. eth.
4950	col. gas.	liq. 0.603^{0}	–145	–10.2	13$\frac{17}{772}$ cm^3	1320$\frac{17}{775}$ cm^3	2790$\frac{18}{773}$ cm^3 eth.
	see *Benzene, iso butyl*–). For isobutyl esters of organic acids see the acids.						
4951	col. inflam. liq., 1.3968$^{17.5}$	0.8011	–108	108.39 (106–8)	9.5^{18}	∞	∞ eth.
4952							
4953	col. liq., 1.39878$^{17.0}$	0.736	–85.5	68 (67–9)	∞	∞	∞ eth.
4954	col. liq	0.722^{18}	. . . .	76–8	. . . . . .	. . . . . .	. . . .
4954M							
4955	. . . .	. . . .	. . . .	242	. . . . . .	. . . . . .	. . . .
4956	col. liq., 1.408.	0.864$\frac{0}{4}$	. . . .	212	d.	∞	∞ eth.
4957	col. liq., 1.436.	1.264	–118.5	91.5	0.0589^{16}	∞	∞ eth.
4958	col. liq., 1.3960	0.875	–131.2	68.9	0.092$^{12.5}$	∞	∞ eth.
4959							
4960							
4960M							
4961							
4962							
4963	col. liq	0.7616$\frac{15}{4}$	. . . .	122.5	sl. s.	∞	∞ eth.
4964	col. gas.	2.58^{21}	. . . .	16	i.	v. s.	v. s. eth.
4966	col. liq., 1.49597	1.605	–93.5	120.4	i.	∞	∞ eth.
4967	col. liq	0.7873^{4}	<–60	114–7	sl. s.	s.	s. eth.
4968							
4969							
4970	col. liq., 1.40130$^{23.3}$	1.0168$\frac{20}{20}$	. . . .	122.9	i.	∞	∞ eth.
4971	liq., 1.37151$^{22.1}$	0.8702$\frac{20}{20}$	. . . .	67	i.	s.	s. eth.
4972	1.415.	1.042^{23}	. . . .	133–4^{19}	. . . . . .	. . . . . .	. . . .
4973	col. liq	0.8386$\frac{16}{4}$	. . . .	172–3	i.	v. s.	v. s. eth.
4974	col. liq., 1.37302	0.7938	–65.9	61.5–3.5	11	∞	∞ eth.
4975	col. oil, 1.43022$^{20.5}$	0.8943$\frac{20}{4}$	<–80	139	sl. s.	. . . . . .	. . . .
4976							
4977	col. monocl. f. bz. or chl.	1.013	129 (123–4)	220	v. s.	v. s.	sl. s. eth.
4978	col. liq., 1.39300	0.949$\frac{20}{4}$	–47.0	154.4	20^{20}	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
4979	**Isobutyric acid**, allyl ester	allyl isobutyrate; 2-propenyl 2-methylpropanoate*	$(CH_3)_2CHCOOC_3H_5$	128.17
4980	——, amyl ester	pentyl 2-methylpropanoate*	$(CH_3)_2CHCOO(CH_2)_4CH_3$	158.24
4981	——, ethyl ester	ethyl isobutyrate; ethyl 2-methylpropanoate*	$(CH_3)_2CHCOOC_2H_5$	116.16
4982	——, isoamyl ester	γ-methylbutyl 2-methylpropanoate*	$(CH_3)_2CHCOOC_5H_{11}$	158.24
4983	——, isobutyl ester	β-methylpropyl 2-methylpropanoate*	$(CH_3)_2CHCOOCH_2CH(CH_3)_2$	144.21
4984	——, isopropyl ester		$(CH_3)_2CHCOOCH(CH_3)_2$	130.18
4985	——, methyl ester	methyl 2-methylpropanoate*; methyl isobutyrate	$(CH_3)_2CHCOOCH_3$	102.13
4986	——, piperazinium salt		$C_4H_{10}N_2\cdot 2C_3H_7COOH$	262.35
4987	——, propyl ester	*n*-propyl isobutyrate	$(CH_3)_2CHCOOC_3H_7$	130.18
4988	——, **α-amino-**	2-amino-2-methylpropanoic acid*	$(CH_3)_2C(NH_2)COOH$	103.12
4989	——, **α-bromo-**	2-bromo-2-methylpropanoic acid*	$(CH_3)_2CBrCOOH$	167.01
4990	——, ——, ethyl ester	ethyl 2-bromo-2-methylpropanoate*	$(CH_3)_2CBrCOOC_2H_5$	195.07
4991	——, **α-hydroxy-**	2-hydroxy-2-methylpropanoic acid*; acetonic acid	$(CH_3)_2COHCOOH$	104.10
4992	——, **α-methoxy-** 3-*p*-menthyl ester	menthol α-methoxyisobutyrate	$(CH_3)_2C(OCH_3)COOC_{10}H_{19}$	256.38
4993	**Isobutyric amide.**	See *Isobutyramide.*		
4994	**Isobutyric anhydride**		$[(CH_3)_2CHCO]_2O$	158.19
4995	**Isobutyronitrile**	2-methylpropanenitrile*; isopropyl cyanide	$(CH_3)_2CHCN$	69.10
4996	——, **α-hydroxy-**	2-hydroxy-2-methylpropanenitrile*; isopropyl cyanohydrin; acetone cyanohydrin	$(CH_3)_2C(OH)CN$	85.10
4997	**Isobutyrophenone**	isopropyl phenyl ketone	$(CH_3)_2CHCOC_6H_5$	148.20
4998	——, **α-bromo-2,4,6-trimethyl-**	α-bromoisopropyl 2-mesityl ketone; α-bromoisobutyrylmesitylene	$(CH_3)_2CBrCOC_6H_2(CH_3)_3$	269.18
4999	**Isobutyryl bromide**	2-methylpropanoyl bromide*	$(CH_3)_2CHCOBr$	151.01
5000	**Isobutyryl chloride**	2-methylpropanoyl chloride*	$(CH_3)_2CHCOCl$	106.55
5001	**Isocalycanthine**		$C_{11}H_{14}N_2\cdot\frac{1}{2}H_2O$	183.25
5002	**Isocamphane**	2,2,3-trimethylnorcamphane; isohydrocamphene; 2,2,3-trimethylbicyclo(2,2,1)-heptane	$C_{10}H_{18}$	138.25
5003	***dl*-Isocamphoric acid**	*dl-trans*-1,2,2-trimethyl-1,3-cyclopentanedicarboxylic acid	$C_8H_{14}(COOH)_2$	200.23
5004	**Isocapric alcohol.**	See 1-*Hexanol, 3-isopropyl-5-methyl-**.		
5005	**Isocaproic acid**	4-methylpentanoic acid*; isobutylacetic acid	$(CH_3)_2CH(CH_2)_2COOH$	116.16
5006	——, **α-amino-.**	See *Leucine.*		
5007	——, **α-hydroxy.**	See *Leucic acid.*		
5008	**Isocaprone.**	See 5-*Nonanone, 2,8-dimethyl*-*.		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
4979	liq.........	....	....	133.5	v. sl. s.	∞	∞ eth.
4980	liq., 1.4076....	0.8592^{18}	....	155	sl. s.	∞	∞ eth.
4981	col. liq., 1.3903	0.86930^{20}_{4}	−88.2	111.7	sl. s.	∞	∞ eth.
4982	col. liq.......	0.876^{0}_{4}	....	168.8	v. sl. s.	s.	s. eth.
4983	col. liq., 1.3999	0.875^{0}_{4}	−80.7	148.7	v. sl. s.	s.	∞ eth.
4984	col. liq.......	0.869^{0}_{4}	....	120.8	i.	s.	s. eth.
4985	col. liq., 1.3840	0.891	−84.7	92.6	sl. s.	∞	∞ eth.
4986	wh. cr........	....	121–2	....	s.	s.	i. eth.; s. h. dioxane
4987	col. liq.......	0.884^{0}_{4}	....	135.4	v. sl. s.	......	....
4988	col. monocl. pl. or pr.	....	203 d.	subl. 280	s.	sl. s.	i. eth.
4989	pl............	liq. 1.5255^{60}	48	198–200	v. s.	s.	s. eth.
4990	col. liq.......	1.311^{25}_{4}	....	164 d.	i.	s.	∞ eth.
4991	col. hyg. pr. f. bz.	....	79	212	v. s.	v. s.	v. s. eth.; v. sl. s. bz.
4992	liq...........	0.9466	....	$124–6^{10}$	......	s.	s. eth.
4993							
4994	col. liq.......	0.950	−53.5	182.5	d.	d.	∞ eth.
4995	col. liq.......	0.773	....	107–8	sl. s.	v. s.	v. s. eth.
4996	col. liq., 1.3996	0.932^{19}	−19	120 d.; 82^{23}	v. s.	v. s.	v. s. eth.; v. sl. s. pet. eth.
4997	col. liq., $1.51919^{16.6}$	0.984	....	217	i.	s.	s. eth.
4998	cr............	....	27	$160–70^{24}$	......	......	s. eth.
4999	....	1.4067^{15}	....	116–8	......	......	....
5000	col. liq., 1.4079	1.017^{20}_{4}	−90.0	92	d.	d.	s. eth.
5001	rhomb........	....	235	....	......	s.	....
5002	....	0.8276^{20}_{4}	64.5	164	......	......	....
5003	cr............	....	191	....	......	v. s.	v. s. eth.
5004							
5005	col. oily liq....	0.925^{20}_{4}	−35	207.7 $(110\text{-}1^{25})$	sl. s.	s.	s. eth.
5006							
5007							
5008							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5009	**Isocapronitrile**	4-methylpentanenitrile*; isoamyl cyanide; isobutylacetonitrile	$(CH_3)_2CH(CH_2)_2$-CN	97.16
5010	**Isocaprophenone**	isoamyl phenyl ketone	$(CH_3)_2CH(CH_2)_2$-COC_6H_5	176.25
5011	**Isocaprylic acid, α-hydroxy-**	2-hydroxy-6-methylheptanoic acid*	$(CH_3)_2CH(CH_2)_3$-CHOHCOOH	160.21
5012	**Isocarbostyril**	1-isoquinolinol or 1(2)-isoquinolone	C_9H_7NO	145.15
5013	**Isocholesterol**	isocholesterin	$C_{27}H_{45}OH$	386.64
5014	——, benzoate		$C_6H_5COOC_{27}H_{45}$	490.75
5015	**Isochrysene.**	See *Triphenylene.*		
5016	**Isocinchomeronic acid**	2,5-pyridinedicarboxylic acid*	$C_5H_3N(COOH)_2 \cdot H_2O$	185.13
5018	**Isocinnamic acid** (of Liebermann)	*cis*-β-phenylacrylic acid (one form); *cis*-benzenepropenoic acid (one form)	$C_6H_5CH:CHCOOH$	148.15
5019	**Isocitric acid**	1-hydroxy-1,2,3-propanetricarboxylic acid*; α-hydroxytricarballylic acid	COOHCH(OH)-CH(COOH)CH_2-COOH	192.12
5020	**Isocodeine**		$C_{18}H_{21}NO_3$	299.36
5021	**Isocorybulbine**		$C_{21}H_{25}NO_4$	355.42
5022	**Isocorydaline**		$C_{22}H_{27}NO_4$	369.45
5023	**Isocotoin**	2,4-dihydroxy-6-methoxybenzophenone	$C_{14}H_{12}O_4$	244.24
5024	**Isocoumarin**	2,1-benzopyrone; *o*-β-hydroxyvinylbenzoic acid lactone	$\underline{C_6H_4COOCH:CH}$	146.14
5025	**Isocrotonic acid**	*cis* (?)-2-butenoic acid*; β-(or liquid)crotonic acid; allocrotonic acid; *cis*(?)-β-methylacrylic acid; quartenylic acid	$CH_3CH:CHCOOH$	86.09
5026	——, **α-methyl-.**	See *Angelic acid.*		
5027	**Isocyanic acid,** ethyl ester		C_2H_5NCO	71.08
5027M	——, isobutyl ester	isobutyl isocyanate	$(CH_3)_2CHCH_2$-NCO	99.13
5028	——, phenyl ester	phenyl isocyanate; phenylcarbonimide; carbanil	$C_6H_5N:CO$	119.12
5029	——, *o*-tolyl ester	*o*-tolylcarbonimide	$CH_3C_6H_4NCO$	133.14
	Isocyanides.	See *Ethyl isocyanide, Methyl isocyanide, etc.*		
5030	**Isocyanuric acid.**	See *Fulminuric acid.*		
5031	——, trimethyl ester	tricarbonimide trimethyl ester	$C_3O_3(NCH_3)_3$	171.16
5032	**Isocymene.**	See *m-Cymene.*		
5033	**Isoderritol**		$C_{21}H_{20}O_5$	352.37
5034	**Isodextrosamine.**	See D-*Fructosamine.*		
5035	**Isodibutol.**	See 2-*Pentanol, 2,4,4-trimethyl*-*.		
5036	**Isodurene**	1,2,3,5-tetramethylbenzene	$(CH_3)_4C_6H_2$	134.21
5037	——, **4-amino-.**	See *Isoduridine.*		
5038	**Isodurenol**	2,3,4,6-tetramethylphenol(?); 4-hydroxyisodurene(?)	$(CH_3)_4C_6HOH$	150.21
5039	**Isoduridine**	2,3,4,6-tetramethylaniline; 4-aminoisodurene	$(CH_3)_4C_6HNH_2$	149.23
5040	**α-Isodurylic acid**	3,4,5-trimethylbenzoic acid	$(CH_3)_3C_6H_2COOH$	164.20
5041	**β-Isodurylic acid**	2,4,6-trimethylbenzoic acid; mesitylene-*eso*-carboxylic acid	$(CH_3)_3C_6H_2COOH$	164.20

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5009	col. liq., 1.406.	$0.806\frac{20}{4}$	–51.1	155.5	i.	s.	∞ eth.
5010	col. liq.......	$0.962\frac{15}{4}$	24.7	242.5	i.	v. s.	v. s. eth.
5011	need. f. eth....	....	152–3 d. (110–1)	192–3 d.	sl. s.	s.	s. eth.
5012	col. monocl. f. bz.	....	208–9.	subl.	sl. s.	v. s.	sl. s. eth., bz.; s. chl.
5013	need. f. eth....	....	138	....	......	s.	s. eth., h. ac. a.
5014	need.........	....	191–5	....	......	s.	v. s. eth.
5015							
5016	col. leaf. f. w..	....	236–7 (anh.)	subl.	v. sl. s.	v. sl. s.	v. sl. s. eth.; s. h. HCl
5018	lng. monocl. pr. f. lgr.	....	58 (42)	265→*trans* form	0.937^{25}	s.	v. s. eth.; s. chl., lgr., ac. a.
5019	pr...........	....	d. 100	....	v. sl. s.	v. sl. s.	v. sl. s. eth.
5020	1.607, 1.642, 1.675	....	144	d.	......	......	....
5021	col. leaf.......	....	180	....	i.	s.	....
5022	....	....	136	....	......	......	....
5023	....	....	162	....	......	......	....
5024	pl. f. bz.......	....	47	286	i.	s.	s. eth., CS_2; v. s. bz.
5025	col. need. f. pet. eth., 1.4457	$1.0312\frac{15}{4}$	14–5	171.9 d.	40	s.	....
5026							
5027	liq., 1.3794_{He}	$0.898\frac{20}{4}$	....	60	i.	∞	∞ eth.
5027M	....	....	....	101.5	......	......	....
5028	liq., $1.53684^{19.6}$	$1.095\frac{20}{4}$	....	165.6	d.	d.	v. s. eth.
5029	liq...........	....	....	186	i., d. h.	d. h.	s. eth.
5030							
5031	pr...........	....	175	295	......	......	....
5032							
5033	....	....	149	....	......	......	....
5034							
5035							
5036	liq...........	$0.896\frac{0}{4}$	–24	197	i.	s.	v. s. eth.
5037							
5038	cr............	....	79–81	230–50	......	s.	s. eth.
5039	cr............	0.978^{24}	23–4	255	......	s.	....
5040	need. f. w.....	....	215	....	v. sl. s. h.	s.	s. eth.
5041	col. cr. f. al...	....	152	....	v. sl. s.	v. s.	v. s. eth.; s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5042	**γ-Isodurylic acid**	2,3,5-trimethylbenzoic acid	$(CH_3)_3C_6H_2COOH$	164.20
5043	**Isoephedrine.**	See *Pseudoephedrine.*		
5044	**Isoerucic acid.**	See *Brassidic acid.*		
5045	**Isoeugenol**	4-propenylguaiacol	$CH_3CH{:}CHC_6H_3$-$(OCH_3)OH$	164.20
5046	——, acetate		$CH_3CH{:}CHC_6H_3$-$(OCH_3)OOCCH_3$	206.23
5047	——, benzyl ether	1-benzyloxy-2-methoxy-4-propenylbenzene	$CH_3CH{:}CHC_6H_3$-$(OCH_3)OC_7H_7$	254.32
5048	——, ethyl ether	1-ethoxy-2-methoxy-4-propenylbenzene	$CH_3CH{:}CHC_6H_3$-$(OCH_3)OC_2H_5$	192.25
5049	——, methyl ether.	See *Veratrole, 4-propenyl-.*		
5050	——, **γ-hydroxy-.**	See *Coniferyl alcohol.*		
5051	***l*-Isofenchyl alcohol**	*l*-6-fenchanol	$C_{10}H_{17}OH$	154.25
5052	**Isoferulic acid**	3-hydroxy-4-methoxycinnamic acid; hesperetic acid	$HO(CH_3O)C_6H_3$-$CH{:}CHCOOH$	194.18
5052M	**Isogeraniolene.**	See 1,3-*Heptadiene, 2,6-dimethyl-*.*		
5053	**Isoglucosamine.**	See D-*Fructosamine.*		
5054	**α,β-Isoheptenic acid.**	See 2-*Hexenoic acid, 5-methyl-**.		
5055	**Isoheptyl alcohol.**	See 1-*Hexanol, 5-methyl-*.*		
5056	**Isoheptylic acid.**	See *Caproic acid, δ-methyl-.*		
5057	**Isohexacosane.**	See *Cerane.*		
5058	**α-Isohexenic acid.**	See 2-*Pentenoic acid, 4-methyl-**.		
5059	**Isohexylamine**	(4-methylamyl)amine; 1-amino-4-methylpentane	$(CH_3)_2CH(CH_2)_3$-NH_2	101.19
5059M	**Isohydroanisoin**	*p,p′*-dimethoxyhydrobenzoin, (one form)	$(p$-$CH_3OC_6H_4$-$CHOH$-$)_2$	274.31
5060	**Isohydrobenzoin**	1,2-diphenyl-1,2-ethanediol (one form)	$C_{14}H_{12}(OH)_2$	214.25
5061	**Isohydrocamphene.**	See *Isocamphane.*		
5062	**1,3-Isoindoledione.**	See *Phthalimide.*		
5063	**1-Isoindolinone.**	See *Phthalimidine.*		
5065	DL-**Isoleucine**	*dl*-α-amino-β-methylvaleric acid; *dl*-2-amino-3-methylpentanoic acid*	$CH_3CH_2CH(CH_3)$-$CH(NH_2)COOH$	131.17
5066	L-**Isoleucine**	*d*-2-amino-3-methylpentanoic acid*; *d*-α-amino-β-methylvaleric acid	$CH_3CH_2CH(CH_3)$-$CH(NH_2)COOH$	131.17
5067	L-*allo*-**Isoleucine**	*d-allo*-α-amino-β-methylvaleric acid	$CH_3CH_2CH(CH_3)$-$CH(NH_2)COOH$	131.17
5068	D-*allo*-**Isoleucine**	*l-allo*-α-amino-β-methylvaleric acid	$CH_3CH_2CH(CH_3)$-$CH(NH_2)COOH$	131.17
5069	**α-Isomalic acid**	2-hydroxy-2-methylpropanedioic acid*; α-hydroxyisosuccinic acid	$CH_3C(OH)$-$(COOH)_2$	134.09
5070	**Isomannide**		$C_6H_{10}O_4$	146.14
5071	**α-Isomorphine**		$C_{17}H_{19}NO_3$	285.33
5072	**Isonaphthazarin**	2,3(or 3,4)-dihydroxy-1,4-naphthoquinone	$C_{10}H_4O_2(OH)_2$	190.15
5073	**Isonicoteine**		$C_{10}H_{12}N_2$	160.21
5074	**Isonicotine**		$C_{10}H_{14}N_2$	162.23
5075	**Isonicotinic acid**	4-pyridinecarboxylic acid*	C_5H_4NCOOH	123.11
5076	**Isonicotinic anhydride**		$(C_5H_4NCO)_2O$	228.20
	Isonitriles.	See *Ethyl isocyanide, Methyl isocyanide, etc.*		
5077	**Isoöctane.**	See *Heptane, 2-methyl-*, Pentane, 2,2,4-trimethyl-*.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5042	pl. f. lgr......	....	127	....	......	s.	....
5043							
5044							
5045	pa. yel. liq., 1.5680^{18}	$1.0839\frac{25}{25}$; $1.0852\frac{20}{4}$	-10	267.5	sl. s.	s.	s. eth.
5046	need. f. bz....	....	79–80	282–3	i.	......	s. eth.
5047	need. f. al.....	....	58–9	....	i.	s.	s. eth.
5048	cr. f. dil. al....	....	64	....	i.	s.	v. s. eth., bz.
5049							
5050							
5051	need.........	$0.961\frac{15}{4}$	62	204	i.	v. s.	v. s. eth.
5052	wh. need......	....	228	....	sl. s. c., s. h.	s.	s. eth.; i. lgr.
5052M							
5053							
5054							
5055							
5056							
5057							
5058							
5059	wh.-yel. liq....	$0.758\frac{25}{4}$	-94.4	123.9	sl. s.	∞	∞ eth.
5059M	col. pr........	....	110	....	......	v. s.	v. s. eth.
5060	col. monocl. f. al.	....	121	$133^{0.02}$	0.19^{15}	v. s.	v. s. eth.
5061							
5062							
5063							
5065	rhomb. or monocl. pl. f. dil. al.	....	292 d.	....	2.19^{25}, 4.83^{75}	s. h.	i. eth.; s. h. ac. a.
5066	greasy rhomb. leaf. f. al.	....	283–4 d.	....	4.12^{25}; 6.08^{75}	i., sl. s. h.	i. eth.; s. h. ac. a.
5067	greasy leaf....	....	280–1 d.	....	2.9^{20}	......	i. eth.
5068	greasy leaf....	....	278 d.	....	......	0.82^{20} 80% 0.12^{20}	....
5069	col. cr.........	....	160 d. (142)	d. 170±	v. s.	v. s.	v. s. eth.
5070	col. monocl....	....	87	274 d.	v. s.	sl. s.	i. eth.
5071	....	....	247	....	......	......	....
5072	or.-red leaf...	....	280	subl.	sl. s.	s.	sl. s. eth., chl., bz.; s. alk., acet.
5073	liq., 1.5749....	$1.098\frac{20}{4}$	....	293	∞	......	∞ eth.
5074	cr............	....	78	260 d.	......	......	....
5075	col. need......	....	317	subl. d.	sl. s. c. v. s. h.	v. sl. s.	v. sl. s. eth.
5076	....	....	103–4	....	......	......	....
5077							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5078	**Isopentane.**	See *Butane, 2-methyl-**.		
5079	**Isophthalaldehyde**	1,3-benzenedicarbonal*; *m*-phthalic aldehyde	$C_6H_4(CHO)_2$	134.13
5080	**Isophthalaldehydic acid**	*m*-formylbenzoic acid	$CHOC_6H_4COOH$	150.13
5081	**——, 2-hydroxy-**	3-formyl-2-hydroxybenzoic acid	$CHOC_6H_3(OH)\text{-}COOH$	166.13
5082	**——, 4-hydroxy-**	3-formyl-4-hydroxybenzoic acid	$CHOC_6H_3(OH)\text{-}COOH$	166.13
5083	**——, 6-hydroxy-**	5-formyl-2-hydroxybenzoic acid	$CHOC_6H_3(OH)\text{-}COOH$	166.13
5084	**Isophthalic acid**	1,3-benzenedicarboxylic acid*; *m*-phthalic acid	$C_6H_4(COOH)_2$	166.13
5085	——, diethyl ester	ethyl *m*-phthalate	$C_6H_4(COOC_2H_5)_2$	222.23
5086	——, dimethyl ester	dimethyl 1,3-benzenedicarboxylate*; methyl isophthalate	$C_6H_4(COOCH_3)_2$	194.18
5087	**——, 4,6-dimethyl-.**	See *α-Cumidic acid.*		
5088	**——, 2-hydroxy-**	....	$HOC_6H_3(COOH)_2$	182.13
5089	**——, 4-hydroxy-**	....	$HOC_6H_3(COOH)_2$	182.13
5090	**——, 5-hydroxy-**	....	$HOC_6H_3(COOH)_2$	182.13
5091	**——, 5-methyl-.**	See *Uvitic acid.*		
5092	**——, 5-nitro-**	....	$NO_2C_6H_3\text{-}(COOH)_2\cdot 1\frac{1}{2}H_2O$	238.15
5093	**Isophthalonitrile**	1,3-benzenedicarbonitrile*; 1,3-dicyanobenzene	$C_6H_4(CN)_2$	128.13
5094	**Isophthalyl chloride**	1,3-benzenedicarbonyl chloride*; *m*-phthalyl dichloride	$C_6H_4(COCl)_2$	203.03
5095	**Isoprene**	2-methyl-1,3-butadiene*; *β*-methylbivinyl; hemiterpene	$CH_2{:}CHC\text{-}(CH_3){:}CH_2$	68.11
5096	**Isopropenyl bromide.**	See *Propene, 2-bromo-**.		
5097	**Isopropenyl chloride.**	See *Propene, 2-chloro-**.		
	Isopropyl. For isopropyl derivatives see the parent compounds (e.g., for isopropylben-			
5098	**Isopropyl alcohol**	2-propanol*; dimethylcarbinol	$CH_3CHOHCH_3$	60.09
5099	**Isopropylamine**	....	$(CH_3)_2CHNH_2$	59.11
5100	**Isopropyl bromide**	2-bromopropane*	$CH_3CHBrCH_3$	123.00
5101	**Isopropyl chloride**	2-chloropropane*	$CH_3CHClCH_3$	78.54
5102	**Isopropyl cyanide.**	See *Isobutyronitrile.*		
5103	**Isopropyl ether**	2-isopropoxypropane*; diisopropyl ether	$(CH_3)_2CHOCH\text{-}(CH_3)_2$	102.17
5104	**Isopropyl fluoride**	2-fluoropropane*	CH_3CHFCH_3	62.09
5105	**Isopropylidene chloride.**	See *Propane, 2,2-dichloro-**.		
5105M	**Isopropylidene fluoride.**	See *Propane, 2,2-difluoro-**.		
5106	**Isopropyl iodide**	2-iodopropane*	CH_3CHICH_3	170.01
5107	**Isopropyl isocyanide**	....	$(CH_3)_2CHNC$	69.10
5108	**Isopropyl mercaptan.**	See *2-Propanethiol**.		
5109	**Isopropyl mustard oil.**	See *Isothiocyanic acid, isopropyl ester.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5078							
5079	need.	. . . .	89.5	. . . .	sl. s.	v. s.	i. pet. eth.
5080	need. f. w.	. . . .	175 (164–6)	. . . .	$4.94^{99.7}$	v. s.	v. s. eth.
5081	need.	. . . .	179	. . . .	6^{100}	s.	. . . .
5082	pr.	. . . .	243–4	subl.	s. h.	s.	s. eth.
5083	need.	. . . .	248–9	. . . .	0.7^{100}	s.	s. eth.
5084	col. need. f. h. w.	. . . .	330; 312–4	subl.	0.013^{25} 0.22 h.	s.	i. bz.
5085	col. liq.	. . . .	. . . .	285	. . . . . .	. . . . . .	. . . .
5086	col. need. f. dil. al.	. . . .	68	. . . .	i.	. . . . . .	. . . .
5087							
5088	col. need. f. w.	. . . .	hyd. 239; anh. 244	. . . .	0.14; 2.5^{100}	v. s.	v. s. eth.; sl. s. chl.
5089	col. need. f. w.	. . . .	310 (306)	d.	0.3^{24}	v. s.	v. s. eth.; s. h. ac. a.; i. chl.
5090	need. f. w.	. . . .	hyd. $-2H_2O$ 100; anh. 288	. . . .	0.06, 18^{100}	v. s.	v. s. eth.; s. bz.
5091							
5092	col.-grn. leaf. . .	. . . .	255 sl. d.	. . . .	0.22^{25}	v. s.	v. s. eth.
5093	col. need.	. . . .	161	subl.	sl. s.	s. h.	s. eth.; i. lgr.
5094	cr.	. . . .	41	276	d.	d.	s. eth.
5095	col. liq., 1.4194^{20}	$0.6806\frac{20}{4}$	−145.95	34	i.	∞	∞ eth.
5096							
5097							
	zene see *Benzene, isopropyl-*). For isopropyl esters of organic acids see the acids.						
5098	col. liq., 1.37757	$0.7854\frac{20}{4}$	−88.5 to −89.5	82.3	∞	∞	∞ eth.
5099	col. liq., $1.37698^{15.4}$	$0.694\frac{15}{4}$; $0.690\frac{20}{4}$	−101.2	34	∞	∞	∞ eth.
5100	col. liq., 1.42508	$1.310\frac{20}{4}$	−89	59.6	0.32^{20}	∞	∞ eth.
5101	col. liq.	$0.8590\frac{20}{4}$	−117	35.4 (34.8) (36.5)	$0.344^{12.5}$	∞	∞ eth.
5102							
5103	col. liq.	$0.7258\frac{20}{4}$	−60	67.5 (68.5–9.0)	0.2	∞	∞ eth.
5104	col. gas, 1.3240^{-20}	$0.7682^{-10.2}$	−133.4	−10.1	. . . . . .	. . . . . .	. . . .
5105							
5105M							
5106	liq., 1.49969. . .	$1.703\frac{20}{4}$	−90.8	89.5	0.14^{20}	∞	∞ eth.
5107	col. liq.	$0.7596\frac{0}{4}$	. . . .	87	i.	∞	∞ eth.
5108							
5109							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5110	**Isopropyl nitrate**	2-propanol nitrate	$(CH_3)_2CHNO_3$	105.09
5111	**Isopropyl nitrite**	2-propanol nitrite	$(CH_3)_2CHONO$	89.09
5112	**Isopropyl sulfide**	2-(isopropylthio)propane*; diisopropyl sulfide	$(CH_3)_2CHSCH(CH_3)_2$	118.23
5113	**Isopurpurin.**	See *Anthrapurpurin.*		
5114	**Isoquinoline**	benzo[*c*]pyridine; 2-benzazine; leucoline	$C_6H_4CH{:}NCH{:}CH$	129.15
5115	——, **nitro-**		$NO_2C_9H_6N$	174.15
5116	——, **1,2,3,4-tetrahydro-6-methoxy-1-methyl-7,8-methylenedioxy-.**			
5117	**1-Isoquinolinol, 1(2)-Isoquinolone.** See *Isocarbostyril.*			
5118	**Isosaccharic acid**	tetrahydro-3,4-dihydroxy-2,5-furandicarboxylic acid	$COOH\text{-}CH(CHOH)_2CH\text{-}COOH$ (—O—)	192.12
5119	**Isosafrole**	3,4-methylenedioxy-1-propenylbenzene	$CH_2(O_2)C_6H_3\text{-}CH{:}CHCH_3$	162.18
5120	**Isosuccinic acid**	2-methylpropanedioic acid*; methylmalonic acid	$CH_3CH(COOH)_2$	118.09
5121	——, **α-hydroxy-.**	See *α-Isomalic acid.*		
5122	**Isothebaine (*d*)**		$C_{19}H_{21}NO_3$	311.37
5123	——, sulfate		$(C_{19}H_{21}NO_3)_2 \cdot H_2SO_4$	720.81
5124	**Isothiocyanic acid,** allyl ester	2-propenyl isothiocyanate*; allyl mustard oil	$CH_2{:}CHCH_2NCS$	99.15
5125	——, amyl ester	*n*-amyl mustard oil	$CH_3(CH_2)_4NCS$	129.22
5126	——, benzyl ester	benzyl mustard oil	$C_6H_5CH_2NCS$	149.20
5127	——, *p*-biphenylyl ester.	See "xenyl ester," below.		
5128	——, butyl ester	butyl mustard oil	$CH_3(CH_2)_2CH_2NCS$	115.19
5129	——, *sec*-butyl ester	α-methylpropylisothiocyanate*; *sec*-butyl mustard oil	$C_2H_5CH(CH_3)\text{-}NCS$	115.19
5130	——, *tert*-butyl ester	α, α-dimethylethylisothiocyanate*; *tert*-butyl mustard oil	$(CH_3)_3CNCS$	115.19
5131	——, ethyl ester	ethyl mustard oil	C_2H_5NCS	87.14
5132	——, isoamyl ester	γ-methylbutyl isothiocyanate*	$C_5H_{11}NCS$	129.22
5133	——, isobutyl ester	isobutyl mustard oil; β-methylpropyl isothiocyanate*	$(CH_3)_2CHCH_2\text{-}NCS$	115.19
5134	——, isopropyl ester	isopropyl mustard oil	$(CH_3)_2CHNCS$	101.16
5135	——, methyl ester	methyl mustard oil	CH_3NCS	73.11
5136	——, phenyl ester	phenyl mustard oil	C_6H_5NCS	135.18

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5110	liq	1.036^{20}_{4}		102			
5111	liq	0.844^{25}_{4}		45			
5112	liq			120.4	i.	s.	s. eth.
5113							
5114	col. pl. or liq., $1.62233^{25.1}$	1.0986^{20}_{4}	23	243	v. sl. s.		
5115	need. f. w.		110		s. h.	s.	
5116	See *Anhalonine*.						
5117							
5118	rhomb.		185	d.	s.	s.	v. sl. s. eth.
5119	(*cis*) 1.5632^{15}	1.107^{15}_{4}	<−18	242–3	i.	s.	
	(*trans*) 1.5736^{15}	1.123^{15}_{4}		248–52	i.	s.	
5120	col. pr. or need.	1.455^{20}_{4}	135 d. (129)		44.3^{0}, 66^{20}	v. s.	v. s. eth.
5121							
5122	rhomb. f. al. or eth.		203–4				
5123			120–1 d.				
5124	col. oil, 1.52212^{24}	1.0155^{15}_{4}	−100	150.7	0.2	v. s.	v. s. eth.; s. bz., CS_2
5125	liq			193.4	v. sl. s.	v. s.	v. s. eth.
5126	liq	1.125^{15}_{4}		243; 125^{12}	i.	∞	s. eth.
5127							
5128	liq	0.946^{20}_{4}		167	i.	v. s.	v. s. eth.
5129	liq. *d*: $[\alpha]$ $61.88^{\circ 20}_{D}$	0.944^{12}_{4} 0.943^{20}_{4}		159.5 (159–63)	i.	s.	s. eth.
5130	liq	0.9187^{10}_{4}	10.5	140^{770}	i.	s.	s. eth.
5131	col. liq., 1.5134	1.004^{15}_{4}; 0.995^{20}_{4}	−5.9	132 (131.2^{733})	i.	s.	s. eth.
5132	yel. liq	0.942^{20}_{4}		182	v. sl. s.	v. s.	v. s. eth.
5133	liq., 1.5005^{14}	0.9638^{14}; 0.943^{20}_{4}		162	i.	s.	∞ eth.
5134	liq			137–7.5			
5135	col. cr., $1.5258^{37.2}$	1.069^{37}_{4}	35	119	v. sl. s.	∞	v. s. eth.
5136	col. liq., $1.64918^{23.4}$	1.135^{16}_{4}; 1.1297^{24}_{4}	−21	218.5	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5137	**Isothiocyanic acid,** propyl ester	*n*-propyl mustard oil	$CH_3CH_2CH_2NCS$	101.16
5138	——, *o*-tolyl ester	*o*-tolyl mustard oil	$CH_3C_6H_4NCS$	149.20
5139	——, *p*-tolyl ester	*p*-tolyl mustard oil	$CH_3C_6H_4NCS$	149.20
5140	——, xenyl ester	xenyl mustard oil; *p*-biphenylyl isothiocyanate; *p*-biphenylyl mustard oil	$C_6H_5C_6H_4NCS$	211.27
5141	**Isovaleraldehyde**	3-methylbutanal*; isoamyl aldehyde	$(CH_3)_2CHCH_2CHO$	86.13
5142	——, oxime	3-methylbutanal oxime*	$(CH_3)_2CHCH_2CH{:}NOH$	101.15
5142M	**Isovaleramide**	3-methylbutanamide*; isopropylacetamide	$(CH_3)_2CHCH_2CONH_2$	101.15
5143	**Isovaleric acid**	3-methylbutanoic acid*; isopropylacetic acid	$(CH_3)_2CHCH_2COOH$	102.13
5144	——, allyl ester	allyl isovalerate; 2-propenyl 3-methylbutanoate*	$(CH_3)_2CHCH_2CO_2C_3H_5$	142.19
5145	——, ethyl ester		$(CH_3)_2CHCH_2COOC_2H_5$	130.18
5146	——, isoamyl ester	isoamyl isovalerate; γ-methylbutyl 3-methylbutanoate*	$(CH_3)_2CHCH_2COOC_5H_{11}$	172.26
5147	——, isobutyl ester	isobutyl isovalerate; β-methylpropyl 3-methylbutanoate*	$(CH_3)_2CHCH_2COOCH_2CH(CH_3)_2$	158.24
5148	——, methyl ester	methyl 3-methylbutanoate*; methyl isovalerate	$(CH_3)_2CHCH_2COOCH_3$	116.16
5149	——, *p*-phenylphenacyl ester		$(CH_3)_2CHCH_2COOCH_2COC_6H_4C_6H_5$	296.35
5150	——, piperazinium salt		$C_4H_{10}N_2 \cdot 2C_4H_9COOH$	290.40
5151	——, propyl ester	*n*-propyl isovalerate	$(CH_3)_2CHCH_2COOC_3H_7$	144.21
5152	**——, α-amino-.**	See *Valine.*		
5153	**——, β-amino-**	3-amino-3-methylbutanoic acid*	$(CH_3)_2C(NH_2)CH_2COOH$	117.15
5154	**——, α-bromo-**	2-bromo-3-methylbutanoic acid*	$(CH_3)_2CHCHBrCOOH$	181.04
5155	**——, α-hydroxy-(*i*)**	2-hydroxy-3-methylbutanoic acid*	$(CH_3)_2CHCHOHCOOH$	118.13
5156	**——, β-hydroxy-**	3-hydroxy-3-methylbutanoic acid*	$(CH_3)_2COHCH_2COOH$	118.13
5157	**Isovalerone.**	See 4-*Heptanone*, 2,6-*dimethyl*-*.		
5158	**Isovaleronitrile**	3-methylbutanenitrile*; isobutyl cyanide	$(CH_3)_2CHCH_2CN$	83.13
5159	**Isovalerophenone**	isobutyl phenyl ketone; 3-methyl-1-phenyl-1-butanone	$(CH_3)_2CHCH_2COC_6H_5$	162.22
5160	**Isovaleryl chloride**	3-methylbutanoyl chloride*	$(CH_3)_2CHCH_2COCl$	120.58
5161	DL-**Isovaline**	*dl*-α-amino-α-methylbutyric acid; *dl*-2-amino-2-methylbutanoic acid*	$CH_3CH_2C(NH_2)(CH_3)COOH$	117.15

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5137	liq..........	$0.9909\frac{0}{4}$; $0.978\frac{16}{4}$	....	152.7^{743}	v. sl. s.	∞	∞ eth.
5138	col. oil........	$1.104\frac{25}{25}$	....	239	i.	v. s.	∞ eth.
5139	need. f. eth....	$1.087\frac{25}{25}$	26	237	i., d. h.	v. s., d. h.	v. s. eth.
5140	need. f. eth....	....	58	....	......	......	v. s. eth.
5141	col. liq., 1.3902	$0.803\frac{17}{4}$; $0.7845\frac{20}{20}$	-51	92.5	sl. s.	s.	s. eth.
5142	$1.43645^{22.1}$....	$0.8934\frac{20}{4}$	48.5	164-5	......	......	....
5142M	monocl. pl. f. al.	$0.965\frac{20}{4}$	135	230-2	s.	s.	s. eth.
5143	col. liq., $1.40178^{22.4}$	$0.937\frac{15}{4}$	-37.6 (-51)	176.7	4.2^{20}	∞	∞ eth.; s. chl.
5144	liq...........	....	....	155	v. sl. s.	∞	∞ eth.
5145	col. liq., $1.39671^{18.3}$	$0.8657\frac{20}{4}$	-99.3	135	0.17^{20}	∞	∞ eth., bz.
5146	col. liq., 1.41311^{19}	$0.8584\frac{12}{0}$ (0.870^{0})	....	194	v. sl. s.	s.	s. eth.
5147	col. liq., 1.4060	$0.854\frac{20}{4}$	....	168.5	i.	∞	∞ eth.
5148	col. liq.......	$0.881\frac{20}{4}$	....	115.7	v. sl. s.	∞	∞ eth.
5149	....	....	76	....	......	......	....
5150	wh. cr........	....	139-40	....	s.	s.	i. eth.; s. h. acet.
5151	col. liq., 1.4036	$0.863\frac{20}{4}$	....	155.9	i.	∞	∞ eth.
5152							
5153	pr...........	....	217	subl. >180	s.	sl. s.	i. eth.
5154	col. pr........	....	44	230; 150^{40}	70–80 c.	v. s.	s. eth.
5155	rhomb........	....	86	subl.	v. s.	v. s.	v. s. eth.
5156	syrup........	....	<-32	....	v. s.	v. s.	v. s. eth.
5157							
5158	col. liq.......	0.802	....	129.3	sl. s.	∞	∞ eth.
5159	col. liq., $1.51385^{15.3}$	0.967	....	225	i.	∞	∞ eth.
5160	col. liq., $1.41361^{24.3}$	$0.989\frac{20}{4}$; $0.9854\frac{24}{4}$	....	113	d.	d.	s. eth.
5161	monocl. pr....	....	307–8 (closed tube)	subl. 300	39	6.6 h.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5162	**Isovanillin**	3-hydroxyanisaldehyde; protocatechualdehyde 4-methyl ether	$CH_3O(OH)C_6H_3CHO$	152.14
5163	**Isoxylic acid**	2,5-dimethylbenzoic acid; 2,5-xylic acid; *p*-xylic acid	$(CH_3)_2C_6H_3COOH$	150.17
5164	**Isuretin.**	See *Formamide, oxime.*		
5165	**Itaconic acid**	methylenebutanedioic acid*; methylenesuccinic acid	$HOOCC(:CH_2)CH_2COOH$	130.10
5166	**——, γ,γ-dimethyl-.**	See *Teraconic acid.*		
5167	**Itamalic acid,** γ-lactone.	See *Paraconic acid.*		
5168	**Japaconine, acetylbenzoyl-.**	See *Japaconitine.*		
5169	**Japaconitine**	acetylbenzoyl, japaconine; same as aconitine?	$C_{34}H_{47}NO_{11}$	645.73
5170	**Japan camphor.**	See *d-Camphor.*		
5171	**Jervine**		$C_{26}H_{37}NO_3{\cdot}2H_2O$	447.60
5172	**Juglone**	5-hydroxy-1,4-naphthoquinone; nucin	$C_{10}H_5O_2(OH)$	174.15
5173	**Kairoline**	1-methyl-1,2,3,4-tetrahydroquinoline	$C_9H_{10}NCH_3$	147.21
5174	**Ketazine, dimethyl-.**	See *Acetone, azine.*		
5175	**Ketene**	ethenone; carbomethene; keten	$CH_2:CO$	42.04
5176	**Ketine**	2,5-dimethylpyrazine	$N:C(CH_3)CH:NC\text{-}(CH_3):CH$	108.14
5176H	**Ketol, diethyl-.**	See *Propioin.*		
5176M	**——, ethyl-.**	See 2-*Butanone, 1-hydroxy-.*		
5176R	**Ketone, aminodiphenyl-.**	See *Benzophenone, 2-amino-*.		
5177	**——, aminophenyl methyl.**	See *Acetophenone, amino*-.		
5178	**——, aminophenyl phenyl.**	See *Benzophenone, amino*-.		
5179	**——, amyl ethyl.**	See 3-*Octanone**.		
5180	**——, amyl methyl.**	See 2-*Heptanone**.		
5181	**——, *p*-anisyl methyl.**	See *Acetophenone, p-methoxy-.*		
5182	**——, benzyl ethyl.**	See 2-*Butanone, 1-phenyl-.*		
5183	**——, benzyl methyl.**	See 2-*Propanone, 1-phenyl-.*		
5184	**——, benzyl 1-naphthyl**	α-phenyl-1-acetonaphthone	$C_6H_5CH_2COC_{10}H_7$	246.29
5185	**——, benzyl 2-naphthyl**		$C_6H_5CH_2COC_{10}H_7$	246.29
5186	**——, benzyl phenyl.**	See *Desoxybenzoin.*		
5187	**——, bisaminophenyl.**	See *Benzophenone, diamino-.*		
5188	**——, bischloromethyl.**	See 2-*Propanone, 1,3-dichloro*-*.		
5189	**——, bishydroxyphenyl.**	See *Benzophenone, dihydroxy*-.		
5190	**——, α-bromoisopropyl 2-mesityl.**	See *Isobutyrophenone, α-bromo*-2,4,6-*tri*-		
5191	**——, 5-bromo-2-thienyl methyl**	2-acetyl-5-bromothiophene	$CH_3COC_4H_2BrS$	205.08
5192	**——, butyl methyl.**	See 2-*Hexanone**.		
5193	**——, *sec*-butyl methyl.**	See 2-*Pentanone, 3-methyl*-*.		
5194	**——, *tert*-butyl methyl.**	See *Pinacolin.*		
5195	**——, butyl phenyl.**	See *Valerophenone.*		
5196	**——, carvacryl methyl.**	See *Acetophenone, 5-isopropyl-2-methyl-.*		
5197	**——, 5-chloro-2-thienyl methyl.**	2-acetyl-5-chlorothiophene	$CH_3COC_4H_2ClS$	160.62
5198	**——, cinnamyl methyl.**	See *Acetone, benzylidene-.*		
5199	**——, cyclobutyl phenyl**	benzoylcyclobutane; benzoyltetramethylene	$C_6H_5COCH(CH_2)_3$	160.21

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5162	monocl. pr. or pl.	1.196	116	179^{15}	s. h.	s.	s. eth.; v. s. chl.; sl. s. CS_2
5163	col. need. f. al.	1.069^{20}_{4}	132 (104)	268 (270–5) subl.	v. sl. s. h.	v. s.	s. eth., acet., bz.
5164							
5165	rhomb........	1.632	161 d.	d.	8.33^{20}	19.73^{15}, 88%	sl. s. eth.; v. sl. s. bz., chl., pet. eth.
5166							
5167							
5168							
5169	col. need. f. al., eth., or chl., $[\alpha]$ $+17.3^{\circ}_{D}$ in chl.	....	204.2 d.	....	i.	s. h.	s. h. eth., chl. v. s. acet.; v. sl. s. pet. eth.
5170							
5171	lng. grouped pr.	....	238–42	....	i.	s.	sl. s. eth.; s. chl., acet.
5172	red-br. pr. f. chl.	....	153–4	d.	i.	sl. s. c.	sl. s. eth.; v. s. chl.; s. h. ac. a.
5173	liq., $1.4802^{23.1}$	1.021	....	245.5	......	v. s.	sl. s. eth.
5174							
5175	col. gas.......	....	–151	–56 (–41)	d.	d.	s. eth., acet.
5176	col. liq., $1.49921^{23.6}$	0.990	15	155	∞	∞	∞ eth.
5176H							
5176M							
5176R							
5177							
5178							
5179							
5180							
5181							
5182							
5183							
5184	pl. f. al.......	....	66–7	....	i.	s.	s. eth.
5185	col. need. f. al.	....	99.5	....	......	s.	s. eth., chl., bz.
5186							
5187							
5188							
5189							
5190	*methyl-.*						
5191	col. need......	....	94	....	......	sl. s. c., v. s. h.	....
5192							
5193							
5194							
5195							
5196							
5197	pl.........	....	52	....	......	v. s.	v. s. eth.
5198							
5199	....	....	....	258	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5200	**Ketone, dibenzyl.**	See 2-_Propanone, 1,3-diphenyl-_*.		
5201	**——, dibutyl.**	See 5-_Nonanone_*.		
5202	**——, dichloromethyl methyl.**	See 2-_Propanone, 1,1-dichloro-_*.		
5203	**——, dicinnamyl.**	See _Styryl ketone._		
5204	**——, diethyl.**	See 3-_Pentanone_*.		
5205	**——, dihendecyl.**	See 12-_Tricosanone_*.		
5206	**——, diheptadecyl.**	See 18-_Pentatriacontanone_*.		
5207	**——, diheptyl.**	See 8-_Pentadecanone_*.		
5208	**——, dihexyl.**	See 7-_Tridecanone_*.		
5209	**——, 2,5-dihydroxyphenyl phenyl.**	See _Benzophenone, 2,5-dihydroxy-._		
5210	**——, diisoamyl.**	See 5-_Nonanone, 2,8-dimethyl-_*.		
5211	**——, diisobutyl.**	See 4-_Heptanone, 2,6-dimethyl-_*.		
5212	**——, diisopropyl.**	See 3-_Pentanone, 2,4-dimethyl-_*.		
5213	**——, dimethyl.**	See _Acetone._		
5214	**——, dinaphthyl.**	See _Naphthyl ketone._		
5215	**——, dinonyl.**	See 10-_Nonadecanone_*.		
5216	**——, di-_n_-octyl.**	See 9-_Heptadecanone_*.		
5217	**——, dipentadecyl.**	See 16-_Hentriacontanone_*.		
5218	**——, dipentyl.**	See 6-_Hendecanone_*.		
5219	**——, diphenyl.**	See _Benzophenone._		
5220	**——, diphenylene.**	See 9-_Fluorenone_*.		
5221	**——, dipropyl.**	See 4-_Heptanone_*.		
5222	**——, distyryl.**	See _Styryl ketone._		
5223	**——, 2,2′-dithienyl-.**	See 2-_Thienyl ketone._		
5224	**——, di-_p_-tolyl.**	See _Benzophenone, 4,4′-dimethyl-._		
5225	**——, diundecyl.**	See 12-_Tricosanone_*.		
5226	**——, ethyl butyl.**	See 3-_Heptanone_*.		
5227	**——, ethyl heptyl.**	See 3-_Decanone_*.		
5228	**——, ethyl hexyl.**	See 3-_Nonanone_*.		
5229	**——, ethyl isoamyl.**	See 3-_Heptanone, 6-methyl-_*.		
5230	**——, ethyl isobutyl.**	See 3-_Hexanone, 5-methyl-_*.		
5231	**——, ethyl isopropyl.**	See 3-_Pentanone, 2-methyl-_*.		
5232	**——, ethyl methyl.**	See 2-_Butanone_*.		
5233	**——, ethyl naphthyl.**	See _Propionaphthone._		
5234	**——, ethyl octyl.**	See 3-_Hendecanone_*.		
5235	**——, ethyl phenyl.**	See _Propiophenone._		
5236	**——, ethyl propyl.**	See 3-_Hexanone_*.		
5237	**——, 2-furyl methyl.**	2-acetylfuran	$C_4H_3O{\cdot}COCH_3$	110.11
5238	**——, 2-furyl phenyl**	2-benzoylfuran	$C_4H_3O{\cdot}COC_6H_5$	172.17
5239	**——, hendecyl methyl.**	See 2-_Tridecanone_*.		
5239M	**——, heptadecyl phenyl.**	See _Stearophenone._		
5240	**——, heptyl methyl.**	See 2-_Nonanone_*.		
5241	**——, hexyl methyl.**	See 2-_Octanone_*.		
5242	**——, hexyl propyl.**	See 4-_Decanone_*.		
5243	**——, 1-hydroxy-2-naphthyl methyl.**	See 2-_Acetonaphthone, 1-hydroxy-._		
5244	**——, 1-hydroxy-2-naphthyl propyl.**	See 2-_Butyronaphthone, 1-hydroxy-._		
5245	**——, 1-hydroxy-2-naphthyl styryl.**	See 2-_Acrylonaphthone, 1-hydroxy-β-phenyl-._		
5246	**——, hydroxyphenyl hydroxyphenyl.**	See _Benzophenone, dihydroxy-._		
5247	**——, isoamyl methyl.**	See 2-_Hexanone, 5-methyl-_*.		
5248	**——, isoamyl phenyl.**	See _Isocaprophenone._		
5249	**——, isobutyl methyl.**	See 2-_Pentanone, 4-methyl-_*.		
5250	**——, isobutyl phenyl.**	See _Isovalerophenone._		
5251	**——, isobutyl propyl.**	See 4-_Heptanone, 2-methyl-_*.		
5252	**——, α-isonitrosobutyl methyl.**	See 2,3-_Hexanedione, 3-oxime_*.		
5253	**——, α-isonitrosoethyl methyl.**	See 2,3-_Butanedione, mono-oxime_*.		
5254	**——, α-isonitrosopropyl methyl.**	See 2,3-_Pentanedione, 3-oxime_*.		
5255	**——, isopropyl methyl.**	See 2-_Butanone, 3-methyl-_*.		
5256	**——, isopropyl phenyl.**	See _Isobutyrophenone._		
5257	**——, methyl naphthyl.**	See _Acetonaphthone._		
5258	**——, methyl nonyl.**	See 2-_Hendecanone_*.		
5259	**——, methyl octyl.**	See 2-_Decanone_*.		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5200							
5201							
5202							
5203							
5204							
5205							
5206							
5207							
5208							
5209							
5210							
5211							
5212							
5213							
5214							
5215							
5216							
5217							
5218							
5219							
5220							
5221							
5222							
5223							
5224							
5225							
5226							
5227							
5228							
5229							
5230							
5231							
5232							
5233							
5234							
5235							
5236							
5237	col. cr. f. pet. eth.	....	33	173	i.	s.	s. eth.
5238	liq...........	1.1839_{19}^{19}	....	285	i.	s.	s. eth.
5239							
5239M							
5240							
5241							
5242							
5243							
5244							
5245							
5246							
5247							
5248							
5249							
5250							
5251							
5252							
5253							
5254							
5255							
5256							
5257							
5258							
5259							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5260	**Ketone, methyl phenacyl.**	See *Acetone, benzoyl-.*		
5261	**——, methyl phenyl.**	See *Acetophenone.*		
5262	**——, methyl propyl.**	See 2-*Pentanone*.*		
5263	**——, methyl styryl.**	See *Acetone, benzylidene-.*		
5264	**——, methyl 2-thienyl**	2-acetylthiophene; α-acetothienone	$CH_3COC_4H_3S$.....	126.17
5265	**——, methyl *p*-tolyl.**	See *Acetophenone, p-methyl-.*		
5266	**——, 1-naphthyl phenyl**	....	$C_{10}H_7COC_6H_5$.....	232.27
5267	**——, 2-naphthyl phenyl**	....	$C_{10}H_7COC_6H_5$.....	232.27
5268	**——, nitrophenyl phenyl.**	See *Benzophenone, nitro-.*		
5269	**——, phenyl propyl.**	See *Butyrophenone.*		
5270	**——, phenyl styryl.**	See *Chalcone.*		
5271	**——, phenyl *o*-tolyl...**	....	$C_6H_5COC_6H_4CH_3$..	196.24
5272	**——, phenyl *m*-tolyl..**	....	$C_6H_5COC_6H_4CH_3$..	196.24
5273	**——, phenyl *p*-tolyl...**	....	$C_6H_5COC_6H_4CH_3$..	196.24
5274	**——, phenyl trityl.**	See *β-Benzopinacolin.*		
5275	**Ketoxime, methyl ethyl.**	See 2-*Butanone*, oxime.*		
5276	**——, methyl isopropyl.**	See 2-*Butanone, 3-methyl-*, oxime.*		
5277	**——, methyl propyl.**	See 2-*Pentanone*, oxime.*		
5278	**Kojic acid**............	5-hydroxy-2-(hydroxymethyl)-1,4-pyrone	$OC(CH_2OH){:}CH\text{-}COC(OH){:}CH$	142.11
5279	**Kynurenic acid**.......	4-hydroxyquinaldic acid.....	$C_9H_5N(OH)COOH$	189.16
5280	**Kynurine.**	See 4-*Quinolinol.*		
5281	**Labordin.**	See *Analgen.*		
5282	**Lactamide**............	2-hydroxypropanamide*; lactic amide	$CH_3CHOHCONH_2$	89.09
5283	**Lactic acid(*dl*)**........	ordinary lactic acid; lactic acid of fermentation; 2-hydroxypropanoic acid*; α-hydroxypropionic acid	$CH_3CHOHCOOH$	90.08
5284	——, benzoate............	*O*-benzoyllactic acid.........	$CH_3CH(OOCC_6H_5)COOH$	194.18
5285	——, butyl ester..........	butyl lactate...............	$CH_3CHOHCOOC_4H_9$	146.18
5286	——, ethyl ester..........	ethyl 2-hydroxypropanoate*; ethyl lactate	$CH_3CHOHCOOC_2H_5$	118.13
5287	——, methyl ester.........	methyl 2-hydroxypropanoate*; methyl lactate	$CH_3CHOHCOOCH_3$	104.10
5288	——, *p*-phenylphenacyl ester	....	$CH_3CHOHCOOCH_2COC_6H_4C_6H_5$	284.30
5289	——, piperazinium salt......	....	$C_4H_{10}N_2{\cdot}2C_3H_6O_3$..	266.29
5290	**Lactic acid(*d*)**.........	*d*-2-hydroxypropanoic acid*; *d*-α-hydroxypropionic acid; sarcolactic acid; paralactic acid	$CH_3CHOHCOOH$	90.08
5291	**——, benzal-.**	See 3-*Butenoic acid, 2-hydroxy-4-phenyl-.*		
5292	**——, *O*-benzoyl-.**	See *Lactic acid, benzoate.*		
5293	**——, α-phenyl-.**	See *Atrolactic acid.*		
5294	**——, β,β,β-trichloro-**	....	$CCl_3CHOHCOOH$	193.43
5295	**Lactic amide.**	See *Lactamide.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
5260							
5261							
5262							
5263							
5264	1.5667	1.1709^{20}_{4}	10.45	213.9	1.4^{30}	∞	∞
5265							
5266	rhomb. f. al.	....	75.5	385	i.	2.4^{12}	....
5267	rhomb. need. f. al.	....	82	398^{754}	i.	2.01^{12}	....
5268							
5269							
5270							
5271	col. liq.	....	<−18	316	i.	∞	∞ eth.
5272	col. liq.	1.088^{18}	....	316.5	i.	∞	∞ eth., chl., bz.
5273	monocl., 1.717, 1.563	....	60	326.5	i.	s.	v. s. eth., bz.
5274							
5275							
5276							
5277							
5278	col. prismatic need	....	152–4	....	3.95^{20}, 6.90^{35}	s.	sl. s. eth.
5279	need.	....	(-H_2O, 140–5) anh. 257–8	....	0.9^{100}	s. h.	sl. s. eth.
5280							
5281							
5282	col. hyg. cr.	1.138^{80}_{4}	74	....	v. s.	v. s.	....
5283	col. hyg. syrup, 1.4414	1.249^{15}	18	122^{15}	∞	∞	∞ eth.
5284	pl.	....	112	....	0.25 c., s. h.	s.	s. eth.; hyd. by h. dil. H_2SO_4
5285	liq.	0.968	....	160-90 ($75–77^{6}$)	sl. s.	∞	∞ eth.
5286	col. liq.	1.031^{20}_{4}	....	154 (150–2)	∞	v. s.	v. s. eth.
5287	col. liq., 1.4156^{16}	1.118^{0}_{4}; 1.08^{16}	....	144.8	s. d.	s.	s. eth.
5288	....	....	145	....	......	......	....
5289	wh. cr.	....	96–6.5	....	s.	s. h.	i. eth.; s. h. cellosolve
5290	hyg. pr. or syrup liq.	1.2485	26	d.	∞	∞	∞ eth.
5291							
5292							
5293							
5294	pr. f. eth.	....	124	170^{45}	v. s.	v. s.	v. s. eth.; s. chl.
5295							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5296	**Lactic anhydride**	2-hydroxypropanoic anhydride*	$(CH_3CHOHCO)_2O$	162.14
5297	**Lactide**	3,6-dimethyl-2,5-*p*-dioxanedione	$OCOCH(CH_3)-$ $OCOCH(CH_3)$	144.12
5298	**Lactobiose.**	See *Lactose.*		
5298M	**Lactoflavin.**	See D-*Riboflavin.*		
5299	**Lactonic acid.**	See *Galactonic acid.*		
5300	**Lactonitrile**	2-hydroxypropanenitrile*; acetaldehyde cyanohydrin; ethylidene cyanohydrin	$CH_3CH(OH)CN$	71.08
5301	**Lactose**	milk sugar; lactobiose	$C_{12}H_{22}O_{11}\cdot H_2O$	360.31
5302	**Lanthopine.**		$C_{20}H_{25}NO_4$	343.41
5303	**Lappaconatine**		$C_{34}H_{48}N_2O_8$ or $C_{32}H_{42}N_2O_9$	612.74 (598.68)
5304	**Laudanidine**	*l*-laudanine; tritopine	$C_{20}H_{25}NO_4$	343.41
5305	***dl*-Laudanine**		$C_{20}H_{25}NO_4$	343.41
5306	***l*-Laudanine.**	See *Laudanidine.*		
5307	***d*-Laudanosine**		$C_{21}H_{27}NO_4$	357.44
5308	**Lauraldehyde**	dodecanal*	$CH_3(CH_2)_{10}CHO$	184.31
5309	**Laurel camphor.**	See *d-Camphor.*		
5310	**Laurent's acid.**	See 1-*Naphthylamine-5-sulfonic acid.*		
5311	**Lauric acid**	dodecanoic acid*	$CH_3(CH_2)_{10}COOH$	200.31
5312	——, benzyl ester		$C_{11}H_{23}COOCH_2-C_6H_5$	290.43
5313	——, ethyl ester	ethyl dodecanoate*; ethyl laurate	$CH_3(CH_2)_{10}-COOC_2H_5$	228.37
5314	——, ethylene ester.	See *Glycol, dilaurate.*		
5314M	——, phenyl ester	phenyl laurate	$C_{11}H_{23}COOC_6H_5$	276.41
5315	——, *p*-phenylphenacyl ester		$CH_3(CH_2)_{10}COOC-H_2COC_6H_4C_6H_5$	394.54
5316	**Lauric anhydride**	dodecanoic anhydride*	$(C_{11}H_{23}CO)_2O$	382.61
5317	**Laurin.**	See *Glycerol, trilaurate.*		
5318	**Laurone.**	See 12-*Tricosanone**.		
5319	**Lauronitrile**	dodecanenitrile*; *n*-undecyl cyanide	$CH_3(CH_2)_{10}CN$	181.31
5319M	**Lauroyl chloride**	dodecanoyl chloride*; lauryl chloride	$CH_3(CH_2)_{10}COCl$	218.76
5320	**Lauryl alcohol**	See 1-*Dodecanol**.		
5321	**Lauryl bromide.**	See *Dodecane, 1-bromo-**.		
5322	**Lauryl chloride.**	See *Lauroyl chloride.*		
5323	**Lauryl ketone.**	See 12-*Tricosanone**.		
5324	**Lauth's violet.**	See *Thionine.*		
5325	**Lead, hexaethyldi-**	hexaethyldiplumbane; diplumbic hexaethyl; lead triethide	$Pb_2(C_2H_5)_6$	588.78
5326	**——, tetraethyl-***	lead tetraethide	$Pb(C_2H_5)_4$	323.45

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5296	lt. yel. amor.	....	260 d.	d.	v. sl. s.	v. s.	v. s. eth.
5297	col. monocl. tab. f. al.	0.862_{4}^{10}	125	255	v. sl. s. c.	v. sl. s.	....
5298							
5298M							
5299							
5300	col. liq.	0.992	-40	182–4 sl. d.	s.	s.	s. eth.; i. pet. eth.
5301	col. rhomb., 1.517, 1.542, 1.555	1.525_{4}^{20}	anh. 201.6	d.	17 c., 40 h.	i.	i. eth., chl.
5302	cr.	....	200	....	...	sl. s.	sl. s. eth.
5303	hex. cr.	....	205	....	sl. s.	s.	s. eth.
5304	hex. pr. f. w. +al.	....	166	....	i.	s.	sl. s. eth.; s. bz., chl.
5305	sm. trim. ylsh. wh. pr.	....	166	....	......	sl. s.	0.154^{18} eth.; s. chl., bz.
5306							
5307	need. f. bz., $[\alpha]+103.23_{D}^{\circ 15}$	....	89–90	....	i.	s.	5.18^{16} eth.; s. chl., h. bz.
5308	col. leaf	0.8352_{4}^{15}	44.5	185^{100}	i.	s.	s. eth.
5309							
5310							
5311	col. need. f. al., $1.4183^{82.1}$	0.883; 0.8679_{4}^{50}	44 (48)	225^{100}	i.	26^{0}, 134^{21}	v. s. eth.; s. bz., 142^{21} me. al.
5312	liq.	0.9457_{25}^{25}	3.5	$209–11^{12}$	i.	s.	v. s. eth.
5313	oil, 1.4321	0.8615_{4}^{20}	-10.7 (-1.68)	269	i.	v. s.	∞ eth.
5314							
5314M	col. cr.	....	....	$159–161^{1}$	i.	s.	s. eth.
5315	....	....	84	....	......	......	....
5316	col. cr.	....	41	166	i., d.	s., d.	v. s. eth.
5317							
5318							
5319	oil	0.8373^{15}	4	198^{100}	i.	sl. s.	v. s. eth.
5319M	col. liq.	....	-17	145^{18}	d.	d.	s. eth.
5320							
5321							
5322							
5323							
5324							
5325	liq.	1.471	....	d.	i.	......	....
5326	col. liq., 1.5218^{18}	1.659^{18}	....	198–202	i.	∞	∞ eth.,; s. in all org. solv.; i. dil. a., dil. alk.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5327	**Lead, tetramethyl-***	tetramethylplumbane; lead tetramethyl	$Pb(CH_3)_4$	267.35
5328	**——, tetraphenyl-***	tetraphenylplumbane	$(C_6H_5)_4Pb$	515.61
5329	**Lead triethide.**	See *Lead, hexaethyldi-.*		
5330	**Lecanoric acid,** monomethyl ether.	See *Evernic acid.*		
5332	**Lepidine**	4-methylquinoline	$CH_3C_9H_6N$	143.18
5333	**——, 2-(*p*-aminophenyl)-.**	See *Flavaniline.*		
5334	**2(1)-Lepidone.**	See *Carbostyril, 4-methyl-.*		
5335	***op*$_2$-Leucaniline**	*o,p′,p″*-methenyltrianiline; *o,p′,p″*-triaminotriphenylmethane; 2,4′,4″-triaminotritan	$CH(C_6H_4NH_2)_3$	289.37
5336	***mp*$_2$-Leucaniline**	*m,p′,p″*-methenyltrianiline; *m,p′,p″*-triaminotriphenylmethane; 3,4′,4″-triaminotritan; pseudoleucaniline	$CH(C_6H_4NH_2)_3$	289.37
5337	***p*$_3$-Leucaniline**	paraleucaniline; *p,p′,p″*-methenyltrianiline; *p,p′,p″*-triaminotriphenylmethane; 4,4′,4″-triaminotritan	$CH(C_6H_4NH_2)_3$	289.37
5338	**——, *N,N,N′,N′*-tetramethyl-**	4-amino-4′,4″-bisdimethylaminotriphenylmethane	$[(CH_3)_2NC_6H_4]_2CHC_6H_4NH_2$	345.47
5339	**Leucaurin**	*p,p′,p″*-methenyltriphenol; leucoaurin	$CH(C_6H_4OH)_3$	292.32
5340	***l*-Leucic acid**	2-hydroxy-4-methylpentanoic acid*; *α*-hydroxyisocaproic acid; leucinic acid	$(CH_3)_2CHCH_2CHOHCOOH$	132.16
5341	**DL-Leucine**	*dl-α*-aminoisocaproic acid	$(CH_3)_2CHCH_2CH(NH_2)COOH$	131.17
5342	**L-Leucine**	*l*-2-amino-4-methylpentanoic acid*; *l-α*-aminoisocaproic acid	$(CH_3)_2CHCH_2CH(NH_2)COOH$	131.17
5343	**Leucoindigo.**	See *Indigo white.*		
5344	**Leucoline.**	See *Isoquinoline.*		
5345	**Leucomalachite green.**	See *Aniline, p,p′-benzylidenebis-N,N-dimethyl-.*		
5346	**Levulin** (synthetic)	fructosin; levulosin	$(C_6H_{10}O_5)_x$	$(162.14)_x$
5347	**Levulinaldehyde**	4-oxopentanal*; levulinic aldehyde; *γ*-ketovaleraldehyde	$CH_3COCH_2CH_2CHO$	100.11
5348	**Levulinic acid**	4-oxopentanoic acid*; *γ*-ketovaleric acid; acetopropionic acid	$CH_3COCH_2CH_2COOH$	116.11
5349	——, ethyl ester		$CH_3CO(CH_2)_2COOC_2H_5$	144.17
5350	**Levulose.**	See D-*Fructose.*		
5351	**Levulosin.**	See *Levulin (synthetic).*		
5352	**Licareol,** esters.	See under *l-Linaloöl.*		
5353	**Lichenin**	moss starch	$(C_6H_{10}O_5)_x$	$(162.14)_x$
5354	**Lignoceric acid**		$C_{23}H_{47}CO_2H$	368.63
5355	***dl*-Limonene**	dipentene; *dl*-1,8(9)-*p*-menthadiene	$C_{10}H_{16}$	136.23
5356	***d*-Limonene**	*d*-1,8(9)-*p*-menthadiene; citrene; carvene; hesperidene	$C_{10}H_{16}$	136.23

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5327	col. liq., 1.5128	1.9951^{20}_{4}	-27.5	110	i.	∞	∞ eth.
5328	wh. need......	....	227.7	....	......	......	s. bz.
5329							
5330							
5332	col. liq........	1.086^{20}_{4}	<0	258–263	v. sl. s.	∞	∞ eth.; s. bz.
5333							
5334							
5335	col. cr. f. al....	....	165	....	v. sl. s. h.	v. s.	v. sl. s. eth.
5336	rosettes f. eth.	....	150	....	i.	s.	s. eth.; v. sl. s. lgr.
5337	col. leaf. f. w..	....	148 (207)	....	i.	s.	s. bz.
5338	glit. cr. f. al...	....	151–2	....	......	v. sl. s.	....
5339	col. need. f. ac. a.	....	....	....	sl. s.	s.	s. ac. a., alk.
5340	need. or pl. f. eth.+pet. eth.	....	72.5 (*dl*, 76–7)	subl. 100	v. s.	v. s.	v. s. eth.
5341	leaf. f. w......	....	332 d. (290)	....	0.99^{25}, 2.28^{75}	0.176^{25} 75%, 0.13^{25} 90%	....
5342	hex. col. leaf. f. w., 1.525, 1.535, 1.560	1.293^{18}_{4}	295 (*d.* 280 d.)	subl.	2.43^{25}, 3.82^{75}	0.072^{17} 99%	i. eth.; 10.9 gl. ac. a.
5343							
5344							
5345							
5346	deliq. amor....	....	140–5 d.	....	∞	10^{22} 84% v. sl. s.	i. eth.
5347	col. liq., 1.4263	1.018^{20}_{4}	<-21	186–8 d.	∞	∞	∞ eth.
5348	col. leaf.......	1.1395^{20}_{4}	37.2	246, 154^{14}	v. s.	v. s.	v. s. eth.
5349	col. liq.......	1.01346^{20}_{4}	....	205.2^{756}	v. s.	∞	∞ eth.
5350							
5351							
5352							
5353	wh. amor. powd.	....	....	....	s. h.	i.	i. eth.; s. conc. HCl
5354	col. need. f. al.	0.8207	81	....	......	s.	s. eth. bz., CS_2, ac. a.
5355	col. liq., 1.473.	0.865^{18}; 0.845^{20}	....	176 (178–80)	i.	s.	s. eth.
5356	col. liq., $1.47489^{14.7}$	0.842^{20}_{4}	-96.9	177	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5357	***d*-Linaloöl**	*d*-3,7-dimethyl-1,6-octadien-3-ol*; coriandrol	$C_{10}H_{18}O$	154.25
5358	***l*-Linaloöl,** acetate	linalyl acetate; licareol acetate	$CH_3COO(C_{10}H_{17})$	196.28
5359	——, formate	*l*-linalyl formate	$HCOOC_{10}H_{17}$	182.26
5359M	**Linaloölene.**	See 1,6-*Octadiene, 3,7-dimethyl*-*.		
5360	**Linalyl esters.**	See under *Linaloöl.*		
5361	**Linoleic acid**	9,12-octadecadienoic acid*; linolic acid	$C_{18}H_{32}O_2$	280.44
5362	——, ethyl ester	ethyl linoleate; ethyl linolate	$C_{17}H_{31}COOC_2H_5$	308.49
5363	——, methyl ester	methyl linolate	$C_{17}H_{31}COOCH_3$	294.47
5364	——, tetrabromide.	See *Stearic acid, θ,ι,λ,μ-tetrabromo-.*		
5365	**Linolenic acid,** ethyl ester		$C_{17}H_{29}COOC_2H_5$	306.48
5366	**α-Linolenic acid**	9,12,15-octadecatrienoic acid* (one form)	$C_{17}H_{29}COOH$	278.42
5367	——, hexabromide.	See *Stearic acid, θ,ι,λ,μ,ξ,ο-hexabromo-.*		
5369	**Lithofellic acid**	lithofellinic acid	$C_{20}H_{36}O_4$	340.49
5370	**Lobeline**		$C_{21}H_{23}NO_2$	321.40
5371	***l*-Lobeline**		$C_{22}H_{27}NO_2$ or $C_{21}H_{23}NO_2$	337.45 (321.40)
5372	**Lophine**	2,4,5-triphenylimidazole	$C_{21}H_{16}N_2$	296.36
5373	**Luminal.**	See *Phenobarbital.*		
5374	**Luminol**	5-amino-2,3-dihydro-1,4-phthalazinedione; 3-aminophthalhydrazide	$NH_2C_6H_3CONH\text{-}NHCO$	177.16
5375	***dl*-Lupanine**		$C_{15}H_{24}N_2O$	248.36
5376	***d*-Lupanine**		$C_{15}H_{24}N_2O$	248.36
5377	**Lupinidine.**	See *Sparteine.*		
5378	**Lupinine**		$C_{21}H_{40}N_2O_2$	352.55
5379	——, hydrochloride		$C_{10}H_{19}NO{\cdot}HCl$	205.73
5380	**——, methyl-**		$C_{10}H_{18}NO{\cdot}CH_3$	183.29
5381	**2,4-Lutidine**	2,4-dimethylpyridine*; αγ-lutidine	$(CH_3)_2C_5H_3N$	107.15
5382	**2,6-Lutidine**	2,6-dimethylpyridine*; αα′-lutidine	$(CH_3)_2C_5H_3N$	107.15
5383	**3,4-Lutidine**	3,4-dimethylpyridine*; βγ-lutidine	$(CH_3)_2C_5H_3N$	107.15
5384	**Lutidinic acid**	2,4-pyridinedicarboxylic acid*	$C_5H_3N(COOH)_2$	167.12
5385	**——, 6-methyl-**	See *Uvitonic acid.*		
5387	**Lyaconitine**		$C_{27}H_{34}N_2O_6{\cdot}2H_2O$	518.59
5388	**Lycine.**	See *Betaine.*		
5389	***l*-Lycorine**		$C_{16}H_{17}NO_4$	287.31
5390	**D-Lysine**	*l*,α,ε-diaminocaproic acid, *l*-2,6-diaminohexanoic acid*	$NH_2(CH_2)_4CH(NH_2)COOH$	146.19

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5357	col. liq., 1.4623	$0.8622\frac{20}{4}$; *d.* $0.8702\frac{20}{4}$	....	198.3	v. sl. s.	∞	∞ eth.
5358	col. liq., 1.4460	$0.895\frac{20}{4}$	....	220	v. sl. s.	∞	∞ eth.
5359	....	....	....	$100\text{–}3^{10}$	i.	s.	s. eth.
5359M							
5360							
5361	col.-yel. oil....	$0.9025\frac{20}{4}$	−11	230^{16}	i.	∞	∞ eth.
5362	col.-yel. oil....	0.8865^{20}	....	$270\text{–}5^{180}$	i.	s.	s. eth.
5363	col.-yel. oil....	0.889^{18}	....	$207\text{–}8^{11}$	i.	s.	v. s. eth.
5364							
5365	oil...........	0.8919	....	$123\text{–}33^{.001}$	i.	s.	s. eth.
5366	col. liq.......	$0.905\frac{20}{4}$	....	$230\text{–}2^{17}$	i.	∞	∞ eth.
5367							
5369	micr. cr.......	....	206	d.	i.	s.	....
5370	yel. syrup.....	....	....	....	sl. s.	v. s.	v. s. eth.; s. bz., chl.
5371	col. need......	....	130–1	....	d. h.	......	....
5372	need.........	....	275	....	i.	0.88^{21}	0.32^{20} eth.
5373							
5374	yel...........	....	*ca.* 280	....	i.	sl. s.	sl. s. eth.
5375	need. f. pet. eth.	....	99	....	v. s.	v. s.	v. s. eth.; s. chl.
5376	col. need......	....	44	....	s.	v. s.	v. s. eth.; s. chl., lgr.
5377							
5378	col. rhomb., $[\alpha]-190^{\circ 17}_{D}$	....	68.5–9.2	256	s. c.	s.	s. eth., chl.
5379	lg. rhomb. cr., $[\alpha]-14^{\circ}_{D}$	....	212–3	....	s.	s.	....
5380	oily liq.......	....	....	$145\text{–}6^{15}$	......	s.	s. eth.
5381	col. liq.......	$0.9493\frac{0}{4}$	....	157.1 (159)	20	s.	s. eth.
5382	col. liq.......	$0.942\frac{0}{4}$	....	143	∞ c., less s. h.	s.	s. eth.
5383	col. liq.......	....	....	163.5–4.5	......	s.	s. eth.
5384	leaf. or pr. f. w.	0.942	248–50	....	s.	s.	i. eth.
5385							
5387	ylsh.-wh. resinous	....	112–5	....	sl. s.	s.	sl. s. eth.; s. chl., CS_2, pet. eth.
5388							
5389	col. pr........	....	250 d.	....	i.	s.l s.	sl. s. eth., chl.; s. a.
5390	need. or hex. pl. f. al.	....	224 d.	....	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5391	**L-Lysine**	*d*-α,ε-diaminocaproic acid, *d*-2,6-diaminohexanoic acid*	$NH_2(CH_2)_4CH(NH_2)COOH$	146.19
5392	——, picrate		$C_6H_{14}N_2O_2 \cdot C_6H_3N_3O_7$	375.30
5392H	**D-Lyxosazone.**	See D-*Xylose.*		
5392R	**D-Lyxose, (α)**		$C_5H_{10}O_5$	150.13
5393	**Maclurin**	2,4,6,3′,4′-pentahydroxybenzophenone; moringatannic acid; moringatannin	$C_{13}H_{10}O_6 \cdot H_2O$	280.23
5395	**Malachite green, leuco.**	See *Aniline, p,p′-benzylidenebis-N,N-dimethyl-.*		
5396	**Malamide**	2-hydroxybutanediamide*; malic amide	$C_2H_3(OH)(CONH_2)_2$	132.12
5397	**Malay camphor.**	See *d-Borneol.*		
5398	**Maleamic acid**	maleamidic acid, maleic acid monoamide	$H_2NCOCH{:}CHCOOH$	115.09
5399	**Maleic acid**	*cis*-butenedioic acid*; *cis*-1,2-ethylenedicarboxylic acid	$HOOCCH{:}CHCOOH$	116.07
5400	——, diethyl ester	diethyl maleate; ethyl maleate	$({:}CHCOOC_2H_5)_2$	172.18
5401	——, dimethyl ester	methyl maleate	$({:}CHCOOCH_3)_2$	144.12
5402	——, monoamide.	See *Maleamic acid.*		
5403	——, *p*-phenylphenacyl ester		$({:}CHCOOCH_2COC_6H_4C_6H_5)_2$	504.51
5404	**——, bromo-**		$BrC(COOH){:}CHCOOH$	194.98
5405	**——, chloro-**		$ClC(COOH){:}CHCOOH$	150.52
5406	**——, methyl-.**	See *Citraconic acid.*		
5407	**Maleic anhydride**	*cis*-butenedioic anhydride*; 2,5-furandione	$\underline{OCOCH{:}CHCO}$	98.06
5408	**——, bromo-**		$\underline{OCOCBr{:}CHCO}$	176.96
5409	**——, chloro-**		$\underline{OCOCCl{:}CHCO}$	132.51
5410	**——, methyl-.**	See *Citraconic anhydride.*		
5411	**Malic acid** (*dl*)		$HOOCCH(OH)CH_2COOH$	134.09
5412	**Malic acid** (*l*)	ordinary malic acid; *l*-hydroxybutanedioic acid*; *l*-hydroxysuccinic acid	$HOOCCH(OH)CH_2COOH$	134.09
5413	——, acetate	acetoxysuccinic acid; *O*-acetylmalic acid	$CH_3COOCH(COOH)CH_2COOH$	176.12
5414	——, diethyl ester	diethyl hydroxybutanedioate*; ethyl malate	$CH_2(COOC_2H_5)CHOHCOOC_2H_5$	190.19
5415	——, dimethyl ester	methyl malate; methyl hydroxysuccinate	$CH_3OOCCH(OH)CH_2COOCH_3$	162.14
5416	——, dipropyl ester	dipropyl hydroxybutanedioate*; propyl malate	$C_3H_7OOCCHOHCH_2COOC_3H_7$	218.25

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5391	flat need. f. w., hex. pl. f. al.	....	224 d.	....	v. s.	v. sl. s.	i. eth.
5392	need.........	....	266 exp.	....	0.54 c.	i.	i. eth.
5392 H							
5392 R	col. monocl., biaxial cr. (hygr.) 1.532^{20}, 1.541^{20}, 1.549^{20}; $[\alpha]_D^{20}+5.5°$ init.,−14° on standing	$1.545\frac{20}{4}$	106–7 (101)	....	v. s.	2.11	....
5393	col.-yel. pr. f. w.	....	220 d.	d.	0.5^{15}	s.	s. eth.
5395							
5396	pr. f. w.......	....	156–8	....	s.	......	....
5397							
5398	pl............	....	152–3	....	v. s.	s. h.	i. eth.
5399	col. monocl. pr.	$1.590\frac{20}{4}$	130.5	135 d.	78.8^{25}, $392.6^{97.5}$	$69.9^{29.7}$	8^{25} eth.; s. glac. ac. a., acet.; v. sl. s. bz.
5400	col. liq.......	$1.064^{25.2}$	....	225; $105\text{–}6^{14}$	i.	s.	s. eth.
5401	col. liq.......	$1.1606\frac{20}{4}$	−19	205; 102^{17}	i.	......	s. eth.
5402							
5403	....	....	168	....	......	......	....
5404	need. or pr....	....	128; 138–41	d.	v. s.	v. s.	v. s. eth.
5405	col. pr. f. eth.-chl.	....	108 (114); sinters 96	....	s. h.	v. s.	v. s. eth.; s. ac. a.; sl. s. bz., chl.; i. pet. eth.
5406							
5407	col. rhomb. need. f. chl.	$0.934\frac{20}{4}$	53 (57–60)	202 (196)	......	v. sl. s.	v. sl. s. CCl_4
5408	liq...........	....	....	215	......	......	....
5409	liq...........	$1.54\frac{25}{25}$	33	196.3; 95^{25}	......	......	....
5410							
5411	col. cr.........	$1.601\frac{20}{4}$	128.5	150 d.	144^{26}, 411^{79}	v. s.	sl. s.
5412	col. need......	1.595	100	140 d.	v. s.	v. s.	6.0 c. eth.
5413	cr............	....	134	d.	s., d. h.	......	i. bz.
5414	col. liq., 1.4362	1.128	....	253	s.	∞	∞ eth.
5415	col. liq., 1.4425	$1.2226\frac{20}{4}$	....	242	v. s.	∞	∞ eth.
5416	liq., 1.4380....	1.075	10.5	151^{10}	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5417	**Malic acid, *O*-acetyl-.**	See *Malic acid, acetate.*		
5418	**——, α-methyl-.**	See *Citramalic acid.*		
5419	**Malic amide.**	See *Malamide.*		
5420	**Malonamide**	propanediamide*; malonic diamide	$CH_2(CONH_2)_2$	102.09
5421	**Malonic acid**	propanedioic acid*; methanedicarboxylic acid	$HOOCCH_2COOH$	104.06
5422	——, diethyl ester	diethyl propanedioate*; ethyl malonate; malonic ester	$CH_2(COOC_2H_5)_2$	160.17
5423	——, dimethyl ester	methyl malonate; dimethyl propanedioate*	$CH_2(COOCH_3)_2$	132.11
5424	——, dipropyl ester	dipropyl propanedioate*; propyl malonate	$CH_2(COOC_3H_7)_2$	188.22
5425	——, monoethyl ester, piperazinium salt		$C_4H_{10}N_2 \cdot 2HOOC\text{-}CH_2COOC_2H_5$	350.37
5426	——, piperazinium salt		$C_4H_{10}N_2 \cdot C_3H_4O_4$	190.20
5427	——, **acetyl-,** diethyl ester	ethyl acetylmalonate; diethyl acetylpropanedioate*	$CH_3COCH\text{-}(COOC_2H_5)_2$	202.20
5428	——, **allyl-**	2-propenylpropanedioic acid*; 3-butene-1,1-dicarboxylic acid*	$COOHCH\text{-}(CH_2CH{:}CH_2)\text{-}COOH$	144.12
5429	——, ——, diethyl ester	ethyl allylmalonate; diethyl (2-propenyl)propanedioate*; diethyl 3-butene-1,1-dicarboxylate*	$CH_2{:}CHCH_2CH\text{-}(COOC_2H_5)_2$	200.23
5430	——, **amino-**	2-aminopropanedioic acid*	$COOHCH(NH_2)\text{-}COOH$	119.08
5431	——, **amyl-,** diethyl ester	ethyl amylmalonate	$CH_3(CH_2)_4CH\text{-}(COOC_2H_5)_2$	230.30
5432	——, **anilino-,** ethyl ester	anilinomalonic ester; diethyl anilinomalonate	$C_6H_5NHCH\text{-}(COOC_2H_5)_2$	251.28
5433	——, **benzylidene-**	2-phenyl-1,1-ethylenedicarboxylic acid	$C_6H_5CH{:}C\text{-}(COOH)_2$	192.16
5434	——, **benzyl-,** diethyl ester	diethyl benzylpropanedioate*; ethyl benzylmalonate	$C_6H_5CH_2CH\text{-}(COOC_2H_5)_2$	250.29
5435	——, **bromo-**	bromopropanedioic acid*	$BrCH(COOH)_2$	182.97
5436	——, ——, diethyl ester	diethyl bromopropanedioate*	$BrCH(COOC_2H_5)_2$	239.08
5437	——, **butyl-,** diethyl ester	ethyl *n*-butylmalonate	$CH_3(CH_2)_3CH\text{-}(COOC_2H_5)_2$	216.27
5438	——, *sec*-**butyl-,** diethyl ester	ethyl *sec*-butylmalonate	$C_2H_5(CH_3)CHCH\text{-}(COOC_2H_5)_2$	216.27
5439	——, **chloro-**	chloropropanedioic acid*	$CHCl(COOH)_2$	138.51
5440	——, **dibenzyl-,** diethyl ester	diethyl 1,3-diphenyl-2,2-propanedicarboxylate	$(C_6H_5CH_2)_2C\text{-}(COOC_2H_5)_2$	340.40
5441	——, **dibromo-,** diethyl ester	diethyl dibromopropanedioate*	$CBr_2(COOC_2H_5)_2$	317.98
5442	——, **diethyl-,** diethyl ester	diethyl diethylpropanedioate*	$(C_2H_5)_2C\text{-}(COOC_2H_5)_2$	216.27
5443	——, ——, piperazinium salt		$C_4H_{10}N_2 \cdot (C_2H_5)_2\text{-}C(COOH)_2$	246.30
5444	——, **dihydroxy-.**	See *Mesoxalic acid.*		
5445	——, **dimethyl-,** diethyl ester	diethyl dimethylpropanedioate*	$(CH_3)_2C\text{-}(COOC_2H_5)_2$	188.22

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5417							
5418							
5419							
5420	col. monocl. need.	....	170	....	8.3^{8}	i.	i. eth.
5421	col. tricl	$1.631\frac{15}{4}$	135.6	d.	61.1^{0}, 73.5^{20}, 92.6^{50}	57^{20}	5.7^{15} eth.
5422	col. liq., 1.4143^{20}	$1.055\frac{20}{4}$	−49.8	198.9 ($94–6^{18}$)	2.08^{20}	∞	∞ eth.; s. chl., bz.
5423	col. liq., 1.41490^{17}	$1.1544\frac{20}{4}$	−62	181	v. sl. s.	∞	∞ eth.
5424	col. liq	$1.027\frac{0}{0}$	....	228.3	......	......	....
5425	wh. cr........	....	144	....	s.	s. h.	i. eth.
5426	wh. cr........	....	180 (d.)	....	s.	s. h.	i. eth.
5427	liq...........	1.080^{23}	....	240 (120^{17})	......	......	s. Na_2CO_3 sol.
5428	tricl. f. eth....	....	103–5	d. 180	s.	s.	s. eth., bz.
5429	col. liq	1.01475^{14}	....	222–3 ($110–2^{14}$)	i.	v. s.	v. s. eth.
5430	col. cr. (+$1H_2O$) f. w.	....	109 d.	....	sl. s.	sl. s.	....
5431	col. liq., 1.4253	....	....	$121–3^{6}$	i.	v. s.	v. s. eth.
5432	need.........	....	44–5	....	......	v. s.	s. eth.
5433	pr. f. w.......	....	d. 195 to cinnamic acid	....	s. h.	s.	sl. s. eth., CS_2, ac. a., chl., bz., lgr.; s. acet., et. acetate
5434	liq...........	$1.077\frac{15}{15}$	....	296–8	i.	......	....
5435	need. f. eth....	....	112–3 d.	....	......	v. s.	v. s. eth.
5436	liq...........	$1.4022\frac{25}{4}$	−54	235 ($125–7^{15}$)	i.	∞	∞ eth.
5437	col. liq., 1.425.	....	....	235–40; $130–5^{20}$	i.	v. s.	v. s. eth.
5438	col. liq., 1.4248	0.988^{15}	....	224–5; $94–5^{3}$	v. sl. s.	v. s.	v. s. eth.
5439	pr...........	....	133	....	v. s.	v. s.	v. s. eth.
5440	thk. oil.......	1.093	13	$243–6^{18}$	......	s.	s. eth.
5441	liq...........	....	....	250–6 d. ($103–6^{4}$)	......	......	....
5442	col. liq., $1.42516^{16.6}$	$0.985\frac{20}{4}$ (0.990)	....	223	v. sl. s. (i)	∞	∞ eth.
5443	wh. cr........	....	80–1	....	s.	s.	i. eth.; s. h. acet.
5444							
5445	col. liq., $1.41049^{24.1}$	$0.9910\frac{25}{4}$	....	196.5^{753}	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5446	**Malonic acid, ethyl-**	ethylpropanedioic acid*; 1, 1-propanedicarboxylic acid*	$C_2H_5CH(COOH)_2$	132.11
5447	——, ——, diethyl ester	ethyl ethylmalonate; ethylmalonic ester	$C_2H_5CH(COOC_2H_5)_2$	188.22
5448	——, **ethylene-.**	See *Vinaconic acid.*		
5449	——, **(α-ethylpropyl)-,** diethyl ester	ethyl *sec*-amylmalonate	$(C_2H_5)_2CHCH(COOC_2H_5)_2$	230.30
5450	——, **heptyl-**	heptylpropanedioic acid*; 1,1-octanedicarboxylic acid	$CH_3(CH_2)_6CH(COOH)_2$	202.25
5451	——, **hydroxy-.**	See *Tartronic acid.*		
5452	——, **isoamyl-,** diethyl ester	ethyl isoamylmalonate	$(CH_3)_2CH(CH_2)_2CH(COOC_2H_5)_2$	230.30
5453	——, **isobutyl-**	3-methyl-1,1-butanedicarboxylic acid*	$(CH_3)_2CHCH_2CH(COOH)_2$	160.17
5454	——, ——, diethyl ester	ethyl isobutylmalonate	$(CH_3)_2CHCH_2CH(COOC_2H_5)_2$	216.27
5455	——, **isopropyl-,** diethyl ester	ethyl isopropylmalonate	$(CH_3)_2CHCH(COOC_2H_5)_2$	202.25
5456	——, **keto-.**	See *Mesoxalic acid.*		
5457	——, **methyl-.**	See *Isosuccinic acid.*		
5458	——, ——, diethyl ester	ethyl isosuccinate	$CH_3CH(COOC_2H_5)_2$	174.19
5459	——, ——, dimethyl ester	dimethyl methylpropanedioate*; methyl isosuccinate	$CH_3CH(COOCH_3)_2$	146.14
5459M	——, **oxo-.**	See *Mesoxalic acid.*		
5460	——, **propyl-**	propylpropanedioic acid*; 1, 1-butanedicarboxylic acid*	$C_3H_7CH(COOH)_2$	146.14
5461	——, ——, diethyl ester		$C_3H_7CH(COOC_2H_5)_2$	202.25
5462	**Malonic anhydride** (so-	called). See *Carbon suboxide.*		
5463	**Malonic diamide.**	See *Malonamide.*		
5464	**Malonic dinitrile.**	See *Malononitrile.*		
5465	**Malonic ester, anilino-**	. See *Malonic acid, anilino-, ethyl ester.*		
5466	——, **ethyl-.**	See *Malonic acid, ethyl-, diethyl ester.*		
5467	**Malonic mononitrile.**	See *Acetic acid, cyano-.*		
5468	——, **methyl-.**	See *Propionic acid, α-cyano-.*		
5469	**Malononitrile**	propanedinitrile*; methylene cyanide; malonic dinitrile	$CH_2(CN)_2$	66.06
5470	**Malourea.**	See *Barbital.*		
5471	**Maltobiose.**	See *Maltose.*		
5472	**Maltonic acid.**	See D-*Gluconic acid.*		
5473	**Maltose**	malt sugar; maltobiose	$C_{12}H_{22}O_{11}\cdot H_2O$	360.31
5474	**Malt sugar.**	See *Maltose.*		
5475	**Mandelic acid**(*dl*)	*dl*-phenylglycolic acid; *dl*-α-hydroxy-α-toluic acid	$C_6H_5CH(OH)(COOH)$	152.14
5476	——, gentiobioside.	See *Amygdalic acid.*		
5477	——, **o-amino-,** lactam.	See *Oxindole, 3-hydroxy-.*		
5478	——, ***p*-isopropyl-**(*i*)	*i*-*p*-isopropylphenylglycolic acid	$(CH_3)_2CHC_6H_4CHOHCOOH$	194.22
5479	**Mandelonitrile**(*dl*)	*dl*-benzaldehyde cyanohydrin	$C_6H_5CH(OH)CN$	133.14
5480	——, gentiobioside.	See *Amygdalin.*		
5481	D-**Mannitol**	*d*-mannite	$CH_2OH(CHOH)_4CH_2OH$	182.17
5482	——, hexanitrate	nitromannite	$C_6H_8(NO_3)_6$	452.17
5483	D-**Mannoheptitol.**	See *Perseitol.*		
5484	D-**Mannoheptose**		$C_6H_7(OH)_6CHO$	210.18

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5446	col. rhomb. cr.	....	111.5	160 d.	s.	s.	s. eth., bz., chl., et. acetate.
5447	col. liq., $1.41802^{14.8}_{\alpha}$	$1.004\frac{20}{20}$	....	211^{748}; $95–7^{15}$	v. sl. s.	v. s.	v. s. eth.
5448							
5449	col. liq., 1.4275	....	....	242–5; 130^{16}	v. sl. s.	v. s.	v. s. eth.
5450	cr. f. bz.	....	95	....	i.	v. s.	v. s. eth., acet.
5451							
5452	col. liq., 1.4255	....	....	240–2; $160–5^{44}$	i.	v. s.	v. s. eth.
5453	cr.	....	107	....	v. s.	v. s.	v. s. eth.
5454	col. liq.	0.983^{17}	....	225; $113–6^{1}$	v. sl. s.	v. s.	v. s. eth.
5455	col. liq., 1.418	$0.984\frac{25}{4}$	....	211–5	v. sl. s.	v. s.	v. s. eth.
5456							
5457							
5458	col. liq., $1.41369^{18.7}$	$1.0192\frac{19}{4}$	....	201.4	v. sl. s.	v. s.	v. s. eth.
5459	col. liq.	$1.028\frac{25}{25}$	....	179	v. sl. s.	∞	∞ eth.
5459M							
5460	pl. f. bz.	....	96	d.	45.6^{0}	s.	s. eth., chl.; sl. s. bz.
5461	col. liq.	0.993	....	221	v. sl. s.	v. s.	v. s. eth.
5462							
5463							
5464							
5465							
5466							
5467							
5468							
5469	col. cr., $1.41463^{34.2}$	1.049^{34}	32.1	220	13.3	40	20 eth.; 6.7 bz.
5470							
5471							
5472							
5473	fine col. need.	1.540	102.5 d.	....	108^{25}	v. sl. s. c.	i. eth.
5474							
5475	col. rhomb. f. bz.	1.361^{4}; $1.300\frac{20}{4}$	118.1	d.	16^{20}	$53.6^{16.5}$	s. eth.
5476							
5477							
5478	....	....	158	....	......	......	....
5479	yel. oily liq.	1.124	−10 (22)	d. 170	i.	s.	s. eth.
5480							
5481	col. rhomb. need.	$1.489\frac{20}{4}$	166.1	$295^{3.5}$	15.6^{18}	0.06^{14}	i. eth.
5482	need.	1.604^{0}	112	exp. 120	i.	2.9^{13}	2.86^{9} eth.
5483							
5484	need.	....	134–5	....	v. s.	sl. s.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5485	D-**Mannose**	seminose; carubinose	$CH_2OH(CHOH)_4$-CHO	180.16
5486	——, phenylhydrazone		$C_6H_{12}O_5NNHC_6H_5$	270.28
5487	**Margaric acid**	heptadecanoic acid*; *n*-heptadecoic acid; *n*-heptadecylic acid	$CH_3(CH_2)_{15}COOH$	270.45
5488	**Margaronitrile**	heptadecanenitrile*; cetyl cyanide; *n*-hexadecyl cyanide	$CH_3(CH_2)_{15}CN$	251.45
5489	**Marsh gas.**	See *Methane**.		
5490	**Meconic acid**	3-hydroxy-4-keto-1,4-pyran-2,6-dicarboxylic acid	$C_7H_4O_7 \cdot 3H_2O$	254.15
5491	**Meconidine**		$C_{21}H_{23}NO_4$	353.40
5492	**Meconin**	5,6-dimethoxyphthalide	$C_{10}H_{10}O_4$	194.18
5493	**Melam**		$C_6H_9N_{11}$	235.22
5494	**Melamine**	2,4,6-triamino-*s*-triazine; cyanurotriamide	$N{:}C(NH_2)N{:}C$- $(NH_2)N{:}C(NH_2)$	126.13
5495	**Melampyrin.**	See *Dulcitol.*		
5496	**Melaniline.**	See *Guanidine, diphenyl-.*		
5497	**Melene**		$C_{30}H_{60}$	420.79
5498	**Meletin.**	See *Quercetin.*		
5498M	**Melibiose**		$C_{12}H_{22}O_{11}$	342.30
5499	**Melilotic acid**	*o*-hydroxyhydrocinnamic acid; *o*-hydrocoumaric acid	$HOC_6H_4CH_2CH_2$-$COOH$	166.17
5500	**Melissic acid**		$C_{29}H_{59}COOH$	452.78
5501	**Melissyl alcohol.**	See *Myricyl alcohol.*		
5502	**Mellitic acid**	benzenehexacarboxylic acid*	$C_6(COOH)_6$	342.17
5503	**——, hexahydro-.**	See 1,2,3,4,5,6-*Cyclohexanehexacarboxylic acid**.		
5504	**Mellophanic acid**	1,2,3,4-benzenetetracarboxylic acid*	$C_6H_2(COOH)_4$	254.15
5505	**1,8(9)-*m*-Menthadiene.**	See *Sylvestrene.*		
5506	**1,3-*p*-Menthadiene.**	See *α-Terpinene.*		
5507	**1,4(8)-*p*-Menthadiene.**	See *Terpinolene.*		
5508	**1,5-*p*-Menthadiene.**	See *α-Phellandrene.*		
5509	**1(7),2-*p*-Menthadiene.**	See *β-Phellandrene.*		
5510	**1,8(9)-*p*-Menthadiene.**	See *Limonene.*		
5511	**3,6-*p*-Menthadiene-2,5-dione.**	See *Thymoquinone.*		
5512	**6,8(9)-*p*-Menthadien-2-one.**	See *Carvone.*		
5513	***p*-Menthane**	4-isopropyl-1-methylcyclohexane; hexahydro-*p*-cymene; terpane; menthonaphthene	$CH_3C_6H_{10}CH$-$(CH_3)_2$	140.26
5514	**——, 1,4-epoxy-.**	See 1,4-*Cineole.*		
5515	**——, 1,8-epoxy-.**	See *Cineole.*		
5516	**1,8-*p*-Menthanediol.**	See *Terpinol.*		
5517	**2-*p*-Menthanol.**	See *Carvomenthol.*		
5518	**3-*p*-Menthanol.**	See *Menthol.*		
5519	**3-*p*-Menthanone.**	See *Menthone.*		
5520	***d*-Menthene**	*d*-3-*p*-menthene; *d*-4-isopropyl-1-methyl-3-cyclohexene	$C_{10}H_{18}$	138.25
5521	**1-*p*-Menthene.**	See *Carvomenthene.*		
5522	**——, 6,8-epoxy-.**	See *dl-Pinol.*		
5523	***i*-1-*p*-Menthene-6,8-diol.**	See *Pinol, hydrate.*		
5524	**1-*p*-Menthen-8-ol.**	See *α-Terpineol.*		
5525	**8(9)-*p*-Menthen-2-ol.**	See *Carveol, dihydro-.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5485	col. rhomb. pr. f. al.	1.539	132	....	248^{17}	v. sl. s.	i. eth.
5486	nearly col.....	....	186–8	....	i.	s. h.	....
5487	col. pl........	$0.8578\frac{60}{4}$	60.66 (58–9)	227^{100}	i.	25.2^{28}	v. s. eth.
5488	col. cr........	$1.4448\frac{25}{0}$	34–35.5	....	i.	sl. s.	sl. s. eth.
5489							
5490	rhomb. tab....	....	$-3H_2O$, 100	d.	25^{100}	sl. s.	sl. s. eth.; v. sl. s. chl.
5491	yel. amor.....	....	58	....	i.	......	....
5492	col. need......	....	101	155 subl.	0.14 c.; 4.5 h.	s.	s. eth., bz., chl., amyl al.
5493	or. powd......	....	d.	....	i.	sl. s.	s. KOH
5494	monocl. pr., 1.490, 1.743, 1.872	1.573^{250}	<250	subl.	sl. s.	v. sl. s. h.	i. eth.
5495							
5496							
5497	col...........	0.890	63	380	i.	3.6^{78}	v. sl. s. eth., bz.
5498							
5498M	cr............	....	85	....	......	......	....
5499	pr. f. w.......	....	83	....	5^{18}	s.	s. eth.
5500	col. sc. or need. f. al.	....	91.9–2.1	....	i.	sl. s. c., s. h.	v. sl. s. eth.
5501							
5502	col. need. f. al.	....	286	d.	v. s.	s.	s. H_2SO_4
5503							
5504	cr. f. w.......	....	238 d.	....	s.	......	....
5505							
5506							
5507							
5508							
5509							
5510							
5511							
5512							
5513	col. liq., 1.437.	$0.793\frac{20}{0}$	....	169–70 (164–7)	i.	v. s.	v. s. eth.
5514							
5515							
5516							
5517							
5518							
5519							
5520	col. liq., $1.44813^{20.4}$	0.8073	....	168	......	s.	s. eth., bz.
5521							
5522							
5523							
5524							
5525							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5526	**3-*p*-Menthen-2-one.**	See *Carvenone.*		
5527	**8(9)-*p*-Menthen-2-one.**	See *Carvone, dihydro-.*		
5528	**4(8)-*p*-Menthen-3-one.**	See *Pulegone.*		
5529	***l*-Menthol**	*l*-3-*p*-menthanol; *l*-hexahydrothymol	$C_{10}H_{19}OH$	156.26
5530	——, α-methoxyisobutyrate.	See *Isobutyric acid α-methoxy-, 3-p-menthyl ester.*		
5531	**Menthonaphthene.**	See *p-Menthane.*		
5532	***l*-Menthone**	*l*-3-*p*-menthanone	$C_{10}H_{18}O$	154.25
5533	**Merchurochrome 220 soluble**	dibromohydroxymercurifluorescein disodium salt	$C_{20}H_8Br_2HgNa_2O_6 \cdot 3H_2O$	804.75
5534	**Mercury, diethyl-***	mercury diethyl; mercury ethyl	$Hg(C_2H_5)_2$	258.73
5535	**——, di-2-furyl-**	2,2′-mercuridifuran	$C_4H_3O \cdot Hg \cdot C_4H_3O$	334.74
5536	**——, diisobutyl-**		$[(CH_3)_2CHCH_2]_2Hg$	314.84
5537	**——, dimethyl-***	mercury methyl	$Hg(CH_3)_2$	230.68
5538	**——, di-1-naphthyl-***	mercury di-α-naphthyl	$Hg(C_{10}H_7)_2$	454.92
5539	**——, diphenyl-***	mercury diphenyl; mercury phenyl	$(C_6H_5)_2Hg$	354.81
5540	**——, dipropyl-***		$(CH_3CH_2CH_2)_2Hg$	286.78
5541	**——, di-*o*-tolyl-**		$(CH_3C_6H_4)_2Hg$	382.86
5542	**——, di-*p*-tolyl-**		$Hg(C_6H_4CH_3)_2$	382.86
5542M	**Mercury chloride, *n*-butyl-**	*n*-butylmercuric chloride	$n\text{-}C_4H_9HgCl$	293.18
5543	**——, ethyl-***	ethylmercuric chloride	C_2H_5HgCl	265.13
5544	**——, methyl-***		CH_3HgCl	251.10
5545	**——, phenyl-***	chloromercuribenzene	C_6H_5HgCl	313.17
5546	**——, *p*-tolyl-**	*p*-chloromercuritoluene	$CH_3C_6H_4HgCl$	327.19
5547	**Mercury mercaptide**		$Hg(SC_2H_5)_2$	322.85
5548	**Mesaconic acid**	methylfumaric acid	$HOOC(CH_3)C{:}CHCOOH$	130.10
5549	**Mescaline**	mezcaline	$C_{11}H_{17}NO_3$	211.26
5550	**Mesidine**	2,4,6-trimethylaniline	$(CH_3)_3C_6H_2NH_2$	135.20
5551	**Mesitol**	2,4,6-trimethylphenol; 2-hydroxymesitylene	$(CH_3)_3C_6H_2OH$	136.19
5552	**Mesitylene**	1,3,5-trimethylbenzene; *sym*-trimethylbenzene	$(CH_3)_3C_6H_3$	120.19
5553	**——, α-bromoisobutyryl-.**	See *Isobutyrophenone, α-bromo-2,4,6-trimethyl*-.		
5554	**——, 2,4-dihydroxy-.**	See *Mesorcinol.*		
5555	**——, 2,4-dinitro-**	1,3,5-trimethyl-2,4-dinitrobenzene	$(NO_2)_2C_6H(CH_3)_3$	210.19
5556	**——, hexahydro-.**	See *Cyclohexane,* 1,3,5-*trimethyl*-.		
5557	**——, 2-hydroxy-.**	See *Mesitol.*		
5558	**——, 2-nitro-**	1,3,5-trimethyl-2-nitrobenzene	$(CH_3)_3C_6H_2NO_2$	165.19
5559	**——, 2,4,6-tribromo-**		$Br_3C_6(CH_3)_3$	356.91

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5526							
5527							
5528							
5529	col. trim.; liq., 1.460^{22};solid, 1.497, 1.476	$0.890\frac{15}{15}$	35.5; 42.5	215	0.04 c.	v. s.	v. s. eth.; s. chl., pet. eth., glac. ac. a.
5530							
5531							
5532	col. liq.	0.896	-6.6	207	sl. s.	∞	∞ eth., CS_2+ bz.
5533	irid. grn. sc	....	....	....	s.	0.015	i. eth., chl.
5534	$1.53990^{23.2}$	2.4660^{20}	....	159; 57^{16}	i.	sl. s.	s. eth.
5535	col. cr. f. w.-acet.	....	114	156^{7}	s. h. +acet.	......	....
5536	col. liq	1.835^{15}	volat. 100	205–7	v. sl. s.	s.	s. eth.
5537	col. liq., $1.5327^{22.2}$	$2.95412\frac{22.2}{4}$	....	95	i.	s.	s. eth., lgr.
5538	leaf. f. bz	1.944	243	d.	i.	sl. s. h.	sl. s. eth.; s. chl., CS_2
5539	rhomb. need.	2.318	121.8	204^{10} >306 d.	i.	sl. s. h.	sl. s. eth.; s. bz., chl., CS_2
5540	col. mobile liq	2.124^{16}	....	189–91	i.	s.	v. s. eth.
5541	tricl. f. bz.	....	107	219^{14}	......	......	s. h. bz.
5542	col. need. f. bz.	....	235–9	d.	i.	sl. s.	i. eth.; s. CS_2, h. bz.
5542M	wh. silv. irid. leaf.	....	127	....	i.	sl. s. c.	s. eth.
5543	silv. irid. leaf.	3.5	192.5	....	i.	sl. s. c., v. s. h.	s. eth.
5544	wh. cr., disagreeable odor	4.063	170	volat. 100	......	......	....
5545	wh. satiny leaf.	....	251	....	......	sl. s. h.	sl. s. eth., bz., pyr.
5546	rhomb. silky tab.	....	233	....	i.	sl. s. h.	i. eth.; sl. s. bz., chl., acet., pyr.
5547	leaf. f. al.	....	76	d.	v. sl. s.	5.29 h.	6.7^{36} eth.
5548	col. need. f. w. or al.	1.466	202–4	250 d.	2.7^{18}, 118^{100}	24.14^{17} 90%	s. eth.; v. sl. s. bz., chl., CS_2, pet. eth.
5549	col. alk. oil.	....	....	180^{12}	s.	s.	i. eth.; s. chl., bz.
5550	liq.	0.963	<-15	233	......	......	....
5551	need.	....	69 (72)	220	v. sl. s.	v. s.	v. s. eth.
5552	rhomb., col. liq., 1.49937^{20}	0.86518^{20}	-52.7	164.716	i.	s.	s. eth.
5553							
5554							
5555	rhomb. f. al.	....	86	....	i.	s. h.	....
5556							
5557							
5558	rhomb. pr. f.al.	....	44	255	......	v. s. h.	....
5559	tricl.need.f. al.	....	224	....	i.	v. sl. s. h.	s. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5560	**Mesitylene, 2,4,6-trinitro-**		$(NO_2)_3C_6(CH_3)_3$	255.19
5561	**Mesitylene-eso-carboxylic acid.**	See *β-Isodurylic acid.*		
5562	**Mesitylenic acid**	3,5-dimethylbenzoic acid; 3,5-xylic acid; *sym-m*-xylic acid	$(CH_3)_2C_6H_3COOH$	150.17
5563	**Mesityl oxide**	4-methyl-3-penten-2-one*; isopropylideneacetone	$(CH_3)_2C:CHCOCH_3$	98.14
5564	**Mesocystine.**	See *Cystine, meso-.*		
5565	**Mesorcinol**	2,4,6-trimethylresorcinol; 2,4-dihydroxymesitylene	$(CH_3)_3C_6H(OH)_2$	152.19
5566	**Mesotartaric acid.**	See *i-Tartaric acid.*		
5567	**Mesoxalic acid**	dihydroxy- or oxopropanedioic acid*; dihydroxy- or ketomalonic acid	$(HO)_2C(COOH)_2$ or $OC(COOH)_2$	136.06 (118.05)
5568	——, diethyl ester	diethyl oxopropanedioate*; ethyl ketomalonate; ethyl mesoxalate	$CO(COOC_2H_5)_2$	174.15
5569	——, diethyl ester hydrate	diethyl dihydroxypropanedioate*; ethyl dihydroxymalonate	$(HO)_2C(COOC_2H_5)_2$	192.17
5570	**Metaacetaldehyde.**	See *Metaldehyde.*		
5572	**Metacrolein**		$(C_3H_4O)_3$	168.19
5573	**Metadiazine.**	See *Pyrimidine.*		
5574	**Metaformaldehyde.**	See *Polyoxymethylene.*		
5575	**Metaldehyde**	metaacetaldehyde	$(C_2H_4O)_{4-6}$	$(44.05)_{4-6}$
5576	**Metanilic acid**	*m*-aminobenzenesulfonic acid; *m*-anilinesulfonic acid	$NH_2C_6H_4SO_3H\cdot 1\frac{1}{2}H_2O$	200.21
5577	**Metastyrene**		$(C_8H_8)_x$	$(104.14)_x$
5578	**Metathiazole.**	See *Thiazole.*		
5579	**Methacetin.**	See *p-Acetaniside.*		
5579M	**Methacrolein.**	See *Acrolein, α-methyl-.*		
5580	**Methacrylic acid**	2-methylpropenoic acid*; *α*-methylacrylic acid	$CH_2:C(CH_3)COOH$	86.09
5580D	——, butyl ester	*n*-butyl methacrylate	$CH_2:C(CH_3)COOC_4H_9$	142.19
5580G	——, ethyl ester	ethyl methacrylate	$CH_2:C(CH_3)COOC_2H_5$	114.14
5580K	——, isobutyl ester	isobutyl methacrylate	$CH_2:C(CH_3)COOCH_2CH(CH_3)_2$	142.19
5580N	——, isopropyl ester	isopropyl methacrylate	$CH_2:C(CH_3)COOCH(CH_3)_2$	128.17
5580R	——, methyl ester	methyl methacrylate	$CH_2:C(CH_3)COOCH_3$	100.11
5580U	——, propyl ester	propyl methacrylate	$CH_2:C(CH_3)COOC_3H_7$	128.17
5581	**Methanal*.**	See *Formaldehyde.*		
5582	**Methanamide*.**	See *Formamide.*		
5583	**Methanamidine, amino-*.**	See *Guanidine.*		
5584	**Methane***	marsh gas; methyl hydride	CH_4	16.04
5585	**——, acetylbenzoyl-.**	See *Acetone, benzoyl-.*		
5586	**——, amino-.**	See *Methylamine*.*		
5587	**——, 4-amino-4′,4″-bisdimethylaminotriphenyl-.**	See *p_3-Leucaniline.*		
5588	**——, aminodiphenyl-.**	See *Aniline, benzyl-.*		
5589	**——, α-aminodiphenyl-.**	See *Benzohydrylamine.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5560	tricl.need. f.al.	....	230–2	exp. 415	......	i. c., sl. s. h.	sl. s. h.eth., acet.
5561							
5562	monocl. f. al...	....	166	subl.	v. sl. s.	v. s.	v. s. eth.
5563	col. oily liq., 1.446^{16}	0.8539^{20}_{4}	–59	128.7 (131.4)	3.0	∞	∞ eth.
5564							
5565	leaf..........	....	150	275.5	sl. s. c.	v. s.	v. s. eth.
5566							
5567	col. deliq. need.	....	121 sl. d.	....	v. s.	s.	s. eth.
5568	lt. yel.-grn. oil, $1.41865^{15.6}$	1.119^{20}_{20}	*ca.*–30	*ca.* 220; 115^{29}	......	s.	s. eth.
5569	col. pl. f. bz...	....	57	*ca.* 200	i.	......	....
5570							
5572	need.........	....	46	170	v. sl. s. h.	s.	s. eth.
5573							
5574							
5575	col. tetr. need. or pr. f. al., 1.530, 1.430	....	246.2 (sealed tube)	subl. 112–5	i.	1.8^{70}	0.535 eth.
5576	need (anh.); tricl. pr.	....	d.	....	0.67^{20}	$2.92^{12.5}$	v. sl. s. eth.
5577	vitreous......	1.054^{13}	d.	....	i.	i.	v. sl. s. eth.
5578							
5579							
5579M							
5580	col. pr., 1.43143	1.015^{20}_{4}	16	163	s.	∞	∞ eth.
5580 D	col. liq., $1.426^{15.6}$	0.895^{20}_{4}	....	163	i.	∞	∞ eth.
5580G	col. liq., 1.414^{20}	0.907^{20}_{4}	....	117	v. sl. s.	∞	∞ eth.
5580 K	col. liq., 1.418^{24}	$0.889^{15.6}_{15.6}$	....	155	i.	∞	∞ eth.
5580 N	col. liq., 1.412^{24}	0.890^{20}_{4}	....	127	i.	∞	∞ eth
5580R	col. liq., 1.413^{20}	0.936^{20}_{4}	*ca.*–50	100	v. sl. s.	∞	∞ eth.
5580U	col. liq., $1.420^{15.6}$	$0.902^{15.6}_{15.6}$	....	141	i.	∞	∞ eth.
5581							
5582							
5583							
5584	col. gas.......	0.415^{-164}; 0.7168^{0} g/1	–184	–161.5	9^{20} cm³	60 cm³	91^{20} cm³ eth.
5585							
5586							
5587	*N,N,N′,N′, tetra*	*methyl-.*					
5588							
5589							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5590	**Methane, aminotriphenyl-.**	See *Aniline, benzohydryl-.*		
5591	**——, amyldimethyl-.**	See *Heptane, 2-methyl-*.*		
5592	**——, amylethylmethyl-.**	See *Octane, 3-methyl-*.*		
5593	**——, benzoyltriphenyl-.**	See *β-Benzopinacolin.*		
5594	**——, benzyltriphenyl-.**	See *Ethane, 1,1,1,2-tetraphenyl-.*		
5595	**——, 4,4′-bisdimethylaminotriphenyl-.**	See *Aniline, p,p′-benzylidenebis-N,*		
5596	**——, bis(2,4-dinitrophenyl)-**	2,2′4,4′-tetranitroditan......	$[(NO_2)_2C_6H_3]_2CH_2$	348.23
5597	**——, bromo-*.**	See *Methyl bromide.*		
5598	**——, bromotrichloro-***	....	$CBrCl_3$..........	198.30
5599	**——, butylethylmethyl.**	See *Heptane, 3-methyl-*.*		
5600	**——, *sec*-butylethylmethyl-.**	See *Hexane, 3,4-dimethyl-*.*		
5601	**——, *tert*-butyltrimethyl-.**	See *Butane, 2,2,3,3-tetramethyl-*.*		
5602	**——, isobutyltrimethyl-.**	See *Pentane, 2,2,4-trimethyl-*.*		
5603	**——, chloro-*.**	See *Methyl chloride.*		
5604	**——, chloro(chloromethoxy)-*.**	See *Ether, bischloromethyl.*		
5604M	**——, chlorodifluoro-***	....	$CHClF_2$..........	86.48
5605	**——, chloroethylmethyl-.**	See *sec-Butyl chloride.*		
5606	**——, chloromethoxy-*.**	See *Ether, chloromethyl methyl.*		
5606M	**——, chlorotrifluoro-***	....	$CClF_3$............	104.47
5607	**——, chlorotrimethyl-.**	See *tert-Butyl chloride.*		
5608	**——, chlorotriphenyl-**	....	$(C_6H_5)_3CCl$.......	278.77
5609	**——, cyclohexyl-.**	See *Cyclohexane, methyl-.*		
5610	**——, 4,4′-diaminodiphenyl-.**	See *Aniline, p,p′-methylenedi-.*		
5611	**——, *p,p′*-diaminotriphenyl-**	*p,p′*-benzaldianiline; 4,4′-diaminotritan	$C_6H_5CH(C_6H_4NH_2)_2$	274.35
5613	**——, diazo-*..........**	azimethylene...............	CH_2N_2..........	42.04
5614	**——, dibenzoyl-.......**	1,3-diphenyl-1,3-propanedione	$(C_6H_5CO)_2CH_2$....	224.25
5615	**——, dibromo-*.**	See *Methylene bromide.*		
5616	**——, dichloro-*.**	See *Methylene chloride.*		
5617	**——, dichlorodifluoro-***	difluorodichloromethane*....	CCl_2F_2...........	120.92
5618	**——, dichlorodimethyl-.**	See *Propane, 2,2-dichloro-*.*		
5619	**——, dichlorofluoro-***	....	$CHCl_2F$..........	102.93
5620	**——, diethoxy-........**	formaldehyde diethylacetal; methylene diethyl ether; diethyl formal; ethylal	$CH_2(OC_2H_5)_2$.....	104.15
5621	**——, diethyldimethyl-.**	See *Pentane, 3,3-dimethyl-*.*		
5622	**——, diethylisopropyl-.**	See *Pentane, 3-ethyl-2-methyl-*.*		
5623	**——, diethylmethyl-.**	See *Pentane, 3-methyl-*.*		
5624	**——, diethylpropyl-.**	See *Hexane, 3-ethyl-*.*		
5624M	**——, difluoro-*.**	See *Methylene fluoride.*		
5625	**——, 4,4′-dihydroxydiphenyl-**	*p,p′*-methylenediphenol......	$HOC_6H_4CH_2C_6H_4OH$	200.23
5626	**——, diisobutyl-.**	See *Heptane, 2,6-dimethyl-*.*		
5627	**——, diisopropyl-.**	See *Pentane, 2,4-dimethyl-*.*		
5628	**——, dimethoxy-*.....**	formaldehyde dimethylacetal; methylene dimethyl ether; formal; methylal	$CH_2(OCH_3)_2$......	76.09
5629	**——, dimethyl-.**	See *Propane*.*		
5630	**——, dimethylene.**	See *Propadiene.**		
5631	**——, dimethylpropyl-.**	See *Pentane, 2-methyl-*.*		
5632	**——, di-1-naphthyl-...**	....	$(C_{10}H_7)_2CH_2$.....	268.34
5633	**——, di-2-naphthyl-...**	....	$(C_{10}H_7)_2CH_2$.....	268.34
5634	**——, dinitro-*........**	....	$CH_2(NO_2)_2$.......	106.04

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5590							
5591							
5592							
5593							
5594							
5595	*N-dimethyl-.*						
5596	yel. pr. f. glac. ac. a.	....	172	....	......	i.	i. eth.; s. alk.; sl. s. bz.
5597							
5598	col. liq., 1.5300	1.959^{15}	–21	104.07	i.	∞	∞ eth.
5599							
5600							
5601							
5602							
5603							
5604							
5604M	col. gas.......	3.87^{0}	–146	–40.8	i.	......	....
5605							
5606							
5606M	col. gas.......	....	–181	–80	......	......	....
5607							
5608	col. need......	....	112 (106–9)	310	i., d.	sl. s.	sl. s. eth.; v. s. CS_2, bz.
5609							
5610							
5611	col. cr. f. eth..	....	139 (136–7)	....	v. sl. s.	v. s.	v. s. eth.; s. chl., lgr.
5613	yel. pois. gas at ord. temp.	....	–145	–23; exp. 200	d.	s.	s. eth.
5614	rhomb........	....	72–3; 78	$219–21^{18}$	v. sl. s.	$4.43^{19.5}$	v. s. eth.; s. chl.
5615							
5616							
5617	col. gas.......	1.486^{-30}	–160	–28	i.	s.	s. eth.
5618							
5619	col. liq. or gas.	1.421^{0}	–127	8.9	i.	s.	s. eth.
5620	....	0.83465^{15}	–66.5	89	9.1^{18}	......	....
5621							
5622							
5623							
5624							
5624M							
5625	leaf. or need. f. h. w.	....	158	subl.	......	s.	s. eth., alk., chl.; i. CS_2
5626							
5627							
5628	col. liq., 1.35344	0.8560	–104.8	44	v. s.	∞	∞ eth.
5629							
5630							
5631							
5632	sm. pr. f. al...	....	109 (107–8)	270^{14}; dist. >360	0.83, 6.67^{78}	......	s. eth., chl., bz.
5633	need. f. al. or eth.	....	93	....	i.	v. s.	s. bz.
5634	yel. unst. oil...	....	liq. at–15	100 exp.	s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5635	**Methane, diphenyl-**	benzylbenzene; ditan	$(C_6H_5)_2CH_2$	168.23
5636	——, ——, *o*-carboxylic acid.	See *Benzoic acid, o-benzyl-.*		
5637	**——, diphenylene-.**	See *Fluorene.*		
5638	**——, diphenyl-*m*-tolyl-**	3-methyltritan	$CH_3C_6H_4CH(C_6H_5)_2$	258.35
5639	**——, diphenyl-*p*-tolyl-**	4-methyltritan	$CH_3C_6H_4CH(C_6H_5)_2$	258.35
5640	**——, dipropoxy-***	formaldehyde dipropyl acetal; methylene dipropyl ether	$CH_2(OC_3H_7)_2$	132.20
5641	**——, ethyldimethyl-.**	See *Butane, 2-methyl-*.*		
5642	**——, *p*-ethyldiphenyl-.**	See *Benzene, 1-benzyl-4-ethyl-.*		
5643	**——, ethyldipropyl-.**	See *Heptane, 4-ethyl-*.*		
5644	**——, ethylisobutyl-.**	See *Hexane, 2-methyl-*.*		
5645	**——, ethylisobutylmethyl-.**	See *Hexane, 2,4-dimethyl-*.*		
5646	**——, ethylisopropylmethyl-.**	See *Pentane, 2,3-dimethyl-*.*		
5647	**——, ethylmethylpropyl-.**	See *Hexane, 3-methyl-*.*		
5648	**——, ethyltrimethyl-.**	See *Butane, 2,2-dimethyl-*.*		
5649	**——, fluoro-*.**	See *Methyl fluoride.*		
5650	**——, *p*-hydroxydiphenyl-.**	See *Phenol, p-benzyl-.*		
5651	**——, iodo-*.**	See *Methyl iodide.*		
5652	**——, isopropyldimethyl-.**	See *Butane, 2,3-dimethyl-*.*		
5653	**——, isopropylmethylpropyl-.**	See *Hexane, 2,3-dimethyl-*.*		
5654	**——, isopropyltrimethyl-.**	See *Butane, 2,2,3-trimethyl-*.*		
5655	**——, methoxy-*.**	See *Methyl ether.*		
5656	**——, methyldipropyl-.**	See *Heptane, 4-methyl-*.*		
5657	**——, methyldithio-*.**	See *Methyl disulfide.*		
5657H	**——, methylsulfinyl-*.**	See *Methyl sulfoxide.*		
5657R	**——, methylsulfonyl-*.**	See *Methyl sulfone.*		
5658	**——, methylthio-*.**	See *Methyl sulfide.*		
5659	**——, 1-naphthylphenyl-**	1-benzylnaphthalene	$C_{10}H_7CH_2C_6H_5$	218.28
5660	**——, 2-naphthylphenyl-**	2-benzylnaphthalene	$C_{10}H_7CH_2C_6H_5$	218.28
5661	**——, nitro-***		CH_3NO_2	61.04
5662	**——, oxo-.**	See *Formaldehyde.*		
5663	**——, α-oxodiphenyl-.**	See *Benzophenone.*		
5664	**——, phenyl-.**	See *Toluene.*		
5665	**——, phenyldi-*p*-tolyl-**	4,4′-dimethyltritan	$C_6H_5CH(C_6H_4CH_3)_2$	272.37
5666	**——, phenyl-*m*-tolyl-**	*m*-benzyltoluene	$C_6H_5CH_2C_6H_4CH_3$	182.25
5667	**——, phenyl-*p*-tolyl-**	*p*-benzyltoluene	$C_6H_5CH_2C_6H_4CH_3$	182.25
5668	**——, tetrabromo-*.**	See *Carbon tetrabromide.*		
5669	**——, tetrachloro-*.**	See *Carbon tetrachloride.*		
5670	**——, tetraethoxy-*.**	See *Orthocarbonic acid, tetraethyl ester.*		
5670M	**——, tetrafluoro-*.**	See *Carbon tetrafluoride.*		
5671	**——, tetraiodo-*.**	See *Carbon tetraiodide.*		
5672	**——, tetramethyl-.**	See *Propane, 2,2-dimethyl-*.*		
5673	**——, *p,p*′-tetramethyldiaminodiphenyl-.**	See *Aniline, p,p′-methylenebis [N,N-*		
5674	**——, *p*-tetramethyldiaminotriphenyl-.**	See *Aniline, p,p′-benzylidenebis-N,N-*		
5675	**——, tetranitro-***		$C(NO_2)_4$	196.04
5676	**——, tetraphenyl-**		$(C_6H_5)_4C$	320.41
5677	**——, tetrapropoxy-.**	See *Orthocarbonic acid, tetrapropyl ester.*		
5678	**——, triaminotriphenyl-.**	See *Leucaniline.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5635	col. rhomb. need., 1.57884^{17}	1.0008^{26}_{4}	26–7	261–2 (264.7)	i.	s.	s. eth., chl.
5636							
5637							
5638	pr. f. al.	1.07^{16}	62	354^{706}	......	sl. s.	v. s. eth.; s. bz., chl., ac. a., lgr.
5639	pr. f. me. al.	....	71	360	i.	s.	v. s. eth., bz., ac. a.; s. lgr.
5640	....	0.835^{20}_{4}	....	137–40	......	......	....
5641							
5642							
5643							
5644							
5645							
5646							
5647							
5648							
5649							
5650							
5651							
5652							
5653							
5654							
5655							
5656							
5657							
5657H							
5657R							
5658							
5659	monocl. leaf. f. al.	1.165^{0}	59	350	......	1.26^{16} 2.62^{78}	35.7 c. eth.; s. bz., CS_2, chl.
5660	monocl. pr. f. al.	1.176	35.5	350	i.	2.3^{15}	v. s. bz.
5661	col. liq., 1.3818^{20}	1.130^{20}_{4}	frz. −29	101	9–10 cc.	s.	s. eth., alk.
5662							
5663							
5664							
5665	need. f. me. al.	....	56	....	.....	s.	v. s. eth., CS_2, bz., chl.
5666	liq.	$0.997^{17.5}$	....	275^{747}	.....	s.	s. eth.
5667	liq.	$0.995^{17.5}$	−30	285–6 (279–80)	......	s.	s. eth.; v.s. chl
5668							
5669							
5670							
5670M							
5671							
5672							
5673	*dimethyl-.*						
5674	*dimethyl-.*						
5675	col. liq., $1.43976^{16.9}_{He}$	1.650^{13}	13	125.7	i.	s.	s. eth.
5676	col. rhomb. f. bz.	....	285	431	i.	i.	i. eth., lgr., ac. a.; s. h. bz.
5677							
5678							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5679	**Methane, tribenzoyl-**		$(C_6H_5CO)_3CH$	328.35
5680	**——, tribromo-*.**	See *Bromoform.*		
5681	**——, tribromonitro-*.**	See *Bromopicrin.*		
5682	**——, trichloro-*.**	See *Chloroform.*		
5683	**——, trichlorofluoro-***		CCl_3F	137.38
5684	**——, trichloronitro-*.**	See *Chloropicrin.*		
5685	**——, triethoxy-*.**	See *Orthoformic acid, triethyl ester.*		
5686	**——, triethyl-.**	See *Pentane, 3-ethyl-*.*		
5687	**——, triethylmethyl-.**	See *Pentane, 3-ethyl-3-methyl-**.		
5688	**——, trifluoro-*.**	See *Fluoroform.*		
5689	**——, triiodo-*.**	See *Iodoform.*		
5690	**——, triisopropoxy-.**	See *Orthoformic acid, triisopropyl ester.*		
5691	**——, trimethoxy-.**	See *Orthoformic acid, trimethyl ester.*		
5692	**——, trimethyl-.**	See *Isobutane.*		
5693	**——, trimethylpropyl-.**	See *Pentane, 2,2-dimethyl-*.*		
5694	**——, trinitro-*.**	See *Nitroform.*		
5695	**——, p_3-trinitrotriphenyl-.**	See *Methane, tris(p-nitrophenyl)-.*		
5696	**——, triphenoxy-.**	See *Orthoformic acid, triphenyl ester.*		
5697	**——, triphenyl-**		$(C_6H_5)_3CH$	244.32
5698	——, ——, *o*-carboxylic acid.	See *Benzoic acid, o-benzohydryl-.*		
5699	**——, tripropoxy-.**	See *Orthoformic acid, tripropyl ester.*		
5699H	**——, tris(hydroxymethyl)amino-.**	See 1,3-*Propanediol, 2-amino-2-hydroxy-*		
5699M	**——, tris(hydroxymethyl)nitro-.**	See 1,3-*Propanediol, 2-hydroxymethyl-2-nitro-*.*		
5700	**——, tris(*p*-nitrophenyl)-**	p_3-trinitrotriphenylmethane	$(NO_2C_6H_4)_3CH$	379.32
5701	**Methanearsonic acid**	methylarsinic acid	$CH_3AsO(OH)_2$	139.96
5702	**Methaneazobenzene.**	See *Benzeneazomethane.*		
5703	**Methanecarbothiolic acid.**	See *Acetic acid, thiol-.*		
5704	**Methanedicarboxylic acid.**	See *Malonic acid.*		
5705	**Methanediol***, esters.	See "methylene diester" under the different acids.		
5706	**——, 2-furyl-**, diacetate.	See *Furfural, diacetate.*		
5707	**Methanedisulfonic acid*.**	See *Methionic acid.*		
5708	**Methane oxide, diphenyl-.**	See *Xanthene.*		
5709	**Methanephosphonic acid**	methylphosphinic acid	$CH_3PO(OH)_2$	96.03
5710	**Methanesiliconic acid**	silicoacetic acid	CH_3SiOOH	76.10
5711	**Methanestannonic acid**	methylstannonic acid; methylstannic acid	CH_3SnOOH	166.74
5712	**Methanesulfonic acid***	methylsulfonic acid	CH_3SO_3H	96.10
5713	**Methanesulfonyl chloride***		CH_3SO_2Cl	114.55
5714	**Methanethial*.**	See *Formaldehyde, thio-.*		
5715	**Methanethiol***	methyl mercaptan	CH_3SH	48.10
5716	**——, 2-furyl-.**	See *Furfuryl mercaptan.*		
5717	**Methanethiolic acid, amino-***, ethyl ester.	See *Carbamic acid, thiol-, ethyl ester.*		
5718	**Methanoic acid*.**	See *Formic acid.*		
5719	**Methanol***	methyl alcohol; carbinol; wood alcohol	CH_3OH	32.04
5720	**Methenamine.**	See *Hexamethylenetetramine.*		
5721	**Methenyl amidoxime.**	See *Formamide, oxime.*		
5722	**Methionic acid**	methanedisulfonic acid*; methylenedisulfonic acid	$CH_2(SO_3H)_2$	176.16

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5679	need. f. al.	....	224–5	subl.	......	v. sl. s.	v. sl. s. eth.; sl. s.acet.; s. CS_2
5680							
5681							
5682							
5683	col. liq	$1.494^{17.2}$	−111	24.1	i.	s.	s. eth.
5684							
5685							
5686							
5687							
5688							
5689							
5690							
5691							
5692							
5693							
5694							
5695							
5696							
5697	col. rhomb. leaf., 1.5839^{99}	$1.014\frac{99}{4}$	92.5	359.2	......	sl. s. c., v. s. h.	v. s. eth.; s. bz., chl.
5698							
5699							
5699H	*methyl-.*						
5699M							
5700	sc. f. bz	....	212.5 (207)	....	......	.....	v. sl. s. eth., bz., glac. ac. a.
5701	monocl. leaf. f. al.	....	161	....	s.	s.	....
5702							
5703							
5704							
5705							
5706							
5707							
5708							
5709	....	....	105	....	......	......	....
5710	amor. powd	....	....	....	i.	......	s. eth., conc. KOH
5711	wh. amor. powd.	....	infus.	....	i.	......	s. a., alk.; i. org. solv.
5712	col. liq	1.481	....	167^{10} d.	v. s.	s.	v. s. eth.
5713	liq	1.51	....	160	i.	s.	s. eth.
5714							
5715	liq. or gas	$0.868\frac{20}{4}$; $0.8599\frac{25}{4}$	−123.1 (−121)	7.6; 5.8^{752}	sl. s., d.	v. s.	v. s. eth.
5716							
5717							
5718							
5719	col. liq., $1.33118^{14.50}$	0.79609^{15}; $0.7928\frac{20}{4}$ $(0.7917\frac{20}{4})$	−97.8	64.65	∞	∞	∞ eth.
5720							
5721							
5722	hyg. need	....	....	....	s.	s.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5723	**DL-Methionine**	*dl*-α-amino-γ-methylmercaptobutyric acid; *dl*-2-amino-4-methylthiobutanoic acid*	$CH_3SCH_2CH_2CH(NH_2)COOH$	149.21
5724	**L-Methionine**		$CH_3SCH_2CH_2CH(NH_2)COOH$	149.21
5725	**Methoxyamine***	α-methylhydroxylamine	CH_3ONH_2	47.06
	Methyl. For methyl derivatives see the parent compounds (e.g., for methylarsine see			
5726	——, **triphenyl-**	trityl	$(C_6H_5)_3C-$	243.31
5727	**Methylal.**	See *Methane, dimethoxy-**.		
5728	**Methyl alcohol.**	See *Methanol**.		
5729	**Methylamine**	aminomethane	CH_3NH_2	31.06
5730	——, hydrochloride		$CH_3NH_2 \cdot HCl$	67.52
5731	——, ***tert*-butyl-.**	See *Propylamine, β, β-dimethyl-**.		
5732	——, **naphthyl-.**	See *Naphthylamine, N-methyl-*.		
5733	**Methyl borate**	trimethyl borate; trimethoxyboron	$B(OCH_3)_3$	103.92
5734	**Methyl bromide**	bromomethane*	CH_3Br	94.95
5735	——, ***tert*-butyl-.**	See *Propane, 1-bromo-2,2-dimethyl-**.		
5736	**Methyl carbitol.**	See *Diethylene glycol, monomethyl ether.*		
5737	**Methyl cellosolve.**	See *Ethanol, 2-methoxy-**.		
5738	**Methyl chloride**	chloromethane*	CH_3Cl	50.49
5739	**Methyl cyanide.**	See *Acetonitrile.*		
5740	——, **allyl-.**	See 4-*Pentenenitrile**.		
5741	**Methyl disulfide**	methyldithiomethane*; dimethyl disulfide	CH_3SSCH_3	94.19
5742	**Methylene blue**	3,9-bisdimethylaminophenazothionium chloride	$C_{16}H_{18}N_3SCl$	319.85
5743	**Methylene bromide**	dibromomethane*	CH_2Br_2	173.86
5744	**Methylene chloride**	dichloromethane*	CH_2Cl_2	84.94
5745	**Methylene cyanide.**	See *Malononitrile.*		
5746	**Methylenedisulfonic acid.**	See *Methionic acid.*		
	Methylene esters.	See "methylene diester" under the different acids.		
5746M	**Methylene fluoride**	difluoromethane*	CH_2F_2	52.03
5747	**Methylene iodide**	diiodomethane*	CH_2I_2	267.87
5748	**Methylenimine, bis(*p*-dimethylaminophenyl)-.**	See *Auramine (base).*		
5749	**Methyl ether**	methoxymethane*; dimethyl ether	$(CH_3)_2O$	46.07
5750	**Methyl fluoride**	fluoromethane*	CH_3F	34.03
5751	**Methyl hydride.**	See *Methane**.		
5752	**Methyl iodide**	iodomethane*	CH_3I	141.95
5753	——, ***tert*-butyl-.**	See *Propane, 1-iodo-2,2-dimethyl-**.		
5754	**Methyl isocyanide**	methylcarbylamine; methyl isonitrile	CH_3NC	41.05
5755	**Methyl mercaptan.**	See *Methanethiol**.		
5756	——, **perchloro-**	thiocarbonyl tetrachloride; trichloromethylsulfur chloride	CCl_3SCl	185.90
5757	**Methyl mustard oil.**	See *Isothiocyanic acid, methyl ester.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5723	....	....	281	....	3.38^{25}, 10.52^{75}	......	....
5724	hex. pl........	....	283 d.	....	s. c.	......	i. eth.
5725	cr.............	....	....	49–50	......	......	....
	Arsine, methyl–). For methyl esters of organic acids see the acids.						
5726	col.-yel. trans. cr.	....	145–7	d.	i.	v. sl. s.	sl. s. eth.; v. s. chl., CS_2
5727							
5728							
5729	col. gas, $1.432^{17.5}$	$0.7691\frac{-70}{4}$	−92.5	−6.5	1153.9 ml $^{12.50}$	s.	∞ eth.
5730	deliq. leaf. f. al.	....	226	230^{15}	v. s.	23^{78}	i. eth.
5731							
5732							
5733	col. liq.......	0.915	....	65	d.	∞	∞ eth.
5734	col. liq. or gas.	$1.732\frac{0}{0}$	−93.66	3.56	0.09	v. s.	v. s. eth.; s. chl., CS_2, bz.
5735		3.974^{25} g/l					
5736							
5737							
5738	col. gas.......	0.991^{-25}; 2.31^{0} g/1	−97.7	−24.22	400 cm³	3500 cm³	s. eth., chl., ac. a.
5739							
5740							
5741	liq...........	$1.057\frac{16}{4}$	....	116–8	i.	∞	∞ eth.
5742	grn. cr. powd.	....	....	....	s.	s.	....
5743	col. liq.......	$2.4953\frac{20}{4}$	−52.8	98.2	1.15^{20}	∞	∞ eth.
5744	col. liq., 1.4237	1.336	−96.7	40.1	2^{20}	∞	∞ eth.
5745							
5746							
5746M	col. gas.......	....	....	−51.6	i.	s.	....
5747	col. liq., leaf. at O°C, $1.7559^{10.5}$	3.325	5–6	180 d.	1.42^{20}	∞	s. eth.
5748							
5749	col. gas.......	2.091 g/1	−138.5	−23.65	3700^{18} cm³	s.	s. eth.
5750	col. gas.......	$0.8774\frac{-78,6}{4}$	−141.8	−78.6	166^{15} cm³	v. s.	v. s. eth.
5751							
5752	col.-br. liq., $1.5293^{21.0}$	2.279	−66.1	42.5	1.4^{20}	∞	∞ eth.
5753							
5754	col. liq.......	0.756^{4}; $0.7464\frac{20}{4}$	−45	59.6	10^{15}	s.	∞ eth.
5755							
5756	yel. liq.......	1.700	....	149 sl. d.	i.	......	....
5757							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5758	**Methyl nitrate**		CH_3NO_3	77.04
5759	**Methyl nitrite**		CH_3ONO	61.04
5760	**Methyloglycolic acid.**	See *Acetic acid, methoxy-*.		
5761	**Methyl orange**	*p*-(*p*-dimethylaminophenylazo)benzenesulfonic acid, sodium salt	$(CH_3)_2NC_6H_4$-$N{:}NC_6H_4SO_3Na$	327.33
5762	**Methyl phosphate**	trimethyl phosphate	$(CH_3)_3PO_4$	140.08
5763	**Methyl selenide**	dimethyl selenide	$(CH_3)_2Se$	109.03
5764	**Methyl sulfate**	dimethyl sulfate	$(CH_3)_2SO_4$	126.13
5765	**——, acid.**	See *Methylsulfuric acid.*		
5766	**Methyl sulfide**	methylthiomethane*; dimethyl sulfide	$(CH_3)_2S$	62.13
5767	**Methyl sulfite**	dimethyl sulfite	$(CH_3)_2SO_3$	110.13
5767M	**Methyl sulfone**	methylsulfonylmethane*; dimethyl sulfone	$CH_3SO_2CH_3$	94.13
5768	**Methylsulfonic acid.**	See *Methanesulfonic acid**.		
5768M	**Methyl sulfoxide**	methylsulfinylmethane*; dimethyl sulfoxide	CH_3SOCH_3	78.13
5769	**Methylsulfuric acid**	hydrogen methyl sulfate; acid methyl sulfate	CH_3HSO_4	112.10
5770	**Methyl telluride**	dimethyl telluride	$(CH_3)_2Te$	157.68
5771	**Metol.**	See *Phenol, p-methylamino-, sulfate.*		
5772	**Mezcaline.**	See *Mescaline.*		
5773	**Miazine.**	See *Pyrimidine.*		
5774	**Michler's hydrol.**	See *Benzohydrol, p,p′-bisdimethylamino-.*		
5775	**Michler's ketone.**	See *Benzophenone, p,p′-bisdimethylamino-.*		
5776	**Milk sugar.**	See *Lactose.*		
5777	**Monoacetin.**	See *Glycerol, monoacetate.*		
5778	**α-Monolaurin.**	See *Glycerol, 1-monolaurate.*		
5778M	**Monoölein.**	See *Glycerol, 1-monoöleate.*		
5779	**α-Monopalmitin.**	See *Glycerol, 1-monopalmitate.*		
5780	**Monosilane.**	See *Silicane.*		
5781	**α-Monostearin.**	See *Glycerol, 1-monostearate.*		
5782	**Morin**	3,5,7,2′,4′-pentahydroxyflavone	$C_{15}H_{10}O_7$	302.23
5783	**Moringatannic acid, Moringatannin.**	See *Maclurin.*		
5784	**Morphine**		$C_{17}H_{19}NO_3{\cdot}H_2O$	303.35
5785	——, acetate (*l*)		$C_{17}H_{19}NO_3{\cdot}C_2H_4O_2{\cdot}3H_2O$	399.43
5786	——, hydrochloride		$C_{17}H_{19}NO_3{\cdot}HCl{\cdot}3H_2O$	375.85
5787	——, methyl ether.	See *Codeine.*		
5789	——, sulfate		$(C_{17}H_{19}NO_3)_2$-$H_2SO_4{\cdot}5H_2O$	758.82
5790	——, **diacetyl-**	heroin	$C_{17}H_{17}(OOCCH_3)_2$-NO	369.40

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5758	liq.	1.217^{15}; $1.206\frac{20}{4}$	. . . .	65 exp.	sl. s.	s.	s. eth.
5759	gas.	0.991^{15}	−17.0	−12	. . . .	s.	s. eth.
5760							
5761	or. yel. powd. .	. . . .	. . . .	. . . .	v. s.	s.	i. eth.
5762	liq.	1.220^{15}	. . . .	193	100^{25}	s.	s. eth.
5763	liq.	$1.4077\frac{14.6}{4}$	. . . .	58.2	i.	v. s.	v. s. eth.
5764	col. liq., 1.3874^{20}	$1.3322\frac{20}{4}$	−31.8; frz. −27	188; 76^{15}	v. sl. s.	∞	s. eth., bz.
5765							
5766	col. liq.	$0.8458\frac{21}{4}$	−83.2	37.5–38	i.	s.	s. eth.
5767	col. liq.	$1.242\frac{0}{0}$	. . . .	126 (122)	s. d.	s.	s. eth.
5767M	pr., 1.4226. . . .	. . . .	109	238	s.	s.	s. bz.
5768							
5768M	oil or thick syrup	. . . .	6	d. 100	s.	s.	s. eth.
5769	oil.	. . . .	<−30	d.	v. s.	s.	∞ eth.
5770	ylsh. liq.	. . . .	. . . .	82	i.	v. s.	v. s. eth.
5771							
5772							
5773							
5774							
5775							
5776							
5777							
5778							
5778M							
5779							
5780							
5781							
5782	col. need.	. . . .	(anh.) 285	. . . .	0.025	s.	sl. s. eth.; s. ac a., alk.
5783							
5784	col. rhomb. pr., fine need. or cr. powd., 1.580, 1.625, 1.645; [α] $-130.9^{\circ 23}_{D}$	1.317	anh. 254 d.	191–3 vac.	0.03	0.39	0.02 eth.; s. chl.
5785	cr. or amor. powd.	. . . .	200 d.	. . . .	44.4	4.63	i. eth.; s. chl.
5786	silky need. f. w., [α] $-111.5^{\circ 25}_{D}$	. . . .	250 d.	. . . .	5.72	2.38	i. eth., chl.; s. glyc.
5787							
5789	wh. need., cubic f. w.	. . . .	d. 250	. . . .	6. 66	0.22	i. eth., chl.
5790	wh. cr. powd., 1.560, 1.600, 1.610	. . . .	171–2	. . . .	0.058	4.0	1.4 eth.; s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5791	**Morphine, diacetyl-,** hydrochloride		$C_{21}H_{23}NO_5 \cdot HCl \cdot H_2O$	423.89
5792	——, **ethyl-**, hydrochloride	dionin	$C_{19}H_{23}NO_3 \cdot HCl \cdot 2H_2O$	385.88
5793	**Morphol**	3,4-phenanthrenediol	$C_{14}H_8(OH)_2$	210.22
5794	——, dimethyl ether.	See *Phenanthrene*, 3,4-*dimethoxy-**.		
5795	**Morpholine**	tetrahydro-1,4-oxazine; diethylenimide oxide	$OCH_2CH_2NH-CH_2CH_2$	87.12
5796	——, **4-(β-ethoxyethyl)-**	ethyl β-4-morpholylethyl ether	$O(CH_2CH_2)_2-NCH_2CH_2OC_2H_5$	159.23
5797	**4-Morpholineëthanol**	diethylene oxide 2-iminoethyl alcohol	$O(CH_2CH_2)_2-NCH_2CH_2OH$	131.17
5798	**Moss starch**	See *Lichenin.*		
5799	**Mucic acid**	2,3,4,5-tetrahydroxyhexanedioic acid* (one form)	$COOH(CHOH)_4-COOH$	210.14
5800	——, *p*-phenylphenacyl ester		$C_{34}H_{30}O_{10}$	598.58
5801	**Muconic acid**	2,4-hexadienedioic acid*	$HOOCCH{:}CH-CH{:}CHCOOH$	142.11
5802	**Murexan.**	See *Uramil.*		
5803	**Murexide**	ammonium purpurate	$C_8H_4O_6N_5NH_4 \cdot H_2O$	302.21
5804	**Musk, artificial.**	See *Toluene*, 3-*tert-butyl*-2,4,6-*trinitro-*.		
5805	**Musk C, Musk ketone.**	See *Acetophenone*, 4-*tert-butyl*-2-*methyl*-3,6-*dinitro-*.		
5806	**Musk xylene.**	See *Benzene*, 1-*tert-butyl*-3,5-*dimethyl*-2,4,6-*trinitro-*.		
5807	**Mustard gas.**	See *Sulfide, β,β′-dichloroethyl.*		
5808	**Mustard oil acetic acid.**	See *Acetic acid, isothiocyano-*.		
5809	**Mustard oils.**	See the different esters under *Isothiocyanic acid.*		
5810	**Myrcene**	2-methyl-6-methylene-2,7-octadiene*	$(CH_3)_2C{:}CHCH_2-CH_2C({:}CH_2)-CH{:}CH_2$	136.23
5810M	——, **dihydro-.**	See 2,6-*Octadiene*, 2,6-*dimethyl-*.		
5811	**Myricyl alcohol**	melissyl alcohol	$C_{30}H_{61}OH$	438.79
5812	——, palmitate.	See *Palmitic acid, myricyl ester*.		
5813	**Myristaldehyde**, oxime	tetradecanal oxime*; myristinaldoxime	$C_{13}H_{27}CH{:}NOH$	227.38
5814	**Myristamide**	tetradecanamide*; myristic amide	$CH_3(CH_2)_{12}-CONH_2$	227.38
5815	**Myristic acid**	tetradecanoic acid*	$CH_3(CH_2)_{12}COOH$	228.37
5816	——, benzyl ester		$C_{13}H_{27}COOCH_2-C_6H_5$	318.49
5817	——, ethyl ester	ethyl tetradecanoate*	$CH_3(CH_2)_{12}-COOC_2H_5$	256.42
5818	——, ethylene ester.	See *Glycol, dimyristate.*		
5819	——, glyceryl ester.	See *Glycerol, trimyristate.*		
5820	**Myristic alcohol.**	See 1-*Tetradecanol**.		
5821	**Myristic anhydride**	tetradecanoic anhydride*	$(C_{13}H_{27}CO)_2O$	438.72
5822	**Myristicin**	5-methoxysafrole	$C_3H_5C_6H_2(O_2CH_2)-OCH_3$	192.21
5823	**Myristinaldoxime.**	See *Myristaldehyde, oxime.*		
5824	**Myristonitrile**	tetradecanenitrile*	$C_{13}H_{27}CN$	209.37
5825	**Myristoyl chloride**	tetradecanoyl chloride*; myristyl chloride	$CH_3(CH_2)_{12}COCl$	246.82
5826	**Napelline.**	See *Benzaconine.*		
5827	**Naphthacetol.**	See 1-*Naphthol*, 4-*acetamido-*.		
5828	**Naphthalane.**	See *Naphthalene, decahydro-**.		
5829	**1-Naphthaldehyde**	1-naphthalenecarbonal; α-naphthoic aldehyde	$C_{10}H_7CHO$	156.17

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
5791	wh. cr. powd.	....	230–1	....	50	s.	i. eth., chl.
5792	wh. micr.–cr. powd.	....	125 d.	....	14.3	50	i. eth.; sl. s. chl.
5793	col. need.	....	143	....	i.	s.	s. eth., alk.
5794							
5795	col. hygr. oil.	0.9998	....	126–30	∞	s.	s. eth.; ∞ ord. solv.
5796	col. liq.	0.963	....	206	∞	......	....
5797	col. liq.	1.071	....	225.5	∞	......	....
5798							
5799	col. cr. or wh. powd.	....	206 d. (213–4)	255	0.33^{14}	i.	v. sl. s. eth.; s. dil. alk.
5800	....	....	149.5 d.	....	......	......	....
5801	need. f. w.	....	298 d.	*ca.* 320	0.02	sl. s.	sl. s. eth.; s. h. ac. a.
5802							
5803	purp. powd.	....	....	....	sl. s.	i.	i. eth.
5804							
5805							
5806							
5807							
5808							
5809							
5810	liq.	0.802	....	167	......	......	....
5810M							
5811	col. need. f. eth.	0.777^{95}	88	....	i.	s. h.	s. eth.; v. s. bz.
5812							
5813	need. f. al.	....	82	....	i.	s.	v. s. eth., chl.
5814	leaf	....	103	217^{12}	i.	sl. s.	sl. s. eth.
5815	col. leaf., 1.4308^{60}	0.858^{60}	58	250.5^{100}	i.	44.9^{21}	sl. s. eth.; s. chl., glac. ac. a.
5816	liq.	$0.9321\frac{25}{25}$	20.5	229.31^{11}	i	s.	v. s. eth.
5817	col. cr.	$0.8589\frac{20}{4}$	10.5 (11.93)	295	i.	s.	sl. s. eth.
5818							
5819							
5820							
5821	col. cr.	0.850^{70}	53.4	198	i.	s.	s. eth.
5822	pa. yel. oil	1.1425^{19}	<-20	149.5^{15}	......	s.	s. eth.
5823							
5824	liq. or cr.	$0.8281\frac{19}{4}$	19	226.5^{100}	i.	sl. s.	v. s. eth.
5825	liq.	....	–1	168^{15} ($159–61^{11}$)	d.	d.	s. eth.
5826							
5827							
5828							
5829	liq., $1.6546^{19.3}$	$1.148\frac{20}{4}$	....	291.6	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5830	**1-Naphthaldehyde, 2-hydroxy-**	2-hydroxy-1-naphthalenecarbonal*; β-naphthol-1-aldehyde	$HOC_{10}H_6CHO$	172.17
5831	**2-Naphthaldehyde**	2-naphthalenecarbonal; β-naphthoic aldehyde	$C_{10}H_7CHO$	156.17
5832	**——, 1-hydroxy-**	1-hydroxy-2-naphthalenecarbonal*; α-naphthol-2-aldehyde	$HOC_{10}H_6CHO$	172.17
5833	**Naphthalene**		$C_{10}H_8$	128.16
5834	——, hexahydride.	See *Naphthalene, hexahydro-.*		
5835	——, tetrachloride.	See *Naphthalene,* 1,2,3,4-*tetrachloro*-1,2,3,4-*tetrahydro*-.		
5836	**——, 1,1′-azoxydi-.**	See 1,1′-*Azoxynaphthalene.*		
5837	**——, 1-benzyl-.**	See *Methane,* 1-*naphthylphenyl*-.		
5838	**——, 2-benzyl-.**	See *Methane,* 2-*naphthylphenyl*-.		
5839	**——, 2-benzyloxy-*.**	See *Ether, benzyl 2-naphthyl.*		
5840	**——, 1-bromo-***		$C_{10}H_7Br$	207.07
5841	**——, 2-bromo-***		$C_{10}H_7Br$	207.07
5842	**——, 1-chloro-***		$C_{10}H_7Cl$	162.61
5843	**——, 2-chloro-***		$C_{10}H_7Cl$	162.61
5844	**——, 1-chlorodecahydro-***	1-chlorodecalin	$C_{10}H_{17}Cl$	172.69
5845	**——, 1-chloro-4-nitro-***		$C_{10}H_6Cl(NO_2)$	207.61
5846	**——, 7-chloro-1-nitro-***		$C_{10}H_6Cl(NO_2)$	207.61
5847	**——, decahydro-***	"Decalin"; bicyclo [4,4,0]-decane; naphthalane; naphthane	$C_{10}H_{18}$	138.25
5848	**——, diamino-.**	See *Naphthylenediamine.*		
5849	**——, diazoamino-.**	See *Diazoaminonaphthalene.*		
5850	**——, 1,2-dichloro-***		$C_{10}H_6Cl_2$	197.06
5851	**——, 1,3-dichloro-***	δ-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5852	**——, 1,4-dichloro-***	β-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5853	**——, 1,5-dichloro-***	γ-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5854	**——, 1,6-dichloro-***	η-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5855	**——, 1,7-dichloro-***	δ′-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5856	**——, 1,8-dichloro-***	peri-dichloronaphthalene; ζ-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5857	**——, 2,3-dichloro-***	ι-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5858	**——, 2,6-dichloro-***	ϵ-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5859	**——, 2,7-dichloro-***	δ-dichloronaphthalene	$C_{10}H_6Cl_2$	197.06
5860	**——, 1,4-dihydro-***		$C_{10}H_{10}$	130.18
5861	**——, dihydrodiketo-.**	See *Naphthoquinone.*		

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5830	br. need......	....	82	192	i.	s.	s. eth.
5831	col. leaf. f. w., $1.6211^{99.4}$	1.078^{99}	60.5	....	s. h.	v. s.	v. s. eth.
5832	yel. grn. need..	....	59–60	....	i.	s.	s. eth.
5833	col. monocl., $1.58218^{99.6}$	1.145	80.22	217.9	0.003	4.18 c.	v. s. eth., chl., CS_2; $40.21^{15.6}$ bz.
5834							
5835							
5836							
5837							
5838							
5839							
5840	col. oil or pr., $1.65876^{19.4}$	$1.4875\frac{20}{4}$	6.2; 0.2–0.7	281.1 $(146–9^{16})$	s. h.	∞	∞ eth., bz.
5841	rhomb. leaf. f. al.	1.605^{0}	59 (56–7)	281–2	i.	6	s. eth., CS_2, chl., bz.
5842	col. liq., 1.63321^{20}	$1.1938\frac{20}{4}$	....	263 (250–2)	i.	s.	s. eth., bz., CS_2
5843	col. leaf. f. al. .	liq. $1.138\frac{70}{4}$	55–6	264–6	i.	s.	s. eth., chl., CS_2, bz.
5844	....	....	....	$114–6^{20}$	......	......	....
5845	brnsh.-yel. need. f. al.	....	85	....	i.	s.	s. eth.
5846	yel. need. f. al.	....	116	....	i.	s.	s. eth.
5847	col. liq., (*cis*) 1.4828	0.8963	–43.26	194.6	i.	s.	s. eth.
	(*trans*) 1.46994^{18}	0.8699	–31.47	185.5	......	......	....
5848							
5849							
5850	monocl. pl. f. al., $1.63375^{48.5}$	liq., $1.315\frac{48.5}{4}$	37	282	......	s.	s. eth.
5851	need. f. al.....	....	61.5	291^{755}	......	s.	....
5852	need. f. al., $1.62282^{75.9}$	1.300^{76}	67–8	287^{740}	i.	sl. s.	s. eth., acet., ac. a.
5853	leaf. f. al. or ac. a.	....	107	subl.	i.	sl. s.	s. eth.
5854	need. f. al.; volat. in steam	....	48–9	subl.	......	......	....
5855	need. f. ac. a., $1.60921^{99.5}$	$1.261\frac{100}{4}$	63–4	286	......	v. s.	s. eth., ac. a., bz.
5856	rhomb. cr. f. al., $1.62357^{99.8}$	$1.292\frac{100}{4}$	88 (83)	d.	......	......	....
5857	col. lust. sc. f. al.	....	120	....	......	s. h.	s. eth.
5858	col. monocl. need. or leaf. f. al.	....	140–41 (135)	285	......	sl. s.	v. s. eth., chl., bz.
5859	col. pl. f. al., (*n*=	1.62845°	114	....	......	s. h.	....
5860	col. liq., $1.58317^{18.3}$	0.998	24.5–25 (15.5)	212 (94.5^{17})	i.	v. s.	v. s. eth.
5861							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5862	**Napthalene, dihydroxy-.**	See *Naphthalenediol.*		
5863	**——, 1,4-dimethyl-***	α-dimethylnaphthalene	$C_{10}H_6(CH_3)_2$	156.22
5864	**——, 2,3-dimethyl-*.**	See *Guaiene.*		
5865	**——, 1,3-dinitro-***		$C_{10}H_6(NO_2)_2$	218.16
5866	**——, 1,5-dinitro-***		$C_{10}H_6(NO_2)_2$	218.16
5867	**——, 1,8-dinitro-***		$C_{10}H_6(NO_2)_2$	218.16
5868	**——, ethoxy-*.**	See *Ether, ethyl naphthyl.*		
5869	**——, 1-ethyl-**	α-naphthylethane; α-ethylnaphthalene	$C_{10}H_7C_2H_5$	156.22
5870	**——, 2-ethyl-**	β-naphthylethane; β-ethylnaphthalene	$C_{10}H_7C_2H_5$	156.22
5870K	**——, 1-fluoro-***	α-fluoronaphthalene	$C_{10}H_7F$	146.16
5870M	**——, 2-fluoro-***	β-fluoronaphthalene	$C_{10}H_7F$	146.16
5871	**——, hexahydro-**	naphthalene hexahydride	$C_{10}H_{14}$	134.21
5872	**——, hydrazodi-.**	See *Hydrazine, dinaphthyl-.*		
5873	**——, hydroxy-.**	See *Naphthol.*		
5874	**——, 1-iodo-***		$C_{10}H_7I$	254.08
5875	**——, 2-iodo-***		$C_{10}H_7I$	254.08
5876	**——, methoxy-.**	See *Ether, methyl naphthyl.*		
5877	**——, 1-methyl-**	α-methylnaphthalene	$C_{10}H_7CH_3$	142.19
5878	**——, 2-methyl-**	β-methylnaphthalene	$C_{10}H_7CH_3$	142.19
5879	**——, 1-(γ-methylbutoxy)-*.**	See *Ether, isoamyl 1-naphthyl.*		
5880	**——, 2-(γ-methylbutoxy)-*.**	See *Ether, isoamyl 2-naphthyl.*		
5881	**——, naphthoxy-.**	See *Naphthyl ether.*		
5882	**——, 1-(2-naphthoyl)-.**	See 1,2′-*Naphthyl ketone.*		
5883	**——, 1-nitro-***	α-nitronaphthalene	$C_{10}H_7NO_2$	173.16
5884	**——, 2-nitro-***	β-nitronaphthalene	$C_{10}H_7NO_2$	173.16
5885	**——, 1-phenyl-**		$C_6H_5C_{10}H_7$	204.26
5886	**——, 2-phenyl-**		$C_6H_5C_{10}H_7$	204.26
5887	**——, 2-(2-propenoxy)-*.**	See *Ether, allyl 2-naphthyl.*		
5888	**——, propoxy-*.**	See *Ether, naphthyl propyl.*		
5889	**——, 1,2,3,4-tetrachloro-1,2,3,4-tetrahydro-***	naphthalene tetrachloride	$C_{10}H_8Cl_4$	269.99
5890	**——, 1,2,3,4-tetrahydro-***	**"Tetralin"** **naphthalene 1,2,3,**4-tetrahydride	$C_{10}H_{12}$	132.20
5891	**——, 1,3,5,8-tetranitro-***	γ-tetranitronaphthalene	$C_{10}H_4(NO_2)_4$	308.16
5892	**——, 1,3,6,8-tetranitro-***	β-tetranitronaphthalene	$C_{10}H_4(NO_2)_4$	308.16
5893	**——, 1,5,?,?-tetranitro-***	α-tetranitronaphthalene	$C_{10}H_4(NO_2)_4$	308.16
5894	**——, 1,2,5-trinitro-***		$C_{10}H_5(NO_2)_3$	263.16
5895	**——, 1,3,5-trinitro-***		$C_{10}H_5(NO_2)_3$	263.16

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5862							
5863	liq., 1.61567^{16}	1.016^{20}_{4}	<−18	264.3	i.	v. s.	∞ eth.
5864							
5865	ylsh. need. f. bz.		144–5	subl.	i.	s.	
5866	hex. need. f. ac. a.	....	217.5 (216)	subl.	i.	sl. s.	v. s. eth.; s. h. bz., h. pyr., ac. a.; v. sl. s. CS_2
5867	yel. rhomb. pl. f. chl.	....	173–3.5 (170)	d.	i.	0.188^{19} 88%	0.72^{19}bz.; s. pyr.; sl. s. chl.
5868							
5869	col. liq	1.018^{20}_{4}	<−14	258 d.	i.	∞	∞ eth.
5870	col. liq	1.008^{0}	−19	251	i.	∞	∞ eth.
5870 K	col. liq., $1.59389^{19.5}$	1.1340	−13 (−9)	212	i.	s.	s. eth.
5870M	wh. need.	....	61	211.5^{737}	i.	s.	s. eth.
5871	col. liq., $1.53311^{18.4}$	0.934	....	205.5	......	......	....
5872							
5873							
5874	oil, 1.70540^{14}..	1.7344^{15}_{4}	....	305	i.	∞	∞ eth.
5875	cr. leaf., $1.6617^{99.4}$	....	54.5	308–10	i.	v. s.	v. s. eth.
5876							
5877	col. liq., 1.618.	1.025	−22	240–3	i.	v. s.	v. s. eth.
5878	col. monocl. f. al., $1.60263^{39.9}$	1.029^{20}_{4}	35.1	245	i.	v. s.	v. s. eth.
5879							
5880							
5881							
5882							
5883	yel. need. f. al	1.331^{4}_{4}	58.8 (56–7)	304	i.	s.	v. s. eth., chl., CS_2
5884	col. rhomb. need. f. al.	....	79	165^{15}	i.	v. s.	v. s. eth.
5885	col. liq. or waxy solid	....	*ca.* 45	325	i.	v. s.	v. s. eth., bz.
5886	col. leaf. f. al.	....	102.5	345	......	v. s.	v. s. eth., bz.
5887							
5888							
5889	cr. f. eth......	....	182–3	....	i.	v. sl. s. h.	s. h. eth.
5890	col. liq., $1.54614^{20.2}$	0.971	−30	207.2	i.	v. s.	v. s. eth.
5891	yel. tetr. f. acet.	....	195	....	......	sl. s.	v. s. acet.; s. HNO_3; sl. s. chl.
5892	long need. f. al.	....	203	exp.	i.	sl. s.	....
5893	lt. yel. need. f. chl.	....	259	exp.	v. sl. s.	v. sl. s.	v. sl. s. eth.
5894	col. need. f. al.	....	113	....	......	s.	....
5895	yel. rhomb. (monocl.) f. chl.	....	123	....	i.	v. s.	sl. s. eth.; v. s. acet.; s. chl., ac. a.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5896	**Naphthalene,1,3,8-trinitro-***	....	$C_{10}H_5(NO_2)_3$......	263.16
5897	**——, 1,4,5-trinitro-***	....	$C_{10}H_5(NO_2)_3$......	263.16
5898	**Naphthalenecarbonal.**	See *Naphthaldehyde.*		
5899	**α-Naphthalenecarboxylic acid.**	See 1-*Naphthoic acid*.		
5900	**β-Naphthalenecarboxylic acid.**	See 2-*Naphthoic acid*.		
5901	**Naphthalenediamine*.**	See *Naphthylenediamine.*		
5902	**1,2-Naphthalenedicarboxylic acid**	....	$C_{10}H_6(COOH)_2$....	216.18
5903	**1,4-Napthalenedicarboxylic acid, 1,2,3,4-tetrahydro-1-phenyl-.**	See α–		
5904	**1,8-Naphthalenedicarboxylic acid.**	See *Naphthalic acid.*		
5905	**1,2-Naphthalenediol***	1,2-dihydroxynaphthalene; β-hydronaphthoquinone; β-naphthohydroquinone	$C_{10}H_6(OH)_2$.......	160.16
5906	**1,3-Naphthalenediol***	1,3-dihydroxynaphthalene; naphthoresorcinol	$C_{10}H_6(OH)_2$.......	160.16
5907	**1,4-Naphthalenediol***	1,4-dihydroxynaphthalene; α-hydronaphthoquinone; α-naphthohydroquinone	$C_{10}H_6(OH)_2$.......	160.16
5908	**1,5-Naphthalenediol***	1,5-dihydroxynaphthalene	$C_{10}H_6(OH)_2$.......	160.16
5909	**1,6-Naphthalenediol***	1,6-dihydroxynaphthalene....	$C_{10}H_6(OH)_2$.......	160.16
5910	**1,7-Naphthalenediol***	1,7-dihydroxynaphthalene....	$C_{10}H_6(OH)_2$.......	160.16
5911	**1,8-Naphthalenediol***	1,8-dihydroxynaphthalene....	$C_{10}H_6(OH)_2$.......	160.16
5912	**2,3-Naphthalenediol***	2,3-dihydroxynaphthalene....	$C_{10}H_6(OH)_2$.......	160.16
5913	**2,6-Naphthalenediol***	2,6-dihydroxynaphthalene....	$C_{10}H_6(OH)_2$.......	160.16
5914	**2,7-Naphthalenediol***	2,7-dihydroxynaphthalene....	$C_{10}H_6(OH)_2$.......	160.16
5915	**1,3-Naphthalenedisulfonic acid, 7-amino-.**	See *Naphthylamine*-6,8-*disul-*		
5916	**1,5-Naphthalenedisulfonic acid**	....	$C_{10}H_6(SO_3H)_2$.....	288.28
5917	**——, 3-amino-.**	See 2-*Naphthylamine*-4,8-*disulfonic acid.*		
5918	**——, 4-amino-.**	See 1-*Naphthylamine*-4,8-*disulfonic acid.*		
5919	**1,6-Naphthalenedisulfonic acid**	....	$C_{10}H_6(SO_3H)_2$.....	288.28
5920	**2,7-Naphthalenedisulfonic acid**	α-naphthlenedisulfonic acid.	$C_{10}H_6(SO_3H)_2$.....	288.28
5921	**——, 4,5-dihydroxy-.**	See *Chromotropic acid.*		
5922	**Naphthalenesulfonic acid, amino-.**	See *Naphthylaminesulfonic acid.*		
5923	**1-Naphthalenesulfonic acid**	α-naphthalenesulfonic acid	$C_{10}H_7SO_3H{\cdot}H_2O$	226.24
5924	**——, 4-amino-.**	See *Naphthionic acid.*		
5925	**2-Naphthalenesulfonic acid**	β-naphthalenesulfonic acid...	$C_{10}H_7SO_3H$.......	208.22
5926	**1-Naphthalenesulfonyl chloride**	....	$C_{10}H_7SO_2Cl$.......	226.67
5927	**2-Naphthalenesulfonyl chloride**	....	$C_{10}H_7SO_2Cl$.......	226.67
5928	**Naphthalenethiol*.**	See *Naphthol, thio-.*		
5929	**Naphthalic acid**.......	1,8-naphthalenedicarboxylic acid	$C_{10}H_6(COOH)_2$....	216.18
5930	**1-Naphthamide**.......	1-naphthalenecarbonamide*; α-naphthoamide	$C_{10}H_7CONH_2$.....	171.19

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5896	monocl. f. chl..	....	218	....	i.	0.046^{23} 88%	v. sl. s. eth., chl.
5897	yel. leaf.......	....	247 (154)	....	i.	0.12^{18}	0.88^{18} eth.; s. bz.; 0.64 chl.
5898							
5899							
5900							
5901							
5902	need. f. al.....	....	175 d.	....	s. h.	i.	i. eth.
5903	*Isatropic acid.*						
5904							
5905	col. leaf. or need. f. CS_2; leaf.($+1H_2O$) f. w.	....	anh. 103–4; $+1H_2O$, 58–60	....	sl. s.	s.	s. eth., alk.
5906	leaf. f. w......	....	124	....	s.	s.	s. eth., ac. a.; sl. s. bz., lgr.; yel. in alk. sol.
5907	lng. monocl. col. need.	....	176	....	s. h.	s.	s. eth., ac. a. v. sl. s. CS_2, lgr., c. bz.
5908	sm. pr. f. w...	....	265 (258)	d.	sl. s.	s.	s. eth., acet., ac. a.; i. bz., pet. eth.
5909	col. pr. f. bz...	....	138 (135)	....	sl. s.	sl. s.	v. s. eth.; s. bz., acet.
5910	col. need. f. bz.	....	178	....	s.	v. s.	v. s. eth.; s. bz.
5911	leaf. or need. f. w.	....	140	....	sl. s. h.	s. h.	v. s. eth.; s. bz.; sl. s. lgr.
5912	monocl. (rhomb.) leaf. f. w.	....	160–1	....	s. h.	v. s.	v. s. eth.; s. bz., lgr.
5913	rhomb. pl. f. w.	....	218	subl.	sl. s.	s.	s. eth., me. al., acet.; sl. s. bz.; i. lgr.
5914	need. f. w.....	....	190	subl.	s.	s.	s. eth., chl., bz.; i. lgr.
5915	*fonic acid.*						
5916	leaf., 1.493, 1.675, 1.739	....	d.	....	102^{20}	s.	i. eth.
5917							
5918							
5919	cr............	....	125 d.	....	164^{20}	s.	i. eth.
5920	hyg. need.....	....	....	....	s.	......	sl. s. c. HCl
5921							
5922							
5923	cr............	....	90	....	v. s.	s.	sl. s. eth.
5924							
5925	col.-wh. deliq. pl.	....	102	d.	76.96^{30}	s.	s. eth.; 0.2 h. bz.
5926	leaf. f. eth....	....	68	195^{13}	i.	s.	v. s. eth.
5927	wh. cr. powd. or leaf.	....	76	201^{13}	i.	s.	v. s. eth.; s. bz., chl., CS_2
5928							
5929	col. need. f. al.	....	270 d.	....	v. sl. s.	sl. s.	sl. s. eth.
5930	col. need. f. al.	....	202	....	v. sl. s.	v. sl. s.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5931	**2-Naphthamide**	2-naphthalenecarbonamide*; β-naphthoamide	$C_{10}H_7CONH_2$	171.19
5932	**Naphthane.**	See Naphthalene, decahydro-*.		
5933	**Naphthazarin**	5,8-dihydroxy-1,4-naphthoquinone	$C_{10}H_4O_2(OH)_2$	190.15
5934	**Naphthionic acid**	1-naphthylamine-4-sulfonic acid; 4-amino-1-naphthalenesulfonic acid	$NH_2C_{10}H_6SO_3H\cdot\frac{1}{2}H_2O$	232.25
5935	**α-Naphthoamide.**	See 1-*Naphthamide.*		
5936	**β-Naphthoamide.**	See 2-*Naphthamide.*		
5937	**α-Naphthohydroquinone.**	See 1,4-Naphthalenediol*.		
5938	**β-Naphthohydroquinone.**	See 1,2-Naphthalenediol*.		
5939	**1,2-Naphthohydroquinone.**	See 1,2-Naphthalenediol*.		
5940	**1,4-Naphthohydroquinone.**	See 1,4-Naphthalenediol*.		
5941	**1-Naphthoic acid**	α-naphthalenecarboxylic acid; α-naphthoic acid	$C_{10}H_7COOH$	172.17
5942	**——, 2-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5943	**——, 5-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5944	**——, 6-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5945	**——, 7-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5946	**——, 8-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5947	**——, 8-nitro-**		$NO_2C_{10}H_6COOH$	217.17
5948	**2-Naphthoic acid**	β-naphthalenecarboxylic acid; β-naphthoic acid	$C_{10}H_7COOH$	172.17
5949	**——, 1-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5950	**——, 3-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5951	**——, 5-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5952	**——, 7-hydroxy-**		$HOC_{10}H_6COOH$	188.17
5953	**α-Naphthoic aldehyde.**	See 1-*Naphthaldehyde.*		
5954	**β-Naphthoic aldehyde.**	See 2-*Naphthaldehyde.*		
5955	**1-Naphthol**	α-naphthol; 1-hydroxynaphthalene	$C_{10}H_7OH$	144.16
5956	——, acetate	α-naphthyl acetate	$CH_3COOC_{10}H_7$	186.20
5957	**——, 4-acetamido-**	*N*-(4-hydroxy-1-naphthyl)-acetamide; naphthacetol	$CH_3CONHC_{10}H_6OH$	201.22
5958	**——, 2-aceto-.**	See 2-*Acetonaphthone, 1-hydroxy-.*		
5959	**——, 2-acetyl-4-bromo-.**	See 2-*Acetonaphthone, 4-bromo-1-hydroxy-.*		
5960	**——, 2-amino-**	1-hydroxy-2-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5961	**——, 4-amino-**	4-hydroxy-1-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5962	**——, 5-amino-**	5-hydroxy-1-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5963	**——, 7-amino-**	8-hydroxy-2-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5964	**——, 8-amino-**	8-hydroxy-1-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5965	**——, 4-bromo-2-propionyl-.**	See 2-*Propionaphthone, 4-bromo-1-hydroxy-.*		
5966	**——, 2-butyryl-.**	See 2-*Butyronaphthone, 1-hydroxy-.*		
5967	**——, 2-cinnamyl-.**	See 2-*Acrylonaphthone, 1-hydroxy-β-phenyl-.*		
5968	**——, 2,4-dibromo-**		$Br_2C_{10}H_5OH$	301.98
5969	**——, 2,4-dichloro-**		$Cl_2C_{10}H_5OH$	213.06
5970	**——, 2,4-dinitro-**		$(NO_2)_2C_{10}H_5OH$	234.16
5971	**——, 2-nitro-**		$NO_2C_{10}H_6OH$	189.16
5972	**——, 4-nitro-**		$NO_2C_{10}H_6OH$	189.16
5973	**——, 2-nitroso-**	1,2-naphthoquinone 2-oxime	$NOC_{10}H_6OH$	173.16

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5931	col. tab. f. al.	....	192	....	sl. s.	sl. s.	s. eth., bz., chl.
5932							
5933	red br. need. f. al.	....	276–80	subl.	sl. s. h.	s.	v. sl. s. eth., bz.; s. alk.
5934	col. need. f. w.	....	d.	....	0.026^{0}, 0.22^{100}	v. sl. s.	v. sl. s. eth.
5935							
5936							
5937							
5938							
5939							
5940							
5941	col. need. f. dil. al.	....	160	300	v. sl. s. h.	v. s. h.	s. eth., chl., NH_4OH
5942	need. f. al. and eth.	....	156–7 d.	....	sl. s. h.	v. s.	v. s. eth.; s. bz.
5943	lng. need. f. w.	....	234–7	subl.	sl. s. h.	v. s.	s. eth., ac. a.
5944	sm. need. f. w.	....	187	....	s. h.	v. s.	....
5945	need. f. w.	....	245–7 d.	....	s. h.	s.	....
5946	need. f. eth.	....	169	....	s. h.	v. s.	s. eth.
5947	pr. f. al.	....	215	....	0.04c.	4.6	sl. s. eth., bz.
5948	col. monocl. need. f. lgr.	$1.077\frac{100}{4}$	185	>300	0.0068^{25}	v. s.	v. s. eth.; s. NaOH sol.
5949	need. f. al. or eth.	....	186–8	....	sl. s.	s.	s. eth., bz.
5950	yel. rhomb. need. f. w.	....	216 (211–4)	....	s. h.	s.	s. eth., bz., chl.
5951	need. f. w. or al.	....	211–2	....	s. h.	s.	....
5952	leaf	....	262	....	s.	s.	s. eth.
5953							
5954							
5955	yel. monocl., $1.6206^{98.7}$	1.224^{4}; 1.099^{99}	96	288 (280)	sl. s. h., i. c.	v. s.	v. s. eth.; s. bz.
5956	need. or pl. f. al.	....	44.8	....	sl. s. h.	s.	v. s. eth.
5957	need. f. al.	....	187	....	s. h.	s.	s. NH_4OH, Na_2CO_3
5958							
5959							
5960	need	....	....	....	sl. s.	......	....
5961	need	....	....	....	sl. s.	s.	s. eth.
5962	cr.	....	170 d.	....	sl. s.	s.	s. eth.
5963	cr. (sc.) f. chl.	....	158	....	sl. s.	s.	s. eth.
5964	wh. need.	....	95–7 d.	....	v. s. h., sl. s. c.	......	s. alk., HCl
5965							
5966							
5967							
5968	wh. need. f. al.	....	105 (111)	....	i.	s.	s. eth., ac. a.
5969	wh. need. f. al. or bz.	....	107	d. 180	i.	s.	s. eth., bz.
5970	yel. need. f. h. al. or chl.	....	138	....	v. sl. s. h.	sl. s.	sl. s. eth., bz.; s. ac. a.
5971	yel. need. or leaf. f. al.	....	128	....	v. sl. s.	sl. s.	....
5972	yel. need. f. w.	....	164	....	s. h.	v. s.	v. s. ac. a.
5973	yel. need. f. bz.	....	152	....	v. sl. s. c.	v. s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5974	**1-Naphthol, 4-nitroso-**	1,4-naphthoquinone 1-oxime	$NOC_{10}H_6OH$	173.16
5975	**——, 1,2,3,4-tetrahydro-**	α-naphthol 1,2,3,4-tetrahydride; *ac*-tetrahydro-α-naphthol	$C_6H_4{:}C_4H_7OH$	148.20
5976	**——, 5,6,7,8-tetrahydro-**	α-naphthol 5,6,7,8-tetrahydride; *ar*-tetrahydro-α-naphthol	$C_4H_8{:}C_6H_3OH$	148.20
5977	**——, thio-**	1-naphthalenethiol*; α-naphthyl mercaptan	$C_{10}H_7SH$	160.22
5978	**2-Naphthol**	β-naphthol; 2-hydroxynaphthalene	$C_{10}H_7OH$	144.16
5979	——, acetate	β-naphthyl acetate	$CH_3COOC_{10}H_7$	186.20
5980	——, benzoate	β-naphthyl benzoate	$C_{10}H_7OOCC_6H_5$	248.27
5981	**——, 1-acetamido-**	*N*-(2-hydroxy-1-naphthyl)-acetamide	$CH_3CONHC_{10}H_6OH$	201.22
5982	**——, 1-amino-**	2-hydroxy-1-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5983	**——, 3-amino-**	3-hydroxy-2-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5984	**——, 5-amino-**	6-hydroxy-1-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5985	**——, 6-amino-**	6-hydroxy-2-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5986	**——, 7-amino-**	7-hydroxy-2-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5987	**——, 8-amino-**	7-hydroxy-1-naphthylamine	$NH_2C_{10}H_6OH$	159.18
5988	**——, 1-bromo-**	....	$BrC_{10}H_6OH$	223.07
5989	**——, 6-bromo-1-methyl-**	....	$CH_3C_{10}H_5BrOH$	237.10
5990	**——, 1-chloro-**	....	$ClC_{10}H_6OH$	178.61
5991	**——, 1,6-dibromo-**	....	$Br_2C_{10}H_5OH$	301.98
5992	**——, 1,6-dinitro-**	....	$(NO_2)_2C_{10}H_5OH$	234.16
5993	**——, 1-methyl-**	....	$CH_3C_{10}H_6OH$	158.19
5994	**——, 1-nitro-**	....	$NO_2C_{10}H_6OH$	189.16
5995	**——, 5-nitro-**	....	$NO_2C_{10}H_6OH$	189.16
5996	**——, 8-nitro-**	....	$NO_2C_{10}H_6OH$	189.16
5997	**——, 1-nitroso-**	1,2-naphthoquinone 1-oxime	$NOC_{10}H_6OH$	173.16
5998	**——, 1-*p*-phenylazo-**	*p*-nitrobenzeneazo-β-naphthol; paranitraniline red	$NO_2C_6H_4N{:}NC_{10}H_6OH$	293.27
5999	**——, 1,2,3,4-tetrahydro-**	β-naphthol 1,2,3,4-tetrahydride; *ac*-tetrahydro-β-naphthol	$C_6H_4{:}C_4H_7OH$	148.20
6000	**——, 5,6,7,8-tetrahydro-**	β-naphthol 5,6,7,8-tetrahydride; *ar*-tetrahydro-β-naphthol	$C_4H_8{:}C_6H_3OH$	148.20
6001	**——, thio-**	2-naphthalenethiol*; β-naphthyl mercaptan	$C_{10}H_7SH$	160.22
6002	**Naphtholaldehyde.**	See *Naphthaldehyde, hydroxy-.*		
6003	**β-Naphtholdisulfonic**	**acid R.** See 2-*Naphthol*-3,6-*di*	*sulfonic acid.*	
6004	**1-Naphthol-3,6-disulfonic acid, 8-amino-**	H acid	$H_2N(OH)C_{10}H_4(SO_3H)_2$	319.30
6005	**2-Naphthol-3,6-disulfonic acid**	β-naphtholdisulfonic acid R; β-naphthol-α-disulfonic acid; R acid	$HOC_{10}H_5(SO_3H)_2$	304.28
6006	**2-Naphthol-6,8-disulfonic acid**	β-naphthol-γ-disulfonic acid; G acid	$HOC_{10}H_5(SO_3H)_2$	304.28
6007	**β-Naphthol-α-monosu**	**lfonic acid.** See *Croceic acid.*		
6008	**1-Naphthol-2-sulfonic acid**	α-naphtholsulfonic acid of Schaeffer	$HOC_{10}H_6SO_3H$	224.22

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5974	yel. need.	....	....	194 d.	i.	v. s.	v. s. eth.
5975	col. liq., 1.5671^{17}	1.090	....	140^{17}	v. sl. s.	v. s.	v. s. eth.
5976	wh. monocl. pl.	....	68	265.3	sl. s. h.	v. s.	v. s. eth.
5977	liq	1.155^{20}_{4}	....	161^{20}; 285 d.	i.	v. s.	v. s. eth.
5978	col. monocl. leaf.	1.217^{4}	122	294.85 (286)	0.074^{25}	12.5^{25}	76.9^{25} eth.; s. chl., oils, alk., glyc.
5979	sm. need. f. al.	....	68.5	....	i.	s.	s. eth., chl.
5980	need. f. al.	....	110 (107–8)	....	i.	v. s. h.	sl. s. eth.
5981	leaf. f. w., al.	....	235 d.	subl.	......	s.	s. eth., h. ac. a.; v.s. NaOH; sl. s. bz.
5982	leaf. unst	....	....	....	sl. s. h.	......	sl. s., fluores. eth.
5983	need. f. w.	....	234	....	s.	v. s.	sl. s. eth., bz.
5984	need. or sc. f. w.	....	186	....	s.	s.	s. eth.
5985	sc. f. h. w	....	190–5 d.	....	s.	s.	....
5986	need. f. al.	....	201	....	sl. s.	v. s.	v. s. eth.
5987	need. f. w. or eth.	....	205–7	....	s.	s.	sl. s. eth.
5988	rhomb. pr.	....	84	d. 130	i.	s.	s. eth.
5989	need	....	129	....	i.	s.	s. eth.
5990	pl. f. w., or need. f. lgr.	....	70	....	sl. s.	s.	s. eth., chl., bz., ac. a.; sl. s. c. lgr.
5991	need. f. ac. a	....	106	....	i.	s.	s. eth.
5992	pa. yel. need	....	195 d.	....	v. sl. s.	s.	s. eth., chl.
5993	need	....	112	....	sl. s.	s.	s. eth.
5994	yel. need. f. al.	....	103 (98–100)	....	v. sl. s.	sl. s.	v. s. eth.
5995	yel. need. f. w.	....	147	....	v. s. h.	v. s.	v. s. eth.
5996	yel. need. f. w.	....	145	....	s.	v. s.	s. eth., bz., chl.
5997	yel. need. f. bz.	....	110 (105–7)	....	0.02 c.	2.4^{18} v. s. h.	v. s. eth.; s. bz., glac. ac. a.
5998	or. to br. pl	....	252	....	i.	i.	....
5999	oil	1.071	....	265.5	v. sl. s.	v. s.	v. s. eth.
6000	need. f. al.	....	57.5	276	v. sl. s.	v. s.	v. s. eth.
6001	glit. sc. f. al.	1.550	81	288 d.	sl. s.	v. s.	v. s. eth.
6002							
6003							
6004	col. cr.	....	....	....	sl. s.	......	....
6005	deliq. col. need.	....	d.	....	v. s.	v. s.	i. eth.
6006	....	....	....	....	s.	......	....
6007							
6008	col. rhomb. tab. f. w.	....	>250	....	s.	s.	i. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6009	**1-Naphthol-3-sulfonic acid**		$HOC_{10}H_6SO_3H$	224.22
6010	**1-Naphthol-4-sulfonic acid**	Nevile-Winther acid	$HOC_{10}H_6SO_3H$	224.22
6011	**1-Naphthol-5-sulfonic acid**	α-naphtholsulfonic acid L	$HOC_{10}H_6SO_3H$	224.22
6012	**——, 8-amino-**	S acid	$C_{10}H_9NO_4S$	239.24
6013	**1-Naphthol-7-sulfonic acid**		$HOC_{10}H_6SO_3H$	224.22
6014	**1-Naphthol-8-sulfonic acid**	α-naphtholsulfonic acid S	$HOC_{10}H_6SO_3H$	224.22
6015	——, inner anhydride	naphthosulfone	$C_{10}H_6OSO_2$	206.21
6016	**2-Naphthol-6-sulfonic acid**	Schäffer's acid; β-naphtholsulfonic acid S	$C_{10}H_6(OH)SO_3H$	224.22
6017	**——, 1-amino-**, sodium salt	eikonogen	$H_2N(OH)C_{10}H_5SO_3Na$	261.23
6018	**2-Naphthol-7-sulfonic acid**	β-naphtholsulfonic acid F	$C_{10}H_6(OH)SO_3H$	224.22
6019	**2-Naphthol-8-sulfonic acid.** See *Croceic acid.*			
6020	**1-Naphthonitrile**	1-naphthalenecarbonitrile*; α-naphthyl cyanide	$C_{10}H_7CN$	153.17
6021	**2-Naphthonitrile**	2-naphthalenecarbonitrile*; β-naphthyl cyanide	$C_{10}H_7CN$	153.17
6022	**α β-Naphthophenazine.** See *Benzo[a]phenazine.*			
6023	**α-Naphthoquinaldine.**	See *Benzo[h]quinoline, 2-methyl-.*		
6024	**β-Naphthoquinaldine.**	See *Benzo[f]quinoline, 3-methyl-.*		
6025	**Naphtho(2,3-*f*)quinoline**	α-anthraquinoline	$C_{17}H_{11}N$	229.27
6026	**α-Naphthoquinoline.**	See *Benzo[h]quinoline.*		
6027	**β-Naphthoquinoline.**	See *Benzo[f]quinoline.*		
6028	**1,2-Naphthoquinone**	1,2-dihydro-1,2-diketonaphthalene; β-naphthoquinone	$C_{10}H_6O_2$	158.15
6029	——, 1-oxime.	See 2-*Naphthol, 1-nitroso-.*		
6030	——, 2-oxime.	See 1-*Naphthol, 2-nitroso-.*		
6031	**——, 6-hydroxy-**		$HOC_{10}H_5O_2$	174.15
6032	**——, 7-hydroxy-**		$HOC_{10}H_5O_2$	174.15
6033	**1,4-Naphthoquinone**	1,4-dihydro-1,4-diketonaphthalene; α-naphthoquinone	$C_{10}H_6O_2$	158.15
6034	——, 1-oxime.	See 1-*Naphthol, 4-nitroso-.*		
6035	**——, 2,3(or 3,4)-dihydroxy-** See *Isonaphthazarin.*			
6036	**——, 5,8-dihydroxy-.**	See *Naphthazarin.*		
6037	**——, 2-hydroxy-**		$HOC_{10}H_5O_2$	174.15
6038	——, 5-hydroxy-.	See *Juglone.*		
6038M	**——, 2-hydroxy-3-methyl-.** See *Phthiocol.*			
6039	**2,6-Naphthoquinone**	2,6-dihydro-2,6-diketonaphthalene; *amphi*-naphthoquinone	$C_{10}H_6O_2$	158.15
6040	**Naphthoresorcinol.**	See 1,3-*Naphthalenediol**.		
6041	**Naphthosulfone.**	See 1-*Naphthol-8-sulfonic acid, inner anhydride.*		
6042	**Naphthylamine, hydroxy-.** See *Naphthol, amino-.*			
6043	**1-Naphthylamine**	α-naphthylamine	$C_{10}H_7NH_2$	143.18
6044	——, hydrochloride		$C_{10}H_7NH_2{\cdot}HCl$	179.65
6045	**——, *N*-acetyl-**	*N*-1-naphthylacetamide; 1-acetonaphthalide	$C_{10}H_7NHCOCH_3$	185.22
6046	**——, *N*-acetyl-*N*-methyl-**	*N*-methyl-*N*-1-naphthylacetamide	$(CH_3CO)(CH_3)NC_{10}H_7$	199.24

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6009	need.	..	....	....	s.	......	....
6010	col. pl. f. w.	....	170 d.	....	v. s.	......	....
6011	wh. hyg. cr.	....	120	....	s.	......	....
6012	wh. need.	....	....	....	sl. s.	i.	i. eth.
6013	cr.	....	....	....	v. s.	v. s.	....
6014	cr.	....	107	$-H_2O$, 180	v. s.	......	....
6015	pr. f. bz	....	154	360	sl. s.	sl. s.	v. s. chl.; s. bz.; sl. s. CS_2
6016	col. leaf	....	125	....	v. s.	v. s.	i. eth.
6017	wh. powd.	....	....	....	s.	......	....
6018	need. f. HCl.	....	89	d. 150	v. s.	v. s.	i. eth., bz.
6019							
6020	col. need. f. lgr.	$1.117\frac{5}{5}$	33.5	296.5	i.	v. s.	v. s. eth.; s. lgr.
6021	col. leaf. f. lgr.	$1.094\frac{60}{60}$	66.5	305	i.	s.	s. eth., lgr.
6022							
6023							
6024							
6025	col. leaf. or tab.	....	170	446	i.	v. s.	v. s. eth.; s. bz.
6026							
6027							
6028	yel.-red need. f. eth.	....	d. 115–120	....	s.	s.	s. eth., H_2SO_4, bz.
6029							
6030							
6031	brick red lvs. f. acet.	....	165 d.	....	s.	s.	s. eth.
6032	br.-red need.	....	194	....	......	s.	i. eth., bz.; s. ac. a.
6033	yel. tricl. f. lgr.	1.422	125	subl. 100	sl. s.	s.	v. s. eth., CS_2, glac. ac. a.; s. bz., chl.
6034							
6035							
6036							
6037	yel. need.	....	190 d.	subl.	sl. s. h.	s.	s. eth.
6038							
6038M							
6039	or. pr.	....	135	....	......	s.	v. sl. s. eth.; s. alk.
6040							
6041							
6042							
6043	col. rhomb. need. f. dil. al., $1.6703^{51.2}$	1.131	50	301	0.17	v. s.	v. s. eth.
6044	sm. need.	....	....	....	3.77^{20}	v. s.	s. eth.
6045	col. cr.	....	159–60	....	s.	4^{25}	v. sl. s. eth.
6046	pr.	....	95	....	sl. s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6047	**1-Naphthylamine, *N*, *N*-diethyl-**		$C_{10}H_7N(C_2H_5)_2$	199.29
6048	**——, *N*,*N*-dimethyl-**		$C_{10}H_7N(CH_3)_2$	171.23
6049	**——, *N*-ethyl-**		$C_{10}H_7NHC_2H_5$	171.23
6050	**——, *N*-methyl-**	α-naphthylmethylamine	$C_{10}H_7NHCH_3$	157.21
6051	**——, 4-(1-naphthylazo)-**	4-amino-1,1′-azonaphthalene	$C_{10}H_7N{:}NC_{10}H_6NH_2$	297.35
6052	**——, 6-nitro-**		$NO_2C_{10}H_6NH_2$	188.18
6053	**——, *N*-phenyl-**		$C_{10}H_7NHC_6H_5$	219.27
6054	**——, 4-phenylazo-**	4-benzeneazo-α-naphthylamine	$C_6H_5N_2C_{10}H_6NH_2$	247.29
6055	**——, *N*-propyl-**		$C_{10}H_7NHCH_2CH_2CH_3$	185.26
6056	**——, 5,6,7,8-tetrahydro-**	α-naphthylamine 5,6,7,8-tetrahydride; *ar*-tetrahydro-α-naphthylamine	$C_4H_8{:}C_6H_3NH_2$	147.21
6057	**——, *N*-*o*-tolyl-**	*N*-1-naphthyl-*o*-toluidine	$C_{10}H_7NHC_6H_4CH_3$	233.30
6058	**——, *N*-*p*-tolyl-**	*N*-1-naphthyl-*p*-toluidine	$C_{10}H_7NHC_6H_4CH_3$	233.30
6059	**2-Naphthylamine**	β-naphthylamine	$C_{10}H_7NH_2$	143.18
6060	——, hydrochloride		$C_{10}H_7NH_2\cdot HCl$	179.65
6061	**——, *N*-acetyl-**	*N*-2-naphthylacetamide; 2-acetonaphthalide	$C_{10}H_7NHCOCH_3$	185.22
6062	**——, *N*,*N*-dimethyl-**		$C_{10}H_7N(CH_3)_2$	171.23
6063	**——, *N*-ethyl-**		$C_{10}H_7NHC_2H_5$	171.23
6064	**——, *N*-methyl-**	β-naphthylmethylamine	$C_{10}H_7NHCH_3$	157.21
6065	**——, 1-nitro-**		$NO_2C_{10}H_6NH_2$	188.18
6066	**——, 5-nitro-**		$NO_2C_{10}H_6NH_2$	188.18
6067	**——, 8-nitro-**		$NO_2C_{10}H_6NH_2$	188.18
6068	**——, 1-nitroso-**		$NOC_{10}H_6NH_2$	172.18
6069	**——, *N*-phenyl-**		$C_{10}H_7NHC_6H_5$	219.27
6070	**——, 1,2,3,4-tetrahydro-**	β-naphthylamine 1,2,3,4-tetrahydride; *ac*-tetrahydro-β-naphthylamine	$C_6H_4{:}C_4H_7NH_2$	147.21
6071	**——, *N*-*o*-tolyl-**	*N*-2-naphthyl-*o*-toluidine	$C_{10}H_7NHC_6H_4CH_3$	233.30
6072	**——, *N*-*p*-tolyl-**	*N*-2-naphthyl-*p*-toluidine	$C_{10}H_7NHC_6H_4CH_3$	233.30
6073	**1-Naphthylamine-4,8-disulfonic acid**	4-amino-1,5-naphthalenedisulfonic acid; α-naphthylaminedisulfonic acid S	$NH_2C_{10}H_5(SO_3H)_2$	303.30
6074	**2-Naphthylamine-4,8-disulfonic acid**	3-amino-1,5-naphthalenedisulfonic acid; β-naphthylaminedisulfonic acid; C acid; acid IV	$H_2NC_{10}H_5(SO_3H)_2$	303.30
6075	**2-Naphthylamine-6,8-disulfonic acid**	amino G acid; 7-amino-1,3-naphthalenedisulfonic acid	$H_2NC_{10}H_5(SO_3H)_2$	303.30
6076	**α-Naphthylaminemonosulfonic acid S.** See 1-*Naphthylamine-8-sulfonic acid.*			
6077	**β-Naphthylaminemonosulfonic acid I (of Dahl).** See 2-*Naphthylamine-8-*			
6078	**α-Naphthylaminesulfonic acid.** See 1-*Naphthylamine-5-sulfonic acid.*			

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6047	col.-br. oil, $1.59331^{18.1}$	1.005	....	290 (285)	i.	s.	s. eth., bz.
6048	col. liq. with vlt. fluores.	$1.0446\frac{15}{15}$	59.5–67	274.5	i.	s.	s. eth.
6049	col. oil, $1.64773^{15.1}$	$1.060\frac{20}{4}$	....	305 (187–90^{20})	i.	s.	s. eth.
6050	red oil........	....	....	293	i.	v. s.	v. s. eth.; s. CS_2
6051	redsh.-br. need.	....	175 (183)	....	i.	sl. s.	sl. s. eth., bz.
6052	yel. pr. f. al...	....	143	....	......	s.	....
6053	col. leaf. or pr. f. al.	....	62	335^{258}	1.44^{25}	s.	v. s. eth.; s. bz.,chl., ac.a.
6054	red need. f. al.	....	120 (123)	....	......	s.	s. eth., bz.
6055	oil..........	....	....	*ca.* 317	i.	......	....
6056	oil, $1.58964^{23.1}$	1.054^{23}	....	276.8	v. sl. s.	s.	s. eth., dil. a.
6057	need. f. lgr....	....	94–5	....	i.	v. s.	v. s. eth., bz.
6058	pr. f. al.......	....	79	230^{10}	i.	s.	v. s. eth.; s. bz.; sl. s. h. pet. eth.
6059	leaf. f. w., $1.64927^{98.4}$	$1.061\frac{98}{4}$	110.2	306.1	i.	s.	s. eth., bz.
6060	leaf..........	....	....	....	v. s.	v. s.	s. eth.; sl. s. HCl
6061	lng. flat need. f. w.	....	132	....	s.	s.	sl. s. eth.
6062	dk. red need., $1.64432^{53.2}$	$1.029\frac{55}{4}$	52–53	305; 212.5^{69}	i.	s.	s. eth.
6063	col. oil, $1.65440^{21.3}$	1.057	<−15	315–6 (305–7)	i.	s.	s. eth.
6064	oil..........	....	....	308–10^{761} (298)	......	......	....
6065	or. -yel. need. f. al.	....	127 (123–4)	....	s. h.	v. s.	s. ac. a.
6066	red need. f. al.	....	143	....	......	v. s. h.	s. bz.; i. lgr.
6067	red need......	....	105	....	......	v. s.	s. eth.; i. lgr.
6068	grn. need. f. al.	....	150–2	....	sl. s. h.	v. s.	v. s. eth.
6069	rhomb. need. f. me. al.	....	108	399.5	i.	s.	s.eth.,h.bz.; v. s. chl.
6070	liq., $1.56039^{22.2}$	1.029^{22}	38	278.5	s. h.	v. s.	v. s. eth.
6071	leaf. f. lgr....	....	95–6	400–5	......	s.	s. eth.; v.s. bz., lgr., chl., acet.
6072	red leaf. f. al..	....	102–3	....	......	sl. s.	s. eth., bz.; sl. s. lgr.
6073	rhomb. cr.....	....	....	....	v. s.	......	....
6074	....	....	....	....	s.	......	....
6075	monocl. need..	....	....	....	s.	......	....
6076							
6077	*sulfonic acid.*						
6078							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6079	**β-Naphthylaminesulfonic acid F.**	See 2-*Naphthylamine-7-sulfonic acid*.		
6080	**β-Naphthylaminesulfonic acid III.**	See 2-*Naphthylamine-5-sulfonic acid*.		
6081	**1-Naphthylamine-2-sulfonic acid**	1-amino-2-naphthalenesulfonic acid	$NH_2C_{10}H_6SO_3H$	223.24
6082	**1-Naphthylamine-4-sulfonic acid.**	See *Naphthionic acid.*		
6083	**1-Naphthylamine-5-sulfonic acid**	5-amino-1-naphthalenesulfonic acid; α-naphthylaminesulfonic acid; Laurent's acid	$NH_2C_{10}H_6SO_3H\cdot H_2O$	241.26
6084	**1-Naphthylamine-6-sulfonic acid**	5-amino-2-naphthalenesulfonic acid	$NH_2C_{10}H_6SO_3H$	223.24
6085	**1-Naphthylamine-7-sulfonic acid**	8-amino-2-naphthalenesulfonic acid	$NH_2C_{10}H_6SO_3H\cdot H_2O$	241.26
6086	**1-Naphthylamine-8-sulfonic acid**	8-amino-1-naphthalenesulfonic acid; α-naphthylaminemonosulfonic acid S; Schöllkopf's acid	$NH_2C_{10}H_6SO_3H\cdot H_2O$	241.26
6087	**2-Naphthylamine-1-sulfonic acid**	Tobias' acid; 2-amino-1-naphthalenesulfonic acid	$NH_2C_{10}H_6SO_3H$	223.24
6088	**2-Naphthylamine-4-sulfonic acid**	3-amino-1-naphthalenesulfonic acid	$NH_2C_{10}H_6SO_3H\cdot H_2O$	241.26
6089	**2-Naphthylamine-5-sulfonic acid**	6-amino-1-naphthalenesulfonic acid; β-naphthylaminesulfonic acid III	$NH_2C_{10}H_6SO_3H$	223.24
6090	**2-Naphthylamine-6-sulfonic acid**	6-amino-2-naphthalenesulfonic acid; Brönner's acid	$NH_2C_{10}H_6SO_3H\cdot H_2O$	241.26
6091	**2-Naphthylamine-7-sulfonic acid**	7-amino-2-naphthalenesulfonic acid; β-naphthylaminesulfonic acid F	$NH_2C_{10}H_6SO_3H\cdot H_2O$	241.26
6092	**2-Naphthylamine-8-sulfonic acid**	7-amino-1-naphthalenesulfonic acid; β-naphthylaminemonosulfonic acid I (of Dahl)	$NH_2C_{10}H_6SO_3H$	223.24
6093	**α-Naphthyl cyanide.**	See 1-*Naphthonitrile.*		
6094	**β-Naphthyl cyanide.**	See 2-*Naphthonitrile.*		
6095	**1,2-Naphthylenediamine**	1,2-naphthalenediamine*; 1,2-diaminonaphthalene	$C_{10}H_6(NH_2)_2$	158.20
6096	**1,4-Naphthylenediamine**	1,4-naphthalenediamine*; 1,4-diaminonaphthalene	$C_{10}H_6(NH_2)_2$	158.20
6097	**1,5-Naphthylenediamine**	1,5-naphthalenediamine*; 1,5-diaminonaphthalene	$C_{10}H_6(NH_2)_2$	158.20
6098	**1,6-Naphthylenediamine**	1,6-naphthalenediamine*; 1,6-diaminonaphthalene	$C_{10}H_6(NH_2)_2$	158.20
6099	**1,7-Naphthylenediamine**	1,7-naphthalenediamine*; 1,7-diaminonaphthalene	$C_{10}H_6(NH_2)_2$	158.20
6100	**1,8-Naphthylenediamine**	1,8-naphthalenediamine*; 1,8-diaminonaphthalene	$C_{10}H_6(NH_2)_2$	158.20
6101	**2,3-Naphthylenediamine**	2,3-naphthalenediamine*; 2,3-diaminonaphthalene	$C_{10}H_6(NH_2)_2$	158.20
6102	**2,6-Naphthylenediamine**	2,6-naphthalenediamine*; 2,6-diaminonaphthalene	$C_{10}H_6(NH_2)_2$	158.20
	Naphthyl esters.	See "naphthyl ester," under the names of the acids.		
6103	**1-Naphthyl ether**	1-(1-naphthoxy)naphthalene*; α-dinaphthyl ether	$(C_{10}H_7)_2O$	270.31
6104	**1,2′-Naphthyl ether**	α,β′-dinaphthyl ether; 1-(2-naphthoxy)naphthalene	$C_{10}H_7OC_{10}H_7$	270.31
6105	**2-Naphthyl ether**	2-(2-naphthoxy)naphthalene*; β-dinaphthyl ether	$(C_{10}H_7)_2O$	270.31

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
6079							
6080							
6081	need. f. w.	....	272 d.	....	0.41^{20}, 3.1^{100}	i.	i. bz.
6082							
6083	sm. pl.	....	189.5	....	sl. s.	v. sl. s.	v. sl. s. eth.
6084	col. pl. f. w.	....	d.	....	0.03^{20}	i.	i. eth.
6085	col. need. f. w	....	....	....	0.464^{25}	v. sl. s.	v. sl. s. eth.
6086	need.	....	$-H_2O$, 130	....	0.42^{100}, 0.02^{21}	v. sl. s.	v. sl. s. eth.; s. ac. a.
6087	leaf. f. h. w.	....	....	....	sl. s. c., s. h.	v. sl. s.	v. sl. s. eth.
6088	need. f. w.	....	....	....	sl. s. c.	v. sl. s.	v. sl. s. eth.
6089	need. f. w.	....	....	....	0.033^{20}	v. sl. s.	v. sl. s. eth.
6090	leaf	....	....	....	0.013^{20}, 0.16^{100}	v. sl. s.	v. sl. s. eth.
6091	col. need.	....	....	....	0.02^{20}, 0.28^{100}	v. sl. s.	v. sl. s. eth.
6092	pr. f. w.	....	....	....	0.06^{20}	sl. s.	v. sl. s. eth.
6093							
6094							
6095	leaf. f. w.	....	96	$150–1^{0.5}$	s. h.	v. s.	v. s. eth.
6096	pr. f. h. w.	....	120	....	sl. s.	v. s.	v. s. eth.
6097	col. pr. f. eth.	....	189.5	subl.	v. sl. s. c.	s. h.	v. s. eth., chl.
6098	need. f. w., $1.7083^{99.4}$	1.147^{99}	78	....	v. sl. s. c., s. h.	s. h.	sl. s. eth.
6099	leaf. f. bz.; need. f. w.	....	117.5	....	sl. s.	v. s.	v. sl. s. eth.
6100	col. cr. f. al., $1.6828^{99.4}$	1.127^{99}	66.5	subl. 205^{12}	sl. s.	v. s.	v. s. eth.
6101	leaf. f. eth.	....	191	....	......	v. s.	s. eth.
6102	need. f. w.	....	216	....	v. sl. s. h.	v. sl. s.	v. sl. s. eth.
6103	col. leaf.	....	110	>360	i.	s. h.	s. eth., bz., h. ac. a.
6104	need. f. al. +eth.	....	81	264^{15}	i.	sl. s.	s. eth., bz., chl.
6105	col. need. f. al.	....	105	250^{20} sl. d.	i.	s. h.	v. s. eth.; s. bz., h. ac. a.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6106	**1-Naphthyl ketone**	α, α-dinaphthyl ketone	$C_{10}H_7COC_{10}H_7$	282.32
6107	**1,2′-Naphthyl ketone**	α,β'-dinaphthyl ketone	$C_{10}H_7COC_{10}H_7$	282.32
6108	**2-Naphthyl ketone**	β, β'-dinaphthyl ketone	$C_{10}H_7COC_{10}H_7$	282.32
6109	**Naphthyl mercaptan.**	See *Naphthol, thio-.*		
6110	**2-Naphthyl salicylate.**	See *Betol.*		
6111	**Narceine**		$C_{23}H_{27}NO_8\cdot 3H_2O$	499.51
6112	——, bisulfate		$C_{23}H_{27}NO_8\cdot H_2SO_4\cdot 10H_2O$	723.69
6113	——, hydrochloride		$C_{23}H_{27}NO_8\cdot HCl\cdot 3H_2O$	535.97
6114	**Narcotine**		$C_{22}H_{23}NO_7$	413.41
6115	——, hydrochloride		$C_{22}H_{23}NO_7\cdot HCl\cdot H_2O$	467.90
6116	***dl*-Narcotine.**	See *Gnoscopine.*		
6117	**Narcotine hemipic acid.**	See *Hemipic acid.*		
6118	**Naringin**		$C_{23}H_{28}O_{12}$(?)	496.46(?)
6119	**Neohexane.**	See *Butane, 2,2-dimethyl-*.*		
6120	**Neopentane.**	See *Propane, 2,2-dimethyl-*.*		
6121	**Neopentyl alcohol.**	See *1-Propanol, 2,2-dimethyl-**		
6122	**Neral.**	See *Citral b.*		
6122M	**Nerol**	3,7-dimethyl-2,6-octadien-1-ol*	$C_{10}H_{17}OH$	154.25
6123	**Nerolin (new).**	See *Ether, ethyl 2-naphthyl.*		
6124	**Nerolin (old).**	See *Ether, methyl 2-naphthyl.*		
6125	**Neurine**	trimethylvinylammonium hydroxide	$CH_2{:}CHN(CH_3)_3OH$	103.16
6126	**Nevile-Winther acid.**	See *1-Naphthol-4-sulfonic acid.*		
6127	**Ngai camphor.**	See *l-Borneol.*		
6128	**Nicoteine**		$C_{10}H_{12}N_2$	160.21
6128M	**Nicotinamide**	nicotinic amide; 3-pyridinecarboxamide*; pellagra-preventive vitamin; P.P. factor	$C_5H_4NCONH_2$	122.12
6129	**Nicotine**		$C_{10}H_{14}N_2$	162.23
6130	——, hydrochloride (*d*)		$C_{10}H_{14}N_2\cdot 2HCl$	235.16
6131	——, picrate		$C_{10}H_{14}N_2\cdot 2C_6H_3N_3O_7$	620.45
6132	——, salicylate		$C_{10}H_{14}N_2\cdot C_7H_6O_3$	300.35
6133	——, tartrate	nicotine bitartrate	$C_{10}H_{14}N_2\cdot 2C_4H_6O_6\cdot 2H_2O$	498.44
6134	**Nicotinic acid**	3-pyridinecarboxylic acid*; pellagra-preventive vitamin; P. P. factor	C_5H_4NCOOH	123.11
6135	——, *N*-methylbetaine.	See *Trigonelline.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6106	need. f. eth....	....	104	subl.	......	s. h.	sl. s.eth., h. ac. a., lgr.; v. s. bz.; s. chl., H_2SO_4
6107	col. need. f. al.	....	136–7 (135)	subl.	......	1.3^{14}	v. s. eth.; s. bz.
6108	(1) need. f. eth.	....	125.5	....	i.	0.37^{19}	....
	(2) leaf. f. chl. + eth.	....	164.5	....	i.	0.08^{19}	sl. s. eth.; s. chl.
6109							
6110							
6111	col. pr. f. w....	....	anh. 170	....	0.078^{13}	0.1	i. eth., bz.; s. alk., NH_4OH; sl. s. chl.; 0.011^{17} CCl_4
6112	cr. powd. or need.	....	d. → yel.	....	s.	s. h.	s. chl.
6113	yel. cr. f. HCl.	....	anh. 192	....	sl. s.	s.	s. me. al.
6114	col. rhomb. need. f. al., $[\alpha]-207.35°_D$	1.374	175	d.	0.004^{20}	1^{20}	0.8^4, 2.1^{35} eth.; v. s. chl.; s. bz., CS_2, eth. ac., acet., pet. eth.
6115	wh. lust. cr....	....	197–8	....	s.	......	s. chl.
6116							
6117							
6118	sm. pr........	....	anh. 171	....	sl. s. c., s. h.	v. s. h.	i. eth.
6119							
6120							
6121							
6122							
6122M	oil..........	0.881^{15}	....	$224–5^{745}$	......	......	....
6123							
6124							
6125	syrup........	....	....	....	s.	s.	s. eth.
6126							
6127							
6128	....	1.078^{12}	....	267	......	......	....
6128M	wh. cr. powd..	....	129–31	....	100	66.6	sl. s. eth., bz.; 10 glyc.
6129	col. oil., $1.52392^{22.4}$ $[\alpha]-161.55°$	$1.00924\frac{20}{4}$	<−80	247.3	s.	∞	∞ eth.; v. s. chl., pet. eth., oils
6130	deliq. cr......	....	....	....	s.	s.	....
6131	yel.need.or pr.	....	218	....	......	......	....
6132	wh. pl........	....	117.5	....	s.	s.	s. eth.
6133	reddish-wh. cr.	....	88–90	....	v. s.	s.	s. eth.
6134	col. need......	....	234–37	subl.	sl. s. c., s. h.	0.73^{25}	v. sl. s. eth.
6135							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6136	**Nicotinic acid, 2-hydroxy-**		$C_5H_3N(OH)COOH$	139.11
6137	**——, 1,2,5,6-tetrahydro-1-methyl-.** See *Arecaidine.*			
6137M	**Nicotinic amide.**	See *Nicotinamide.*		
6138	**Nicotyrine**	3-(1-methyl-2-pyrryl)pyridine; dipyridine	$C_{10}H_{10}N_2$	158.20
6139	**Niobe oil.**	See *Benzoic acid, methyl ester.*		
6140	**Nitramine diethyl-.**	See *Diethylamine, N-nitro-.*		
6141	**——, dimethyl-.**	See *Dimethylamine, N-nitro-.*		
6142	**——, methylpicryl-.**	See *Tetryl.*		
6143	**——, phenyl-.**	See *Aniline, N-nitro-.*		
6144	**——, *n*-propyl-.**	See *Propylamine, N-nitro-.*		
6145	**Nitranilic acid**	2,5-dihydroxy-3,6-dinitroquinone	$(NO_2)_2C_6O_2(OH)_2$	230.09
6146	**Nitranilide.**	See *Aniline, N-nitro-.*		
6147	**Nitric diethylamide.**	See *Diethylamine, N-nitro-.*		
6148	**Nitric dimethylamide.**	See *Dimethylamine, N-nitro-.*		
6149	**Nitric ether.**	See *Ethyl nitrate.*		
	Nitro-. See the parent compounds (e.g., for nitrobenzene see *Benzene, nitro-*).			
6150	**Nitroerythrite.**	See *Erythritol, tetranitrate.*		
6151	**Nitroform**	trinitromethane*	$CH(NO_2)_3$	151.04
6152	**Nitroglycerin**	glycerol trinitrate; glyceryl nitrate; trinitrin; glonoin; etc.	$C_3H_5(ONO_2)_3$	227.09
6153	**Nitrolic acid, ethyl-.**	See *Acetonitrolic acid.*		
6154	**——, methyl-.**	See *Formonitrolic acid.*		
6155	**Nitromannite.**	See *Mannitol, hexanitrate.*		
6156	**Nitron**	4,5-dihydro-1,4-diphenyl-3,5-phenylimino-1,2,4-triazole	$C_{20}H_{16}N_4$	312.36
6157	**Nitrosamine, diethyl-.**	See *Diethylamine, N-nitroso-.*		
6158	**——, diisopropyl-.**	See *Diisopropylamine, N-nitroso-.*		
6159	**——, dimethyl-.**	See *Dimethylamine, N-nitroso-.*		
6160	**——, diphenyl-.**	See *Diphenylamine, N-nitroso-.*		
6161	**——, dipropyl-.**	See *Dipropylamine, N-nitroso-.*		
6162	**——, methylphenyl-.**	See *Aniline, N-methyl- N-nitroso-.*		
	Nitroso-. See the parent compounds (e.g., for nitrosobenzene see *Benzene, nitroso-*).			
6163	**Nitrous diethylamide.**	See *Diethylamine, N-nitroso-.*		
6164	**Nitrous diisopropylamide.** See *Diisopropylamine, N-nitroso-.*			
6165	**Nitrous dimethylamide.** See *Dimethylamine, N-nitroso-.*			
6166	**Nitrous diphenylamide.** See *Diphenylamine, N-nitroso-.*			
6167	**Nitrous dipropylamide.** See *Dipropylamine, N-nitroso-.*			
6168	**Nitrous ether.**	See *Ethyl nitrite.*		
6168M	**1-Nonacosanol***	*n*-nonacosyl alcohol	$n\text{-}C_{29}H_{59}OH$	424.78
6168R	***n*-Nonacosyl alcohol.**	See 1-*Nonacosanol.**		
6169	**Nonadecane***	*n*-nonadecane	$CH_3(CH_2)_{17}CH_3$	268.51
6170	**Nonadecanoic acid***	*n*-nonadecylic acid	$CH_3(CH_2)_{17}COOH$	298.50
6171	**1-Nonadecanol***	*n*-nonadecyl alcohol	$CH_3(CH_2)_{18}OH$	284.51
6172	**10-Nonadecanone***	caprinone; dinonyl ketone	$(C_9H_{19})_2CO$	282.50
6173	***n*-Nonadecyl alcohol.**	See 1-*Nonadecanol**.		
6174	***n*-Nonadecylic acid.**	See *Nonadecanoic acid**.		
6175	**Nonamethylene glycol.**	See 1,9-*Nonanediol**.		
6176	**Nonanal,** oxime.	See *Pelargonaldehyde, oxime.*		
6177	**Nonanamide*.**	See *Pelargonamide.*		
6178	**Nonane***	*n*-nonane	$CH_3(CH_2)_7CH_3$	128.25
6178M	**——, 1-amino-.**	See *Nonylamine**(*n*).		
6179	**Nonanedioic acid*.**	See *Azelaic acid.*		
6180	**1,9-Nonanediol***	nonamethylene glycol; enneamethylene glycol	$CH_2OH(CH_2)_7CH_2OH$	160.25

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6136	need. f. w.....	....	α256; β301–2 d.	subl.	sl. s. h.	sl. s.	sl. s. eth.; v. sl. s. chl.
6137							
6137M							
6138	need. f. h. w...	1.124^{18}	108	$286–90^{735}$ (280–1)	sl. s. c., s. h.	s.	s. eth.
6139							
6140							
6141							
6142							
6143							
6144							
6145	lng. yel. pl. f. acet.	....	100	170 d.	v. s.	v. s.	i. eth.
6146							
6147							
6148							
6149							
6150							
6151	col. oil or wh. cr.	$1.5967^{24.3}_{4}$	15	$45–7^{22}$ exp.	s.	......	s. alk.
6152	col.-yel. liq., $1.482^{18.6}$	1.601	2.9; 13.2	exp. 260	0.18^{20}	25	∞ eth.; 7 me. al.
6153							
6154							
6155							
6156	yel. need......	....	189 d.	....	i.	s.	sl. s. eth.; s. bz., acet., chl., et. ac.
6157							
6158							
6159							
6160							
6161							
6162							
6163							
6164							
6165							
6166							
6167							
6168							
6168M	....	....	84.6–85.0	....	......	......	....
6168R							
6169	leaf., $1.436^{34.6}$	0.777^{32}	32	330	i.	sl. s.	s. eth.
6170	glit. leaf. f. al..	....	66.5	299^{100}	i.	sl. s.	s. eth.
6171	opaque cr......	....	62	....	......	......	....
6172	leaf. f. al......	....	58	>350	i.	s. h.	s. eth.
6173							
6174							
6175							
6176							
6177							
6178	col. liq., 1.40542^{20}	0.71763^{20}	–53.7 (–51.0)	150.798	i.	v. s.	v. s. eth.
6178M							
6179							
6180	....	....	....	$147–50^{2}$	sl. s.	s.	i. eth.

No.	Name	Synonyms	Formula	Mol. Wt.
6181	**Nonanenitrile*.**	See *Pelargononitrile.*		
6182	**Nonanoic acid*.**	See *Pelargonic acid.*		
6183	**1-Nonanol***	*n*-nonyl alcohol	$CH_3(CH_2)_7CH_2OH$	144.25
6184	**——, 2-methyl-***	2-heptyl-2-methylethanol	$CH_3(CH_2)_6CH(CH_3)CH_2OH$	158.28
6185	**2-Nonanol***	heptylmethylcarbinol	$CH_3CHOH(CH_2)_6CH_3$	144.25
6186	**3-Nonanol***	ethylhexylcarbinol	$CH_3CH_2CHOH(CH_2)_5CH_3$	144.25
6187	**4-Nonanol***	amylpropylcarbinol	$CH_3(CH_2)_2CHOH(CH_2)_4CH_3$	144.25
6188	**5-Nonanol***	dibutylcarbinol	$(C_4H_9)_2CHOH$	144.25
6189	**——, 2,8-dimethyl-***	diisoamylcarbinol	$[(CH_3)_2CH(CH_2)_2]_2CHOH$	172.30
6190	**2-Nonanone***	heptyl methyl ketone	$CH_3CO(CH_2)_6CH_3$	142.24
6191	**3-Nonanone***	ethyl hexyl ketone	$C_2H_5CO(CH_2)_5CH_3$	142.24
6192	**5-Nonanone***	dibutyl ketone	$(CH_3CH_2CH_2CH_2)_2CO$	142.24
6193	**——, 2,8-dimethyl-***	diisoamyl ketone; isocaprone; diisopentyl ketone	$[(CH_3)_2CH(CH_2)_2]_2CO$	170.29
6194	**Nonanoyl chloride*.**	See *Pelargonyl chloride.*		
6195	**1-Nonene***	α-nonylene	$CH_3(CH_2)_6CH{:}CH_2$	126.24
6196	**1-Nonine.**	See 1-*Nonyne*.*		
6197	***n*-Nonyl alcohol.**	See 1-*Nonanol*.*		
6198	**Nonylamine*(*n*)**	1-aminononane	$CH_3(CH_2)_7CH_2NH_2$	143.27
6199	***n*-Nonyl cyanide.**	See *Caprinitrile.*		
6200	**α-Nonylene.**	See 1-*Nonene*.*		
6201	***n*-Nonylic acid.**	See *Pelargonic acid.*		
6202	**Nonylone.**	See 9-*Heptadecanone*.*		
6203	**Nonyl sulfate**	di-*n*-nonyl sulfate	$[CH_3(CH_2)_8]_2SO_4$	350.55
6204	**1-Nonyne***	1-nonine; *n*-heptylacetylene	$CH \vdots C(CH_2)_6CH_3$	124.22
6205	**Norcamphane, 2,2-dimethyl-3-methylene-.**	See *Camphene.*		
6206	**——, 7,7-dimethyl-2-methylene-.**	See *α-Fenchene.*		
6207	**——, 2-keto-1,7,7-trimethyl-.**	See *Camphor.*		
6208	**——, 1,7,7-trimethyl-.**	See *Camphane.*		
6209	**——, 2,2,3-trimethyl-.**	See *Isocamphane.*		
6210	**2-Norcamphanone, 1,3,3-trimethyl-.**	See *Fenchone.*		
6211	**DL-Norleucine**	*dl*-α-aminocaproic acid; *dl*-glycoleucine; *dl*-2-aminohexanoic acid*	$CH_3(CH_2)_3CH(NH_2)COOH$	131.17
6212	**L-Norleucine**	*d*-α-aminocaproic acid; *d*-2-aminohexanoic acid*; *d*-glycoleucine	$CH_3(CH_2)_3CH(NH_2)COOH$	131.17
6213	**D-Norleucine**	*l*-α-aminocaproic acid; *l*-2-aminohexanoic acid*; *l*-glycoleucine	$CH_3(CH_2)_3CH(NH_2)COOH$	131.17
6214	**Normenthane.**	See *Cyclohexane, isopropyl-.*		
6215	**3-Nortropanol, 8-methyl-.**	See *Tropine.*		
6216	**Nosophen.**	See *Phenolphthalein,* 3′,3″,5′,5″-tetraiodo-.		
6217	**Novocain.**	See *Procaine, hydrochloride.*		
6218	**Nucin.**	See *Juglone.*		
6219	**Ocimene**	3,7-dimethyl-1,3,6-octatriene* (one form)	$(CH_3)_2C{\cdot}CHCH_2CH{:}C(CH_3)CH{:}CH_2$	136.23

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6181							
6182							
6183	col. liq., 1.43347^{20}	$0.8274\frac{20}{4}$	-5	213	i.	∞	∞ eth.
6184	liq	$0.849\frac{0}{4}$	....	118^{15}	i.	s.	s. eth.
6185	col. liq., 1.4290^{25}	$0.8190\frac{25}{4}$; $0.8471\frac{20}{4}$	-35	193-4 (198.3)	i.	s.	s. eth.
6186	liq	$0.825\frac{20}{4}$	-22	$194\text{-}5^{750}$	i.	s.	s. eth.
6187	liq	0.8282	....	192-3	i.	s.	s. eth.
6188	thick oil, 1.4289^{18}	0.823^{18}	....	194	i.	∞	∞ eth.
6189	liq	$0.8305\frac{12.6}{4}$	....	105^{9}	i.	s.	s. eth.
6190	liq	0.8317	-8.2 (-19)	194-6	i.	s.	s. eth.
6191	pr.	0.840^{0}	-8	190	......	s.	s. eth.
6192	col. liq., 1.421^{15}	$0.8270\frac{13}{4}$	-5.9	186-7 (181-2)	v. sl. s.	s.	s. eth.; v. s. chl., CS_2
6193	yel. oil	$0.8208\frac{25}{4}$	14.6	226	i.	s.	s. eth.
6194							
6195	col. liq., 1.41572^{20}	0.72922^{20}	−81.37	46.868	i.	s.	s. eth.
6196							
6197							
6198	col. liq	....	....	202.2	sl. s.	s.	s. eth.
6199							
6200							
6201							
6202							
6203	....	....	41.9-2.1	....	......	......	....
6204	col. liq	0.7924	-36	160^{745}	i.	s.	s. eth.
6205							
6206							
6207							
6208							
6209							
6210							
6211	shiny leaf	....	327 d.	....	1.18^{25}, 2.88^{75}	0.267^{25} 75%	....
6212	hex. leaf. f. w.	....	301 d.	....	1.5^{25}	i.	....
6213	leaf. f. w	....	301 d.	....	1.6^{19}	......	....
6214							
6215							
6216							
6217							
6218							
6219	liq., 1.4883^{14}	0.801^{15}	....	176-8	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6219B	**Allo-Ocimene "A" form**	2,6 dimethyl-2,4,6-octatriene	$C_{10}H_{16}$	136.23
6219C	**Allo-Ocimene "B" form**	" "	$C_{10}H_{16}$	136.23
6219M	**1-Octacosanol***	*n*-octacosyl alcohol	$n\text{-}C_{28}H_{57}OH$	410.75
6219R	***n*-Octacosyl alcohol.**	See 1-*Octacosanol.*		
6220	**9,12-Octadecadienoic acid*.**	See *Eleostearic acid.*		
6221	**9,13-Octadecadienoic acid*(?).**	See *Eleomargaric acid.*		
6222	**Octadecanal*.**	See *Stearaldehyde.*		
6223	**Octadecanamide*.**	See *Stearamide.*		
6224	**Octadecane***	*n*-octadecane	$CH_3(CH_2)_{16}CH_3$	254.49
6224F	**——, 1-amino-.**	See *Octadecylamine*(n).*		
6224M	**——, 1-bromo-***	*n*-octadecyl bromide	$CH_3(CH_2)_{17}Br$	333.40
6224T	**——, 1-iodo-***	*n*-octadecyl iodide	$CH_3(CH_2)_{17}I$	380.40
6225	**Octadecanenitrile*.**	See *Stearonitrile.*		
6226	**Octadecanoic acid*.**	See *Stearic acid.*		
6227	**Octadecanoic anhydride*.**	See *Stearic anhydride.*		
6228	**1-Octadecanol***	*n*-octadecyl alcohol	$CH_3(CH_2)_{16}CH_2\text{-}OH$	270.49
6228M	**1-Octadecanone, 1-phenyl-.**	See *Stearophenone.*		
6229	**Octadecanoyl chloride*.**	See *Stearoyl chloride.*		
6230	**9,12,15-Octadecatrienoic acid*.**	See *α-Linolenic acid.*		
6231	**9-Octadecenamide*.**	See *Oleamide.*		
6232	**9-Octadecenoic acid*.**	See *Elaidic acid; Oleic acid.*		
6233	**——, 12-hydroxy-*.**	See *Ricinoleic acid.*		
6233M	**9-Octadecen-1-ol*, *cis*-**	*cis*-9-octadecenyl alcohol; oleyl alcohol	$CH_3(CH_2)_7CH{:}CH\text{-}(CH_2)_8OH$	268.47
6233T	**9-Octadecenyl alcohol.**	See 9-*Octadecen-1-ol*.*		
6234	***n*-Octadecyl alcohol.**	See 1-*Octadecanol*.*		
6234H	**Octadecylamine*(*n*)**	1-aminoöctadecane	$CH_3(CH_2)_{17}NH_2$	269.50
6234R	***n*-Octadecyl bromide.**	See *Octadecane, 1-bromo-*.*		
6235	***n*-Octadecylic acid.**	See *Stearic acid.*		
6235M	***n*-Octadecyl iodide.**	See *Octadecane, 1-iodo-*.*		
6236	**Octadecyl sulfate**	di-*n*-octadecyl sulfate	$[CH_3(CH_2)_{17}]_2SO_4$	603.02
6236M	**1-Octadecyne***	hexadecylacetylene	$CH \vdots C(CH_2)_{15}CH_3$	250.46
6237	**9-Octadecynoic acid*.**	See *Stearolic acid.*		
6238	**Octadiene.**	See *Conylene.*		
6238F	**1,6-Octadiene, 3,7-dimethyl-***	linaloölene	$C_{10}H_{18}$	138.25
6238M	**2,6-Octadiene, 2,6-dimethyl-**	dihydromyrcene	$C_{10}H_{18}$	138.25
6238T	**2,4-Octadiene, 7-methyl-***	....	C_9H_{16}	124.22
6239	**2,7-Octadiene, 2-methyl-6-methylene-*.**	See *Myrcene.*		
6240	**2,6(and 2,7)-Octadienoic acid, 3,7-dimethyl-*.**	See *Geranic acid.*		
6241	**1,6-Octadien-3-ol, 3,7-dimethyl-*.**	See *Linaloöl.*		
6241H	**2,6-Octadien-1-ol, 3,7-dimethyl-*.**	See *Geraniol; Nerol.*		
6242	**Octamethylene glycol.**	See 1,8-*Octanediol*.*		
6243	**Octanal*.**	See *Caprylaldehyde.*		
6244	**Octanamide*.**	See *Caprylamide.*		
6245	**Octane***	*n*-octane	$CH_3(CH_2)_6CH_3$	114.23
6246	**——, 1-amino-.**	See *Octylamine*.*		
6247	**——, 2-amino-.**	See *Heptylamine, α-methyl-.*		
6248	**——, 1-bromo-***	*n*-octyl bromide	$CH_3(CH_2)_6CH_2Br$	193.13
6249	**——, 2-bromo-*(*l*)**	*l*-*sec*-*n*-octyl bromide	$CH_3CHBr(CH_2)_5\text{-}CH_3$	193.13
6250	**——, 1-chloro-***	*n*-octyl chloride	$CH_3(CH_2)_6CH_2Cl$	148.67

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6219B	1.5446^{20}	0.8060	−21.0– −20.6	89^{20}	......	......	....
6219C	1.5446^{20}	0.8118	−35.4– −34.0	91^{20}	......	......	....
6219M	....	....	83.2–83.4	....	......	......	....
6219R							
6220							
6221							
6222							
6223							
6224	cr. f. al., $1.4349^{35.2}$	$0.7768\frac{28}{4}$	28	317	i.	sl. s.	s. eth.
6224F							
6224M	col. cr........	....	28.5	....	i.	s.	s. eth.
6224T	col. cr........	....	34	$169^{0.5}$	i.	sl. s.	sl. s. eth.
6225							
6226							
6227							
6228	leaf. f. al......	$0.8124\frac{59}{4}$	59 (57.85)	210.5^{15}	i.	s.	s. eth.
6228M							
6229							
6230							
6231							
6232							
6233							
6233M	col. liq........	$0.8489\frac{20}{4}$	....	$205–10^{15}$	i.	s.	s. eth.
6233T							
6234							
6234H	col. cr........	....	....	232.0^{32}; 176.1^{2}	i.	s.	s. eth.
6234R							
6235							
6235M							
6236	....	....	70.2–0.7	....	......	......	....
6236M	cr............	0.796^{30}	26	180^{15}	......	......	....
6237							
6238							
6238F	liq...........	0.788^{20}	....	165–8	......	......	....
6238M	liq...........	$0.775\frac{21}{4}$	....	171.5–3.5	......	......	....
6238T	liq...........	$0.752\frac{18}{4}$	....	149	i.	......	....
6239							
6240							
6241							
6241H							
6242							
6243							
6244							
6245	col. liq., 1.3975	0.7036	−56.5	125.8 (124.6)	0.0015^{16}	sl. s.	s. eth.
6246							
6247							
6248	liq., 1.4503^{25}	$1.1160\frac{15}{4}$; $1.118\frac{20}{4}$	−55	202–3 (201.5)	i.	∞	∞ eth.
6249	liq...........	1.099^{22}	....	191 $(91–3^{20})$	i.	∞	∞ eth.
6250	liq...........	$0.8745\frac{20}{4}$	....	184.6	i.	v. s.	v. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6251	**Octane, 2-chloro-***	*sec*-octyl chloride	$CH_3(CH_2)_5CHClCH_3$	148.67
6252	**——, 2,7-dimethyl-***	biisoamyl	$(CH_3)_2CH(CH_2)_4CH(CH_3)_2$	142.28
6253	**——, 1-ethoxy-*.**	See *Ether, ethyl octyl.*		
6254	**——, 1-iodo-***	*pri-n*-octyl iodide	$CH_3(CH_2)_7I$	240.14
6255	**——, 3-methyl-*,(*d*)-**	*d*-amylethylmethylmethane	$CH_3CH_2CH(CH_3)(CH_2)_4CH_3$	128.25
6256	**——, 1-octyloxy-*.**	See *Octyl ether.*		
6257	**——, 1-phenoxy-*.**	See *Ether, octyl phenyl.*		
6258	**1,1-Octanedicarboxylic acid.**	See *Malonic acid, heptyl*-.		
6259	**Octanedioic acid*.**	See *Suberic acid.*		
6260	**1,8-Octanediol***	octamethylene glycol	$CH_2OH(CH_2)_6CH_2OH$	146.23
6261	**4,5-Octanediol***	octylene glycol (one form)	$[CH_3(CH_2)_2CHOH]_2$	146.23
6262	**Octanenitrile*.**	See *Caprylonitrile.*		
6263	**Octanoic acid*.**	See *Caprylic acid.*		
6264	**Octanoic anhydride*.**	See *Caprylic anhydride.*		
6265	**1-Octanol***	heptylcarbinol; *pri-n*-octyl alcohol	$CH_3(CH_2)_6CH_2OH$	130.23
6266	——, acetate	*n*-octyl acetate	$CH_3COO(CH_2)_7CH_3$	172.26
6267	——, esters of other organic acids.	See "octyl ester" under the corresponding acids.		
6268	——, nitrate.	See *Octyl nitrate.*		
6269	——, nitrite.	See *Octyl nitrite.*		
6270	**——, 3,7-dimethyl-*(*i*)**	tetrahydrogeraniol	$(CH_3)_2CH(CH_2)_3CH(CH_3)CH_2CH_2OH$	158.28
6271	**2-Octanol***	methylhexylcarbinol; *sec-n*-octyl alcohol	$CH_3CHOH(CH_2)_5CH_3$	130.23
6272	**——, 2-methyl-***	hexyldimethylcarbinol	$(CH_3)_2COH(CH_2)_5CH_3$	144.25
6273	**3-Octanol, 3-ethyl-***	amyldiethylcarbinol; *tert*-decyl alcohol	$(C_2H_5)_2COH(CH_2)_4CH_3$	158.28
6274	**2-Octanone***	hexylmethyl ketone	$CH_3COC_6H_{13}$	128.21
6275	**3-Octanone***	amyl ethyl ketone	$C_2H_5CO(CH_2)_4CH_3$	128.21
6276	**Octanoyl chloride*.**	See *Caprylyl chloride.*		
6277	**1,3,6-Octatriene, 3,7-dimethyl-*.**	See *Ocimene.*		
6278	**6-Octen-1-ol, 3,7-dimethyl-*.**	See *Rhodinol.*		
6279	**Octine.**	See *Octyne.*		
6280	***n*-Octoic acid.**	See *Caprylic acid.*		
6281	***n*-Octoic anhydride.**	See *Caprylic anhydride.*		
6282	***n*-Octyl acetate.**	See 1-*Octanol*, acetate.*		
6283	***pri-n*-Octyl alcohol.**	See 1-*Octanol*.*		
6284	**sec-*n*-Octyl alcohol.**	See 2-*Octanol*.*		
6285	***n*-Octyl aldehyde.**	See *Caprylaldehyde.*		
6286	**Octylamine*(*n*)**	1-aminoöctane; *pri-n*-octylamine	$CH_3(CH_2)_6CH_2NH_2$	129.24
6287	**sec-*n*-Octylamine.**	See *Heptylamine, α-methyl-*.*		
6288	***n*-Octyl bromide.**	See *Octane, 1-bromo-*.*		
6289	**sec-*n*-Octyl bromide.**	See *Octane, 2-bromo-*.*		
6290	***n*-Octyl chloride.**	See *Octane, 1-chloro-*.*		
6291	**sec-*n*-Octyl chloride.**	See *Octane, 2-chloro-*.*		
6292	***n*-Octyl cyanide.**	See *Pelargononitrile.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6251	liq..........	$0.871\frac{15}{4}$	....	173	i.	v. s.	s. eth.
6252	mobile liq., $1.40924^{18.1}$; 1.41049^{15}	0.7479^{20}	−52.5	159.66	i.	s.	s. eth., ac. a.
6253							
6254	liq., 1.489.....	1.341^{15} (1.3531^{15})	−45.9	225–225.5	i.	s.	s. eth.
6255	col. liq.......	0.7206^{17}	....	142–3	i.	i.	s. eth.
6256							
6257							
6258							
6259							
6260	need.........	....	63	172^{20}	sl. s.	s.	i. eth.
6261	(α) liq........ (β)...........	....	 123–4	$112–5^{10}$ $115–8^{10}$	i. i.	...... s.	.... sl. s. eth.
6262							
6263							
6264							
6265	col. liq., 1.42920^{20}	$0.8246\frac{20}{4}$	−16.3	195	s.	∞	∞ eth.
6266	col. liq.......	$0.885\frac{0}{4}$	−38.5	210	i.	s.	s. eth.
6267							
6268							
6269							
6270	liq...........	0.8333^{15}	....	221–3	i.	s.	s. eth.
6271	col. oily liq., 1.4260	0.8193	−38.6	178.5 (179)	i.	s.	s. eth.
6272	liq...........	....	....	178	i.	s.	s. eth.
6273	col. oil.......	$0.8360\frac{15}{4}$	....	199	i.	s.	....
6274	col. liq., 1.41613	0.818	−20.9	173.5	i.	∞	∞ eth.
6275	col. liq.......	$0.850\frac{0}{4}$	....	168	i.	∞	∞ eth.
6276							
6277							
6278							
6279							
6280							
6281							
6282							
6283							
6284							
6285							
6286	col. liq., 1.430.	0.777^{27}	....	179.6	sl. s.	v. s.	v. s. eth.
6287							
6288							
6289							
6290							
6291							
6292							

No.	Name	Synonyms	Formula	Mol. Wt.
6293	**Octylene**	caprylene	C_8H_{16}	112.21
6294	**Octylene glycol.**	See 4,5-*Octanediol**.		
6295	**Octyl ether**	1-octyloxyoctane*; di-*n*-octyl ether	$(C_8H_{17})_2O$	242.44
6296	***n*-Octylic acid.**	See *Caprylic acid.*		
6297	***pri-n*-Octyl iodide.**	See *Octane, 1-iodo-**.		
6298	**Octyl nitrate**	*n*-octyl nitrate	$CH_3(CH_2)_7NO_3$	175.23
6299	**Octyl nitrite**	*n*-octyl nitrite	$CH_3(CH_2)_7ONO$	159.23
6300	**Octyl sulfate**	di-*n*-octyl sulfate	$[CH_3(CH_2)_7]_2SO_4$	322.50
6301	**1-Octyne***	1-octine; *n*-hexylacetylene; caprylidene	$CH{\vdots}C(CH_2)_5CH_3$	110.19
6301F	**2-Octyne***	2-octine; amylmethylacetylene	$CH_3C{\vdots}C{\cdot}C_5H_{11}$	110.19
6301J	**3-Octyne***	3-octine; butylethylacetylene	$C_2H_5C{\vdots}C(CH_2)_3CH_3$	110.19
6301M	**4-Octyne***	4-octine; dipropylacetylene	$C_3H_7C{\vdots}C{\cdot}C_3H_7$	110.19
6302	**2-Octynoic acid***, methyl ester	"methyl heptinecarbonate"	$CH_3(CH_2)_4C{\vdots}C{-}COOCH_3$	154.20
	Oenanth-.	See *Enanth-*.		
6303	**Oil of wintergreen**, artificial.	See *Salicylic acid, methyl ester*.		
6304	**Oleamide**	9-octadecenamide* (one form); oleic acid amide	$C_{17}H_{33}CONH_2$	281.47
6305	**Oleic acid**	9-octadecenoic acid* (*cis* form)	$C_8H_{17}CH{:}CH(CH_2)_7COOH$	282.46
6306	——, benzyl ester		$C_{17}H_{33}COOCH_2C_6H_5$	372.57
6307	——, butyl ester	butyl 9-octadecenoate* (one form)	$C_8H_{17}CH{:}CHC_7H_{14}COOC_4H_9$	338.56
6308	——, diethylene glycol ester.	See under *Diethylene glycol.*		
6309	——, ethyl ester		$C_8H_{17}CH{:}CH(CH_2)_7COOC_2H_5$	310.51
6310	——, isoamyl ester		$C_{17}H_{33}COO(CH_2)_2CH(CH_3)_2$	352.59
6311	——, methyl ester	methyl oleate	$C_{17}H_{33}COOCH_3$	296.48
6312	——, *p*-phenylphenacyl ester		$C_{17}H_{33}COOCH_2COC_6H_4C_6H_5$	476.68
6313	**Olein.**	See *Glycerol, trioleate.*		
6313M	**Oleyl alcohol.**	See 9-*Octadecen-1-ol*, cis-*.		
6314	**Opianic acid**	5,6-dimethoxyphthalaldehydic acid	$(CH_3O)_2C_6H_2(CHO)COOH$	210.18
6315	**Orcein**		$C_{28}H_{24}N_2O_7$	500.49
6316	**Orcinol**	5-methyl-1,3-benzenediol*; 5-methylresorcinol; 3,5-dihydroxytoluene	$CH_3C_6H_3(OH)_2$	124.13
6317	——, **2,4,6-trinitro-**		$(NO_2)_3C_6(CH_3)(OH)_2$	259.13
6318	**β-Orcinol.**	See *Resorcinol, 2,5-dimethyl-*.		
6319	**Orcinolphthalein**		$C_{22}H_{16}O_5$	360 35
6320	**Orexin.**	See *Quinazoline, 3,4-dihydro-3-phenyl-*.		
6321	**L-Ornithine**	*d*-α,δ-diaminovaleric acid; *d*-2,5-diaminopentanoic acid	$CH_2(NH_2)(CH_2)_2CH(NH_2)COOH$	132.16

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6293	col. liq., 1.4087	0.722^{17}; $0.7155\frac{20}{4}$	−104	123	i.	s.	s. eth.
6294							
6295	liq..........	$0.820\frac{0}{0}$; $0.805\frac{17}{17}$	....	291.8	sl. s.	s.	s. eth.
6296							
6297							
6298	liq..........	$0.8419\frac{17}{17}$	....	110–2^{20}	......	......	....
6299	grn. liq.......	0.862^{17}	....	174–5	......	......	....
6300	1.4408^{25}......	$0.9661\frac{25}{25}$	20.3	166.1^{2}	......	......	....
6301	col. liq., 1.4140^{25}	0.743^{25}	....	126; 50.8^{50}	i.	s.	s. eth.
6301F	col. liq., 1.4285^{25}	0.761^{25}	....	137.2; 60.2^{50}	i.	s.	s. eth.
6301J	col. liq., 1.4230^{25}	0.7501^{25}	....	133; 56.7^{50}	i.	s.	s. eth.
6301M	col. liq., 1.4225^{25}	0.7474^{25}	....	131; 55^{50}	i.	s.	s. eth.
6302	....	0.9524^{0}	....	107^{20}	i.	......	....
6303							
6304	cr............	....	76	....	i.	s.	s. eth.
6305	col. need., $1.463^{17.7}$	$0.895\frac{18}{4}$	14	286^{100}	i.	∞	∞ eth.; s. bz., chl.
6306	....	$0.9330\frac{25}{25}$	....	237^{7}	i.	s.	v. s. eth.
6307	liq..........	0.868^{25}	....	180–95^{2}; 173–235^{75}	i.	s.	s. eth.
6308							
6309	liq..........	0.871^{15}; 0.8671^{25}	....	205–8^{10}	i.	∞	∞ eth.
6310	col. liq.......	....	....	223–4^{10}	i.	s.	v. s. eth.
6311	oil..........	0.879^{18}	....	216–7^{20} (189–91^{10})	i.	∞	∞ eth.
6312	....	....	60.5	....	......	......	....
6313							
6313M							
6314	need. f. w.....	....	150	160 d.	0.25, 1.7^{100}	s.	s. eth.
6315	red-br. powd..	....	....	....	......	s.	i. eth., bz., chl., CS_2; s. acet., alk., ac. a.
6316	col. monocl. cr. f. chl.	1.290^{4}	+$1H_2O$, 58; anh. 107–8	289–90	s.	v. s.	v. s. eth.
6317	lng. yel. need.	....	163.5	exp.	i.	sl. s.	sl. s. eth.; v. s. h. bz.
6318							
6319	col. pr. f. acet.	....	230 d.	....	i.	s.	i. eth., bz.; s. h. ac. a., alk.
6320							
6321	syrup........	....	....	....	v. s.	v. s.	sl. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6322	**Ornithine, N^{δ}-guanyl-**.	See *Arginine.*		
6323	**Orsellinic acid,** 4-everninate.	See *Evernic acid.*		
6324	——, 4-methyl ether.	See *Everninic acid.*		
6325	***o*-Orsellinic acid**	4,6-dihydroxy-*o*-toluic acid; orsellinic acid	$(HO)_2C_6H_2(CH_3)$-$COOH$	168.14
6326	**Orthanilic acid**.......	*o*-aminobenzenesulfonic acid, *o*-anilinesulfonic acid	$NH_2C_6H_4SO_3H\cdot\frac{1}{2}H_2O$	182.19
6327	**Orthoacetic acid,** triethyl ester	1,1,1-triethoxyethane*.......	$CH_3C(OC_2H_5)_3$....	162.23
6328	**Orthocarbonic acid,** tetraethyl ester	tetraethoxymethane*........	$C(OC_2H_5)_4$........	192.25
6329	——, tetrapropyl ester......	*n*-propyl orthocarbonate; tetrapropoxymethane	$C(OC_3H_7)_4$........	248.36
6330	**Orthodiazine.**	See *Pyridazine.*		
6331	**Orthoformic acid,** triethyl ester	triethoxymethane*..........	$HC(OC_2H_5)_3$......	148.20
6332	——, triisopropyl ester......	isopropyl orthoformate; triisopropoxymethane	$HC[OCH(CH_3)_2]_3$..	190.28
6333	——, trimethyl ester........	trimethoxymethane.........	$HC(OCH_3)_3$......	106.12
6334	——, triphenyl ester........	triphenoxymethane.........	$CH(OC_6H_5)_3$......	292.32
6335	——, tripropyl ester........	*n*-propyl orthoformate; tripropoxymethane	$HC(OC_3H_7)_3$......	190.28
6335H	**Oryzanin.**	See *Vitamin B_1.*		
6335R	**Ovoflavin.**	See D-*Riboflavin.*		
6336	**7-Oxabicyclo[2,2,1]heptane-2,3-dicarboxylic anhydride, 2,3-dimeth**			
6337	**6-Oxabicyclo[3,2,1]oct-3-ene, 4,7,7-trimethyl-.**		See *Pinol.*	
6338	**Oxalacetic acid,** diethyl ester	diethyl oxobutanedioate*; diethyl hydroxybutenedioate*	$C_2H_5OOCCOCH_2$-$COOC_2H_5$	188.18
6339	**Oxalaldehyde.**	See *Glyoxal.*		
6340	**Oxalaldehydic acid.**	See *Glyoxylic acid.*		
6341	**Oxalamide.**	See *Oxamide.*		
6342	**Oxalan.**	See *Oxaluramide.*		
6343	**Oxalic acid**...........	ethanedioic acid*..........	$COOHCOOH\cdot2H_2O$	126.07
6344	——, diallyl ester.........	di-2-propenyl ethanedioate*; allyl oxalate	$(COOC_3H_5)_2$......	170.16
6345	——, dianilide.	See *Oxanilide.*		
6346	——, dibutyl ester..........	dibutyl ethanedioate*; butyl oxalate	$(COOCH_2CH_2$-$CH_2CH_3)_2$	202.25
6347	——, diethyl ester..........	diethyl ethanedioate*; ethyl oxalate; oxalic ester	$(COOC_2H_5)_2$......	146.14
6348	——, diisoamyl ester........	isoamyl oxalate; bis(γ-methylbutyl)ethanedioate*	$(COOC_5H_{11})_2$.....	230.30
6349	——, diisobutyl ester.......	bis(β-methylpropyl)ethanedioate*; isobutyl oxalate	$(COOC_4H_9)_2$......	202.25
6350	——, dimethyl ester........	dimethyl ethanedioate*; methyl oxalate	$(COOCH_3)_2$.......	118.09
6351	——, dipropyl ester.........	propyl oxalate; dipropyl oxalate	$(COOCH_2CH_2$-$CH_3)_2$	174.19
6352	——, ethyl methyl ester.....	....	$CH_3OOCCOOC_2$-H_5	132.11
6353	——, monoamide.	See *Oxamic acid.*		
6354	——, monoanilide.	See *Oxanilic acid.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6322							
6323							
6324							
6325	need. f. acet...	....	$-H_2O$, 100; 176 d.	....	s.	s.	15.7^{20} eth.; s. glyc.; sl. s. bz.
6326	col. pr........	....	d.	....	1.57^{19}	v. sl. s.	v. sl. s. eth.
6327	col. liq.......	$0.8847\frac{25}{4}$	....	142	......	∞	∞ eth.
6328	col. liq., 1.393.	$0.9197\frac{18}{4}$	....	159	......	∞	∞ eth.
6329	col. liq.......	0.911^{8}	....	224.2	......	......	....
6330							
6331	col. liq........	$0.8971\frac{19}{4}$	-76.1	145.9 (143–5)	s. d.	s.	s. eth.
6332	liq............	0.8621	....	166–8	......	......	....
6333	....	0.974^{23}	....	101–2	......	......	....
6334	cr.............	....	71	265^{50}	......	s.	s. eth.
6335	liq............	0.8805	....	105^{30}	2.1^{22}	......	....
6335H							
6335R							
6336	**yl-.** See *Canth*	*aridin.*					
6337							
6338	col. liq., $1.45614^{16.6}$	1.159	....	132^{24}	i.	∞	∞ eth., bz.
6339							
6340							
6341							
6342							
6343	col. monocl.; 1.440, 1.475, 1.625	1.653	101; 189 anh.	subl. 150	9.5^{15}, 120^{90}	23.7^{15}	1.37, anh. 16.9 eth.; i. chl., pet. eth., bz.
6344	oil...........	1.055	....	217	i.	s.	....
6345							
6346	col. liq........	1.011	....	243.4	i.	s.	s. eth.
6347	col. liq., 1.41011	1.08426^{15}; $1.0785\frac{20}{4}$	-40.6	185.4	sl. s.	∞	∞ eth., ord. org. solv.
6348	liq...........	$0.968\frac{11}{11}$	....	265	i.	v. s.	v. s. eth.
6349	col. liq.......	1.002^{14}	....	229	i.	s.	s. eth.
6350	col. monocl. tab., $1.379^{82.1}$	1.120^{82}; 1.1479^{54}; $1.422\frac{20}{4}$	54	163.3	6.18	s.	s. me. al.
6351	col. liq........	1.02, $1.038\frac{0}{0}$	....	214–5	sl. s.	∞	s. eth.
6352	col. liq........	1.156^{0}	....	173.7	i.	v. s.	v. s. eth.
6353							
6354							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6355	**Oxalic acid**, monoureide.	See *Oxaluric acid.*		
6356	——, *p*-phenylphenacyl ester		$(COOCH_2COC_6H_4C_6H_5)_2$	478.48
6357	——, piperazinium salt		$C_4H_{10}N_2 \cdot C_2H_2O_4$	176.17
6357M	——, urea salt.	See *Urea, oxalate.*		
6358	**Oxalic ester.**	See *Oxalic acid, diethyl ester.*		
6359	**Oxalimide.**	See *Oximide.*		
6360	**Oxalonitrile.**	See *Cyanogen.*		
6361	**Oxaluramide**	oxamic acid ureide; oxalan	$NH_2CONHCOCONH_2$	131.09
6362	**Oxaluric acid**	carbamyloxamic acid; oxalic monoureide	$NH_2CONHCOCOOH$	132.08
6363	**Oxalyl chloride**	ethanedioyl chloride*	$COClCOCl$	126.93
6364	**Oxamethan.**	See *Oxamic acid, ethyl ester.*		
6365	**Oxamic acid**	oxalic acid monoamide	$NH_2COCOOH$	89.05
6366	——, ethyl ester	ethyl oxamate; oxamethan	$NH_2COCOOC_2H_5$	117.10
6367	——, ureide.	See *Oxaluramide.*		
6368	——, ***N*-acetyl-**, ethyl ester	ethyl acetyloxamate	$CH_3CONHCOCOOC_2H_5$	159.14
6369	——, **carbamyl-.**	See *Oxaluric acid.*		
6370	——, **phenyl-.**	See *Oxanilic acid.*		
6371	**Oxamide**	ethanediamide*; oxalamide	$NH_2COCONH_2$	88.07
6372	——, ***N,N′*-diethyl-**	*N,N′*-diethylethanediamide*; *sym*-diethyloxamide	$(CONHC_2H_5)_2$	144.17
6373	——, ***N,N*-dimethyl-**	*unsym*-dimethyloxamide	$(CH_3)_2NCOCONH_2$	116.12
6374	——, ***N,N′*-dimethyl-**	*sym*-dimethyloxamide	$(CONHCH_3)_2$	116.12
6375	——, ***N,N′*-diphenyl-.**	See *Oxanilide.*		
6376	**Oxanilic acid**	phenyloxamic acid; oxalic acid monoanilide	$C_6H_5NHCOCOOH$	165.14
6377	**Oxanilide**	*N,N′*-diphenyloxamide; oxalic acid dianilide	$(CONHC_6H_5)_2$	240.25
6378	**Oxanthranol**	9,10-anthradiol or 10-hydroxyanthrone; anthrahydroquinone	$C_6H_4(COH)_2C_6H_4$	210.22
6379	**1,2-Oxathietan-4-one, 2,2-dihydro-2,2-dimethyl-.**	See *Thetin, dimethyl-.*		
6380	**1,4-Oxazine, tetrahydro-.**	See *Morpholine.*		
6381	**Oxazole, triphenyl-**	benzilam; azobenzil	$OC(C_6H_5){:}NC(C_6H_5){:}C(C_6H_5)$	297.34
6382	**Oximide**	oxalimide	$NCOHCO$	71.04
6383	**Oxindole**	2(3) indolone; *o*-amino-α-toluic acid lactam	$C_6H_4NHCOCH_2$	133.14
6384	——, **3-hydroxy-**	dioxindole; *o*-aminomandelic acid lactam	$C_6H_4NHCOCHOH$	149.14
6385	——, **3-imino-.**	See *Imesatin.*		
6386	**Oxirane.**	See *Ethylene oxide.*		
6387	——, **(chloromethyl)-.**	See *Epichlorohydrin.*		
6388	——, **(iodomethyl)-.**	See *Epiiodohydrin.*		
6389	——, **methyl-.**	See *Propene oxide.*		
6390	**Oxiraneacetonitrile.**	See *Epicyanohydrin.*		
6391	**Oxirene, methyl-.**	See *Propene,* 1,2 *epoxy-**.		
6392	**Oxyacanthine**	vinetine	$C_{19}H_{21}NO_3$	311.37

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6355							
6356	....	....	165.5 d.	....	......	......	....
6357	wh. cr........	....	>300	....	s. h.	v. sl. s.	i. eth.
6357M							
6358							
6359							
6360							
6361	cr...........	....	d.	....	i.	s.	s. H_2SO_4, KOH
6362	cr. powd......	....	187	....	v. sl. s.	......	....
6363	col. fum. liq., $1.43395^{12.9}$	1.488^{13}	–12	64	d.	d.	s. eth.
6364							
6365	col. cr........	....	210 d.	....	1.4^{14}	v. sl. s.	v. sl. s. eth.
6366	rhomb. leaf...	0.808^{19}	115	....	s. h.	s.	s. eth.; v. sl. s. bz.
6367							
6368	need.........	....	54	....	i., d. h.	s.	s. eth.
6369							
6370							
6371	wh. powd. monocl.	1.667	419 d.	....	$0.04^{7.3}$	v. sl. s.	v. sl. s. eth.
6372	col. need. f. al.	1.169^4	190	179	sl. s.	s.	v. sl. s. eth.
6373	col. pl. f. bz...	....	104	....	v. s.	v. s.	v. sl. s. eth.
6374	col. leaf. or need. f. w.	1.3^4	217 (209–10)	subl.	$2.5^{9.4}$	sl. s.	v. sl. s. eth.
6375							
6376	rhomb. need. f. bz.	....	150	....	s. h.	v. s.	v. s. eth.
6377	lust. sc. f. bz..	....	250 (246–7)	320	i.	v. sl. s. h.	i. (sl. s. h.) eth.
6378	ylsh. need. unst.	....	180	....	i.	s. (grn. fluores.)	s. alk.
6379							
6380							
6381	rhomb. pr. f. al.-eth.	....	115	....	......	sl. s.	sl. s. eth.
6382	col. pr........	....	....	....	v. sl. s., d. h.	......	sl. s. NH_4OH
6383	col. need. f. w.	....	120	d.	v. s. h.	s.	s. eth., alk.
6384	rhomb. pr. f. al.	....	180	195 d.	7.7 c., 16.7 h.	6.6	s. alk.
6385							
6386							
6387							
6388							
6389							
6390							
6391							
6392	wh. need. f. al. or eth., $[\alpha]+131.6^{\circ 15}_{D}$	....	202–14	....	s.	s.	s. eth., chl., bz., pet. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6393	**Oxyacanthine**, hydrochloride		$C_{19}H_{21}NO_3{\cdot}HCl{\cdot}2H_2O$	383.87
6394	——, nitrate		$C_{19}H_{21}O_3N{\cdot}HNO_3{\cdot}2H_2O$	410.42
6395	**Oxynarcotine**		$C_{22}H_{23}NO_8$	429.41
6396	**Oxyneurine.**	See *Betaine.*		
6397	**Oxysparteine**		$C_{15}H_{24}N_2O$	248.36
6398	——, hydrochloride		$C_{15}H_{24}N_2O{\cdot}HCl{\cdot}4H_2O$	356.89
6399	**Paeonol.**	See *Peonol.*		
6400	**Palmitaldehyde**, oxime	hexadecanal oxime*	$CH_3(CH_2)_{14}$-$CH{:}NOH$	255.44
6401	**Palmitamide**	hexadecanamide*; palmitic amide	$CH_3(CH_2)_{14}CONH_2$	255.44
6402	**Palmitic acid**	hexadecanoic acid*; *n*-hexadecylic acid	$CH_3(CH_2)_{14}COOH$	256.42
6403	——, benzyl ester		$C_{15}H_{31}COOCH_2$-C_6H_5	346.54
6404	——, cetyl ester	cetyl palmitate; hexadecyl hexadecanoate*	$C_{15}H_{31}COOC_{16}H_{33}$	480.84
6405	——, ethyl ester	ethyl hexadecanoate*	$CH_3(CH_2)_{14}$-$COOC_2H_5$	284.47
6406	——, ethylene ester.	See *Glycol, dipalmitate.*		
6407	—— glyceryl ester.	See *Glycerol, tripalmitate.*		
6408	——, methyl ester	methyl hexadecanoate*; methyl palmitate	$C_{15}H_{31}COOCH_3$	270.45
6409	——, myricyl ester		$C_{15}H_{31}COOC_{31}H_{63}$	691.23
6410	**Palmitic amide.**	See *Palmitamide.*		
6411	**Palmitin.**	See *Glycerol, tripalmitate.*		
6412	**Palmitolic acid**	7-hexadecynoic acid*	$CH_3(CH_2)_7C{:}C$-$(CH_2)_5COOH$	252.39
6413	**Palmitone.**	See 16-*Hentriacontanone**.		
6414	**Palmitonitrile**	hexadecanenitrile*	$CH_3(CH_2)_{14}CN$	237.42
6415	**Palmitoyl chloride, Palmityl chloride**	hexadecanoyl chloride*	$CH_3(CH_2)_{14}COCl$	274.87
6415M	**Pantothenic acid**	*N*-(α, γ-dihydroxy-β,β-dimethylbutyryl)-β-alanine; chick antidermatitis factor	$C_9H_{17}NO_5$	219.24
6416	**Papaverine**		$C_{20}H_{21}NO_4$	339.38
6417	——, hydrochloride		$C_{20}H_{21}NO_4{\cdot}HCl$	375.84
6418	**Paraacetaldehyde.**	See *Paraldehyde.*		
6419	**Parabanic acid**	oxalylurea	$\underline{NHCONHCOCO}$	114.06
6420	——, **dimethyl-.**	See *Cholestrophan.*		
6421	**Parabutyraldehyde**		$(C_3H_7CHO)_3$	216.31
6422	**Paraconic acid**	tetrahydro-5-oxo-3-furancarboxylic acid; itamalic acid γ-lactone	$\underline{CH_2COOCH_2CH}$- $COOH$	130.10
6423	——, **2,2-dimethyl-.**	See *Terebic acid.*		
6425	**Paracyanogen**		$(CN)_x$	$(26.02)_x$
6426	**Paradiazine.**	See *Pyrazine.*		
6427	**Paraformaldehyde.**	See *Polyoxymethylene.*		
6428	**Paralactic acid.**	See *d-Lactic acid.*		
6429	**Paraldehyde**	2,4,6-trimethyl-1,3,5-trioxane; paraacetaldehyde	$\underline{OCH(CH_3)OCH}$- $\underline{(CH_3)OCHCH_3}$	132.16

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6393	sm. need., $[\alpha]_D^{15}$ −163.6°	....	....	....	......	......	....
6394	need.........	....	195–200	....	sl. s.	......	....
6395	need.........	....	....	....	......	s.	....
6396							
6397	wh. hyg. need.	....	84	....	v. s.	v. s.	v. s. eth.; s. chl.
6398	wh. cr.........	....	48–50	....	s.	s.	....
6399							
6400	need. f. al.....	....	89.5	....	i.	s.	v. s. eth.
6401	col. leaf.......	....	106	236^{12}	i.	sl. s.	sl. s. eth.
6402	col. need., $1.4273^{79.8}$	liq. 0.853^{62}	64	339–56 d.	i.	9.3^{20}	s. eth.
6403	cr.............	$0.9136\frac{38}{25}$	36.0	....	i.	s.	v. s. eth.
6404	pl. f. eth. or ac. a., 1.4398^{70}	0.832^{50}	55.5	d.	i.	i. c., s. h.	s. eth., acet., bz., chl., CS_2
6405	col. need. $1.4347^{34.3}$	$0.8577\frac{25}{4}$	24.2 (19–20)	185.5^{10}	i.	s.	s. eth.
6406							
6407							
6408	col., $1.4175^{80.7}$	....	29.5	196^{15}	i.	s.	s. eth.
6409	feath. cr......	....	72	....	i.	i.	s. eth.
6410							
6411							
6412	col. need. f. w.	....	47	240^{15}	i.	v. s.	v. s. eth.
6413							
6414	col. hex. tab...	liq. 0.822^{31}	31	251.5^{100}	i.	s.	s. eth.
6415	col. liq. or cr..	....	11–2	194.5^{17}	d.	d.	v. s. eth.
6415M							
6416	col. rhomb. need. f. al., $\alpha 1.625$, $\gamma 1.690$	1.337	147	d.	v. sl. s. c., s. h.	v. s.	0.39^{10} eth.; s. h. chl., h. bz.
6417	monocl. pl....	....	231	....	2.7^{18}	s.	....
6418							
6419	col. monocl. pl. f. w.	....	243 (227) d.	....	4.7^{8}	v. s.	sl. s. eth.
6420							
6421	....	0.918	....	$98\text{–}100^{35}$	......	......	....
6422	deliq. cr......	....	58	....	s.	......	....
6423							
6425	br. powd......	....	....	subl.	i.	i.	s. KOH
6426							
6427							
6428							
6429	col. liq., 1.40486	$0.9943\frac{20}{4}$	12.6 (10.5)	124.4^{752}	5.88^{100}; 12^{13}	∞	∞ eth., chl., oils

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6430	**Paraldol**		$(C_4H_8O_2)_2$	176.21
6431	**Paraleucaniline.**	See *p₃-Leucaniline.*		
6432	**Param.**	See *Guanidine, 1-cyano-.*		
6433	**Paramorphine.**	See *Thebaine.*		
6434	**Paranitraniline red.**	See 2-*Naphthol, 1-p-phenylazo-.*		
6435	**Pararosaniline**	tris(*p*-aminophenyl)carbinol; *p,p′,p″*-triaminotriphenylcarbinol	$(H_2NC_6H_4)_3COH$	305.37
6436	——, **hexamethyl-.**	See *Crystal violet (base).*		
6437	**Pararosolic acid.**	See *Aurin.*		
6438	**Paraxylic acid.**	See 3,4-*Xylic acid.*		
6439	**Parsley camphor.**	See *Apiole.*		
6440	**α-Parvoline**	2-ethyl-3,5-dimethylpyridine	$C_9H_{13}N$	135.20
6441	**β-Parvoline**	tetramethylpyridine; parvuline	$C_5H(CH_3)_4N$	135.20
6442	**Parvuline.**	See *β-Parvoline.*		
6443	**Paucine**		$C_{27}H_{39}N_5O_5\cdot6\frac{1}{2}H_2O$	630.73
6444	**Pectinose.**	See *dl-Arabinose.*		
6445	**Pelargonaldehyde,** oxime	nonanal oxime*	$CH_3(CH_2)_7\text{-}CH{:}NOH$	157.25
6446	**Pelargonamide**	nonanamide*	$CH_3(CH_2)_7CONH_2$	157.25
6447	**Pelargone.**	See 9-*Heptadecanone*.*		
6448	**Pelargonic acid**	nonanoic acid*; *n*-nonylic acid	$CH_3(CH_2)_7COOH$	158.24
6449	——, ethyl ester	ethyl nonanoate*; ethyl *n*-nonoate	$CH_3(CH_2)_7CO\text{-}OC_2H_5$	186.29
6450	——, methyl ester	methyl nonanoate*; methyl pelargonate	$CH_3(CH_2)_7CO\text{-}OCH_3$	172.26
6451	**Pelargononitrile**	nonanenitrile*; *n*-octyl cyanide	$CH_3(CH_2)_7CN$	139.24
6452	**Pelargonyl chloride**	nonanoyl chloride*	$CH_3(CH_2)_7COCl$	176.68
6452M	**Pellagra-preventive vitamin.** See *Nicotinamide; Nicotinic acid.*			
6453	**Pelletierine**	punicine	$C_8H_{15}NO$	141.21
6454	——, sulfate		$(C_8H_{15}NO)_2\cdot H_2SO_4$	380.50
6455	**Pellotine**		$C_{13}H_{19}NO_3$	237.29
6456	**Pentadecanal,** oxime*		$CH_3(CH_2)_{13}\text{-}CH{:}NOH$	241.41
6457	**Pentadecane***	*n*-pentadecane	$CH_3(CH_2)_{13}CH_3$	212.41
6457H	——, **1-amino-.**	See *Pentadecylamine*(n).*		
6457R	——, **2,5,8,11,14-pentoxa-*.** See *Tetraethyleneglycol, dimethyl ether.*			
6458	**1-Pentadecanol***	*n*-pentadecyl alcohol	$CH_3(CH_2)_{14}OH$	228.41
6459	**8-Pentadecanone***	diheptyl ketone; caprylone	$[CH_3(CH_2)_6]_2CO$	226.39
6460	***n*-Pentadecyl alcohol.**	See 1-*Pentadecanol*.*		
6460M	**Pentadecylamine*(*n*)**	1-aminopentadecane	$CH_3(CH_2)_{14}NH_2$	227.43
6461	**1,2-Pentadiene***	ethylallene	$CH_2{:}C{:}CHCH_2\text{-}CH_3$	68.11
6462	**1,3-Pentadiene***	piperylene; α-methylbivinyl	$CH_2{:}CHCH{:}CH\text{-}CH_3$	68.11
6463	**1,4-Pentadiene***	divinylmethane	$CH_2{:}CHCH_2\text{-}CH{:}CH_2$	68.11
6464	**2,3-Pentadiene***	*sym*-dimethylallene	$CH_3CH{:}C{:}CHCH_3$	68.11
6465	**2,4-Pentadienoic acid***	β-vinylacrylic acid; αγ-pentadienic acid	$CH_2{:}CHCH{:}CH\text{-}COOH$	98.10

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6430	wh. tricl. cr...	$1.345^{\frac{15.6}{4}}$	82	90^{15}	s.	20.5^{25}	3.6^{23} eth.
6431							
6432							
6433							
6434							
6435	col.-red leaf...	....	189	....	i.	s.	s. eth.
6436							
6437							
6438							
6439							
6440	liq..........	0.9338^{0}	....	188	sl. s.	s.	....
6441	liq..........	0.916	....	220	......	......	....
6442							
6443	yel. leaf......	....	d. 126	....	i.	i.	i. eth.
6444							
6445	leaf. f. dil. al..	....	63	....	i.	s.	s. eth.
6446	col..........	....	99–100	....	i.	sl. s.	sl. s. eth.
6447							
6448	col. oily liq., 1.4330	$0.9055\frac{20}{4}$	12	254	v. sl. s.	s.	s. eth., chl.
6449	col. liq., 1.42200^{20}	$0.8657\frac{20}{4}$	–36.7 (–44.5)	227.5	i.	s.	∞ eth.
6450	liq..........	0.877^{18}	....	214	i.	s.	s. eth.
6451	col. liq.......	0.8331^{0}; 0.786^{16}	–34.2	224.0	i.	sl. s.	s. eth.
6452	col. liq., 1.4380^{15}	$0.9590\frac{0}{4}$; $0.946\frac{20}{4}$	–60.5	215.35 $(108\text{–}10^{22})$	d.	d.	s. eth.
6452M							
6453	col. oil.......	$0.988^{15.5}$	....	195 d.	5	∞	∞ eth.; s. chl.
6454	br. syrupy liq. or cr. mass, $[\alpha]\text{–}30°_D$	....	....	....	v. s.	s.	....
6455	pl. f. al.......	....	110	....	i.	v. s.	v. s. eth.
6456	need. f. dil. al.	....	86	....	i.	sl. s.	v. s. eth.; sl. s. bz.
6457	col. liq.......	$0.7689\frac{20}{4}$	10	270.5	i.	v. s.	v. s. eth.
6457H							
6457R							
6458	cr............	....	43.84 (45–6)	....	......	......	....
6459	cr. f. al.......	....	40	178	......	s.	....
6460							
6460M	col. cr.......	....	....	307.6; 132.3^{2}	i.	s.	s. eth.
6461	1.42091^{20}	0.69257^{20}	−137.26	44.856	......	......	....
6462	liq., 1.4280^{20}	0.6830^{20}	....	43 (42–4)	...	..	....
6463	1.38876^{20}	0.66076^{20}	−148.28	25.967	...	..	....
6464	liq 1.42842^{20}	0.69502^{20}	−125.65	48.265	......	......	....
6465	pr. f. eth......	....	80	d. 110–5	s. h.	v. s.	v. s. eth.; sl. s. pet. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6466	**2,4-Pentadienoic acid*, 5-(3,4-methylenedioxyphenyl)-.** See *Piperic acid.*			
6467	**1,4-Pentadien-3-one, 1,5-diphenyl-*.** See *Styryl ketone.*			
6468	**Pentaerythritol**	pentaerythrite; 2,2-bishydroxymethyl-1,3-propanediol*	$C(CH_2OH)_4$	136.15
6469	**Pentaglycerine, Pentaglycerol.** See 1,3-*Propanediol, 2-hydroxymethyl-2-methyl-*.*			
6470	**Pentamethylene.**	See *Cyclopentane*.*		
6471	**——, keto-.**	See *Cyclopentanone*.*		
6472	**Pentamethylenediamine.** See *Cadaverine.*			
6473	**Pentamethylene dibromide.** See *Pentane,* 1,5-*dibromo-*.*			
6474	**Pentamethylene dichloride.** See *Pentane,* 1,5-*dichloro-*.*			
6475	**Pentamethylene glycol.** See 1,5-*Pentanediol*.*			
6476	**Pentamethylene oxide.**	See *Pyran, tetrahydro-.*		
6477	**Pentamethylenimine.**	See *Piperidine.*		
6478	**Pentanal*.**	See *Valeraldehyde.*		
6479	**——, 4-oxo-*.**	See *Levulinaldehyde.*		
6480	**Pentanamide*.**	See *Valeramide.*		
6481	**Pentane***	*n*-pentane	$CH_3(CH_2)_3CH_3$	72.15
6482	**——, 1-amino-.**	See *Amylamine.*		
6483	**——, 2-amino-.**	See *Butylamine, α-methyl-.*		
6484	**——, 3-amino-.**	See *Propylamine, α-ethyl-.*		
6485	**——, 1-amino-4-methyl-.** See *Isohexylamine.*			
6486	**——, 3,3-bisethylsulfonyl-*.** See *Tetronal.*			
6487	**——, 1-bromo-*.**	See *Amyl bromide.*		
6488	**——, 1-chloro-*.**	See *Amyl chloride.*		
6489	**——, 2-chloro-***		$CH_3CHClCH_2CH_2CH_3$	106.60
6490	**——, 3-chloro-***		$CH_3CH_2CHClCH_2CH_3$	106.60
6490M	**——, 3-cyano-.**	See *Butyronitrile, α-ethyl-.*		
6491	**——, 1,5-dibromo-***	pentamethylene dibromide	$CH_2Br(CH_2)_3CH_2Br$	229.96
6492	**——, 1,5-dichloro-***	pentamethylene dichloride	$Cl(CH_2)_5Cl$	141.05
6493	**——, 2,2-dimethyl-***	trimethylpropylmethane	$(CH_3)_3CCH_2CH_2CH_3$	100.20
6494	**——, 2,3-dimethyl-***	ethylisopropylmethylmethane	$CH_3CH(CH_3)CH(CH_3)CH_2CH_3$	100.20
6495	**——, 2,4-dimethyl-***	diisopropylmethane	$(CH_3)_2CHCH_2CH(CH_3)_2$	100.20
6496	**——, 3,3-dimethyl-***	diethyldimethylmethane	$CH_3CH_2C(CH_3)_2CH_2CH_3$	100.20
6497	**——, 1-ethoxy-*.**	See *Ether, amyl ethyl.*		
6498	**——, 3-ethyl-***	triethylmethane	$(C_2H_5)_3CH$	100.20
6499	**——, 3-ethyl-2-methyl-***	diethylisopropylmethane	$(CH_3)_2CHCH(C_2H_5)_2$	114.23
6500	**——, 3-ethyl-3-methyl-***	triethylmethylmethane	$CH_3CH_2C(CH_3)(C_2H_5)CH_2CH_3$	114.23
6500M	**——, 1-fluoro-*.**	See *Amyl fluoride* (*n*).		
6501	**——, 1-iodo-*.**	See *Amyl iodide.*		
6502	**——, 1-methoxy-***	amyl methyl ether	$CH_3(CH_2)_4OCH_3$	102.17
6503	**——, 2-methyl-***	dimethylpropylmethane	$(CH_3)_2CH(CH_2)_2CH_3$	86.17
6504	**——, 3-methyl-***	diethylmethylmethane	$CH_3CH_2CH(CH_3)CH_2CH_3$	86.17
6505	**——, 3-methylene-*.**	See 1-*Butene, 2-ethyl-*.*		
6506	**——, 2-methyl-3-methylene-.** See 1-*Butene, 2-ethyl-3-methyl-*.*			
6506M	**——, 3-methylol-.**	See 1-*Butanol, 2-ethyl-*.*		
6507	**——, 4-methyl-1-phenyl-.** See *Benzene, isohexyl-.*			

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
6466							
6467							
6468	tetrag. cr., 1.559, 1.548	....	260.5	....	5.56^{15}	......	....
6469							
6470							
6471							
6472							
6473							
6474							
6475							
6476							
6477							
6478							
6479							
6480							
6481	col. liq., $1.3570^{15.7}$	$0.626\frac{20}{4}$; $0.6214\frac{25}{4}$	-131.5 (-129.9)	36.2 (34-5.5)	0.036^{16}	∞	∞ eth.
6482							
6483							
6484							
6485							
6486							
6487							
6488							
6489	liq., 1.4060....	$0.870\frac{20}{4}$	....	96-7	i.	s.	s. eth.
6490	1.4163^{15}.......	$0.8967\frac{15}{4}$	....	104-5	......	......	....
6490M							
6491	col. arom. liq..	$1.702\frac{18}{0}$	-35	224	i.	......	....
6492	....	$1.0940\frac{25}{4}$	....	178	i.	s.	s. eth.
6493	col. liq., 1.38215^{20}	0.67385^{20}	-125	79.197	i.	s.	s. eth.
6494	col. liq., 1.39196^{20}	0.69508^{20}	....	89.784	i.	s.	s. eth.
6495	col. liq., 1.38145^{20}	0.67270^{20}	-123.4	80.500	i.	s.	s. eth.
6496	col. liq., 1.39092^{20}	0.69327^{20}	....	86.064	i.	s.	s. eth.
6497							
6498	col. liq., 1.39339^{20}	0.69816^{20}	-94.5 (-125.6)	93.475	i.	s.	s. eth.
6499	col. liq., 1.4016	0.7078	....	114.0	i.	sl. s.	s. eth.
6500	liq..........	0.712	....	119.0	i.	......	3 eth.
6500M							
6501							
6502	liq...........	0.754	....	88.5	......	......	....
6503	col. liq., 1.372.	0.654	....	60	i.	s.	s. eth.
6504	col. liq........	$0.676\frac{20}{4}$	....	64	i.	∞	s. eth.
6505							
6506							
6506M							
6507							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6508	**Pentane, pentyloxy-*.**	See *Amyl ether.*		
6509	**——, 1-phenyl-.**	See *Benzene, amyl-.*		
6510	**——, 2-phenyl-.**	See *Benzene, (α-methylbutyl)-.*		
6511	**——, 2,2,4-trimethyl-***	isobutyltrimethylmethane; "isoöctane"	$(CH_3)_3CCH_2CH(CH_3)_2$	114.23
6512	**3-Pentanecarboxylic acid.**	See *Butyric acid, α-ethyl-.*		
6513	**1,5-Pentanediamine*.**	See *Cadaverine.*		
6514	**Pentanedinitrile*.**	See *Glutaronitrile.*		
6515	**Pentanedioic acid*.**	See *Glutaric acid.*		
6516	**——, 3-oxo-*.**	See *Acetonedicarboxylic acid.*		
6517	**1,2-Pentanediol*......**	α-*n*-amyleneglycol..........	$CH_3CH_2CH_2CH(OH)CH_2OH$	104.15
6518	**1,4-Pentanediol*......**	γ-pentylene glycol..........	$CH_3CHOHCH_2CH_2CH_2OH$	104.15
6519	**1,5-Pentanediol*......**	pentamethylene glycol.......	$CH_2OHCH_2CH_2CH_2CH_2OH$	104.15
6520	**2,3-Pentanediol*......**	methylethylethylene glycol; β-*n*-amylene glycol	$CH_3CH_2CH(OH)CH(OH)CH_3$	104.15
6521	**2,4-Pentanediol, 2-methyl-***	α,α,α′-trimethyltrimethylene glycol	$(CH_3)_2COHCH_2CHOHCH_3$	118.17
6522	**1,4-Pentanedione, 1-phenyl-.**	See *Valerophenone, γ-oxo-.*		
6523	**1,5-Pentanedione, 1,2,3,4,5-pentaphenyl-.**	See *Benzamarone; Isobenzamarone.*		
6524	**2,3-Pentanedione, 3-oxime***	α-isonitrosopropyl methyl ketone	$CH_3COC(:NOH)C_2H_5$	115.13
6525	**2,4-Pentanedione* ....**	acetylacetone..............	$CH_3COCH_2COCH_3$	100.11
6526	**Pentanenitrile*.**	See *Valeronitrile.*		
6527	**——, 4-methyl-*.**	See *Isocapronitrile.*		
6528	**1,2,3,4,5-Pentanepentol*.**	See *Arabitol.*		
6529	**1-Pentanethiol*.......**	amyl mercaptan............	$CH_3(CH_2)_4SH$....	104.21
6530	**Pentanoic acid*.**	See *Valeric acid.*		
6531	**——, 4-methyl-*.**	See *Isocaproic acid.*		
6532	**——, 4-oxo-*.**	See *Levulinic acid.*		
6533	**Pentanoic anhydride*.**	See *Valeric anhydride.*		
6534	**1-Pentanol*..........**	butylcarbinol; *pri-n*-amyl alcohol	$CH_3(CH_2)_3CH_2OH$	88.15
6535	**——, 2-methyl-*......**	2-methyl-2-propylethanol....	$CH_3(CH_2)_2CH(CH_3)CH_2OH$	102.17
6536	**——, 3-methyl-*......**	active hexyl alcohol.........	$(C_2H_5)(CH_3)CHCH_2CH_2OH$	102.17
6537	**——, 4-methyl-*......**	isoamylcarbinol............	$(CH_3)_2CH(CH_2)_2CH_2OH$	102.17
6538	**2-Pentanol*..........**	methylpropylcarbinol; *sec-act*-amyl alcohol	$CH_3CH_2CH_2CHOHCH_3$	88.15
6539	**——, 2,4-dimethyl-*...**	isobutyldimethylcarbinol.....	$(CH_3)_2COHCH_2CH(CH_3)_2$	116.20
6540	**——, 2-methyl-*......**	dimethylpropylcarbinol......	$(CH_3)_2COH(CH_2)_2CH_3$	102.17
6541	**——, 4-methyl-*......**	isobutylmethylcarbinol......	$(CH_3)_2CHCH_2CHOHCH_3$	102.17
6542	——, ——, acetate.........	α, γ-dimethylbutylacetate...	$CH_3CH(OOCCH_3)CH_2CH(CH_3)_2$	144.21
6543	——, ——, butyrate........	α-methylisoamyl butyrate...	$(CH_3)_2CHCH_2CH(OOCC_3H_7)CH_3$	172.26

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6508							
6509							
6510							
6511	col. liq., 1.3916	0.6918	f. p.–107.4	99.3	i.	sl. s.	s. eth.
6512							
6513							
6514							
6515							
6516							
6517	col. liq.	0.980^{20}_{20}	....	211.8	∞	∞	∞ eth.
6518	liq	0.9954^{18}_{18}	....	$131\text{–}3^{18}$	∞	∞	v. sl. s. eth.
6519	thick liq., 1.4499	0.994^{20}_{20}	....	239.4	∞	∞	sl. s. eth.
6520	liq	0.9945^{0}	....	187	s.	s.	....
6521	liq	0.9240^{17}_{4}	....	$196;\ 96\text{–}8^{10}$	s.	s.	s. eth.
6522							
6523							
6524	leaf. f. lgr.	....	56–7	183–7	sl. s.	v. s.	v. s. eth., chl.
6525	col. inflam. liq., $1.45178^{18.5}$	0.976	–23.2	139^{746}	12.5, 51.5^{80}	∞	∞ eth.; s. bz., chl., acet., glac. ac. a.
6526							
6527							
6528							
6529	liq., 1.44366	0.857	–75.7	126	i.	∞	∞ eth.
6530							
6531							
6532							
6533							
6534	col. liq., 1.40994^{20}	0.8144^{20}_{4}	–78.5	138	2.7^{22}	∞	∞ eth.
6535	....	$0.831^{15.6}_{15.6}$	....	148	......	......	....
6536	liq	0.8262; 0.8205^{25}_{4}	....	153.7–54.1	i.	s.	s. eth.
6537	liq., 1.4490	0.8243^{0}; 0.8156^{20}_{4}	....	147–8; 151.8–2.8	v. sl. s. (i.)	s.	s. eth.
6538	col. liq., 1.4053	0.809^{20}_{4}	....	119.28	5.3^{30}	∞	∞ eth.
6539	col. liq., 1.4172	0.8158	<–20	132.8–3.4 (129–30)	i.	s.	s. eth.
6540	liq	....	4 (<–38)	122.5–3.5	v. sl. s.	s.	∞ eth.
6541	col. liq., 1.409	0.806 (0.813^{20}_{4})	....	131.4	1.8	∞	∞ eth.
6542	col. liq.	0.8580^{20}_{4}	....	146	0.082^{25}	......	....
6543	col. liq.	0.853	–48	183	0.8^{35}	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6544	**2-Pentanol, 2,4,4-trimethyl-(?)**	isodibutol	$(CH_3)_3CCH_2COH(CH_3)_2$	130.23
6545	**3-Pentanol***	diethylcarbinol	$CH_3CH_2CHOHCH_2CH_3$	88.15
6546	**——, 2,3-dimethyl-***	ethylisopropylmethylcarbinol	$(CH_3)_2CHCOH(CH_3)CH_2CH_3$	116.20
6547	**——, 2,4-dimethyl-***	diisopropylcarbinol	$(CH_3)_2CHCHOHCH(CH_3)_2$	116.20
6548	**——, 2,4-dimethyl-3-phenyl-**	diisopropylphenylcarbinol	$[(CH_3)_2CH]_2COHC_6H_5$	192.29
6549	**——, 3-ethyl-***	triethylcarbinol	$(C_2H_5)_3COH$	116.20
6550	**——, 3-ethyl-2-methyl-***	diethylisopropylcarbinol	$(CH_3)_2CHCOH(C_2H_5)CH_2CH_3$	130.23
6551	**——, 2-methyl-***	ethylisopropylcarbinol	$(CH_3)_2CHCHOHCH_2CH_3$	102.17
6552	**——, 3-methyl-***	diethylmethylcarbinol	$CH_3CH_2COH(CH_3)CH_2CH_3$	102.17
6553	**2-Pentanone***	methyl propyl ketone	$CH_3CO(CH_2)_2CH_3$	86.13
6554	——, oxime	methyl propyl ketoxime	$CH_3C(:NOH)(CH_2)_2CH_3$	101.15
6555	**——, 4-hydroxy-4-methyl-***	diacetone alcohol	$CH_3COCH_2C(OH)(CH_3)_2$	116.16
6556	**——, 3-methyl-***	*sec*-butyl methyl ketone; *asym*-ethylmethylacetone	$CH_3COCH(CH_3)CH_2CH_3$	100.16
6557	**——, 4-methyl-***	isobutyl methyl ketone	$CH_3COCH_2CH(CH_3)_2$	100.16
6558	**3-Pentanone***	diethyl ketone; *sym*-dimethylacetone; propione; ethyl ketone	$C_2H_5COC_2H_5$	86.13
6559	**——, 2,4-dimethyl-***	diisopropyl ketone	$(CH_3)_2CHCOCH(CH_3)_2$	114.18
6560	**——, 2-methyl-***	ethyl isopropyl ketone	$C_2H_5COCH(CH_3)_2$	100.16
6561	**Pentanoyl chloride*.**	See *Valeryl chloride.*		
6562	**Pentatriacontane***	*n*-pentatriacontane	$CH_3(CH_2)_{33}CH_3$	492.93
6563	**18-Pentatriacontanone***	diheptadecyl ketone; stearone	$(C_{17}H_{35})_2CO$	506.92
6564	**1-Pentene***	propylethylene; α-*n*-amylene	$CH_3CH_2CH_2CH:CH_2$	70.13
6565	**——, 2,3-dimethyl-***	1-*sec*-butyl-1-methylethylene	$CH_2:C(CH_3)CH(CH_3)CH_2CH_3$	98.18
6566	**——, 2,4-dimethyl-***	1-isobutyl-1-methylethylene	$CH_2:C(CH_3)CH_2CH(CH_3)_2$	98.18
6567	**——, 3,3-dimethyl-***	....	$CH_2:CHC(CH_3)_2CH_2CH_3$	98.18
6568	**——, 2-ethyl-***	1-ethyl-1-propylethylene; 3-methylenehexane*	$CH_2:C(C_2H_5)CH_2CH_2CH_3$	98.18
6569	**——, 2-methyl-***	1-methyl-1-propylethylene	$CH_2:C(CH_3)CH_2CH_2CH_3$	84.16
6570	**——, 3-methyl-***	*sec*-butylethylene	$CH_2:CHCH(CH_3)CH_2CH_3$	84.16
6571	**——, 4-methyl-***	isobutylethylene	$CH_2:CHCH_2CH(CH_3)_2$	84.16

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6544	col. liq., 1.42085	0.8417^{0}; $0.8228\frac{20}{4}$	-20	147.5 (152-4)	i.	sl. s.	s. eth.
6545	col. liq., 1.4077^{25}	0.815^{25}	....	115.6	sl. s.	s.	s. eth.
6546	liq...........	0.8329^{21}	<-30	$138\text{-}40^{75}$	i.	s.	s. eth.
6547	col. liq., 1.42259	$0.8288\frac{20}{4}$	<70	140	v. sl. s.	s.	s. eth.
6548	yel. liq.......	0.959	60.5	157^{60}; 229^{755}	sl. s.	i.	s. eth.
6549	col. oil, 1.4314.	0.83892	....	140-2	i.	s.	s. eth.
6550	liq...........	0.8463^{0}; $0.8295\frac{20}{4}$	....	$159\text{-}61^{750}$	i.	s.	s. eth.
6551	liq...........	$0.826\frac{18}{4}$	....	127.5^{721}	v. sl. s.	∞	∞ eth.
6552	col. liq., 1.4196	0.824; $0.8233\frac{25}{4}$	-22 (<-38)	122.8-3.0	sl. s.	∞	∞ eth.
6553	col. liq., $1.38946^{20.2}$	$0.812\frac{15}{15}$	-77.8	101.7	v. sl. s.	∞	∞ eth.
6554	col. liq., 1.4450	0.909	....	168	s.	∞	∞ eth.
6555	col. liq., 1.4300^{9}	$0.9306\frac{25}{4}$; $0.938\frac{20}{4}$	-54 to -57	164-6	∞	∞	∞ eth.
6556	col. liq........	$0.818\frac{14}{4}$	....	118	sl. s.	∞	∞ eth.
6557	col. liq........	$0.8017\frac{20}{4}$	-84.7	119 (115-8)	1.9	∞	∞ eth., bz.
6558	col. inflam. liq., $1.3939^{16.6}$	$0.8159\frac{19}{4}$	-42	102.7	4.7^{20}; 3.8^{100}	∞	∞ eth.
6559	col. liq........	$0.8062\frac{20}{4}$	....	123.7	i.	∞	∞ eth.; s. bz.
6560	col. liq........	0.830^{0}	....	114.5	v. sl. s.	v. s.	∞ eth.
6561							
6562	cr.............	$0.782\frac{75}{4}$	74.7	331^{15}	......	......	....
6563	leaf. f. lgr.....	liq. 0.793^{95}	88	....	i.	sl. s. h.	sl. s. h. eth.
6564	col. liq., 1.37148^{20}	0.64050^{20}	-138	29.968	i.	∞	∞ eth.; v. s. dil. H_2SO_4
6565	....	0.7054	....	84.1-4.3	......	......	....
6566	....	0.6937	....	80.9-1.3	......	......	....
6567	1.3991........	0.6961	....	76.9	......	......	....
6568	....	0.7079	....	93.9-4.3	......	......	....
6569	....	0.6817	−135.76	61.5-2.0	......	......	....
6570	....	0.6700	....	53.6-4.0	......	......	....
6571	....	0.6646	−153.63	53.6-3.9	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6572	**2-Pentene***	*sym*-methylethylethylene; β-*n*-amylene	$CH_3CH_2CH{:}CHCH_3$	70.13
6573	**——, 2,3-dimethyl-***	ethyltrimethylethylene	$(CH_3)_2C{:}C(CH_3)CH_2CH_3$	98.18
6574	**——, 2,4-dimethyl-***	isopropyldimethylethylene	$(CH_3)_2C{:}CHCH(CH_3)_2$	98.18
6575	**——, 3,4-dimethyl-***	1-isopropyl-1,2-dimethylethylene	$CH_3CH{:}C(CH_3)CH(CH_3)_2$	98.18
6576	**——, 4,4-dimethyl-***		$CH_3CH{:}CHC(CH_3)_3$	98.18
6577	**——, 3-ethyl-***	1,1-diethyl-2-methylethylene	$CH_3CH{:}C(C_2H_5)_2$	98.18
6578	**——, 2-methyl-***	2-ethyl-1,1-dimethylethylene	$(CH_3)_2C{:}CHCH_2CH_3$	84.16
6579	**——, 3-methyl-***	1-ethyl-1,2-dimethylethylene	$CH_3CH{:}C(CH_3)CH_2CH_3$	84.16
6580	**——, 4-methyl-***	1-isopropyl-2-methylethylene	$CH_3CH{:}CHCH(CH_3)_2$	84.16
6582	**2-Pentene-3-carboxylic acid***.	See *Crotonic acid, α-ethyl-*.		
6583	**4-Pentenenitrile***	allylacetonitrile; allylmethyl cyanide	$CH_2{:}CHCH_2CH_2CN$	81.11
6584	**2-Pentenoic acid, 4-methyl-***	β-isopropylacrylic acid; α-isohexenic acid	$(CH_3)_2CHCH{:}CHCOOH$	114.14
6585	**4-Pentenoic acid***	allylacetic acid	$CH_2{:}CHCH_2CH_2COOH$	100.11
6586	**1-Penten-3-ol***	ethylvinylcarbinol	$CH_2{:}CHCHOHCH_2CH_3$	86.13
6587	**3-Penten-2-ol, 2-methyl-***	dimethylpropenylcarbinol	$C_6H_{11}OH$	100.16
6588	**4-Penten-1-ol***	β-allylethyl alcohol	$CH_2{:}CHCH_2CH_2CH_2OH$	86.13
6589	**4-Penten-2-ol***	allylmethylcarbinol	$CH_2{:}CHCH_2CHOHCH_3$	86.13
6590	**——, 2-methyl-***		$CH_2{:}CHCH_2COH(CH_3)_2$	100.16
6591	**3-Penten-2-one***	ethylideneacetone	$CH_3CH{:}CHCOCH_3$	84.11
6592	**——, 4-methyl-***.	See *Mesityl oxide*.		
6592M	**4-Pentenylamine, 1,2-dimethyl-**	5-amino-4-methyl-1-hexene	$CH_2{:}CHCH_2CH(CH_3)CH(CH_3)NH_2$	113.20
6593	**Pentine.**	See *Pentyne**.		
	Pentyl*.	See *Amyl*.		
6594	**1-Pentyne***	1-pentine; *n*-propylacetylene	$HC\vdots CCH_2CH_2CH_3$	68.11
6595	**2-Pentyne***	2-pentine; ethylmethylacetylene; valerylene	$CH_3C\vdots CCH_2CH_3$	68.11
6596	**2-Pentynoic acid***	ethylpropiolic acid; ethylacetylenecarboxylic acid	$CH_3CH_2C\vdots CCOOH$	98.10
6596H	**1-Pentyn-3-ol, 3,4-dimethyl-***	ethynyl isopropylmethyl carbinol	$HC\vdots C{\cdot}C(OH)(CH_3)CH(CH_3)_2$	112.17
6596R	**——, 3-methyl-***	ethylethynylmethylcarbinol	$HC\vdots C{\cdot}C(OH)(CH_3)C_2H_5$	98.14
6597	**Peonol**	2-hydroxy-4-methoxyacetophenone; resacetophenone 4-methyl ether; paeonol	$CH_3COC_6H_3(OCH_3)OH$	166.17
6598	**Perbenzoic acid**	benzoyl hydroperoxide	$C_6H_5COO_2H$	138.12
6599	**Perchloromethyl formate.**	See *Diphosgene*.		
6600	**Pereirine**		$C_{19}H_{24}N_2O$	296.40

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6572	col. inflam. liq.	0.651	−139	36.4	i.	∞	∞ eth.; v. s. dil. H_2SO_4
6573	liq	0.719	....	95.1	i.	s.	s. eth.
6574	liq., 1.4020....	0.6947^{20}_{4}	....	82.6	i.	s.	s. eth.
6575	1.4052........	0.7126^{20}_{4}	....	86.2–6.4	......	......	....
6576	1.3986........	0.6881^{20}_{4}	....	76.0	......	.....	....
6577	....	0.7172	....	94.8–4.9	......	......	....
6578	....	0.6904	....	67.2–7.5	......	......	....
6579	1.4002	(1) 0.6956	−134.84	67.6–8.2	......	......	....
		(2) 0.6940	....	65.7–6.2	......	......	....
6580	1.38885	(1) 0.6709	−134.43	57.7–8.5	......	......	....
		(2) 0.6702	....	54.2–5.2	......	......	....
6582							
6583	liq	1.18^{13}	....	140	i.	∞	∞ eth.
6584	liq., 1.4506^{16}...	0.959	....	108^{12}	......	s.	....
6585	col. liq., $1.4341^{7.5}$	0.984^{18}	<−18	189	sl. s.	v. s.	v. s. eth.
6586	....	0.840^{20}_{4}	....	114–5	sl. s.	∞	∞ eth.
6587	col. liq., 1.4295	0.8343^{20}_{4}	....	121.6–122	10^{10}	∞	∞ eth.
6588	col. liq........	0.863^{0}_{4}	....	140–2	......	......	....
6589	col. liq........	0.834^{20}_{4}	....	116.4	12.5	∞	∞ eth.
6590	liq	0.8430^{0}	....	119.5	sl. s.	......	....
6591	col. liq., $1.43903^{19.6}$	0.856	....	122–4	s.	......	....
6592							
6592M	....	0.793^{15}	....	133.6	s.	......	....
6593							
6594	col. liq., 1.4079^{18}	0.7221^{0}; 0.6882^{25}_{4}	−95	40	i.	v. s.	∞ eth.
6595	liq., 1.40044...	0.687; $0.7127^{17.2}$	−101	56	i.	v. s.	∞ eth.
6596	cr.............	....	50	....	v. s.	......	....
6596H	col. liq., 1.459^{15}	0.876^{15}	....	133	s.	s.	s. eth.
6596R	col. liq., 1.4310^{20}	0.8688^{20}	....	118–21	s.	s.	s. eth.
6597	....	....	50	....	i.	s.	s. eth.
6598	leaf..........	....	42	exp. 80–100	sl. s.	s.	s. eth.
6599							
6600	br. amor. powd.	....	118–24	....	i.	v. s.	v. s. eth.; s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6601	**Peroxide, dibenzoyl.**	See *Benzoyl peroxide.*		
6602	**Perseitol**	*d*-mannoheptitol; perseite	$C_7H_9(OH)_7$	212.20
6603	**Peucedanin**	imperatorin	$C_{16}H_{16}O_4$	272.29
6604	**Phaseomannitol.**	See *i-Inositol.*		
6605	**α-Phellandrene**	1,5-*p*-menthadiene; 5-isopropyl-2-methyl-1,3-cyclohexadiene	$C_{10}H_{16}$	136.23
6606	**β-Phellandrene**	1(7),2-*p*-menthadiene; 3-isopropyl-6-methylenecyclohexene	$C_{10}H_{16}$	136.23
6607	**Phenacetin.**	See *p-Acetophenetide.*		
6608	**Phenacyl alcohol.**	See *Acetophenone, α-hydroxy-.*		
6609	**Phenacyl bromide.**	See *Acetophenone, α-bromo-.*		
6610	**Phenacyl chloride.**	See *Acetophenone, α-chloro-.*		
6611	**Phenanthrahydroquinone.**	See 9,10-*Phenanthrenediol.*		
6612	**Phenanthraquinone.**	See *Phenanthrenequinone.*		
6613	**Phenanthrene**		$C_{14}H_{10}$	178.22
6614	**——, amino-.**	See *Phenanthrylamine.*		
6615	**——, ?-benzyl-**		$C_6H_5CH_2C_{14}H_9$	268.34
6616	**——, 9,10-dihydro-9,10-dioxo-.**	See *Phenanthrenequinone.*		
6617	**——, 3,4-dimethoxy-**	morphol dimethyl ether	$C_{14}H_8(OCH_3)_2$	238.27
6618	**——, 9,10-dimethyl-**		$C_{14}H_8(CH_3)_2$	206.27
6619	**——, 9,10-diphenyl-**		$C_{14}H_8(C_6H_5)_2$	330.41
6620	**——, hydroxy-.**	See *Phenanthrol.*		
6621	**——, 7-isopropyl-1-methyl-.**	See *Retene.*		
6622	**——, 1-methyl-**		$CH_3C_{14}H_9$	192.25
6623	**——, 3-methyl-**		$CH_3C_{14}H_9$	192.25
6624	**——, 3,4,5-trihydroxy-.**	See 3,4,5-*Phenanthrenetriol.*		
6625	**3,4-Phenanthrenediol.**	See *Morphol.*		
6626	**9,10-Phenanthrenediol**	phenanthrahydroquinone	$C_{14}H_8(OH)_2$	210.22
6627	**Phenanthrenequinone**	9,10-dihydro-9,10-dioxophenanthrene; phenanthraquinone	$\underbrace{C_6H_4COCOC_6H_4}$	208.20
6628	**——, 2,7-dinitro-**		$NO_2C_6H_3(CO)_2\text{-}C_6H_3NO_2$	298.20
6629	**——, 2-nitro-**		$NO_2C_6H_3(CO)_2\text{-}C_6H_4$	253.20
6630	**3,4,5-Phenanthrenetriol**	3,4,5-trihydroxyphenanthrene	$C_{14}H_7(OH)_3$	226.22
6631	**2-Phenanthrol**	2-hydroxyphenanthrene	$C_{14}H_9OH$	194.22
6632	**3-Phenanthrol**	3-hydroxyphenanthrene	$C_{14}H_9OH$	194.22
6633	**4-Phenanthrol**	4-hydroxyphenanthrene	$C_{14}H_9OH$	194.22
6634	**9-Phenanthrol**		$C_{14}H_9OH$	194.22
6635	**2-Phenanthrylamine**	2-aminophenanthrene	$C_{14}H_9NH_2$	193.24
6636	**3-Phenanthrylamine**	3-aminophenanthrene	$C_{14}H_9NH_2$	193.24
6637	**9-Phenanthrylamine**	9-aminophenanthrene	$C_{14}H_9NH_2$	193.24
6638	**Phenazine**		$\underbrace{C_6H_4NC_6H_4N}$	180.20
6639	**——, 5,10-dihydro-**	hydrazophenylene	$\underbrace{C_6H_4NHC_6H_4NH}$	182.22

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6601							
6602	col. need.	....	188	....	5.5^{18}	sl. s. c.	....
6603	rhomb. pr.	....	75	....	i.	s. h.	s. eth., pet. eth., KOH
6604							
6605	liq.	0.843	....	175	......	i.	s. eth.
6606	liq., 1.4788	0.852	....	171.2	i.	i.	s. eth.
6607							
6608							
6609							
6610							
6611							
6612							
6613	col. monocl. leaf. f. al., 1.6567^{129}	1.025; liq. 1.063^{100}	100 (97.5–8.5)	340.2	i.	2^{14}, 10.0^{78}	8.93$^{15.5}$ eth.; s. bz., chl., ac. a., CS_2
6614							
6615	need. f. bz. or leaf. f. al.	....	91–2 (155–6)	....	i.	sl. s.	sl. s. bz.
6616							
6617	leaf. f. al. +w.	....	44	298–303^{112}	i.	v. s.	v. s. eth.
6618	pr. f. dil. ac. a.	....	139	subl.	......	v. sl. s.	v. s. bz., chl.; s. ac. a.
6619	col. need. f. al.	....	235	270 subl.	i.	v. sl. s.	s. eth., bz.
6620							
6621							
6622	leaf. f. al.	....	123	....	i.	s.	....
6623	cr. f. al.	....	65	....	i.	s.	....
6624							
6625							
6626	col. need.	....	147–8	....	s. h.	v. s.	v. s. eth., bz.
6627	yel.-or. need.	1.405	207 (203–5)	360	sl. s.	v. s.	v. s. eth.; 0.54^{20} bz.
6628	yel. gold need. f. ac. a.	....	301–3	....	i.	v. sl. s.	sl. s. ac. a.
6629	yel. leaf. f. ac. a.	....	257	....	......	i.	sl. s. ac. a.
6630	leaf. f. w.	....	148	....	i.	v. s.	v. s. eth.
6631	leaf. f. dil. al.	....	168	....	sl. s.	v. s.	v. s. eth.
6632	need. f. dil. al.	....	122 (118–9)	....	i. c., sl. s. h.	v. s.	v. s. eth.
6633	cr.	....	108	....	i.	s.	s. eth.
6634	col. need. f. lgr.	....	153	....	i.	v. s.	v. s. eth., chl., bz., h. lgr.
6635	lt. yel. cr. f. lgr.	....	85	....	i.	s.	s. eth.
6636	cr. f. lgr.	....	α, 143; β, 87.5	....	sl. s.	v.s.(vlt. fluores.)	s. dil. HCl
6637	lt. yel. pr.	....	137–8; 104	subl.	......	v. s.	v. s. eth., bz., chl.
6638	yel. need.	....	171	>360 subl.	v. sl. s.	2 c.	sl. s. eth.
6639	rhomb. leaf	....	d.	....	i.	v. sl. s. h.	i. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6640	**Phenazine, 2-methyl-**		$C_6H_4{:}N_2{:}C_6H_3CH_3$	194.23
6641	**2(10)-Phenazinone, 10-phenyl-.**	See *Aposafranone.*		
6642	**Phenazone.**	See *Antipyrine.*		
6643	**Phenazothionium chloride, 3,9-bisdimethylamino-.**	See *Methylene blue.*		
6644	**Phene*.**	See *Benzene*.*		
6645	**Phenethyl alcohol**	2-phenylethanol; benzylcarbinol	$C_6H_5CH_2CH_2OH$	122.16
6646	**Phenethylamine**	β-phenylethylamine; 1-amino-2-phenylethane	$C_6H_5CH_2CH_2NH_2$	121.18
6647	**——, p-hydroxy-.**	See *Tyramine.*		
6648	**——, p-hydroxy-N,N-dimethyl-.**	See *Hordenine.*		
6649	**Phenetidine, N-acetyl-.**	See *Acetophenetide.*		
6650	**o-Phenetidine**	o-ethoxyaniline; o-aminophenetole	$C_2H_5OC_6H_4NH_2$	137.18
6651	**m-Phenetidine**	m-ethoxyaniline	$C_2H_5OC_6H_4NH_2$	137.18
6652	**p-Phenetidine**	p-ethoxyaniline	$C_2H_5OC_6H_4NH_2$	137.18
6653	**——, N,N-diacetyl-.**	See *Diacetanilide, p-ethoxy-.*		
6654	**——, 2-nitro-**(NH_2=1)	4-ethoxy-2-nitroaniline; 4-amino-3-nitrophenetole	$NO_2(C_2H_5O)C_6H_3$-NH_2	182.18
6655	**Phenetole**	ethoxybenzene*; ethyl phenyl ether	$C_2H_5OC_6H_5$	122.16
6656	**——, o, m, or p-amino-.**	See *Phenetidine.*		
6657	**——, azodi-.**	See *Azophenetole.*		
6658	**——, β-bromo-**	β-bromoethyl phenyl ether	$C_6H_5OCH_2CH_2Br$	201.07
6659	**——, o-chloro-**	1-chloro-2-ethoxybenzene*; o-chlorophenyl ethyl ether	$ClC_6H_4OC_2H_5$	156.61
6660	**——, p-chloro-**	1-chloro-4-ethoxybenzene*; p-chlorophenyl ethyl ether	$ClC_6H_4OC_2H_5$	156.61
6661	**——, o-nitro-**	ethyl o-nitrophenyl ether	$NO_2C_6H_4OC_2H_5$	167.16
6662	**——, m-nitro-**		$NO_2C_6H_4OC_2H_5$	167.16
6663	**——, p-nitro-**		$NO_2C_6H_4OC_2H_5$	167.16
6664	**Phenmiazine.**	See *Quinazoline.*		
6665	**Phenobarbital**	5-ethyl-5-phenylbarbituric acid; luminal	$NHCONHCOC$- $(C_2H_5)(C_6H_5)CO$	232.23
6666	**Phenocoll**	α-amino-p-acetophenetide	NH_2CH_2CONH-$C_6H_4OC_2H_5$	194.23
6667	**Phenol**	carbolic acid; hydroxybenzene	C_6H_5OH	94.11
6668	——, acetate	phenyl acetate; acetylphenol	$CH_3COOC_6H_5$	136.14
6669	**——, acetamido-.**	See *Acetanilide, hydroxy-.*		
6670	**——, acetyl-.**	See *Phenol, acetate.*		
6671	**——, acetylamino-.**	See *Acetanilide, hydroxy-.*		
6672	**——, o-(acetylmethylamino)-.**	See *Acetanilide, o-hydroxy-N-methyl-.*		
6673	**——, p-allyl-.**	See *Chavicol.*		
6674	**——, o-amino-**	o-hydroxyaniline	$NH_2C_6H_4OH$	109.12
6675	**——, m-amino-**	m-hydroxyaniline	$NH_2C_6H_4OH$	109.12
6676	**——, p-amino-**	p-hydroxyaniline; rodinal	$NH_2C_6H_4OH$	109.12
6677	**——, 2-amino-4,6-dinitro-.**	See *Picramic acid.*		
6678	**——, p-(β-aminoethyl)-.**	See *Tyramine.*		
6679	**——, 2-amino-3-nitro-**		$NH_2(NO_2)C_6H_3OH$	154.12
6680	**——, 2-amino-4-nitro-**		$NH_2(NO_2)C_6H_3OH$	154.12

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
6640	need.	....	117	350 d.	sl. s. h.	sl. s.	sl. s. eth.; s. chl., H_2SO_4
6641							
6642							
6643							
6644							
6645	col. liq., 1.5240	1.0235^{15}	–27	219–21	1.6^{20}	∞	∞ eth.
6646	liq., 1.575	0.958^{24}	....	195 (198)	s.	v. s.	v. s. eth.
6647							
6648							
6649							
6650	liq	....	<–21	229.2	v. sl. s.	s.	s. eth.
6651	liq	....	....	248	v. sl. s.	s.	s. eth.
6652	liq	1.0613^{15}	2.4	254.2	v. sl. s.	s.	s. eth.
6653							
6654	red pr. f. al.	....	112–3	....	......	v. sl. s. c., s. h.	s. eth.
6655	col. liq., 1.5076^{21}	$0.9666\frac{20.2}{4}$	–30.2	172; $60^{9.12}$	i.	s.	∞ eth.
6656							
6657							
6658	....	....	35 (30–1)	240–50 d.	v. v. sl. s.	s.	s. eth.
6659	col. liq	....	....	208	......	s.	s. eth., bz.
6660	cr., 1.5227^{19}	....	21	212	......	s.	s. eth.
6661	yel. liq., 1.5425^{20}	1.19^{15}	2.1 (5–6)	268 (275); 149.3^{6}	i.	s.	s. eth.
6662	yel. need.	....	34 (31–2)	284; 169^{70}	i.	s.	s. eth.
6663	col. monocl. pr. f. eth.	1.18^{15}	60	283	i.	s. h.	v. s. eth.
6664							
6665	wh. lust.	....	174	....	s. h.	s.	s. eth.
6666	col. need.	....	anh. 100.5	....	sl. s.	s.	s. eth.
6667	col. rhomb. need., $1.54247^{40.6}$	1.072	41	182	6.7^{16}; ∞^{66}	∞	v. s. eth.; s. chl., glyc., CS_2
6668	col. liq., 1.503.	$1.077\frac{20}{4}$	....	195.5	0.0318	∞	∞ eth., chl., glac. ac. a.
6669							
6670							
6671							
6672							
6673							
6674	col. rhomb. pl. or need.	....	170 (174)	subl.	1.7^{0}	4.4^{0}	sl. s. eth.
6675	col. pr. f. tol.	....	122–3	....	2.6	v. s.	v. s. eth.; sl. s. bz., lgr.
6676	wh. leaf	....	184 d.	subl.	1.1^{0}	4.5^{0}	sl. s. eth.; i. bz.
6677							
6678							
6679	red need.	....	216–7	subl.	s.	......	....
6680	or. pr	....	143	....	sl. s.	v. s.	v. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6681	**Phenol, 2-amino-5-nitro-**	....	$NH_2(NO_2)C_6H_3OH$	154.12
6682	**——, 2-amino-6-nitro-**	....	$NH_2(NO_2)C_6H_3OH$	154.12
6683	**——, 3-amino-4-nitro-**	....	$NH_2(NO_2)C_6H_3OH$	154.12
6684	**——, 3-amino-5-nitro-**	....	$NH_2(NO_2)C_6H_3OH$	154.12
6685	**——, 4-amino-2-nitro-**	....	$NH_2(NO_2)C_6H_3OH$	154.12
6686	**——, 4-amino-3-nitro-**	....	$NH_2(NO_2)C_6H_3OH$	154.12
6687	**——, 5-amino-2-nitro-**	3-amino-6-nitrophenol.......	$NH_2(NO_2)C_6H_3OH$	154.12
6688	**——, *o*-aminothio-....**	2-aminobenzenethiol*; *o*-aminophenyl mercaptan; *o*-mercaptoaniline	$NH_2C_6H_4SH$......	125.18
6689	**——, *m*-aminothio-...**	3-aminobenzenethiol*; *m*-aminophenyl mercaptan; *m*-mercaptoaniline	$NH_2C_6H_4SH$......	125.18
6690	**——, *p*-aminothio-....**	4-aminobenzenethiol*; *p*-aminophenyl mercaptan; *p*-mercaptoaniline	$NH_2C_6H_4SH$......	125.18
6691	**——, *o*-amoxy-........**	pyrocatechol monoamyl ether	$CH_3(CH_2)_4OC_6H_4OH$	180.24
6692	**——, *m*-amoxy-.......**	resorcinol monoamyl ether....	$CH_3(CH_2)_4OC_6H_4OH$	180.24
6693	**——, *p*-amoxy-.......**	hydroquinone monoamyl ether	$CH_3(CH_2)_4OC_6H_4OH$	180.24
6694	**——, *p*-amyl-.........**	....	$CH_3(CH_2)_4C_6H_4OH$	164.24
6695	**——, *p*-*tert*-amyl-....**	*p*-(*α*,*α*-dimethylpropyl)-phenol	$CH_3CH_2C(CH_3)_2C_6H_4OH$	164.24
6696	**——, *o*-anilino-.......**	*o*-hydroxydiphenylamine.....	$C_6H_5NHC_6H_4OH$..	185.22
6697	**——, *m*-anilino-......**	*m*-hydroxydiphenylamine....	$C_6H_5NHC_6H_4OH$..	185.22
6698	**——, *p*-anilino-.......**	*p*-hydroxydiphenylamine.....	$C_6H_5NHC_6H_4OH$..	185.22
6699	**——, azodi-.**	See *Azophenol.*		
6700	**——, *p*-benzalamino-.**	See *Phenol, p-benzylideneamino-.*		
6701	**——, benzenylaminothio-.**	See *Benzothiazole, 2-phenyl-.*		
6702	**——, *o*-benzyl-........**	....	$C_6H_5CH_2C_6H_4OH$	184.23
6703	**——, *p*-benzyl-........**	*p*-hydroxydiphenylmethane..	$C_6H_5CH_2C_6H_4OH$	184.23
6704	**——, *p*-benzylamino-..**	....	$C_6H_5CH_2NHC_6H_5OH$	200.25
6704M	**——, *p*-benzylidene-amino-**	*N*-benzal-*p*-hydroxyaniline...	$C_6H_5CH{:}NC_6H_4OH$	197.23
6705	**——, *o*-bromo-.......**	....	BrC_6H_4OH.......	173.02
6706	**——, *m*-bromo-.......**	....	BrC_6H_4OH.......	173.02
6707	**——, *p*-bromo-........**	....	BrC_6H_4OH.......	173.02
6708	**——, *o*-butoxy-.......**	pyrocatechol monobutyl ether	$CH_3(CH_2)_3OC_6H_4OH$	166.21
6709	**——, *m*-butoxy-.......**	resorcinol monobutyl ether...	$CH_3(CH_2)_3OC_6H_4OH$	166.21
6710	**——, *p*-butoxy-.......**	hydroquinone monobutyl ether	$CH_3(CH_2)_3OC_6H_4OH$	166.21
6711	**——, *o*-butyl-.........**	....	$C_4H_9C_6H_4OH$.....	150.21
6712	**——, *m*-butyl-........**	....	$C_4H_9C_6H_4OH$.....	150.21

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6681	br. need. f. w..	....	202	....	......	s. h.	....
6682	red need. f. al.	....	111	....	sl. s. h.	v. s.	v. s. eth., bz., chl.
6683	or. need......	....	185–6	....	sl. s. h.	s.	v. s. eth., bz., chl.
6684	yel. cr........	....	165	....	......	v. s.	v. s. eth.; v. sl. s. bz., chl.
6685	red need. f. al.	....	131 (142–3)	....	......	......	....
6686	red pr. f. eth..	....	154	....	s.	s.	s. eth.
6687	or.-yel. need...	....	163	....	......	......	....
6688	need.........	....	26	234	......	......	....
6689	oily liq.......	....	....	180–90^{16}	s.	s.	i. eth.
6690	wh. gran. cr. mass	....	46	140–5^{16}	s.	s.	s. eth.
6691	....	....	....	104–6^{4}	......	......	....
6692	....	....	....	140^{5}	......	......	....
6693	....	....	49–50	....	......	......	....
6694	col. liq.......	....	<0	262	v. sl. s. h.	s.	s. eth., NaOH
6695	col. need......	....	92–3	248–50; 138–9^{15}	v. sl. s.	v. s.	v. s. eth.
6696	pr. f. w.......	....	69–70	180–9^{20}	sl. s. h.	s.	s. eth.; sl. s. bz.
6697	leaf. f. w......	....	82	340	sl. s. h.	s.	s. eth., alk.; sl. s. lgr.
6698	leaf. f. w......	....	70	330	s. h.	s.	s. eth., chl., alk.
6699							
6700							
6701							
6702	....	....	21	312	v. s. h.	v. s.	v. s. eth.
6703	col. need. f. al.	....	83–4	320–2 (308)	s. h.	s.	s. eth.
6704	leaf..........	....	90 (84–5)	....	i.	v. s.	v. s. bz.
6704M	leaf. f. dil. al..	....	183 (185–6)	....	i.	v. s.	....
6705	col. oily liq....	1.4924$^{20}_{4}$	5.6 (4–6)	194–5	v. sl. s.	s.	s. eth., alk.
6706	leaf..........	....	33	236.5; 135–40^{12}	v. sl. s.	v. s.	v. s. eth.; s. chl., alk.
6707	tetr..........	1.840^{15}; 1.588^{80}	63.5	238	1.42^{15}	v. s.	v. s. eth.; s. chl., ac. a.
6708	1.5113^{25}.......	1.026^{25}	....	231–4; 159^{69}	......	......	....
6709	....	....	....	130^{5}	......	......	....
6710	....	....	64–5	....	......	......	....
6711	col., 1.496^{15}...	0.975$^{20}_{4}$	....	234–7	v. sl. s.	s.	s. eth.
6712	col...........	0.974$^{20}_{4}$	....	247–9^{758}	v. sl. s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6713	**Phenol, *p*-butyl-**		$C_4H_9C_6H_4OH$	150.21
6714	**——, *p-sec*-butyl-**		$C_2H_5(CH_3)CHC_6H_4OH$	150.21
6715	**——, *p-tert*-butyl-**	4-(α,α-dimethylethyl)-phenol	$(CH_3)_3CC_6H_4OH$	150.21
6716	**——, *o*-chloro-**	1-chloro-2-hydroxybenzene	ClC_6H_4OH	128.56
6717	**——, *m*-chloro-**	1-chloro-3-hydroxybenzene	ClC_6H_4OH	128.56
6718	**——, *p*-chloro-**	1-chloro-4-hydroxybenzene	ClC_6H_4OH	128.56
6719	**——, 2-chloro-4-nitro-**		$Cl(NO_2)C_6H_3OH$	173.56
6720	**——, 2-chloro-5-nitro-**	6-chloro-3-nitrophenol	$Cl(NO_2)C_6H_3OH$	173.56
6721	**——, 4-chloro-2-nitro-**		$Cl(NO_2)C_6H_3OH$	173.56
6722	**——, 5-chloro-2-nitro-**	3-chloro-6-nitrophenol	$Cl(NO_2)C_6H_3OH$	173.56
6723	**——, *p*-cyclohexyl-**		$C_6H_{11}C_6H_4OH$	176.25
6724	**——, 2,4-diamino-**		$(NH_2)_2C_6H_3OH$	124.14
6725	——, ——, dihydrochloride	diamol; amidol (one form)	$(NH_2)_2C_6H_3OH \cdot 2HCl$	197.07
6726	**——, 2,5-diamino-**		$(NH_2)_2C_6H_3OH$	124.14
6727	**——, 3,4-diamino-**		$(NH_2)_2C_6H_3OH$	124.14
6728	**——, 3,5-diamino-**		$(NH_2)_2C_6H_3OH$	124.14
6729	**——, 2,4-dibromo-**		$Br_2C_6H_3OH$	251.92
6730	**——, 2,6-dibromo-**		$Br_2C_6H_3OH$	251.92
6731	**——, 2,6-dibromo-4-nitro-**		$Br_2(NO_2)C_6H_2OH$	296.92
6732	**——, 2,3-dichloro-**		$Cl_2C_6H_3OH$	163.01
6733	**——, 2,4-dichloro-**		$Cl_2C_6H_3OH$	163.01
6734	**——, 2,5-dichloro-**		$Cl_2C_6H_3OH$	163.01
6735	**——, 2,6-dichloro-**		$Cl_2C_6H_3OH$	163.01
6736	**——, 3,4-dichloro-**		$Cl_2C_6H_3OH$	163.01
6737	**——, 3,5-dichloro-**		$Cl_2C_6H_3OH$	163.01
6738	**——, 2,6-dichloro-4-nitro-**		$Cl_2(NO_2)C_6H_2OH$	208.01
6739	**——, *m*-diethylamino-**		$(C_2H_5)_2NC_6H_4OH$	165.23
6740	**——, 2,4-diiodo-**		$I_2C_6H_3OH$	345.93
6741	**——, 2,6-diiodo-**		$I_2C_6H_3OH$	345.93
6742	**——, 2,3-dimethoxy-**	pyrogallol 1,2-dimethyl ether	$(CH_3O)_2C_6H_3OH$	154.16
6743	**——, 2,6-dimethoxy-**	pyrogallol 1,3-dimethyl ether	$(CH_3O)_2C_6H_3OH$	154.16
6744	**——, 3,5-dimethoxy-**	phloroglucinol dimethyl ether	$(CH_3O)_2C_6H_3OH$	154.16
6745	**——, dimethyl-**	See *Xylenol.*		
6746	**——, *m*-dimethylamino-**	*m*-hydroxy-*N*,*N*-dimethylaniline	$(CH_3)_2NC_6H_4OH$	137.18
6747	**——, *p*-(α,α-dimethyl propyl)-.** See *Phenol, p-tert-amyl-.*			

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6713	col. liq.	$0.978\frac{20}{4}$	...	$246\text{–}50^{751}$	v. sl. s.	s.	s. eth.
6714	col. need.	...	59	240.5^{750}	v. sl. s.	s.	v. s. eth.
6715	need. f. w.	$0.9081\frac{114}{4}$	99	236–8	s.	s.	s. eth.
6716	col. liq., 1.5473^{40}	$1.241\frac{18}{15}$	α 7; β 0; γ–4.1	175.6	2.85^{20}	s.	s. eth.
6717	col. liq. or need. 1.5565^{40}	liq. 1.245^{45}; 1.268^{25}	32.8	214	2.60^{20}	s.	s. eth.; 512 bz.
6718	need. f. al., 1.5579^{40}	1.306	43 (39–40)	217	2.71^{20}	v s	v. s. eth.; 272^{2} bz.; s. alk.
6719	lng. col. need. f. al. or w.	...	111	...	s. h.	v. s.	v. s. eth.; s chl.
6720	yel. need. f. w.	...	118–9	...	sl. s.	...	s. chl.
6721	yel. monocl. need. f. al.	...	87	...	v. sl. s	s.	s. eth., chl.
6722	yel. pr. f. w.	...	38.9	subl.	sl. s	s.	s. eth., ac. a.
6723	col. need.	...	133	...	i.	sl. s.	s. eth.
6724	col. leaf.	...	78–80 d.	...	...	s.	sl. s. eth., chl.; s. acet., alk., ac. a.
6725	gray-wh. cr.	...	168–70	...	s.	sl. s.	sl. s. eth.
6726	need.	...	68	...	v. s.	...	...
6727	cr.	...	167–8 d.	...	...	...	...
6728	pr.	...	168–70	...	s.	...	sl. s. eth.
6729	col. need.	...	40 (35–6)	177^{17}; 238–9	0.19^{15}	v. s.	v. s. eth.; s. CS_2, bz., alk.
6730	col. need. f. h. w.	...	56–7	162^{21}	sl. s	v. s.	v. s. eth.
6731	yel. pr. f. al.	...	144	d. >144	v. sl. s.	s. h.	s. eth., CS_2, et. ac., chl.; sl. s. ac. a.
6732	col. cr. f. pet. eth.	...	57	...	...	s.	s. eth.
6733	col. need. f. bz.	...	45	210	0.46^{20}	s.	s. eth., chl., bz.
6734	col. pr. f. pet. eth.	...	58	211^{744}	sl. s.	s.	s. eth., bz.
6735	col. need.	...	67	219–20	...	s.	s. eth.
6736	col. need. f. bz.	...	68	253.5^{767}	...	...	...
6737	...	...	68	233–4	...	s.	...
6738	yel. monocl. leaf. f. al.	1.822	125 d.	subl. <100 exp.	sl. s.	s h.	s. eth., chl., bz.
6739	rhomb. f. CS_2+lgr.	...	78	276–80; 201^{25}	s.	s.	s. eth., CS_2; i. lgr.
6740	col. need. f. w.	...	72	subl. 100	sl. s.	s.	s. eth.; sl. s. chl., bz.
6741	col. cr.	...	68	...	...	s.	...
6742	col. liq.	...	...	233–4; $124\text{–}5^{17}$	...	...	...
6743	monocl. pr. f.w.	...	55–56	258 (262.7)	1.75^{13}	v. s.	v. s. eth.
6744	cr.	...	36–8	$172\text{–}5^{17}$	...	...	...
6745							
6746	need. f. lgr.	...	85–7	265–8	v. sl. s. h.	v. s.	v. s. eth.; s bz., acet., alk., min. a.
6747							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6748	**Phenol, 2,3-dinitro-**	1-hydroxy-2,3-dinitrobenzene	$(NO_2)_2C_6H_3OH$	184.11
6749	**——, 2,4-dinitro-**		$(NO_2)_2C_6H_3OH$	184.11
6750	——, ——, dimethylthiolthionocarbamate. See *Carbamic acid, dimethylthiolthiono*-, 2,4-			
6751	**——, 2,6-dinitro-**		$(NO_2)_2C_6H_3OH$	184.11
6752	**——, 3,4-dinitro-**		$(NO_2)_2C_6H_3OH$	184.11
6753	**——, 3,5-dinitro-**		$(NO_2)_2C_6H_3OH$	184.11
6754	**——, ethenylamino-.**	See *Benzoxazole, 2-methyl-.*		
6755	**——, ethenylaminothio-.** See *Benzothiazole, 2-methyl-*.			
6756	**——, *o*-ethoxy-**	pyrocatechol monoethyl ether; guaethol; catechol monoethyl ether	$C_2H_5OC_6H_4OH$	138.16
6757	**——, *m*-ethoxy-**	resorcinol monoethyl ether	$C_2H_5OC_6H_4OH$	138.16
6758	**——, *p*-ethoxy-**	hydroquinone monoethyl ether	$C_2H_5OC_6H_4OH$	138.16
6759	**——, *o*-ethyl-.**	See *Phlorol.*		
6760	**——, *m*-ethyl-**		$C_2H_5C_6H_4OH$	122.16
6761	**——, *p*-ethyl-**		$C_2H_5C_6H_4OH$	122.16
6762	**——, *o*-ethylamino-**	*N*-ethyl-2-hydroxyaniline	$C_2H_5NHC_6H_4OH$	137.18
6763	**——, *m*-ethylamino-**	*N*-ethyl-3-hydroxyaniline	$C_2H_5NHC_6H_4OH$	137.18
6764	**——, *p*-ethylamino-**	*N*-ethyl-4-hydroxyaniline	$C_2H_5NHC_6H_4OH$	137.18
6765	**——, *p*-heptyloxy-**	hydroquinone monoheptyl ether	$CH_3(CH_2)_6OC_6H_4OH$	208.29
6766	**——, hexahydro-.**	See *Cyclohexanol.*		
6767	**——, *p*-hexyloxy-**	hydroquinone monohexyl ether	$CH_3(CH_2)_5OC_6H_4OH$	194.27
6768	**——, *o*-iodo-**		IC_6H_4OH	220.02
6769	**——, *m*-iodo-**		IC_6H_4OH	220.02
6770	**——, *p*-iodo-**		IC_6H_4OH	220.02
6771	**——, *p*-isoamyl-**		$C_5H_{11}C_6H_4OH$	164.24
6772	**——, *o*-isopropyl-**	*o*-cumenol	$(CH_3)_2CHC_6H_4OH$	136.19
6773	**——, *p*-isopropyl-**		$(CH_3)_2CHC_6H_4OH$	136.19
6774	**——, *p,p′,p″*-methenyltri-.** See *Leucaurin.*			
6775	**——, *o*-methoxy-.**	See *Guaiacol.*		
6776	**——, *m*-methoxy-**	resorcinol monomethyl ether	$CH_3OC_6H_4OH$	124.13
6777	**——, *p*-methoxy-**	hydroquinone monomethyl ether	$CH_3OC_6H_4OH$	124.13
6778	**——, 2-methoxy-4-methyl-.** See *Creosol.*			
6779	**——, methyl-.**	See *Cresol.*		
6780	**——, *o*-methylamino-**		$CH_3NHC_6H_4OH$	123.15
6781	**——, *p*-methylamino-,** sulfate	metol; photol; pictol	$(CH_3NHC_6H_4OH)_2 \cdot H_2SO_4$	344.38
6782	**——, *p,p′*-methylenedi-.** See *Methane, 4,4′-dihydroxydiphenyl-.*			
6783	**——, *o*-nitro-**		$NO_2C_6H_4OH$	139.11
6784	**——, *m*-nitro-**		$NO_2C_6H_4OH$	139.11
6785	**——, *p*-nitro-**		$NO_2C_6H_4OH$	139.11

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6748	yel. monocl. need. f. w.	1.681^{20}	144	....	sl. s.	v. s. h.	v. s. eth.
6749	yel rhomb. pl. f. w.	1.683^{24}	111.6; 114	....	0.56^{18}, 4.3^{100}	3.9^{19}	3.065^{15} eth.; s. bz., chl.
6750	*dinitrophenyl ester.*						
6751	pa. yel. rhomb. need. or leaf. f. w.	....	63–4 (61.8)	....	v. sl. s. c., v. s. h.	v. s. h.	v. s. eth.; s. bz., chl.
6752	col. tricl. need. f. w.	1.672	134	....	......	s.	s. eth.
6753	monocl. leaf. f. dil. HCl	1.702	123	....	......	s.	s. eth., chl., bz.; sl. s. pet. eth.
6754							
6755							
6756	oily liq.......	....	29	217	sl. s.	∞	∞ eth.
6757	col.-pa. yel. liq.	....	....	246–7	i.	s.	s. eth.
6758	leaf. f. w......	....	66	247	sl. s. c., s. h.	v. s.	v. s. eth.
6759							
6760	liq...........	1.025^{0}	–4	214^{752}	sl. s.	v. s.	v. s. eth.
6761	col. need......	....	46	219	sl. s.	v. s.	v. s. eth.
6762	rhomb. pl.....	....	107.5 (108–9)	....	i.	s.	sl. s. eth.; s. h. bz.
6763	cr. f. bz.......	....	62	176^{12}	s. h.	s.	s. eth.; v. s. chl.; sl. s. lgr.
6764	need. f. w.....	....	100	....	s. h.	s.	s. eth.
6765	....	....	60	....	......	......	....
6766							
6767	....	....	48	....	......	......	....
6768	need. or pl....	1.8757^{80}	43 (40.4)	$186\text{–}7^{160}$	s. h.	v. s.	v. s. eth.; s. CS_2
6769	need. f. lgr....	....	40	d.	sl. s.	s.	s. eth.
6770	col. need. f. w.	1.857^{112}	94	d.	sl. s.	v. s.	v. s. eth.
6771	need. f. h. w...	....	93	255	v. sl. s. h.	v. s.	v. s. eth.
6772	col...........	1.028^{18}	16	204	sl. s.	s.	s. eth.
6773	need.........	....	61	229.3^{758}	sl. s.	s.	....
6774							
6775							
6776	liq...........	>1	<-17.5	244.3	sl. s.	∞	∞ eth.
6777	rhomb. leaf. f. w.	....	53	243	s.	v. s.	v. s. eth., bz.
6778							
6779							
6780	pl. f. bz.......	....	86–7	....	i.	s.	s. bz.
6781	wh. cr. powd..	....	250–60 d.	....	5 c., 16.67 h.	s.	....
6782							
6783	lt. yel. monocl. need. or pr.	1.657^{20}	45	214.5 (217.25)	0.21^{20}, 1.08^{100}	46.0^{25}	v. s. eth.; s. alk.
6784	col.-yel. monocl. f. eth.	1.485	96	194^{70}	1.35^{25}, 13.3^{90}	195.0^{25}	v. s. eth.; s. bz., alk.
6785	col.-ylsh. monocl. pr.	1.479^{20}	114	279 d.	1.6^{25}, 26.9^{90}	189.5^{25}	v. s. eth.; s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6786	**Phenol, *p*-nitroso-**	quinone monoxime	NOC_6H_4OH or $HON{:}C_6H_4{:}O$	123.11
6787	**——, *p*-octyloxy-**	hydroquinone monoöctyl ether	$CH_3(CH_2)_7OC_6H_4OH$	222.32
6788	**——, pentabromo-**		C_6Br_5OH	488.65
6789	**——, pentachloro-**		Cl_5C_6OH	266.35
6790	**——, pentamethyl-**		$(CH_3)_5C_6OH$	164.24
6791	**——, *o*-phenyl-**	*o*-hydroxybiphenyl	$C_6H_5C_6H_4OH$	170.20
6792	**——, *m*-phenyl-**	*m*-hydroxybiphenyl	$C_6H_5C_6H_4OH$	170.20
6793	**——, *p*-phenyl-**	*p*-hydroxybiphenyl	$C_6H_5C_6H_4OH$	170.20
6794	**——, phenylazo-.**	See *Azobenzene, hydroxy-.*		
6795	**——, *p*-propenyl-.**	See *Anol.*		
6796	**——, *o*-propoxy-**	pyrocatechol monopropyl ether	$CH_3CH_2CH_2OC_6H_4OH$	152.19
6797	**——, *m*-propoxy-**	resorcinol monopropyl ether	$CH_3CH_2CH_2OC_6H_4OH$	152.19
6798	**——, *p*-propoxy-**	hydroquinone monopropyl ether	$CH_3CH_2CH_2OC_6H_4OH$	152.19
6799	**——, *o*-propyl-**		$C_3H_7C_6H_4OH$	136.19
6800	**——, *m*-propyl-**		$C_3H_7C_6H_4OH$	136.19
6801	**——, *p*-propyl-**		$C_3H_7C_6H_4OH$	136.19
6802	**——, *p*-salicyloyl-.**	See *Benzophenone, 2,4′-dihydroxy-.*		
6803	**——, 2,3,4,6-tetranitro-**		$(NO_2)_4C_6HOH$	274.11
6804	**——, thio-**	benzenethiol*; phenyl mercaptan	C_6H_5SH	110.17
6805	**——, 2,4,6-triamino-**		$(NH_2)_3C_6H_2OH$	139.16
6806	**——, 2,4,6-tribromo-**	*sym*-tribromophenol	$Br_3C_6H_2OH$	330.83
6807	**——, 2,3,5-trichloro-**		$Cl_3C_6H_2OH$	197.46
6808	**——, 2,4,6-trichloro-**	*sym*-trichlorophenol	$Cl_3C_6H_2OH$	197.46
6809	**——, 2,4,6-triiodo-**		$I_3C_6H_2OH$	471.84
6810	**——, 2,4,5-trimethyl-.**	See *Pseudocumenol.*		
6811	**——, 2,4,6-trimethyl-.**	See *Mesitol.*		
6812	**——, 2,3,6-trinitro-**	γ-trinitrophenol	$(NO_2)_3C_6H_2OH$	229.11
6813	**——, 2,4,5-trinitro-**	β-trinitrophenol	$(NO_2)_3C_6H_2OH$	229.11
6814	**——, 2,4,6-trinitro-**	See *Picric acid.*		
6815	**——, *o*-vinyl-**	*o*-hydroxystyrene	$CH_2{:}CHC_6H_4OH$	120.14
6816	**——, *m*-vinyl-**	*m*-hydroxystyrene	$CH_2{:}CHC_6H_4OH$	120.14
6817	**Phenolphthalein**	2,2-bis(*p*-hydroxyphenyl)-phthalide	$C_{20}H_{14}O_4$	318.31
6818	**——, 3′,3″,5′,5″-tetraiodo-**	nosophen; iodophen	$C_{20}H_{10}I_4O_4$	821.96
6819	**1-Phenol-2-sulfonic acid**	*o*-phenolsulfonic acid; aseptol; sozolic acid	$HOC_6H_4SO_3H$	174.17

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6786	yel. rhomb. need.	....	126 d.	....	s.	v. s.	v. s. eth.; s. acet., dil. alk. sol.
6787	....	....	60–1	....	......	......	....
6788	col. monocl. need. f. al.	....	225	d. subl.	i.	s. h.	sl. s. eth.; s. h. bz.
6789	monocl. pr....	1.978	191	310 d.	i.	v. s.	v. s. eth.
6790	need. f. al.....	....	125	267	0.15 h.	s.	....
6791	need. f pet. eth.	....	56	275	sl. s.	v. s.	v. s. eth.; s. lgr.
6792	need. f. pet. eth. or h. w.	....	78 (76–7)	>300	sl. s.	v. s.	s. KOH, bz.
6793	col. need. or leaf. f. dil. al.	....	165	308	sl. s.	s.	s. eth., chl., NH_4OH
6794							
6795							
6796	1.5176^{25}.......	1.0523^{25}	....	223–6; 140^{68}	......	......	....
6797	....	....	....	120^{5}	......	......	....
6798	....	....	56–7	....	......	......	....
6799	liq...........	1.015^{0}; 1.000^{15}_{15}	....	220 (226.6)	sl. s.	s.	s. eth.
6800	col. liq.......	....	26	228	v. sl. s.	s.	s. eth.
6801	cr...........	1.009	22 (61)	232.6^{758}	sl. s.	s.	....
6802							
6803	yel. need. f. chl.	....	140 d.	exp.	v. s.	......	v. sl. s. bz., lgr.
6804	col. liq., $1.58613^{23.2}$	1.078^{20}_{4}	....	169.5	i.	v. s.	∞ eth.
6805	need. unst....	....	....	257	v. s.	v. s.	v. s. eth.
6806	col. monocl. pr. f. dil. al. or bz.	2.55^{20}_{20}	96	subl.	0.007	v. s.	s. eth., glyc., chl.
6807	lng. col. need. f. al.	....	62	253	sl. s. h.	s.	s. eth., lgr.
6808	rhomb. need...	1.490^{75}_{4}	68	244.5	0.08^{25}, 0.243^{96}	v. s.	v. s. eth.
6809	col. need. f. al.	....	156–8	subl. d.	i.	1.58	s. eth., acet.
6810							
6811							
6812	need.........	....	118	....	sl. s.	v. s.	v. s. eth.; s. bz.
6813	need.........	....	96	....	sl. s.	v. s.	v. s. eth.; s. bz.
6814							
6815	need.........	$1.061^{19.2}_{4}$	29	108^{15}	s.	v. s.	v. s. eth.
6816	oil..........	....	....	$114\text{–}6^{16}$	......	......	....
6817	rhomb. need. f. dil. al.	1.277^{32}; 1.300^{20}_{4}	261	....	0.018^{20}	20.9	5.92 eth.
6818	cr. or amor. grn. powd.	....	225 d.	....	i.	v. sl. s.	s. eth., chl., alk.; i. a.
6819	col. liq.......	1.155^{15}	50	....	s.	s.	s. glyc.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6820	**1-Phenol-4-sulfonic acid**	*p*-phenolsulfonic acid	$HOC_6H_4SO_3H$	174.17
6821	**——, 2-amino-**	aminophenolsulfonic acid II	$HO(NH_2)C_6H_3SO_3H$	189.18
6822	**——, 2-amino-6-nitro-**		$HO(NH_2)(NO_2)C_6H_2SO_3H$	234.18
6823	**——, 2-nitro-**		$HOC_6H_3(NO_2)SO_3H$	219.17
6824	**Phenol-2,4,6-tricarboxylic acid.**	See *Trimesic acid, hydroxy-.*		
6825	**Phenosuccin.**	See *Succinamide, N-p-phenetyl-.*		
6826	**Phenothiazine**	phenthiazine; thiodiphenylamine	$C_6H_4NHC_6H_4S$	199.26
	Phenyl. For phenyl derivatives see the parent compounds (e.g., for phenylacridine see			
6827	**Phenylamine.**	See *Aniline.*		
6828	**Phenyl bromide.**	See *Benzene, bromo-*.*		
6828M	**Phenyl cellosolve.**	See *Ethanol, 2-phenoxy-.*		
6829	**Phenyl chloride.**	See *Benzene, chloro-*.*		
6830	**Phenyl cyanide.**	See *Benzonitrile.*		
6831	**Phenyl disulfide**	phenyldithiobenzene*; diphenyl disulfide	$(C_6H_5)_2S_2$	218.32
6832	**Phenylene, diphenyl-.**	See *Terphenyl.*		
6833	**_p_-Phenylene cyanide.**	See *Terephthalonitrile.*		
6834	**_p_-Phenylene diacetate.**	See *Hydroquinone, diacetate.*		
6835	**Phenylenediamine, _N_-acetyl-.**	See *Acetanilide, amino-.*		
6836	**_o_-Phenylenediamine**	1,2-benzenediamine*; 1,2-diaminobenzene	$C_6H_4(NH_2)_2$	108.14
6837	**——, _N,N′_-diacetyl-**	1,4-diacetamidobenzene	$C_6H_4(NHCOCH_3)_2$	192.21
6838	**——, _N,N_-dimethyl-**	*o*-amino-*N, N*-dimethylaniline; 1-amino-2-dimethylaminobenzene	$(CH_3)_2NC_6H_4NH_2$	136.19
6839	**——, _N_-phenyl-**	*o*-aminodiphenylamine	$NH_2C_6H_4NHC_6H_5$	184.23
6840	**_m_-Phenylenediamine**	1,3-benzenediamine*; 1,3-diaminobenzene	$C_6H_4(NH_2)_2$	108.14
6841	**——, 4-(3-aminophenylazo)-**	2,4,3′-triaminoazobenzene	$NH_2C_6H_4N_2C_6H_3(NH_2)_2$	227.27
6842	**——, _N,N_-dimethyl-**	*m*-amino-*N,N*-dimethylaniline; 1-amino-3-dimethylaminobenzene	$(CH_3)_2NC_6H_4NH_2$	136.19
6843	**——, _N,N′_-di-_p_-tolyl-**		$C_6H_4(NHC_6H_4CH_3)_2$	288.38
6844	**——, 4-phenylazo-.**	See *Chrysoidine. (base).*		
6845	**_p_-Phenylenediamine**	1,4-benzenediamine*; 1,4-diaminobenzene	$C_6H_4(NH_2)_2$	108.14
6846	**——, _N,N_-diethyl-**	*p*-amino-*N, N*-diethylaniline; 1-amino-4-diethylamino-benzene	$(C_2H_5)_2NC_6H_4NH_2$	164.25
6847	**——, _N,N_-dimethyl-**	*p*-amino-*N,N*-dimethylaniline; 1-amino-4-dimethylamino-benzene	$(CH_3)_2NC_6H_4NH_2$	136.19
6848	**——, _N_-methyl-**	*p*-methylaminoaniline; *p*-amino-*N*-methylaniline	$CH_3NHC_6H_4NH_2$	122.17
6849	**——, _N_-phenyl-**	*p*-aminodiphenylamine	$C_6H_5NHC_6H_4NH_2$	184.23
6850	**——, _N,N,N′,N′_-tetramethyl-**		$C_6H_4[N(CH_3)_2]_2$	164.25
6851	**_m_-Phenylene dimercaptan.**	See *Resorcinol, dithio-.*		
6852	**_p_-Phenylene dimercaptan.**	See *Hydroquinone, dithio-.*		
6853	**Phenyl ether**	phenoxybenzene*; diphenyl ether	$(C_6H_5)_2O$	170.20

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of: Water	Alcohol	Ether, etc.
6820	deliq. need.	....	....	....	s.	s.	....
6821	rhomb.	....	d.	....	0.7^{14}	i.	i. eth.
6822					s.		
6823	need. f. w.	....	141	d.	s.	v. s.	v. s. chl.
6824							
6825							
6826	yel. rhomb. leaf. f. al.	....	180	371 d.	....	sl. s.	sl. s. eth.; s. bz.
	Acridine, phenyl-). For phenyl esters of organic acids see the acids.						
6827							
6828							
6828M							
6829							
6830							
6831	need. f. al.	....	61	310 d.	i.	s.	s. eth., CS_2, bz.
6832							
6833							
6834							
6835							
6836	brnsh. yel. monocl. cr. or tab. f. chl.	....	102	252 (256–8)	4.15^{35}, 733^{81}	v. s.	v. s. eth.; s. chl.
6837	need. f. w.	....	186	....	v. s. h.	v. s.	v. sl. s. eth.
6838	col. oil	....	....	218^{751}	sl. s.	v. s.	v. s. eth.
6839	need. f. w.	....	79–80	....	s.	......	s. bz., acet., chl.; sl. s. lgr.
6840	col. rhomb. need., $1.63390^{57.7}$	1.1389^{5}; 1.107^{58}	62.8	287 (282–4)	35.1^{25}	s.	s. eth.
6841	or.-red. monocl. f. w.	....	143.5	....	i.	v. s.	v. s. eth.
6842	oil	0.995^{25}	<–20	268–70 (258)	sl. s.	v. s.	v. s. eth.
6843	lng. need. f. al.	....	138–9	d.	i.	sl. s.	sl. s. eth., bz., ac. a.
6844							
6845	col. monocl. f. w. or eth.	....	139.7 (139–41)	267	3.8^{24}, 669^{107}	s.	s. eth., chl.
6846	liq	....	....	261–2	s.	v. s.	v. s. eth.
6847	col. need.	$1.036\frac{20}{4}$; liq., 1.0168^{90}	53 (41)	262	s.	v. s.	v. s. eth.; s. chl.
6848	leaf	....	35.5^{0}	259.5	v. s.	v. s.	v. s. eth.
6849	need. f. al.	....	66–7; 75	354 in H_2	sl. s.	v. s.	v. s. eth.
6850	leaf. f. dil. al.	....	51	260	v. sl. s. h.	v. s.	v. s. eth., chl.
6851							
6852							
6853	col. monocl. (rhombic) 1.5826^{24}	1.0728^{20}	28	259	v. sl. s.	4.97^{10} 87%	s. eth., ac. a., bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6853M	**Phenyl fluoride.**	See *Benzene, fluoro-**.		
6854	**Phenyl iodide.**	See *Benzene, iodo-**.		
6855	**Phenyl isocyanide**	phenylcarbylamine	C_6H_5NC	103.12
6856	**Phenyl ketone.**	See *Benzophenone.*		
6857	**Phenyl mercaptan.**	See *Phenol, thio-.*		
6858	**Phenyl mustard oil.**	See *Isothiocyanic acid, phenyl ester.*		
	***p*-Phenylphenacyl esters.**	See under the corresponding acids.		
6859	**Phenyl sulfide**	diphenyl sulfide; phenylthiobenzene*; benzene sulfide	$(C_6H_5)_2S$	186.26
6859M	**Phenylsulfonamide**	See *Benzenesulfonamide.*		
6860	**Phenyl sulfone**	diphenyl sulfone; phenylsulfonylbenzene*; benzene sulfone; sulfobenzide	$(C_6H_5)_2SO_2$	218.26
6861	**Phenzoline.**	See *Quinazoline,* 3,4-*dihydro-3-phenyl-.*		
6862	**Phloretic acid**	*p*-hydroxyhydrocinnamic acid; α, β-dihydro-*p*-coumaric acid	$HOC_6H_4CH_2CH_2COOH$	166.17
6863	——, phloroglucinol monoester.	See *Phloretin.*		
6864	**Phloretin**	phloroglucinol monophloretate	$C_{15}H_{14}O_5$	274.26
6865	**Phlorizin**	phloridzin	$C_{21}H_{24}O_{10}\cdot 2H_2O$	472.44
6866	**Phloroglucinol**	1,3,5-benzenetriol; *sym*-trihydroxybenzene	$C_6H_3(OH)_3$	126.11
6867	——, dimethyl ether.	See *Phenol, 3,5-dimethoxy-.*		
6867M	——, monomethyl ether.	See *Resorcinol, 5-methoxy-.*		
6868	——, monophloretate.	See *Phloretin.*		
6869	——, triethyl ether.	See *Benzene,* 1,3,5-*triethoxy-**.		
6870	——, trimethyl ether.	See *Benzene,* 1,3,5-*trimethoxy-**.		
6871	——, trioxime.	See 1,3,5-*Cyclohexanetrione, trioxime.*		
6872	**Phloroglucinolcarboxylic acid.**	See *Benzoic acid,* 2,4,6-*trihydroxy-.*		
6873	**Phlorol**	*o*-ethylphenol	$C_2H_5C_6H_4OH$	122.16
6874	**Phlorone**	*p*-xyloquinone; 2,5-dimethylquinone	$(CH_3)_2C_6H_2O_2$	136.14
6874M	**——, 3,6-dibromo-**		$(CH_3)_2C_6Br_2O_2$	293.96
6875	**Phorone**	diisopropylideneacetone; 2,6-dimethyl-2,5-heptadien-4-one*	$CO[CH:C(CH_3)_2]_2$	138.20
6876	**Phosgene**	carbonyl chloride; chloroformyl chloride	$COCl_2$	98.92
6877	**——, phenylimino-.**	See *Aniline, N-(dichloromethylene)-.*		
6878	**——, thio-**	thiocarbonyl chloride	$CSCl_2$	114.98
6879	**Phosphaniline.**	See *Phosphine, phenyl-.*		
6880	**Phosphenyl chloride.**	See *Phosphine, dichlorophenyl-.*		
6881	**Phosphine, dichlorophenyl-**	phosphenyl chloride	$C_6H_5PCl_2$	178.99
6882	**——, diethyl-***		$(C_2H_5)_2PH$	90.11
6883	**——, dimethyl-***		$(CH_3)_2PH$	62.06
6884	**——, ethyl-***	phosphinoethane	$C_2H_5PH_2$	62.06
6885	**——, ethyldiphenyl-**		$(C_6H_5)_2PC_2H_5$	214.24
6886	**——, methyl-***		CH_3PH_2	48.03
6887	**——, phenyl-**	phosphaniline	$C_6H_5PH_2$	110.10
6888	**——, triethyl*-**		$(C_2H_5)_3P$	118.16
6889	——, ——, oxide		$(C_2H_5)_3PO$	134.16
6890	——, ——, sulfide		$(C_2H_5)_3PS$	150.22
6891	**——, trimethyl-***		$(CH_3)_3P$	76.08

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6853M							
6854							
6855	col.-grnsh. liq..	0.9775^{15}	....	166 d.	d.	d.	s. eth.
6856							
6857							
6858							
6859	col. liq., 1.635^{18}	$1.1185\frac{15}{15}$	<−40	296	i.	s.	∞ eth., CS_2, bz.
6859M							
6860	monocl. pr. f. bz.; pl. f. al.; need. f. w.	$1.252\frac{20}{4}$	125	377.8; 232^{18}	i. c., sl. s. h.	s. h.	s. eth., bz.
6861							
6862	monocl. f. eth.	....	129	....	s. h.	s.	s. eth.
6863							
6864	sm. leaf........	....	255 d.	....	sl. s. h.	∞	0.81 eth.; ∞ ac. a.
6865	silky need.....	1.4298^{19}	$2H_2O$ 108–9; anh. 170 d.	....	0.1 c., v. s. h.	25	v. sl. s. eth.; i. chl.
6866	rhomb........	....	anh. 219	subl. d.	1.13^{25}	v. s.	v. s. eth.
6867							
6867M							
6868							
6869							
6870							
6871							
6872							
6873	col. liq........	1.0374^{12}	<−18	207.5	sl. s.	v. s.	v. s. eth.; s. bz.
6874	yel. tricl. f. al.	....	125	subl.	sl. s. h.	s.	s. eth., bz., chl.
6874M	yel. sc........	....	185–86	....	i.	s.	s. eth.
6875	yel. cr., 1.49982	0.885	28	198.5	sl. s. (i.)	s.	s. eth.
6876	pois. gas......	$1.392\frac{19}{4}$	−118 (−104)	8.3	d.	d.	v. s. eth.; s. bz., ac. a., tol.
6877							
6878	red liq., 1.5442.	1.5085^{15}	....	73.5	d.	d.	s. eth.
6879							
6880							
6881	fum. liq., 1.6053^{7}	1.319	....	224.6	d.	......	∞ bz., CS_2
6882	col. liq........	<1	....	85	i.	s.	∞ eth.
6883	col. liq., ign...	<1	....	25	i.	s.	s. eth.
6884	col. liq........	<1	....	25	d.	......	....
6885	liq...........	....	....	293	......	s.	s. bz.
6886	col. gas........	....	....	−14	sl. s.	sl. s.	v. s. eth.
6887	liq...........	1.001^{15}	....	160	......	......	....
6888	col. liq., 1.446.	$0.801\frac{20}{4}$	....	128	i.	s.	s. eth.
6889	col. deliq. need.	....	52.9	242.9	s. h.	s.	s. eth.; i. KOH
6890	hex. pr., 1.590, 1.650	....	94	subl.; ign. 70	s. h.	s.	s. eth.
6891	col. liq........	<1	....	42	i.	......	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6892	**Phosphine, triphenyl-**		$(C_6H_5)_3P$	262.28
6892M	——, ——, oxide		$(C_6H_5)_3PO$	278.28
6893	**Phosphinic acid, dimethyl-**		$(CH_3)_2POOH$	94.06
6894	——, **methyl-.**	See *Methanephosphonic acid.*		
6895	**Phosphoric acid, diethyl-.**	See *Diethylphosphoric acid.*		
6896	**Phosphorobenzene**	phosphobenzene	$C_6H_5P{:}PC_6H_5$	216.16
6896M	**Photoanethole.**	See *Stilbene, 4,4′-dimethoxy-.*		
6897	**Photol.**	See *Phenol, p-methylamino-, sulfate.*		
6898	**Phthalaldehyde**	1,2-benzenedicarbonal*; *o*-phthalic aldehyde	$C_6H_4(CHO)_2$	134.13
6899	**Phthalaldehydic acid**	*o*-formylbenzoic acid	$CHOC_6H_4COOH$	150.13
6900	——, **5,6-dimethoxy-.**	See *Opianic acid.*		
6901	**Phthalamide**	phthalic diamide	$C_6H_4(CONH_2)_2$	164.16
6902	**Phthalandione.**	See *Phthalic anhydride.*		
6903	**Phthalanil**	*N*-phenylphthalimide	$C_6H_4(CO)_2NC_6H_5$	223.22
6904	**1,4-Phthalazinedione, 5-amino-2,3-dihydro-.**	See *Luminol.*		
6905	**Phthalhydrazide, 3-amino-.**	See *Luminol.*		
6906	**Phthalic acid**	1,2-benzenedicarboxylic acid*; *o*-phthalic acid	$C_6H_4(COOH)_2$	166.13
6907	——, dibenzyl ester		$C_6H_4(COOCH_2C_6H_5)_2$	346.37
6908	——, dibutyl ester	dibutyl 1,2-benzenedicarboxylate*; butyl phthalate	$C_6H_4(COOC_4H_9)_2$	278.34
6909	——, diethyl ester		$C_6H_4(COOC_2H_5)_2$	222.23
6910	——, dimethyl ester	dimethyl 1,2-benzenedicarboxylate*; methyl phthalate	$C_6H_4(COOCH_3)_2$	194.18
6911	——, diphenyl ester	phenyl phthalate	$C_6H_4(COOC_6H_5)_2$	318.31
6912	——, monoethyl ester	ethyl hydrogen 1,2-benzenedicarboxylate*	$C_6H_4(COOC_2H_5)COOH$	194.18
6913	——, **3-benzoyl-**	2,3-benzophenonedicarboxylic acid	$C_6H_5COC_6H_3(COOH)_2$	270.23
6914	——, **4-benzoyl-**	3,4-benzophenonedicarboxylic acid	$C_6H_5COC_6H_3(COOH)_2$	270.23
6915	——, **3-bromo-**	3-bromo-1,2-benzenedicarboxylic acid*	$BrC_6H_3(COOH)_2$	245.04
6916	——, **4-chloro-**	4-chloro-1,2-benzenedicarboxylic acid*	$ClC_6H_3(COOH)_2$	200.58
6917	——, **1,6-dihydro-**	2,4-cyclohexadiene-1,2-dicarboxylic acid*	$C_6H_6(COOH)_2$	168.14
6918	——, **3,6-dihydro-**	1,4-cyclohexadiene-1,2-dicarboxylic acid*	$C_6H_6(COOH)_2$	168.14
6919	——, **4,5-dihydro-**	2,6-cyclohexadiene-1,2-dicarboxylic acid*	$C_6H_6(COOH)_2$	168.14
6920	——, **3,4-dimethoxy-.**	See *Hemipic acid.*		
6921	——, **hexahydro-.**	See *1,2-Cyclohexanedicarboxylic acid.*		
6922	——, **3-hydroxy-**		$HOC_6H_3(COOH)_2$	182.13
6923	——, **4-hydroxy-**		$HOC_6H_3(COOH)_2$	182.13
6924	——, **3-nitro-**		$NO_2C_6H_3(COOH)_2$	211.13
6925	——, **4-nitro-**		$NO_2C_6H_3(COOH)_2$	211.13

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6892	monocl. pr. f. eth.	1.194	79	>360	i.	s.	v. s. eth.; s. HCl, bz.
6892M	wh. cr.	$1.2124^{22.6}$	156 (153)	>360	sl. s. h.	v. s.	v. s. bz.; sl. s. eth., lgr.
6893	cr.	....	76	subl.	s.	s.	s. eth.
6894							
6895							
6896	pa. yel. powd.	....	149	....	i.	i.	i. eth.; v. s. h. bz.
6896M							
6897							
6898	yel. need.	....	56	....	0.62^{25}, 1.63^{50}	s.	s. eth.
6899	monocl. f. w.	1.404	97 (98–9)	d.	9.48^{46}	v. s.	v. s. eth.
6900							
6901	col. rhbdr.	....	220	....	i.	i.	i. eth.
6902							
6903	col. need. f. al.	....	207	subl.	i.	i.	∞ chl.
6904							
6905							
6906	col. rhomb. or monocl. f. w.	1.593	206–8 d.	d. >191	0.54^{14}, 18^{99}	11.7^{18}	0.69^{15} eth., i. chl.
6907	....	....	42–4	277^{15}	i.	v. s.	v. s. eth.
6908	col. oily liq.	1.0465	....	340	0.04^{25}	∞	∞ eth., acet., bz.
6909	col. liq., 1.5019	$1.123\frac{25}{4}$	....	296.1	i.	∞	∞ eth.; s. bz.
6910	col. liq., $1.51546^{20.8}$	$1.189\frac{25}{25}$	....	282	0.5	....	....
6911	col. rhomb.	....	69–70 (73–5)	....	i.	sl. s.	sl. s. eth.
6912	liq.	....	2	d.	sl. s.	s.	s. eth.
6913	pl. or need. (+1H_2O) f. w.	....	–H_2O 100; 145–50 → anh.	....	s. h.	s.	v. sl. s. bz.
6914	cr.	....	189	....	s.	s.	....
6915	need. f. w.	....	–H_2O, 178.5; anh. 188	....	s.	s.	s. eth.; i. chl.
6916	need. f. al.	....	150	–H_2O, >150	s.	s.	s. eth.
6917	monocl. pr. f. w. or al.	....	179–80	....	0.2^{10}, 2^{100}	s.	sl. s. eth.
6918	monocl. pr. f. w.	....	153	....	1.7^{6}	......	....
6919	tricl.	....	215	....	0.3^{25}	s.	s. acet.
6920							
6921							
6922	pr. f. w.	....	244	....	0.14^{24}, 2.5^{100}	v. s.	v. s. eth.
6923	col. rosettes f. w.	....	181 d.	....	3^{10}	v. s.	s. eth.
6924	yel. monocl. f. eth.	....	220 (206)	....	2.05^{25}	v. s.	v. s. eth.
6925	lt. yel. need.	....	164 (161)	....	s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6926	**Phthalic acid, tetrachloro-**		$C_6Cl_4(COOH)_2$	303.92
6927	**——, Δ^1-tetrahydro-.**	See *1-Cyclohexene-1, 2-dicarboxylic acid.*		
6928	***m*-Phthalic acid.**	See *Isophthalic acid.*		
6929	***p*-Phthalic acid.**	See *Terephthalic acid.*		
6930	**Phthalic aldehyde.**	See *Phthalaldehyde.*		
6931	***m*-Phthalic aldehyde.**	See *Isophthalaldehyde.*		
6932	***p*-Phthalic aldehyde.**	See *Terephthalaldehyde.*		
6933	**Phthalic anhydride**	phthalandione	$C_6H_4(CO)_2O$	148.11
6934	**Phthalic diamide.**	See *Phthalamide.*		
6935	**Phthalic imide.**	See *Phthalimide.*		
6936	**Phthalide**	1(3)-isobenzofuranone; α-hydroxy-*o*-toluic acid lactone	$\underline{C_6H_4COOCH_2}$	134.13
6937	**——, benzal-.**	See *Phthalide, benzylidene-.*		
6938	**——, benzylidene-**	benzalphthalide	$C_6H_4COOC{:}CH\text{-}C_6H_5$	222.23
6939	**——, 2,2-bis(*p*-hydroxyphenyl)-**	See *Phenolphthalein.*		
6940	**——, 5,6-dimethoxy-.**	See *Meconin.*		
6941	**——, 3,3-diphenyl-**	triphenylcarbinol *o*-carboxylic anhydride; "phthalophenone"	$\underline{C_6H_4COOC}(C_6H_5)_2$	286.31
6942	**——, 6-nitro-**		$NO_2\underline{C_6H_3COOCH_2}$	179.13
6943	**Phthalimide**	1,3-isoindoledione; *o*-phthalic imide	$C_6H_4(CO)_2NH$	147.13
6944	**——, *N*-isobutyl**	2-isobutyl-1,3-isoindoledione	$\underline{C_6H_4CON(C_4H_9)CO}$	203.23
6945	**——, *N*-phenyl-.**	See *Phthalanil.*		
6946	**Phthalimidine**	1-isoindolinone	$\underline{C_6H_4CONHCH_2}$	133.14
6947	**Phthalonic acid**	*o*-carboxyphenylglyoxylic acid	$C_6H_4(COCOOH)\text{-}COOH$	194.14
6948	**Phthalophenone.**	See *Phthalide, 3,3-diphenyl-.*		
6949	**Phthalyl alcohol.**	See *o-Xylylene glycol.*		
6950	**Phthalyl chloride**	1,2-benzenedicarbonyl chloride*; *o*-phthalyl dichloride	$C_6H_4(COCl)_2$	203.03
6951	***m*-Phthalyl dichloride.**	See *Isophthalyl chloride.*		
6952	***p*-Phthalyl dichloride.**	See *Terephthalyl chloride.*		
6952M	**Phthiocol**	2-hydroxy-3-methyl-1,4-naphthoquinone; vitamin K (one form)	$C_{11}H_8O_3$	188.17
6953	**Phycitol.**	See *i-Erythritol.*		
6954	**Physostigmine**	eserine	$C_{15}H_{21}N_3O_2$	275.34
6955	——, hydrochloride		$C_{15}H_{21}N_3O_2\cdot HCl$	311.81
6956	——, salicylate		$C_{15}H_{21}N_3O_2\cdot C_7H_6O_3$	413.46
6957	——, sulfate		$(C_{15}H_{21}N_3O_2)_2\cdot H_2SO_4$	648.76
6957M	**Phytadiene**		$C_{20}H_{38}$	278.51
6958	**Phytol**	3,7,11,15-tetramethyl-2-hexadecen-1-ol*	$C_{20}H_{39}OH$	296.52
6959	**Piazine.**	See *Pyrazine.*		
6960	**Picene**	dibenzo[*a,i*]phenanthrene	$C_{22}H_{14}$	278.33
6961	**2-Picoline**	2-methylpyridine; α-picoline	$CH_3C_5H_4N$	93.12

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6926	leaf. or need. f. w.	....	250 d.	....	0.57^{14}, 3^{99}	v. s.	v. s. eth., acet.; v. sl. s. chl.
6927							
6928							
6929							
6930							
6931							
6932							
6933	col. rhomb. need.	1.527^{4}	130.8	284.5 subl.	v. sl. s.	s.	sl. s. eth.
6934							
6935							
6936	need. f. w., $1.53560^{99.1}$	....	73	290	v. sl. s.	v. s.	....
6937							
6938	col. monocl. pr. f. al.	....	108 (99)	....	i.	s. h.	....
6939							
6940							
6941	leaf. f. al......	....	115	419–28 sl. d.	d. h.	s.	s. H_2SO_4
6942	need. f. al.....	....	141	....	i. c.	s.	s. eth.; v. s. h. chl.; i. alk. carb.
6943	hex. pr. f. eth.	....	238 (234)	subl.	0.06^{25}	s.	sl. s. eth.; s. caustic alk., ac. a.; v. sl. s. bz., chl.
6944	....	....	93	293–5	......	......	....
6945							
6946	need.........	....	150	337^{730}	s.	v. s.	v. s. eth., chl.
6947	pr. f. bz. or al.	....	138–40	....	115^{15}	s.	s. eth.; sl. s. chl.
6948							
6949							
6950	col. oily liq., $1.57099^{15.5}$	1.408	(*sym.*) 16; (*uns.*) 89	281 275	d.	d.	s. eth. ....
6951							
6952							
6952M	yel. pr........	....	173	....	......	......	....
6953							
6954	col. hyg. trim. f. bz., β 1.602	....	unst. 86–7; stab. 105–6	....	sl. s.	v. s.	s. eth., bz., chl.
6955	wh. cr........	....	....	....	s.	......	....
6956	col.-yel. acicular cr.	....	178.9	....	1.33	7.71	0.57 eth.; s. chl.
6957	micro-cr. powd.	....	140	....	v. s.	v. s.	0.083 eth.; s. chl.
6957M	liq...........	$0.826\frac{0}{4}$	....	$185–8^{22}$	......	......	∞ me. al., ac. a., pet. eth.
6958	col. oil, 1.46380	$0.864\frac{0}{4}$; $0.852\frac{20}{4}$	....	$145^{.03–.04}$; $203–4^{9–10}$	i.	∞	∞ eth., me. al.
6959							
6960	col. leaf.......	....	364	520	i.	v. sl. s.	v. sl. s. eth.; sl. s. chl., h. bz.
6961	col. liq., $1.50293^{16.7}$	$0.950\frac{15}{4}$	−69.9	128	v. s.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6962	**3-Picoline**	3-methylpyridine; β-picoline	$CH_3C_5H_4N$	93.12
6963	**4-Picoline**	4-methylpyridine; γ-picoline	$CH_3C_5H_4N$	93.12
6964	**2-Picoline-4,6-dicarboxylic acid.**	See *Uvitonic acid.*		
6965	**Picolinic acid**	2-pyridinecarboxylic acid*	C_5H_4NCOOH	123.11
6966	**Picraconitine.**	See *Benzaconine.*		
6967	**Picramic acid**	2-amino-4,6-dinitrophenol*	$NH_2(NO_2)_2C_6H_2OH$	199.12
6968	**Picramide.**	See *Aniline*, 2,4,6-*trinitro-.*		
6969	**Picric acid**	2,4,6-trinitrophenol	$(NO_2)_3C_6H_2OH$	229.11
6970	——, methyl ether.	See *Anisole*, 2,4,6-*trinitro-.*		
6971	**Picryl chloride**	2-chloro-1,3,5-trinitrobenzene*	$(NO_2)_3C_6H_2Cl$	247.56
6972	**Pictol.**	See *Phenol, p-methylamino-, sulfate.*		
6973	**Pilocarpidine(*d*)**		$C_{10}H_{14}N_2O_2$	194.23
6974	——, chloroplatinate		$(C_{10}H_{14}N_2O_2\cdot HCl)_2PtCl_4\cdot 4H_2O$	870.51
6975	——, nitrate		$C_{10}H_{14}N_2O_2\cdot HNO_3$	257.25
6976	**Pilocarpine**		$C_{11}H_{16}N_2O_2$	208.26
6977	——, hydrochloride		$C_{11}H_{16}N_2O_2\cdot HCl$	244.72
6978	——, nitrate		$C_{11}H_{16}N_2O_2\cdot HNO_3$	271.27
6979	——, salicylate		$C_{11}H_{16}N_2O_2\cdot C_7H_6O_3$	346.37
6980	——, sulfate		$(C_{11}H_{16}N_2O_2)_2\cdot H_2SO_4$	514.59
6981	***d*-Pimaric acid**		$C_{20}H_{30}O_2$	302.44
6982	**Pimelic acid**	heptanedioic acid*	$COOH(CH_2)_5COOH$	160.17
6983	——, diethyl ester	ethyl pimelate	$CH_2(CH_2CH_2COOC_2H_5)_2$	216.27
6984	**——, γ-keto-.**	See *Acetonediacetic acid.*		
6985	**Pimelic ketone.**	See *Cyclohexanone**.		
6986	**Pinacol**	2,3-dimethyl-2,3-butanediol*; tetramethylethylene glycol; pinacone	$(CH_3)_2C(OH)COH(CH_3)_2$	118.17
6987	**Pinacolin**	3,3-dimethyl-2-butanone*; *tert*-butyl methyl ketone	$CH_3COC(CH_3)_3$	100.16
6988	**Pinacolyl alcohol**	3,3-dimethyl-2-butanol*; methyl-*tert*-butylcarbinol	$(CH_3)_3CCHOHCH_3$	102.17
6989	**Pinacone.**	See *Pinacol.*		
6990	**Pinene,** hydrochloride.	See *Bornyl chloride.*		
6991	***dl*-Pinene**	*dl*-2,6,6-trimethylbicyclo-[3,1,1] hept-2-ene; *dl*-α-pinene	$C_{10}H_{16}$	136.23

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6962	col. liq., $1.50432^{24.0}$	$0.9613\frac{15}{4}$	....	143.5	∞	∞	∞ eth.
6963	col. liq........	$0.9571\frac{15}{4}$	....	142.1	∞	∞	∞ eth.
6964							
6965	need. f. w......	....	137	subl.	v. s.	5.44^{25}	v. sl. s. eth., bz., chl.
6966							
6967	red monocl. f. chl., 1.54, >1.95, 1.505	....	168–9	....	0.14^{22}	s.	sl. s. eth.; s. bz., glac. ac. a., aniline
6968							
6969	yel. rhomb. leaf. f. w.	1.763	121.8	exp. >300	1.4^{20}, 6.8^{100}	4.91^{20}	1.43 c. eth.; s. bz.
6970							
6971	yel. monocl. pr. f. eth.	1.797	83	d.	0.018^{15}	4.48^{17}	7.23^{17} eth.
6972							
6973	viscid oil, $[\alpha]+81.3^{\circ}_{D}$	....	....	....	s.	v. s.	sl. s. eth.
6974	or. yel. leaf. or dk. red pyr.	....	88–9; anh. 187 d.	....	......	i.	....
6975	wh. cr.........	....	137	....	50	s.	....
6976	col. oil or need., $[\alpha]+106^{\circ 18}_{D}$ in w.	....	34	....	v. s.	v. s.	sl. s. eth.; v. s. chl.; v. sl. s. bz.; i. pet. eth.
6977	deliq. pr. or need., $[\alpha]$- $+91.74^{\circ}_{D}$	....	anh. 196.7	....	333	37^{25}	i. eth.; sl. s. chl.
6978	pr. f. al. or w., $[\alpha]+82.9^{\circ}_{D}$	....	176–8 (173)	....	16^{20}	6.2^{60}	i. eth., chl.
6979	wh. cr., $[\alpha]+62.5^{\circ}_{D}$	....	120	....	s.	s.	....
6980	wh. cr. f. al. +eth., $[\alpha]+84.72^{\circ}_{D}$	....	132 (120)	....	s.	s.	....
6981	cr.............	....	212	282^{20}	i.	s.	s. eth.
6982	monocl. pr. f. w.	1.329^{15}	103	272^{100} subl.	2.52^{13}, 5^{20}	v. s.	v. s. eth.
6983	col. liq........	$0.999\frac{15}{15}$	....	$252–5^{748}$	i.	s.	s. eth.
6984							
6985							
6986	col. need......	0.9672^{15}	38 (41–3)	172.8	s. c., v. s. h.	v. s.	v. s. eth.; sl. s. CS_2
6987	col. liq........	0.811; $0.8208\frac{0}{4}$	–52.5	106.2	2.51^{15}	s.	s. eth.; v. s. acet.
6988	liq. or silky need.	0.812^{25}	5.5	121–3	v. sl. s.	s.	∞ eth.
6989							
6990							
6991	col. liq., 1.4658	$0.8582\frac{20}{4}$	–55 (–50)	154 (158–61)	v. sl. s.	∞	∞ eth., chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6992	**Pinole(*dl*)**	6,8-epoxy-1-*p*-menthene; 4,7,7-trimethyl-6-oxabicyclo-[3,2,1]oct-3-ene; *dl*-sobrerone	$C_{10}H_{16}O$	152.23
6993	——, hydrate	*i*-1-*p*-menthene-6,8-diol	$C_{10}H_{16}(OH)_2$	170.25
6994	**2-Pipecoline**	2-methylpiperidine; α-pipecoline	$CH_3C_5H_9NH$	99.17
6995	**3-Pipecoline**	3-methylpiperidine; β-pipecoline	$CH_3C_5H_9NH$	99.17
6996	**4-Pipecoline**	4-methylpiperidine; γ-pipecoline	$CH_3C_5H_9NH$	99.17
6997	**Piperazine**	hexahydropyrazine; diethylenediamine	$NHCH_2CH_2$- $NHCH_2CH_2$	86.14
6998	——, dihydrobromide		$C_4H_{10}N_2 \cdot 2HBr$	247.99
6999	——, dihydrochloride		$C_4H_{10}N_2 \cdot 2HCl$	159.07
7000	——, hexahydrate		$C_4H_{10}N_2 \cdot 6H_2O$	194.23
7001	——, salts of organic acids. See under the acids.			
7002	**——, 1,4-bis(hydrocinnamyl)-**		$(C_6H_5CH_2CH_2CO)_2C_4H_8N_2$	350.45
7003	**——, α,γ-diaci-.**	See *Glycine anhydride.*		
7004	**——1,4-dianisoyl-**		$(CH_3OC_6H_4CO)_2C_4H_8N_2$	354.39
7005	**——, 2,5-dimethyl-(*trans*)**		$(CH_3)_2C_4H_8N_2$	114.19
7006	**——, 1,4-dinitroso-**		$C_4H_8N_2(NO)_2$	144.14
7007	**——, 1,4-di-α-toluyl-**		$(C_6H_5CH_2CO)_2C_4H_8N_2$	322.39
7008	**——, 1-phenyl-**		$C_4H_9N_2C_6H_5$	162.23
7009	**2,5-Piperazinedione.**	See *Glycine anhydride.*		
7010	**Piperethylalkine.**	See *Piperidineëthanol.*		
7011	**Piperic acid**	5-(3,4-methylenedioxyphenyl)-2,4-pentadienoic acid*; β-(3,4-methylenedioxystyryl)acrylic acid	$(CH_2O_2)C_6H_3CH:CHCH:CHCOOH$	218.20
7012	**Piperidic acid.**	See *Butyric acid, γ-amino-.*		
7013	**Piperidine**	hexahydropyridine; pentamethylenimine	$(CH_2)_5NH$	85.15
7014	**——, 1-acetyl-**	acetic acid piperidide; *N*-acetylpiperidine	$CH_3CON(CH_2)_5$	127.18
7015	**——, 2-allyl-.**	See *β-Coniceine.*		
7015M	**——, 1-amyl-**	*N*-*n*-pentylpiperidine	$C_5H_{10}NC_5H_{11}$	155.28
7016	**——, 4-benzoxy-2,2,6-trimethyl-**, lactate. See *β-Eucaine, lactate.*			
7017	**——, 1-benzoyl-**		$C_6H_5CONC_5H_{10}$	189.25
7017M	**——, 1-butyl-**		$C_5H_{10}NC_4H_9$	141.25
7018	**——, 1,2-dimethyl-**	*N*, α-dimethylpiperidine	$C_5H_9N(CH_3)_2$	113.20
7018M	**——, 1-dodecyl-**		$C_5H_{10}N(CH_2)_{11}CH_3$	253.46
7019	**——, ethoxyl-.**	See *Piperidineëthanol.*		
7020	**——, 1-ethyl-**	*N*-ethylpiperidine	$C_2H_5NC_5H_{10}$	113.20
7021	**——, 2-ethyl-(*dl*)**	*dl*-α-ethylpiperidine	$NHCH(C_2H_5)$- $(CH_2)_4$	113.20
7022	**——, 3-ethyl-(*dl*)**	*dl*-β-ethylpiperidine	$NHCH_2CH$- $(C_2H_5)(CH_2)_3$	113.20
7023	**——, 1-formyl-**	*N*-formylpiperidine	$HCONC_5H_{10}$	113.16
7023H	**——, 1-heptyl-**		$C_5H_{10}N(CH_2)_6CH_3$	183.33

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6992	1.4715........	$0.9420\frac{20}{4}$	....	184	......	s.	s. eth.
6993	col...........	....	150	270–1	3.3^{15}	v. s.	v. s. eth.
6994	liq., $1.44627^{24.3}$	0.844^{24}	9	119	s.	......	i. dil. KOH
6995	liq., $1.43779^{21.6}$	0.845^{24}	....	126	v. s.	......	....
6996	liq...........	0.867^{0}	....	129	s.	......	....
6997	col. rhomb. f. al., 1.446^{113}	....	104	145	s.	v. v. s.	....
6998	wh. need......	....	d.	....	v. s.	i. c.	i. eth.
6999	wh. need......	....	d.	....	v. s.	i. c.	i. eth.
7000	wh. cr........	....	44	....	v. s.	s.	v. sl. s. eth.
7001							
7002	wh. cr........	....	122.5–3.0	....	i.	s. h.	sl. s. eth.
7003							
7004	wh. cr........	....	192.5–3.5	....	i.	s. h.	i. eth.
7005	monocl. pr....	....	(*cis*) 114 (*trans*) 118	162	v. s.	v. s.	sl. s. eth.
7006	wh. pl........	....	157–8	....	s. h.	i. c.	i. eth.
7007	wh. cr........	....	150–1	....	v. sl. s.	s. h.	sl. s. eth.
7008	pa. yel. oil....	$1.0621\frac{20}{4}$	....	$156–7^{10}$	i.	∞	∞ eth.
7009							
7010							
7011	yel. need. f. al.	....	217	220 d. subl.	v. sl. s.	2.84 c.	s. eth.
7012							
7013	col. liq., 1.4534^{20}	0.8622^{20}	−9 (−17)	106.3	∞	∞	∞ eth.
7014	lt. liq.........	1.0111	107–9	227–8 (224)	∞	s.	....
7015							
7015M	1.4498^{20}......	0.8282^{20}	....	198.2^{160}	......	......	....
7016							
7017	col. need......	....	48 (29–33)	184^{17}	i.	s.	s. eth.
7017M	1.4467^{20}.......	0.8245^{20}	....	175.8	......	......	....
7018	liq...........	....	....	127.9	......	......	....
7018M	1.4569^{25}.......	0.8348^{25}	....	$139–40^{2}$	......	......	....
7019							
7020	liq., 1.4440^{20}...	0.8249^{20}	....	130.8	......	......	....
7021	....	0.867^{0}	....	143	5	......	....
7022	liq...........	0.8658^{0}	....	152.6 (155)	v. sl. s.	......	....
7023	wh.-yel. liq....	$1.0205\frac{25}{4}$	....	218–22	∞	∞	∞ eth.
7023H	1.4531^{20}.......	0.8316^{20}	....	239.5	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7023R	**Piperidine, 1-hexyl-**		$C_5H_{10}N(CH_2)_5CH_3$	169.30
7024	——, **β-hydroxyethyl-.**	See *Piperidineëthanol.*		
7025	——, **1-methyl-**		$C_5H_{10}NCH_3$	99.17
7026	——, **2-methyl-.**	See 2-*Pipecoline.*		
7027	——, **3-methyl-.**	See 3-*Pipecoline.*		
7028	——, **4-methyl-.**	See 4-*Pipecoline.*		
7028H	——, **1-nonyl-**		$C_5H_{10}N(CH_2)_8CH_3$	211.38
7028M	——, **1-octyl-**		$C_5H_{10}N(CH_2)_7CH_3$	197.36
7028R	——, ***N-n*-pentyl-.**	See *Piperidine, 1-amyl-.*		
7029	——, **1-piperyl-.**	See *Piperine.*		
7030	——, **1-propyl-**	*N-n*-propylpiperidine	$CH_3CH_2CH_2NC_5H_{10}$	127.23
7031	——, **2-propyl-.**	See *Coniine.*		
7032	——, **2-(3-pyridyl)-.**	See *Anabasine.*		
7033	**1-Piperidinecarbodithioic acid,** piperidinium salt	piperidinium cyclopentamethylenedithiocarbamate	$C_5H_{10}NCSSNH_2C_5H_{10}$	246.42
7034	——, zinc salt		$(C_5H_{10}NCSS)_2Zn$	385.92
7035	**Piperidineëthanol**	β-hydroxyethylpiperidine; ethoxylpiperidine; piperethylalkine	$C_5H_{10}NCH_2CH_2OH$	129.20
7036	**4-Piperidone, 2,2,6,6-tetramethyl-.**	See *Triacetonamine.*		
7037	**Piperine**	1-piperylpiperidine	$C_{17}H_{19}NO_3$	285.33
7038	——, hydriodide diiodide		$(C_{17}H_{19}NO_3)_2\cdot HI\cdot I_2$	952.43
7039	**Piperolidine**	octahydropyrrocoline; δ-coniceine	$C_8H_{15}N$	125.21
7040	**Piperonal**	3,4-methylenedioxybenzaldehyde; protocatechualdehyde methylene ether; heliotropin	$CH_2(O_2)C_6H_3CHO$	150.13
7041	**Piperonyl alcohol**	3,4-methylenedioxybenzyl alcohol	$CH_2(O_2)C_6H_3CH_2OH$	152.14
7042	**Piperonylic acid**	3,4-methylenedioxybenzoic acid; protocatechuic acid methylene ether	$CH_2(O_2)C_6H_3COOH$	166.13
7043	**Piperylene.**	See 1,3-*Pentadiene**.		
7044	**Pivalaldehyde**	2,2-dimethylpropanal*; trimethylacetaldehyde	$(CH_3)_3CCHO$	86.13
7045	——, oxime	trimethylacetaldoxime	$(CH_3)_3CCH:NOH$	101.15
7046	**Pivalic acid**	2,2-dimethylpropanoic acid*; α,α-dimethylpropionic acid; trimethylacetic acid	$(CH_3)_3CCOOH$	102.13
7047	——, methyl ester	methyl pivalate	$(CH_3)_3CCOOCH_3$	116.16
7048	**Plumbane, tetramethyl-.**	See *Lead, tetramethyl-**.		
7049	——, **tetraphenyl-.**	See *Lead, tetraphenyl-**.		
7050	**Polyoxymethylene**	trioxymethylene; paraformaldehyde; metaformaldehyde. See also *sym-Trioxane.*	$(CH_2O)_x$	$(30.03)_x$
7051	**Populin**	benzoylsalicin	$C_{20}H_{22}O_8\cdot 2H_2O$	426.41
7052	——, (anhydrous synthetic)	benzoylsalicin	$C_{20}H_{22}O_8$	390.38
7052M	**P. P. factor.**	See *Nicotinamide*; *Nicotinic acid.*		
7053	**Prehnitene**	1,2,3,4-tetramethylbenzene; prehnitole	$(CH_3)_4C_6H_2$	134.21

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7023R	1.4517^{20}......	0.830^{20}	....	219.2	......	......	....
7024							
7025	liq., 1.4378^{20}...	0.8207^{20}	....	105.9	14.8^{49}; 5.5^{77}	∞	∞ eth.
7026							
7027							
7028							
7028H	1.4538^{25}......	0.8313^{25}	....	135.7^{11}	......	......	....
7028M	....	0.834^{20}	....	142^{25}	......	......	....
7028R							
7029							
7030	col. liq., 1.4446^{20}	0.8231^{20}	....	152.1	$2.774^{0.5}$; 0.606^{32}	v. s.	v. s. eth.
7031							
7032							
7033	pa. yel. pl.....	....	171–2	....	v. s.	v. s.	v. sl. s. eth.
7034	wh. powd.....	....	223–5	....	i.	i.	i. eth.; sl. s. chl.
7035	liq..........	....	....	199	s.	s.	....
7036							
7037	col. monocl. need. f. al.	1.193	128–9.5	....	v. sl. s. c.	6.7, 23^{60}	2.8 eth.; s. chl.
7038	steel bl. need .	....	145	....	s.	......	v. s. chl.
7039	liq..........	$0.904\frac{15}{4}$	....	(*dl*) 161; (*l*) 158	......	......	....
7040	wh.-yel. cr. f. w.	....	37	263	0.2 c., ∞^{78}	s. c., ∞ h.	∞ eth.
7041	cr...........	....	51	d.	sl. s.	∞	∞ eth.
7042	need. f. w. or al.	....	228	subl.	sl. s. h.	s. h.	sl. s. eth.; s. alk.
7043							
7044	liq..........	0.793^{17}	3	75	......	s.	s. eth.
7045	cr...........	....	41	65^{20}	......	s.	....
7046	col. need., $1.3931^{36.5}$	0.905^{50}	35.5	163.8	2.2	v. s.	v. s. eth.
7047	col. liq.......	1.044^{0}	....	102	sl. s.	∞	∞ eth.
7048							
7049							
7050	wh. need......	....	64 (60)	subl.	17.2^{18}, 21.1^{25}	s.	s. eth.
7051	col. need......	....	anh. 180	....	0.04^{15}, 2.4^{100}	s.	s. eth., dil. a., alk.
7052	pr...........	....	178–9	....	......	......	....
7052M							
7053	col., $1.52031^{16.0}$	$0.901\frac{20}{4}$, $1.801\frac{20}{4}$	–4	204	i.	∞	∞ eth.

No.	Name	Synonyms	Formula	Mol. Wt.
7054	**Prehnitic acid**	1,2,3,5-benzenetetracarboxylic acid*	$C_6H_2(COOH)_4$	254.15
7055	**Prehnitylic acid**	2,3,4-trimethylbenzoic acid	$(CH_3)_3C_6H_2COOH$	164.20
7056	**Procaine,** hydrochloride	β-diethylaminoethyl *p*-aminobenzoate hydrochloride; novocain; ethocain	$NH_2C_6H_4COOC_2H_4N(C_2H_5)_2 \cdot HCl$	272.77
7057	**Proline, hydroxy-L-**		$C_4H_7N(OH)COOH$	131.13
7058	**Proline, 4-hydroxy-D-**	4-hydroxy-2-pyrrolidinecarboxylic acid	$C_4H_7N(OH)COOH$	131.13
7059	**DL-Proline**	*dl*-2-pyrrolidinecarboxylic acid	$C_4H_8N \cdot COOH$	115.13
7060	**D-Proline**	*d*-2-pyrrolidinecarboxylic acid	C_4H_8NCOOH	115.13
7061	**L-Proline**	*l*-2-pyrrolidinecarboxylic acid	$C_4H_8N \cdot COOH$	115.13
7061M	**Prontosil album.**	See *Sulfanilamide.*		
7062	**Propadiene***	allene; dimethylenemethane	$CH_2:C:CH_2$	40.06
7063	**——, dioxo-.**	See *Carbon suboxide.*		
7064	**——, tetraphenyl-**	tetraphenylallene	$(C_6H_5)_2C:C:C(C_6H_5)_2$	344.43
7065	**Propanal*.**	See *Propionaldehyde.*		
7066	**——, 2,2-dimethyl-*.**	See *Pivaldehyde.*		
7067	**——, 2-methyl-*.**	See *Isobutyraldehyde.*		
7068	**——, 2-oxo-*,** 1-oxime.	See *Pyruvaldehyde, aldoxime.*		
7069	**——, 3-phenyl-.**	See *Hydrocinnamaldehyde.*		
7070	**Propanamide*.**	See *Propionamide.*		
7071	**——, 2-hydroxy-*.**	See *Lactamide.*		
7072	**——, 2-methyl-*.**	See *Isobutyramide.*		
7073	**Propane***	dimethylmethane	$CH_3CH_2CH_3$	44.09
7074	**——, 1-amino-2,2-dimethyl-.**	See *Propylamine, β, β-dimethyl-*.*		
7075	**——, 1-amino-2-methyl-.**	See *Isobutylamine.*		
7076	**——, 2,2-bis(ethylsulfonyl)-***	acetone diethylsulfone; sulfonmethane; sulfonal	$(CH_3)_2C(SO_2C_2H_5)_2$	228.32
7077	**——, 1-bromo-*.**	See *Propyl bromide.*		
7078	**——, 2-bromo-*.**	See *Isopropyl bromide.*		
7079	**——, 1-bromo-2-chloro-***		$CH_3CHClCH_2Br$	157.45
7080	**——, 2-bromo-1-chloro-***		$CH_3CHBrCH_2Cl$	157.45
7081	**——, 1-bromo-2,2-dimethyl-***	*tert*-butylmethyl bromide	$(CH_3)_3CCH_2Br$	151.06
7082	**——, 1-bromo-2-methyl-*.**	See *Isobutyl bromide.*		
7083	**——, 2-bromo-2-methyl-*.**	See *tert-Butyl bromide.*		
7084	**——, 1-chloro-*.**	See *Propyl chloride.*		
7085	**——, 2-chloro-*.**	See *Isopropyl chloride.*		
7086	**——, 1-chloro-2-(β-chloroisopropoxy)-*.**	See *Ether, bis-β-chloroisopropyl.*		
7087	**——, 1-chloro-2,2,-dimethyl-***		$(CH_3)_3CCH_2Cl$	106.60
7088	**——, 1-chloro-2,3-epoxy-*.**	See *Epichlorohydrin.*		
7089	**——, 1-chloro-2-methyl-*.**	See *Isobutyl chloride.*		
7090	**——, 2-chloro-2-methyl-*.**	See *tert-Butyl chloride.*		
7091	**——, 1,1-dibromo-***	propylidene bromide	$CH_3CH_2CHBr_2$	201.91
7092	**——, 1,2-dibromo-***	propylene bromide; propylene dibromide	$CH_2BrCHBrCH_3$	201.91

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7054	pr. (+2H_2O) f. w.	....	237 d.	d.	s.	....	s. eth.
7055	pr. f. al.......	....	167.5	....	s.	s.	s. eth.
7056	col. need. f. al.	0.707^{17}	156	....	166^{25}	3.3^{25}	v. sl. s. eth.; sl. s. chl.
7057	rhomb. pl. or fine need.	....	274; (238–41) d.	....	25^{0}	v. sl. s.	i. eth.
7058	....	....	(a) 274; (b) 238–41 d.	....	......	......	....
7059	....	....	205 d.	....	s.	s.	i. eth.; sl. s. chl., acet., bz.
7060	pr...........	....	215–20 d.	....	......	......	....
7061	flat need. f. al.; pr. f. w.	....	220–2 d.	....	v. s.	1.55^{19}	i. eth., butyl al., propyl al.
7061M							
7062	gas..........	1.787 g/1	–146	–32	......	......	....
7063							
7064	need. or pr. f. dil. al. or acet.	....	166	....	i.	sl. s. c.	s. eth.
7065							
7066							
7067							
7068							
7069							
7070							
7071							
7072							
7073	col. gas.......	liq. $0.5853_{4}^{-44.5}$; 2.0096^{0} g/l	–189.9; frz. –187.1	–42.17	6.5^{18} cm^3	790^{17} cm^3	926^{17} cm^3 eth.
7074							
7075							
7076	col. monocl. pr. f. al.	1.260_{4}^{25}	128	300 d.	2^{15}, 6.7^{100}	1.2 c., 39 h.	0.54 c. eth.
7077							
7078							
7079	liq., 1.47449...	1.531_{4}^{20}	....	118.0	......	......	....
7080	liq., 1.47763...	1.537_{4}^{20}	....	117.0^{756}	......	......	....
7081	col. liq........	1.2604_{0}^{20}	....	$89–91^{749}$	i.	s.	s. eth.
7082							
7083							
7084							
7085							
7086							
7087	....	....	....	84.4	......	......	....
7088							
7089							
7090							
7091	liq..........	....	....	*ca.* 130	......	......	....
7092	col. liq., 1.5203	1.9333_{4}^{20}	–55.5	141.6 (140)	0.25^{20}	s.	v. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol Wt.
7093	**Propane, 1,3-dibromo-***	trimethylene bromide; trimethylene dibromide	$BrCH_2CH_2CH_2Br$	201.91
7094	**——, 2,2-dibromo-***	bromacetol	$CH_3CBr_2CH_3$	201.91
7095	**——, 1,2-dibromo-2-methyl-***	isobutylene bromide	$(CH_3)_2CBrCH_2Br$.	215.94
7096	**——, 1,1-dichloro-***	propylidene chloride	$CH_3CH_2CHCl_2$	112.99
7097	**——, 1,2-dichloro-***	propylene chloride; propylene dichloride	$CH_2ClCHClCH_3$	112.99
7098	**——, 1,3-dichloro-***	trimethylene chloride; trimethylene dichloride	$ClCH_2CH_2CH_2Cl$	112.99
7099	**——, 2,2-dichloro-***	acetone dichloride; isopropylidene chloride	$CH_3CCl_2CH_3$	112.99
7099M	**——, 2,2-difluoro-***	isopropylidene fluoride; acetone fluoride; fluoroacetol; difluorodimethylmethane	$CH_3CF_2CH_3$	80.08
7100	**——, 1,2-diiodo-***	propylene diiodide; propylene iodide	CH_3CHICH_2I	295.92
7101	**——, 2,2-dimethyl-***	tetramethylmethane; neopentane	$(CH_3)_4C$	72.15
7102	**——, 1,3-diphenoxy-***	trimethylene glycol diphenyl ether	$C_6H_5OCH_2CH_2$-$CH_2OC_6H_5$	228.28
7103	**——, 1,2-epoxy-.**	See *Propene oxide.*		
7104	**——, 1,2-epoxy-3-iodo-.**	See *Epiiodohydrin.*		
7105	**——, 1,2-epoxy-2-methyl-.**	See *Ethylene oxide, α, α-dimethyl-.*		
7106	**——, 1-ethoxy-*.**	See *Ether, ethyl propyl.*		
7107	**——, 2-ethoxy-*.**	See *Ether, ethyl isopropyl.*		
7108	**——, 1-ethoxy-2-methyl-*.**	See *Ether, ethyl isobutyl.*		
7109	**——, 2-ethoxy-2-methyl-*.**	See *Ether, tert-butyl ethyl.*		
7110	**——, 1-fluoro-*.**	See *Propyl fluoride.*		
7111	**——, 2-fluoro-*.**	See *Isopropyl fluoride.*		
7112	**——, 1-fluoro-2-methyl-*.**	See *Isobutyl fluoride.*		
7113	**——, 1-iodo-*.**	See *Propyl iodide.*		
7114	**——, 2-iodo-*.**	See *Isopropyl iodide.*		
7115	**——, 1-iodo-2,2-dimethyl-***	*tert*-butylmethyl iodide	$(CH_3)_3CCH_2I$	198.06
7116	**——, 1-iodo-2-methyl-*.**	See *Isobutyl iodide.*		
7117	**——, 2-iodo-2-methyl-*.**	See *tert-Butyl iodide.*		
7118	**——, 2-(isopropylthio)-*.**	See *Isopropyl sulfide.*		
7119	**——, 2-isopropoxy-*.**	See *Isopropyl ether.*		
7120	**——, 1-methoxy-*.**	See *Ether, methyl propyl.*		
7121	**——, 2-methoxy-*.**	See *Ether, isopropyl methyl.*		
7122	**——, 1-methoxy-2-methyl-*.**	See *Ether, isobutyl methyl.*		
7123	**——, 2-methyl-*.**	See *Isobutane.*		
7124	**——, 1-methyl-1-(methylpropylthio)-*.**	See *sec-Butyl sulfide.*		
7125	**——, 2-methyl-1-(β-methylpropoxy)-*.**	See *Isobutyl ether.*		
7126	**——, 2-methyl-1-(β-methylpropylthio)-*.**	See *Isobutyl sulfide.*		
7127	**——, 2-methyl-1-nitro-***	nitroisobutane	$(CH_3)_2CHCH_2NO_2$	103.12
7128	**——, 2-methyl-1-phenoxy-.**	See *Ether, isobutyl phenyl.*		
7129	**——, 2-methyl-1-phenyl-.**	See *Benzene, isobutyl-.*		
7130	**——, 2-methyl-2-phenyl-.**	See *Benzene, tert-butyl-.*		
7131	**——, 1-nitro-***		$CH_3CH_2CH_2NO_2$	89.09
7131F	**——, 2-nitro-***	*sec*-nitropropane	$(CH_3)_2CHNO_2$	89.09

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7093	col. liq., 1.523.	$1.979\frac{20}{4}$; $1.987\frac{17}{4}$	-34.4	167	0.168^{30}	s.	s. eth.
7094	....	1.7825^{20}	....	$114\text{–}5^{740}$	......	......	....
7095	liq., 1.509.....	1.759	-70.3	149.0	......	......	....
7096	liq., 1.42887...	$1.1321\frac{20}{4}$	....	88.3	......	......	....
7097	col. liq., 1.4388	$1.1593\frac{20}{20}$; 1.1656^{14}	....	96.8	0.27^{20}	v. s.	v. s. eth.
7098	col. liq., 1.4469	1.201^{15}; $1.1896\frac{18}{4}$		125; 119^{740}	0.287^{30}	v. s.	v. s. eth.
7099	liq., 1.4471....	$1.093\frac{20}{20}$	-34.6	69.7	i.	s.	∞ eth., CS_2
7099M	col. gas........	0.92^{0}	....	-0.6 (-0.2)	......	......	....
7100	liq............	2.490	....	d.	......	......	....
7101	gas...........	$0.613\frac{0}{0}$...	-20	9.5	i.	s.	s. eth.
7102	shiny leaf. f. al.	....	61	338–40	i.	s.	s. eth.
7103							
7104							
7105							
7106							
7107							
7108							
7109							
7110							
7111							
7112							
7113							
7114							
7115	col. oil........	1.5317^{13}	....	127–9 d.	i.	s.	s. eth.
7116							
7117							
7118							
7119							
7120							
7121							
7122							
7123							
7124							
7125							
7126							
7127	col. liq.	$0.9625\frac{25}{25}$		140.8 (158–9)	v. sl. s.	∞	∞ eth.
7128							
7129							
7130							
7131	col. liq., $1.40027^{24.3}$; 1.4015	$1.003\frac{20}{20}$	frz. -108	132	1.4 cc	∞	∞ eth.
7131F	w. wh. liq., 1.3941^{20}	$0.992\frac{20}{20}$	frz. -93	120	1.7 cc	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7132	**Propane, 2-phenoxy-.**	See *Ether, isopropyl phenyl.*		
7133	**——, 1-phenyl-.**	See *Benzene, propyl-.*		
7134	**——, 2-phenyl-.**	See *Cumene.*		
7135	**——, 1-propoxy-*.**	See *Propyl ether.*		
7135M	**——, 1-(propylsulfinyl)-*.**	See *Propyl sulfoxide.*		
7136	**——, 1-propylsulfonyl-*.**	See *Propyl sulfone.*		
7137	**——, 1-propylthio-*.**	See *Propylsulfide.*		
7138	**——, 1,2,3-tribromo-*.**	glycerol tribromohydrin; tribromohydrin; allyl tribromide	$CH_2BrCHBrCH_2Br$	280.82
7139	**——, 1,2,3-trichloro-***	glycerol trichlorohydrin; allyl trichloride; trichlorohydrin	$CH_2ClCHClCH_2Cl$	147.44
7140	**——, 1,1,1-triphenyl-.**	α-ethyltritan	$(C_6H_5)_3CCH_2CH_3$	272.37
7140M	**1-Propaneboronic acid.**	See *Boric acid, propyl-.*		
7141	**Propanediamide*.**	See *Malonamide.*		
7142	***dl*-1,2-Propanediamine***	*dl*-propylenediamine	$CH_3CH(NH_2)CH_2NH_2$	74.13
7143	**1,3-Propanediamine*.**	trimethylenediamine	$NH_2(CH_2)_3NH_2$	74.13
7144	**Propanedinitrile*.**	See *Malononitrile.*		
7145	**Propanedioic acid*.**	See *Malonic acid.*		
7146	**——, 2-propenyl-*.**	See *Malonic acid, allyl-.*		
7147	**1,2-Propanediol*.**	propylene glycol	$CH_2OHCHOHCH_3$	76.09
7148	**——, 3-chloro-*.**	α-chlorohydrin; glycerol α-chlorohydrin	$CH_2ClCHOHCH_2OH$	110.54
7149	**——, 3-mercapto-*.**	See *Glycerol, 1-thio-.*		
7150	**——, 2-methyl-*.**	isobutylene glycol; *as*-dimethylethylene glycol	$(CH_3)_2C(OH)CH_2OH$	90.12
7151	**——, 3-octadecyloxy-***	glycerol 1-octadecyl ether	$CH_3(CH_2)_{17}OCH_2CHOHCH_2OH$	344.57
7152	**1,3-Propanediol*.**	trimethylene glycol	$HOCH_2CH_2CH_2OH$	76.09
7152H	**——, 2-amino-2-ethyl-**		$HOCH_2C(NH_2)(C_2H_5)CH_2OH$	119.16
7152M	**——, 2-amino-2-hydroxymethyl-**	tris(hydroxymethyl)aminomethane	$H_2NC(CH_2OH)_3$	121.14
7152R	**——, 2-amino-2-methyl-**		$HOCH_2C(NH_2)(CH_3)CH_2OH$	105.14
7153	**——, 2,3-bishydroxymethyl-.**	See *Pentaerythritol.*		
7154	**——, 2,2-dimethyl-*.**	dimethyltrimethylene glycol	$(CH_3)_2C(CH_2OH)_2$	104.15
7154M	**——, 2-ethyl-2-nitro-***	2-nitro-2-methylol-1-butanol	$HOCH_2C(C_2H_5)(NO_2)CH_2OH$	149.15
7155	**——, 2-hydroxymethyl-2-methyl-***	pentaglycerol; pentaglycerin	$CH_3C(CH_2OH)_3$	120.15
7155H	**——, 2-hydroxymethyl-2-nitro-***	tris(hydroxymethyl)nitromethane	$NO_2C(CH_2OH)_3$	151.12
7155R	**——, 2-methyl-2-nitro-***		$HOCH_2C(CH_3)(NO_2)CH_2OH$	135.12
7156	**1,3-Propanedione, 1,3-diphenyl-.**	See *Methane, dibenzoyl-.*		
7157	**Propanenitrile*.**	See *Propionitrile.*		
7158	**——, 2-hydroxy-*.**	See *Lactonitrile.*		
7159	**——, 2-methyl-*.**	See *Isobutyronitrile.*		
7160	**——, 2-oxo-*.**	See *Pyruvonitrile.*		
7161	**——, 3-oxo-3-phenyl-.**	See *Acetonitrile, benzoyl-.*		
7162	**1-Propanethiol*.**	*n*-propyl mercaptan	$CH_3CH_2CH_2SH$	76.15
7163	**——, 2-methyl-*.**	isobutyl mercaptan	$(CH_3)_2CHCH_2SH$	90.18
7164	**2-Propanethiol*.**	isopropyl mercaptan	$CH_3CHSHCH_3$	76.15

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7132							
7133							
7134							
7135							
7135M							
7136							
7137							
7138	pr., 1.584.....	2.436^{23}	16	220	i.	v. s.	v. s. eth.
7139	col. liq........	1.417^{15}_{4}	–14.7	156–8	i.	s.	s. eth.
7140	col. cr. f. me. al.	....	51–1.5	....	i.	s.	v. s. eth.
7140M							
7141							
7142	col. liq........	0.878^{15}	....	119	......	......	....
7143	col. liq........	0.884^{25}_{4}	....	135.5	s.	∞	∞ eth.
7144							
7145							
7146							
7147	col. liq........	1.040	....	189	∞	∞	s. eth.
7148	ylsh. liq......	1.326^{18}_{15}	....	213 d. ($115–20^{18}$)	s.	s.	s. eth.
7149							
7150	liq...........	1.003	....	177	s.	......	....
7151	col. cr........	....	70–1	....	i.	s. h.	s. eth.
7152	visc. liq., 1.4398	1.0526^{18}_{4}	....	214 d.	∞	∞	v. s. eth.
7152H	1.490^{20}........	1.099	37.5–38.5	$152–3^{10}$	∞	......	....
7152M	....	....	170.5–171.5	$219–220^{10}$	80	......	....
7152R	....	....	109–111	$151–2^{10}$	250	......	....
7153							
7154	need. f. bz....	....	127	203^{738}	s.	v. s.	v. s. eth.
7154M	....	....	56–57	d.	400^{20}	......	....
7155	need. f. al.....	....	199	subl.	s.	v. s.	i. eth.
7155H	....	....	165–70	d.	220^{20}	......	....
7155R	....	....	147–9	d.	80^{20}	......	....
7156							
7157							
7158							
7159							
7160							
7161							
7162	liq............	0.8357^{25}_{4}	–111.5	68	v. sl. s.	s.	s. eth.
7163	liq., 1.43859...	0.8357^{20}_{4}	<–79	88	sl. s..	v. s.	v. s. eth.
7164	col. liq........	0.8055^{25}_{4}	–130.7	60	sl. s.	∞	∞ eth.

For explanations and abbreviations see beginning of table

No.	Name	Synonyms	Formula	Mol. Wt.
7165	**1,2,3-Propanetricarboxylic acid***.	See *Tricarballylic acid.*		
7166	**1,2,3-Propanetriol***.	See *Glycerol.*		
7167	**Propanetrione, diphenyl-***	diphenyl triketone	$C_6H_5(CO)_3C_6H_5$	238.23
7168	**Propanoic acid***.	See *Propionic acid.*		
7169	——, **2-amino-3-mercapto-**.	See *Cysteine.*		
7170	——, **3,3′-dithiobis(2-amino-**.	See *Cystine.*		
7171	——, **2-hydroxy-**.	See *Lactic acid.*		
7172	——, **2-methyl-***.	See *Isobutyric acid.*		
7173	**1-Propanol***.	See *Propyl alcohol.*		
7173M	——, **2-amino-2-methyl-**		$(CH_3)_2C(NH_2)-CH_2OH$	89.14
7174	——, **3-bromo-***	trimethylene bromohydrin	$BrCH_2CH_2CH_2OH$	139.00
7175	——, **2-chloro-***, acetate	β-chloropropyl acetate; 2-chloropropyl ethanoate*	$CH_3COOCH_2CH-ClCH_3$	136.58
7176	——, **3-chloro-***	trimethylene chlorohydrin	$ClCH_2CH_2CH_2OH$	94.54
7177	——, **2,3-dibromo-***	β, γ-dibromopropyl alcohol; β-dibromohydrin; allyl alcohol dibromide	$CH_2BrCHBrCH_2-OH$	217.91
7178	——, **2,3-dichloro-***	β-dichlorohydrin; *asym*-glycerol dichlorohydrin; β, γ-dichloropropyl alcohol; allyl alcohol dichloride	$CH_2ClCHClCH_2-OH$	128.99
7178H	——, ——, nitrate	β, γ-dichloropropyl nitrate	$ClCH_2CHClCH_2-NO_3$	173.99
7179	——, **2,2-dimethyl-***	*tert*-butylcarbinol; neopentyl alcohol	$(CH_3)_3CCH_2OH$	88.15
7180	——, **2,2-dimethyl-1-phenyl-**	*tert*-butylphenylcarbinol	$C_6H_5CHOHC-(CH_3)_3$	164.24
7181	——, **2,3-epoxy-***.	See *Glycidol.*		
7182	——, **2-methyl-***.	See *Isobutyl alcohol.*		
7183	——, **2-methylamino-1-phenyl-**.	See *Pseudoephedrine.*		
7183M	——, **2-methyl-2-nitro-***	β-nitroisobutyl alcohol	$(CH_3)_2C(NO_2)-CH_2OH$	119.12
7184	——, **1-phenyl-**	ethylphenylcarbinol	$C_2H_5CHOHC_6H_5$	136.19
7185	——, **3-phenyl-**	hydrocinnamyl alcohol	$C_6H_5CH_2CH_2CH_2OH$	136.19
7186	**2-Propanol***.	See *Isopropyl alcohol.*		
7187	——, nitrate.	See *Isopropyl nitrate.*		
7188	——, nitrite.	See *Isopropyl nitrite.*		
7189	——, **1-chloro-***	propylene chlorohydrin	$CH_2ClCHOHCH_3$	94.54
7190	——, ——, acetate	β-chloroisopropyl ethanoate*	$CH_3COOCH-(CH_3)CH_2Cl$	136.58
7191	——, **1,3-dichloro-***	α-dichlorohydrin; *sym*-glycerol dichlorohydrin; *sym*-dichloroisopropyl alcohol	$CH_2ClCHOH-CH_2Cl$	128.99
7192	——, ——, nitrate	β, β′-dichloroisopropyl nitrate; dichloronitrohydrin	$CH_2ClCH(NO_3)-CH_2Cl$	173.99
7193	——, **2-methyl-***.	See *tert-Butyl alcohol.*		
7193M	——, **1,1′-oxydi-**	dipropylene glycol; β, β′-dihydroxydi-*n*-propyl ether	$(CH_3CHOHCH_2)_2O$	134.17
7194	——, **2-phenyl-**	α, α-dimethylbenzyl alcohol; dimethylphenylcarbinol	$C_6H_5(CH_3)_2COH$	136.19
7195	——, **1,1,1-trichloro-2-methyl-***.	See *Chloretone.*		
7196	**1-Propanone, 1-phenyl-**.	See *Propiophenone.*		
7197	**2-Propanone***.	See *Acetone.*		
7198	——, **1-amino-***	aminoacetone; acetonylamine	$CH_3COCH_2NH_2$	73.09

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7165							
7166							
7167	yel. need........	....	68–70	....	i.	sl. s.	s. eth.
7168							
7169							
7170							
7171							
7172							
7173							
7173M	1.449^{20}.......	0.934	25–26	165; 67.4^{10}	∞	......	....
7174	liq...........	$1.5710\frac{20}{4}$	....	$98–112^{185}$	16.6 c.	∞	∞ eth.
7175	col. liq........	1.098	....	$152–3^{750}$	i.	s.	s. eth.
7176	liq...........	$1.1309\frac{20}{4}$	....	160–2	50 c.	s.	s. eth.
7177	col. liq........	2.1682^{0}; 2.1259^{25}	....	219 sl. d.; 118^{17}	sl. s.	s.	s. eth., acet., bz.
7178	col. liq........	1.3681^{11}; $1.355^{17.5}$	....	182; $81–81.5^{13.5}$	s.	s.	s. eth.
7178H	liq...........	1.3^{7}	....	180	......	......	....
7179	col. cr........	0.812	53	114; 111.5^{738}	sl. s.	v. s.	v. s. eth.
7180	need.........	....	45	$114–6^{16}$	i.	s.	....
7181							
7182							
7183							
7183M	....	....	90–95.5	94.5–95.5	350^{20}	......	....
7184	liq...........	$0.9962\frac{17}{4}$	....	219 (212)	i.	s.	s. eth.
7185	liq., 1.53565...	1.008	<−18	235.6 (237.4)	s.	∞	∞ eth.
7186							
7187							
7188							
7189	col. liq........	1.103^{20}	....	127.0	∞	∞	∞ eth.
7190	liq...........	....	....	149–50	......	......	....
7191	col. liq., 1.480245^{17}	$1.367\frac{20}{4}$; $1.3506\frac{17}{4}$	....	174	11^{19}	∞	∞ eth.
7192	col. liq........	1.459	....	180	i.	s.	s. eth.
7193							
7193M	col. liq........	$1.0224\frac{20}{20}$	....	229.2	∞	s.	....
7194	pr., 1.5314^{19}...	$0.9724\frac{19}{4}$	35–7	202 (215–20 d.)	i.	s.	s. eth.
7195							
7196							
7197							
7198	need. f. al.....	....	189 d.	....	v. s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7199	**2-Propanone, 1-bromo-***	bromoacetone	$CH_2BrCOCH_3$	136.99
7200	**——, 1-chloro-***	chloroacetone	CH_3COCH_2Cl	92.53
7201	**——, 1,1-dichloro-***	*uns*-dichloroacetone; dichloromethyl methyl ketone	$CH_3COCHCl_2$	126.98
7202	**——, 1,3-dichloro-***	*sym*-dichloroacetone; bis-chloromethyl ketone	$CH_2ClCOCH_2Cl$	126.98
7202M	**——, 1,3-dihydroxy-***	dihydroxyacetone	$CO(CH_2OH)_2$	90.08
7203	**——, 1,3-diphenyl-***	dibenzyl ketone; diphenyl-acetone	$(C_6H_5CH_2)_2CO$	210.26
7204	**——, 1-hydroxy-*.**	See *Acetol.*		
7205	**——, 1-phenyl-**	benzyl methyl ketone	$CH_3COCH_2C_6H_5$	134.17
7206	**——, 1,1,3,3-tetra-chloro-***	*sym*-tetrachloroacetone	$CHCl_2COCHCl_2\cdot 2H_2O$	231.91
7207	**——, 1-ureido-.**	See *Urea, acetonyl-.*		
	Propanoyl*.	See *Propionyl.*		
7208	**Propargyl acetate.**	See 2-*Propyn*-1-*ol, acetate.*		
7209	**Propargyl alcohol.**	See 2-*Propyn*-1-*ol*.*		
7210	**Propargylaldehyde.**	See *Propiolaldehyde.*		
7211	**Propargyl bromide.**	See *Propyne, 3-bromo-*.*		
7212	**Propargyl chloride.**	See *Propyne, 3-chloro-*.*		
7213	**Propargylic acid.**	See *Propiolic acid.*		
7214	**Propargyl iodide.**	See *Propyne, 3-iodo-*.*		
7215	**Propenal*.**	See *Acrolein.*		
7215M	**——, 2-methyl-*.**	See *Acrolein, α-methyl-.*		
7216	**——, 3-phenyl-.**	See *Cinnamaldehyde.*		
7216M	**Propenamide.**	See *Acrylamide.*		
7217	**Propene***	methylethylene; propylene	$CH_2:CHCH_3$	42.08
7218	**——, 1-bromo-***	propenyl bromide	$CH_3CH:CHBr$	120.99
7219	**——, 2-bromo-***	isopropenyl bromide	$CH_3CBr:CH_2$	120.99
7220	**——, 3-bromo-*.**	See *Allyl bromide.*		
7221	**——, 1-chloro-***	propenyl chloride; α-chloropropylene	$CH_3CH:CHCl$	76.53
7222	**——, 2-chloro-***	isopropenyl chloride; β-chloropropylene	$CH_3CCl:CH_2$	76.53
7223	**——, 3-chloro-*.**	See *Allyl chloride.*		
7224	**——, 3-chloro-1-phenyl-***	(γ-chloropropenyl)benzene; cinnamyl chloride	$C_6H_5CH:CHCH_2Cl$	152.62
7225	**——, 2,3-dibromo-***	α-bromoallyl bromide; α-epidibromohydrin	$CH_2BrCBr:CH_2$	199.89
7226	**——, 1,2-dichloro-***	allylene dichloride	$CHCl:CClCH_3$	110.98
7227	**——, 2,3-dichloro-***	α-epidichlorohydrin; α-chloroallyl chloride	$CH_2:CClCH_2Cl$	110.98
7228	**——, 1,1-diphenyl-**		$(C_6H_5)_2C:CHCH_3$	194.26
7229	**——, 1,2-epoxy-***	allylene oxide; methyl-oxirene	$CH_3\underbrace{C:CH\cdot O}$	56.06
7230	**——, 3-ethoxy-*.**	See *Ether, allyl ethyl.*		
7231	**——, 3-fluoro-*.**	See *Allyl fluoride.*		
7232	**——, 3-iodo-*.**	See *Allyl iodide.*		
7233	**——, 3-methoxy-*.**	See *Ether, allyl methyl.*		
7234	**——, 2-methyl-***	*uns*-dimethylethylene; isobutylene; γ-butylene	$CH_2:C(CH_3)CH_3$	56.10

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7199	pois. liq........	1.634^{23}	-54	136.5^{725}	sl. s.	sl. s.	s. acet.
7200	col. liq.........	1.15^{20}	-44.5	119	s.	s.	s. eth., chl.
7201	col. liq.........	1.234^{15}	....	120	sl. s.	s.	∞ eth.
7202	pl. or need., 1.47144^{46}	1.383^{46}	45	173.4	s.	v. s.	v. s. eth.
7202M	crystallizes as dimeride $(C_3H_6O_3)_2$	....	80	....	s. h.	s. h.	s. h. eth., acet.; i. lgr.
7203	cr. f. dil. al....	....	34–5	330.5	i.	v. s.	v. s. eth.
7204							
7205	col. cr.........	1.019^{0}; 1.003^{20}	-15.4	216.7	i.	v. s.	v. s. eth.
7206	tricl..........	....	48	....	......	......	....
7207							
7208							
7209							
7210							
7211							
7212							
7213							
7214							
7215							
7215M							
7216							
7216M							
7217	col. gas.......	liq. $0.6095\frac{-47}{4}$; 1.937^{0} g/1	-185.2	-47.0	44.6 cm^3	1250 cm^3	524.5 cm^3 ac. a.
7218	liq., 1.4554....	$1.428^{19.5}$	-116.6	60.2	......	......	....
7219	liq............	1.362	-124.8	48.4	......	...	....
7220							
7221	liq............	....	....	35–6	.....	.....	....
7222	liq............	0.918^{9}	....	23^{738}	......	......	....
7223							
7224	col. liq........	....	....	213–5	i.	∞	∞ eth.
7225	liq............	$1.934\frac{20}{4}$	....	140	......	......	... .
7226	liq............	....	.... .	75 (84–6)	......	......	....
7227	col. liq........	$1.205\frac{25}{4}$; $1.236\frac{0}{4}$	....	94	i.	∞	∞ eth.
7228	leaf. f. al......	0.984^{60}	51.5–52	284.5	i.	v. s.	v. s. eth.; s. bz.
7229	liq............	....	....	63	sl. s.	∞	∞ eth.
7230							
7231							
7232							
7233							
7234	col. gas........	....	....	-6	i.	v. s.	v. s. eth.; s. H_2SO_4

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7235	**Propene, 1-phenyl-.**	See *Benzene, propenyl-.*		
7236	**——, 2-phenyl-.**	See *Benzene, isopropenyl-.*		
7237	**——, 3-(2-propenoxy)-*.**	See *Allyl ether.*		
7238	**——, 3-(2-propenylthio)-*.**	See *Allyl sulfide.*		
7239	**Propenenitrile*.**	See *Acrylonitrile.*		
7240	**Propene oxide**	1,2-epoxypropane; propylene oxide; methyloxirane	$\underbrace{OCH_2CH}CH_3$	58.08
7241	**2-Propene-1-thiol*.**	allyl mercaptan	$CH_2:CHCH_2SH$	74.14
7242	**1,2,3-Propenetricarboxylic acid*.**	See *Aconitic acid.*		
7243	**Propenoic acid*.**	See *Acrylic acid.*		
7244	**2-Propen-1-ol*.**	See *Allyl alcohol.*		
7245	**——, 2-bromo-***	β-bromoallyl alcohol	$CH_2:CBr\cdot CH_2OH$	136.99
7246	**——, 2-chloro-***	β-chloroallyl alcohol	$CH_2:CClCH_2OH$	92.53
7246C	**——, 3-chloro-***	γ-chloroallyl alcohol	$CHCl:CHCH_2OH$	92.53
7248	**——, 3-(4-hydroxy-3-methoxyphenyl)-.**	See *Coniferyl alcohol.*		
7249	**——, 3-phenyl-.**	See *Cinnamic alcohol.*		
7251	**2-Propen-1-one, 1,3-diphenyl-.**	See *Chalcone.*		
7251M	**Propenoyl chloride*.**	See *Acrylyl chloride.*		
7252	**2-Propenylamine*.**	See *Allylamine.*		
7253	**Propenyl bromide.**	See *Propene, 1-bromo-*.*		
7254	**Propenyl chloride.**	See *Propene, 1-chloro-*.*		
7254H	**Propenyl cyanide.**	See *Crotononitrile.*		
7255	**2-Propenyl sulfide*.**	See *Allyl sulfide.*		
7256	**Propine.**	See *Propyne*.*		
7256M	**Propioin**	4-hydroxy-3-hexanone; diethylketol	$C_2H_5COCHOHC_2H_5$	116.16
7257	**Propiolaldehyde**	propynal*; propargylaldehyde	$CH\vdots CCHO$	54.05
7258	**Propiolic acid**	propynoic acid*; propargylic acid	$CH\vdots CCOOH$	70.05
7259	——, ethyl ester		$CH\vdots CCOOC_2H_5$	98.10
7260	**——, ethyl-.**	See 2-*Pentynoic acid*.*		
7261	**——, methyl-.**	See *Tetrolic acid.*		
7262	**——, *o*-nitrophenyl-**		$NO_2C_6H_4C\vdots CCOOH$	191.14
7263	**——, *p*-nitrophenyl-**		$NO_2C_6H_4C\vdots CCOOH$	191.14
7264	**——, phenyl-**	phenylpropynoic acid	$C_6H_5C\vdots CCOOH$	146.14
7264M	——, ——, ethyl ester		$C_6H_5C\vdots CCOOC_2H_5$	174.19
7265	**Propiolic alcohol.**	See 2-*Propyn-1-ol*.*		
7266	**Propionaldehyde**	propanal*; methylacetaldehyde	CH_3CH_2CHO	58.08
7267	——, oxime	propanal oxime*; propionaldoxime	$CH_3CH_2CH:NOH$	73.09
7269	**——, α,β-dihydroxy-.**	See *Glyceraldehyde.*		
7270	**Propionaldoxime.**	See *Propionaldehyde, oxime*		
7271	**Propionamide**	propanamide*; propionic acid amide	$CH_3CH_2CONH_2$	73.09
7272	**——, *N*-phenyl-.**	See *Propionanilide.*		
7273	**Propionanilide**	*N*-phenylpropionamide	$CH_3CH_2CONHC_6H_5$	149.19
7274	**2-Propionaphthone, 4-bromo-1-hydroxy-**	4-bromo-2-propionyl-1-naphthol	$CH_3CH_2COC_{10}H_5BrOH$	279.14
7275	**——, 1-hydroxy-**	ethyl 1-hydroxy-2-naphthyl ketone	$CH_3CH_2COC_{10}H_6OH$	200.23
7276	**Propione.**	See 3-*Pentanone*.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7235							
7236							
7237							
7238							
7239							
7240	col. liq.	$0.859\frac{0}{4}$; $0.8313\frac{20}{20}$	......	35	65^{30}	∞	∞ eth.
7241	liq	......	......	67–68	i.	∞	∞ eth.
7242							
7243							
7244							
7245	liq	1.6^{15}	......	152	......	......	......
7246	liq	......	......	136–40	......	......	......
7246C	liq	......	......	153	......	......	......
7248							
7249							
7251							
7251M							
7252							
7253							
7254							
7254H							
7255							
7256							
7256M	1.4340^{21}	$0.956\frac{21}{4}$	......	$57–78^{10}$	......	......	......
7257	oil	......	......	61	v. s.	......	......
7258	col. liq.	$1.139\frac{15}{15}$	9	144 d.	s.	s.	s. eth.
7259	col. liq.	$0.968\frac{15}{15}$	......	119.5	i.	v. s.	v. s. eth., chl.
7260							
7261							
7262	need. f. h. w.	......	155.5 d.	exp. 155–6	v. s. h.	s.	s. eth., alk.; sl. s. chl.; i. CS_2
7263	need. f. al.	......	181 d.	d.	sl. s.	s. h.	s. eth.; i. pet. eth.
7264	col. trim. need. f. w.	......	137	subl.	v. sl. s.	v. s.	v. s. eth.; 3.32 CCl_4
7264M	oil	$1.063\frac{13}{4}$	......	260–70 sl. d.	......	......	......
7265							
7266	col. liq., 1.36356	$0.807\frac{20}{4}$	–81	48.8	20^{20}	∞	∞ eth.
7267	liq	$0.926\frac{20}{4}$	21.5	131–5	......	......	......
7269							
7270							
7271	col. rhomb. leaf. f. chl., $1.4161^{107.8}$	1.042	79	213	s.	s.	s. eth.
7272							
7273	col. leaf. f. al.	1.175	104	222.2	0.42^{24}	v. s.	v. s. eth.
7274	yel. need.	......	98	......	i.	s.	s. eth.
7275	yel.-grn. leaf.	......	81	......	i.	s.	s. eth.
7276							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7277	**Propionic acid**	propanoic acid*; methylacetic acid	CH_3CH_2COOH	74.08
7278	——, amide.	See *Propionamide.*		
7279	——, amyl ester	amyl propionate; pentyl propanoate*	$CH_3CH_2COO(CH_2)_4CH_3$	144.21
7280	——, butyl ester	butyl propionate; butyl propanoate*	$CH_3CH_2COOC_4H_9$	130.18
7281	——, ethylene ester.	See *Glycol, dipropionate.*		
7282	——, ethyl ester		$CH_3CH_2COOC_2H_5$	102.13
7283	——, furfuryl ester.	See *Furfuryl alcohol, propionate.*		
7284	——, isoamyl ester	isoamyl propionate; γ-methylbutyl propanoate*	$CH_3CH_2COOC_5H_{11}$	144.21
7285	——, isobutyl ester	β-methylpropyl propanoate*	$CH_3CH_2COOCH_2CH(CH_3)_2$	130.18
7286	——, isopropyl ester		$CH_3CH_2COOCH(CH_3)_2$	116.16
7287	——, methyl ester	methyl propanoate*; methyl propionate	$CH_3CH_2COOCH_3$	88.10
7288	——, *p*-phenylphenacyl ester		$CH_3CH_2COOCH_2COC_6H_4C_6H_5$	268.30
7289	——, piperazinium salt		$C_4H_{10}N_2{\cdot}2C_2H_5COOH$	234.29
7290	——, propyl ester	propyl propanoate*; *n*-propyl propionate	$CH_3CH_2COOC_3H_7$	116.16
7290M	——, **α-amino-.**	See *Alanine.*		
7291	——, **β-amino-.**	See *β-Alanine.*		
7292	——, **α-amino-β-hydroxy-.**	See *Serine.*		
7293	——, **α-benzal-.**	See *Cinnamic acid, α-methyl-.*		
7294	——, **β-benzal-.**	See *3-Butenoic acid, 4-phenyl-.*		
7295	——, **α-benzamido-.**	See *Alanine, N-benzoyl-.*		
7296	——, **β-benzoyl-**	γ-keto-γ-phenylbutyric acid; 4-oxo-4-phenylbutanoic acid	$C_6H_5COCH_2CH_2COOH$	178.18
7296H	——, **α-benzylidene-.**	See *Cinnamic acid, α-methyl-.*		
7296R	——, **β-benzylidene-.**	See *3-Butenoic acid, 4-phenyl-.*		
7297	——, **α-bromo-(*dl*)**	*dl*-2-bromopropanoic acid*	$CH_3CHBrCOOH$	152.99
7298	——, **α-bromo-,** ethyl ester	ethyl 2-bromopropanoate*	$CH_3CHBrCOOC_2H_5$	181.04
7299	——, **β-bromo-**	3-bromopropanoic acid*	CH_2BrCH_2COOH	152.99
7300	——, **β-carbamyl-.**	See *Succinamic acid.*		
7301	——, **α-chloro-**	2-chloropropanoic acid*	$CH_3CHClCOOH$	108.53
7302	——, ——, ethyl ester	ethyl 2-chloropropanoate*	$CH_3CHClCOOC_2H_5$	136.58
7303	——, **β-chloro-**	3-chloropropanoic acid*	CH_2ClCH_2COOH	108.53
7304	——, ——, ethyl ester	ethyl 3-chloropropanoate*	$CH_2ClCH_2COOC_2H_5$	136.58
7305	——, **α-cyano-**	2-cyanopropanoic acid*; methylmalonic mononitrile; methylcyanoacetic acid	$CH_3CH(CN)COOH$	99.09
7306	——, **α,β-dibromo-**	2,3-dibromopropanoic acid*	$CH_2BrCHBrCOOH$	231.89
7307	——, **β,β-diethyl-.**	See *Valeric acid, β-ethyl-.*		
7308	——, **α,β-dihydroxy-.**	See *Glyceric acid.*		
7309	——, **α,α-dimethyl-.**	See *Pivalic acid.*		
7310	——, **α-hydroxy-.**	See *Lactic acid.*		
7311	——, **β-hydroxy-.**	See *Hydracrylic acid.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
7277	col. liq., $1.38736^{19.9}$	0.992	−22	141.1	∞	∞	∞ eth., chl.
7278							
7279	....	$0.8761\frac{15}{4}$	−73.1	164–6	i.	∞	∞ eth.
7280	col. liq.	0.8828^{15}	−89.55	145.4	v. sl. s.	∞	∞ eth.
7281							
7282	col. liq., $1.38385^{20.2}$	0.89574^{15}; 0.8846^{25}	−73.9 (−72.6)	99.10	2.4^{20}	∞	∞ eth.
7283							
7284	col. liq., 1.4065	0.870	....	160.2	0.09^{25}	s.	s. eth.
7285	col. liq.	0.8876^{0}	−71.4	136.8	v. sl. s.	s.	s. eth.
7286	col. liq.	0.893^{0}	....	111.3	0.6^{25}	∞	∞ eth.
7287	col. liq., $1.37767^{18.5}$	$0.9148\frac{20}{4}$	−87.5	79.9	6.5^{20}	∞	∞ eth.
7288	....	....	102	....	......	......	....
7289	wh. cr.	....	124–5	....	s.	s.	i. eth.; s. h. dioxane
7290	col. liq., 1.3935	0.883	−75.9	123.4; 122–5	0.5	∞	∞ eth.
7290M							
7291							
7292							
7293							
7294							
7295							
7296	leaf. f. al.	....	116	d.	s. h.	s.	s. eth., chl., CS_2, bz.; i. lgr.
7296H							
7296R							
7297	col. pr., 1.4753	1.700	25.7	203.5	v. s.	v. s.	s. eth.
7298	col. liq.	$1.394\frac{20}{4}$	....	159–61 d. (160–5)	i.	∞	∞ eth.
7299	col. leaf.	1.48	62.5	....	s.	s.	s. eth.
7300							
7301	col. liq., $[\alpha]_{D}^{17}$ −2.36°	1.28^{0}	....	186	∞	∞	∞ eth.
7302	col. liq., 1.41850	1.087	....	146	v. sl. s.	∞	∞ eth.
7303	col. leaf. f.w.	hyg.	41 (61)	204	s.	s.	∞ eth.
7304	col. liq.	$1.1086\frac{20}{4}$	....	$162–3^{765}$	v. sl. s.	∞	∞ eth.
7305	oil	$1.14\frac{20}{4}$	....	$142–5^{11}$	s.	s.	....
7306	monocl. need. or pl.	....	51; 64	220–40 d.; 160^{20}	1945^{11}	160^{20}	304^{10} eth.; s. bz., CS_2
7307							
7308							
7309							
7310							
7311							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7312	**Propionic acid, α-iodo-**	2-iodopropanoic acid*	$CH_3CHICOOH$	199.99
7313	**——, β-iodo-**	3-iodopropanoic acid*	CH_2ICH_2COOH	199.99
7314	**——, α-keto-.**	See *Pyruvic acid.*		
7315	**——, α-methyl-.**	See *Isobutyric acid.*		
7316	**——, α-phenyl-.**	See *Hydratropic acid.*		
7317	**——, β-phenyl-.**	See *Hydrocinnamic acid.*		
7318	**Propionic anhydride**	propanoic anhydride*	$(CH_3CH_2CO)_2O$	130.14
7319	**Propionitrile**	propanenitrile*; ethyl cyanide	CH_3CH_2CN	55.08
7320	**——, α,α-dimethyl-**	2,2-dimethylpropanenitrile*; *tert*-butyl cyanide; trimethylacetonitrile	$(CH_3)_3CCN$	83.13
7321	**——, β-hydroxy-.**	See *Hydracrylonitrile.*		
7322	**Propionyl bromide**	propanoyl bromide*	CH_3CH_2COBr	136.99
7323	**——, α-methyl-**	See *Isobutyryl bromide.*		
7324	**Propionyl chloride**	propanoyl chloride*	CH_3CH_2COCl	92.53
7325	**——, α-methyl-.**	See *Isobutyryl chloride.*		
7325M	**Propionyl fluoride**	propanoyl fluoride*	CH_3CH_2COF	76.07
7326	**Propionyl iodide**	propanoyl iodide*	CH_3CH_2COI	183.99
7327	**Propiophenone**	ethyl phenyl ketone; 1-phenyl-1-propanone	$C_2H_5COC_6H_5$	134.17
7328	**——, β-acetyl-.**	See *Valerophenone, γ-oxo-.*		
7329	**——, 2,4-dihydroxy-**	4-propionylresorcinol	$CH_3CH_2COC_6H_3(OH)_2$	166.17
7330	**Proponal.**	See *Barbituric acid, 5,5-dipropyl-.*		
	Propyl. For propyl derivatives see the parent compounds (e.g., for propylbenzene see			
7331	**Propyl alcohol (*n*)**	1-propanol*; ethylcarbinol	$CH_3CH_2CH_2OH$	60.09
7332	——, derivatives.	See under 1-*Propanol**.		
7333	**Propylamine*(*n*)**		$CH_3(CH_2)_2NH_2$	59.11
7334	**——, α,α-dimethyl-.**	See *tert-Amylamine.*		
7335	**——, α,β-dimethyl-**	3-amino-2-methyl-*n*-butane; methylisopropylcarbinylamine	$(CH_3)_2CHCH(CH_3)NH_2$	87.16
7336	**——, β,β-dimethyl-**	*tert*-butylmethylamine; 1-amino-2,2-dimethylpropane	$(CH_3)_3CCH_2NH_2$	87.16
7337	**——, α-ethyl-**	diethylcarbinylamine; *sec-n*-amylamine; 3-aminopentane	$CH_3CH_2CH(C_2H_5)NH_2$	87.16
7338	**——, α-methyl-.**	See *sec-Butylamine.*		
7339	**——, β-methyl-.**	See *Isobutylamine.*		
7340	**——, *N*-methyl-**		$CH_3NHC_3H_7$	73.14
7341	**——, *N*-nitro-**	*n*-propylnitramine	$C_3H_7NHNO_2$	104.11
7341M	**——, α,α,β-trimethyl-**	2-amino-2,3-dimethyl-*n*-butane	$(CH_3)_2CHC(CH_3)_2NH_2$	101.19
7341P	**——, α,β,β-trimethyl-**		$(CH_3)_3C\cdot CH(CH_3)NH_2$	101.19
7342	**Propyl borate**	tripropyl borate; tripropoxyboron	$B(OC_3H_7)_3$	188.08
7343	**Propyl bromide (*n*)**	1-bromopropane*	$CH_3CH_2CH_2Br$	123.00
7344	**Propyl chloride (*n*)**	1-chloropropane*	$CH_3CH_2CH_2Cl$	78.54

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7312	pr. or need....	....	45.5	$105^{0.3}$	sl. s.	v. s.	v. s. eth.
7313	leaf..........	....	82	....	8^{25}	v. s.	v. s. eth.
7314							
7315							
7316							
7317							
7318	col. liq., 1.4038	$1.0336\frac{0}{4}$; $1.010\frac{20}{4}$	–45	169.3 (166)	d.	d.	∞ eth.
7319	col. liq., $1.36888^{14.6}$	$0.783\frac{21}{4}$	–91.9 (–104)	97.1 (96–7)	11.9^{40}, 28^{100}	∞	s. eth.
7320	cr...........	....	15–6	105–6	....	......	....
7321							
7322	liq...........	1.521^{16}	....	103.5	d.	d.	s. eth.
7323							
7324	col. liq., 1.40507	1.065	–94	80	d.	d.	s. eth.
7325							
7325M	col. liq........	0.972^{15}	....	44	......	......	....
7326	liq...........	....	....	127	d.	d.	....
7327	col. leaf. or liq. $1.52900^{15.9}$	$1.012\frac{20}{4}$	21	218	i.	s.	s. eth.
7328							
7329	....	....	97.5	....	sl. s.	s.	s. eth.
7330							
	Benzene, propyl–). For propyl esters of organic acids see the acids.						
7331	col. liq., 1.38543	$0.8044\frac{20}{4}$; $0.7998\frac{25}{4}$	–127	97.19 (97.8)	∞	∞	∞ eth.
7332	....						
7333	col. liq., $1.39006^{16.6}$	0.719	–83	48.7	s.	∞	∞ eth.
7334							
7335	liq., $1.40959^{17.9}$	0.7574^{19}	....	84–87	v. s.	s.	....
7336	liq...........	....	....	82–3	......	......	....
7337	oil...........	$0.7487\frac{20}{4}$	....	91	......	s.	....
7338							
7339							
7340	col. liq........	0.720^{17}	....	62–4	s.	s.	....
7341	col. liq........	1.103^{15}	–21	128^{40}	sl. s.	v. s.	v. s. eth.
7341M	1.4096^{17}.......	$0.7683\frac{0}{0}$	....	104–5	......	......	....
7341P	....	....	–20	103	v. s. c.	......	....
7342	col. liq........	0.867^{16}	....	175	d.	∞	∞ eth.
7343	liq., 1.43414...	$1.353\frac{20}{4}$	–110	70.9	0.25^{20}	∞	∞ eth.
7344	col. liq., 1.38856	$0.890\frac{20}{4}$	–122.8	47.2 (45–7)	0.27^{20}	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7345	***n*-Propyl cyanide.**	See *Butyronitrile.*		
7346	**Propylene.**	See *Propene*.*		
7347	**Propylene aldehyde.**	See *Crotonaldehyde.*		
7348	**Propylene bromide.**	See *Propane, 1,2-dibromo-*.*		
7349	**Propylene chloride.**	See *Propane, 1,2-dichloro-*.*		
7350	**Propylene chlorohydrin.**	See *2-Propanol, 1-chloro-*.*		
7351	**Propylenediamine.**	See *1,2-Propanediamine*.*		
7352	**Propylene glycol.**	See *1,2-Propanediol*.*		
7353	**Propylene iodide.**	See *Propane, 1,2-diiodo-*.*		
7354	**Propylene oxide.**	See *Propene oxide.*		
7355	**——, γ-chloro-.**	See *Epichlorohydrin.*		
7356	**——, γ-cyano-.**	See *Epicyanohydrin.*		
7357	**——, γ-iodo-.**	See *Epiiodohydrin.*		
7358	**Propyl ether**	di-*n*-propyl ether; 1-propoxypropane*	$(CH_3CH_2CH_2)_2O$	102.17
7359	**Propyl fluoride (*n*)**	1-fluoropropane*	$CH_3CH_2CH_2F$	62.09
7360	**Propylidene bromide.**	See *Propane, 1,1-dibromo-*.*		
7361	**Propylidene chloride.**	See *Propane, 1,1-dichloro-*.*		
7362	**Propyl iodide (*n*)**	1-iodopropane*	$CH_3CH_2CH_2I$	170.01
7363	**Propyl isocyanide (*n*)**	propylcarbylamine	$CH_3(CH_2)_2NC$	69.10
7364	***n*-Propyl mercaptan.**	See *1-Propanethiol*.*		
7365	***n*-Propyl mustard oil.**	See *Isothiocyanic acid, propyl ester.*		
7366	**Propyl nitrate (*n*)**		$CH_3CH_2CH_2NO_3$	105.09
7367	**Propyl nitrite (*n*)**		$CH_3CH_2CH_2ONO$	89.09
7368	**Propyl sulfate**	*di-n*-propyl sulfate	$(CH_3CH_2CH_2)_2SO_4$	182.23
7369	**Propyl sulfide**	1-propylthiopropane*; di-*n*-propyl sulfide	$(C_3H_7)_2S$	118.23
7370	**Propyl sulfone**	1-propylsulfonylpropane*; dipropyl sulfone	$(CH_3CH_2CH_2)_2SO_2$	150.23
7370M	**Propyl sulfoxide**	1-(propylsulfinyl)propane*; di-*n*-propyl sulfoxide	$(CH_3CH_2CH_2)_2SO$	134.23
7371	**Propynal*.**	See *Propiolaldehyde.*		
7372	**Propyne***	propine; methylacetylene	$CH_3C{\vdots}CH$	40.06
7373	**——, 3-bromo-***	propargyl bromide; γ-bromoallylene	$CH{\vdots}CCH_2Br$	118.97
7374	**——, 3-chloro-***	propargyl chloride	$CH{\vdots}CCH_2Cl$	74.51
7374M	**——, 1,3-dibromo-***		$BrC{\vdots}CCH_2Br$	197.88
7375	**——, 3-ethoxy-***	ethyl propargyl ether	$CH{\vdots}CCH_2OC_2H_5$	84.11
7375T	**——, 1-iodo-***		$CI{\vdots}CCH_3$	165.97
7376	**——, 3-iodo-***	propargyl iodide	$CH{\vdots}CCH_2I$	165.97
7377	**——, 3-methoxy-***	methyl propargyl ether	$CH{\vdots}CCH_2OCH_3$	70.09
7378	**——, 1-phenyl-**	methylphenylacetylene; 1-propynylbenzene; phenylallylene	$C_6H_5C{\vdots}CCH_3$	116.15
7379	**Propynoic acid*.**	See *Propiolic acid.*		
7380	**2-Propyn-1-ol***	propargyl alcohol; ethynylcarbinol; acetylenylcarbinol; propiolic alcohol	$CH{\vdots}CCH_2OH$	56.06
7381	——, acetate	propargyl acetate	$CH_3COOCH_2C{\vdots}CH$	98.10
7382	**Propytal.**	See *Barbituric acid, 5,5-dipropyl-.*		
7383	**Protocatechualdehyde**	3,4-dihydroxybenzaldehyde; 3,4-dihydroxybenzenecarbonal*	$(HO)_2C_6H_3CHO$	138.12
7384	——, dimethyl ether.	See *Veratraldehyde.*		

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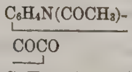
*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7345							
7346							
7347							
7348							
7349							
7350							
7351							
7352							
7353							
7354							
7355							
7356							
7357							
7358	col. liq., 1.3807	0.7360^{20}_{4}	-122	91	0.25^{25}	∞	∞ eth.
7359	col. gas, 1.3326^{-20}	$0.7788^{-3.2}$	-159	-3.2	sl. s.	v. s.	∞ eth.
7360							
7361							
7362	col. liq., 1.50508	1.747	-101.4	102.4	$.0867^{20}$	∞	∞ eth.
7363	liq.	....	....	99.5	i.	∞	∞ eth.
7364							
7365							
7366	liq., 1.3972....	1.058^{20}_{4}	....	110.5	v. sl. s.	s.	s. eth.
7367	liq., 1.3613....	0.935	....	57	......	s.	s. eth.
7368	col. oil, $1.4139^{20}\phi$	$1.11^{22.5}$	d. 140–70	120^{20};	i.; sl. d.	......	....
7369	liq...........	0.814^{17}	frz. -101.9	141–2	i.	s.	s. eth.
7370	sc............	....	29–30	....	sl. s.	s.	s. eth.
7370M	....	....	15	not dist.	sl. s.	s.	s.
7371							
7372	gas..........	liq. 0.6785^{-27}_{4}; 1.787^{0} g/1	-104.7; frz. -110	-23.3	v. sl. s.	v. s.	2142^{16} cm^3 eth.
7373	liq...........	1.520	....	88–90	......	......	....
7374	liq...........	1.0454^{5}	....	65	i.	∞	∞ eth.
7374M	liq...........	2.137^{0}	....	$73–4^{30}$	......	......	....
7375	liq., 1.40390...	0.8326	....	80	i.	s.	s. eth.
7375T	need. f. w.....	1.857^{112}	93–4	d.	sl. s.	v. s.	v. s.
7376	liq...........	2.018^{0}	....	115	......	......	s. eth.
7377	col. liq.......	0.83^{13}	....	62	sl. s.	∞	∞ eth.
7378	arom. oil......	....	....	185	i.	......	s. eth.
7379							
7380	col. liq., 1.43064	0.9715^{20}_{4}	-17	114–115	s.	∞	∞ eth.
7381	col. liq., 1.42047	1.005	....	125	sl. s.	s.	s. eth.
7382							
7383	col. tab. f. w..	....	154	d.	5	78.9 h.	v. s. eth.
7384							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7385	**Protocatechualdehyde,** 4-ethyl 3-methyl ether.	See *Benzaldehyde, 4-ethoxy-3-meth*		
7386	——, methylene ether.	See *Piperonal.*		
7387	——, 3-methyl ether.	See *Vanillin.*		
7388	——, 4-methyl ether.	See *Isovanillin.*		
7389	**Protocatechuic acid**	3,4-dihydroxybenzoic acid; 3,4-dihydroxybenzenecarboxylic acid*	$(OH)_2C_6H_3COOH$	154.12
7390	——, dimethyl ether.	See *Veratric acid.*		
7391	——, methylene ether.	See *Piperonylic acid.*		
7392	**Protopine**		$C_{20}H_{19}NO_5$	353.36
7393	**Protoveratrine**		$C_{32}H_{51}NO_{11}$	625.74
7373M	**Provitamin A.**	See *β-Carotene.*		
7394	**Prussic acid.**	See *Hydrocyanic acid.*		
7395	**Prussite.**	See *Cyanogen.*		
7396	**Pseudaconine, acetylbenzoyl-.**	See *Indaconitine.*		
7397	**——, acetylveratryl-.**	See *Pseudaconitine.*		
7398	**Pseudaconitine**	acetylveratrylpseudaconine	$C_{36}H_{49}NO_{12}$	687.76
7399	**Pseudobutylene.**	See 2-*Butene**.		
7400	**Pseudobutylene glycol.**	See 2,3-*Butanediol**.		
7401	**Pseudocinchonine.**	See *Cinchotine.*		
7402	**Pseudocodeine**		$C_{18}H_{21}NO_3$	299.36
7403	**Pseudoconhydrine**	ψ-conhydrine	$C_8H_{17}NO$	143.23
7404	**Pseudoconiceine**		$C_8H_{15}N$	125.21
7405	**Pseudocumene**	1,2,4-trimethylbenzene; *as*-trimethylbenzene	$(CH_3)_3C_6H_3$	120.19
7406	**——, 5-nitro-**		$NO_2C_6H_2(CH_3)_3$	165.19
7407	**——, 6-nitro-**	1,2,4-trimethyl-6-nitrobenzene	$NO_2C_6H_2(CH_3)_3$	165.19
7408	**——, 3,5,6-trinitro-**		$(NO_2)_3C_6(CH_3)_3$	255.19
7409	**Pseudocumenol**	2,4,5-trimethylphenol	$(CH_3)_3C_6H_2OH$	136.19
7410	**Pseudocumidine**	2,4,5-trimethylaniline	$(CH_3)_3C_6H_2NH_2$	135.20
7411	**Pseudoephedrine (*d*)**	2-methylamino-1-phenyl-1-propanol (one form); *d*-isoephedrine	$C_6H_5CHOHCH(NHCH_3)CH_3$	165.23
7412	——, hydrochloride		$C_{10}H_{15}NO{\cdot}HCl$	201.69
7413	**Pseudohexyl alcohol.**	See 1-*Butanol, 2-ethyl-**.		
7414	**Pseudohyoscyamine**		$C_{17}H_{23}NO_3$	289.36
7415	**3-Pseudoindolone, 2-chloro-.**	See *Isatin chloride.*		
7416	**Pseudoisatin, 1-acetyl-**	acetylisatin	 $C_6H_4N(COCH_3)\text{-}COCO$	189.16
7417	**Pseudoleucaniline.**	See *mp₂-Leucaniline.*		
7418	**Pseudomorphine**		$C_{34}H_{36}N_2O_6$	568.65
7419	——, hydrochloride (*l*)		$C_{34}H_{36}N_2O_6{\cdot}2HCl{\cdot}2H_2O$	677.61
7420	**Pseudopelletierine**	methylgranatonine; ψ-pelletierine	$C_9H_{15}NO$	153.22
7421	**Pseudotropeine, benzoyl-.**	See *Tropacocaine.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7385	*oxy-*.						
7386							
7387							
7388							
7389	monocl. need.	1.542^4	199 d.	......	1.82^{14}, 27^{80}	v. s.	s. eth.
7390							
7391							
7392	monocl. cr	......	207	......	i.	v. sl. s.	v. sl. s. eth.; s. acet.; sl. s. NH_4OH, bz.
7393	rect. tab.	......	245–50	......	......	sl. s.	sl. s. eth., chl.
7393M							
7394							
7395							
7396							
7397							
7398	rhomb. f. chl. + eth.	......	211–2 d.	......	v. sl. s.	s.	s. eth., chl.
7399							
7400							
7401							
7402	col. need., 1.574, 1.602, 1.647	1.315; 1.290^{180}	181	......	sl. s.	s.	......
7403	slend. col. need., [α] $+11^{\circ 15}_{D}$	......	105–6	236.5	s.	s.	s. eth., bz.
7404	oily liq.	0.8776^{15}	......	171–2	......	......	......
7405	col. liq., 1.50484^{20}	0.87582^{20}	–57.4 (–61)	169.351	i.	s.	s. eth.
7406	lng. col. or grn.-yel. need.	......	65; 45–6 (71)	265	......	s.	s. pet. eth.
7407	grn. pr.	......	20	......	......	s.	......
7408	pr.	......	185	......	i.	v. sl. s. h.	s. h. bz.
7409	need. f. w.	......	72	235	v. v. sl. s.	v. s.	v. s. eth.
7410	col. need. f. al.	0.957	66–8	234–5	0.12^{19}	s.	s. eth., chl.
7411	col. rhomb. tab. f. eth.	......	116–7	......	sl. s. c.	s.	s. eth., chl.
7412	ylsh. need.	......	176	......	s.	s.	......
7413							
7414	ylsh. need.	......	133–4	......	sl. s.	v. s.	s. eth., chl.
7415							
7416	yel. need. f. bz.	......	141	......	sl. s.	s.	s. bz.; d. h. HCl
7417		......	......		......	......	
7418	crusts or need.	......	327 d.	......	i.	i.	i. eth., chl.; s. alk., NH_4OH
7419	cr. powd.	......	......	......	70^{10}	......	......
7420	pl. f. pet. eth., $1.47596^{99.5}$	1.001^{100}	48–9	246	s.	v. s.	v. s. eth.; s. chl., bz.; sl. s. pet. eth.
7421							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7422	**Pseudotropine**		$C_8H_{15}NO$	141.21
7423	**Pukateine (*l*)**		$C_{17}H_{17}NO_3$	283.32
7424	**Pulegone**	4(8)-*p*-menthen-3-one	$C_{10}H_{16}O$	152.23
7425	**Punicine**	See *Pelletierine.*		
7426	**Purine**	imidazo[4,5-*d*]pyrimidine	$C_5H_4N_4$	120.11
7427	**——, 6-amino-.**	See *Adenine.*		
7428	**——, 2,6-dioxy-.**	See *Xanthine.*		
7429	**——, 2,6,8-trioxy-.**	See *Uric acid.*		
7430	**2,6(1,3)Purinedione.**	See *Xanthine.*		
7431	**2,6,8(1,3,9)-Purinetrione.**	See *Uric acid.*		
7432	**6(1)-Purinone.**	See *Hypoxanthine.*		
7433	**Purpuric acid,** ammonium salt.	See *Murexide.*		
7434	**Purpurin**	1,2,4-trihydroxyanthraquinone	$C_6H_4(CO)_2C_6H(OH)_3$	256.20
7435	**Purpuroxanthin**	1,3-dihydroxyanthraquinone	$C_6H_4(CO)_2C_6H_2(OH)_2$	240.20
7436	**Putrescine**	1,4-butanediamine*; tetramethylenediamine	$NH_2(CH_2)_4NH_2$	88.15
7437	**Pyraconitine**		$C_{32}H_{43}NO_9$	585.68
7438	**Pyran, tetrahydro-**	pentamethylene oxide	$O(CH_2)_4CH_2$	86.13
7439	**1,4-Pyran, 4-oxo-.**	See 1,4-*Pyrone.*		
7440	**1,2-Pyran-5-carboxylic acid, 2-oxo-.**	See *Coumalic acid.*		
7441	**1,4-Pyran-2,5-dicarboxylic acid, tetrahydro-2,6,6-trimethyl-*.**	See *Cin-*		
7442	**1,4-Pyran-2,6-dicarboxylic acid, 3-hydroxy-4-keto-.**	See *Meconic acid.*		
7443	**2,4-Pyrandione, 3-acetyl-6-methyl-.**	See *Dehydroacetic acid.*		
7444	**Pyrantin.**	See *Succinamide, N-p-phenetyl-.*		
7445	**Pyrazine**	1,4-diazine; paradiazine; piazine	$N{:}CHCH{:}NCH{:}CH$	80.09
7446	**——, 2,5-dimethyl-.**	See *Ketine.*		
7447	**——, hexahydro-.**	See *Piperazine.*		
7448	**——, tetraphenyl-.**	See *Amaron.*		
7449	**Pyrazole**	1,2-diazole; α-pyrromonazole	$NHN{:}CHCH{:}CH$	68.08
7450	**——, 4,5-dihydro-.**	See 2-*Pyrazoline.*		
7451	**——, 4,5-dihydro-5-oxo-.**	See 5-*Pyrazolone.*		
7452	**2-Pyrazoline**	Δ^2-pyrazoline; 4,5-dihydropyrazole; pyrazoline	$NHN{:}CHCH_2CH_2$	70.09
7453	**——, 1-phenyl-**		$C_6H_5NN{:}CHCH_2CH_2$	146.19
7454	**3-Pyrazolone, 1,5-dimethyl-2-phenyl-.**	See *Antipyrine.*		
7455	**——, 1,5-dimethyl-2-phenyl-3-thio-.**	See *Thiopyrine.*		
7456	**5-Pyrazolone**	4,5-dihydro-5-oxopyrazole	$NHN{:}CHCH_2CO$	84.08
7457	**——, 3-methyl-1-phenyl-**		$N(C_6H_5)N{:}C(CH_3)CH_2CO$	174.20
7458	**Pyrene**	benzo[*def*]phenanthrene	$C_{16}H_{10}$	202.24
7459	**Pyridazine**	1,2-diazine; orthodiazine	$N{:}NCH{:}CHCH{:}CH$	80.09
7460	**Pyridine**		$N{:}CHCH{:}CHCH{:}CH$	79.10

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
7422	rhbdr. tab. or pr. f. eth.	....	108	243	v. s.	v. s.	sl. s. eth.; s. chl.
7423	cr. f. al.......	....	....	....	......	s.	0.6 eth.; s. chl., pyr., alk.
7424	col. liq., $1.48705^{18.3}$	0.9323^{20}	....	224	i.	∞	∞ eth.
7425							
7426	need. f. al.....	....	217	d.	v. s.	s.	v. sl. s. eth.; s. tol.
7427							
7428							
7429							
7430							
7431							
7432							
7433							
7434	red. need. f. al.	....	256	d. subl.	s.	s.	s. eth.
7435	yel. need. f. ac. a.	....	262–3	subl.	i.	sl. s.	s. h. ac. a., acet.
7436	leaf..........	....	27	158	v. s.	v. s.	v. s. eth.
7437	need.........	....	167–8	....	sl. s.	v. s.	v. s. eth.
7438	....	0.8540	....	81–2	s.	∞	∞ eth.
7439							
7440							
7441	*eolic acid.*						
7442							
7443							
7444							
7445	col. pr. f. w., $1.49526^{60.9}$	$1.031\frac{61}{4}$	53	118	∞	v. s.	v. s. eth.; s. chl., HCl, H_2SO_4
7446							
7447							
7448							
7449	need. f. al., $1.47027^{99.8}_{He}$	....	70	188	v. s.	v. s.	v. s. eth.; s. bz.
7450							
7451							
7452	col. liq.........	....	....	144	∞	∞	sl. s. eth.
7453	cr............	....	52	273	i.	s.	....
7454							
7455							
7456	need. f. tol....	....	165	subl. d.	s.	s.	sl. s. eth.
7457	pr., β 1.637...	....	127	287^{205}	s. h.	s. h.	v. sl. s. eth.; sl. s. bz.
7458	lt. yel. monocl. tab.	....	150	>360	i.	1.4	v. s. eth.
7459	col. liq., $1.52311^{23.5}$	1.107	−8	208	∞	v. s.	v. s. eth.; s. HCl, bz., H_2SO_4; i. lgr.
7460	col. liq., 1.50919^{21}	0.982	−42	115.3	∞	∞	∞ eth.; s. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7461	**Pyridine, 2-allyl-**		$C_3H_5C_5H_4N$	119.16
7462	**——, 2-amino-**	α-pyridylamine	$NH_2C_5H_4N$	94.11
7463	**——, 3-amino-**	β-pyridylamine	$NH_2C_5H_4N$	94.11
7464	**——, 4-amino-**	γ-pyridylamine	$NH_2C_5H_4N$	94.11
7465	**——, 2-benzyl-**		$C_6H_5CH_2C_5H_4N$	169.22
7466	**——, 3-benzyl-**		$C_6H_5CH_2C_5H_4N$	169.22
7467	**——, 3-bromo-***		BrC_5H_4N	158.01
7468	**——, 2-chloro-***	α-chloropyridine	ClC_5H_4N	113.55
7469	**——, 3-chloro-***	β-chloropyridine	ClC_5H_4N	113.55
7470	**——, 4-chloro-***	γ-chloropyridine	ClC_5H_4N	113.55
7471	**——, 3,5-dibromo-***		$C_5H_3Br_2N$	236.91
7472	**——, dihydroxy-.**	See *Pyridinediol.*		
7473	**——, dimethyl-.**	See *Lutidine.*		
7474	**——, 2-ethyl-**	α-ethylpyridine	$C_2H_5 \cdot C_5H_4N$	107.15
7475	**——, 3-ethyl-**	β-ethylpyridine	$C_2H_5 \cdot C_5H_4N$	107.15
7476	**——, 4-ethyl-**	γ-ethylpyridine	$C_2H_5 \cdot C_5H_4N$	107.15
7477	**——, 2-ethyl-3,5-dimethyl-.**	See *α-Parvoline.*		
7478	**——, 3-ethyl-4-methyl-.**	See *β-Collidine.*		
7479	**——, 4-ethyl-2-methyl-.**	See *α-Collidine.*		
7480	**——, 5-ethyl-2-methyl-.**	See *Aldehydine.*		
7481	**——, hexahydro-*.**	See *Piperidine.*		
7482	**——, hydroxy-.**	See *Pyridol.*		
7483	**——, 2-isopropyl-**		$(CH_3)_2CHC_5H_4N$	121.18
7484	**——, 4-isopropyl-**		$(CH_3)_2CHC_5H_4N$	121.18
7485	**——, 4-methoxy-***		$N:CHCH:C(OCH_3)CH:CH$	109.12
7486	**——, methyl-.**	See *Picoline.*		
7487	**——, 3-(1-methyl-2-pyrryl)-.**	See *Nicotyrine.*		
7488	**——, 2-phenyl-**		$C_6H_5C_5H_4N$	155.19
7489	**——, 3-phenyl-**		$C_6H_5C_5H_4N$	155.19
7490	**——, 4-phenyl-**		$C_6H_5C_5H_4N$	155.19
7491	**——, 2-propyl-.**	See *Conyrine.*		
7491M	**——, 2-sulfanilamido-.**	See *Sulfapyridine.*		
7491T	**——, 2-(sulfanilylamino)-.**	See *Sulfapyridine.*		
7492	**——, 1,2,3,4-tetrahydro-6-propyl-.**	See *γ-Coniceine.*		
7493	**——, tetramethyl-.**	See *β-Parvoline.*		
7494	**——, 2,4,6-trihydroxy-.**	See 2,4,6-*Pyridinetriol.*		
7495	**——, 2,4,6-trimethyl-.**	See *γ-Collidine.*		
7495M	**3-Pyridinecarboxamide.**	See *Nicotinamide.*		
7496	**2-Pyridinecarboxylic acid*.**	See *Picolinic acid.*		
7497	**3-Pyridinecarboxylic acid*.**	See *Nicotinic acid.*		
7498	**4-Pyridinecarboxylic acid*.**	See *Isonicotinic acid.*		
7498M	**3,4-Pyridinedicarbinol, 6-methyl-.**	See *Vitamin B_6.*		
7499	**2,3-Pyridinedicarboxylic acid*.**	See *Quinolinic acid.*		
7500	**2,4-Pyridinedicarboxylic acid*.**	See *Lutidinic acid.*		
7501	**2,5-Pyridinedicarboxylic acid*.**	See *Isocinchomeronic acid.*		
7502	**2,6-Pyridinedicarboxylic acid*.**	See *Dipicolinic acid.*		
7503	**3,4-Pyridinedicarboxylic acid*.**	See *Cinchomeronic acid.*		
7504	**3,5-Pyridinedicarboxylic acid*.**	See *Dinicotinic acid.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
7461	liq...........	0.959^{0}	....	190	sl. s.	∞	∞ eth.
7462	leaf. f. lgr.....	....	56	204	s.	v. s.	s. eth.; sl. s. lgr.
7463	leaf. f. bz.....	....	64	252	v. s.	v. s.	v. s. eth.; i. lgr.
7464	col. need. f. bz.	....	158	....	s.	s.	s. eth., alk., bz.; sl. s. lgr.
7465	need.........	$1.067\frac{0}{0}$	139	276^{742}	i.	s.	s. eth.
7466	need.........	$1.061^{\frac{20}{0}}$	34	286^{740}	i.	s.	s. eth.
7467	oil...........	1.632^{10}; $1.645\frac{0}{4}$	....	169–70 (173)	v. sl. s.	v. s.	v. s. eth.
7468	oily liq.......	1.205^{15}	....	170 (166^{714})	v. sl. s.	......	s. eth.
7469	liq...........	....	....	148^{744}	s.	......	....
7470	liq...........	....	....	147–8	s.	......	....
7471	col. need. f. al.	....	112 (110–1)	222; subl. 100	sl. s. h.	s. h.	v. s. eth.; s. H_2SO_4
7472							
7473							
7474	liq., $1.50214^{22.5}$	0.950^{0}	....	148.8	sl. s.	∞	v. s. eth.
7475	col. liq........	0.945^{15}	....	165.3	v. sl. s.	s.	s. eth.
7476	col. liq........	0.936	....	166	......	......	s. dil. a.
7477							
7478							
7479							
7480							
7481							
7482							
7483	liq...........	0.934^{0}	....	159	sl. s.	∞	∞ eth.
7484	liq...........	0.944^{0}	....	178	sl. s.	∞	∞ eth.
7485	liq...........	....	....	191	s.	......	....
7486							
7487							
7488	liq...........	>1	....	270	i.	v. s.	v. s. eth.
7489	oil...........	>1	....	270.4	i.	v. s.	v. s. eth.
7490	leaf. f. w......	....	78	275	v. sl. s. h.	s.	s. eth.
7491							
7491M							
7491T							
7492							
7493							
7494							
7495							
7495M							
7496							
7497							
7498							
7498M							
7499							
7500							
7501							
7502							
7503							
7504							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7505	**2,4-Pyridinediol**	2,4-dihydroxypyridine	$C_5H_3N(OH)_2$	111.10
7506	**2,6-Pyridinediol**	2,6-dihydroxypyridine	$C_5H_3N(OH)_2 \cdot H_2O$	129.11
7507	**Pyridinepentacarboxylic acid***		$C_5N(COOH)_5 \cdot 2H_2O$	335.18
7508	**3-Pyridinesulfonic acid***		$C_5H_4NSO_3H$	159.16
7508M	**2,3,4,5-Pyridinetetracarboxylic acid***(anh.)		$C_5HN(COOH)_4$	255.14
7508P	**2,3,4,6-Pyridinetetracarboxylic acid***(anh.)		$C_5HN(COOH)_4$	255.14
7508R	**2,3,5,6-Pyridinetetracarboxylic acid***(anh.)		$C_5HN(COOH)_4$	255.14
7509	**2,3,4-Pyridinetricarboxylic acid*.**	See *Carbocinchomeronic acid.*		
7509H	**2,3,5-Pyridinetricarboxylic acid***(anh.)	carbodinicotinic acid	$C_5H_2N(COOH)_3$	211.13
7509K	**2,3,6-Pyridinetricarboxylic acid***(anh.)		$C_5H_2N(COOH)_3$	211.13
7510	**2,4,5-Pyridinetricarboxylic acid*.**	See *Berberonic acid.*		
7511	**2,4,6-Pyridinetricarboxylic acid*.**	See *Trimesitic acid.*		
7512	**3,4,5-Pyridinetricarboxylic acid***	β-carbocinchomeronic acid	$C_5H_2N(COOH)_3$	211.13
7513	**2,4,6-Pyridinetriol**	2,4,6-trihydroxypyridine	$C_5H_2N(OH)_3$	127.10
7514	**2-Pyridol**	2(1)-pyridone; α-pyridone	HOC_5H_4N	95.10
7515	**3-Pyridol**	3-hydroxypyridine	HOC_5H_4N	95.10
7516	**4-Pyridol**	4(1)-pyridone; γ-pyridone	HOC_5H_4N	95.10
7517	**α-Pyridone.**	See 2-*Pyridol.*		
7518	**γ-Pyridone.**	See 4-*Pyridol.*		
7519	**2(1)-Pyridone.**	See 2-*Pyridol.*		
7520	**4(1)-Pyridone.**	See 4-*Pyridol.*		
7520M	**Pyridoxin.**	See *Vitamin* B_6.		
7521	**α-Pyridylamine.**	See *Pyridine, 2-amino-.*		
7522	**β-Pyridylamine.**	See *Pyridine, 3-amino-.*		
7523	**γ-Pyridylamine.**	See *Pyridine, 4-amino-.*		
7524	**Pyrimidine**	1,3-diazine; *m*-diazine; miazine	$\underbrace{N{:}CHN{:}CHCH{:}CH}$	80.09
7525	**2,4(1,3)-Pyrimidinedione.**	See *Uracil.*		
7526	**Pyrimidinetetrone.**	See *Alloxan.*		
7527	**Pyrimidinetrione.**	See *Barbituric acid.*		
7528	**Pyrocatechol**	1,2-benzenediol*; catechol; pyrocatechin	$C_6H_4(OH)_2$	110.11
7529	——, dibutyl ether.	See *Benzene,* 1,2-*dibutoxy-**.		
7530	——, diethyl ether.	See *Benzene,* 1,2-*diethoxy-**.		
7531	——, dimethyl ether.	See *Veratrole.*		
7532	——, dipropyl ether.	See *Benzene,* 1,2-*dipropoxy-**.		
7533	——, monoamyl ether.	See *Phenol, o-amoxy-.*		
7534	——, monobutyl ether.	See *Phenol, o-butoxy-.*		
7535	——, monoethyl ether.	See *Phenol, o-ethoxy-.*		
7536	——, monomethyl ether.	See *Guaiacol.*		
7537	——, monopropyl ether.	See *Phenol, o-propoxy-.*		
7538	——, **3-methoxy-**	pyrogallol 1-methyl ether	$CH_3OC_6H_3(OH)_2$	140.13

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7505	yel. rhomb. cr. f. w. or al.	....	265	....	sl. s.	sl. s.	v. sl. s. eth.
7506	yel. need. f. w.	....	195	....	sl. s.	sl. s.	v. sl. s. eth.
7507	cr. f. eth., $2H_2O$; f. w. $3H_2O$	....	220 d. $-H_2O$, 100	d.	v. s.	......	v. sl. s. eth.
7508	need. or leaf...	....	d.	....	v. s.	v. sl. s.	i. eth.
7508M	cr. with 2 or $3H_2O$	....	$-H_2O$, 115; d. 160	....	s.	......	....
7508P	need. with $2H_2O$	....	dried at 115: 227 d. (235) dried at 100: 187 d. (192)	....	v. s.	v. sl. s.	v. sl. s. eth.; s. ac. a.
7508R	cr. with $2H_2O$ f. w.	....	d. 150	....	v. s.	......	....
7509							
7509 H	cr. with 1.5 or $2H_2O$	....	sl. d. 150	....	s. h.	s.	....
7509 K	cr. with $2H_2O$ f. dil. al.	....	*ca.* 130 d.	....	v. s.	i.	i. eth., acetic anhydride
7510							
7511							
7512	leaf. or pl.....	....	$-H_2O$, 115; anh. 261	....	s. h.	......	....
7513	need. or powd.	....	230 d.	....	sl. s.	s.	s. eth.
7514	col. need. f. bz.	....	107	281	v. s.	v. s.	s. eth.; sl. s. lgr.
7515	need.........	....	129	....	v. s.	v. s.	sl. s. eth.
7516	col. monocl....	....	$+H_2O$, 92; anh. 148.5	>350	100^{15}	v. s.	v. sl. s. eth., chl.; i. bz.
7517							
7518							
7519							
7520							
7520M							
7521							
7522							
7523							
7524	cr............	....	22	124	s.	s.	....
7525							
7526							
7527							
7528	col. monocl. leaf. f. bz., 1.604, 1.615, 1.650	1.371^{15}	105	240 (240–5)	45.1^{20}	v. s.	s. eth., bz., chl., alk.
7529							
7530							
7531							
7532							
7533							
7534							
7535							
7536							
7537							
7538	need..........	....	38–41	$146\text{–}7^{15-16}$	......	......	....

No.	Name	Synonyms	Formula	Mol. Wt.
7539	**Pyrocatechol, 3-methyl-**	3-methyl-1,2-benzenediol*; isohomopyrocatechol; 2,3-dihydroxytoluene	$CH_3C_6H_3(OH)_2$	124.13
7540	**——, 4-methyl-.**	See 4-*Homopyrocatechol.*		
7541	**Pyrocatechol-o-acid.**	See *Benzoic acid, 2,3-dihydroxy-*.		
7542	**o-Pyrocatechuic acid.**	See *Benzoic acid, 2,3-dihydroxy-*.		
7543	**Pyrocoll**	5,10-dipyrrolo[1,2-*a*,1,2-*d*]-pyrazinedione	$C_4H_3N(CO)_2NC_4H_3$	186.16
7544	**Pyrodin.**	See *Hydrazine, 1-acetyl-2-phenyl-*.		
7545	**Pyrogallol**	1,2,3-benzenetriol*; *v*-trihydroxybenzene	$C_6H_3(OH)_3$	126.11
7546	——, 1,2-dimethyl ether.	See *Phenol, 2,3-dimethoxy-*.		
7547	——, 1,3-dimethyl ether.	See *Phenol, 2,6-dimethoxy-*.		
7548	——, 1-methyl ether.	See *Pyrocatechol, 3-methoxy-*.		
7549	——, 2-methyl ether.	See *Resorcinol, 2-methoxy-*.		
7550	——, triacetate		$C_6H_3(OOCCH_3)_3$	252.22
7551	——, trimethyl ether.	See *Benzene, 1,2,3-trimethoxy-**.		
7552	**——, 4-acetyl-.**	See *Gallacetophenone.*		
7553	**——, 4-benzoyl-.**	See *Benzophenone, 2,3,4-trihydroxy-*.		
7554	**——, 5-methyl-**	3,4,5-trihydroxytoluene	$CH_3C_6H_2(OH)_3$	140.13
7555	**4-Pyrogallolcarboxylic acid.**	See *Benzoic acid, 2,3,4-trihydroxy-*.		
7556	**Pyrogallolphthalein.**	See *Galleïn.*		
7557	**Pyromellitic acid**	1,2,4,5-benzenetetracarboxylic acid*	$C_6H_2(COOH)_4$	254.15
7558	**Pyromucic acid.**	See 2-*Furoic acid.*		
7559	——, amyl ester	*n*-amyl furoate; pentyl 2-furancarboxylate	$C_4H_3O\cdot COOC_5H_{11}$	182.21
7560	——, butyl ester	*n*-butyl furoate	$C_4H_3O\cdot COOC_4H_9$	168.19
7561	——, *sec*-butyl ester	*sec*-butyl furoate	$C_4H_3OCOOC_4H_9$	168.19
7562	——, ethyl ester	ethyl pyromucate; ethyl furoate	$C_4H_3O\cdot COOC_2H_5$	140.13
7563	——, furfuryl ester.	See *Furfuryl alcohol, 2-furoate.*		
7564	——, heptyl ester	*n*-heptyl furoate	$C_4H_3OCOOC_7H_{15}$	210.27
7565	——, hexyl ester	*n*-hexyl furoate	$C_4H_3OCOOC_6H_{13}$	196.24
7566	——, isoamyl ester	isoamyl furoate	$C_4H_3O\cdot COOC_5H_{11}$	182.21
7567	——, methyl ester	methyl furoate	$C_4H_3OCO_2CH_3$	126.11
7568	——, octyl ester		$C_4H_3OCOOC_8H_{17}$	224.29
7569	——, propyl ester	*n*-propyl furoate	$C_4H_3OCOOC_3H_7$	154.16
7570	**——, 3-bromo-**	3-bromofuroic acid	$C_4H_2BrO\cdot COOH$	190.99
7571	**——, 5-bromo-**		$BrC_4H_2O\cdot COOH$	190.99
7572	——, ——, ethyl ester		$BrC_4H_2O\cdot COOC_2H_5$	219.04
7573	**——, 3-chloro-**	3-chloro-2-furancarboxylic acid*; 3-chlorofuroic acid	$C_4H_2ClO\cdot COOH$	146.53
7574	**——, 5-chloro-**	5-chloro-2-furancarboxylic acid*; 5-chlorofuroic acid	$C_4H_2ClO\cdot COOH$	146.53
7575	**——, 5-methyl-**		$CH_3C_4H_2O\cdot COOH$	126.11
7576	——, ——, methyl ester		$CH_3C_4H_2O\cdot COOCH_3$	140.13
7577	**——, 5-nitro-**		$NO_2C_4H_2O\cdot COOH$	157.08
7578	**——, tetrahydro-**	tetrahydrofuroic acid	$C_4H_7O\cdot COOH$	116.11

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7539	leaf. f. bz	....	68 (47)	241	s.	s.	s. eth., chl., bz.
7540							
7541							
7542							
7543	yel. monocl. leaf.	....	269	subl.	i.	v. sl. s.	v. sl. s. eth.; s. ac. a.
7544							
7545	need. or leaf	$1.453\frac{4}{4}$	133–4	309 (293 d.)	62.5^{25}	100^{25}	83.3^{25} eth.; sl. s. bz., chl., CS_2
7546							
7547							
7548							
7549							
7550	wh. cr. powd.	....	165	....	v. v. sl. s.	......	s. dil. alk.
7551							
7552							
7553							
7554	need. f. bz	....	129	....	......	......	....
7555							
7556							
7557	tricl. tab. ($+2H_2O$) f. w.	....	264 (269–71)	....	1.42^{16}	v. s.	sl. s. eth.
7558							
7559	col. liq.	1.0335	....	$95–7^{1}$	i.	∞	....
7560	col. liq.	1.0555	....	$118–20^{25}$; $83–4^{1}$	i.	∞	∞ eth.
7561	col. liq.	1.0465	....	$67–9^{1}$	i.	∞	∞ eth.
7562	wh. cr. leaf., 1.4699^{40}	$1.0974\frac{40}{4}$; $1.1774\frac{21}{4}$	34 (30–3)	195^{706}	i.	∞	s. eth.
7563							
7564	col. liq.	$1.0005\frac{20}{4}$	....	$116–7^{1}$	i.	s.	....
7565	col. liq.	$1.0170\frac{20}{4}$	....	$105–7^{1}$	i.	s.	....
7566	col. liq.	....	....	$135–7^{25}$	i.	∞	....
7567	liq	1.178	....	181.3	i. (sl. s.)	∞	∞ eth.
7568	col. liq.	0.9885	....	$126–7^{1}$	i.	s.	....
7569	col. liq.	1.075	....	211	i. (sl. s.)	s.	∞ eth.
7570	wh. need. f. w.	....	127–9	....	1.3^{20}	s.	s. eth.; v. sl. s. lgr., CS_2
7571	wh. leaf. f. w.	....	186	....	v. sl. s c.	s.	v. s. eth.
7572	pr.	1.528^{20}	17	235^{767}	i.	s.	s. eth.
7573	wh. cr.	....	148.5–9.5	....	i.	s.	....
7574	wh. leaf.	....	179–80	....	0.3^{20}	s.	....
7575	pl. or need. f. w.	....	108–9	....	v. s. h.	v. s.	v. s. eth.
7576	col. liq.	....	....	98^{15}	......	......	s. eth.
7577	wh. cr. f. w.	....	185.0–5.5	subl.	s. h.	s.	s. eth.
7578	wh. cr.	1.1933	21	$131–2^{14}$	......	......	....

No.	Name	Synonyms	Formula	Mol. Wt.
7579	**Pyromucyl chloride.**	See *Furoyl chloride.*		
7580	**1,4-Pyrone**	4-oxo-1,4-pyran; γ-pyrone	$OCH:CH-$ $COCH:CH$	96.08
7581	**——, 5-hydroxy-2-hydroxymethyl-.** See *Kojic acid.*			
7582	**Pyroracemic acid.**	See *Pyruvic acid.*		
7583	**Pyrotartaric acid**	methylbutanedioic acid*; methylsuccinic acid	$COOHCH_2CH$- $(CH_3)COOH$	132.11
7584	**——, α-hydroxy-.**	See *Citramalic acid.*		
7585	**Pyrotritaric acid**	2,5-dimethyl-3-furancarboxylic acid; uvic acid; uvinic acid	$(CH_3)_2C_4HO\cdot$ $COOH$	140.13
7587	**Pyrrocoline, octahydro-.** See *Piperolidine.*			
7588	**Pyrro[ab_1]diazole.**	See 1,2,4-*Triazole.*		
7589	**Pyrrole**	azole	$NHCH:CH-$ $CH:CH$	67.09
7590	**——, 1-acetyl-**	*N*-acetylpyrrole	$CH_3CONC_4H_4$	109.12
7591	**——, dihydro-*.**	See *Pyrroline*.*		
7592	**——, 2,4-dimethyl-**		$NHC(CH_3):CHC-$ $(CH_3):CH$	95.14
7593	**——, 2,5-dimethyl-**		$NHC(CH_3):CH-$ $CH:C(CH_3)$	95.14
7594	**——, 1-ethyl-**	*N*-ethylpyrrole	$C_2H_5NC_4H_4$	95.14
7595	**——, 1-methyl-**	*N*-methylpyrrole	$N(CH_3)CH:CH-$ $CH:CH$	81.11
7596	**——, 2-methyl-**	α-methylpyrrole	$NCH(CH_3):CH-$ $CH:CH$	81.11
7597	**——, 3-methyl-**	β-methylpyrrole	$NCH:CH(CH_3)-$ $CH:CH$	81.11
7598	**——, 1-propyl-**	*N*-*n*-propylpyrrole	$CH_3CH_2CH_2NC_4H_4$	109.17
7599	**——, tetrahydro-*.**	See *Pyrrolidine*.*		
7600	**——, tetrahydro-2-oxo-.** See 2-*Pyrrolidone.*			
7601	**——, 2,3,4,5-tetraiodo-***	iodol	C_4I_4NH	570.74
7602	**2-Pyrrolecarboxylic acid***		$C_4H_4N\cdot COOH$	111.10
7603	**Pyrrolidine***	tetrahydropyrrole; tetramethylenimine	$NHCH_2CH_2CH_2C-$ H_2	71.12
7604	**——, 2-keto-.**	See 2-*Pyrrolidone.*		
7605	**——, 1-methyl-**	*N*-methylpyrrolidine	$CH_3NC_4H_8$	85.15
7605M	**——, 2-oxo-.**	See 2-*Pyrrolidone.*		
7606	**2-Pyrrolidinecarboxylic acid*.** See *Proline.*			
7607	**2,5-Pyrrolidinedione.**	See *Succinimide.*		
7608	**2-Pyrrolidone**	2-oxopyrrolidine; α-pyrrolidone	$NHCOCH_2CH_2C-$ H_2	85.10

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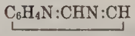
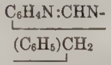
*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7579							
7580	pr., $1.5238^{40.3}$	$1.190^{40.3}$	32.5	217.7	v. sl. s.	s.	v. s. eth.
7581							
7582							
7583	tricl., $1.43025^{15.3}$	1.410	111	d.	66.7^{20}	71	s. eth.; 110^{19} me. al.
7584							
7585	col. need. f. w.	....	135 (136–7)	subl.	0.25^{100}	v. s.	v. s. eth.
7587							
7588							
7589	col. liq., 1.5035	$0.948\frac{20}{4}$; ($0.9669\frac{21}{4}$)	....	131	i.	v. s.	v. s. eth.; s. bz., dil. a.; i. dil. alk.
7590	liq	....	....	181–2	sl. s.	......	d. HCl
7591							
7592	pa. bl. fluores. liq.	$0.927\frac{14}{4}$	....	165^{743} (171)	sl. s.	v. s.	v. s. eth.; s. bz.
7593	oil, 1.50357	0.935	....	165 (169)	v. sl. s.	s.	s. eth.
7594	....	0.888^{16}	....	130–1	i.	∞	∞ eth.
7595	col. liq., 1.4888^{16}	0.9203^{10}	....	$114\text{–}5^{748}$	i.	∞	∞ eth.
7596	liq	0.945	....	148	i.	∞	∞ eth.
7597	liq	....	....	143	......	......	sl. s. dil. a.
7598	liq	....	....	145.5–6.5	......	......	....
7599							
7600							
7601	yel. need. f. dil. al.	....	d. 150	....	0.02	5.8^{15} 90%	50 eth.; s. bz., chl.
7602	monocl. pr	....	191.5 d.	d. 208.5	s.	s.	s. eth.
7603	col. liq	0.871^{16}; 0.8520^{22}	....	88.5	∞	∞	∞ eth.
7604							
7605	liq	....	....	81–3	s.	......	....
7605M							
7606							
7607							
7608	cr	1.116^{25}	24.6	245 (250.8)	v. s.	v. s.	v. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7609	**Pyrroline***.	dihydropyrrole*	C_4H_7N	69.10
7610	**Pyrrolylene.**	See 1,3-*Butadiene**.		
7611	**α-Pyrromonazole.**	See *Pyrazole.*		
7612	**Pyruvaldehyde,** aldoxime	2-oxopropanal 1-oxime*; isonitrosoacetone	$CH_3COCH{:}NOH$	87.08
7613	**Pyruvic acid**	2-oxopropanoic acid*; α-ketopropionic acid; pyroracemic acid; acetylformic acid	$CH_3COCOOH$	88.06
7614	——, ethyl ester	ethyl pyruvate	$CH_3COCOOC_2H_5$	116.11
7615	——, methyl ester	methyl 2-oxopropanoate*; methyl pyruvate	$CH_3COCOOCH_3$	102.09
7616	**Pyruvonitrile**	2-oxopropanenitrile*; acetyl cyanide	CH_3COCN	69.06
7617	**Quercetin**	3,3′,4′,5,7-pentahydroxyflavone; meletin; sophoretin	$C_{15}H_{10}O_7$	302.23
7618	***d*-Quercitol**	cyclohexanepentol* (one form); *d*-quercite	$C_6H_7(OH)_5$	164.16
7619	**Quercitrin**		$C_{21}H_{20}O_{11}$	448.37
7620	**Quinacetophenone.**	See *Acetophenone, 2,5-dihydroxy-.*		
7620M	**Quinaldic acid** (anh.)	2-quinolinecarboxylic acid*	C_9H_6NCOOH	173.16
7621	——, **4-hydroxy-.**	See *Kynurenic acid.*		
7622	**Quinaldine**	2-methylquinoline	$CH_3C_9H_6N$	143.18
7623	——, **hydroxy-.**	See *Quinolinol, 2-methyl-.*		
7624	——, **methyl-.**	See *Quinoline, dimethyl-.*		
7625	**Quinalgen.**	See *Analgen.*		
7626	**Quinalizarin**	1,2,5,8-tetrahydroxyanthraquinone; alizarin bordeaux	$(HO)_2C_6H_2(CO)_2C_6H_2(OH)_2$	272.20
7627	**Quinamine**		$C_{19}H_{24}N_2O_2$	312.40
7628	***p*-Quinanisole.**	See *Quinoline, 6-methoxy-.*		
7629	**Quinazine.**	See *Quinoxaline.*		
7630	**Quinazoline**	benzo[*a*]pyrimidine; 1,3-benzodiazine; phenmiazine	 $C_6H_4N{:}CHN{:}CH$	130.14
7631	——, **3,4-dihydro-3-phenyl-**	orexin; phenzoline; cedrarine	 $C_6H_4N{:}CHN\text{-}(C_6H_5)CH_2$	208.25
7632	**Quinhydrone**	benzoquinhydrone	$C_6H_4O_2 \cdot C_6H_4(OH)_2$	218.20
7633	**Quinic acid**	1,3,4,5-tetrahydroxycyclohexanecarboxylic acid*	$(HO)_4C_6H_7COOH$	192.17
7634	**Quinicine**		$C_{20}H_{24}N_2O_2$	324.41
7635	——, oxalate (*d*)		$(C_{20}H_{24}N_2O_2)_2 \cdot H_2C_2O_4 \cdot 9H_2O$	901.00
7636	**Quinidine**	conquinine	$C_{20}H_{24}N_2O_2 \cdot 2\frac{1}{2}H_2O$	369.45
7637	——, bisulfate		$C_{20}H_{24}N_2O_2 \cdot H_2SO_4 \cdot 4H_2O$	494.55

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7609	liq.	0.910_{4}^{20}	....	90	v. s.	∞	∞ eth.
7610							
7611							
7612	leaf. f. eth.	$1.074^{67.5}$	69	subl.	v. s.	......	v. s. eth.; v. sl. s. pet. eth.
7613	col. liq.	1.267	13.6	165 sl. d.	∞	∞	∞ eth.
7614	col. liq.	1.060_{4}^{16}	....	144; 55^{17}	sl. s.	∞	∞ eth.
7615	col. liq.	1.154^{0}	....	137	sl. s.	∞	∞ eth.
7616	rhomb.	....	....	93	d.	......	s. eth.
7617	yel. need.	....	anh. 310 d.	subl.	0.35	0.48	v. sl. s. eth.; s. alk.
7618	col. monocl.	1.585^{13}	234	d.	10 c.	sl. s.	i. eth.
7619	yel. need. or leaf.	....	250–2; 185; (168 d.)	....	0.04^{20}, 0.69^{100}	25.6^{78}	0.8 eth.; s. alk. sol., amyl. al., ac. a.
7620							
7620M	need. with $2H_2O$ f. w.; anh., cr. f. bz.	....	156 anh.	....	sl. s. c.; s. h.	......	v. s. h. bz.
7621							
7622	col. liq.	1.1013	....	246–7	v. sl. s.	s.	s. eth., chl.
7623							
7624							
7625							
7626	red rhomb. need.	....	>275	subl.	i.	v. sl. s.	v. sl. s. eth.
7627	need.	....	172	....	i.	v. s. h.	s. h. eth.
7628							
7629							
7630	pl. f. pet. eth.	....	48	243	v. s.	s.	s. eth.
7631	hex. pl.	1.290^{4}	95	....	......	s.	s. eth.
7632	dk. grn. rhomb. pr.	1.401_{4}^{20}	171	subl.	s. h.	v. s.	v. s. eth.; s. NH_4OH; d. chl.
7633	col. monocl. f. w.	1.637	163	d.	40^{9}	s.	v. sl. s. eth.; s. ac. a.
7634	yel. oil.	....	60	....	sl. s.	s.	s. eth., chl.
7635	pr. f. chl. or need. f. al.	....	149	....	s. h.	s.	s. chl.
7636	pr. f. al., $[\alpha]$ $-274.7_{D}^{\circ 17}$ in al. +chl.	....	171.5 d.	....	0.05^{15}	4^{20} 80%	4.5^{20} eth.; s. chl.
7637	hair-like need.; bl. fluores. in sol., $[\alpha]$ 184.17°_{D} 3% sol. in chl.	....	....	....	1^{15}	12	v. sl. s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7638	**Quinidine**, hydrochloride (*d*)		$C_{20}H_{24}N_2O_2 \cdot HCl \cdot H_2O$	378.89
7639	——, sulfate (*d*)		$(C_{20}H_{24}N_2O_2)_2 \cdot H_2SO_4 \cdot 2H_2O$	782.93
7640	**Quinine** (anhydrous)		$C_{20}H_{24}N_2O_2$	324.41
7641	**Quinine** (hydrate)		$C_{20}H_{24}N_2O_2 \cdot 3H_2O$	378.46
7642	——, arsenate		$(C_{20}H_{24}N_2O_2)_2 \cdot H_3AsO_4 \cdot 8H_2O$	934.88
7643	——, bisulfate		$C_{20}H_{24}N_2O_2 \cdot H_2SO_4 \cdot 7H_2O$	548.60
7644	——, dihydrochloride		$C_{20}H_{24}N_2O_2 \cdot 2HCl$	397.34
7645	——, formate		$C_{20}H_{24}N_2O_2 \cdot HCOOH$	370.44
7646	——, hydrobromide		$C_{20}H_{24}N_2O_2 \cdot HBr \cdot H_2O$	423.35
7647	——, (mono)hydrochloride		$C_{20}H_{24}O_2N_2 \cdot HCl$	360.88
7648	——, (mono)hydrochloride (hydrate)		$C_{20}H_{24}O_2N_2 \cdot HCl \cdot 2H_2O$	396.91
7649	——, iodosulfate	herapathite	$4C_{20}H_{24}N_2O_2 \cdot 3H_2SO_4 \cdot 2HI \cdot I_4 \cdot 6H_2O$	2463.50
7650	——, salicylate		$C_{20}H_{24}N_2O_2 \cdot C_7H_6O_3 \cdot H_2O$	480.55
7651	——, sulfate		$(C_{20}H_{24}N_2O_2)_2 \cdot H_2SO_4$	746.90
7652	——, sulfate (hydrate)		$(C_{20}H_{24}N_2O_2)_2 \cdot H_2SO_4 \cdot 2H_2O$	782.93
7653	——, urea-hydrochloride		$C_{20}H_{24}O_2N_2 \cdot HCl \cdot CO(NH_2)_2 \cdot HCl \cdot 5H_2O$	547.48
7654	——, valerate		$C_{20}H_{24}N_2O_2 \cdot C_5H_{10}O_2 \cdot H_2O$	444.56
7655	**Quinizarin**	1,4-dihydroxyanthraquinone	$C_6H_4(CO)_2C_6H_2(OH)_2$	240.20
7656	**Quinol.**	See *Hydroquinone.*		
7657	**Quinoline**	benzo[*b*]pyridine; 1-benzazine	$C_6H_4N{:}CHCH{:}CH$	129.15

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7638	asbestos-like pr., $[\alpha]$ 2.212-2.562°$_D$ 97% al.	....	anh. 258–9 d.	....	1.6^{10}	v. s.	v. sl. s. eth.; v. s. chl.
7639	pr. or need.; sol. fluores. bl., $[\alpha]$+184.17°$_D$ 3% sol. in chl.	....	....	....	1^{15}	12	v. sl. s. eth.; s. chl.
7640	amor. powd...	....	174.9	....	0.0571	166	22.2 eth.
7641	flaky or micro. cr. powd. efflor., 1.620, 1.625, 1.630; $[\alpha]$ $-145.2^{\circ 15}_{D}$	....	57	....	0.064	154	73.8 eth.; s. chl., bz., CS_2, oils, glyc.
7642	wh. cr........	....	....	....	s. h.	......	....
7643	sm. ortho-rhomb. need. efflor.	....	160 d.	....	11.1	5.36	0.056 eth.; s. chl.
7644	wh. powd. or need.	....	....	....	166.6	10.3	v. sl. s. eth.; sl. s. chl.
7645	cr. powd......	....	109	....	3	s.	v. sl. s. eth.; s. chl.
7646	silky efflor. need.	....	152–200	....	2.5	149.2	6.25 eth.; s. chl.
7647	silky efflor. need., $[\alpha]$ $-144.98^{\circ 15}_{D}$	....	158–60	259 d.	5.6^{25}	166^{25}	0.42^{25} eth.; s. CS_2, bz., oils, glyc., NH_4OH, KOH sol., a.
7648	silky efflor. need. $[\alpha\}$ $-144.98^{\circ 15}_{D}$	....	156–90	....	5.55	166	0.415 eth.; s. chl., glyc.
7649	red-grn. dichroic cr. or olive grn. powd.	....	....	....	d.	0.12 c., s. h.	....
7650	col. need......	....	185 d.	....	1.3	8.8	0.88 eth.; s. chl., glyc.
7651	silky efflor. need.	....	anh. 235	....	0.14^{25}	1.16^{25}	sl. s. eth.; s. CS_2, bz., oils, glyc., KOH sol., NH_4OH, a.; sl. s. chl.
7652	silky cr. or need., efflor.	....	205	....	0.139	1.16	sl. s. eth., chl.; s. glyc.
7653	wh. pr. or powd.	....	70–5	....	111.1	51.4	....
7654	cr. powd......	....	90	....	0.8	50	7 eth.
7655	red need. f. al.	....	194–5	subl. sl. d.	......	s.	s. eth., bz., KOH, H_2SO_4
7656							
7657	col. liq., $1.62450^{24.9}$	1.095^{20}_{4}	−19.5	237.7	6	∞	∞ eth., CS_2

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7658	**Quinoline, 2-amino-**	α-quinolylamine	$NH_2C_9H_6N$	144.17
7659	**——, 4-amino-**	γ-quinolylamine	$NH_2C_9H_6N$	144.17
7660	**——, 5-benzamido-8-ethoxy-.**	See *Analgen.*		
7661	**——, 2-chloro-***	α-chloroquinoline	ClC_9H_6N	163.60
7662	**——, 3-chloro-***	β-chloroquinoline	ClC_9H_6N	163.60
7663	**——, 4-chloro-***	γ-chloroquinoline	ClC_9H_6N	163.60
7664	**——, decahydro-***		$C_9H_{17}N$	139.24
7665	**——, 2,3-dichloro-***		$C_9H_5Cl_2N$	198.05
7666	**——, 5,8-dichloro-***		$C_9H_5Cl_2N$	198.05
7667	**——, 6,8-dichloro-***		$C_9H_5Cl_2N$	198.05
7668	**——, 7,8-dichloro-***		$C_9H_5Cl_2N$	198.05
7670	**——, 2,3-dimethyl-**	3-methylquinaldine	$(CH_3)_2C_9H_5N$	157.21
7671	**——, 2,4-dimethyl-**	4-methylquinaldine	$(CH_3)_2C_9H_5N$	157.21
7672	**——, 2,6-dimethyl**	*p*-toluquinaldine; 6-methylquinaldine	$(CH_3)_2C_9H_5N$	157.21
7673	**——, 3,4-dimethyl-**		$(CH_3)_2C_9H_5N$	157.21
7674	**——, 5,8-dimethyl-**		$(CH_3)_2C_9H_5N$	157.21
7675	**——, 6,8-dimethyl-**	β-cytisolidine	$(CH_3)_2C_9H_5N$	157.21
7676	**——, 2-homopiperonyl-4-methoxy-.**	See *Cusparine.*		
7677	**——, 6-methoxy-**	*p*-quinanisole; methyl 6-quinolyl ether	$C_9H_6N{\cdot}OCH_3$	159.18
7678	**——, 2-methyl-.**	See *Quinaldine.*		
7679	**——, 3-methyl-**	β-methylquinoline	$CH_3C_9H_6N$	143.18
7680	**——, 4-methyl-.**	See *Lepidine.*		
7681	**——, 6-methyl-**		$CH_3C_9H_6N$	143.18
7682	**——, 7-methyl-**		$CH_3C_9H_6N$	143.18
7683	**——, 8-methyl-**		$CH_3C_9H_6N$	143.18
7684	**——, 1-methyl-1,2,3,4-tetrahydro-.**	See *Kairoline.*		
7685	**——, 5-nitro-***		$NO_2C_9H_6N$	174.15
7686	**——, 6-nitro-***		$NO_2C_9H_6N$	174.15
7687	**——, 7-nitro-***		$NO_2C_9H_6N$	174.15
7688	**——, 8-nitro-***		$NO_2C_9H_6N$	174.15
7689	**——, 2-phenyl-**		$C_6H_5C_9H_6N$	205.25
7690	**——, 6-phenyl-**		$C_6H_5C_9H_6N$	205.25
7691	**——, 8-phenyl-**		$C_6H_5C_9H_6N$	205.25
7692	**——, 1,2,3,4-tetrahydro-***		$C_9H_{11}N$	133.19
7693	**——, 1,2,3,4-tetrahydro-6-methoxy-.**	See *Thalline.*		
7694	**——, 2,3,4-trimethyl-**		$C_9H_4N(CH_3)_3$	171.23

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7658	leaf. f. w.	....	129	....	v. sl. s. c., s. h.	v. s.	v. s. eth.; s. chl.; sl. s. bz., lgr.
7659	need. (+1H_2O) f. w.	....	anh. 154; +1H_2O, 69–70	–H_2O, 100	s.	s.	v. s. chl.; sl. s. lgr., CS_2
7660							
7661	need. f. dil. al.	1.275^{17}	37–8	266–7 (276)	i.	s.	s. eth., bz., lgr.
7662	hyg	....	....	255^{743}	......	......	....
7663	cr.	1.251	34	261^{744}	......	v. s.	v. s. eth.; s. dil. HCl
7664	(*cis*) col. liq.	$0.9426\frac{20}{4}$	–40	205–6 ($83–3.5^{16}$)	sl. s.	s.	s. eth.
	(*trans*) wh. cr.	$0.9021\frac{55.5}{4}$	48	203^{735}	s. h.	v. s.	v. s. eth.
7665	cr. f. dil. al.	....	104–5	....	i.	s.	s. eth., bz.; sl. s. lgr.
7666	sh. need. f. al.	....	92–3	....	......	s.	s. eth.
7667	need. f. eth. or al.	....	104–5	volat. >100	......	s.	s. eth.
7668	need.	....	85.5	....	......	s.	s. eth.
7670	yel. need. or leaf.	1.1013^{10}	68–9	261 (247)	sl. s.	s.	s. eth., lgr.
7671	liq.	$1.061\frac{15}{4}$	....	264	v. sl. s.	v. s.	v. s. eth.
7672	trim. f. eth.	....	60	266–7 (259–61)	sl. s. h.	s.	s. eth.
7673	cr.	....	73–4 (65)	290^{737}	i.	s.	s. eth.
7674	liq.	$1.070\frac{21}{4}$	4–5	265^{736}	sl. s.	s.	s. eth.
7675	liq.	1.0665^{4}	....	269	sl. s.	s.	s. eth.
7676							
7677	liq.	1.665^{0}; 1.154^{20}	<–18	186^{35}	......	s.	....
7678							
7679	col. liq. or cr., $1.60695^{23.3}$	1.074	14	250	i.	s.	s. eth.
7680							
7681	1.6141^{23}	1.066	10–4	255	v. sl. s (i.)	s.	s. eth.
7682	yel. oil.	1.072	<–20	252.5	v. sl. s. (i.)	s.	s. eth.
7683	liq.	1.073	....	$247.3–8.3^{751}$	v. sl. s. (i.)	s.	s. eth.
7684							
7685	need. f. w.	....	72	subl.	sl. s. h.	......	s. bz.
7686	need.	....	150	subl.	v. sl. s c., s. h.	v. sl. s.	v. sl. s. eth.; v. s. bz.; sl. s. lgr.
7687	need. f. al.	....	133	....	......	v. sl. s.	v. s. eth.
7688	monocl. need. f. al.	....	89	....	v. sl. s. c.	s.	s. eth., bz.
7689	need. f. al.	....	86	363	sl. s.	v. s. h.	v. s. eth.
7690	trim. f. eth. or al.	1.195	111	260^{77}	v. sl. s.	s.	s. eth.
7691	thk. fluores. oil.	....	....	283^{187}	......	s.	s. eth., bz.
7692	col.-yel. cr., $1.59331^{23.9}$	1.055	20	251	v. sl. s.	∞	∞ eth.
7693							
7694	cr.	....	*ca.* 65	285	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7695	**Quinoline, 2,4,5-trimethyl-**		$C_9H_4N(CH_3)_3$	171.23
7696	**——, 2,5,7-trimethyl-**	tetracoline	$C_9H_4N(CH_3)_3$	171.23
7697	**——, 2,6,7-trimethyl-**		$C_9H_4N(CH_3)_3$	171.23
7698	**——, 2,6,8-trimethyl-**		$C_9H_4N(CH_3)_3$	171.23
7698H	**2-Quinolinecarboxylic acid*.**	See *Quinaldic acid.*		
7698K	**3-Quinolinecarboxylic acid***		C_9H_6NCOOH	173.16
7698M	**4-Quinolinecarboxylic acid*.**	See *Cinchoninic acid.*		
7698P	**5-Quinolinecarboxylic acid***		C_9H_6NCOOH	173.16
7698R	**6-Quinolinecarboxylic acid***		C_9H_6NCOOH	173.16
7698T	**7-Quinolinecarboxylic acid***		C_9H_6NCOOH	173.16
7698V	**8-Quinolinecarboxylic acid***		C_9H_6NCOOH	173.16
7699	**Quinolinic acid**	2,3-pyridinedicarboxylic acid*	$C_5H_3N(COOH)_2$	167.12
7700	**2-Quinolinol.**	See *Carbostyril.*		
7701	**4-Quinolinol**	kynurine	$HOC_9H_6N{\cdot}3H_2O$	199.20
7702	**——, 2-methyl-**	4-hydroxyquinaldine	$C_{10}H_9NO$	159.18
7703	**5-Quinolinol**		HOC_9H_6N	145.15
7704	**6-Quinolinol**		HOC_9H_6N	145.15
7705	**——, 2-methyl-**	6-hydroxyquinaldine	$C_{10}H_9NO$	159.18
7706	**7-Quinolinol**		HOC_9H_6N	145.15
7707	**——, 2-methyl-**	7-hydroxyquinaldine	$C_{10}H_9NO$	159.18
7708	**8-Quinolinol**		HOC_9H_6N	145.15
7709	**——, 2-methyl-**	8-hydroxyquinaldine	$C_{10}H_9NO$	159.18
7710	**2(1)-Quinolone.**	See *Carbostyril.*		
7711	**——, 3,4-dihydro-.**	See *Hydrocarbostyril.*		
7712	**α-Quinolylamine.**	See *Quinoline, 2-amino-.*		
7713	**γ-Quinolylamine.**	See *Quinoline, 4-amino-.*		
7714	**Quinone** (para or ordinary)	*p*-benzoquinone; 1,4-cyclohexadienedione*	$O{:}C_6H_4{:}O$	108.09
7715	——, bischloroimide	*p*-benzoquinone bischloroimide	$C_6H_4({:}NCl)_2$	175.02
7716	——, chloroimide	*p*-benzoquinone monochloroimide	$O{:}C_6H_4{:}NCl$	141.56
7717	——, dioxime	*p*-benzoquinone dioxime	$C_6H_4({:}NOH)_2$	138.12
7718	——, monoxime.	See *Phenol, p-nitroso-.*		
7719	**——, 2,6-dichloro-**	2,6-dichloro-*p*-benzoquinone	$C_6H_2Cl_2O_2$	176.99
7720	**——, 2,5-dichloro-3,6-dihydroxy-.**	See *Chloranilic acid.*		
7721	**——, 2,5-dihydroxy-**	2,5-dihydroxy-*p*-benzoquinone	$C_6H_2O_2(OH)_2$	140.09
7722	**——, 2,5-dihydroxy-3,6-dinitro-.**	See *Nitranilic acid.*		
7723	**——, 2,3-dimethyl-.**	See *o-Xyloquinone.*		
7724	**——, 2,5-dimethyl-.**	See *Phlorone.*		
7725	**——, 2,6-dimethyl-.**	See *m-Xyloquinone.*		
7726	**——, 2-methyl-.**	See *Toluquinone.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7695	need. f. w.	....	63–4	....	s.	......	....
7696	pr.	....	43	285–7	v. s.	v. s.	v. s. eth.
7697	monocl.	....	....	....	......	......	....
7698	monocl. pr. f. lgr.	....	46	260^{719}	i.	v. s.	v. s. lgr.
7698 H							
7698 K	tab. f. dil. al.	....	275 sl. d.	....	sl. s. c.; s. h.	s.	....
7698M							
7698P	cr. by subl.	....	338–40	subl.	v. sl. s.	v. sl. s.	i. eth., bz., CS_2; s. min. a., alk.
7698R	pr. by subl.	....	290–1	subl.	v. sl. s.	s. h.	s. min. a., alk.
7698T	need. f. w. or al.	....	248.5–50	subl.	v. sl. s. c.	s.	i. eth.
7698V	need. f. w.	....	186–7.5	subl.	s. h.	s. h.	s. min. a., alk.
7699	monocl. pr.	....	190 d.(195)	....	$0.55^{6.5}$	sl. s.	v. sl. s. eth.
7700							
7701	col. monocl. need. f. w.	....	$3H_2O$, 52; $-H_2O$, 110; anh. 201	>300 d.	0.47^{15}	s.	sl. s. eth.
7702	pr. f. w.	....	231	d.	1 c., 10 h.	s.	v. sl. s. eth., bz.
7703	pr. or leaf. f. al.	....	224	subl.	sl. s.	s.	sl. s. eth.; v. s. h. Na_2CO_3; i. lgr.
7704	sm. pr. f. al	....	193	360	v. sl. s.	sl. s.	v. sl. s. eth.; s. alk.
7705	cr.	....	213	sl. d.	v. sl. s.	s.	s. eth.
7706	pr. f. al.	....	235–8 d.	subl.	sl. s.	v. s.	s. alk.
7707	leaf. f. al.	....	232–4	sl. d.	i.	s. h.	s. eth.
7708	pr. f. dil. al	....	76 (73–4)	266.9	v. sl. s.	v. s.	sl. s. eth.; s. dil. alk.
7709	tricl. pr. f. al.	....	74	267	......	......	....
7710							
7711							
7712							
7713							
7714	yel. monocl. pr. f. w.	$1.318\frac{20}{4}$	115.7	subl.	sl. s.	s.	s. eth., h. lgr., alk.
7715	need. f. w.	....	124 d.	....	sl. s. h.	s. h.	s. eth.; v. s. bz.
7716	yel. cr. f. lgr.	....	84.7–5.0	exp.	s. h.	v. s. h.	v. s. eth., chl.; s. a.
7717	col. or yel. need.	....	240 d.	....	s. h.	......	s. NH_4OH
7718							
7719	yel. rhomb. pr. f. lgr. or bz.	....	121	subl. <120	sl. s.	s. h.	s. chl.
7720							
7721	dk. yel. need. f. et. al.	....	....	subl. 215–220 d.	v. sl. s.	s.	v. sl. s. eth.; s. ac. a.
7722							
7723							
7724							
7725							
7726							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7727	**Quinone, nitro-**		$NO_2C_6H_3O_2$	153.09
7728	**——, tetrachloro-.**	See *Chloranil.*		
7729	**——, tetrahydro-.**	See 1,4-*Cyclohexanedione*.*		
7730	**——, tetrahydroxy-**		$(HO)_4C_6O_2$	172.0
7731	**——, trichloro-**		$Cl_3C_6HO_2$	211.44
7732	**Quinovic acid**		$C_{32}H_{48}O_6$	528.71
7733	**Quinoxaline**	benzopyrazine; 1,4-benzodiazine; quinazine	$C_6H_4N{:}CHCH{:}N$	130.14
7734	**Racemic acid.**	See *dl-Tartaric acid.*		
7735	**R acid.**	See 2-*Naphthol*-3,6-*disulfonic acid.*		
7736	**Rahmnose**		$C_{18}H_{32}O_{16}\cdot 5H_2O$	594.52
7737	**Resacetophenone**	2,4-dihydroxyacetophenone	$CH_3COC_6H_3(OH)_2$	152.14
7738	——, 4-methyl ether.	See *Peonol.*		
7739	**Resodiacetophenone**	4,6-diacetylresorcinol	$(CH_3CO)_2C_6H_2(OH)_2$	194.18
7740	**Resorcinol**	1,3-benzenediol*; resorcin	$C_6H_4(OH)_2$	110.11
7741	——, diethyl ether.	See *Benzene,* 1,3-*diethoxy-*.*		
7742	——, diisoamyl ether.	See *Benzene,* 1,3-*diisoamoxy-.*		
7743	——, dimethyl ether.	See *Benzene,* 1,3-*dimethoxy-*.*		
7744	——, dipropyl ether.	See *Benzene,* 1,3-*dipropoxy-*.*		
7745	——, monoamyl ether.	See *Phenol, m-amoxy-.*		
7746	——, monobutyl ether.	See *Phenol, m-butoxy-.*		
7747	——, monoethyl ether.	See *Phenol, m-ethoxy-.*		
7748	——, monomethyl ether.	See *Phenol, m-methoxy-.*		
7749	——, monopropyl ether.	See *Phenol, m-propoxy-.*		
7750	**——, 4-amyl-**	1-*n*-amyl-2,4-dihydroxybenzene	$CH_3(CH_2)_4C_6H_3(OH)_2$	180.24
7751	**——, 4-benzoyl-.**	See *Benzophenone,* 2,4-*dihydroxy-.*		
7752	**——, 4-butyl-**	1-*n*-butyl-2,4-dihydroxybenzene	$CH_3(CH_2)_3C_6H_3(OH)_2$	166.21
7753	**——, 4-caproyl-.**	See *Caprophenone,* 2,4-*dihydroxy-.*		
7754	**——, 4,6-diacetyl-.**	See *Resodiacetophenone.*		
7755	**——, dihydro-.**	See 1,3-*Cyclohexanedione*.*		
7756	**——, 2,4-dimethyl-**	2,4-dimethyl-1,3-benzenediol*; 2,4-dihydroxy-*m*-xylene	$(CH_3)_2C_6H_2(OH)_2$	138.16
7757	**——, 2,5-dimethyl-**	2,5-dimethyl-1,3-benzenediol*; *p*-xylorcinol; *β*-orcinol; 2,6-dihydroxy-*p*-xylene; betorcinol	$(CH_3)_2C_6H_2(OH)_2$	138.16
7758	**——, 4,5-dimethyl-**	4,5-dimethyl-1,3-benzenediol*; 3,5-dihydroxy-*o*-xylene	$(CH_3)_2C_6H_2(OH)_2$	138.16
7759	**——, 4,6-dimethyl-**	4,6-dimethyl-1,3-benzenediol*; *m*-xylorcinol; 4,6-dihydroxy-*m*-xylene	$(CH_3)_2C_6H_2(OH)_2$	138.16
7760	**——, 2,4-dinitro-**	2,4-dinitro-1,3-benzenediol*; *v*-dinitroresorcin	$(NO_2)_2C_6H_2(OH)_2$	200.11
7761	**——, dithio-**	1,3-benzenedithiol*; *m*-phenylene dimercaptan	$C_6H_4(SH)_2$	142.23
7762	**——, 4-ethyl-**	1,3-dihydroxy-4-ethylbenzene	$C_2H_5C_6H_3(OH)_2$	138.16
7763	**——, 4-hexyl-**	1-*n*-hexyl-2,4-dihydroxybenzene; caprokol	$CH_3(CH_2)_5C_6H_3(OH)_2$	194.27
7764	**——, 4-isoamyl-**	2,4-dihydroxy-1-isoamylbenzene	$(CH_3)_2CH(CH_2)_2C_6H_3(OH)_2$	180.24

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7727	yel.	....	d. *ca.* 206	....	v. s. h.	s.	sl. s. eth.
7728							
7729							
7730	bl. cr.	....	d.	....	s. h.	v. s.	sl. s. eth.
7731	yel. leaf. f. w.	....	168–9	subl.	i.	sl. s.	v. s. eth.
7732	wh. cr. powd.	....	....	....	i.	sl. s. h.	i. eth.; s. chl., NH_4OH
7733	wh. cr., $1.62311^{48.0}$	1.133^{48}	30.5	226	s.	s.	s. eth.; ∞ bz.
7734							
7735							
7736	need. f. w.	1.465^{0}	anh. 118–9	130 d.	14^{20}, ∞ h.	v. sl. s.	i. eth.; s. me. al.
7737	need.	....	147	....	i.	s.	s. eth.
7738							
7739	wh. need.	....	180	....	i.	sl. s.	s. eth.
7740	col. rhomb. tab. f. w. or bz.	1.285^{15}	110	276.5 (281.4)	229^{30}	243^{25}	v. s. eth.; s. glyc., bz., amyl. al.
7741							
7742							
7743							
7744							
7745							
7746							
7747							
7748							
7749							
7750	col.	....	71.5–3.0	$168–70^{6}$	v. sl. s.	s.	s. eth.
7751							
7752	col.	....	47–8	$196–200^{24}$	v. sl. s.	s.	s. eth.
7753							
7754							
7755							
7756	need. by subl.	....	149–50	....	s.	v. s.	v. s. eth.
7757	tetr. f. w. or bz.	....	163	277–80	s.	s.	s. eth.
7758	need. f. bz.; pr. (+1H_2O) f. w.	....	+1H_2O, 115–7; anh. 136–7	subl.	s.	v. s.	v. s. eth.; s. ac. a.; sl. s. chl., bz.; v. sl. s. CS_2
7759	monocl. cr. f. w., chl. or bz.	....	124.5–5	276–9 subl.	s.	s.	s. eth.
7760	yel. leaf.	....	147–8	subl.; exp.	sl. s.	v. s.	v. s. eth.; s. chl.
7761	col. shiny cr.	....	27 (25)	243–5	i.	s.	s. eth., alk.
7762	col. pr.	....	98–9	131^{15}	s.	s.	s. eth.
7763	col. need.	....	68–70	$178–80^{7}$	0.05	v. s.	v. s. eth., acet.; s. bz.; sl. s. pet. eth.
7764	col.	....	61–2.5	$177–8^{6}$	v. sl. s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7765	**Resorcinol, 4-isobutyl-**	2,4-dihydroxy-1-isobutylbenzene	$(CH_3)_2CHCH_2$-$C_6H_3(OH)_2$	166.21
7766	**——, 4-isohexyl-**	2,4-dihydroxy-1-isohexylbenzene	$(CH_3)_2CH(CH_2)_3$-$C_6H_3(OH)_2$	194.27
7767	**——, 4-isopropyl-**	2,4-dihydroxy-1-isopropylbenzene	$(CH_3)_2CHC_6H_3$-$(OH)_2$	152.19
7768	**——, 2-methoxy-**	pyrogallol 2-methyl ether	$CH_3OC_6H_3(OH)_2$	140.13
7769	**——, 5-methoxy-**	phloroglucinol monomethyl ether	$CH_3OC_6H_3(OH)_2$	140.13
7770	**——, 2-methyl-**	2-methyl-1,3-benzenediol*; 2,6-dihydroxytoluene	$CH_3C_6H_3(OH)_2$	124.13
7771	**——, 4-methyl-**	See *Cresorcinol.*		
7772	**——, 5-methyl-**	See *Orcinol.*		
7773	**——, 4-propionyl-.**	See *Propiophenone, 2,4-dihydroxy-.*		
7774	**——, 4-propyl-**	2,4-dihydroxy-1-propylbenzene	$CH_3(CH_2)_2C_6H_3$-$(OH)_2$	152.19
7775	**——, 2-salicylyl-.**	See *Benzophenone, 2,2′,6-trihydroxy-.*		
7776	**——, 2,4,6-tribromo-**		$Br_3C_6H(OH)_2$	346.83
7777	**——, 2,4,6-trimethyl-.**	See *Mesorcinol.*		
7778	**——, 2,4,6-trinitro-.**	See *Styphnic acid.*		
7779	**Resorcinolphthalein.**	See *Fluoresceïn.*		
7780	**β-Resorcylaldehyde**	2,4-dihydroxybenzaldehyde; 2,4-dihydroxybenzenecarbonal*	$(HO)_2C_6H_3CHO$	138.12
7781	——, dimethyl ether.	See *Benzaldehyde, 2,4-dimethoxy-.*		
7782	**α-Resorcylic acid**	3,5-dihydroxybenzoic acid; 3,5-dihydroxybenzenecarboxylic acid*	$(HO)_2C_6H_3COOH\cdot 1\frac{1}{2}H_20$	181.14
7783	**β-Resorcylic acid**	2,4-dihydroxybenzoic acid; 2,4-dihydroxybenzenecarboxylic acid*	$(HO)_2C_6H_3COOH\cdot 3H_2O$	208.17
7784	**γ-Resorcylic acid**	2,6-dihydroxybenzoic acid; 2,6-dihydroxybenzenecarboxylic acid*	$(HO)_2C_6H_3COOH\cdot 1\frac{1}{2}H_2O$	181.14
7785	**Retene**	7-isopropyl-1-methylphenanthrene	$C_{18}H_{18}$	234.33
7786	**Rhamnitol**	1,2,3,4,5-hexanepentol* (one form); rhamnite	$CH_3(CHOH)_4$-CH_2OH	166.17
7787	**β-Rhamnose**		$C_6H_{12}O_5\cdot H_2O$	182.17
7788	**Rheadine**	rhoeadine	$C_{21}H_{21}NO_6$	383.39
7789	**Rheum emodin.**	See *Emodin.*		
7789M	**Rhodanates.**	See under *Thiocyanic acid.*		
7790	**Rhodinal.**	See *Citronellal.*		
7791	**Rhodinol**	3,7-dimethyl-6-octen-1-ol*(?)	$C_{10}H_{19}OH$	156.26
7792	**Rhoeadine.**	See *Rheadine.*		
7792M	**D-Riboflavin**	vitamin B_2; vitamin G; lactoflavin; ovoflavin; hepatoflavin; 6,7-dimethyl-9-(1-D-ribityl)isoalloxazine	$C_{17}H_{20}N_4O_6$	376.36
7792T	**D-Ribose**		$C_5H_{10}O_5$	150.13
7793	**Ricinine**		$C_8H_8N_2O_2$	164.16
7794	**Ricinoleïc acid**	12-hydroxy-9-octadecenoic acid* (one form); ricinolic acid	$CH_3(CH_2)_5CHOH$-$CH_2CH{:}CH$-$(CH_2)_7COOH$	298.46

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7765	col.	....	63.5	166–8^{6}	sl. s.	s.	s. eth.
7766	col.	....	70–1.5	182–3^{6}	v. sl. s.	s.	s. eth.
7767	col.	....	105	265–81	sl. s.	s.	s. eth.
7768	cr. f. bz.	....	85–7	154–5^{24}	......	......	....
7769	tab. f. bz	....	78–81	213^{16}	sl. s.	v. s.	v. s. eth.
7770	col. need.	....	116–21	264	s.	s.	s. eth., bz.
7771							
7772							
7773							
7774	col. pr. f. bz	....	107–8 (82–3)	172–4$^{14-5}$	s.	s.	s. eth.
7775							
7776	col. need. f. w.	....	111	....	sl. s.	v. s.	s. eth.
7777							
7778							
7779							
7780	yel. need. f. w.	....	135	220–8^{22}	v. s.	v. s.	v. s. eth.; sl. s. c. bz.
7781							
7782	col. pr.	....	232–3; anh. 237	....	s.	v. s.	v. s. eth.
7783	col. need. f. eth.	....	*ca.* 213 (226–7 d.)	d.	0.26^{17}	v. s.	v. s. eth.
7784	col. need. f. w.	....	anh. 167 d.	....	v. s. h.	......	s. alk.
7785	leaf. f. al.	1.13^{16}	98.5	394	i.	2.13 c., 69^{78}	s. eth., bz., CS_2
7786	tricl. pr.	....	121	....	v. s.	v. s.	v. sl. s. eth.; sl. s. acet., chl.
7787	col. monocl. f. w., 1.523, 1.531, 1.534	1.471	126	....	57^{18}, 109^{40}	sl. s.	i. eth.
7788	sm. pr.	....	245–7 d.	....	sl. s.	sl. s.	sl. s. eth., chl.; i. bz.
7789							
7789M							
7790							
7791	col. oily liq.	....	....	113–4^{15}	......	......	... .
7792							
7792M	fine or.-yel. need.	....	275–80 d.	....	0.012$^{27.5}$ 0.019^{40}	0.045$^{27.5}$	i. eth., acet., chl., bz.
7792T	$[\alpha]_D\ H_2O,^{-21.5°}$ (−19.5°)	....	95; *dl* −86–7	....	s.	sl. s.	....
7793	pr. or tab. f. al. or w.	....	201 subl.	....	s. h.	s. h.	sl. s. eth., bz.
7794	col. liq., or cr. mass	0.945^{15}	γ, 5.0, α, 7.7; β, 16.0	250^{15}	i.	∞	∞ eth.; s. chl.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7795	**Ricinoleïc acid,** butyl ester	butyl ricinoleate; butyl 12-hydroxy-9-octadecenoate* (one form)	$C_{18}H_{33}O_3C_4H_9$	354.56
7796	——, glycerol esters.	See under *Glycerol.*		
7797	——, isobutyl ester	isobutyl ricinoleate; β-methylpropyl 12-hydroxy-9-octadecenoate* (one form)	$C_{22}H_{42}O_3$	354.56
7798	**Rodinal.**	See *Phenol, p-amino-.*		
7799	**Rosaniline**	bis-*p*-aminophenyl-4-amino-*m*-tolylcarbinol	$H_2NC_7H_6(H_2NC_6H_4)_2COH$	319.39
7800	**Rosinduline**	5,8-dihydro-8-imino-5-phenylbenzo[*b*]phenazine	$HN{:}C_{10}H_5{:}NC_6H_4NC_6H_5$	321.37
7801	**Rosolic acid.**	See *Aurin.*		
7802	**Rotenone**		$C_{23}H_{22}O_6$	394.41
7803	**Rufigallic acid**	1,2,3,5,6,7-hexahydroxyanthraquinone; rufigallol	$C_{14}H_2O_2(OH)_6$	304.20
7804	**Rufigallol.**	See *Rufigallic acid.*		
7805	**Rufiopin**	1,2,5,6-tetrahydroxyanthraquinone	$C_{14}H_4(OH)_4O_2$	272.20
7806	**Rufol**	1,5-anthracenediol*; 1,5-anthradiol	$HOC_6H_3(CH)_2C_6H_3OH$	210.22
7807	**Rutaecarpine**		$C_{18}H_{13}N_3O$	287.31
7807M	**Rutylidene.**	See 1-*Hendecyne.**		
7808	**Sabadine**		$C_{29}H_{51}NO_8$	541.71
7809	**Sabinane, 6-keto-.**	See *α-Thujone.*		
7810	**Sabinene**	1-isopropyl-4-methylenebicyclo[3,1,0]hexane	$C_{10}H_{16}$	136.23
7811	D-**Saccharic acid**	2,3,4,5-tetrahydroxyhexanedioic acid* (one form)	$COOH(CHOH)_4COOH$	210.14
7812	**Saccharin**	*o*-sulfobenzoic imide; benzoic sulfimide; glucide	$C_6H_4SO_2NHCO$	183.18
7813	**Saccharose.**	See *Sucrose.*		
7814	**S acid.**	See 1-*Naphthol-5-sulfonic acid, 8-amino-.*		
7815	**Safrole**	1-allyl-3,4-methylenedioxybenzene; shikimole	$CH_2(O_2)C_6H_3CH_2CH{:}CH_2$	162.18
7816	**——, 2,5-dimethoxy-.**	See *Apiole.*		
7817	**——, 5-methoxy-.**	See *Myristicin.*		
7818	**Salazolon.**	See *Salipyrine.*		
7819	**Salicin**		$C_6H_{11}O_5OC_6H_4CH_2OH$	286.28
7820	**——, benzoyl-.**	See *Populin.*		
7821	**Salicyl alcohol.**	See *Saligenin.*		
7822	**Salicylaldehyde**	*o*-hydroxybenzaldehyde; salicylic aldehyde	HOC_6H_4CHO	122.12
7823	——, glucoside.	See *l-Helicin.*		
7824	——, methyl ether.	See *Benzaldehyde, o-methoxy-.*		
7825	**Salicylamide**	*o*-hydroxybenzamide; salicylic amide	$HOC_6H_4CONH_2$	137.13
7826	**——, *N*-phenyl-.**	See *Salicylanilide.*		
7827	**Salicylanilide**	*N*-phenylsalicylamide	$HOC_6H_4CONHC_6H_5$	213.23
7828	**Salicylic-*O*-acetic acid**	See *Benzoic acid, o-(carboxymethoxy)-.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7795	liq.	0.906^{22}	......	275^{13}	i.	......	s. eth.
7796							
7797	liq., 1.4538^{22}	0.903^{22}	......	262^{9}	i.	......	s. eth.
7798							
7799	col. need. f. w.	......	186 d.	d.	sl. s.	s.	i. eth.; s. a., aniline
7800	br. leaf. f. al. or need. f. eth.	......	199	......	i.	v. s.	v. s. eth.; s. bz.
7801							
7802	hex. pl. f. al. or eth.; need. f. bz., chl., or CCl_4	......	163	......	i.	0.2^{20}	0.4 eth.; 8.5 bz.; 0.6 CCl_4; 7.34 chl.
7803	or. red cr.	......	subl. sl. d.	......	i.	......	s. eth., alk., conc. H_2SO_4
7804							
7805	yel.-red need.	......	subl.	d.	sl. s. h.	s.	sl. s. eth.; s. ac. a., H_2SO_4
7806	cr. f. bz.	......	280–5 d. (265)	......	v. s.	s. (vlt. fluores.)	s. alk.
7807	yel. pl.; need f. et. ac.		257–8			sl. s.	
7807M							
7808	need. f. eth.	......	238–40 d.	......	sl. s.	v. s.	sl. s. eth.
7809							
7810	col. liq., $1.46738^{17.0}$	0.842	......	165	i.	∞	∞ eth.
7811	syrup	......	125–6 d.	......	v. s.	v. s.	i. eth.
7812	col. monocl. f. acet.	......	228 d. (224–6)	subl.	0.43^{25}	3.1	sl. s. eth., chl., acet., glyc.; s. alk., bz., amyl ac., et. ac., xylol
7813							
7814							
7815	col. liq. or monocl., 1.5420^{12}	1.096	11	234.5	i.	v. s.	v. s. eth.; ∞ chl.
7816							
7817							
7818							
7819	col. rhomb. need. or leaf.	1.434^{26}	198–202	240 d.	3.6^{15}	1.13^{25}, 3.33^{60}	i. eth., chl.
7820							
7821							
7822	col. liq., $1.57358^{19.7}$	$1.1669\frac{20}{4}$	–7 (1.6)	196.5	1.72^{85}	∞	∞ eth.; 64.6^{13} bz.
7823							
7824							
7825	leaf. f. w.	......	140 (137–8)	270 d.	sl. s.	s.	sl. s. eth.; s. Na_2CO_3 sol.
7826							
7827	pr. f. al.	......	135	d.	sl. s. h.	s.	s. eth.; sl. s. CS_2
7828							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7829	**Salicylic acid**	*o*-hydroxybenzoic acid	HOC_6H_4COOH	138.12
7830	——, acetate.	See *Aspirin.*		
7831	——, amyl ester	amyl salicylate; pentyl *o*-hydroxybenzoate	$HOC_6H_4CO_2C_5H_{11}$	208.25
7832	——, ethyl ester		$HOC_6H_4COOC_2H_5$	166.17
7833	——, ethyl ether.	See *Benzoic acid, o-ethoxy-.*		
7834	——, isoamyl ester	isoamyl salicylate; isoamyl *o*-hydroxybenzoate	$HOC_6H_4COOC_5H_{11}$	208.25
7835	——, isobutyl ester		$HOC_6H_4COOC_4H_9$	194.22
7836	——, methyl ester	methyl salicylate; artificial oil of wintergreen	$HOC_6H_4COOCH_3$	152.14
7837	——, methyl ether.	See *Benzoic acid, o-methoxy-.*		
7838	——, 1-naphthyl ester	α-naphthyl salicylate	$HOC_6H_4COOC_{10}H_7$	264.27
7839	——, 2-naphthyl ester.	See *Betol.*		
7840	——, nicotine salt.	See *Nicotine, salicylate.*		
7841	——, phenyl ester	salol	$HOC_6H_4COOC_6H_5$	214.21
7842	——, phenyl ether.	See *Benzoic acid, o-phenoxy-.*		
7843	——, propyl ester	*n*-propyl salicylate	$HOC_6H_4COOC_3H_7$	180.20
7844	**——, acetyl-.**	See *Aspirin.*		
7845	**——, 5-allyl-3-methoxy-.**	See *Eugetic acid.*		
7846	**——, 3-amino-**	3-amino-2-hydroxybenzoic acid	$NH_2C_6H_3(OH)COOH$	153.13
7847	**——, 4-amino-**	4-amino-2-hydroxybenzoic acid	$NH_2C_6H_3(OH)COOH$	153.13
7848	**——, 5-amino-**	5-amino-2-hydroxybenzoic acid	$NH_2C_6H_3(OH)COOH$	153.13
7849	**——, 3,5-dinitro-**	3,5-dinitro-2-hydroxybenzoic acid	$(NO_2)_2(HO)C_6H_2COOH$	228.12
7850	**——, hexahydro-.**	See *Cyclohexanecarboxylic acid, 2-hydroxy-.*		
7851	**——, 3-nitro-**	2-hydroxy-3-nitrobenzoic acid	$NO_2C_6H_3(OH)COOH\cdot H_2O$	201.13
7852	**——, 5-nitro-**	2-hydroxy-5-nitrobenzoic acid	$NO_2C_6H_3(OH)COOH$	183.12
7853	**——, 6-nitro-**	2-hydroxy-6-nitrobenzoic acid	$NO_2C_6H_3(OH)COOH$	183.12
7854	**——, *O*-phenyl-.**	See *Benzoic acid, o-phenoxy-.*		
7855	**——, thio-.**	See *Benzoic acid, o-mercapto-.*		
7856	**Salicylic anhydride**	*o,o'*-dihydroxybenzoic anhydride	$(HOC_6H_4CO)_2O$	258.22
7857	**Saligenin**	*o*-hydroxybenzyl alcohol; salicyl alcohol; α,2-toluenediol	$HOC_6H_4CH_2OH$	124.13
7858	——, 2-methyl ether.	See *Benzyl alcohol, o-methoxy-.*		
7859	**Salipyrazolon.**	See *Salipyrine.*		
7860	**Salipyrine**	antipyrine salicylate; salazolon; salipyrazolon; etc.	$C_{11}H_{12}N_2O\cdot C_7H_6O_3$	326.34
7861	**Salol.**	See *Salicylic acid, phenyl ester.*		
7862	**Salvarsan.**	See *Arsphenamine.*		
7863	**Sanguinarine**		$C_{20}H_{15}NO_4\cdot H_2O$	351.35
7864	**Santalic acid**		$C_{15}H_{14}O_5$	274.26
7865	**Santonic lactone.**	See *Santonin.*		
7866	**Santonin**	santonic lactone	$C_{15}H_{18}O_3$	246.30

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7829	monocl. col. need, f.w., 1.565	$1.443\frac{20}{4}$	159	subl. 76	0.18^{20}; 1.76^{75}	39.2^{15}	50.5^{15} eth.; s. chl.
7830							
7831	col.-ylsh. liq...	1.065^{15}	....	265	i.	∞	∞ eth.; s. chl.
7832	col. liq., $1.52511^{14.4}$	$1.1362\frac{15}{4}$	1.3	234.0 (231.5)	i.	∞	∞ eth.
7833							
7834	col.-ylsh. liq...	$1.042\frac{25}{4}$	....	273 ($128–30^{12}$)	0.004^{22}	33 90%	∞ eth.; s. chl.
7835	....	1.075	....	259	i.	s.	s. eth.
7836	col. liq., 1.5369	$1.1840\frac{20.2}{4}$	−8.6	223.3	0.074^{30}	∞	∞ eth.; s. glac. ac. a., CS_2
7837							
7838	wh. cr. powd..	....	83	....	i.	s..	s. eth., fixed oils
7839							
7840							
7841	col. rhomb. f. al.	1.250	43	173^{12}	0.015^{25}	21.5^{25}	v. s. eth., bz., chl.; v. sl. s. glyc.
7842							
7843	col. liq........	1.099^{15}	....	240	v. sl. s.	∞	∞ eth.
7844							
7845							
7846	cr...........	....	235 d.	....	......	v. sl. s.	....
7847	redsh. br. cr. powd.	....	220 d.	....	s.	s.	s. eth.
7848	wh. need......	....	283 (280 d.)	....	sl. s. h.	i.	s. CS_2
7849	need. or pl. (+$1H_2O$) f. w.	....	anh. 174 (170–2)	subl. d.	v. s. h.	v. s.	v. s. eth.
7850							
7851	rhomb. need. f. w.	....	hyd. 125; anh. 144	....	0.13^{15}	v. s.	v. s. eth.
7852	need. f. w.....	1.650^{20}	228	....	0.18^{22}	v. s.	v. s. eth.
7853	yel. need......	....	130	....	......	sl. s.	v. s. eth.; s. acet.
7854							
7855							
7856	yel. amor.....	....	200–20	d.	i.	v. s.	v. s. eth.
7857	rhomb. f. w...	1.161^{25}	86	subl.	6.7^{22}	v. s.	v. s. eth.
7858							
7859							
7860	cr. powd......	....	92	....	0.5^{15}, 4.0^{100}	......	s. eth., bz.; v. s. chl.
7861							
7862							
7863	bl. fluores. need.	....	213	....	i.	s.	s. eth.
7864	red micr. pr...	....	226 (104)	195^{9}	i.	s.	s. eth., alk.
7865							
7866	col. rhomb. pr., 1.590, 1.630, 1.640	1.187	170	subl.	0.02^{17}, 0.4^{100}	2.0^{22} 37^{80}	sl. s. eth.; s. chl., alk.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7867	**Sarcine.**	See *Hypoxanthine.*		
7868	**Sarcolactic acid.**	See *d-Lactic acid.*		
7869	**Sarcosine**	*N*-methylglycine	CH_3NHCH_2-$COOH$	89.09
7870	——, hydrochloride		$HCl \cdot NH(CH_3)$-CH_2COOH	125.56
7871	**Schäffer's acid.**	See 2-*Naphthol-6-sulfonic acid*.		
7872	**Schöllkopf's acid.**	See *Naphthionic acid.*		
7873	***i*-Scopolamine**	atroscine	$C_{17}H_{21}NO_4$	303.35
7874	***l*-Scopolamine.**	See *Hyoscine.*		
7875	**Sebacic acid**	decanedioic acid*	$COOH(CH_2)_8$-$COOH$	202.25
7876	——, diethyl ester	ethyl sebacate	$[(CH_2)_4COOC_2H_5]_2$	258.35
7877	——, piperazinium salt		$C_4H_{10}N_2 \cdot C_{10}$-$H_{18}O_4$	288.38
7878	**Selenide, diethyl.**	See *Ethyl selenide.*		
7879	**——, dimethyl.**	See *Methyl selenide.*		
7880	**Semicarbazide**	aminourea; carbamylhydrazine	$NH_2NHCONH_2$	75.07
7881	——, hydrochloride		$NH_2NHCONH_2 \cdot$ HCl	111.54
7882	**——, 1-phenyl-**	1-carbamyl-2-phenylhydrazine	$C_6H_5NHNHCO$-NH_2	151.17
7884	**——, thio-**		$NH_2NHCSNH_2$	91.13
7885	**Seminose.**	See D-*Mannose.*		
7886	**Septentrionaline**		$C_{31}H_{46}N_2O_9$(?)	590.70
7887	**DL-Serine**		$CH_2OHCH(NH_2)$-$COOH$	105.09
7888	**D-Serine**	*d*-β-hydroxyalanine	$CH_2OHCH(NH_2)$-$COOH$	105.09
7889	**L-Serine**	*l*-α-amino-β-hydroxypropionic acid; *l*-β-hydroxyalanine	$HOCH_2CH(NH_2)$-$COOH$	105.09
7890	**Shikimole.**	See *Safrole.*		
7891	**Silanol** (mono).	See *Silicol.*		
7892	**Silicane, dimethyl-**	dimethylmonosilane	$(CH_3)_2SiH_2$	60.14
7893	**——, ethoxytriethyl-**	triethylsilicol ethyl ether	$(C_2H_5)_3SiOC_2H_5$	160.30
7894	**——, hydroxy-.**	See *Silicol.*		
7895	**——, methyl-**	methylmonosilane	CH_3SiH_3	46.12
7896	**——, tetraethyl-**	silicon tetraethyl	$(C_2H_5)_4Si$	144.30
7897	**——, tetramethyl-**	silicon tetramethyl; tetramethylsilicon	$(CH_3)_4Si$	88.20
7898	**——, trichlorophenyl-**	phenylsilicon trichloride	$C_6H_5SiCl_3$	211.53
7899	**——, triethyl-**	triethylsilicon hydride	$(C_2H_5)_3SiH$	116.25
7900	**Silicoheptyl alcohol.**	See *Silicol, triethyl-.*		
7901	**Silicol, triethyl-**	silicoheptyl alcohol	$(C_2H_5)_3SiOH$	132.25
7902	——, ——, ethyl ether.	See *Silicane, ethoxytriethyl-.*		
7903	**Silicon, tetramethyl-.**	See *Silicane, tetramethyl-.*		
7904	**Silicon hydride, triethyl-.**	See *Silicane, triethyl-.*		
7905	**Silicon oxide, triethyl-.**	See *Silicyl oxide, hexaethyl-.*		
7906	**Silicon tetraethyl-.**	See *Silicane, tetraethyl-.*		
7907	**Silicon trichloride, phenyl-.**	See *Silicane, trichlorophenyl-.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7867							
7868							
7869	deliq. col. rhomb. f. dil. al.	....	210 d.	d.	v. s.	sl. s.	i. eth.
7870	need. f. al.....	....	170–2	d.	v. s.	v. sl. s.	v. sl. s. eth.
7871							
7872							
7873	cr., [α]–33.1°D.	....	82–3 (50–9)	....	10.52^{15}	v. s.	v. s. eth.; s. chl.; sl. s. bz.
7874							
7875	thin col. leaf., $1.422^{133.3}$	....	133	295^{100}	0.1^{17}, 2.0^{100}	v. s.	v. s. eth.
7876	col. liq........	$0.9646\frac{20}{4}$	1	308	0.008^{20}	s.	s. eth.
7877	wh. cr........	....	166–8	....	s. h.	s. h.	i. eth.
7878							
7879							
7880	pr. f. al.......	....	96	....	v. s.	s.	i. eth., bz., chl
7881	pr. f. dil. al....	....	173 d.	....	v. s.	i.	i. eth.
7882	leaf. f. dil. al..	....	172	....	s. h., sl. s. c.	s.	sl. s. eth.; s. chl., acet.
7884	need. f. w.....	....	183	....	s.	s.	....
7885							
7886	wh. powd.....	....	129	....	1.7	58	50 eth.
7887	monocl. pr. f. w.	....	246 d.	....	5.02^{25}, 19.21^{75}	0.187 75% i. abs.	i. eth.
7888	hex. tab., 1.515, 1.575, 1.586	....	228 d.	....	*ca.* 25^{20}	i.	i. eth.
7889	hex. pl. or pr..	....	228 d.	....	25^{20}	......	....
7890							
7891							
7892	....	0.68^{-30}	–150	–20.1	......	......	....
7893	liq...........	0.8403^{0}	....	153	i.	∞	∞ eth.; s. H_2SO_4
7894							
7895	....	0.62^{-57}	–156.5	–56.8	......	......	....
7896	col. liq........	0.7682	....	153	i.	......	....
7897	liq. ign. in air..	$0.645\frac{20}{4}$	....	$26–7^{761}$	i.	v. s.	v. s. eth.; i. H_2SO_4
7898	liq...........	....	....	197	d.	d.	s. eth.
7899	liq...........	$0.751\frac{0}{4}$	....	107 (95–6)	i.	......	i. H_2SO_4
7900							
7901	liq...........	0.8709^{0}	....	154	i.	∞	∞ eth.
7902							
7903							
7904							
7905							
7906							
7907							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7908	**Silicyl oxide, hexaethyl-**	triethylsilicon oxide	$[(C_2H_5)_3Si]_2O$	246.48
7909	**Silvan**	See *Furan, 2-methyl-.*		
7911	**Sinapine**, bisulfate		$C_{16}H_{24}NO_6HSO_4 \cdot 3H_2O$	477.48
7912	——, thiocyanate		$C_{16}H_{24}NO_5SCN \cdot H_2O$	386.46
7913	**Sincaline.**	See *Choline.*		
7914	**Skatole**	3-methylindole	C_9H_9N	131.17
7915	**Sneezing gas.**	See *Arsine, chlorodiphenyl-.*		
7916	***dl*-Sobrerone.**	See *Pinole* (*dl*).		
7917	**Sodium glycerolate.**	See *Glycerol, 1-sodium derivative.*		
7918	**Sodium mercaptide.**	See *Ethanethiol, sodium derivative.*		
7919	**Sodium thioethylate.**	See *Ethanethiol, sodium derivative.*		
7920	**Solanidine**		Mixt.	......
7921	**Solanine**		Mixt. (?)	......
7922	**Sophoretin.**	See *Quercetin.*		
7923	**Sophorine.**	See *Cytisine.*		
7924	**Sorbic acid**	2,4-hexadienoic acid*	$CH_3CH{:}CH\text{-}CH{:}CHCOOH$	112.12
7925	D-**Sorbitol**	1,2,3,4,5,6-hexanehexol* (one form); D-sorbite; D-sorbol	$C_6H_{14}O_6 \cdot \frac{1}{2}H_2O$	191.18
7926	D-**Sorbose**	1,3,4,5,6-pentahydroxy-2-hexanone* (one form); D-sorbinose	$C_6H_{12}O_6$	180.16
7927	**Sozolic acid.**	See 1-*Phenol-2-sulfonic acid.*		
7928	**Sparteine**	lupinidine	$C_{15}H_{26}N_2$	234.38
7929	——, bisulfate		$C_{15}H_{26}N_2 \cdot H_2SO_4 \cdot 5H_2O$	422.53
7930	**Spirit of wine.**	See *Ethyl alcohol.*		
7931	**Stachydrine**		$C_7H_{13}NO_2 \cdot H_2O$	161.20
7932	——, oxalate		$C_7H_{13}NO_2 \cdot H_2C_2O_4$	233.22
7933	**Stannane, diethyldimethyl-.**	See *Tin, diethyldimethyl-.*		
7934	**——, tetraethyl-.**	See *Tin, tetraethyl-*.*		
7935	**——, tetramethyl-.**	See *Tin, tetramethyl-*.*		
7936	**Stannone, diethyl-.**	See *Tin oxide, diethyl-*.*		
7937	**Stannonic acid, methyl-.**	See *Methanestannonic acid.*		
7938	**Starch**		$(C_6H_{10}O_5)_x$	$(162.14)_x$
7938M	——, triacetate	acetyl starch; triacetyl starch	$[C_6H_7O_5(C_2H_3O)_3]_{18}$	5188.49
7939	**——, animal.**	See *Glycogen.*		
7940	**Starch gum.**	See *Dextrin.*		
7941	**Stearaldehyde**	octadecanal*	$C_{17}H_{35}CHO$	268.47
7942	**Stearamide**	octadecanamide*	$CH_3(CH_2)_{16}CO\text{-}NH_2$	283.49
7942H	**——, *N*-phenyl-.**	See *Stearanilide.*		
7942R	**Stearanilide**	*N*-phenylstearamide	$C_{17}H_{35}CONHC_6H_5$	359.58
7943	**Stearic acid**	octadecanoic acid*; *n*-octadecylic acid	$CH_3(CH_2)_{16}COOH$	284.47

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7908	liq	0.859^0	....	231	i.	s.	s. eth., H_2SO_4
7909							
7911	leaf. f. al.	....	127; 186 dry	....	s.	s. h.	i. eth.
7912	pa. yel. need. f. w.	....	178	....	sl. s.	sl. s.	....
7913							
7914	leaf. f. lgr.	....	95	266.2	0.05 c.	v. s.	s. eth., bz., chl., lgr.
7915							
7916							
7917							
7918							
7919							
7920	need. f. eth.	....	191	....	v. sl. s.	s. h.	sl. s. eth.; s. chl.
7921	slend. need. f. al.	....	244–50 (262)	d.	v. sl. s.	s. h.	i. eth., chl., bz.
7922							
7923							
7924	col. need. f. w.	....	134.5	228 d.	sl. s.	v. s.	v. s. eth.
7925	col. need.	....	anh. 110 (89–93)	....	s.	v. sl. s.	i. eth.
7926	col. rhomb.	*d* 1.612; (*dl* 1.64)	165	....	55^{17}	v. sl. s. h., 0.26^{17}	i. eth.; sl. s. me. al.
7927							
7928	col. oil, $[\alpha]$-14.6°$_D$ in al.	$1.023\frac{20}{4}$	....	325^{754} in H_2; $180\text{–}1^{20}$	0.304^{22}	v. s.	v. s. eth.; s. chl.; i. bz.
7929	col. hyg. rhbdr. cr. or powd., 1.5289^{19}	....	136; anh. 150–2	....	91^{25}	32^{25}	i. eth., chl.
7930							
7931	deliq. cr.	....	210 dry	....	s.	s.	i. eth., chl.
7932	need.	....	105–7	....	......	i. c.	....
7933							
7934							
7935							
7936							
7937							
7938	wh. amor., 1.53	1.50^{21}	d.	....	i.	i.	i. eth.
7938M	fine wh. powd. $[\alpha]^{28}_D$ 170.2 (chl.); 160.4 (ac. a.); $[\alpha]^{14}_D$ 159.6 (pyr.)	....	sinters 258; sl. d. >270	....	v. sl. s.	sl. s.	sl. s. eth., bz., $CHCl_3$; s. acet., toluene
7939							
7940							
7941	sc. f. eth.	....	63.5	261^{100}	i.	s.	s. eth.
7942	col. leaf.	....	109	251^{12}	i.	sl. s.	sl. s. eth.
7942 H							
7942R	col. cr	....	94	153.5^{10}	i.	s.	s. eth.
7943	col. monocl. leaf., $1.4299^{80.2}$	0.847^{69}	69.4	383	0.034^{25}, 0.1^{37}	2.5 c.	v. s. eth.; s. chl., CCl_4, CS_2

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7944	**Stearic acid**, amyl ester		$C_{17}H_{35}COO(CH_2)_4CH_3$	354.60
7945	——, benzyl ester		$C_{17}H_{35}COOCH_2C_6H_5$	374.59
7946	——, butyl ester	butyl stearate; butyl octadecanoate*	$C_{17}H_{35}COOC_4H_9$	340.58
7947	——, diethylene glycol ester.	See *Diethylene glycol, distearate*.		
7948	——, ethylene ester.	See *Glycol distearate.*		
7949	——, ethyl ester	ethyl octadecanoate*	$C_{17}H_{35}COOC_2H_5$	312.52
7950	——, glycerol ester	See *Glycerol, tristearate.*		
7951	——, isoamyl ester	isoamyl stearate; γ-methylbutyl octadecanoate*	$CH_3(CH_2)_{16}COOC_5H_{11}$	354.60
7952	——, methyl ester	methyl octadecanoate*; methyl stearate	$C_{17}H_{35}COOCH_3$	298.50
7952M	——, phenyl ester	phenyl stearate	$C_{17}H_{35}COOC_6H_5$	360.56
7953	——, *p*-phenylphenacyl ester		$C_{17}H_{35}COOCH_2COC_6H_4C_6H_5$	478.69
7954	——, **θ, ι-dibromo-.**	See *Elaidic acid, dibromide.*		
7955	——, **α, β-dihydroxy-**	2,3-dihydroxyoctadecanoic acid*	$C_{17}H_{33}(OH)_2COOH$	316.47
7956	——, **θ, ι-dihydroxy-**	9,10-dihydroxyoctadecanoic acid*	$CH_3(CH_2)_7CH(OH)CH(OH)(CH_2)_7COOH$	316.47
7957	——, **θ, ι-dioxo-.**	See *Stearoxylic acid.*		
7958	——, **θ, ι, λ, μ, ξ, ο-hexabromo-**	9,10,12,13,15,16-hexabromooctadecanoic acid*; α-linolenic acid hexabromide	$C_{17}H_{29}Br_6COOH$	757.92
7959	——, ——, ethyl ester		$C_{17}H_{29}Br_6COOC_2H_5$	785.97
7960	——, **α-hydroxy-**	2-hydroxyoctadecanoic acid*	$CH_3(CH_2)_{15}CHOHCOOH$	300.47
7961	——, **β-hydroxy-(*dl*)**	*dl*-3-hydroxyoctadecanoic acid*	$CH_3(CH_2)_{14}CHOHCH_2COOH$	300.47
7962	——, **ι-hydroxy-**	10-hydroxyoctadecanoic acid*	$CH_3(CH_2)_7CHOH(CH_2)_8COOH$	300.47
7963	——, **κ-hydroxy-**	11-hydroxyoctadecanoic acid*	$CH_3(CH_2)_6CHOH(CH_2)_9COOH$	300.47
7964	——, **λ-hydroxy-**	12-hydroxyoctadecanoic acid*	$CH_3(CH_2)_5CHOH(CH_2)_{10}COOH$	300.47
7965	——, **θ, ι, λ, μ-tetrabromo-**	9,10,12,13-tetrabromooctadecanoic acid*; linoleic acid tetrabromide	$C_{17}H_{31}Br_4COOH$	600.10
7966	——, ——, ethyl ester		$C_{17}H_{31}Br_4COOC_2H_5$	628.16
7967	——, ——, methyl ester		$C_{17}H_{31}Br_4COOCH_3$	614.13
7968	**Stearic anhydride**	octadecanoic anhydride*	$(C_{17}H_{35}CO)_2O$	550.93
7969	**Stearin.**	See *Glycerol, tristearate.*		
7970	**Stearolic acid**	9-octadecynoic acid*	$CH_3(CH_2)_7C \vdots C(CH_2)_7COOH$	280.44
7971	**Stearone.**	See 18-*Pentatriacontanone**.		
7972	**Stearonitrile**	octadecanenitrile*	$C_{17}H_{35}CN$	265.47
7972M	**Stearophenone**	heptadecyl phenyl ketone; 1-phenyl-1-octadecanone	$C_{17}H_{35}COC_6H_5$	344.56
7973	**Stearoxylic acid**	9,10-dioxooctadecanoic acid*; θ, ι-diketostearic acid	$CH_3(CH_2)_7COCO(CH_2)_7COOH$	312.44
7974	**Stearoyl chloride**	octadecanoyl chloride*; stearyl chloride	$C_{17}H_{35}COCl$	302.92
7975	**Stibine, triethyl-**	antimony triethyl	$Sb(C_2H_5)_3$	208.94

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7944	pl.	0.860	30	360	i.	s.	v. s. eth.
7945	cr.	0.9075^{50}_{25}	45.8		i.	s.	v. s. eth.
7946	col. liq.	$0.855–75^{25}$	19.5 (27.5)	$220–5^{25}$	0.29^{25}	s.	s. eth.
7947							
7948							
7949	col. cr.		33.7	$213–15^{15}$	i.	s.	s. eth.
7950							
7951	cr.	0.855^{20}_{4}	23	$185–90^{1}$	i.	sl. s.	s. eth.
7952	col. cr. f. eth.		38 (35–7)	215^{15}	i.	s.	s. eth.
7952M	col. cr.		51.5–53	267^{15}	i.	s.	s. eth.
7953			91				
7954							
7955	(a) leaf. f. al.		132 (136.5)			0.47 c.	sl. s. eth.
	(b) leaf. or pl. f. w.		99		s.	2.8^{18}	s. eth.
7956	leaf.		131.5 (136.5)		v. sl. s c.	2.84^{18}	sl. s. eth.
7957							
7958	need.		180–1		i.		i. eth., chl., bz.; s. h. xylene
7959	fine need.		151.5–2.5		i.	i.	i. eth.; sl. s. glac. ac. a.
7960	need. f. chl.		93; 85			6.94 c.	1.64 c. eth.; v. s. h. bz.
7961	pl. f. chl.		89			s. h.	s. eth., chl.
7962	hex. pl.		81–1.5		i.	8.78	2.3 eth.
7963	tab. f. al.		84 (77–9)		i.	0.58	1.71^{20} eth.
7964	cr. f. al.		81–2		i.	s.	s. eth., chl.
7965	wh. pl.		114–5		i.	v. s.	v. s. chl.; sl. s. pet. eth.
7966	need.		58–8.5		i.	s.	s. pet. eth., glac. ac. a.
7967	leaf.		50–6		i.	s.	s. pet. eth., glac. ac. a.
7968	col. cr.	0.8368^{82}_{4}	71.5		i., d.	d.	s. eth.
7969							
7970	col. pr. f. al.		48	260	i.	sl. s. c.	v. s. eth.
7971							
7972	col. cr	0.817^{41}_{4}	42.5–43	214^{13}	i.	sl. s.	sl. s. eth.
7972M	col. waxy cr.		64–65		i.	s.	s. eth.
7973	yel. leaf.		86		i.	v. s. h.	v. s. h. eth.; sl. s. lgr.
7974	col. cr.		23	215^{15}	d.	d.	v. s. eth.
7975	col. liq.	1.324^{16}	<-29	159.5	i.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7976	**Stibine, trimethyl-...**	antimony trimethyl.........	$Sb(CH_3)_3$.........	166.86
7977	**Stilbene..............**	*trans*-1,2-diphenylethylene; *trans-sym*-diphenylethylene; toluylene	$C_6H_5CH{:}CHC_6H_5$	180.24
7978	**——, diamino-........**	See *Stilbenediamine.*		
7979	**——, 2,2′-diamino- (*cis*)**	....	$NH_2C_6H_4CH{:}CH\text{-}C_6H_4NH_2$	210.27
7979M	**——, 4,4′-dimethoxy-..**	bianisal; photoanethole......	$[p\text{-}CH_3OC_6H_4CH{:}]_2$	240.29
7980	**——, *α*-phenyl-.**	See *Ethylene, triphenyl-.*		
7981	**2,2′-Stilbenediamine..**	*o,o′*-diaminostilbene.........	$NH_2C_6H_4CH{:}CH\text{-}C_6H_4NH_2$	210.27
7982	**4,4′-Stilbenediamine..**	*p,p′*-diaminostilbene.........	$NH_2C_6H_4CH{:}CH\text{-}C_6H_4NH_2$	210.27
7983	**Strychnine...........**	....	$C_{21}H_{22}N_2O_2$.......	334.40
7984	——, hydrochloride.........	....	$C_{21}H_{22}N_2O_2\cdot HCl\cdot 2H_2O$	406.90
7985	——, nitrate...............	....	$C_{21}H_{22}N_2O_2\cdot HNO_3$	397.42
7986	——, sulfate...............	....	$(C_{21}H_{22}N_2O_2)_2\cdot H_2SO_4\cdot 5H_2O$	856.97
7987	**Styphnic acid.........**	2,4,6-trinitroresorcinol.......	$(NO_2)_3C_6H(OH)_2$..	245.11
7988	**Stypticin.**	See *Cotarnine, hydrochloride.*		
7989	**Styptol.**	See *Cotarnine, phthalate.*		
7990	**Styracin..............**	*γ*-phenylallyl cinnamate; cinnamyl cinnamate	$C_{18}H_{16}O_2$.........	264.31
7991	**Styrene...............**	vinylbenzene; phenylethylene; cinnamene	$C_6H_5CH{:}CH_2$.....	104.14
7992	**——, *α*-bromo-.......**	1-bromo-1-phenylethylene; *α*-bromostyrol; (*α*-bromovinyl)benzene	$C_6H_5CBr{:}CH_2$....	183.05
7993	**——, *β*-bromo-.......**	1-bromo-2-phenylethylene; (*β*-bromovinyl)benzene; *ω*-bromostyrene	$C_6H_5CH{:}CHBr$...	183.05
7994	**——, *α*-chloro-........**	1-chloro-1-phenylethylene....	$C_6H_5CCl{:}CH_2$.....	138.59
7995	**——, *β*-chloro-........**	1-chloro-2-phenylethylene; *ω*-chlorostyrene	$C_6H_5CH{:}CHCl$....	138.59
7996	**——, *o*, *m* or *p*-hydroxy-.**	See *Phenol, vinyl-.*		
7997	**——, 3-hydroxy-4-methoxy-.**	See *Hesperetol.*		
7998	**——, *o*, *m* or *p*-methoxy-.**	See *Anisole, vinyl-.*		
7999	**——, *o*-nitro-.........**	1-nitro-2-vinylbenzene.......	$NO_2C_6H_4CH{:}CH_2$	149.14
8000	**——, *m*-nitro-........**	1-nitro-3-vinylbenzene.......	$NO_2C_6H_4CH{:}CH_2$	149.14
8001	**——, *p*-nitro-.........**	1-nitro-4-vinylbenzene.......	$NO_2C_6H_4CH{:}CH_2$	149.14
8002	**_o,β_-Styrenedicarboxylic acid.**	See *Cinnamic acid, o-carboxy-.*		
8003	**_p,β_-Styrenedicarboxylic acid.**	See *Cinnamic acid, p-carboxy-.*		
8004	**Styrone.**	See *Cinnamic alcohol.*		
8005	**Styryl ketone.........**	1,5-diphenyl-1,4-pentadien-3-one*; dibenzalacetone; cinnamone; dicinnamyl ketone; distyryl ketone	$(C_6H_5CH{:}CH)_2\text{-}CO$	234.28
8006	**Suberane.**	See *Cycloheptane*.*		
8007	**Suberene.**	See *Cycloheptene*.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7976	col. monocl. liq. f. w.	1.523^{15}	....	80.6	sl. s.	i.	s. eth.
7977	col. monocl. tab. f. al.	liq. $0.970\frac{12.5}{13}$; $1.164\frac{0}{4}$	124	307	i.	0.88^{17}	5.59^{13} eth.; s. bz.
7978							
7979	red need. f. w.	....	123	....	......	......	....
7979M	col. leaf.......	....	214	....	......	s.	s. bz., ac. a.
7980							
7981	(*cis*) red need. f. w.	....	123	....	......	s.	s. eth., bz.
	(*trans*) gold-yel. pr. f. al.	....	176 (168)	....	......	......	....
7982	yel. need. or leaf. f. al.	....	227–8	subl.	s. h.	s.	s. eth., me. al.; sl. s. bz., chl., CS$_2$
7983	col. rhomb. f. al.	1.359^{18}	268	270^{5}	0.016^{25}	0.9	0.018 eth.; s. chl.; sl. s. bz.
7984	col. trim. efflor.	....	....	....	2.9 c.	1.7	i. eth., HCl
7985	col. need., $[\alpha]$–46°D	....	d.	....	2.4^{25}	0.83^{25}	i. eth.; 0.64^{25} chl.; s. glyc.
7986	col. monocl. pr., 1.6137, 1.5988	....	anh. 200	....	3.2^{25}	1.5^{25}	i. eth.; s. chl., glyc.
7987	yel. hex. pr. f. acet.	1.829	180 (176–7)	subl.	0.6^{14}	s.	sl. s. eth.
7988							
7989							
7990	need. or pr....	$1.085^{16.5}$	44	....	i.	3.95 c.	v. s. eth.; s. bz.
7991	col. liq., 1.54344^{17}	$0.9074\frac{20}{4}$	....	146	v. sl. s.	∞	∞ eth.
7992	oil., $1.5881^{19.5}$..	1.4057	–43.5	160^{75} ($86–7^{14}$)	......	......	....
7993	(1) $1.6094^{20.5}$..	1.4269^{16}	+7	219 sl. d.	i.	∞	∞ eth.
	(2) 1.5990^{22}...	1.4322^{16}	–8 to –7	71^{6}	......	......	....
7994	liq., 1.5623^{17}...	$1.1016\frac{18}{4}$	–23	199	i.	s.	s. eth.
7995	liq..........	$1.112\frac{15}{4}$	....	199	i.	s.	s. eth.
7996							
7997							
7998							
7999	col. liq.......	....	13.5	....	......	......	s. conc. H_2SO_4
8000	yel. oil.......	....	–5	....	......	v. s.	s. eth., lgr., chl.
8001	pr. f. lgr......	....	29	d.	......	v. s. h.	v. s. eth., bz., s. lgr.
8002							
8003							
8004							
8005	yel. monocl. leaf. f. acet. or eth.	....	112	d.	v. sl. s. c.	sl. s.	sl. s. eth.; s. acet.
8006							
8007							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8008	**Suberic acid**	octanedioic acid*	$COOH(CH_2)_6\text{-}COOH$	174.19
8009	——, diethyl ester	ethyl suberate	$(CH_2CH_2CH_2\text{-}COOC_2H_5)_2$	230.30
8010	**Suberol.**	See *Cycloheptanol**.		
8011	**Suberone.**	See *Cycloheptanone**.		
8012	**Suberyl alcohol.**	See *Cycloheptanol**.		
8013	**Suberylene.**	See *Cycloheptene**.		
8014	**Succinaldehyde**	butanedial*	$CHO(CH_2)_2CHO$	86.09
8015	**Succinamic acid**	β-carbamylpropionic acid; succinic acid monoamide	$NH_2COCH_2CH_2\text{-}COOH$	117.10
8016	——, **α-amino-.**	See *Asparagine.*		
8016M	——, ***N*-phenyl-.**	See *Succinanilic acid.*		
8017	**Succinamide**	butanediamide*	$NH_2COCH_2CH_2\text{-}CONH_2$	116.12
8018	——, **α-hydroxy-.**	See *Malamide.*		
8019	——, ***N*-*p*-phenetyl-**	pyrantin; phenosuccin	$(CH_2CO)_2NC_6H_4\text{-}OC_2H_5$	219.23
8019H	**Succinanil**	*N*-phenylsuccinimide	$(CH_2CO)_2NC_6H_5$	175.18
8019R	**Succinanilic acid**	*N*-phenylsuccinamic acid	$C_6H_5NHOC\text{-}(CH_2)_2COOH$	193.20
8020	**Succinic acid**	butanedioic acid*	$COOH(CH_2)_2\text{-}COOH$	118.09
8021	——, dibenzyl ester		$(CH_2COOCH_2\text{-}C_6H_5)_2$	298.33
8022	——, diethyl ester	ethyl succinate	$(CH_2COOC_2H_5)_2$	174.19
8023	——, dimethyl ester	dimethyl butanedioate*; methyl succinate	$CH_3OOC(CH_2)_2\text{-}COOCH_3$	146.14
8024	——, monoamide	See *Succinamic acid.*		
8025	——, *p*-phenylphenacyl ester		$(CH_2COOCH_2CO\text{-}C_6H_4C_6H_5)_2$	506.53
8026	——, piperazinium salt		$C_4H_{10}N_2\cdot C_4H_6O_4$	204.23
8027	——, **acetoxy-.**	See *Malic acid, acetate.*		
8028	——, **acetyl-**, diethyl ester	ethyl acetylsuccinate; diethyl acetylbutanedioate*	$CH_3COCH(COO\text{-}C_2H_5)CH_2COO\text{-}C_2H_5$	216.23
8029	——, **α-amino-**	See *Aspartic acid.*		
8030	——, **bromo-(*dl*)**	*dl*-2-bromobutanedioic acid*	$CH_2CHBr\text{-}(COOH)_2$	197.00
8031	——, **α,β-dibromo-**	2,3-dibromobutanedioic acid*	$C_2H_2Br_2(COOH)_2$	275.90
8032	——, **α,β-dihydroxy-.**	See *Tartaric acid.*		
8033	——, **ethyl-**	2-ethylbutanedioic acid*; 1, 2-butanedicarboxylic acid	$(COOH)CH(C_2H_5)\text{-}CH_2COOH$	146.14
8034	——, ——, methyl ester		$C_2H_5OOC(CH_2)_2\text{-}COOCH_3$	160.17
8035	——, **ethylene-.**	See 1,2-*Cyclobutanedicarboxylic acid**.		
8036	——, **formyl-**, lactone.	See *Aconic acid.*		
8037	——, **hydroxy-.**	See *Malic acid.*		
8038	——, **α-hydroxy-α-methyl-.**	See *Citramalic acid.*		
8039	——, **isopropylidene-.**	See *Teraconic acid.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8008	col. need. f. w.	....	140	279^{100}	0.14^{16}	s.	v. sl. s. eth.
8009	col. liq.	$0.982\frac{20}{4}$	....	282–6	i.	s.	s. eth.
8010							
8011							
8012							
8013							
8014	liq., 1.4254	$1.064\frac{20}{4}$	....	169–70 sl. d. (201–3)	s.	s.	s. eth.
8015	col. need. or tab.	....	157	....	s.	v. sl. s.	i. bz.
8016							
8016M							
8017	col. need. f. w.	....	243	....	0.45^{15}, 11^{100}	i.	i. eth.
8018							
8019	pr. f. al.	....	155	....	0.75^{17}, 1.2^{100}	v. s. h.	i. eth.
8019H	col. need.	....	156	*ca.* 400	sl. s. h.	s. h.	s. eth.
8019R	col. need.	....	144.5–45.5	....	s. h.	s.	s. eth.
8020	col. monocl., 1.450, 1.534, 1.610	$1.564\frac{15}{4}$	185 (189–90)	235 d.	6.8^{20}, 121^{100}	$7.5^{21.5}$	0.3 eth.; i. bz., chl.
8021	leaf. f. al.	....	44–6	238^{14}	i.	v. s.	v. s. eth.
8022	col. liq., 1.42007	$1.0402\frac{20}{4}$	–21	217.7	i.	∞	∞ eth.
8023	col., $1.41976^{18.3}$	$1.1202\frac{18}{4}$	19.5	192.8	2.8	s.	....
8024							
8025	....	....	208	....	....	....	....
8026	wh. cr.	....	205–6, d.	....	s.	s. h.	i. eth.
8027							
8028	col., liq. 1.438^{16}	$1.081\frac{20}{4}$	....	256 d.	i.	s.	s. eth., bz., CS_2
8029							
8030	col. cr.	2.073	159	....	19^{15}	v. s.	i. eth.
8031	(*d*) $[\alpha]$ $+126.3_{D}^{\circ 24}$ in et. ac.	....	151–3	....	....	....	....
	(*l*) need. f. bz., $[\alpha]$ $-148_{D}^{\circ 13}$ in et. ac.	....	157–8 d. (152–4)	....	s.	s.	s. me. al., acet., et. ac.; sl. s. chl., CCl_4, pet. eth.
	(*dl*)	....	166–7; 255–6 d.	....	s. h.	s.	s. eth.
8032							
8033	col. pr.	....	98	....	v. s.	v. s.	v. s. eth.; 1.06 chl.
8034	col. liq.	1.093^{0}	<–20	208.2	i.	v. s.	v. s. eth.
8035							
8036							
8037							
8038							
8039							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8040	**Succinic acid, methyl-**	See *Pyrotartaric acid.*		
8041	**——, methylene-.**	See *Itaconic acid.*		
8042	**——, tetrahydroxy-**	tetrahydroxybutanedioic acid*; dihydroxytartaric acid	$(COOH)C(OH)_2$-$C(OH)_2COOH$	182.09
8043	**——, tetramethyl-**	tetramethylbutanedioic acid*; 2,3-dimethyl-2,3-butanedicarboxylic acid	$HOOCC(CH_3)_2C$-$(CH_3)_2COOH$	174.19
8044	**Succinic anhydride**	butanedioic anhydride*	$(CH_2CO)_2O$	100.07
8045	**Succinimide**	butanimide*; 2,5-pyrrolidinedione	$(CH_2CO)_2NH$	99.09
8045M	**——, *N*-phenyl-.**	See *Succinanil.*		
8046	**Succinonitrile**	butanedinitrile*; ethylene cyanide	$CNCH_2CH_2CN$	80.09
8047	**Succinyl chloride**	butanedioyl chloride*	$(CH_2COCl)_2$	154.99
8048	**Sucrose**	cane sugar; saccharose	$C_{12}H_{22}O_{11}$	342.30
8048M	——, octaacetate	octaacetylsucrose	$C_{28}H_{38}O_{19}$	678.59
8049	**Sulfanilamide**	*p*-aminobenzenesulfonamide; *p*-anilinesulfonamide; prontosil album	$H_2NC_6H_4SO_2NH_2$-(p)	172.20
8049M	**——, *N*¹-2-pyridyl-.**	See *Sulfapyridine.*		
8050	**Sulfanilic acid**	*p*-aminobenzenesulfonic acid; *p*-anilinesulfonic acid	$NH_2C_6H_4SO_3H\cdot$$H_2O$	191.20
8050M	**Sulfapyridine**	*N*¹-2-pyridylsulfanilamide; *p*-amino-*N*-2-pyridylbenzenesulfonamide; 2-sulfanilamidopyridine	$H_2NC_6H_4SO_2$-NHC_5H_4N	249.28
8051	**Sulfide, 2-benzothiazyl 2,4-dinitrophenyl.**	See *Benzothiazole, 2-(2,4-dinitro-*		
8052	**——, bis-β-chloroethyl.**	See *Sulfide, β, β′-dichloroethyl.*		
8053	**——, bis(dimethylthiocarbamyl)**	tetramethylthiuram (mono)-sulfide	$[(CH_3)_2NCS]_2S$	208.35
8054	**——, bis-β-hydroxyethyl.**	See *Ethanol, 2,2′-thiodi-.*		
8055	**——, bis(β-methylbutyl)**	di-*act*-amyl sulfide; 2-methyl-1-(β-methylbutylthio)-butane*	$[CH_3CH_2CH$-$(CH_3)CH_2]_2S$	174.34
8056	**——, bis(1-piperidylthiocarbonyl)**	dicyclopentamethylenethiuram monosulfide	$(C_5H_{10}NCS)_2S$	288.48
8057	**——, 4,4′-diaminodiphenyl.**	See *Aniline, p,p′-thiodi-.*		
8058	**——, di-*act*-amyl.**	See *Sulfide, bis(β-methylbutyl).*		
8059	**——, dibenzyl.**	See *Benzyl sulfide.*		
8060	**——, dibutyl.**	See *Butyl sulfide.*		
8061	**——, β,β′-dichloroethyl**	1-chloro-2-(β-chloroethylthio)ethane*; bis-β-chloroethyl sulfide; 2,2′-dichlorodiethyl sulfide; mustard gas; yperite; yellow cross liquid	$(ClCH_2CH_2)_2S$	159.08
8062	**——, diethyl.**	See *Ethyl sulfide.*		
8063	**——, diisoamyl.**	See *Isoamyl sulfide.*		
8064	**——, diisobutyl.**	See *Isobutyl sulfide.*		
8065	**——, diisopropyl.**	See *Isopropyl sulfide.*		
8066	**——, dimethyl.**	See *Methyl sulfide.*		
8067	**——, diphenyl.**	See *Phenyl sulfide.*		
8068	**——, dipropyl.**	See *Propyl sulfide.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8040							
8041							
8042	wh. cr........	....	114–5	....	v. s., d. h.	......	....
8043	cr............	....	190–2	subl.	$0.48^{13.5}$	v. s.	s. eth.; i. lgr.
8044	col. need. f. al.	1.104	119.6	261	v. sl. s.	s.	v. sl. s. eth.
8045	octahdr. col. need. f. acet.	1.412^{16}	124–6	288	23^{20}, 152^{70}	4.1^{20}, 16^{50}	v. sl. s. eth.
8045M							
8046	col., $1.41645^{63.1}$	$0.985\frac{63}{4}$; 1.023^{45}	54.5	267	v. s.	v. s.	s. eth.
8047	col. fum. liq. or cr., $1.47348^{15.2}$	$1.395\frac{20}{4}$	17	132	d.	d.	v. s. eth.; s. bz.; i. pet. eth.
8048	col. monocl., 1.5376, 1.5651, 1.5705	1.588^{15}	186 d.	d.	179^{0}, 487^{100}	0.9	i. eth., chl.; sl. s. me. al.
8048M	wh. need. f. al.	1.27^{16}	72.3	....	v. sl. s.	s.	s. eth., common org. solv.
8049	col. leaf. or need.	....	163; 164.5–6.5	....	0.4^{15}	3	s. c. acet.; i. bz.
8049M							
8050	col. rhomb pl. or monocl. cr. (+$2H_2O$)	....	288 d.	....	1.08^{20}, 6.67^{100}	v. sl. s.	v. sl. s. eth.
8050M	wh. cr........	....	190–3	....	0.03	0.2	....
8051	*phenylthio*)-.						
8052							
8053	yel. cr........	1.40	107	....	i.	s. h.	sl. s. eth.; s. chl.
8054							
8055	$[\alpha]+24.5^{\circ 20}_{D}$	$0.8362\frac{20}{0}$	$95–8^{13}$	....	......	......	....
8056	yel. cr........	....	121	....	i.	sl. s. c., s. h.	sl. s. eth.; s. chl.
8057							
8058							
8059							
8060							
8061	col. oily liq. or col. pr.	sld. 1.338^{13}; 1.2741^{20}	13–14	215–7; 98^{10}	0.048	s.	s. eth., ord. org. solv.
8062							
8063							
8064							
8065							
8066							
8067							
8068							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8069	**Sulfide, divinyl.**	See *Vinyl sulfide.*		
8070	**——, ethyl methyl**	methylthioethane*	$CH_3SC_2H_5$	76.15
8071	**Sulfobenzide.**	See *Phenyl sulfone.*		
8072	**Sulfocyanic acid.**	See *Thiocyanic acid.*		
8073	**Sulfonal.**	See *Propane, 2,2-bis(ethylsulfonyl)-**.		
8074	**Sulfone, dibenzyl.**	See *Benzyl sulfone.*		
8074M	**——, di-*n*-butyl.**	See *Butyl sulfone.*		
8075	**——, diethyl.**	See *Ethyl sulfone.*		
8075M	**——, dimethyl.**	See *Methyl sulfone.*		
8076	**——, diphenyl.**	See *Phenyl sulfone.*		
8077	**——, dipropyl.**	See *Propyl sulfone.*		
8078	**——, ethylenebisphenyl.**	See *Ethane, 1,2-bisphenylsulfonyl-**.		
8079	**——, ethyl phenyl**	ethylsulfonylbenzene*	$C_2H_5SO_2C_6H_5$	170.22
8080	**——, pentane-γ,γ-diethyl.**	See *Tetronal.*		
8081	**Sulfonmethane.**	See *Propane, 2,2-bis(ethylsulfonyl)-**.		
8082	**Sulfoxide, dibenzyl.**	See *Benzyl sulfoxide.*		
8082M	**——, di-*n*-butyl.**	See *Butyl sulfoxide.*		
8083	**——, diethyl.**	See *Ethyl sulfoxide.*		
8083H	**——, dimethyl.**	See *Methyl sulfoxide.*		
8083M	**——, di-*n*-propyl.**	See *Propyl sulfoxide.*		
8084	**Sulfur chloride, trichloromethyl-.**	See *Methyl mercaptan, perchloro-.*		
8085	**Sulfuric ether.**	See *Ethyl ether.*		
8086	**Sumatra camphor.**	See *d-Borneol.*		
8087	**Superpalite.**	See *Diphosgene.*		
8088	**Suprarenine.**	See *Adrenaline.*		
8089	**Sylvan.**	See *Furan, 2-methyl-*		
8090	***d*-Sylvestrene**	*d*-1,8(9)-*m*-menthadiene	$C_{10}H_{16}$	136.23
8091	**Sylvic acid.**	See *Abietic acid.*		
8091M	**D-Talose**		$C_6H_{12}O_6$	180.16
8092	**Tannin.**	See *m-Digallic acid.*		
8093	**Tartaric acid, dihydroxy-.**	See *Succinic acid, tetrahydroxy-.*		
8094	***dl*-Tartaric acid**	racemic acid	$HOOC(CHOH)_2COOH \cdot H_2O$	168.10
8094M	——, diethyl ester	diethyl tartrate (*dl*-); diethyl racemate	$C_8H_{14}O_6$	206.19
8095	——, dimethyl ester	dimethyl *dl*-2,3-dihydroxybutanedioate*; methyl racemate	$(COOCH_3)(CHOH)_2COOCH_3$	178.14
8096	***d*-Tartaric acid**	*d*-2,3-dihydroxybutanedioic acid*; *d*-*a*, *β*-dihydroxysuccinic acid	$HOOC(CHOH)_2COOH$	150.09
8097	——, dibutyl ester	dibutyl *d*-2,3-dihydroxybutanedioate*	$(CHOHCOOC_4H_9)_2$	262.30
8098	——, diethyl ester	diethyl *d*-2,3-dihydroxybutanedioate*; ethyl *d*-tartrate	$(CHOH \cdot CO_2C_2H_5)_2$	206.19
8099	——, diethyl ester diacetate	ethyl diacetyl-*d*-tartrate; ethyl *d*-diacetoxysuccinate	$[CH(OOCCH_3)COOC_2H_5]_2$	290.27
8100	——, dimethyl ester	methyl *d*-tartrate	$(COOCH_3)(CHOH)_2COOCH_3$	178.14
8101	——, dinitrate	dinitrotartaric acid	$COOH(CHNO_3)_2COOH$	240.09

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8069							
8070	liq.	0.837	–104.8	66	i.	∞	∞ eth.
8071							
8072							
8073							
8074							
8074M							
8075							
8075M							
8076							
8077							
8078							
8079	monocl. pl. f. eth.	1.010^{22}	42	>300	sl. s. c.	s.	s. eth.
8080							
8081							
8082							
8082M							
8083							
8083B							
8083M							
8084							
8085							
8086							
8087							
8088							
8089							
8090	liq., 1.47717$^{17.2}$	0.863$\frac{20}{4}$	....	177	i.	∞	∞ eth.
8091							
8091M	cr.	....	128–30	....	......	......	....
8092							
8093							
8094	col. tricl.	1.697	–H_2O, 100; anh. 204–6	....	20.6^{20} 9.23^{0} 185^{100}	1.66 c.	0.87 c. eth.
8094M	1.4454^{25}, [α] $+7.45^{\circ 20}_{D}$	1.2036$\frac{20}{4}$	17	280	sl. s.	∞	∞ eth.; s. ord. org. solv.
8095	monocl. f. al.	....	stable 90; metastable 84; meso 111	282	......	s.	....
8096	col. monocl., 1.4955, 1.5352, 1.6045	1.7598$\frac{20}{4}$	170	....	139^{20}, 343^{100}	19.85^{15}	0.44 c. eth.; s. acet.; i. bz., chl.
8097	pr.	1.087^{21}	22.5	203^{18}	......	......	....
8098	col. hyg. liq., 1.4454^{25}, $[\alpha]^{20}_{D}+7.45°$	1.2036$\frac{20}{4}$	17	280	s.	s.	∞ eth.; s. ord. org. solv.
8099	monocl. cr.	1.109^{71}	67	291–2^{727}	sl. s.	s.	v. s. eth.
8100	col., [α] $+9.32^{20}_{D}$ in me. al.	1.3046$\frac{50}{4}$	(1)48; (2) 50; (3)61	280	s.	v. s.	s. chl., bz.
8101	need.	....	d.	....	d.	s.	s. eth.; i. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8102	*d*-**Tartaric acid**, dipropyl ester	dipropyl *d*-2,3-dihydroxybutanedioate*; propyl tartrate	$(CHOHCOOC_3H_7)_2$	234.25
8103	——, monoethyl ester	ethyl hydrogen *d*-tartrate	$COOH(CHOH)_2COOC_2H_5$	178.14
8104	——, nicotine salt	See *Nicotine, tartrate.*		
8105	——, **dinitro-.**	See *d-Tartaric acid, dinitrate.*		
8105M	*l*-**Tartaric acid,** diethyl ester	ethyl *l*-tartrate	$C_8H_{14}O_6$	206.19
8106	*i*-**Tartaric acid**	mesotartaric acid	$HOOC(CHOH)_2COOH$	150.09
8106M	——, diethyl ester	diethyl tartrate (meso)	$C_8H_{14}O_6$	206.19
8107	**Tartronic acid**	2-hydroxypropanedioic acid*; hydroxymalonic acid	$HOCH(COOH)_2$	120.06
8108	——, **benzyl-**	1-hydroxy-2-phenyl-1,1-ethanedicarboxylic acid	$C_6H_5CH_2C(OH)(COOH)_2$	210.18
8109	**Taurine**	2-aminoethanesulfonic acid	$H_2NCH_2CH_2SO_3H$	125.14
8110	**Taurocholic acid**		$C_{26}H_{45}NO_7S{\cdot}H_2O$	533.71
8111	**Telluride, diethyl.**	See *Ethyl telluride.*		
8112	——, **dimethyl.**	See *Methyl telluride.*		
8113	**Tellurium ethyl.**	See *Ethyl telluride.*		
8114	**Teraconic acid**	2-isopropylidenebutanedioic acid*; isopropylidenesuccinic acid; γ, γ-dimethylitaconic acid	$(CH_3)_2C{:}C(COOH)CH_2COOH$	158.15
8116	**Terebic acid**	2,2-dimethylparaconic acid	$C_7H_{10}O_4$	158.15
8117	**Terephthalaldehyde**	1,4-benzenedicarbonal*	$C_6H_4(CHO)_2$	134.13
8118	**Terephthalaldehydic acid**	*p*-formylbenzoic acid	$CHOC_6H_4COOH$	150.13
8119	——, **3-hydroxy-**	4-formyl-3-hydroxybenzoic acid	$CHOC_6H_3(OH)COOH$	166.13
8120	**Terephthalic acid**	1,4-benzenedicarboxylic acid*; *p*-phthalic acid	$C_6H_4(COOH)_2$	166.13
8121	——, diethyl ester	ethyl *p*-phthalate	$C_6H_4(COOC_2H_5)_2$	222.23
8122	——, dimethyl ester	dimethyl 1,4-benzenedicarboxylate*	$C_6H_4(COOCH_3)_2$	194.18
8123	——, mononitrile.	See *Benzoic acid, p-cyano-.*		
8124	——, **benzoyl-**	2,5-benzophenonedicarboxylic acid	$C_6H_5COC_6H_3(COOH)_2$	270.23
8125	——, **2,3-dihydro-.**	See 1,3-*Cyclohexadiene*-1,4-*dicarboxylic acid.*		
8126	——, **2,5-dihydroxy-**	2,5-dihydroxy-1,4-benzenedicarboxylic acid*; 2,5-hydroquinone dicarboxylic acid	$(HO)_2C_6H_2(COOH)_2$	198.13
8127	——, **hexahydro-.**	See 1,4-*Cyclohexanedicarboxylic acid*.*		
8128	——, **2-nitro-**		$NO_2C_6H_3(COOH)_2$	211.13
8129	**Terephthalonitrile**	1,4-benzenedicarbonitrile*; *p*-phenylene cyanide	$C_6H_4(CN)_2$	128.13
8130	**Terephthalyl chloride.**	1,4-benzenedicarbonyl chloride*; *p*-phthalyl dichloride	$C_6H_4(COCl)_2$	203.03
8131	**Terpane.**	See *p-Menthane.*		
8132	**Terphenyl**	1,4-diphenylbenzene; *p*-phenylbiphenyl; triphenyl; diphenylphenylene	$(C_6H_5)_2C_6H_4$	230.29
8133	*m*-**Terphenyl.**	See *Benzene*, 1,3-*diphenyl-.*		
8134	α-**Terpinene**	1,3-*p*-menthadiene	$C_{10}H_{16}$	136.23
8135	*dl*-α-**Terpineol**	*dl*-1-*p*-menthen-8-ol	$C_{10}H_{17}OH$	154.25
8136	**Terpin hydrate.**	See *Terpinol, hydrate*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8102	liq.	1.139	...	303	i.	v. s.	v. s. eth.
8103	col. rhomb.	...	90	...	s.	s.	s. eth.
8104							
8105							
8105M	$[\alpha]-7.55^{\circ 19.7}_{D}$	$1.2054\frac{19.7}{4}$	...	162^{19}	...	...	...
8106	col. tab., 1.495, 1.536, 1.605	1.666	anh. 140	...	125^{16}	s.	sl. s. eth.
8106M	...	...	55	...	...	...	...
8107	col. pr. f. eth.	...	158 d.	d.; subl. 110–20	v. s.	v. s.	sl. s. eth.
8108	pr.	...	153 (147 d.)	...	s.	s.	s. eth.
8109	tetr. need.	...	328–9 d.	d.	6.5^{12}	0.0032^{17}	i. eth.
8110	deliq. need.	...	180 d.	...	v. s.	v. s.	sl. s. eth.
8111							
8112							
8113							
8114	tricl. f. eth.	...	161 d.	...	v. s.	v. s.	v. s. eth.; v. sl. s. bz.
8116	monocl. f. al.	$0.8155\frac{24}{4}$	174	d.	sl. s.	s.	1.21 c. eth.
8117	need. f. w.	...	116	248	1.5^{100}	v. s.	v. sl. s. eth.
8118	need. f. w.	...	256 (248–50)	subl.	s. h.	v. s.	sl. s. eth., chl.
8119	need.	...	234	...	sl. s. h.	s.	s. eth.
8120	need. or amor.	1.510	subl.	subl. *ca.* 300	0.0016	v. sl. s.	v. sl. s. eth., chl.; s. alk.
8121	col.	...	44	...	...	...	...
8122	rhomb. f. al.	...	140	subl. >300	0.33 h.	s. h.	s. eth.
8123							
8124	need.	...	285	...	i.	s.	s. eth.; i. tol.
8125							
8126	yel. cr. f. al. or eth.	...	d.	...	s. (grn. fluores.)	s. (bl. fluores.)	s. eth.
8127							
8128	...	...	270 (263)	...	v. s. h.	s. h.	...
8129	col. need. f. bz.	...	222	...	i.	sl. s.	sl. s. eth.; s. h. ac. a.
8130	need.	...	78	259	d.	d.	s. eth.
8131							
8132	col. leaf. f. al.	$1.234\frac{0}{4}$	213	subl. 427	...	v. sl. s.	sl. s. eth., ac. a., CS_2; s. h. bz. (bl. fluores.)
8133							
8134	col. liq., 1.4846	(α)0.846 (β)0.838	...	180 173	i.	∞	∞ eth.
8135	col. liq., 1.4827	$0.9357\frac{20}{4}$	35; d. 40	219.8	i.	v. s.	v. s. eth.; s. chl.
8136							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8138	*cis*-**Terpinol**, hydrate....	*cis*-1,8-*p*-menthanediol hydrate; *cis*-terpin hydrate	$C_{10}H_{18}(OH)_2 \cdot H_2O$..	190.28
8139	**Terpinolene**..........	1,4(8)-*p*-menthadiene........	$C_{10}H_{16}$..........	136.23
8140	**Tetracoline.**	See *Quinoline, 2,5,7-trimethyl-*		
8141	**Tetracosane*(*n*)**......	....	$CH_3(CH_2)_{22}CH_3$...	338.65
8142	**Tetradecanal***, oxime.	See *Myristaldehyde, oxime.*		
8143	**Tetradecanamide*.**	See *Myristamide.*		
8144	**Tetradecane***.........	*n*-tetradecane.............	$CH_3(CH_2)_{12}CH_3$...	198.38
8145	——, **1-amino-.**	See *Tetradecylamine*.*		
8146	**Tetradecanenitrile*.**	See *Myristonitrile.*		
8147	**Tetradecanoic acid*.**	See *Myristic acid.*		
8148	**Tetradecanoic anhydride*.**	See *Myristic anhydride.*		
8149	**1-Tetradecanol***.......	*n*-tetradecyl alcohol; myristic alcohol	$CH_3(CH_2)_{12}CH_2$-OH	214.38
8150	**Tetradecanoyl chloride*.**	See *Myristoyl chloride.*		
8151	**1-Tetradecene***.......	α-tetradecylene............	$CH_2{:}CH(CH_2)_{11}$-CH_3	196.37
8152	*n*-**Tetradecyl alcohol.**	See 1-*Tetradecanol*.*		
8153	**Tetradecylamine*(*n*)**..	1-aminotetradecane; *prim*-*n*-tetradecylamine	$CH_3(CH_2)_{13}NH_2$...	213.40
8154	**Tetradecyl sulfate**.....	di-*n*-tetradecyl sulfate.......	$[CH_3(CH_2)_{13}]_2SO_4$..	490.81
8154M	**2-Tetradecyne***.......	....	$CH_3C \vdots C(CH_2)_{10}$-$CH_3$	194.35
8154T	**Tetraethylene glycol,** dimethyl ether	2,5,8,11,14-pentoxapentadecane*	$(CH_3OC_2H_4OC_2$-$H_4)_2O$	222.28
	Tetrahydro-. See the parent compounds (e.g., for tetrahydronaphthalene see *Naphth-*			
8155	**"Tetralin".**	See *Naphthalene, 1,2,3,4-tetrahydro-*.*		
8156	**Tetramethylene.**	See *Cyclobutane*.*		
8157	**Tetramethylenediamine.**	See *Putrescine.*		
8158	**Tetramethylene glycol.**	See 1,4-*Butanediol*.*		
8159	**Tetramethylene oxide.**	See *Furan, tetrahydro-.*		
8160	**Tetramethylenimine.**	See *Pyrrolidine.*		
8160M	**1-Tetratriacontanol***..	....	*n*-$C_{34}H_{69}OH$......	494.91
8161	**s-Tetrazine**..........	1,2,4,5-tetrazine...........	$\underline{N{:}NCH{:}NN{:}CH}$..	82.07
8162	*s*-**Tetrazinedione, tetrahydro-.**	See *p-Urazine.*		
8163	**2,1,3,4-Tetrazole**......	1,2,3,5-tetrazole...........	$NHN{:}NCH{:}N$ ...	70.06
8164	**Tetrolic acid**..........	2-butynoic acid*; methylpropiolic acid	$CH_3C \vdots CCOOH$....	84.07
8165	**Tetronal**.............	3,3-bisethylsulfonylpentane*; pentane γ, γ-diethyl sulfone	$(C_2H_5)_2C$-$(SO_2C_2H_5)_2$	256.37
8166	**Tetryl**...............	*N*-methyl-*N*-2,4,6-tetranitroaniline; methylpicrylnitramine	$(NO_2)_3C_6H_2N$-$(NO_2)CH_3$	287.15
8167	**Thalline**.............	1,2,3,4-tetrahydro-6-methoxyquinoline	$C_{10}H_{13}NO$........	163.21
8168	**Thebaine**............	paramorphine.............	$C_{19}H_{21}NO_3$.......	311.37
8169	——, hydrochloride.........	....	$C_{19}H_{21}NO_3 \cdot HCl \cdot H_2O$	365.85
8170	**Theine.**	See *Caffeine.*		
8171	α-**Thenyl alcohol.**	See 2-*Thiophenecarbinol.*		
8172	**Theobromine**.........	3,7-dimethylxanthine........	$C_7H_8N_4O_2$........	180.17

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8138	col. rhomb., 1.505, 1.512, 1.524	....	anh. 117.1	subl. 100	0.36^{20}	7.94^{15}	0.714^{15} eth.; 0.745^{15} chl.
8139	col. liq., 1.4823	0.855	....	185	i.	∞	∞ eth.
8140							
8141	cr.............	$0.7786\frac{51}{4}$	51.1	324.1; 243^{15}	i.	v. s.	v. s. eth.
8142							
8143							
8144	col. liq., 1.4459	0.765	5.5	252.5	i.	v. s.	v. s. eth.
8145							
8146							
8147							
8148							
8149	opaque leaf. f. al.	0.8355; liq. $0.8236\frac{38}{4}$	37.62	263.2; 167^{15}	$.02^{20}$	sl. s.	s. eth.
8150							
8151	col. liq..	0.775	–12	246	i.	v. s.	v. s. eth.
8152							
8153	col. cr..........	....	37	291.2; 162^{15}	v. sl. s.	s.	s. eth.
8154	....	....	57.8–8.0	....	......	......	....
8154M	col. liq........	$0.765\frac{20}{4}$	5.5	252.5	i.	v. s.	v. s. eth.
8154T	col. liq..	$1.0132\frac{20}{20}$	....	275.8	∞	s.	... .
	alene, tetrahydro	–).					
8155							
8156							
8157							
8158							
8159							
8160							
8160M	....	....	91.9–92.2	....	......	......	....
8161	red..........	....	99	subl.	s.	......	....
8162							
8163	leaf. f. al......	....	155	subl.	s.	s.	i. eth.; s. ac. a.; sl. s. bz.
8164	col. tab. f. eth. or CS_2	....	76.5	203	v. s.	v. s.	v. s. eth.; 8.33 CS_2
8165	glit. leaf. f. w	....	85	....	0.22 c.	4.3^{15}	7.1^{15} eth.
8166	yel. monocl. f. al.	1.57^{19}	130	exp. 187	i.	0.422^{18}	v. s. eth.; s. bz., ac. a.
8167	rhomb........	....	43	283.8	s. h.	v. s.	v. s. eth., bz.
8168	glit. pr. f. al., $[\alpha]-218.64^{\circ 15}_{D}$ in al.	1.305	193	....	v. sl. s.	10 c.	0.71^{10} eth.; v. s. chl.; s. bz.
8169	rhomb., $[\alpha]-168.32°_{D}$	....	....	....	s. h.	6.3^{10}	s. eth.
8170							
8171							
8172	wh. rhomb. f. w.	....	337	subl. 290–5	0.03^{18} 0.67^{100}	0.023^{17}	sl. s. eth., amyl. al.; v. sl. s. bz.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8173	**Theophylline**	1,3-dimethylxanthine	$C_7H_8N_4O_2$	180.17
8174	**Thetin, dimethyl-**	2,2-dihydro-2,2-dimethyl-1, 2-oxathietan-4-one	$\underbracket{OS(CH_3)_2CH_2CO}$	120.16
8175	**Thialdine**	5,6-dihydro-2,4,6-trimethyl-1,3,5-dithiazine	$\underbracket{SCH(CH_3)SCH}$- $\underbracket{(CH_3)NHCHCH_3}$	163.29
8175M	**Thiamin,** chloride; **Thiamine,** hydrochloride. See *Vitamin B_1.*			
8176	**Thianthrene**	dibenzo-*p*-dithiin; diphenylene disulfide	$\underbracket{C_6H_4SC_6H_4S}$	216.30
8177	**Thiazole**	thio[*b*]monazole; metathiazole	$\underbracket{SCH:NCH:CH}$	85.12
8178	——**, 2-amino-**	2-thiazolylamine	$C_3H_2NS{\cdot}NH_2$	100.14
8179	**2-Thiazolylamine.**	See *Thiazole, 2-amino-.*		
8180	**2-Thienyl ketone**	2,2′-dithienyl ketone; thienone	$(C_4H_3S)_2CO$	194.26
8180M	**Thiirane.**	See *Ethylene sulfide.*		
8181	**Thioacetic acid**	See *Acetic acid, thiol-.*		
8182	**Thioaniline.**	See *Aniline, p,p′-thiodi-.*		
8183	**Thiocarbonyl chloride.**	See *Phosgene, thio-.*		
8184	**Thiocarbonyl tetrachloride.** See *Methyl mercaptan, perchloro-.*			
8185	**Thiocyanic acid**	sulfocyanic acid	$CNSH$	59.09
8186	——, allyl ester	2-propenyl thiocyanate*; allyl sulfocyanide	$CH_2:CHCH_2CNS$	99.15
8188	——, butyl ester	*n*-butyl sulfocyanate; *n*-butyl rhodanate	$CH_3(CH_2)_3SCN$	115.19
8190	——, *tert*-butyl ester	*tert*-butyl sulfocyanate; *tert*-butyl rhodanate	$(CH_3)_3CSCN$	115.19
8191	——, cyanogen ester	cyanogen sulfide; cyanogen thiocyanate	$N\vdots CSC\vdots N$	84.10
8192	——, ethylene ester.	See *Glycol, dithiocyanate.*		
8193	——, ethyl ester		C_2H_5SCN	87.14
8194	——, isoamyl ester	isoamyl sulfocyanate; isoamyl rhodanate	$(CH_3)_2CH(CH_2)_2$-SCN	129.22
8195	——, isobutyl ester	isobutyl sulfocyanate; isobutyl rhodanate	$(CH_3)_2CHCH_2$-SCN	115.19
8196	——, isopropyl ester	isopropyl sulfocyanate; isopropyl rhodanate	$(CH_3)_2CHSCN$	101.16
8197	——, methyl ester	methyl thiocyanate; methyl sulfocyanate	CH_3SCN	73.11
8198	——, phenyl ester	phenyl sulfocyanate; phenyl rhodanate	C_6H_5SCN	135.18
8199	——, propyl ester	*n*-propyl sulfocyanate; *n*-propyl rhodanate	$CH_3CH_2CH_2SCN$	101.16
8200	**Thiocyanuric acid**	trithiocyanuric acid	$C_3H_3N_3S_3$	177.26
8201	**Thiodiglycol.**	See *Ethanol, 2,2′-thiodi-.*		
8202	**Thiodiphenylamine.**	See *Phenothiazine.*		
8203	**Thiofuran.**	See *Thiophene.*		
8204	**Thioglycolic acid.**	See *Acetic acid, mercapto-.*		
8205	**Thiohydantoin.**	See *Hydantoin, 2-thio-.*		
8206	**Thioisatin.**	See *Thionaphthenequinone.*		
8207	**Thio[*b*]monazole.**	See *Thiazole.*		
8208	**Thionaphthene**	benzothiophene; benzothiofuran	$\underbracket{C_6H_4SCH:CH}$	134.19
8209	**Thionaphthenequinone**	1,2-thionaphthenedione; thioisatin	$\underbracket{C_6H_4SCOCO}$	164.17
8210	**Thionine**	Lauth's violet	$C_{12}H_9N_3S$	227.27
8211	**Thiophene**	thiofuran	$\underbracket{SCH:CHCH:CH}$	84.13

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
8173	monocl. need. f. w.	....	269–72	....	0.44^{15} 1.3^{37}	1.25	sl. s. eth.; s. alk., NH_4OH
8174	deliq. cr......	....	d.,-H_2O	....	s.	s.	....
8175	monocl.......	1.191	43	d.	sl. s.	s.	v. s. eth.
8175M							
8176	monocl. pr. f. al.	....	158–60	353–4 d.; 204^{11}	i.	0.25 c.	s. h. eth., CS_2, H_2SO_4, bz.
8177	col. liq.......	1.198	....	116.8	......	s.	s. eth.
8178	yel. cr. f. al...	....	90	d.	sl. s.	sl. s.	sl. s. eth.
8179							
8180	col. need. f. al.	....	87–8	326	i.	s. h.	s. ord. org. solv.
8180M							
8181							
8182							
8183							
8184							
8185	col. liq..	....	5	d.	∞, d.	v. s.	v. s. eth.
8186	oil..........	1.056^{15}; (1.071^{0})	....	161	v. sl. s.	∞	∞ eth.
8188	col. liq., 1.4636$^{21.5}$	0.9563^{25}	....	184.5–5.5^{743}	i.	s.	s. eth.
8190	oil..........	....	....	d.	......	......	....
8191	rhomb. pl. or leaf.	....	65 (60)	d., subl. 30–40	s.	s.	s. eth.
8192							
8193	col. liq., 1.4666	0.996$\frac{25}{4}$	–85.5	144.4	i.	∞	∞ eth.
8194	col. liq......	....	....	197; 193.5–5^{740}	v. sl. s.	s.	s. eth.
8195	col. liq.......	....	....	174–6	∞	......	....
8196	....	0.963^{20}	....	149–51 (152–3)	i.	∞	∞ eth.
8197	col. liq., 1.46801$^{23.8}$	1.068	–51	133	i. (v. sl. s.)	∞	∞ eth.
8198	liq..........	1.1228$^{23.6}$	....	232	i.	s.	s. eth.
8199	col. liq.......	....	....	163	......	......	....
8200	yel. need......	....	d. 200	....	v. s. h.	v. sl. s.	v. sl. s. eth.
8201							
8202							
8203							
8204							
8205							
8206							
8207							
8208	leaf., 1.63324$^{36.2}$	1.165$\frac{20}{4}$	32	221 volat.	i.	v. s.	v. s. eth.
8209	yel. pr........	....	121	247	i.	s.	....
8210	grn. powd. or br.-blk. leaf.	....	....	....	v. v. sl. s. c.	sl. s.	s. eth.
8211	liq. 1.5287	1.0644$\frac{20}{4}$	–38.30	84.12	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8212	**Thiophene, 2-acetyl-.**	See *Ketone, methyl 2-thienyl.*		
8213	**——, 2-acetyl-5-bromo-.**	See *Ketone, 5-bromo-2-thienyl methyl.*		
8214	**——, 2-acetyl-5-chloro-.**	See *Ketone, 5-chloro-2-thienyl methyl.*		
8215	**——, 2-amino-.**	See *Thiophenine.*		
8216	**——, 2-bromo-**		SCBr:CHCH:CH	163.04
8217	**——, 2-chloro-**		SCCl:CHCH:CH	118.58
8218	**——, 2,5-dibromo-**		SCBr:CHCH:CBr	241.95
8219	**——, 2,5-dibromo-3,4-dinitro-**		$(NO_2)_2C_4Br_2S$	331.95
8220	**——, 2,5-dichloro-**		SCCl:CHCH:CCl	153.03
8221	**——, 2,3-dihydro-2-imino-.**	See *Thiophenine.*		
8222	**——, 2,5-diiodo-**		SCI:CHCH:CI	335.96
8223	**——, 2,3-dimethyl-**	2,3-thioxene	$(CH_3)_2C_4H_2S$	112.18
8224	**——, 2,4-dimethyl-**	2,4-thioxene	$(CH_3)_2C_4H_2S$	112.18
8225	**——, 2,5-dimethyl-**	2,5-thioxene	$(CH_3)_2C_4H_2S$	112.18
8226	**——, 2,5-dinitro-**		$(NO_2)_2C_4H_2S$	174.13
8227	**——, 2-ethyl-**		$C_2H_5C_4H_3S$	112.18
8228	**——, 3-ethyl-**		$C_2H_5C_4H_3S$	112.18
8229	**——, 2-formyl-.**	See 2-*Thiophenecarbonal.*		
8230	**——, 2-iodo-**		C_4H_3IS	210.04
8231	**——, 2-iodo-5-nitro-**		$NO_2C_4H_2IS$	255.04
8232	**——, 2-methyl-**	α-thiotolene	$CH_3C_4H_3S$	98.16
8233	**——, 3-methyl-**	β-thiotolene	$CH_3C_4H_3S$	98.16
8234	**——, 2-methyl-5-phenyl-**		$CH_3{\cdot}C_4H_2S{\cdot}C_6H_5$	174.25
8235	**——, 2-nitro-**		$NO_2C_4H_3S$	129.13
8236	**——, tetrabromo-**		C_4Br_4S	399.76
8237	**——, tetrachloro-**		C_4Cl_4S	221.93
8238	**——, 2,3,5-tribromo-**		C_4HBr_3S	320.86
8239	**——, 2,3,5-tribromo-4-nitro-**		$NO_2C_4Br_3S$	365.86
8240	**——, 2,3,5-trichloro-**		C_4HCl_3S	187.48
8241	**——, 2,3,5-trichloro-4-nitro-**		$NO_2C_4Cl_3S$	232.48
8242	**——, 2,3,5-trimethyl-**		$(CH_3)_3C_4HS$	126.21
8243	**2-Thiopheneacetic acid**	2-thienylacetic acid	$C_4H_3S{\cdot}CH_2COOH$	142.17
8244	**——, α-oxo-**	2-thienylglyoxylic acid; 2-thenoylformic acid	$C_4H_3SCOCOOH$	156.15
8245	**Thiophene aldehyde.**	See *Thiophenecarbonal*.*		
8246	**2-Thiophenecarbinol**	α-thienylcarbinol; α-thenyl alcohol	$C_4H_3S{\cdot}CH_2OH$	114.16
8247	**2-Thiophenecarbonal***	2-thiophenealdehyde; α-thienylformaldehyde; 2-formylthiophene	$C_4H_3S{\cdot}CHO$	112.14
8248	——, oxime	2-thiophenealdoxime	$C_4H_3S{\cdot}CH{:}NOH$	127.16
8249	——, phenylhydrazone	2-thienylformaldehyde phenylhydrazone	$C_4H_3S{\cdot}CH{:}NNH\text{-}C_6H_5$	202.27

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8212							
8213							
8214							
8215							
8216	col..........	$1.652\frac{23}{23}$	....	149.5–50.5	i.	v. s.	v. s. eth.
8217	col., 1.5487	$1.2863\frac{20}{4}$	−71.91	128.32	i.	∞	∞ eth.
8218	col..........	$2.147\frac{23}{23}$	....	210.5–1.0	i.	v. s.	v. s. eth.
8219	pa. yel.......	....	139–40	....	......	v. s. h.	....
8220	col., 1.5626	$1.4422\frac{20}{4}$	−40.46	162.08	i.	∞	∞ eth.
8221							
8222	col. fluores....	....	40.5	....	i.	v. s.	....
8223	col. liq........	$0.9938\frac{20}{20}$	....	136–7	i.	v. s.	v. s. eth.
8224	liq............	0.9956^{20}	....	138	i.	s.	s. eth.
8225	liq., 1.51418...	$0.9859\frac{19}{4}$	....	137.5	i.	s.	s. eth.
8226	yel. pl........	....	52	290	sl. s.	s.	v. s. eth.
8227	col..........	$0.990\frac{24}{24}$	....	132–4	i.	v. s.	v. s. eth.
8228	col..........	$1.0012\frac{16}{16}$	....	135–6	i.	v. s.	v. s. eth.
8229							
8230	col..........	....	....	182; 73^{15}	......	......	v. s. eth.
8231	lem, yel., shiny	.....	74	....	......	s.	....
3232	col., 1.5203	$1.0194\frac{20}{4}$	−63.5	112.5	i.	∞	∞ eth.
8233	col. oil, 1.5204	$1.0216\frac{20}{4}$	−68.9	115.4	i.	∞	∞ eth.
8234	col. need......	....	49–51	....	......	v. s.	v. s. eth.
8235	monocl. f. al...	....	46.5	225	i.	v. s.	v. s. eth.; i. alk.
8236	wh. need...	.....	116	326	i.	s. h.	v. s. eth.
8237	sp., $1.5915\frac{30}{D}$	$1.7036\frac{30}{4}$	29.09	233.39	i.	v. s.	∞ eth.
8238	shiny spears...	.....	29	259–60	i.	sl. s. h.	v. s. eth.
8239	red-yel. need..	....	106	....	......	......	v. s. eth.
8240	col. oil, 1.5791	$1.5856\frac{20}{4}$	−16.06	198.66	i.	∞	∞ eth.
8241	red-yel. need..	.....	86	....	......	s.	v. s. eth., bz.
8242	col..........	....	....	160–3	......	......	....
8243	col..........	....	76	....	s. h.	s.	s. eth.
8244	cr.+H_2O......	....	+1H_2O 58–59; anh. 91.5	....	v. s.	......	v. s. eth.
8245							
8246	col. liq........	....	....	207	i.	v. s.	v. s. eth.
8247	yel. oil........	$1.215\frac{21}{21}$	....	198	i.	v. s.	s. eth.
8248	wh. need......	....	128	....	......	......	v. s. eth.
8249	yel. need......	....	134.5	....	i.	s.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8250	**2-Thiophenecarboxylic acid***	α-thiophenic acid	$C_4H_3S{\cdot}COOH$	128.14
8251	**——, 3-methyl-**		$CH_3C_4H_2S{\cdot}COOH$	142.17
8252	**——, 5-methyl-**	*o,o*-thiotolenic acid	$CH_3C_4H_2S{\cdot}COOH$	142.17
8253	**3-Thiophenecarboxylic acid***	β-thiophenic acid	$C_4H_3S{\cdot}COOH$	128.14
8254	**2,3-Thiophenedicarboxylic acid***		$C_4H_2S(COOH)_2$	172.15
8255	**2,4-Thiophenedicarboxylic acid***		$C_4H_2S(COOH)_2$	172.15
8256	**2,5-Thiophenedicarboxylic acid***		$C_4H_2S(COOH)_2$	172.15
8257	——, diethyl ester		$C_4H_2S(COOC_2H_5)_2$	228.26
8258	**2-Thiophene-ol, 5-methyl-**	2,5-thiotenol	$CH_3C_4H_2S{\cdot}OH$	114.16
8259	**2-Thiophenesulfonamide**		$C_4H_3S{\cdot}SO_2NH_2$	163.21
8260	**3-Thiophenesulfonamide**		$C_4H_3S{\cdot}SO_2NH_2$	163.21
8261	**α-Thiophenic acid.**	See 2-*Thiophenecarboxylic acid**.		
8262	**β-Thiophenic acid.**	See 3-*Thiophenecarboxylic acid**.		
8263	**Thiophenine**	2-aminothiophene or 2,3-dihydro-2-iminothiophene	$C_4H_3S{\cdot}NH_2$ or $C_4H_4S(:NH)$	99.15
8264	**——, *N*-acetyl-.**	See *Acetamide, N-2-thienyl-*.		
8265	**——, *N*-methyl-**		$CH_3NHC_4H_3S$	113.17
8266	**Thiophenol.**	See *Phenol, thio-*.		
8267	**Thiopyrine**	1,5-dimethyl-2-phenyl-3-thio-3-pyrazolone	$CH_3NN(C_6H_5)$- $CSCH{:}CCH_3$	204.28
8268	**Thiosalicylic acid.**	See *Benzoic acid, o-mercapto-*.		
8269	**Thiosinamine.**	See *Urea, allylthio-*.		
8270	**2,5-Thiotenol.**	See 2-*Thiophene-ol, 5-methyl-*.		
8271	**α-Thiotolene.**	See *Thiophene, 2-methyl-*.		
8272	**β-Thiotolene.**	See *Thiophene, 3-methyl-*.		
8273	**o,o-Thiotolenic acid.**	See 2-*Thiophenecarboxylic acid, 5-methyl-*.		
8274	**Thiourea.**	See *Urea, thio-*.		
8275	**Thioxene.**	See *Thiophene, dimethyl-*.		
8276	**Thiuram disulfide, dicyclopentamethylene-.**	See *Disulfide, bis(1-piperidyl-*		
8277	**——, diethyldimethyl-.**	See *Disulfide, bis(ethylmethylthiocarbamyl)*.		
8278	**——, tetrabenzyl-.**	See *Disulfide, bis(tetrabenzylthiocarbamyl)*.		
8279	**——, tetrabutyl-.**	See *Disulfide, bis(dibutylthiocarbamyl)*.		
8280	**——, tetraethyl-.**	See *Disulfide, bis(diethylthiocarbamyl)*.		
8281	**——, tetramethyl-.**	See *Disulfide, bis(dimethylthiocarbamyl)*.		
8282	**——, dicyclopentamethylene-.**	See *Sulfide, bis(1-piperidylthiocarbonyl)*.		
8283	**Thiuram sulfide, tetramethyl-.**	See *Sulfide, bis(dimethylthiocarbamyl)*.		
8283M	**D-Threose**	*l*-threose, formerly	$C_4H_8O_4$	120.10
8284	**α-Thujone**	6-ketosabinane (one form)	$C_{10}H_{16}O$	152.23
8286	**Thymine**	5-methyluracil	$NHCONHCOC$- $(CH_3){:}CH$	126.11

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
8250	need. f. w.		126.5	260 d.	0.75^{25}, v.s.h.	v. s.	v. s. eth.; sl. s. lgr.
8251	col. need.		140; 144		sl. s. c., v.s.h.	v. s.	v. s. eth.
8252	col. need.		137 subl.		sl. s. c., v. s. h.	v. s.	v. s. eth.
8253	need. f. w.		136	subl.	0.43^{25}		
8254	need. f. w.		270 d.		sl. s. h.		v. s. eth.
8255	cr.		280 subl. d.		sl. s. h.		
8256	wh. cr.		subl. >350		sl. s. h.	s.	s. eth.
8257	need. or pr.		50			v. s.	
8258	col. oil			85^{40} unst.	sl. s.	v. s.	v. s. eth.
8259	wh.		141–2		sl. s.		
8260	shiny pl.		152–3		sl. s.		
8261							
8262							
8263	yel. resin. oil			$61–2^{1}$ d.	v. s.	v. s.	i. eth.
8264							
8265	col.			$88–92^{15}$			
8266							
8267	col. cr.		166		sl. s. c., s.h.	s.	s. eth.
8268							
8269							
8270							
8271							
8272							
8273							
8274							
8275							
8276	*thiocarbonyl*).						
8277							
8278							
8279							
8280							
8281							
8282							
8283							
8283M	micr. col. need., v. hygr.; $[\alpha]^{22}_{D}$ +29.09 to +19.59, $[\alpha]^{20}_{D}$ −12.5		126–32		v. s.	v. sl. s.	i. eth., pet. eth.
8284	col. liq., $1.4540^{13.6}$	0.913^{20}		200	v. sl. s.	∞	∞ eth.
8286	need. f. al.		d. 270		0.74^{22}	sl. s.	v. sl. s. eth.; s. alk., H_2SO_4

No.	Name	Synonyms	Formula	Mol. Wt.
8287	**Thymohydroquinone**	2,5-*p*-cymenediol	$CH_3(C_3H_7)C_6H_2-(OH)_2$	166.21
8288	**Thymol**	3-*p*-cymenol	$CH_3(C_3H_7)C_6H_3-OH$	150.21
8289	——, *l*-**hexahydro-**.	See *l-Menthol.*		
8290	——, **6-nitroso-**	thymoquinone 2-oxime	$C_{10}H_{13}O(:NOH)$	180.22
8291	**Thymolphthalein**		$\underbrace{OCOC_6H_4C}-$ $(C_{10}H_{13}O)_2$	430.52
8292	**Thymoquinone**	3,6-*p*-menthadiene-2,5-dione; 2-isopropyl-5-methylhydroquinone	$(CH_3)_2CHC_6H_2-(CH_3)O_2$	164.20
8293	——, 2-oxime.	See *Thymol, 6-nitroso-.*		
8294	*o*-**Thymotic acid**	3-hydroxy-2-*p*-cymenecarboxylic acid	$CH_3(C_3H_7)C_6H_2-(OH)COOH$	194.22
8295	**Thymylamine**	3-*p*-cymylamine; 2-isopropyl-5-methylaniline	$C_3H_7(CH_3)C_6H_3-NH_2$	149.23
8296	**Thyronine, tetraiodo-.**	See *Thyroxine.*		
8297	*d*-**Thyroxine**	β-[(3,5-diiodo-4-hydroxyphenoxy)-3,5-diiodophenyl]-*d*-alanine	$HOC_6H_2I_2OC_6H_2-I_2CH_2CH(NH_2)-COOH$	776.93
8298	L-**Thyroxine**	*l*-tetraiodothyronine	$C_{15}H_{11}I_4NO_4$	776.93
8299	**Tiglaldehyde**	2-methyl-2-butenal*; α, β-dimethylacrolein; guaiole	$CH_3CH:C(CH_3)-CHO$	84.11
8300	**Tiglic acid**	2-methyl-2-butenoic acid* (one form); α, β-dimethylacrylic acid	$CH_3CH:C(CH_3)-COOH$	100.11
8301	**Tin, diethyl-***	tin diethyl	$Sn(C_2H_5)_2$	176.82
8302	——, **diethyldimethyl-***	diethyldimethylstannane	$(C_2H_5)_2Sn(CH_3)_2$	206.89
8303	——, **hexaethyldi-**	triethyltin	$(C_2H_5)_3SnSn-(C_2H_5)_3$	411.76
8304	——, **tetraethyl-***	tetraethylstannane; tin tetraethyl	$Sn(C_2H_5)_4$	234.94
8305	——, **tetraisoamyl-**	tetraisoamylstannane	$[(CH_3)_2CHCH_2-CH_2]_4Sn$	403.26
8306	——, **tetramethyl-***	tin tetramethyl; tetramethylstannane	$Sn(CH_3)_4$	178.84
8307	——, **tetraphenyl-***	tetraphenylstannane	$(C_6H_5)_4Sn$	427.10
8308	——, **tetrapropyl-***	tetrapropylstannane	$(CH_3CH_2CH_2)_4Sn$	291.05
8309	——, **tetra-*o*-tolyl-**	tetra-*o*-tolylstannane	$(CH_3C_6H_4)_4Sn$	483.21
8310	——, **tetra-*p*-tolyl-**	tetra-*p*-tolylstannane	$(CH_3C_6H_4)_4Sn$	483.21
8311	——, **triethyl-.**	See *Tin, hexaethyldi-.*		
8312	**Tin chloride, tribenzyl-***		$(C_6H_5CH_2)_3SnCl$	427.54
8313	——, **triethyl-***		$(C_2H_5)_3SnCl$	241.34
8314	——, **triisoamyl-**		$[(CH_3)_2CHCH_2-CH_2]_3SnCl$	367.57
8315	——, **triphenyl-***		$(C_6H_5)_3SnCl$	385.46
8316	**Tin dichloride, diethyl-***		$(C_2H_5)_2SnCl_2$	247.74

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8287	pr.	....	143 (139)	290	s. h.	s.	s. eth.
8288	col. hex. pl. $1.51893^{24.4}$, 1.525, 1.609	$0.969\frac{20}{4}$; $0.978\frac{15}{4}$	51.5	233.5	0.085^{20}, 0.132^{37}	357^{20} 91%	360^{20} eth.; s. chl., CS_2, glac. ac. a.; sl. s. glyc.
8289							
8290	need.	....	160	....	i.	v. s.	v. s. eth.
8291	col. need.	....	245–6	....	....	s.	s. eth., acet. caustic alk., chl.
8292	yel. tricl. tab.	....	45.5	232	v. sl. s.	v. s.	v. s. eth.; s. chl.
8293							
8294	monocl. f. w. or bz.	....	127	subl.	0.01 c.	s.	s. eth., bz.
8295	oil	....	....	230	v. sl. s.	s.	s. eth.
8296							
8297	need.	....	237 d.	....	....	....	....
8298	wh. or sl. yel. need.	....	235–6 d.	....	0.001	i.	i. eth.
8299	liq., 1.4495	0.865	....	116.5	40–50	∞	∞ eth.
8300	col. tricl. pr., 1.4342^{81}	$0.872\frac{20}{4}$; $0.964\frac{76}{4}$	64	198.5	sl. s. c., v. s. h.	s.	s. eth.
8301	yel. oil	1.558^{15}	....	d.	i.	s.	s. eth.
8302	col. liq.	1.2319^{19}	<-13	144–6	i.	i.	s. org. solv.
8303	liq.	$1.4115\frac{0}{4}$	....	270 d.	i.	i.	s. eth., bz.
8304	col. liq., 1.5143	1.187^{23}	–112	181	i.	s.	s. eth.
8305	liq.	$1.035^{19.6}$	....	188^{24}	....	....	....
8306	col. liq., 1.5201	$1.314\frac{0}{4}$	....	78	i.	s.	s. eth.
8307	col. tetr. f. xylene	$1.490\frac{0}{4}$	226	>420	i.	sl. s.	s. h. bz., pyr., CCl_4, chl., ac. a.
8308	col. liq.	$1.1065^{20.2}$	....	222–5	i.	....	s. org. solv.
8309	col. liq.	....	158–9 (215)	....	i.	i.	s. eth., bz.
8310	col. need.	....	230–3	....	i.	sl. s.	sl. s. eth.; s. bz., chl., CS_2, pyr.
8311							
8312	wh. need.	....	142–4	d.	i.	i.	s. eth., ac. a., acet., bz., chl., pyr.
8313	col. liq.	1.428^{8}	10(15.5)	208–10	i. c.	....	s. org. solv.
8314	....	$1.1290^{34.2}$	–30.2	114^{13}	....	....	....
8315	col. cr.	....	106	$240^{13.5}$	i.	....	s. org. solv.
8316	wh. need.	....	84–5	220	s.	....	s. HCl, org. solv.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8317	**Tin difluoride, diethyl-***		$(C_2H_5)_2SnF_2$	214.82
8318	**Tin oxide, diethyl-***	diethylstannone	$(C_2H_5)_2SnO$	192.82
8319	**Tin trichloride, methyl-***		CH_3SnCl_3	240.11
8320	**T.N.A.**	See *Aniline, 2,4,6-trinitro-*.		
8321	**T.N.T.**	See *Toluene, 2,4,6-trinitro-**.		
8322	**Tobias' acid.**	See *2-Naphthylamine-1-sulfonic acid.*		
8322M	**α-Tocopherol**	one factor of vitamin E	$C_{29}H_{50}O_2$	430.70
8323	**Tolan.**	See *Acetylene, diphenyl-*.		
8324	***o*-Tolidine**	4,4′-bi-*o*-toluidine ($NH_2=1$); 4,4′-diamino-3,3′-dimethylbiphenyl	$[NH_2(CH_3)C_6H_3]_2$	212.29
8325	***m*-Tolidine**	4,4′-bi-*m*-toluidine ($NH_2=1$); 4,4′-diamino-2,2′-dimethylbiphenyl	$[NH_2(CH_3)C_6H_3]_2$	212.29
8326	***p*-Tolidine**		$[NH_2(CH_3)C_6H_3]_2$	212.29
8327	***o*-Tolualdehyde**	2-methylbenzenecarbonal*; *o*-methylbenzaldehyde	$CH_3C_6H_4CHO$	120.14
8328	***m*-Tolualdehyde**	*m*-methylbenzaldehyde	$CH_3C_6H_4CHO$	120.14
8329	***p*-Tolualdehyde**	*p*-methylbenzaldehyde	$CH_3C_6H_4CHO$	120.14
8330	**α-Tolualdehyde**	phenylacetaldehyde	$C_6H_5CH_2CHO$	120.14
8331	***o*-Toluamide**	*o*-methylbenzamide	$CH_3C_6H_4CONH_2$	135.16
8332	***m*-Toluamide**	*m*-methylbenzamide	$CH_3C_6H_4CONH_2$	135.16
8333	***p*-Toluamide**	*p*-methylbenzamide	$CH_3C_6H_4CONH_2$	135.16
8334	**α-Toluanilide**	α-phenylacetanilide	$C_6H_5CH_2CONH-C_6H_5$	211.25
8335	**Tolubenzyl alcohol.**	See *Carbinol, tolyl-*.		
8336	**Toluene**	methylbenzene; phenylmethane	$C_6H_5CH_3$	92.13
8337	——, **α-amino-.**	See *Benzylamine.*		
8338	——, **ω-azido-.**	See *Toluene, α-triazo-*.		
8339	——, **benzyl-.**	See *Methane, phenyltolyl-*.		
8340	——, **α-(benzyldithio)-.**	See *Benzyl disulfide.*		
8341	——, ***o*-bromo-**	*o*-tolyl bromide	$CH_3C_6H_4Br$	171.04
8342	——, ***m*-bromo-**	*m*-tolyl bromide	$BrC_6H_4CH_3$	171.04
8343	——, ***p*-bromo-**	*p*-tolyl bromide	$BrC_6H_4CH_3$	171.04
8344	——, **α-bromo-.**	See *Benzyl bromide.*		
8345	——, **α-bromo-*o*-nitro-**	*o*-nitrobenzyl bromide	$NO_2C_6H_4CH_2Br$	216.04
8346	——, **α-bromo-*m*-nitro-**	*m*-nitrobenzyl bromide	$NO_2C_6H_4CH_2Br$	216.04
8347	——, **α-bromo-*p*-nitro-**	*p*-nitrobenzyl bromide	$NO_2C_6H_4CH_2Br$	216.04
8348	——, **butoxy-.**	See *Ether, butyl tolyl.*		
8349	——, ***o*-butyl-**	1-butyl-2-methylbenzene	$CH_3C_6H_4(CH_2)_3-CH_3$	148.24

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8317	sq. pl. or lng. rhomb. tab. f. me. al.	....	229	....	....	0.45^{31}	2.64^{31} me. al.; 0.047^{31} bz.
8318	wh. powd.	....	infus.	....	i.	....	s. HCl, dil. a., conc. alk.; i. org. solv.
8319	col. cr.	....	43	....	s. c.	....	s. org. solv.; hyd. by alk.
8320							
8321							
8322							
8322M	pa. yel. oily liq.	....	....	d. 350	i.	s.	s. eth.
8323							
8324	col. sc. f. h. w.	....	126.5–9	....	sl. s.	v. s.	v. s. eth.
8325	pr. f. h. w.	....	107–8	....	s. h.	v. s.	v. s. eth.
8326	leaf	....	103	....	s. h.	v. s.	v. s. eth.
8327	liq., $1.54852^{19.0}$	1.039	....	195.5	sl. s.	s.	s. eth.
8328	liq., $1.54068^{21.4}$	1.019	....	199(195.5)	sl. s.	∞	∞ eth.
8329	liq., $1.54693^{16.6}$	1.020	....	204	sl. s.	∞	∞ eth.
8330	col. liq., $1.52546^{19.6}$	1.027	<−10	194	v. sl. s.	∞	∞ eth.
8331	col. need. f. w.	....	147 (139–40)	....	sl. s. c., v. s. h.	v. s.	v. s. eth.
8332	need. f. eth.	....	97 (94)	....	sl. s.	s.	sl. s. eth.; v. sl. s. bz.
8333	col. need. f. w.	....	165 (159–60)	....	sl. s. c., v. s. h.	v. s.	v. s. eth.
8334	wh. pr. f. al.	....	117	....	i.	3.3	1.1 eth.; i. H_2SO_4, dil. KOH
8335							
8336	col. liq., 1.49693^{20}	0.86694^{20}	−95	110.626	0.047^{16}	∞	∞ eth.; s. chl., glac. ac. a., acet., CS_2, bz.
8337							
8338							
8339							
8340							
8341	col. liq.	1.422	−27 (−26 to −29)	181.75	i.	v. s.	v. s. eth., bz.
8342	col. liq., 1.551	$1.4099\frac{20}{4}$	−39.8	183.7	i.	s.	∞ eth.
8343	rhomb. cr. f. al., 1.5490	$1.3898\frac{20}{4}$	28	184–5	i.	s.	s. eth., bz.
8344							
8345	cr. f. dil. al.	....	46–7	....	i.	v. s.	s. bz.
8346	need.	....	58	....	v. sl. s.	s.	....
8347	need. f. al.	....	100 (97–8)	....	sl. s. (i.)	2^{19}; 37^{75}	v. s. eth.
8348							
8349	oil	$0.8702\frac{18}{4}$	....	200–1	i.	sl. s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8350	**Toluene, *m*-butyl-**	1-butyl-3-methylbenzene	$CH_3C_6H_4C_4H_9$	148.24
8351	**——, *p*-butyl-**	1-butyl-4-methylbenzene	$CH_3C_6H_4C_4H_9$	148.24
8352	**——, 3-*tert*-butyl-2,4,6-trinitro-**	artificial musk	$[(CH_3)_3C](CH_3)C_6H(NO_2)_3$	283.24
8353	**——, *o*-chloro-**	2-chloro-1-methylbenzene	$ClC_6H_4CH_3$	126.58
8354	**——, *m*-chloro-**	3-chloro-1-methylbenzene	$ClC_6H_4CH_3$	126.58
8355	**——, *p*-chloro-**	4-chloro-1-methylbenzene	$ClC_6H_4CH_3$	126.58
8356	**——, α-chloro-.**	See *Benzyl chloride.*		
8357	**——, α-chloro-α,α-difluoro-**	benzodifluorochloride	$C_6H_5CF_2Cl$	162.57
8358	**——, chloromercuri-.**	See *Mercury chloride, tolyl-.*		
8359	**——, α-chloro-*o*-nitro-**	*o*-nitrobenzyl chloride	$NO_2C_6H_4CH_2Cl$	171.58
8360	**——, α-chloro-*m*-nitro-**	*m*-nitrobenzyl chloride	$NO_2C_6H_4CH_2Cl$	171.58
8361	**——, α-chloro-*p*-nitro-**	*p*-nitrobenzyl chloride	$NO_2C_6H_4CH_2Cl$	171.58
8362	**——, diamino-.**	See *Tolylenediamine.*		
8363	**——, α,α-dibromo-.**	See *Benzylidene bromide.*		
8364	**——, α,α-dibromo-*p*-nitro-**	*p*-nitrobenzal bromide	$NO_2C_6H_4CHBr_2$	294.95
8365	**——, α,α-dichloro-.**	See *Benzylidene chloride.*		
8366	**——, α,4-dichloro-.**	See *Benzyl chloride, p-chloro-.*		
8366M	**——, α,α-dichloro-α-fluoro-**	benzofluoride dichloride	$C_6H_5CCl_2F$	179.02
8367	**——, α,α-dichloro-*m*-nitro-**	*m*-nitrobenzal chloride	$NO_2C_6H_4CHCl_2$	206.03
8368	**——, α,α-dichloro-*p*-nitro-**	*p*-nitrobenzal chloride	$NO_2C_6H_4CHCl_2$	206.03
8369	**——, 3,5-diethyl-**	1,3-diethyl-5-methylbenzene*	$(C_2H_5)_2C_6H_3CH_3$	148.24
8370	**——, *o*-diethylamino-.**	See *o-Toluidine, N,N-diethyl-.*		
8371	**——, *p*-diethylamino-.**	See *p-Toluidine, N,N-diethyl-.*		
8371M	**——, α,α-difluoro-.**	See *Benzal fluoride.*		
8372	**——, 1,2-dihydro-**		$C_6H_7CH_3$	94.15
8373	**——, 2,3-dihydroxy-.**	See *Pyrocatechol, 3-methyl-.*		
8374	**——, 2,4-dihydroxy-.**	See *Cresorcinol.*		
8375	**——, 2,5-dihydroxy-.**	See *Toluhydroquinone.*		
8376	**——, 2,6-dihydroxy-.**	See *Resorcinol, 2-methyl-.*		
8377	**——, 3,5-dihydroxy-.**	See *Orcinol.*		
8378	**——, 2,4-dinitro-**	1-methyl-2,4-dinitrobenzene	$(NO_2)_2C_6H_3CH_3$	182.13
8379	**——, 2,5-dinitro-**	2-methyl-1,4-dinitrobenzene	$(NO_2)_2C_6H_3CH_3$	182.13
8380	**——, 2,6-dinitro-**	2-methyl-1,3-dinitrobenzene	$(NO_2)_2C_6H_3CH_3$	182.13
8381	**——, 3,4-dinitro-**	4-methyl-1,2-dinitrobenzene	$(NO_2)_2C_6H_3CH_3$	182.13
8382	**——, 3,5-dinitro-**	1-methyl-3,5-dinitrobenzene	$(NO_2)_2C_6H_3CH_3$	182.13
8383	**——, *o*, *m* or *p*-ethoxy-.**	See *Ether, ethyl tolyl.*		
8384	**——, α-ethoxy-.**	See *Ether, benzyl ethyl.*		
8385	**——, *o*-ethyl-**	1-ethyl-2-methylbenzene	$CH_3C_6H_4C_2H_5$	120.19

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8350	oil	0.8624_{4}^{18}	...	197–8	i.	sl. s.	s. eth.
8351	oil	0.86132_{4}^{14}	...	198–9	i.	sl. s.	s. eth.
8352	wh. need. f. al.	...	85(97)	...	i.	s.	s. eth., bz.
8353	col. liq., 1.5238	1.0817_{4}^{20}	–34(–36)	159	i.	s.	∞ eth.; s. bz., chl.
8354	col. liq., 1.5214^{19}	1.0722_{4}^{20}	–47.8	162	i.	s.	∞ eth.; s. bz., chl.
8355	col. liq., 1.5199^{19}	1.0697_{4}^{20}	7.5	162	i.	s.	∞ eth.; s. bz., chl.
8356							
8357	col. liq.	1.254^{13}	...	142.6^{770}	i.	s.	s. eth.
8358							
8359	cr. f. lgr., $1.5557^{61.5}$	...	49	...	i.	s.	v. s. h. eth.
8360	yel. need. f. lgr., $1.5577^{61.5}$	...	44.5	183^{35}	i.	s.	s. eth.
8361	leaf. or need. f. w. $1.5647^{61.5}$	...	71	...	i.	7.10^{25}	s. eth.; 8.87^{25} me. al.; 69.7^{25} bz.
8362							
8363							
8364	need. f. al.	...	82.0–2.5	...	i.	v. s.	v. s. eth.
8365							
8366							
8366M	col. liq., 1.5180^{11}	1.3138^{11}	...	178–180	d.	s. d.	...
8367	monocl. cr. f. al.	...	65	...	i.	v. s. h.	v. s. h. eth.
8368	pr. f. al.	...	46	...	i.	s.	s. eth.
8369	col. liq.	0.879_{4}^{20}	...	198–200	i.	∞	∞ eth.
8370							
8371							
8371M							
8372	liq., 1.4763	0.8354_{4}^{20}	...	110.1	i.	v. s.	s. eth.
8373							
8374							
8375							
8376							
8377							
8378	yel. need. f. al. or CS_2, 1.442, 1.662, 1.756	1.521^{15}; 1.321^{71}	69.5–70.5	300 sl. d.	0.027^{22}	3.04^{15}	9.4^{22} eth.; s. bz., CS_2
8379	need. f. al.	1.282^{111}	52.5(50.5)	...	...	v. s.	v. s. bz., CS_2
8380	rhomb. need., 1.479, 1.669, 1.734	1.283^{111}	66(61)	...	...	s.	...
8381	yel. need. f. CS_2	1.259^{111}	59.8 (59–61)	...	i.	s.	s. eth.; 2.2^{17} CS_2
8382	yel. monocl. need. f. w.	1.277^{111}	93	subl.	sl. s.	s.	v. s. eth.; s. CS_2, chl., bz.; sl. s. lgr.
8383							
8384							
8385	col. liq., $1.50569^{16.05}$	0.873	<–17	162	i.	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8386	**Toluene, *m*-ethyl-**	1-ethyl-3-methylbenzene	$CH_3C_6H_4C_2H_5$	120.19
8387	**——, *p*-ethyl-**	1-ethyl-4-methylbenzene	$CH_3C_6H_4C_2H_5$	120.19
8388	**——, *o*-fluoro-**		$CH_3C_6H_4F$	110.13
8389	**——, *m*-fluoro-**		$CH_3C_6H_4F$	110.13
8390	**——, *p*-fluoro-**		$CH_3C_6H_4F$	110.13
8390M	**——, α-fluoro-.**	See *Benzyl fluoride.*		
8391	**——, hexahydro-.**	See *Cyclohexane, methyl-.*		
8392	**——, *o, m* or *p*-hydroxy-.**	See *Cresol.*		
8393	**——, α-hydroxy-.**	See *Benzyl alcohol.*		
8394	**——, *o*-iodo-**		$CH_3C_6H_4I$	218.05
8395	**——, *m*-iodo-**		$CH_3C_6H_4I$	218.05
8396	**——, *p*-iodo-**		$CH_3C_6H_4I$	218.05
8397	**——, α-iodo-.**	See *Benzyl iodide.*		
8398	**——, isopropyl-.**	See *Cymene.*		
8399	**——, *o, m* or *p*-methoxy-.**	See *Ether, methyl tolyl.*		
8400	**——, α-methoxy-.**	See *Ether, benzyl methyl.*		
8402	**——, *o*-nitro-**		$NO_2C_6H_4CH_3$	137.13
8403	**——, *m*-nitro-**		$NO_2C_6H_4CH_3$	137.13
8404	**——, *p*-nitro-**		$NO_2C_6H_4CH_3$	137.13
8405	**——, *o*-nitroso-**		$NOC_6H_4CH_3$	121.13
8406	**——, *m*-nitroso-**		$NOC_6H_4CH_3$	121.13
8407	**——, *p*-nitroso-**		$NOC_6H_4CH_3$	121.13
8408	**——, *o, m* or *p*-phenyl-.**	See *Biphenyl, methyl-.*		
8408M	**——, α-phenyl-.**	See *Methane, diphenyl-.*		
8409	**——, (2-propenoxy-).**	See *Ether, allyl tolyl.*		
8410	**——, propoxy-.**	See *Ether, propyl tolyl.*		
8411	**——, *o*-propyl-**	1-methyl-2-propylbenzene	$CH_3C_6H_4(CH_2)_2CH_3$	134.21
8412	**——, *m*-propyl-**	1-methyl-3-propylbenzene	$CH_3C_6H_4(CH_2)_2CH_3$	134.21
8413	**——, *p*-propyl-**	1-methyl-4-propylbenzene	$CH_3C_6H_4(CH_2)_2CH_3$	134.21
3414	**——, 1,2,3,6-tetrahydro-.**	See *Cyclohexene, 4-methyl-.*		
8415	**——, α-triazo-**	benzyl azide; ω-azidotoluene	$C_6H_5CH_2N_3$	133.15
8416	**——, α-trichloro-**	benzotrichloride; phenylchloroform	$C_6H_5CCl_3$	195.48
8417	**——, α-trifluoro-**	benzotrifluoride; phenyl fluoroform	$C_6H_5CF_3$	146.11
8417M	**——, α-trifluoro-*m*-nitro-**	*m*-nitrobenzotrifluoride	$CF_3C_6H_4NO_2$	191.11
8418	**——, 3,4,5-trihydroxy-.**	See *Pyrogallol, 5-methyl-.*		
8419	**——, 2,3,4-trinitro-***		$(NO_2)_3C_6H_2CH_3$	227.13
8420	**——, 2,4,5-trinitro-***	γ-trinitrotoluene	$(NO_2)_3C_6H_2CH_3$	227.13
8421	**——, 2,4,6-trinitro-***	*sym*-trinitrotoluene; α-trinitrotoluene; "T.N.T."	$(NO_2)_3C_6H_2CH_3$	227.13
8421H	**Tolueneboronic acid, *o*- and *m*-.**	See *Boric acid, o(and m)-tolyl-.*		
8421K	**α-Tolueneboronic acid.**	See *Boric acid, benzyl-.*		
8422	**Toluenediamine.**	See *Tolylenediamine.*		
8423	**α,α-Toluenediamine, *N,N*-dibenzylidene-.**	See *Hydrobenzamide.*		
8424	**α,2,-Toluenedicarboxylic acid.**	See *Homophthalic acid.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8386	col. liq., $1.49966^{19.9}$	0.869^{20}	....	162.5 (158–9)	i.	s.	s. eth.
8387	col. liq., $1.49303^{22.8}$	0.862	<–20	162	i.	s.	s. eth.
8388	col. liq., 1.4704	1.0041^{13}	<–80	114	i.	v. s.	v. s. eth.
8389	col. liq., 1.4691	0.9972^{13}	–110.8	116	i.	v. s.	v. s. eth.
8390	col. liq., 1.470	1.001^{15}	....	117	i.	v. s.	v. s. eth.
8390M							
8391							
8392							
8393							
8394	liq., $1.61066^{15.9}$	1.697	....	211	i.	∞	∞ eth.
8395	liq..........	1.698	....	204	i.	∞	∞ eth.
8396	leaf..........	....	35	211.5	i.	v. s.	v. s. eth.
8397							
8398							
8399							
8400							
8402	yel. liq., $1.54739^{20.4}$	$1.163\frac{20}{4}$	(α)–10.6; (β)–4.1	222.3	0.0652^{30}	∞	∞ eth.; s. bz., chl., pet. eth.
8403	cr. or liq., 1.5475	1.164^{15}; $1.157\frac{20}{4}$	15.5	231	0.0498^{30}	∞	∞ eth.; s. bz.
8404	col. rhomb. need., $1.5346^{62.5}$	1.286^{20}; $1.139\frac{55}{55}$	51.3	238	0.0442^{30}	s.	v. s. eth.; s. bz.
8405	need..........	....	72–2.5	....	....	v. s.	v. s. eth., chl.
8406	need..........	....	53	....	i.	sl. s.	s. eth.
8407	col. need. f. lgr.	....	48	....	v. sl. s. (i.)	....	v. s. bz., h. me. al.
8408							
8408M							
8409							
8410							
8411	liq., $1.50139^{15.75}$	....	....	181–2	i.	s.	....
8412	liq., $1.49640^{17.0}$	0.863^{16}	....	176–7	i.	s.	∞ eth.
8413	liq., $1.49655^{18.8}$	0.8682^{15}	....	183–4	i.	s.	s. eth.
8414							
8415	oil, 1.53414^{25}..	1.0655^{25}	exp.	108^{23}	i.	∞	∞ eth.
8416	col. oil.......	1.38	–22	214	i.	s.	s. eth., bz.
8417	col. liq., 1.41707^{14}	1.196^{14}	–29.05	102.4	i.	∞	∞ eth.
8417M	col. liq., 1.47582^{15}	1.43571	<–20	201.5	i.	s.	s. eth.
8418							
8419	tricl. leaf. f. al.	1.620	112	302 d. exp.	i.	sl. s. c.	v. s. eth.
8420	yel. rhomb. pl. f. acet.	1.620	104	291 d.	i.	sl. s. c.	v. s. eth.
8421	col. monocl. (rhomb.) f.al.	1.654	80.7(81–2)	240 exp.	0.02^{15}	1.99^{32} 18.6^{74}	$3.33^{20.3}$ eth.
8421H							
8421K							
8422							
8423							
8424							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8425	**α,2-Toluenediol.**	See *Saligenin.*		
8426	**α,3-Toluenediol.**	See *Benzyl alcohol, m-hydroxy-.*		
8427	**α,4-Toluenediol.**	See *Benzyl alcohol, p-hydroxy-.*		
8428	***o*-Toluenesulfonamide**		$CH_3C_6H_4SO_2NH_2$	171.21
8429	***p*-Toluenesulfonamide**		$CH_3C_6H_4SO_2NH_2$	171.21
8430	**——, *N*,*N*-dichloro-.**	See *Dichloramine(T).*		
8431	***o*-Toluenesulfonic acid**	2-methylbenzenesulfonic acid	$CH_3C_6H_4SO_3H$	172.19
8432	**——, 5-amino-** ($SO_3H=1$)	*p*-toluidine-3-sulfonic acid ($NH_2=1$)	$NH_2C_6H_3(CH_3)(SO_3H)$	187.21
8433	***m*-Toluenesulfonic acid**		$CH_3C_6H_4SO_3H$	172.19
8434	***p*-Toluenesulfonic acid**	4-methylbenzenesulfonic acid	$CH_3C_6H_4SO_3H$	172.19
8435	**——, 3-amino-** ($SO_3H=1$)	*o*-toluidine-5-sulfonic acid ($NH_2=1$)	$NH_2C_6H_3(CH_3)(SO_3H)$	187.21
8436	***p*-Toluenesulfonyl chloride**	*p*-toluenesulfone chloride	$CH_3C_6H_4SO_2Cl$	190.64
8437	***o*, *m* or *p*-Toluenethiol**	See *Cresol, thio-.*		
8438	**α-Toluenethiol**	benzyl mercaptan; thiobenzyl alcohol; benzyl hydrosulfide	$C_6H_5CH_2SH$	124.19
8439	**Toluhydroquinone**	2-methyl-1,4-benzenediol*; 2-methylhydroquinone; homohydroquinone; 2,5-dihydroxytoluene; hydrotoluquinone	$CH_3C_6H_3(OH)_2$	124.13
8440	***o*-Toluic acid**	*o*-methylbenzoic acid	$CH_3C_6H_4COOH$	136.14
8441	——, ethyl ester		$CH_3C_6H_4COOC_2H_5$	164.20
8442	——, methyl ester		$CH_3C_6H_4COOCH_3$	150.17
8443	——, *p*-phenylphenacyl ester		$CH_3C_6H_4COOCH_2COC_6H_4C_6H_5$	330.37
8444	**——, 4,6-dihydroxy-.**	See *o-Orsellinic acid.*		
8445	**——, α-hydroxy-**	*o*-(hydroxymethyl)benzoic acid	$HOCH_2C_6H_4COOH$	152.14
8446	——, ——, lactone.	See *Phthalide.*		
8447	**——, 3-hydroxy-.**	See 3,2-*Cresotic acid.*		
8448	**——, 4-hydroxy-.**	See 4,2-*Cresotic acid.*		
8449	**——, 5-hydroxy-.**	See 3,6-*Cresotic acid.*		
8450	**——, 6-hydroxy-.**	See 2,6-*Cresotic acid.*		
8451	***m*-Toluic acid**	*m*-methylbenzoic acid	$CH_3C_6H_4COOH$	136.14
8452	——, ethyl ester		$CH_3C_6H_4COOC_2H_5$	164.20
8453	——, *p*-phenylphenacyl ester		$CH_3C_6H_4COOCH_2COC_6H_4C_6H_5$	330.37
8454	**——, 2-hydroxy-.**	See 2,3-*Cresotic acid.*		
8455	**——, 4-hydroxy-.**	See 4,3-*Cresotic acid.*		
8456	**——, 5-hydroxy-.**	See 3,5-*Cresotic acid.*		
8457	**——, 6-hydroxy-.**	See 2,5-*Cresotic acid.*		
8458	***p*-Toluic acid**	*p*-methylbenzoic acid	$CH_3C_6H_4COOH$	136.14
8459	——, ethyl ester		$CH_3C_6H_4COOC_2H_5$	164.20
8460	——, methyl ester		$CH_3C_6H_4COOCH_3$	150.17
8461	——, *p*-phenylphenacyl ester		$CH_3C_6H_4COOCH_2COC_6H_4C_6H_5$	330.37
8462	**——, 2-hydroxy-.**	See 2,4-*Cresotic acid.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
8425							
8426							
8427							
8428	octahdr.	...	153–6	...	0.1^{9}	3.6^{5}	sl. s. eth.
8429	monocl.	...	137.5	...	1.94^{9}	7.42^{5}	sl. s. eth.
8430							
8431	deliq. cr.	...	67.5	128.8^{25}	v. s.	s.	i. eth.
8432	cr.+H_2O	...	d.	...	0.45	i.	...
8433	need.	...	...	...	v. s.	s.	i. eth.
8434	monocl. leaf. or pr.	...	106–7	140^{20}	v. s.	s.	s. eth.
8435	need.	...	...	...	0.974	i.	...
8436	col. tricl. or rhomb.	...	69	146^{15}	i.	s.	s. eth.; v. s. bz.
8437							
8438	liq.	1.058^{20}	...	194–5	i.	v. s.	v. s. eth.; ∞ CS_2
8439	col. rhomb. leaf. f. bz.	...	124–25	163^{11} subl.	v. s.	v. s.	v. s. eth.; sl. s. bz.
8440	col. need., $1.512^{114.6}$	$1.062\frac{115}{4}$	103.7 (104–5)	259.2	0.118c., 2.17^{100}	v. s.	s. chl.
8441	col. liq., $1.50699^{21.6}$	1.033; $1.038\frac{15}{4}$	<−10	221.3	i.	∞	∞ eth.
8442	liq.	1.073^{15}	<−50	213	i.	∞	∞ eth.
8443	...	...	94.5	...	...	...	...
8444							
8445	need.	...	120 (128) d.	...	0.4^{20}	v. s.	v. s. eth.
8446							
8447							
8448							
8449							
8450							
8451	col. pr. f. w., 1.509	1.054^{112}	108.75 (109–12)	263	0.085^{15} 1.7^{100}	v. s.	v. s. eth.
8452	col. liq., $1.50502^{21.6}$	1.028	...	226.4	i.	∞	∞ eth.
8453	...	...	136.5	...	...	...	...
8454							
8455							
8456							
8457							
8458	col. need. f. w.	...	179.6	275	0.034c., 1.26^{100}	v. s.	v. s. eth.
8459	col. liq., $1.50888^{18.3}$	1.026	...	228 (235.5)	i.	∞	∞ eth.
8460	cr. f. pet. eth.	...	33	217	i.	v. s.	v. s. eth.
8461	...	...	165	...	...	...	...
8462							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8463	***p*-Toluic acid, 3-hydroxy-**. See 3,4-*Cresotic acid.*			
8464	**α-Toluic acid**	phenylacetic acid	$C_6H_5CH_2COOH$	136.14
8465	——, ethyl ester	ethyl phenylacetate	$C_6H_5CH_2COOC_2H_5$	164.20
8466	——, isobutyl ester	eglantine	$C_6H_5CH_2COOC_4H_9$	192.25
8467	——, methyl ester	methyl phenylacetate	$C_6H_5CH_2COOCH_3$	150.17
8468	——, piperazinium salt		$C_4H_{10}N_2 \cdot 2C_8H_8O_2$	358.43
8469	——, **o-amino-**, lactam.	See *Oxindole.*		
8470	——, ***p*-amino-**	*p*-aminophenylacetic acid	$NH_2C_6H_4CH_2COOH$	151.16
8471	——, **α-amino-(*dl*)**	*dl*-α-amino-α-phenylacetic acid	$C_6H_5CH(NH_2)COOH$	151.16
8472	——, **2,4-dinitro-**	2,4-dinitrophenylacetic acid; 2,4-dinitrobenzeneethanoic acid	$(NO_2)_2C_6H_3CH_2COOH$	226.14
8473	——, ***o*-hydroxy-**	*o*-hydroxyphenylacetic acid	$HOC_6H_4CH_2COOH$	152.14
8474	——, ***m*-hydroxy-**		$HOC_6H_4CH_2COOH$	152.14
8475	——, ***p*-hydroxy-**		$HOC_6H_4CH_2COOH$	152.14
8476	——, **α-hydroxy-.**	See *Mandelic acid.*		
8477	——, ***o*-methyl-**	*o*-tolylacetic acid	$CH_3C_6H_4CH_2COOH$	150.17
8478	——, ***m*-methyl-**	*m*-tolylacetic acid	$CH_3C_6H_4CH_2COOH$	150.17
8479	——, ***p*-methyl-**	*p*-tolylacetic acid	$CH_3C_6H_4CH_2COOH$	150.17
8480	——, **α-methyl-.**	See *Hydratropic acid.*		
8481	——, **α-methylene-.**	See *Atropic acid.*		
3482	——, ***p*-nitro-**		$NO_2C_6H_4CH_2COOH$	181.14
8483	***o*-Toluic anhydride**		$(CH_3C_6H_4CO)_2O$	254.27
8484	**Toluidine, *N*-naphthyl-**. See *Naphthylamine, N-tolyl-.*			
8485	***o*-Toluidine**	*o*-methylaniline	$CH_3C_6H_4NH_2$	107.15
8486	——, ***N*-acetyl-.**	See *o-Acetotoluide.*		
8487	——, ***N*-benzoyl-.**	See *o-Benzotoluide.*		
8488	——, ***N,N*-diethyl-**	1-diethylamino-2-methylbenzene	$CH_3C_6H_4N(C_2H_5)_2$	163.26
8489	——, ***N,N*-dimethyl-**		$CH_3C_6H_4N(CH_3)_2$	135.20
8490	——, ***N*-methyl-**		$CH_3C_6H_4NHCH_3$	121.18
8491	——, **3-nitro-(NH_2=1)**	2-methyl-3-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8492	——, **4-nitro-**	2-methyl-4-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8493	——, **5-nitro-**	2-methyl-5-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8494	——, **6-nitro-**	2-methyl-6-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8495	——, **4-*o*-tolylazo-** (NH_2=1)	4′-amino-2,3′-dimethylazobenzene	$CH_3C_6H_4N{:}NC_6H_3(CH_3)NH_2$	225.29
8496	——, **4-*p*-tolylazo-**	4-amino-3,4′-dimethylazobenzene	$CH_3C_6H_4N{:}NC_6H_3(CH_3)NH_2$	225.29
8497	***m*-Toluidine**	*m*-methylaniline	$CH_3C_6H_4NH_2$	107.15
8497M	——, hydrochloride		$CH_3C_6H_4NH_3Cl$	143.62

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8463							
8464	col. leaf......	$1.228\frac{20}{4}$; liq. 1.0778^{83}	76.7	265.5	1.66^{20}	186	v. s. eth.; 151 chl.
8465	col. liq., $1.49921^{18.5}$	1.031	....	226 ($120\text{–}1^{20}$)	i.	∞	∞ eth.
8466	....	0.990	....	254; $128\text{–}31^{20}$	i.	s.	s. eth.
8467	col. liq.........	1.044^{16}	d. 360	220	i.	∞	∞ eth.
8468	wh. need......	....	146.5–7.5	....	s. h.	s. h.	i. eth.
8469							
8470	leaf..........	....	199–200 d.	....	i. c., s. h.	s.	....
8471	pr. f. w.+al.	....	237–8 d.	subl. 256	i.	sl. s.	sl. s. most org. solv.
8472	col. need. f. w.	....	179 d. (188–9)	d.	sl. s.	s.	s. eth.
8473	need f. eth....	....	137 (145–7)	240–3 d.	s.		v. s. eth.; sl. s. c. chl.
8474	need. f. bz.+ lgr.	....	129	190^{11}	v. s.	v. s.	v. s. eth.
8475	pr. or need. f. w.	....	148	subl.	v. s. h.	v. s.	v. s. eth.
8476							
8477	col. need. f. w.	....	88–9	....	v. s. h.	....	....
8478	need..........	....	61	....	v. s. h.	....	....
8479	col. need. f. w.	....	91	266	sl. s. c., v. s. h.	v. s.	v. s. eth.; s. bz.
8480							
8481							
8482	col. need. f. w.	....	152–3	d.	sl. s.	sl. s.	sl. s. eth.
8483	col. f. eth.....	....	39	325	d.	d.	v. s. eth.
8484							
8485	col. liq., 1.57276	$1.004\frac{20}{4}$	α,–24.4; β,–16.3	199.84	1.50^{25}	∞	∞ eth.
8486							
8487							
8488	pr. f. w.......	....	72–3	206	v. sl. s.	s.	s. eth.
8489	1.5153.........	$0.9286\frac{20}{4}$	–60.0	184.6	v. sl. s.	∞	∞ eth.
8490	liq., 1.5649....	0.973^{15}	....	207	i.	∞	∞ eth.
8491	yel. rhomb. leaf.	1.378^{15}	91.5	305 d.	1.3 h.	v. s.	v. s. eth., bz.
8492	yel. monocl. f. w.	1.366^{15}	129(127.5)	....	v. sl. s. h.	v. s.	s. bz., glac. ac. a.
8493	yel. monocl. f. al.	1.365^{15}	105 (107)	....	v. sl. s.	s.	s. eth.
8494	or. pr. f. al....	....	96	....	sl. s.	v. s.	v. s. eth.; s. bz., chl.
8495	yel. monocl. pl.	....	100	....	v. sl. s.	s.	s. eth., chl.
8496	yel. pl. f. al....	....	127–8	....	i.	sl. s.	sl. s. lgr.
8497	liq., $1.57106^{22.4}$	$0.989\frac{20}{4}$	–31.5	203.3	sl. s.	∞	∞ eth.
8497M	leaf..........	....	228	249.8	96.3^{12}	61.91^{9} 94%	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8498	***m*-Toluidine, *N*-acetyl-.**	See *m-Acetotoluide.*		
8499	**——, *N*-benzoyl-.**	See *m-Benzotoluide.*		
8500	**——, *N*,*N*-dimethyl-**		$CH_3C_6H_4N(CH_3)_2$	135.20
8501	**——, *N*-methyl-**		$CH_3C_6H_4NHCH_3$	121.18
8502	**——, 2-nitro- (NH_2=1)**	3-methyl-2-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8503	**——, 4-nitro-**	3-methyl-4-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8504	**——, 5-nitro-**	3-methyl-5-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8505	**——, 6-nitro-**	3-methyl-6-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8506	**——, 4-*m*-tolylazo- (NH_2=1)**	4-amino-2,3′-dimethylazobenzene	$CH_3C_6H_4N{:}NC_6H_3(CH_3)NH_2$	225.29
8506M	**——, α-trifluoro-**	*m*-trifluoromethylaniline; *m*-aminobenzotrifluoride	$CF_3C_6H_4NH_2$	161.13
8507	***p*-Toluidine**	*p*-methylaniline	$CH_3C_6H_4NH_2$	107.15
8507M	——, hydrochloride		$CH_3C_6H_4NH_3Cl$	143.62
8508	**——, *N*-acetyl-.**	See *p-Acetotoluide.*		
8509	**——, *N*-benzoyl-.**	See *p-Benzotoluide.*		
8510	**——, 2-bromo-**	2-bromo-4-methylaniline	$Br(CH_3)C_6H_3NH_2$	186.06
8511	**——, 2-bromo-5-nitro-**	2-bromo-4-methyl-5-nitroaniline	$CH_3(NO_2)BrC_6H_2NH_2$	231.06
8512	**——, *N*,*N*-diethyl-**	1-diethylamino-4-methylbenzene	$CH_3C_6H_4N(C_2H_5)_2$	163.26
8513	**——, *N*,*N*-dimethyl-**		$CH_3C_6H_4N(CH_3)_2$	135.20
8514	**——, *N*-methyl-**		$CH_3C_6H_4NHCH_3$	121.18
8515	**——, 2-nitro- (NH_2=1)**	4-methyl-2-nitroaniline; *m*-nitro-*p*-toluidine	$NO_2(CH_3)C_6H_3NH_2$	152.15
8516	**——, 3-nitro-**	4-methyl-3-nitroaniline	$NO_2(CH_3)C_6H_3NH_2$	152.15
8517	**Toluidinesulfonic acid.**	See *Toluenesulfonic acid, amino-.*		
8518	***o*-Tolunitrile**	2-methylbenzenecarbonitrile*; *o*-methylbenzonitrile	$CH_3C_6H_4CN$	117.14
8519	***m*-Tolunitrile**	*m*-methylbenzonitrile	$CH_3C_6H_4CN$	117.14
8520	***p*-Tolunitrile**	4-methylbenzenecarbonitrile*; *p*-methylbenzonitrile	$CH_3C_6H_4CN$	117.14
8521	**——, 2-amino-**	homoanthranilonitrile	$CH_3C_6H_3(NH_2)CN$	132.16
8522	**α-Tolunitrile**	benzyl cyanide; phenylacetonitrile	$C_6H_5CH_2CN$	117.14
8523	**——, α-keto-.**	See *Benzoyl cyanide.*		
8524	**——, *o*-nitro-**	*o*-nitrobenzyl cyanide	$NO_2C_6H_4CH_2CN$	162.14
8525	**——, *p*-nitro-**		$NO_2C_6H_4CH_2CN$	162.14
8525M	**——, α-oxo-.**	See *Benzoyl cyanide.*		
8526	***p*-Toluquinaldine.**	See *Quinoline, 2,6-dimethyl-**.		
8527	**Toluquinone**	2-methylquinone; *p*-toluquinone	$CH_3C_6H_3O_2$	122.12
8528	**α-Toluyl chloride**	phenylacetyl chloride	$C_6H_5CH_2COCl$	154.59
8529	**Toluylene.**	See *Stilbene.*		
8530	**Toluylenediamine.**	See *Tolylenediamine.*		
	Tolyl-. For tolyl derivatives see the parent compounds (e.g., for tolylhydrazine see *Hy-*			
8531	**Tolyl bromide.**	See *Toluene, bromo-.*		
8532	**Tolyl chloride.**	See *Toluene, o,m, or p-chloro-*; see also *Xylene, α-chloro-.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8498							
8499							
8500	1.5492	0.941	....	212.5	v. sl. s.	∞	∞ eth.
8501	liq.	....	....	206	i.	∞	∞ eth.
8502	yel. need.	....	53	....	sl. s.	v. s.	s. a.
8503	yel. need. f. w.	....	138	....	s. h.	s.	s. eth., a.; sl. s. CS_2
8504	or. need.	....	98.4	....	v. sl. s.	v. s.	v. s. eth.; s. bz.
8505	yel. leaf. f. w.	....	109	....	s. h.	v. s.	v. s. eth.; s. bz., chl.
8506	ylsh. br. need. f. al.	....	80	....	sl. s.	s.	....
8506M	col. liq., $1.4847^{12.5}$	$1.30467^{12.5}$	....	187.5	sl. s.	s.	s. eth.
8507	leaf. f. w., $1.55324^{59.1}$	$1.046\frac{20}{4}$; $0.973\frac{50}{50}$	45 (42–3)	200.3	0.74^{21}	150^{30}	s. eth.
8507M	monocl. need.	....	243	257.5 subl.	22.9^{11}	25^{17} 89%	i. eth., bz., CS_2
8508							
8509							
8510	leaf.	1.51^{20}	26 (12–3)	240	i.	s.	s. eth.
8511	yel. need. f. al.	....	121	....	....	....	....
8512	col. liq.	$0.9242\frac{15}{4}$	229	....	v. sl. s.	∞	∞ eth.
8513	liq., 1.53664	$0.9287\frac{20}{4}$	....	210–11	v. sl. s.	∞	∞ eth.
8514	liq.	....	....	206–8	i.	∞	∞ eth.
8515	red monocl. pr. f. al.	1.312^{17}	117 (114)	....	v. sl. s. h.	v. s.	s. conc. H_2SO_4
8516	yel. monocl. f w.	....	77.5 (81.5)	....	s.	v. s. h.	s. eth.; sl. s. CS_2
8517							
8518	col. liq., $1.52720^{23.1}$	$0.9941\frac{25}{4}$	-13 to -14	204	i.	∞	∞ eth.
8519	col. liq.	$0.986\frac{25}{4}$	-23	214	0.085 c., 1.67 h.	∞	∞ eth.
8520	wh.-yel. need. f. al.	$0.9805\frac{30}{30}$	29.5	217	i.	v. s.	v. s. eth.
8521	need. f. al.	....	136	....	i.	v. s.	v. s. eth.
8522	col. liq., 1.52165^{25}	1.015^{18}	-23.8	234; 107^{12}	i.	∞	∞ eth.
8523							
8524	need. f. w.	....	82.5–4.0	....	s. h.	s.	s. eth.
8525	leaf. or pr. f. al.	....	117	....	i.	s.	s. eth.
8525M							
8526							
8527	yel. leaf. or need.	....	69 (65–7)	subl.	s. h.	v. s.	v. s. eth.
8528	col. fum. liq.	$1.168\frac{20}{4}$	....	170^{250}; $94\text{–}5^{12}$	d.	d.	v. s. eth.
8529							
8530	*drazine, tolyl-).*						
8531							
8532							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8533	**Tolylene.**	See also *Xylylene.*		
8534	**3-*o*-Tolylenediamine** (NH_2=1,2)	2,3-toluenediamine; 2,3-diaminotoluene; 2,3-toluylenediamine	$CH_3C_6H_3(NH_2)_2$...	122.17
8535	**4-*o*-Tolylenediamine** (NH_2=1,2)	3,4-toluenediamine; 3,4-diaminotoluene; 3,4-toluylenediamine	$CH_3C_6H_3(NH_2)_2$...	122.17
8536	**2-*m*-Tolylenediamine** (NH_2=1,3)	2,6-toluenediamine; 2,6-diaminotoluene; 2,6-toluylenediamine	$CH_3C_6H_3(NH_2)_2$...	122.17
8537	**4-*m*-Tolylenediamine** (NH_2=1,3)	2,4-toluenediamine; 2,4-diaminotoluene; 2,4-toluylenediamine	$CH_3C_6H_3(NH_2)_2$...	122.17
8538	**5-*m*-Tolylenediamine** (NH_2=1,3)	3,5-toluenediamine; 3,5-diaminotoluene; 3,5-toluylenediamine	$CH_3C_6H_3(NH_2)_2$...	122.17
8539	***p*-Tolylenediamine** (NH_2=1,4)	2,5-toluenediamine; 2,5-diaminotoluene; 2,5-toluylenediamine	$CH_3C_6H_3(NH_2)_2$...	122.17
8540	**Tolylene glycol.**	See *Hydrobenzoin.*		
8541	**Tolyl mercaptan.**	See *Cresol, thio-.*		
8542	**Tolyl mustard oil.**	See *Isothiocyanic acid, tolyl ester.*		
8543	***o*-Tolyl phosphate**....	tri-*o*-cresyl phosphate........	$(CH_3C_6H_4)_3PO_4$...	368.36
8544	***p*-Tolyl phosphate**....	tri-*p*-cresyl phosphate.......	$(CH_3C_6H_4)_3PO_4$...	368.36
8544M	**Torulin.**	See *Vitamin* B_1.		
8545	**Toxicarol**............	....	$C_{23}H_{22}O_7$.........	410.41
8546	**Tragacanthin.**	See *Bassorin.*		
	Tri-. For tribromo, triethyl, etc. derivatives see the parent compounds (e.g., *Acetic*			
8547	**Triacetamide**.........	....	$(CH_3CO)_3N$......	143.14
8548	**Triacetin.**	See *Glycerol, triacetate.*		
8549	**Triacetonamine**.......	2,2,6,6-tetramethyl-4-piperidone	$C_9H_{17}NO{\cdot}H_2O$....	173.25
8550	**Triacontane***.........	*n*-triacontane..............	$CH_3(CH_2)_{28}CH_3$...	422.80
8550M	**1-Triacontanol***.......	....	n-$C_{30}H_{61}OH$......	438.80
8551	**Triazene, 1,3-bis(*p*-nitrophenyl)-.** See *Diazoaminobenzene, 4,4′-dinitro-*.*			
8552	**——, 1,3-di-1-naphthyl-*.** See 1,1′-*Diazoaminonaphthalene*.*			
8553	**——, 1,3-di-2-naphthyl-*.** See 2,2′-*Diazoaminonaphthalene*.*			
8554	**——, 1,3-diphenyl-*.**	See *Diazoaminobenzene*.*		
8555	**——, 1-phenyl-3-*p*-tolyl-**	4-methyldiazoaminobenzene..	$C_6H_5N_2NHC_6H_4$-CH_3	211.26
8556	***sym*-Triazine, hexahydro-1,3,5-triphenyl-**	anhydroformaldehydeaniline; methyleneaniline, trimethylenetrianiline	$(C_6H_5N{\cdot}CH_2)_3$....	315.40
8557	**——, 2,4,6-triamino-.**	See *Melamine.*		
8558	**——, trichloro-.**	*See Cyanuric chloride.*		
8559	***sym*-Triazine-2, 4-diol, 6-amino-.** See *Ammelide.*			
8560	***sym*-Triazinetriol.**	See *Cyanuric acid.*		
8561	***sym*-Triazin-2-ol, 4,6-diamino-.** See *Ammeline.*			
8562	**Triazobenzene.**	See *Benzene, triazo-.*		
8563	**1,2,4-Triazole**.........	*sym*-triazole (one form); pyrro[*ab*$_1$] diazole..........	$\underbrace{NHN{:}CHN{:}CH}$...	69.07
8564	**——, 4,5-dihydro-1,4-diphenyl-3,5-phenylimino-.** See *Nitron.*			
8565	**Tribenzaldiamine.**	See *Hydrobenzamide.*		
8566	**Tribenzoin.**	See *Glycerol, tribenzoate.*		
8567	**Tribenzylamine**.......	....	$(C_6H_5CH_2)_3N$.....	287.39
8568	**Tribromohydrin.**	See *Propane*, 1,2,3-*tribromo-*.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
8533							
8534	cr...........	....	61	255	s.	s.	s. eth.
8535	col. leaf. f. lgr.	....	88.5	265	s.	....	....
8536	pr. f. w.......	....	105	....	s.	s.	....
8537	col. rhomb.; need. f. w.; pr. f. al.	....	99	280	s.	v. s.	v. s. eth.
8538	liq...........	....	....	285	......	s.	s. eth.
8539	leaf. f. bz......	....	64	274	v. s.	v. s.	v. s. eth.
8540							
8541							
8542							
8543	liq...........	....	....	410 sl. d.; 263–5^{20}	i.	v. s.	v. s. eth., bz.
8544	need. f. w.....	....	77–8	....	i.	v. s.	v. s. eth., bz.
8544M							
8545	bright yel.-grn. hex. pl. or rods, 1.580, 1.618, 1.768	....	219	....	......	sl. s.	s. h. chl.
8546							
	acid, tribromo-; (Benzene, triethyl-).						
8547	need. f. eth....	....	79	....	......	......	s. eth.
8548							
8549	tetr. need. f. w.	....	anh. 40; 1H_2O 58	....	s.	s.	s. eth.
8550	cr...........	liq. 0.7797	66.1 (69–70)	235^1	i.	sl. s.	s. eth., bz.
8550M	....	....	86.3–86.5	....	......	......	....
8551							
8552							
8553							
8554							
8555	ylsh. leaf......	....	90–1	d.	i.	......	....
8556	wh. silky need.	....	140–1(143)	185	v. sl. s.	sl. s.	s. eth., bz., chl., tol.
8557							
8558							
8559							
8560							
8561							
8562							
8563	need., 1.48544$^{25.3}$	....	121	260	s.	s.	sl. s. eth.
8564							
8565							
8566							
8567	monocl. f. al...	$0.991\frac{95}{4}$	92	380–90	v. sl. s.	s. h.	s. eth.
8568							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8569	**Tributylamine***	tri-*n*-butylamine	$(CH_3CH_2CH_2CH_2)_3N$	185.35
8570	**Tricarballylic acid**	1,2,3-propanetricarboxylic acid*	$HOOCCH_2CH(COOH)CH_2COOH$	176.12
8571	——, *α,β*-**dihydroxy-**	1,2-dihydroxy-1,2,3,-propanetricarboxylic acid*; hydroxycitric acid	$COOHCH_2COH(COOH)CHOHCOOH$	208.12
8572	——, *α*-**hydroxy-.**	See *Isocitric acid.*		
8573	——, *β*-**hydroxy-.**	See *Citric acid.*		
8574	——, *α,α,β*-**trimethyl-.**	See *Camphoronic acid.*		
8575	**Tricarbonamide**	See *Fulminuric acid.*		
8576	**Tricosane***	*n*-tricosane	$CH_3(CH_2)_{21}CH_3$	324 62
8577	**12-Tricosanone***	dihendecyl ketone; diundecyl ketone; laurone	$[CH_3(CH_2)_{10}]_2CO$	338 60
8578	**Tricresyl phosphate.**	See *Tolyl phosphate.*		
8579	**Tricyanic acid.**	See *Cyanuric acid.*		
8580	**Tricyanogen chloride.**	See *Cyanuric chloride.*		
8581	**Tridecanal*,** oxime	*n*-tridecylaldoxime	$CH_3(CH_2)_{11}CH:NOH$	213 36
8582	**Tridecane***		$CH_3(CH_2)_{11}CH_3$	184 36
8583	——, **1-amino-.**	See *Tridecylamine*.*		
8584	**Tridecanoic acid***	*n*-tridecoic acid; *n*-tridecylic acid	$CH_3(CH_2)_{11}COOH$	214 34
8585	——, **13-(2-cyclopentenyl)-.**	See *Chaulmoogric acid.*		
8586	**1-Tridecanol***	*prim-n*-tridecyl alcohol	$CH_3(CH_2)_{11}CH_2OH$	200 36
8587	**2-Tridecanone***	hendecyl methyl ketone	$CH_3CO(CH_2)_{10}CH_3$	198.34
8588	**7-Tridecanone***	dihexyl ketone; enanthone; oenanthone	$[CH_3(CH_2)_5]_2CO$	198 34
8589	***n*-Tridecoic acid.**	See *Tridecanoic acid*.*		
8590	***n*-Tridecyl alcohol.**	See *1-Tridecanol**		
8591	***n*-Tridecylaldoxime.**	See *Tridecanal, oxime*.*		
8592	**Tridecylamine*** (*n*)	1-aminotridecane; *prim-n*-tridecylamine	$CH_3(CH_2)_{12}NH_2$	199.37
8593	**Tridecylene**		$C_{13}H_{26}$	182 34
8594	***n*-Tridecylic acid.**	See *Tridecanoic acid*.*		
8595	**Triethanolamine.**	triethanolamine	$N(CH_2CH_2OH)_3$	149.19
8596	**Triethylamine***		$(C_2H_5)_3N$	101.19
8597	——, hydrochloride	triethylammonium chloride*	$(C_2H_5)_3N\cdot HCl$	137.65
8598	——, *β, β*-**diethoxy-**	diethylaminoacetal	$(C_2H_5)_2NCH_2CH(OC_2H_5)_2$	189 29
8599	——, *β, β*-**dihydroxy-.**	See *Ethanol, 2,2′-ethyliminodi-.*		
8600	——, *β*-**hydroxy-.**	See *Ethanol, 2-diethylamino-*.*		
8601	——, **2,2′,2″-trihydroxy-.**	See *Triethanolamine*		
8602	**Triethyl arsenate.**	See *Ethyl arsenate.*		
8603	**Triethyl arsenite.**	See *Ethyl arsenite.*		
8604	**Triethyl borate.**	See *Ethyl borate.*		
8606	**Triethylene glycol**	2,2′-ethylenedioxydiethanol; glycol bis(hydroxyethyl) ether	$(CH_2OCH_2CH_2OH)_2$	150.17
8607	**Triethylolamine.**	See *Triethanolamine.*		
8608	**Triethyl phosphate.**	See *Ethyl phosphate.*		
8609	**Triethyl phosphite.**	See *Ethyl phosphite.*		
8610	**Trifuraldiamine.**	See *Hydrofuramide.*		

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* Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C.	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8569	deliq. col. liq.	0.7782^{20}	....	214	sl. s.	v. s.	v. s. eth.
8570	col. rhomb. pr. f. w.	....	162–3	d.	40.5	v. s.	0.86^{15} eth.
8571	need.........	1.39^{35}	160	....	v. s.	sl. s.	v. s. eth.
8572							
8573							
8574							
8575							
8576	glit. leaf. f. al.	0.7799^{48}	47.7	234^{15}	i.	sl. s.	s. eth.
8577	sc. or pl., $1.4283^{79.5}$	$0.8086\frac{69}{4}$	69	....	i.	v. sl. s.	s. eth.
8578							
8579							
8580							
8581	need. f. dil. al.	....	80.5	....	i.	sl. s.	v. s. eth., chl.; sl. s. bz., pet. eth.
8582	col. liq., $1.4419^{16.8}$	0.757	-6.2	234	i.	v. s.	v. s. eth.
8583							
8584	pl............	....	51 (39.5–40.5)	236^{100}	i.	v. s.	v. s. eth.
8585							
8586	col. cr........	$0.8223\frac{31}{4}$	30.63	$155–6^{15}$	i.	s.	s. eth.
8587	cr...........	0.8229^{28}	28	263	i.	v. s.	v. s. eth.
8588	leaf. f. al......	0.825^{30}	33	255^{760}(264)		v. s.	v. s. eth., s. chl., lgr.
8589							
8590							
8591							
8592	col. cr........	....	27	275.7; 108.0^{2}	sl. s.	s.	s. eth.
8593	col. liq........	$0.7977\frac{20}{4}$	....	232.7	i.	v. s.	v. s. eth.
8594							
8595	vis. col. liq., 1.4852	$1.1242\frac{20}{4}$	21.2	$277–9^{150}$	∞	∞	sl. s. eth.
8596	col. liq., 1.40032	$0.7229\frac{25}{4}$	-114.8	89.5	1.5^{20} 1.97^{65}	∞	∞ eth.
8597	cr. f. al.......	$1.0688\frac{21}{4}$	254	subl.	150^{28}	s.	i. eth.
8598	liq...........	0.863^{16}	....	194–5	s.	s.	s. eth.
8599							
8600							
8601							
8602							
8603							
8604							
8606	col. liq........	1.1254	-5	280–90	∞	∞	sl. s. eth.
8607							
8608							
8609							
8610							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8611	**Trifurfurylamine**	α,α′,α″-tri-2-furyltrimethylamine	$(C_4H_3OCH_2)_3N$	257.28
8612	**Trigonelline**	nicotinic acid *N*-methylbetaine	$C_7H_7NO_2$	137.13
8613	**Triisoamylamine**		$[(CH_3)_2CHCH_2CH_2]_3N$	227.43
8614	**Triisoamyl borate.**	See *Isoamyl borate.*		
8615	**Triisobutylamine**		$[(CH_3)_2CHCH_2]_3N$	185.35
8616	**Triisobutyl arsenite.**	See *Isobutyl arsenite.*		
8617	**Triisobutyl borate.**	See *Isobutyl borate.*		
8618	**Triketone, diphenyl-.**	See *Propanetrione, diphenyl-*.*		
8619	**Trilaurin.**	See *Glycerol, trilaurate.*		
8620	**Trimellitic acid**	1,2,4-benzenetricarboxylic acid*	$C_6H_3(COOH)_3$	210.14
8621	**Trimesic acid**	1,3,5-benzenetricarboxylic acid*	$C_6H_3(COOH)_3$	210.14
8622	**——, hydroxy-**	phenol-2,4,6-tricarboxylic acid	$HOC_6H_2(COOH)_3$	226.14
8623	**Trimesitic acid**	2,4,6-pyridinetricarboxylic acid	$C_5H_2N(COOH)_3$	211.13
8624	**Trimethylamine***		$(CH_3)_3N$	59.11
8625	——, hydrochloride	trimethylammonium chloride*	$(CH_3)_3N{\cdot}HCl$	95.58
8626	**——, α,α′,α″-tri-2-furyl-.**	See *Trifurfurylamine.*		
8627	**Trimethyl borate.**	See *Methyl borate.*		
8628	**Trimethylene.**	See *Cyclopropane*.*		
8629	**Trimethylene bromide.**	See *Propane, 1,3-dibromo-*.*		
8630	**Trimethylene bromohydrin.**	See 1-*Propanol, 3-bromo-*.*		
8631	**Trimethylene chloride.**	See *Propane, 1,3-dichloro-*.*		
8632	**Trimethylene chlorohydrin.**	See 1-*Propanol, 3-chloro-*.*		
8633	**Trimethylene cyanide.**	See *Glutaronitrile.*		
8634	**Trimethylenediamine.**	See 1,3-*Propanediamine*.*		
8635	**Trimethylene dibromide.**	See *Propane, 1,3-dibromo-*.*		
8636	**Trimethylene dichloride.**	See *Propane, 1,3-dichloro-*.*		
8637	**Trimethylene dicyanide.**	See *Glutaronitrile.*		
8638	**Trimethylene glycol.**	See 1,3-*Propanediol*.*		
8639	——, diphenyl ether.	See *Propane, 1,3-diphenoxy-*.*		
8640	——, methylene ether.	See *m-Dioxane.*		
8641	**——, α-methyl-.**	See 1,3-*Butanediol*.*		
8642	**——, α,α,α′-trimethyl-.**	See 2,4-*Pentanediol, 2-methyl-*.*		
8643	**Trimethylene methylene dioxide.**	See *m-Dioxane.*		
8644	**Trimethylenetrianiline.**	See *sym-Triazine, hexahydro-1,3,5-triphenyl-.*		
8645	**Trimethylene trisulfide.**	See *Formaldehyde, thio-(trimer).*		
8646	**Trimethylenimine**	tetrahydroazete; azetidine	$CH_2CH_2CH_2NH$	57.09
8647	**Trimethyl phosphate.**	See *Methyl phosphate.*		
8648	**Trinitrin.**	See *Nitroglycerin.*		
	Trinitro-. See the parent compounds (e.g., for trinitrotoluene see *Toluene, trinitro-*).			
8649	**Triolein.**	See *Glycerol, trioleate.*		
8650	**Trional**	2,2-bis(ethylsulfonyl)butane*	$CH_3C(SO_2C_2H_5)_2CH_2CH_3$	242.35
8651	***sym*-Trioxane**	1,3,5-trioxane; α-trioxymethylene	$OCH_2OCH_2OCH_2$	90.08
8652	**——, 2,4,6-trimethyl-.**	See *Paraldehyde.*		
8653	***sym*-Trioxanetriimine.**	See *Cyamelide.*		
8654	**Trioxymethylene.**	See *Polyoxymethylene.*		
8655	**α-Trioxymethylene.**	See *s-Trioxane.*		
8656	**Tripalmitin.**	See *Glycerol, tripalmitate.*		
8657	**Triphenyl.**	See *Terphenyl.*		
	Triphenyl-. For triphenyl derivatives see the parent compounds (e.g., for triphenyl-			

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8611	col. liq........	....	....	133–8^1	i.	......	s. eth.
8612	hyg. pr. f. al...	....	218 d.	....	v. s.	s.	sl. s. eth., chl.; i. bz.
8613	col. liq........	0.7859^{20}	....	237 (242–5)	i.	v. s.	∞ eth.
8614							
8615	col. liq., 1.42519$^{17.3}$	0.766^{25}_{25}	–21.8	191.5 *l*	i.	v. s.	∞ eth.
8616							
8617							
8618							
8619							
8620	col. need. f. w.	....	216 d.	....	s. h.	v. s.	s. eth.
8621	col. pr. f. w....	....	350 (375–80)	subl. <300	2.69^{22}	v. s.	s. eth.
8622	need. f. w.....	....	d. 180	....	0.5^{10}	v. s. h.	sl. s. eth.; i. chl.
8623	pl. f. dil. H_2SO_4	....	227 d.	subl. d.	s. h.	....	sl. s. eth.
8624	col. gas.......	0.662^{-5}	–124	3.5	v. s.	v. s.	s. eth.
8625	col. deliq. cr. f. al.	....	275 d.	....	v. s.	s.	i. eth.
8626							
8627							
8628							
8629							
8630							
8631							
8632							
8633							
8634							
8635							
8636							
8637							
8638							
8639							
8640							
8641							
8642							
8643							
8644							
8645							
8646	col. liq.; odor NH_3	0.843	....	63	∞	....	....
8647							
8648							
8649							
8650	col. tab. f. al. or eth.	1.251^{25}_{4}	74–6	d.	0.3	5.7	4.71^{15} eth.
8651	need.........	....	64	subl. 46	s.	s.	s. eth.
8652							
8653							
8654							
8655							
8656							
8657							
	methane see *Methane, triphenyl-*).						

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8658	**Triphenylamine***		$(C_6H_5)_3N$	245.31
8659	**Triphenylene**	benzo[*l*]phenanthrene; isochrysene	$C_{18}H_{12}$	228.28
8660	**Tripropylamine***(*n*)		$(CH_3CH_2CH_2)_3N$	143.27
8661	**Tripropyl borate.**	See *Propyl borate.*		
8662	**Triquinoyl hydrate.**	See *Cyclohexanehexone, hydrate*.		
8663	**Trisulfide, diallyl.**	See *Allyl trisulfide.*		
8664	**Tritan.**	See *Methane, triphenyl-.*		
8665	——, **α-benzyl-.**	See *Ethane,* 1,1,1,2-*tetraphenyl-.*		
8666	——, **4,4′-dimethyl-.**	See *Methane, phenyldi-p-tolyl-.*		
8667	——, **α-ethyl-.**	See *Propane,* 1,1,1-*triphenyl-.*		
8668	——, ***m* or *p*-methyl-.**	See *Methane, diphenyltolyl-.*		
8669	——, **α-methyl-.**	See *Ethane,* 1,1,1-*triphenyl-.*		
8670	**Tritanol.**	See *Carbinol, triphenyl-.*		
8671	***sym*-Trithiane.**	See *Formaldehyde, thio-.*		
8672	——, **2,4,6-trimethyl-(α)**	α-trithioacetaldehyde; α-trimolecular thioacetaldehyde	$SCH(CH_3)SCH(CH_3)SCHCH_3$	180.34
8673	——, **2,4,6-trimethyl-(β)**	β-trithioacetaldehyde; β-trimolecular thioacetaldehyde	$SCH(CH_3)SCH(CH_3)SCHCH_3$	180.34
8674	——, **triphenyl-** (higher-melting)	β-trithiobenzaldehyde	$[SCH(C_6H_5)]_3$	366.54
8675	——, **triphenyl-** (lower-melting)	α-trithiobenzaldehyde	$(SCHC_6H_5)_3$	366.54
8676	**Tritopine.**	See *Laudanidine.*		
8677	**Trityl.**	See *Methyl, triphenyl-.*		
8678	**Tropacocaine**	benzoylpseudotropeine	$C_{15}H_{19}NO_2$	245.31
8679	——, hydrochloride		$C_{15}H_{19}NO_2 \cdot HCl$	281.78
8680	**Tropaic acid.**	See *Tropic acid.*		
8681	**Tropic acid**	α-phenylhydracrylic acid; tropaic acid	$C_6H_5CH(COOH)CH_2OH$	166.17
8682	——, tropine ester.	See *Atropine.*		
8683	**Tropine**	8-methyl-3-nortropanol; *N*-methyltropoline	$C_8H_{15}NO$	141.21
8684	——, chloroplatinate		$(C_8H_{15}NO \cdot HCl)_2PtCl_4$	692.41
8685	**Tropinecarboxylic acid**	See *l-Ecgonine.*		
8686	**Tropoline, *N*-methyl-.**	See *Tropine.*		
8687	**DL-Tryptophan**	*dl*-β-(3-indyl)alanine; *dl*-α-amino-3-indolepropionic acid	$C_8H_6NCH_2CH(NH_2)COOH$	204.22
8688	**D-Tryptophan**	*d*-β-(3-indyl)alanine; *d*-α-amino-3-indolepropionic acid	$C_8H_6NCH_2CH(NH_2)COOH$	204.22
8689	**L-Tryptophan**	*l*-α-amino-3-indolepropionic acid; *l*-β-3-indylalanine	$C_6H_4NHCH{:}CCH_2CH(NH_2)COOH$	204.22
8690	**Tyramine**	*p*-(β-aminoethyl)phenol; *p*-hydroxyphenethylamine	$HOC_6H_4CH_2CH_2NH_2$	137.18
8691	**Tyrosine, 3,5-diiodo-.**	See *Iodogorgoic acid.*		
8692	**DL-Tyrosine**	*dl*-β-*p*-hydroxyphenylalanine	$HOC_6H_4CH_2CH(NH_2)COOH$	181.19

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8658	monocl. pr. f. eth., 1.353^{16}	$0.774\frac{0}{0}$	126.5	365	i.	sl. s.	s. eth., acet.; v. s. bz.
8659	wh. cr........	....	198.5	....	i.	s.	s. eth.
8660	col. liq., $1.41756^{19.4}$	$0.757\frac{20}{4}$	−93.5	156	v. sl. s.	∞	s. eth.
8661							
8662							
8663							
8664							
8665							
8666							
8667							
8668							
8669							
8670							
8671							
8672	pr............	....	101	247	....	......	....
8673	....	....	125	....	....	......	....
8674	need..........	....	225	....	....	sl. s.	s. ac. a., bz.
8675	wh. amor. powd.	....	160	d.	i.	i.	v. s. chl.; s. bz.
8676							
8677							
8678	glit. need. f. eth., $1.50801^{100.1}$	1.043^{100}	49	d.	sl. s.	v. s.	v. s. eth., bz., chl., NH_4OH
8679	col. need. or pl. f. w.+al.	....	271 (276-7d.)	....	s.	sl. s. c.	i. eth.
8680							
8681	need. or pl. f. al.	....	117–8	d.	2^{15}	s.	s. eth.; i. CS_2
8682							
8683	hyg. tab. f. eth., $1.48113^{99.8}$	$1.039\frac{76}{4}$	63	233	v. s.	v. s.	v. s. eth.; s. chl., bz.
8684	or.-red monocl.	....	198–200	....	s.	i.	....
8685							
8686							
8687	col. hex. pl....	....	283–5	....	sl. s. c., s. h.	sl. s.	....
8688	....	....	281–2	....	....	....	....
8689	col. hex. leaf...	....	293–5 (289 d.)	....	1.14^{25}, 2.79^{75}	sl. s.	i. eth.
8690	need. or leaf. f. bz.	....	161	180	1.05 c.	10	s. bz.; sl. s. h. xylene
8691							
8692	sh. need.......	....	316	....	0.041^{20}	v. sl. s.	i. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8693	**D-Tyrosine**	*d*-*β*-*p*-hydroxyphenylalanine	$HOC_6H_4CH_2CH(NH_2)COOH$	181.19
8694	**L-Tyrosine**	*l*-*α*-amino-*p*-hydroxyhydrocinnamic acid; *l*-*β*-(*p*-hydroxyphenyl)alanine	$HOC_6H_4CH_2CH(NH_2)COOH$	181.19
8695	**Ulexine.**	See *Cytisine.*		
8696	**Umbellic acid**	2,4-dihydroxycinnamic acid	$(HO)_2C_6H_3CH{:}CHCOOH$	180.15
8697	**Umbelliferone**	7-hydroxycoumarin	$C_9H_6O_3$	162.14
	Undecan-.	See *Hendecan-.*		
8698	**Undecene*.**	See *Hendecene*.*		
8699	**Undecenoic acid*.**	See *Hendecenoic acid*.*		
8700	***pri*-*n*-Undecyl alcohol.**	See 1-*Hendecanol*.*		
8701	***n*-Undecylaldehyde.**	See *Hendecanal*.*		
8702	***n*-Undecylamine.**	See *Hendecylamine*.*		
8703	***n*-Undecyl cyanide.**	See *Lauronitrile.*		
8704	***β*-Undecylene.**	See 2-*Hendecene*.*		
8705	***θ*-Undecylenic acid.**	See 9-*Hendecenoic acid*.*		
8706	***n*-Undecylic acid.**	See *Hendecanoic acid*.*		
8706M	**Undecyne.**	See *Hendecyne.*		
8707	**Uracil**	2,4(1,3)-pyrimidinedione	$NHCONHCO$- $CH{:}CH$	112.09
8708	——, **5-methyl-.**	*See Thymine.*		
8708M	**Uradal.**	See *Adalin.*		
8709	**Uramil**	5-aminobarbituric acid; dialuramide; murexan	$NHCONHCO$- $CH(NH_2)CO$	143.10
8710	***p*-Urazine**	tetrahydro-*sym*-tetrazinedione; diurea	$NHNHCONH$- $NHCO$	116.08
8711	**Urea**	carbamide	NH_2CONH_2	60.06
8712	——, chloride.	See *Carbamyl chloride.*		
8712M	——, nitrate		$CO(NH_2)_2 \cdot HNO_3$	123.07
8713	——, **acetonyl-**	1-ureido-2-propanone	$CH_3COCH_2NHCONH_2$	116.12
8714	——, **acetyl**		$CH_3CONHCONH_2$	102.09
8715	——, ***N*-acetyl-*N'*-methyl-**		$CH_3CONHCONHCH_3$	116.12
8716	——, **acetyl-thio-**	*N*-(thiocarbamyl)acetamide	$CH_3CONHCSNH_2$	118.15
8717	——, **allyl-**	2-propenylurea*	$C_3H_5NHCONH_2$	100.12
8718	——, ***N*-allyl-*N'*-phenyl-**		$C_3H_5NHCONHC_6H_5$	176.21
8719	——, **allyl-thio-**	thiosinamine; 2-propenylthiourea; allylsulfocarbamide	$CH_2{:}CHCH_2NHCSNH_2$	116.18
8720	——, **amino-.**	See *Semicarbazide.*		
8721	——, **benzoyl-thio-**	benzoylthiocarbamide	$C_6H_5CONHCSNH_2$	180.22
8722	——, **benzyl-***	benzylcarbamide	$C_6H_5CH_2NHCONH_2$	150.18
8723	——, **benzyl-thio-**	benzylthiocarbamide	$C_6H_5CH_2NHCSNH_2$	166.24

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8693	....	....	310–4	....	....	....	....
8694	sm. silky need. f. w., 1.550, 1.600, 1.680	$1.456\frac{20}{4}$	295 d.	....	0.048^{25}, 0.238^{75}	0.01^{17} 95% i. abs.	i. eth., acet.; s. alk.
8695							
8696	yel. powd.....	....	240 d.	....	sl. s.	s.	i. eth., bz., lgr.
8697	need..........	....	225–7	subl.	1^{100}	s.	sl. s. eth.; s. H_2SO_4
8698							
8699							
8700							
8701							
8702							
8703							
8704							
8705							
8706							
8706M							
8707	need. f. w.....	....	338	....	v. sl. s. c., v. s. h.	i.	s. eth., NH_4OH
8708							
8708M							
8709	need..........	....	....	....	sl. s. h.	....	s. NH_4OH, c. H_2SO_4, NH_3
8710	monocl. pr. f. w.	....	270	....	sl. s.	sl. s.	sl. s. h. ac. a.
8711	col. tetr., 1.484, 1.602	1.335	132.7	d.	78^5, 119.3^{25}	15.8^{20}	sl. s. eth.; s. conc. HCl; i. chl.
8712							
8712M	monocl. pr.....	....	152 d.	....	s. h.	....	sl. s. HNO_3; d. HCl, H_2SO_4
8713	pr............	0.8018^4	−41	82	s.	s.	s. eth.
8714	need. f. w.....	....	218–9	d.	1.2^{20}	1^{20}	sl. s. eth.
8715	col. monocl. f. w.	....	180	d.	s.	s.	sl. s. eth.
8716	pr. f. w.......	....	165–6	....	sl. s.	s.	sl. s. eth.
8717	need. f. al.....	....	85	....	v. s.	v. s.	sl. s. eth., chl.; i. pet. eth., tol., CS_2
8718	need. f. bz.....	....	115.5	....	v. sl. s.	s.	s. bz.
8719	col. monocl. or rhomb., $\gamma 1.63454^{78}$ liq.	$1.219\frac{20}{20}$	78.4	....	3	s.	sl. s. eth.; i. bz.
8720							
8721	pr. f. al.......	....	171	....	sl. s.	s.	i. eth.
8722	col. need. f. al.	....	147–8	....	1.7^{45}	s.	$0.36^{22.5}$ eth.; 3.1^{23} acet.
8723	pr. f. w.......	....	162–4	....	i. c.	1.31 c.	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8723F	**Urea, (α-bromo-α-ethylbutyryl)-.**	See *Adalin.*		
8723M	**——, butyl-***	*n*-butylcarbamide	$C_4H_9NHCONH_2$	116.16
8723P	**——, sec-butyl-**	*sec*-butylcarbamide	$C_4H_9NHCONH_2$	116.16
8723S	**——, *tert*-butyl-**	*tert*-butylcarbamide	$(CH_3)_3CNH-CONH_2$	116.16
8724	**——, carbamyl-.**	See *Biuret.*		
8725	**——, *N,N′*-diacetyl-**	*sym*-diacetylurea	$CH_3CONH-CONHCOCH_3$	144.13
8726	**——, *N,N*-diethyl-***	*uns*-diethylurea; *N,N*-diethylcarbamide	$(C_2H_5)_2NCONH_2$	116.16
8727	**——, *N,N′*-diethyl-***	*sym*-diethylurea; *N,N′*-diethylcarbamide	$CO(NHC_2H_5)_2$	116.16
8728	**——, *N,N′*-diethylthio-**	*sym*-diethylthiourea; *N,N′*-diethylthiocarbamide	$(C_2H_5NH)_2CS$	132.22
8729	**——, *N,N*-dimethyl-***	*uns*-dimethylurea	$(CH_3)_2NCONH_2$	88.11
8730	**——, *N,N′*-dimethyl-***	*sym*-dimethylurea	$CH_3NHCONHCH_3$	88.11
8731	**——, *N,N*-diphenyl-**	*uns*-diphenylurea	$(C_6H_5)_2NCONH_2$	212.24
8732	**——, *N,N′*-diphenyl-.**	See *Carbanilide.*		
8733	**——, *sym*-diphenyl-.**	See *Carbanilide.*		
8734	**——, *N,N*-diphenylthio-**		$(C_6H_5)_2NCSNH_2$	228.30
8735	**——, ditolylthio-.**	See *Carbanilide, dimethyl-thio-.*		
8736	**——, *sym*-di-*o*-tolylthio-.**	See *Carbanilide, thio-o,o′-dimethyl-.*		
8737	**——, *p*-ethoxyphenyl-.**	See *Urea, p-phenetyl-.*		
8738	**——, ethyl-***		$NH_2CONHC_2H_5$	88.11
8739	**——, ethylene-**	2-ketotetrahydroglyoxaline; dihydro-2(3)-imidazolone	$CH_2NHCONHCH_2$	86.09
8740	**——, ethylidene-**	4-methyluretidone	$NHCONHCHCH_3$	86.09
8741	**——, *N*-ethyl-*N′*-phenyl-**		$C_2H_5NHCONH-C_6H_5$	164.20
8742	**——, furfuralmalonylthio-.**	See *Barbituric acid, 5-(2-furfurylidene)-2-thio-.*		
8743	**——, glycolyl-.**	See *Hydantoin.*		
8744	**——, glycolyl-thio-.**	See *Hydantoin, 2-thio-.*		
8745	**——, glyoxalyl-.**	See *Allanturic acid.*		
8746	**——, guanyl-**	dicyan(o)diamidine; 1-carbamylguanidine	$NH_2C(:NH)NH-CONH_2$	102.10
8747	**——, hydroxy-**	carbamide oxide	$NH_2CONHOH$	76.06
8748	**——, isoamyl-**	(γ-methylbutyl)urea*	$C_5H_{11}NHCONH_2$	130.19
8749	**——, isobutyl-**	(β-methylpropyl)urea*	$NH_2CONHCH_2-CH(CH_3)_2$	116.16
8750	**——, α-lactyl-.**	See *Hydantoin, 5-methyl-.*		
8751	**——, malonyl-.**	See *Barbituric acid.*		
8752	**——, mesoxalyl-.**	See *Alloxan.*		
8753	**——, methyl-***		$NH_2CONHCH_3$	74.08
8754	**——, methyl-thio-**		$CH_3NHCSNH_2$	90.14
8755	**——, nitro-***		$NH_2CONHNO_2$	105.06
8755M	——, oxalate		$2CO(NH_2)_2 \cdot H_2C_2O_4$	210.15
8756	**——, oxalyl-.**	See *Parabanic acid.*		
8757	**——, oximidomesoxalyl-.**	See *Violuric acid.*		
8758	**——, *p*-phenetyl-**	*p*-ethoxyphenylurea; dulcin	$C_2H_5OC_6H_4NH-CONH_2$	180.20
8759	**——, phenyl-***		$C_6H_5NHCONH_2$	136.15
8760	**——, phenylene-.**	See *2(3)-Benzimidazolone.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8723F							
8723M	wh. need. f. bz.	....	96	....	s.	......	....
8723P	wh. need.	....	166	....	......	s.	....
8723S	wh. need.	....	172 d.	....	s.	s.	....
8724							
8725	need. f. al.	....	152	subl.; d. 179–80	v. sl. s.	sl. s.	....
8726	col. deliq. need. f. al.	....	74 (70)	....	v. s.	v. s.	1.86 c. eth.
8727	col. deliq. need f. al., 1.4616$^{48.6}$	1.042	112 (106–8)	263	v. s.	v. s.	v. s. eth.
8728	col. cr.	....	77	d.	s.	s.	v. s. eth.
8729	col. monocl. pr. f. me. al.	1.255	182	....	v. s.	v. sl. s.	v. sl. s. eth.
8730	col. rhomb. pr.	1.142	106(102.5)	270	v. s.	s.	i. eth.
8731	col. rhomb. need.	1.276	189	d.	v. sl. s.	s.	s. eth., chl.
8732							
8733							
8734	cr.	....	189	....	i.	s.	....
8735							
8736							
8737							
8738	col. monocl. pr. f. al.+eth.	1.213^{18}	92	d.	v. s.	v. s.	i. eth.
8739	col. need.	....	131	....	v. s. h.	v. s. h.	sl. s. eth.; s. chl.
8740	col. need.	....	154	160 d.	v. sl. s.	sl. s.	v. sl. s. eth.
8741	need. f. al.	....	99	....	......	s.	....
8742							
8743							
8744							
8745							
8746	col. pr. f. al.	....	105	d. 160	s. h.	sl. s. c.	i. eth., chl., bz., CS_2; s. pyr.
8747	col. need. f. al.	....	128–30 (139–40)	d.	v. s.	s.	....
8748	col. cr.	....	89–91	....	sl. s.	......	....
8749	need. f. acet.	....	141	....	......	......	v. sl. s. eth.; sl. s. acet., bz.
8750							
8751							
8752							
8753	col. rhomb. pr. f. w. or al.	1.204	101	d.	v. s.	v. s.	0.073 eth.
8754	pr.	....	118	....	s.	s.	sl. s. eth.
8755	wh. cr. f. al. or eth.	....	155–6	exp.	sl. s.	v. s.	v. s. eth.
8755M	monocl. pr.	....	d.	....	4.4^{16} c.	1.6	i. eth.
8756							
8757							
8758	col. leaf. or need. f. dil. a.	....	173–4	d.	0.125 c., 2 h.	4, 90%	sl. s. eth.
8759	monocl., α 1.602, γ 1.627	1.302	147	238	sl. s. c., v. s. h.	v. s.	v. s. eth.
8760							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8761	**Urea, phenyl-thio-**		$C_6H_5NHCSNH_2$	152.21
8762	**——, 2-propenyl-*.**	See *Urea, allyl-.*		
8763	**——, propyl-***		$C_3H_7NHCONH_2$	102.14
8764	**——, tartronyl-.**	See *Dialuric acid.*		
8765	**——, tetraethyl-***		$(C_2H_5)_2NCON(C_2H_5)_2$	172.27
8766	**——, tetramethyl-***		$(CH_3)_2NCON(CH_3)_2$	116.16
8767	**——, tetraphenyl-**	*N,N'*-diphenylcarbanilide	$(C_6H_5)_2NCON(C_6H_5)_2$	364.43
8768	**——, thio-**	thiocarbamide	NH_2CSNH_2	76.12
8769	**——, thio-*m*-tolyl-**		$CH_3C_6H_4NHCSNH_2$	166.24
8770	**——, o-tolyl-**		$CH_3C_6H_4NHCONH_2$	150.18
8771	**——, *m*-tolyl-**		$CH_3C_6H_4NHCONH_2$	150.18
8772	**——, *p*-tolyl-**		$CH_3C_6H_4NHCONH_2$	150.18
8773	**——, trimethyl-***		$CH_3NHCON(CH_3)_2$	102.14
8774	**Ureaacetic acid.**	See *Hydantoic acid.*		
8775	**Urethan.**	See *Carbamic acid, ethyl ester.*		
8776	**——, methyl-.**	See *Carbamic acid, methyl ester; Carbamic acid, methyl-,*		
8777	**——, phenyl-.**	See *Carbanilic acid, ethyl ester.*		
8777M	**——, *n*-propylphenyl-.**	See *Carbanilic acid, propyl ester.*		
8778	**——, thio-.**	See *Carbamic acid, thiol-, ethyl ester; Carbamic acid,*		
8779	**Uretidone, 4-methyl-.**	See *Urea, ethylidene-.*		
8780	**Uric acid**	2,6,8(1,3,9)-purinetrione; 2,6,8-trioxypurine	$C_5H_4N_4O_3$	168.11
8781	**——, 1-methyl-**		$C_6H_6N_4O_3$	182.14
8782	**——, 3-methyl-**		$C_6H_6N_4O_3$	182.14
8783	**——, 7-methyl-**		$C_6H_6N_4O_3$	182.14
8784	**"Urotropin".**	See *Hexamethylenetetramine.*		
8785	***dl*-Usnic acid**	*dl*-usninic acid	$C_{18}H_{16}O_7$	344.31
8786	***d*-Usnic acid**	*d*-usninic acid	$C_{18}H_{16}O_7$	344.31
8787	**Uvic acid, Uvinic acid.**	See *Pyrotritaric acid.*		
8788	**Uvitic acid**	5-methylisophthalic acid	$CH_3C_6H_3(COOH)_2$	180.15
8789	**Uvitonic acid**	6-methyllutidinic acid; 2-picoline-4,6-dicarboxylic acid	$CH_3C_5H_2N(COOH)_2$	181.14
8790	**Valeraldehyde**	pentanal*; *n*-valeric aldehyde; *n*-amyl aldehyde	$CH_3(CH_2)_3CHO$	86.13
8791	——, oxime	pentanal oxime*	$CH_3(CH_2)_3CH{:}NOH$	101.15
8792	**——, γ-oxo-.**	See *Levulinaldehyde.*		
8793	**Valeramide**	pentanamide*	$CH_3(CH_2)_3CONH_2$	101.15
8793H	**——, *N,N*-dimethyl-**		$CH_3(CH_2)_3CON(CH_3)_2$	129.20
8793R	**Valeranilide**	*n*-valeranilide	$CH_3(CH_2)_3CONHC_6H_5$	177.24
8794	**Valeric acid (*active*).**	See *Butyric acid, α-methyl-.*		
8795	**Valeric acid (*n*)**	pentanoic acid*	$CH_3(CH_2)_3COOH$	102.13

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8761	col. need. f. w. or trim. f. al.	1.3	154	....	0.26^{18}	5.66^{25}	....
8762							
8763	col. cr........	....	107	....	s.	......	....
8764							
8765	liq...........	....	....	210–5	i.	......	s. a.; i. alk.
8766	liq...........	0.972^{15}	....	177	......	v. s.	v. s. eth.
8767	col. rhomb....	1.222	183	....	i.	s.	....
8768	rhomb. pr. f. al.	$1.405\frac{20}{4}$	182 (174–6)	d.	9.18^{18}	s.	v. sl. s. eth.
8769	pr. f. al......	....	110–1	....	s. h.	v. s.	v. s. eth.
8770	leaf. f. al.....	....	190–1	....	0.25^{45}	s.	s. eth.
8771	leaf. f. w......	....	142–3	....	s.	v. s.	sl. s. eth.
8772	need. f. w...	....	187	....	0.31^{45}	s.	$0.062^{22.5}$ eth.
8773	monocl.......	1.19	75.5	232.5	v. s.	v. s.	s. eth.
8774							
8775							
8776	*ethyl ester.*						
8777							
8777M							
8778	*thiono-, ethyl ester.*						
8779							
8780	sc...........	1.893	d.	....	0.00645^{37}, 0.06 h.	i.	i. eth.; s. glyc., h. conc. H_2SO_4
8781	col. need......	....	400 d.	....	0.05^{100}	v. sl. s.	....
8782	col. pr. f. w....	....	>360 d.	....	0.38^{100}	v. sl. s.	s. alk.
8783	col. leaf. f. w.	....	370 d.	....	1.25^{100}	......	s. alk.
8784							
8785	yel. monocl. pr.	....	193	....	i.	v. sl. s.	0.3^{20} eth.
8786	yel. pr. f. al., 1.463, 1.653, 1.780	....	203	d.	i.	v. sl. s.	sl. s. eth.
8787							
8788	col. need. f. w.	....	290	subl.	sl. s. h.	v. s.	v. s. eth.
8789	col. cr. powd..	....	274 d.	....	v. sl. s.	......	s. a., aniline; v. sl. s. h. bz.
8790	liq., 1.3952....	0.8185^{11}	–91.5	103.4	sl. s.	v. s.	v. s. eth.
8791	cr............	....	52	....	s.	s.	....
8792							
8793	monocl. pl.....	1.023	114–6 (105.8)	....	s.	s.	s. eth.
8793H	col. liq.......	1.4419^{25}	–51	141^{100}	∞	∞	∞ eth.
8793R	col. monocl. pr.	....	63	....	......	s.	s. eth.
8794							
8795	col. liq., 1.4086	$0.942\frac{20}{4}$; $0.9435\frac{15}{4}$	–59; –34.5	187	3.7^{16}	∞	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8796	**Valeric acid**, amyl ester	amyl valerate; pentyl pentanoate*	$C_4H_9COOC_5H_{11}$	172.26
8797	——, butyl ester	butyl valerate; butyl pentanoate*	$CH_3(CH_2)_3COOC_4H_9$	158.24
8798	——, ethyl ester	ethyl valerate; ethyl pentanoate	$CH_3(CH_2)_3COOC_2H_5$	130.18
8799	——, 2-furylmethyl ester	furfuryl valerate	$CH_3(CH_2)_3COOCH_2C_4H_3O$	182.21
8800	——, isobutyl ester	isobutyl valerate; β-methylpropyl pentanoate*	$CH_3(CH_2)_3COOCH_2CH(CH_3)_2$	158.24
8801	——, methyl ester	methyl pentanoate*; methyl valerate	$CH_3(CH_2)_3COOCH_3$	116.16
8802	——, *p*-phenylphenacyl ester		$CH_3(CH_2)_3COOCH_2COC_6H_4{\cdot}C_6H_5$	296.35
8803	——, piperazinium salt		$C_4H_{10}N_2{\cdot}2C_4H_9COOH$	290.40
8804	——, propyl ester	*n*-propyl *n*-valerate	$CH_3(CH_2)_3COOC_3H_7$	144.21
8806	——, **α-amino-**	2-aminopentanoic acid*	$CH_3CH_2CH_2CH(NH_2)COOH$	117.15
8807	——, **γ-amino-**	4-aminopentanoic acid*	$CH_3CH(NH_2)CH_2CH_2COOH$	117.15
8808	——, **δ-amino-**	5-aminopentanoic acid*	$NH_2(CH_2)_4COOH$	117.15
8809	——, **α-amino-δ-guanido-.**	See *Arginine.*		
8810	——, **α-amino-β-methyl-.**	See *Isoleucine.*		
8811	——, **α-bromo-**	2-bromopentanoic acid*	$CH_3(CH_2)_2CHBrCOOH$	181.04
8812	——, ——, ethyl ester	ethyl 2-bromopentanoate*	$CH_3CH_2CH_2CHBrCOOC_2H_5$	209.09
8813	——, **α,δ-diamino-.**	See *Ornithine.*		
8814	——, **α-ethyl-**	2-ethylpentanoic acid*; 3-hexanecarboxylic acid; ethylpropylacetic acid	$CH_3CH_2CH_2CH(C_2H_5)COOH$	130.18
8815	——, **β-ethyl-**	3-ethylpentanoic acid*; β,β-diethylpropionic acid	$(C_2H_5)_2CHCH_2COOH$	130.18
8816	——, **α-hydroxy-**	2-hydroxypentanoic acid*; valerolactic acid	$CH_3CH_2CH_2CHOHCOOH$	118.13
8817	——, **γ-hydroxy-**, lactone	4-hydroxypentanoic acid lactone; γ-valerolactone	$CH_3\text{-}\underline{CHCH_2CH_2COO}$	100.11
8818	——, **γ-keto-.**	See *Levulinic acid.*		
8819	——, **α-methyl-**	2-methylpentanoic acid*; methylpropylacetic acid	$CH_3(CH_2)_2CH(CH_3)COOH$	116.16
8820	——, **β-methyl-**	3-methylpentanoic acid*; *sec*-butylacetic acid	$C_2H_5CH(CH_3)CH_2COOH$	116.16
8820M	——, **γ-oxo-.**	See *Levulinic acid.*		
8821	——, **α,β,γ,δ-tetrahydroxy-.**	See *Arabonic acid.*		
8822	**Valeric anhydride**	pentanoic anhydride*	$[CH_3(CH_2)_3CO]_2O$	186.25
8823	**Valerolactic acid.**	See *Valeric acid, α-hydroxy-.*		
8824	**γ-Valerolactone.**	See *Valeric acid, γ-hydroxy-, lactone.*		
8825	**Valerone.**	See 4-*Heptanone, 2,6-dimethyl-**.		
8826	**Valeronitrile**	pentanenitrile*; *n*-butyl cyanide	$CH_3(CH_2)_3CN$	83.13
8827	**Valerophenone**	butyl phenyl ketone	$CH_3(CH_2)_3COC_6H_5$	162.22
8828	——, **γ-oxo-** (or **γ-keto-**)	1-phenyl-1,4-pentanedione; phenacylacetone; β-acetylpropiophenone; α-acetonylacetophenone	$C_6H_5COCH_2CH_2COCH_3$	176.21
8829	**Valeryl chloride**	pentanoyl chloride*	$CH_3(CH_2)_3COCl$	120.58
8830	**Valerylene.**	See 2-*Pentyne**.		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8796	col. liq., 1.4145	0.881^{0}	−78.8	203.7	sl. s.	∞	∞ eth.
8797	liq.	0.8700_{4}^{15}	−92.8	185.6	v. sl. s.	∞	∞ eth.
8798	col. liq., 1.40094^{20}	0.8739_{4}^{20}	−91.2	146	0.237^{25}	∞	∞ eth.
8799	col. liq.	1.0284_{4}^{20}	....	$228–9^{764}$; $82–3^{1}$	i.	s.	s. eth.
8800	col. liq.	0.854	....	157	i.	∞	∞ eth.
8801	col. liq.	0.910^{0}	−91.0	127.3	v. sl. s.	∞	∞ eth.
8802	....	....	63.5	....	......	......	....
8803	wh. cr.	....	112.5–13	....	s.	s.	i. eth.; s. h. dioxane
8804	col. liq.	0.889^{0}	....	167.5	i.	s.	∞ eth.; s. chl.
8806	leaf. f. w.	....	291.5 d.	subl.	10.7^{15}	sl. s.	i. eth.
8807	cr.	....	193	d.	v. s.	sl. s.	i. eth., bz., lgr.
8808	leaf	....	157	d.	v. s.	sl. s.	i. eth.
8809							
8810							
8811	....	....	....	67^{10} $(126–30^{27})$	sl. s.	v. s.	s. eth.
8812	liq.	1.226_{4}^{18}	....	$192(74–6^{11})$	i.	∞	∞ eth.
8813							
8814	col. oil	....	....	209.2	i.	s.	s. eth.
8815	oil	....	....	212	......	......	....
8816	hyg. pl.	....	34	subl.	v. s.	v. s.	v. s. eth.
8817	liq.	1.072	−31	206–7	s.	s.	....
8818							
8819	col. liq.	0.928_{4}^{20}	....	193.5	0.57^{17}	s.	s. eth.
8820	liq.	0.930^{15}	....	195–6	......	s.	s. eth.
8820M							
8821							
8822	col. liq.	0.929_{4}^{20}	−56.1	215	d. h.	s. d.	v. s. eth.
8823							
8824							
8825							
8826	col. liq., 1.3909	0.8014_{4}^{20}	−96.0	141	i.	s.	s. eth.
8827	liq.	....	....	239.5	i.	v. s.	v. s. eth.
8828	yel. oil	>1	....	162^{12}d.	sl. s. c.	......	i. alk.
8829	col. liq., 1.41555	1.016^{15}	−110.0	128	d.	d.	∞ eth.
8830							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8831	**DL-Valine**	*dl*-α-aminoisovaleric acid; *dl*-2-amino-3-methylbutanoic acid*	$(CH_3)_2CHCH(NH_2)COOH$	117.15
8832	**L-Valine**	*d*-α-aminoisovaleric acid	$(CH_3)_2CHCH(NH_2)COOH$	117.15
8833	**D-Valine**	*l*-α-aminoisovaleric acid; *l*-2-amino-3-methylbutanoic acid*	$(CH_3)_2CHCH(NH_2)COOH$	117.15
8834	**Valylene**		Mixt. (?)	
8835	**Vanillaldehyde.**	See *Vanillin.*		
8836	**Vanillic acid**	4-hydroxy-3-methoxybenzoic acid	$CH_3O(HO)C_6H_3COOH$	168.14
8837	——, ethyl ester		$HO(CH_3O)C_6H_3COOC_2H_5$	196.20
8838	**Vanillin**	vanillaldehyde; 4-hydroxy-3-methoxybenzaldehyde; protocatechualdehyde 3-methyl ether	$CH_3O(OH)C_6H_3CHO$	152.14
8839	——, acetate	4-acetoxy-3-methoxybenzaldehyde; acetylvanillin	$CH_3O(CH_3COO)C_6H_3CHO$	194.18
8840	——, ethyl ether.	See *Benzaldehyde, 4-ethoxy-3-methoxy-.*		
8841	**——, acetyl-.**	See *Vanillin, acetate.*		
8842	**——, 5-bromo-**	5-bromo-4-hydroxy-3-methoxybenzaldehyde	$CH_3O(OH)BrC_6H_2CHO$	231.05
8843	**——, 5-chloro-**	5-chloro-4-hydroxy-3-methoxybenzaldehyde	$CH_3O(OH)ClC_6H_2CHO$	186.59
8443H	**——, 2,5-diiodo-**		$CH_3O(OH)C_6HI_2CHO$	403.97
8843M	**——, 2-iodo-**		$CH_3O(OH)C_6H_2ICHO$	278.06
8843N	**——, 5-iodo-**		$CH_3O(OH)C_6H_2ICHO$	278.06
8844	**Vanillyl alcohol**	4-hydroxy-3-methoxybenzyl alcohol; vanillic alcohol	$CH_3O(HO)C_6H_3CH_2OH$	154.16
8845	**Vasicine**		$C_{11}H_{12}N_2O$	188.22
8846	**Veratraldehyde**	3,4-dimethoxybenzaldehyde; protocatechualdehyde dimethyl ether; 3,4-dimethoxybenzenecarbonal*	$(CH_3O)_2C_6H_3CHO$	166.17
8847	**Veratric acid**	3,4-dimethoxybenzoic acid; protocatechuic acid dimethyl ether	$(CH_3O)_2C_6H_3COOH$	182.17
8848	**Veratrine** (crystalline)	cevadine	$C_{32}H_{49}NO_9$	591.72
8850	**Veratrole**	1,2-dimethoxybenzene*; pyrocatechol dimethyl ether	$C_6H_4(OCH_3)_2$	138.16
8851	**——, 4-allyl-**	eugenol methyl ether; methyleugenol	$CH_2{:}CHCH_2C_6H_3(OCH_3)_2$	178.22
8852	**——, 4-propenyl-**	isoeugenol methyl ether	$CH_3CH{:}CHC_6H_3(OCH_3)_2$	178.22
8853	**Veronal.**	See *Barbital.*		
8854	***l*-Vicine**		$C_{10}H_{16}O_7N_4$	304.26
8856	**Vinaconic acid**	1,1-cyclopropanedicarboxylic acid*; ethylenemalonic acid	$\underbrace{CH_2CH_2C}(COOH)_2$	130.10

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8831	monocl. leaf. f. al.	....	298(292)d.	subl.	7.44^{25}, 13.31^{75}	0.571^{25} 75% ; 0.014^{0} abs.	i. eth., acet.
8832	hex. leaf. f. al.; pr. f. w.	....	315 d.	subl. d.	9.1$^{16.5}$	v. sl. s.	i. eth.
8833	leaf. f. al......	....	293 d.	....	5.3^{20}	......	....
8834	col. liq.	....	....	50	i.	v. s.	∞ eth.
8835							
8836	col. need. f. w.	....	207	subl.	0.12^{14}, 2.5^{100}	v. s.	v. s. eth.
8837	col. need......	....	44	293	i.	v. s.	v. s. eth.; s. alk.
8838	col. monocl. need. f. w. or lgr.	....	81–2	285 (in CO_2); 140–5^{6}	1 c.; 5 h.	v. s.	v. s. eth.; s. chl., glyc.
8839	col. need......	....	77	....	v. sl. s.	v. s.	v. s. eth.
8840							
8841							
8842	col. leaf.......	....	164	....	i.	s. h.	sl. s. c. eth., s. bz.
8843	col. pl........	....	164–5	....	i.	s. h.	....
8843H	nearly col. rod	....	200	....	i.	s.	sl. s. eth.
8843M	nearly col. need.	....	155–156	....	i.	s.	sl. s. eth.
8843N	pa. yel. need. .	....	180	....	i.	sl. s.	sl. s. eth.
8844	col. need. f. w. or bz.	....	115	d.	v. s. h.	v. s.	v. s. eth.
8845	need..........	....	198 d.	....	sl. s.	s.	sl. s. eth., bz.; s. chl.; i. pet. eth.
8846	col. need. f. eth.	....	42–3 (44–5)	283	i., sl. s. h.	v. s.	v. s. eth.
8847	cr. f. w........	....	anh. 181	subl.	0.05^{14}, 0.6^{100}	v. s.	v. s. eth.
8848	col. cr. f. al., $[\alpha]+12.5^{\circ 17}_{D}$ in al.	....	205 d.	....	0.11 c.	s.	s. chl.
8850	col. cr. f. pet. eth., 1.52870$^{21.2}_{\alpha}$	1.0842$\frac{25}{25}$	22.5 (19–20)	206–7	sl. s.	s.	s. eth.
8851	col. liq., 1.5383^{17}	1.055^{15}	....	248–9	i.	∞	∞ eth.
8852	col. liq., 1.5720$^{11.5}$	1.0551^{22}	....	262–4	i.	s.	s. eth.
8853							
8854	need..........	....	242	....	s.	i.	s. me. al.
8856	tricl. need. f. eth.	....	175	210^{30}	v. s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8857	**Vinetine.**	See *Oxyacanthine.*		
8858	**Vinyl alcohol**.........	ethenol; vinol..............	$CH_2{:}CHOH$......	44.05
8859	**Vinylamine**..........	ethenylamine*.............	$CH_2{:}CHNH_2$.....	43.07
8860	**Vinyl bromide**........	bromoethene*; bromoethylene	$CH_2{:}CHBr$.......	106.96
8861	**Vinyl chloride**........	chloroethylene; chloroethene*	$CH_2{:}CHCl$.......	62.50
8862	**Vinyl cyanide.**	See *Acrylonitrile.*		
8863	**Vinyl ether**..........	ethenyloxyethene*; divinyl ether	$(CH_2{:}CH)_2O$......	70.09
8863M	**Vinyl fluoride**.........	fluoroethylene.............	$CH_2{:}CHF$........	46.04
8864	**Vinyl iodide**..........	iodoethylene; iodoethene*....	$CH_2{:}CHI$........	153.96
8865	**Vinyl sulfide**..........	ethenylthioethene*; divinyl sulfide	$(CH_2{:}CH)_2S$......	86.15
8866	**Vinyl tribromide.**	See *Ethane*, 1,1,2-*tribromo-**.		
8867	**Vinyl trichloride.**	See *Ethane*, 1,1,2-*trichloro-**.		
8868	**Violuric acid**..........	alloxan 5-oxime; 5-isonitrosobarbituric acid; oximidomesoxalylurea	CONHCO- NHCOC:NOH	157.09
8868D	**Vitamin A**............	axerophthol................	$C_{20}H_{29}OH$........	286.44
8868H	**Vitamin B₁**...........	thiamine hydrochloride; thiamin chloride; aneurin; antineuritic vitamin; oryzanin; torulin	$C_{12}H_{18}ON_4SCl_2$....	337.27
8868M	**Vitamin B₂.**	See D-*Riboflavin.*		
8868S	**Vitamin B₆**...........	adermin; pyridoxin; 5-hydroxy-6-methyl-3,4-pyridinedicarbinol	$C_8H_{11}NO_3$........	169.18
8868U	——, hydrochloride........	....	$C_8H_{11}NO_3{\cdot}HCl$....	205.64
8869	**Vitamin C.**	See *l-Ascorbic acid.*		
8869C	**Vitamin D₂.**	See *Calciferol.*		
8869G	**Vitamin E.**	See *Tocopherol.*		
8869J	**Vitamin F.**	See *Linoleic acid*		
8869M	**Vitamin G.**	See *D-Riboflavin.*		
8869S	**Vitamin K.**	See *Phthiocol.*		
8870	**Wintergreen oil.**	See *Salicylic acid, methyl ester.*		
8871	**Wood alcohol.**	See *Methanol*.*		
8872	**Wood sugar.**	See *l-Xylose.*		
8873	**Xanthaline**...........	....	$C_{37}H_{36}N_2O_9$.......	652.68
8874	**Xanthene**.............	dibenzo-1,4-pyran; diphenylmethane oxide; *o,o'*-methylenediphenyl ether	$C_6H_4OC_6H_4CH_2$...	182.21
8875	**9-Xanthene-o-benzoic acid, 9-hydroxy-,** lactone.		See *Fluoran.*	
8876	**——, 3,4,5,6-tetrahydroxy-.** See *Gallin.*			
8877	**9-Xanthenone.**	See *Xanthone.*		
8878	**Xanthic acid,** ethyl ester	ethyl ethoxymethanethionothiolate*; ethyl xanthogenate	$C_2H_5OCSSC_2H_5$...	150.25
8879	**Xanthine**.............	2,6(1,3)purinedione; 2,6-dioxypurine	$C_5H_4N_4O_2$........	152.11
8880	**——, 1,3-dimethyl-.**	See *Theophylline.*		
8881	**——, 3,7-dimethyl-.**	See *Theobromine.*		
8882	**——, 1,3,7-trimethyl-.**	See *Caffeine.*		

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*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8857							
8858	unstable......	....	....	....	......	......	....
8859	liq...........	$0.832\frac{20}{4}$	....	56	∞	s.	∞ eth.
8860	liq., 1.4462....	1.5167^{14}	−137.8	15.8	i.	∞	∞ eth.
8861	gas..........	liq. $0.9195\frac{15}{4}$	−159.7	−13.9	sl. s.	s.	v. s. eth.
8862							
8863	col. liq........	$0.774\frac{20}{20}$	....	39 (28.3)	i.	∞	∞ eth.
8863M	col. gas.......	....	....	−51	i.	400^{20} cm^3	550^{20} cm^3 eth.
8864	liq..........	2.08^0	....	56	i.	∞	∞ eth.; s. chl., bz., tol., CS_2
8865	oil...........	0.912	....	101	sl. s.	∞	∞ eth.
8866							
8867							
8868	rhomb........	....	−H_2O, 100; 224 d.	....	s. h.	s.	....
8868D	micr. need.; pa. yel. visc. liq.; 1.627^{40}	$0.948\frac{25}{4}$	63–64	$120\text{-}30^{0.001}$	i.	s.	v. s. eth.
8868H	wh. cr........	....	245–8 d.	....	100^{25}	0.3; 1 95%	i. eth., bz.
8868M							
8868S	clusters of wh. need. or wh. platelets	....	160 d.	subl. in vacuo	v. s.	s.	sl. s. eth., chl.; s. acet.
8868U	wh. platelets..	....	206–8 d.	....	22.2	1.1	sl. s. acet.
8869							
8869C							
8869G							
8869J							
8869M							
8869P							
8869S							
8870							
8871							
8872							
8873	cr. powd......	....	208	....	i.	v. sl. s. h.	....
8874	leaf. f. al......	....	100.5	315	v. sl. s.	sl. s.	s. eth., bz., chl., CS_2, H_2SO_4
8875							
8876							
8877							
8878	cr., garlic odor	$1.085\frac{19}{4}$	....	200 ($91\text{–}3^{18}$)	......	......	....
8879	yel.-wh. powd.; sm. pl. become anh. at 125	....	>150 d.	subl. d.	0.26^{17}	0.033^{17}	v. s. alk.
8880							
8881							
8882							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8883	**Xanthogenamide.**	See *Carbamic acid, thiono-, ethyl ester.*		
8884	**Xanthogenic acid**	thiolthionocarbonic acid *O*-ethyl ester; ethylxanthogenic acid	C_2H_6OCSSH	122.20
8885	**——, ethyl-.**	See *Xanthogenic acid.*		
8886	**Xanthone**	9-xanthenone; diphenylene ketone oxide	$CO:(C_6H_4)_2:O$	196.19
8887	**——, 1,7-dihydroxy-.**	See *Euxanthone.*		
8888	**——, 1,7-dihydroxy-3-methoxy-.**	See *Gentisin.*		
8889	**Xenylamine**	*p*-biphenylamine; 4-aminobiphenyl; *p*-phenylaniline	$C_6H_5C_6H_4NH_2$	169.22
8890	**Xenyl isothiocyanate, Xenyl mustard oil.**	See *Isothiocyanic acid, xenyl ester.*		
8891	**Xylene, musk.**	See *Benzene, 1-tert-butyl-3,5-dimethyl-2,4,6-trinitro-.*		
8892	***o*-Xylene**	1,2-dimethylbenzene*	$C_6H_4(CH_3)_2$	106.16
8893	**——, α-bromo-**	*o*-xylyl bromide; ω-bromo-*o*-xylene	$CH_3C_6H_4CH_2Br$	185.07
8894	**——, 4-bromo-**	*as*-bromo-*o*-xylene	$BrC_6H_3(CH_3)_2$	185.07
8895	**——, α-chloro-**	*o*-xylyl chloride; ω-chloro-*o*-xylene; *o*-tolyl chloride (incorrect)	$CH_3C_6H_4CH_2Cl$	140.61
8896	**——, α,α′-dibromo-**	*o*-xylylene bromide; *o*-xylylene dibromide; ω,ω′-dibromo-*o*-xylene	$C_6H_4(CH_2Br)_2$	263.98
8897	**——, α,α′-dichloro-**	*o*-xylylene (di)chloride; ω,ω′-dichloro-*o*-xylene	$C_6H_4(CH_2Cl)_2$	175.06
8898	**——, dihydro-.**	See *Cantharene.*		
8899	**——, 3,5-dihydroxy-.**	See *Resorcinol, 4,5-dimethyl-.*		
8900	**——, 3,6-dihydroxy-.**	See *Hydroquinone, 2,3-dimethyl-.*		
8901	**——, 3,4-dinitro-**	1,2-dimethyl-3,4-dinitrobenzene	$(NO_2)_2C_6H_2(CH_3)_2$	196.16
8902	**——, 3,5-dinitro-**	1,2-dimethyl-3,5-dinitrobenzene	$(NO_2)_2C_6H_2(CH_3)_2$	196.16
8903	**——, 3,6-dinitro-**	2,3-dimethyl-1,4-dinitrobenzene	$(NO_2)_2C_6H_2(CH_3)_2$	196.16
8904	**——, 4,5-dinitro-**	1,2-dimethyl-4,5-dinitrobenzene	$(NO_2)_2C_6H_2(CH_3)_2$	196.16
8905	**——, 4-ethyl-**	4-ethyl-1,2-dimethylbenzene*	$(CH_3)_2C_6H_3C_2H_5$	134.21
8906	**——, 3-nitro-**	....	$NO_2C_6H_3(CH_3)_2$	151.16
8907	**——, 4-nitro-**	....	$NO_2C_6H_3(CH_3)_2$	151.16
8908	***m*-Xylene**	1,3-dimethylbenzene*	$C_6H_4(CH_3)_2$	106.16
8909	**——, α-bromo-**	*m*-xylyl bromide; ω-bromo-*m*-xylene	$CH_3C_6H_4CH_2Br$	185.07
8910	**——, 4-bromo-**	*as*-bromo-*m*-xylene	$BrC_6H_3(CH_3)_2$	185.07
8911	**——, α-chloro-**	*m*-xylyl chloride; ω-chloro-*m*-xylene; *m*-tolyl chloride (incorrect)	$CH_3C_6H_4CH_2Cl$	140.61
8912	**——, 4,6-dibromo-**	4,6-dibromo-1,3-dimethylbenzene	$C_6H_2Br_2(CH_3)_2$	263.98
8913	**——, α,α-dichloro-**	*m*-xylene (di)chloride; ω,ω′-dichloro-*m*-xylene	$C_6H_4(CH_2Cl)_2$	175.06
8914	**——, 2,4-dihydroxy-.**	See *Resorcinol, 2,4-dimethyl-.*		
8915	**——, 2,5-dihydroxy-.**	See *Hydroquinone, 2,6-dimethyl-.*		
8916	**——, 4,6-dihydroxy-.**	See *Resorcinol, 4,6-dimethyl-.*		

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*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8883							
8884	liq.	>1	–53	24 d.	v. sl. s. (i.)	......	....
8885							
8886	wh. need. f. al.	....	174	351	sl. s. h.	0.55 c., 6.71 h.	sl. s. eth., bz., lgr.
8887							
8888							
8889	col. leaf. f. dil. al.	$1.160\frac{20}{20}$	53	302	sl. s. c.	$44.18^{19.5}$	v. s. eth.; s. chl.; $58^{19.5}$ me. al.
8890							
8891							
8892	col. liq., 1.50545^{20}	0.88020^{20}	–29(–27.1)	144.411	i.	v. s.	v. s. eth.
8893	pr.	$1.381\frac{23}{4}$	21	217.7	i.	s.	v. s. eth.
8894	liq.	....	–2	214	i.	v. s.	v. s. eth.
8895	liq.	....	....	199	i.	∞	∞ eth.
8896	rhomb. cr. f. chl.	1.988	95	d.	i.	v. s.	20 eth.
8897	monocl. f. pet. eth.	$1.393\frac{0}{4}$	55	241	i.	v. s.	v. s. eth., chl.
8898							
8899							
8900							
8901	need. f. al.	....	82	exp. 413	......	sl. s.	v. s. eth.; s. chl., CS_2, bz.
8902	yel. need. f. al.	....	75–6	....	......	s.	v. s. bz., chl.; s. acet.
8903	col. cr. f. al.	....	89–90(56)	....	v. sl. s.	s.	s. eth., chl., bz., acet.
8904	need. f. al.	....	115–6	....	v. sl. s. h.	v. sl. s.	s. eth., chl., CS_2, acet., bz.; sl. s. pet. eth.
8905	liq.	$0.869\frac{20}{4}$	<–20	189(183–4)	i.	v. s.	s. eth.
8906	liq. or need. f. al.	1.147^{15}	7–9	245(250.8)	i.	s.	....
8907	yel. pr. f. al.	1.139^{8}	30	258	i.	∞	s. eth.
8908	col. liq., 1.49722^{20}	0.86417^{20}	–53.6 (–47.4)	139.104	i.	v. s.	v. s. eth.
8909	liq.	1.371^{23}	....	215.8 sl. d.	i.	v. s.	v. s. eth.
8910	liq.	....	....	203	i.	v. s.	v. s. eth.
8911	liq.	1.064^{20}	....	196	i.	∞	∞ eth.
8912	cr.	....	69–72	255–6	i.	sl. s. c., s. h.	
8913	col. cr.	$1.302\frac{20}{4}$	34.2	255	i.	v. s.	v. s. eth.
8914							
8915							
8916							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8917	***m*-Xylene, 2,5-dinitro-**	1,3-dimethyl-2,5-dinitrobenzene*	$(NO_2)_2C_6H_2(CH_3)_2$	196.16
8918	**——, 4-ethyl-**	1-ethyl-2,4-dimethylbenzene*	$(CH_3)_2C_6H_3C_2H_5$	134.21
8919	**——, 5-ethyl-**	1-ethyl-3,5-dimethylbenzene*	$(CH_3)_2C_6H_3C_2H_5$	134.21
8920	**——, hexahydro-.**	See *Cyclohexane*, 1,3-*dimethyl*-.		
8921	**——, 2-nitro-**		$NO_2C_6H_3(CH_3)_2$	151.16
8922	**——, 4-nitro-**		$NO_2C_6H_3(CH_3)_2$	151.16
8923	**——, 5-nitro-**		$NO_2C_6H_3(CH_3)_2$	151.16
8924	**——, 2,4,6-trinitro-**		$(NO_2)_3C_6H(CH_3)_2$	241.16
8925	***p*-Xylene**	1,4-dimethylbenzene*	$C_6H_4(CH_3)_2$	106.16
8926	**——, *α*-bromo-**	*p*-xylyl bromide; *ω*-bromo-*p*-xylene	$CH_3C_6H_4CH_2Br$	185.07
8927	**——, 2-bromo-**	*eso*-bromo-*p*-xylene	$BrC_6H_3(CH_3)_2$	185.07
8928	**——, *α*-chloro-**	*p*-xylyl chloride; *ω*-chloro-*p*-xylene; *p*-tolyl chloride (incorrect)	$CH_3C_6H_4CH_2Cl$	140.61
8929	**——, *α,α′*-dibromo-**	*p*-xylylene bromide; *p*-xylylene dibromide	$C_6H_4(CH_2Br)_2$	263.98
8930	**——, *α,α′*-dichloro-**	*p*-xylylene (di)chloride; *ω,ω′*-dichloro-*p*-xylene	$C_6H_4(CH_2Cl)_2$	175.06
8931	**——, 2,5-dihydroxy-.**	See *Hydroquinone*, 2,5-*dimethyl*-.		
8932	**——, 2,6-dihydroxy-.**	See *Resorcinol*, 2,5-*dimethyl*-.		
8933	**——, 2,3-dinitro-**	1,4-dimethyl-2,3-dinitrobenzene	$(NO_2)_2C_6H_2(CH_3)_2$	196.16
8934	**——, 2,5-dinitro-**	1,4-dimethyl-2,5-dinitrobenzene	$(NO_2)_2C_6H_2(CH_3)_2$	196.16
8935	**——, 2,6-dinitro-**	2,5-dimethyl-1,3-dinitrobenzene	$(NO_2)_2C_6H_2(CH_3)_2$	196.16
8936	**——, 2-ethyl-**	2-ethyl-1,4-dimethylbenzene*	$(CH_3)_2C_6H_3C_2H_5$	134.21
8937	**——, hexahydro-.**	See *Cyclohexane*, 1,4-*dimethyl*-.		
8938	**——, 2-nitro-**		$NO_2C_6H_3(CH_3)_2$	151.16
8939	**——, 2,3,5-trinitro-**		$(NO_2)_3C_6H(CH_3)_2$	241.16
8940	***α,α′*-Xylenediol.**	See *Xylylene glycol*.		
8941	***o*-Xylene-4-sulfonic acid**	3,4-xylenesulfonic acid	$(CH_3)_2C_6H_3SO_3H$	186.22
8942	**2,3-Xylenol**	2,3-dimethylphenol; *vic-o*-xylenol	$(CH_3)_2C_6H_3OH$	122.16
8943	**2,4-Xylenol**	2,4-dimethylphenol; *as-m*-xylenol	$(CH_3)_2C_6H_3OH$	122.16
8944	**2,5-Xylenol**	2,5-dimethylphenol; *p*-xylenol	$(CH_3)_2C_6H_3OH$	122.16
8945	**2,6-Xylenol**	2,6-dimethylphenol; *vic-m*-xylenol	$(CH_3)_2C_6H_3OH$	122.16
8946	**3,4-Xylenol**	3,4-dimethylphenol; *as-o*-xylenol	$(CH_3)_2C_6H_3OH$	122.16
8946M	**——, 2,5,6-tribromo-**		$(CH_3)_2C_6Br_3OH$	358.88
8947	**3,5-Xylenol**	3,5-dimethylphenol; *sym-m*-xylenol	$(CH_3)_2C_6H_3OH$	122.16
8947M	**——, 2,4,6-tribromo-**		$(CH_3)_2C_6Br_3OH$	358.88
8948	***vic-o*-Xylic acid.**	See *Hemellitic acid*.		
8949	***sym-m*-Xylic acid.**	See *Mesitylenic acid*.		
8950	***p*-Xylic acid.**	See *Isoxylic acid*.		
8951	**2,3-Xylic acid.**	See *Hemellitic acid*.		
8952	**2,4-Xylic acid**	2,4-dimethylbenzoic acid; *as-m*-xylic acid	$(CH_3)_2C_6H_3COOH$	150.17

*Name approved by the International Union of Chemistry.

ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8917	ylsh. cr. f. al.	....	101	....	......	s.	s. eth., CS_2, chl., bz.
8918	col. liq........	0.8686^{20}_{4}	<−20	185–6	i.	v. s.	s. eth.
8919	col. liq........	0.861^{20}	<20	185	i.	s.	s. eth.
8920							
8921	liq............	1.112^{15}	13	225	i.	......	....
8922	liq............	1.135^{15}	2	244	i.	s.	s. eth.
8923	col. need. f. al.	....	71	273.7	i.	v. s.	v. s. eth.
8924	rhomb. need. f. al.+bz.	1.604^{19}	181.5	.....	i.	0.039 c.	sl. s. eth.
8925	col. monocl. or liq., 1.49582^{20}	0.86105^{20}	13.2	138.351	i.	v. s.	v. s. eth.
8926	need. f. al.....	1.3237^{20}_{4}	38(34–5.5)	220.7	i.	v. s.	v. s. eth., chl.
8927	liq............	....	9	200	i.	v. s.	v. s. eth.
8928	oil............	....	....	202	i.	∞	∞ eth.
8929	monocl. f. bz.	2.012^{0}	143.5	245	i.	v. s.	2.65^{20} eth.; s. h. chl.
8930	monocl. pl. or leaf.	1.417^{0}	100.5	240–50	i.	s.	v. s. eth.
8931							
8932							
8933	monocl. pr. f. al.	....	93	....	i.	s. h.	s. eth., chl., bz., acet.
8934	yel. need. f. al.	....	147	....	i.	s. h.	s. h. eth., bz., acet.
8935	need. f. al.....	....	123–4	....	i.	sl. s.	s. eth.
8936	liq............	0.875^{22}	<−20	185	i.	sl. s.	s. eth.
8937							
8938	ylsh. liq........	1.132^{15}	....	239.9	i.	s.	s. eth.
8939	col. monocl. need. f. al.	1.59^{19}	140	exp. 410	v. sl. s.	s. h.	sl. s. eth.
8940							
8941	pl. f. dil. H_2SO_4	....	d.	....	s.	......	....
8942	lng. need. f. w.	....	75	218	s.	s.	....
8943	col. need......	1.036^{20}_{4}	26	211.5	v. sl. s.	∞	∞ eth.
8944	col. monocl. f. al.+eth.	1.169^{15}_{4}	74.5	211.5	s.	s.	v. s. eth.
8945	col. leaf.......	....	49	212	s. h.	s.	....
8946	need. f. w.....	1.023^{17}_{15}	65	225	s.	s.	∞ eth.
8946M	col. silky need.	....	173–74	....	i.	s.	s. eth.
8947	need. f. w.....	....	68(64)	219.5	sl. s.	s.	s. NaOH
8947M	col. need......	....	166	....	i.	v. s.	s. eth.
8948							
8949							
8950							
8951							
8952	col. monocl....	....	126	268	v. sl. s. h.	v. s. h.	s. eth., bz., chl., acet., tol.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8953	**2,5-Xylic acid.**	See *Isoxylic acid.*		
8954	**2,6-Xylic acid**	2,6-dimethylbenzoic acid; *vic-m*-xylic acid	$(CH_3)_2C_6H_3COOH$	150.17
8955	**3,4-Xylic acid**	3,4-dimethylbenzoic acid; *as-o*-xylic acid; paraxylic acid	$(CH_3)_2C_6H_3COOH$	150.17
8956	**3,5-Xylic acid.**	See *Mesitylenic acid.*		
8957	**2,3-Xylidine**	2,3-dimethylaniline; *vic-o*-xylidine	$(CH_3)_2C_6H_3NH_2$	121.18
8958	**2,4-Xylidine**	2,4-dimethylaniline; *as-m*-xylidine	$(CH_3)_2C_6H_3NH_2$	121.18
8959	**2,5-Xylidine**	2,5-dimethylaniline; *p*-xylidine	$(CH_3)_2C_6H_3NH_2$	121.18
8960	**2,6-Xylidine**	2,6-dimethylaniline; *vic-m*-xylidine	$(CH_3)_2C_6H_3NH_2$	121.18
8961	**3,4-Xylidine**	3,4-dimethylaniline; *as-o*-xylidine	$(CH_3)_2C_6H_3NH_2$	121.18
8962	**3,5-Xylidine**	3,5-dimethylaniline; *sym-m*-xylidine	$(CH_3)_2C_6H_3NH_2$	121.18
8963	***p*-Xylohydroquinone.**	See *Hydroquinone, 2,5-dimethyl-.*		
8964	***o*-Xyloquinone**	2,3-dimethylquinone	$(CH_3)_2C_6H_2O_2$	136.14
8965	***m*-Xyloquinone**	2,6-dimethylquinone	$(CH_3)_2C_6H_2O_2$	136.14
8965M	**——, 3,5-dibromo-**		$(CH_3)_2C_6Br_2O_2$	293.96
8966	***p*-Xyloquinone.**	See *Phlorone.*		
8967	***m*-Xylorcinol.**	See *Resorcinol, 4,6-dimethyl-.*		
8968	***p*-Xylorcinol.**	See *Resorcinol, 2,5-dimethyl-.*		
8968M	**D-Xylose,** phenylosazone	D-xylosazone; D-lyxosazone	$C_{17}H_{20}N_4O_3$	328.36
8969	**D-Xylose**	wood sugar	$C_5H_{10}O_5$	150.13
8970	**Xylyl bromide.**	See *Xylene α-bromo-.*		
8971	**Xylyl chloride.**	See *Xylene, α-chloro-.*		
8972	**Xylylene alcohol.**	See *Xylylene glycol.*		
8973	**Xylylene bromide.**	See *Xylene, α,α'-dibromo-.*		
8974	**Xylylene chloride.**	See *Xylene, α,α'-dichloro-.*		
8975	**Xylylene cyanide.**	See *Benzenediacetonitrile.*		
8976	***o*-Xylylene glycol**	α,α'-*o*-xylenediol; 1,2-benzenedicarbinol; *o*-xylylene alcohol; phthalyl alcohol	$C_6H_4(CH_2OH)_2$	138.16
8977	***m*-Xylylene glycol**	α-α'-*m*-xylenediol; 1,3-benzenedicarbinol; *m*-xylylene alcohol	$C_6H_4(CH_2OH)_2$	138.16
8978	***p*-Xylylene glycol**	α,α'-*p*-xylenediol; 1,4-benzenedicarbinol; *p*-xylylene alcohol	$C_6H_4(CH_2OH)_2$	138.16
8979	**Yara-yara.**	See *Ether, methyl 2-naphthyl.*		
8980	**Yellow cross liquid.**	See *Sulfide, β, β'-dichloroethyl.*		
8981	**Yohimbine**	corynine	$C_{21}H_{26}N_2O_3$	354.44
8982	**——,** hydrochloride(*d*)	corynine hydrochloride; aphrodine hydrochloride	$C_{21}H_{26}N_2O_3 \cdot HCl$	390.90
8983	**——,** nitrate		$C_{21}H_{26}N_2O_3 \cdot HNO_3$	417.45
8985	**Yperite.**	See *Sulfide, β, β'-dichloroethyl.*		
8986	**Zinc, diethyl-***	zinc ethyl; zinc diethyl; zinc ethide	$Zn(C_2H_5)_2$	123.50
8987	**——, dimethyl-***	zinc methyl; zinc methide	$Zn(CH_3)_2$	95.45
8987M	**Zinc ethide.**	See *Zinc, diethyl-*.*		
8988	**Zinc methide.**	See *Zinc, dimethyl-*.*		

*Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8953							
8954	col. need. f. lgr.	....	116	274.5	sl. s.	s.	v. s. eth.
8955	col. pr. f. al....	....	165–6	subl.	sl. s. h.	s.	s. eth., bz.
8956							
8957	liq., 1.570.....	0.991^{15}	<−15	223.8	v. sl. s.	v. s.	v. s. eth.
8958	liq., 1.559....	$0.974\frac{20}{4}$; $0.9761\frac{18}{4}$	....	216	v. sl. s.	s.	s. eth., bz.
8959	oil...........	0.980^{15}	15.5	217	v. sl. s.	0.980	s. eth.
8960	col. liq., 1.561	0.979	....	216.9	i.	s.	s. eth.
8961	monocl. tab. f. lgr.	1.076	49	226	sl. s.	......	v. s. lgr.
8962	liq., 1.558	$0.972\frac{20}{4}$; 0.9935^{0}	....	221	sl. s.	......	....
8963							
8964	yel. need......	....	55	subl.	sl. s.	s.	s. eth.
8965	yel. need......	....	73	subl.	......	......	....
8965M	yel. pl........	....	174	....	i.	s.	s. eth.
8966							
8967							
8968							
8968M	bright yel. rhomb. need.; 1.725, 1.760, 1.805; $[\alpha]_D$ −40.9 (al.)	0.85 (in al.)	160; d. 167	....	sl. s.	s.	s. eth., acet.
8969	wh. rhomb. need.; 1.517, 1.544, 1.546	$1.525\frac{20}{4}$; 1.535^{0}	153(144)	....	117^{20}	6.2^{20} 80%	v. sl. s. eth.
8970							
8971							
8972							
8973							
8974							
8975							
8976	pl. f. eth......	....	62.0–4.8	....	s.	s.	17.9 eth.
8977	col. cr. f. bz....	1.161^{18}	46–7	....	v. s.	......	s. eth.
8978	need...........	....	115–6	....	v. s.	v. s.	v. s. eth.
8979							
8980							
8981	col. need. f. w. +al.	....	248(231)	....	v. sl. s.	v. s.	s. eth., chl., bz.
8982	col. cr........	....	295–300 d.	....	s.	......	....
8983	col. pr........	....	276	....	......	......	....
8985							
8986	col. liq. ign. in air	1.182^{18}	−28	118	d.	d.	s. eth.
8987	col. liq. ign....	1.386^{10}	−40	46	d.	d.	∞ eth.
8987M							
8988							

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
64Z	**Acetanilide, *m*-ethoxy-.**	See *m-Acetophenetide*		
71Z	**——, *m*-methoxy-.**	See *m-Acetaniside.*		
83M	**——, α-trichloro-**	trichloroacetic anilide	$CCl_3CONHC_6H_5$	238.51
83T	***m*-Acetaniside**	*N*-acetyl-*m*-anisidine; *m*-methoxyacetanilide	$CH_3CONHC_6H_4OCH_3$	165.19
87M	**Acetic acid,** acetonyl ester.	See *Acetol,* acetate.		
107W	——, vinyl ester	vinyl acetate; ethenyl ethanoate*	$CH_3COOCH{:}CH_2$	86.09
164F	**——, naphthyl-.**	See *Naphthaleneacetic acid.*		
164T	**——, nitrilotri-**	trimethylamine-α, α′, α″-tricarboxylic acid; triglycolamidic acid; triglycollamic acid	$N(CH_2COOH)_3$	191.14
207C	**Acetol,** acetate	acetonyl acetate; acetoxyacetone; acetylmethyl acetate	$CH_3COOCH_2COCH_3$	116.11
222M	**Acetone, acetoxy-.**	See *Acetol,* acetate.		
238M	**——, hexamethyl-.**	See 3-*Pentanone,* 2,2,4,4-*tetramethyl-**.		
263W	***m*-Acetophenetide**	*N*-acetyl-*m*-phenetidine; *m*-ethoxyacetanilide	$CH_3CONHC_6H_4OC_2H_5$	179.21
285M	**Acetophenone, 3,4-dimethoxy-.**	See *Acetoveratrone.*		
285Q	**——, *m*-dimethylamino-**		$CH_3COC_6H_4N(CH_3)_2$	163.21
285R	**——, *p*-dimethylamino-**		$CH_3COC_6H_4N(CH_3)_2$	163.21
286W	**——, *o*-hydroxy-**	*o*-acetylphenol	$CH_3COC_6H_4OH$	136.14
286X	**——, *m*-hydroxy-**	*m*-acetylphenol	$CH_3COC_6H_4OH$	136.14
288F	**——, 4-hydroxy-3-methoxy-.**	See *Acetovanillone.*		
293X	**——, *o*-methoxy-**	*o*-acetylanisole; *o*-anisyl methyl ketone	$CH_3COC_6H_4OCH_3$	150.17
293Y	**——, *m*-methoxy-**	*m*-acetylanisole; *m*-anisyl methyl ketone	$CH_3COC_6H_4OCH_3$	150.17
294X	**——, *o*-methyl-**	methyl *o*-tolyl ketone	$CH_3COC_6H_4CH_3$	134.17
312M	**Acetovanillone**	4-hydroxy-3-methoxyacetophenone; apocynin	$CH_3COC_6H_2(OH)OCH_3$	165.16
312T	**Acetoveratrone**	3,4-dimethoxyacetophenone	$CH_3COC_6H_3(OCH_3)_2$	180.20
372M	**Acridine, 6-chloro-9-(4-diethylamino-1-methylbutylamino)-2-**			
406E	**Acrylonitrile, α-methyl-.**	See *Methacrylonitrile.*		
419S	**Alanine, β-(3,4-dihydroxyphenyl)-(*l*).**	*l*-2-amino-3-(3,4-dihydroxyphenyl)propanoic acid; *l*-dopa	$(HO)_2C_6H_3CH_2CH(NH_2)COOH$	197.19
425F	**——, β, β′-methylenedithiodi-.**	See *Djenkolic acid.*		
441M	**Aleuritic acid**	9,10,16-trihydroxyhexadecanoic acid*; θ, ι, ο, -trihydroxypalmitic acid	$C_{16}H_{32}O_5$	304.42
522M	**Amphetamine**	*dl*-α-methylphenethylamine; *dl*-2-phenylisopropylamine; Benzedrine (trade name)	$C_6H_5CH_2CH(CH_3)NH_2$	135.20
555M	**Amyl phosphate (*n*)**	tri-*n*-amyl phosphate	$(C_5H_{11})_3PO_4$	308.39
562F	**Androstane, 3(α)-hydroxy-17-keto-.**	See *Androsterone.*		
562L	**3-Androstenone, 17-hydroxy-.**	See *Testosterone.*		
562Q	**Androsterone**	3(α)-hydroxy-17-ketoandrostane	$C_{19}H_{30}O_2$	290.43

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* Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
64Z							
71Z							
83M	sc............	....	95–7	....	......	......	....
83T	nd. or lf.......	....	80–1	....	......	v. s.	....
87M							
107W	col. liq., 1.3953	0.9317	−100.2	72.3^{765}	2.5	∞	∞
164F							
164T	sm. pr........	....	258–9 d. (246 d.)	....	0.13^{5}; 3.3^{100}	......	....
207C	col. liq., 1.415	1.075	....	174–5; 65^{11}	......	s.	s. eth.
222M							
238M							
263W	lf. f. w........	....	96	....	......	......	....
285M							
285Q	col. cr.........	....	42–3	148^{13}	......	......	v. s. eth.
285R	col. cr.........	....	110.5	$108\text{–}10^{12}$	v. s. h.	......	v.s.eth.; v.s.h. pet. eth.
286W	col. liq., $1.558^{21.3}$	$1.1307^{20.8}$	....	$106\text{–}7^{17}$	sl. s.	s.	s. eth., ac. a.
286X	yel. powd.....	....	99	....	v. s. h.	v. s.	v. s. eth., chl., ac. a., bz.; i. lgr.
288F							
293X	yel. liq........	....	....	245	......	......	....
293Y	col. liq. $1.543^{15.35}$	1.0943^{19}	....	239	......	......	....
294X	col. liq. $1.535^{12.7}$	$1.0201\frac{13}{4}$	....	$92\text{–}3^{17}$	......	......	....
312M	pr. f. h. w.....	....	115	295–300; $233\text{–}5^{15-20}$	s. h.	s.	s. eth., bz., chl.; sl. s. lgr.
312T	pr. f. dil. al....	....	51	$205\text{–}7^{10-15}$	s. h.	s.	s. eth., bz., chl.
372M	**methoxy-.** See *Quinacrine*.						
406E							
419S	nd. or pr. f. w..	....	280	....	0.5	i.	i. eth., s. alk., a.
425F							
441M	lf. or nd.......	....	101(102)	....	......	......	....
552M	liq............	....	....	203 (205); $63\text{–}4^{7}$	......	......	....
555M	col. liq........	$0.9497\frac{25}{4}$	....	$158\text{–}63^{6}$	i.	s.	s. eth., tol., CS_2
562F							
562L							
562Q	lf. or nd.; $[\alpha] + 94.6°$ (in al.)	....	185–5.5 (184–5)	....	v. sl. s.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
716V	**Anisole, acetyl-.**	See *Acetophenone, methoxy-.*		
718M	**——, p-anisoyl-.**	See *Benzophenone, p,p′-dimethoxy-.*		
726M	**——, thio-.**	See *Sulfide, methyl phenyl.*		
870M	**Apocynin.**	See *Acetovanillone.*		
933M	**Atabrine, Atebrin.**	See *Quinacrine,* dihydrochloride.		
935M	**Atophan.**	See *Cinchoninic acid, 2-phenyl-.*		
950C	**Auxenetriolic acid.**	See *Auxin a.*		
950E	**Auxenolonic acid.**	See *Auxin b.*		
950H	**Auxin a**	auxenetriolic acid; 3-5-di-*sec*-butyl-α,β,δ-trihydroxy-1-cyclopentenevaleric acid	$C_{18}H_{32}O_5$	328.44
950J	**Auxin b**	auxenolonic acid 3,5-di-*sec*-butyl-δ-hydroxy-β-oxo-2-cyclopentenevaleric acid	$C_{18}H_{30}O_4$	310.42
952M	**5-Azepotetrazole, 6,7,8,9-tetrahydro-.**	See *Metrazol.*		
1032M	**Benz[*j*]aceanthrene.**	See *Cholanthrene.*		
1062M	**Benzaldehyde, 4-hydroxy-3,5-dimethoxy-.**	See *Syringaldehyde.*		
1112M	**Benzedrine** (trade name)	See *Amphetamine.*		
1255M	**Benzene, methylthio-.**	*See *Sulfide, methyl phenyl.*		
1384M	**Benzenesulfonic acid, 3,4-dichloro-,** dihydrate	. . . .	$Cl_2C_6H_3SO_3H.2H_2O$	263.10
1540B	**Benzoic acid, 3,5-dinitro-,** amyl ester	. . . .	$(NO_2)_2C_6H_3$-$COOC_5H_{11}$	282.25
1540D	——, ——, benzyl ester	. . . .	$(NO_2)_2C_6H_3COO$-$CH_2C_6H_5$	302.24
1540F	——, ——, butyl ester	. . . .	$(NO_2)_2C_6H_3COO$-C_4H_9	268.22
1540H	——, ——, ethyl ester	. . . .	$(NO_2)_2C_6H_3COO$-C_2H_5	240.17
1540Q	——, ——, isopropyl ester . . .	. . . .	$(NO_2)_2C_6H_3COO$-C_3H_7	254.20
1540T	——, ——, methyl ester	. . . .	$(NO_2)_2C_6H_3COO$-CH_3	226.14
1540W	——, ——, phenyl ester	. . . .	$(NO_2)_2C_6H_3COO$-C_6H_5	288.21
1540Y	——, ——, propyl ester(*n*) . . .	. . . .	$(NO_2)_2C_6H_3COO$-C_3H_7	254.20
1561M	**——, 4-hydroxy-3,5-dimethoxy-.**	See *Syringic acid.*		
1602J	**——, *m*-sulfo-,** dichloride.	See *Benzoyl chloride, m-chlorosulfonyl.-*		
1669M	**Benzophenone, *p,p′*-dimethoxy**	-*p*-anisoylanisole.	$(CH_3OC_6H_4)_2CO$ . . .	242.26
1686M	**Benzopyran, dihydro-.**	See *Chroman.*		
1687M	**Benzo[*a*]pyrene, 1,2-Benzopyrene**	3,4-Benzpyrene	$C_{20}H_{12}$	252.30
1719M	**2-Benzoxazolol**	2-hydroxybenzoxazole; 2(3)-benzoxazolone (tautomer); oxycarbanil	$C_6H_4OC(OH){:}N$ . . .	135.12
1725M	**Benzoyl chloride, *m*-chlorosulfonyl-**	*m*-sulfobenzoyl dichloride	$ClSO_2C_6H_4COCl$ . . .	239.08
1737M	**Benzpyrene.**	See *Benzopyrene.*		
1813M	**3,3′-Bicoumarinyl.**	See *Dicoumarin.*		
1818M	**Bicyclohexyl**	Dicyclohexyl; dodecahydrobiphenyl	$C_6H_{11}C_6H_{11}$	166.30
1841M	**Biotin**	hexahydro-2-oxo-1-thieno-[3,4]imidazole-4-valeric acid; vitamin H; coenzyme R	$C_{10}H_{16}N_2O_3S$	244.30

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* Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
716V							
718M							
726M							
870M							
933M							
935M							
950C							
950E							
950H	hex. cr. [α] − 3.19° (alc.)	....	196	....	sl. s.	s.	sl. s. eth., i. pet. eth.
950J	cr. [α] − 2.8°	....	183	....	......	......	....
952M							
1032M							
1062M							
1112M							
1255M							
1384M	need.........	....	69–70 (71–2,	....	v. s.	v. s.	v. s. eth.; i. c. chl.; sl. s. h. chl.
1540B	....	....	46	....	......	s. h.	....
1540D	....	....	112	....	......	......	....
1540F	monocl. nd., 1.488, 1.621	....	63	....	......	s. h.	....
1540H	monocl. nd., 1.560, 1.576	....	93	....	......	s. h.	....
1540Q	monocl. nd., (β)1.609	....	122	....	......	s. h.	....
1540T	monocl. pl., 1.382, 1.780	....	108	....	......	s. h.	....
1540W	col. rods, 1.505, 1.690, >1.740	....	145.8	....	i.	s. h.	v. s. eth.
1540Y	monocl. pl., 1.486, 1.603	....	73	....	......	s. h.	....
1561M							
1602J							
1669M	wh. nd........	....	144	....	......	v. s. h.	v. s. chl., bz.
1686M							
1687M	lt. yel. nd.....	....	(176–7)	$310–12^{10}$	i.	......	....
1719M	nd...........	....	141–2(137)	>360	sl. s.	s.	s.
1725M	....	....	20.4	$153–4^{7}$	......	......	....
1737M							
1813M							
1818M	col. liq. 1.4766	0.8644^{20}	3.65	234	<0.01	∞ (abs. al. above 23.4)	∞
1841M	lng. nd........	1.41	230–2	....	......	......	....

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
1877M	**Biphenyl, dodecahydro-.** See *Bicyclohexyl.*			
1983M	**Bromoprene.**	See 1,3-*Butadiene, 2-bromo-**.		
1991M	**1,3-Butadiene, 2-bromo-***	bromoprene...............	$CH_2:CBrCH:CH_2$..	133.00
2008M	**Butane, 1-butoxy-3-methyl-*.**	See *Ether, butyl isoamyl.*		
2036F	**——, 1-(2-methylpropoxy)-*.** See *Ether, butyl isobutyl.*			
2036J	**——, 3-methyl-1-propoxy-*.** See *Ether, isoamyl propyl.*			
2039M	**——, 1-propoxy-*.**	See *Ether, butyl propyl.*		
2177F	**2,3-Butylene glycol.** See 2,3-*Butanediol* in the Main Table.			
2186Q	***tert*-Butyl ketone.** See 3-*Pentanone, 2,2,4,4-tetramethyl-**.			
2193M	**Butyl phosphate (n)..**	tri-*n*-butyl phosphate........	$(C_4H_9)_3PO_4$	266.32
2239F	**Butyric acid, α-amino-γ-(aminooöxy)-.** See *Canaline.*			
2239M	**——, α-amino-γ-(guanidoöxy)-.** See *Canavanine.*			
2239Q	**——, α-amino- α-hydroxy-.** See *Threonine.*			
2328F	**Canaline..............**	α-amino-γ-(aminoöxy)-butyric acid	$H_2NOCH_2CH_2CH(NH_2)COOH$.....	134.14
2328M	**Canavanine...........**	α-amino-γ-(guanidoöxy)-butyric acid	$CH_4N_3OCH_2CH_2CH(NH_2)COOH$	176.18
2329M	**Cannabidiol..........**	....	$C_{21}H_{30}O_2$	314.45
2329Q	**Cannabinol...........**	3-amyl-1-hydroxy-6,6,9-trimethyl-5-dibenzopyrone	$C_{21}H_{26}O_2$..........	310.42
2446J	**Carbazone, diphenylthio-.** See *Dithizone.*			
2595M	****Cardiazol.**	See *Metrazol.*		
2652M	**Cetyl mercaptan.**	See 1-*Hexadecanethiol**.		
2690M	**Cholanthrene.........**	benz[*j*]aceanthrene..........	$C_{20}H_{14}$.............	254.31
2690T	**Cholanthrene, 3-methyl-.**	20-methylcholanthrene......	$C_{21}H_{16}$............	268.34
2698M	**Chroman.............**	3,4-dihydro-1,2-benzopyran; 2,3-dihydro-1,4-benzopyran	$C_9H_{10}O$...........	134.17
2698T	**——, 6-hydroxy-2,5 (or 7), 8-trimethyl-2-(4, 8, 12-trimethyl**			
2731R	**Cinchoninic acid 2-phenyl-**	cincophen; atophan; quinophan	$C_6H_5C_9H_5NCOOH$.	249.26
2731W	**Cincophen.**	See *Cinchoninic acid, 2-phenyl-.*		
2799M	**Citrulline.............**	α-amino-δ-ureidovaleric acid; *N* δ-carbamylornithine; δ-ureidonorvaline	$H_2NCONH(CH_2)_3CH(NH_2)COOH$	175.19
2810M	**Coenzyme R.**	See *Biotin.*		
2827M	**Coniferin, methoxy-.**	See *Syringin.*		
2837J	**Coronene.............**	....	$C_{24}H_{12}$.............	300.34
2837M	**Corticosterone........**	11,21-dihydroxyprogesterone.	$C_{21}H_{30}O_4$..........	346.45
2975J	**1,3-Cyclobutanedicarboxylic acid, bis-(*o*-hydroxyphenyl)-,** dilactone.			
3035M	**2-Cyclohexen-1-one, 3,5,5-trimethyl-*.** See *Isophorone.*			
3047M	**Cyclopentane, methyl-**	....	$C_5H_9CH_3$.........	84.16
3060M	**2-Cyclopentenevaleric acid, 3,5-di-sec-butyl-δ-hydroxy-β-oxo-.**			
3060P	**1-Cyclopentenevaleric acid, 3,5-di-sec-butyl α, β, δ-trihyrdoxy.-**			
3094F	**DDT.**	See *Ethane, 1-trichloro-2,2-bis (p-chlorophenyl)-.*		
3104M	**1-Decanethiol*........**	*n*-decyl mercaptan..........	$CH_3(CH_2)_9SH$.....	174.34
3117M	***cis*-5-Decene*..........**	*cis*-1,2-dibutylethylene......	$[CH_3(CH_2)_3CH:]_2$..	140.26
3117N	***trans*-5-Decene*......**	*trans*-1,2-dibutylethylene....	$[CH_3(CH_2)_3CH:]_2$..	140.26
3117T	**1-Decene-1,10-dicarboxylic acid.** See *Traumatic acid.*			
3130M	***n*-Decyl mercaptan.**	See 1-*Decanethiol**.		
3141J	**Desoxycorticosterone..**	deoxycorticosterone; 21-hydroxyprogesterone	$C_{21}H_{30}O_3$..........	330.45

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* Name approved by the International Union of Chemistry.

** Trade mark.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
1877M							
1983M							
1991M	liq., 1.4988....	1.397	....	42–3^{165}	i.	s.	s. eth.
2008M							
2036F							
2036J							
2039M							
2177F							
2186Q							
2193M	col. liq........	$0.9727\frac{25}{4}$	....	289; 160–2^{15}	i.	s.	s. eth., tol., CS_2
2239F							
2239M							
2239Q							
2328F	nd. f. al.; $[\alpha]^{21} - 8.31^\circ$	....	214 d.	....	......	......	....
2328M	cr. f. al.; $[\alpha] + 7.9^\circ$	....	184	....	......	......	....
2329M	rods f. pet. eth.	....	66–7	187–90^{2}	i.	s.	s. eth., bz., chl.
2329Q	pl. or lf.; $[\alpha] - 148^\circ$ (alc.)	....	76–7	185$^{0.05}$	i.	s.	s. alk.
2446J							
2595M							
2652M							
2690M	pa. yel. lf......	....	173(170–1)	....	i.	......	....
2690T	pa. yel. nd.....	....	176.5–7.5	....	i.	......	....
2698M	liq. 1.544......	1.064	....	214–5^{749}; 95^{12}	s. h.	......	∞ org. solv.
2698T	**tridecyl.**) See	*Tocopherol.*					
2731R	sm. wh. nd....	....	209(212–3)	....	i. c., s. h.	0.8	s. eth.; 0.25 chl.; sl. s. bz.
2731W							
2799M	pr.; $[\alpha] + 3.7^\circ$.	....	222	....	s.	i.	....
2810M							
2827M							
2837J	yel. nd........	....	437–40	....	......	......	s. h. bz.
2837M	pl. or nd.; $[\alpha]^{25}_{D} + 222^\circ$ (in al.)	....	181–2 (177–9)	....	......	......	....
2475J	See *Dicoumarin*.						
3035M							
3047M	col. liq., 1.4098^{20}	0.7488	−142.4	71.8	i.	∞	∞ eth., bz.
3060M	See *Auxin b.*						
3060P	See *Auxin a.*						
3094F							
3104M	col. liq., 1.4558	....	....	132–4^{40}	i.	s.	s. eth.
3117M	col. liq., 1.4252	0.7445	−112	169.5^{739}	i.	∞	∞ eth.
3117N	col. liq., 1.4235	0.7401	−73	170.2^{739}	i.	∞	∞ eth.
3117T							
3130M							
3141J	$[\alpha]^{22}$ 178° (in al.)	....	141–2	....	sl. s.	s.	s. acet.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3192M	**5-Dibenzopyrone, 3-amyl-1-hydroxy-6,6,9-trimethyl-.** See *Cannabin*			
3208L	**Dicoumarin** (Ciamician, Silber)	3,4-bis(o-hydroxyphenyl)-1,2-cyclobutane dicarboxylic dilactone	$C_{18}H_{12}O_4$	292.28
3208M	**Dicoumarin** (Fittig, Dyson)	3,3′-bicoumarinyl	$C_{18}H_{10}O_4$	290.26
3208N	**Dicoumarin** (Ström)	2,4-bis(*o*-hydroxyphenyl)-1,3-cyclobutanedicarboxylic dilactone	$C_{18}H_{12}O_4$	292.28
3210M	**Dicyclohexyl.**	See *Bicyclohexyl.*		
3376M	**Dithizone**	phenylazothionoformic phenylhydrazide; formazyl mercaptan; diphenylthiocarbazone	$C_6H_5N{:}NCSNHNHC_6H_5$ or C_6H_5-$N{:}NC(SH){:}NNHC_6H_5$	256.32
3382M	**Djenkolic acid**	3,3′-methylenedithiobis-(2-aminopropanoic acid); β,β'-methylenedithiodialanine	$CH_2(SCH_2CHNH_2COOH)_2$	254.32
3389M	**Dodecanamide*.**	See *Lauramide.*		
3393M	**1-Dodecanethiol***	*n*-dodecyl mercaptan	$CH_3(CH_2)_{11}SH$	202.39
3398F	**2-Dodecenedioic acid*.**	See *Traumatic acid.*		
3400C	**Dodecylamine,** hydrochloride	dodecylammonium chloride	$CH_3(CH_2)_{11}NH_3Cl$	221.81
3401M	***n*-Dodecyl mercaptan.**	See 1-*Dodecanethiol*.*		
3402W	**Dopa.**	See *Alanine, β-(3,4-dihydroxyphenyl)-.*		
3445D	**Enanthonitrile**	heptanenitrile*; *n*-hexyl cyanide	$CH_3(CH_2)_5CN$	111.18
3478M	**Estradiol**	$\Delta^{1,3,5(10)}$-estratriene-3,17-diol; dihydroxyestrin; dihydrotheelin; dihydromenformone	$C_{18}H_{24}O_2$	272.37
3479F	**$\Delta^{1,3,5(10)}$-Estratriene-3,17-diol.**	See *Estradiol.*		
3479J	**Estrin, dihydroxy-.**	See *Estradiol.*		
3479M	**——, trihydroxy-.**	See *Estriol.*		
3479Q	**Estriol**	oestriol; theelol; trihydroxyestrin	$C_{18}H_{24}O_3$	288.37
3479T	**Estrone**	oestrone; theelin; menformone	$C_{18}H_{22}O_2$	270.36
3502F	**Ethane, 1-chloro-1-nitro-***	....	$CH_3CH(Cl)NO_2$	109.52
3509M	**——, dichlorodiphenyltrichloro-.**	See *Ethane,* 1,1,1-*trichloro*-2,2-*bis-(p-chlorophenyl)-*		
3555J	**——, 1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)-**	dichlorodiphenyltrichloroethane; DDT	$CCl_3CH(C_6H_4Cl)_2$	354.50
3578M	**Ethaneorthosiliconic acid,** triethyl ester	triethoxyethylsilicane	$C_2H_5Si(OC_2H_5)_3$	192.30
3578Q	——, trimethyl ester	ethyltrimethoxysilicane	$C_2H_5Si(OCH_3)_3$	150.22
3680J	**Ether, butyl isoamyl**	1-butoxy-3-methylbutane*	$C_4H_9OC_5H_{11}$	144.25
3680Q	**——, butyl isobutyl**	1-(2-methylpropoxy)-butane*	$CH_3(CH_2)_3OCH_2CH(CH_3)_2$	130.22
3682M	**——, butyl propyl**	1-propoxybutane*	$CH_3(CH_2)_2O(CH_2)_3CH_3$	116.20

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* Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3192M	*ol.*						
3208L	lf. f. glac. ac.a.	....	262	......	......	......	....
3208M	nd. f. glac. ac. a.	......	>330	....	......	i.	i. eth., bz.; v. sl. s. chl.
3208N	nd. or lf. f. glac. ac. a.	......	>275	......	......	......	....
3210M							
3376M	bl. blk. cr.....	....	......	....	i.	sl. s.	sl. s. eth.; s. chl., alk.
3382M	nd.; $[\alpha]^{26}$ − 44.5°	....	300–50d.	....	......	......	....
3389M							
3393M	col. liq., 1.4589	....	....	143^{15}	i.	s.	s. eth.
3398F							
3400C	col. cr.... ...	....	d. > 150	....	0.4^{25}; 33.3^{30} 77^{60} 103^{100}	20.0^{20} 66^{40} 157^{60} (95%)	i. eth.; $i.^{0-40}$, 6.2^{50}, 46.5^{70} bz.
3401M							
3402W							
3445D	1.41037^{30}	$0.80176\frac{30}{4}$	−65	186.1; 74.7^{16}	v. sl. s.	∞ abs., 95%	∞ eth., bz., CCl_4, chl., acet., ac. a., me. al. meCN
3478M	(α)[α] + 81° (alc.); (β)$[\alpha]^{18}$ + 56.7° (alc.)	....	(α)170–8 (β)222	....	......	......	(α) s. pet. eth.
3479F							
3479J							
3479M							
3479Q	[α] + 30°	......	281	....	......	sl. s.	s. pyr.; sl. s. me. al., pet. eth.
3479T	[α] − 167°. ..	....	....	....	0.002	v. sl. s.	s. pet. eth.; sl. s. acet.; v. sl. s. bz.
3502F	liq., 1.423	$1.258\frac{20}{20}$	....	$124–5^{758}$	0.4^{20}	s.	s. eth., glycols, esters, min. oil
3509M							
3555J	nd. f. al... ...	....	107	d.	i.	s.	s. eth., bz.
3578M	....	0.9281	....	158–60	......	......	....
3578Q	....	0.9747^{0}	....	125–6	......	s.	....
3680J	liq.	....	....	157^{756}	i.	s.	∞ eth.
3680Q	liq...........	0.763	....	131.5–32	i.	s.	∞ eth.
3682M	liq..........	0.7773	....	117	i.	s.	∞ eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
3690M	**Ether, 2-chloroethyl phenyl.** See *Phenetole, β-chloro-*.			
3709M	**——, difurfuryl.**	See *Furfuryl ether.*		
3751J	**——, isoamyl propyl**	3-methyl-1-propoxybutane*	$C_3H_7OC_5H_{11}$	130.22
3753J	**——, isobutyl propyl**	2-methyl-1-propoxypropane*	$(CH_3)_2CHCH_2O(CH_2)_2CH_3$	116.20
3755F	**——, isopropyl propyl**	2-propoxypropane*	$(CH_3)_2CHOCH_2CH_2CH_3$	102.17
3815M	**Ethylene, 1-butyl-2-ethyl-.** See 3-*Octene**.			
3821M	**——, 1,2-dibutyl-.**	See 5-*Decene.*		
3833M	**——, 1,2-dipropyl-.**	See 4-*Octene**.		
3881M	**Ethylenediamine, *N,N*-diethyl-**		$H_2NCH_2CH_2N(C_2H_5)_2$	116.20
4015M	**Formazyl mercaptan.**	See *Dithizone.*		
4046F	**Formic acid, phenylazothiono-,** phenylhydrazide. See *Dithizone.*			
4070M	**Fumaryl chloride**	*trans*-butenedioyl chloride*	$(ClCOCH{:})_2$	152.97
4140M	**Furfuryl alcohol, tetrahydro-,** stearate. See *Stearic acid, tetrahydrofurfuryl ester.*			
4143J	**Furfuryl ether**	difurfuryl ether; di-α-furfuryl ether	$(C_4H_3O{\cdot}CH_2)_2O$	178.18
4157M	**Gallaldehyde, 3,5-dimethyl ether.** See *Syringaldehyde.*			
4160M	**Gallic acid,** 3,5-dimethyl ether. See *Syringic acid.*			
4204F	**Glucurone**	glucuronic acid lactone	$C_5H_8O_4COO$	176.12
4204K	**β-ᴅ-Glucuronic acid**		$C_5H_9O_5COOH$	194.14
4400M	**Guanidine, 1-sulfanilyl-.** See *Sulfaguanidine.*			
4475M	**Heptanenitrile*.**	See *Enanthonitrile.*		
4522M	**Heteroauxin.**	See 3-*Indoleacetic acid.*		
4532M	**1-Hexadecanethiol***	cetyl mercaptan; *n*-hexadecyl mercaptan	$CH_3(CH_2)_{15}SH$	258.49
4538M	***n*-Hexadecyl mercaptan.** See 1-*Hexadecanethiol**.			
4569M	**Hexane, 1-hexylthio-*.**	See *Hexyl sulfide.*		
4623A	***cis*-2-Hexene***		$CH_3CH{:}CHCH_2CH_2CH_3$	84.16
4623B	***trans*-2-Hexene***		$CH_3CH{:}CHCH_2CH_2CH_3$	84.16
4628A	***cis*-3-Hexene***		$CH_3CH_2CH{:}CHCH_2CH_3$	84.16
4628B	***trans*-3-Hexene***		$CH_3CH_2CH{:}CHCH_2CH_3$	84.16
4643M	***n*-Hexyl cyanide.**	See *Enanthonitrile.*		
4649F	**Hexyl sulfide**	di-*n*-hexyl sulfide; 1-hexylthiohexane*	$[CH_3(CH_2)_5]_2S$	202.39
4658J	**ʟ-Histidine** bis-3,4-dichlorobenzenesulfonate		$C_6H_9N_3O_2(Cl_2C_6H_3SO_3H)_2$	609.29
4675J	**Hydantoin, 5,5-diphenyl-**		$C_{15}H_{12}N_2O_2$	252.26
4882M	**Indole, 1,3-dimethyl-**	*N*-methylskatole	$C_6H_4N(CH_3)CH{:}C(CH_3)$	145.20
4884M	**3-Indoleacetic acid**	heteroauxin; indole-β-acetic acid	$C_8H_6NCH_2COOH$	175.18
4950M	**Isobutenol.**	See 2-*Propen-1-ol, 2-methyl-**.		
4950T	**Isobutenyl chloride.**	See *Propene, 3-chloro-2-methyl-**.		
4996F	**Isobutyric acid, α-hydroxy-,** ethyl ester		$(CH_3)_2COHCOOC_2H_5$	132.16
5026M	**Isocrotyl chloride.**	See *Propene, 1-chloro-2-methyl-**.		
5053M	**Isohemipinic acid**	4,5-dimethoxyisophthalic acid	$(CH_3O)_2C_6H_2(COOH)_2$	226.18

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* Name approved by the International Union of Chemistry.

COMPOUNDS, SUPPLEMENTARY TABLE (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
3690M							
3709M							
3751J	liq......... ...	....	....	130	i.	s.	∞ eth.
3753J	liq............	....	....	105–6	i.	s.	∞ eth.
3755F	liq............	....	....	82–3	i.	s.	∞ eth.
3815M							
3821M							
3833M							
3881M	liq............	$0.827\frac{18.5}{18.5}$	....	145; 75^{20}	sl. s.	s.	s. eth., tol.
4015M							
4046F							
4070M	1.500^{18}........	1.410	....	160	......	......	....
4140M							
4143J	col. liq., 1.5088	1.1405; 1.137$\frac{20}{0}$	....	101^{2}; 88–9^{1}	i.	......	....
4157M							
4160M							
4204F	monocl. pl; [α] + 19.21° (in w.)	....	175–8	....	s.	i.	....
4204K	need.; [α]^{24} + 11.73→36.26° (5.6% i. w.)	....	156	....	s.	s.	i. eth.
4400M							
4475M							
4522M							
4532M	col. liq., 1.4623	....	18	167–70^{3}	i.	sl. s.	s. eth.
4538M							
4569M							
4623A	col. liq., 1.3954	0.6845	−146	68.2^{749}	i.	∞	∞ eth.
4623B	col. liq., 1.3935	0.6780	−133	67.5^{750}	i.	∞	∞ eth.
4628A	col. liq., 1.3934	0.6796	−135	66.8^{741}	i.	∞	∞ eth.
4628B	col. liq., 1.3938	0.6779	−113	67.5^{741}	i.	∞	∞ eth.
4643M							
4649F	1.459.........	0.841	....	230; 113.5^{4}	......	......	....
4658J	rhomb. need...	....	280–1 d.	....	sl. s. c.; s. h.	i.	0.051^{8} 10% w. sol reagent
4675J	cr............	....	286	....	i.	s.	s. acet., ac. a.; sl. s. chl., bz.
4882M	liq............	....	....	225–32; 135–8^{18}	......	......	....
4884M	lf. f. bz.; pl. f. chl.; [α] − 3.8° (alc.)	....	165	....	v. sl. s.	v. s.	v. s. eth.
4950M							
4950T							
4996F	....	....	....	150	∞	∞	∞
5026M							
5053M	nd. f. w.	....	245–6	....	sl. s. h.	s.	s. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
5078M	**3-Isophenoxazinone,**	10-oxide. See *Resazurin.*		
5078T	**Isophorone**	3,5,5-trimethyl-2-cyclohexen-1-one*	$C_9H_{14}O$	138.20
5086M	**Isophthalic acid, 4,5-dimethoxy-.**	See *Isohemipinic acid.*		
5099M	**Isopropylamine,** ***dl*-2-phenyl-.**	See *Amphetamine*.		
5180T	**Ketone, anisyl methyl.**	See *Acetophenone, mehoxy-.*		
5264W	**——, methyl *o*-tolyl.**	See *Acetone, o-methyl-.*		
5286M	**Lactic acid,** isopropyl ester	isopropyl 2-hydroxypropanoate*	$CH_3CHOHCOO-CH(CH_3)_2$	132.16
5287M	——, phenyl ether.	See *Propionic acid, α-phenoxy-.*		
5300F	**Lactonitrile,** acetate	α-cyanoethyl acetate; α-acetoxypropionitrile	$CH_3CH(OOCCH_3)-CN$	113.11
5308F	**Lauramide**	dodecanamide*	$CH_3(CH_2)_{10}CO-NH_2$	199.33
5308M	**——, *N*-phenyl-.**	See *Lauranilide.*		
5308T	**Lauranilide**	*N*-phenyldodecanamide; *N*-phenyllauramide	$CH_3(CH_2)_{10}CON-HC_6H_5$	275.42
5314H	**Lauric acid,** methyl ester.	methyl laurate	$C_{11}H_{23}COOCH_3$	214.34
5504M	**α-Menaphthyl chloride.**	See *Naphthalene, 1-(chloromethyl)-.*		
5504R	**Menformone.**	See *Estrone.*		
5504U	**——, dihydro-.**	See *Estradiol.*		
5532M	**Mepacrine.**	See *Quinacrine,* dihydrochloride.		
5580W	**Methacrylic anhydride**		$[CH_2:C(CH_3)CO]_2-O$	154.16
5580X	**Methacrylonitrile**	α-methylacrylonitrile; 2-methylpropenenitrile*	$CH_2:C(CH_3)CN$	67.09
5580Y	**Methallyl alcohol.**	See *2-Propen-1-ol, 2-methyl-*.*		
5580Z	**Methallyl chloride.**	See *Propene, 3-chloro-2-methyl-*.*		
5707M	**Methaneorthosiliconic acid,** ethyl ester	triethoxymethylsilicane	$CH_3Si(OC_2H_5)_3$	178.27
5761M	**Methyl orthosilicate**	methyl silicate; tetramethoxysilicane	$(CH_3)_4SiO_4$	152.20
5771M	**Metrazol	6,7,8,9-tetrahydro-5-azepotetrazole; pentamethylenetetrazole; Cardiazol	$C_6H_{10}N_4$	138.17
5771T	**Metycaine**	2-methyl-1-piperidinepropanol benzoate-hydrochloride	$C_{16}H_{24}ClNO_2$	297 82
5779M	**Monophenyl orthophosphate.**	See *Phenylphosphoric acid.*		
5819M	**Myristic acid,** methyl ester	methyl myristate	$C_{13}H_{27}COOCH_3$	242.39
5844M	**Naphthalene, 1-(chloromethyl)-**	α-menaphthyl chloride	$C_{10}H_7CH_2Cl$	176.64
5897M	**1-Naphthaleneacetic acid**	α-naphthylacetic acid	$C_{10}H_7CH_2COOH$	186.20
5972M	**1-Naphthol, 4-*p*-nitrophenylazo-**	*p*-nitrobenzeneazo-α-naphthol	$O_2NC_6H_4N:NC_{10}-H_6OH$	293.27
6038R	**1,-4-Naphthoquinone, 2-methyl-**	vitamin K (one form)	$C_{11}H_8O_2$	172.17

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* Name approved by the International Union of Chemistry.

** Trade mark.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
5078M							
5078T	....	0.9229^{20}_{20}	....	252	......	......	....
5086M							
5099M							
5180T							
5264W							
5286M	col. liq.	....	....	166–8	s.	s.	s. eth., bz.
5287M							
5300F	liq.	1.032^{14}	....	172–3; $60–2^{10}$	4.0	s.	v. s. alk., eth., glac. ac. a.
5308F	col. cr.	....	frz. 102.4	....	i.	9.0^{30} (95%)	v. sl. s. eth., bz., CCl_4, chl.; sl. s. acet.; s. me. al.
5308M							
5308T	col. cr.	....	frz. 77.2	....	i.	17.6^{30} (95%)	s. eth., bz., CCl_4, chl., acet., me. al.
5314H	col. oil	....	frz. 5.15	....	i.	∞ abs. 95%	∞ eth., bz., CCl_4, chl., et. acetate, acet., ac. a., me. al.
5504M							
5504R							
5504U							
5532M							
5580W	col. liq., 1.4525^{25}	1.0243	....	98^{25}; 84^{11}	d.	∞	∞
5580X	col. liq., 1.4002	0.805	-40	90	......	∞	∞
5580Y							
5580Z							
5707M	....	0.938	....	150–1	......	s.	....
5761M	....	1.028^{22}	....	$121–2^{759}$; $25–27^{12}$	......	s.	....
5771M	sm. cr	....	59(57–8)	....	v. s.	......	v. s. org. solv.
5771T	sm. cr	....	171–3	....	v. s.	s.	i. eth.; s. chl.
5779M							
5819M	col. oil	....	frz. 18.37	....	i.	∞ abs., 95%	∞ eth., bz., CCl_4, chl., et. acetate, acet., ac. a., me. al.
5844M	pr	....	32(34)	291–2; 134^{3}	......	......	....
5897M	need	....	134(131)	d.	$0.042^{20.5}$; s. hot	s.	s. eth., bz., glac. ac. a.
5972M	br.-red nd	....	277–9d.	....	v. sl. s.	......	s. boiling $PhNO_2$
6038R	yel. nd	....	106(104)	....	sl. s.	s.	s. eth., bz., ac. a.; sl. s. pet. eth.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
6038U	**1,4-Naphthoquinone,2-methyl-3-phytyl-.**	See *Vitamin K_1.*		
6127M	**Niacin.**	See *Nicotinic acid*, in the Main Table.		
6139M	**Niperyt.**	See *Pentaerythritol*, tetranitrate.		
6151M	**“Nitrogen mustard gas.”**	See *Triethylamine, 2,2′,2″-trichloro-.*		
6214M	***l*-Nornicotine**	*l*-3-(2-pyrrolidyl)pyridine	$C_9H_{12}N_2$	148.20
6215M	**Norvaline.**	See *Valeric acid, α-amino-*, in the Main Table.		
6215S	**——, *δ*-ureido-.**	See *Citrulline.*		
6225M	**1-Octadecanethiol***	*n*-octadecyl mercaptan	$CH_3(CH_2)_{17}SH$	286.54
6234M	**Octadecylamine,** hydrochloride	octadecylammonium chloride	$C_{18}H_{37}NH_3Cl$	305.97
6235T	***n*-Octadecyl mercaptan.**	See 1-*Octadecanethiol**.		
6277J	***cis*-3-Octene***	1-butyl-2-ethylethylene	$CH_3CH_2CH{:}CH(CH_2)_3CH_3$	112.21
6277K	***trans*-3-Octene***	*trans*-1-butyl-2-ethylethylene	$CH_3CH_2CH{:}CH(CH_2)_3CH_3$	112.21
6277Q	***cis*-4-Octene***	*cis*-1,2-dipropylethylene	$[CH_3(CH_2)_2CH{:}]_2$	112.21
6277R	***trans*-4-Octene***	*trans*-1,2-dipropylethylene	$[CH_3(CH_2)_2CH{:}]_2$	112.21
6302M	**Oestr-.**	See *Estr-.*		
6321M	**Ornithine, N^{δ}-carbamyl-.**	See *Citrulline.*		
6394M	**Oxycarbanil.**	See 2-*Benzoxazolol.*		
6401F	**Palmitamide, *N*-phenyl-.**	See *Palmitanilide.*		
6401M	**Palmitanilide**	*N*-phenylhexadecanamide; *N*-phenylpalmitamide	$CH_3(CH_2)_{14}CONHC_6H_5$	331.52
6403M	**Palmitic acid,** butyl ester	butyl hexadecanoate*	$C_{15}H_{31}COOC_4H_9$	312.52
6409Q	**——, θ,ι,o-trihydroxy-.**	See *Aleuritic acid.*		
6457V	**Pentadecanoic acid***	*n*-pentadecylic acid	$CH_3(CH_2)_{13}COOH$	242.39
6468J	**Pentaerythritol,** tetranitrate	penthrit(e); pentrit(e); PETN; niperyt	$C(CH_2NO_3)_4$	316.15
6560M	**3-Pentanone, 2,2,4,4-tetramethyl-***	Hexamethylacetone; *tert*-butyl ketone; pivalone	$(CH_3)_3CCOC(CH_3)_3$	142.23
6592T	**Penthrit(e), Pentrit(e), PETN.**	See *Pentaerythritol*, tetranitrate.		
6615J	**Phenanthrene, 9-bromo-**		$C_{14}H_9Br$	257.13
6626T	——, quinhydrone		$C_{28}H_{18}O_4$	418.42
6648M	**Phenethylamine, *dl*-*α*-methyl-.**	See *Amphetamine.*		
6660C	**Phenetole, *β*-chloro-**	2-chloroethyl phenyl ether	$C_6H_5OCH_2CH_2Cl$	156.61
6670A	**Phenol, acetyl-.**	See *Acetophenone, hydroxy-.*		
6795M	**——, *p*-propionyl-.**	See *Propiophenone, p-hydroxy-.*		
6836M	**o-Phenylenediamine, 4-chloro-**		$ClC_6H_3(NH_2)_2$	142 59
6858M	**Phenyl phosphate**	triphenyl orthophosphate	$(C_6H_5)_3PO_4$	326.28
6858Q	**Phenylphosphoric acid.**	monophenyl orthophosphate; dihydrogen phenyl phosphate	$C_6H_5OPO(OH)_2$	174.10

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* Name approved by the International Union of Chemistry.

COMPOUNDS, SUPPLEMENTARY TABLE (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
6038U							
6127M							
6139M							
6151M							
6214M	col. liq. 1.538^{18} [α]−88.8°^{22}	1.074	. . . .	266–7, 131^{11}	s.	. . .	. . . .
6215M							
6215S							
6225M	solid, 1.4648...	....	20–30	169–71^{1}	i.	sl. s.	s. eth.
6234M	col. cr........	... .	d. > 180	... .	i.$^{0-55}$; 7.8^{60}; 12.7^{100}	2.3^{30}, 11.3^{50}, 80^{70} (95%)	i. eth., bz.
6235T							
6277J	col. liq., 1.4125	0.7189	−126	122.3^{741}	i.	∞	∞ eth.
6277K	col. liq., 1.4124	0 7163	−108	122.4^{741}	i.	∞	∞ eth.
6277Q	col. liq., 1.4136	0.7205	−118	121.7^{739}	i.	∞	∞ eth.
6277R	col. liq., 1.4116	0.7147	−94	121.4^{739}	i.	∞	∞ eth.
6302M							
6321M							
6394M							
6401F							
6401M	col. cr	....	frz. 90.2	....	i.	1.7^{30} (95%)	sl. s. bz , CCl_4, chl., acet., me. al.
6403M	col. oil........	....	(α) frz. 14.88; (β) m. 18.3	....	i.	∞ abs., 95%	∞ eth., bz., CCl_4, chl., et. acetate, acet., ac. a., me. al.
6409Q							
6457V	1.4348^{55}; 1.4254^{80}	0.8423^{80}	frz. 52.54	212.0^{16}; 157.8^{1}	0.0012^{20}; 0.0020^{60}	3.1^{0}, 15.6^{20}, 230^{40} (95%)	s. eth., CS_2; 31.8 bz.; 35.4 CCl_4; 56.5 chl.; 10.9 acet.; 9.2 ac. a.; 13.0 me. al.
6468J	tetr. cr........	1.773	140–1 (138–40)	....	sl. s.	sl. s.	v. sl. s. eth.; s. acet.
6560M	col. liq. 1.41702^{25}	0.81992$\frac{25}{4}$	....	149–51	.....	∞	v. s. eth., bz.
6592T							
6615J	col. pr........	....	63	....	i.	v. sl. s.	s. eth., ac. a., CS_2
6626T	blk. nd........	....	167–9	....	......	......	.. ..
6648M							
6660C	pr.......	....	28	220; 100–2^{12}	i.	v. s.	v. s. eth., bz., lgr.
6670A							
6795M							
6836M	lf............	....	76	....	sl. s. c. w.	s.	s. eth.
6858M	pr. f. al	....	49.5	245^{11}	i.	s.	s. eth., bz., chl.
6858Q	nd. f. w., sc. f. chl.	....	99.5	....	s.	......	s. eth., bz., alk.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7035M	**1-Piperidinepropanol, 2-methyl-,** hydrochloride.	See *Metycaine.*		
7047M	**Pivalone**	See 3-*Pentanone, 2,2,4,4-tetramethyl*-*.		
7052G	**Porphine**		$C_{20}H_{14}N_4$	310.34
7052T	**Δ^4-Pregnene-3, 20-dione.**	See *Progesterone*		
7056J	**Progesterone**	Δ^4-pregnene-3,20-dione; progestine	$C_{21}H_{30}O_2$	314.45
7056M	**——, 11,21-dihydroxy-.**	See *Corticosterone.*		
7056Q	**——, 21-hydroxy-.**	See *Desoxycorticosterone.*		
7090F	**Propane, 1-chloro-1-nitro-***		$CH_3CH_2CH(Cl)NO_2$	123.54
7090M	**——, 2-chloro-2-nitro-***		$CH_3CCl(NO_2)CH_3$	123.54
7130M	**——, 2-methyl-1-propoxy-*.**	See *Ether, isobutyl propyl.*		
7135B	**——, 2-propoxy-*.**	See *Ether, isopropyl propyl.*		
7143F	**1,3-Propanediamine, 2-hydroxy-*.**	See 2-*Propanol, 1,3-diamino*-.		
7190M	**2-Propanol, 1,3-diamino-***	2-hydroxy-1,3-propanediamine*	$H_2NCH_2CHOHCH_2NH_2$	90.13
7223M	**Propene, 1-chloro-2-methyl-***	isocrotyl chloride	$(CH_3)_2C{:}CHCl$	90.55
7223Q	**——, 3-chloro-2-methyl-***	methallyl chloride; isobutenyl chloride	$CH_2{:}C(CH_3)CH_2Cl$	90.55
7234F	**——, 2-methyl-*,** tetramer	tetraisobutylene	$(C_4H_8)_4$	224.42
7234J	——, ——, trimer	triisobutylene	$(C_4H_8)_3$	168.31
7234Q	**——, 2-nitro-1-phenyl-.**	See *Styrene, β-methyl-β-nitro-.*		
7248M	**2-Propen-1-ol, 2-methyl-***	methallyl alcohol; isobutenol.	$CH_2{:}C(CH_3)CH_2OH$	72.10
7277M	**Propionic acid,** allyl ester		$CH_3CH_2COOC_3H_5$	114.14
7315M	**——, α-phenoxy-**	lactic acid phenyl ether	$CH_3CH(OC_6H_5)COOH$	166.17
7319M	**Propionitrile, α-acetoxy-.**	See *Lactonitrile,* acetate.		
7319T	**——, β-chloro-**	3-chloropropanenitrile*	$ClCH_2CH_2CN$	89.53
7329J	**Propiophenone, *p*-hydroxy-**	*p*-propionylphenol	$CH_3CH_2COC_6H_4OH$	150.17
7367M	**Propyl phosphate** (*n*)	tri-*n*-propyl orthophosphate	$(C_3H_7)_3PO_4$	224.24
7382M	**Prostigmine bromide.**		$C_{12}H_{19}BrN_2O_2$	303.20
7447M	**Pyrazine, 2-sulfanilamido-.**	See *Sulfapyrazine.*		
7491G	**Pyridine, 3-(2-pyrrolidyl)-.**	See *Nornicotine.*		
7495G	**——, 2-vinyl-**	α-vinylpyridine	$CH_2{:}CHC_5H_4N$	105.13
7524M	**Pyrimidine, 2-sulfanilamido-.**	See *Sulfadiazine.*		
7620G	**Quinacrine,** dihydrochloride	6-chloro-9-(4-diethylamino-1-methyl-butylamino)-2-methoxyacridine dihydrochloride; Atabrine; atebrin; mepacrine.	$C_{23}H_{30}ClN_3O.2HCl$	472.88
7731M	**Quinophan.**	See *Cinchoninic acid, 2-phenyl*-.		
7738M	**Resazurin**	3-isophenoxazinone 10-oxide; resazoin	$C_{12}H_7NO_4$	229.18
7824M	**Salicylaldehyde, 3-methoxy-.**	See *o-Vanillin.*		
7882M	**Semicarbazide, 1-phenyl-3-thio-.**		$C_6H_5NHNHCSNH_2$	167.23

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* Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
7035M							
7047M							
7052G	dk. red pl., met. lust.	....	....	....	i.	v. sl. s.	sl.s.
7052T							
7056J	sm. cr. [α] 193.5° (alc.)	....	(α)128.5; (β)121	....	i.	s.	s. org. solv.
7056M							
7056Q							
7090F	liq., 1.430.....	1.209^{20}_{20}	....	$141\text{–}3^{761}$	0.8^{20}	s.	s. eth., glycols, esters, min. oil
7090M	liq., 1.425.....	1.193^{20}_{20}	....	$133\text{–}4^{758}$	0.5^{20}	s.	s. eth., glycols, esters, min. oil
7130M							
7135B							
7143F							
7190M	....	....	42	235	......	......	....
7223M	col. liq., 1.4221	0.9186	....	68.1	......	∞	∞
7223Q	col. liq., 1.427..	0.925	....	72.2	......	∞	∞
7234F	1.448	0.794	....	106^{7} (109.5–11^{15})	......	......	....
7234J	1.431	0.759 (0.760)	....	179–81	......	......	....
7234Q							
7248M	col. liq. 1.4255.	0.8515	....	114.5	19.4	∞	∞
7277M	....	....	....	$124\text{–}4.5^{774}$	......	......	....
7315M	nd..........	....	115–6 (112–3)	265–6	v. sl. s. c., s. h.	s.	s. eth.
7319M							
7319T	col. liq........	$1.144^{18.5}$	....	175–6 (173–4.5)	......	......	....
7329J	wh. nd. or pr..	....	148–8.5	....	sl. s. c.; s. h.	v. s.	v. s. eth.
7367M	col. liq........	1.0023^{25}_{4}	....	252; 138^{47}; 133.5^{22}	i.	s.	s. eth., tol, CS_2
7382M	sm. cr.........	....	*ca.* 167 d.	....	s.	......	....
7447M							
7491G							
7495G	liq............	0.999^{0}	....	158–9 d.; $79\text{–}82^{29}$	sl. s.	......	v. s. eth., chl., alk.
7524M							
7620G	cr. f. w........	....	248–50	....	......	......	....
7731M							
7738M	pr., grnsh., lust	....	d.	....	i.	sl. s.	sl. s. glac. ac. a.; i. eth.
7824M							
7882M	monocl. pr....	....	201 d.	....	sl. s.	s. h.	sl. s. eth., chl., bz.; s. conc. alk.

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
7882Q	**Semicarbazide, 4-phenyl-3-thio-**		$H_2NNHCSNH-C_6H_5$	167.23
7886W	**Serine, β,β-dimethyl-.**	See *Valine, β-hydroxy-.*		
7893M	**Silicane, ethyltrimethoxy-.**	See *Ethaneorthosiliconic acid*, trimethyl ester.		
7896M	**——, tetramethoxy-.**	See *Methyl orthosilicate.*		
7898M	**——, triethoxyethyl-.**	See *Ethaneorthosiliconic acid*, triethyl ester.		
7898Q	**——, triethoxymethyl-.**	See *Methaneorthosiliconic acid*, ethyl ester.		
7914J	**Skatole, *N*-methyl-.**	See *Indole, 1,3-dimethyl-.*		
7946M	**Stearic acid,** cyclohexyl ester	cyclohexyl octadecanoate*	$C_{17}H_{35}COOC_6H_{11}$	366.61
7953M	——, propyl ester	propyl octadecanoate*	$C_{17}H_{35}COOC_3H_7$	326.55
7953T	——, tetrahydrofurfuryl ester.	tetrahydrofurfuryl octadecanoate	$C_{17}H_{35}COOCH_2-C_4H_7O$	368.58
7982J	***trans*-4,4′-Stilbenediol.**	See *Stilbestrol.*		
7982M	**Stilbestrol**	*trans*-4,4′-stilbenediol; stilboestrol	$(HOC_6H_4CH{:})_2$	212.24
7982Q	——, **α,α′-diethyl-**	stilbestrol	$[HOC_6H_4C-(C_2H_5){:}]_2$	268.34
7993T	**Styrene, *o*-chloro-**	1-chloro-2-vinylbenzene	$ClC_6H_4CH{:}CH_2$	138.59
7993U	**——, *m*-chloro-**	1-chloro-3-vinylbenzene	$ClC_6H_4CH{:}CH_2$	138.59
7993V	**——, *p*-chloro-**	1-chloro-4-vinylbenzene	$ClC_6H_4CH{:}CH_2$	138.59
7995M	**——, *o*-fluoro-**	1-fluoro-2-vinylbenzene	$FC_6H_4CH{:}CH_2$	122.14
7995N	**——, *m*-fluoro-**	1-fluoro-3-vinylbenzene	$FC_6H_4CH{:}CH_2$	122.14
7995P	**——, *p*-fluoro-**	1-fluoro-4-vinylbenzene	$FC_6H_4CH{:}CH_2$	122.14
7998M	**——, β-methyl-β-nitro-**	2-nitro-1-phenylpropene	$C_6H_5CH{:}C(NO_2)-CH_3$	163.17
8001C	**——, β-nitro-**	(2-nitrovinyl)benzene	$C_6H_5CH{:}CHNO_2$	149.14
8048T	**Sulfadiazine**	*N*¹-2-pyrimidylsulfanilamide; 2-sulfanilamidopyrimidine	$H_2NC_6H_4SO_2-NHC_4H_3N_2$	250.27
8048V	**Sulfaguanidine**	1-sulfanilylguanidine *N*¹-guanylsulfanilamide	$NH_2C_6H_4SO_2NHC-({:}NH)NH_2$	214.24
8049E	**Sulfanilamide, *N*¹-guanyl-.**	See *Sulfaguanidine.*		
8049J	**——, *N*¹-2-pyrazinyl-.**	See *Sulfapyrazine.*		
8049Q	**——, *N*¹-2-pyrimidyl-.**	See *Sulfadiazine.*		
8049T	**——, *N*¹-2-thiazolyl-.**	See *Sulfathiazole.*		
8050J	**Sulfapyrazine**	2-sulfanilamidopyrazine; *N*¹-2-pyrazinylsulfanilamide	$C_{10}H_{10}N_4O_2S$	250.27
8050T	**Sulfathiazole**	*N*¹-2-thiazolylsulfanilamide; 2-sulfanilamidothiazole; thiazomide	$H_2NC_6H_4SO_2-NHC_3H_2NS$	255.31
8062M	**Sulfide, dihexyl.**	See *Hexyl sulfide.*		
8070M	**——, methyl phenyl**	methylthiobenzene*; thioanisole	$C_6H_5SCH_3$	124.19
8091F	**Syringaldehyde**	4-hydroxy-3,5-dimethoxybenzaldehyde; gallaldehyde 3,5-dimethyl ether	$(CH_3O)_2(OH)C_6-H_2CHO$	182.17
8091H	**Syringic acid**	4-hydroxy-3,5-dimethoxybenzoic acid; gallic acid 3,5-dimethyl ether	$(CH_3O)_2(OH)C_6-H_2COOH$	198.17
8091K	**Syringin**	methoxyconiferin	$C_{17}H_{24}O_9$	372.36

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* Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of Water	Alcohol	Ether, etc.
7882Q	lf. or pr.......	....	140–1 (140 d.)	....	......	......	v. sl. s. bz.; i. eth., lrg., alk.
7886W							
7893M							
7896M							
7898M							
7898Q							
7914J							
7946M	semisolid......	0.890^{25}_{25}	28–9	....	i.	i.	s. eth.
7953M	col. cr.........	....	frz. 28.78	....	i.	$\infty^{28.3}$ abs., 95%; 9.2^{20} 95%	v. s. eth., bz., CCl_4, chl., et. acetate, acet., ac. a.; s. me. al.
7953T	liq...........	0.917^{25}_{25}	22	....	i.	s.	s. eth.
7982J							
7982M	nd. or tab.....	....	284	....	......	sl. s.	s. acet., h. ac. a.; sl. s. eth.; v. sl. s. bz.
7982Q	pl...........	....	171 (167–8)	....	i.	s.	....
7993T	col. liq., 1.5648	1.100	....	$60–1^4$	i.	s.	s. eth.
7993U	col. liq., 1.5619	1.090	....	$62–3^6$	i.	s.	s. eth.
7993V	col. liq., 1.5658	1.090	....	$53–4^3$	i.	s.	s. eth.
7995M	col. liq., 1.5197	1.030	....	$32–4^3$	i.	s.	s. eth.
7995N	col. liq., 1.5173	1.025	....	$30–1^4$	i.	s.	s. eth.
7995P	col. liq., 1.5158	1.024	....	$29–30^4$	i.	s.	s. eth.
7998M	yel. nd........	....	64	....	i.	sl. s.	s. pet. eth., eth.; i. alk.
8001C	yel. pr........	....	58	....	i.	s.	s. eth., pet. eth., bz., CCl_4, CS_2
8048T	....	....	255–6 (251–2)	....	$.012^{37}$	......	....
8048V	col. cr........	....	189–90	....	sl. s.	sl. s.	i.
8049E							
8049J							
8049Q							
8049T							
8050J	clusters tiny nd.	....	253(251–1.5)	....	......	......	sl. s. h. cyclohexanol
8050T	col. cr........	....	200–2	....	0.06	0.5	s. acet., dil. HCl, alk.
8062M							
8070M	col. liq., 1.5847, 1.5832^{25}	1.053^{25}	....	$58–60^6$	i.	s.	s. eth.
8091F	col. cr. f. lgr...	....	113	$192–3^{14}$	sl. s.	v. s.	v. s. eth., chl., ac. a., h. bz.; v. sl. s. lgr.; i. pet. eth.
8091H	col. nd. f. w. or eth.	....	204.5	....	v. sl. s. c.	s.	v. s. eth. chl.
8091K	nd. ($1H_2O$) f. w.; [α] — 17.1°	....	191–2	....	v. sl. s. c.; s. h.	s. h.	i. eth.; s. c. HNO_3, H_2SO_4

For explanations and abbreviations see beginning of table.

No.	Name	Synonyms	Formula	Mol. Wt.
8139M	**Testosterone**	17-hydroxy-3-androstenone	$C_{19}H_{28}O_2$	288.41
8146M	**1-Tetradecanethiol***	*n*-tetradecyl mercaptan	$CH_3(CH_2)_{13}SH$	230.44
8153M	***n*-Tetradecyl mercaptan.**	See 1-*Tetradecanethiol**.		
8154W	**Tetraethylene glycol** monostearate	3,6,9-trioxahendecane-1,11-diol monoöctadecanoate*	$C_{17}H_{35}COOCH_2CH_2(OC_2H_4)_3OH$	460.68
8154X	**Tetraisobutylene.**	See *Propene, 2-methyl-**, tetramer.		
8162M	**Tetrazole, pentamethylene-.**	See *Metrazol.*		
8169M	**Theelin.**	See *Estrone.*		
8169P	**——, dihydro-.**	See *Estradiol.*		
8169R	**Theelol.**	See *Estriol.*		
8174Q	**8-Thiachromineëthanol, 2,7-dimethyl-.**	See *Thiochrome.*		
8178M	**Thiazole, 2-sulfanilamido-.**	See *Sulfathiazole.*		
8179M	**Thiazomide.**	See *Sulfathiazole.*		
8179T	**1-Thieno[3,4]imidazole-4-valeric acid, hexahydro-2-oxo-.**	See *Biotin.*		
8184M	**Thiochrome**	2,7-dimethyl-8-thiachromineëthanol	$C_{12}H_{14}N_4OS$	262.32
8283G	**DL-Threonine**	*dl*-α-amino-β-hydroxybutyric acid	$CH_3CHOHCH(NH_2)COOH$	119.1
8322P	**β-Tocopherol**	Vitamin E (one form); 6-hydroxy- 2,5,8-trimethyl-2-(4,8,12-trimethyltridecyl) chroman	$C_{28}H_{48}O_2$	416.66
8322R	**γ-Tocopherol**	vitamin E (one form); 6-hydroxy-2,7,8-trimethyl-2-(4,8,12-trimethyltridecyl) chroman	$C_{28}H_{48}O_2$	416.66
8434M	***p*-Toluenesulfonic acid,** methyl ester	methyl *p*-toluenesulfonate	$CH_3C_6H_4SO_3CH_3$	186.22
8546M	**Traumatic acid**	2-dodecenedioic acid*; 1-decene-1,10-dicarboxylic acid	$C_{10}H_{18}(COOH)_2$	228.28
8550T	**Triamyl phosphate.**	See *Amyl phosphate.*		
8569M	**Tributyl phosphate.**	See *Butyl phosphate.*		
8600Q	**Triethylamine, 2,2′2″-trichloro-**	"nitrogen mustard gas"	$(ClCH_2CH_2)_3N$	204.54
8611M	**Triglycolamidic acid.**	See *Acetic acid, nitrilotri-.*		
8611P	**Triglycollamic acid.**	See *Acetic acid, nitrilotri-.*		
8617J	**Triisobutylene.**	See *Propene, 2-methyl-**, trimer.		
8626M	**Trimethylaminetricarboxylic acid.**	See *Acetic acid, nitrilotri-.*		
8650M	**3,6,9-Trioxahendecane-1,11-diol*.**	See *Tetraethylene glycol.*		
8659M	**Triphenyl orthophosphate.**	See *Phenyl phosphate.*		
8686M	**Tripropyl orthophosphate.**	See *Propyl phosphate.*		
8690T	**L-Tyrosine, 3,5-dibromo-,** dihydrate		$HOC_6H_2Br_2CH_2CH(NH_2)COOH \cdot 2H_2O$	375.03
8810J	**Valeric acid, α-amino-δ-ureido-.**	See *Citrulline.*		
8831M	**DL-Valine, β-hydroxy-**	α-amino-β-hydroxyisovaleric acid; β,β-dimethylserine	$(CH_3)_2COHCH(NH_2)COOH$	133.15
8843T	***o*-Vanillin**	2-hydroxy-3-methoxybenzaldehyde; 3-methoxysalicylaldehyde	$CH_3O(OH)C_6H_3CHO$	152.14
8869P	**Vitamin H.**	See *Biotin.*		
8869T	**Vitamin K.**	See also 1,4-*Naphthoquinone, 2-methyl-.*		
8869U	**Vitamin K₁**	2-methyl-3-phytyl-1,4-naphthoquinone	$C_{31}H_{46}O_2$	450.68

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* Name approved by the International Union of Chemistry.

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of		
					Water	Alcohol	Ether, etc.
8139M	sm. cr.; [α] + 109° (alc.)	....	154–4.5	.....	i.	s.	s. org. solv.
8146M	col. liq., 1.4613	....	....	160–2^5	i.	s.	s. eth.
8153M							
8154W	solid.	$0.971\frac{25}{25}$	35–40	....	......	......	....
8154X							
8162M							
8169M							
8169P							
8169R							
8174Q							
8178M							
8179M							
8179T							
8184M	yel. pr. f. chl...	....	277–8	....	......	sl. s.	s. me. al.; sl. s. eth., acet., chl.
8283G	orth. cr. ($\frac{1}{2}H_2O$)	....	229–30 d.	....	v. s.	i.	i. eth., chl.
8322P	$[\alpha]_{5461}^{20}$ 2.9°(al.)	....	....	....	......	......	....
8322R	liq. $[\alpha]_{5461}^{20}$ − 2.4° (al.)	....	....	....	......	......	....
8434M	col. liq. or cr...	....	28	....	i.	s.	∞ eth., bz.
8546M	....	....	165–6	....	......	......	....
8550T							
8569M							
8600Q	col. or yel. liq..	....	−4	143–4^{15}	v. sl. s.	∞	∞ eth., bz.; s. HCl
8611M							
8611P							
8617J							
8626M							
8650M							
8659M							
8686M							
8690T	rhomb. nd. or tab. f. w.; [α] + 1.3° in dil. HCl	....	*ca.* 245 d.	....	sl s.	sl. s.	i. eth.; s. a., alk.
8810J							
8831M	pl. f. al.......	....	218 d.	....	s.	i.	i. eth., bz., et. acetate
8843T	yel. nd. f. w., lgr.	....	45.5	265–6; 128^{10}	i.	s.	s. eth., chl., lgr., ac. a.
8869P							
8869T							
8869U	yel. oil.......	$0.97\frac{25}{25}$	....	140–45	i.	sl. s.	v. s. pet. eth.; s. acet., eth., bz., chl.

For explanations and abbreviations see beginning of table.

FORMULA INDEX OF ORGANIC COMPOUNDS

Numbers refer to compounds in the preceding table Physical Constants of Organic Compounds.

The arrangement of symbols in formulas is alphabetical except that C always comes first followed immediately by H if hydrogen is present. The arrangement of formulas is also alphabetical except that the number of atoms of any specific kind influences the order of compounds.

The numbers following any one formula are given in numerical order which is also their occurrence in the table of physical constants.

NOTE: the letter S preceding any compound number indicates that it is to be found in the **Supplement** to the table Physical Constants of Organic Compounds.

C

$CAgNO$, 4062.
$CBrCl_3$, 5598.
$CBrN$, 2959.
CBr_3NO_2, 1983.
CBr_4, 2586.
$CClF_3$, 5606M.
$CClN$, 2960.
CCl_2F_2, 5617.
CCl_2O, 6876.
CCl_2S, 6878.
CCl_3F, 5683.
CCl_3NO_2, 2687.
CCl_4, 2587.
CCl_4S, 5756.
CF_4, 2587M.
$CHBr_3$, 1981.
$CHClF_2$, 5604M.
$CHCl_2F$, 5619.
$CHCl_3$, 2679.
CHF_3, 3993.
CHI_3, 4898.
CHN, 4783.
$CHNO$, 2952.
$CHNS$, 8185.
CHN_3O_6, 6151.
CH_2Br_2, 5743.
CH_2ClNO, 2428.
CH_2Cl_2, 5744.
CH_2F_2, 5746M.
CH_2I_2, 5747.
CH_2N_2, 2947, 5613.
$CH_2N_2O_3$, 4049.
$CH_2N_2O_4$, 5634.
CH_2N_4, 8163.
CH_2O, 3995.
$(CH_2O)_x$, 7050.
CH_2O_2, 4016.
CH_2S_3, 2579.
CH_3AsCl_2, 910.
CH_3AsO, 902.
CH_3Br, 5734.
CH_3Cl, 5738.
CH_3ClHg, 5544.
CH_3ClO_2S, 5713.
CH_3Cl_3Sn, 8319.
CH_3F, 5750.
CH_3I, 5752.
CH_3NO, 3999, 4003.
CH_3NO_2, 5661, 5759.
CH_3NO_3, 5758.
CH_3NS_2, 2415.
$CH_3N_3O_3$, 8755.
CH_4, 5584.
CH_4N_2O, 4004, 4048, 8711.
$CH_4N_2O_2$, 8747.
CH_4N_2S, 8768.
$CH_4N_4O_2$, 4399.
CH_4O, 5719.
CH_4O_2Si, 5710.
CH_4O_2Sn, 5711.
CH_4O_3S, 5712.
CH_4O_4S, 5769.
$CH_4O_6S_2$, 5722.
CH_4S, 5715.
CH_5As, 913.
CH_5AsO_3, 5701.
CH_5N, 5729.
CH_5NO, 4825, 5725.
CH_5N_3, 4391.
CH_5N_3O, 7880.
$CH_5N_3O_4$, 8712M.
CH_5N_3S, 7884.
CH_5O_3P, 5709.
CH_5P, 6886.
CH_6ClN, 5730.
CH_6ClN_3O, 7881.
CH_6N_2, 4721.
CH_6N_4, 4392.
CH_6N_4O, 2558.
CH_6Si, 7895.
CIN, 2962.
CI_4, 2588.
$(CN)_x$, 6425.
CN_4O_8, 5675.
CO, 2583.
COF_2, 2589M.
COS, 2590.
CO_2, 2563.
CS_2, 2565.

C_2

C_2Br_2, 336H.
C_2Br_6, 3529.
C_2ClF_5, 3502M.
$C_2Cl_2F_4$, 3510R, 3511.
$C_2Cl_2O_2$, 6363.
$C_2Cl_3F_3$, 3555R, 3556.
C_2Cl_4, 3862.
$C_2Cl_4F_2$, 3549K, 3549P.
C_2Cl_4O, 325.
$C_2Cl_4O_2$, 3339.
C_2Cl_5F, 3539M.
C_2Cl_6, 3530.
C_2F_4, 3862M.
C_2F_6, 3530M.
C_2HBr, 333.
C_2HBr_3, 3866.
C_2HBr_3O, 1976.
$C_2HBr_3O_2$, 176.
C_2HBr_5, 3538.
C_2HCl, 336.
C_2HCl_3, 3867.
C_2HCl_3O, 323, 2665.
$C_2HCl_3O_2$, 177.
C_2HCl_5, 3539.
$C_2HF_3O_2$, 180M.
$C_2HI_3O_2$, 181.
C_2HI_5, 3541.
C_2HNO_2, 6382.
C_2H_2, 328.
$C_2H_2Br_2$, 3821.
$C_2H_2Br_2O$, 320.
$C_2H_2Br_2O_2$, 133.
$C_2H_2Br_4$, 3546, 3547.
$C_2H_2Cl_2$, 3822, 3823, 3823A.
$C_2H_2Cl_2O$, 18, 322.
$C_2H_2Cl_2O_2$, 135.
$C_2H_2Cl_3NO$, 49.
$C_2H_2Cl_4$, 3548, 3549.
$C_2H_2F_2$, 3826M.
$C_2H_2F_2O_2$, 138M.
$C_2H_2I_2O_2$, 139.
$C_2H_2N_4$, 8161.
C_2H_2O, 5175.
$C_2H_2O_2$, 4363.
$C_2H_2O_3$, 4373.
$C_2H_2O_4 \cdot 2H_2O$, 6343.
C_2H_3Br, 8860.
C_2H_3BrO, 319.
$C_2H_3BrO_2$, 119.
$C_2H_3Br_3$, 3552.
$C_2H_3Br_3O_2$, 1977.
C_2H_3Cl, 8861.
C_2H_3ClO, 321.
$C_2H_3ClO_2$, 123, 4042.
$C_2H_3Cl_2NO$, 36.
$C_2H_3Cl_3$, 3553, 3555.
$C_2H_3Cl_3O$, 3633.
$C_2H_3Cl_3O_2$, 2668.
C_2H_3F, 8863M.
C_2H_3FO, 356.
$C_2H_3FO_2$, 149M.
$C_2H_3F_3$, 3557M.
C_2H_3I, 8864.
C_2H_3IO, 357.
$C_2H_3IO_2$, 154.
$C_2H_3I_3$, 3558.
C_2H_3N, 250, 5754.
$C_2H_3NO_3$, 6365.
C_2H_3NS, 5135, 8197.
$C_2H_3N_3$, 8563.
C_2H_4, 3809.
C_2H_4BrCl, 3495.
C_2H_4BrNO, 33.
$C_2H_4Br_2$, 3505, 3871.
C_2H_4ClNO, 34.
$C_2H_4ClNO_2$, S3502F.
$C_2H_4Cl_2$, 3507, 3874.

FORMULA INDEX OF ORGANIC COMPOUNDS
(Continued)

$C_2H_4Cl_2O$, 3607, 3670.
$C_2H_4F_2$, 3512L, 3891H.
$C_2H_4I_2$, 3513, 3894.
$C_2H_4N_2O_2$, 4370, 6371.
$C_2H_4N_2O_3$, 262.
$C_2H_4N_2O_4$, 3516, 4303.
$C_2H_4N_2O_6$, 4302.
$C_2H_4N_4$, 4394.
$C_2H_4N_4O_2$, 985, 8710.
C_2H_4O, 10, 3899, 8858.
$(C_2H_4O)_{4-6}$, 5575.
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$C_{24}H_{20}Pb$, 5328.
$C_{24}H_{20}Sn$, 8307.
$C_{24}H_{21}N_3O_3$, 2966.
$C_{24}H_{40}O$, 7972M.
$C_{24}H_{40}O_2$, 7952M.
$C_{24}H_{40}O_5 \cdot H_2O$, 2694.
$C_{24}H_{41}NO$, 7942R.
$C_{24}H_{46}O_2$, S7946M.
$C_{24}H_{46}O_3$, 5316.
$C_{24}H_{48}O_2$, 1029, 5354.
$C_{24}H_{50}$, 8141.
$C_{24}H_{50}O$, 2597.
$C_{24}H_{50}O_4S$, 3402.

C_{25}

$C_{25}H_{20}$, 5676.
$C_{25}H_{20}N_2O$, 8767.
$C_{25}H_{21}N_3$, 4401.
$C_{25}H_{26}O_9$, 3952.
$C_{25}H_{31}N_3O$, 2921.
$C_{25}H_{34}N_2O_4 \cdot H_2O$, 7654.
$C_{25}H_{40}O_2$, 6306.
$C_{25}H_{42}O_2$, 7945.
$C_{25}H_{50}O_2$, 4832.

C_{26}

$C_{26}H_{18}$, 6619.
$C_{26}H_{20}$, 3865.
$C_{26}H_{20}O$, 1685.
$C_{26}H_{21}NO_{11}$, 361.
$C_{26}H_{21}N_7O_{18}S_2$, 4657.
$C_{26}H_{22}$, 3550, 3551.
$C_{26}H_{22}N_4$, 1426, 1427.
$C_{26}H_{22}O$, 1448.
$C_{26}H_{22}O_2$, 1684.
$C_{26}H_{26}N_8O_{18}S_2$, 893M.
$C_{26}H_{34}O_3$, 5315.
$C_{26}H_{37}NO_3 \cdot 2H_2O$, 5171.
$C_{26}H_{43}NO_6$, 4283.
$C_{26}H_{45}NO_7S \cdot H_2O$, 8110.
$C_{26}H_{50}O_4$, 4300.
$C_{26}H_{52}O_2$, 2642.
$C_{26}H_{52}O_6$, S8154W.
$C_{26}H_{54}$, 2641.
$C_{26}H_{54}O$, 2645.

C_{27}

$C_{27}H_{20}$, 7064.
$C_{27}H_{30}N_2O_5 \cdot H_2O$, 7650.
$C_{27}H_{34}N_2O_6 \cdot 2H_2O$, 5387.
$C_{27}H_{39}N_5O_5 \cdot 6\tfrac{1}{2}H_2O$, 6443
$C_{27}H_{46}O$, 2691, 5013.
$C_{27}H_{52}O_5$, 4234.
$C_{27}H_{56}$, 4440.
$C_{27}H_{56}O$, 4440M.

C_{28}

$C_{28}H_{14}N_2O_4$, 4865.
$C_{28}H_{18}O_4$, S6626T.
$C_{28}H_{20}N_2$, 505.
$C_{28}H_{24}N_2O_7$, 6315.
$C_{28}H_{28}Sn$, 8309, 8310.
$C_{28}H_{30}O_4$, 8291.
$C_{28}H_{33}N_5O_{11}$, 2145.
$C_{28}H_{38}O_{19}$, 2627, 8048M.
$C_{28}H_{44}O$, 2296M, 3461.
$C_{28}H_{48}O_2$, S8322P, S8322R.
$C_{28}H_{54}O_3$, 5821.
$C_{28}H_{58}O$, 6219M.
$C_{28}H_{58}O_4S$, 8154.

C_{29}

$C_{29}H_{30}N_2S_2$, 2403.
$C_{29}H_{42}Cl_2N_2O_4 \cdot 7H_2O$, 3433.
$C_{29}H_{50}O_2$, 8322M.
$C_{29}H_{51}NO_8$, 7808.
$C_{29}H_{60}O$, 6168M.

C_{30}

$C_{30}H_{22}O_6$, 6356
$C_{30}H_{28}N_2S_4$, 3360.
$C_{30}H_{28}N_2S_4Zn$, 2404.
$C_{30}H_{36}O_7$, 2705.
$C_{30}H_{40}N_2O_5$, 3432.
$C_{30}H_{44}N_6O_8S$, 6957.
$C_{30}H_{48}O_3$, 2618.
$C_{30}H_{58}O_4$, 4301.
$C_{30}H_{60}$, 5497.
$C_{30}H_{62}$, 8550.
$C_{30}H_{62}O$, 8550M.

C_{31}

$C_{31}H_{46}N_2O_9$, 7886.
$C_{31}H_{46}O_2$, S8869U.
$C_{31}H_{62}O$, 4439.
$C_{31}H_{62}O_2$, 5500.
$C_{31}H_{64}$, 4438.
$C_{31}H_{64}O$, 5811.

C_{32}

$C_{32}H_{24}O_6$, 5403.
$C_{32}H_{26}O_6$, 8025.
$C_{32}H_{32}FeN_4O_4$, 4415.
$C_{32}H_{36}N_2O_{12}$, 2845.
$C_{32}H_{36}N_4O_6$, 1832.
$C_{32}H_{36}N_4O_8$, 1833.
$C_{32}H_{43}NO_9$, 7437.
$C_{32}H_{43}NO_{10}$, 1033.
$C_{32}H_{44}O_3$, 6312.
$C_{32}H_{46}O_3$, 7953.
$C_{32}H_{48}O_6$, 7732.
$C_{32}H_{49}NO_9$, 8848.
$C_{32}H_{51}NO_{11}$, 7393.
$C_{32}H_{52}O_2$, 3415.

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$C_{32}H_{64}O_2$, 6404.
$C_{32}H_{66}$, 3403.
$C_{32}H_{66}O$, 2651, 3403M.
$C_{32}H_{66}O_4S$, 2653.

C_{34}

$C_{34}H_{30}O_{10}$, 5800.
$C_{34}H_{36}N_2O_6$, 7418.
$C_{34}H_{38}Cl_2N_2O_6 \cdot 2H_2O$, 7419.
$C_{34}H_{39}I_3N_2O_6$, 7038.
$C_{34}H_{40}N_2O_{10}S \cdot 5H_2O$, 5789.
$C_{34}H_{44}N_2O_{12}S \cdot 2H_2O$, 4835.
$C_{34}H_{47}NO_9$, 3137.
$C_{34}H_{47}NO_{10}$, 4861.
$C_{34}H_{47}NO_{11}$, 5169.
$C_{34}H_{48}N_2O_8$, 5303.
$C_{34}H_{48}N_2O_{10}S$, 941.
$C_{34}H_{48}N_2O_{10}S \cdot 2H_2O$, 4839.
$C_{34}H_{49}NO_{11}$, 365.
$C_{34}H_{50}BrNO_{11} \cdot \frac{1}{2}H_2O$, 366.
$C_{34}H_{50}ClNO_{11} \cdot 3H_2O$, 367.
$C_{34}H_{50}N_2O_{14} \cdot 5H_2O$, 368.
$C_{34}H_{50}O_2$, 2692, 5014.
$C_{34}H_{66}O_4$, 4304.
$C_{34}H_{70}O$, 8160M.

C_{35}

$C_{35}H_{28}O_2$, 1078, 4947.
$C_{35}H_{39}N_5O_5$, 3463.
$C_{35}H_{40}O_{12}$, 3967.
$C_{35}H_{41}N_5O_6$, 3464.
$C_{35}H_{68}O_5$, 4236.
$C_{35}H_{70}O$, 6563.
$C_{35}H_{72}$, 6562.

C_{36}

$C_{36}H_{44}N_2O_{10}S \cdot 5H_2O$, 2810.
$C_{36}H_{49}NO_{12}$, 7398.
$C_{36}H_{51}NO_{11}$, 1829.
$C_{36}H_{54}O_6$, 1796.
$C_{36}H_{60}O_3$, 1797.
$C_{36}H_{60}O_{30} \cdot H_2O$, 4895.
$C_{36}H_{62}O_{31}$, 359.
$C_{36}H_{70}O_3$, 7968.
$C_{36}H_{74}O_4S$, 6236.
$C_{36}H_{75}N$, 3292M.

C_{37}

$C_{37}H_{36}N_2O_9$, 8873.

C_{38}

$C_{38}H_{30}$, 3532.
$C_{38}H_{44}N_2O_{10}S$, 5123.
$C_{38}H_{46}N_4O_6S \cdot 2H_2O$, 2730.
$C_{38}H_{46}N_4O_6S \cdot 3H_2O$, 2725.
$C_{38}H_{53}NO_{13}$, 370.
$C_{38}H_{74}O_4$, 4307.

C_{39}

$C_{39}H_{74}O_6$, 4255.
$C_{39}H_{76}O_5$, 4237.

C_{40}

$C_{40}H_{50}N_4O_8S$, 7651.
$C_{40}H_{50}N_4O_8S \cdot 2H_2O$, 7639, 7652.
$C_{40}H_{51}AsN_4O_8 \cdot 8H_2O$, 7642.
$C_{40}H_{56}$, 2599, 2600.
$C_{40}H_{74}O_5$, 3233.
$C_{40}H_{78}O_5$, 3234.

C_{42}

$C_{42}H_{46}N_4O_8S \cdot 5H_2O$, 7986.
$C_{42}H_{50}N_4O_8 \cdot 9H_2O$, 7635.

C_{44} to C_{216}

$C_{44}H_{32}O_3$, 1971.
$C_{45}H_{86}O_6$, 4256.
$C_{46}H_{54}N_4O_{12}S \cdot 7H_2O$, 1988.
$C_{47}H_{94}O_2$, 6409.
$C_{48}H_{38}O_{10}$, 2793.
$C_{51}H_{98}O_6$, 4260.
$C_{55}H_{70}MgN_4O_6$, 2686.
$C_{55}H_{72}MgN_4O_5 \cdot \frac{1}{2}H_2O$, 2685.
$C_{57}H_{104}O_6$, 4259.
$C_{57}H_{110}O_6$, 4261.
$C_{68}H_{100}N_2O_{26}S$, 369.
$C_{80}H_{104}I_6N_4O_{20}S_3 \cdot 6H_2O$, 7649.
$C_{216}H_{288}O_{144}$, 7938M.

MELTING POINT INDEX OF ORGANIC COMPOUNDS

The following table lists the melting points of organic compounds in ascending order of temperature in degrees Centigrade. The compounds are identified by the numbers as given in the table Physical Constants of Organic Compounds.

The letter **S** preceding any compound number indicates that it is to be found in the **Supplement** to the table.

Melting points will be quoted as they occur in this table. The order of compounds listed with the same melting point is not significant and will be arbitrarily given in the order of the compound numbers. Owing to lack of agreement in values reported by various observers more than one value is sometimes given or the melting point is indicated by a temperature range. In such cases the position in the list is determined by the lower temperature of the stated range or by the *first* of two stated values, the second value being given in parentheses. Where the values are separated by more than 5° C the melting points are listed separately.

Melting points are given in bold face followed by the numbers of the compounds.

Abbreviations: a = anhydrous; h = hydrate.

(−213), 2583
−207, 2583
−189.9, 7073
−185.2, 7217
−184, 2587M, 5584
−181, 5606M
−172, 3488
−169.4, 3809
−161.5, 1947
−160.5, 2028
−159.7, 8861
−159, 7359
−156.5, 7895
−151, 5175
−150, 4650, 7892
(−147.3), 3586
−146, 5604M, 7062, S4623A
−145, 4950, 5613
−142.5, 3862M
−142.4, S3047M
−141, 4541
−139, 6572
−138.7, 3806
−138.5, 5749
−138, 2590, 6564
−137.8, 8860
−136.4, 478
−135.1, 2019
−135, 1998, 2117, S4628A
−133, S4623B
−131.5(−129.9), 6481
−131.3, 2167
−131.2, 4958
−130.7, 7164
−130, 2110, 2198
−129, 468
−127, 7331
−126.6, 3062
−126.4, 3002
−126, S6277J
(−125.6), 6498
−125, 6493
−124.8, 7219
−124, 2120, 3678, 8624
−123.5, 10
−123.4, 6495
−123.3, 3902β
−123.1(−121), 5715
−123.1, 2166
−122.8, 7344
−122, 7358
−121, 3586
−120, 1990M, 5095
−119.4, 476, 4572
−119.1, 4571
−119, 3804
−118.5, 4957
−118, 6876, S6277Q
−117.3, 3785
−117.2, 4923
−117, 5101
−116.6, 7218
−116.3, 3902α
−115.9, 2072
−115.5, 3681
−114.8, 8596
−114.6, 3785
−114, 2589M
−113, S4628B
−112.6, 2266
−112.4, 2160
−112, 321, 8304, S3117M
(−112), 3917
−111.9, 4928
−111.5, 7162
−111.3(−107), 2585
−111.3, 3899
−110.8, 8389
−110, 7343, 8829
−108.6, 2565
−108.5(−105 to **−111)**, 3912
−108, 4951, S6277K
−107, 3557M
−105, 534
−104.8, 5628, 8070
−104.7, 7372
−104.5, 2157
−104, 2182
(−104), 6876, 7319
−103.7, 3029
−103.5, 2181, 3691
−102.1, 3930
−102, 3917
−101.6, 1276
−101.4, 7362
−101.2, 5099
−101, 6595
−100.6, 3530M
−100.2, S107W
<−100, 2083, 2347
−100, 5124
−99.3, 488, 5145
−99, 537, 2204, 4031
−98.9, 100
−98.5, 4618
−98.2, 2018
−98.1, 103
−98, 2982
−97.8, 5719
−97.6, 5738
−96.9, 2925, 5356
−96.7, 3507, 5744
−96.5, 319
−96, 3276, 8826
−95.3, 4028
−95.2(−98), 2178
−95.2, 2235
−95, 213, 6594, 8336
<−95, 2232
−94.5, 6498
−94.4, 5059
−94.3, 4556
−94, 7324, S6277R
−93.9(−92.8), 1210
−93.66, 5734
−93.5, 4966, 8660
−93.3, 2225, 3046 3058
−93, 4597
−92.9, 4034
−92.8, 8797
−92.5, 107, 5729
−92, 2100, 3995
−91.9, 7319
−91.5, 2224, 8790
−91.3, 4543
−91.2, 8798
−91, 4566, 8801
−90.8, 5106
−90.5, 4458
−90, 4020, 5000
−89.55, 7280
−89.2 to **−89.8**, 2149
−89, 2150, 2272, 5100
−88.5 to **−89.5**, 5098
−88.2, 4981
−88, 535
−87.7, 378

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−87.5, 7287
−87.3, 2374
−87, 3117
−86.4, 2095
−86, 2993
(**−86**), 3867
−85.6, 547
−85.5, 4953, 8193
−85, 2992, 4559
−84.7, 4985, 6557
−83.6, 94
−83.2, 5766
−83, 492, 4560, 7333
−82.7, 1147
−82, 406
−81.8, 328
−81.2, 1146
−81.03, 4590
−81, 7266
−80.7, 4983
−80.6, 3787, 4039
−80.5, 3823, 4022
<−80, 192, 545M, 2257, 3627, 4975, 6129, 8388
(**−79.9**), 2149
−79.7, 2195
−79.4, 2372
<−79, 3737, 7163
−78.8, 8796
−78.5, 99, 6534
−78.25, 1122
<−78, 2801
−78, 4250
−77.8, 6553
−76.8, 91
−76.1, 6331
<−76, 4596
−75.9, 7290
−75.7, 6529
<−75, 3600, 4253
−75, 2260
−73.9(**−72.6**), 7282
−73.5(**−68.9**), 3070
−73.5, 3068, 4018
−73.4, 101
−73.2, 2222, 2230
−73.1, 187, 7279
−73, 2015, 3867, S3117N
−71.4, 7285
−70.3, 7095
−70, 3267
>−70, 4515
−69.9, 6961
−69.5, 4460
−69.3, 545
−69, 2909, 3605
−67.5, 2158, 2353
−67.3, 4498
−66.5, 5620
−66.1, 5752
<−66, 3913
−65.9, 4974
<−65, 2418
−65, 1993, S3445D
−64, 633, 2687
−63.5, 635, 2679
−63, 2932
−62, 5423
−60.5, 6452
<−60, 356, 4967
−60, 5103, 8489
−59, 910, 5563, 8795
−58.86, 4459
−58.2, 3057
−58.1, 1148
−57.5, 2665
−57.4(**−61**), 7405
−57, 655, 3339
−56.9, 4610
−56.6$^{5.2\text{atm.}}$, 2563
−56.5, 6245
−56.1, 8822
(**−56.1**), 2260
(**−56**), 1220
−55.5, 7092
−55(**−50**), 6991
−55, 530, 6248
−54 to **−57**, 6555
−54, 5436, 7199
−53.7(**−51**), 6178
−53.6, 8908
−53.5, 4994
−53, 3821, 8884
−52.8, 5743
−52.7, 5552
−52.5, 6252, 6987
−52, 1195
−51.6, 1464, 4593
−51.5, 90
−51.1, 550, 5009
−51, 1650δ, 5141, 8197, 8793H
(**−51**), 5143
−50.5, 2153
<−50, 3537, 8442
−50, 2971, 3216, 3668, 3823A
−50, *ca.*, 5580R
>−50, 2823
−49.8, 5422
−48.2, 4465
−48, 6543
−47.8, 8354
(**−47.4**), 8908
−47 to **−48**, 2086M
−47, 3021, 4978
−45.9, 6254
−45.6, 2391
<−45, 2276
−45, 1152, 3435, 5754, 7318
−44.8(**−43.1**), 2382
−44.5, 7200
(**−44.5**), 6449
−44, 3264
−43.9, 2991
−43.8, 3549
−43.5, 7992
−43.4, 4476
−43.26, 5847
−43(**−48**), 1767
−43, 632, 2568
−42, 6558, 7460
−41.9, 1221
−41.5, 4484
−41 to **−44**, 250
−41, 2384, 8713
−40.6, 2367, 6347
−40 to **−48**, 1220
<−40d, 2280
<−40, 6859
−40, 3131, 5300, 7664, 8211, 8987, S5580X
−39.8, 8342
−39.6, 3345
−39, 2129, 4490
(**−39**), 3216
−38.8, 616
−38.6, 6271
−38.5, 6266
(**<−38**), 6540, 6552
−37.6, 5143
−37.5, 411
−37.3, 715
−36.7, 3555, 6449
−36.5, 4121
−36.4, 1995, 3556
−36, 6204
(**−36**), 3549
−35.3, 3874
−35, 1183, 1773M, 2927, 5005, 6185, 6491
−34.6, 1454, 4478, 7099
−34.5, 2379, 8795
−34.4, 2958, 7093
−34.2, 6451
−34(**−36**), 8353
−33.65, 2183
−33, 4436M
−32.7, 126
−32.6(**−34**), 4492
<−32, 5156
−32, 1217
−31.8, 5764
−31.5, 3398, 8497
−31.47, 5847
−31.4, 1233
−31, 4293, 8817
−30.6, 1132
−30.2, 6655, 8314
−30 to **−32**, 3099
<−30, 2132, 4235h, 5769, 6546
−30, *ca.*, 5568
−30, 5667, 5890
−29.5, 2096, 2205
−29.05, 8417
−29(**−27.1**), 8892
<−29, 7975
−29, 3539, 4222
−28.95, 637K
−28.5, 2168
−28, 8986
−27.7, 1157M
−27.5, 5327
−27.2(**−19.3**), 1223
−27(**−26** to **−29**), 8341
−27, 6645
−26.5, 4426
−26.45, 3617M
−26, 125, 1037, 3197, 3552

−25.6, 3454
<−25, 2365, 2658, 3069
−25, 2041, 2279, 4539
−24.8, 1175
−24.5, 3929
−24.4, 8485α
−24.1, 4214
−24, 5036
−23.8, 8522
−23.2, 6525
−23, 1215, 4503, 7994, 8519
−22.8, 2587
−22.5, 130, 131
−22.4, 1453
−22.35, 3862
−22, 132, 5877, 6186, 6552, 7277, 8416
−21.8, 8615
−21.2, 1134
−21.2 to **−20.5,** 3020
<−21, 5347, 6650
−21, 412, 2283, 5136, 5598, 7341, 8022
−20.9, 6274
<−20, 1181, 1182, 1212, 1213, 1261, 1856, 2248, 2534, 2884, 4689, 5822, 6539, 6842, 7682, 8034, 8387, 8417M, 8905, 8918, 8936
−20, 2162, 4264, 4302, 6544, 7101, 7341P
−19.96, 2336
−19.5, 7657
−19, 531, 4641, 4996, 5401, 5870
(**−19**), 6190
<−18, 500, 771, 1437, 2363, 5119, 5271, 5863, 6585, 6873, 7185, 7677
−18, 2337
−17.9, 2344
<−17.5, 6776
−17.5, 179, 1174
−17.4, 4290
<−17, 173, 8385
−17, 207, 2251, 4259, 5319M, 5759, 7380
(**−17**), 7013
−16.6, 3495
−16.5, 160
−16.3, 6265, 8485β
−16, 1774R, 2607, 2821, 3632
−15.4, 7205
−15.3, 1738
−15.25, 180M
−15.05, 3108
<−15, 2247, 4173, 4303, 4419, 5550, 6063, 8957
−14.7, 7139
−14.5, 2575
<−14, 5869
−14, 600α, 2088, 2245, 4783
−13.8, 3602
−13 to **−14,** 8518
<−13, 8302
−13, 1635
−13(**−9**), 5870K
−12.5, 1461
<−12, 713, 3379
−12, 2978, 3390, 6363, 8151
(**−12**), 4290
−11.9, 2090
−11, 5361
−10.7, 5313
−10.6, 8402α
−10.45(**−6.5**), 3231
−10.4, 601
<−10, 3760, 8330, 8441
−10, 3437, 4495, 5045, 5479
−9.5 to **−9.2,** 3020
(**−9.5**), 2350
−9.3, 1139
−9, 3115, 3402M, 4585, 7013
−8.6, 7836
−8.2, 6190
−8 to **−7,** 7993(2)
−8, 1577, 6191, 7459
−7.9, 2220
−7.6, 3329
−7.5, 2737
−7, 7822
−6.9, 1171
−6.6, 5532
−6.5, 5821
−6.2, 571, 8582
−6, 1223H, 2274, 2392, 2960, 3107, 4853
−5.9, 5131, 6192
−5, 634, 6183, 8000, 8606
−5^{713}**,** 1991
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BOILING POINT INDEX OF ORGANIC COMPOUNDS

The following table lists the boiling points of organic compounds in ascending order of temperature in degrees Centigrade. The compounds are identified by the numbers as given in the table Physical Constants of Organic Compounds.

The letter **S** preceding any compound number indicates that it is to be found in the **Supplement** to the table.

Boiling points will be quoted as they occur in this table. Only boiling points at or near atmospheric pressure will be listed. The order of compounds listed with the same boiling point is not significant and will be arbitrarily given in the order of the compound numbers. Owing to lack of agreement in values reported by various observers more than one value is sometimes given or the boiling point is indicated by a temperature range. In such cases the position in the list is determined by the lower temperature of the stated range or by the *first* of two stated values, the second value being given in parentheses. Where the values are separated by more than 5° C the boiling points are listed separately.

Boiling points are given in bold face followed by the numbers of the compounds.

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−103.9, 3809
−88.5, 328
−88.3, 3488
−83.6, 328
−83, 2589M
−82.2, 3993
−80, 5606M
−78.6, 5750
−78.5, 2563
−78.4, 3862M
−78.2, 3530M
<−70, 3826M
−56.8, 7895
−56, 5175
−51.6, 5746M
−51, 8863M
−50.2(−47.5), 2590
−47, 7217
−46.8, 3557M
−42.17, 7073
(−41), 5175
−40.8, 5604M
−38, 3502M
−37.7, 3903
−34.4, 3062
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−28, 5617
−24.7, 3512L
−23.7, 5738
−23.65, 5749
−23.3, 7372
−23, 5613
−21, 3995
−20.5, 2958
−20.1, 7892
−20, 1947
−14, 6886
−13.9, 8861
−12, 5759
−10.2, 4950
−10.1, 5104
−10, 487
−6.5, 5729
−6, 7234
−5, 2110
−3.2, 7359
−3, 1991
−2, 333, 3510R
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(−0.2), 7099M
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3.8, 3511
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10.7, 3899
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13.8, 2960
15.8, 8860
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29.3, 2199
30–1^{4}, S7995N
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35.5, 3742
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36.2(34–5.5), 6481
36.4, 6572
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PHYSICAL CONSTANTS OF INDUSTRIAL ORGANIC COMPOUNDS

The following table is intended to provide information concerning the characteristics and properties of commercially available organic compounds. The material presented has been compiled from information furnished by the manufacturers whose courtesy is gratefully acknowledged. Where the same compound has been reported by two or more manufacturers separate entries have been made.

ABBREVIATIONS

a	acid
absorb	absorbent
accel	accelerator
acet	acetone
agt	agent
al	alcohol
alk	alkali
amm	ammoniacal
approx	approximately
art	artificial
astring	astringent
boil	boiling
br	brown
bz	benzene
c	cold
ca	about
cellu	cellulose
char	characteristic
chem	chemical
cl	clear
col	colorless
com	common
comp	compound, compartment
conc	concentrated
copoly	copolymer, copolymerization
cr	crystals
d	decomposes
deliq	deliquescent
den	denaturant
deriv	derivative
det	detergent
disp	dispersible
dist	distilled
dk	dark
emuls	emulsifying
et	ethyl
eth	ether
ethylcellu	ethylcellulose
extr	extractant, extracting, extraction
f	finger
fa	faint
fl	flakes
flam	flammable
fumi	fumigant
g	grams
gen	general
germ	germicide
gran	granules, granular
grn	green
h	hot, high
hyg	hygroscopic
i	insoluble
imm	immiscible
indust	industrial
init	initial
insect	insecticide—al
inter	intermediate
lab	laboratory
lacq	lacquer
liq	liquid
lt	light
lubr	lubricating
lust	lustrous
m	most
mat	material
meth	methyl
mfg	manufacture
min	minimum
misc	miscible
mix	mixture
moist	moistening
monocl	monoclinic
need	needles
nitrocellu	nitrocellulose
n. res	non residual
n. vol	non volatile
org	organic
pa	pale
pen	penetrating
per	permanent
pet	petroleum
pharm	pharmaceutical
photo	photographic
pk	pink
plast	plastics, plasticizer
pl	plates
pleas	pleasant
poly	polymer, polymerization
powd	powder
ppnt	precipitant
prep	preparatory, preparation
press	pressure
pung	pungent
purif	purification
pyr	pyridene
quant	quantities
redsh	reddish
rub	rubbing
s	soluble
sec	secondary
sl	slight, slightly
sld	solid
soft	softener, softening
solv	solvent
suff	suffocating
syn	synthesis
synth	synthetic
tech	technical
tert	tertiary
tetr	tetragonal
thick	thickening
trans	transparent
trig	trigonal
typ	typical
v	very
veget	vegetable
visc	viscous
vol	volume
w	water
wh	white
wt	weight
yel	yellow
>	above
<	below
∞	soluble in all proportions

Sources of Information*

An.	Ansul Chemical Company
Arm.	Armour and Company
At.	Atlas Powder Company
C. & C.	Carbide and Carbon Chemicals Company
C.S.	Commercial Solvents Corporation
C.P.	Corn Products Refining Company
D.	The Dow Chemical Company
G.	Glyco Products Co., Inc.
K	Koppers Company, Inc.
P.P.	Phillips Petroleum Company
Q.O.	The Quaker Oats Company
Sh.	Sharples Chemicals, Inc.
S.C.L.	Shawinigan Chemicals Limited
S.C.	Shell Chemical Corporation
S.P.	Solvay Process Division Allied Chemical & Dye Corporation
St.	Standard Oil Development Company
U.S.I.	U.S. Industrial Chemicals, Inc.

* See last page of this Table.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
1	Accelerator 52 (Sharples)	tetramethylthiuram disulfide	$[(CH_3)_2NCS_2]_2$	240.4
2	“ 57 (Sharples)	zinc dimethyl dithio carbamate	$Zn[(CH_3)_2NCS_2]_2$	305.8
3	“ 62 (Sharples)	tetraethyl thiuram disulfide	$[(C_2H_5)_2NCS_2]_2$	296.4
4	“ 67 (Sharples)	zinc diethyl dithio carbamate	$Zn\ [(C_2H_5)_2NCS_2]_2$	361.9
5	“ 77 (Sharples)	zinc dibutyl dithio carbamate	$Zn\ [(C_4H_9)_2NCS_2]_2$	474.1
6	Acetaldehyde	acetaldehyde	CH_3CHO	44.05
7	Acetaldehyde ammonia		$CH_3CHOHNH_2$	61.08
8	Acetaldol	*β*-hydroxybutyraldehyde; aldol	$CH_3CHOHCH_2CHO$	88.10
9	Acetic acid, Glacial	ethanoic acid; methane carboxylic acid	CH_3COOH	60.05
10	Acetic anhydride	ethanoic anhydride; acetyl oxide; acetic acid anhydride	$(CH_3CO)_2O$	102.09
11	Acetoacetanilide	acetoacetanilide	$CH_3COCH_2CONHC_6H_5$	177.20
12	“	“	$CH_3COCH_2CONHC_6H_5$	177.20
13	Acetoacet-*o*-anisidide		$CH_3COCH_2CONHC_6H_4OCH_3$	207.2
14	Acetoacet-*o*-chloranilide	acetoacet-*o*-chloranilide	$CH_3COCH_2CONHC_6H_4Cl$	211.65
15	Acetoacet-*o*-chloranilide	“	$CH_3COCH_2CONHC_6H_4Cl$	211.65
16	Acetoacet-*p*-phenetidide		$CH_3COCH_2CONHC_6H_4OCH_2\text{-}CH_3$	221.25
17	Acetoacet-*o*-toluidide	acetoacet-*o*-toluidide	$CH_3COCH_2CONHC_6H_4CH_3$	191.22
18	“	“	$CH_3COCH_2CONHC_6H_4CH_3$	191.22
19	*α*-Acetochloroglucose		$C_{14}H_{19}O_9Cl$	366.75
20	Acetone	dimethyl ketone; 2-propanone; dimethyl ketal	CH_3COCH_3	58.08
21	“	dimethyl ketone	CH_3COCH_3	58.08
22	“	“ “	CH_3COCH_3	58.08
23	“	“ “	CH_3COCH_3	58.08
24	Acetonitrile	ethyl nitrile; methyl cyanide	CH_3CN	41.05
25	Acetophenone	methyl phenol ketone	$C_6H_5COCH_3$	120.14
26	Acetonyl acetone	hexandione 2,5	$CH_3COCH_2CH_2COCH_3$	114.14
27	*N*-Acetyl morpholine		$CH_3CO\underbrace{NCH_2CH_2OCH_2CH_2}$	129.16

ORGANIC COMPOUNDS

No.	Physical form and color	Odor	Purity %	Sp. gr.
1	wh. powd		98 min	1.29
2	wh. powd		97 min	1.65
3	cr. col. powd		98 min	1.17
4	wh. powd		98 min	1.47
5	wh. to sl. yel. powd		98 min	1.24
6	col. mobile liq	pungent	99 min	$0.7801\frac{20}{20}$
7	rhom. cr			
8	visc. liq		90 min	$1.103\frac{20}{20}$
9	w. wh. liq	vinegar	99.8	$1.049\frac{20}{20}$
10	col. liq	sharp penetrating	97.5	$1.0830\frac{20}{20}$
11	wh. cr. sld			$1.104\frac{85}{20}$
12	wh. fine cr. sld	very mild	97	
13	wh. cr. sld			
14	wh. cr. sld	odorless		$1.1920\frac{107}{20}$
15	wh. fine gran. powd	very mild	98	
16				
17	wh. fine gran. powd	very mild	96	
18	wh. fine gran. sld			$1.0639\frac{106}{20}$
19	sld			
20	w. wh. liq	penetrating	99.5	$0.7910\frac{20}{20}$
21	w. wh. liq	mild, n. res	99–100	$0.791–.793\frac{20}{20}$
22	col. liq	pleasant	99.5–100	$0.791–793\frac{20}{20}$
23	w. wh. liq	mild	99	$.791–.799\frac{20}{20}$
24	col. liq	ethereal	99	$.7839\frac{20}{20}$
25	col. liq	fragrant		$1.030\frac{20}{20}$
26	col. liq	pleasant		$0.9734\frac{20}{20}$
27				$1.1164\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
1	Accelerator 52 (Sharples)	142.5 (min)			
2	“ 57 (Sharples)	243 (min)			
3	“ 62 (Sharples)	66.5 (min)			
4	“ 67 (Sharples)	171 (min)			
5	“ 77 (Sharples)	104 (min)			
6	Acetaldehyde	−123.4	20.8		−40
7	Acetaldehyde ammonia	97	100 dec.		
8	Acetaldol	<0	dec.		
9	Acetic acid, Glacial	16.6	118.1		135
10	Acetic anhydride	−67.7	139.9		150
11	Acetoacetanilide	85			365
12	“	<82.5			
13	Acetoacet-*o*-anisidide	84			365
14	Acetoacet-*o*-chloranilide	107			230
15	“	102.5			
16	Acetoacet-*p*-phenetidide	103.3			325
17	Acetoacet-*o*-toluidide	104–105			
18	“	106			
19	α-Acetochloroglucose	70–71			
20	Acetone	−95.1	56.1	56.1–57.1	15
21	“	−94.9	56.1	55.0–57.0	15
22	“	−95.0	56.1	<55.8 none; >56.6 none	<−4
23	“	−95	56.1	<55.6 none; >57.1 none	14
24	Acetonitrile	−44.9	81.6		55
25	Acetophenone	19.7	201.7		205
26	Acetonyl acetone	−5.4	192.2	185–195	185
27	*N*-Acetyl morpholine	14.0	dec.		235

See two preceding pages for additional data on above compouuds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
1	s. CS_2, bz., chl.; i. w., gasoline, 1% NaOH	rubber vulcanization accelerator; lub. oil additive; insect. fungicide	fiber drums	Sh.
2	s. 1% NaOH, CS_2, bz., chl.; i. w., gasoline	rubber vulcanization accelerator	fiber drums	Sh.
3	s. in CS_2, bz., chl., i. w., gasoline, 1% NaOH	rubber vulcanization accelerator; lubr. oil additive; insecticide; fungicide	fiber drums	Sh.
4	s. in 1% NaOH; CS_2 bz., chl.; i. w., gasoline	rubber vulcanization accelerator	fiber drums	Sh.
5	s. gasoline, CS_2, bz., chl.; i. w., 1% NaOH	rubber vulcanization accelerator; lub. oil additive	fiber drums	Sh.
6	w. ∞	chem. syn.	cans, drums, tank cars	C. & C.
7		accelerator in vulcanization of thread rubber; pickling inhibitor for steel; ether stabilizer		C. & C.
8	w. ∞	chem. interm.; prep. of rubber accelerators; denaturant	jugs, cans, tanks	C. & C.
9	w. ∞	chem. syn.	cans, drums, tank cars	C. & C.
10	w. dec.	acetylating agent, rayon, cellu., acetate dyestuffs, alkyd resins	cans, drums, tank cars	C. & C.
11	0.9^{20}% by wt. w	printing ink dyes	cans, drums	C. & C.
12	sl. s. w.; v. s. al., eth., $CHCl_3$, alk., a., h. bz.	dye inter.	barrels	U.S.I.
13		dye inter.	cans, drums	C. & C.
14		dye inter.	cans, drums	C. & C.
15		dye inter.	barrels	U.S.I.
16		dye inter.	cans, drums	C. & C.
17		dye inter.	barrels	U.S.I.
18		dye inter.	cans, drums	C. & C.
19	d. h. w.; s. et. al., meth. al., acet., eth., CCl_4			C.P.
20	∞ w.	solv. acetylene, process solv. rayon, art. leath. films, plastics, solv. lacq., dopes	cans, drums, tank cars	C. & C.
21	∞ w.	solvent	cans, drums, tank cars	C.S.
22	∞ w., al., benzol, gasoline kerosene, org. liq.	solv. lacq., gums; raw material for org. syn. plastics, extr. fats	drums, tank cars	S.C.
23	∞ w.	cellu. acetate solv., acetylene absorb. dewaxing agt., mfg. acetic anhydride, $CHCl_3$, indigo	cans, drums, tank cars	U.S.I.
24	∞ w.	chem. inter.; extr.; reaction medium	jugs, drums	C. & C.
25	s. w. 0.55^{20}	solv., perfume base; soporofic, chem. inter.	cans, drums	C. & C.
26	∞ w.	solv. cellu. acetate; syn. of cyclic comp.	drums	C. & C.
27	∞ w.	inter.	cans	C. & C.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
28	*cis*-Acetylene dichloride	*cis*-dichloroethylene	$CHCl:CHCl$	96.95
29	*trans*-Acetylene dichloride	*trans*-dichloroethylene	$CHCl:CHCl$	96.95
30	Acetylene tetrabromide	tetrabromoethane 1,1,2,2-tetrabromoethane	$CHBr_2{\cdot}CHBr_2$	345.7
31	Acrolein	acrylic aldehyde	$CH_2:CHCHO$	56.06
32	Acrylic acid (Glacial)		$CH_2:CHCOOH$	72.06
33	DL-Alanine	*dl-α*-aminopropionic acid	$CH_3CHN\ H_2COOH$	89.09
34	Alkazene 3	*x*-triethyl benzene	$C_6H_3(C_2H_5)_3$	162.27
35	“ 13	*x*-triisopropylbenzene	$C_6H_3[CH(CH_3)_2]_3$	204.34
36	“ 16	*x*-triisopropyltoluene	$CH_3C_6H_2[CH(CH_3)_2]_3$	218.37
37	“ 32	ethyl pentachlorobenzene	$Cl_5C_6C_2H_5$	278.41
38	“ 40	*ar*-bromoethylbenzene	$BrC_6H_4C_2H_5$	185.07
39	“ 42	*ar*-dibromoethylbenzene	$Br_2C_6H_3C_2H_5$	263.98
40	“ 47	*ar*-bromoisopropylbenzene	$BrC_6H_4CH(CH_3)_2$	199.10
41	Allyl alcohol	allyl alcohol	CH_2CHCH_2OH	58.05
42	“ bromide	3-bromopropene	$CH_2:CH{\cdot}CH_2Br$	120.99
43	“ chloride	allyl chloride	CH_2CHCH_2Cl	76.50
44	Allylidene diacetate		$CH_2:CHCH(OCOCH_3)_2$	158.15
45	Amine 220	1-hydroxyethyl-2-heptadecenyl glyoxalidine	$C_{17}H_{33}\underbrace{C:NC_2H_4N}C_2H_4OH$	350.57
46	4-Aminobenzophenone	4-aminobenzophenone	$C_6H_5COC_6H_4NH_2$	197.23
47	Aminoethyl ethanolamine	hydroxyethyl-ethylene diamine	$NH_2C_2H_4NHC_2H_4OH$	104.15
48	*N*-Aminoethyl-morpholine		$\underbrace{C_2H_4OC_2H_4N}C_2H_4NH_2$	130.19
49	*N*-Aminopropyl morpholine		$\underbrace{C_2H_4OC_2H_4N}C_3H_6NH_2$	144.21
50	Ammonium stearate, anhydrous	ammonium stearate, anhydrous	$NH_4C_{18}H_{35}O_2C_{18}H_{36}O_2$	585.98
51	Amyl acetate, Technical	amyl acetate	$CH_3COOC_5H_{11}$	130.18
52	“ “ , High Test	“ “	$CH_3COOC_5H_{11}$	130.18
53	“ alcohol	isoamyl alcohol	$C_5H_{11}OH$	88.15
54	*pri-n*-Amyl alcohol	(1-pentanol)(normal butyl carbitol)	$CH_3(CH_2)_3CH_2OH$	88.15

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
28	col. mobile liq	mildly sweet		$1.281\frac{25}{25}$
29	col. mobile liq	mildly sweet		$1.252\frac{25}{25}$
30	cl. col. liq	mildly sweet	97	$2.955\text{–}2.970\frac{25}{25}$
31	cl. col. liq	piercing, disagreeable		$0.8427\frac{20}{20}$
32	col. liq			$1.052\frac{20}{20}$
33	wh. cr.	none	99	
34	cl. col. liq	mild char		$0.870\frac{25}{25}$
35	cl. col. liq	almost none		$0.854\frac{25}{25}$
36	cl. col. liq	almost none		$0.866\frac{25}{25}$
37	wh. cr. sld			$1.552\frac{60}{25}$
38	col.-pa. straw liq	char		$1.35\text{–}1.40\frac{25}{25}$
39	cl. col. liq	faint		$1.73\text{–}1.75\frac{25}{25}$
40	col. liq	char		$1.294\frac{25}{25}$
41	col. liq. (poison)	lachrymatory, irritating	98 by wt	$0.852\text{–}0.855\frac{20}{20}$
42	cl. col. liq	sharp		$1.415\frac{25}{25}$
43	col.-straw. liq. (poisonous)	char	97 by wt	$0.935\text{–}0.940\frac{20}{20}$
44	col. liq			$1.0749\frac{20}{20}$
45	liq			$0.9300\frac{20}{20}$
46	lt. br. cr. sld	fa. char		
47	liq	mildly ammon	99	$1.0304\frac{20}{20}$
48				$.9915\frac{20}{20}$
49	liq			$0.9872\frac{20}{20}$
50	cream-col. wax-like sld	fa. fatty	tech	$0.889\frac{22}{22}$
51	w. wh. liq	mild, n. res.	90–93 by wt	$.868\text{–}872\frac{20}{20}$
52	w. wh. liq	mild, n. res	85–88 by wt	.860–864
53	w. wh. liq	n. res		$.811\text{–}.815\frac{20}{20}$
54	w. wh.			$0.82\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
28	*cis*-Acetylene dichloride	<−80		58.3–5%; 60.1–95%	39.2
29	*trans*-Acetylene dichloride	<−20		47.9–5%; 49.0–95%	35.6
30	Acetylene tetrabromide	±1	119^{15}		none
31	Acrolein	−87.9	52.6		<0
32	Acrylic acid (Glacial)	12.1	141.9		
33	DL-Alanine	270.8–275.8			
34	Alkazene 3	<−70		217.6–5%; 219.3–95%	181.4
35	" 13	−15		235.9–5%; 237.4–95%	206.6
36	" 16	<−20		252.7–5%; 255–95%	204.8
37	" 32	53.2–53.6	305		none
38	" 40	−65	201	200.5–5%; 202.8–95%	199.4
39	" 42	−43 to −38		258–5%; 266–95%	none
40	" 47	−20		212.4–5%; 216.2–95%	204.8
41	Allyl alcohol	−129	97	<95° none; >98° none	85
42	" bromide	<−20		70–5%; 71–95%	30.2
43	" chloride	−134.5	45	<43° none; >49° none	−20
44	Allylidene diacetate	−37.6	107^{50}		180
45	Amine 220		235^{1}		465
46	4-Aminobenzophenone	119–122.2			
47	Aminoethyl ethanolamine		243.7	232–250	275
48	*N*-Aminoethyl morpholine	25.6	204.2		175
49	*N*-Aminopropyl morpholine	−15	224.7		220
50	Ammonium stearate, anhydrous	74–76	d. before boiling, *ca* 110		
51	Amyl acetate, Technical			<110–none; 130–50%; >150–none	94
52	" " , High Test	−78.5	142.1	<100–none; 140–60%; >150–none	84
53	" alcohol		131	>145–none; <126–none; >132–none.	127
54	*pri-n*-Amyl alcohol	−78.5	137.9	134.5–138.5; 5%–95%	136

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
28	∞ acet., bz., CCl_4, eth., meth. al.; i. w.			D.
29	∞ acet., bz., CCl_4, eth., meth. al.; i. w.			D.
30	∞ al., chl., eth.; 0.065^{30}, 0.28^{80} w.	liq. med. for lever gauges and nonflam. solv.	cans, carboys, drums	D.
31	20.8^{20}% by wt. in w.	chem. inter.	drums	C. & C.
32	∞ w.	pharm. inter.; prep. of spec. rubbers	cans, drums	C. & C.
33	17^{25} w., 32^{75} w., i. acet., bz., CCl_4, eth., meth. al.	inter. and supplement in experimental nutritional diets		D.
34	∞ eth., acet., bz., CCl_4; g. per 100 g.: 120 meth. al.; i. w.			D.
35	∞ eth., CCl_4, bz., acet.; g. per 100 g.: 43 meth. al.; i. w.			D.
36	g. per 100 g: 22 meth. al.; eth., CCl_4, bz., acet.; i. w.			D.
37	v.s. bz.; g. per 100 g.: 23 acet., 157 CCl_4, 166 eth., 2 meth. al.; i. w.			D.
38	∞ meth. al., eth., bz., CCl_4, acet.; i. w.			D.
39	∞ eth., CCl_4, bz., acet.; g. per 100 g.: 50 meth. al.; i. w.	gauge fluid and hydraulic liq. heavy and great stability in many conditions	5, 10, 55 gal. drums	D.
40	∞ acet., bz., CCl_4, eth., meth. al.; i. w.		5, 10, 55 gal. drums	D.
41	∞ w.	flavorings, perfumes, pharm.; raw mat. for plastics	drums, tank cars	S.C.
42	∞ acet., bz., CCl_4, eth., meth. al., V.M.P. naphtha; i. w.	org. syn.	carboys	D.
43	<.1, w	syn. pharm. and anesthetics mfg. plastics and synth. resins	drums, tank cars	S.C.
44	1.8^{20}% by wt. in w.	chem. inter.	cans, drums	C. & C.
45	w. at 20° sl. s.	cationic emulsifying agt.	cans, drums	C. & C.
46	g. per 100 g.: 44 acet., 4 bz., .1 CCl_4, 2 eth., 2 meth. al.; i. w.			D.
47	w. ∞	inter. for pharm. cationic agt., dyestuffs, rubber products	cans, drums, tank cars	C. & C.
48	w. ∞	corrosion inhibitor mfg. textile auxil., cationic surface. active comp. and pharm.	cans, drums	C. & C.
49	w. ∞	textile process. assist.	cans, drums	C. & C.
50	disp. h. w.; s. h. al., hydrocarbons, oils	emulsifying, thickening, dispersing agt., cosmetics, waterproof	drums, slabs	G.
51	1.744^{25} w.	solv. cellu. nitrate; lacq. dopes, art. leath. coated paper, polishes	cans, drums, tank cars	C.S.
52	1.8^{25} w.	solv. nitro. cellu, et. acetate, mfg. perfumes and flavors	cans, drums, tank cars	U.S.I.
53	∞ comm. org. solvents	chem. syn.	cans, drums, tank cars	U.S.I.
54	sl. s. w.; s. meth. al., ethyl eth., acet., bz., gasoline, acetate	mfg. of pharm. and synth. chem.	cans, drums	Sh.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
55	*tert*-Amyl alcohol, Refined	2 butanol, 2-methyl	$CH_3CH_2C(CH_3)OHCH_3$	88.15
56	*n*-Amyl bromide	1-bromopentane	$CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2Br$	151.05
57	Amyl phthalate	diamyl phthalate	$C_6H_4(COOC_5H_{11})_2$	306.39
58	Aniline	aminobenzene	C_6H_7N	93.12
59	*N*-(β-phenoxyethyl) Aniline	aniline, *N*-(β-phenoxyethyl)	$C_6H_5O(CH_2)_3NHC_6H_5$	213.27
60	Arlacel A	mannide monooleate	$C_6H_8O_2(OH)OCO(CH_2)_7$-$CH(C_8H_{17})CH$†	410.4†
61	" B	mannitan monooleate	$C_6H_8(OH)_3OCO(CH_2)_7$-$CH(C_8H_{17})CH$†	429†
62	" C	sorbitan monooleate	$C_6H_8O(OH)_3OCO(CH_2)_7$-$CH(C_8H_{17})CH$†	429†
63	Arlex	sorbitol	$C_6H_{14}O_6$	182.1
64	Atlas A-815	sorbide	$C_6H_8O_2(OH)_2$	146.1
65	" G-220	sorbitol tri-2-butylidene	$C_6H_8O_6(C_4H_8)_3$	344.44
66	" G-221	" tributylidene	$C_6H_8O_6(C_4H_8)_3$	344.44
67	" G-750	sodium sorbitol borate		
68	" G-2400	sorbitan tetrapropionate	$C_6H_8O(C_2H_5COO)_4$	388
69	" G-2800	mannitol polyoxyalkylene deriv. of oleic acid		
70	" G-9046T	polyoxyalkylene deriv. of mannitan monolaurate		
71	" K-100	triisopropylidene mannitol	$C_6H_8O_6[C(CH_3)_2]_3$	302.36
72	" K-101	trimethylene mannitol	$C_6H_8O_6(CH_2)_3$	218.20
73	" K-103	triethylidene mannitol	$C_{12}H_{20}O_6$	260.28
74	" K-110	triisopropylidene sorbitol	$C_6H_8O_6[C(CH_3)_2]_3$	203.36
75	" K-111	trimethylene sorbitol	$C_6H_8O_6(CH_2)_3$	218.20
76	" K-113	triethylidene sorbitol	$C_{12}H_{20}O_6$	260.28
77	" NNO	mannitan monolaurate		
78	Benzene, Pure	benzene	C_6H_6	78.11

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† Theoretical.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
55	w. wh.			$0.81\frac{20}{20}$
56	cl. col. liq.	sweet, pen.		$1.200\text{–}1.220\frac{25}{25}$
57	col. liq.	sl. pleas.	99–100	$1.022\text{–}1.026\frac{20}{20}$
58	col. refractory, oily, poisonous liq.			$1.021\frac{25}{25}$
59	straw colored sld.	amine-like		$1.070\frac{60}{25}$
60	lt. amber oily liq.; ref. index 1.475^{25}	sl. char., pleas.; sl. oily taste	tech.	0.99–1.03
61	lt. amber oily liq.; ref. index 1.460^{25}	sl. char., pleasant; sl. oily taste	tech.	0.99–1.03
62	lt. amber oily liq.	faint, fatty	tech.	0.99–1.03
63	w. wh. to lt. straw-colored liq.; ref. index 1.487^{25}	faint, sweet; bland sweet taste	83	1.322
64	pa. yel. liq.	carmel, with bitter taste	83	
65	lt. yel., non-hygroscopic fluid, liq.	sl. pungent; bitter taste	tech.	
66	lt. yel., non-hygroscopic fluid, liq.	sl. pungent; bitter taste		
67	w. wh. resin sol.; ref. index 1.45^{25}		80	1.47–1.54
68	lt. yel. mobile liq.; non-hygroscopic fluid	bland, ester-like; bitter taste	tech.	1.15^{20}
69	amber oily liq.; ref. index 1.471^{25}	faint, oily odor; sl. bitter taste	tech.	0.98–1.02
70	amber oily liq.; ref. index 1.4740	sl. sweet odor; sharp bitter taste	tech.	1.03–1.05
71	col. cr. need.	none; bitter taste		
72	col. cr. need.	none; bitter taste		
73	col. cr. need.	sl. pung.; bitter taste		
74	col. cr. need.	none, bitter taste		
75	col. cr. need.	none, bitter taste		
76	lt. yel. liq.	none, bitter taste		
77	amber oily liq.	pleasant oily	tech.	1.00–1.05
78	col. flam. liq.		99 min.	$0.878\frac{20}{4}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
55	*tert*-Amyl alcohol, Refined			99.8–103.8; 5–95%	70
56	*n*-Amyl bromide	<−30		128–5%; 130–95%	90
57	Amyl phthalate	−30 (approx)	$264^{99.5}$	$256–269^{99.5mm}$	359.6
58	Aniline	−6.2		184.3–5%; 184.5–95%	158
59	*N*-(β-phenoxyethyl) Aniline	43.8–48.5	202^{10}		338
60	Arlacel A	−5 to 0°			395
61	" B	11–14°			
62	" C				395
63	Arlex				
64	Atlas A-815				
65	" G-220		$145–165^{3mm}$		
66	" G-221		$162–167^{4mm}$		
67	" G-750				
68	" G-2400				
69	" G-2800				
70	" G-9046T				610
71	" K-100	68–69	$136–139^{4}$		
72	" K-101	228–231		volatile with steam	
73	" K-103	171–172			
74	" K-110	39.5–40.5	$127–130^{4}$		
75	" K-111	211–214		volatile with steam	
76	" K-113		$122–126^{4}$	distilled with steam	
77	" NNO	15–16			385
78	Benzene, Pure	5.3	80.1		

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
55	partially s. w.; s. meth. al., ethyl eth., acet., bz., gasoline, ethyl acetate	drycleaning; coating material	cans, drums	Sh.
56	∞ acet., bz., CCl_4, eth., VMP. naphtha.; i. w.	org. syn	carboys	D.
57	0.01^{25}% by wt	plasticizer, lubricant	cans, drums	C.S.
58	g. per 100 g. at 25°: ∞ acet., bz., CCl_4, eth., meth. al., *n.* hept. 7; 3.5 w.	in mfg. dyestuffs	drums, tank cars	D.
59	v. sl. s. eth., bz., acet., CCl_4, meth. al.; i. w.	…	…	D.
60	s. most org. solv; i. w. polyal.; sl. s. veg. and animal oils, ether and glycols	w/o emulsifier; drugs cosmetics	cans, drums	At.
61	s. most org. solv.; sl. s. veget. & animal oils, eth., & glycols; i. w., polyal.	w/o emulsifier; drugs, cosmetics	drums, cans	At.
62	s. most org. solv.; i. w., polyal.	w/o emulsifier; stab. to a. and salts; cosmetics	drums, cans	At.
63	s. w., methanol; sl. s. pyridine, ethanolamines, acetic acid; i. hydrocarbons, other org. solv.	humectant; plasticizer cosmetics; leather finishing; glue	drums, cans	At.
64	s. w., lower al., ethylene, glycol, cellosolve, pyridine; i. most other solv.	humectant, solvent	drums, cans	At.
65	s. hydrocarbons, eth., ketones; sl. s. veget. & mineral oils; i. w.	plasticizer for vinyl polymers & cellu. deriv.	drums, cans	At.
66	s. hydrocarbons, eth., ketone, al.; sl. s. veg.-mineral oils; i. w.	plasticizer for cellu. deriv. & vinyl polymers	drums, cans	At.
67	s. w.; i. most org. solv	w. sol. resin binder, size, filler	drums, cans	At.
68	s. hydrocarbons, eth., ketones, esters; v. sl. s. w.	plasticizer for vinyl polymers, synth. rubber; various cellu. deriv.	drums, cans	At.
69	s. veg. oils, most org. solv. disp. w.	oil soluble emulsifying agt. for Vitamin oils	drums, cans	At.
70	s. w., most org. solv.; i. mineral & veget. oils	emulsifier, wetting dispersing and solubilizing agt.	drums, cans	At.
71	i. w.; sl. s. veget., animal oils; s. all organic solvents	antioxidant, color stab., source of mannitol plasticizer	…	At.
72	s. ketones, amines, eth., al.; sl. s. w., hydrocarbons, esters, oils	plasticizer, hardener for cellu. acetate and nitrate.	…	At.
73	s. al., eth. amines, ketones. sl. s. hydrocarbons, esters, eth. al. v. sl. s. w.	plasticizer, hardening agt., alk. resistant, resins	…	At.
74	i. s. w.; sl. s. veget. & animal oils; s. org. solv.	plasticizer, carrier for sorbitol and acetone	…	At.
75	s. al., amines, eth., ketones; sl. s. w., hydrocarbons, veget. and animal oils, esters, polyhydric al.	hardener or stiffener, alk. resistant resins	…	At.
76	s. al. eth., ketones, amines, esters; sl. s. hydrocarbons, veg. & animal oils; v. sl. s. w	alkaline resistant resins, plasticizer	…	At.
77	s. most org. solv.; dispersible w.	insecticidal spreader	drums, cans	At.
78	imm. w	solv. organic syn	bottles, cans, drums	P.P.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
79	Benzene azophenol	*p*-hydroxy azobenzene	$C_6H_5N_2C_6H_4OH$	198.22
80	*meta*-Benzendisulfonic acid	benzene-*meta*-disulfonic acid	$C_6H_4(SO_3H)_2$	238.23
81	Bromoacetic acid	bromoacetic acid; monobromoacetic acid	$BrCH_2COOH$	138.96
82	5-Bromo-aspirin	acetyl-5-bromosalicylic acid	$BrC_6H_3COOHOCOCH_3$	259.06
83	Bromobenzene	monobromobenzene	C_6H_5Br	157.02
84	2-Bromo-4-*tert*-butyl phenol	2-bromo-4-*tert*-butyl phenol	$BrC_6H_3(OH)C(CH_3)_3$	229.12
85	Bromoform, U.S.P. IX	bromoform, pharmaceutical grade tribromomethane	$CHBr_3$	252.77
86	4-Bromodiphenyl	4-bromobiphenyl	$C_6H_5C_6H_4Br$	233.11
87	*p*-Bromophenol	*p*-bromophenol	BrC_6H_4OH	173.02
88	2-Bromo-4-phenylphenol	3-bromo-4-hydroxydiphenyl	$C_6H_5C_6H_3(OH)Br$	249.11
89	5-Bromosalicylic acid	5-bromosalicylic acid	$BrC_6H_2COOH(OH)$	217.03
90	*o*-Bromotoluene	*o*-bromotoluene	$BrC_6H_4CH_3$	171.04
91	*p*-Bromotoluene	*p*-bromotoluene	$BrC_6H_4CH_3$	171.04
92	Butadiene	butadiene	$CH_2{:}CHCH{:}CH_2$	54.09
93	Butadiene-1,3, Pure	1,3-butadiene	$CH_2CHCHCH_2$	54.09
94	Butalyde	*n*-butyraldehyde	$CH_3(CH_2)_2CHO$	72.10
95	Butane	liquified petroleum gas	$CH_3CH_2CH_2CH_3$	58.12
96	*n*-Butane, Pure	*n*-butane	$CH_3CH_2CH_2CH_3$	58.12
97	Butanol	*n*-butyl alcohol	$CH_3(CH_2)_2CH_2OH$	74.12
98	“	“ “ “	$CH_3(CH_2)_2CH_2OH$	74.12
99	*sec*-Butanol (2)	*sec*-butyl alcohol	$CH_3CH(OH)CH_2CH_3$	74.12
100	Butene-1, Pure	1-butene	$CH_2CHCH_2CH_3$	56.10
101	Butene-2, Pure, (high-boiling)	*cis*-2-butene	$CH_3CHCHCH_3$	56.10
102	Butyl acetate	*n*-butyl acetate	$CH_3COO(CH_2)_3CH_3$	116.16
103	*n*-Butyl acetate	“ acetate	$CH_3COOC_4H_9$	116.16
104	“ “	“ acetate	$CH_3COOC_4H_9$	116.16

No.	Physical form and color	Odor	Purity %	Sp. gr.
79	tan cr. powd			
80	cr. sld	like SO_2	*ca.* 90	
81	wh. pa. yel., deliq. cr. sld	sharp, pen		
82	wh. cr	none		
83	cl. col. mobile liq	pleas. char		1.495_{25}^{25}
84	cl. pa. straw col. liq	mild		1.338_{25}^{25}
85	heavy col. mobile liq	resemb. chloroform	96 %	$2.595\text{–}2.620_{25}^{25}$
86	wh. cr	mild aromatic	97 %	
87	wh.-pk. cr	phenolic		
88	light gray cr. lumps	fa. char		
89	wh. powd	fa. aromatic		
90	pa.-straw col. liq	char. like bromobenzene		1.422_{25}^{25}
91	wh. cr. sld	char. like bromobenzene		1.400_{25}^{25}
92	col. gas			0.6218_{20}^{20}
93	col. flam. liquefied gas		99 min	0.621_{4}^{20}
94	w. wh. liq	char. pung	94	$.803\text{–}809_{20}^{20}$
95	col. gas		99	0.5792_{20}^{20}
96	col. flam. liquefied gas		99 min	0.579_{4}^{20}
97	w. wh. liq	n. res	95	$.810\text{–}.813_{20}^{20}$
98	w. wh. liq	n. res	98–100	$.810\text{–}.813_{20}^{20}$
99	liq	char	99–100	$0.807\text{–}.8107_{20}^{20}$
100	col. flam. liquefied gas, olefin		99 min	0.595_{4}^{20}
101	col. flam. liquefied gas, olefin		99 min	0.627_{60}^{60}
102	w. wh. liq	pleas. fruity, n. res	88–92	$.872\text{–}.880_{20}^{20}$
103	col. liq	char. ester	90–92	0.8826_{20}^{20}
104	w. wh. liq	mild, n. res	90–92	$0.874\text{–}0.878_{20}^{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
79	Benzene azophenol	152.1–153.6			
80	*meta*-Benzendisulfonic acid	109–115			
81	Bromoacetic acid	45–46	none		
82	5-Bromo aspirin	155.5–163.8			
83	Bromobenzene	−30.6	156.0		123.8
84	2-Bromo-4-*tert* butylphenol	<−20		109–5%; 129–95%	240.8
85	Bromoform, U.S.P. IX				
86	4-Bromodiphenyl	88.3–90.3	311		291.2
87	*p*-Bromophenol	64.0–66.0	237		>464
88	2-Bromo-4-phenylphenol	93.6–95.6			
89	5-Bromosalicylic acid	165.2–167.7			
90	*o*-Bromotoluene	−27		180.4–5%; 181.3–95%	174.2
91	*p*-Bromotoluene	25.5		183.3–5%; 184.1–95%	185
92	Butadiene	−108.9	−4.6		<0
93	Butadiene-1,3, Pure	−108.9	−4.4		
94	Butalyde	−99	75.7	71–78	64.4
95	Butane	−135	−0.5		<20
96	*n*-Butane, Pure	−138.5	−0.5		
97	Butanol	−89 (approx)	117.7	<115–none; >118–none	116
98	“	−89.8	117.7	<115–none; >118–none	95
99	*sec*-Butanol, (2)			<94–none; 96–5%; 102–90%; >109–none	72
100	Butene-1, Pure		6.1		
101	Butene-2, Pure (high boiling)	−139.0	3.7		
102	Butyl acetate	−76.8	126.5	<110–none; >145–none	102
103	*n*-Butyl acetate	−75	126.3	118–128	105
104	“ “	−76.8	126.5	<115–none, <127–70%; >135–none	81

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
79	v. s. eth. g. per 100 g: 6 CCl_4, 2 bz., 31 al.; i. w.			D.
80	v. s. w.; sl. s. $CHCl_3$, bz.; i. eth.	electroplating, resin catalyst; chem. inter.	drums	K.
81	∞ w., al., eth., 26 g. per 100 g: CCl_4	org. syn	bottles, carboys	D.
82	sl. s. eth., al.; i. w., CCl_4, bz.	org. syn		D.
83	g. per 100 g.: 10.4^{25} al., 71.3^{25} eth., 0.045^{30}, 0.07^{80} w.	org. syn	cans, drums	D.
84	∞ al., bz., CCl_4, eth., monochlorbenzene, pet. eth.; i. w.	org. syn		D.
85	g. per 100 g. 25°C: ∞ al., CCl_4, eth.; 0.1 w.	anaesthetic and sedative	cases of bottles, carboys	D.
86	g. per 100 g: 50 acet., 100 bz., 50 CCl_4, 34 eth., 3 meth. al; i. w.	org. syn		D.
87	v. s. meth. al., eth.: g. per 100 g.: 88 acet., 40 bz., 3 CCl_4. 1 w.	org. syn		D.
88	v. s. eth., acet., g. per 100 g.: 125 al., 32 bz., 8 CCl_4; i. w.	incorporated in disinfectant mfg.	fiber drums	D.
89	g. per 100 g.: 85 al., 70 eth., 1 bz., $.3^{80}$ w.; i. CCl_4, i. $w.^{25}$	org. syn		D.
90	∞ meth. al., eth., CCl_4, bz., acet.; i. w.	org. syn		D.
91	∞ meth. al., eth., CCl_4, bz., acet.; i. w.	org. syn		D.
92	0.2 vol. of gas per vol. water	mfg. of synth. rubber; chem. inter.	cylinders, tank cars	C. & C.
93		copoly. to form synth. rubbers; org. syn.	cylinders	P.P.
94	6.24^{25} w	mfg. butyric acid, flavoring extracts, medicines, perfumes syn. resins	cans, drums, tank cars	C.S.
95	0.14 vol. gas per volume water.	refrigerant extr. solv.; fuel	cylinders	C. & C.
96		hydrocarbon research; refrig., solv., fuel research	cylinders, tank cars	P.P.
97	9.8^{25} w.; ∞ all org. solv.;	blending agent; solv. resins, waxes, gums, oils, alkaloids; deter.; syn. base mat.	tank cars, comp. tank cars, drums	C.S.
98	20^{25} w	mfg. nitro. solv. gen. org. mfg. of derivatives	drums, tank cars	U.S.I.
99	19^{25} w	general solvent	cans, drums, tank cars	St.
100		poly., resin mfr., org. syn	cylinders	P.P.
101		resin mfg.; copoly., org. syn.	cylinders	P.P.
102	misc. all com. org. solv. 0.5 w .	high boil. solv. in nitro. cellu. lacq. dopes and thinners; solv. in inks, adhes. solv. as in the isolation of penicillin and phenols	drums, tank cars	C.S.
103	0.68^{20}% by wt. in w	solv. nitrocellu., lacq., art. leather, photo film, plastics, coatings, safety glass	cans, drums, tank cars	C. & C.
104	1.2^{25} w	nitro. solv.; textile sizing	cans, drums, tank cars	U.S.I.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
105	*sec*-Butyl acetate	*sec*-butyl acetate	$CH_3(C_2H_5)CHCOOCH_3$	116.16
106	*n*-Butyl acrylate		$CH_2{:}CHCOOC_4H_9$	128.17
107	Butyl acetyl ricinoleate	butyl acetyl ricinoleate	$C_{17}H_{32}(OCOCH_3)(COOC_4H_9)$	396.60
108	*n*-Butyl alcohol	1 butanol	$CH_3CH_2CH_2C_2OH$	74.12
109	*sec*-Butyl alcohol	*sec*-butyl alcohol	$CH_3CH(OH)CH_2CH_3$	74.12
110	*tert*-Butyl alcohol	*tert*-butanol	$CH_3C(CH_3)(CH_3)OH$	74.12
111	*n*-Butyl amine	*n*-butyl amine, 1-aminobutane	$CH_3CH_2CH_2CH_2NH_2$	73.14
112	*n*-Butylbenzene, Technical	*n*-butylbenzene	$C_6H_5CHCH_3C_2H_5$	134.21
113	*sec*-Butylbenzene (C-4 Aromatic Solvent)	*sec*-butylbenzene	$C_6H_5CHCH_3C_2H_5$	134.21
114	*sec*-Butylbenzene, Pure	“ “	$C_6H_5CHCH_3C_2H_5$	134.21
115	*tert*-Butylbenzene, Pure	*tert*-butylbenzene	$C_6H_5CHCH_3C_2H_5$	134.21
116	*n*-Butyl benzoate		$C_6H_5COOC_4H_9$	178.22
117	“ bromide	1-bromobutane	$CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2Br$	137.03
118	Butyl “Carbitol”*	diethylene glycol monobutyl ether, butoxydiethylene glycol	$C_4H_9OCH_2CH_2OCH_2CH_2OH$	162.23
119	“ “ acetate	diethylene glycol monobutyl ether acetate	$CH_3CO(OC_2H_4)_2OC_4H_9$	204.26
120	4-*tert*-Butyl catechol	4-tert-butyl-1,2-dihydroxybenzene	$(OH)_2C_6H_3C(CH_3)_3$	166.21
121	Butyl “Cellosolve”*	ethylene glycolmonobutyl ether; 2-butoxyethanol	$C_4H_9OC_2H_4OH$	118.17
122	*n*-Butyl chloride	1 chlorobutane	$CH_3CH_2CH_2CH_2Cl$	92.57
123	4-*tert*-Butyl-2-chlorophenol	4-*tert*-butyl-2-chlorophenol	$ClC_6H_3(OH)C(CH_3)_3$	184.66
124	*p*-*tert*-Butyl-*o*-cresol	4-*tert*-butyl-2-methyl phenol	$(OH)C_6H_3CH_3C(CH_3)_3$	164.24
125	Butyl ether	dibutyl ether; dibutyl oxide	$C_4H_9OC_4H_9$	130.23
126	“ “	butyl ether	$C_4H_9OC_4H_9$	130.22
127	“ ethyl “Cellosolve”*		$C_4H_9OCH_2CH_2OC_2H_5$	146.22
128	“ lactate	butyl lactate	$CH_3CHOHCOO(CH_2)_3CH_3$	146.18
129	2-Butyl octanol		$C_6H_{13}CH(C_4H_9)CH_2OH$	186.33
130	β-*n*-Butyloxyethyl salicylate	β-*n*-butyloxyethyl salicylate	$OHC_6H_4COOCH_2CH_2OC_4H_9$	238.28

* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
105	liq	char	85	$0.8598–.8658^{20}_{20}$
106	liq			0.9015^{20}_{20}
107	yel. oily liq	mild	95	$.94^{20}_{20}$
108	col. liq	mild char		0.8109^{20}_{20}
109	w. wh. liq	char	99–100	$0.807–0.809^{20}_{20}$
110	w. cr. sld	sl. camphor-like	99 by wt	$0.781–0.784^{26}_{26}$
111	col. liq	char. amm	95	0.7385^{20}_{20}
112	col. flam. liq		95 min	0.860^{20}_{4}
113	nearly col. liq	pleas		0.865–0.870
114	col. flam. liq		99 min	0.862^{20}_{4}
115	col. flam. liq		99 min	0.867^{20}_{4}
116	col. liq	pleas		1.0073^{20}_{20}
117	cl. col. to pa. straw colored liquid	char. alk. bromide		1.274^{25}_{25}
118	col. liq	almost none	96	0.9536^{20}_{20}
119	col. liq	almost none	95	0.9810^{20}_{20}
120	tan cr. sld	phenolic		1.049^{60}_{25}
121	w. wh. liq	mild	99	0.9019^{20}_{20}
122	liq			0.8875^{20}_{20}
123	lt. straw-colored liq	char		1.112^{25}_{25}
124	straw colored liq	char		$.969^{25}_{25}$
125	col. liq	ethereal		0.7694^{20}_{20}
126	w. wh. liq	mild, ethereal	99.95	$.769–.771^{20}_{20}$
127				0.8389^{20}_{20}
128	w. wh. liq	mild. n. res	95	$.974–.984^{20}_{20}$
129	liq			0.8350^{20}_{20}
130	col. refractive liq	mild, pleas		1.077^{25}_{25}

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
105	*sec*-Butyl acetate			104–none; 111–50%; 116–95% 125–none	66
106	*n*-Butyl acrylate	−64	145		120
107	Butyl acetyl ricinoleate	−32 to −65		220–235$^{3-5}$	230
108	*n*-Butyl alcohol	−88.9	117.7	entirely within a 1.5 range	115
109	*sec*-Butyl alcohol	−114.7	99.5	98.0–101.0	85
110	*tert*-Butyl alcohol	25.6	82.4	81.5–83	60
111	*n*-Butyl amine	−49.2	77.1	74–82	45
112	*n*-Butylbenzene, Technical	−88.9		182.5–183.1	
113	*sec*-Butylbenzene (C-4 Aromatic Solvent)			160–185	135 (C.O.C.)
114	*sec*-Butylbenzene, Pure	−75.6	173.5		
115	*tert*-Butylbenzene, Pure	−57.9	169.2		
116	*n*-Butyl benzoate	−21.5	250	236–249	225
117	" bromide	<−30	101.5		65
118	Butyl "Carbitol"*	−68.1	230.4	220–235	240
119	Butyl "Carbitol" acetate	−32.2	264.4	235–250	240
120	4-*tert*-Butyl catechol	55.4–56.7	285		266
121	Butyl "Cellosolve"*		171.2	166–173	165
122	*n*-Butyl chloride	−122.8	78.6	77.5–180	15
123	4-*tert*-Butyl-2-chlorophenol	<−20		234–5%; 251–95%	224.6
124	*p*-*tert*-Butyl-*o*-cresol	27		136.8–5%; 138–95%	244.4
125	Butyl ether	−95.2	142.2	137–143	100
126	" "	−96	140.9	<137–none; >143–none	87
127	Butyl ethyl "Cellosolve"*	−90	164.2		
128	" lactate	−43	188	149–none; 155–195–90%; 187–189–60%	159.8
129	2-Butyl octanol	−50	252		230
130	β-*n*-Butyloxyethyl salicylate	<−20		186–5%; 192.8–95%	314.6

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* Trade mark.

See two preceding pages for additional data on above compounds.

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
105	$.74^{25}$ w.	lacq. solv.	cans, drums, tank cars	St.
106	0.16^{20}% by wt. in w.	prep. of polymers and copolymers	cans, drums	C. & C.
107	misc. most org. solv; i. w.	Plasticizing agt; emulsifying, lubricating deter. agt.	cans, drums, tank cars, comp. tank cars	C.S.
108	7.7^{20}% by wt. in w.	dehydrating agt; processing solv.; latent solv. nitro. lacq.	cans, drums, tank cars	C. & C.
109	24.4^{20}% by wt. in w.; w. in comp. 56.0^{20}% by wt.	lacq. thinners, solv., mfg. org. chem.	tank cars	S.C.
110	misc. w., org., solv.	extr. solv. drugs; blend. agt., insect., fumi., denaturant, synth. resins, mfg. perfumes, disinfections	tins, drums, tank cars	S.C.
111	∞ w.	chem. inter.	cans, drums, tank cars	C. & C.
112		org. syn.	bottles, cans, drums	P.P.
113	s. bz., eth., CCl_4, al.; i. w.	solvent; chem. inter.	drums, tank cars	K.
114		org. syn.	cans, bottles.	P.P.
115		org. syn.	bottles.	P.P.
116	0.01^{20}% by wt. in w.	high boiling solv. for inks, dyes and resins; chem. inter.	cans, drums	C. & C.
117	∞ acet., bz., CCl_4, eth., meth. al., V.M.P. naphtha; $w.^{25}$	org. syn.	bottles, carboys, drums	D.
118	∞ w.	solv. nitro. and resins.	cans, drums, tank cars	C. & C.
119	6.5^{20}% by wt. in w.	solv. in nitro. cellu. and syn. resins	cans, drums	C. & C.
120	v. s. meth. al., eth., CCl_4, bz., acet.; i. w.		tin lined cans.	D.
121	∞ w.	solv. lacq., nitro., resins	cans, drums, tank cars	C. & C.
122	0.11^{20}% by wt. in w.	chem. inter.	cans, drums.	C. & C.
123	∞ meth. al., eth., CCl_4, bz., acet.; i. w.			D.
124	∞ meth. al., eth., CCl_4, bz., acet.; i. w.			D.
125	0.03^{20}% by wt. in w.	extr. agt. inert reaction medium	drums.	C. & C.
126	s. most com. org. solv.; i. imm. w.	solv. gums, oils, org. a.; extr. ppnt. grignard solv.	cans, drums	C.S.
127	1.4^{20}% by wt. in w.	inert reaction med. extr.; heat transfer med.	cans, drums	C. & C.
128	3.5^{20}% by wt. in w.	Super high-boil. solv. useful in brushing and stripping lacq. in mfg. inks, adhes. resins and enamel.	drums, comp. cars, tanks	C.S.
129	0.01^{20}% by wt. in w.	inter. in prep. of lubricant additives, rubber chem. surface-active agt.	cans, drums	C. & C.
130	∞ eth., CCl_4, bz., al., acet.; i. w.			D.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
131	4-*tert*-Butyl-2-phenylphenol	5-*tert*-Butyl-2-hydroxydiphenyl	$C_6H_5C_6H_3OHC(CH_3)_3$	226.31
132	Butyl propionate	butyl propionate	$CH_3CH_2COOC_4H_9$	130.18
133	" stearate	" stearate	$C_{17}H_{35}COOC_4H_9$	340.58
134	Butyraldehyde	*n*-butyric aldehyde; butanol; butylaldehyde	$CH_3CH_2CH_2CHO$	72.10
135	Butyric acid	butanic acid; ethyl acetic acid	$CH_3CH_2CH_2COOH$	88.10
136	" anhydride	butanoic anhydride	$(CH_3CH_2CH_2CO)_2O$	158.19
137	Camphor, monobromated, N.F.	3-bromocamphor	$C_{10}H_{15}OBr$	231.14
138	Capric acid	decanoic acid	$C_9H_{19}COOH$	172.26
139	Caprinitrile	decanenitrile	$C_9H_{19}CN$	153.26
140	Caproic acid	*n*-caproic acid	$CH_3(CH_3)_4COOH$	116.16
141	Caprylic acid	octanoic acid	$C_7H_{15}COOH$	144.21
142	Caprylonitrile	octanenitrile	$C_7H_{15}CN$	125.21
143	"Carbitol"* solvent	diethylene glycol monoethyl ether; ethoxydiglycol	$C_2H_5O(C_2H_4O)_2H$	134.17
144	"Carbitol"* acetate	diethylene glycol monoethyl ether	$CH_3COO(CH_2CH_2O)_2C_2H_5$	176.21
145	Catechol		$C_6H_4(OH)_2$	110.11
146	"Cellosolve"* solvent	ethylene glycol monoethyl ether; 2 ethoxyethanol	$C_2H_5OC_2H_4OH$	90.12
147	"Cellosolve"* acetate	ethylene glycol monoethyl ether acetate; 2 ethoxyethyl acetate	$CH_3COOCH_2CH_2OC_2H_5$	132.16
148	Chloramine-B	sodium *N*-chlorobenzenesulfonamide	$C_6H_5SO_2Na{:}NCl \cdot 1\frac{1}{2}H_2O$	240.6
149	Chloroacetic acid, purified		$ClCH_2COOH$	94.50
150	5-Chloroanthranilic acid	2-amino-5-chlorobenzoic acid	$ClC_6H_2NH_3COOH$	171.58
151	*p*-Chlorobenzophenone	p-Chlorobenzophenone	$C_6H_5COC_6H_4Cl$	216.66
152	2-Chloroethyl acetate	acetic acid; 2-chloroethyl ester	$CH_3COOCH_2CH_2Cl$	122.55
153	2-Chloroethyl-2-xenyl ether	2-(β-chloroethoxy) diphenyl	$C_6H_5C_6H_4OCH_2CH_2Cl$	232.70
154	Chloroform, Technical		$CHCl_3$	119.39
155	β-Chlorophenetole	β-phenoxyethyl chloride	$C_6H_5OCH_2CH_2Cl$	156.61
156	*o*-Chlorophenoxyacetic acid	*o*-chlorophenoxyacetic acid	$ClC_6H_4OCH_2COOH$	186.59

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* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
131	wh. cr. sld. or visc. liq	fa. char.		$1.022\frac{55}{25}$
132	w. wh. liq	mild, n. res	90–92	$.868-.872\frac{20}{20}$
133	w. wh.	practically odorless	98.5	$0.856-0.861\frac{25}{25}$
134	col. liq	char. pung. aldehyde	96	$0.8048\frac{20}{20}$
135	col. liq	strong, char	99	$0.9590\frac{20}{20}$
136	col. liq	pung	95	$0.9681\frac{20}{20}$
137	wh. glisten. cr. sld. or powd	mild, camphoraceous		
138	wh. liq	mild	90	0.855^{40}
139	wh. liq	char	90	0.825^{15}
140	col. liq	char	98	$0.9295\frac{20}{20}$
141	wh. liq	char	90	0.910^{20}
142	wh. liq	strong, char	90	0.820^{15}
143	col. sl. hyg. liq	mild. pleas		$1.0273\frac{20}{20}$
144	col. liq	pleas. ester-like	95	$1.0114\frac{20}{20}$
145	wh. cr	phenolic	99–100	1.371
146	w. wh. liq	mild, agreeable, n. res	99	$0.9311\frac{20}{20}$
147	w. wh. liq	pleas. ester-like	95	$0.9748\frac{20}{20}$
148	col. flat cr	essentially odorless	99	
149	wh. cr. fl		99 min	
150	grayish-wh. gran	fa. char		
151	col. cr. sld	fa. pleas		
152	col. liq	fruity		$1.152\frac{25}{25}$
153	fine wh. cr			$1.142\frac{60}{25}$
154	cl. col. nonflam. volatile liq			$1.474-1.482\frac{25}{25}$
155	col. liq	pleas. aromatic		$1.147\frac{25}{25}$
156	wh. sl. colored powd	almost none		

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
131	4 *tert*-Butyl-2-phenylphenol	50		196–5%; 198–95%	320
132	Butyl propionate	−89.5	146.8	<120–none; <140–50% <150–85%	109
133	" stearate	19		220–225^{25}	370
134	Butyraldehyde	−99	75.7	<70–none; <80–95%	20
135	Butyric acid	−6.3	163.7	<158–none; >165–none	170
136	" anhydride	65.1	199.5	190–205	190
137	Camphor, monobromated, N.F.	76			
138	Capric acid	30	150^{10}		
139	Caprinitrile	−20	112^{10}		
140	Caproic acid	−5.4	205.1	195–212	215
141	Caprylic acid	13	125^{10}		
142	Caprylonitrile	−50	81^{10}		
143	"Carbitol"* solvent		195.0	185–205	205
144	"Carbitol"* acetate	−25	217.7	208–223	230
145	Catechol	103.5			279
146	"Cellosolve"* solvent		135.1	132–137	130
147	"Cellosolve"* acetate	−61.7	156.4	145–165	120
148	Chloramine-B	d, *ca* 170			
149	Chloroacetic acid, purified	61			
150	5-Chloroanthranilic acid	179.4–185.4			
151	*p*-Chlorobenzophenone	64.5–72.1	331		
152	2-Chloroethyl acetate	<−20		144.7–5%; 146.5–95%	150.8
153	2-Chloroethyl-2-xenyl ether	53.8–56.7	323		320
154	Chloroform, Technical	−63	61.2	60.–61.8	none
155	*β*-Chlorophenetole	24.5		152.6–5%; 155.2–95%	224.6
156	*o*-Chlorophenoxyacetic acid	145–146			

* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
131	v. s. meth. al., eth., CCl_4, bz., acet.; i. w.			D.
132	1.2^{75} w	cellu. nitrate solv	cans, drums, tank cars	U.S.I.
133	misc. org. liq.; 171^{25} w	plasticizer, lubricant, polish cosmetic base	cans, drums	C.S.
134	7.1^{20}% by wt. in w	prep. rubber accel., synth. resins, org. syn.	cans, drums, tank cars	C. & C.
135	∞ w	drugs, deliming hides, lacq	cans, drums, tank cars	C. & C.
136	d. w	esterfying agt	cans, drums	C. & C.
137	g. 100 g. at 25°C: 135 acet., bz., 19.7 al. ∞ chloroform, 50 eth.; i. w.	ingredient in pharm. prep.	kegs	D.
138	0.006^{30} w., 4660^{30} acet., 8980^{30} al., 5150^{30} hexane	mfg. perfumes and flavors, mineral concentration, plasticizers, syn inter.	drums	Arm.
139	∞^{30} al.	syn. inter	drums	Arm.
140	1.10^{20}% by wt. in w	chem. inter	cans, drums	C. & C.
141	0.08^{30} w. ∞^{30} al., acet., hexane	mfg. perfumes and flavors, mineral concentration, pharm. plast., synth. inter.	drums	Arm.
142	∞^{30} al.	synth. inter	drums	Arm.
143	∞ w	solv. nitro.; non-shatterable glass	cans, drums	C. & C.
144	∞ w.; misc. most org. solvents	resin finishes; printing ink	cans, drums	C. & C.
145	s. w., eth., al., amyl al., acet	antioxident, photog. developer, pharm. and dye inter.	drums	K.
146	∞ w	lacq., nitrocellu. solv	cans, drums, tank cars	C. & C.
147	22.9^{20}% by wt. in w	solv. for nitro. and resins	cans, drums, tank cars	C. & C.
148	25^{20} w., d. eth., al., acet.; i. bz.	germicide, oxidizing agt	barrels, fiber containers	S.P.
149	g. per 100 g. at 25°C: 165 acet., 16.5 bz., 5.5 CCl_4, 143 eth., 100 meth. al., sl. s. naphtha v. s. w.	org. syn	fiber drums	D.
150	g. per 100 g.: 10 al.; l. w., bz., CCl_4, eth.			D.
151	g. per 100 g.: 3 meth. al.; 57 eth.; 54 CCl_4; 95 bz., 94 acet.; i. w.			D.
152	∞ meth. al., eth., CCl_4, bz., acet., g. 100 g: 3 w.			D.
153	g. per 100 g: 12 meth. al.; 29 CCl_4, 51 isopropyl eth., v. s. bz., acet.; v. sl. s. w.			D.
154	∞ acet., al., bz., CCl_4, eth., *n*-hep. meth. al.; w.^{25} 0.8		cans, drums, tank cars	D.
155	∞ meth. al., isopropyl eth., CCl_4, bz., acet. v. sl. s. w.			D.
156	g. per 100 g: 5 w., 9 eth., 21 al.; i. bz., CCl_4			D.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
157	2-Chloro-4-phenylphenol	3-chloro-4-hydroxydiphenyl	$C_6H_5C_6H_3ClOH$	204.65
158	*x*-Chloro-(phenylxenyl ether)	*x*-chloro(phenyl diphenyl ether)	$C_{18}H_{13}OCl$	280.74
159	Chloropicrin	chloropicrin	CCl_3NO_2	164.38
160	α-Chloropropionic acid	α-chloropropionic acid	$CH_3CHClCOOH$	108.53
161	1-Chloropropylene	1-chloro-1-propene	$CH_3CHCHCl$	76.53
162	Coumarin-3-carboxylic acid	coumarin-3-carboxylic acid	$C_6H_4(CHCCOOH)(OCO)$	190.15
163	*m*-Cresol		$CH_3C_6H_4OH$	108.13
164	Crotonaldehyde	crotenaldehyde	$CH_3CH{:}CHCHO$	70.07
165 57a)	Crystalline sorbitan	monoanhydrosorbitol	$C_6H_8O(OH)_4$	164.16
166	Cumene	isopropylbenzene	$C_6H_5CH(CH_3)_2$	120.19
167	*p*-α-Cumylphenol	*p*(α,α-dimethylbenzyl) phenol	$C_6H_5C(CH_3)_2C_6H_4(OH)$	212.28
168	Cyclohexane	hexahydrobenzene	$(CH_2)_6$	84.16
169	"	"	$(CH_2)_6$	84.16
170	" , Pure	"	$(CH_2)_6$	84.16
171	Cyclohexene	cyclohexene	$(CH_2)_4(CH)_2$	82.14
172	" , Pure	"	$(CH_2)_4(CH)_2$	82.14
173	Cyclohexyl glycolate	cyclohexyl glycolate	$(CH_2)_5CHOOC{\cdot}CH_2OH$	158.2
174	" levulinate	" levulinate	$(CH_2)_5CHOOCCH_2CH_2COCH_3$	198.25
175	" stearate	" stearate	$(CH_2)_5CHOOCC_{17}H_{35}$	366.6
176	Cyclopentane, Pure	cyclopentane	C_5H_{10}	70.13
177	*o*-Cyclohexylphenol	*o*-cyclohexylphenol	$(HO)C_6H_4(C_6H_{11})$	176.25
178	*p*-Cyclohexylphenol	*p*-cyclohexylphenol	$(HO)C_6H_4(C_6H_{11})$	176.25
179	Decylamine	decylamine	$C_{10}H_{21}NH_2$	157.29
180	Dehydranone	3-aceto-6-methylpyronone	$C_8H_8O_4$	168.06
181	Dextrose (Cerelose brand)	Dextrose hydrate	$C_6H_{12}O_6{\cdot}H_2O$	198.17
182	Dextrose (Cerelose brand, anhydrous)	anhydrous dextrose	$C_6H_{12}O_6$	180.16
183	Diacetone alcohol	4-hydroxy-4-methylpentanone-2	$(CH_3)_2COHCH_2COCH_3$	116.16
184	" "	4-hydroxy-4-methylpentanone-2	$(CH_3)_2COHCH_2COCH_3$	116.16
185	" (Acetone free)	diacetone	$CH_3COCH_2C(CH_3)_2OH$	116.16
186	" , Technical	"	$CH_3COCH_2C(CH_3)_2OH$	116.16

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
157	wh. cr	char		
158	pa. straw-colored visc	none		$1.162\frac{25}{25}$
159	liq	pen. tear gas	99.5	$1.651\frac{20}{4}$
160	lt. amber liq	none		$1.263\frac{25}{25}$
161	col. volatile liq	char		$0.935\frac{15}{25}$
162	lt. tan cr. powd			
163	yel. liq	phenolic	95–98	1.03
164	col. to lt. straw	irritating	91 min	$0.8531\frac{20}{20}$
165	col. cr	none; sweet with bitter aftertaste	v. high	
166	cl. col. mobile liq	pleas. char		$.861\frac{25}{25}$
167	wh.-lt. tan cr. sld	fa. phenolic		
168	col. liq	char. aromatic		$0.777\frac{25}{25}$
169	col. liq	clean aromatic	95–100	$0.774–0.778\frac{20}{20}$
170	col. flam. liq		99 min	$0.777\frac{20}{4}$
171	col. liq	char		$0.808\frac{25}{25}$
172	col. flam. liq		99 min	$0.811\frac{20}{4}$
173	yel. liq	spicy		1.030^{27}
174	amber liq	spicy		$1.023\frac{25}{25}$
175	cream-col. soft sld	spicy		$0.925\frac{25}{25}$
176	col. flam. liq		99 min	$0.745\frac{20}{4}$
177	grayish-wh. sld	phenolic		$1.018\frac{60}{25}$
178	grayish-wh. fine cr	fa. phenolic		
179	wh. liq	ammoniacal	90	$0.79^{20°C}$
180	sld			
181	cr. wh	none	>99.8	1.571^{20}
182	cr. wh	none	>99.9	$1.538\frac{20}{20}$
183	col. liq	mild		$0.9406\frac{20}{20}$
184	w. wh	sweetish char		$0.938–0.941\frac{20}{20}$
185	w. wh. liq	mild		$0.937–0.943\frac{20}{20}$
186	w. wh. liq	mild	85–87 by wt	$.915–920\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
157	2-Chloro-4-phenylphenol	78–80	323		345.2
158	*x*-Chloro-(phenylxenyl ether)	−10	$>180^{10}$		314.6
159	Chloropicrin	−64	112.21, some.	110.5–113.5, 96%	none
160	α-Chloropropionic acid	<−20		178–5%; 190–95%	224.6
161	1-Chloropropylene	<−20		30.3–5%; 32.0–95%	<21.2
162	Coumarin-3-carboxylic acid	189.4–190.4			
163	*m*-Cresol	9–11	202		
164	Crotonaldehyde	−75	102.3		70
165	Crystalline sorbitan	110–111			
166	Cumene	−96	152.3	147–5%; 155–95%	111.2
167	*p*-α-Cumylphenol	70	187^{10}		320
168	Cyclohexane	>0		80–5%; 82–95%	32
169	"	>0	80.7	2° including 80.7	
170	" , Pure	4.8	80.8		
171	Cyclohexene	<−20		83.1–84.2	21.2
172	" , Pure	−103.6	83.2		
173	Cyclohexyl glycolate				
174	" levulinate				
175	" stearate	28–29			
176	Cyclopentane, Pure	−93.9	49.3		
177	*o*-Cyclohexylphenol	47.3–55.5	148^{10}		273.2
178	*p*-Cyclohexylphenol	129.2–131.4	166		
179	Decylamine	8	95^{10}		
180	Dehydranone	110.5	273^{755}		275
181	Dextrose (cerelose brand)	<85			
182	" (cerelose brand, anhydrous)	146			
183	Diacetone alcohol	−42.8	169.1	<135–none; >172–none	170
184	" "	−44	166 (approx)		151
185	" (Acetone free)	−44	164–166	130–180; 150–170 85%	153
186	" , Technical	−63 (approx.)		60–180	39

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
157	g. per 100 g: .03 w. 100 meth. al., 100 eth., 100 acet., 50 bz., 25 CCl_4			D.
158	g. per 100 g: meth. al., eth., CCl_4, bz., acet.; i. w.			D.
159	0.162^{25} w.	fumigant, tear gas	steel cylinders	An.
160	∞ w., acet., bz., CCl_4, eth., meth. al.			D.
161	∞ acet., bz., CCl_4, eth., meth. al.			D.
162	g. per 100 g.: 0.9 al., 0.7 bz., i. w.			D.
163	s. eth., al. alkalis; sl. s. w.	chem. mfr.	drums	K.
164	15.8^{20}% by wt. in w.	chem. inter.	cans, drums	C. & C.
165	s. w., pyridene, acet., a.; sl. s. dioxan, acet., meth. et., ketone; i. most other org. solv.	org. syn.		At.
166	∞ eth , CCl_4, bz., al.; i. w			D.
167	v. s. acet., eth. meth., bz. 161, CCl_4 50			D.
168	∞ acet., bz., CCl_4; i. w.	solv. for nat, and synth. rubber, etc.	5, 10, 55 gal. drums	D.
169	i. w.; complete with acet., CCl_4, bz.	solv. inter.	drums, tank cars	S.C.
170		chem. mfg.; org. syn., solv.	bottles, cans, drums	P.P.
171	v. s. acet., bz., meth. al., CCl_4; v. sl. s. w.			D.
172		org. syn.	bottles, cans, drums	P.P.
173	sl. s. w.; s. al., acet., toluene, naphtha, ethyl acetate	plast. for proteins		G.
174	s. al., acet., ethyl acetate, toluene, naphtha; i. w.	plast.; solv.		G.
175	s. h. al., acet., toluene, naphtha; i. w.	plasticizer		G.
176		motor fuel research, org. syn.	bottles, cans, drums	P.P.
177	v. s. acet., bz., eth., 75 g. per 100 g.: CCl_4; v. sl. s. w.			D.
178	g. per 100 g.: 70 acet., 4 bz., 2 CCl_4; v. sl. s. w.			D.
179	∞^{30} al., hexane	synth. inter.	drums	Arm.
180	0.1 at 25°C.			Arm.
181	w. 55^{25}	sweetener, fermentation, pharm., rayon spinn. baths, ind. inter.	multiwall bag	C.P
182	w. 50^{25}; meth. al. 1.5^{25}	pharm., dry beverage mixes	multiwall bag	C.P.
183	∞ w.	solv. nitrocellu., acetate oils, resins, waxes	cans, drums, tank cars	C. & C.
184	∞ w.	solv. nitro. cellu. acetate, resins, gums, lacq. thinners	drums, tank cars	S.C.
185	misc. w.	thinner, preservative, anti-freeze	cans, drums, comp. tank cars, tank cars	C.S.
186	misc. w.	thinner, preservative, anti-freeze	cans, drums, tank cars	C.S.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
187	Diacetone glucose	diacetone glucose	$C_{12}H_{20}O_6$	260.28
188	Diallyl phthalate monomer	diallyl phthalate	$C_6H_4(CO_2C_3H_5)_2$	246.25
189	Di(2-ethylhexyl)amine		$[C_4H_9CH(C_2H_5)CH_2]_2NH$	241.45
190	4,4′-Diaminobenzophenone	4-4′diaminobenzophenone	$(NH_2C_6H_4)_2CO$	212.24
191	4,4′-Diamino diphenyl ether	4-4′diamino diphenyl ether	$NH_2C_6H_4OC_6H_4NH_2$	200.23
192	1,3-Diaminoisopropanol	1,3-diamino-2-propanol	$NH_2CH_2CHOHCH_2NH_2$	90.13
193	Di-*sec*-amylphenol		$(C_5H_{11})_2C_6H_3OH$	234.4
194	Di-*tert*-amylphenol		$(C_5H_{11})_2C_6H_3OH$	234.4
195	Diamyl phthalate	amyl phthalate	$C_6H_4(CO_2C_5H_{11})_2$	306.39
196	Di(β-ethyloxy)aniline	*N*-phenyldiethanolamine	$C_6H_5C(CH_2CH_2OH)_2$	181.23
197	Dibenzyl disulfide	dibenzyl disulfide	$C_6H_5CH_2SSCH_2C_6H_5$	246.37
198	*p*-Dibromobenzene	*p*-dibromobenzene	$C_6H_4Br_2$	235.92
199	4,4′-Dibromodiphenyl	4,4′-dibromobiphenyl	$BrC_6H_4C_6H_4Br$	312.02
200	Dibutoxy tetraglycol	butoxyethoxy ethyl ether	$(C_4H_9OC_2H_4OC_2H_4)_2O$	306.43
201	Dibutylamine		$(CH_3CH_2CH_2CH_2)_2NH$	129.24
202	Di-*n*-butylamine	dibutylamine	$(C_4H_9)_2NH$	129.23
203	Dibutyl "Carbitol"*	diethylene glycol; dibutyl-ether	$C_4H_9O(C_2H_4O)_2C_4H_9$	218.33
204	Dibutyl "Cellosolve"*	ethylene glycol dibutyl ether	$C_4H_9OC_2H_4OC_4H_9$	174.28
205	Di-*tert*-butyl-*m*-cresol		$C_6H_2(C_4H_9)_2(CH_3)OH$	220.34
206	Di-*tert*-butyl-*p*-cresol		$C_6H_2(C_4H_9)_2(CH_3)OH$	220.34
207	Dibutyl fumarate	dibutyl fumarate	$C_4H_9OCOCH{:}CHCOOC_4H_9$	228.28
208	" isopropanolamine	2-propanol, 1-*N*,*N*-dibutylamine	$CH_3CHOHCH_2N(C_4H_9)_2$	187.32
209	" maleate		$C_4H_9OOCHC{:}CHOOC_4H_9$	228.28
210	" oxalate	dibutyl oxalate	$(COOC_4H_9)_2$	202.25
211	" phthalate	" phthalate	$C_6H_4(CO_2C_4H_9)_2$	278.34
212	" phthalate	dibutyl phthalate	$C_6H_4(COOC_4H_9)_2$	278.34
213	" tartrate	" tartrate	$(CO_2C_4H_9)_2(CHOH)_2$	262.30

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* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
187	cr. sld			
188	pa. straw colored liq	faint		$1.117\text{–}1.123\frac{20}{20}$
189			98	$0.8062\frac{20}{20}$
190	lt. tan gran	none		
191	tan powd	faint		
192	wh.-pa. yel. hyg. cr. sld	amine-like		$1.085\frac{60}{25}$
193	cl. amber liq. at room temperature		tech	$0.91\text{–}0.92\frac{15}{30}$
194	cl. amber liq. at room temperature		tech	0.93^{30}
195	w. wh. liq	almost none	99–100	$1.022\text{–}1.026\frac{20}{20}$
196	lt. tan sld	fa. amine-like		$1.119\frac{60}{25}$
197	pk. cr. sld	pungent		
198	wh. cr. sld	mild naphthalene	98	
199	wh. cr	fa. aromatic		
200		mild		$0.9436\frac{20}{20}$
201	liquid	char., ammoniacal		$0.7680\frac{20}{20}$
202	w. wh. liq	ammoniacal	98	$0.76\frac{20}{20}$
203	col. liq	mild, n. res		$0.8853\frac{20}{20}$
204	col. liq			$0.8374\frac{20}{20}$
205	yel. sld	sl. phenolic		
206	wh. fl	sl. phenolic		
207	liquid			$0.9873\frac{20}{20}$
208	liquid		99.8	$0.8419\frac{20}{20}$
209	liquid		98	$0.9964\frac{20}{20}$
210	w. wh. liq	mild	99	$.989\text{–}.993\frac{20}{20}$
211	w. wh. liq	none	99–100	$1.047\text{–}1.051\frac{20}{20}$
212	w. wh	none	99–100	1.047–1.049
213	lt. straw	mild, pleas	98	$1.087\text{–}1.093\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
187	Diacetone glucose	110–111			
188	Diallyl phthalate monomer		150 at 1 mm; 200 at 760 mm		330
189	Di(2-ethylhexyl) amine		281.1		270
190	4,4′-Diaminobenzophenone	239.0–244.6			
191	4,4′-Diamino diphenyl ether	178–185			
192	1,3-Diaminoiso-propanol	39.4	130^{10}		269.6
193	Di-*sec*-amylphenol			280–305–95%	260
194	Di-*tert*-amylphenol			275–300–95%	260
195	Diamyl phthalate		$247–255^{50}$	$247–255^{10}$	357
196	Di(β-ethyloxy) aniline	55	200^{10}		392
197	Dibenzyl disulfide	58.9–65.4			
198	*p*-Dibromobenzene	87.5	218.6		
199	4,4′-Dibromodiphenyl	164–167			
200	Dibutoxy tetraglycol	−20.0	237^{50}		305
201	Dibutylamine	−62	159.8		125
202	Di-*n*-butylamine	<−50	159	153–165	135
203	Dibutyl "Carbitol"*	−60.2	254.6	230–258	245
204	Dibutyl "Cellosolve"*	−69.1	203.3		185
205	Di-*tert*-butyl-*m*-cresol	50			262
206	Di-*tert*-butyl-*p*-cresol	68		257–266	261
207	Dibutyl fumarate	−15.6	285.1		
208	" isopropanolamine	−80 sets to a glass	228.9	221–229	205
209	" maleate	−85 sets to a glass	280.6	265–281	285
210	" oxalate	−29.6	245.5	<240–5%; 248–90%; >255–none	265
211	" phthalate		$236–244^{50}$mm	$236–244^{50}$mm	352
212	" phthalate	<−10		$227–235^{37}$	347
213	" tartrate	21	204^{26}	197–204	270

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* Trade mark.

See two preceding pages for additional data on above compounds.

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
187	s. w., acet., ethanol, meth. al.			C.P.
188	i. w.; s. in al., acet., ethyl acetate, bz., toluene	plast., plastics mfg.	drums, tank cars	S.C.
189	0.02^{20}% by wt. in w.	chem. inter.	cans, drums	C. & C.
190	i. w., bz., CCl_4, eth., meth. al., acet.			D.
191	15 g. per 100 g.: acet.; i. w., al., CCl_4, eth., bz.			D.
192	s. w. al., acet.; i. bz., CCl_4, eth.			D.
193	s. in most org. solv.; i. w.	resin mfg. antioxidant org. syn.	drums, tank cars	Sh.
194	s. in most org. solv.; i. w.	resin mfg.; antioxidant plast.	drums	Sh.
195	0.05^{25} w.	nitro. cellu. solv. mfg. lacq., plastics	cans, drums, tank cars	U.S.I.
196	g. per 100 g.: 5 w., 1 CCl_4, 23 bz., 29 eth.; v. s. acet., meth. al.			D.
197	s. bz., CCl_4; v. sl. s. al; i. w.			D.
198	1.6 al., s. CCl_4, 71 eth.; i. w.	org. syn.	5 gal. jars	D.
199	g. per 100 g.: 3 meth. al.; 2 eth.; 4 CCl_4; 8 bz.; 3 acet.; i. w.			D.
200	1.3^{20}% by wt. in w.		cans, drums	C. & C.
201	∞ w.	prod. of rubber accel. and inhibitors; gel. breaker fluid	cans, drums, tank cars	C. & C.
202	∞ most org. solv.; i. w.	inter. for rubber vulcanization accel.; dyestuffs; corrosion inhibitors	drums, tank cars	Sh.
203	0.3^{20}% by wt. in w.	solv., plast., lubr., inert medium, extr., dispersing and coupl. agt.	cans, drums	C. & C.
204	0.2^{20}% by wt. in water	solv., plast., lubr., inert reaction medium	cans, drums	C. & C.
205	s. al., eth., CCl_4, acet.; v. sl. s. w.	rubber compounding, rubber reclaiming; resin mfg.	pails, drums	K.
206	s. al., eth., hydrocarbons; i. water, alkalis	antioxidant for motor fuels, lubricants, waxes, rubber, plast. and insecticides	drums	K.
207	$<0.1^{20}$% by wt. in w.	copoly., resin modification	cans	C. & C.
208	0.10^{20}% by wt. in w.	chem. inter.	cans, drums	C. & C.
209	$<0.01^{20}$% by wt. in w.	mfr. of poly. and copoly. for coatings, films, molded prod. and textile spec.	cans, drums	C. & C.
210	1.6^{25} w.	org. syn.	drums, tank cars	U.S.I.
211	0.15^{25} w.	nitro. cellu. plast. paper coatings, linoleum, shatterproof glass, airplane dope	cans, drums, tank cars	U.S.I.
212	0.04^{25} w.; ∞ all org. liq.	solv. dyes, oils, resins, nitro., lubr., perfume fixative, antifoaming agt., plast.	drums, comp. cars, tanks	C.S.
213	∞ meth., et. and butyl al., butyl, et. acetates, eth., acet., benzol, naphtha	plast. for cellu. acetates; syn. resins, lubr., mfg. rubber goods	cans, drums	C.S.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
214	1,3-Dibutylthiourea		$C_4H_9NHCSNHC_4H_9$	188.4
215	2,5-Dichloracetoacetanilide	2,5-dichloracetoacetanilide	$CH_3COCH_2CONHC_6H_3Cl_2$	246.09
216	Dichlorethyl ether	2,2′-dichlorethyl ether	$ClCH_2CH_2OCH_2CH_2Cl$	143.02
217	“ formal	dichlorethyl formal	$CH_2(OCH_2CH_2Cl)_2$	173.04
218	Dichlorisopropyl ether	chloroisopropyl ether	$[ClCH_2(CH_3)CH]_2O$	171.07
219	Dichloroacetic acid		$C_2H_2Cl_2O_2$	128.95
220	3,4-Dichloroaniline	3,4-dichloroaniline	$NH_2C_6H_3Cl_2$	162.02
221	*o*-Dichlorobenzene	*o*-dichlorobenzene	$C_6H_4Cl_2$	147.01
222	*p*-Dichlorobenzene	*p*-dichlorobenzene	$C_6H_4Cl_2$	147.01
223	2,4-Dichlorobenzophenone	2,4-dichlorobenzophenone	$ClC_6H_4COC_6H_4Cl$	251.11
224	4,4′-Dichlorobenzophenone	4,4′-dichlorobenzophenone	$ClC_6H_4COC_6H_4Cl$	251.11
225	2,4-Dichlorophenol	2,4-dichlorophenol	$Cl_2C_6H_3OH$	163.01
226	*x*-Dichloro-(phenol xenyl ether)	*x*-dichloro-(phenol diphenyl ether)	$C_{18}H_{12}OCl_2$	315.19
227	Dicyclohexyl	dicyclohexyl	$C_6H_{11}C_6H_{11}$	166.30
228	Didodecylamine	didodecylamine	$(C_{12}H_{25})_2NH$	253.66
229	1,2-Di(-2-phenylphenoxy)ethane	1,2-di(-2-xenoxy)ethane	$C_6H_5C_6H_4O(CH_2)_2OC_6H_4C_6H_5$	366.44
230	Diethanolamine	dihydroxyethylamine	$(HOCH_2CH_2)_2NH$	105.14
231	Di(ethylhexyl) ethanolamine		$[C_4H_9CH(C_2H_5)CH_2]_2NC_2H_4OH$	285.50
232	Diethylamine	diethylamine	$(C_2H_5)_2NH$	73.14
233	“	“	$(C_2H_5)_2NH$	73.14
234	Diethyl acetal		$CH_3CH(OC_2H_5)_2$	118.11
235	“ benzene	diethyl benzene	$C_2H_5C_6H_4C_2H_5$	134.21
236	“ “	“ “	$C_2H_5C_6H_4C_2H_5$	134.21
237	“ carbinol	*sec-n*-amyl alcohol	$(CH_3CH_2)_2CHOH$	88.15
238	“ “Carbitol”*	diethylene glycol	$(C_2H_5OC_2H_4)_2O$	162.23
239	“ carbonate	ethyl carbonate	$(C_2H_5)_2CO_3$	118.13
240	“ “Cellosolve”*	1,2-diethyoxyethylene; ethylene glycol diethyl	$C_2H_5OCH_2CH_2OC_2H_5$	118.17
241	“ ethanolamine	diethylaminoethanol	$(C_2H_5)_2NC_2H_4OH$	117.19
242	“ fumarate		$C_2H_5OCOCH:CHCOOC_2H_5$	172.18

* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
214	wh. to lt. tan powd		98	
215	wh. cr. sld			
216	col. liq	chloroform-like	99	$1.2220\frac{20}{20}$
217				$1.2339\frac{20}{20}$
218	col. liq	chloroform-like		$1.1135\frac{20}{20}$
219	col. liq		99	$1.560\frac{25}{25}$
220	fine lt. tan cr	mild		
221	cl. col. liq	aromatic		$1.303\frac{20}{4}$
222	gran. wh.-trans. sld	aromatic	100	1.520^{25}
223	wh. powd	fa		
224	wh. cr	musty		
225	wh. cr. sld	phenolic		$1.383\frac{60}{25}$
226	lt. straw-colored visc. liq			$1.233\frac{25}{25}$
227	col. liquid	aromatic		$.885\frac{25}{25}$
228	wh. sld	fa. ammoniacal	90	
229	fine wh. cr	none		
230	col. liq	ammoniacal	95–100	$1.0919\frac{30}{20}$
231				$0.8573\frac{20}{20}$
232	cl. w. wh. liq	amm	98	$0.70–0.71\frac{20}{20}$
233	liq	amm		$0.7062\frac{20}{20}$
234				$0.8260\frac{20}{20}$
235	col. cl. mobile liq	pleas. char		$.868\frac{25}{25}$
236	w. wh. liq	pleas		0.865–0.875
237	w. wh			$0.82\frac{20}{20}$
238	col. liq	almost none	99	$0.9082\frac{20}{20}$
239	w. wh. liq	mild, n. res	98–100	$.973–.977\frac{20}{20}$
240	col. liq	sl. ethereal	95	$0.8417\frac{20}{20}$
241	col. hyg. liq	amine-like	98–100	$0.8851\frac{20}{20}$
242	wh. cr. sld			$1.0529\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
214	1,3-Dibutylthiourea	60 (min) freezing			
215	2,5-Dichloracetoacetanilide	92–96			none
216	Dichlorethyl ether	−51.9	178.5	<170-none; >180-none	185
217	“ formal	−32.8	218.1		230
218	Dichlorisopropyl ether		187.4	180–190	185
219	Dichloroacetic acid	10		191–5%; 194.7–95%	none
220	3,4-Dichloroaniline		71.0–73.2	144^{10}	330.8
221	*o*-Dichlorobenzene	−17.2	173	173–186	167
222	*p*-Dichlorobenzene	53.04	173		158
223	2,4-Dichlorobenzophenone	194^{10}	60–62.2		366.8
224	4,4′-Dichlorobenzophenone	146.6–147.8			
225	2,4-Dichlorophenol	41–42.2	100^{10}		237.2
226	*x*-Dichloro-(phenyl xenyl ether)	<0	222^{10}		399.2
227	Dicyclohexyl	3		238–5%; 239–95%	210.2
228	Didodecylamine	50	210^{1}		
229	1,2-Di(-2-phenylphenoxy) ethane	101.1–102.3			
230	Diethanolamine	28	dec		305
231	Di(ethylhexyl) ethanolamine	−60 sets to a glass	216^{50}		280
232	Diethylamine	−50		not <53; not >59.5	<0
233	“	−49.8	55.5		5
234	Diethyl acetal		102.2		
235	“ benzene	−70		180–5%; 182–95%	138.2
236	“ “			175–185	138.6 (C.O.C.)
237	“ carbinol	<−75	115.6	113.6–117.6; 95%	102
238	“ “Carbitol”*	−44.3	188.9	180–190	180
239	“ carbonate	−43.0	126.8	<120-none; <128–90%; >130-none	89
240	“ “Cellosolve”*	−74	121.4	115–140	95
241	“ ethanolamine		162.1	158–165	140
242	“ fumarate	1.0	216.9		220

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* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
214	part. s. in H_2SO_4, HCl.; sl. s. hydrocarbon oil	corrosion inhibiter	fiber drums	Sh.
215	....	printing ink, coloring	cans, drums	C. & C.
216	1.1^{20} % by wt. in w	h. boil. solv., textile scouring	cans, drums, tank cars	C. & C.
217	0.78^{20} % by wt. in w	inter	cans, drums, tank cars	C. & C.
218	0.17^{20} % by wt. in w	solv., extr., fats, waxes, greases	drums	C. & C.
219	∞ acet., bz., CCl_4, eth., *n*-heptane, meth. al., w.	mfr. of inter. and pharm	bottles, carboys	D.
220	g. per 100 g.: 6 CCl_4, 51 bz., 70 al.; v. s. eth.; i. w.	....	....	D.
221	s. al., eth.; i. w	insecticide, deodorant, solv. org. syn.	cans, drums	S.P.
222	s. al., eth.; i. w	insecticide, fungicide, deodorant	cans, drums, barrels	S.P.
223	g. per 100 g.: 10 meth. al., 48 eth., 20 CCl_4, 190 bz., 150 acet.; i. w.	....	....	D.
224	g. per 100 g.: 1 meth. al., 2 eth.; 2 CCl_4, 12 bz., 5 acet.; i. w.	....	....	D.
225	v. s. acet., al., eth.; g. per 100 g.: 160 CCl_4, 5 w.	....	....	D.
226	g. per 100 g.: 14 meth. al., >100 eth., >100 CCl_4, >100 bz., >100 acet.; i. w	....	....	D.
227	g. per 100 g.: 7 meth. al., ∞ eth., CCl_4, bz., acet., i. w.	....	....	D.
228	54^{30} bz., 27.5^{30} hexane	synth. inter	drums	Arm.
229	g. per 100 g.: .02 w., 4 meth. al., 2 isopropyl eth., 9 CCl_4, 55 bz., 19 acet.	....	....	D.
230	96.4^{20} % by wt. in w	absorb. for a. gases, emulsifier, inter.	cans, drums, tank cars	C. & C.
231	0.01^{20} % by wt. in w	chem. inter	cans, drums	C. & C.
232	s. w., meth. al., et. eth., acet., bz., gasoline, et. acetate	rubber chem., soap	drums, tank cars	Sh.
233	∞ w	rubber accelerators, emulsifiers, insect. pharm., dyestuffs and textile finish	cans, drums, tank cars	C. & C.
234	4.4^{25} % by wt. in w	chem. inter	cans, drums	C. & C.
235	∞ bz., CCl_4, eth.; s. al.; i. w	....	....	D.
236	s. bz., eth., CCl_4, al.; i. w	solv. chem. inter	drums, tank cars	K.
237	s. meth. al., et. eth., acet., bz., gasoline, et. acetate; sl. s. w.	mfg. pharm	cans, drums	Sh.
238	∞ w	h. boil. reaction medium	cans, drums	C. & C.
239	1.4^{25} w	neutral lacq. solv	cans, drums, tanks	U.S.I.
240	21^{20} % by wt. in w	inert reaction med	drums	C. & C.
241	∞ w	formation esters, inter. in pharm.	cans, drums, tank cars	C. & C.
242	0.04^{20} % by wt. in w	copoly., resin modification	cans, drums	C. & C.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
243	Diethyl ketone	3-pentanone	$C_2H_5COC_2H_5$	86.13
244	“ maleate		$(:CHCOOC_2H_5)_2$	172.18
245	“ “		$(:CHCOOC_2H_5)_2$	172.18
246	“ oxalate	ethyl oxalate	$(COOC_2H_5)_2$	146.14
247	“ phthalate	diethyl phthalate	$C_6H_4(CO_2C_2H_5)_2$	222.23
248	“ “	“ “	$C_6H_4(CO_2C_2H_5)_2$	222.23
249	2,2-Diethyl propanediol-1,3		$HOCH_2C(C_2H_5)_2CH_2OH$	132.20
250	Diethyl succinate		$(CH_2COOC_2H_5)_2$	174.19
251	“ sulfate	diethyl sulfate	$(C_2H_5)_2SO_4$	154.18
252	1,3-Diethylthiourea		$C_2H_5NHCSNHC_2H_5$	132.2
253	Diethylene glycol	diglycol	$HO(C_2H_4O)_2H$	106.12
254	Diethylene glycol diglycolate	diethylene glycol diglycolate	$(CH_2CH_2OOCCH_2OH)_2O$	222.18
255	Diethylene glycol dilevulinate	diethylene glycol dilevulinate	$[CH_2CH_2OOC(CH_2)_2COCH_3]_2O$	270.4
256	Diethylene triamine	diethylene triamine	$(H_2NC_2H_4)_2NH$	103.17
257	Diglycol diacetate	diethylene glycol diacetate	$(CH_3COOCH_2CH_2)_2:O$	190.19
258	“ laurate	diglycol laurate	$HCCH_2CH_2OCH_2CH_2OOC$-$(CH_2)_{10}CH_3$†	288.42†
259	“ myristate	“ myristate	$HOCH_2CH_2OCH_2CH_2OOC$-$(CH_2)_{12}CH_3$†	316.47†
260	“ oleate	“ oleate	$HOCH_2CH_2OCH_2CH_2OOC$-$(CH_2)_7CH(C_8H_{17})CH$†	370.56†
261	“ palmitate	“ palmitate	$HOCH_2CH_2OCH_2CH_2OOC$-$(CH_2)_{14}CH_3$†	344.52†
262	“ stearate	“ stearate	$HOCH_2CH_2OCH_2CH_2OOC$-$(CH_2)_{16}CH_3$†	372.58†
263	Di-*n*-hexyl maleate		$HCCOOC_6H_{13}:HCCOOC_6H_{13}$	284.38
264	2,4′-Dihydroxybenzophenone	2,4′-dihydroxybenzophenone	$OHC_6H_4COC_6H_4OH$	214.21
265	4,4′-Dihydroxybenzophenone	4,4′-dihydroxybenzophenone	$OHC_6H_4COC_6H_4OH$	214.21
266	*N*,*N*¹-Dihydroxyethyl ethylene diamine		$HOC_2H_4NHCH_2CH_2NHC_2H_4$-$OH$	148.20
267	Diisobutyl carbinol	nonyl alcohol	$(CH_3)_2CHCH_2CH(OH)CH_2CH$-$(CH_3)_2$	144.25
268	“ ketone	diisobutyl ketone	$(CH_3)_2CHCH_2COCH_2CH(CH_3)_2$	142.24
269	Diisopropanolamine	diisopropanolamine	$(CH_3CHOHCH_2)_2NH$	133.19

† Theoretical.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
243	liq			0.08155^{20}_{20}
244	liq			1.0703^{20}_{20}
245	w. wh.		>99	1.0705^{20}_{20}
246	w. wh. liq	mild, n. res	99	$1.075–1.079^{20}_{20}$
247	w. wh. liq	none	99–100	$1.117–1.121^{20}_{20}$
248	w. wh. liq	none	99–100	$1.118–1.120^{20}_{20}$
249	wh. cr. sld			0.949^{61}_{20}
250	col. liq	pleas. mild		1.0418^{20}_{20}
251	w. wh. liq	fa. ethereal		1.1803^{20}_{20}
252	coarse white to light tan powd		98	
253	w. wh. liq	almost none		1.1184^{20}_{20}
254	yel. liq	faint		1.30^{30}
255	amber liq	pleas		1.145^{25}
256	hyg. visc. liq	mildly ammon		0.9542^{20}_{20}
257	w. wh. liq			1.1159^{20}_{20}
258	lt. straw-colored oily, liq	v. fa	tech	0.965–0.975
259	lt. colored, wax-like	v. fa	tech	0.938^{38}
260	lt. red oily liq	fatty	tech	0.930
261	lt. colored, wax-like	v. faint	tech	0.924^{46}
262	wh. wax-like sld	faint, fatty	tech	0.960
263	liq			0.9602^{20}_{20}
264	straw colored cr	faint		
265	lt. tan gran	none		
266				
267	liq			0.8121^{20}_{20}
268	col. liq	agreeable, ketone-like	95	0.8089^{20}_{20}
269	col. liq	amine-like		0.9890^{45}_{20}

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
243	Diethyl ketone	−39.8	102.0	100–108	55
244	" maleate	−11.2	222.4		200
245	" "	−11.5	225.3		250
246	" oxalate	−40.6	185.4	<180–none; >190–none	168
247	" phthalate	−5	200–207^{50}	200–207^{50}	325
248	" "	−40.5	296.1		305
249	2,2-Diethyl propanediol-1,3	61.3	125 (10 mm)		
250	Diethyl succinate	−20.9	217.7		
251	" sulfate	−24.4	dec		250
252	1,3-Diethylthiourea	73.5°C freezing			
253	Diethylene glycol	−8.0	245.0	235–255	290
254	Diethylene glycol diglycolate				
255	Diethylene glycol dilevulinate				
256	Diethylene triamine	−39	206.7	185–215	215
257	Diglycol diacetate	19.1	250.0		255
258	" laurate	10–12	315–325	240–325, 75%; rest in vacuo	290
259	" myristate	36–37			290
260	" oleate	<0		240–330, 85%	290
261	" palmitate	46.5			290
262	" stearate	54–59			290
263	Di-*n*-hexyl maleate	−70	179 (10 mm)		
264	2,4′-Dihydroxybenzophenone	139–143.6			
265	4,4′-Dihydroxybenzophenone	206.–218.8			
266	*N*,*N*^{1}-Dihydroxyethyl ethylene diamine	98.1	196^{10}		355
267	Diisobutyl carbinol	−65 sets to a glass	178.3		165
268	" ketone	41.5	168.1	163–173	140
269	Diisopropanolamine	42	248.7		260

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
243	3.4^{40}% by wt. in w.	solvent	cans, drums	C. & C.
244	1.5^{20}% by wt. in w.	mfr. of poly. and copoly. for coatings, films, molded prod. and textile spec.	cans, drums	C. & C.
245	1.3^{30} w., ∞ acet., meth., al., eth., CCl_4	synth. plast., pharm. rubber chem. surfacing active agts.	cans, drums	C.S.
246	1.5^{25} w	dye inter. pharm. base, nitro. cellu. base	cans, drums, tank cars	U.S.I.
247	0.7^{25} w	nitrocellu. plast., cellu. acetate plast., perfume fixative, insecticide, synth. resins	cans, drums, tank cars	U.S.I.
248	$.09^{25}$% by vol. w.; misc. most org. liq.	plast. fixative, denaturant	cans, drums	C.S.
249	25^{20}% by wt. in w.	inter. for prepar. of plast.; synth. lubr. and emulsifying agts.	cans, drums	C. & C.
250	2.1^{20}% by wt. in w.	prep. of perfumes and flavors.	cans, drums	C. & C.
251	0.7^{20}% by wt. in w.	ethylating agent	cans, drums, tank cars	C. & C.
252	sl. s. in H_2SO_4 and HCl, and in hydrocarbons, oils	corrosion inhibitor	fiber drums	Sh.
253	∞ w	soft. agt., humectant solv., coupling agt.	cans, drums, tank cars	C. & C.
254	∞ w.; s. polar solv.; i. nonpolar solv.	compatible with nitro. cellu. acetate, hygroscopic		G.
255	∞ w.; s. al., acet., ethyl acetate, toluene; i. naphtha	compatible with nitro. cellu. acetate, some vinyl resins	cans, drums	G.
256	∞ w	inter., metal plating asphalt	cans, drums, tank cars	C. & C.
257	∞ w	solvent for cellu. esters, printing inks, and lacq.	cans	C. & C.
258	disp. c. w.; s. al., hydrocarbons, oils	emulsifying, disp. agt. cosmetics, dry cleaning, dye solv.; furs and leather	cans, drums	G.
259	disp. h. w.; s. h. al., hydrocarbons, oils	emulsifying, thick., disp. agt.	drums, slabs	G.
260	disp. c. w.; s. al., hydrocarbons, oils	emulsifying disp. agt.; sprays, polishes	cans, drums	G.
261	disp. h. w.; s. h. al., hydrocarbons, oils	emulsifying, thick., disp. agt.	drums, slabs	G.
262	disp. h. w.; s. al., hydrocarbons, oils	emulsifying, thick., disp. agt.; ceramic insulation; cosmetics, pharm., lubr.	drums, slabs	G.
263	$<0.01^{20}$% by wt. in w.	prep. of resins for use in coatings, films, molded prod. and textile spec.	cans, drums	C. & C.
264	g. per 100 g.: 44 eth., 44 meth. al.; 52 acet.; i. w., bz., CCl_4.			D.
265	G. per 100 g.: 2 meth. al., .6 acet.; i. w., bz., CCl_4			D.
266		chem. inter.	cans, drums	C. & C.
267	0.06^{20}% by wt. in w.	solv. coupler, defoaming agt., chem. inter.	tank cars	C. & C.
268	misc. most org. liq., $<0.06^{20}$% by wt. in w.	syn.; wolv. rubber nitro., synth., resins	drums	C. & C.
269	87^{20}% by wt. in w.	prep. soaps and emulsifiers	cans, drums	C. & C.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
270	Diisopropyl amine		$[(CH_3)_2CH]_2NH$	101.19
271	Diisopropylamine	diisopropylamine	$[(CH_3)_2CH]_2NH$	101.2
272	Diisopropylbenzene	diisopropylbenzene	$C_{12}H_{18}$	162.26
273	1,3-Diisopropylthiourea		$(CH_3)_2CHNHCSNH\ CH(CH_3)_2$	160.3
274	Di(2-ethylhexyl) maleate		$[CHCOOCH_2CH(C_2H_5)C_4H_9]_2$	340.49
275	Di(methyl "Cellosolve")* maleate		$CH_3OCH_2CH_2OCOCH{:}$-$CHCOOCH_2CH_2OCH_3$	232.23
276	Dimethyl acetal		$CH_3CH(OCH_3)_2$	90.12
277	Dimethylamine	dimethylamine	$(CH_3)_2NH$	45.08
278	Dimethylaminoethanol		$(CH_3)_2NC_2H_4OH$	89.14
279	2,2-Dimethylbutane, Pure (Neohexane)	2,2-dimethylbutane	$(CH_3)_3CCH_2CH_3$	86.17
280	2,3-Dimethylbutane, Pure	2,3-dimethylbutane	C_6H_{14}	86.17
281	1,3-Dimethyl-1,3-diphenyl cyclobutane	1,3-dimethyl-1,3-diphenyl cyclobutane	$C_6H_5CCH_3(CH_2)_2CCH_3C_6H_5$	236.34
282	Dimethyl ethanolamine	dimethylethanolamine	$(CH_3)_2NC_2H_4OH$	89.14
283	Dimethylfuran	dimethylfuran	$OC(CH_3){:}CHCH{:}C(CH_3)$	96.12
284	2,6-Dimethylheptene-3, Technical	2,6-dimethyl-3-heptene	C_9H_{18}	126.23
285	2,3-Dimethylhexane, Technical	2,3-dimethylhexane	C_8H_{18}	114.22
286	2,4-Dimethylhexane, Technical	2,4-dimethylhexane	C_8H_{18}	114.22
287	Dimethyl isopropanolamine	1-dimethylamino propanol-2	$(CH_3)_2NCH_2CH(OH)CH_3$	103.16
288	2,3-Dimethylpentane, Technical	2,3-dimethylpentane	C_7H_{16}	100.20
289	2,4-Dimethylpentane, Pure	2,4-dimethylpentane	C_7H_{16}	100.20
290	Dimethyl phthalate	dimethyl phthalate	$C_6H_4(CO_2CH_3)_2$	194.18
291	" "	" "	$C_6H_4(COOCH_3)_2$	194.18
292	2,2-Dimethylpropane, Pure (Neopentane)	2,2-dimethylpropane	C_5H_{12}	72.15
293	1,3-Dimethylurea		$CH_3NHCOHN\ CH_3$	88.1
294	2,5-Dimethylpiperazine		$HNCH_2CH(CH_3)NHCH_2CH$-(CH_3)	114.19
295	Dioctadecylamine	dioctadecylamine	$(C_{18}H_{37})NH$	521.97
296	Dioxane	diethylene dioxide	$OCH_2CH_2OCH_2CH_2$	88.10
297	Dioxolane	dioxolane	$OCH_2CH_2OCH_2$	74.08

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* Trade name.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
270	col. liq	ammon	98	0.7178^{20}_{20}
271	w. wh. liq		98 (min)	$0.715–0.720^{20}_{20}$
272	cl. col. liq		96	$0.863–0.867^{25}_{25}$
273	grayish white powd		97 min	
274	liq			0.9436^{20}_{20}
275	liq			1.1413^{20}_{20}
276	liq			0.8521^{20}_{20}
277	gas	strong amm	98	$.6865^{-6}$
278	w. wh. liq		98 min	0.885^{20}_{20}
279	col. flam. liq		99 min	0.650^{20}_{4}
280	col. flam. liq		99 min	0.662^{20}_{4}
281	wh. cr	none		$.982^{50}_{25}$
282				0.887^{20}_{20}
283	w. wh. liq			0.9018^{20}_{20}
284	col. flam. liq		95 min	0.718^{20}_{4}
285	col. flam. liq		95 min	0.713^{20}_{4}
286	col. flam. liq		95 min	0.700^{20}_{4}
287				0.8512^{20}_{20}
288	col. flam. liq		95 min	0.694^{20}_{4}
289	col. flam. liq		99 min	0.673^{20}_{4}
290	w. wh. liq	none	99–100	$1.192–1.194^{20}_{20}$
291	lt. straw	v. fa	99–100	$1.192–1.194^{20}_{20}$
292	col. flam. liq. gas		99 min	0.590^{20}_{4}
293	wh. to lt. gray fl	slight amine	98 min	
294				
295	wh. sld	fa. ammon	90	
296	col. liq	mild, n. res	99 by wt	1.0356^{20}_{20}
297	col. liq	pleas. ethereal		1.065

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
270	Diisopropyl amine	−96.3	84.0		30
271	Diisopropylamine				30
272	Diisopropylbenzene	<−55	205.1	203–5%; 208–95%	170.6
273	1,3-Diisopropylthiourea	136°C min. freezing pt.			
274	Di(ethylhexyl) maleate	−60 sets to a glass	164^{10}		365
275	Di(methyl "Cellosolve"*) maleate	−50 sets to a glass	152 (5 mm)		
276	Dimethyl acetal	−111.9	64.5		
277	Dimethylamine	−96	6.9		
278	Dimethylaminoethanol			130–137	115
279	2,2-Dimethylbutane, Pure (Neohexane)	−101.9	49.7		
280	2,3-Dimethylbutane, Pure	−129.5	58.0		
281	1,3-Dimethyl-1,3-diphenyl cyclobutane	49		306.9–5%; 308.7–95%	289.4
282	Dimethyl ethanolamine	−59.0	134.6	130.0–139.0	105
283	Dimethylfuran	−88.5	93.3		60
284	2,6-Dimethylheptene-3, Technical			127.5–128	
285	2,3-Dimethylhexane, Technical			115.6–115.8	
286	2,4-Dimethylhexane, Technical			109.39–109.44	
287	Dimethyl isopropanolamine	−85 sets to a glass	125.8		95
288	2,3-Dimethylpentane, Technical			89.55–89.72	
289	2,4-Dimethylpentane, Pure	−119.5	79.8		
290	Dimethyl phthalate		282	<186–none; >194–none	310
291	" "	0.8 (approx.)	282	<280–none; >290–none	295
292	2,2-Dimethylpropane, Pure (Neopentane)	−17.7	9.4		
293	1,3-Dimethylurea	106	268–270		
294	2,5-Dimethylpiperazine	115.5			210
295	Dioctadecylamine	70	270^{1}		
296	Dioxane	10	101.1	95–none; 103–none	65
297	Dioxolane		74		45

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* Trade name.

See two preceding pages for additional data on above compounds.

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
270	∞ w.	inter. in the prep. of vapor-phase inhibitors	cans, drums, tank cars	C. & C.
271	s. most org. solv.; sl. s. in w	inter.	drums, tank cars	Sh.
272	∞ acet., bz., CCl_4, eth., meth. al.; l. w.		drums	D.
273	sl. s. in H_2SO_4 and HCl; sl. s. hydrocarbon oil	corrosion inhibitor	fiber drums	Sh.
274	0.01^{20}% by wt. in w.	mfg. of polymers and copolymers for coatings, films, molded prod., and textile spec.	cans, drums	C. & C.
275	4.5^{20}% by wt. in w.	Poly.; prepar. of surface-active agts.	cans, drums	C. & C.
276	27.2^{20}% by wt. in w.	solv., chemical inter.	cans, drums	C. & C.
277	s. w., al., eth., org. liq	dehairing agt.; acid gas absorb. solv.; gasoline stabilizer	bottles, drums	C.S.
278		pharm. inter.	drums	Sh.
279		org. synth., motor fuel research	bottles, cans, drums	P.P.
280		org. synth., motor fuel research	bottles, cans, drums	P.P.
281	g. per 100 g.: 8 meth. al.; 147 eth.; 104 CCl_4, 190 bz., 125 acet.; i. w.			D.
282	∞ w.	inter. corrosion inhibitors, acet. ray. dyestuffs, germ. and textile aux. and lubr.	cans, drums, tank cars	C. & C.
283	0.13^{20}% by wt. in w.	solvent	cans, drums	C. & C.
284		org. syn	bottles, cans	P.P.
285		org. syn., motor oil research	bottles, cans	P.P.
286		org. syn., motor oil research	bottles, cans	P.P.
287	∞ w.	chem. inter.	cans, drums	C. & C.
288		org. syn., motor fuel research	bottles	P.P.
289		org. syn., motor fuel research	bottles, cans, drums	P.P.
290	misc. com. org. solv.; imm. gas	plasticizer	cans, drums, tank cars	U.S.I.
291	misc. most com. org. solv.; 536 w.	plasticizer rubber mix. cellu. acetate; solv. gelatinizing agt.	cans, drums	C.S.
292		org. syn	cylinders	P.P.
293	s. meth. al., acet., bz., ethyl acetate; i. ethyl eth., gasoline	pharm. inter.	fiber drums	Sh.
294		chem. inter.	cans	C. & C.
295	2.2^{30} bz., 2.1^{40} hexane	synth. inter.	drums	Arm.
296	∞ w.	solv. extr. and dispersing agt.	cans, drums, tank cars	C. & C.
297	∞ w.		cans	C. & C.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
298	Diphenylamine chlorarsine (DM)	diphenylamine chlorarsine	$NH(C_6H_4)_2AsCl$	277.57
299	Diphenyl	Biphenyl	$C_{12}H_{10}$	154.20
300	1,1-Diphenylethane	1,1-diphenyl ethane	$C_6H_5CHCH_3C_6H_5$	182.25
301	Diphenyl phosphate	diphenyl phosphate	$C_6H_5OHPO_3C_6H_5 \cdot H_2O$	286.22
302	*N,N'*-Diphenyl piperazine	*N,N*-diphenyl piperazine	$C_6H_5N(CH_2)_4NC_6H_5$	238.32
303	Dipropylene glycol	dipropylene glycol	$[CH_3CH(OH)CH_2]_2O$	134.17
303a	Di(2-ethylhexyl) succinate		$(C_{10}H_{19}O_2)_2$	342.50
304	Divinyl benzene	divinylbenzene	$C_6H_4(CH{=}CH_2)_2$	130.18
305	Dodecylamine	dodecylamine	$C_{12}H_{25}NH_2$	185.35
306	“ acetate	dodecylammonium acetate	$C_{12}H_{25}NH_2 \cdot CH_3CO_2H$	245.39
307	Dowanol 4	ethylene glycol, *p-tert*-butylphenyl	$C_6H_4C(CH_3)_3OCH_2CH_2OH$	194.27
308	“ 33 B	1-methoxy-2-propanol; propylene glycol methyl ether (b)	$C_4H_{10}O_2$	90.12
309	“ 50 B	d-propylene glycol methyl ether (b)	$C_7H_{16}O_3$	148.20
310	“ 62 B	tripropylene glycol methyl ether (b)	$C_{10}H_{22}O_4$	206.28
311	Dypnone	(α-methylstyrl phenol ketone)	$C_6H_5COCH{:}C(CH_3)C_6H_5$	222.27
312	Epichlorohydrin	epichlorohydrin	$CH_2ClCHOCH_2$	92.53
313	Ethane		CH_3CH_3	30.07
314	Ethanol	ethyl alcohol	CH_3CH_2OH	46.07
315	“ (200 proof)	“ “	CH_3CH_2OH	46.07
316	Ether, (4-*tert*-butyl-2-chloro-phenyl)(2-chloroethyl)	β-(4-*tert*-butyl-2-chlorophenoxy)ethyl chloride	$ClC_6H_3C(CH_3)_3OCH_2CH_2Cl$	247.16
317	2-Ethoxymethyl-2,4-dimethyl pentanediol-1,5-		$HOCH_2C(CH_3)(CH_2OC_2H_5)CH_2CH(CH_3)CH_2OH$	190.28
318	3-Ethoxypropionaldehyde		$C_2H_5OCH_2CH_2CHO$	102.13
319	3-Ethoxypropionic acid		$C_2H_5OCH_2CH_2COOH$	118.13
320	Ethoxytriglycol	ethoxytriethylene glycol	$C_2H_5O(C_2H_4O)_3H$	178.22
321	Ethylac	2 benzothiazyl-*N,N*-diethyl thiocarbamyl sulfide	$C_{12}H_{14}N_2S_3$	282.4
322	Ethyl acetate (99 %)	ethyl acetate	$CH_3COOC_2H_5$	88.10
323	“ “	“ “	$CH_3COOC_2H_5$	88.10
324	“ “	“ “	$CH_3COOC_2H_5$	88.10

No.	Physical form and color	Odor	Purity %	Sp. gr.
298	lt. yel.-green gran. sld	lacrimatory, sternutatory	90–95	
299	pa. amber sld			$0.991\frac{75}{4}$
300	pa. straw colored liq	aromatic		$.987\frac{25}{25}$
301	wh.-pk. cr. powd	mild, phenolic		$1.242\frac{60}{25}$
302	wh.-pk. cr			
303	col. liq	none		$1.0252\frac{20}{20}$
303a				$0.9346\frac{20}{20}$
304	Hellige varnish scale (3 max.)	aromatic	90 min.	$0.902\text{–}0.917\frac{15.5}{15.5}$
305	wh. sld	ammon	90	0.80^{25}
306	wh. sld	mild	90	
307	cl. col. pa. straw, visc. liq	none		$1.016\text{–}1.018\frac{25}{25}$
308	col. mob. liq	mild and pleas		$0.921\frac{25}{25}$
309	col. mob. liq	mild and pleas		$0.949\text{–}0.952\frac{25}{25}$
310	col. liq	mild and pleas		$0.968\frac{25}{25}$
311	lt. yel. liq	pleas. fruity		$1.093\frac{20}{20}$
312	col. liq	sweetish	98–100	$1.179\text{–}1.184\frac{20}{20}$
313	col. gas		95	$0.364\frac{20}{20}$
314	w. wh. liq	char	99.9	$<.7944\frac{60}{60}$
315	col. liq	char		$0.7905\frac{20}{20}$
316	col.-pa. straw liq	fa. aromatic		$1.149\frac{25}{25}$
317	col. liq	none		$0.9805\frac{20}{20}$
318				$9181\frac{20}{20}$
319	col. liq			$1.0474\frac{20}{20}$
320	liq			$1.0208\frac{20}{20}$
321	lt. yel. powd		tech	1.27
322	w. wh. liq	fruity	99	$0.9000\text{–}0.9030\frac{20}{20}$
323	w. wh. liq	n. res. pleas. fruity	85–88 by wt	$.883\text{–}.888\frac{20}{20}$
324	w. wh. liq	mild, n. res	99–100	$.899\text{–}.902\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
298	Diphenylamine chlorarsine (D M)	182–3	d. 195		
299	Diphenyl	69.4	255		222.8
300	1,1-Diphenylethane	−20		272.1–5%; 274.6–95%	264.2
301	Diphenyl phosphate	50–51			
302	*N,N′*-Diphenyl piperazine	165.7–167.7			
303	Dipropylene glycol		231.8	220–240	280
303a	Di(2-ethylhexyl) succinate	<−60 sets to a glass	257^{50}		315
304	Divinyl benzene				169 (C.O.C.)
305	Dodecylamine	24	125^{10}		
306	" acetate	65	d.		
307	Dowanol 4	12.2	$289\text{–}328^{10}$		314.6
308	" 33 B		120	118–5%; 126–95%	102
309	" 50 B		190	188–5%; 194–95%	182
310	" 62 B		243	238–5%; 247–95%	238
311	Dypnone	<−30 sets to a glass	246^{50}		350
312	Epichlorohydrin	−57	116		105
313	Ethane	−183.2	−88.6		<20
314	Ethanol	−114.4	78.4		65
315	" (200 proof)	−114.4	78.3		70
316	Ether, (4-*tert*-butyl-2-chlorophenyl) (2-chlorethyl)	−20		176.0–5%; 179.8–95%	339.8
317	2-Ethoxymethyl-2,4-dimethyl pentanediol-1,5	<−30	214^{100}		
318	3-Ethoxypropionaldehyde	−69.4	135.2		100
319	3-Ethoxypropionic acid	−10.7	219.0		225
320	Ethoxytriglicol	−18.7	255.4		275
321	Ethylac	69 (min.)			
322	Ethyl acetate (99%)	−83.5	77.1	ent. distillation within 2.0°C range which shall include 77.1	45
323	" "	−83.6	77.1	<70–none; <72–10%; >80–none	23
324	" "	−83.6	77.1	<75–none; >80–none	42

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
298	s. acet., al.; i. w. with slow dec.	antifouling compositions tear gas grenades	drums	K.
299	sl. sl. al.; ∞ CCl_4; i. w.		drums	D.
300	∞ acet., bz., CCl_4, eth., meth. al.; i. w.			D.
301	v. s. al.; s. w.; g per 100 g.: 100 eth., acet., 10 bz., 4 CCl_4			D.
302	g. per 100 g.: 2 meth. al., 2 eth., 3 CCl_4, 7 bz., 4 acet.; i. w.			D.
303	∞ w	high boil. solv. plast., humectant	cans, drums	C. & C.
303a	0.01^{20}% by wt. in w	chem. inter	cans, drums	C. & C.
304	i. w.; s. al., eth	resins, plast., synth. rubbers, synth. dry. oils, ion exchange resins	drums, tank cars	K.
305	∞^{30} al., hexane	synth. inter	drums, tank cars	Arm.
306	% by wt.: -33^{25} w., 12^{30} hexane, 70^{25} al.	mineral concentration, anti-static, corrosion inhibitor	drums	Arm
307	∞ meth. al., isopropyl eth., bz., acet.; s. CCl_4; i. w.			D.
308	∞ acet., bz., CCl_4, eth., meth., V.M.P. naphtha, w.	solvent	drums, tank cars	D.
309	∞ acet., bz., CCl_4, eth., meth. al., V.M.P. naphtha, w.	solvent	drums, tank cars	D.
310	∞ acet., bz., CCl_4, eth., meth. al., V.M.P. naphtha, w.	solvent	drums, tank cars	D.
311	$<0.01^{20}$% by wt. in w	sun screen. agt., odorant, ink and dye solv., plastic	cans, drums, tank cars	C. & C.
312	6 w			S. D.
313	0.04724 vol. gas per vol w	refrigerant; chem. inter	cylinders	C. & C.
314	∞ w.; misc. com. solv	solv. lacq., resins, flavors, oils, chem. syn.	cans, drums, tank cars	U.S.I.
315			cans, drums, tank cars	C. & C.
316	∞ meth. al., eth., CCl_4, bz., acet.; i. w.			D.
317	2.5^{20}% by wt. in w	coupler, blend. agt., plast., soft. solv., inter.	cans	C. & C.
318	∞ w	chem. inter	cans, drums	C. & C.
319	∞ w	pharm. inter	cans, drums	C. & C.
320	∞ w		cans, drums, tank cars	C. & C.
321		rubber vulcanization accelerator	fiber drums	Sh.
322	8.7^{20}% by wt. in w	solv. indust. chem	cans, drums, tank cars	C. & C.
323	misc. et. al., butyl al., acet., $CHCl_3$, CCl_3, 7.6 w.	solv. nitro. lacq., prep. medicines, perfumes, flavors, denaturant.	cans, drums, tank cars	C.S.
324	3.5^{25} w	nitrocellu. solv., syn. bases for org. chem., pharm., flavoring denaturant	cans, drums, tank cars	U.S.I.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
325	Ethyl acetoacetate	diacetic ether; acetoacetic ester	$CH_3COCH_2COOC_2H_5$	130.14
326	" "	ethyl acetoacetate	$CH_3COCH_2COOC_2H_5$	130.14
327	" acrylate	" acrylate	$CH_2{:}CHCOOC_2H_5$	100.11
328	" alcohol 190 proof	" alcohol	CH_3CH_2OH	46.07
329	" "	" "	CH_3CH_2OH	46.07
330	" amine 70%	monoethylamine	$CH_3CH_2NH_2$	45.08
331	Ethylbenzene		C_8H_{10}	106.16
332	"		$C_6H_5C_2H_5$	106.16
333	" (Pure)	ethylbenzene	$C_6H_5CH_2CH_3$	106.16
334	Ethyl benzoylacetate	diethyl benzoylacetate	$(C_6H_5COCH_2COOC_2H_5)$	192.20
335	" borate, 30%	ethyl borate	$(C_2H_5O)_3B$	146.00
336	" bromide	bromoethane	$CH_3{\cdot}CH_2Br$	108.98
337	" bromoacetate	bromoacetic acid, ethyl ester	$C_4H_7BrO_2$	167.01
338	2-Ethylbutanol	2-ethylbutyl alcohol	$(C_2H_5)_2CHCH_2OH$	102.17
339	2-Ethylbutyl "Cellosolve"*	2,2-ethylbutoxy ethanol	$(C_2H_5)_2CHCH_2OC_2H_4OH$	146.22
340	Ethyl *n*-butyl ether	butyl ethyl ether	$C_2H_5OC_4H_9$	102.17
341	" butyl ketone	3-heptanone	$C_2H_5COC_4H_9$	114.18
342	2-Ethyl-2-butyl propanediol-1,3		$HOCH_2C(C_2H_5)(C_4H_9)CH_2OH$	160.25
343	2-Ethylbutyraldehyde	diethyl acetaldehyde	$(C_2H_5)_2CHCHO$	100.16
344	2-Ethylbutyric acid	2 ethylbutanoic acid	$(C_2H_5)_2CHCOOH$	116.16
345	Ethyl chloride	chloroethane	CH_3CH_2Cl	64.52
346	" "	ethyl chloride	CH_3CH_2Cl	64.52
347	" chloroacetate	chloroacetic acid, ethyl ester	$ClCH_2COOCH_2CH_3$	122.55
348	" chloroformate	ethyl chloroformate	$ClCOOC_2H_5$	108.53
349	" cyanoacetate	cyanoacetic acid	$CH_2CNCOOC_2H_5$	113.11
350	*N*-Ethyl diethanolamine	2,2′-ethylaminodiethanol	$CH_3CH_2N(CH_2CH_2OH)_2$	133.19

* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
325	col. liq		97.5	$1.0261\frac{20}{20}$
326	almost w. wh	mild	96	$1.027–1.030\frac{20}{20}$
327	cl. col. liq			$0.9230\frac{20}{20}$
328	col. liq	char. mild	95	0.8158 max 60/60°F
329	liq	mild, n. res	99.9	$0.7944\frac{15.56}{15.56}$
330			70	$.79\frac{20}{20}$
331	cl. col. mobile liq			$0.869–0.871\frac{60}{60}$
332	APHA (15 max.)	aromatic	99 min.	0.870
333	col. flam. liq		99 min.	$0.867\frac{20}{4}$
334	lt. yel. liq	char.	95.5	$1.111–1.117\frac{20}{20}$
335	col. liq		98–100	0.864
336	cl. col. vol. liq	pleasant		$1.452\frac{25}{25}$
337	cl. to straw-colored liq	mildly sw. odor becomes sharp and stinging and irritating to eyes		$1.505\frac{25}{25}$
338	col. liquid	mild	99	$0.8328\frac{20}{20}$
339	liq			$0.8954\frac{20}{20}$
340	liq			$0.7528\frac{20}{20}$
341	w. wh. liq	pleas		$0.8197\frac{20}{20}$
342	w. cr. sld			$0.931\frac{50}{20}$
343	col. liq		90	$0.8164\frac{20}{20}$
344	w. wh. liq	faint	95	$0.9225\frac{20}{20}$
345	cl. col. mobile volatile liq	mildly sw. ethereal odor and burning taste		$0.922\frac{0}{4}$
346	col. liq	char. v. sl		$0.922–0.925\frac{0}{4}$
347	cl. col. liq	irritating to eyes and mucous membrane	97	$1.140–1.150\frac{25}{25}$
348	w. wh. liq	irritating, tear producing	96	$1.135–1.139\frac{20}{20}$
349	col. liq	sweetish, ester-like	95	$1.060\frac{25}{25}$
350				$1.0156\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
325	Ethyl acetoacetate	−43.3	180.7	<96–5%; >110–none	185
326	" "		180		171
327	" acrylate	−72.0	99.4		60
328	" alcohol 190 proof	−114.4	78.2	78.0–78.3	
329	" "	−112	78.3		*ca* 57
330	" amine 70%			30 to 100	<0.0
331	Ethylbenzene			135.6–5%; 136.1–95%	87.8
332	"			range of 1.2°C to include 136.19	185
333	" (Pure)	−95.0	136.2		
334	Ethyl benzoylacetate		146^{10}	$<114^{10}$–none; $>148^{10}$–none	285
335	" borate, 30%	−86.6	120.0	112–121	65
336	" bromide	−119	38.4		none
337	" bromoacetate		158.8		
338	2-Ethylbutanol		148.9	<140–none; >160–none; <145–5%; <155–95%	135
339	2-Ethylbutyl "Cellosolve"*	−90 sets to a glass	196.8		180
340	Ethyl *n*-butyl ether	−103	92.2		40
341	" butyl ketone	−36.7	147.8		115
342	2-Ethyl-2-butyl propanediol-1,3	41.4	178 (50 mm)		
343	2-Ethylbutyraldehyde	−89.0	116.8	80–135	70
344	2-Ethylbutyric acid	−9.4	194.0	190–200	210
345	Ethyl chloride	−139	12.2	12.0–13.0	
346	" "				
347	" chloroacetate	<−20		141–5%; 145–95%	149
348	" chloroformate	−80.6	95		82
349	" cyanoacetate	<−20		205.3–5%; 209.1–95%	230
350	*N*-Ethyl diethanolamine		252.6		280

* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
325	11.6^{20}% by wt. in w.	inter., dyes, pharm., optical bleaches, stabilizers	cans, drums	C. & C.
326	4.8^{25} w	mfg. dyes, pharm	bottles, cans, drums	U.S.I.
327	2.0^{20}% by wt. in w	mfr. of poly. and copoly; chem. inter.	cans, drums, tank cars	C. & C.
328	∞ w.; misc. common solv	solv., org. inter	drums, tank cars	S.C.
329	misc., w., most org. liq	solv. lacq., varnishes, flavors, raw mat. in chem. syn.	bottles, drums, cans, tank cars	C.S.
330		chem. inter	cans, drums, tank cars	C. & C.
331	∞ al., bz., CCl_4, eth.; i. w	solv. for use as an anti-knock agt.	drums	D.
332	i. w., s. al., eth	solvent, chem. inter	drums, tank cars	K.
333		solv. org. syn., motor fuel research	bottles, cans, drums	P.P.
334	misc. com. org. solv	dye inter	cans, drums	U.S.I.
335	d. w	chem. syn., indust. solv	drums	C. & C.
336	∞ al., CCl_4, chloroform, eth.; i. w.	org. syn	drums	D.
337	∞ al., CCl_4, eth.; i. w	tear gas	5 gal. carboys	D.
338	0.43^{20}% by wt. in w	lacq., synth. resin, varnishes	cans, drums, tank cars	C. & C.
339	1.2^{20}% by wt. in w	high boiling solvent	cans, drums	C. & C.
340	0.44^{20}% by wt. in w	extr., inert reaction medium	cans, drums	C. & C.
341	1.43^{20}% by wt. in w	solv. applications, pharm., dyestuffs, dewaxing lubr. oils and nat. gums; chem. inter.	cans, drums, tank cars	C. & C.
342	8^{20}% by wt. in w	insect. repellent formulations, prep. of plast., synth. lubr. emulsifying agts.	cans, drums	C. & C.
343	0.4^{20}% by wt. in w	prep. of pharm., rubber accel., synth. resins	cans, drums	C. & C.
344	0.22^{20}% by wt. in w	inter. drugs, dyes	cans, drums	C. & C.
345	g. per 100 g. at 25°C.: 48.3 al., 21°C.; ∞ CCl_4, eth.; 0.57 w. at 20°C.	anaesthetic	cylinders, barrels	D.
346	0.8 at 25°C w	org. inter	tank cars	S.C.
347	g. per 100 g. at 25°C.: ∞ acet., bz., CCl_4, eth., *n*-heptane, meth. al., <0.1 w.	solv. in org. syn	1 gal. bottles, carboys, drums	D.
348	d. w	flotation agt.; diethyl carbonate inter.	glass	U.S.I.
349	∞ acet., bz., CCl_4, eth., meth. al.	org. syn	cans, drums	D.
350	∞ w	chem. inter	cans, drums	C. & C.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
351	*x*-Ethyl diphenyl ether	*x*-ethyl diphenyl ether	$C_6H_5OC_6H_4C_2H_5$	198.25
352	*N*-Ethyl ethanolamine		$C_2H_5NHC_2H_4OH$	89.14
353	Ethyl ether	ethyl oxide; diethyl ether	$C_2H_5OC_2H_5$	74.12
354	" ether, A.C.S.	ethyl ether (sulphuric ether)	$(C_2H_5)_2O$	74.12
355	" -3-ethoxypropionate		$C_2H_5OCH_2CH_2COOC_2H_5$	146.18
356	" formate	ethyl formate	$HCOOC_2H_5$	74.08
357	2-Ethylhexaldehyde	2-ethyl hexanol	$C_4H_9CH(C_2H_5)CHO$	128.21
358	2-Ethylhexanediol-1,3	octylene glycol	$CH_3(CH_2)_5CH(OH)CH_2OH$	146.22
359	2-Ethylhexanol	2-ethyl hexyl alcohol	$C_4H_9CH(C_2H_5)CH_2OH$	130.23
360	2-Ethylhexoic acid	2-ethylhexanoic acid	$C_4H_9CH(C_2H_5)COOH$	144.21
361	2-Ethylhexyl acetate	2-ethylhexyl ethanoate	$CH_3COOCH_2CH(C_2H_5)C_4H_9$	172.26
362	" acrylate		$CH_2:CHCOOCH_2CH(C_2H_5)C_4H_{19}$	184.25
363	" amine		$C_4H_9CH(C_2H_5)CH_2NH_2$	129.24
364	2-Ethylhexyl "Cellosolve"*	2-(2-ethylhexoxyethanol)	$C_{10}H_{22}O_2$	174.28
365	" chloride		$C_4H_9CH(C_2H_5)CH_2Cl$	148.67
366	" ether		$[C_4H_9CH(C_2H_5)CH_2]_2O$	242.43
367	Ethylidene diacetate	ethylidene diacetate	$CH_3CH(OCOCH_3)_2$	146.08
368	" dichloride	1,1-dichloroethane	CH_3CHCl_2	98.97
369	Ethyl lactate	ethyl lactate	$CH_3CHOHCOOC_2H_5$	118.13
370	" "	" "	$CH_3CHOHCOOC_2H_5$	118.13
371	*N*-Ethyl morpholine		$C_2H_4OC_2H_4NCH_2CH_3$	115.17
372	*p*-Ethyl phenol	*p*-ethyl phenyl	$OHC_6H_4C_2H_5$	122.16
373	Ethyl phenyl ether	phenetole	$C_6H_5OC_2H_5$	122.16
374	2-Ethyl-3-propylacrolein	2-ethyl-3-propylacrolein	$CH_3C_2H_4CH:C(C_2H_5)CHO$	126.19
375	2-Ethyl-3-propylacrylic acid		$C_8H_{14}O_2$	142.19
376	Ethyl sodium oxalacetate	sodium ethyl oxalacetate	$C_2H_5OOCC(ONa)CHCOOC_2H_5$	210.17
377	Ethylene		$CH_2:CH_2$	28.05

* Trade mark.

No.	Physical form and color	Odor	Purity %	Sp. gr.
351	lt. grn.-yel. liq	pleas. aromatic		1.032^{25}_{25}
352	liq			0.9182^{20}_{20}
353	w. wh. flam. liq	ethereal	99–100	0.7146^{20}_{20}
354	w. wh. liq	char., n. res	99.7	$<.7100^{20}_{20}$
355				0.9496^{20}_{20}
356	w. wh. liq	pleas. aromatic	95–100 by wt	$.900-.930^{20}_{20}$
357	liq		90	0.8205^{20}_{20}
358	col. liq			0.9422^{20}_{20}
359	col. liq	mild	99	0.8340^{20}_{20}
360	liq	mild	95–100	0.9077^{20}_{20}
361	col. liq			0.8734^{20}_{20}
362	liq			0.8869^{20}_{20}
363	w. wh. liq	sl. amm		0.7894^{20}_{20}
364	liq			0.8859^{20}_{20}
365	w. wh. liq	mild		0.8833^{20}_{20}
366				0.8121^{20}_{20}
367	w. wh. liq	heavy, pleas. char	90.0+	
368	col. liq	sweet		$1.170-1.172^{25}_{25}$
369	w. wh. liq	mild, n. res	96–100	$1.020-1.036^{20}_{20}$
370	w. wh. liq	mild, n. res	96	$1.020-1.036^{20}_{20}$
371	col. liq			0.9143^{20}_{20}
372	dk.-strawcolored cr. sld	phenolic odor		$.984^{60}_{25}$
373	col. refractive liq	pleas. char		$.964^{25}_{25}$
374	yel. liq	powerful	90	0.8518^{20}_{20}
375	liq			0.9484^{20}_{20}
376	lt. yel. fine gran. powd	none	92	
377	col. gas	fa., pleas	96	0.3433^{20}_{20}

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
351	*x*-Ethyl diphenyl ether	<−20		159.5–5%; 166.5–95%	294.8
352	*N*-Ethyl ethanolamine	−7.8	167.1	163–169	160
353	Ethyl ether	−116.3	34.5		−40
354	" ether, A.C.S.	−116.3	34.5		<10
355	" -3-ethoxypropionate	−100 sets to a glass	170.1		
356	" formate	−80.5	54.3	<51–none; >55–none	−2.2
357	2-Ethylhexaldehyde		163.4	150–185	125
358	2-Ethylhexanediol-1,3	<−40 sets to a glass	244.2		265
359	2-Ethylhexanol		183.5	<180–none; >190–none	185
360	2-Ethylhexoic acid	−118.1	226.9	220–230	260
361	2-Ethylhexyl acetate		198.6	192–205	190
362	" acrylate	−90	130 (50 mm)		180
363	" amine		169.2		140
364	2-Ethylhexyl "Cellosolve"*		228.3		230
365	" chloride	−135	172.9		140
366	" ether	<−95 sets to a glass	269.4		235
367	Ethylidene diacetate		166		
368	" dichloride	−96.7		57.2–5%; 57.4–95%	19.94
369	Ethyl lactate	−25	154	<102–none; >173–none	145
370	" "		153.9	<102–none; >173–none	129
371	*N*-Ethyl morpholine	−63	138.0		100
372	*p*-Ethyl phenol	37		216.6–5%; 219.3–95%	219.2
373	Ethyl phenyl ether	<−20		169–171	145.4
374	2-Ethyl-3-propylacrolein	−100 sets to a glass	175	85–185	155
375	2-Ethyl-3-propylacrylic acid	−7.8	232.1		
376	Ethyl sodium oxalacetate				
377	Ethylene	−169.1	−103.88		<20

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* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
351	∞ meth. al., eth., CCl_4, bz., acet.; i. w.			D.
352	∞ w.	prep. of surface-active agt., dyes, pharm., insect., fungicides	cans, drums	C. & C.
353	6.9^{20}% by wt. in w	solv. denaturant extr.	drums, tank cars	C. & C.
354	0.9^{25} w.	lab. agt., solv. synth. base dry-cleaner, denaturant	drums	U.S.I.
355	1.6^{20}% by wt. in w	chem. inter	cans	C. & C.
356	9.15^{20} w.	fumigant, larvicide, synth. flavor prep., medicine	cans, drums	C.S.
357	$<0.02^{20}$% by wt. in w	prep. dyes, flavors, perfumes, synth. resins, rubber accelerators	cans, drums	C. & C.
358	4.2^{20}% by wt. in w	plast., soft. coup. agt., solv. chem. inter.	cans, drums	C. & C.
359	0.10^{20}% by wt. in w.	inter. for plast., defoaming agt., solv. synth. gums, waxes, resins, wetting agt.	cans, drums	C. & C.
360	0.25^{20}% by wt. in w	org. syn., metallic driers for paints and enamels	cans, drums, tank cars	C. & C.
361	$<0.03^{20}$% by wt. in w	solv. nitro., lacq	cans, drums, tank cars	C. & C.
362	$<0.01^{20}$% by wt. in w	Poly. in adhesives, paper treat., specialty rubbers, textile processing protective coatings	cans, drums	C. & C.
363	0.25^{20}% by wt. in w	chem. inter.; source of ethylhexylamine group	cans, drums	C. & C.
364	0.09^{20}% by wt. in w.		cans	C. & C.
365	$<0.1^{20}$% by wt. in w	solv. for oils, fats, waxes. Inter. for surface active agt., alkylating agt.	cans, drums	C. & C.
366	$<0.1^{20}$% by wt. in w	solvent	cans, drums	C. & C.
367	5% w.	inter. anhydride mfg., acetylating agt., solv.	steel drums	S.C.L.
368	∞ meth. al., eth., CCl_4, bz., acet.; v. sl. s. w.			D.
369	∞ w.	solvent	cans, drums	C.S.
370	∞^{25} w.	cellu. nitrate solv., cellu. acetate solv., resins solv.	cans, drums	U.S.I.
371	∞	solv. for waxes, resins and oils; chem. inter.	cans	C. & C.
372	∞ meth. al., eth., CCl_4, bz., acet.; v. sl. s. w.			D.
373	∞ bz., acet., CCl_4, eth., meth. al.; i. w.			D.
374	0.07^{20}% by wt. in w	warning agt., insect	cans, drums	C. & C.
375	$.02^{20}$% by wt. in w	pharm. inter.; prep. of resins, plast., and lubr.		C. & C.
376	d. w	mfg. dyes	barrels	U.S.I.
377	0.122 vol. gas per vol. w.	coloring accel. for matured citrus fruits, tomatoes, bananas, melons	cylinders	C. & C.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
378	Ethylene carbonate		$C_3H_4O_3$	88.06
379	“ chlorhydrin anhydrous	2-chloroethanol	$ClCH_2CH_2OH$	80.52
380	“ chlorobromide	1-bromo-2-chloroethane	$CH_2Cl{\cdot}CH_2Br$	143.43
381	“ diamine	ethylene diamine	$H_2NC_2H_4NH_2$	60.10
382	“ dibromide		$CH_2Br{\cdot}CH_2Br$	187.88
383	“ dichloride	ethylene chloride; 1,2-dichloroethane; glycol dichloride	$ClCH_2CH_2Cl$	98.97
384	“ glycol	ethylene glycol; ethanediol-1,2-glycol	$HOCH_2CH_2OH$	62.07
385	“ glycol monostearate	ethylene glycol monostearate	$HOCH_2CH_2OOC(CH_2)_{16}CH_3$	328.52
386	“ “ silicate	“ “ silicate	$(HOCH_2CH_2O)_4Si$	272.30
387	“ oxide	“ oxide	$\underbrace{CH_2CH_2O}$	44.05
388	“ thiourea	(2-imidazolidine thione)	$C_3H_6N_2S$	102.2
389	“Flexol”* Plasticizer A-26	di(2-ethylhexyl) adipate	$C_4H_9(C_2H_5)CHCH_2OCOC_4H_8$-$COOCH_2CH(C_2H_5)C_4H_9$	370.56
390	“Flexol”* Plasticizer DHP	di(*n*-hexyl) phthalate	$C_6H_4(COOCH_2C_4H_8CH_3)_2$	334.4
391	“Flexol”* Plasticizer DOP	di(2-ethylhexyl) phthalate	$C_6H_5[COOCH_2CH(C_2H_5)C_4H_9]_2$	390.54
392	“Flexol”* Plasticizer 2GB	diethylene glycol, dibenzoate	$C_6H_5COOCH_2CH_2OCH_2CH_2$-$OCOC_6H_5$	290.30
393	“Flexol”* Plasticizer 3GH	triglycol di(2-ethylbutyrate)	$C_5H_{11}COOC_2H_4(OC_2H_4)_2$-$OOCC_5H_{11}$	346.46
394	“Flexol”* Plasticizer 3GO	triglycol di(2-ethylhexoate)	$C_7H_{15}COOC_2H_4(OC_2H_4)_2$-$OOCC_7H_{15}$	402.56
395	“Flexol”* Plasticizer 4GO	polyethylene glycol, 200 di(2-ethyl hexoate)	$C_7H_{15}COOCH_2(CH_2OCH_2)_x$-$CH_2OCOC_7H_{15}$	466.6
396	“Flexol”* Plasticizer 8HP	di(2-ethylhexyl tetratrihydrophthalate	$C_6H_8(COOC_8H_{17})_2$	394.58
397	“Flexol”* Plasticizer TOF	tri(2-ethylhexyl) phosphate	$[C_4H_9CH(C_2H_5)CH_2O]_3P{=}O$	434.6
398	Fumaric acid		$HOOCCH{:}CHCOOH$ (trans.)	116.07
399	Furan	furfuran	$\underbrace{OCH{:}CHCH{:}CH}$	68.07
400	Furfural	furfural; 2-furancarbonal	$C_4H_3O{\cdot}CHO$	96.08
401	Furfuryl alcohol	furfuryl alcohol; 2-furylcarbinol	$C_4H_3O{\cdot}CH_2OH$	98.10
402	Fusel oil	isoamyl alcohol	$C_5H_{11}OH$	88.15
403	Gelvatol	polyvinyl alcohol	$CH_3CHOH(CH_2CHOH)n$	....

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* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
378	wh. cr. sld			true density 1.322 g/ml. at 20°
379	w. wh. liq	fa. ethereal	98	1.2045_{20}^{20}
380	cl. col. volatile liq	sweet		1.720_{25}^{25}
381	liq	mildly ammon		0.8995_{20}^{20}
382	cl. col. heavy liq	sweet char		2.172_{25}^{25}
383	col. liq	chloroform-like	99	1.2554_{20}^{20}
384	w. wh. liq	mild, n. res		1.1155_{20}^{20}
385	solid cream	fa., fatty	tech	0.96
386	col. liq			
387	col. gas; col. liq.; low temp	pleas. agreeable		0.8711_{20}^{20}
388	fine cr. wh. to pa. green powd		97.5	
389	liq			0.9268_{20}^{20}
390	liq			1.0074_{20}^{20}
391	liq.; wax col. 50 Pt-Co	mild, sl. aromatic	98	0.9861_{20}^{20}
392	liq			1.1765_{20}^{20}
393	liq	mild	98.5	0.9946_{20}^{20}
394	liq	mild	98.5–100	0.9679_{20}^{20}
395				0.9892_{20}^{20}
396	liq			0.9685_{20}^{20}
397	liq			0.9262_{20}^{20}
398	wh. cr. sld			
399	col. liq	like pet. ether		0.937_{4}^{20}
400	yel.-amber liq	pungent aromatic	99+	1.161_{20}^{20}
401	yel.-dk. amber liq	mild	>95	1.130_{25}^{25}
402	w. wh. liq	n. res		$.811–.815_{20}^{20}$
403	wh. powd	none	96	1.329

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
378	Ethylene carbonate	35.7	156 (50 mm)		
379	" chlorhydrin	−62.6	128.7	122–135	140
380	" anhydrous chlorobromide	−18.4	106.1		none
381	" diamine	10.8	117.2	<115–none; >122–none	110
382	" dibromide	9.3	131.5		none
383	" dichloride	−35.5	83.5	<82.5–none; >84–none	70
384	" glycol	−13.0		193–210	240
385	" " mono-stearate	57–60			
386	" " silicate				
387	" oxide	−111	10.7		<0
388	" thiourea	191 (min)			
389	"Flexol"* Plasticizer A-26	−60	214 (5 mm)		385
390	"Flexol"* Plasticizer DHP	−58**	220^5		375
391	"Flexol"* Plasticizer DOP	−46**	230^5		425
392	"Flexol"* Plasticizer 2GB	15.9	236.0 (5 mm)		555
393	"Flexol"* Plasticizer 3GH	−65**	197^5		385
394	"Flexol"* Plasticizer 3GO	−55	218^5		405
395	"Flexol"* Plasticizer 4GO	−55**	215–290^5	not more than 1.0 by wt. distil. in 30 min. at 200°C	395
396	"Flexol"* Plasticizer 8HP	−50**	219^5		350
397	"Flexol"* Plasticizer TOF	−74**	216^5		405
398	Fumaric acid	284	290		
399	Furan		32		below room temp.
400	Furfural	−36.5	161.7	157–167 (99+%)	140.0
401	Furfuryl alcohol	−20	170^{760}	167–177 (95%)	167
402	Fusel oil			<110–none; >135–none	123
403	Gelvatol	none, dec. over 200°C	none		>392

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* Trade mark.
** Pour pt. (approx. 50,000 centistokes).

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
378	∞ at 40°	solv. for polymide resins, and aromatic polyesters; in situ source of ethylene oxide	cans, drums	C. & C.
379	∞ w.	chem. syn.	cans, drums, tank cars	C. & C.
380	∞ al., CCl_4, eth.; w.^{30} 0.69, w.^{80} 0.7	org. syn.	drums	D.
381	∞ w.	inter., fungicidal chem., pharm., thermoplastic resins	cans, drums	C. & C.
382	g. 100 g.: s. al. at 25°, ∞ CCl_4, eth. at 25°C; 0.43 w.	solv. for celluloid	drums, tank cars	D.
383	0.81^{20}% by wt. in w.	solv. for oils, fats, waxes, extr. spotting agt.	cans, drums, tank cars	C. & C.
384	∞ w.	prep of esters, liq. coolant	cans, drums tank cars	C. & C.
385	i. w.; s. hot al., acet., hydrocarbons	stabilizer, emulsifier	cans, drums	G.
386	∞ w.		research quantity	C. & C.
387	∞ w.	fumigant, org. syn. inter.	cylinders, tank cars	C. & C.
388	s. in warm acet. acid; sl. s. cold acet. acid, w. meth. al, acet. i. ethyl ether, bz., hexane, ethyl acetate	antioxidant, inter. in syn.	fiber drums	Sh.
389	i. w.	primary plast. for vinyl chloride-copolymer resins	cans, drums, tank cars	C. & C.
390	i. w.	vinyl plast.; strong solv. action on resins at high temperature, aids hot processing	cans, drums, tank cars	C. & C.
391	i. w.	basic plast. for vinyl resins, exc. elect. prop.	cans, drums, tank cars	C. & C.
392	i. w.	plast. for vinyl chloride resins.	cans, drums	C. & C.
393	0.02^{20}% by wt. in w.	plast. for vinyl butyral resin, for safety glass interlayer	cans, drums, tank cars	C. & C.
394	i. w.	plasticizer	cans, drums, tank cars	C. & C.
395	i. w.	vinyl plast. nitro. lacq.	cans, drums tank cars	C. & C.
396	i. w.	vinyl plasticizer	cans, drums, tank cars	C. & C.
397	i. w.	vinyl plast. that gives excellent low temp. flex. resist to w. extr.	cans, drums, tank cars	C. & C.
398	0.5^{20}% by wt. in w.	copoly.; inter. for surface active agts.	cans, drums	C. & C.
399	i. w., s. al., eth.	plasticizer		Q.O.
400	∞ al., eth., 8.3^{20} w.	solv. resins, org. syn.	cans, drums, tanks	Q.O.
401	∞ al., eth., w.	solv. resins, wetting agt.	cans, drums, tanks	Q.O.
402	misc. com. org. solv.	lacq.	cans, drums, tank cars	U.S.I.
403	s. 35–40% cold w. ∞ s. hot w.	sizes, coatings, chem. resistant tubing	100 lb. fiber keg	S.C.L.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
404	Glaurin	diethylene glycol monolaurate	$C_{11}H_{23}COOC_2H_4OC_2H_4OH$	288.42
405	*α-d*-Glucose pentaacetate	*α-d*-glucose pentaacetate	$C_{16}H_{22}O_{11}$	390.34
406	*β-d*-glucose pentaacetate	*β-d*-glucose pentaacetate	$C_{16}H_{22}O_{11}$	390.34
407	Glucose pentabutyrate	glucose pentabutyrate	$C_{26}H_{42}O_{11}$	530.60
408	" pentapalmitate	glucose pentapalmitate	$C_{86}H_{162}O_{11}$	1372.17
409	" pentapropionate	glucose pentapropionate	$C_{21}H_{32}O_{11}$	460.47
410	Glucuronolactone (Argo brand)	glucofururono-γ-lactone; glycurone	$\underbrace{C_5H_8O_4COO}$	176.12
411	Glycerin dichlorohydrin	glycerin dichlorohydrin	$CH_2ClCHClCH_2OH$	128.99
412	" , synthetic	glycerin	$CH_2OHCHOHCH_2OH$	92.09
413	Glycerol dichlorhydrin	1,3-dichloro-2-propanol	$CH_2ClCHOHCH_2Cl$	128.99
414	Glyceryl laurate	glyceryl laurate	$CH_2OHCHOHCH_2OOC(CH_2)_{10}CH_3$	274.39
415	" monooleate	" monooleate	$CH_2OHCH_2OHCH_2OOC(CH_2)_7CH{:}CH(CH_2)_7CH_3$	357.54
416	" monoricinoleate	" monoricinoleate	$CH_2OHCHOHCH_2OOC(CH_2)_7CHCHCH_2CHOH(CH_2)_5CH_3$	372.53
417	" monostearate	" monostearate	$CH_2OHCHOHCH_2OOCC_{17}H_{35}$	358.55
418	" myristate	" myristate	$CH_2OHCHOHCH_2OOC(CH_2)_{12}CH_3$	302.45
419	" palmitate	" palmitate	$CH_2OHCHOHCH_2OOC(CH_2)_{14}CH_3$	330.5
420	Glycol diacetate	ethylene acetate; ethylene glycol diacetate	$(CH_3COO)_2C_2H_4$	146.14
421	" diformate	ethylene glycol diformate	$HCOOCH_2CH_2OCOH$	118.09
422	Heptadecanol	3,9 diethyl tridecanol-6	$C_4H_9CH(C_2H_5)C_2H_4CH(OH)C_2H_4CH(C_2H_5)_2$	256.46
423	Heptane	*n*-heptane	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	100.20
424	*n*-Heptane, Pure	*n*-heptane	C_7H_{16}	100.20
425	Heptanol-3	3-heptanol	$CH_3CH_2CH(OH)C_4H_9$	116.2
426	Heptene-2, Pure	2-heptene	C_7H_{14}	98.18
427	Heptene-3, Technical	3-heptene	C_7H_{14}	98.18
428	Heptyl-3 "Cellosolve"*		$C_9H_{20}O_2$	160.25
429	Hexachlorocyclohexa-2, 5-diene-1-one	hexachlorophenol	$Cl_2C_6Cl_4{:}O$	300.80
430	Hexadecylamine	hexadecylamine	$C_{10}H_{33}NH_2$	241.45
431	*n*-Hexaldehyde	caproaldehyde; *n*-hexoic-aldehyde	$CH_3CH_2CH_2CH_2CH_2CHO$	100.16
432	Hexamethyl mannitol	hexamethyl ether of mannitol	$C_6H_8O_6(CH_3)_6$	266.33
433	" sorbitol	hexamethyl ether of sorbitol	$C_6H_8O_6(CH_3)_6$	266.33

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* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
404	lt. yel. oily liq	pleas		0.97
405	sld			
406	sld			
407	visc. oil			
408	waxy sld			
409	visc. oil			
410	cr. wh	none	>99	1.76_{4}^{30}
411	col. liq	fa. chloroform-like	95	1.362_{4}^{20}
412	col. visc. liq	char. mild	99–100	$1.263^{60°F}$
413	dk. amber-colored liq	char. chlorohydrin-like		1.351_{25}^{25}
414	cream-colored semi-sld	v. faint		0.97_{25}^{25}
415	soft sld. yel	fa. fatty	tech	0.95
416	yellow oily liq	faint	tech	1.01
417	wh. beads	faint, fatty	tech	0.97_{20}^{20}
418	lt. colored, wax-like sld	v. faint	tech	0.954^{44}
419	cream-colored, wax-like sld	faint, fatty	tech	0.916^{57}
420	w. wh. liq	mild	98	1.1063
421	liq			1.2277_{20}^{20}
422	liq	mild		0.8475_{20}^{20}
423	liq			0.6845_{20}^{20}
424	col. flam. liq		99 min	0.684_{4}^{20}
425	liq			0.8224_{20}^{20}
426	col. flam. liq		99 min	0.709_{4}^{20}
427	col. flam. liq		95 min	0.702_{4}^{20}
428				0.8855_{20}^{20}
429	wh.-grayish yel. cr. powd	pung. char		
430	wh. sld	amm	90	0.80^{40}
431	col. liq	sharp aldehyde	90	0.8156_{20}^{20}
432	col.-pa. yel. liq	sl. ethereal		1.02
433	col. pa. yel. liq	sl. ethereal		1.02

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
404	Glaurin	16–19	>280		
405	α-*d*-Glucose pentaacetate	112–113			
406	β-*d*-Glucose pentaacetate	131–132			
407	Glucose pentabutyrate		$228^{1.5}$		
408	" pentapalmitate	*ca* 70			
409	" pentapropionate		205^{2}		
410	Glucuronolactone (Argo brand)	167–172			
411	Glycerin dichlorohydrin		182		200
412	" , synthetic				
413	Glycerol dichlorhydrin	<−20		78–5%; 104–95%	195.8
414	Glyceryl laurate	20–25			
415	" monooleate	26–30			
416	" monoricinoleate	<−20			
417	" monostearate	57–61			
418	" myristate	47–48			
419	" palmitate	54–55			
420	Glycol diacetate	41.5	190.5	183–195	205
421	" diformate	−10	177.1		200
22	Heptadecanol		309.0		310
423	Heptane	−90.595	98.43		30
424	*n*-Heptane, Pure	−90.7	98.4		
425	Heptanol-3	−70	156.2		140
426	Heptene-2, Pure		98.49		
427	Heptene-3, Technical			95.7–95.8	
428	Heptyl-3 "Cellosolve"*	<−80 sets to a glass	212.7	200–216	205
429	Hexachlorocyclohexa-2,5-diene-1-one	104.9–105.9			
430.	Hexadecylamine	38	132^{1}		
431	*n*-Hexaldehyde	−56.3	128.7	90–150	90
432	Hexamethyl mannitol	7	134.6^{10}		
433	" sorbitol	0	$134–6^{10}$		

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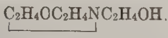
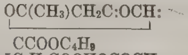
* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
404	s. al., hydrocarbons; i. w.	emulsifying, lubricant, plasticizer, solvent.	cans, drums	G.
405	s. eth., acet., bz.; i. w., pet. eth., $CHCl_3$			C.P.
406	s. eth., bz., acet., CCl_4; i. w., pet. eth.			C.P.
407	s. ethanol, meth. al., $CHCl_3$			C.P.
408	i. w			C.P.
409	s. $CHCl_3$, eth., al., meth. al.; i. w.			C.P.
410	s. w. 25.9^{25}, s. al. 0.7^{25}	pharm	glass jars	C.P.
411	13 w			S.C.
412	∞ w., al	inter., pharm., solvent	drums, tank cars	S.C.
413	∞ acet., bz., CCl_4, eth., meth. al., 12 w.			D.
414	disp. w.; s. al., veg. oils; i. hydrocarbons	emulsifying, disp. agt	cans, drums	G.
415	i. w.; s. al., eth., ketones, esters	emulsifier	cans, drums	G.
416	disp. w.; s. al., veg. oils, hydrocarbons	emulsifying agt	cans, drums	G.
417	disp. w.; s. h. al., hydrocarbons, oils	emulsifying, thick, disp. agt	drums, slabs	G.
418	disp. h. w.; s. h. al., hydrocarbons, oils	emulsifying, thick agt	drums, slabs	G.
419	disp. h. w.; s. h. al., hydrocarbons, oils	emulsifying, thick, disp. agt	drums, slabs	G.
420	16.4^{20}% by wt. in w	solv. inks, lacq., perfume fix	cans, drums	C. & C.
421	d. w	in reactions requir. grad. liberation of formic acid	cans, drums	C. & C.
422	$<0.02^{20}$% by wt. in w	perf. fix., inter. for plasticizers, and surface active agt.	cans, drums	C. & C.
423	$<0.01^{20}$% by wt. in w		cans, drums	C. & C.
424		motor fuel research, solvent, org. syn.	cans, drums, tank cars	P.P.
425	0.45^{20}% by wt. in w	flotation frother, solv. and dilutent in coatings, inter.	cans, drums, tank cars	C. & C.
426		org. syn	bottles, cans	P.P.
427		org. syn	bottles, cans	P.P.
428	0.60^{20}% by wt. in w	solvent	cans	C. & C.
429	s. al., ethylene dichloride $CHCl_3$ monochlorobz., pet.-eth.; i. w.			D.
430	64.8^{30} hexane, 239^{30} al	synth. inter. for mfg. cationic surface-active agts., germicides	drums, tank cars	Arm.
431	0.6^{20}% by wt. in w	org. syn	cans, drums	C. & C.
432	∞ w., org. solv	solubilizer blending agt		At.
433	∞ w., org. solv	solubilizer blending agt		At.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
434	*n*-Hexane, Pure	*n*-hexane	C_6H_{14}	86.17
435	Hexanediol-2,5		$CH_3CH(OH)CH_2CH_2CH(OH)\text{-}CH_3$	118.17
436	Hexanetriol-1,2,6		$HOCH_2CH(OH)CH_2CH_2CH_2\text{-}CH_2OH$	134.17
437	*n*-Hexanol	capryl alcohol hexyl alcohol	$CH_3(CH_2)_4CH_2OH$	102.17
438	Hexene-1, Pure	1-hexene	C_6H_{12}	84.16
439	Hexene-2, Technical	2-hexene	C_6H_{12}	84.16
440	*n*-Hexyl amine		$C_6H_{13}NH_2$	101.19
441	*n*-Hexyl "Carbitol"*	*n*-hexylether of diethylene glycol	$C_{10}H_{21}O_3$	190.28
442	*n*-Hexyl "Cellosolve"*	*n*-hexylether of ethylene glycol	$C_6H_{13}OCH_2CH_2OH$	146.22
443	*n*-Hexyl ether	di-*n*-hexyl ether	$C_6H_{13}OC_6H_{13}$	186.33
444	Hexylene glycol	2-methyl-2,4-pentanediol	$CH_3CCH_3OHCH_2CHOHCH_3$	118.17
445	" "	hexylene glycol	$(CH_3)_2C(OH)CH_2CH(OH)CH_3$	118.17
446	Hydroxyacetic acid	glycolic acid	$OHCH_2COOH$	76.05
447	*p*-Hydroxybenzaldehyde	*p*-hydroxybenzaldehyde	OHC_6H_4CHO	122.12
448	*p*-Hydroxybenzoic acid	*p*-hydroxybenzoic acid	OHC_6H_4COOH	138.12
449	*p*-Hydroxybenzoic acid, ethyl ester	ethyl-*p*-hydroxybenzoate	$OHC_6H_4COOC_2H_5$	166.17
450	*p*-Hydroxybenzoic acid, methyl ester	methyl-*p*-hydroxybenzoate	$OHC_6H_4COOCH_3$	152.14
451	4-Hydroxybenzophenone	4-hydroxybenzophenone	$C_6H_5COC_6H_4OH$	198.21
452	*N*-Hydroxyethyl morpholine		 $C_2H_4OC_2H_4NC_2H_4OH$	131.17
453	*N*-Hydroxyethyl propylene diamine		$CH_3CH(NHC_2H_4OH)CH_2NH_2$	118.18
454	*β*-Hydroxyphenetole	*β*-phenoxy ethanol	$C_6H_5OCH_2CH_2OH$	138.16
455	4-Hydroxypropiophenone	4-hydroxypropiophenone	$CH_3CH_2COC_6H_4OH$	150.17
456	Indalone	*α*,*α*-dimethyl-*α*′-carbobutoxy-dihydro-*γ*-pyrone	 $OC(CH_3)CH_2C{:}OCH{:}CCOOC_4H_9$	226.27
457	*x*-Iodo asprin (acetyl-*x*-iodosalicylic acid)	acetyl-*x*-iodosalicylic acid	$IC_6H_3COOHOCOCH_3$	306.07
458	*x*-Iodosalicylic acid	*x*-iodosalicylic acid	$IC_6H_3COOHOH$	264.03
459	Inositol (Argo brand)	1,2,3,4,5,6-cyclohexanehexol myo-, meso-, or i-inositol; inosite	$C_6H_6(OH)_6$	180.16
460	Isobutane, Pure	isobutane, 2-methylpropane	$(CH_3)_2CHCH_3$	58.12

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* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
434	col. flam. liq		99 min	0.660_{4}^{20}
435	col. liq			0.9617_{20}^{20}
436	w. wh. liq			1.1063_{20}^{20}
437	col. liq	mild		0.8208_{20}^{20}
438	col. flam. liq		99 min	0.673_{4}^{20}
439	col. flam. liq		95 min	0.681_{4}^{20}
440				0.7675_{20}^{20}
441	liq			0.9346_{20}^{20}
442				0.8894_{20}^{20}
443	col. liq	mild		0.7942_{20}^{20}
444	col. visc. liq	mild		$0.922\text{–}0.925_{20}^{20}$
445	liq	mild		0.9234_{20}^{20}
446	wh. yel. cr	char		
447	wh. pk. powd	fa. pleas		
448	wh.-buff cr. sld			
449	wh. cr	none		
450	wh. cr	none		
451	yel.-tan gran	fa		
452	col. liq	sl. amm		1.0740_{20}^{20}
453				0.9938_{20}^{20}
454	col.-pa. straw-colored liq	faint		1.106_{25}^{25}
455	tan gran	faint		
456	amber liq	mild	100	1.08_{20}^{20}
457	wh. cr			
458	wh. powd			
459	cr. wh	none	>99	1.43_{4}^{30}
460	col. flam. liq. gas		99 min	0.557_{4}^{20}

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
434	*n*-Hexane, Pure	−95.5	68.8		
435	Hexanediol-2,5		220.8		220
436	Hexanetriol-1,2,6	<−20 sets to a glass	178 (5mm)		380
437	*n*-Hexanol	−44.6	157.2	<153–none; >160–none	165
438	Hexene-1, Pure	−140.0	63.55		
439	Hexene-2, Technical			67.4–67.5	
440	*n*-Hexyl amine	−22.9	131.4		85
441	*n*-Hexyl "Carbitol"*	−33.3	258.2		285
442	*n*-Hexyl "Cellosolve"*	−45.1	208.3		195
443	*n*-Hexyl ether	−43.0	226.2	205–235	170
444	Hexylene glycol				
445	" "		197.1	193–200	215
446	Hydroxyacetic acid	76.2–77.9			
447	*p*-Hydroxybenzaldehyde	116.4–117.0			
448	*p*-Hydroxybenzoic acid	213.8–215.0			
449	*p*-Hydroxybenzoic acid, ethyl ester	114.5–115.0			
450	*p*-Hydroxybenzoic acid, methyl ester	126–127			
451	4-Hydroxybenzophenone	125.6–131.0			
452	*N*-Hydroxyethyl morpholine	1.6	226.3		215
453	*N*-Hydroxyethyl propylene diamine	−65	240.4		260
454	*β*-Hydroxyphenetole	12.5		131.5–5%; 138.8–95%	244.4
455	4-Hydroxypropiophenone	137.0–148.8			
456	Indalone		113		315
457	*x*-iodo aspirin (acetyl-*x*-iodosalicylic acid)	161–168			
458	*x*-iodosalicylic acid	189.4–197.2			
459	Inositol (Argo brand)	225			
460	Isobutane, Pure	−159.7	−11.7		

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* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
434		solvent, org. syn.	bottles, cans, drums	P.P.
435	∞ w.	moistening and softening agt; solvent	cans	C. & C.
436	∞ w.	softener and plast. inter., coupling agt., solv.	cans	C. & C.
437	0.58^{20}% by wt. in w.	synthesize hypnotics, antiseptics and pharm.	cans, drums	C. & C.
438		org. syn.	bottles, cans	P.P.
439		org. syn.	bottles, cans	P.P.
440		chem. inter	cans, drums	C. & C.
441	1.7^{20}% by wt. in w.	solvent, coupling agt., comp. of hydraulic fluids	cans, drums	C. & C.
442	0.99^{20}% by wt. in w.	solvent	cans, drums	C. & C.
443	$<0.01^{20}$% by wt. in w.	inert med. for reactions, component of foam breakers	cans, drums	C. & C.
444	∞ w., ketones, al., CCl_4, CS_2, toluene, octanes		drums, tank cars	S.C.
445	∞ w.	solv. and coupler in text. oils, paper coatings, ptg. and duplic. inks, leath. oils and dressings	cans, drums, tank cars	C. & C.
446	s. w., eth.; i. CCl_4; g. per 100 g.: 90 al., 59 acet.			D.
447	g. per 100 g.: 90 meth. al., 70 acet., 18 eth., 4 bz., 1 w.; v. s. al.			D.
448	g. per 100 g.: 50 meth., 30 acet., 23 eth., 5 w.; i. bz., CCl_4			D.
449	g. per 100 g.: 72 acet., 83 meth., 45 eth., 1 CCl_4, 1 bz., .1 w.			D.
450	g. per 100 g.: <1 bz., 50 acet., 25 eth., 59 meth. al., .2 w.			D.
451	g. per 100 g.: 25 acet., 8 eth., 1 meth. al., i. w., bz., CCl_4			D.
452	∞ w.	to form fatty ester for textile and metal oil emulsifier; corrosion inhibitor.	cans	C. & C.
453	∞ w.		cans	C. & C.
454	∞ meth. al., isopropyl eth., CCl_4, bz., acet.; g. per 100 g.: 2 w.			D.
455	g. per 100 g.: meth. al., 8 acet., 4 eth.; i. w., CCl_4, bz.			D.
456	misc. common org. solv.	light screen, insect repellent, solv.	cans, drums	U.S.I.
457	sl. s. eth., al.; i. w., CCl_4, bz.			D.
458	g. per 100 g.: 72 eth., 6 al.; i. w., CCl_4, bz.			D.
459	w. 14.5^{25}, 28.5^{60} sl. s. al.	pharm.	cans, drums	C.P.
460		reagent, refrigerant, org. syn.	cylinders, tank cars	P.P.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
461	Isobutane, Pure	isobutane	$(CH_3)_2CHCH_3$	58.12
462	Isobutylene, Pure	2-methylpropene	C_4H_8	56.10
463	Isopentane, Pure	2-methylbutane	$(CH_3)_2CHCH_2CH_3$	72.14
464	Isophorone	isophorone	$\underbrace{COCH:C(CH_3)CH_2C(CH_3)_2CH_2}$	138.20
465	Isopropanol	isopropyl alcohol dimethyl carbinol	$(CH_3)_2CHOH$	60.09
466	Isopropenyl acetate	1 methylvinyl acetate	$CH_3COOC(CH_3):CH_2$	100.11
467	Isopropyl acetate	isopropyl acetate	$CH_3COOCH(CH_3)_2$	102.13
468	“ “	“ “	$(CH_3)_2CHCOOCH_3$	102.13
469	“ “	“ “	$CH_3COOCH(CH_3)_2$	102.13
470	“ alcohol	isopropanol	$CH_3CH(OH)CH_3$	60.09
471	Isopropylamine		$(CH_3)_2CHNH_2$	59.11
472	“		$(CH_3)_2CHNH_2$	59.11
473	Isopropylbenzene, Pure, (Cumene)	isopropylbenzene	$C_6H_5CH(CH_3)_2$	120.19
474	Isopropyl bromide	2-bromopropane	$CH_3CHBrCH_3$	123.00
475	“ benzoate		$C_6H_5COOCH(CH_3)_2$	164.2
476	“ ether	isopropyl ether	$(CH_3)_2CHOCH(CH_3)_2$	102.17
477	“ “	“ “	$(CH_3)_2CHOCH(CH_3)_2$	102.17
478	“ phenol		$C_6H_4[CH(CH_3)_2]OH$	136.19
479	“Kromfax”* Solvent (Thiodiglycol)	thiodiglycol	$HOC_2H_4SC_2H_4OH$	122.18
480	Lauric acid	dodecanoic acid	$C_{11}H_{23}COOH$	200.31
481	Lauronitrile	dodecanenitrile	$C_{11}H_{23}CN$	181.31
482	Malonic acid	malonic acid	$CH_2(COOH)_2$	104.06
483	Mannitol	*d*-mannitol	$C_6H_3(OH)_6$	182.17
484	“ , hexacetate	mannitol hexacetate	$C_6H_8O_6(CH_3CO)_6$	434.39
485	“ monoborate	“ monoborate	$C_6H_{15}O_8B$	226.00
486	Melaniline octadecanoate	melaniline octadecanoate	$(C_6H_5NH)_2CNHC_{17}H_{35}COOH$	495.7
487	Mercaptan, 3B	*tert*-dodecyl mercaptan	$C_{12}H_{25}SH$	202.4

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* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
461	col. gas		99	$0.5641\frac{60}{60}$°F
462	col. flam. liq. gas		99 min	$0.600\frac{60}{60}$
463	col. flam. liq	sweet	99 min	$0.620\frac{20}{4}$
464	liq	mild	98	0.9229
465	col. liq	pleas. char	99	$0.7862\frac{20}{20}$
466	liq			$0.9226\frac{20}{20}$
467	w. wh. liq	mild, n. res	95–97	$0.8737\frac{20}{20}$
468	liq	char	85–88	$0.8608\text{–}8648\frac{20}{20}$
469	w. wh. liq	mild, n. res	85–88	$.860\text{–}870\frac{20}{20}$
470	w. wh. liq	pleas. sl. bitter taste	99	$0.785\text{–}0.787\frac{20}{20}$
471	w. wh. liq		98 (min)	$0.68\text{–}0.70\frac{20}{20}$
472	liq	strong amm		$0.6881\frac{20}{20}$
473	col. flam. liq		99 min	$0.862\frac{20}{4}$
474	cl. col. mobile liq	mildly sweet		$1.290\text{–}1.310\frac{25}{25}$
475	col. liq	pleas. aromatic		$1.0112\frac{20}{20}$
476	col. liq	ethereal	99	$0.7244\frac{20}{20}$
477	w. wh. liq	pung. ethereal	*ca.* 99	$0.725\text{–}0.727\frac{20}{20}$
478	yel. liq	phenolic		0.98
479	liq	mild		$1.1847\frac{20}{20}$
480	wh. sld	mild	90	$0.869^{50°}$
481	wh. liq	char	90	$0.828^{15°}$
482	wh. cr			
483	col. cr. powd	none; fa. sweet taste	100	$1.51^{15\text{–}20}$
484	wh. cr	none; bitter taste		
485	col. cr. powd	none, sharp taste		
486	amber balsam	fa. fatty		
487	w. wh. to light yel. liq		95 (min.)	$0.85\text{–}0.86\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
461	Isobutane, Pure		10.29		<20
462	Isobutylene, Pure	−140.5	−6.9		
463	Isopentane, Pure	−160	27.8		
464	Isophorone	−8.1	215.2	205–220	205
465	Isopropanol	−87.3	82.3	shall entirely distill within 1.0°C, includ. 82.3	70
466	Isopropenyl acetate	−92.9	97.5		60
467	Isopropyl acetate	−69.3	88.4	84.5–90.0	60
468	" "	−73.4		<81.5–none; 91.5–95%; >95–none	36
469	" "	−73.4	89.0	<81–none; 91–90%; >95–none	59
470	" alcohol	−89.5	82.3	81.5–83.0	56
471	Isopropylamine	−101.2	31.9	30.5–34.5–95%	−35
472	"	−95.9	32.4		<0
473	Isopropylbenzene, Pure (Cumene)	−96.3	152.4		
474	Isopropyl bromide	−90		58.5–5%; 60.5–95%	none
475	" benzoate	−26.4	219		210
476	" ether	−85.5	68.5	<63–none; >69–none	15
477	" "	−86.8	68.4^{760}	65–70	16
478	" phenol			207–225	*ca.* 221
479	"Kromfax"* Solvent (Thiodiglycol)	−10	282		320
480	Lauric acid	38	130^{1}		
481	Lauronitrile	0	96^{1}		
482	Malonic acid	131.2–136.8			
483	Mannitol	167			
484	" hexacetate	121–124			
485	" monoborate	78–80			
486	Melaniline octadecanoate				
487	Mercaptan, 3B			200–235–95%	205

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* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
461		refrigerant	cylinders	C. & C.
462		org. syn	cylinders	P.P.
463	imm. w	aviation blending agt; research; org. syn.	cans, drums	P.P.
464	1.2^{20}% by wt. in w	solv. "vinylite"* resins, lacq.	drums	C. & C.
465	∞ w	solv. gums, alkaloids, oils; germicides; pharm.	cans, drums, tank cars	C. & C.
466	3.25^{20}% by wt. in w	copoly.; acetylating agt.; chem. inter.	cans, drums	C. & C.
467	2.9^{20}% by wt. in w	solv. nitro. lacq. extr	cans, drums, tank cars	C. & C.
468	3.2^{25} w	lacq. solv	tank cars, drums, tank wagon, cans	St.
469	4.0^{25} w	nitrocellu. solv	cans, drums, tank cars	U.S.I.
470	∞^{25} w	solv., thinner lacq.; germ., preservative, dehydrating agt., mfg. pectin; antifreeze; rubb. al.	drums, tank cars	S.C.
471	s. w. and most organic solvents.	solvent solubilizer for 2,4-D inter.	drums, tank cars	Sh.
472	∞ w	solubilizing agt. for 2,4-D, chem. inter.	cans, drums, tank cars	C. & C.
473	imm. w	motor fuel research, org. syn., solvent	bottles, cans, drums	P.P.
474	∞ al., acet., CCl_4, bz., eth., sl. s. w.	org. syn	5, 10, 55 gal. drums	D.
475	0.01^{20}% by wt. in w	high-boiling solv. odorant; control of poly.; inter.	cans, drums, tank cars	C. & C.
476	0.90^{20}% by wt. in w	dewaxing agt., solv	cans, drums, tank cars	C. & C.
477	$.72^{20}$ w	solvent oils, waxes, ethylcellu.; extr., delusterizing agt. for art. silk	drums, tank cars	S.C.
478	s. bz., al., eth.; v. sl. s. w	resins, plasticizers, carbon removers	cans, drums, tank cars	K.
479	∞ w	solv. for vat dyestuffs	cans, drums, tank cars	C. & C.
480	0.0008^{30} w., 260^{30} al., 218^{30} acet., 193^{30} hexane	mfg. surface active agts. deter., emulsifiers, plasticizers, syn. inter.	drums, tank cars	Arm.
481	∞^{30} al	syn. inter	drums, tank cars	Arm.
482	v. s. w.; s. acet., g. per 100 g.: 42 al., 8 eth.; i. bz., CCl_4			D.
483	s. w	fermentation industries, resins, pharm.; form. derivatives	cans, barrels	At.
484	s. al., amines, chlorinated solv., eth., ketones; sl. s. other org. solv.; i. w.	lacq. hardener, plast		At.
485	s. w.; sl. s. ketones, polyhydric al.; i. other org. solv.	electrolytic condensers; syn. of mannitol		At.
486	s. h. al., acet., ethyl acetate, naphtha, c. toluene; i. w.			G.
487	s. most org. solv.; i. w	org. syn., modifier in poly. of diene polymers	drums	Sh.

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* Trade mark.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
488	Mercaptoethanol	2-hydroxyethyl mercaptan; thiomonoglycol	$HSCH_2CH_2OH$	78.13
489	Mesityl oxide	4-methylpenten-3-one-2	$(CH_3)_2C{:}CHCOCH_3$	98.14
490	" "	4-methyl-3-pentenone-2	$CH_3COCHC(CH_3)_2$	98.14
491	" "	mesityl oxide	$(CH_3)_2CCHCOCH_3$	98.14
492	Methacrolein		$CH_2{:}C(CH_3)CHO$	70.09
493	Methallyl chloride	isobutenyl chloride	$CH_2C(CH_3)CH_2Cl$	90.56
494	Methane	methane	CH_4	16.04
495	" , Pure	"	CH_4	16.04
496	Methanol	methyl alcohol; carbinol; wood alcohol	CH_3OH	32.04
497	"	methyl alcohol	CH_3OH	32.04
498	"	" "	CH_3OH	32.04
499	3-Methoxybutanol		$CH_3OCH(CH_3)CH_2CH_2OH$	104.15
500	3-Methoxybutyl acetate		$CH_3OC_4H_8OCOCH_3$	146.18
501	3-Methoxybutyric acid		$CH_3OC_3H_6COOH$	118.13
502	Methoxy triglycol acetate		$CH_3COO(C_2H_4O)_3CH_3$	206.3
503	2-Methoxymethyl 2,4-dimethyl pentanediol-1,5		$HOCH_2C(CH_3)(CH_2OCH_3)\text{-}CH_2CH(CH_3)CH_2OH$	176.25
504	Methyl amyl acetate	methyl isobutyl carbinol acetate	$CH_3COOCH(CH_3)CH_2CH\text{-}(CH_3)_2$	144.21
505	" " alcohol	4,methyl pentanol-2; methyl isobutyl carbinol	$(CH_3)_2CHCH_2CH(OH)CH_3$	102.17
506	*N*-Methylaniline	*N*-methylaniline	$C_6H_5NHCH_3$	107.15
507	α-Methylbenzylamine		$C_6H_5CH(CH_3)NH_2$	121.18
508	α-Methylbenzyl diethanolamine		$C_6H_5CH(CH_3)N(C_2H_4OH)_2$	209.28
509	α-Methylbenzyl ether		$C_6H_5CH(CH_3)OCH(CH_3)C_6H_5$	226.30
510	α-Methylbenzyl monoethanolamine		$C_6H_5CH(CH_3)NHC_2H_4OH$	165.23
511	Methyl bromide	bromoethane	CH_3Br	94.95
512	2-Methylbutadiene-1,3 (Isopropene) Pure	2-Methyl-1,3-butadiene	C_5H_8	68.11
513	3-Methylbutene-1, Pure	3 methyl-1-butene	C_5H_{10}	70.13
514	2-Methylbutene-1, Technical	2-methyl-1-butene	C_5H_{10}	70.13
515	2-Methylbutene-2, Pure	2-methyl-2-butene	C_5H_{10}	70.13

No.	Physical form and color	Odor	Purity %	Sp. gr.
488	w. wh. liq	comb. of hydrogen sulfide and ethanol		$1.1168\frac{20}{20}$
489	col. liq	mild		$0.8569\frac{20}{20}$
490	straw yel. liq	peppermint	97–100	$0.853\text{–}0.856\frac{20}{20}$
491	straw colored liq	mild, ethereal		$0.853\text{–}0.863\frac{20}{20}$
492	w. wh. liq			$0.8474\frac{20}{20}$
493	col.-straw liq	char	95	$0.926\text{–}0.929\frac{20}{20}$
494	col. gas	none	96	0.4248 at b. p.
495	col. flam. gas		99	$0.559\frac{60}{60}$
496	col. liq		99.85	$0.7924\frac{20}{20}$
497	w. wh. liq	no foreign odor	99.8–100	$.792\text{–}.793\frac{20}{22}$
498	w. wh. liq	no foreign odor	99.8 by wt	$.7962\frac{15}{4}$
499				$0.9229\frac{20}{20}$
500	col. liq			$0.9561\frac{20}{20}$
501	col. liq			$1.053\frac{20}{20}$
502	col. liq			$1.0940\frac{20}{20}$
503	col. liq	none		$1.0165\frac{20}{20}$
504	w. wh. liq	mild, agreeable	95	$0.8595\frac{20}{20}$
505	w. wh. liq	mild	99	$0.8079\frac{20}{20}$
506	straw colored liq	char. amine-like		$.985\frac{25}{25}$
507	w. wh. liq	mild, amm		$0.9535\frac{20}{20}$
508	dk. amb. liq	mild, amm		$1.0812\frac{20}{20}$
509	straw yel. liq			$1.0017\frac{20}{20}$
510	amber liq	mild, amm		$1.0327\frac{20}{20}$
511	col. non flam. liq		99	$1.732\frac{0}{0}$
512	col. flam. liq		99 min	$0.682\frac{20}{4}$
513	col. flam. liq		99 min	$0.624\frac{20}{4}$
514	col. flam. liq		95 min	$0.656\frac{60}{60}$
515	col. flam. liq		99 min	$0.662\frac{20}{4}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
488	Mercaptoethanol		157.1		170
489	Mesityl oxide	−46.4	128.0	123–132	90
490	" "	−59	129.5	<120–none; >135–none	83
491	" "	−59	128.7	110–40%; 126–131–60%	78
492	Methacrolein	−81	68		35
493	Methallyl chloride		72.2	68–77	14
494	Methane	−182.5	−161.5		<20
495	" , Pure	−182.9	−161.5		
496	Methanol	−97.6	64.5	64.5–65.0	65
497	"	−97.8	64.5	<64–none; >66–none	60
498	"	−97.8	64.5	<64–none; >65–95%; 66–none	52 (approx.)
499	Methoxybutanol	<−85 sets to a glass	161.1		165
500	3-Methoxybutyl acetate	−95	171.2		
501	3-Methoxybutyric acid	12	140 (50 mm)		
502	Methoxy triglycol acetate		244.0		260
503	2-Methoxymethyl 2,4-dimethyl pentanediol-1,5	<−40 sets to a glass	208^{100}		295
504	Methyl amyl acetate	−63.8	146.3	<140–none; >150–none	110
505	" " alcohol	−90 sets to a glass	131.8	<125–none; >135–none	130
506	*N*-Methylaniline	−20		194.9–5%; 195.7–95%	185
507	α-Methylbenzylamine	−65 sets to a glass	188.5		175
508	α-Methylbenzyl diethanolamine	−7 sets to a glass	244 (50 mm)		370
509	α-Methylbenzyl ether	−30 sets to a glass	286.3		275
510	α-Methylbenzyl monoethenolamine	−15	182 (50 mm)		280
511	Methyl bromide	−93	4.6		none
512	2-Methylbutadiene-1,3 Pure (Isoprene)	−146.1	34.0		
513	3-Methylbutene-1, Pure	−168.53	20.06		
514	2-Methylbutene-1, Technical			31.0–31.2	
515	2-Methylbutene-2, Pure	−133.9	38.5		

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
488	∞ w	sulfid. agt.; sulfhydryl reagent for ind. depilatories; chem. inter.	cans, drums	C. & C.
489	2.8^{20}% by wt. in w	solv. inter. in org. syn	cans, drums, tank cars	C. & C.
490	3.1^{20} by wt. in w.; w. in comp. 3.1^{20} by wt.	solv. thinners, lacq. nitro., gums, resins	drums, tank cars	S.C.
491	3.4% by vol. in w	industrial solv., chem. syn., rust remover	drums	C.S.
492	5.9^{20}% by wt. in w	chem. inter.; copoly. in spec. rubbers and plastics	cans, drums	C. & C.
493	<0.1	fumigant; synthesis	drums, tins	S.C.
494	0.03308 vol. gas per vol. w	testing and adapting gas appl. that are to use nat. gas	cylinders	C. & C.
495	imm. with w	research	cylinders	P.P.
496	∞ w	org. syn., antifreeze	cans, drums, tank cars	C. & C.
497	∞ w., org. solv	solv. antifreeze, synth. perfume, resins, flavors, pharm., refrig.	drums, tank cars	C.S.
498	∞^{25} w	solv. embalming fluid, org. deriv. base	cans, drums, tank cars	U.S.I.
499	∞ w		cans, drums	C. & C.
500	6.2^{20}% by wt. in w	solvent for lacq. and printing inks	cans, drums	C. & C.
501	∞ w	inter. for synth. flavors, plast., varnish dryers, and pharm.	cans, drums	C. & C.
502	∞ w	solvent, protective coatings; heat dry printing inks, anti-dusting agt.	cans, drums	C. & C.
503	∞ w	coupler, blending agt., plast., softener, solv. inter.	cans, drums, tank cars	C. & C.
504	0.13^{20}% by wt. in w	h. boil. solvent	cans, drums, tank cars	C. & C.
505	1.7^{20}% by wt. in w	penicillin extr. lacq. form.; prep. esters, ore flotation	cans, drums, tank cars	C. & C.
506	.01 w., meth. al., eth., CCl_4, bz., acet.			D.
507	4.8^{20}% by wt. in w	prep. of amine salts and amides, emulsifying agt.	cans, drums	C. & C.
508	5.3^{20}% by wt. in w	emulsifying agts. prep. of amine salts and quaternary amm. bases	cans, drums	C. & C.
509	$<0.1^{20}$% by wt. in w	high boil. solv.; styrenating agt.	cans, drums	C. & C.
510	9.8^{20}% by wt. in w	emulsifying agt.; prep. of amine salts and amides	cans, drums	C. & C.
511	∞ al., CCl_4, eth.; 0.09^{20} w	fumigant; fire extinguisher liq. for airplane motors, reagent in mfr. of dyes pharm.	1 lb. cans, cylinders	D.
512		synth. rubber research, org. syn.	bottles, cans, drums	P.P.
513		org. syn	cylinders	P.P.
514		org. syn	bottles, cans	P.P.
515		org. syn	bottles, cans	P.P.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
516	Methyl "Carbitol"*	diethylene glycol monomethyl ether	$CH_3OCH_2CH_2OCH_2CH_2OH$	120.15
517	" "Carbitol"* acetate		$CH_3COOC_2H_4OC_2H_4OCH_3$	162.18
518	" "Cellosolve"*	ethylene glycol monomethyl ether	$CH_3OCH_2CH_2OH$	76.09
519	" "Cellosolve"* acetate	ethylene glycol monomethyl ether acetate	$CH_3COOCH_2CH_2OCH_3$	118.13
520	" chloride	methyl chloride	CH_3Cl	50.49
521	" chloroform	1,1,1-trichloroethane	CH_3CCl_3	133.42
522	Methylcyclohexane, Pure	methylcyclohexane	C_7H_{14}	98.18
523	4-Methylcyclohexene-1, Technical	4-methyl-1-cyclohexene	$C_6H_9CH_3$	96.17
524	Methylcyclopentane, Pure	methylcyclopentane	$C_5H_9CH_3$	84.16
525	*N*-Methyl-diethanolamine	2,2-methylaminodiethanol	$CH_3N(CH_2CH_2OH)_2$	119.16
526	4-Methyl-1,3-dioxolane		$CH_2OCH_2OCH(CH_3)$	88.06
527	2-Methyl-1,3-Dioxolane	methyl dioxolane	$CH_2OCH_2OCH(CH_3)$	88.06
528	*N*-Methyl-ethanolamine	2-methylaminoethanol	$CH_3NHCH_2CH_2OH$	75.11
529	Methyl ethyl ketone	butanone-2	$CH_3COCH_2CH_3$	72.10
530	" " "	methyl ethyl ketone	$CH_3COCH_2CH_3$	72.10
531	" " "	" " "	$CH_3COC_2H_5$	72.10
532	2-Methyl-5-ethyl pyridine	aldehyde collidine	$N{:}C(CH_3)CH{:}CHC(C_2H_5){:}CH$	121.2
533	Methyl formate	methyl formate	$HCOOCH_3$	60.05
534	α-Methyl-*d*-glucoside	α-methyl-*d*-glucoside	$C_7H_{14}O_6$	194.18
535	Methyl isobutyl carbinol	4-methyl-2-pentanol	$CH_3CHOHCH_2CHCH_3CH_3$	102.17
536	" " ketone	hexone; 4-methyl-pentanone-2	$(CH_3)_2CHCH_2COCH_3$	100.16
537	" " "	4-methylpentanone-2	$(CH_3)_2CHCH_2COCH_3$	100.16
538	" lactate	methyl lactate	$C_3H_5O_3CH_3$	104.10
539	*N*-Methyl morpholine		$C_2H_4OC_2H_4NCH_3$	101.15
540	2-Methylpentane, Pure	2-methylpentane	C_6H_{14}	86.17
541	3-Methylpentane, Pure	3-methylpentane	C_6H_{14}	86.17
542	2-Methyl pentanol-1		$CH_3CH_2CH_2CHCH_3CH_2OH$	102.17
543	4-Methylpentene-1, Technical	4 methyl-1-pentene	C_6H_{12}	84.16
544	2-Methylpentene-2, Technical	2-methyl-2-pentene	C_6H_{12}	84.16

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* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
516	col. liq	mild, n. res		$1.0211\frac{20}{20}$
517	col. liq	mild	99	1.396
518	w. wh. liq	mild, n. res		$0.9663\frac{20}{20}$
519	col. liq	pleas. ester	95–100	$1.0067\frac{20}{20}$
520	col. gas under press.-w. wh. liq	ethereal, fa. sweet	99.87	$0.909^{26.7}$
521	cl. col. liq	mild, chloroform-like		$1.324\text{–}1.333\frac{25}{25}$
522	col. flam. liq		99 min	$0.769\frac{20}{4}$
523	col. flam. liq		95 min	$0.800\frac{20}{4}$
524	col. flam. liq		99 min	$0.749\frac{20}{4}$
525	liq	char. amine-like		$1.0418\frac{20}{20}$
526	liq			$0.988\frac{20}{20}$
527	liq			$0.982\frac{20}{20}$
528	liq			$0.9414\frac{20}{20}$
529	cl. liq	n. res	98	$0.8063\frac{20}{20}$
530	col. liq	typical ketone, less pung. than acetone		$0.805\text{–}0.807\frac{20}{20}$
531	liq	char	98	$0.8037\text{–}0.8067\frac{20}{20}$
532	liq			$0.9215\frac{20}{20}$
533	w. wh. col. liq	pleas. ethereal	95–100 by wt.	$.95\text{–}.98\frac{20}{20}$
534	sld			
535	col. liq	mild	97.5	$0.807\text{–}0.809\frac{20}{20}$
536	w. wh. liq	mild, n. res	99	$0.8042\frac{20}{20}$
537	w. wh. liq		99 by wt	$0.800\text{–}0.804\frac{20}{20}$
538	w. wh. liq	mild, n. res	95 by wt	1.087–1.097
539				$0.921\frac{20}{20}$
540	col. flam. liq		99 min	$0.653\frac{20}{4}$
541	col. flam. liq		99 min	$0.664\frac{20}{4}$
542	liq			$0.8230\frac{20}{20}$
543	col. flam. liq		95 min	$0.665\frac{20}{4}$
544	col. flam. liq		95 min	$0.687\frac{20}{4}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
516	Methyl "Carbitol"*		194.2	188–198	200
517	" "Carbitol"* acetate		209.1		230
518	" "Cellosolve"*	−85.1	124.5	123.5–125.5	115
519	" "Cellosolve"* acetate	−65.1	144.5	<132–none; >152–none	140
520	" chloride	−97.7	−24.22	−23.7–24.7	632
521	" chloroform			73.0–5%; 75.0–95%	none
522	Methylcyclohexane, Pure	−126.6	100.6		
523	4-Methylcyclohexene-1 Technical			102.5–103.0	
524	Methylcyclopentane, Pure	−142.5	71.8		
525	*N*-Methyl-diethanolamine	−21	247.2	240–260	260
526	4-Methyl-1,3-dioxolane		85		
527	2-Methyl-1,3-dioxolane		81		
528	*N*-Methyl-ethanolamine	−4.5	159.5		165
529	Methyl ethyl ketone	−86.8	79.6	78.0–81.0	35
530	" " "	−86.4	79.6	<79.0–none; >81.0–none	34
531	" " "	−86.4		78–5%; 82–85%; 84–none	24
532	2-Methyl-5-ethyl pyridine	−70.3	178.3	172–179	160
533	Methyl formate	−99.8	31.8	<31.5–none; >35.0–none	−25.6
534	α-Methyl-*d*-glucoside	165–166			
535	Methyl isobutyl carbinol			130.0–133.0	122
536	" " ketone	−80.4	115.8	113–117	75
537	" " "	−83.5	115.9	<114–none; >117–none	81
538	" lactate	−66	144.8	<115–none; 141–145–60% >155–none	142
539	*N*-Methyl morpholine	−65.9	115.14		75
540	2-Methylpentane, Pure	−153.8	60.3		
541	3-Methlypentane, Pure		63.3		
542	2-Methyl pentanol-1		147.5		135
543	4-Methylpentene-1, Technical			53.9–54.1	
544	2-Methylpentene-2, Technical			67.1–68.2	

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* Trade mark.

See two preceding pages for additional data on above compounds

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
516	∞ w.	solv. dyes, org. syn.	cans, drums, tank cars	C. & C.
517	∞ w.	lacq. solv.	cans	C. & C.
518	∞ w.	rapid drying, varnishes, enamels; dyeing leather	cans, drums, tank cars	C. & C.
519	∞ w.	solv. cellu. acetate	cans, drums, tank cars	C. & C.
520	303^{3-20} w.	refrigerant	steel cylinders	An.
521	∞ acet., al., bz., CCl_4. eth.; i. w.			D.
522		solvent, org. syn.	bottles, cans, drums	P.P.
523		org. syn.	bottles, cans, drums	P.P.
524		motor fuel research, solvent, org. syn.	bottles, cans, drums	P.P.
525	∞ w.	chem. inter.	cans, drums	C. & C.
526	20.0^{20}% by wt. in w.	solvent; resin inter.	cans	C. & C.
527	59.0^{20}% by wt. in w.	solvent; resin inter.	cans, drums	C. & C.
528	∞ w.	textile chem., pharm. inter.	cans, drums	C. & C.
529	26.8^{20}% by wt. in w.	solv. extr., chem. inter.	cans, drums, tank cars	C. & C.
530	misc. nitro. lacq. solv.; imm. w.	solv., dewaxing lubr. oil, plastics; art-leather, airplane dopes; synth. rubber	drums, tank cars	S.C.
531	23.4^{25} w.	lacq. dewaxing solv., art leather; airplane dopes; printing; solv. synth. rubber	cans, drums, tank wagons, tank cars	St.
532	1.22^{20}% by wt. in w.	inter. prep. of nicotinic acid, quaternary germicides	cans, drums, tank cars	C. & C.
533	28.95 w.	fumigants, larvacide	cans, drums	C.S.
534	s. meth. al., ethanol, w.; i. eth., acet.			C.P.
535	6.7^{20} w.	org. solv., lacq. solv. org. inter., flotation reagent	drums, tank cars	S.C.
536	2.0^{20}% by wt. in w.	lacq. solv. extr. dewax. oils	cans, drums, tank cars	C. & C.
537		solv. cellu. acetate, natural and synth. resins, gums, waxes	drums, tank cars	S.C.
538	v. s. w., most org. liq.	solv. cellu. acetate	cans	C.S.
539	∞ w.	reactive solv. and catalyst; stabilizer	cans, drums	C. & C.
540		org. syn., solv., motor fuel research	bottles, cans, drums	P.P.
541		org. syn., solvent, motor fuel research	bottles, cans, drums	P.P.
542	0.31^{20}% by wt. in w.		cans, drums	C. & C.
543		org. syn.	bottles, cans	P.P.
544		org. syn.	bottles, cans	P.P.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
545	4-Methylpentene-2, Technical	4-methyl-2-pentene	C_6H_{12}	84.16
546	1-Methyl-1-phenyl-ethylene	α-methyl sterene	$C_6H_5CCH_2CH_3$	118.17
547	α-Methyl tetraacetyl-*d*-glucoside	α-Methyl tetraacetyl-*d*-glucoside	$C_{15}H_{22}O_{10}$	362.33
548	Methyl tetramethyl glucoside	methyl tetramethyl glucoside	$C_{11}H_{22}O_6$	250.29
549	β-Methyl umbelliferone	....	$C_{10}H_8O_3$	176.2
550	Methylene bromide	dibromethane	$BrCH_2Br$	173.86
551	" chloride, Technical	dichloromethane	CH_2Cl_2	84.94
552	" chlorobromide	bromochloromethane	CH_2BrCl	129.40
553	Monoacetone glucose	monoacetone glucose	$C_9H_{16}O_6$	220.22
554	Mono-*n*-butylamine	1-amino butane	$C_4H_9NH_2$	73.14
555	Mono-*tert*-butyl-*m*-cresol	....	$C_6H_3(C_4H_9)(CH_3)OH$	164.24
556	Monochlorobenzene	monochlorobenzene	C_6H_5Cl	112.56
557	" , Technical	chlorobenzene	C_6H_5Cl	112.56
558	Monoethanolamine	2-hydroxyethyl amine; 2-aminoethanol	$HOCH_2CH_2NH_2$	61.08
559	Monoethylamine	ethylamine	$C_2H_5NH_2$	45.08
560	Monoisopropanolamine	1-aminopropanol	$CH_3CHOHCH_2NH_2$	75.11
561	Monomethylamine	monomethylamine	CH_3NH_2	31.06
562	Morpholine	morpholine	$\underbrace{C_2H_4OC_2H_4N}_{}H$	87.12
563	Myristic acid	tetradecanoic acid	$C_{13}H_{27}COOH$	228.37
564	Myristonitrile	tetradecanenitrile	$C_{13}H_{27}CN$	209.37
565	1-Naphthyl acetic acid	α-naphthalene acetic acid	$C_{12}H_{10}O_2$	186.20
566	*n*-Nonane, Pure	*n*-nonane	C_9H_{20}	128.25
567	Nonyl acetate	diisobutyl carbinyl acetate; 2,6-dimethylheptyl-4-acetate	$CH_3COOC_9H_{19}$	186.29
568	" phenol	....	$C_6H_4(C_9H_{19})OH$	220.3
569	Octadecylamine	octadecylamine	$C_{18}H_{37}NH_2$	269.50
570	Octadecylamine acetate	octadecylammonium acetate	$C_{18}H_{37}NH_2\cdot CH_3CO_2H$	329.55
571	*n*-Octane, Pure	*n*-octane	C_8H_{18}	114.22
572	Octene-1, Pure	1-octene	C_8H_{16}	112.21
573	Octene-2, Technical	2-octene	C_8H_{16}	112.21

No.	Physical form and color	Odor	Purity %	Sp. gr.
545	col. flam. liq		95 min	0.670_{4}^{20}
546	col. liq	styrene-like		0.908_{25}^{25}
547	sld			
548	visc. oil			
549	wh. to lt. yel. sld	none	96–99	
550	cl. col. liq	char. sw		$2.471\text{–}2.495_{25}^{25}$
551	cl. col. volatile liq			$1.317\text{–}1.322_{25}^{25}$
552	cl. col. liq	sweet		1.916_{25}^{25}
553	sld			
554	w. wh. liq	amm	96.5 min	$0.74\text{–}0.75_{20}^{20}$
555	cl. yel. liq	phenolic		0.97
556	cl. col. liq	arom	tech	1.107_{20}^{20}
557	cl. col. volatile liq			1.105_{25}^{25}
558	w. wh. liq	mild. amm	97–100	1.0179_{20}^{20}
559	w. wh. liq	amine		$0.79\text{–}0.81_{20}^{20}$
560	liq	sl. amm		0.9619_{20}^{20}
561	flam. gas	strongly amm	98	$.699\,\frac{-10.8}{15}$
562	col. liq	sharp, amm	98–100	0.999–1.004
563	wh. sld	fa. fatty	90	0.862^{54}
564	wh. liq	fa. char	90	0.824^{25}
565	w. cr	none		
566	col. flam. liq		99 min	0.718_{4}^{20}
567	liq			0.8530_{20}^{20}
568	cl. yel. visc. liq	sl. phenolic		0.94
569	wh. sld	amm	90	0.79^{55}
570	wh. sld	mild	90	
571	col. flam. liq		99 min	0.703_{4}^{20}
572	col. flam. liq		99 min	0.715_{4}^{20}
573	col. flam. liq		95 min	0.723_{4}^{20}

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
545	4-Methylpentene-2, Technical			57.2–57.9	
546	1-Methyl-1-phenylethylene	<−20		164.9–5%; 166.2–95%	129.2
547	α-Methyl tetraacetyl-*d* glucoside	100–101			
548	Methyl tetramethyl glucoside	145–150^5			
549	β-Methyl umbelliferone	186–188			
550	Methylene bromide	<−50		95.6–5%; 97.4–95%	none
551	“ chloride, Technical			40.0–5%; 42–95%	none
552	“ chlorobromide	<−40		66–5%; 68–95%	none
553	Monoacetone glucose	157–158			
554	Mono-*n*-butylamine	−50.5	77.8	73–85	10
555	Mono-*tert*-butyl-*m*-cresol	*ca.* 19		233–243	116
556	Monochlorobenzene	−45	130.6	130.6–131.8	87.8
557	“ Technical	−45.2	131.6		80.6
558	Monoethanolamine	10.5	170.5	160–176	200
559	Monoethylamine	−80.6			<0
560	Monoisopropanolamine	1.4	159.9		160
561	Monomethylamine	−92.5	−6.3		
562	Morpholine	−3.1	128.6	120–132	100
563	Myristic acid	51	150^1		
564	Myristonitrile	15	120^1		
565	1-Naphthyl acetic acid	132.4–135.3			
566	*n*-Nonane, Pure	53.8	150.8		
567	Nonyl acetate	−48.1	192.4		155
568	“ phenol			279–301	140
569	Octadecylamine	50	154^1		
570	“ acetate	65	d		
571	*n*-Octane, Pure	−56.98	125.67		
572	Octene-1, Pure	−101.97	121.3		
573	Octene-2, Technical			124.2–124.6	

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
545	....	org. syn....................	bottles, cans....	P.P.
546	∞ acet., bz., CCl_4, eth., meth. al.; i. w.	....	....	D.
547	s. $CHCl_3$, acet., eth., CCl_4, et. acet.	....	....	C.P.
548	5 w.; s. $CHCl_3$; sl. s. eth., pet. eth.	....	....	C.P.
549	v. sl. s. w.; s. al...............	optical bleach for soaps, plastics, sun-tan agt.	drums.........	K.
550	∞ CCl_4, eth., meth. al.; i. w...	org. syn..................	drums.........	D.
551	∞ acet., bz., CCl_4, eth., *n*-heptane, meth. al.; i. w.	solvent....................	drums, tank cars	D.
552	∞ acet., bz., CCl_4, eth., meth. al., V.M.P. naphtha; 2.4 w.	org. syn. and fire extinguisher fluid	drums.........	D.
553	s. w.; ethanol, meth. al.......	....	....	C.P.
554	s. w., bz., acet., methyl al., gasoline et. acetate, et. ether.	chem. inter................	drums, tank cars	Sh.
555	s. bz., al., eth., CCl_4; i. w.....	germicides, chem. inter......	drums, tank cars	K.
556	s. al., eth.; i. w.............	mfg. sulfur dyes, poison gases, phenol, aniline	tank cars......	S.P.
557	∞ al., eth.; i. w.............	solvent for synth. rubbers and extraction of penicillin	drums, tank cars	D.
558	∞ w......................	extr. CO_2 inter. for soaps; deter. and text. processing chem.	cans, drums, tank cars	C. & C.
559	s. w., meth. al., et. eth., acet., bz., gasoline, et. acetate	inter. for emulsifiers, rubber chemicals, plastics, textile chemicals	drums, tank cars	Sh.
560	∞ w......................	prep. soaps with fatty acids..	research quantity	C. & C.
561	v. s. w., al.; s. eth...........	tanning, dyestuffs..........	bottles, drums..	C.S.
562	∞ w......................	corrosion inhibitor, solv. dyes, resins, waxes, shellacs	cans, drums, tank cars	C. & C.
563	0.0004^{30} w., 68^{30} al., 42^{30} acet., hexane	mfg. surface active agts., cosmetics, metallic soaps	drums, tank cars	Arm.
564	∞^{30} al....................	synth. inter................	drums, tank cars	Arm.
565	g. per 100 g.: 83 meth. al., 22 eth., 1 CCl_4, 7 bz., 71 acet., .04 w.	....	....	D.
566	....	solvent, org. syn...........	bottles, cans....	P.P.
567	$<0.02^{20}$% by wt. in w.......	anti-biotic extr.; solvent.....	cans, drums, tank cars	C. & C.
568	v. sl. s. w.; s. bz., eth., CCl_4, al., acetone	chem. mfr. deter., oil additives, rubber chem.	drums, tank cars	K.
569	27.9^{30} hexane, 75^{30} al.........	synth. inter., corrosion inhibitor, mold release agt., anti-static agt.	drums, tank cars	Arm.
570	% by wt. 25^{60} w., 12^{30} al......	mineral concentration, anti-static, corrosion inhibitor	drums.........	Arm.
571	....	org. syn., solvent...........	bottles, cans....	P.P.
572	....	org. syn....................	bottles, cans....	P.P.
573	....	org. syn....................	bottles, cans....	P.P.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
574	Octylamine	octylamine	$C_8H_{17}NH_2$	129.24
575	Oleic acid	9-octadecenoic acid	$C_{17}H_{33}COOH$	282.46
576	Ortho Xylene, Pure	1,2-dimethylbenzene	C_8H_{10}	106.16
577	Palmitic acid	hexadecanoic acid	$C_{15}H_{31}COOH$	256.47
578	Palmitonitrile	hexadecanenitrile	$C_{15}H_{31}CN$	237.42
579	Paraldehyde		$(CH_3CHO)_3$	132.16
580	Pentachloroethane	pentachloroethane	$CHCl_2CCl_3$	202.31
581	Pentachlorophenol	pentachlorophenol	Cl_5C_6OH	266.35
582	*n*-Pentane, Pure	*n*-pentane	$CH_3(CH_2)_3CH_3$	72.09
583	Pentanedione-2,4	acetylacetone	$CH_3COCH_2COCH_3$	100.11
584	Pentanol-3	*sec*-amyl alcohol	$(CH_3CH_2)_2CHOH$	88.15
585	Pentaphen	*p-tert*-amyl phenol	$C_5H_{11}C_6H_4OH$	164.24
586	Pentene-1, Pure	1-pentene	C_5H_{10}	70.13
587	" -2, "	2-pentene	C_5H_{10}	70.13
588	Perchlorobenzene	hexachlorobenzene	C_6Cl_6	284.80
589	Petrohol 91%	propanol-2	$CH_3CH(OH)CH_3$	60.09
590	" 99%	"	$CH_3CH(OH)CH_3$	60.09
591	Phenol, I.S.P.	carbolic acid	C_6H_6O	94.11
592	Phenothioxin	phenoxathin	$C_6H_4SOC_6H_4$	200.24
593	Phenoxyacetic acid	phenoxyacetic acid	$C_6H_5OCH_2COOH$	152.14
594	β-Phenoxy phenetole	1,2-diphenoxy ethane	$C_6H_5OCH_2CH_2OC_6H_5$	214.25
595	1-Phenylbutene-2, Technical	1-phenyl-2-butene	$C_6H_5C_4H_7$	132.20
596	Phenyl "Carbitol"*	diethylene glycol, monophenyl ether	$C_6H_5OCH_2CH_2OCH_2CH_2OH$	182.21
597	" "Cellosolve"*	2-phenoxyethanol	$C_6H_5OC_2H_4OH$	138.16
598	" diethanolamine	2,2-dihydroxyethyl aniline	$C_6H_5N(C_2H_4OH)_2$	181.23
599	" ethyl ethanolamine	ethyl phenyl ethanolamine	$C_6H_5N(C_2H_5)C_2H_4OH$	165.23
600	*x*-Phenyl diphenyl ether	phenyl xenyl ether	$C_6H_5OC_6H_4C_6H_5$	246.29
601	Phenyl ethane	ethyl benzene	$C_6H_5C_2H_5$	106.16

* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
574	wh. liq.	ammon.	90	$0.777^{26.8}$
575	wh. liq.	fa. fatty	90	0.898^{20}
576	col. flam. liq.		99 min.	$0.880\frac{20}{4}$
577	wh. sld.	fa. fatty	90	0.853^{62}
578	wh. sld.	faint	90	0.822^{31}
579	w. wh. liq.	pleas.		$0.9943\frac{20}{40}$
580	col. liq.	mild, pleas.		$1.670\frac{25}{25}$
581	wh. cr.	phenolic		
582	col. flam. liq.	sweet	99 min.	$0.626\frac{20}{4}$
583	liq.	mild, ketone-like		$0.9753\frac{20}{20}$
584				$0.8169\frac{20}{20}$
585	wh. fl. sld.			0.92–0.93[illegible]
586	col. flam. liq.		99 min.	$0.642\frac{20}{4}$
587	col. flam. liq.		99 min.	$0.651\frac{20}{4}$
588	wh.-pa. yel. need.			
589	liq.	char.	90.9	$.818–.819\frac{20}{20}$
590	liq.	char.	99	$—.786–.7937\frac{20}{20}$
591	wh. cr. sld.			$1.058\frac{41}{4}$
592	wh. cr.	fa. pleas.		$1.226\frac{60}{25}$
593	lt. tan cr.	none	98	
594	wh. cr.	pleas.		
595	col. flam. liq.		95 min.	$0.855\frac{20}{4}$
596	col. liq.			$1.1158\frac{20}{20}$
597	w. wh. liq.	fa. aromatic		$1.1094\frac{20}{20}$
598	yel. waxlike sld.			$1.1203\frac{60}{20}$
599	col. liq.			$1.04\frac{20}{20}$
600	lt. yel. cr.	none		$1.109\frac{30}{25}$
601	cl. col. mobile liq.	pleas.		$.866\frac{25}{25}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
574	Octylamine	−13	60^{10}		
575	Oleic acid	14	226^{10}		
576	Ortho Xylene, Pure	−25.49	144.4		
577	Palmitic acid	56	167^{1}		
578	Palmitonitrile	26	142^{1}		
579	Paraldehyde	12.6	124.5		111.2
580	Pentachloroethane	<−20		159–5%; 161.4–95%	none
581	Pentachlorophenol	187.1–189.1			
582	*n*-Pentane, Pure	−129.8	36.1		
583	Pentanedione-2,4	−23.5	140.5		110
584	Pentanol-3	−50 sets to a glass	115.9	105–142	105
585	Pentaphen	90° (min) freezing			232 (C.O.C.)
586	Pentene-1, Pure	−165.4	30.0		
587	" -2, "		36.5		
588	Perchlorobenzene	229.9–230.6			
589	Petrohol 91%	−85.8		79.5–80.7	63
590	" 99%	−85.8		80.5–82.5	59
591	Phenol, U.S.P.	40.7 congealing point	181.6		
592	Phenothioxin	53–55	180^{10}		323.6
593	Phenoxyacetic acid	97.5			
594	*β*-Phenoxy phenetol	95.9–98.0			
595	1-Phenylbutene-2, Technical	−74.5		178.9–193.3	
596	Phenyl "Carbitol"*	−50 sets to a glass	207 (55 mm)		
597	" "Cellosolve"*	14.0	244.7	240–248	250
598	" diethanolamine	56.6	200^{10}		370
599	" ethyl ethanolamine		268^{740}	$260–268^{740}$	270
600	*x*-Phenyl diphenyl ether	27.6	205^{10}		359.6
601	Phenyl ethane	<−70		135–5%; 137–95%	68

* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
574	∞^{30} al., hexane	synth. inter	drums	Arm.
575	∞^{30} al., eth.	mfg. soaps, cosmetics, surface active agts., textile treating agt. lubr. additives, metallic soaps	drums, tank cars	Arm.
576		org. syn., solvent	bottles, cans, drums	P.P.
577	16.7^{30} al., 15.6^{30} acet., 14.5^{30} hexane	mfg. cosmetics, wetting agts., rubber, plast., metallic soaps, synth. inter.	bags (flake), tank cars	Arm.
578	1000^{30} al., 2650^{30} hexane	synth. inter	drums, tank cars	Arm.
579	10.5^{20}% by wt. in w.	prep. of resins and plast., rubber, dyestuffs and leather		C. & C.
580	∞ meth. al., eth., CCl_4, bz., acet.; i. w.			D.
581	g. per 100 g.: 53 acet., 11 bz., 4 CCl_4, 148 eth., 57 meth. al., .002 w.			D.
582	imm. w.	lab. reagent, solvent, org. syn.	bottles, cans, drums	P.P.
583	16.6^{20}% by wt. in w.	fung., insect., driers for paints and varn. and colors for inks	cans, drums	C. & C.
584	4.1^{20}% by wt. in w.	mfr. of pharm. and flotation agts.	cans, drums, tank cars	C. & C.
585	s. 10% KOH, oil, al., eth., bz., chl., acet.; i. w.	resin mfr., org. syn., pharm. prep.	cartons	Sh.
586		org. syn	bottles, cans	P.P.
587		org. syn.	bottles, cans, drums	P.P.
588	v. s. eth.; s. CCl_4,; sl. s. bz.; i. w., al.			D.
589	∞^{25} w.	solv., antiseptics, cosmetics	cans, drums, tank wagons, tank cars	St.
590	∞^{25} w.	solv. antiseptics, cosmetics	cans, drums, tank wagons, tank cars	St.
591	g. per 100 g. at 25°C: ∞ al., CCl_4, eth., w. at 80°C 9.5.	mfr. synth. resins, disinfect.	drums	D.
592	G. per 100 g.: 7 meth. al., 165 eth., 100 CCl_4, 165 bz., 200 acet.; i. w.			D.
593	v. s. al.: g. per 100 g.: 29 eth., 3 bz., 1 w.; i. CCl_4	org. syn	barrels	D.
594	g. per 100 g.: 23 acet., 27 bz., 7 CCl_4, 9 eth., 2 meth. al.; i. w.			D.
595		org. syn	bottles, cans	P.P.
596	3.6^{20}% by wt. in w.	high boiling solvent	cans, drums	C. & C.
597	2.7^{20}% by wt. in w.	fixative for perfumes; org. syn.	cans, drums	C. & C.
598	3.34^{20}% by wt. in w.	chem. inter. for dyestuffs and acetate rayons	cans, drums	C. & C.
599	0.5^{20}% by wt. in w.	dye inter	cans, drums	C. & C.
600	g. per 100 g.: 100 eth., 100 CCl_4, 100 bz., 100 acet.; i. w.			D.
601	∞ eth., CCl_4, bz., al.; i. w.			D.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
602	Phenyl ethanolamine	phenyl ethanolamine	$C_6H_5NHC_2H_4OH$	137.18
603	" methyl carbinol	α-methyl benzyl alcohol	$C_6H_5CH(OH)CH_3$	122.16
604	*N*-Phenyl morpholine	phenyl morpholine	$C_6H_5\underbrace{NCH_2CH_2OCH_2CH_2}$	163.21
605	Phorone	phorone	$(CH_3)_2C{:}CHCOCH{:}C(CH_3)_2$	138.2
606	Phosphen 1	diphenyl mono-(*p-tert*-butyl phenyl) phosphate	$(CH_3)_3CC_6H_4OP(OC_6H_5)_2\dot{O}$	382.39
607	" 2	bis(*p-tert*-butylphenol) phenyl phosphate	$C_{26}H_{31}O_4P$	438.49
608	" 3	*o*-chlorophenyl diphenyl phosphate	$C_{18}H_{14}O_4ClP$	360.73
609	" 4	bis(*o*-chlorophenyl)phenyl phosphate	$C_{18}H_{13}O_4Cl_2P$	395.18
610	" 5	2-bi-phenyl diphenyl phosphate	$C_{24}H_{19}O_4P$	402.37
611	" 9	tri-2-biphenylyl phosphate	$C_{36}H_{27}O_4P$	554.56
612	Phthalic anhydride		$C_6H_4(CO)_2O$	148.11
613	Piperazine	piperazine	$\underbrace{NHCH_2CH_2NHCH_2CH_2}$	86.14
614	Polyethylene glycol chloride 110	diethylene glycol chlorhydrin	$ClCH_2CH_2OCH_2CH_2OH$	124.57
615	Polyethylene glycol chloride 410	polyethylene chlorhydrin	$HOCH_2(CH_2OCH_2)_xCH_2Cl$	390. to 430
616	Polyethylene glycol chloride 610	" "	$HOCH_2(CH_2OCH_2)_xCH_2Cl$	580 to 640
617	Polyethylene glycol chloride 400 dilaurate	" glycol 400 dilaurate	$CH_3(CH_2)_{10}COOCH_2CH_2$-$(CH_2CH_2O)_8OOC(CH_2)_{10}CH_3$	779.08
618	Polyethylene glycol 200 (mono)laurate	" glycol 200 (mono)-laurate	$HO(CH_2CH_2O)_3CH_2CH_2COC$-$(CH_2)_{10}CH_3$	376.52
619	Polyethylene glycol 400 (mono)laurate	" glycol 400 mono-laurate	$HO(CH_2CH_2O)_8CH_2CH_2OOC$-$(CH_2)_{10}CH_3$	596.78
620	Polyethylene glycol 600 (mono)laurate	" glycol 600 mono-laurate	$HO(CH_2CH_2O)_{12}CH_2CH_2OOC$-$(CH_2)_{10}CH_3$	772.99
621	Polyethylene glycol 4000 dioleate	Polyethylene glycol 4000 dioleate	$C_{216}H_{426}O_{93}$	4511.57
622	Polyethylene glycol 400 monooleate	Polyethylene glycol 400 monooleate	$C_{36}H_{70}O_{11}$	678.92
623	Polyethylene glycol 6000 monooleate	Polyethylene glycol 6000 monooleate	$C_{290}H_{598}O_{138}$	6293.68
624	Polyethylene glycol 400 di, triricinoleate	Polyethylene glycol 400 di, triricinoleate	$C_{126}H_{230}O_{22}$	2097.10
625	Polyethylene glycol 400 monoricinoleate	Polyethylene glycol 400 monoricinoleate	$HO(CH_2CH_2O)_8CH_2CH_2OOC$-$(CH_2)_7CH{:}CHCH_2OHCH$-$(CH_2)_5CH_3$	694.92
626	Polyethylene glycol 400 distearate	Polyethylene glycol 400 distearate	$CH_3(CH_2)_{16}COOCH_2CH_2$-$(CH_2CH_2O)_8OOC(CH_2)_{16}CH_3$	947.39
627	Polyethylene glycol 600 distearate	Polyethylene glycol 600 distearate	$C_{62}H_{122}O_{16}$	1123.60
628	Polyethylene glycol 200 monostearate	Polyethylene glycol 200 monostearate	$HO(CH_2CH_2O)_3CH_2CH_2OOC$-$(CH_2)_{16}CH_3$	460.68

No.	Physical form and color	Odor	Purity %	Sp. gr.
602	liq.			$1.0970\frac{20}{20}$
603	col. liq			$1.0150\frac{20}{20}$
604	sld.			$1.0599\frac{57}{20}$
605	yel. liq	geranium-like		0.8791
606	cl.-col. pa. straw mobile perm. liq.	none		$1.16\frac{25}{25}$
607	cl. col. visc. per. liq	none		$1.11\frac{25}{25}$
608	cl. col. pa. straw mobile perm. liq.			$1.3\frac{25}{25}$
609	cl. col.-pa. straw mobile perm. liq.			$1.34\frac{25}{25}$
610	cl. col. mobile liq	none		$1.20\frac{60}{4}$
611	wh. gran. sld	none		
612	wh. fl.			
613	liq.	amine-like		
614	w. wh. liq		99.8	$1.1753\frac{20}{20}$
615	semi-solid			$1.143\frac{20}{20}$
616	semi-solid			$1.144\frac{20}{20}$
617	yel. liq	faint fatty	tech.	0.97
618	light, yellow liq	faint fatty	tech.	0.99
619	light, yellow liq	faint fatty	tech.	1.03
620	light, yellow liq	faint fatty	tech.	1.01
621	soft solid amber	faint fatty	tech.	1.06
622	liq. amber	faint fatty	tech.	1.01
623	solid amber	faint fatty	tech.	1.1
624	liq. amber	faint fatty	tech.	0.96
625	liq. yellow	faint fatty	tech.	1.03
626	soft solid yellow	faint fatty	tech.	0.98
627	solid yellow	faint fatty	tech.	1.00
628	soft solid yellow	faint fatty	tech.	1.02

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
602	Phenyl ethanolamine	10.6	285.2	280–290	305
603	" methyl carbinol	21.4	203.9		205
604	*N*-Phenyl morpholine	57	270		220
605	Phorone	28.0	197.9		185
606	Phosphen 1	<0	245–260^5		>437
607	" 2	<0	260–275^5		482
608	" 3	<0	240–255^5		>419
609	" 4	<0	255–270^5		>437
610	" 5	<0	250–285^5		437
611	" 9	113–115			
612	Phthalic anhydride	130.7 min			
613	Piperazine	104			
614	Polyethylene glycol chloride 110	−90 sets to a glass	198.9		225
615	" " " 410				370
616	" " " 610				370
617	" " 400 dilaurate	<15			
618	" " 200 (mono) laurate	<10			
619	" " 400 (mono-) laurate	<8			
620	" " 600 "	20–25			
621	Polyethylene glycol 4000 dioleate	50–55			
622	" " 400 monooleate	<2			
623	" " 6000 "	58–61			
624	" " 400 di, triricinoleate	<−10			
625	" 400 monoricinoleate	<0			
626	" " 400 distearate	33–37			
627	" " 600 "	24–26			
628	" " 200 monostearate	26–31			

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
602	4.6^{20}% by wt. in w.	components of antirust comp., lubr., and cutting oils	cans, drums	C. & C.
603	2.3^{20}% by wt. in w.	mfr. of phenyl urethane and its acetate; high boiling solv.	cans, drums	C. & C.
604	1.0^{20}% by wt. in w.	reactant with benzaldehyde to make green dye	cans, drums	C. & C.
605	0.11^{50}% by wt. in w.	inter.	cans, drums	C. & C.
606	∞ bz., CCl_4; v. s. al.; s. V.M.P. naphtha; i. w.			D.
607	∞ CCl_4, bz., v. s. al.; s. V.M.P. naphtha; i. w.			D.
608	∞ CCl_4, bz.; v. s. al., sl. s. V.M.P. naphtha; i. w.			D.
609	∞ CCl_4, bz., v. s. al.; sl. s. V.M.P. naphtha; i. w.			D.
610	∞ CCl_4, bz.; v. s. al.; sl. s. V.M.P. naphtha; i. w.			D.
611	g. per 100 g.: 8 bz., 1 CCl_4; sl. s. V.M.P. naphtha; i. w., al.			D.
612	v. sl. s. w., ether, s. al.	alkyd resins, plasticizers, dyes, pharm.	bags	K.
613	15^{20}% by wt. in w.	synth. drugs	research quantity	C. & C.
614	∞ w.	chem. inter.	cans	C. & C.
615	∞ w.	inter. for surface-active agts., dyestuffs, and emulsion breakers	cans	C. & C.
616	∞ w.	inter. for surface-active agts., dye assists., dyestuffs, and emulsion breakers	cans	C. & C.
617	i. w.; s. al., hydrocarbon	plasticizer emulsion stabilizer	drums, cans	G.
618	sl. s. w.; s. al., toluol	emulsifier, stabilizer, plasticizer	cans, drums	G.
619	s. w., al., toluol	emulsifier, wetting agt., stabilizer	cans, drums	G.
620	s. w., al., aromatics; i. aliphatics	wetting agt., emlusifier		G.
621	disp. h. w.; s. h. al., h. toluol, h. mineral oil	emulsifier, stabilizer, lubricant	cans, drums	G.
622	sl. s. w.; s. al., toluol; i. aliphatics	emulsifier, wetting agt	cans, drums	G.
623	s. h. w., h. al., toluol; i. mineral oil	emulsifier, stabilizer, lubricant	can, drums	G.
624	disp. w.; i. meth.; s. ethers, esters, ketones, hydrocarbons	lubricant emulsifier	cans, drums	G.
625	disp. w.; s. al., toluol; i. aliphatic hydrocarbons	wetting agt., emulsifier	cans, drums	G.
626	i. w.; s. ethanol, hydrocarbons.	emulsifier, spreading agent	cans, drums	G.
627	i. w.; s. al., hydrocarbons	emulsifier thickener	cans, drums	G.
628	disp. w.; s. al., ketones, esters; i. hydrocarbons	emulsifier lubricant	cans, drums	G.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
629	Polyethylene glycol 300 monostearate	Polyethylene glycol 300 monostearate	$HO(CH_2CH_2O)_5CH_2CH_2OOC\text{-}(CH_2)_{16}CH_3$	548.78
630	Polyethylene glycol 400 monostearate	Polyethylene glycol 400 monostearate	$HO(CH_2CH_2O)_8CH_2CH_2OOC\text{-}(CH_2)_{16}CH_3$	680.93
631	Polyethylene glycol 600 monostearate	Polyethylene glycol 600 monostearate	$HO(CH_2CH_2O)_{12}CH_2CH_2OOC\text{-}(CH_2)_{16}CH_3$	857.14
632	Polyethylene glycol 1000 monostearate	Polyethylene glycol 1000 monostearate	$C_{62}H_{124}O_{24}$	1253.61
633	Polyethylene glycol 4000 monostearate	Polyethylene glycol 4000 monostearate	$C_{195}H_{396}O_{92}$	4249.15
634	Propane, Pure	propane	$CH_3CH_2CH_3$	44.09
635	“	“	$CH_3CH_2CH_3$	44.09
636	Propionic anhydride	propanoic anhydride; propionyl oxide	$(CH_3CH_2CO)_2O$	130.14
637	Propiophenone		$C_6H_5COC_2H_5$	134.17
638	Propyl *p*-hydroxybenzoate	propyl *p*-hydroxybenzoate	$C_{10}H_{12}C_3$	180.20
639	*n*-Propyl bromide	bromopropane	$CH_3CH_2CH_2Br$	123.00
640	Propylene		$CH_3CH{:}CH_2$	42.08
641	“ , Pure	propene	CH_2CHCH_3	42.08
642	“ chlorhydrin	chlorisopropyl alcohol; 1-chloropropanol-2	$CH_3CH(OH)CH_2Cl$	94.54
643	“ diamine	propylene diamine; 1,2-diaminopropane	$CH_3CH(NH_2)CH_2NH_2$	74.13
644	“ dibromide	1,2-dibromopropane; propylene bromide	$CH_3CHBrCH_2Br$	201.91
645	“ dichloride	1,2-dichloropropane	$CH_3CHClCH_2Cl$	112.99
646	“ glycol	1,2-dihydroxypropane; propanediol-1,2	$CH_3CH(OH)CH_2CH$	76.09
647	“ “ diricinoleate	propylene glycol diricinoleate	$CH_3CHCH_2(C_{17}H_{32}OHCOO)_2$	639.14
648	“ glycol, distearate	propylene glycol distearate	$CH_3CHCH_2(C_{17}H_{32}COO)_2$	609.14
649	“ glycol monolaurate	propylene glycol monolaurate	$CH_3CHOHCH_2OOC(CH_2)_{10}CH_3$	258.39
650	“ “ monostearate	propylene glycol monostearate	$CH_3CHOHCH_2OOCC_{17}H_{35}$	342.54
651	“ oxide	propylene oxide	CH_3CHCH_2O	58.08
652	Pyrosal	antipyrene acetyl salicylate	$C_{20}H_{20}O_5N_2$	368.38
653	Resorcinol, (U.S.P.)		$C_6H_4(OH)_2$	110.11
654	*β*-Resorcylic acid		$C_6H_3(OH)_2COOH$	154.12
655	Salicyl salicylic acid	salicyl salicylic acid	$C_{14}H_{10}O_5$	258.22
656	Sodium diphenyl-4-sulfonate	diphenyl-4-sulfonic acid	$C_{12}H_9O_3SNa$	256.25
657	Sorbic acid	2,4-hexadienoic acid	$CH_3CH{:}CHCH{:}CHCOOH$	112.12
657a	Crystalline sorbitan	monoanhydrosorbitol	$C_6H_8O(OH)_4$	164.16

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
629	soft solid yellow	faint fatty	tech.	1.03
630	soft solid white	faint fatty	tech.	1.00
631	soft solid yellow	faint fatty	tech.	1.01
632	solid yellow	faint fatty	tech.	1.02
633	solid yellow	faint fatty	tech.	1.10
634	col. flam. liq. gas	char. pleas. sweet	99 min.	0.501^{20}_{4}
635	gas	char. nat. gas	99	0.5007^{20}_{20}
636	col. liq.	pungent	97	1.0119^{20}_{20}
637	col. liq.	sweet, pleas.	*ca.* 95	1.01–1.02
638	wh. cr.	none		
639	cl. col. liq.	pen.		1.333^{25}_{25}
640	col. gas			0.5142^{20}_{20}
641	col. flam. liq. gas		99 min.	0.514^{20}_{4}
642	w. wh.	mild, n. res.	98	1.1128^{20}_{20}
643	col. liq.	mild, amm.	90–95	0.8732
644	cl. col. heavy liq.	sweet		1.930–1.945
645	w. wh. liq.	chloroform-like		1.1583^{20}_{20}
646	w. wh. liq.	none		1.0381^{20}_{20}
647	amber oil	fa. fatty		0.942^{25}_{25}
648	cr. col. sld.	fa. fatty		0.965^{25}_{25}
649	yel. liq.	fa. fatty	Tech.	0.93
650	cr. colored soft sld.	fa. fatty		0.93^{25}_{25}
651	w. wh. liq.			$0.831–0.836^{20}_{20}$
652	wh. powd.			
653	wh. cr. or powd.	phenolic	99.5	
654	wh. cr. powd.	aromatic	97 (min.)	
655	wh. powd.	none		
656	fine wh. cr.	aromatic		
657	wh. cr. sld.		99	
657a	col. cr.	none; sweet with bitter aftertaste	v. high	

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
629	Polyethylene glycol 300 monostearate	26–30			
630	Polyethylene glycol 400 monostearate	24–28			
631	Polyethylene glycol 600 monostearate	29–35			
632	Polyethylene glycol 1000 monostearate	37–42			
633	Polyethylene glycol 4000 monostearate	54–57			
634	Propane, Pure	−187.7	−42.1		
635	"	−187.7	−42.1		<20
636	Propionic anhydride	−43	169.0	160–175	165
637	Propiophenone	16.5–17.5	215–218, 80%	215–218, 80%	210
638	Propyl *p*-hydroxybenzoate	96			
639	*n*-Propyl bromide	<−30		70–5%; 72–95%	none
640	Propylene	−185.2	−47.7		<20
641	" , Pure	−185.4	−47.7		
642	" chlorhydrin		127.4	122.-134.0	125
643	" diamine		119.7	112.0–122.0	160
644	" dibromide			139.6–5%; 142.6–95%	none
645	" dichloride		96.3	<93–none; >99–none	70
646	" glycol		188.2	185–194	225
647	" " diricinoleate				
648	" " distearate	34–35			
649	" " monolaurate	<12			
650	" " monostearate	37.39			
651	" oxide	−104.4	33.9	<30–none; >40–5%	−35
652	Pyrosal	61.4–63.8			
653	Resorcinol, (U.S.P.)	109.4			339 (T.O.C.)
654	β-Resorcylic acid	215 min			
655	Salicyl salicylic acid	145.7–149.2			
656	Sodium diphenyl-4-sulfonate				
657	Sorbic acid	134.5	120^{10}		260 (approx.)
657a	Crystalline sorbitan	110–111			

See two preceding pages for additional data on above compounds

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
629	i. w.; s. al., esters, ethers, ketones	emulsifier plasticizer	cans, drums	G.
630	disp. h. w.; s. al., esters, ketones, aromatics	emulsifier	cans, drums	G.
631	s. w., al., toluol; i. aliphatic hydrocarbons	emulsifier	cans, drums	G.
632	s. h. w., al., toluol; i. aliphatic hydrocarbons	emulsifier stabilizer	cans, drums	G.
633	s. h. w., al., esters, ketones, hydrocarbons	emulsifier, stabilizer, thickener, lubricant	cans, drums	G.
634	imm. w	refrig., reagent, org. syn., motor fuel research	cylinders, tank cars	P.P.
635	0.065 at 17.8°C vol. gas per vol. w.	refrigerant fuel	cylinders	C. & C.
636	d. w	esterifying agt.	cans, drums	C. & C.
637	i. w.; s. eth., al	perfume agt., pharm. mfr	bottles, cans	K.
638	g. per 100 g.: 105 acet., 100 meth. al., 50 eth., 3 bz., .5 CCl_4; i. w.			D.
639	∞ acet., bz., CCl_4, eth., meth. al., V.M.P. naphtha; i. w.	org. syn	drums	D.
640	0.207 vol. gas per vol. w	chem. inter	cylinders	C. & C.
641		poly., org. syn., motor fuel research	cylinders	P.P.
642	∞ w	chem. syn	cans, drums	C. & C.
643	∞ w	chem. syn	cans, drums	C. & C.
644	∞ acet., bz., CCl_4; v. s. eth.; s. al; g. per 100 g.: 0.2^{25} w.	org. syn		D.
645	0.26^{20}% by wt. in w	clean. comp.; org. syn. solid fumigant, extr.	cans, drums, tank cars	C. & C.
646	∞ w	solv. for flav. and col.; humectant, liq. coolant in freezing systems	cans, drums, tank cars	C. & C.
647	s. al., naphtha; i. w	hydraulic fluids, lubricants, plasticizer		G.
648	s. naphtha, h. al.; i. w			G.
649	disp. w.; s. al., hydrocarbons, esters	emulsifier	cans, drums	G.
650	s. acet., et. acetate, h. al., toluene, naphtha; i. w.	suppositories; emulsifier with soap		G.
651	40.5^{20}% by wt. in w	fumigant, chem. syn	cans, drums, tank cars	C. & C.
652	g. per 100 g.: 126 al., 113 bz., 13 eth., 4^{80} w.; i. CCl_4			D.
653	s. w., al., eth., acetone; sl. s. glycerin	pharm. properties, dyes, syn. drugs, resins.	drums	K.
654	sl. s. w.; s. al., eth., alkalis	chem. inter. for dyestuffs and pharm.	drums	K.
655	g. per 100 g.: 66 acet., 45 al., 28 eth., 1 bz., v. sl. s. CCl_4; i. w.			D.
656	g. per 100 g.: 1.5 w., .02 acet., .002 bz., .03 CCl_4, eth., .06 meth. al.			D.
657	0.15^{20}% by wt. in w	chem. inter	cans, drums	C. & C.
657a	s. w., pyridene, acet. a.; sl. s. dioxane, acet., meth. e. ketone; i. most other organ. solv.	org. syn		At.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
658	Sorbitol hexaacetate	sorbitol hexaacetate	$C_6H_8O_6(CH_3CH)_6$	434.39
659	Span 20	sorbitan monolaurate	$C_6H_8O(OH)_3(OCOC_{11}H_{23})$†	346.3†
660	" 40	" monopalmitate	$C_6H_8O(OH)_3OCO(CH_2)_{14}(CH_3)$†	402.3†
661	" 60	" monostearate	$C_6H_8O(OH)_3OCO(CH_2)_{16}CH_3$†	430.4†
662	" 80	" monooleate	$C_6H_8O(OH)_3OCO(CH_2)_7$-$CH(C_8H_{17})CH$†	428.4†
663	" 85	" trioleate	$C_6H_8O(OH)[OCOC_{17}H_{33}]_3$†	957.0†
664	Stearamide	octadecanamide	$C_{17}H_{35}CONH_2$	283.49
665	Stearic acid	octadecanoic acid	$C_{17}H_{35}COOH$	284.47
666	Stearonitrile	octadecanenitrile	$C_{17}H_{35}CN$	265.47
667	Styrene (monomer)	styrene	$C_6H_5CH{:}CH_2$	104.14
668	" (polymer)		$C_6H_5(CH{:}CH_2)$	104.14
669	" dibromide	(1,2-dibromoethyl) benzene	$C_8H_8Br_2$	263.98
670	Succinic acid		$COOH(CH_2)_2COOH$	118.09
671	Sucrose Octa acetate		$C_{12}H_{14}O_3(OOCCH_3)_8$	678.58
672	1,2,4,5-Tetrachlorobenzene	1,2,4,5-tetrachlorobenzene	$C_6H_2Cl_4$	215.90
673	Tetrachlorohydroquinone	tetrachlorohydroquinone	$C_6H_2O_2Cl_4$	247.90
674	2,3,4,6-Tetrachlorophenol	2,3,4,6-tetrachlorophenol	$C_6H_2OCl_4$	231.90
675	Tetrachloroquinone	chloranil	$Cl_4C_6O_2$	245.89
676	Tetradecanol	7-ethyl-2-methyl-undecanol-4	$C_4H_9CH(C_2H_5)C_2H_4CH(OH)$-$CH_2CH(CH_3)_2$	214.38
677	Tetradecylamine	tetradecylamine	$C_{14}H_{29}NH_2$	213.40
678	Tetraethanolammonium hydroxide	tetraethanolammonium hydroxide	$(HOCH_2CH_2)_4NOH$	211.26
679	Tetraethoxy propane		$(C_2H_5O)_2CHCH_2CH(OC_2H_5)_2$	220.30
680	Tetraethyl-*o*-silicate		$(C_2H_5)_4SiO_4$	208.30
681	Tetraethylene glycol (distilled)	tetraglycol	$HO(CH_2CH_2O)_3CH_2CH_2OH$	194.23
682	Tetraethylene pentamine	tetraethylene pentamine	$NH_2(CH_2CH_2NH)_3CH_2CH_2NH_2$	189.31
683	Tetraglycol dichloride	tetraglycol dichloride	$(ClCH_2CH_2OCH_2CH_2)_2O$	231.12
684	Tetrahydrofurfuryl alcohol	tetrahydrofurfuryl alcohol; tetrahydro-2-furfurylcarbinol	$C_4H_7O{\cdot}CH_2OH$	102.13
685	Tetrahydrofurfuryl glycolate	tetrahydrofurfuryl glycolate	$(CH_2)_3CHOCH_2OOC{\cdot}CH_2OH$	160.16

† Theoretical.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
658	wh. cr	none, bitter aftertaste		1.34^{25}
659	amber col. visc. oily liq	fatty	tech	1.00–1.06
660	yel. wax	faint, fatty	tech	1.00–1.05
661	yel. brittle wax	faint, fatty	tech	0.98–1.03
662	amber-col., visc. oily liq	fatty	tech	1.00–1.05
663	amber, oily liq	fatty	tech	0.92–0.98
664	wh. solid	none	93	
665	wh. solid	faintly fatty	90	0.849^{70}
666	wh. solid	fa	93	0.814^{45}
667	liq	sw. pleas. when pure	99.7	$0.9045\frac{25}{25}$
668	col. liq	aromatic	99.5 min	
669	sl. colored coarse gran	persistent char	97	
670	solid			
671	wh. cr		99.4	$1.28\frac{20}{20}$
672	lt. tan cr	like *p*-dichlorobenzene		
673	lt. tan powd	pung		
674	tan flakes	strong, char		$1.63\frac{60}{4}$
675	golden br. cr. sld	mild, char		
676	col. liq	mild	95	0.8355
677	wh. sld	amm	90	$0.80^{30°C}$
678				
679	liq			$0.924\frac{20}{20}$
680	col. liq		97	$0.9356\frac{20}{20}$
681	col. hyg. liq			$1.1247\frac{20}{20}$
682	visc. hyg. liq	char. amine-like		$0.9980\frac{20}{20}$
683	liq			1.186
684	col.-straw liq	mild	95 min	$1.052\frac{25}{25}$
685	amber liq	fa		$1.172\frac{25}{25}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
658	Sorbitol hexaacetate	98-100	220–240^{12}		
659	Span 20	14–16			400
660	" 40				415
661	" 60				450
662	" 80	10–12			410
663	" 85	10			
664	Stearamide	100	d.		
665	Stearic acid	67	184^{1}		
666	Stearonitrile	39	163^{1}		
667	Styrene (monomer)	−30.63	145.2		87.8
668	" (polymer)				100 (Tag O.C.)
669	" dibromide	70–75			
670	Succinic acid	185	235 dec.		
671	Sucrose Octa acetate		89		
672	1,2,4,5-Tetrachlorobenzene	136.0–139.0			none
673	Tetrachlorohydroquinone	235.0–236.1			
674	2,3,4,6-Tetrachlorophenol	55–62			none
675	Tetrachloroquinone	285–287			
676	Tetradecanol		264.1		285
677	Tetradecylamine	29	110^{1}		
678	Tetraethanolammonium hydroxide				
679	Tetraethoxy propane		109 (20 mm)		
680	Tetraethyl *o*-silicate	−77	168.1	160–170	135
681	Tetraethylene glycol (distilled)	−6.2	327.3		345
682	Tetraethylene pentamine		333	310–320	365
683	Tetraglycol dichloride		114^{2}		>250
684	Tetrahydrofurfuryl alcohol	<−80	177–8^{743}	170–180, 99%	167.0
685	Tetrahydrofurfuryl glycolate				

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
658	$.27^{25}$ w., 3.0^{100} w.	hardening agt. plasticizer		At.
659	disp. w.; s. oil and org. solv.	emulsifier, wetting and drying agt. edible	cans, drums	At.
660	disp. h. w.; s. warm oils, most org. solv.	emulsifier, thickening agt.	drums, fiber containers	At.
661	disp. h. w.; s. warm oils, most org. solv.	emulsifier, thickening agt.	drums, fiber containers	At.
662	disp. w.; s. oils, most org. solv.	w/o emulsifier, edible	cans, drums	At.
663	s. oils, org. solv. sl. w. disp.	w/o emulsifier, dispersing agt.	cans, drums	At.
664	0.8^{30}, 50^{70} al., 0.05^{60} hexane	plasticizer, anti-block, anti-tack, textile water repellent	bags (flake)	Arm.
665	3.42^{30} al., 4.93^{30} acet., 4.3^{30} hexane	mfg. cosmetics, metallic soaps, chemicals, rubber, prtg. ink	bags (flake) tank cars	Arm.
666	35.7^{30} al., 166^{30} hexane	synth. inter. plasticizer	drums, tank cars	Arm.
667	$.0125^{20}$ w.	in mfr. of synth. rubber		D.
668	i. w.; s. bz	in mfr. of polystyrene plastics	drums, tank cars	K.
669	g. per 100 g. at 25°C: acet. 154, bz. 158, CCl_4 50, meth. al. 12, V.M.P. naphtha 18; i. w.	org. syn. corn ear worm control	drums	D.
670	6.3^{20}% by wt. in w.	chem. inter.	drums	C. & C.
671	v. sl. s. w.	denaturant; bittering agt.	drums	C. & C.
672	G. per 100 g.: 0.8 al., 6 CCl_4, 58 monochlorobenzene; i. w.			D.
673	g. per 100 g.: 45 acet., 0.2 bz., .04 CCl_4, 20 eth., meth. al.; i. w.			D.
674	v. s. acet., al., bz., eth., meth. al.; v. sl. s. w.; g. per 100 g.: 31 CCl_4			D.
675	s. epichlorohydrin; sl. s. CCl_4; i. w., al., bz., eth.			D.
676	0.02^{20}% by wt. in w.	plasticizer inter., perfume fixatives	cans, drums	C. & C.
677	216^{30} hexane, 660^{30} al.	synth, inter. for mfg. of cationic surface-active agents, germicides	drums, tank cars	Arm.
678	∞ w.	textile auxiliary	research quant.	C. & C.
679	i. w.	chem. and pharm. syn.	cans, drums	C. & C.
680	dec.	precision casting mold binder	cans, drums	C. & C.
681	∞ w.	softener, humectant, inter. plasticizer	cans, drums	C. & C.
682	∞ w.	saponifying fatty acids ion-exchange resins	cans, drums, tank cars	C. & C.
683	sl. s. w.	chem. syn.	research quant.	C. & C.
684	∞ w., al., eth.	solv., org. syn. wetting agt., mfg. plasticizer		Q.O.
685	s. w., al., acet., toluene; i. naphtha	compatible nitro, et. cellu., cellu. acetate, vinylite resin		G.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
686	Tetrahydrofurfuryl laurate	tetrahydrofurfuryl ester; dodecanoic acid	$CH_3\cdot(CH_2)_{10}COOCH_2\cdot\text{-}\underline{OCH_2\cdot CH_2\cdot CH_2\cdot CH_2}$	284.39
687	Tetrahydrofurfuryl levulinate	tetrahydrofurfuryl levulinate	$(CH_2)_3OCHCH_2OOC(CH_2)_2\text{-}COCH_3$	200.19
688	Tetrahydrofurfuryl levulinate	tetrahydrofurfuryl levulinate	$CH_3COCH_2CH_2COO\cdot CH_2\cdot\text{-}\underline{OCH_2\cdot CH_2\cdot CH_2\cdot CH_2}$	200.19
689	Tetrahydrofurfuryl oleate	tetrahydrofurfuryl oleate	$(CH_2)_3OCHCH_2OOCC_{17}H_{33}$	366.64
690	Tetrahydrofurfuryl oleate	tetrahydrofurfuryl ester; 9-octadecenoic acid	$C_8H_{17}CH{:}CH(CH_2)_7COOH_2\cdot\text{-}\underline{OCH_2\cdot CH_2\cdot CH_2}$	366.64
691	Tetrahydrofurfuryl phthalate	ditetrahydrofurfuryl phthalate	$C_6H_4(COOCH_2\cdot\text{-}\underline{OCH_2CH_2CH_2CH_2})_2$	336.37
692	Tetrahydrofurfuryl ricinoleate	tetrahydrofurfuryl ester; 12-hydroxy-9-octadecenoic acid	$CH_3(CH_2)_5CHOH\cdot CH_2\cdot CH{:}\text{-}CH(CH_2)_7COOCH_2\cdot\text{-}\underline{OCH_2\cdot CH_2\cdot CH_2\cdot CH_2}$	382.54
693	Tetrahydrofurfuryl stearate	octadecanoic acid, tetrahydrofurfuryl ester	$CH_3\cdot(CH_2)_{16}COOCH_2\cdot\text{-}\underline{OCH_2\cdot CH_2\cdot CH_2\cdot CH_2}$	368.55
694	Tetrahydrophthalic anhydride	1,2,3,6-tetrahydrophthalic anhydride	$C_8H_8O_3$	152.14
695	Tetramethylene oxide	tetrahydrofuran	$\underline{OCH_2CH_2CH_2CH_2}$	72.06
696	Thiodiphenylamine	phenothiazine	$C_6H_4SNHC_6H_4$	199.26
697	Toluene, Pure	toluene	$C_6H_5CH_3$	92.13
698	*m*-Tolyl diethanolamine		$(HOC_2H_4)_2NC_6H_4CH_3$	195.28
699	*o*-Tolyl monoethanolamine		$(HOC_2H_4)NHC_6H_4CH_3$	151.20
700	2,4,6-Tribromophenol	2,4,6-tribromophenol	$(C_6H_3OBr_3$	330.83
701	Tri-*n*-butylamine	tributylamine	$(C_4H_9)_3N$	185.34
702	Tributyl citrate	tributyl citrate	$(CH_2COOC_4H_9)_2C(OH)\text{-}COOC_4H_9$	360.44
703	“ phosphate	“ phosphate	$(C_4H_9)_3PO_4$	266.32
704	1,1,2-Trichlorethane	*β*-trichlorethane	$ClCH_2CHCl_2$	133.42
705	Trichlorobenzene		$C_6H_3Cl_3$	181.46
706	2,4,5-Trichlorophenol	2,4,5-trichlorophenol	$C_6H_3OCl_3$	197.46
707	1,1,2-Trichloropropane	1,1,2-trichloropropane	$CH_3CHClCHCl_2$	147.44
708	1,2,3- “	1,2,3- “	$CH_2ClCHClCH_2Cl$	147.44
709	Triethanolamine	tri(2-hydroxyethyl)amine	$(HOCH_2CH_2)_3N$	149.19
710	Triethylamine	triethylamine	$(C_2H_5)_3N$	101.19
711	“	“	$(C_2H_5)_3N$	101.19

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
686	yel. liq		<1.0% free acid	0.930^{25}
687	amber liq	fa		1.10^{30}
688	yel. liq		2.0% free acid	1.110^{25}
689	yel. liq	fa		0.927^{30}
690	yel. liq		0.5% free acid	0.923^{25}
691	amber liq		1.5% free acid	1.94^{25}
692	yel. liq		0.5% free acid	0.955^{25}
693	yel. liq		1.0% free acid	0.917^{25}
694	sld			$1.375\frac{25}{20}$
695	col. liq	ether-like		$0.888\frac{20}{4}$
696	pa. yel. lust. pl	fa. char		
697	col. flam. liq		99 min	$0.866\frac{20}{4}$
698				
699				$1.0723\frac{20}{20}$
700	lt. pk. cr	fa. char. sw. astringent taste	95	
701	pa. yel. liq		96.5	$0.77–0.78\frac{20}{20}$
702	lt. straw stable, n, vol. liq	none	99	$1.043–1.049\frac{20}{20}$
703	w. wh. liq	none	99.95	$.973–983\frac{20}{20}$
704	col. liq			$1.4432\frac{20}{20}$
705	cl. col. refr. liq			$1.460\frac{25}{25}$
706	tan fl	strong phenolic		
707	cl. col. liq	sweetish char		$1.343\frac{25}{25}$
708	cl. col. liq	sweet char		$1.388\frac{25}{25}$
709	visc. hyg. liq	char	98	$1.1258\frac{20}{20}$
710	w. wh			$0.7293\frac{20}{20}$
711	w. wh. liq		98.5 (min.)	$0.73\frac{20}{20}$

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
686	Tetrahydrofurfuryl laurate	−7 to −9			
687	Tetrahydrofurfuryl levulinate				
688	Tetrahydrofurfuryl levulinate	−59 to −61			
689	Tetrahydrofurfuryl oleate				
690	Tetrahydrofurfuryl oleate	2–5			
691	Tetrahydrofurfuryl phthalate	<−15			
692	Tetrahydrofurfuryl ricinoleate	<−40			
693	Tetrahydrofurfuryl stearate	22			
694	Tetrahydrophthalic anhydride	101.9	195^{50}		315
695	Tetramethylene oxide	−65	66		below room temperature
696	Thiodiphenylamine	184.3–185.2			
697	Toluene, Pure	−95.2	111.8		
698	*m*-Tolyl diethanolamine	63.2			385
699	*o*-Tolyl monoethanolamine	−25 sets to a glass			290
700	2,4,6-Tribromophenol	91.5–92.6	sublimes		none
701	Tri-*n*-butylamine	<−70	214	95 % between 199–216	175
702	Tributyl citrate	−20	$233.5^{22.5}$	234–236	365^{25}
703	“ phosphate	<−80	$177–178^{27}$		294
704	1,1,2-Trichlorethane	−36.4	113.7	110.0–115.0	none
705	Trichlorobenzene	7.5	215		212
706	2,4,5-Trichlorophenol	60	252		none
707	1,1,2-Trichloropropane	<−20		132.0–5 %; 134.3–95 %	none
708	1,2,3- “	−15		155.4–5 %; 156–95 %	none
709	Triethanolamine	21.2	360		380
710	Triethylamine	−115.3	89.7		25
711	“	−114.8	88.5	not <85; not >91	20

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
686	i. w.; s. al., acet., toluene		cans, drums	Q.O.
687	∞ w.; s. al., toluene, naphtha	compatible nitro., et. cellu., cellu. acetate, vinylite		G.
688	s. w., al., acet., toluene		cans, drums	Q.O.
689	s. al., toluene, naphtha, acet., ethyl acetate, i. w.	plasticizer		G.
690	i. w., s. al., acet., toluene	plasticizer	cans, drums	Q.O.
691	i. w.; s. al., acet., toluene	plasticizer	cans, drums	Q.O.
692	i. w.; s. al., acet., toluene		cans, drums	Q.O.
693	i. w.; s. al., acet., toluene		cans, drums	Q.O.
694		alkyd resins, upgrad. dry. oils, wett., foaming, emulsify. agt. chem. inter.	cans, drums	C. & C.
695	∞ w., org. solv	solv. org. syn	research quant.	Q.O.
696	g. per 100 g.: 27 acet., 3 bz., .6 CCl_4, 7 eth., 2 meth. al.; i. w.			D.
697		solv., motor fuel research, org. syn.	bottles, cans, drums	P.P.
698		dyestuff inter.	cans, drums	C. & C.
699	1.67^{20}% by wt. in w	chem. inter.	cans, drums	C. & C.
700	v. s. acet., al., eth.; v. sl. s. w.; g. per 100 g.: 12 CCl_4, 50 bz.	disinfectant and antiseptic		D.
701	∞ most org. solv.; i. w.	corrosion inhibitor inter.	drums	Sh.
702	i., imm. w	plasticizer, cellu. nitrate, acetate, resins; antifoaming agt., lub. agt.		C.S.
703	0.6^{25} w	plasticizer nitro. lacq., plastics, cellu. acetates	cans, drums	C.S.
704	0.45^{20}% by wt. in w	solv., ingredient of spotting fluids, extr.	cans, drums, tank cars	C. & C.
705	g. per 100 g.: 280 al., ∞ bz., CCl_4, eth.; i. w.		drums, tank cars	D.
706	v. s. al., bz., CCl_4, eth., i. w.			D.
707	∞ acet., al., bz., CCl_4, eth.; i. w.			D.
708	∞ acet., al., bz., CCl_4, eth.; i. w.			D.
709	∞ w	gas absorbent, form soaps, emulsifying agts.	cans, drums, tank cars	C. & C.
710	5.5^{20}% by wt. in w	inter. for textile and rubber chem. pharm.	cans, drums, tank cars	C. & C.
711	∞ w., 18; s. meth. al., ethyl eth., acet., bz., gasoline, ethyl acetate	org. inter., solubilizer for 2,4-D and 2,4,5-T; prep. quarternary amm. comp.	drums, tank cars	Sh.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
712	Triethyl phosphate	triethyl phosphate	$(C_2H_5)_3PO_4$	182.16
713	Triethylene glycol	triethylene glycol	$HO(C_2H_4O)_3H$	150.17
714	" tetramine	" tetramine; 3,6-diaza-octane-1, 8-diamine	$H_2N(C_2H_4NH)_3H$	146.24
715	Triglycol dichloride	triethyleneglycol dichloride	$Cl(C_2H_4O)_2C_2H_4Cl$	187.07
716	Triisopropanolamine	triisopropanolamine; tri-(2-hydroxypropyl)amine	$[CH_3CH(OH)CH_2]_3N$	191.27
717	Trimethylamine	trimethylamine	$(CH_3)_3N$	59.11
718	3,3,5-Trimethyl cyclohexanol (low m.p.)	isophoronyl alcohol	$CH(OH)CH_2C(CH_3)_2CH_2$- $CH(CH_3)CH_2$	142.23
719	3,3,5-Trimethyl cyclohexanol (high m.p.)	" "	$CH(OH)CH_2C(CH_3)_2CH_2$- $CH(CH_3)CH_2$	142.23
720	Trimethyl nonyl alcohol	2,6,8-trimethyl nonanol-4	$CH_3CH(CH_3)CH_2CHOHCH_2$- $CH(CH_3)CH_2CH(CH_3)CH_3$	186.33
721	2,2,4-Trimethylpentane, Pure (Isooctane)	2,2,4-trimethylpentane	C_8H_{18}	114.22
722	2,4,4-Trimethylpentene-1, Pure	2,4,4-trimethyl-1-pentene	C_8H_{16}	112.21
723	2,4,4-Trimethylpentene-2, Technical	2,4,4-trimethyl-2-pentene	C_8H_{16}	112.21
724	Trimethyl phosphate	trimethyl phosphate	$(CH_3)_3PO_4$	140.08
725	Trimethylene bromide	1,3-dibromopropane	$CH_2Br{\cdot}CH_2{\cdot}CH_2Br$	201.91
726	Trimethylene chlorobromide	1-bromo-3-chloropropane	$CH_2Cl{\cdot}CH_2{\cdot}CH_2Br$	157.45
727	Triphenyl carbinol	triphenol methanol	$C_{19}H_{16}O$	260.32
728	Tween 20	polyoxyalkylene deriv. of sorbitan monolaurate		1226†
729	" 40	polyoxyalkylene deriv. of sorbitan monopalmitate		1282†
730	" 60	polyoxyalkylene deriv. of sorbitan monostearate		1310†
731	" 61	polyoxyalkylene deriv. of sorbitan monostearate		606†
732	" 80	polyoxyalkylene deriv. of sorbitan monooleate		
733	" 81	polyoxyalkylene deriv. of sorbitan monooleate		
734	" 85	polyoxyalkylene deriv. of sorbitan trioleate		
735	Undecanol	5-ethylnonanol-2	$C_{11}H_{23}OH$	172.30
736	Urethan	ethyl carbamate	$NH_2COOC_2H_5$	89.09
737	Vinyl acetate	vinyl acetate	$CH_2CHOCOCH_3$	86.09
738	" "	" "	$CH_3COOCH{:}CH_2$	86.09

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† Theoretical.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
712	col. liq	apple-like	97 by wt	$1.068\text{–}1.072^{20}_{20}$
713	col. liq	almost none		1.1254^{20}_{20}
714	visc. liq	mild. amm		0.9818^{20}_{20}
715	straw col. liq	mild		1.1974^{20}_{20}
716	wh. cr. sld	sl. amm		0.9909^{60}_{20}
717	col. gas	pung. amm	98	$.662^{-5}$
718	col. liq	menthol-like		0.8778^{40}_{20}
719				0.8643^{60}_{20}
720	col. liq	mild		0.8193^{20}_{20}
721	col. flam. liq		99 min	0.692^{20}_{20}
722	col. flam. liq		99 min	0.715^{20}_{4}
723	col. flam. liq		95	0.715^{20}_{4}
724	w. wh. liq	mild	98 by wt	$1.205\text{–}1.220^{20}_{20}$
725	cl. col. highly refractory liq	sw. suffocating		1.977^{25}_{25}
726	cl. col. liq	cl. sweet		1.594^{25}_{25}
727	lt. straw colored cr	fa		
728	amber, oily liq	fa. fatty	tech	1.08–1.13
729	amber, oily liq	fa. fatty	tech	1.05–1.10
730	amber, oily liq	fa. fatty	tech	1.05–1.10
731	yel. waxy sld	fa. fatty	tech	0.98–1.03
732	amber, oily sld	fa. fatty	tech	1.05–1.10
733	amber, oily liq	fa. fatty	tech	1.00–1.05
734	amber, oily liq	fa. fatty	tech	1.03–1.05
735	col. liq	mild		0.8363
736	wh. cr	slight	98	$1.06^{48.2}_{4}$
737	w, wh. liq	char. sharp; irritating to the eyes	99.0+	0.9317^{20}_{4}
738	col. liq	pung		0.9334^{20}_{20}

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
712	Triethyl phosphate	−56.4	216	190–220; 210–5%	*ca.* 240
713	Triethylene glycol	−7.2	287.4	275–300	330
714	" tetramine		277.5	260–290	290
715	Triglycol dichloride	−31.5	241.3	230–245	250
716	Triisopropanolamine	58	305		320
717	Trimethylamine	−124	2.9		
718	3,3,5-Trimethyl cyclohexanol (low m.p.)	37.0	197.6		190
719	3,3,5-Trimethyl cyclohexanol (high m.p.)	55.8	189.2		170
720	Trimethyl nonyl alcohol	−60	225.2		200
721	2,2,4-Trimethylpentane, Pure (Isooctane)	−107.4	99.2		
722	2,4,4-Trimethyl-pentene-1, Pure	−93.86	101.44		
723	2,4,4-Trimethyl-pentene-2, Technical			101.1–101.7	
724	Trimethyl phosphate	−47.1	196	190–205, 90%	none
725	Trimethylene bromide	−33	166.5		
726	" chlorobromide			143–5%; 145–95%	none
727	Triphenyl carbinol	160–161.2			
728	Tween 20				610
729	" 40				
730	" 60				
731	" 61				
732	" 80				
733	" 81				550
734	" 85				610
735	Undecanol		225.4		235
736	Urethan	48–50	183		
737	Vinyl acetate		72.5	72–73	−8
738	" "	−93.2	72.5		20

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
712	∞ w.; s. most org. solv	solv. plasticizer	cans, drums	C.S.
713	∞ w	chem. syn., treat. nat. gas, air cond.	cans, drums, tank cars	C. & C.
714	∞ w	ion-exchange resin, softener in rubber reclamation, detergents, softg. agts., chem. syn.	cans, drums, tank cars	C. & C.
715	$1.9^{20}\%$ by wt. in w	chlorinated solv., extr. inter. in prep. of deter., dyes, resins and insect.	cans, drums	C. & C.
716	∞ w	emulsifying agt	cans, drums	C. & C.
717	v. s. w	synth. chem. base; warning agt.; insect attractant	bottles, drums	C.S.
718	$0.17^{20}\%$ by wt. in w	mutual solv. and coupl. agt. inter.	cans, drums	C. & C.
719	$0.11^{20}\%$ by wt. in w	mutual solv. and coupl. agt. inter.	cans, drums	C. & C.
720	$0.02^{20}\%$ by wt. in w	inter. for surface active agts., chem. inter.	cans, drums	C. & C.
721		org. syn., motor fuel research, solvent	bottles, cans, drums, tank cars	P.P.
722		org. syn	bottles, cans	P.P.
723		org. syn	bottles, cans	P.P.
724	∞ w., most org. liq	solvent	cans, drums	C.S.
725	g. per 100 g.: s. al. at 20°C; ∞ CCl_4, eth. at 20°C 0.1 w.	org. syn. mfr. cyclopropane	drums, carboys	D.
726	∞ acet., bz., CCl_4, eth., meth. al., V.M.P. naphtha; i. w.	org. syn	drums	D.
727	g. per 100 g.: 22 acet., 16 bz., 16 eth., 2 CCl_4, 3 meth. al			D.
728	s. w., most org. solv.; i. mineral, veget. oils	emulsifier, wetting, disp.; solubilizing agt.	cans, drums	At.
729	s. w., most org. solv.; i. mineral, veget. oils	emulsifier, disp., solubilizing agt.	cans, drums	At.
730	s. w., most org. solv.; i. mineral, veget. oils	emulsifier, disp. solubilizing agt.	cans, drums	At.
731	s. org. solv.; i. w.; disp. h. w	emulsifier, thick. agt	cans, drums	At.
732	s. w., most org. solv.; i. mineral, veget. oils	emulsifier, wetting, disp. agt	cans, drums	At.
733	disp. w.; s. all org. solv	emulsifier, disp. agt. lubricant	cans, drums	At.
734	s. w., most org. solv.; i. mineral, veget. oils	emulsifier, wetting, disp. solubilizing agt.	cans, drums	At.
735	$<0.02^{20}\%$ by wt. in w	anti-foaming agt., inter.	drums	C. & C.
736	180^{25} w., 125^{25} eth	pharm	cans, drums	U.S.I.
737	2.5 w	inter. resin, drug mfg	drums, tank cars	S.C.L.
738	$2.0^{20}\%$ by wt. in w	prep. of resins; chem. inter.	cans, drums, tank cars	C. & C.

No.	Trade name	Chemical name or synonyms	Formula	Mol. wt.
739	Vinyl butyl “Cellosolve”*		$CH_2{:}CHOCH_2CH_2OC_4H_9$	144.21
740	“ butyl ether		$CH_2{:}CHOC_4H_9$	100.16
741	Vinyl 2-chlorethyl ether		$CH_2{:}CHOCH_2CH_2Cl$	106.55
742	“ chloride	chloroethylene	CH_2CHCl	62.50
743	4-Vinylcyclohexene-1, Pure	4-vinyl-1-cyclohexene	$C_6H_9C_2H_3$	108.18
744	Vinyl ethyl ether		$CH_2{:}CHOC_2H_5$	72.10
745	“ 2-ethylhexyl ether	1-ethenoxy-2-ethylhexane	$C_{10}H_{20}O$	156.26
746	“ isobutyl ether		$CH_2{:}CHOCH_2CH(CH_3)CH_3$	100.16
747	“ methyl “Cellosolve”*	vinyl 2-methoxyethyl ether	$CH_2CHOCH_2CH_2OCH_3$	102.13
748	“ “ ether	methyl vinyl ether; methoxyethane	$CH_2{:}CHOCH_3$	58.08

* Trade mark.

ORGANIC COMPOUNDS (Continued)

No.	Physical form and color	Odor	Purity %	Sp. gr.
739	liq.			0.8654_{20}^{20}
740	liq.			0.7803_{20}^{20}
741	liq.			1.0498_{20}^{20}
742	col. liq. under press.	ethyl chloride-like		0.908
743	col. flam. liq.		99 min.	0.831_{4}^{20}
744	liq.			0.7541_{20}^{20}
745	liq.			0.8102_{20}^{20}
746	liq.			0.7706_{20}^{20}
747	liq.			0.8967_{20}^{20}
748	gas			0.7500_{20}^{20}

See two following pages for additional data on above compounds.

No.	Trade name	Melting point, °C	Boiling point, °C	Distillation range, °C	Flash point, °F
739	Vinyl butyl "Cellosolve"*	−71	88 (50 mm)		
740	" butyl ether	−112.7	94.1		15
741	" 2-chlorethyl ether	−70.3	108.9		80
742	" chloride		−14		<−22
743	4-Vinylcyclohexene-1, Pure	−109.05	130.0		
744	Vinyl ethyl ether	−115.3	35.5		<0
745	" 2-ethylhexyl ether	<−100 sets to a glass	177.5		135
746	" isobutyl ether	−132.3	83.3		15
747	" methyl "Cellosolve"*	−82.8	108.8	102–113	65
748	" " ether	−121.6	6.0		

* Trade mark.

See two preceding pages for additional data on above compounds.

ORGANIC COMPOUNDS (Continued)

No.	Solubility, grams per 100 ml	Uses	Shipping container	Source of information
739	.20^{20}% by wt. in w	pharm. syn.; prep. of resins	cans, drums	C. & C.
740	0.3^{20}% by wt. in w	poly. and copoly. inter	cans, drums	C. & C.
741	0.3^{20}% by wt. in w	poly. and copoly. inter	cans, drums	C. & C.
742	v. s. CCl_4, eth.; s. al.; sl. s. w			D.
743		org. syn	bottles, cans	P.P.
744	0.9^{20}% by wt. in w	poly. and copoly. inter	cans, drums, tank cars	C. & C.
745	0.01^{20}% by wt. in w	poly. and copoly. inter	cans, drums	C. & C.
746	0.2^{20}% by wt. in w	poly. and copoly. inter	cans, drums, tank cars	C. & C.
747	8.8^{20}% by wt. in w	poly. and copoly. inter	cans, drums	C. & C.
748	1.50^{20}% by wt. in w	poly. and copoly. inter	cylinders, tank cars	C. & C.

(Referred from first page of this table)

* Although the companies referred to in the appropriate column of this table supplied the information indicated, there is no assurance that the compounds are currently manufactured by those companies. It is also possible that several companies manufacture a compound, i. e. phthalic anhydride, but that only one supplied data for this table.

CONSTANTS OF OILS,

Revised by

Natural Oils and Waxes

No.	Common name	Scientific name	Class†
1	Almond	*Prunus amygdalus*	I
2	Beef marrow	*Adeps bovis*	IX
3	Beef tallow	*Adeps bovis*	IX
4	Beechnut	*Fagus sylvatica, F. Americana*	V
5	Beeswax—ordinary	*Apis mellifera*	XIII
6	Beeswax—Indian	*Apis mellifera*	XIII
7	Black mustard	*Sinapis nigra*	II
8	Bone fat	*Sevum ossis*	IX
9	Butter fat	*Vaccae lactis adeps*	IX
10	Candelilla	*Euphorbia cerifera*	XI
11	Candlenut	*Aleurites moluccana*	VI
12	Candlenut	*Aleurites triloba*	VI
13	Carnauba #1. yellow	*Corypha cerifera*	XI
14	Carnauba #3. crude	*Corypha cerifera*	XI
15	Carnauba #3. refined	*Corypha cerifera*	XI
16	Castor	*Ricinus communis*	III
17	Ceresine		XIV
18	Chaulmoogra	*Taraktogenos Kurzii*	V
19	Chaulmoogra	U. S. P. 10th Revision	V
20	Chinese insect wax	*Coccus cerifera*	XIII
21	Chinese vegetable tallow	*Stillingia sebifera*	VIII
22	Coconut	*Cocos butyracea, C. nucifera*	VIII
23	Coca butter (Cacao)	*Theobroma cacao*	VIII
24	Cod liver	*Gadus morrhua*	VII
25	Corn (maize)	*Zea mais*	V
26	Cotton seed	Species *Gossypium*	V
27	Cotton seed stearin	*Gossypium*	VIII
28	Croton	*Croton tiglium*	V
29	Esparto	*Stipa Tenacissim*	XI
30	Goose fat	*Anser cinereus*	IX
31	Grape seed	*Vites vinefera*	III
32	Hazelnut	*Corylus avellana*	I
33	Hemp seed	*Cannabus sativa*	VI
34	Horse fat	*Equus caballus*	IX
35	Human fat		IX
36	Japan wax	*Rhus succedaneum*	XI
37	Lard oil	*Oleum adipis*	IV
38	Lard oil (fatty tissue)	*Adeps*	IX
39	Laurel (bayberry)	*Laurus nobilis*	VIII
40	Linseed	*Linum usitatissimum*	VI
41	Menhaden	*Alosa menhaden (Brevortia tyrannus)*	VII
42	Montan (Reibeck)		XV
43	Montan (Domestic)		XV
44	Mutton tallow	*Adeps ovis*	IX
45	Myrtle wax	*Myrica cerifera (M. Carolinensis)*	VIII
46	Neat's foot	*Oleum pedis bovis*	IV
47	Nutmeg butter (mace)	*Myristica officinalis*	VIII
48	Olive	*Olea Europaea sativa*	I
49	Ouricury	*Syagrus coronata (mart)*	XI
50	Ozokerite		XIV
51	Palm	*Elaeis guineensis*	VIII
52	Palm kernel	*Elaeis guineensis* (W. Africa)	VIII
53	Palm kernel	*Elaeis guineensis* (S. America)	VIII

FATS AND WAXES

Raymond J. Rosen

Natural Oils and Waxes

No.	Specific gravity at $\frac{15^\circ}{15^\circ}$ C.	Solidifying point °C.	Saponification value	Iodine value	Hehner's number
1	0.914–0.921	−15 to −20	183.3–207.6	93–103.4	96.0
2	0.9311–0.938	31 to 29	196–199.6	39–55.4	....
3	0.895	31 to 38	196–200	35.4–42.3	96–96.5
4	0.922	−17	191–196	97–111	95–96
5	0.953–0.970	62 to 66	88–100	8.0–11.0	....
6	0.953–0.970	61 to 67	87–117	4.0–10.5	....
7	0.915–0.919	−17	173–175	99–110	96
8	0.914–0.916	15–17	190–196	50–55	94–95
9	$0.907–0.912\frac{40^\circ}{15^\circ}$	19 to 24.5	210–230	26–28	87.6–89.6
10	0.981–0.994	73 to 77	55.0–64.2	....	....
11	0.925	<−18	189–195	163–164	95–96
12	0.927	<−18	202–204	139–143.8	....
13	0.990–0.996	86 to 88	75–86	....	....
14	0.994–1.010	86 to 90	75–89	....	....
15	0.990–0.996	86 to 89	76–85	7.0–14.5	....
16	0.960–0.967	−12 turbid; −17 to −18 solid	175–183	84	....
17	0.900–0.920	56 to 82	0	4.0–8.0	....
18	0.943–0.954	20 to 25	196–213	97.6–110.4	......
19	ca. 0.950^{25°	<25	196–213	98–104	....
20	0.950–0.970	80 to 85	78–93	1.0–2.5	....
21	0.918–0.922	24 to 34	179–206	23–40.5	95.3
22	0.926	14 to 22	253.4–262	6.2–10	82.3–90.5
23	0.964–0.974	21.5 to 27.3	192.8–195	32.8–41.7	94–95
24	0.922–0.931	−3	171–189	137–166	95.3
25	0.921–0.928	−10 to −20	187–193	111–128	93–95
26	$0.917–0.918\frac{25^\circ}{25^\circ}$	+12 to −13	194–196	103–111.3	95.7
27	0.9188–0.923	16–22	195	89–103	95.9
28	0.942–0.944	−8 to −18	193–215	108–109	89.0
29	0.985–0.995	75 to 79	58.0–72.5	7.0–15.0	....
30	0.923–0.930	22 to 24	191–193	58–67	94.5–95.3
31	0.917–0.933	−10 to −17	171–191	94.3–135	92
32	0.917	−17 to −18	191–197	87	95.5
33	0.928–0.934	−15 to −28	190–195	145–161.7	....
34	0.919–0.933	20 to 45	195–200	75–86	95–98
35	0.9179	15	193.3–199	64	....
36	0.970–0.998	49 to 56	210–235	4.0–15.0	89–91
37	0.913–0.915	+4 to −2	193–198	62.5–79	97
38	0.934–0.938	27.1 to 29.9	195–203	47–66.5	93–95
39	0.880^{100°	24 to 25	198–199	68–80	....
40	0.930–0.938	−19 to −27	188–195	175–202	94.5–95.5
41	0.923–0.933	−5	189–192.9	148–185	....
42	0.995–1.040	83 to 89	80–99	....	....
43	1.020–1.040	80 to 86	100–115	....	....
44	0.937–0.953	36 to 41	195–196	48–61	95.5
45	0.995	39 to 43	205.5–211.7	3.9–9.5	92–94
46	0.913–0.918	−2 to +10	193–199	57.5–75	94.8–95.9
47	0.945–0.996	40 to 44	154–178	59.3–65	....
48	0.915–0.920	+2 turbid; −6 solid	185–196	79–88	95
49	0.990–1.010	86 to 89	88.0–95.8	....	....
50	0.900–0.996	56 to 82	0	4.0–8.0	....
51	0.924	....	200–205	49.2–58.9	94.5–97
52	$0.866–0.873^{100^\circ}$	20 to 24	243–255	10.5–17.5	91–91.5
53	....	27.4	220.2–231.4	25.5–31.6	....

Natural Oils and Waxes

No.	Common name	Maumené number	Acid value	Acetyl value	Refractive index at 25°C.
1	Almond	51–53	0.5–3.5	9.6	1.4593–1.4646*
2	Beef marrow	.....	1.6	....	1.4628
3	Beef tallow	.....	0.25	2.7–8.6	....
4	Beechnut	.....	....	....	1.4698
5	Beeswax—ordinary	.....	17.0–21.0	13.0–16.0	1.4445–1.4473$^{65°}$
6	Beeswax—Indian	.....	5.0–10.5	....	1.4380–1.4420$^{80°}$
7	Black mustard	43	5.7–7.3	....	1.4718
8	Bone fat	.....	....	11.3	....
9	Butter fat	.....	0.45–35.4	1.9–8.6	1.4555–1.4578*
10	Candelilla	.....	18.6–23.9	....	1.4565–1.4610$^{80°}$
11	Candlenut	.....	2	9.8	1.4760–1.4790
12	Candlenut	.....	....	....	1.4760–1.4790
13	Carnauba #1. yellow	.....	1.5–2.5	....	1.4490–1.4525$^{95°}$
14	Carnauba #3. crude	.....	3.0–8.5	....	1.4460–1.4520$^{95°}$
15	Carnauba #3. refined	.....	3.0–5.0	54.0–56.0	1.4465–1.4500$^{95°}$
16	Castor	46–47	0.12–0.8	146–150.5	1.4771
17	Ceresine	.....	0	....	1.4320–1.4370$^{80°}$
18	Chaulmoogra	.....	0.79–21.5	....	1.4777–1.4779
19	Chaulmoogra	.....	....	....	....
20	Chinese insect wax	.....	1.9–8.9	....	....
21	Chinese vegetable tallow	.....	2.4	....	1.4470–1.4579*
22	Coconut	21	2.5–10.0	2.3–6.9	1.4477–1.4495*
23	Coca butter (Cacao)	.....	1.1–1.9	1.97	1.4537–1.4580*
24	Cod liver	102–115	5.6	1.15	1.4758–1.4783
25	Corn (maize)	81–86	1.37–2.02	7.5–11.5	1.4733
26	Cotton seed	75–90	0.6–0.9	21–25	1.4743–1.4752$^{15°}$
27	Cotton seed stearin	.....	....	....	....
28	Croton	.....	27–30.9	19.8–38.6	1.4710*
29	Esparto	.....	22.0–27.0	....	1.4550–1.4590$^{80°}$
30	Goose fat	.....	0.59	....	1.4583–1.4626*
31	Grape seed	53	0.75	13.5–14.5	1.4713–1.4725
32	Hazelnut	36	....	3.2	1.4667
33	Hemp seed	97	0.45	....	1.4740–1.4745*
34	Horse fat	.....	0–2.44	....	1.4618–1.4696*
35	Human fat	.....	....	....	1.459–1.4613*
36	Japan wax	.....	4.0–15.0	17.0–25.0	1.4520–1.4585$^{80°}$
37	Lard oil	41–45	1.56	....	1.4607*
38	Lard oil (fatty tissue)	.....	0.5–0.8	2.6	1.4609–1.4620
39	Laurel (bayberry)	.....	26.3	....	1.4783
40	Linseed	103–126	1–3.5	....	1.4797–1.4802
41	Menhaden	123–128	5–8	....	1.4787
42	Montan (Reibeck)	.....	35.0–45.0	....	....
43	Montan (Domestic)	.....	35.0–45.0	....	....
44	Mutton tallow	.....	1.7–14	....	1.4545–1.4585*
45	Myrtle wax	.....	3–4.4	....	1.4511*
46	Neat's foot	43–49	0.1–0.6	7.7–9.3	1.4643–1.4685
47	Nutmeg butter (mace)	.....	17.2	....	1.4704*
48	Olive	41.5–47	0.3–1.0	10.5	1.4657–1.4667
49	Ouricury	.....	12.0–18.8	....	1.4530–1.4555$^{95°}$
50	Ozokerite	.....	0	....	1.4320–1.4370$^{80°}$
51	Palm	.....	10	15.7	1.4603–1.4639*
52	Palm kernel	.....	5–22	7.6	1.4492–1.4543*
53	Palm kernel	.....	0.33–0.55	....	....

Natural Oils and Waxes

No.	Reichert Meissl number	Unsaponifiable matter	Insoluble fatty acids			
			Melting point °C.	Solidifying point °C.	Iodine value	Acid value
1	0.5	0.75	13–14	9.5–11.8	93.5–96.5	204
2	2.2	....	45–46	37.9–40	55.5	204.5
3	....	....	42.5–44	37.9–46.2	41.3	197.2
4	....	....	23–24	17	114	....
5	....	52–55	....	....	....	....
6	....	52–55	....	....	....	....
7	....	3.3	16–17	13.4–13.7	87–93	179.2
8	0.2–1.7	0.5–1.5	42.5–44	28	55.7–57.4	200
9	17.0–34.5	0.3–0.45	38–41	33–39	28–31	210–220
10	....	....	....	....	....	....
11	1.2	0.5–0.9	20–21	13	185.7	....
12	....	....	....	17.8	....	....
13	....	50–55	....	....	....	....
14	....	50–55	....	....	....	....
15	....	50–55	....	....	....	....
16	1.4	0.6	13	3	86.6–88.3	192.1
17	....	100	....	....	....	....
18	....	....	....	....	....	....
19	....	....	....	....	....	....
20	....	49–55	....	....	....	....
21	0.2–0.9	....	39–57	45.2–47.2; 50.9–52.5	34.2	182–208.5
22	6.6–7.5	0.2	24–27	21.2–25.2	8.4–8.8	258
23	0.3–1	....	48–53	47.2–49.2	32.6–39	190
24	0.2	0.54–2.68	21.8–38	17.5–24.3	164–171	204–207
25	4.3	1.5–2.8	17–20	14–16	113–125	198.4
26	0.95	1.1	34.5	32–35	111–115	201.6–203.9
27	....	....	27–30	35.1	94	....
28	12–13.6	0.55	....	17–19	111–112	201
29	....	15–20	....	....	....	....
30	0.2–0.98	....	36.6–40	31–34	65.3	202.4
31	0.46	1.6	23–25	18–20	99–132	187.4
32	0.99	0.5	22–25	19–20	87.5–90.1	200.6
33	....	1.08	17–21	15.6–16.6	141	....
34	1.64–2.14	....	31.3–53.4	37.7	83.9–87.1	202.6
35	0.25–0.55	....	35.5	30.5	64	....
36	....	1.0–3.0	....	....	....	....
37	....	0.6	33–38.4	27–33	....	....
38	....	....	37–46.6	36–42.4	....	....
39	1.6	....	....	....	81.6–82	....
40	0.95	0.4–1.2	20–24	16–20.6	179–209.8	196–198.8
41	1.2	0.6–1.43	....	....	....	....
42	....	30–45	....	....	....	....
43	....	....	....	....	....	....
44	....	....	33.5–49	40–48.5	34.8	198
45	0.5	....	47–48	46	....	230.9
46	0.9–1.2	0.12–0.65	29–41	16–26.5	62–77	201.2–206.3
47	1.1–4.2	....	42.5	40–45	31.6	....
48	0.6–1.5	0.4–1.0	26–30	16.9–26.4	86–90	193
49	....	....	....	....	....	....
50	....	100	....	....	....	....
51	0.9–1.9	....	50	42.5–45.5	53.3	204–207
52	5–6.8	....	25–28.5	20–25.5	12	251–265
53	....	....	....	....	....	....

Natural Oils and Waxes

No.	Common name	Scientific name	Class†
54	Peach kernel	*Amygdalus Persica*	I
55	Peanut	*Arachis hypogaea*	I
56	Poppy seed	*Papaver somniferum*	VI
57	Porpoise (body oil)	*Delphinus phecaena*	VII
58	Pumpkin seed	*Cucurbita pepo*	V
59	Rabbit fat	*Lepus cuniculus*	IX
60	Rape seed	*Brassica campestris*	II
61	Safflower	*Carthamus tinctorius*	VI
62	Seal	*Species Phoca*	VII
63	Sesame	*Sesamum indicum*	V
64	Soja bean (Soya, Soy)	*Soja hispida (Dolichos hispida)*	V
65	Sperm	*Physter macrocephalus*	X
66	Spermaceti	*Cetaceum*	XII
67	Sunflower	*Helianthus annus*	VI
68	Tung (China wood)	*Aleurites Fordii*	VI
69	Tung (China wood)	*Aleurites montana*	VI
70	Walnut	*Juglans regia*	VI
71	Whale	*Balaena mysticetus*	VII
72	White mustard seed	*Sinapis alba*	II
73	Wool fat	*Adeps lanae*	XII

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† Class I, Non-drying vegetable oil of the olive oil type; Class II, non-drying vegetable oil of the rape oil type; Class III, non-drying vegetable oil of the castor oil type; Class IV, non-drying animal oil; Class V, semi-drying vegetable oil; Class VI, drying vegetable oil; Class VII, fish and marine animal oil; Class VIII, vegetable fat; Class IX, animal fat; Class X, sperm oil; Class XI, vegetable non-glyceridic wax; Class XII, animal wax; Class XIII, insect wax; Class XIV, mineral wax; Class XV, semi-mineral wax.

Natural Oils and Waxes

No.	Specific gravity at $\frac{15°}{15°}$ C.	Solidifying point °C.	Saponification value	Iodine value	Hehner's number
54	0.918–0.925	−20	191–193	92–99.7	94–96
55	0.917–0.926	3	186–194	88–98	95
56	0.924–0.926	−16 to −18	193–195	128–141	95.4
57	0.926	−16	203.4	126.9	68.4
58	0.923–0.925	−15	188–193	121–130	96
59	0.934–0.936	22 to 24	199–203	70–99.8	99.5
60	0.913–0.917	−10	168–179	94–105	94.5–96.3
61	0.925–0.928	−13 to −18	188–203	122–141	95
62	0.915–0.926	−3	187.5–196.2	130–152	93–96
63	$0.919\frac{25°}{25°}$	−4 to −16	188–193	103–117	95
64	0.924–0.927	−10 to −16	189–193.5	122–134	93–94.5
65	0.878–0.884	15.5	120–137	80–84	....
66	0.905–0.960	41 to 49	121–135	2.5–8.5	....
67	0.924–0.926	−17	188–193	129–136	95
68	0.939–0.949	2 to 3	190–197	163–171	96.2
69	0.925	....	189–195	163–164	95–96
70	0.925–0.927	−27.5	190.1–197	139–150	93.4–95.4
71	0.917–0.924	0 to −2	160–202	90–146	93–95
72	0.912–0.916	−8 to −16	171–174	94–98.4	96–97
73	0.970–0.973	....	82–130	17–29	......

Natural Oils and Waxes

No.	Common name	Maumené number	Acid value	Acetyl value	Refractive index at 25°C.
54	Peach kernel	42.5	1–1.5	6.5	1.4682–1.4701
55	Peanut	45–67	0.8	3.5	1.4620–1.4653*
56	Poppy seed	86–88	2.5	....	1.4739–1.4742
57	Porpoise (body oil)	50–61	1.2	....	1.4622–1.4625
58	Pumpkin seed	.....	....	....	1.4724–1.4739
59	Rabbit fat	.....	6.2–7.2	....	1.459*
60	Rape seed	51–64	0.36–1.0	14.75	1.4649–1.4659*
61	Safflower	.....	0.6	16.1	1.4769
62	Seal	.....	....	....	1.4742–1.4762
63	Sesame	65.5	9.8	....	1.4704–1.4717
64	Soja bean (Soya, Soy)	87–88	0.3–1.8	4.9	1.4723–1.4756
65	Sperm	51	13.2	4.5–64	1.4573
66	Spermaceti	.....	0.5–3.0	2.0–3.0	....
67	Sunflower	72	11.2	....	1.4659–1.4721*
68	Tung (China wood)	.....	2	....	1.515–1.520
69	Tung (China wood)	.....	2	....	1.515–1.520
70	Walnut	96–110	2.5	....	1.4770
71	Whale	85–92	1.9	11–23	1.4679–1.4724
72	White mustard seed	44–49	5.4	....	1.4649
73	Wool fat	.....	59.8	23	1.4784–1.4822*

* Refractive index at 40°.

Natural Oils and Waxes

No.	Reichert Meissl number	Unsaponifiable matter	Insoluble fatty acids			
			Melting point °C.	Solidifying point °C.	Iodine value	Acid value
54	....	....	10–18.9	13–13.5	94.1–101.9	205–209.9
55	0.4	0.5–0.9	....	30.5–39	95.5–103.4	201.6
56	0.6	0.43	20.5	17–19	139	199
57	46.9	16–17	....	....	126	207
58	4.45	....	26.5–29.8	26–28	....	....
59	0.7–2.8	....	39–50	35–41	64.4–101.1	210–218
60	0–0.79	1.48	18.5–20	11.7–136	100–106	....
61	0–0.2	....	11–17	7–12	132.5–148.2	199
62	0.2	0.3–1.0	22–23	13–17	186.5–201.8	190.4–198
63	1.1–1.2	0.95–1.32	25–35	23–32	109–112	196–201.6
64	0.5–2.8	1.27–1.54	26.2–27.5	21.2	122	....
65	....	39–42	13.4	16.1	88–99	23.6
66	....	50–55	....	....	....	....
67	0.5	0.31	22–24	18–19.8	124–134	201.6
68	1.10	0.4–0.8	40–43.8	31.2–37	145–159.4	188.8
69	0.35	0.4–0.8	....	....	....	....
70	0.92	0.5–1.0	15–20	14.3	150	....
71	14	1–4	14–27	10–24	130.3–132	....
72	....	....	15–16	9–10	94.7–110.4	181–185.8
73	8	39–44	41.8	40	17	....

Synthetic Waxes

Trade names	Mfrer or supplier	Color	Melting point °C.
Abril Wax I	1	brown	79–83
X		brown	68–74
P		brown	101–103
E		cream	78–82
8 NS		brown	119–122
10 DS		white	138–142
BJ		brown	65–72
N		brown	71–73
ND		tan	73–76
Acrawax	2	tan	95–97
B		brown	86–90
C		brown	140–142
Albacer		white	99–104
Alcowax, hard	3	white	100–102
extra hard		white	103–105
Alrowax 75	4	yellow	75
Aquawax	5	white	47
Armowax	6	tan	132
"B" Wax	7	white	
Beeswax syn. Yellow 619	8	amber	63–66
Beeswax syn. Special 1429		amber	85–87
Carbowax 1500	9	white	30–40
4000		white	54–57
Carlisle 280	10	white	138–143
Castorwax	11	white	84–87
Ceramid	2	yellow	80–81
Cerax 1320	8	yellow	87–88
1355		tan	85–87
1420		yellow	85–87
Cerita 27	12	brown	85
86		yellow	62–65
111		white	85
143		tan	83
Ceroflex 1610	8	yellow	101–103
Chlorowax	13	cream	95–110
Concord wax 159	5	brown	84
190		brown	90
CWB			85.5
Durowax 1032	8	amber	85–86
1227		yellow	87–89
Emulsowax 1214		amber	72–74
1433		brown	80–81
1508		amber	72–74
1530		brown	82–85
1630		amber	81–83
Estawax	14	brown	102
Flexo Wax C	2	tan	64–70
C Lt		cream	62–64
Gersthofen OP	15	yellow	102–106
E		yellow	79–82
S		yellow	80–83
L		yellow	80–83
CR		brown	80–83
KP		tan	80–83
KPE		tan	80–81
KPS		yellow	80–83
Special		brown	90–93
Glyco Wax S932	2	white	57–61

Synthetic Waxes

Specific gravity at 20°C.	Saponification value	Acid value	Iodine	Flash °C.
1.02	155–170	6–16	...	...
0.99	140–160	7–20	...	...
1.00	120–135	11–16	...	...
0.97	180–200	21–26	...	...
0.98	90–110	5–10	...	...
0.99	90–105	4–9	...	...
0.97	140–160	16–22	7–11	...
0.98	140–160	27–33	12–17	...
0.98	150–170	27–33	3–7	...
1.04	...	...	...	230
0.97	...	2	...	235
0.97	...	10	...	285
1.05	...	...	...	285–295
0.922	6–7	0	0.35	243–256
0.927	0–1	0	0.35	249–260
...	...	...	...	...
...	167	...	...	...
...	17	12	...	250
0.95	93	20.3	...	...
...	91–96	18–20	...	...
...	65–70	8–10	...	...
1.151	...	...	...	221
1.204	...	...	...	280
...	...	10	...	285
0.98–1.00	175–185	2.0	3–6	...
...	...	...	...	260
...	170–175	2.5	...	...
...	150–155	3.5	...	...
...	130–135	2.5	...	...
...	20–25	0	...	...
...	123	2	...	...
...	170	5–7	...	...
...	94	4	...	...
...	0	0	...	...
1.62–1.70	...	...	...	...
...	67	...	43.4	...
...	19.9	...	6.5	...
...	39.6	0.8	...	...
...	17–20	0–1	...	...
...	53–55	24–25	...	...
...	103–110	28–32	...	...
...	75–80	27–29	...	...
...	119–126	30–34	...	...
...	110–120	22–26	...	...
...	105–110	20–25	...	...
0.931	0	0	0	...
0.82	...	...	...	257
0.82	...	...	...	230–240
1.03–1.04	110–132	10–15	...	...
1.01–1.02	158–178	17–25	...	...
1.01–1.02	169–175	142–157	...	...
0.99–1.00	155–170	127–139	...	...
1.00–1.01	115–130	31–37	...	...
1.02–1.03	130–145	25–35	...	...
1.04–1.06	116–125	20–25	...	...
1.02–1.03	130–145	25–35	...	...
1.00–1.01	95–110	13–18	...	...
0.96	...	...	...	328

Synthetic Waxes

Trade names	Mfrer or supplier	Color	Melting point °C.
Inkowax 1226	8	yellow	83–85
Karagami	5	white	50
Lanette Wax	16	white	50
Merizol	14	green	108
Opalwax	16	white	77–81
Paradox wax	14	white	98
Parwax	5	brown	93–95
Rezo Wax B	2	brown	95–110
Rilan Wax	16	.....	84–85
Santaowax, regular	17	yellow	60–145
M	......	yellow	83–85
P	......	white	....
Solvawax 1292	8	gray	87–89
1402	......	gray	82–84
Stroba Wax	2	tan	98–102
Tiona Wax 51 A	18	yellow	85–90
52 A	......	tan	97
53 A	......	tan	101
54 A	......	tan	110
55 A	......	tan	130
56 A	......	brown	89
Warco Wax A-101-A	19	tan	134–140

CODE TO NUMBERS OF MANUFACTURERS OR SUPPLIERS

1. Distributing and Trading Co., Inc.
2. Glyco Products Co., Inc.
3. Semet-Solvay Div., Allied Chemical & Dye Corp.
4. Alrose Chemical Co.
5. Concord Chemical Co.
6. Armour Chemical Div., Armour and Co.
7. National Wax Refining Co.
8. Cornelius Products Co. (supplier), General Wax Refining Co. (Mfrer.).
9. Carbide and Carbon Chemical Corporation.
10. Carlisle Chemical Works, Inc.
11. Baker Castor Oil Co.
12. Mamaroneck Chemical Corp.
13. Diamond Alkali Co.
14. Lovell Chemical Co.
15. Wax and Rosin Products Co.
16. E. I. DuPont de Nemours & Co., Inc.
17. Monsanto Chemical Co.
18. Tiona Petroleum Company.
19. Warwick Chemical Co.

Synthetic Waxes

Specific gravity at 20°C.	Saponification value	Acid value	Iodine	Flash °C.
...	64–67	26–28	...	...
...	199.4	6.8	17.6	...
0.81	0	0	...	...
0.944	...	...	...	...
0.98–1.00	175–185	2.0	2–5	...
0.911	...	...	...	...
...	61	12	...	...
1.01	...	42–48	...	230
0.98	155	25	...	...
1.10	...	...	...	191
...	...	...	...	207
...	...	...	...	207
...	145–150	19–21	...	...
...	128–135	16–18	...	...
1.04	...	35–43	...	212
...	178–190	2	2–8	...
...	22	3	5	...
...	21	4	7	...
...	19	6	5	...
...	19	10	5	...
...	50	3	7	...
...	17	12	...	...

CHELATING AGENTS

Compiled by George R. Hodgins

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Barisol BRM		Dexter Chemical Company[1]	Silicate Si $PO_4^{=}$	
C-29 Compound		Blockson Chemical Co.[2]	In alkaline solution Ca Mg Fe Al Ni Cu	
Cequestrall	E.D.T.A. (Ethylene diamine tetra acetic acid)	Wica Chemical Co.[3]	All di- and trivalent cations Fe, Ca, Mg, Cu, and other alkaline earths	
			H^+	1.996 (pK_1) 2.672 (pK_2) 6.161 (pK_3) 10.262 (pK_4)
			Li^+	2.79
			Na^+	1.66
			Ca^{++}	10.59
				10.77
			Sr^{++}	8.63
			Ba^{++}	2.07
			Mg^{++}	2.28
			Sr^{++}	2.30
			Mn^{++}	13.4

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Cequestrall (continued)			Fe^{++}	14.45
				14.
				14.22
				4.8
				4.1
			Fe^{+++}	25.1
				24.0
				2.8
				3.4
				12.0
			Co^{++}	16.1
			Ni^{++}	18.4
				19.0
			Cu^{++}	18.3
			Zn^{++}	16.1
			Cd^{++}	16.4
			Pb^{++}	18.2
			La^{+++}	15.4
Chel		Geigy Industrial Chemicals[4]	For all polyvalent metallic ions	
Chel 185	Na dihydroxyethyl glycine 50 % aq.			
Chel DM Acid	Hydroxyethyl ethylene diamine triacetic acid			
Chel DM 41	Trisodium hydroxyethyl ethylene diamine triacetate 41 % aq.			
Chel 330	Pentasodium diethylene triamine pentaacetate			
Chel 600	1,2-diaminocyclohexane tetraacetic acid			
Chel 300	Nitrilotriacetic acid			
Chel 242P			Fe^{+++} specific	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Cheloid 30	Na salt of E.D.T.A.	Colloids Incorporated[5]	Ca	3.51
			F^{+++}	25.00
Citric Acid	Citric acid	Charles Pfizer and Company, Inc.[6]	Mg^{++}	3.2
			Ca^{++}	3.2
			Sr^{++}	2.7
			Ba^{++}	2.98
				3.02
			Ra^{++}	2.0
				1.9
				2.4
			Ce^{+++}	3.2
			Pr^{+++}	3.4
			Y^{+++}	3.6
			Pb^{++}	5.74
				6.50
			Cu^{++}	14.21
			Cd^{++}22	4.22
Cyquest 40	Tetrasodium ethylenediamine tetraacetate	American Cyanamid Company[7]	Di- or trivalent metal ions. There is preferential chelation when added to a mixture of metallic ions. pH also changes this order pH of 7 and above Ni Co Cu Zn Cd Ca Mg	Same as other E.D.T.A. types

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Evans Acid 3CS	Carboxymethyl mercaptosuccinic acid	Evans Chemetics, Inc.[8]	Metal inactivators in glyceride oils	
Gluconic Acid	COOH | (CHOH) | CH_2OH[4] 1,2,3,4,5-Pentahydroxy caproic acid	Charles Pfizer and Company, Inc.[6]	H^+	3.56
			Mg^{++}	0.70
			Ca^{++}	1.21
			Sr^{++}	1.00
			Ba^{++}	0.95
			Zn^{++}	1.70
Hy-Phos	Na Hexametapyrophosphate	I. P. Thomas and Son Co.[9]	Fe^{+++}	
			Ca^{++}	
			Cu^{++}	
			Mg^{++}	
			Cr^{++}	
			Ni^{++}	
			Zn^{++}	
			Sn^{++}	
			Pb^{++}	
			Al^{+++}	
Kojic Acid	2-hydroxymethyl-5-hydroxy-rr-pyrone	Charles Pfizer and Company, Inc.[6]	Cu^{++}	7.90
			Fe^{++}	8.03
			– – – –	
			Na^+	
			Ba^{++}	
			Ca^{++}	
			St^{++}	
			Sn^{++}	
			Zn^{++}	
			Mn^{++}	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Kojic Acid (continued)			Al^{+++} Cd^{++} La^{+++}	
Marco Sequestrols	Sugar acid	Maher Color and Chemical Co.[10]	Ca^{++} Mg^{++}	
Marco Sequestrol 14	Sugar acid		Ca^{++} Mg^{++} Fe^{++}	
Marco Sequestrol SL Marco Sequestrol SP	Sugar acid, liquid Sugar acid, powder			
Novanols	Polyaminocarboxylates	Nova Chemicals Corporation[11]	Fe^{+++} Cu^{++} Ni^{++} Pb^{++} Cd^{++} Zn^{++} Co^{++} Fe^{++} Mn^{++} Ca^{++} Mg^{++} Sr^{++} Ba^{++} In order of decreasing stability	
Novanol Nap	Polyaminocarboxylates		Ca^{++} Fe^{+++}	
Novanol P	Polyaminocarboxylates		Fe^{+++} In normal pH range	
Novanol H	Polyaminocarboxylates		Fe^{+++} In caustic alkali	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Nullapons	E.D.T.A. type	Antara Chemical[12]	All polyvalent metal ions	
Nullapon BF Acid	Ethylenediamine tetraacetic acid (99 % pure)		Cr^{++} Cu^{++} Ni^{++} Pb^{++} Co^{++} Zn^{++} Cd^{++} Ca^{++} Mg^{++} Fe^{+++}	18.3 18.4 19.0 18.2 16.1 16.1 16.4 3.51 10.59 10.77 8.69 25.1
Nullapon BF78	Tetra Na ethylene diamine tetraacetate (78–80 %)		Co^{++} Ni^{++} Cu^{++} Cd^{++} Zn^{++} Ca^{++} Mg^{++} Fe^{+++}	16.1 18.4 18.3 16.4 16.1 10.59 10.77 8.69 25.1
Nullapon Fe-12	Tetra Na ethylene diamine tetracetate		And other metal ions as BF-12	
Nullapon BF-12	Tetra Na ethylene diamine tetra acetate (25–27 %)		Co^{++} Ni^{++} Cu^{++} Cd^{++} Zn^{++} Cu^{++} Mg^{++}	
Nullapon BF-13	Tetra Na ethylenediamine tetraacetate (38–40 %)		Same as BF-12	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Orzans				
Orzan A	Ammonium Lignin sulfonate and wood sugars	Crown Zellerbach Corporation[13]	Cu^{++} Fe^{+++} Ni^{++} Sn^{++} Zn^{++} Al^{+++}	
Orzan Al-50	50 % sol. of Orzan A		Same as Orzan A	
Orzan S	Sodium lignin sulfonate and wood sugars: Mannose 48 % Glucose 15 % Xylose 15 % Galactose 10 % Arabinose 6 % Fructose 2 % or less		Same as Orzan A	
Orzan Sl 50	50 % solution Orzan S		Same as Orzan A	
Oxalic Acid	HOOC—COOH	Charles Pfizer and Company, Inc.[6]	Fe^{+++}	10.00
Perma-Kleers	E.D.T.A. types and polyaminocarboxylates	Refined Products Corporation[14]		
Perma-Kleer 80 Liquid and Bead			Ca^{++} Fe^{++}	
Perma-Kleer SP Beads			Fe^{+++} In normal pH range Fe^{+++}	
Perma-Kleer OH			In high concentrations of caustic alkali	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Perma-Kleers (continued)				
Perma-Kleer 50 In 3 Forms	E.D.T.A. Trisodium salt Disodium salt Acid E.D.T.A.		Fe^{+++}	25.01
			Cu^{++}	18.3
			Ni^{++}	18.4
			Pb^{++}	18.2
			Cd^{++}	16.4
			Zn^{++}	16.1
			Co^{++}	16.1
			Fe^{++}	14.45
			Ca^{++}	10.59
			Mn^{++}	13.4
			Mg^{++}	2.28
			Sr^{++}	8.63
			Ba^{++}	2.07
Plexenes	E.D.T.A. type and tetra Na salts	Chemplex Company[15]		
Plexene and Plexene Concentrate	E.D.T.A. type and tetra Na salts		Mg^{++}	8.69
			Ca^{++}	10.59
Plexene Fe	E.D.T.A. type and tetra Na salts		Ca^{++}	10.59
			Fe^{+++}	25.1
				24.0
				2.8
				3.4
				12.0
Plexene FNa	E.D.T.A. type and tetra Na salts		Ca^{++}	12.0
			Fe^{+++} In 3–30 % caustic soda)	12.0
Plexene RR	E.D.T.A. type and tetra Na salts		(Does not sequester Ca) Fe^{+++} (In pH of 2 to 12.5)	12.0
Plexene Special	E.D.T.A. type and tetra Na salts		Fe^{+++} (At pH 3 to 12.5 and Ca in the absence of Fe^{+++} at pH 11)	12.0

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Pluronics	Polyethylene glycol chain $HO(C_2H_4O)_a(C_3H_6O)_b(C_2H_4O)_cH$	Wyandotte Chemical Corporation[16]	Ca^{++}	
			Mg^{++}	
			Cu^{++}	
			Ni^{++}	
			Al^{+++}	
L44			Fe^{+++}	
			Pb^{++}	
L62			Zn^{++}	
L64			Suspends carbon black; soil	
L68			suspending properties	
Quadrol	N,N,N,N′-tetrakis (2-hydroxypropyl) ethylenediamine		Cu	10.58
			Ti	
Questex	E.D.T.A. type	Victor Chemical Works[17]	Na	1.7
			Li	2.8
			Ag	7.3
			Ba	7.8
4H	Specially purified anhydrous form of E.D.T.A.		Sr	8.6
			Mg	8.7
			Ca	10.7
			V	12.7
			Mn	13.4
4SW	Tetrahydrate of tetrasodium—E.D.T.A.		Fe(II)	14.3
			Al	16.1
			Cd	16.5
2SW	Disodium dihydrogen E.D.T.A. dihydrate		Zn	16.5
			Co(II)	16.2
			Ti(IV)	17.3
			Pb	18.0

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Questex (continued) 4S	Anhydrous granular form of tetrasodium E.D.T.A.		Ni(II)	18.6
			Cu(II)	18.8
			VO(IV)	18.8
			Ti(III)	21.0
			Hg(II)	21.8
			Th	23.2
			Cr(III)	24.0
			Pu(III)	24.0
			In(III)	25.0
			Fe(III)	25.1
			V(III)	25.9
			Co(III)	36.0
			Rare Earths	
			La	15.4
			Ce	16.0
			Pr	16.4
			Nd	16.6
			Sm	17.1
			Gd	17.2
			Y	18.0
			Er	18.2
			Lu	19.5
			Sc	23.1
Saccharol		Reading Testing Laboratories[18]	Fe^{+++} mainly Cu^{++} Ca^{++} Ni^{++} also Al^{+++}	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
				log K_2
Sequestrene	E.D.T.A. type	Geigy Industrial Chemicals[4]	Li	
Sequestrene AA	Ethylenediaminetetraacetic acid (T.P.)		Li^+	2.79
			Na^+	1.66
			Mg^{++}	8.69
			Ca^{++}	10.59
Sequestrene NA2	Disodium ethylene diaminetetraacetate dihydrate (T.P.)		Sr^{++}	8.63
			Ba^{++}	7.76
			Zn^{++}	16.58
			Fe^{++}	14.22
Sequestrene NA3	Trisodium ethylene diamine tetraacetate monohydrate (T.P.)		Mn^{++}	13.47
			Co^{++}	16.10
			Ni^{++}	18.45
			Cd^{++}	16.48
			Pb^{++}	18.2
Sequestrene NA4	Tetrasodium ethylenediamine tetraacetate dihydrate (T.P.)		La^{+++}	15.5
			Cr^{++}	24.0
			Fe^{+++}	25.0
			Cu^{++}	18.38
Sequestrene A	Tetrasodium ethylene diaminetetraacetate (aqueous sol.)			
Sequex	E.D.T.A. type	Scher Brothers[19]	Hg^{++}	
Sequex 67	Tetra sodium salt of E.D.T.A.			10.59
				8.69
Sequex 100	Tetra Na salt of E.D.T.A.		Ca^{++}	10.59
			Mg^{++}	8.68
Sequex 120	Na salt of modified E.D.T.A. derivative		Ca^{++}	10.59
			Mg^{++}	8.68
			Fe^{+++}	25.1
			(Not recommended for use in any peroxide or perborate bleaching operations)	24.0
				2.8
				3.4
				12.0

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Tartaric Acid	Dextro form of 2,3-dihydroxy succinic acid 1	Charles Pfizer and Company, Inc.[6]	Fe Al Cu	
Teac-90	Organic salt from acids and amines	Process Chemical Specialties[20]	All polyvalent metallic and alkaline earth ions	
Tetrapotassium Pyrophosphate	$K_4P_2O_7$	Blockson Chemical Company[2]	Not a true sequestering agent	
Tetrines	E.D.T.A. types	Glyco Products Co.[21]	All trivalent metallic ions, especially	
Tetrine Acid	E.D.T.A.		Fe^{+++}	25.1
Tetrasodium Tetrine	Tetra Na dihydrate		Cu^{++}	18.38
			Ca^{++}	10.59
			Mg^{++}	8.69
Sodium Tetrine Liquid Concentrate	Sol. of above			
Sodium Tetrine Liquid	Sol. of above			
Trisodium Tetrine	Trisodium salt monohydrate			
Disodium T Tetrine	Disodium salt dihydrate			
Iron Tetrine				
Iron Tetrine 6V				
VC Products	Sodium Tripolyphosphate	Virginia-California Chemical Corporation[22]	Ca^{++} Mg^{++} Fe^{+++}	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Versenes	E.D.T.A. type	Dow Chemical Company[23]	All divalent and polyvalent metallic ions	
Versene 67	Aq. sol. tetrasodium salt of E.D.T.A.		Polyvalent metallic ions	
Versene 100	Conc. aq. sol. of tetrasodium salt of E.D.T.A.		Divalent and polyvalent metallic ions in aq. sol.	
Versene Powder	Powder form of tetrasodium salt of E.D.T.A.		di- and polyvalent metallic ions	
Versene Beads	Dry form of tetrasodium salt of E.T.D.A.		Ca^{++} at pH II	10.59
Versene 9	Powder form of trisodium salt of E.D.T.A.		Polyvalent ions (metallic)	
Versene Acid	Dry form of E.D.T.A.		Polyvalent ions (metallic)	
Versene Beads	Spray dried form of above		Polyvalent ions (metallic)	
Versene Fe-3 Liquid	Conc. aq. sol. of tetra Na salt of E.D.T.A. and the monosodium salt of N,N-di (2-hydroxyethyl glycine)		Polyvalent metallic ions, especially Fe^{+++} in mildly alkaline range	
Versene Fe-3 Powder	Dry powder form of Fe-3 Liquid		Polyvalent metallic ions especially Fe^{+++} in mildly alkaline range	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Versenes (continued)				
Versene Fe-3 Beads	Spray dried form of above		Polyvalent metallic ions especially Fe^{+++} in mildly alkaline range	
Versene Fe-3 Specific	Aq. sol. of monosodium salt of N,N-di (2-hydroxyethyl) glycine		Specific agent for Fe^{+++} in an alkaline medium	
Versene T			Chelate iron in presence of free caustic. Also alkaline earth ions under same conditions.	
Versene S			Fe^{+++} in presence of free caustic	
Versenol 120	Conc. sol. of trisodium salt of N-hydroxyethyl-ethylene-diaminetriacetic acid		Fe^{+++} in pH range 7 to 12	25.1 24.0 2.8 3.4 12.0
Versenol Powder	Powder form of trisodium salt of N-hydroxyethyl-ethylene-diaminetriacetic acid		Fe^{+++} in pH range 7 to 12	25.1 24.0 2.8 3.4 12.0
Victor STPP	$Na_5P_3O_{10}$ (anhydrous) $Na_4P_2O_7$ (anhydrous)	Victor Chemicals[17]	Ca^{++} Mg^{++}	

CHELATING AGENTS (Continued)

Trade name	Chemical name or formula	Manufacturer	Specific ions chelated	Stability $\log_{10}$
Warkeelates	E.D.T.A. type	Warwick Chemical Company[24]	Fe^{+++}	25.1
			Cr^{++}	
Warkeelate Acid (Powder)	Pure E.D.T.A.		Ni^{++}	18.4
			Cu^{++}	18.3
			Pb^{++}	18.2
Warkeelate PS-47 (Powder and Flakes)	Na salt of E.D.T.A.		Zn^{++}	16.1
			Cd^{++}	16.4
			Co^{++}	16.1
			La^{++}	15.4
Warkeelate S-43 (Liquid)	Tetra Na salt of E.D.T.A.		Fe^{++}	14.45
			Mn^{++}	13.4
			Ca^{++}	10.59
Warkeelate PS-28 (Powder)	Di Na salt E.D.T.A. (dihydrate)		Mg^{++}	2.28
			Sr^{++}	8.63
			Ba^{++}	2.07
Warkeelate PS-38 (Powder)	Tri Na salt E.D.T.A. (monohydrate)			
Woonco D-Ionize	E.D.T.A type	Woonsocket Color and Chemical Company[25]		
#2			Al^{+++}	
#3			Di- and trivalent metallic ions	
#4			Di- and trivalent metallic ions	
#4L	28% sol. of #4		Di- and trivalent metallic ions	

CHELATING AGENTS (Continued)

This table was compiled by George R. Hodgins who received the cooperation of the following:

1. Dexter Chemical Company, 819 Edgewater Road, New York 59, New York.
2. Blockson Chemical Company, Division of Olin Matheson Chemical Corporation, Joliet, Illinois.
3. Wica Chemical Company, P. O. Box 506, Charlotte, North Carolina.
4. Geigy Industrial Chemicals, Ardsley, New York.
5. Colloids, Incorporated, 394 Frelinghuysen Avenue, Newark 12, New Jersey.
6. Charles Pfizer and Company, Inc., 630 Flushing Avenue, Brooklyn 6, New York.
7. American Cyanamid Company, New York 20, New York.
8. Evans Chemetics, 250 East 43rd Street, New York 17, New York.
9. I. P. Thomas and Son Company, Division of Pennsylvania Salt Manufacturing Company, 3 Penn Center Plaza, Philadelphia, Pa.
10. Maher Color and Chemical Company, 1700 North Elston Avenue, Chicago 22, Illinois.
11. Nova Chemical Corporation, 153 Waverly Place, New York 14, New York.
12. Antara Chemical, Sales Division of General Analine and Film Corporation, 435 Hudson Street, New York 14, N. Y.
13. Crown Zellerbach Corporation, Chemical Products Division, Camas, Washington.
14. Refined Products Corporation, Lyndhurst, New Jersey.
15. Chemplex Company, Inc., Belleville Turnpike, Kearney, N. J.
16. Wyandotte Chemicals Corporation, Biddle Avenue, Wyandotte, Michigan.
17. Victor Chemicals Works, 155 North Wacker Drive, Chicago 6, Illinois.
18. Reading Testing Laboratories, Reading, Pennsylvania.
19. Scher Brothers, 519 Getty Avenue, Clifton, New Jersey.
20. Process Chemical Specialties Company, Beverly, Massachusetts.
21. Glyco Products Company, Inc., Empire State Building, New York 1, N. Y.
22. Virginia-Carolina Chemical Corporation, 401 East Main Street, Richmond 8, Virginia.
23. Dow Chemical Company, Midland, Michigan.
24. Warwick Chemical Company, Wood River Junction, Rhode Island.
25. Woonsocket Color and Chemical Company, Woonsocket, Rhode Island.

Reference: Martell and Calvin, Chemistry of the Metal Chelate Compounds, Appendix 1, Chelate Constants.

ION EXCHANGE RESINS

Compiled by George R. Hodgins

Trade name	Source	Ion exchanged	Type of polymer resin	Acid or base	Capacity*	Stability
Amberlites	Rohm and Haas[1]					
120-IR		cation	polystyrene, nuclear sulfonic acid	strong acid	41.5 1.9 4.30	resistant to attrition and chemical attack
IRC-50		cation	carboxylic acid	weak acid	71.0 3.5 10.0	resistant to attrition and chemical attack
IRA-400		anion	polystyrene, quaternary amine	strong base	22.0 1.0 3.0	resistant to attrition, acids, alkalies and common organic solvents
IRA-401		anion	polystyrene, quaternary amine, more porous analog of IRA-400	strong base	17.5 0.8 3.0	same as IRA-400
IR-45		anion	polystyrene, base polyamine	weak base	43.0 2.0 5.0	resistant to attrition and chemical attack especially at high temperatures
IRA-410		anion	polystyrene, quaternary amine	base	26.0 1.2 3.0	resistant to acid, alkalies, common organic solvents
Monobed						
MB-1	Mixture of Amberlite IR-120 and IRA-400 (properties same as components)				10.0, 0.46	
MB-2	Mixture of IR-120 and IRA-410 (properties same as components)				12.0, 0.55	
MB-3	Mixture of IR-120 and IRA-410 with indicator				12.0, 0.55	

* Capacity recorded in this order—Kgr as $CaCO_3$ per foot^3; meq/ml wet resin; meq/gr dry resin; c = cation; a = anion.

ION EXCHANGE RESINS (Continued)

Trade name	Source	Ion exchanged	Type of polymer resin	Acid or base	Capacity*	Stability
Decalso	Permutit Company[2]	cation	precipitated Na alumino silicate gel (inorganic)		high Kgr/cu ft up to 10.0 (Na cycle)	good to organic solvents. Has physical stability
De-Acidite		anions of strong acids only	aliphatic polyamine resin	weakly basic	Kgr/cu ft up to 20.0	resistant to acids, alkalies. Has physical stability
Duolites	Chemical Process Company[3]				as Kgr/cu ft range	
A-2		anion	functional groups primary, secondary, tertiary amines	weak base	10–35	
A-4		anion	functional groups primary, secondary, tertiary, amines	weak base		exceptionally resistant to oxidation. Good thermal stability
A-6		anion	tertiary amines	weak base	12–30	excellent thermal stability. Resist oxidation
A-7		anion	primary, secondary, tertiary amines	weak base	12–35	good thermal stability
A-14		anion	polystyrene matrix	weak base	20–40	high stability
A-114		anion	hydrocarbon matrix	weak base	20–40	high resistance to oxidative degradation
A-30		anion	alkylene bridge cross-linking of polyalkylene amines	intermediate base	10–45	thermal stability
A-41		anion	tertiary and quaternary amine functional groups	intermediate base	10–35	

ION EXCHANGE RESINS (Continued)

Trade name	Source	Ion exchanged	Type of polymer resin	Acid or base	Capacity*	Stability
Duolites (continued)						
A-43		anion	mixed polyalkylene amines as functional groups	inter-medate base	10–35	
A-40		anion	type 2 base (quaternary NH_4)	strong base	10–26	
A-42		anion	type 1 base (quaternary NH_4)	strong base	8–22	thermal fair
A-101		anion	hydrocarbon matrix, type 1	strong base	6–18	
A-102		anion	type 2, hydrocarbon matrix	strong base	8–20	
C-3		cation	phenolic matrix, functional group is methylene sulfonic acid	strong acid	8–28	
C-10		cation	highly expanded phenolic matrix, methylene sulfonic acid as functional group	strong acid	5–12	
C-20		cation	polystyrene matrix, nuclear sulfonic acid as functional group	strong acid	10–48	very good thermal stability resistant to oxidation
C-25		cation	polystyrene matrix, nuclear sulfonic acid as functional group	strong acid	10–36	
C-62		cation	hydrocarbon matrix, phosphoric acid as functional group	inter-mediate	~56	

ION EXCHANGE RESINS (Continued)

Trade name	Source	Ion exchanged	Type of polymer resin	Acid or base	Capacity*	Stability
Duolites (continued)						
C-63		cation	hydrocarbon matrix, phosphoric acid as functional group	intermediate acid	~76	
C-65		cation	hydrocarbon matrix, phosphoric acid as functional group	intermediate	39–48	experimental as yet
CS-101		cation	cross linked acrylic resin with carboxylic acid as functional group	weak acid	5–100	thermal stability and inert to oxidizing conditions
S-10		electron exchanger	redox resin copper-amine complex as functional group			
S-30		resinous adsorbent	phenolic matrix, mixed-polar functional groups	indeterminable		
Dowex Fine Mesh Resins	Dow Chemical Company[4]					
Dowex-50		cation	styrene divinyl benzene copolymers with functional groups sulfonic acid	strongly acidic	Na^+ form 41.5 4.8 1.9 H^+ form 37.0 5.0 1.7	thermal stability good up to 150°C. Very good against solvents. Very good against reduction
Dowex-1		anion	styrene divinyl benzene copolymers, quaternary ammon. as functional group	strong base	Cl^- form 29.0 3.5 1.33	breaks down in presence of S containing reducing agents. Very good against solvents

ION EXCHANGE RESINS (Continued)

Trade name	Source	Ion exchanged	Type of polymer resin	Acid or base	Capacity*	Stability
Dowex Fine Mesh Resins (continued)						
Dowex-2		anion		strongly basic	Cl⁻ form 29.0 3.6 1.33	resistant to acids, alkalines, common organic solvents and attrition
Dowex-3		anion	styrene-divinyl benzene matrix with polyalkylamine functional groups	weakly basic	OH form 54.5 5.5 2.5	good towards acids, alkalies and mild oxidizing agents. Insoluble in common solvents
Dowex resins come in 24 different mesh sizes						
Lewatit	Farbenfabriken Bayer A. G.[5]					
Lewatit KS		cation	sulfonated phenolic resin	acidic	3.0 1.2	
Lewatit PN		cation	sulfonated phenolic resin	acidic	1.9 0.9	
Lewatit C		cation	carboxylic		5.0 1.6	
Lewatit M		anion		weakly basic	3.5 1.7	
Lewatit MI		anion		medium basic	10.2 2.7	
Lewatit MII		anion		strongly basic		
Nalco Materials	National Aluminate Corporation[6]					
Nalcite HCR		cation	sulfonated copolymer of styrene and divinylbenzene	weak acid	20–30	resistant to attrition, a fair amount of resistance to oxidation

ION EXCHANGE RESINS (Continued)

Trade name	Source	Ion exchanged	Type of polymer resin	Acid or base	Capacity*	Stability
Nalco Materials (continued)						
Nalcite SAR**		anion	polymerized styrene with divinylbenzene as cross-linking agent	strongly basic	18.7	resistant to attrition. Not resistant to heat over 100°F
SBR**		anion	polymerized styrene with divinylbenzene as cross-linking agent, 3 of the alkyl groups in the structure are methyl groups	strongly basic	10–14	not stable over 150°F. Resistant to attrition
HGR		cation	styrene and divinylbenzene, containing sulfonic acid groups	acid	20–30	experimental
WBR		anion	styrene and divinylbenzene, containing polyamine groups	basic	20	resistant to attrition
HDR		cation	styene and divinylbenzene with sulfonic groups	acidic	5–35 kgr	resistant to high temperatures and highly resistant to oxidizing agents
Permutits	Permutit Company[2]					
Permutit Q		cation	sulfonated styrene type resin with $-SO_3H$ exchange groups	acidic	up to 40 Kgr/cu ft on hydrogen cycle up to 35 on Na cycle	exceptionally good at high temperatures and pH. Resistant to oxidation
Permutit H-70		cation	carboxylic acid resin	acidic	up to 80 Kgr/cu ft	
Permutit W		anion		weakly basic	up to 30	

** Dowex resins of the Dow Chemical Company.

ION EXCHANGE RESINS (Continued)

Trade name	Source	Ion exchanged	Type of polymer resin	Acid or base	Capacity*	Stability
Permutits (continued)						
Permutit A		anion		medium base	up to 25	
Permutit S		anion	quaternary amine resin	strongly basic	up to 15	
ZEO-DUR		cation	processed glauconite		2.8 Kgr/cu ft	
ZEO-KARB		cation	sulfonated coal type resin	basic	8 Kgr/cu ft	
Wofatits*** Wofatit K	I. G. Farbenindustrie[7]	cation	sulfonated phenolic		2.5 0.9	
Wofatit KS		cation	sulfonated phenolic		2.5 0.9	
Wofatit P		cation	sulfonated phenolic		1.4 0.5	
Wofatit C		cation	carboxylic		7.0 2.5	
Wofatit M		anion		weakly basic	7.0 1.2	

*** Capacity of Lewatits and Wofatits are recorded in the following order: meq per gr., meq per ml.

This table was compiled by George R. Hodgins who received the cooperation of the following:

1. Rohm and Haas, Washington Square, Philadelphia 5, Pennsylvania.
2. Permutit Company, 330 West 42nd Street, New York 36, New York.
3. Chemical Process Company, P. O. Box 829, Redwood City, California.
4. Dow Chemical Company, Midland, Michigan.
5. Farbenfavriken Bayer, Leverkusen-Bayerwerk, Germany.
6. National Aluminate Corporation,Chicago, Illinois.
7. I. G. Farbenindustrie, Wolfen, Germany.

MISCIBILITY OF ORGANIC SOLVENT PAIRS

MISCIBILITY OF ORGANIC SOLVENT PAIRS

J. S. Drury

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Compound number	Compounds	Acetone	Acetyl acetone	2-Amino-2-methyl-1-propanol	Aniline	Benzaldehyde	Benzene	Benzin	Benzyl alcohol	Butyl acetate	Butyl alcohol	*n*-Butyl ether	Capryl alcohol
1	Acetone	..	M	M	..	M	M	M	M	M	M	M	M
2	Acetyl acetone	M	..	R	..	M	M	M	M	M	M	M	M
3	Adiponitrile	M	M	M	M	..	M	..	M	M	M	I	..
4	2-Amino-2-methyl-1-propanol	M	R	..	..	M	M	I	M	M	M	Is	M
5	Benzaldehyde	M	M	M	..	..	M	M	M	M	M	M	M
6	Benzene	M	M	M	..	M	..	M	M	M	M	M	M
7	Benzin	M	M	I	..	M	M	..	I	M	M	M	M
8	Benzonitrile	M	M	M	M	..	M	..	M	M	M	M	..
9	Benzothiazole	M	M	M	M	..	M	..	M	M	M	M	..
10	Benzyl alcohol	M	M	M	..	M	M	I	..	M	M	M	M
11	Benzyl mercaptan	M	M	I	M	..	M	..	M	M	M	M	..
12	Butyl acetate	M	M	M	..	M	M	M	M	..	M	M	M
13	Butyl alcohol	M	M	M	..	M	M	M	M	M	..	M	M
14	*n*-Butyl ether	M	M	Is	..	M	M	M	M	M	M	..	M
15	Capryl alcohol	M	M	M	..	M	M	M	M	M	M	M	..
16	Carbon tetrachloride	M	M	M	..	M	M	M	M	M	M	M	M
17	Diacetone alcohol	M	M	R	..	M	Is	I	M	M	M	M	M
18	Diethanolamine	M	R	M	..	I	I	I	M	I	M	I	M
19	Diethyl Cellosolve	M	M	M	..	M	M	M	M	M	M	M	M
20	Diethyl ether	M	M	M	..	M	M	M	M	M	M	M	M
21	Dimethylaniline	M	M	M	..	M	M	M	M	M	M	M	M
22	Di-*N*-propylaniline	M	M	I	M	..	M	..	M	M	M	M	..
23	Ethyl alcohol	M	M	M	..	M	M	M	M	M	M	M	M
24	Ethyl benzoate	M	M	M	..	M	M	M	M	M	M	M	M
25	Ethyl isothiocyanate	M	M	R	M	..	M	..	M	M	M	M	..
26	Ethyl thiocyanate	M	M	M	M	..	M	..	M	M	M	M	..
27	Ethylene glycol	M	M	M	..	Is	I	M	M	Is	M	I	M
28	2-Ethylhexanol	M	M	M	..	M	M	M	M	M	M	M	M

MISCIBILITY OF ORGANIC SOLVENT PAIRS (Continued)

The classifications were made by shaking together 5 ml. of each of the solvents listed in a test tube for 1 minute, then allowing the mixture to settle. If no interfacial meniscus was observed, the solvent pair was considered miscible. If such a meniscus was present, the solvent pair was regarded as immiscible. The classification of immiscible is a qualitative one since solvent pairs may exhibit some degree of partial miscibility while existing as separate phases. Solvent pairs possessing a pronounced degree of partial miscibility are designated by the symbol Is.

Carbon tetrachloride	Diacetone alcohol	Diethanolamine	Diethyl cellosolve	Diethyl ether	Dimethylaniline	Ethyl alcohol	Ethyl benzoate	Ethylene glycol	2-Ethylhexanol	Formamide	Furfuryl alcohol	Glycerol	Hydroxyethyl-ethylenediamine	Isoamyl alcohol	Methyl isobutyl ketone	Nitromethane	Dibutoxytetra-ethylene glycol	Pyridine	Triethanolamine	Trimethylene glycol	Compound number
M	M	M	M	M	M	M	M	M	M	M	M	I	M	M	M	M	M	M	. .	M	1
M	M	R	M	M	M	M	M	M	M	M	M	I	R	M	M	M	M	M	. .	M	2
I	M	. .	M	I	M	M	M	I	I	M	M	I	M	I	M	. .	M	M	M	M	3
M	R	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M	4
M	M	I	M	M	M	M	M	Is	M	M	M	Is	R	M	M	M	M	M	. .	M	5
M	Is	I	M	M	M	M	M	I	M	I	M	I	I	M	M	I	M	M	. .	I	6
M	I	I	M	M	M	M	M	M	M	I	I	I	Is	M	M	M	M	M	. .	I	7
M	M	. .	M	M	M	M	M	I	M	I	M	I	M	M	M	. .	M	M	M	I	8
M	M	. .	M	M	M	M	M	M	M	I	M	I	M	M	M	. .	M	M	M	M	9
M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M	10
M	M	. .	M	M	M	M	M	I	M	I	M	I	M	M	M	. .	M	M	R	I	11
M	M	I	M	M	M	M	M	Is	M	I	M	I	I	M	M	M	M	M	. .	Is	12
M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	. .	M	13
M	M	I	M	M	M	M	M	I	M	I	M	I	I	M	M	I	M	M	. .	I	14
M	M	M	M	M	M	M	M	M	M	I	M	I	M	M	M	Is	M	M	. .	M	15
. .	Is	I	M	M	M	M	M	I	M	I	M	I	I	M	M	M	M	M	. .	I	16
Is	. .	M	M	M	M	M	M	M	M	M	M	I	R	M	M	M	M	M	. .	M	17
I	M	. .	I	I	Is	M	M	M	M	M	M	M	M	M	I	I	I	M	. .	M	18
M	M	I	. .	M	M	M	M	M	M	M	M	I	I	M	M	M	M	M	. .	M	19
M	M	I	M	. .	M	M	M	I	M	I	M	I	I	M	M	M	M	M	. .	I	20
M	M	Is	M	M	. .	M	M	I	M	I	M	I	I	M	M	M	M	M	. .	I	21
M	I	. .	M	M	M	M	M	I	M	I	M	I	I	M	M	. .	M	M	I	I	22
M	M	M	M	M	M	. .	M	M	M	M	M	M	M	M	M	M	M	M	. .	M	23
M	M	M	M	M	M	M	. .	I	M	I	M	I	M	M	M	M	M	M	. .	Is	24
M	M	. .	M	M	M	M	M	I	M	I	M	I	R	M	M	. .	M	M	M	I	25
M	M	. .	M	M	M	M	M	I	M	I	M	I	M	M	M	. .	M	M	M	I	26
I	M	M	M	I	I	M	I	. .	M	M	M	M	M	M	I	I	M	M	. .	M	27
M	M	M	M	M	M	M	M	M	. .	I	M	I	M	M	M	I	M	M	. .	M	28

MISCIBILITY OF ORGANIC SOLVENT PAIRS
(Continued)

Compound number	Compounds	Acetone	Acetyl acetone	2-Amino-2-methyl-1-propanol	Aniline	Benzaldehyde	Benzene	Benzin	Benzyl alcohol	Butyl acetate	Butyl alcohol	*n*-Butyl ether	Capryl alcohol
29	Formamide	M	M	M	. .	M	I	I	M	I	M	I	I
30	Furfuryl alcohol	M	M	M	. .	M	M	I	M	M	M	M	M
31	Glycerol	I	I	M	. .	I	I	I	M	I	M	I	I
32	Hydroxyethylethylenediamine	M	R	M	. .	R	I	Is	M	I	M	I	M
33	Isoamyl alcohol	M	M	M	. .	M	M	M	M	M	M	M	M
34	Isoamyl sulfide	M	M	I	M	. .	M	. .	M	M	M	M	. .
35	Isobutyl mercaptan	M	M	M	M	. .	M	. .	M	M	M	M	. .
36	Methyl disulfide	M	M	M	M	. .	M	. .	M	M	M	M	. .
37	Methyl isobutyl ketone	M	M	M	. .	M	M	M	M	M	M	M	M
38	Nitromethane	M	M	M	. .	M	I	M	M	M	M	I	Is
39	Dibutoxytetraethylene glycol	M	M	M	. .	M	M	M	M	M	M	M	M
40	Pyridine	M	M	M	. .	M	M	M	M	M	M	M	M
41	Tri-*n*-butylamine	M	M	I	I	. .	M	. .	M	M	M	M	. .
42	Trimethylene glycol	M	M	M	. .	M	I	I	M	Is	M	I	M

MISCIBILITY OF ORGANIC SOLVENT PAIRS
(Continued)

Carbon tetrachloride	Diacetone alcohol	Diethanolamine	Diethyl cellosolve	Diethyl ether	Dimethylaniline	Ethyl alcohol	Ethyl benzoate	Ethylene glycol	2-Ethylhexanol	Formamide	Furfuryl alcohol	Glycerol	Hydroxyethyl-ethylenediamine	Isoamyl alcohol	Methyl isobutyl ketone	Nitromethane	Dibutoxytetra-ethylene glycol	Pyridine	Triethanolamine	Trimethylene glycol	Compound number
I	M	M	M	I	I	M	I	M	I	..	M	M	M	M	Is	M	M	M	..	M	29
M	M	M	M	M	M	M	M	M	M	M	..	M	M	M	M	M	M	M	..	M	30
I	I	M	I	I	I	M	I	M	I	M	M	..	M	I	I	I	I	M	..	M	31
I	R	M	I	I	I	M	M	M	M	M	M	M	..	M	M	M	M	M	..	M	32
M	M	M	M	M	M	M	M	M	M	M	M	I	M	..	M	M	M	M	..	M	33
M	I	..	M	M	M	M	M	I	M	I	I	I	I	M	M	..	M	M	I	I	34
M	M	..	M	M	M	M	M	I	M	I	M	I	I	M	M	..	M	M	R	R	35
M	M	..	M	M	M	M	M	I	M	I	M	I	I	M	M	..	M	M	I	R	36
M	M	I	M	M	M	M	M	I	M	Is	M	I	M	M	..	M	M	M	..	I	37
M	M	I	M	M	M	M	M	I	I	M	M	I	M	M	M	..	M	M	..	I	38
M	M	I	M	M	M	M	M	M	M	M	M	I	M	M	M	M	..	M	..	M	39
M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	..	..	M	40
M	I	..	M	M	M	M	M	I	M	I	M	I	I	M	M	..	M	M	I	I	41
I	M	M	M	I	I	M	Is	M	M	M	M	M	M	M	I	I	M	M	..	..	42

PHYSICAL AND CHEMICAL CONSTANTS OF

The following abbreviations are used: Class I, Resins; Class II, Oleo-
acid; al. alcohol; bz, benzene; chl., chloroform; eth., ether; eth. acet., ethyl
oil of turpentine; p. sol., partly soluble; sol., soluble; sl. sol., slightly soluble;

Name	Class	Specific Gravity	Melting Point °C.	Saponification No.	Iodine No.	Acid No.
Amber	I	1.05–1.10	250–325	85–150	62	15–35
Ammoniacum	III	1.2	.....	160–77	....	100–6
Anime (East Indian)	I	1.03	230–40	60–90	128–37	18–27
Anime (West Indian)	I	....	.....	150–60	....	45–7
Benzoin	I	1.2	75–100	155–270	....	90–190
Canada Balsam	II	....	.....	90–6	....	80–90
Caoutchouc	I	....	.....	.....	71	81
Colophony	I	1.07–.09	120–50	150–200	112–7	150–80
Copaiba (Para)	II	0.9–1.0	.....	.....	....	30–68
Copaiba (Maracaibo)	II	0.9–1.0	.....	.....	....	79–91
Copaiba (Maranham)	II	0.9–1.0	.....	.....	....	72–90
Copal (Benin)	I	1.06–.08	120–66	125–150	61	100–34
Copal (Loango)	I	....	.....	126–34	....	106–15
Copal (Sierra Leone)	I	....	.....	146–50	....	109–14
Copal (Manilla)	I	....	.....	178	....	128
Dammar	I	1.00–.05	95–190	20–65	....	18–60
Dragon's Blood	I	1.2	120	150–60	....	....
Elemi	....	1.02–.08	75–120	25–45	....	18–25
Galbanum	III	1.11–.13	.....	75–225	....	5–65
Guaiacum	I	1.2	85–90	.....	....	70–80
Jalap	I	1.14–.15	150	.....	....	12–25
Mastic	I	1.04–.07	105–20	82–92	64	50–71
Myrrh	III	1.12–.28	.....	160–200	....	59–72
Olibanum	III	1.2	.....	65–120	....	45–88
Sandarac	I	1.04	135–50	143	....	140–55
Shellac	I	1.08–.13	.....	194–213	....	48–64
Storax	I	1.12	.....	130–230	....	35–175
Tolu	II	1.1	.....	154–220	....	112–68
Turpentine (Common)	II	....	.....	100–75	....	110–50
Turpentine (Larch)	II	1.1–1.2	.....	75–125	....	75–100

RESINS, OLEO-RESINS AND GUM-RESINS

Resins; Class III, Gum-Resins; a, acid; acet., acetone; acet. a., glacial acetic acetate; insol., insoluble; lgr., ligroin; meth. al., methyl alcohol; oil turp., w., water.

Ester No.	% Volatile at 100° C.	% Ash	Solubility
71–91	.....	0.3	p. sol. in CS_2, oil turp; sl. sol. in al., meth. al., amyl al., bz., eth; insol. in acet. a., acet., chl.
60–70	2–15	2–7	p. sol. w., al., eth.
47–62	.....	......	
100–15	.....	0.05–.1	
30–175	4–10	0.2–3.0	sl. sol. w.; p. sol. al.
4–8	.....	......	sol. in bz., chl., eth. acet., oil turp.; p. sol. in al., eth., lgr.
.....	.....	......	sol. bz.; insol. acet.
7–22	0–0.5	0.02–.05	sol. in acet., al., meth. al., amyl al., bz., acet. a., chl., eth., eth. acet., CS_2, oil turp.; p. sol. in lgr.
2–18	.....	......	sol. in bz., chl., eth., oil turp.; p. sol. al., lgr., eth. acet., CS_2; insol. w.
1–8	.....	......	sol. chl., eth., lgr.; p. sol. in al., eth. acet., oil turp.; insol. w.
2–18	.....	......	sol. in bz., chl., eth., oil turp.; p. sol. al., lgr., eth. acet., CS_2; insol. w.
.....	0.5–2.5	0.25–2.0	p. sol. acet. a., bz., chl., eth., oil turp.; insol. in acet., al., meth. al., lgr., CS_2.
.....	.....	......	98.7 % sol. in eth.-al. mixture.
.....	.....	......	92.9 % sol. in eth.-al. mixture.
.....	.....	......	
.....	0.1–1.0	0.01–.1	sol. in bz., chl., CS_2; p. sol. in al., eth., acet., amyl al., lgr.
.....	.....	3.6	sol. in al., eth., bz.; p. sol. in chl., eth. acet., lgr.
6–26	12–20	0.02–.1	sol., in eth., chl. bz., amyl al., CS_2; sl. sol. in lgr.; p. sol. in acet. a., acet., al., meth. al., eth. acet., oil turp.
50–175	1–30	1–25	15–20 % sol. in w.; p. sol. in al.
.....	.....	1–5	p. sol. in al., bz., eth., lgr., CS_2
120–5	.....	......	sol. in al.; p. sol. in acet. a., eth., chl.; insol. in w., bz., oil turp., CS_2
29	0.1–1.5	0.1–.2	p. sol. in acet. a., acet., al., meth. al. chl., oil turp.; sl. sol. in CS_2; sol. in amyl al., bz., eth.; insol. w.
108–31	.....	1–8	p. sol. in w., al.
7–72	.....	......	p. sol. in al., acet., meth. al., amyl al., chl., eth., eth. acet., oil turp.; sl. sol. in acet. a., bz.
1–33	0.05–.2	0.04–.1	sol. in acet., amyl al.; p. sol. in acet. a., al., meth. al., bz., chl., eth., lgr., CS_2; sl. sol. in oil turp.
137–63	.....	0.72–1.4	p. sol. in acet. a., meth. al., amyl. al., bz., chl., eth., lgr., eth. acet., oil turp., CS_2
70–185	5–35	0–2	sol. in acet. a., al., meth. al., amyl al.; sl. sol in acet., bz., oil turp.; insol. in eth., lgr., CS_2
25–70	.....	......	sol in al., chl., eth. acet.; sl. sol. in w.; p. sol. in bz., eth., lgr., oil turp.
5–55	.....	......	sol. in al., bz., chl., eth., eth acet., oil turp.; p. sol. in lgr., CS_2
0–50	.....	......	sol. in acet. a., al., meth. al., amyl al., bz., chl., eth., eth. acet., oil turp.; p. sol. in lgr., CS_2

PHYSICAL CONSTANTS OF MINERALS

The following table presents data for about 350 of the more common minerals.

In order to avoid duplication and save space, very few cross references are given in the body of the table. If the name sought is not found in the table, consult the **synonym index** given below.

Specific gravities are given at normal atmospheric temperatures, a more precise statement being valueless considering the large variations in natural minerals.

Hardness is given in terms of Mohs' scale. (See under Hardness.)

Indices of refraction for the sodium line, $\lambda = 5893$ Å, unless otherwise indicated. Li, $\lambda = 6708$ Å. Indices will invariably be given in the order ω, ϵ or α, β, γ. Uniaxial crystals are considered positive if $\epsilon > \omega$, negative if $\omega > \epsilon$. Biaxial crystals are considered positive if β is nearer α in value than it is γ and negative if β is nearer γ than α.

ABBREVIATIONS

amor	amorphous	hex	hexagonal	rhbdr	rhombohedral
bet	between	int	internal	rhomb	rhombic
bl	blue	inter	intermediate	silv	silver
blk	black	iridesc	iridescent	sl	slightly
blksh	blackish	lt	light	somet	sometimes
blsh	bluish	monocl	monoclinic	st	steel
br	brown	oft	often	tarn	tarnishes
brnsh	brownish	opt	optically	tetr	tetragonal
col	colorless	pa	pale	tricl	triclinic
cub	cubic	prob	probably	trig	trigonal
dk	dark	purp	purple	var	variety
emer	emerald	(R)	radioactive	vlt	violet
expos	exposure	rar	rarely	wh	white
gold	golden	redsh	reddish	yel	yellow
grn	green	refl	reflection	yelsh	yellowish
grnsh	greenish				

SYNONYM INDEX

Compound sought	Listed	Compound sought	Listed
Aegirite	Acmite	+Fe Bronzite	Enstatite
Alalite	Diopside	Brown hematite	Limonite
Allanite	Orthite	Calcium-chromium garnet	Uvarovite
Alum stone	Alunite	Calcspar	Calcite
Amphibole	Hornblende	Caporcianite	Laumonite
Amphigene	Leucite	Carbonado	Diamond
Antimonite	Stibnite	Carbuncle, Al-Fe garnet	Almandite
Aphthitalite	Arcanite	Chalybite	Siderite
Arsenic nickel	Niccolite	Chessylite	Azurite
Asparagus-stone	Apatite	Chile saltpeter	Soda niter
Beauxite	Bauxite	China clay	Kaolinite
Black hematite	Psilomelane	Chlorite	Clinochlorite
Black lead	Graphite	Chrome-spinel	Picotite
Black mica	Biotite	Cobalt bloom	Erythrite
Blue iron ore	Vivianite	Cobalt glance	Cobaltite
Blue malachite	Azurite	Copper pyrites	Chalcopyrite
Blue stone	Chalcanthite	Copper uranite	Torbernite (R)
Blue vitriol	Chalcanthite		
Bortz	Diamond		
Brimstone	Sulfur		

SYNONYM INDEX (Continued)

Compound sought	Listed
Copperas	Melanterite
Cromfordite	Phosgenite
Crysolite	Olivine
Cymophane	Chrysoberyl
Dark red silver ore	Pyrargyrite
Desmine	Stilbite
Dialogite	Rhodochrosite
Dichroite	Cordierite
Disthene	Cyanite
Dry bone	Smithsonite
Elaeolite	Nephelite
Emerald	Beryl
Epsom salt	Epsomite
Erubescite	Bornite
Facellite	Kaliophilite
Fahlerz	Tetrahedrite
Fibrolite	Sillimanite
Flint	Chalcedony
Fluorapatite	Apatite
Fluorspar	Fluorite
Fool's gold	Pyrite
Fowlerite	Rhodonite
Glance	Galena
Glaserite	Arcanite
Glauber salt	Mirabilite
Grammatite	Tremolite
Gray copper ore	Tetrahedrite
Gray manganese ore	Manganite
Green carbonate of copper	Malachite
Green lead ore	Pyromorphite
Harmotomite	Harmotome
Hebronite	Amblygonite
Hessonite	Grossularite
Hiddenite	Spodumene
Horn mercury	Calomel
Horn silver	Cerargyrite
Hyacinth	Zircon
Hydrargillite	Gibbsite
Hydrohematite	Turgite
Hypersthene	Enstatite
Ice stone	Cryolite
Iceland spar	Calcite
Idocrase	Vesuvianite
Iolite	Cordierite
Iron pyrites	Pyrite
Iron spinel	Hercynite
Jargon	Zircon
Kunzite	Spodumene
Lapis-Lazuli	Lazurite
Lead carbonate	Cerussite
Lead oxide	Litharge
Leonhardite	Laumontite
Lime feldspar	Anorthite
Lime-soda feldspar	Oligoclase
Lithiophyllite	Triphylite
Lithium mica	Lepidolite
Lodestone	Magnetite
Magnesium mica	Phlogopite

Compound sought	Listed
Magnetic pyrites	Pyrrhotite
Malacolite	Diopside
Manganblende	Alabandite
Manganese-aluminum garnet	Spessartite
Meershaum	Sepiolite
Menaccanite	Ilmenite
Microcosmic salt	Stercorite
Mispickel	Arsenopyrite
Molybdenum glance	Molybdenite
Needle zeolite	Natrolite
Nickelin	Niccolite
Nigrine	Rutile
Niobite	Columbite
Noumeite	Garnierite
Octahedrite	Anatase
Peanut ore	Wolframite
Pearl spar	Dolomite
Pencil stone agalmatolite	Pyrophyllite
Peridot	Olivine
Pistacite	Epidote
Plumbago	Graphite
Polianite	Pyrolusite
Potassium feldspar	Orthoclase
Purple copper ore	Bornite
Red copper ore	Cuprite
Red zinc ore	Zincite
Rock salt	Halite
Ruby	Corundum
Ruby silver ore	Proustite
Sapphire	Corundum
Silver glance	Argentite
Soapstone	Talc
Soda-microcline	Anorthoclase
Sodium feldspar	Albite
Spathic iron	Siderite
Sphene	Titanite
Stassfurtite	Boracite
Steatite	Talc
Stream tin	Cassiterite
Tabular spar	Wollastonite
Tincal	Borax
Tinstone	Cassiterite
Titanic iron ore	Ilmenite
Troosite, var. cont. Mn	Willemite
Urao	Trona
Vermilion, natural	Cinnabar
Websterite	Aluminite
Wernerite	Scapolite
Wheel ore	Bournonite
White iron pyrites	Marcasite
White lead ore	Cerussite
White mica	Muscovite
Wood tin	Cassiterite
Zincblende	Sphalerite
Zinc-spinel	Gahnite
Zinc vitriol	Goslarite

No.	Name	Synonym	Formula	Sp. gr.
1	Acmite	aegirite	$Na_2O.Fe_2O_3.4SiO_2$	3.5–3.56
2	Actinolite		$Ca(Mg, Fe)_3(SiO_3)_4$	2.9–3.2
3	Agate See *chalcedony*			
4	Alabandite	manganblende	MnS	3.95–4.04
5	Albite	sodium feldspar	$Na_2O.Al_2O_3.6SiO_2$	2.61–2.64
6	Almandite	carbuncle, Al-Fe garnet	$Al_2O_3.3FeO.3SiO_2$	3.688–4.33
7	Aluminite	websterite	$Al_2O_3.SO_3.9H_2O$	1.66
8	Alunite	alum stone	$K_2Al_6(OH)_{12}(SO_4)_4$	2.58–2.75
9	Alunogenite	alunogen	$Al_2(SO_4)_3.18H_2O$	1.6–1.8
10	Amblygonite	hebronite	$AlPO_4.LiF$	2.98–3.15
11	Analcite	analcime	$Na_2O.Al_2O_3.4SiO_2.2H_2O$	2.22–2.29
12	Anatase	octahedrite	TiO_2	3.82–3.95
13	Andalusite		Al_2SiO_5 or $Al_2O_3.SiO_2$	3.1–3.2
14	Andesine	feldspar group	$(CaO,Na_2O)Al_2O_3.4SiO_2$	2.647–2.69
15	Andradite	common garnet, black garnet	$3CaO.Fe_2O_3.3SiO_2$	3.64–3.9
16	Anglesite		$PbSO_4$	6.12–6.39
17	Anhydrite		$CaSO_4$	2.899–2.985
18	Anorthite	lime feldspar	$CaO.Al_2O_3.2SiO_2$	2.703–2.763
19	Anorthoclase	feldspar group, soda-microcline	$(Na,K)_2O.Al_2O_3.6SiO_2$	2.56–2.651
20	Anthophyllite		$(Mg,Fe)SiO_3$	2.857–3.2
21	Antigorite		$3MgO.3SiO_2.2H_2O$	2.55–2.62
22	Apatite	fluorapatite, asparagus-stone	$CaF_2.3Ca_3P_2O_8$	3.151–3.270
23	Apophyllite		$K_2O.8CaO.16SiO_2.16H_2O$	2.3–2.4
24	Aragonite		$CaCO_3$	2.85–2.94
25	Arcanite	aphthitalite, glaserite	$(K,Na)_2SO_4$	2.662
26	Argentite	silver glance	Ag_2S	7.24–7.40
27	Arsenic	native arsenic	As	5.64–5.78
28	Arsenopyrite	mispickel	$FeS_2.FeAs_2$	5.89–6.20
29	Atacamite		$3CuO.CuCl_2.3H_2O$	3.77–3.94
30	Augelite		$2Al_2O_3.P_2O_5.3H_2O$	2.77
31	Augite		$CaMg(SiO_3)_2+(Mg,Fe)(AlFe)_2SiO_6$	3.2–3.6
32	Autunite	lime uranite	$CaO.2UO_3.P_2O_5.8H_2O$	3.05–3.19
33	Axinite		$HCa_3Al_2BSi_4O_{16}$	3.22–3.314
34	Azurite	blue malachite, chessylite	$2CuCO_3.Cu(OH)_2$	3.77–3.83
35	Baddeleyite		ZrO_2	5.50–6.03
36	Barite	barytes	$BaSO_4$	4.3–4.6
37	Barysilite		$Pb_3Si_2O_7$	6.53–6.707
38	Bauxite	beauxite	$Al_2O_3.2H_2O$	2.55
39	Beccarite		$ZrO_2.SiO_2$	6.54–6.74
40	Benitoite		$BaTiSi_3O_9$	3.64–3.65
41	Bertrandite		$4BeO.2SiO_2.H_2O$	2.571–2.60
42	Beryl		$3BeO.Al_2O_3.6SiO_2$	2.63–2.91
43	Beryllonite		$NaBePO_4$	2.845
44	Biotite	black mica	$(K,H)_2(Mg,Fe)_2(Al,Fe)_2(SiO_4)_3$	2.69–3.16

OF MINERALS

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V °	′
1	6.0–6.5	monocl., blk., brnsh. or redsh.	1.763, 1.799, 1.813	62	13
2	5–6	monocl., grn., gray-grn. or br.	1.611, 1.627, 1.636	75	
3					
4	3.5–4.0	cub., iron-blk.	(Li) 2.70	...	
5	6.0–6.5	tricl., gray, or rarely colored	1.525, 1.529, 1.536	70	
6	7.0–7.5	cub., deep red to brnsh.-red or blk.	1.801	...	
7	1–2	monocl.	1.459, 1.464, 1.470	...	
8	3.5–4.0	hex. (trig.), col., wh., yelsh., gray or redsh.	1.572, 1.592	...	
9	1.5–2.0	monocl. wh., yelsh. or redsh.	1.474, 1.476, 1.483	...	
10	6	tricl., wh. to grnsh., blsh., yelsh., grayish or brnsh. wh.	1.579, 1.593, 1.597	50	
11	5.0–5.5	cub., col. or wh., yelsh, redsh or grnsh.	1.4874	...	
12	5.5–6.0	tetr., br., bl., blk.	2.554, 2.493	...	
13	7.0–7.5	rhomb., gray, redsh., grnsh., blsh.	1.632, 1.638, 1.643	84	30
14	5–6	tricl., wh., gray, grnsh., yelsh., flesh red	1.549, 1.553, 1.556	88	
15	6.5–7.0	cub., brnsh. red. br., blk., also yel. or grn.	1.857	...	
16	2.75–3.0	rhomb. or monocl., wh., gray, yel., bl., grn., (col.)	1.8771, 1.8823, 1.8937	75	24
17	3.0–3.5	rhomb. or monocl., col., wh., gray, bl., br. or redsh.	1.5693, 1.5752, 1.6130	43	41
18	6.0–6.5	tricl., col., wh. or grayish. (yelsh. blsh. or redsh.)	1.5755, 1.5832, 1.5885	77	
19	6.0–6.5	tricl.	1.523, 1.529, 1.531	...	
20	5.5–6.0	rhomb., br., yelsh. or grnsh., to emer. grn.	1.633, 1.642, 1.657	83	54
21	3–4	rhomb., brnsh. grn.	1.490, 1.502, 1.511	...	
22	4–5	hex., br., grn., gray, yel., red or wh.	1.634, 1.632	...	
23	4.5–5.0	tetr., col. or wh., grn., yel. or redsh.	1.537, 1.535	...	
24	3.5–4.0	rhomb., col., wh., yel., redsh., blsh. or blk.	1.5299, 1.6809, 1.6854	18	
25	...	rhbdr., wh.	1.4935, 1.4947, 1.4973	...	
26	2.0–2.5	cub., dk. lead gray	...	...	
27	3–4	hex., tin-wh., tarn. dk. gray to blk.	...	...	
28	5.5–6.0	rhomb., silver-wh. to grayish-wh.	...	...	
29	3.0–3.5	rhomb., bright or blksh. grn.	1.831, 1.861, 1.880	...	
30	4.5–5.0	monocl., col. to wh.	1.574, 1.576, 1.588	50	49
31	5–6	monocl., dk. grn. to blk.	1.712, 1.717, 1.733	60	
32	2.0–2.5	rhomb., yel.	1.553, 1.575, 1.577	...	
33	6.5–7.0	tricl., br., bl., gray, yel.	1.678, 1.685, 1.688	72	
34	3.5–4.0	monocl., bl.	1.730, 1.758, 1.838	...	
35	6.5	monocl., col.-yel., br., blk.	2.13, 2.19, 2.20	...	
36	2.5–3.5	rhomb., col., wh., yel., bl., br. or red	1.6369, 1.6381, 1.6491	37	28
37	3	trig., wh.	2.070, 2.050	...	
38	1–3	amor., wh., br., yel. or redsh.	1.570	...	
39	...	...	1.9272, 1.9277, 1.9820	...	
40	6.0–6.5	hex., trig., bl., col.	1.757, 1.804	...	
41	6–7	rhomb., col., pa. yel.	1.591, 1.605, 1.614	74	51
42	7.5–8.0	hex., grn., bl., yel., redsh.	1.581, 1.575	...	
43	5.5–6.0	rhomb., col. to wh., pa. yel.	1.5520, 1.5579, 1.5608	67	56
44	2.5–3.0	monocl., blk. or dk. br. or grn.	1.541, 1.574, 1.574	...	

No.	Name	Synonym	Formula	Sp. gr.
1	Bismuth	native bismuth	Bi	9.70–9.83
2	Bloedite	blödite	$MgSO_4.Na_2SO_4.4H_2O$	2.22–2.28
3	Boracite	stassfurtite	$Mg_7Cl_2B_{16}O_{30}$	2.9–3.0
4	Borax	tincal	$Na_2B_4O_7.10H_2O$	1.69–1.72
5	Bornite	purple copper ore, erubescite	$FeS.2Cu_2S.CuS$	4.9–5.4
6	Bournonite	wheel ore	$PbCuSbS_3$	5.7–5.9
7	Brochantite		$CuSO_4.3Cu(OH)_2$	3.8–3.9
8	Bromyrite		AgBr	5.8-6.0
9	Brookite		TiO_2	3.87–4.084
10	Brucite		$MgO.H_2O$	2.38–2.4
11	Bunsenite		NiO	6.398
12	Cacoxenite		$FePO_4.Fe(OH)_3.4\frac{1}{2}H_2O$.	3.38
13	Calamine See *hemi*	*morphite, smithsonite*		
14	Calcite	calcspar, iceland spar	$CaCO_3$	2.711
15	Caledonite		$2(Pb,Cu)O.SO_3.H_2O$	6.4
16	Calomel	horn mercury	HgCl	6.482
17	Cancrinite		$4Na_2O.CaO.4Al_2O_3.$-$2CO_2.9SiO_2.3H_2O$	2.42–2.50
18	Carnallite		$KCl.MgCl_2.6H_2O$	1.60
19	Carnotite		$K_2O.2U_2O_3.V_2O_5.3H_2O$	
20	Cassiterite	incl. tinstone, stream tin, wood tin	$SnSnO_4$	6.8–7.1
21	Celestite	celestine	$SrSO_4$	3.84–3.97
22	Cerargyrite	horn silver	AgCl	5.552
23	Cerussite	white lead ore	$PbCO_3$	6.46–6.57
24	Chabazite		$CaAl_2Si_6O_{16}.8H_2O$ (+Na,K)	2.06–2.16
25	Chalcanthite	blue vitriol, blue stone.	$CuSO_4.5H_2O$	2.12–2.30
26	Chalcedony	flint, agate	SiO_2	2.55–2.63
27	Chalcopyrite	copper pyrites	$CuFeS_2$	4.1–4.3
28	Chiolite		$5NaF.3AlF_3$	2.84–3.005
29	Chondrodite		$[Mg(F,OH)]_2Mg_3[SiO_4]_2$.	3.10–3.22
30	Chromite		$FeO.Cr_2O_3$	4.32–4.57
31	Chrysoberyl	cymophane	$BeO.Al_2O_3$	3.50–3.84
32	Chrysocolla		$CuSiO_3.2H_2O$	2.40–2.42
33	Cinnabar	natural vermilion	HgS	8.0–8.2
34	Claudetite		As_2O_3	3.85–4.151
35	Cleveite (R)	A cryst. var. of uraninite		7.49
36	Clinochlorite	clinochlore	$H_8Mg_5Al_2Si_3O_{18}$	2.65–2.78
37	Cobaltite	cobalt glance	CoAsS	6.0–6.3
38	Colemanite		$Ca_2B_6O_{11}.5H_2O$	2.417–2.428
39	Columbite	niobite	$(Fe,Mn)(Cb,Ta)_2O_6$	5.26–7.30
40	Connellite		$CuSO_4.2CuCl_2.19Cu$-$(OH)_2.H_2O$	3.4
41	Copiapite		$2Fe_2O_3.5SO_3.18H_2O$	2.1–2.2
42	Copper	native copper	Cu	8.8–8.9
43	Coquimbite		$Fe_2(SO_4)_3.9H_2O$	2.07–2.105
44	Cordierite	iolite, dichroite	$4(Mg,Fe)O.4Al_2O_3.$-$10SiO_2.H_2O$	2.57–2.66
45	Corundum	ruby, sapphire	Al_2O_3	3.95–4.10

MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V	
				°	′
1	2.0–2.5	hex., redsh. wh.	....	....	
2	2.5	monocl., col. to grnsh., yelsh or red	1.486, 1.488, 1.489	....	
3	7	rhomb., wh., gray, yel. or grn.	1.662, 1.667, 1.673	83	33
4	2.0–2.5	monocl., wh., grayish, blsh. or grnsh.	1.4468, 1.4686, 1.4715	39	
5	3	cub., dk. redsh. br., tarn. blue, purp. or iridesc.	....	....	
6	2.5–3.0	rhomb., st. gray to iron blk.	....	....	
7	3.5–4.0	rhomb., emer. to blksh. grn.	1.730, 1.778, 1.803	77	
8	2–3	cub., yel. to grn. or gray	2.253	....	
9	5.5–6.0	rhomb., br., yelsh, redsh. to iron blk.	2.583, 2.586, 2.741	....	
10	2.5	trig., wh., gray, blue or grn.	1.559, 1.580	....	
11	5.5	cub., grn.	(Li) 2.18	....	
12	3–4	hex., yel. or brnsh.	1.582, 1.645	....	
13					
14	3	hex., col., wh. or yelsh.; rar. pa. gray, red, grn., bl., vlt.	1.6583, 1.4864	....	
15	2.5–3.0	rhomb., deep grn.	1.818, 1.866, 1.909	....	
16	1–2	tetr., wh., yelsh, gray or br.	1.97325, 2.6559	....	
17	5–6	hex., wh., gray, yel., grn., bl., redsh.	1.524, 1.496	....	
18	1	rhomb., wh. or redsh.	1.466, 1.475, 1.494	70	
19	1–2	hex., rhomb., yel.	1.750, 1.925, 1.95	....	
20	6–7	tetr., br. or blk., somet. red, gray, wh. or yel.	1.997, 2.093	....	
21	3.0–3.5	rhomb., col., wh. or yel., oft. blsh., redsh. or grnsh.	1.6220, 1.6237, 1.6309	51	12
22	1–1.5	cub. wh., gray, yelsh., grnsh., turns vlt., br. or blk. in light	2.0710	....	
23	3.0–3.5	rhomb., col., wh. or gray	1.8037, 2.0763, 2.0780	8	34
24	4–5	hex. (rhbdr.), col., wh., redsh., yelsh. or br.	1.480, 1.482	65 ±	
25	2.5	tricl., bl. or grnsh. bl.	1.5140, 1.5368, 1.5433	56	2
26	6	wh., grayish bl., br.-blk.	1.537 (1.533–1.539), 1.530	....	
27	3.5–4.0	tetr., brass to gold. yel. tarn. to bl., purp. tints	....	....	
28	3.5–4	tetr., wh.	1.349, 1.342	....	
29	6.0–6.5	monocl., wh., yel., red.-br.	1.607, 1.619, 1.639	80	
30	5.5	cub., blk.-brnsh. blk.	....	2.16	
31	8.5	rhomb., grn.-yel.	1.747, 1.748, 1.757	....	
32	2–4	amor., tetr. or hex., grn.-bl.-blk.	1.46–1.57	....	
33	2.0–2.5	hex., scarlet, redsh.-br., blk.	2.854, 3.201	....	
34	2.5	monocl.	1.871, 1.92, 2.01	....	
35	5.5	cub.	....	....	
36	2.0–2.5	monocl., grn. to yelsh. or wh.	1.585, 1.586, 1.596	....	
37	5–6	cub., silv. wh., redsh. or grayish	....	....	
38	4.0–4.5	monocl., col. to wh. or yelsh.	1.5863, 1.5920, 1.6139	55	20
39	6	rhomb., br. to blk.	2.26, 2.29, 2.34	....	
40	....	hex., blue	1.724, 1.746	....	
41	2.5	monocl., yel.	1.530, 1.543, 1.595	....	
42	2.5–3.0	cub., red	....	....	
43	2.0–2.5	hex. (trig.), wh., yelsh., brnsh.	1.5519, 1.5575	....	
44	7.0–7.5	rhomb., lt.-dk. blue	1.534, 1.538, 1.540	70	23
45	9	hex. (trig. rhbdr.) col., red, yel., bl., br. or gray	1.768, 1.760	....	

No.	Name	Synonym	Formula	Sp. gr.
1	Cotunnite		$PbCl_2$	5.84
2	Cristobalite		SiO_2	2.27–2.34
3	Crocoite	crocoisite	$PbCrO_4$	5.9–6.1
4	Cryolite	ice stone	Na_3AlF_6 or $3NaF.AlF_3$	2.95–3.00
5	Cryolithionite		$3NaF.3LiF.2AlF_3$	2.777–2.778
6	Cuprite	red copper ore	Cu_2O	5.85–6.15
7	Cyanite	disthene	Al_2SiO_5 or $Al_2O_3.SiO_2$	3.559–3.675
8	Danburite		$CaO.B_2O_3.2SiO_2$	2.93–3.02
9	Datolite		$Ca(B.OH)SiO_4$	2.89–3.00
10	Derbylite		$6FeO.Sb_2O_3.5TiO_2$	4.512–4.530
11	Diamond	bortz, carbonado	C	3.150–3.525
12	Diaspore		$Al_2O_3.H_2O$	3.3–3.5
13	Diopside	malacolite, alalite	$CaMg(SiO_3)_2$	3.20–3.38
14	Dioptasite	dioptase	$H_2O.CuO.SiO_2$	3.05–3.35
15	Dolomite	pearl spar	$CaCO_3MgCO_3$	2.80–2.99
16	Douglasite		$2KCl.FeCl_2.2H_2O$	2.16
17	Dysanalite		CaO,FeO,TiO_2, etc.	4.02–4.26
18	Eglestonite		Hg_4Cl_2O	8.327
19	Embolite		$Ag(Br,Cl)$	5.31–5.81
20	Emery	mix. of corundum, magnetite, hematite, quartz and spinel		3.75–4.31
21	Enargite		$3Cu_2S.As_2S_5$	4.43–4.55
22	Erythrite	cobalt bloom	$Co_3(AsO_4)_2.8H_2O$	2.912–2.948
23	Euclasite		$Be(AlOH)SiO_4$	3.051–3.103
24	Eudialite		$6Na_2O.6(Ca,Fe)O.20(Si,Zr)O_2.NaCl$	2.8–3.1
25	Eulytite		$3SiO_2.2Bi_2O_3$	6.106
26	Enstatite	+Fe, bronzite, hypersthene	$MgO.SiO_2$	3.10–3.43
27	Epidote	pistacite	$4CaO.3(AlFe)_2O_3.6SiO_2.H_2O$	3.07–3.50
28	Epsomite	epsom salt	$MgSO_4.7H_2O$	1.68
29	Fayalite		Fe_2SiO_4	3.91–4.34
30	Feldspars See *orthoclase, microline, albite, labradorite, andesine, anorthoclase* or *anorthite*			
31	Ferberite		$FeWO_4$	6.801–7.109
32	Fluorite	fluorspar	CaF_2	2.97–3.25
33	Forsterite		Mg_2SiO_4	3.191–3.33
34	Franklinite		$(Fe,Mn,Zn)(FeO_2)_2$	5.07–5.22
35	Gahnite	zinc-spinel	$ZnAl_2O_4$	4.478–4.602
36	Galena	galenite, glance	PbS	7.3–7.6
37	Ganomalite		$4CaO.6PbO.6SiO_2.H_2O$	5.57–5.7
38	Garnet See *almandite, andradite, grossularite, spessartite, uvarovite*			
39	Garnierite	noumeite	$H_2(Ni,Mg)SiO_4$ (variable)	2.27–2.87
40	Gay-Lussite		$CaCO_3.Na_2CO_3.5H_2O$	1.93–1.95
41	Gehlenite		$CaO.MgO.Al_2O_3.SiO_2$	2.9–3.07
42	Geikielite		$(Mg,Fe)O.TiO_2$	3.98–4.0
43	Gibbsite	hydrargillite	$Al_2O_3.3H_2O$	2.3–2.42
44	Glauberite		$Na_2SO_4.CaSO_4$	2.7–2.85
45	Glaucophane	glaucophanite	$NaAl(SiO_3)_2.(Fe,Mg)SiO_3$	2.991–3.15
46	Gold	native gold	Au	14.56–19.33

MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V °	′
1	soft	rhomb., wh., yelsh.	2.1992, 2.2172, 2.2596	....	
2	6–7	pseudo-isometric?	1.486	....	
3	2.5–3.0	monocl., red.	(Li): 2.31, 2.37, 2.66	....	
4	2.5	monocl., col. to wh.; rar. redsh , brnsh. or blk.	β 1.364	....	
5	2.5–3.0	....	1.339	....	
6	3.5–4.0	cub., red.; rar. br.-blk.	2.705	....	
7	4–7	tricl., bl., gray, wh., grn. or blk.	1.712, 1.720, 1.728	82	
8	7	rhomb., yel.-col.	1.632, 1.634, 1.636	88	
9	5.0–5.5	monocl., col., wh., yelsh., redsh., grnsh.	1.625, 1.653, 1.669	74	
10	5	rhomb., blk.	(Li): 2.45, 2.51	....	
11	10	cub., col. or sl. yelsh., also yel., red, grn., blue or blk.	2.4173	....	
12	6.5–7.0	rhomb., gray, wh., pink, yel., br.	1.702, 1.722, 1.750	84	
13	5–6	monocl., lt. to dk. grn., col., gray, yel., rar. bl.	1.664, 1.671, 1.694	59	
14	5	trig., emer. grn.	1.644, 1.697	....	
15	3.5–4.5	hex. (trig. rhbdr.), wh., yel., redsh., br., blk., rar. col.	1.6817, 1.5026	....	
16	....	....	1.488, 1.500	....	
17	5–6	cub., iron blk.	2.330	....	
18	2–3	cub., brnsh., yel., blk. on expos	(Li) 2.49	....	
19	1–1.5	grayish grn. to yelsh-grn., yel.	2.15	....	
20	7–9	dk. gray to blk.	....	....	
21	3	rhomb., gray to blk.	....	....	
22	1.5–2.5	monocl., red., pink or pearl gray	1.6263, 1.6614, 1.6986	....	
23	7.5	monocl., col., pa. grn , blue	1.652, 1.655, 1.671	....	
24	5–6	hex., red to br.	1.606, 1.611		
25	4.5	cub., br. to yel. or col.	2.05	....	
26	5–6	rhomb., grayish or yelsh., wh., grnsh. or brnsh.	1.650, 1.653, 1.658	31	
27	6–7	monocl., yelsh to blksh. grn ; rar. red or col.	1.729, 1.754, 1.768	....	
28	2.0–2.5	rhomb., col. or wh.	1.4326, 1.4554, 1.4609	51	25
29	6.5	rhomb., yel.-blk.	1.835, 1.877, 1.886	....	
30					
31	4.0–4.5	monocl., br. to blk.	(Li) β 2.40	....	
32	4	cub., col., oft. yel., bl., grn., vlt.; rar. red	1.4339	....	
33	6–7	rhomb., wh., grnsh, yelsh.	1.635, 1.651, 1.670	....	
34	5.5–6.5	cub., iron blk.	(Li) 2.360	....	
35	7.5–8.0	cub., grn., br., blk.	1.780	....	
36	2.5	cub., lead gray to blk.	3.912	....	
37	3	tetr., col., gray.	1.910, 1.91, 1.945	....	
38					
39	2–3	amor., bright grn., pa. grn. to wh.	1.59	....	
40	2–3	monocl., wh. to yelsh.	1.4435, 1.5156, 1.5233	33	46
41	5.5–6.0	tetr., grayish grn. to br.	1.666, 1.661	....	
42	6	hex. (trig.), bluish or brnsh. blk.	2.31, 1.95	....	
43	2.5–3.5	monocl., wh., grnsh., redsh. to yel.	1.566, 1.566, 1.587	....	
44	2.5–3.0	monocl., pa. yel., gray, or red	1.515, 1.532, 1.536	7	
45	6.0–6.5	monocl., blue	1.621, 1.638, 1.638	43	58
46	2.5–3.0	cub., yel.	....	....	

No.	Name	Synonym	Formula	Sp. gr.
1	Goslarite	zinc vitriol	$ZnSO_4.7H_2O$	1.9–2.1
2	Göthite		$Fe_2O_3.H_2O$	4.0–4.4
3	Graphite	plumbago, black lead	C (traces of Fe, SiO_2, etc.)	2.09–2.25
4	Grossularite	hessonite	$3CaO.Al_2O_3.3SiO_2$	3.4–3.6
5	Gummite (R)		$(Pb,Ca,Ba)SiU_3O_{12}.5H_2O(?)$	3.9–5.16
6	Gypsum		$CaSO_4.2H_2O$	2.314–2.328
7	Halite	rock salt	$NaCl$	2.135–2.170
8	Hambergite		Be_2HBO_4	2.347–2.36
9	Hanksite		$9Na_2SO_4.2Na_2CO_3.KCl$	2.562
10	Harmotome	harmotomite	$(K_2,Ba)O.Al_2O_3.5SiO_2.5H_2O$	2.345–2.50
11	Hausmannite		Mn_3O_4	4.722–4.856
12	Haüynite		$5(Na_2,Ca)O.3Al_2O_3.6SiO_2.2SO_3$	2.4–2.5
13	Helvite		$3(Be,Mn,Fe)_2SiO_4.(Mn,Fe)S$	3.16–3.37
14	Hematite		Fe_2O_3	4.9–5.3
15	Hemimorphite	calamine	$2ZnO.SiO_2.H_2O$	3.45
16	Hercynite	iron spinel	$FeAl_2O_4$	3.91–3.95
17	Herderite		$CaPO_4.BeFOH$	2.952–3.012
18	Heulandite		$CaO.Al_2O_3.6SiO_2.5H_2O$	2.16–2.249
19	Hopeite		$3ZnO.P_2O_5.4H_2O$	3.03
20	Hornblende	amphibole	$Ca(Mg,Fe)_3(SiO_2)_4,Al_2(Mg,Fe)_2(AlO_3)_2(SiO_3)_2,Fe(Mg,Fe)_2(FeO_3)_2(SiO_3)_2$	3.0–3.5
21	Hübnerite		$MnO.WO_3$	7.2–7.5
22	Hutchinsonite		$(Tl,Ag,Cu)_2S.As_2S_3 + PbS.As_2S_3(?)$	4.6
23	Hydronephelite		$HNa_2Al_3Si_3O_{12}.3H_2O$	2.263–2.48
24	Hydrotalcite		$MgCO_3.5Mg(OH)_2.2Al(OH)_3.4H_2O$	2.04–2.091
25	Ilmenite	menaccanite, titanic iron ore	$FeO.TiO_2$	4.44–4.90
26	Iodyrite	iodargyrite	AgI	5.60–5.707
27	Jarosite		$K_2Fe_6(OH)_{12}.(SO_4)_4$	3.15–3.26
28	Kainite		$MgSO_4.KCl.3H_2O$	2.067–2.188
29	Kaliophilite	phacellite	$KAlSiO_4$	2.49–2.67
30	Kaolinite	china clay, kaolin	$Al_2O_3.2SiO_2.2H_2O$	2.60–2.63
31	Kieserite		$MgSO_4.H_2O$	2.57
32	Labradorite	Labrador feldspar, inter. bet. albite and anorthite	$NaAlSi_3O_8$, $CaAl_2Si_2O_8$, ratio 1:1 to 1:3	2.70–2.72
33	Lanarkite		$Pb_2O.(SO_4)$	6.3–6.8
34	Lanthanite		$La_2(CO_3)_3.9H_2O$	2.6–2.74
35	Laubanite		$Ca_2Al_2Si_5O_{15}.6H_2O$	2.23
36	Laumontite	leonhardite, caporcianite	$CaO.Al_2O_3.4SiO_2.4H_2O$	2.23–2.42
37	Laurionite		$PbCl_2.Pb(OH)_2$	6.24
38	Lazulite		$(Fe,Mg)O.Al_2O_3.P_2O_5.H_2O$	3.057–3.122
39	Lazurite	lapis-lazuli	$3Na_2O_3.3Al_2O_3.6SiO_2.2Na_2S$	2.38–2.45
40	Leadhillite		$Pb(OH)_2.PbSO_4.2PbCO_3$	6.26–6.44

MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V °	′
1	2.0–2.5	rhomb., wh. or yelsh.	1.457, 1.480, 1.484	....	
2	5.0–5.5	rhomb., yel., red or br.	2.26, 2.39, 2.40	....	
3	1–2	hex., blk., dk. gray.	....	....	
4	6.5–7.0	cub., yel., grn., br., red or wh.	1.735	....	
5	2.5–3.0	gumlike masses, redsh. yel. to brnsh.	1.61	....	
6	1.5–2.0	monocl., wh.; oft. yel., red, br., blk.	1.5205, 1.5226, 1.5296	58	5
7	2.5	cub., col.-yelsh.; oft. redsh.-bl., gray or blk.	1.5442	....	
8	7.5	rhomb., grayish wh.	1.5595, 1.5908, 1.6311	....	
9	3.0–3.5	hex., wh. to yel.	1.481, 1.461	....	
10	4.5	monocl., wh., gray, yel., red or br.	1.503, 1.505, 1.508	43	
11	5.0–5.5	tetr., brnsh.-blk. to blk.	(Li): 2.46, 2.15	....	
12	5.5–6.0	cub., bl., grn., red, yel.	1.496	....	
13	6.0–6.5	cub., yel., yelsh.-br., grn. or redsh.-br.	1.739	....	
14	5.5–6.5	hex. (trig.), st. gray-blk.	(Li): 3.01, 2.94	....	
15	4.5–5.0	rhomb. wh., yel., br., blsh. or grnsh.	1.614, 1.617, 1.636	46	10
16	7.5–8.0	cub., blk.	1.800	....	
17	5	monocl., yel., grnsh. wh.	1.592, 1.612, 1.621	68	2
18	3.5–4.0	monocl., wh., red, gray, brown	1.498, 1.499, 1.505	....	
19	2.5–3.0	rhomb., grayish wh.	1.572, 1.590, 1.590	54	44
20	5–6	monocl., dk. grn. to blk.	1.629, 1.642, 1.653	84	
21	4.5–5.5	monocl., brnsh. red, yel. to blk.	2.170, 2.220, 2.320	....	
22	1.5–2.0	rhomb., scarlet to red	3.078, 3.176, 3.188	....	
23	4.5–6.0	hex., wh., dk. gray	1.490, 1.502	....	
24	2	hex., wh.	1.512, 1.498	....	
25	5–6	hex. (trig.), iron-brnsh. blk.	....	....	
26	1	hex., pa. yel. or grn.	2.21, 2.22	....	
27	2.5–3.5	rhomb., ocher-yel., br.	1.820, 1.715	....	
28	2.5–3.0	monocl., wh.-gray or redsh.	1.494, 1.505, 1.516	....	
29	6	hex. or fine threads, col.	1.537, 1.533	....	
30	2.0–2.5	monocl., wh., yelsh., redsh., blsh., grnsh., brnsh.	1.561, 1.565, 1.567	....	
31	3.0–3.5	monocl., col.-wh. or yelsh.	1.523, 1.535, 1.586	57	
32	5.0–6.0	tricl., gray, br. or grnsh.	1.559, 1.563, 1.568		
33	2.0–2.5	monocl., grnsh., wh., pa. yel. or gray	1.93, 1.99, 2.02	....	
34	2.5–3.0	rhomb., grayish wh., pink, yelsh.	1.520, 1.587, 1.613	....	
35	4.5–5.0	wh.	1.475, 1.486	....	
36	3–4	monocl., wh., yel., gray or red	1.513, 1.524, 1.525	....	
37	3.0–3.5	rhomb., col.	2.0767, 2.1161, 2.1580	....	
38	5–6	monocl., azure-blue	1.603, 1.632, 1.639	69	
39	5.0–5.5	cub., dk.-lt. bl., vlt. or grnsh. bl.	1.500	....	
40	2.5	monocl.	1.87, 2.00, 2.01	....	

No.	Name	Synonym	Formula	Sp. gr.
1	Lepidocrocite		$Fe_2O_3.H_2O$	4.09
2	Lepidolite	lithium mica	$KLi[Al(OH,F)_2]Al(SiO_3)_3$	2.799–2.9
3	Leucite	amphigene	$K_2O.Al_2O_3.4SiO_2$	2.45–2.51
4	Lewisite		$5CaO.2TiO_2.3Sb_2O_5$	4.950
5	Limonite	mixt., chiefly goethite	$2Fe_2O_3.3H_2O$	3.6–4.0
6	Litharge	lead oxide, lithargite	PbO	9.13
7	Magnesite		$MgCO_3$	2.95–3.2
8	Magnetite	lodestone	Fe_3O_4	4.967–5.180
9	Malachite	green carbonate of copper	$CuCO_3.Cu(OH)_2$	3.90–4.03
10	Manganite	gray manganese ore	$Mn_2O_3.H_2O$	4.2–4.4
11	Manganosite		MnO	5.18
12	Marcasite	white iron pyrites	FeS_2	4.61–4.90
13	Marialite		$3NaO_2.3Al_2O_3.18SiO_2.2NaCl$	2.50–2.692
14	Marshite		CuI	5.59–5.62
15	Mascagnite		$(NH_4)_2SO_4$	1.76–1.77
16	Matlockite		$PbO.PbCl_2$	7.21
17	Meionite		$4CaO.3Al_2O_3.6SiO_2$	2.70–2.815
18	Melanterite	copperas	$FeSO_4.7H_2O$	1.89–1.90
19	Melilite		$Na_2(Ca,Mg)_{11}(Al,Fe)_4(SiO_4)_9$	2.9–3.4
20	Mellite		$Al_2O_3.C_{12}O_9.18H_2O$	1.55–1.65
21	Mendipite		$2PbO.PbCl_2$	7–7.1
22	Microcline		$K_2O.Al_2O_3.6SiO_2$	2.54–2.57
23	Microlite		$6CaO.3Ta_2O_5.CbOF_3$	5.405–5.562
24	Miersite		$4AgI.CuI$	5.64
25	Milarite		$K_2O.4CaO.2Al_2O_3.24SiO_2.H_2O$	2.5–2.59
26	Mimetite		$9PbO.3As_2O_5.PbCl_2$	6.98–7.25
27	Mirabilite	glauber salt	$Na_2SO_4.10H_2O$	1.40–1.481
28	Moissanite	carborundum, artificial	SiC	3.2
29	Molybdenite	molybdenum glance	MoS_2	4.7–4.8
30	Monazite		$(Ce,Nd,Pr,La)PO_4$ $(+Th_3[PO_4]_4)$	5.2(4.9–5.3)
31	Monetite		$HCaPO_4$	2.75–2.863
32	Monticellite		$CaMgSiO_4$	3.03–3.25
33	Montroydite		HgO	11.14
34	Muscovite	white mica	$K_2O.3Al_2O_3.6SiO_2.2H_2O$	2.76–3.00
35	Nantokite		$CuCl$	3.930
36	Natrolite	needle zeolite	$Na_2O.Al_2O_3.3SiO_2.2H_2O$	2.18–2.25
37	Nephelite	nepheline, elaeolite	$(Na,K)_8Al_8Si_9O_{34}$ or $NaAlSiO_4$	2.55–2.65
38	Newberyite		$HMgPO_4.3H_2O$	2.10
39	Niccolite	arsenic nickel, nickelin	$NiAs$	7.33–7.67
40	Noselite	nosean	$5Na_2O.3Al_2O_3.6SiO_2.2SO_3$	2.25–2.4
41	Oligoclase	lime-soda feldspar	$NaAlSi_3O_8 + CaAl_2Si_2O_8$	2.62–2.672
42	Olivenite		$4CuO.As_2O_5.H_2O$	4.1–4.4
43	Olivine	chrysolite, peridot	$(Mg,Fe)_2SiO_4$	3.26–3.40
44	Opal		$SiO_2.xH_2O$	2.1–2.3

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ε; α, β, γ	Angle of the optic axes, 2V ° ′
1	....	rhomb.	1.94, 2.20, 2.51	....
2	2.5–4.0	monocl., pink, oft. wh.-gray or vlt.	1.560, 1.598, 1.605	....
3	5.5–6.0	cub., wh., gray	1.508, 1.509	....
4	5.5	cub., yel.	2.20	....
5	5.0–5.5	prob. amor., br.-yelsh.	....	....
6	2	tetr., yel.	2.510, 2.610, 2.710	....
7	3.5–4.5	hex. (trig. rhbdr.), col., wh.-yelsh., br.-blk.	1.700, 1.509	....
8	5.5–6.5	cub., iron blk.	....	....
9	3.5–4.0	monocl., lt-dk. grn.	1.655, 1.875, 1.909	....
10	4–5	rhomb., iron blk. to steel gray	2.24, 2.24 (Li), 2.53	....
11	5–6	cub., emer. grn., blk. on expos.	2.16	....
12	6.0–6.5	rhomb., pa. yel. to steel gray	....	....
13	5.5–6.0	tetr.	1.539, 1.537	....
14	2.5–3.0	cub., br.	2.346	....
15	2.0–2.5	rhomb., lem. yel., yelsh., gray	1.5209, 1.5230, 1.5330	....
16	2.5–3.0	tetr., yelsh. or grnsh.	2.150, 2.040	....
17	5.5–6.0	tetr. col. to wh.	1.597, 1.560	....
18	2	monocl., var. shades of grn. to yel.	1.4713, 1.4782, 1.4856	85 27
19	5–6	tetr., wh., yel., grnsh., redsh., br.	1.634, 1.629	....
20	2.0–2.5	tetr., yel.	1.539, 1.511	....
21	2.5–3.0	rhomb., wh.	2.24, 2.27, 2.31	....
22	6.0–6.5	tricl., wh., yelsh., gray, grn. or red.	1.522, 1.526, 1.530	83
23	5.5	cub., yel., br., rar. red	1.925	....
24	2	cub., bright yel.	2.20	....
25	5.5–6.0	hex. col., grn., glassy	1.532, 1.529	....
26	3.5	hex., yel., br., wh. or col.	2.135, 2.118	....
27	1.5–2.0	monocl., wh.	1.394, 1.396, 1.398	76
28	9.5	hex., grn., bluish-blk.	2.654, 2.697	....
29	1.0–1.5	hex., blue gray	....	....
30	5.0–5.5	monocl., red or yelsh. br.	1.786, 1.788, 1.837	14
31	3.5	tricl., yel., wh.	1.515, 1.518, 1.525	....
32	5.0–5.5	rhomb., col. to gray	1.651, 1.662, 1.668	....
33	1.5–2.0	rhomb., orange red	2.37, 2.50, 2.65	....
34	2.5–3.0	monocl., col. or pa. yel., gray or br.; rar. rose	1.561, 1.590, 1.594	40 (?)
35	2.0–2.5	cub., col. to wh. or grayish	1.93	....
36	5.0–5.5	rhomb. wh. also redsh., yelsh., grnsh.	1.480, 1.482, 1.493	63
37	5.5–6.0	hex. col. wh., yelsh., gray or red	1.542, 1.538	....
38	3.0–3.5	rhomb., wh. cryst.	1.514, 1.518, 1.533	....
39	5.0–5.5	hex., lt. copper-red	....	....
40	5.5	cub., grayish, blsh., brnsh.	1.495	....
41	6–7	tricl., wh., gray, grnsh., redsh.	1.539, 1.543, 1.547	....
42	3	rhomb., olv. grn., dk. grn. to br.	1.747, 1.788, 1.829	....
43	6.5–7.0	rhomb., olv. grn., or grayish grn. to yelsh. br.	1.662, 1.680, 1.699	88 54
44	5.5–6.5	amor., col., wh., yel., br., red, grn.; int. refl.	1.41–1.46	....

No.	Name	Synonym	Formula	Sp. gr.
1	Orpiment		As_2S_3	3.4–3.5
2	Orthite	allanite	$Ca_2(Al,Ce,Fe)_2(Al.OH)(SiO_4)_3$	3.0–4.2
3	Orthoclase	potassium feldspar	$K_2O.Al_2O_3.6SiO_2$	2.56
4	Parisite		$CaO.2CeOF.3CO_2$	4.320–4.42
5	Pectolite		$H.NaCa_2(SiO_3)_3$	2.74–2.88
6	Penfieldite		$PbO.2PbCl_2$	
7	Penninite		$5(Mg,Fe)O.Al_2O_3.3SiO_2.4H_2O$	2.6–2.85
8	Percylite		$PbCl_2.CuO.H_2O$	4.675–4.71
9	Periclase		MgO	3.64–3.674
10	Perovskite		$CaO.TiO_2$	3.95–4.039
11	Petalite		$Li_2O.Al_2O_3.8SiO_2$	2.386–2.465
12	Pharmacosiderite		$3Fe_2O_3.2As_2O_3.13H_2O$	2.9–3.0
13	Phenacite		$2BeO.SiO_2$	2.944–3.041
14	Phlogopite	magnesium mica	$(K,H)_3Mg_3Al(SiO_4)_3...(+Na,Fe,F)$	2.737–2.869
15	Phosgenite	cromfordite	$PbCl_2,PbCO_3$	6.0–6.305
16	Picotite	chrome-spinel	$(Mg,Fe)O.(Al,Cr)_2O_3$	4.08
17	Pitchblende (R)	See *uraninite*		
18	Platinum	native platinum	Pt	13.35–19.00
19	Pleonaste	iron-magnesium spinel	$(Mg,Fe)O.Al_2O_3$	3.5–3.6
20	Pollucite		$2Cs_2O.2Al_2O_3.9SiO_2.H_2O$	2.868–2.901
21	Powellite		$CaO.MoO_3$	4.356–4.526
22	Prehnite		$2CaO.Al_2O_3.3SiO_2.H_2O$	2.80–2.95
23	Proustite	ruby silver ore	$3Ag_2S.As_2S_3$	5.51–5.64
24	Pseudobrookite		$2Fe_2O_3.3TiO_2$	4.4–4.9
25	Psilomelane	black hematite	$MnO_2,BaO,H_2O,K_2O,$ etc.	3.7–4.7
26	Pyrargyrite	dark red silver ore	$Ag_6Sb_2S_6$	5.77–5.86
27	Pyrite	iron pyrites, fool's gold	FeS_2	4.95–5.17
28	Pyrochlorite	pyrochlore	$RNb_2O_6.R(Ti,Th)O_3$	4.2–4.36
29	Pyrochroite		$Mn(OH)_2$	3.258
30	Pyrolusite	polianite	$MnO_2(+nH_2O)$	4.73–4.86
31	Pyromorphite	green lead ore	$PbCl_2.3Pb_3(PO_4)_2$	6.50–7.12
32	Pyrophyllite	pencil stone agalmatolite	$Al_2O_3.4SiO_2.H_2O$	2.66–2.90
33	Pyrrhotite	magnetic pyrites	Fe_5S_6 to $Fe_{16}S_{17}$	4.53–4.66
34	Quartz		SiO_2	2.59–2.660
35	Raspite		$PbO.WO_3$	
36	Realgar		AsS	3.56
37	Rhodochrosite	dialogite	$MnCO_3$	3.30–3.76
38	Rhodonite	fowlerite	$MnO.SiO_2$	3.40–3.68
39	Rutile	nigrine	TiO_2	4.18–5.13
40	Sassolite		$B(OH)_3$	1.48
41	Scapolite	wernerite	$nNa_4Al_3Si_9O_{24}Cl + mCa_4Al_6Si_6O_{25}$	2.6–2.8
42	Scheelite		$CaWO_4$	5.88–6.14
43	Schorlomite		$3CaO.(Fe,Ti)_2O_3.3(Si,Ti)O_2$	3.783–3.88
44	Scolecite		$CaO.Al_2O_3.3SiO_2.3H_2O$	2.16–2.4

OF MINERALS (Continued)

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optio axes, 2V	
				°	′
1	1.5–2.0	monocl., lem. yel.	(Li) β 2.72	....	
2	5.5–6.0	monocl., br. to blk.	β 1.682	....	
3	6	monocl., col., wh., pa. yel., flesh red to gray.	1.518, 1.524, 1.526	69	43
4	4.5	trig., rhbdr., brnsh., yel.	1.5690, 1.6700	....	
5	4.5–5.0	monocl., col., wh., grayish wh.	1.595, 1.606, 1.634	60	
6	....	hex., wh.	2.13, 2.21	....	
7	2.0–2.5	pseudo-rhbdr., grn., vlt., pink, rose red; rar. yelsh. or silver wh.	1.576, 1.579	....	
8	2.0–2.5	cub., blue	2.05	....	
9	5.5–6.0	cub.	1.7364	....	
10	5.5	cub., yel., redsh. br., grayish blk.	β 2.38	....	
11	6.0–6.5	monocl., col., wh., gray; rar. redsh or grnsh.	1.504, 1.510, 1.516	83	34
12	2.5	monocl., grn., yelsh. br.	β 1.676	....	
13	7.5–8.0	tricl., col., yel., red, br.	1.6542, 1.6700	....	
14	2.5–3.0	monocl., wh.-gray., yelsh. br. to brnsh. red	1.562, 1.606, 1.606	....	
15	2.75–3.0	tetr., col., gray or yel.	2.114, 2.140	....	
16	....	yelsh. br., grnsh. br. to blk.	2.950	......	
17					
18	4–6	cub., silvery metal	....	....	
19	....	br., blk., dk. grn.	....	....	
20	6.5	cub., col.	1.521	....	
21	3.5	tetr., yel., grn. or blsh.	1.967, 1.978	....	
22	6.0–6.5	rhomb., lt. grn., wh. or gray	1.616, 1.626, 1.649	67	
23	2.0–2.5	hex., scarlet to vermilion	3.0877, 2.7924	....	
24	6	rhomb., dk. br. to blk.	(Li): 2.38, 2.39, 2.42	....	
25	5–6	cryptocryst., iron blk. to gray	....	....	
26	2.5	hex. (trig.), dk. red to gray or blk.	(Li): 3.084, 2.881	......	
27	6.0–6.5	cub., pa. brass to gold yel.	....	....	
28	5.0–5.5	cub. br.-blk.	1.960–2.000	......	
29	2.5	trig., rhbdr., wh.; dk. on expos.	1.723, 1.681	......	
30	2.0–2.5	rhomb., blk., steel gray	....	....	
31	3.5–4.0	hex., grn., yel., gray, br. or wh.	2.042, 2.050, 2.050	....	
32	1–3	monocl., wh., grn., yelsh., grayish	1.552, 1.588, 1.600	......	
33	3.5–4.5	hex., yel., red to dk. br.	....	.....	
34	7	hex. (trig.), col. or yel., rose, br., grn., bl., gray	1.544, 1.553	....	
35	....	monocl., brnsh. yel.	2.27, 2.27, 2.30	....	
36	1.5–2.0	monocl., red, yel.	(Li): 2.46, 2.59, 2.61	....	
37	3.5–4.5	hex. (trig), red, pink, gray, br.; rar. col.	1.817, 1.5973	....	
38	5.5–6.5	tricl., red, pink, yelsh., grnsh., brnsh., blk.	1.733, 1.740, 1.744	....	
39	6.0–6.5	tetr., redsh. br., red, yelsh., blsh., vlt., blk.	2.6158, 2.9029	......	
40	1	tricl., wh. scales	1.340, 1.456, 1.459	......	
41	5–6	tetr., col., wh., gray, grnsh., blsh., redsh.	1.570, 1.549	....	
42	4.5–5.0	tetr., col., wh., yel., br., grn., redsh.	1.918, 1.934	....	
43	7.0–7.5	blk.	1.980	....	
44	5.0–5.5	monocl.	1.512, 1.519, 1.519	36	

No.	Name	Synonym	Formula	Sp. gr.
1	Scorodite		$FeAsO_4.4H_2O$	3.1–3.3
2	Selenite, colorless tr	ansparent gypsum, which	see	
3	Sellaite		MgF_2	2.972–3.170
4	Senarmontite		Sb_2O_3	5.22–5.30
5	Sepiolite	meerschaum	$2MgO.3SiO_2.2H_2O$	2.02
6	Serpentine	incl. chrysotile or asbestos and verd-antique	$3MgO.2SiO_2.2H_2O$	2.50–2.65
7	Siderite	spathic iron, chalybite	$FeCO_3$	3.00–3.88
8	Sillimanite	fibrolite	$Al_2O_3.SiO_2$	3.23–3.25
9	Silver	native silver	Ag	10.1–11.1
10	Smaltite		$CoAs_2$	6.4–6.6
11	Smithsonite	calamine, dry bone	$ZnCO_3$	4.30–4.45
12	Sodalite		$Na_4(AlCl)Al_2(SiO_4)_3$	2.14–2.40
13	Soda niter	Chile saltpeter	$NaNO_3$	2.24–2.290
14	Spessartite	manganese-aluminum garnet	$3MnO.Al_2O_3.3SiO_2$	4.0–4.3
15	Sphalerite	zincblende	ZnS	3.90–4.11
16	Spinel		$MgO.Al_2O_3$	3.5–4.1
17	Spodumene	hiddenite, kunzite	$Li_2O.Al_2O_3.4SiO_2$	β2.644–2.649
18	Staurolite		$5Al_2O_3.2FeO.4SiO_2.H_2O$	3.65–3.77
19	Stercorite	microcosmic salt	$HNa(NH_4)PO_4.4H_2O$	1.615
20	Stibiotantalite		$Sb_2O_3.Ta_2O_5$	6.6–7.9
21	Stibnite	antimonite	Sb_2S_3	4.52–4.62
22	Stilbite	desmine	$(Na_2,Ca)O.Al_2O_3.6SiO_2.6H_2O$	2.09–2.24
23	Stolzite		$PbO.WO_3$	7.87–8.13
24	Strengite		$FePO_4.2H_2O$	2.84–2.87
25	Strontianite		$SrCO_3$	3.680–3.714
26	Struvite		$(NH_4)_2O.2MgO.P_2O_5.12H_2O$	1.65–1.72
27	Sulfur	brimstone	S	2.05–2.09
28	Sylvite	sylvine	KCl	1.988
29	Talc	soapstone, steatite	$3MgO.4SiO_2.H_2O$	2.7–2.8
30	Tantalite		$(Fe,Mn)[(Cb,Ta)O_3]_2$	6.5–8.20
31	Tapiolite		$Fe(Ta,Nb)_2O_6$	7.3–7.8
32	Terlinguaite		Hg_2ClO	8.723–8.728
33	Tetrahedrite	gray copper ore, fahlerz	$4Cu_2S.Sb_2S_3$	4.4–5.1
34	Thaumasite		$3CaO.SiO_2.CO_2.SO_3.15H_2O$	1.83–1.877
35	Thenardite		Na_2SO_4	2.68–2.69
36	Thermonatrite		$Na_2CO_3.H_2O$	1.5–1.6
37	Thomsenolite		$NaF.CaF_2.AlF_3.H_2O$	2.93–3.0
38	Thomsonite		$(Na_2Ca)O.Al_2O_3.2SiO_2.3H_2O$	2.196–2.4
39	Thorianite (R)		$(ThU)O_2(+He,Ce,La,Pb, Fe)$	9.32–9.33
40	Thorite (R)		$ThSiO_4(+He)$	blk. 4.5–5 yel. 5.2–5.4
41	Titanite	sphene	$CaO.TiO_2.SiO_2$	3.40–3.56
42	Topaz		$(AlF)_2SiO_4$ or $[Al(F,OH)]_2SiO_4$	3.4–3.65
43	Torbernite (R)	copper uranite	$Cu(UO_2)_2P_2O_8.12H_2O$	3.22–3.60
44	Tourmaline		$(H,Li,Na,K)_9Al_3[B.OH]_2Si_4O_{19}(+Fe_2O_3,FeO,MgO,MnO)$?	2.9–3.2
45	Tremolite	grammatite	$CaMg_3(SiO_4)_3$	2.9–3.2
46	Tridymite		SiO_2	2.28–2.33

No.	Hard-ness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V	
				°	′
1	3.5–4.0	rhomb., grn., br.	1.765, 1.774, 1.797	....	
2					
3	5	tetr., col.	1.378, 1.390	....	
4	2.0–2.5	cub., col. to grayish	2.087	....	
5	2.0–2.5	monocl., wh., yelsh., grayish	β, 1.55	....	
6	2.5–4.0	monocl. (opt.), fibrous var., asbestos; gray to grnsh. or brnsh.	1.490–1.571	....	
7	3.5–4.5	hex., brnsh. to blk., gray, grn., wh.	1.875, 1.633	....	
8	6.0–7.5	rhomb., gray, br., yelsh., grnsh.	1.638, 1.642, 1.653	25–30	
9	2.5–3.0	cub., wh.; tarn. to gray or blk.	0.18	....	
10	5.5–6.0	cub., tin wh. to lt. steel gray	....	....	
11	4.5–5.0	hex. (trig.), wh.-yel. or br.; rar. grn., bl.	1.818, 1.618	....	
12	5.5–6.0	cub., bl., wh., grn., redsh. or gray	1.483	....	
13	1.5–2.0	hex., col., wh., yelsh., gray, redsh., br.	1.5874, 1.3361	....	
14	....	cub., dk. red to brnsh. red	1.811	....	
15	3.5–4.0	cub., wh., yel., br., blk.	2.368	....	
16	8	cub., col. or red, bl., grn., yel., br., blk.	1.723	....	
17	β 5.5–6.0	monocl., wh., gray, grn., pink or purp.	1.660, 1.666, 1.676	....	
18	7.0–7.5	rhomb., redsh. br., blk., yelsh. br., gray	1.736, 1.741, 1.746	88	
19	2	monocl., wh.	1.439, 1.441, 1.469	....	
20	5.0–5.5	rhomb., br., redsh. yel., yel.	2.374, 2.404, 2.457	....	
21	2	rhomb., lead gray or blk.	3.194, 4.046, 4.303	....	
22	3.5–4.0	monocl., col., wh., also br., yel., redsh.	1.494, 1.498, 1.500	30	
23	2.75–3.0	tetr., grn. to gray or br.	2.2685, 2.182	....	
24	3–4	rhomb., pa. red	1.730, 1.732, 1.762	....	
25	3.5–4.0	rhomb., col., wh., gray, yel., grn.	1.516, 1.664, 1.666	....	
26	2	rhomb., wh. or yelsh.	1.495, 1.496, 1.504	....	
27	1.5–2.5	rhomb., yel.	1.95047,2.03832,2.24052	68	58
28	2	cub., col., wh., blsh. or yelsh.-red	1.4903	....	
29	1.0–1.5	monocl., wh., grnsh. wh., lt. grn.	1.539, 1.589, 1.589	....	
30	6	rhomb., blk. to redsh. br.	2.26, 2.29, 2.34	....	
31	6	tetr., blk.	(Li): 2.270, 2.420	....	
32	2–3	monocl., yel. to olive grn.	(Li): 2.35, 2.64, 2.66	....	
33	3.0–4.5	cub., st. gray to iron blk.	....	....	
34	3.5	hex.	1.507, 1.468	....	
35	2–3	rhomb., wh. to brnsh.	1.464, 1.474, 1.485	....	
36	1.0–1.5	rhombic	1.420, 1.495, 1.518	....	
37	2	monocl.	1.407, 1.414, 1.415	....	
38	5.0–5.5	rhomb., wh., redsh. grn. to br.	1.497, 1.503, 1.525	53	50
39	6.5	cub., blk.	....	....	
40	4.5–5.0	tetr., blk. or or. yel. (orangite)	....	....	
41	5.0–5.5	monocl., yel., grn., br., redsh. or blk.	1.900, 1.907, 2.034	23	9
42	8	rhomb., col. or yel., lt. blue, grn. or pink	1.619, 1.620, 1.627	65	17
		Brazil	1.6294, 1.6308, 1.6375	49	31
43	2.0–2.5	tetr., grn.	1.592, 1.582	....	
44	7.0–7.5	hex. (rhbdr.), blk.-br.-bl.-grn., red; rar. wh. or col.	1.6366, 1.6193 (col.)	....	
45	5–6	monocl., wh., gray, grnsh., yelsh.	1.609, 1.623, 1.635	88	
46	7	rhomb., col. or wh.	1.469, 1.47, 1.473	....	

PHYSICAL CONSTANTS OF

No.	Name	Synonym	Formula	Sp. gr.
1	Triphylite-lithiophyllite		$Li(Fe,Mn)PO_4$	3.42–3.56
2	Trögerite (R)		$(UO_2)_3As_2O_8.12H_2O$	3.3
3	Trona	urao	$Na_2CO_3.HNaCO_3.2H_2O$	2.11–2.147
4	Turgite	hydrohematite	$2Fe_2O_3.H_2O$	4.29–5.00
5	Turquois		$H_5(CuOH)[Al(OH)_2]_6(PO_4)_4$	2.60–2.89
6	Uraninite (R)	pitchblende; incl. cleveite (+Th,A,He), nivenite (+Yt), Bröggerite (+Th)	$UO_3.UO_2,PbO$, etc.	6.5–9.7
7	Uranite lime (R)	See autunite		
8	Uvarovite	calcium-chromium garnet	$3CaO.Cr_2O_3.3SiO_2$	3.418–3.81
9	Valentinite		Sb_2O_3	5.566
10	Vanadinite		$9PbO.3V_2O_5.PbCl_2$	6.7–7.2
11	Variscite		$AlPO_4.2H_2O$	2.47–2.54
12	Vesuvianite	idocrase	$Ca_6[Al(OH,F)]Al_2(SiO_4)_5$	3.35–3.45
13	Villiaumite		NaF	2.79
14	Vivianite	blue iron ore	$Fe_3(PO_4)_2.8H_2O$	2.58–2.693
15	Wagnerite		$Mg_3P_2O_8MgF_2$	2.985–3.14
16	Wavellite		$4AlPO_4.2Al(OH)_3.9H_2O$	2.316–2.356
17	Whewellite		$CaC_2O_4.H_2O$	2.23
18	Willemite	troosite, var. cont. Mn	Zn_2SiO_4, (+Mn)	3.89–4.19
19	Witherite		$BaO.CO_2$	4.28–4.35
20	Wolframite	peanut ore	$(Fe.Mn)WO_4$	7.14–7.54
21	Wollastonite	tabular spar	$CaSiO_3$	2.80–2.92
22	Wulfenite		$PbMoO_4$	6.7–7.0
23	Xenotime	xenotimite	$Y_2O_3.P_2O_5$	4.45–4.56
24	Zeunerite (R)		$Cu(UO_2)_2As_2O_8.8H_2O$	3.28
25	Zincite	red zinc ore	ZnO	5.43–5.70
26	Zircon	hyacinth, jargon	$ZrSiO_4$	4.02–4.86

No.	Hardness	Crystalline form and color	Index of refract. (Na); n; ω, ϵ; α, β, γ	Angle of the optic axes, 2V ° ′
1	4.5–5.0	rhomb., grnsh. gray, bluish, pink, yel. to br.	1.688, 1.688, 1.692	....
2	soft	monocl.	1.585, 1.630, 1.630	....
3	2.5–3.0	monocl., gray or yelsh. wh.	1.410, 1.492, 1.542	....
4	5.5–6.0	dk. redsh. blk. or br., red.	(Li): 2.450, 2.550, 2.550	....
5	5	tricl., blue, grn.	1.61, 1.62, 1.65	....
6	5.5	cub. or amor., gray, br.-blk.	....	....
7				
8	6.5–7.5	cub., emer. grn.	1.838	....
9	2.5–3.0	rhomb., wh., gray	2.18, 2.35, 2.35	....
10	3	hex., yel., br. or red	2.354, 2.299	....
11	4	rhomb., grn.	1.551, 1.558, 1.582	....
12	6.5	tetr., yel., grn., br., rar. bl., red., blk.	1.716, 1.718	....
13	3.5	cub.	1.336	....
14	1.5–2.0	monocl., col. to bl. or blsh. grn. on expos.	1.579, 1.603, 1.633	....
15	5.0–5.5	monocl., col., yel., grayish, grnsh., redsh.	1.569, 1.570, 1.582	37 49
16	3.5–4.0	rhomb., col., gray., yel., grn., blue, blk.	1.525, 1.534, 1.552	....
17	2.5	monocl., col.	1.491, 1.555, 1.650	....
18	5.5	hex. (trig.-rhbdr.), wh. or grn. yel.-redsh.-br.	1.694, 1.723	....
19	3.00–3.75	rhomb., col., grayish wh. or yelsh.	1.529, 1.676, 1.677	....
20	5.0–5.5	monocl., dk. gray or brnsh. blk.	2.310, 2.360, 2.460	....
21	4.5–5.0	monocl., wh.-gray, yel., red or br.	1.616, 1.629, 1.631	40
22	2.5–3.0	tetr., yel., red, grn., gray, wh.	(Li): 2.402, 2.304	....
23	4–5	tetr., yel.-br., brnsh. red-gray	1.721, 1.816	....
24	2.0–2.5	tetr.	1.643–1.623	....
25	4.0–4.5	hex., red or yel.	2.008, 2.029	....
26	7.5	tetr., col., pa. yel., gray, yelsh. grn., br., redsh.-br.	1.9239, 1.9682	....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS*

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Aluminum				
99.2Al	Aluminum 2S	2.71	23.94×10^{-6}	660
97Al, 3Cu	....	.....	24	640
95Al, 5Cu	Lynite, body alloy	.....	26	650
95Al, 4.2Cu, 0.6Mn, 0.5Si, 0.4Fe	Zeppelin rod	.....	....	.....
95Al, 2Cu, 1.5Mg, 0.8Fe, 0.2Si, 0.01Mn	Lynite, piston	.....	....	.....
94Al, 4Cu, 0.5Mg, 0.5Mn, coated with 99.7 + Al	Alclad 17 ST	2.96	21.96	538–46
93Al, 7–8.5Cu, ≯1.7 other elements	Lynite, 146	.....	....	.....
92Al, 9.3–11Cu, ≯2 other elements	Lynite, 122	.....	....	.....
90Al, 7.8Cu, 1.5Zn, 1.3Fe	Lynite, crank case	.....	....	.....
89Al, 11Cu, 0.5Mg	Lynite, piston	.....	....	.....
89Al, 12–14Cu, ≯2 other elements	Lynite, 109	.....	....	.....
99Al, 0.4Fe, 0.4Si, 0.1Zn, 0.06Cu	Zeppelin braces	.....	....	.....
90 Al, 10Mg	Magnalium	2.50	24	600
70Al, 30Mg	Magnalium	2.00	....	435
98Al, 1.25Mn	Aluminum Alloy 3S	2.74	23.04	640–55
95Al, 5Si	Aluminum-silicon 43	2.58	21.96	577–630
91Al, 9Zn	....	2.80	26	650
90Al, 7.8Zn, 0.7Cu, 0.5Fe, 0.4Si, 0.3Mn, 0.1Sn	Zeppelin angles	.....	....	.....
89Al, 9Zn, 0.7Cu, 0.5Si, 0.5Mn, 0.4Fe, 0.2Sn	Zeppelin channels	.....	....	.....
77Al, 21Zn, 1.1Cu, 0.5Fe, Pb, Sn	Liberty pistons	.....	....	.....
70Al, 30Zn	....	.....	26	610
Bismuth				
53Bi, 32Pb, 15Sn	Eutectic fusible alloy	.....	....	96
52Bi, 40Pb, 8Cd	Eutectic fusible alloy	.....	....	91.5
50Bi, 27.1Pb, 22.9Sn	Rose metal	.....	....	.....
50Bi, 27Pb, 13Sn, 10Cd	Eutectic fusible alloy; Lipowitz alloy	.....	....	70–4
50Bi, 25Pb, 12.5Sn, 12.5Cd	Wood's metal	9.70	....	70
40Bi, 40Pb, 20Sn	Bismuth solder	.....	....	111
54Bi, 26Sn, 20Cd	Eutectic fusible alloy	.....	....	103
45Bi, 17Sn, 30Pb, 5–10Hg	Fusible tea spoons	.....	....	.....
Cerium				
70–3Ce, 17–24Zn, 1.6–6Fe, 0–2.4Al, Mn	Ignition pin alloy	.....	....	.....
61Ce, 37Fe	Ignition pin alloy	.....	....	.....
Cobalt				
Co, Cr, W Alloy	Stellite No. 1 Alloy	8.59	14.4×10^{-6}	1250
Co, Cr, W Alloy	Stellite No. 6 Alloy	8.38	16.9×10^{-6}	1275
Co, Cr, W Alloy	Stellite No. 12 Alloy	8.40	15.8×10^{-6}	1263
Co, Cr, W Alloy	Stellite Star J-Metal	8.76	14.6×10^{-6}	1270
Co, Cr, W Alloy	Stellite "2400" Alloy	.....	....	.....

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* See also Supplementary Table following this table.

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C
Copper				
99.9 + Cu	Deoxidized copper	8.50	17.71×10^{-6}	1082
99.90 + Cu, 0.01P	Deoxidized copper	8.91	17.71	1082
90Cu, 10Al	Aluminum bronze	7.6	16.5	1050
90Cu, 9Al, 1Fe	Resistac	.....	....	1066
80–90Cu, 8–10Al, 6–7Fe	Ampco Metal	7.20	....	649
88–96.1Cu, 2.3–10.5Al, Fe, Sn	Aluminum bronze	7.50–8.19	....	1038–71
50Cu, 25Au, 25Ag	Cooper's pen metal	.....	....	.....
47Cu, 33Au, 20Ag	Gold 8 carat	.....	....	.....
40Cu, 31Au, 19Ag, 10Pd	Palladium gold	.....	....	.....
77Cu, 15Pb, 8Sn	"B" Alloy, P.R.R.	.....	....	.....
95Cu, 5Mn	Manganese bronze	8.8	....	1060
82–6Cu, 4–15Mn, 2–12Ni, Fe	Manganin	.....	....	.....
82Cu, 15Mn, 3Ni	Manganin	8.5	....	.....
70Cu, 25Mn, 5Ni	Manganin	.....	....	.....
61Cu, 26Mn, 13Al	Magnetic alloy	.....	....	.....
88.5Cu, 5Ni, 5Sn, 1.5Si	Barberite	8.80	....	1070
80Cu, 20Ni	Nickeline	8.5	....	1185
75Cu, 25Ni	Nickel coinage, U.S.A.	.....	....	1205
75Cu, 20Ni, 5Zn	....	8.58	16.40	1150
65Cu, 18Ni, 17Zn	Nickel silver 18% A	8.75	18.36	1110
60Cu, 40Ni	Constantan	8.4	....	1280
55–65Cu, 12–18Ni, 11–17Zn, 8–12Fe, 0.5–1Si	Glass mold alloy, U.S.P. 1,360,773	.....	....	.....
57Cu, 20Ni, 20Zn, 3Al	Typewriter metal	.....	....	.....
55Cu, 18Ni, 27Zn	Nickel silver 18% B	8.69	....	1055
45–60Cu, 40–55Ni, 0–1.4Mn, 0.1C, Fe	Constantan	.....	....	.....
45Cu, 33Ni, 16Sn, 5.5Zn, 1Bi	Sea water bronze	.....	....	.....
67–81Cu, 19–30Pt, 0–4Zn	Cooper's gold	.....	....	.....
94.8–96Cu, 3–4Si, 1–1.2Mn	....	8.46	16.99	1000
98.55Cu, 1.40Sn	Phono-electric wire	.....	....	.....
95.5Cu, 4.3Sn, 0.2P	Phosphor bronze 30	8.91	18.90	1050
95Cu, 4Sn, 1Zn	Coinage bronze	8.96	....	.....
92–7Cu, 1–8Sn, 0–2Zn	Medal bronze	.....	....	.....
91.6Cu, 8.25Sn, 0.15P	Phosphor bronze 47	8.91	....	.....
90Cu, 10Sn, trace P	Phosphor bronze 209	9.00	....	.....
90Cu, 10Sn	Bronze, gun metal	8.8	18	1000
88Cu, 10Sn, 2Zn	U.S. Government bronze, spec. G	.....	....	.....
82Cu, 16Sn, 2Zn	Bronze bearings	.....	....	.....
83Cu, 14Sn, 3.5Pb	Naval journal bearing, spec. HX	.....	....	.....
83Cu, 14Sn, 3.5Zn	Naval journal bearing, spec. H	.....	....	.....
83Cu, 14Sn, 3Zn, 0.8Pb	U.S. Government bronze, spec. H	.....	....	.....
79.7Cu, 10Sn, 9.5Sb, 0.8P	Phosphor bronze	8.8	....	.....
78Cu, 22Sn	Bell metal	8.7	....	870
67Cu, 33Sn	Bronze, speculum metal	8.6	18.6	745
58Cu, 28Sn, 9.5Pt, 3.5Zn, 1.5As	Cooper's mirror	.....	....	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Copper				
90Cu, 10Zn	Commercial bronze; red brass	8.80	18.18×10^{-6}	1050
89Cu, 9Zn, 2Pb	Hardware bronze	8.83	18.18	1050
85Cu, 15Zn	Red brass	8.75	18.72	1030
85Cu, 13Zn, 2Sn	Pen metal	.....	....	.....
84Cu, 16Zn	Medal metal	.....	....	.....
70Cu, 29Ni, 1Sn	Adnic	.....	16.29	1205
70Cu, 29Zn, 1Sn	Admiralty	8.17	20.16	935
67–72Cu, 28–33Zn, Pb, Fe	Spring brass	.....	....	.....
67–70Cu, 30–33Zn, Pb, Fe	Cartridge brass	.....	....	.....
67Cu, 33Zn	Brass, ordinary yellow	8.40	18.5	940
64Cu, 25Zn, 8.5Pb, 2.5Sn	Ship nail brass	.....	....	.....
61.2Cu, 37.3Zn, 0.9Sn, 0.4Pb, 0.2Fe	....	.....	....	.....
61Cu, 39Zn	Pin wire brass	.....	....	905
60–1Cu, 31–7Zn, 1.4Sn, 0.7–.9Pb	Pewter, for clock work	.....	....	.....
60Cu, 40Zn	Muntz metal	.....	....	840
60Cu, 25Zn, 15Ni	German silver	.....	18.4	.....
60Cu, 19Zn, 10Al, 6Fe, 5Mn	Hytensl bronze	.....	....	980
58Cu, 42Zn	Solder, very refractory	.....	....	850
58Cu, 17.5Zn, 11.5Ni, 11Co, 2Ag	Chinese silver	.....	....	.....
57Cu, 28Zn, 15Sn	Solder, very soft, white	.....	....	.....
55Cu, 45Zn	For brazing	.....	....	880
55Cu, 25Zn, 20Ni	German silver, common formula	.....	....	.....
53Cu, 43Zn, 1.3Sn, 0.3Pb	Solder, hard yellow	.....	....	.....
53Cu, 39Zn, 2.7Sn, 2.5Ni, 1.7Mn, 0.2Al	Manganin	.....	....	.....
52Cu, 26Zn, 22Ni	German silver	8.45	....	.....
51Cu, 32Zn, 9.5Pb, 6.4Ni, 1.6Sn	Dienett's German silver	.....	....	.....
50Cu, 50Zn	Solder, refractory	.....	....	900
50–7Cu, 43–50Zn	Solder, hard	.....	....	.....
50–62Cu, 20–32Zn, 12–30Ni	German silver, Birmingham	.....	....	.....
50–60Cu, 20–5Zn, 20–5Ni	German silver, Austrian (Gersdorf)	.....	....	.....
46Cu, 34Zn, 20Ni	German silver, best	.....	....	.....
Gold				
79Au, 21Al	Roberts-Austen (purple gold)	.....	....	750
92Au, 8Cu	Standard gold, Great Britain	.....	....	900
90Au, 10Cu	Coinage	17.17	....	940
84Au, 16Cu	Jewelry	.....	....	895
75Au, 24Cu	Jewelry	.....	....	925
67Au, 25Cu, 8Ag	Pen metal	.....	....	....
67Au, 8–27Cu, 6.6–26Ag	Gold 16 carat	.....	....	.....
62Au, 13Cu, 11Ag	Gold 15 carat	.....	....	.....
58Au, 14–28Cu, 4–28Ag	Gold 14 carat	.....	....	.....
50Au, 50Cu	Dark red gold	.....	....	1000
50Au, 35Cu, 15Ag	Gold solder 12 carat	.....	....	..

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point C
Gold			$\times 10^{-6}$	
42Au, 38–46Cu, 12–20Ag	Gold 10 carat	.....	....	.....
86Au, 5.7–17Fe, 0–8.6Ag	Gray gold	.....	....	.....
75Au, 25Fe	Blue gold	.....	....	1165
75–85Au, 8–10Ni, 2–9Zn	White gold	.....	....	.....
90Au, 10Pd	White gold, palladium gold	.....	....	1265
60–90Au, 10–40Pd	Rhotanium	.....	....	.....
80Au, 20Pd	Palau	.....	....	1375
60Au, 40Pt	Platinum gold, white	.....	....	1500
92Au, 4.9Ag, 3 1Cu	Gold 22 carat dental, dark	.....	....	.....
91.66Au, 4.16Ag, 4.16Cu	Gold 22 carat	.....	....	.....
92Au, 0–8.3Ag, 0–8.3Fe	Pale yellow gold	.....	....	.....
84Au, 8.3–11Ag, 6–8.3Cu	Gold 20 carat	.....	....	.....
75Au, 17Ag, 8.3Cu	Gold solder 16 carat	.....	....	.....
75Au, 10–20Ag, 5–15Cu	Gold 18 carat	.....	....	.....
63–75Au, 13–31Ag, 6.3–12Cu	Gold solder 18 carat	.....	....	.....
70Au, 25Ag, 5Ni or Pt	Platinum substitute, electrical	.....	....	.....
68Au, 25Ag, 7.5Pt	Platinum substitute, electrical	.....	....	.....
63Au, 23Ag, 15Cu	Gold solder, best	.....	....	.....
58Au, 30Ag, 12Cu	Gold 14 carat dental	.....	....	.....
55Au, 32Ag, 14Cu	Gold solder, easy melt	.....	....	.....
50 Au, 33Ag. 17Cu	Gold solder 14 carat	.....	....	.....
41Au, 37Ag, 21Cu, 0.6 brass	Gold solder 10 carat	.....	....	.....
40Au, 37Ag, 23Cu	Gold solder 8 carat	.....	....	.....
Iridium				
95Ir, 5Pt	....	22.38	....	.....
Iron				
99.94Fe, 0.025S, 0.017Mn, 0.012C, 0.005P	Armco ingot iron	7.86	....	1530
98.5Fe	Wrought iron	7.70	....	1510
80Fe, 20Al	Ferro-aluminum	6.30	....	1480
99Fe, 1C	Steel	7.83	12.0	1430
97Fe, 3C	Cast iron, white	7.60	....	1150
94Fe, 3.5C, 2.5Si	Cast iron, gray	7.0	11.2	1230
Fe, 30–40Co, 5–9W, 1.5–3Cr, 0.4–0.8C	K. S. Magnet steel	.....	....	....
Fe, 0.45Cu, 0.07Mo, 0.03C	Toncan copper; molybdenum iron	7.83	11.99	1525
Fe, + 10Cr, < 0.5Mn, + 0.25C	Stainless steel	7.75	....	1510
90–2Fe, +8Cr, 0.4Mn, < 0.12C	Stainless steel	7.75	11.00	1450
90Fe, +8Cr, 0.4Mn, < 0.12C	Stainless iron	7.75	11.00	1450
88Fe, 16–7Cr, 0.4Mn, 0.1C max	Stainless iron	.....	9.99	....
86–8Fe, 12–4Cr, 0.3C	Carpenter stainless steel 2	7.75	....	1425
86–8Fe, 12–4Cr, <0.5Mn, < 0.1C, trace Ni	Defirust rustless iron	7.75	....	1480

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C
			$\times 10^{-6}$	
Iron				
86–8Fe, 12–4Cr, 0.1C	Carpenter stainless steel 1	7.78	....	1490
85–9 Fe, 10–4 Cr, <0.5Mn, <0.13C	Stainless iron	7.78	10.19	1490
82–6Fe, 12–6Cr, <0.5Ni, <0.05Si, <0.5 Mn, <0.12C	Ascoloy 33	7.64	10.89	1495
86.7Fe, 12.5Cr, 0.35Mn, 0.35Ni, 0.12C	Sterling stainless steel T	7.75	9.99	1430
86.4Fe, 13.5Cr, 0.1C	Stainless I	7.75	10.91	.....
84–6Fe, 12.5–4.5Cr, 0.5Mn max., 0.5Si max., 0.5Ni min., 0.12–0.18C	Enduro S15	7.86	10.89	1475
84–6Fe, 12.5–4.5Cr, 0.5Mn max., 0.5Si max., 0.25Ni, 0.05–.12C	Enduro S	7.86	10.89	1500
85.8Fe, 13.5Cr, 0.35Mn, 0.35C	Sterling stainless steel A	7.75	10.30	1425
85.6Fe, 14Cr, 0.35C	Stainless A	7.75	10.91	...
85Fe, 13–4Cr, 2Ni max., 0.3–.6Mn, 0.12C max.	Enduro KM1	7.75	9.99	1490
82–4Fe, 16–8Cr, <0.5Mn, C	Duraloy B	7.61	....	1510
84.3Fe, 12Cr, 2.15C, 0.75V, 0.75Co	Crocar	.....	....	...
82–4Fe, 16–8Cr, <0.5Mn, <0.1C, trace Ni	Special defirust rustless iron	7.75	....	1480
81–3Fe, 16.5–8.5Cr, 0.75Si, 0.1C max	Enduro A	7.64	11.00	1510
82.8Fe, 16.5Cr, 0.65C	Stainless B	.....	....	...
82.5Fe, 16.5Cr, 0.65C, 0.35Mn	Sterling stainless steel B	7.72	10.91	1425
82Fe, 16–8Cr, 0.5Mn, 0.5Ni, 0.35C	Sweetaloy 16	7.83	11.00	1495
79–82Fe, 16–9Cr, <0.5Mn, <0.5Ni, <0.5Si, <0.12C	Ascoloy 66	7.64	....	....
79–82Fe, 16.5–8.5Cr, 0.5Mn max., 0.5–1.25Si max., 0.25Ni max., 0.1C max.	Enduro A	7.86	10.80	1490
79–81Fe, 16.5–18Cr, 1–1.1C, 0.75–1Si, 0.35–.5Mn	Delhi hard	7.75	9.99	1500
78.7Fe, 20Cr, 1Cu, 0.3C	Carpenter stainless steel 3	7.70	....	1475
71–6Fe, 17–9Cr, 7–10Ni, <0.05Mn, 0.2C	Defistain rustless iron	7.83	....	1455
71–5Fe, 17–9Cr, 8–9Ni, <0.5Mn, 0.06–.25C	Midvale V2A	7.89	16.99	1450
70–5Fe, 25–30Cr, <0.5Mn, 0.25C, trace Ni	Defiheat rustless iron	7.89	....	1595
70–5Fe, 17–20Cr, 7–10Ni, <0.5Mn, <0.5Si, <0.2C	Allegheny metal	7.86–.95	17.30	1430–70
69–75Fe, 16.5–9.5Cr, 7–10 Ni, 0.75Si max., 0.5Mn max., 0.15C max	Enduro KA2	7.86	15.98	1400

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Iron				
74Fe, 18Cr, 8Ni, 0.18C	Stainless N	.....	18.00×10^{-6}	.....
71–4Fe, 17.5–19Cr, 8–9Ni, 0.5Mn, 0.15C max.	Rezistal KA2	7.86	15.98	.....
73.5Fe, 18Cr, 8Ni, 0.35Mn, 0.15C	Sterling nirosta steel	7.92	16.99	1425
73Fe, 18Cr, 9Ni, 0.5Mn, C	Duraloy 18–8	7.86	14.99	1475
70–3Fe, 27–30Cr, 0.5Mn, C	Duraloy A	7.61	....	1510
72.4Fe, 18Cr, 9.5Ni, 0.1C	Carpenter stainless steel 4	7.72	....	1400
70–2Fe, 17.5–19Cr, 8–9Ni, 2–2.5Si, 0.1–.2C	Rezistal 2C	7.86	15.98	.....
68–72Fe, 26–30Cr, <1Mn, <0.6Ni, <0.6Si, <0.25C	Ascoloy 55	7.61	10.19	.....
70Fe, 28Cr, 0.5Mn, 0.5Ni, 0.5C	Sweetaloy 19	7.86	11.00	1495
70Fe, 19Cr, 9Ni, 1Cu, 1Mo, 0.2C	Stainless U	.....	18.00	.....
69Fe, 18–20Cr, 8–10Ni, 0.5 Mn, 0.15C	Sweetaloy 17	7.86	15.98	1450
68.1Fe, 20Cr, 7Ni, 4W, 0.35C, 0.5Mn	Midvale HR	8.03	....	.....
60–6Fe, 22–5Cr, 10–3Ni, <1Mn, <0.5Si, <0.2C	Ascoloy 44	7.86–.95	16.20	1400–25
57–62Fe, 28–30Cr, 8–10Ni, 1.5Si, 0.5–.7C, 0.4–.5Mn	Misco C	7.89	....	1540
60Fe, 28Cr, 10Ni, 0.5Mn, 0.35C	Sweetaloy 22	7.97	....	1495
50–4Fe, 25–6Cr, 19–21Ni, 2–3Si, 0.2C	Rezistal 7	.....	....	.....
85–8Fe, 11–4Mn, 1–1.3C	Rol-Man Manganese steel	.....	....	1290
86Fe, 13Mn, 1C	Manganese steel	7.81	....	1510
96.5Fe, 3.5Ni	Nickel steel	.....	....	1530
95.1Fe, 3Ni, 1.5Cr, 0.4C	Nickel-chrome steel	.....	....	.....
79Fe, 15Ni, 2.5Cr, 3Si, 0.6C	Durimet D	.....	....	1450
74.2Fe, 25Ni, 0.8C	Ferro-nickel	8.1	18	1500
70.9Fe, 20Ni, 8Cr, 0.75Mn, 0.4C	Cyclops 17 Metal	8.00	....	1425–80
70Fe, 25Ni, 5Si, 0.25C	Durimet A	7.89	....	1500
67.8Fe, 32Ni, 0.2C	Ferro-nickel, valve steel	8.0	4	1480
67Fe, 22Ni, 10Cr, 0.5Mn, 0.2C	Sweetaloy 18	7.97	18.90	1450
63.8Fe, 36Ni, 0.2C	Invar	8.0	0.8	1495
57–61Fe, 24–6Ni, 10–2Cr, 4.5–5.5Si, 0.15C	Rezistal 255C	7.81	....	.....
51–8Fe, 25–8Ni, 13–5Cr, 3–4W, 1–1.5Mn, 0.4–0.5-C	Midvale ATV 3	8.11	....	.....
57Fe, 25Ni, 15Cr, 0.3C	Pyrasteel	7.89	17.10	1450
47–56Fe, 33–9Ni, 10–2Cr, 1.1–1.8Mn, 0.25–.35C	Midvale ATV 1	8.06	....	1450
53–6Fe, 24–6Ni, 17–8Cr, 2.5Si, 0.15–.25C	Rezistal 4	7.78	16.29	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Iron				
53.85Fe, 46Ni, 0.15C	Platinite	8.2	7.5×10^{-6}	1470
47–52Fe, 34–6Ni, 10–2Cr, 4.5–5.5Si 0.15C	Rezistal 355C	7.81	....	.....
Fe, 35–7Ni 15–7Cr, 1.4–1.6Si, 0.6–8Mn, 0.5–.7C	Standard Misco	7.97	13.50	1540
50Fe, 35Ni. 15Cr	Chromax castings	7.81	12.19	1480
48Fe, 35Ni, 12Cr, 5Si, 0.25 C	Durimet B	7.89	....	1500
45Fe, 36Ni, 18Cr, 0.5Mn, 0.3C	Sweetaloy 20	7.97	....	1495
97.6Fe, 2Si, 0.4C	Silicon steel	.....	....	.....
73–97Fe, 1–24Si, 2–3C, 0.1P, 0.04–.14S	Meehanite metal	.....	....	.....
84.86Fe, 13.5Si, 1C, 0.4Mn, 0.18P, 0.05S	Tantiron	7.83	....	1315
84.3Fe, 14.5Si, 0.85C, 0.35 Mn	Duriron	7.00	15.59	1265
94.5Fe, 5W, 0.5C	Tungsten steel	.....	....	.....
75Fe, 18W, 6Cr, 0.3V, 0.7C	High speed steel	.....	....	.....
66Fe, 17W, 10Cr, 3.5C, 2.5 Mo	Cristite 1	7.61	15.59	.....
Lead				
99.8Pb, 0.2As	Lead shot	.....	....	.....
94Pb, 6Sb	Battery plates	.....	....	300
92–4Pb, 6–8Sb	Antimonial lead	11.0	27.00	245–90
90Pb, 10Sb	Magnolia	.....	....	270
85Pb, 15Sb	....	10.4	19.5	250
84.33Pb, 14.38Sb, 0.61Fe, 0.68Zn	Car box metal	.....	....	.....
82Pb, 15Sb, 3Sn	Type metal	.....	....	.....
75Pb, 19Sb, 5Sn, 1Cu	White metal	9.5	....	238
70Pb, 18Sb, 10Sn, 2Cu	Type metal	.....	....	.....
92Pb, 8Cd	Aluminum solder, U.S.P. 1,333,666	.....	....	310
99.93Pb, 0.08Cu	Chemical lead	11.35	28.98	327
87Pb, 13Sn, 1Cu	Lead foil (Calin)	.....	....	.....
72Pb, 21Sn, 7Sb	Marine babbitt	.....	....	.....
67Pb, 33Sn	Solder, plumber's	9.4	25.0	275
56–60Pb, 10–40Sn, 4.5–30Sb	Type metal, common	.....	....	.....
58Pb, 26Sn, 15Sb, 1Cu	Type metal, standard	.....	....	.....
50Pb, 50Sn	Solder, half and half	.....	24	225
Mercury				
80Hg, 20Bi	Bismuth amalgam	.....	....	90
70Hg, 30Cu	Dentist's amalgam	.....	....	.....
Nickel				
99–99.5Ni(+Co), 1–0.25C, 1–0.25Si, 1–0.3Mn, 1–0.55Fe, 1–0.25Cu	Nickel	8.86	....	1450
Ni–Cr steel alloy of high Si content	Elcomet	8.03	....	.....
80Ni 20Cr	Chromel A	8.4	....	.....
80Ni, 20Cr	Tophet A	8.50	13 00	1345
80Ni, 20Cr	Nichrome IV*	8.50	13.21	1395

* Trade mark.

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
			$\times 10^{-6}$	
Nickel				
58Ni, 22Cr, 6-7Cu, 4Mo, 2W, 1Mn, 6-7Fe	Illium (Illium G)	8.31	13.50	1300
60Ni, 20Cr, 10Fe, 1.75Mn, 0.5C	Firearmor	8.00	13.99	1330
73Ni, 17.5Co, 6.5Fe, 2.5Ti, 0.2Mn	Konel	8.61	10.66	1450–1500
90Ni, 3Cu, 1.5Al, 10 ± Si	Hastelloy D	7.81	11.59	1160
60–70Ni, 25–35Cu, 1–3Fe, 0.25–2Mn, 0.02–1.5Si, 0.5–.3C	Monel metal	8.80	....	1330
60Ni, 33Cu, 6.5Fe	Monel metal	8.90	14	1360
75Ni, 12Fe, 11Cr, 2Mn	Nichrome wire or ribbon*	.....	....	.....
61Ni, 23Fe, 16Cr	Chromel C	8.24	....	.....
60–2Ni, 23–6Fe, 10–11Cr, 2–2.5W, 1.2–1.5Mn, 0.3–.35C	Midvale BTG	8.47	....	1450
60Ni, 28Fe, 12Cr	Tophet C	8.19	13.70	1350
60Ni, 25Fe, 15Cr, 0.7C	Nichrome castings*	8.08	12 10	.....
60Ni, 24Fe, 16Cr, 0.1C	Nichrome*	8.17	13.70	1350
60Ni, 20Fe, 20Mo	Hastelloy A	8.80	10.71	1300
35Ni, 17Fe, 15Cr, 1.75Mn, 0.5C	Zorite	7.92	....	1300
Ni, 2–6Mn, Fe, Cu	Spark plug wire	.....	....	.....
Ni, Fe, Mo	Hastelloy C	8.91	....	1350
60Ni, 20Pt, 10Pd, 10V	Palau	.....	....	.....
Magnesium				
93.8Mg, 6Al, 0.2Mn	Dowmetal E	1.79	27.00	616
90.8Mg, 6Al, 0.2Mn, 3Zn	Dowmetal H	1.83	27.00	613
92.6Mg, 6.5Al, 0.2Mn, 0.7Zn	Dowmetal J	1.80	27.00	618
98.5Mg, 1.5Mn	Dowmetal M	1.76	27.00	649
90.8Mg, 8.5Al, 0.2Mn, 0.5Zn	Dowmetal O	1.80	27.00	610
88.9Mg, 10Al, 0.1Mn, 1Zn	Dowmetal P	1.82	27.00	596
90.2Mg, 9Al, 0.2Mn, 0.6Zn	Dowmetal R	1.81	27.00	604
93.8Mg, 3Al, 0.2Mn, 3Zn	Dowmetal X	1.80	27.00	635
Palladium				
67Pd, 33Ag	Palladium alloy	.....	....	1415
90Pd, 10Rh	Palladium alloy	.....	....	.....
Platinum				
80–100Pt, 0–20Ir	Platinum-iridium	.....	7.5–8.8	.....
90Pt, 10Ir	Platinum-iridium	21.61	8.8	.....
55Pt, 28Ir, 7Rh, 3Cu, 4Fe, Pd, As	Platinum-iridium (natural)	.....	....	.....
80–100Pt, 0–20Rh	Platinum-rhodium for thermocouples	.....	8.8	.....
90Pt, 10Rh	Platinum-rhodium	.....	....	.....
50Pt, 38Ag, 12Cu	Cooper's pen metal	.....	....	.....
Silver				
92.5Ag, 7.5Cu	Standard silver	.....	18	920
92.5Ag, 5.75Cu, 1.75Cd	Standard cadmium silver	.....	....	.....
92Ag, 8Cu	Silver-rupee	.....	....	920
90Ag, 10Cu	Silver U.S.coins	10.3	....	890

* Trade mark.

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
Silver				
80Ag, 20Cu	Jewelry	.....	18×10^{-6}	820
80Ag, 13Cu, 6.8Zn	Silver solder, hard	.....	....	.....
70–5Ag, 20–3Cu, 5–7.5Zn	Silver solder, medium	.....	....	.....
66Ag, 23Cu, 10Zn	Silver solder, French	.....	....	.....
63Ag, 30Cu, 7.5Zn	Silver solder, common	.....	....	.....
55Ag, 29Cu, 12Au, 5.5Zn	Gold solder, very easy melt	.....	....	.....
70Ag, 25Pd, 5Co	Platinum substitute (Cooper's)	.....	....	.....
73Ag, 27Pt	Platinum solder	.....	....	1160
70 Ag, 25Pt, 5Ni	Platinum substitute (Cooper's)	.....	....	.....
66.7Ag, 33.3Pt	Platinum silver	.....	....	1230
40Ag, 40Sn, 14Cu, 6Zn	Silver solder, Bu. Stands.	.....	....	.....
Tantalum				
99.5Ta	Tantalum	16.6	6.50	2850
Tin				
78Sn, 9Al, 8Zn, 5Cd	Aluminum solder, Bu. Stands. SN1	.....	....	.....
70–94Sn, 3.7–15Sb, 1.8–5-Cu, 0–9Pb, 0–5Zn	Brittania metal, German	.....	....	.....
90–1Sn, 7–8Sb, 1.4Cu	Brittania metal, plate	.....	....	.....
90Sn, 10Sb	Brittania	.....	....	255
90Sn, 7Sb, 3Cu	Babbitt	.....	....	.....
85–90Sn, 9–11Sb, 0–3Zn, 0.2–1Cu	Brittania metal, cast	.....	....	.....
85–90Sn, 5–10Sb, 1–3Cu, 0–3Zn, 0–2Bi	Brittania metal, English	.....	....	.....
89Sn, 7.3Sb, 3.7Cu	Babbitt metal	.....	....	.....
85–8Sn, 5.6–15Sb, 1–5Bi, 0.1–3.7 Cu, 0–1.5Zn	Brittania metal, spoons	.....	....	.....
82Sn, 12Sb, 6Cu	White metal	.....	....	.....
80Sn, 20Sb	....	.....	....	320
75Sn, 12.5Sb, 12.5Cu	Antifriction	7.53	....	233
72Sn, 24Sb, 3.9Cu	Brittania metal, plate (Ludenscheidt)	.....	....	.....
68Sn, 32Cd	....	7.70	....	180
85Sn, 6.8Cu, 6Bi, 1.7Sb	Pewter	.....	....	.....
83Sn, 8.4Cu, 8.3Sb	Hard babbitt	.....	....	.....
97Sn, 3Cu	Rhine metal	7.35	....	300
74–89Sn, 0–20Pb, 0–7.6Sb, 0–3.5Cu, Zn	Pewter	.....	....	.....
88Sn, 8Pb, 4Cu, 0.5Sb	Tinfoil	.....	....	.....
67Sn, 33Pb	Solder, tinman's	.....	....	180
60Sn, 40Pb	Tinsel	.....	....	.....
50Sn, 32Pb, 18Cd	Eutectic fusible alloy	.....	....	145
86Sn, 9Zn, 5Al	Aluminum solder, Bu. Stands. SN4	.....	....	.....
86Sn, 9Zn, 5Al, 0.25P	Aluminum solder, Bu. Stands. SN3	.....	....	.....
73Sn, 21Zn, 5Pb, 1P, Sn	Aluminum solder, Seifert	.....	....	.....
69Sn, 26Zn, 2.4Al, 2.4P	Aluminum solder, Bu. Stands. SN2	.....	....	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (Continued)

Composition	Name	Sp. gr.	Thermal expansion coefficient per °C.	Melting point °C.
			$\times 10^{-6}$	
Tin				
62Sn, 15Zn, 11Al, 8.3Pb, 2.5Cu, 1.2Sb	Aluminum solder, Sterling	.....	....	.....
55Sn, 33Zn, 11Al, 1Cu	Aluminum solder, Soluminum	.....	....	.....
48Sn, 48Zn, 3Cu, 1Pb, 1Sb	Brittania metal, cast	.....	....	....
41Sn, 28Zn, 3Cu, 0.6Mn, 0.1Al	Aluminum solder, U.S.P. 1,332,899	.....	....	.....
Tungsten				
W_2C	Blackor	14.0	....	.....
W, 0.5–0.75ThO_2	Tungsten filaments	.....	....	.....
WC + 13% Co	Carboloy	14.10	6	.....
Zinc				
96Zn, 4Al, .05Mg	ASTM Alloy XXIII SAE Alloy 903 Zamak-3	6.7	26.9	380.9
95Zn, 4Al, 1Cu, .05Mg	Zamak-5	6.7	27.4	380.6
93Zn, 4Al, 3Cu, .05Mg	ASTM Alloy XXI SAE Alloy 902 Zamak-2	6.8	27.7	379.5
95Zn, 5Al	....	**6.80**	**28**	**380**
90Zn, 6Al, 4Cu	Aluminum solder, Geophysical Lab., Carnegie Inst.	.....	....	...
65Zn, 20Al, 15Cu	Aluminum solder, Wüst No. 2	.....	....	...
50Zn, 30Al, 20Cu	Aluminum solder, Wüst	.....	....	...
75Zn, 20Cd, 5Al	Aluminum solder, Bu. Stands. ZN1	.....	....	...
67Zn, 33Cu	Solder, readily fusible	.....	20	795
60Zn, 40Cu	Solder, white	.....	21	840
50Zn, 44Cu, 3.3Sn, 1.2Pb	Solder, nearly white	.....	....	.....
45–57Zn, 35–45Cu, 8–10Ni	Solder, brazing	.....	....	.....
69Zn, 26Sn, 5Cu, 3Sb	Zinc babbitt	.....	....	.....
63Zn, 21Sn, 12Pb, 3.2Cu	Battery plates	.....	....	.....
50Zn, 49Sn, 0.7Sb, 0.2Cu	Aluminum solder, Roesch	.....	....	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Supplementary Table

Composition	Name	Sp. gr.	Thermal expansion coeff. per °C.	Melting point °C.
Aluminum				
98.8Al, 1.2Mn	Wrought Aluminum alloy 3S	....	....	....
97.75Al, 1.3Mg, 0.25Cr, 0.7Si	Wrought Aluminum alloy 53S	....	....	....
98.4Al, 1.0Si, 0.6Mg	Aluminum alloys 51S	....	....	....
98.15Al, 1.0Si, 0.6Mg, 0.25Cr	Wrought Aluminum alloy A51S	....	....	....
97.25Al, 2.5Mg, 0.25Cr	Wrought Aluminum Alloy 52S	....	....	....
97.2Al, 2.5Cu, 0.3Mg	Aluminum alloys A17S	....	....	....
96.2Al, 3.8Mg	Sand-casting Aluminum alloys 214	....	....	....
96Al, 4.0Cu	Sand-casting Aluminum alloys 195	....	....	....
95Al, 4.0Cu, 0.5Mn, 0.5Mg	Wrought Aluminum alloy 17S	....	....	....
93.5Al, 4.0Cu, 0.5Mg, 2.0Ni	Wrought Aluminum alloy 18S	....	....	....
93.4Al, 4.5Cu, 0.6Mn, 1.5Mg	Wrought Aluminum alloy 24S	....	....	....
93.2Al, 1.3Cu, 5.0Si, 0.5Mg	Sand-casting Aluminum alloys 355	....	....	....
92.7Al, 7.0Si, 0.3Mg	Sand-casting Aluminum alloys 356	....	....	....
91.6Al, 1.4Cu, 5.0Si, 0.75Mn, 0.5Mg, 0.75Ni	Wrought Aluminum alloy A355	....	....	....
90.0Al, 10Mg	Sand-casting Aluminum alloy 220	....	....	......
89.3Al, 7.5Cu, 1.2Fe, 2.0Zn	Sand-casting Aluminum alloy 112	....	....	....
87.5Al, 12.5Si, 0.8Ni	Aluminum Alloys, 47	....	....	....
85.4Al, 0.8Cu, 12.0Si, 1.0Mg, 0.8Ni	Aluminum Alloys, 32S	....	....	....
Chromium				
66–70Cr, 4–6C, 24–30Fe	High carbon ferrochromium	....	....	1200–1300
67–72Cr, 0.06–2.00C, 32.94–26Fe	Low carbon ferrochromium	....	....	1255–1350
Copper				
97.6Cu, 1.4Sn, 1.0Si	Tin-Silicon Bronze	8.78	17.9×10^{-6}	1041
97.0Cu, 3Si	Silicon Bronze	8.55	17.9×10^{-6}	1024
90.85Cu, 7.15Al, 2.0Si	Aluminum Silicon Bronze Rod	7.70	17.9×10^{-6}	990
67.0Cu, 31.0Zn, 2.0Al	Aluminum Brass Condenser Tubing	8.33	....	970
70.0Cu, 30.0Ni	Cupro Nickel Condenser Tubing	8.94	16.0×10^{-6}	1227
62.25Cu, 35.75Zn, 2.0Pb	Leaded Brass Sheet	8.50	....	921
60.75Cu, 35.85 Zn, 3.4Pb	Free Turning Brass Rod	8.50	20.4×10^{-6}	885
60.0Cu, 39.0Zn, 1.0Sn	Naval Brass	8.42	21.1×10^{-6}	888

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (CONTINUED)

Composition	Name	Melting point °C.
Iron		
98.755–98.355Fe, .90–1.05C, .25–.50Mn, .040P, .055S	Steel, S.A.E. No. 1095	....
98.31–97.61Fe, .25–.35C, .80–1.10Cr, .40–.60Mn, .15–.25Mo, .040P, .050S	Steel, S.A.E. No. X4130	....
98.16–97.46Fe, .35–.45C, .80–1.10Cr, .60–.90Mn, .040P, .050S	Steel, S.A.E. No. 5140	....
98.03–97.13Fe, .12–.17C, .40–.60Cr, .70–.90Mn, .15–.25Mo, .40–.60Ni, .20–.35Si	Natl. Emergency Steel, NE8613	....
98.01–97.21Fe, .35–.45C, .60–.90Mn, .80–1.10Cr, .15–.25Mo, .040P, .050S	Steel, S.A.E. No. 4140	......
97.72–97.22Fe, .48–.53C, 1.60–1.90Mn, .20–.35Si	Natl. Emergency Steel, NE1350	....
97.72–96.97Fe, .28–.33C, .40–.60Cr, 1.20–1.5Mn, .40–.60Si	Natl. Emergency Steel, NE9630	....
97.91–97.21Fe, .45–.55C, .80–1.10Cr, .60–.90Mn, .035P, .040S, 0.15V	Steel, S.A.E. No. 6150	....
97.51–96.31Fe, .35–.45C, .45–.75Cr, .60–.90Mn, 1.00–1.50Ni, .040P, .050S	Steel, S.A.E. No. 3140	....
97.36–96.16Fe, .35–.45C, .60–.90Cr, .60–.90Mn, 1.00–1.50Ni, .040P, .050S	Steel, S.A.E. No. X3140	....
97.21–96.36Fe, .35–.45C, .50–.80Mn, .20–.30Mo, 1.65–2.00Ni, .040P, .050S	Steel, S.A.E. No. 4640	....
96.87–96.07Fe, .95–1.10C, .25–.45 Mn, .20–.35Si, 1.30–1.60Cr, 0.35Ni, 0.08Mo	Natl. Emergency Steel, NE52100C	....
96.76–95.46Fe, .35–.45C, .60–.90Cr, .50–.80Mn, .20–.30Mo, 1.50–2.00Ni, .040P, .050S	Steel, S.A.E. No. X4340	....
96.57–95.60Fe, .38–.45C, .95–1.0Al, 1.40–1.80Cr, .40–.70 Mn, .30–.45Mo	Nitriding Steels N135, Modified	....
95.71–94.81Fe, .35–.45C, .60–.90Mn, 3.25–3.75Ni, .040P, .050S	Steel, S.A.E. No. 2340	....
94.94–93.64Fe, 0.17C, 1.25–1.75Cr, .30–.60Mn, 3.25–3.75Ni, .040P, .050S	Steel, S.A.E. No. 3312	....
94.76–93.86Fe, .10–.20C, .30–.60Mn, 4.75–5.25Ni, .040P, .050S	Steel, S.A.E. No. 2515	....
93.85–92.18,Fe, .20–.37C, 1.10–1.40Al, 1.00–1.30Cr, .40–.70Mn, .20–.30Mo, 3.25–3.75Ni	Nitriding Steels, N125N	....
81.20–77.00Fe, .50–.70C, 3.00–4.00Cr, .30Mn, 15.00–18.00W	Steel, S.A.E. No. 71660	......
80.5–65Fe, 4.5–5C, 15–30Mn	Spiegeleisen	1065–1225
73.91–68.49Fe, .08C, 17.00–20.00Cr, .20–.70Mn, .75Mo, 8.00–10.00Ni, .030P, .030S	Steel, S.A.E. No. 30905	....
71.11–65.61Fe, 0.08C, 17.5–20Cr, 1.25Mn, 8–10Ni, 2–3Si, .03P, .03S	Enduro 18–8–B	......
67.9Fe, .10C, 17Cr, 3.0Mo, 12Ni	Stainless 316	......
63.55–39.5Fe, 0.2–3.5C, 35–45V	Ferrovanadium	1425–1475
56.75–52.75Fe, 0.25C, 24–26Cr, 19–21Ni	Stainless 310	......
Magnesium		
98.5Mg, 1.5Mn	Wrought Magnesium Alloys No. AM3S	....
95.8Mg, 3Al, 1Zn, 0.2Mn	Wrought Magnesium Alloys No. AM52S	....
93.7Mg, 2.5Al, 0.3Mn, 3.5Cd	Dowmetal L	....
93.1Mg, 6.5Al, 0.2Mn, 0.2Si	Dowmetal EX	......
91.6Mg, 7Al, 1.2Zn, 0.2Mn	Wrought Magnesium Alloys No. AM-C57S	....
91Mg, 3.5Al, 0.5Mn, 5Sn	Wrought Magnesium Alloys No. AM65S	....
90.8Mg, 8.5Al, 0.5Zn, 0.2Mn	Wrought Magnesium Alloys No. AM-C58S	....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS (CONTINUED)

Composition	Name	Melting point °C.
Magnesium		
90.8Mg, 6Al, 3Zn, 0.2Mn	Casting Magnesium Alloys No. AM265	......
89.8Mg, 10Al, 0.2Mn	Casting Magnesium Alloys No. AM240	......
89.4Mg, 10Al, 0.1Mn, 0.5Si	Dowmetal K	......
89.3Mg, 10Al, 0.2Mn, 0.5Si	Casting Magnesium Alloys No. AM230	......
88.8Mg, 9Al, 2Zn, 0.2Mn	Casting Magnesium Alloys No. AM260	......
Manganese		
80–85Mn, 0.3–1.0C, 19.7–14Fe	Low carbon ferromanganese	......
78–82Mn, 6–8C, 16–10Fe	Standard ferromanganese	1255
Molybdenum		
55–65Mo, 45–35Fe	Ferromolybdenum	1625
Silicon		
74–79Si, 26–21Fe	75% Ferrosilicon	1175
Tungsten		
78–83W, 1.0C, 21–16Fe	Ferrotungsten	1800–1900

TRADE NAMES OF COMMERCIAL RESINS AND PLASTICS

THERMOSETTING

Trade Name	Composition	Manufacturers
Agilene HT	Irradiated polyethylene	American Agile Corporation, Box 168, Bedford, Ohio.
Allymer	Diglycol allyl carbonates	Pittsburgh Plate Glass Company, Fiber Glass Div., 1 Gateway Center, Pittsburgh 22, Pa.
A R Resins	Polyesters	General Electric Company, Plastics Dept., 1 Plastics Avenue, Pittsfield, Mass.
Araldite	Epoxy resins	Ciba Company, Inc., Plastics Div., 627 Greenwich Street, New York 14, N. Y.
Atlas	Polyester	Atlas Powder Company, Plastics Div., Wilmington 99, Delaware.
Atlas	Furan	Atlas Powder Company, Plastics Div., Wilmington 99, Delaware.
Bakelite	Phenol formaldehyde	Bakelite Company, a division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
Beckamine	Urea aldehyde	Reichhold Chemicals, Inc. 525 North Broadway, White Plains, N. Y.
Beetle	Urea formaldehyde	American Cyanamid Company, Beetle Div., 30 Rockefeller Plaza, New York 20, N. Y.
B R Resins	Epoxy resins	Bakelite Company, a div. of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
BV and BVQ	Phenolic	Bakelite Company, a div. of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
Carboline	Epoxy	Carboline Company, 331 Thornton Street, St. Louis 19, Mo.
Carboline	Furan	Carboline Company, 331 Thornton Street, St. Louis 19, Mo.
Catalin	Phenol formaldehyde (cast)	Catalin Corporation of America, 1 Park Avenue, New York 16, N. Y.
Catalin	Phenolic or resorcinol aldehyde	Catalin Corporation of America, 1 Park Avenue, New York 16, N. Y.
Catavar	Phenol formaldehyde (lamination)	Catalin Corporation of America, 1 Park Avenue, New York 16, N. Y.
Cycleweld	Phenolic epoxy	Cycleweld Cement Products Plant, Div. of Chrysler Corporation, Box 775, Trenton, Michigan.
DC Resins	Silicones	Dow Corning Corporation, Midland, Michigan.
Duralon	Furan	United States Stoneware Company, Talmadge Avenue, Akron 9, Ohio.
Durez	Phenol formaldehyde	Durez Plastics and Chemicals, Inc., 888 Walck Road, North Tonawanda, N. Y.
Durite	Phenol formaldehyde	Durite Plastics, 5010 Summerdale Avenue, Philadelphia, Pa.
Durite	Phenol furfural	Durite Plastics, 5010 Summerdale Avenue, Philadelphia, Pa.
Epibond	Epoxy	Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, California.
Epons	Epoxy	Shell Chemical Corporation, 50 W. 50th Street, New York 20, N. Y.
Formica	Phenol formaldehyde (lamination)	The Formica Company, 4600 Spring Grove Avenue, Cincinnati 32, Ohio.
Haveg	Phenol formaldehyde (lamination)	Haveg Corporation, Newark, Delaware.
Heresite	Phenolic	Heresite and Chemical Company, 822 South 14th Street, Manitowoc, Wisc.

TRADE NAMES OF COMMERCIAL RESINS AND PLASTICS (Continued)

THERMOSETTING (Continued)

Trade Name	Composition	Manufacturers
Hetron	Polyester	Hooker Electrochemical Company, 36 47th Street, Niagara Falls, N. Y.
IC Resins	Polyesters	Interchemical Corporation, Finishes Div., 224 McWharter Avenue, Newark, N. J.
Indur	Phenol formaldehyde	Reilly Tar and Chemical Corporation, 191 Doremus Street, Newark 5, N. J.
Laminac	Polyesters	American Cyanamid Company, 30 Rockefeller Plaza, New York 20, N. Y.
3 M	Epoxy	Minnesota Mining and Manufacturing Company, 900 Fauquier Avenue, St. Paul 6, Minn.
Marblette	Phenol formaldehyde	Marblette Corporation, 37-00 30th Street, Long Island City 1, New York.
Marco M R	Polyesters	Celenese Corporation of America, Marco Products Dept., 290 Ferry Street, Newark 5, N. J.
Melmac	Melamine formaldehyde	American Cyanamid Company, Beetle Div., 30 Rockefeller Plaza, New York 20, N. Y.
Micarta	Phenol formaldehyde (lamination)	Westinghouse Electric Corporation, Micarta Div., Trafford, Pa.
Nevillac	Phenol modified coumarone indene resins	Neville Chemical Company, Neville Island, Pittsburgh 25, Pa.
Neville	Coumarone indene	Neville Chemical Company, Neville Island, Pittsburgh 25, Pa.
Paraplex	Polyesters	Rohm and Haas Company, Washington Square, Philadelphia 5, Pa.
Paraplex P	Solutions of polyesters in styrene	Rohm and Haas Company, Washington Square, Philadelphia 5, Pa.
Penacolite	Phenol or resorcinol aldehyde	Koppers Company, Inc., Chemical Div., Pittsburgh 19, Pa.
Plaskon	Melamine formaldehyde	Barrett Div. of Allied Chemical and Dye Corporation, 40 Rector Street, New York 6, N. Y.
Plaskon	Polyesters, diallyl phthalate and styrene modified	Barrett Div. of Allied Chemical and Dye Corporation, 40 Rector Street, New York 6, N. Y.
Plaskon	Urea formaldehyde	Barrett Div. of Allied Chemical and Dye Corporation, 40 Rector Street, New York 6, N. Y.
Plyolite	Polyesters	Reichhold Chemicals, Inc., 525 North Broadway, White Plains, N. Y.
Plyophen	Phenolic	Reichhold Chemicals, Inc., 525 North Broadway, White Plains, N. Y.
Plyophen	Phenolic or resorcinol aldehyde	Reichhold Chemicals, Inc., 525 North Broadway, White Plains, N. Y.
Polybond	Urea aldehyde	Polymer Industries, Inc., Springdale, Conn.
Pylene	Epoxy	Polymer Industries, Inc., Springdale, Conn.
Resimene	Melamine formaldehyde	Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.
Resimene	Urea formaldehyde	Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.
Resinox	Phenol formaldehyde	Monsanto Chemical Company, Plastics Div., Springfield 2, Mass.

TRADE NAMES OF COMMERCIAL RESINS AND PLASTICS (Continued)

THERMOSETTING (Continued)

Trade Name	Composition	Manufacturers
Resyn	Epoxy	National Starch Products, Inc., National Adhesive Div., 270 Madison Avenue, New York 16, N. Y.
Selectron	Polyesters	Pittsburgh Plate Glass Company, Selectron Products Div., Gateway Center, Pittsburgh 22, Penn.
Silastic	Silicon elastomers	Dow Corning Corporation, Midland, Michigan.
Silastic	Silicone rubber	Dow Corning Corporation, Midland, Michigan.
Stypol	Polyesters	H. H. Robertson Company, Pittsburgh, Penn.
Synco	Phenolics	Snyder Chemical Corporation, Bethel, Conn.
Synthane	Laminates	Synthane Corporation, Oaks, Penn.
Synvar	Polyesters	Synvar Corporation, Wilmington 99, Delaware.
Synvar	Furan	Synvar Corporation, Wilmington 99, Delaware.
Synvaren	Phenolic	Synvar Corporation, Wilmington 99, Delaware.
Synvaren	Resorcinol aldehyde	Synvar Corporation, Wilmington 99, Delaware.
Synvarol	Urea aldehyde	Synvar Corporation, Wilmington 99, Delaware.
Textolite	Melamine formaldehyde	General Electric Company, Plastics Dept., 1 Plastics Avenue, Pittsfield, Mass.
Textolite	Phenol formaldehyde	General Electric Company, Plastics Dept., 1 Plastics Avenue, Pittsfield, Mass.
Textolite	Urea formaldehyde	General Electric Company, Plastics Dept., 1 Plastics Avenue, Pittsfield, Mass.
Uformite	Urea aldehyde	Rohm and Haas Company, Washington Square, Philadelphia 5, Penn.
Urac	Urea aldehyde or urea	American Cyanamid Company, 30 Rockefeller Plaza, New York 20, N. Y.
Valite	Sugar cane resins	Valite Corporation, 726 Whitney Building, New Orleans 12, La.
Vibrin	Polyesters	Naugatuck Chemical, Division of United States Rubber Company, 2 Elm Street, Naugatuck, Conn.

THERMOPLASTICS

Trade Name	Composition	Manufacturers
Acryloid	Acrylic	Rohm and Haas Company, Washington Square, Philadelphia 5, Pa.
Acrylon	Ethyl acrylic	American Monomer Corporation, 511 Lancaster Street, Leominster, Mass.
Alvar	Vinyl acetal	Shawinigan Products Corporation, 350 Fifth Avenue, New York 1, N. Y.
Alvar	Polyvinyl acetal	Shawinigan Products Corporation, 350 Fifth Avenue, New York 1, N. Y.
Ameroid	Casein	American Plastics Corporation, 342 Madison Avenue, New York 17, N. Y.
Armar	Coumarone indene	Barrett Division, Allied Chemical and Dye Corporation, 40 Rector Street, New York 6, N. Y.
Aroplaz	Alkyd	United States Industrial Chemicals Company, a Division of National Distillers Products Corporation, 120 Broadway, New York 5, N. Y.

TRADE NAMES OF COMMERCIAL RESINS AND PLASTICS (Continued)

THERMOPLASTICS (Continued)

Trade Name	Composition	Manufacturers
Bakelite	Polyethylene	Bakelite Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
Bakelite	Polystyrene	Bakelite Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
Bunarex	Coumarone indene	Pennsylvania Industrial Chemical Company, 120 State Street, Clairton, Pa.
Butacite	Vinyl butyral	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Butacite	Polyvinyl acetal (butyral)	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Butvar	Polyvinyl butyral	Shawinigan Products Corporation, 350 Fifth Avenue, New York 1, N. Y.
Campco	Styrene rubber sheet	Campco Division of Chicago Molded Products Corporation, 2709 Normandy Avenue, Chicago 35, Ill.
Catalin	Polystyrene	Catalin Corporation of America, 1 Park Avenue, New York 16, N. Y.
DC resins	Silicones	Dow Corning Corporation, Midland, Michigan.
Darex	Vinyl acetate	Dewey and Almy Chemical Company, 62 Whittemore Avenue, Cambridge 40, Mass.
Elvacot	Vinyl acetate	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Elvanol	Polyvinyl alcohol	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Elvanol	Vinyl alcohol	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Ethocel	Ethylcellulose	The Dow Chemical Company, Midland, Michigan.
Exon	Polyvinyl chloride	Firestone Plastics Company, Pottstown, Pa., Chemical Sales Division.
Fibestos	Cellulose acetate	Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.
Formvar	Polyvinyl formal	Shawinigan Products Corporation, 350 Fifth Avenue, New York 1, N. Y.
Forticel	Cellulose propionate	Celanese Corporation of America, Plastics Division, 180 Madison Avenue, New York 16, N. Y.
Gelva	Polyvinyl acetate	Shawinigan Products Corporation, 350 Fifth Avenue, New York 1, N. Y.
Geon	Polyvinyl chloride	B. F. Goodrich Chemical Company, 324 Rose Building, Cleveland 15, Ohio.
Glyptal	Alkyd	General Electric Company, Plastics Department, 1 Plastics Avenue, Pittsfield, Mass.
Hypalon	Chloro sulfonated polyethylene	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Koroseal	Modified polyvinyl chloride	B. F. Goodrich Chemical Company, 324 Rose Building, Cleveland 15, Ohio.
Lauxite	Vinyl acetate	Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.
Laxite	Coumarone indene	Xylos Rubber Company, Akron, Ohio.

TRADE NAMES OF COMMERCIAL RESINS AND PLASTICS (Continued)

THERMOPLASTICS (Continued)

Trade Name	Composition	Manufacturers
Lucite	Acrylic (methyl methacrylate) resin	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Lumarith	Cellulose acetate	Celanese Corporation of America, Plastic Division, 180 Madison Avenue, New York 16, N. Y.
Lustrex	Polystyrene	Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.
3 M	Acrylic	Minnesota Mining and Manufacturing Company, 900 Fauquier Avenue, St. Paul 6, Minn.
Marvinol	Polyvinyl chloride	Naugatuck Chemical Division of United States Rubber Company, 2 Elm Street, Naugatuck, Conn.
Monsanto	Polystyrene	Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.
Nebony	Hydrocarbon resins	Neville Chemical Company, Neville Island, Pittsburgh 25, Pa.
Nevindene	Coumarone indene resins	Neville Chemical Company, Neville Island, Pittsburgh 25, Pa.
Nitron	Cellulose nitrate	Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.
Nuba	Coumarone indene	Neville Chemical Company, Neville Island, Pittsburgh 25, Pa.
Nylon	Polyamides	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Opalon	Polyvinyl chloride (resins and compounds)	Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.
Panarez	Petroleum resins	Pan American Refining Corporation, Pan American Chemicals Division, 122 East 42nd Street, New York 17, N. Y.
Paradene	Coumarone indene	Neville Chemicals Company, Neville Island, Pittsburgh 25, Pa.
Parlon	Rubber derivative	Hercules Powder Company, Inc., Wilmington 99, Delaware.
Picco	Coumarone indene	Pennsylvania Industrial Chemical Company, 120 State Street, Clairton, Pa.
Piccoumaron	Coumarone indene	Pennsylvania Industrial Chemical Company, 120 State Street, Clairton, Pa.
Piccovar	Coumarone indene	Pennsylvania Industrial Chemical Company, 120 State Street, Clairton, Pa.
Plastacele	Cellulose acetate	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Plexene	Modified polystyrene	Rohm and Haas Company, Washington Square, Philadelphia 5, Pa.
Plexiglas	Acrylate and methacrylate resin	Rohm and Haas Company, Washington Square, Philadelphia 5, Pa.
Pliolite 3-6	Styrene-butadiene	Goodyear Tire and Rubber Company, Chemical Division, Akron 16, Ohio.
Pliolite N R	Rubber derivative	Goodyear Tire and Rubber Company, Chemical Division, Akron 16, Ohio.
Pliovic	Vinyl	Goodyear Tire and Rubber Company, Chemical Division, Akron 16, Ohio.
Polyeth	Polyethylene	Spencer Chemical Company, Dwight Building, Kansas City, Mo.

TRADE NAMES OF COMMERCIAL RESINS AND PLASTICS (Continued)

THERMOPLASTICS (Continued)

Trade Name	Composition	Manufacturers
Polythene	Polyethylene	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Pyralin	Cellulose nitrate	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Rez N. Bond	Acrylic	Schwartz Chemical Company, Inc., 326 W. 70th Street, New York 23, N. Y.
Saflex	Polyvinyl butyrals	Monsanto Chemical Company, Plastics Division, Springfield 2, Mass.
Saran	Vinylidene chloride	Dow Chemical Company, Midland, Michigan.
Silastic	Silicon elastomers	Dow Corning Corporation, Midland, Michigan.
Styrofoam	Expanded polystyrene	Dow Chemical Company, Midland, Michigan.
Styron	Polystyrene	Dow Chemical Company, Midland, Michigan.
Synvac	Vinyl acetate	Snyder Chemical Corporation, Bethel, Conn.
Teflon	Tetrafluoroethylene	E. I. Du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.
Tenite	Polyethylene	Tennessee Eastman Company, Division of Eastman Kodak Company, Kingsport, Tenn.
Tenite I	Cellulose acetate	Tennessee Eastman Company, Division of Eastman Kodak Company, Kingsport, Tenn.
Tenite II	Cellulose acetate butyrate	Tennessee Eastman Company, Division of Eastman Kodak Company, Kingsport, Tenn.
Tornesit	Rubber derivative	Hercules Powder Company, Inc., Wilmington 99, Delaware.
Ultron	Polyvinyl chloride film and sheeting	Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.
Valite	Sugar cane resins	Valite Corporation, 726 Whitney Building, New Orleans 12, La.
Vinol	Vinyl alcohol	The Colton Chemical Company, 1545 East 18th Street, Cleveland, Ohio.
Vinylite A	Polyvinyl acetate	Bakelite Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
Vinylite Q	Polyvinyl chloride	Bakelite Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
Vinylite V	Vinyl chloride-acetate copolymer	Bakelite Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
Vinylite X	Polyvinyl butyral	Bakelite Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.
Vuepak	Cellulose acetate	Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.

PROPERTIES OF COMMERCIAL PLASTICS

Compiled by Marion C. Reed—1958

Of the many plastics commercially available in each chemical class only one or a very few individuals have been selected for this table as typical of the class. In some cases the range of properties has been expanded to include several grades or types. It is impractical to include a comprehensive list of materials or known properties of these materials in a table of convenient size. Properties vary widely with amount and kind of modifier such as filler and plasticizer. Within any type of thermoplastic resins molecular weight is an important variable. This property is controlled to afford the best physical properties available consistent with economical processing properties.

The information shown refers in all cases, except for "Forms available" and "Fabrication," to material in the fabricated form, which in the case of thermosetting materials means commercially cured. Physical and electrical properties will vary, to a greater or less degree with different materials, with humidity conditioning environment and with orientation. Strength values are quoted on the basis of short time tests at normal room temperature and are not suitable for engineering design purposes for load bearing applications. Maximum continuous service temperature refers to unloaded structures. The user of this table is referred to the specifications and test procedures of the American Society for Testing Materials. The property data was obtained, for the most part, from "Technical Data on Plastics," Manufacturing Chemists' Association, Inc., 1625 Eye Street, N. W., Washington, 6, D. C.

		GROUP NUMBER	1	2
		Resin Type	Thermoplastic	Thermoplastic
		Chemical Class	CELLULOSE ACETATE	CELLULOSE ACETATE
		Subclass or Modification	Soft	Hard
1		**Forms Available** Cs—castings, F—film, Fb—fibers, I—impregnants, L—laminations, Lq—lacquers, Mf—monofilaments, P—Powder, pellet, or granules, R—rods, tubes, or other extruded forms, S—sheets.	F, Lq, P, R, S	F, Lq, P, R, S
2		**Fabrication** Cl—calendering, Cs—casting, E—extrusion, F—hot forming or drawing, I—impregnation. MB—blow molding, MC—compression molding, MI—injection molding, S—spreading.	Cs, E, F, MB, MC, MI, S	Cs, E, F, MB, MC, MI, S
3		**Electrical Properties**		
	a	D. C. Resistivity, ohm-cm	10^{10}–10^{13}	10^{10}–10^{13}
	b	Dielectric Constant 60 cps	3.5–7.5	3.5–7.5
	c	Dielectric Constant 10^6 cps	3.2–7.0	3.2–7.0
	d	Dissipation Factor 60 cps	0.01–0.06	0.01–0.06
	e	Dissipation Factor 10^6 cps	0.01–0.10	0.01–0.10
4		**Mechanical Properties**		
	a	Modulus of Elasticity, 10^3 psi	86–250	190–400
	b	Tensile Strength, psi	1,900–4,700	4,600–8,500
	c	Ultimate Elongation, %	32–50	6–40
	d	Yield Stress, psi	2,200–4,200	4,100–7,600
	e	Yield Strain, %		
	f	Rockwell Hardness	R49–R103	R101–R123
	g	Notched Izod Impact Strength, ft. lb./in.	2.0–5.2	0.4–2.7
	h	Specific Gravity	1.27–1.34	1.27–1.34
5		**Thermal Properties**		
	a	Burning Rate	Medium	Medium
	b	Heat Distortion 264 psi, C	44–57	60–113
	c	Specific Heat cal/gm	0.3–0.42	0.3–0.42
	d	Thermal Coefficient of Expansion, linear, 10^{-5}/degrees C	8–16	8–16
	e	Maximum Continuous Service Temperature, C		
6		**Chemical Resistance**		
	a	Mineral Acids, Weak	Fair to good	Fair to good
	b	Mineral Acids, Strong	Poor	Poor
	c	Oxidizing Acids, Concentrated	Very poor	Very poor
	d	Alkalies, Weak	Poor	Poor
	e	Alkalies, Strong	Very poor	Very poor
	f	Alcohols	Poor	Poor
	g	Ketones	Poor	Poor
	h	Esters	Poor	Poor
	i	Hydrocarbons, Aliphatic	Fair to good	Fair to good
	j	Hydrocarbons, Aromatic	Poor to fair	Poor to fair
	k	Oils, Vegetable, Animal, Mineral	Fair to good	Fair to good
7		**Miscellaneous Properties**		
	a	Clarity	Excellent	Excellent
	b	Color	Pale to colorless	Pale to colorless
	c	Refractive Index	1.46–1.50	1.46–1.50
8		Applicable ASTM Specifications and Test Methods	D786, D706, D257, D150, D638, D785, D256, D792, D648, D696, D543, D542	D786, D706, D257, D150, D638, D785, D256, D792, D648, D696, D543, D542

	3	4	5
	Thermoplastic	Thermoplastic	Thermoplastic
	CELLULOSE ACETATE-BUTYRATE	CELLULOSE ACETATE-BUTYRATE	NYLON
	Soft	Hard	
1	F, Lq, P, R, S	F, Lq, P, R, S	F, Fb, Mf, P, R, S
2	Cs, E, F, MB, MC, MI, S	Cs, E, F, MB, MC, MI, S	E, F, MB, MC, MI
3			
a	10^{10}–10^{12}	10^{10}–10^{12}	$4–40 \times 10^{13}$
b	3.5–6.4	3.5–6.4	3.9–7.6
c	3.2–6.2	3.2–6.2	3.5–3.6
d	0.01–0.04	0.01–0.04	0.01–0.09
e	0.01–0.04	0.01–0.04	0.02–0.08
4			
a	74–126	150–200	70–410
b	1900–3800	5,000–6,800	6,000–12,000
c	[illegible]0–74	38–54	60–300
d	1200–2600	3,600–6,100	6,000–12,000
e			3.6–30
f	R59–R95	R108–R117	R45–R118
g	2.5–5.4	0.7–2.4	0.6–>16
h	1.15–1.22	1.19–1.25	1.09–1.14
5			
a	Medium	Medium	Very slow
b	49–58	70–99	38–66
c	0.3–0.4	0.3–0.4	0.3–0.5
d	11–17	11–17	8.3–10
e			60–121
6			
a	Good	Good	Good
b	Fair to good	Fair to good	Poor
c			Poor
d	Good	Good	
e	Poor	Poor	
f	Poor	Poor	Good
g	Poor	Poor	Good
h	Poor	Poor	Good
i	Fair to good	Fair to good	Excellent
j	Poor	Poor	Fair to good
k	Good	Good	Good to excellent
7			
a	Good to excellent	Good to excellent	Clear
b	Pale to colorless	Pale to colorless	Pale amber to colorless
c	1.46–1.49	1.46–1.49	1.53
8	D707, D257, D150, D638, D785, D256, D792, D648, D696	D707, D257, D150, D638, D785, D256, D792, D648, D696	D257, D150, D638, D785, D256, D792, D648, D696, D543, D542

	GROUP NUMBER	6	7
	Resin Type	Thermoplastic	Thermoplastic
	Chemical Class	POLY(BISPHENOL-A CARBONATE)	POLYETHYLENE
	Subclass or Modification		Lower Density
1	**Forms Available** Cs—castings, F—film, Fb—fibers, I—impregnants, L—laminations, Lq—lacquers, Mf—monofilaments, P—Powder, pellet, or granules, R—rods, tubes, or other extruded forms, S—sheets.	F, Fb, Mf, P, R, S	F, Mf, P, R, S
2	**Fabrication** Cl—calendering, Cs—casting, E—extrusion, F—hot forming or drawing, I—impregnation, MB—blow molding, MC—compression molding, MI—injection molding, S—spreading.	Cs, E, F, MB, MC, MI	Cl, E, F, MB, MC, MI
3	**Electrical Properties**		
a	D. C. Resistivity, ohm-cm	2×10^{16}	$>10^{15}$
b	Dielectric Constant 60 cps	3.17	2.3
c	Dielectric Constant 10^6 cps	2.96	2.3
d	Dissipation Factor 60 cps	0.0009	<0.0005
e	Dissipation Factor 10^6 cps	0.01	<0.0005
4	**Mechanical Properties**		
a	Modulus of Elasticity 10^3 psi	290–325	14–38
b	Tensile Strength, psi	5,000–10,000	1,500–2,400
c	Ultimate Elongation, %	20–100	400–700
d	Yield Stress, psi	8,000–10,000	1,100–1,700
e	Yield Strain, %		20–40
f	Rockwell Hardness	M70–M118	
g	Notched Izod Impact Strength, ft. lb./in.	8–16	N.A.
h	Specific Gravity	1.20	0.912–0.925
5	**Thermal Properties**		
a	Burning Rate	Slow	Medium
b	Heat Distortion 264 psi C	135–145	N.A.
c	Specific Heat cal/gm		0.55
d	Thermal Coefficient of Expansion, linear, 10^{-5}/degrees C	7	15–30
e	Maximum Continuous Service Temperature, C	138–143	60–77
6	**Chemical Resistance**		
a	Mineral Acids, Weak		Excellent
b	Mineral Acids, Strong		Excellent
c	Oxidizing Acids, Concentrated		Good to poor
d	Alkalies, Weak		Excellent
e	Alkalies, Strong		Excellent
f	Alcohols	Poor	Excellent to poor
g	Ketones	Poor	Excellent to poor
h	Esters	Poor	Excellent to poor
i	Hydrocarbons, Aliphatic	Poor	Fair
j	Hydrocarbons, Aromatic	Poor	Fair
k	Oils, Vegatable, Animal, Mineral	Poor	Good
7	**Miscellaneous Properties**		
a	Clarity	Excellent	Translucent
b	Color	Colorless	Colorless
c	Refractive Index		1.50–1.54
8	Applicable ASTM Specifications and Test Methods	D257, D150, D638, D785, D256, D792, D648, D696, D543, D542	D702, D788, D257, D150, D412, D638, D696, D543, D542, D1248

COMMERCIAL PLASTICS (Continued)

	8	9	10
	Thermoplastic	Thermoplastic	Thermoplastic
	POLYETHYLENE	POLYETHYLENE	POLY(METHYL METHACRYLATE)
	Medium Density	Higher Density	Unmodified
1	F, Mf, P, R, S	F, Fb, Mf, P, R, S	Cs, P, R, S
2	Cl, E, F, MB, MC, MI	Cl, E, F, MB, MC, MI	Cs, E, F, Lq, MB, MC, MI
3			
a	$>10^{15}$	$>10^{15}$	$>10^{14}$
b	2.3	2.3	3.5–4.5
c	2.3	2.3	2.7–3.2
d	<0.0005	<0.0005	0.04–0.06
e	<0.0005	<0.0005	0.02–0.03
4			
a	35–90	85–160	350–500
b	1600–2500	2,500–5,000	6,000–10,000
c	200–500	10–300	2–10
d	1500–2600	2,400–5,000	N.A.
e	10–20	5–10	N.A.
f		R30–R50	M84–M105
g	N.A.	1–10	0.4–0.6
h	0.926–0.941	0.942–0.965	1.18–1.19
5			
a	Medium	Medium	Slow
b	N.A.	N.A.	66–99
c	0.55	0.55	0.35
d	15–30	15–30	9
e	71–93	93–200	60–93
6			
a	Excellent	Excellent	Good
b	Excellent	Excellent	Fair to poor
c	Good to poor	Good to poor	Attacked
d	Excellent	Excellent	Good
e	Excellent	Excellent	Poor
f	Excellent to poor	Excellent to poor	
g	Excellent to poor	Excellent to poor	Dissolves
h	Excellent to poor	Excellent to poor	Dissolves
i	Fair	Fair	Good
j	Good	Fair	Softens
k	Excellent	Good	Good
7			
a	Translucent	Translucent	Excellent
b	Colorless	Colorles	Colorless
c	1.50–1.54	1.50–1.54	1.485–1.500
8	D257, D150, D412, D638, D696, D543, D542, D1248	D257, D150, D412, D638, D785, D256, D696, D543, D542, D1248	D257, D150, D638, D785, D256, D792, D648, D696, D543, D542

	GROUP NUMBER	11	12
	Resin Type	Thermoplastic	Thermoplastic
	Chemical Class	POLYPROPYLENE	POLYSTYRENE
	Subclass or Modification		Unmodified
1	**Forms Available** Cs—castings, F—film, Fb—fibers, I—impregnants, L—laminations, Lq—lacquers, Mf—monofilaments, P—powder, pellet, or granules, R—rods, tubes, or other extruded forms, S—sheets.	F, Fb, Mf, P, R, S	F, Fb, Mf, P, R, S
2	**Fabrication** Cl—calendering, Cs—casting, E—extrusion, F—hot forming or drawing, I—impregnation, MB—blow molding, MC—compression molding, MI—injection molding, S—spreading.	Cl, E, F, MB, MC, MI	E, F, MB, MC, MI
3	**Electrical Properties**		
a	D. C. Resistivity, ohm-cm	$>10^{15}$	10^{17}–10^{21}
b	Dielectric Constant 60 cps	2.2	2.50–2.65
c	Dielectric Constant 10^6 cps	2.2	2.50–2.65
d	Dissipation Factor 60 cps	<0.0005	<0.0005
e	Dissipation Factor 10^6 cps	<0.0005	<0.0005
4	**Mechanical Properties**		
a	Modulus of Elasticity 10^3 psi	1.4–1.7	400–600
b	Tensile Strength, psi	5,000	5,500–9,500
c	Ultimate Elongation, %	>220%	1.0–2.5
d	Yield Stress, psi	4,900	N.A.
e	Yield Strain, %	15	N A.
f	Rockwell Hardness	93	M70–M85
g	Notched Izod Impact Strength, ft. lb./in.	1.0	0.25–0.60
h	Specific Gravity	0.90	1.05–1.08
5	**Thermal Properties**		
a	Burning Rate	Medium	Medium
b	Heat Distortion 264 psi, C		80–99
c	Specific Heat cal/gm	0.5	0.32–0.35
d	Thermal Coefficient of Expansion, linear, 10^{-5}/degrees C		6–8
e	Maximum Continuous Service Temperature, C		66–82
6	**Chemical Resistance**		
a	Mineral Acids, Weak	Excellent	Excellent
b	Mineral Acids, Strong	Excellent	Excellent
c	Oxidizing Acids, Concentrated	Good to poor	Excellent to poor
d	Alkalies, Weak	Excellent to good	Excellent
e	Alkalies, Strong	Excellent to good	Excellent
f	Alcohols	Excellent to good	Excellent
g	Ketones	Excellent to good	Dissolves
h	Esters	Excellent to good	Poor
i	Hydrocarbons, Aliphatic	Good to fair	Poor
j	Hydrocarbons, Aromatic	Good to fair	Dissolves
k	Oils, Vegetable, Animal, Mineral	Good	Fair to poor
7	**Miscellaneous Properties**		
a	Clarity	Sl. hazy	Transparent
b	Color	Colorless to sl. yellow	Colorless
c	Refractive Index		1.585–1.600
8	Applicable ASTM Specifications and Test Methods	D257, D150, D412, D638, D785, D256, D648, D543, D542	D257, D150, D638, D785, D256, D792, D648, D696, D543, D542

	13	14	15
	Thermoplastic	Thermoplastic	Thermoplastic
	POLY(STYRENE-ACRYLONITRILE)	POLYTETRAFLUOROETHYLENE	POLYTRIFLUOROCHLOROETHYLENE
	Unmodified	Unmodified	Unmodified
1	F, Mf, P, R, S	F, L, P, R, S	F, Mf, P, R, S
2	Cl, E, F, MB, MC, MI	E, F, MC, MI	Cs, E, F, I, MC, MI, S
3			
a	10^{13}–10^{17}	10^{19}	10^{18}
b	2.6–3.4	2.0	2.65
c	2.5–3.1	2.0	2.34
d	0.0005–0.001	0.0002	0.015
e	0.0005–0.001	0.0002	0.005
4			
a	400–600	33–65	150
b	6,000–12,000	1,500–3,000	4,500
c	1.0–3.5	120–350	150
d	N.A.	1,600–2,000	4,200
e	N.A.	50–75	10
f	M75–M90	J75–J95	R112
g	0.3–0.6	2.5–4.0	3.6
h	1.05–1.10	2.1–2.3	2.1
5			
a	Medium	S.E.	S.E.
b	91–104	60	
c	0.32–0.35	0.25	0.22
d	6.0–8.0	5.5	7
e	77–88	260	200
6			
a	Excellent	Excellent	Excellent
b	Good to excellent	Excellent	Excellent
c	Poor to fair	Excellent	Excellent
d	Excellent	Excellent	Excellent
e	Good to excellent	Excellent	Excellent
f	Good to excellent	Excellent	Excellent
g	Dissolves	Excellent	Excellent
h	Poor to fair	Excellent	Excellent
i	Good to excellent	Excellent	Excellent
j	Fair to good	Excellent	Excellent
k	Good to excellent	Excellent	Excellent
7			
a	Transparent	Translucent	Transparent
b	Colorless to sl. amber	Colorless to grey	Pale to colorless
c	1.57–1.60	1.30–1.40	1.43
8	D257, D150, D638, D785, D256, D792, D648, D696, D543, D542	D1457, D257, D150, D638, D785, D256, D792, D648, D696, D543, D542	D1430, D257, D150, D638, D785, D256, D792, D648, D696, D543, D542

	GROUP NUMBER	16	17
	Resin Type	Thermoplastic	Thermoplastic
	Chemical Class	POLYVINYL CHLORIDE AND POLY (VINYL CHLORIDE-VINYL ACETATE)	POLYVINYL CHLORIDE AND POLY (VINYL CHLORIDE-VINYL ACETATE)
	Subclass or Modification	(Unmodified (Rigid)	Plasticized (Non-rigid)
1	**Forms Available** Cs—casting, F—film, Fb—fibers, I—impregnants, L—laminations, Lq—lacquers, Mf—monofilaments, P—Powder, pellet, or granules, R—rods, tubes, or other extruded forms, S—sheets.	F, Fb, I, Lq, Mf, P, R, S	F, L, P, R, S
2	**Fabrication** Cl—calendering, Cs—casting, E—extrusion, F—hot forming or drawing, I—impregnation, MB—blow molding, MC—compression molding, MI—injection molding, S—spreading.	Cl, Cs, E, F, I, MB, MC, MI, S	Cl, Cs, E, MB, MC, MI, S
3	**Electrical Properties**		
a	D. C. Resistivity, ohm-cm	10^{12}–10^{16}	10^{11}–10^{14}
b	Dielectric Constant 60 cps	3–4	3–11
c	Dielectric Constant 10^6 cps	3–4	3–4
d	Dissipation Factor 60 cps	0.01–0.02	0.03–0.13
e	Dissipation Factor 10^6 cps	0.01–0.02	0.06–0.10
4	**Mechanical Properties**		
a	Modulus of Elasticity 10^3 psi	200–600	
b	Tensile Strength, psi	5,000–9,000	2,000–3,000
c	Ultimate Elongation, %		200–400
d	Yield Stress, psi		
e	Yield Strain, %	1–5	
f	Rockwell Hardness	R110–R120	
g	Notched Izod Impact Strength, ft. lb./in.	0.4–1.0	
h	Specific Gravity	1.36–1.41	1.15–1.65
5	**Thermal Properties**		
a	Burning Rate	Self extinguishing	Slow to S.E.
b	Heat Distortion 264 psi, C	60–80	
c	Specific Heat cal/gm	0.20–0.28	0.36
d	Thermal Coefficient of Expansion, linear, 10^{-5}/degrees C	5–6	
e	Maximum Continuous Service Temperature, C	70–74	80–105
6	**Chemical Resistance**		
a	Mineral Acids, Weak	Excellent	Fair to good
b	Mineral Acids, Strong	Good to excellent	Fair to good
c	Oxidizing Acids, Concentrated	Fair to good	Poor to fair
d	Alkalies, Weak	Excellent	Fair to good
e	Alkalies, Strong	Good	Fair to good
f	Alcohols	Excellent	Fair
g	Ketones	Poor	Poor
h	Esters	Poor	Poor
i	Hydrocarbons, Aliphatic	Excellent	Poor
j	Hydrocarbons, Aromatic	Poor	Poor
k	Oils, Vegetable, Animal, Mineral	Excellent	Poor
7	**Miscellaneous Properties**		
a	Clarity	Transparent	Transparent to opaque
b	Color	Colorless to amber	Colorless to amber
c	Refractive Index	1.54	1.50–1.55
8	Applicable ASTM Specifications and Test Methods	D708, D728, D257, D150, D638, D256, D792, D648, D696, D543, D542	D1432, D257, D150, D412, D792, D543, D542

	18	19	20
	Thermoplastic	Thermosetting	Thermosetting
	SARAN	EPOXY	MELAMINE-FORMALDEHYDE
	Monofilament Grade (Oriented)	Unfilled—General Purpose	Alpha Cellulose Filled—Gen. Purpose
1	F, Lq, Mf, P, R, S	Cs, Lq	P, R, S
2	Cs, E, F, MB, MC, MI, S	Cs, I, S	MC
3			
a	$>10^{14}$	10^{12}–10^{14}	10^{12}–10^{14}
b	4.5–6.0	3.5–5.0	8.9–9.4
c	3.0–4.0	3.4–4.4	5.6–5.8
d	0.03–0.045	0.001–0.015	0.052–0.083
e	0.045–0.065	0.015–0.035	0.034–0.043
4			
a	70–200	>300	1,300
b	20,000–50,000	>2,000	7,000–8,000
c	20–30	2–6	0.6
d			
e			
f		M75–M110	M118–M124; E110
g		0.16–0.7	0.24–0.28
h	1.65–1.72	1.115	1.47–1.52
5			
a	S.E.	Slow	S.E.
b		Up to 120	204
c		0.25–0.4	
d		3–9	2.0–5.7
e		80	99
6			
a	Excellent	Excellent	Fair to good
b	Fair to good	Fair to good	Poor
c	Poor to good	Poor	Poor
d	Excellent	Excellent	Fair to good
e	Fair to good	Excellent	Poor
f	Excellent	Excellent	Good
g	Poor	Poor	Good
h	Fair		Good
i	Excellent	Excellent	Good
j	Poor to fair	Excellent	Good
k	Excellent	Excellent	Good
7			
a	Transparent to translucent	Transparent	Translucent
b	Colorless to amber	Almost colorless	Almost colorless
c	1.60–1.65	1.58	
8	D729, D257, D150, D638, D792, D543, D542	D257, D150, D651, D785, D256, D792, D648, D696, D543	D704, D257, D150, D638, D785, D256, D792, D648, D696, D543

	GROUP NUMBER	21	22
	Resin Type	Thermosetting	Thermosetting
	Chemical Class	MELAMINE-FORMALDEHYDE	PHENOL-FORMALDEHYDE
	Subclass or Modification	Mineral Filled—Electrical	Cellulose Filled—Gen. Purpose
1	**Forms Available** Cs—casting, F—film, Fb—fibers, I—impregnants, L—laminations, Lq—lacquers, Mf—monofilaments, P—powder, pellet, or granules, R—rods, tubes, or other extruded forms, S—sheets.	P, R, S	L, P, S
2	**Fabrication** Cl—calendering, Cs—casting, E—extrusion, F—hot forming or drawing, I—impregnation, MB—blow molding, MC—compression molding, MI—injection molding, S—spreading.	MC	MC
3	**Electrical Properties**		
a	D. C. Resistivity, ohm-cm	10^{13}–10^{14}	10^{11}–10^{13}
b	Dielectric Constant 60 cps	10.2	5–9
c	Dielectric Constant 10^6 cps	6.1	4–7
d	Dissipation Factor 60 cps	0.10	0.04–0.3
e	Dissipation Factor 10^6 cps	0.051	0.03–0.07
4	**Mechanical Properties**		
a	Modulus of Elasticity 10^3 psi	1,950	800–1,200
b	Tensile Strength, psi	5,500–6,500	6,500–8,500
c	Ultimate Elongation, %		0.6–1.0
d	Yield Stress, psi		
e	Yield Strain, %		
f	Rockwell Hardness	E90	M110–M120
g	Notched Izod Impact Strength, ft. lb./in.	0.3–0.4	0.24–0.34
h	Specific Gravity	1.78	1.32–1.55
5	**Thermal Properties**		
a	Burning Rate	S.E.	S.E.
b	Heat Distortion 264 psi, C.	130	143–171
c	Specific Heat cal/gm		0.35–0.40
d	Thermal Coefficient of Expansion, linear, 10^{-5}/degrees C	2.1–4.3	3.0–4.5
e	Maximum Continuous Service Temperature, C	149	149–177
6	**Chemical Resistance**		
a	Mineral Acids, Weak	Fair	Varies
b	Mineral Acids, Strong	Poor	Poor
c	Oxidizing Acids, Concentrated	Poor	Poor
d	Alkalies, Weak	Fair	Varies
e	Alklies, Strong	Poor	Poor
f	Alcohols	Good	Good to excellent
g	Ketones	Good	Fair
h	Esters	Good	Fair to good
i	Hydrocarbons, Aliphatic	Good	Excellent
j	Hydrocarbons, Aromatic	Good	Excellent
k	Oils, Vegetable, Animal, Mineral	Good	Excellent
7	**Miscellaneous Properties**		
a	Clarity	Opaque	Opaque
b	Color	Dark	
c	Refractive Index		
8	Applicable ASTM Specifications and Test Methods	D704, D257, D150, D638, D785, D256, D792, D648, D696, D543	D700, D257, D150, D638, D651, D785, D256, D792, D648, D696, D543

COMMERCIAL PLASTICS (Continued)

	23	24	25
	Thermosetting	Thermosetting	Thermosetting
	PHENOL-FORMALDEHYDE	PHENOL-FORMALDEHYDE	PHENOL-FORMALDEHYDE
	Very High Shock Resistant—Cord Filled	Chopped Fabric Filled, Rubber—Phenolic	Shock and Heat Resistant Mineral—Fiber Filled
1	L, P, S.	L, P, S.	L, P, S.
2	MC	MC	MC
3			
a	10^{11}–10^{12}	10^{8}	10^{10}–10^{12}
b	7–10	15	30–70
c	5–6	5	5–7
d	0.1–0.3	0.5	0.3–0.5
e	0.04–0.09	0.09	0.1–0.25
4			
a	900–1,300		1,500–2,500
b	6,000–9,000	3,500	4,000–7,000
c	0.5–1.0		0.2–0.5
d			
e			
f			
g	4.0–8.0	2.3	0.34–1.0
h	1.36–1.41	1.30–1.35	1.8–2.0
5			
a	S.E.	S.E.	S.E.
b	121–177	104–138	143–177
c			0.28–0.32
d		3.0	1.5–2.0
e	121	100–107	177–218
6			
a	Varies	Varies	Varies
b	Poor	Poor	Poor
c	Poor	Poor	Poor
d	Varies	Varies	Varies
e	Poor	Poor	Poor
f	Good	Good	Excellent
g	Poor to fair	Poor to fair	Fair to good
h	Fair to good	Fair to good	Good
i	Fair to good	Fair to good	Excellent
j	Fair to good	Fair to good	Excellent
k	Good	Good	Excellent
7			
a	Opaque	Opaque	Opaque
b			
c			
8	D700, D257, D150, D638, D651, D785, D256, D792, D648, D543	D700, D257, D150, D638, D651, D785, D256, D792, D648, D543	D700, D257, D150, D638, D651, D785, D256, D792, D648, D543

	GROUP NUMBER	26	27
	Resin Type	Thermosetting	Thermosetting
	Chemical Class	PHENOL-FORMALDEHYDE	POLYESTER (STYRENE-ALKYD)
	Subclass or Modification	Unfilled Cast Phenolic Mechanical and Chemical Grade	Glass Fiber Mat Reinforced
1	**Forms Available** Cs—castings, F—film, Fb—fibers, I—impregnants, L—laminations, Lq—lacquers, Mf—monofilaments, P—Powder, pellet, or granules, R—rods, tubes, or other extruded forms, S—sheets.	Cs, R, S	L, S
2	**Fabrication** Cl—calendering, Cs—casting, E—extrusion, F—hot forming or drawing, I—impregnation, MB—blow molding, MC—compression molding, MI—injection molding, S—spreading.	Cs, F	I
3	**Electrical Properties**		
a	D. C. Resistivity, ohm-cm	$1.0–7.0 \times 10^{12}$	10^{11}
b	Dielectric Constant 60 cps	6.5–7.5	3.4–6.0
c	Dielectric Constant 10^6 cps	4.0–5.5	3.4–5.6
d	Dissipation Factor 60 cps	0.10–0.15	0.01–0.04
e	Dissipation Factor 10^6 cps	0.04–0.05	0.01–0.03
4	**Mechanical Properties**		
a	Modulus of Elasticity 10^3 psi	4.0–5.0	500–1,500
b	Tensile Strength, psi	6,000–9,000	8,000–25,000
c	Ultimate Elongation, %	1.5–2.0	0.5–1.5
d	Yield Stress, psi		
e	Yield Strain, %		
f	Rockwell Hardness	M93–M120	M80–M120
g	Notched Izod Impact Strength, ft. lb./in.	0.25–0.4	7–15
h	Specific Gravity	1.307–1.318	1.5–2.2
5	**Thermal Properties**		
a	Burning Rate	S.E.	S.E.
b	Heat Distortion 264 psi, C.	74–80	93–>288
c	Specific Heat cal/gm		0.2–0.4
d	Thermal Coefficient of Expansion, linear, 10^{-5}/degrees C	6.0–8.0	1.8–2.5
e	Maximum Continuous Service Temperature, C		121–204
6	**Chemical Resistance**		
a	Mineral Acids, Weak	Fair to good	Good
b	Mineral Acids, Strong	Poor to good	Poor
c	Oxidizing Acids, Concentrated	Poor	Poor
d	Alkalies, Weak	Poor to good	Good
e	Alkalies, Strong	Poor	Poor
f	Alcohols	Good to excellent	Good
g	Ketones	Poor to fair	Poor
h	Esters	Fair to good	Good
i	Hydrocarbons, Aliphatic	Good to excellent	Good
j	Hydrocarbons, Aromatic	Good	Poor to fair
k	Oils, Vegetable, Animal, Mineral	Excellent	Good
7	**Miscellaneous Properties**		
a	Clarity	Clear	Translucent
b	Color	Colorless to pale amber	Almost colorless
c	Refractive Index		
8	Applicable ASTM Specifications and Test Methods	D257, D150, D638, D785, D256, D792, D648, D696, D543	D257, D150, D638, D785, D256, D792, D648, D696, D543

	28	29
	Thermosetting	Thermosetting
	SILICONES	UREA-FORMALDEHYDE
	Mineral Filled	Alpha Cellulose Filled
1	P	P, R, S
2	MC	MC
3		
a	$>10^{13}$	0.5–5.0
b	4.0–4.5	7.7–7.9
c	4.0–4.5	6.7–6.9
d	0.010–0.013	0.036–0.043
e	0.005–0.007	0.029–0.031
4		
a		1,300–1,400
b	3,500–4,000	5,500–7,000
c		0.6
d		
e		
f	M85–M90	E94–E97
g	0.25–0.30	0.24–0.28
h	1.8–2.0	1.48–1.52
5		
a	Non-burning	S.E.
b	>260	130
c	0.2–0.3	0.4
d	1–10	2.2–3.6
e	288	77
6		
a	Fair to good	Poor
b	Poor to good	Poor
c		Poor
d		Fair
e		Poor
f	Poor	Good
g	Poor	Good
h		Good
i	Fair to good	Good
j	Poor	Good
k	Good	Good
7		
a	Opaque	Translucent
b	Pale to dark	Colorless
c		1.54–1.56
8	D257, D150, D785, D256, D792, D648, D696, D543	D705, D257, D150, D638, D785, D256, D792, D648

PHYSICAL PROPERTIES OF NATURAL AND SYNTHETIC RUBBER STOCKS

Compiled by I. B. Prettyman

This table was compiled, for the most part, from the literature. Every effort has been made to give values for stocks of comparable formulation and vulcanization for any one property. It was manifestly impossible to do so between properties. Furthermore, the polymers themselves varied in the proportions of base materials and in the methods of preparation, often in an undisclosed manner. Finally, it is to be realized that changes are constantly being made, both in the polymers and in the stock formulations, and that often variations may be effected for the purpose of enhancing one or more of the specific properties, as desired.

Type of polymer	Natural rubber		Butadiene-styrene copolymer	Butadiene-acrylonitrile copolymer	Polychloroprene (neoprene)	Isobutylene diolefin copolymer (butyl)	Alkylene polysulfide	Dimethyl siloxane polymer (silicone)
	trans-isomer (Balata and Gutta-Percha)	*cis*-isomer (Hevea)						
RAW POLYMER								
Specific gravity, 25°C.	0.96	0.92	0.94	1.02	1.25	0.91	1.34	0.97
Heat capacity, 25°C. (Int. joules × gm^{-1} × $°C.^{-1}$)	....	1.88	1.97	1.97	....	1.94	....	....
Refractive index, 20°C	1.55	1.52	1.53	1.52	1.56	1.51	....	1.40
Second order transition temperature (°C.)	....	−74	−64	−23	−50	−75	....	−123
Crystallization temp. of unstretched polymer, maximum rate (°C.)	25	−25	−45	none	0	none	0	−64
Crystal melting temperature (°C.)	α β 65 56	6	−35	....	32	....	70	−52
Probable unit cell of crystal:								
System	Orthorhombic	Monoclinic	Orthorhombic	none	Orthorhombic	Orthorhombic	Monoclinic	....
Dimensions a (Å)	.... 7.78	12.46	....	....	8.84	6.94	8.68	3.0
b (Å)	.... 11.78	8.89	....	....	10.24	11.96	5.03	7.0
(fiber axis) c (Å)	8.80 4.72	8.10	5.05	....	4.79	18.63	4.32	6.0
β (°)	....	92	....	....	....	....	87	....
VULCANIZED PURE GUM TYPE COMPOUND								
D.-C. resistivity, 25°C. (ohm × cm)	10^{16}	10^{17}	10^{15}	10^{10}	10^{11}	10^{17}	10^{13}	10^{11}
Dielectric constant, 1 kc × sec^{-1}, 25°C	3.0	2.7	2.9	13.0	9.0	2.4	6.0	3.1
Power factor, 1 kc × sec^{-1}, 25°C. (%)	0.30	0.23	0.32	5.5	3.0	0.30	....	0.40
Permeability to gas (cc at NTP × cm^{-2} × cm^{-1} thickness × sec^{-1} × cm^{-1} Hg								
Hydrogen	7×10^{-10}	47×10^{-10}	11×10^{-10}	20×10^{-10}	12×10^{-10}	6×10^{-10}	4×10^{-10}	....
Air	....	11×10^{-10}	....	....	....	1×10^{-10}	....	....

PHYSICAL PROPERTIES OF NATURAL AND SYNTHETIC RUBBER STOCKS (Continued)

Type of polymer	Natural rubber		Butadiene-styrene copolymer	Butadiene-acrylonitrile copolymer	Polychloroprene (neoprene)	Isobutylene diolefin copolymer (butyl)	Alkylene polysulfide	Dimethyl siloxane polymer (silicone)
	trans-isomer (Balata and Gutta-Percha)	*cis*-isomer (Hevea)						
Thermal coefficient of linear expansion (increase in length/unit length/°C.)	...	0.00017	0.00015	0.00016	...	0.00021	...	0.00039
Thermal diffusivity, 60°C. (cm² × sec⁻¹)	...	0.0011	0.0012	0.0012	0.0011	0.0009	...	...
VULCANIZED CARBON BLACK (FILLED*) TYPE COMPOUND								
Thermal coefficient of linear expansion (increase in length/unit length/°C.)	...	0.00013	0.00022	0.00022	0.00021	...	...	0.00024
Thermal diffusivity, 25°C. to 100°C. (cm² × sec⁻¹)	...	0.0015	0.0016	0.0016	0.0016	0.0013	...	0.0028
Thermal conductivity, 25°C. to 100°C. (cal × sec⁻¹ × cm⁻¹ × °C.⁻¹)	...	0.00050	0.00046	0.00049	0.00046	0.00046	...	0.00085
Tensile strength based on original section, 25°C. (kg × cm⁻²)	230	315	280	280	245	210	110	56
Elongation at break, 25°C. (%)	470	600	580	580	580	640	600	250
Stress at 300% elongation based on original section, 25°C. (kg × cm⁻²)	...	120	120	135	125	55	70	...
Static shear modulus (shear strain in 0.01 to 0.05 range) (megadynes × cm⁻²)								
30°C.	...	18	25	15	14	18	...	...
100°C.	...	13	10	10	11	9	...	...
Dynamic shear modulus at 60 cycles/sec. (shear strain in 0.05 to 0.15 range) (megadynes × cm⁻²)								
30°C.	...	24	54	27	27	35	...	20
100°C.	...	14	17	13	18	13	...	...
Hysteresis index (frequency × internal friction) measured in shear at 60 cycles/sec (shear strain in 0.05 to 0.15 range) (megagm. × cm⁻¹ × sec⁻²)								
30°C.	...	3.0	8.8	5.1	5.0	14.6	...	2.6
100°C.	...	1.1	3.0	1.5	2.0	2.0	...	...
Ball rebound (1.9 cm. steel ball dropped 100 cm. on sample 1.9 cm. thick) (%)								
−20°C.	...	12	13	13	8	15	...	...

PHYSICAL PROPERTIES OF NATURAL AND SYNTHETIC RUBBER STOCKS (Continued)

[*]Type of polymer	Natural rubber		Butadiene-styrene copolymer	Butadiene-acrylonitrile copolymer	Polychloroprene (neoprene)	Isobutylene diolefin copolymer (butyl)	Alkylene poly-sulfide	Dimethyl siloxane polymer (silicone)
	trans-isomer (Balata and Gutta-Percha)	*cis*-isomer (Hevea)						
20°C.	....	45	37	33	35	9	47	43
100°C.	....	71	47	63	67	50	....	....
Compression set (ASTM method B, 30% const. deflection 22 hrs. @ 70°C.) (%)	....	35	42	27	48	38	40	15
(@ 200°C.) (%)	....	....	....	....	104	....	....	68
Stress relaxation (time for 0.076 cm. thick sample to relax to 60% of 10 sec. stress value, 50% elongation, 100°C.) (hr.)	....	3.7	14	16	1.5	5	....	....
Gough-Joule coefficient at constant stress (change in strain/unit stress/°C.) (kg^{-1} × cm^2 × °C.$^{-1}$)	....	0.00038	0.00056	0.00033	0.00048	0.00060	....	....
Gough-Joule coefficient at constant strain (change in stress/unit strain/°C.) (kg × cm^{-2} × °C.$^{-1}$)	....	0.021	0.028	0.017	0.017	0.016	....	....
Tear resistance (crescent test) (kg × cm^{-1})	....	125	65	50	75	75	50	8
Weather exposure cracking (elongated) (rating)	4	4	5	3	0	0	0	0
Ozone exposure cracking (elongated 12.5%) (rating)	2	4	5	3	<1	<<1	0	0
Swelling in solvents, volume in 7 days (%)								
Gasoline 25°C.	....	150	100	15	20	300	1	300
Benzene 25°C.	....	190	210	160	150	150	90	200
Mineral oil 70°C.	....	130	70	1	10	200	0	7
Water 70°C.	0.2	3	2	3	3	2	12	3
Cold stiffening index (temp. to reach bending modulus of 700 kg × cm^{-2}, 20 min. exposure) (°C.)	....	−47[†]	−40	−30	−37[†]	−40	−40[†]	....
Cold brittle point (Bell Lab. impact type test) (°C.)	−23	−54	−60	−38	−40	−40	−40	−80
Coefficient of friction on ice (dry surface) @ −7°C. with 5 kg × cm^{-2} load								
Static	....	0.22	0.20	0.14	0.15	0.26	....	....
Dynamic	....	0.28	0.25	0.12	0.19	0.19	....	....
Volume compressibility (pressure of 300 kg × cm^{-2}) (bar^{-1})	....	0.000037	0.000036	0.000033	0.000031	....	....	....

[*] Silicone rubber.

[†] Higher temperatures upon extended exposure,

PHYSICAL PROPERTIES OF COMMON WOODS

Values of density marked * are for air dry samples.

Common name	Botanical name	Density, oven-dry		Modulus of rupture, air dry kg/mm²	Modulus of elasticity, air dry kg/mm²
		g/cm³	lbs./ft.³		
Applewood or wild apple	*Pyrus malus*	0.745	46.51	8.96	894.
Ash, black	*Fraxinus nigra*	0.526	32.84	8.97	1126.
Ash, blue	*Fraxinus quadrangulata*	0.603	37.65	9.82	984.
Ash, green	*Fraxinus pennsylvanica lanceolata*	0.610	38.08	10.04	1170.
Ash, white	*Fraxinus americana*	0.638	39.83	11.01	1249.
Aspen	*Populus tremuloides*	0.401	25.03	6.04	838.
Aspen, large tooth	*Populus grandidentata*	0.412	25.72	6.38	996.
Balsa (Tropical America)	*Ochroma*	*0.12–0.20	7.49–12.49		
Basswood	*Tilia glabra* or *Tilia americanus*	0.398	24.85	6.13	1029.
Beech	*Fagus grandifolia* or *Fagus americana*	0.655	40.89	10.25	1180.
Beech, blue	*Carpinus caroliniana*	0.717	44.76	8.48	752.
Birch, gray	*Betula populifolia*	0.552	34.46	6.88	797.
Birch, paper	*Betula papyrifera*	0.600	37.46	8.79	1119.
Birch, sweet	*Betula lenta*	0.714	44.58	11.81	1520.
Birch, yellow	*Betula lutea*	0.668	41.70	11.88	1482.
Buckeye, yellow	*Aesculus octandra*	0.383	23.91	5.36	829.
Butternut	*Juglans cinerea*	0.404	25.22	5.72	830.
Cedar, eastern red	*Juniperus virginiana*	0.492	30.72	6.07	612.
Cedar, northern white	*Thuja occidentalis*	0.315	19.67	4.56	568.
Cedar, southern white	*Chamaecyparis thyoides*	0.352	21.98	4.77	655.
Cedar, (Tropical American)	*Cedrela odorata*	*0.37–0.70	23.10–43.70		
Cedar, western red	*Thuja plicata*	0.344	21.48	5.38	819.
Cherry, black	*Prunus serotina*	0.534	33.34	8.81	1046.
Cherry, wild red	*Prunus pennsylvanica*	0.425	26.53	6.10	892.
Chestnut	*Castanea dentata*	0.454	28.34	6.16	870.
Corkwood	*Leitneria floridana*	0.207	12.92		
Cottonwood, eastern	*Populus deltoides*	0.433	27.03	6.14	972.

PHYSICAL PROPERTIES OF COMMON WOODS

Values of density marked * are for air dry samples.

Common name	Botanical name	Density, oven-dry		Modulus of rupture, air dry kg/mm²	Modulus of elasticity, air dry kg/mm²
		g/cm³	lbs./ft.³		
Cypress, southern	*Taxodium distichum*	0.482	30.09	7.44	1010.
Dogwood (flowering)	*Cornus florida*	0.796	49.69	10.72	1085.
Douglas fir (coast type)	*Pseudotsuga taxifolia*	0.512	31.96	8.44	1357.
Douglas fir (mountain type)	*Pseudotsuga taxifolia*	0.446	27.84	6.72	981.
Ebony, Andaman marble-wood (India)	*Diospyros kurzii*	*0.978	61.06	7.80	1270.
Ebony, Ebène marbre (Mauritius, E. Africa)	*Diospyros melanida*	*0.768	47.95	5.55	1007.
Elm, American	*Ulmus americana*	0.554	34.59	8.44	948.
Elm, rock	*Ulmus racemosa* or *Ulmus thomasi*	0.658	41.08	10.55	1086.
Elm, slippery	*Ulmus fulva* or *pubescens*	0.568	35.46	9.29	1050.
Eucalyptus, Karri (W. Australia)	*Eucalyptus diversicolor*	*0.829	51.75	12.16	1885.
Eucalyptus, Mahogany (New South Wales)	*Eucalyptus hemilampra*	*1.058	66.05	11.50	1608.
Eucalyptus, West Australian mahogany	*Eucalyptus marginata*	*0.787	49.13	10.54	1462.
Fir, balsam	*Abies balsamea*	0.414	25.85	5.42	879.
Fir, Douglas (See Douglas Fir)					
Fir, silver	*Abies amabilis*	0.415	25.91	6.69	1076.
Greenheart (British Guiana)	*Nectandra rodioei*	*1.06–1.23	66.18–76.79		
Gum, black	*Nyssa sylvatica*	0.552	34.46	6.82	839.
Gum, blue	*Eucalyptus globulus*	0.796	49.69	11.75	1683.
Gum, red	*Liquidambar styraciflua*	0.530	33.09	8.40	1045.
Gum, tupelo	*Nyssa aquatica*	0.524	32.71	6.85	889.
Hemlock, eastern	*Tsuga canadensis*	0.431	26.91	6.06	846.
Hemlock, mountain	*Tsuga mertensiana*	0.480	29.97	6.95	797.
Hemlock, western	*Tsuga heterophylla*	0.432	26.97	6.51	1015.
Hickory, bigleaf shagbark	*Hicoria laciniosa*		50.53	12.91	1335.

PHYSICAL PROPERTIES OF COMMON WOODS

Values of density marked * are for air dry samples.

Common name	Botanical name	Density, oven-dry		Modulus of rupture, air dry kg/mm²	Modulus of elasticity, air dry kg/mm²
		g/cm³	lbs./ft.³		
Hickory, mockernut	*Hicoria alba*		51.21	13.56	1570.
Hickory, pignut	*Hicoria glabra*		51.21	14.25	1603.
Hickory, shagbark	*Hicoria ovata*		52.17	14.39	1525.
Hornbeam	*Ostrya virginiana*	0.762	47.57	10.22	1199.
Ironwood, black	*Rhamnidium ferreum*	1.077	67.24	18.10	2100.
Jacarandá, Brazilian rosewood	*Dalbergia nigra*	*0.85	53.07		
Larch, western	*Larix occidentalis*	0.587	36.65	8.24	1188.
Locust, black or yellow	*Robinia pseudacacia*	0.708	44.20	13.63	1448.
Locust, honey	*Gleditsia triacanthos*	0.666	41.58	10.59	1165.
Magnolia, cucumber	*Magnolia acuminata*	0.516	32.21	8.91	1276.
Mahogany (W. Africa)	*Khaya ivorensis*	*0.668	41.70	< 12.38	1079.
Mahogany (Central America)	*Swietenia macrophylla*	*0.54	33.71	6.73	817.
Mahogany (W. India)	*Swietenia mahogani*	*0.54	33.71	7.10	890.
Maple, black	*Acer nigrum*	0.620	38.71	9.37	1141.
Maple, red	*Acer rubrum*	0.546	34.09	9.35	1155.
Maple, silver	*Acer saccharinum*	0.506	31.59	6.34	805.
Maple, sugar	*Acer saccharum*	0.676	42.20	10.97	1290.
Oak, black	*Quercus velutina*	0.669	41.77	9.66	1153.
Oak, bur	*Quercus macrocarpa*	0.671	41.89	7.21	723.
Oak, canyon live	*Quercus chrysolepis*	0.838	52.32	9.26	1149.
Oak, chestnut	*Quercus montana*	0.674	42.08	9.45	1114.
Oak, laurel	*Quercus laurifolia*	0.703	43.89	8.98	1182.
Oak, live	*Quercus virginiana*	0.977	60.99	12.95	1381.
Oak, pin	*Quercus palustris*	0.677	42.27		
Oak, post	*Quercus stellata or Quercus minor*	0.738	46.07	9.30	1063.
Oak, red	*Quercus borealis*	0.657	41.02	10.02	1274.
Oak, scarlet	*Quercus coccinea*	0.709	44.26		
Oak, swamp chestnut	*Quercus prinus*	0.756	47.20	9.73	1247.

PHYSICAL PROPERTIES OF COMMON WOODS

Values of density marked * are for air dry samples.

Common name	Botanical name	Density, oven-dry		Modulus of rupture, air dry kg/mm^2	Modulus of elasticity, air dry kg/mm^2
		g/cm^3	lbs./ft.^{3}		
Oak, swamp white	*Quercus bicolor or Quercus platanoides*	0.792	49.44	12.36	1446.
Oak, white	*Quercus alba*	0.710	44.33	10.68	1251.
Persimmon	*Diospyros virginiana*	0.776	48.45	12.72	1443.
Pine, eastern white	*Pinus strobus*	0.373	23.29	6.26	898.
Pine, jack	*Pinus banksiana or Pinus divaricata*	0.461	28.78	5.70	868.
Pine, loblolly	*Pinus taeda*	0.593	37.02	9.09	1354.
Pine, longleaf	*Pinus palustris*	0.638	39.83	10.90	1445.
Pine, pitch	*Pinus rigida*	0.542	33.84	7.40	965.
Pine, red	*Pinus resinosa*	0.507	31.65	8.81	1264.
Pine, shortleaf	*Pinus echinata*	0.584	36.45	9.34	1345.
Poplar, balsam	*Populus balsamifera or Populus candicans*	0.331	20.66	4.76	716.
Poplar, yellow	*Liriodendron tulipifera*	0.427	26.66	6.52	1058.
Redwood	*Sequoia sempervirens*	0.436	27.22	7.56	958.
Sassafras	*Sassafras variafolium*	0.473	29.53	6.43	790.
Satinwood (Ceylon)	*Chloroxylon swietenia*	*1.031	64.37	9.68	1101.
Sourwood	*Oxydendrum arboreum*	0.593	37.02	8.24	1083.
Spruce, black	*Picea mariana*	0.428	26.72	7.24	1069.
Spruce, red	*Picea rubra or Picea rubens*	0.413	25.78	7.15	1071.
Spruce, white	*Picea glauca*	0.431	26.91	6.38	1001.
Sycamore	*Platanus occidentalis*	0.539	33.65	7.12	1002.
Tamarack	*Larix laricina or Larix americana*	0.558	34.84	8.23	1154.
Teak (India)	*Tectona grandis*	*0.582	36.33	9.04	1195.
Walnut, black	*Juglans nigra*	0.562	35.09	10.42	1185.
Willow, black	*Salix nigra*	0.408	25.47	4.42	513.

THERMAL CONDUCTIVITY OF OVEN-DRY WOOD ACROSS THE GRAIN

Species	Number of tests	Average specific gravity[1]	Average conductivity k[2]
Hardwoods			
Aspen, bigtooth	5	0.41	0.71
Balsa	4	.16	.41
Basswood, American	7	.38	.69
Elm, rock	1	.76	1.16
Maple, sugar	5	.68	1.13
Oak, red[3]	5	.67	1.19
Prima vera	1	.47	.82
Tangile	4	.58	1.00
Softwoods			
Baldcypress	5	.39	.75
Douglas-fir	8	.46	.76
Fir, white	2	.41	.71
Hemlock, western	2	.46	.79
Larch, western	3	.57	.94
Pine:			
Southern yellow[3]	7	.56	.94
White[3]	10	.40	.72
Redcedar, western	3	.34	.64
Redwood	8	.40	.74
Spruce, Engelmann	4	.34	.62

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[1] Based on volume and weight when oven-dry.

[2] k is the quantity of heat expressed in British thermal units that flows in 1 hour through a 1-inch thickness of material, 1 square foot in area, when the temperature difference between the 2 surfaces is 1°F.

[3] Average of several species.

THERMAL CONDUCTIVITY OF WOOD ACROSS THE GRAIN AT VARIOUS MOISTURE CONTENT VALUES

Species	Number of tests	Average specific gravity[1]	Average moisture content (percent)	Average conductivity k[2]
Hardwoods				
Ash, white	7	0.56	15.6	1.19
Aspen, bigtooth	10	.41	12.1	.87
Balsa	6	.17	8.0	.44
Basswood, American	20	.37	9.3	.78
Beech, American	1	.59	11.1	1.17
Birch, yellow	11	.64	10.8	1.25
Cherry, black	1	.68	7.8	1.26
Chestnut, American	1	.42	11.0	.88
Elm:				
American	1	.54	9.4	1.06
Rock	9	.65	17.9	1.39
Greenheart	4	.85	18.4	1.78
Maple:				
Silver	1	.47	9.9	.95
Sugar	27	.66	11.7	1.30
Oak:				
Red[3]	12	.62	12.4	1.24
White[3]	18	.62	11.1	1.22
Pecan	1	.67	10.0	1.28
Prima vera	9	.46	9.7	.93
Sweetgum	1	.55	11.0	1.10
Sycamore, American	1	.52	9.0	1.02
Tangile	6	.54	10.6	1.08
Tupelo, black	1	.46	10.0	.93
Softwoods				
Baldcypress	30	.38	11.7	.82
Douglas-fir	52	.46	18.4	1.04
Fir, white[3]	2	.38	11.7	.82
Hemlock, western	5	.44	23.0	1.06
Juniper, bigberry	1	.44	16.0	.97
Larch, western	13	.46	12.6	.97
Pine:				
Southern yellow[3]	59	.53	13.8	1.11
White[3]	20	.36	9.8	.76
Redcedar, western	16	.32	13.3	.73
Redwood	15	.39	11.7	.83
Spruce	12	.35	13.0	.78

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[1] Based on volume at current moisture content and weight when oven-dry.

[2] k is the quantity of heat expressed in British thermal units that flows in one hour through a 1-inch thickness of material, 1 square foot in area, when the temperature difference between the 2 surfaces is 1°F.

[3] Average of several species.

PHYSICAL PROPERTIES OF PIGMENTS

Rutherford J. Gettens

Trial Data on Painting Materials—Pigments and Inert Materials
Technical Studies, VIII, 1939, 1955

Pigment Name and Chemical Composition[1]	Specific Gravity[2]	Particle Characteristics[3]	Refractive Index[4]
Aluminum hydrate, $Al(OH)_3$	2.45	v. fine amorph part.	n_Σ *c* 1.50–1.56 [M*]
Aluminum stearate, $Al(C_{18}H_{35}O_2)_3$	0.99	agg. of spher. gr.	1.49 (w. bi.) [W]
Anhydrite, $CaSO_4$	2.93	cryst. frag.	α1.570, γ1.614, β1.575 [LB]
Antimony oxide, Sb_2O_3	5.75	v. fine cryst.	{ valentinite, α2.18, γ and β 2.35 { senarmonite, 2.09 (isot.) [LB,M*]
Antimony vermillion, Sb_2S_3	....	v. fine red glob.	n_{Li} 2.65 (isot.) [M*]
Asphaltum (bitumen), carbonaceous	....	irr. amorph. part.	1.64–1.66 [M*]
Azurite, $2CuCO_3.Cu(OH)_2$	3.80	cryst. frag.	α1.730, γ1.838, β1.758 [LB]
Barytes (barite, nat.) $BaSO_4$	4.45	cryst. frag.	α1.636, γ1.648, β1.637 [LB]
(blanc fixe, art.), $BaSO_4$	4.36	v. fine cryst. agg.	1.62–1.64 [M*]
Barium carbonate, $BaCO_3$ (witherite)	4.3	....	α1.529, γ1.677, β1.676 [LB]
Barium yellow, $BaCrO_4$	4.49	v. fine cryst. gr.	1.94–1.98 (bi.) [M]
Blue verditer, $2CuCO_3.Cu(OH)_2$	....	fibrous agg.	α_Σ1.72, γ_Σ slightly > 1.74 [M*]
Bone black $C + Ca_3(PO_4)_2$	2.29	irr. coarse lumps	1.65–1.70 (for larger translucent gr.) [M]
Cadmium red, CdS (Se)	4.5	min. round. gr.	2.64 (bright red)–2.77 (deep red) (isot.) [M*]
Cadmium red lithopone, $CdS(Se) + BaSO_4$	4.30	min. round. gr.	2.50–2.76 (for CdS (Se) part) (isot.) [M*]
Cadmium yellow, CdS	4.35	min. round. gr.	2.35–2.48 (isot.) [M*]
Cadmium yellow lithopone, $CdS + BaSO_4$	4.25	fine comp. gr.	2.39–2.40 (for CdS part) [M*]
Cerulean blue, $CoO.nSnO_2$	....	round. gr.	1.84 (isot.) [M*]
Chalk (whiting), $CaCO_3$	2.70	hollow spherulites	ϵ_Σ *c* 1.510, ω_Σ *c* 1.645 [M*]
Charcoal black, C	....	irr. splintery part.	(opaque)
China clay (kaolinite), $Al_2O_3.2SiO_2.2H_2O$	2.60	fine, vermicular cryst.	α1.558, γ1.565, β1.564 (all ± .005) [LB,M*]
Chrome green (med.) $Fe_4[Fe(CN)_6]_3 + PbCrO_4$	4.06	fine green agg.	*c* 2.4 (cf. Prussian blue and chrome yellow) [M*]
Chrome red, $PbCrO_4.Pb(OH)_2$	6.7	tabular cryst.	α2.42, γ2.7+, β2.7 [M]
Chrome yellow (med.) $PbCrO_4$	5.96	fine prism. gr.	$\alpha_{620m\mu} < 2.31$, $\gamma_{650m\mu}$ 2.49 [M]

PHYSICAL PROPERTIES OF PIGMENTS (Continued)

Pigment Name and Chemical Composition[1]	Specific Gravity[2]	Particle Characteristics[3]	Refractive Index[4]
Chromium oxide green, opaque, Cr_2O_3	5.10	fine cryst. agg.	n_{Li} 2.5 [M]
Chrysocolla, $CuSiO_3.nH_2O$	2.4	crypt. agg.	α1.575, γ1.598, β1.597 [LB]
Cobalt blue, $CoO.Al_2O_3$	3.83	round. gr.	n var.; max. c 1.74$_{\text{blue}}$ (isot.) [M]
Cobalt green, $CoO.nZnO$	....	spher. gr.	1.94–2.0 (w. bi.) [M*]
Cobalt violet, $Co_3(PO_4)_2$	....	round. gr.	ϵ1.65–1.79 (dull violet), ω1.68–1.81 (salmon) (s. bi.) [M]
Cobalt yellow, $CoK_3(NO_2)_6.H_2O$	....	fine dendritic cryst.	1.72–1.76 (isot.) [W]
Diatomaceous earth, SiO_2	2.31	min. fossil forms	n mostly 1.435, some 1.40 [M*]
Egyptian blue, $CaO.CuO.4SiO_2$	....	cryst. frag.	ϵ1.605, ω1.635 [APL]
Emerald green, $Cu(C_2H_3O_2)_2.3Cu(AsO_2)_2$	3.27	spherulites and disks	α_Σ1.71, γ_Σ1.78 (w. pleo.) [M*]
Gamboge, organic resin	....	irr. amorph. part.	1.582–1.586 [W]
Graphite, C	2.36	irr. plates	(opaque) [M]
Green earth (celadonite and glauconite), Fe, Mg, Al, K, hydrosilicate	2.5–2.7	round. irr. gr.	n var. c 1.62 (porous) [M*]
Gypsum, $CaSO_4.2H_2O$	2.36	fine cryst. gr.	α1.520, γ1.530, β1.523 [LB]
Indian yellow, $C_{19}H_{16}O_{11}Mg.5H_2O$	....	prisms, plates	1.67 (w. bi.) [M*]
Iron oxide red (haematite), Fe_2O_3	5.2	min. cryst.	ϵ_{Li} 2.78, ω_{Li} 3.01 [M]
Lamp black, C	1.77	min. round. part.	(opaque)
Lithopone (regular), ZnS (28–30%), $BaSO_4$ (72–70%)	4.30	fine comp. gr.	2.3 (ZnS)–1.64 ($BaSO_4$) [M]
Lithopone	....	....	Av. 1.84 [TPC]
Malachite, $CuCO_3.Cu(OH)_2$	4.0	cryst. frag.	α1.655, γ1.909, β1.875 [LB]
Manganese blue, $BaMnO_4 + BaSO_4$	....	gr. and stubby prisms	c 1.65 [W]
Manganese violet, $(NH_4)_2Mn_2(P_2O_7)_2$	....	fine cryst. gr.	α1.67, γ1.75, β1.72, (for violet) [M]
Massicot (litharge), PbO	9.40	min. flakes	α_{Li} 2.51, γ_{Li}2.71, β_{Li} 2.61 [M]
Mayan blue, Fe, Mg, Ca, Al, silicate (?)	....	porous irr. agg.	β_Σ1.54 (irr.; bi. and pleo.) [M*]
Mica (muscovite), $H_2KAl_3(SiO_4)_3$	2.89	platy frag.	α1.563, γ1.604, β1.599 [LB]
Molybdate orange, Pb(Mo, S, Cr, P)O_4	....	min. round. gr.	β_{Li} 2.55 (s. bi.) [M*]
Naples yellow, $Pb_3(SbO_4)_2$	....	round. gr.	2.01–2.28 (isot.) [M*]
Ochre, yellow (goethite), $Fe_2O_3.H_2O$, clay, etc.	2.9–4.0	irr. spherulites	n_Σ2.0 (isot. part); $(\alpha\beta)_\Sigma$2.05–2.31, γ_Σ2.08–2.40 (bi. part) [M*]

PHYSICAL PROPERTIES OF PIGMENTS (Continued)

Pigment Name and Chemical Composition[1]	Specific Gravity[2]	Particle Characteristics[3]	Refractive Index[4]
Orpiment, As_2S_3	3.4	min. flakes	α_{Li} 2.4 ±, γ_{Li} 3.02, β_{Li} 2.81 [LB]
Prussian blue, $Fe_4[Fe(CN_6]_3$	1.83	colloidal agg.	$1.56_{460m\mu}$ [M*]
Pumice (volcanic glass), Na, K, Al, silicate	....	vesicular vitr. frag.	c 1.50 (isot.) [M*]
Realgar, As_2S_2	3.56	cryst. frag.	α_{Li} 2.46 γ_{Li} 2.61 β_{Li} 2.59 [LB]
Red lead, Pb_3O_4 (c 95 %)	8.73	crypt. agg.	2.42_{Li} (w. bi.; pleo.) [M]
Sepia, organic	....	angular frag.	(opaque) [M*]
Sienna, burnt, Fe_2O_3, clay, etc.	3.56	uneven, round. part.	c 1.85 (var.) (isot.) [M]
Sienna, raw (goethite), $Fe_2O_3.H_2O$, clay, etc.	3.14	uneven sperulites	1.87–2.17 (mostly 2.06) (isot.) [M*]
Silica (quartz), SiO_2	2.66	cryst. frag.	ϵ1.553, ω1.544 [LB]
(chalcedony), SiO_2	2.6	crypt. agg.	ϵ, ω 1.54 [LB, M*]
Smalt, K, Co(Al), silicate (glass)	....	splintery vitr. frag.	1.49–1.52 [M*]
Strontium yellow. $SrCrO_4$	....	small needles	α, β (or ω) 1.92, γ (or ϵ) 2.01 ($\parallel$ ext.) [M*]
Talc, $3MgO.4SiO_2.H_2O$	2.77	platy frag.	α1.539, γ1.589, β1.589 [LB]
Titanium barium white, TiO_2 (25 %) + $BaSO_4$ (75 %)	4.30	min. round. gr.	$n_{\Sigma}c$ 1.7–2.5 [M*]
Titanium calcium white, TiO_2 (25 %) + $CaSO_4$ (75 %)	3.10	prism. or ragged gr.	mostly 1.8–2.0 (irr.) (bi.) [M*]
Titanium dioxide (anatase), TiO_2	3.9	min. round. gr.	ϵ and ω2.5 (w. bi.) [M*]
(rutile), TiO_2	4.2	round, or prism, gr.	ϵ2.9, ω2.6 [M*]
Titanium dioxide (rutile) + $CaSO_4$	3.25	....	Av. 1.98 [TPC]
Ultramarine blue (art.), $Na_{8-10}Al_6Si_6O_{24}S_{2-4}$	2.34	uniform small round. gr.	n 1.51_{green}, 1.63_{red} (isot.) [M]
(nat., lazurite), $3Na_2O.3Al_2O_3.6SiO_2.2Na_2S$	2.4	angular, broken frag.	1.50 ± (isot.) [LB]
Ultramarine violet	....	round, gr, (blue, rose, and violet)	c 1.56 (isot.) [M*]
Umber, burnt, $Fe_2O_3 + MnO_2$, clay, etc.	3.64	uneven, round. gr.	mostly 2.2–2.3 [M*]
Umber, raw, $Fe_2O_3 + MnO_2 + H_2O$, clay, etc.	3.20	uneven, round. gr.	mostly 1.87–2.17 [M*]
Van Dyke brown, bituminous earth	1.66	irr. amorph. part.	1.62–1.69 [M*]
Verdigris (copper basic acetate) $Cu(C_2H_3O_2)_2$.-$2Cu(OH)_2$	....	cryst. frag.	α1.53, γ1.56 [M]

PHYSICAL PROPERTIES OF PIGMENTS (Continued)

Pigment Name and Chemical Composition[1]	Specific Gravity[2]	Particle Characteristics[3]	Refractive Index[4]
Vermilion (art.), HgS	8.09	hexagonal gr. and pr.	ϵ_{Li} 3.14, ω_{Li} 2.81 [M]
(nat., cinnabar), HgS	8.1	cryst. frag.	ϵ_{Li} 3.146, ω_{Li} 2.819 [LB]
Viridian (chromium oxide, transparent), $Cr_2O_3.2H_2O$	3.32	spherul. gr.	$\alpha, \beta_{\Sigma}1.82, \gamma_{\Sigma}2.12$ [M*]
White lead (basic carbonate), $2PbCO_3.Pb(OH)_2$	6.70	v. fine cryst.	$\epsilon1.94, \omega2.09$ [M]
White lead (basic sulfate), $PbSO_4.PbO$	6.40	....	Av. 1.93 [TPC]
Zinc sulfide (sphalerite), ZnS	4.00	....	2.37 (isot.) [LB]
Zinc white (ordinary), ZnO	5.65	v. fine cryst. gr.	$\epsilon2.02, \omega2.00$ [M]
(acicular), ZnO	....	spicules, fourlets	$\epsilon2.02, \omega2.00$ [M]
Zinc yellow, $ZnCrO_4$	3.46	min. spher. gr.	1.84–1.9 (irr.; bi.) [M*]
Zirconium oxide (baddeleyite) ZrO_2	5.69	....	$\alpha2.13, \gamma2.20, \beta2.19$ [LB] Av. 2.40 [TPC]

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[1] Abbreviations: art. = artificial; med. = medium; nat. = natural. The chemical formulas are those commonly accepted in chemical and mineralogical literature, but they may not compare exactly with structural formulas based on X-ray diffraction data or even on critical chemical analysis.

[2] The figures for specific gravity of the artificial pigments are mainly from H. A. Gardner, and those on the mineral pigments are chiefly from E. S. Larsen and H. Berman.

[3] Symmetry terms (monoclinic, orthorhombic, etc.) are omitted because pigments are so finely divided that it is rare when observations on crystal symmetry can be made. The term, "spherulitic," as used here means aggregates that tend toward radial structure and spherical shape. "Amorphous" describes materials that are microscopically formless but may be truly crystalline on the basis of X-ray diffraction data. Abbreviations: agg. = aggregate(s); amorph. = amorphous; comp. = composite; crypt. = cryptocrystalline; cryst. = crystal(s); frag. = fragment(s); glob. = globule(s); gr. = grain(s); irr. = irregular; min. = minute; part. = particle(s); prism. = prismatic; round. = rounded; spher. = spheroidal; spherul. = spherulitic; var. = variable; v = very; vitr. = vitreous.

[4] Unless otherwise indicated, all refractive index measurements are by sodium light. Σ is the symbol used by H. E. Merwin to indicate greater or less indefiniteness or irregularity in the case of aggregates, especially in respect to refractive index. Abbreviations: bi. = birefringent; *c* = *circa;* ext. = extinction; isot. = isotropic; ‖ = parallel; pleo. = pleochroic; s. = strongly; w. = weakly. The letters in brackets refer to the authorities for the refractive index data; M = H. E. Merwin; M* = H. E. Merwin, data by private communication, hitherto unpublished; W = C. D. West, data by private communication, hitherto unpublished; LB = E. S. Larsen and H. Berman; APL = A. P. Laurie and co-authors. TPC = Titanium Pigment Corporation.

COMMON NAMES OF COMPOUNDS, THEIR CHEMICAL NAMES AND FORMULAS

Common Name	Chemical Name	Formula
Acetic ether	Ethyl acetate	$CH_3CO_2C_2H_5$
Acid of sugar	Oxalic acid	$(CO_2H)_2$
Aldehyde	Acetaldehyde	CH_3CHO
Alum	Generally refers to potassium aluminum sulfate	$K_2Al_2(SO_4)_4 \cdot 24H_2O$
Alum flour		
Alum meal		
Alumina	Aluminum oxide	Al_2O_3
Alumino-ferric	A mixture of aluminum and sodium sulfates	
Alundum	Fused alumina	Al_2O_3
Aniline	Phenyl amine	$C_6H_5NH_2$
Aniline salt	Aniline hydrochloride	$C_6H_5NH_2 \cdot HCl$
Antichlor	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Antifebrin	Acetanilide	$C_6H_5NHCOCH_3$
Antimony bloom	Antimony trioxide	Sb_2O_3
Antimony black	Antimony trisulfide	Sb_2S_3
Antimony glance		
Antimony red	Antimonous oxysulfide	$Sb_2S_3 + Sb_2O_3$
Antimony vermilion		
Antimony white	Antimonous oxide	Sb_2O_3
Antimony yellow	Basic lead antimonate	$PbO \cdot Sb_2O_5$
Aqua fortis	Nitric acid	HNO_3
Aqua regia	Nitric acid and hydrochloric acid	$HNO_3 + 3HCl$
Argol	Crude potassium acid tartrate	$KHC_4H_4O_6$
Arsenic glass	Arsenous oxide	As_2O_3
Aspirin	Acetyl-salicylic acid	$C_6H_4(CO_2H)(OCOCH_3)$
Azurite	Basic copper carbonate	$2CuCO_3 \cdot Cu(OH)_2$
Bakelite	Resin from phenol + formaldehyde	
Baking soda	Sodium bicarbonate	$NaHCO_3$
Barium white	Barium sulfate	$BaSO_4$
Baryta	Barium oxide	BaO
Barytes	Barium sulfate (natural)	$BaSO_4$
Bauxite	Hydrated alumina	$Al_2O_3 \cdot 2H_2O$
Beet sugar	Sucrose	$C_{12}H_{22}O_{11}$
Bentonite	Impure aluminum silicate	
Benzine	Mixture of low boiling liquid alkanes	
Benzol	Benzene	C_6H_6
Bichrome	Potassium dichromate	$K_2Cr_2O_7$
Bitter salt	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
Black ash	Impure sodium carbonate	
Blanc-fixe	Barium sulfate (artificial)	$BaSO_4$
Bleaching powder	Calcium chloro-hypochlorite	$CaOCl_2$
Blende	Natural zinc sulfide	ZnS
Blue copperas	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Blue stone		
Blue vitriol		
Blue salts	Nickel sulfate	$NiSO_4 \cdot 7H_2O$
Blue verditer	Basic copper carbonate	$2CuCO_3 \cdot Cu(OH)_2$
Bone ash	Impure calcium phosphate	
Bone black	Crude animal charcoal	C
Boracic acid	Boric acid	H_3BO_3
Borax	Sodium tetraborate	$Na_2B_4O_7 \cdot 10H_2O$
Bremen blue	Basic copper carbonate	$xCuCO_3 \cdot yCu(OH)_2$
Brimstone	Sulfur	S

COMMON NAMES OF COMPOUNDS, THEIR CHEMICAL NAMES AND FORMULAS (Continued)

Common Name	Chemical Name	Formula
Burnt alum	Anhydrous potassium aluminum sulfate	$K_2Al_2(SO_4)_4$
Burnt lime	Calcium oxide	CaO
Burnt ochre	Ferric oxide	Fe_2O_3
Burnt ore		
"Butter of"	Refers to the chloride	
Cadmium yellow	Cadmium sulfide	CdS
Calamine	Zinc silicate	$2ZnO \cdot SiO_2 \cdot H_2O$
Calcite	Mineral calcium carbonate	$CaCO_3$
Caliche	Impure sodium nitrate	$NaNO_3$
Calomel	Mercurous chloride	$HgCl$
Camphor, artificial	Pinene hydrochloride	$C_{10}H_{17}Cl$
Cane sugar	Sucrose	$C_{12}H_{22}O_{11}$
Carbolic acid	Phenol	C_6H_5OH
Carbonic acid	Carbon dioxide	CO_2
Carbonic anhydride		
Carborundum*	Silicon carbide	SiC
Carnallite	Magnesium potassium chloride	$MgCl_2 \cdot KCl \cdot 6H_2O$
"Caustic"	Refers to the hydroxide of a metal	
Ceruse	Basic lead carbonate	$2PbCO_3 \cdot Pb(OH)_2$
Chalk	Calcium carbonate	$CaCO_3$
Chili niter	Sodium nitrate	$NaNO_3$
Chili saltpeter		
China clay	Aluminum silicate	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$
Chinese red	Basic lead chromate	$PbCrO_4 \cdot PbO$
Chinese white	Zinc oxide	ZnO
Chloramine T	Sodium p-toluene-sulfochloramide	$(CH_3C_6H_4SO_2NCl\text{-}Na) \cdot 3H_2O$
Chloride of lime	Calcium chloro-hypochlorite	$CaOCl_2$
Chloride of soda	Sodium hypochlorite solution	$NaOCl$
Chrome alum	Potassium chromium sulfate	$K_2Cr_2(SO_4)_4 \cdot 24H_2O$
Chrome green	Chromium oxide	Cr_2O_3
Chrome red	Basic lead chromate	$PbCrO_4 \cdot PbO$
Chrome yellow	Lead chromate	$PbCrO_4$
Chromic acid	Chromium trioxide	CrO_3
Cinnabar	Mercuric sulfide	HgS
Cobalt black	Cobalt oxide	CoO
Cobalt green	Cobalt zincate	$CoZnO_2$
Common salt	Sodium chloride	$NaCl$
Copperas	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Corn sugar	Glucose	$C_6H_{12}O_6 \cdot H_2O$
Corrosive sublimate	Mercuric chloride	$HgCl_2$
Corundum	Aluminum oxide	Al_2O_3
Cream of tartar	Potassium hydrogen tartrate	$KHC_4H_4O_6$
Cresylic acid	Mixture of *o*, *m*, and *p*-cresol	$CH_3C_6H_4OH$
Cupferron	Nitrosophenylhydroxylamine	$C_6H_5N(NO)OH$
Dekaline	Decahydronaphthalene	$C_{10}H_{18}$
Derby red	Basic lead chromate	$PbO \cdot PbCrO_4$
Dermatol	Basic bismuth gallate	$Bi(OH)_2 \cdot C_7H_5O_5$
Dextrose	Glucose	$C_6H_{12}O_6 \cdot H_2O$
Dutch liquid	Ethylene chloride	$(CH_2Cl)_2$

* Trade name

COMMON NAMES OF COMPOUNDS, THEIR CHEMICAL NAMES AND FORMULAS (Continued)

Common Name	Chemical Name	Formula
Eau-de-Javelle	Potassium hypochlorite solution	$KOCl$
Eau-de-Labarraque	Sodium hypochlorite solution	$NaOCl$
Emerald green	Copper aceto-arsenite	$Cu(C_2H_3O_2)_2{\cdot}3CuAs_2O_4$
Emery powder	Impure aluminum oxide	Al_2O_3
Epsom salts	Magnesium sulfate	$MgSO_4{\cdot}7H_2O$
Essence of bitter almonds	Benzaldehyde	C_6H_5CHO
Essence of mirbane	Nitrobenzene	$C_6H_5NO_2$
Everitt's salt	Potassium ferrous ferrocyanide	$K_2Fe_2(CN)_6$
Feldspar	Potassium aluminum silicate	$K_2Si_3O_7{\cdot}Al_2Si_3O_6$
Ferro prussiate	Potassium ferrocyanide	$K_4Fe(CN)_6$
Fixed white	Barium sulfate	$BaSO_4$
Flowers of sulfur	Sulfur	S
"Flowers of" a metal is a	synonym for the oxide	
Fluorspar	Calcium fluoride	CaF_2
Formalin	Forty per cent solution of formaldehyde in water	$HCHO$
Formin	Hexamethylene tetramine	$(CH_2)_6N_4$
Freezing salt	Crude sodium chloride	$NaCl$
French chalk	Hydrated silicate of magnesium	$Mg_3Si_4O_{11}{\cdot}H_2O$
French verdigris	Basic copper acetate	$Cu_2(C_2H_3O_2)_2(OH)_2$
Fruit sugar	Fructose	$C_6H_{12}O_6$
Fuller's earth	Hydrated magnesium and aluminum silicates	....
Fulminate of mercury	Mercuric fulminate	$Hg(ONC)_2$
Fusel oil	Mixed amyl alcohols	$C_5H_{11}OH$
Gasoline	Mixture of low boiling hydrocarbons suitable for use in internal combustion engines	
Galena	Natural lead sulfide	PbS
Glauber's salt	Sodium sulfate	$Na_2SO_4{\cdot}10H_2O$
Glucose	Dextrose	$C_6H_{12}O_6{\cdot}H_2O$
Glycerin	Glycerol	$C_3H_5(OH)_3$
Grain alcohol	Ethyl alcohol	C_2H_5OH
Grape sugar	Glucose	$C_6H_{12}O_6{\cdot}H_2O$
Green verditer	Basic copper carbonate	$CuCO_3{\cdot}Cu(OH)_2$
Green vitriol	Ferrous sulfate	$FeSO_4{\cdot}7H_2O$
Gypsum	Calcium sulfate	$CaSO_4{\cdot}2H_2O$
Hartshorn salt	Ammonium carbonate carbamate	$NH_4HCO_3{\cdot}NH_4CO_2NH_2$
Heavy spar	Barium sulfate	$BaSO_4$
Hexamine	Hexamethylene tetramine	$(CH_2)_6N_4$
Horn silver	Silver chloride	$AgCl$
Hypo	Sodium thiosulfate	$Na_2S_2O_3{\cdot}5H_2O$
Iron black	Precipitated antimony	Sb
Indian red	Ferric oxide	Fe_2O_3
Iron mordant	Ferric sulfate	$Fe_2(SO_4)_3$
Kainit	Double salt of potassium magnesium sulfate and magnesium chloride	$K_2Mg(SO_4)_2{\cdot}MgCl_2\text{-}6H_2O$
Kaolin	Aluminum silicate	$Al_2O_3{\cdot}2SiO_2{\cdot}2H_2O$
Kieselguhr	Siliceous earth	SiO_2
Kieserite	Mineral magnesium sulfate	$MgSO_4$
King's yellow	Arsenous sulfide	As_2S_3
Lampblack	Impure carbon	C

COMMON NAMES OF COMPOUNDS, THEIR CHEMICAL NAMES AND FORMULAS (Continued)

Common Name	Chemical Name	Formula
Lanolin	Mixt. of cholesterol and esters	
Laughing gas	Nitrous oxide	N_2O
Lemon chrome	Barium chromate	$BaCrO_4$
Levulose	Fructose	$C_6H_{12}O_6$
Lime	Calcium oxide	CaO
Litharge	Lead monoxide	PbO
Lithopone	Zinc sulfide + barium sulfate	$ZnS + BaSO_4$
Liver of sulfur	Mixed potassium sulfides	
Lunar caustic	Silver nitrate	$AgNO_3$
Lysol	Cresol soap solution	
Magnesia	Magnesium oxide	MgO
Magnesite	Magnesium carbonate	$MgCO_3$
Malachite	Basic copper carbonate	$CuCO_3 \cdot Cu(OH)_2$
Manganese black	Manganese dioxide	MnO_2
Marble	Calcium carbonate	$CaCO_3$
Marsh gas	Methane	CH_4
Massicot	Lead monoxide	PbO
Methanol	Methyl alcohol	CH_3OH
Metol	*p*-Methylaminophenol sulfate	$(CH_3NHC_6H_4OH)_2 \cdot H_2SO_4$
Microcosmic salt	Sodium ammonium hydrogen phosphate	$Na(NH_4)HPO_4 \cdot 4H_2O$
Milk of barium	Barium hydroxide	$Ba(OH)_2$
Milk of lime	Calcium hydroxide	$Ca(OH)_2$
Milk of magnesium	Magnesium hydroxide	$Mg(OH)_2$
Milk of sulfur	Precipitated sulfur	S
Milk sugar	Lactose	$C_{12}H_{22}O_{11} \cdot H_2O$
Minium	Lead tetroxide	Pb_3O_4
Mohr's salt	Ferrous ammonium sulfate	$Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$
Molybdenite	Molybdenum disulfide	MoS_2
"Muriate of" a metal	Chloride of the metal	
Muriatic acid	Hydrochloric acid	HCl
Naphtha (Petroleum)	A petroleum distillate	
Naphtha (Solvent)	A coal tar distillate	
Natron	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Niter	Potassium nitrate	KNO_3
Nitro-lime	Calcium cyanamide	$CaNCN$
Nitrous ether	Ethyl nitrite	C_2H_5ONO
Nordhausen acid	Fuming sulfuric acid	$H_2SO_4 + SO_3$
Oil of bitter almond	Benzaldehyde	C_6H_5CHO
Oil of garlic	Allyl sulfide	$(C_3H_5)_2S$
Oil of mirbane	Nitrobenzene	$C_6H_5NO_2$
Oil of mustard, artificial	Allyl isothiocyanate	C_3H_5NCS
Oil of pears	Amyl acetate	$CH_3CO_2C_5H_{11}$
Oil of pineapple	Ethyl butyrate	$C_3H_7CO_2C_2H_5$
Oil of vitriol	Concentrated sulfuric acid	H_2SO_4
Oil of wintergreen, artificial	Methyl salicylate	$o\text{-}HOC_6H_4CO_2CH_3$
Oleum	Fuming sulfuric acid	$H_2SO_4 + SO_3$
Olifiant gas	Ethylene	C_2H_4
Orpiment	Arsenic trisulfide	As_2S_3
Osmic acid	Osmic tetroxide	OsO_4
Paris blue	Ferric ferrocyanide	$Fe_4[Fe(CN)_6]_3$
Paris green	Copper aceto-arsenite	$Cu(C_2H_3O_2)_2 \cdot 3CuAs_2O_4$
Pearl ash	Potassium carbonate	K_2CO_3
Permanent white	Barium sulfate	$BaSO_4$

COMMON NAMES OF COMPOUNDS, THEIR CHEMICAL NAMES AND FORMULAS (Continued)

Common Name	Chemical Name	Formula
Petroleum ether	Mixture of hydrocarbons boiling from 40 to 60°C.	
Phenic acid	Phenol	C_6H_5OH
Phosgene	Carbonyl chloride	$COCl_2$
Phosphate rock	Calcium phosphate	$Ca_3(PO_4)_2$
Picric acid	*sym*-Trinitrophenol	$C_6H_2(NO_2)_3OH$
Plaster of Paris	Calcium sulfate	$CaSO_4 \cdot \frac{1}{2}H_2O$
Plumbago	Graphite	C
Precipitated chalk	Calcium carbonate	$CaCO_3$
Prussian blue	Ferric ferrocyanide	$Fe_4[Fe(CN)_6]_3$
Prussic acid	Hydrocyanic acid	HCN
Putty powder	Impure stannic oxide	SnO_2
Pyrites	Ferrous di-sulfide	FeS_2
Pyroligneous acid	Crude acetic acid	CH_3CO_2H
Pyroligneous spirit	Methyl alcohol	CH_3OH
Pyrolusite	Manganese dioxide	MnO_2
Quick lime	Calcium oxide	CaO
Quicksilver	Mercury	Hg
Quinol	Hydroquinone	$C_6H_4(OH)_2(1, 4)$
Realgar	Arsenic disulfide	As_2S_2
Rectified spirit	Alcohol 90–5%	C_2H_5OH
Red antimony	Antimony oxysulfide	$Sb_2O_3 \cdot 2Sb_3S$
Red lead	Lead tetroxide	Pb_3O_4
Red liquor	Aluminum acetate solution	$Al(C_2H_3O_2)_3$
Red precipitate	Oxide of mercury	HgO
Red prussiate of potash	Potassium ferricyanide	$K_3Fe(CN)_6$
Rochelle salt	Potassium sodium tartrate	$KNaC_4H_4O_6 \cdot 4H_2O$
Rock salt	Sodium chloride	$NaCl$
Rouge	Ferric oxide	Fe_2O_3
Saccharin	Benzoic sulfimide	$o\text{-}C_6H_4 \cdot SO_2 \cdot NHCO$
Sal ammoniac	Ammonium chloride	NH_4Cl
Salol	Phenyl salicylate	$C_6H_4(OH)(CO_2C_6H_5)(1, 2)$
Salt	Sodium chloride	$NaCl$
Salt cake	Impure sodium sulfate	Na_2SO_4
Salt of amber	Succinic acid	$(CH_2CO_2H)_2$
Salt of lemon	Potassium acid oxalate	$KHC_2O_4 \cdot H_2O$
Salt of sorrel		
Salt of tartar	Potassium carbonate	K_2CO_3
Salt of wormwood		
Salt peter	Potassium nitrate	KNO_3
Salvarsan	3, 3′-Diamino-4, 4′-dihydroxy-arsenobenzene dihydrochloride	$[(HO)(NH_2)C_6H_3As]_2 \cdot 2HCl$
Satin white	Calcium sulfate	$CaSO_4 \cdot 2H_2O$
Scheele's green	Copper hydrogen arsenite	$CuHAsO_3$
Schlippe's salt	Sodium thioantimonate	$Na_3SbS_4 \cdot 9H_2O$
Silica	Silicon dioxide	SiO_2
Slaked lime	Calcium hydroxide	$Ca(OH)_2$
Soda (washing)	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Soda crystals	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Soda lime	Mixture of calcium oxide and sodium hydroxide	$CaO + NaOH$
Sodium hyposulfite	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Soft soap	Potash soap	....
Soluble glass	Sodium silicate	$Na_2SiO_3 + H_2O$
Soluble tartar	Potassium tartrate	$2K_2C_4H_4O_6 \cdot H_2O$
Spirit of hartshorn	Ammonia solution	NH_4OH
Spirit of salt	Hydrochloric acid	HCl
Spirit of wine	Ethyl alcohol	C_2H_5OH

COMMON NAMES OF COMPOUNDS, THEIR CHEMICAL NAMES AND FORMULAS (Continued)

Common Name	Chemical Name	Formula
Stassfurtite	Magnesium borate and chloride double salt	$2Mg_3B_2O_{15} \cdot MgCl_2$
Sugar of lead	Lead acetate	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$
Sugar of milk	Lactose	$C_{12}H_{22}O_{11} \cdot H_2O$
Sulfuric ether	Diethyl ether	$(C_2H_5)_2O$
Superphosphate	Impure calcium acid phosphate	$CaH_4(PO_4)_2$
Sylvine	Potassium chloride	KCl
Sylvinite	Sylvine with rock salt	
Table salt	Sodium chloride	$NaCl$
Talc	Hydrated magnesium silicate	$Mg_3Si_4O_{11} \cdot H_2O$
Tartar	Crude potassium bitartrate	$KHC_4H_4O_6$
Tartar emetic	Potassium antimonyl tartrate	$KSbC_4H_4O_7 \cdot \frac{1}{2}H_2O$
Tetralin	Tetrahydronaphthalene	$C_{10}H_{12}$
Tin crystals	Stannous chloride	$SnCl_2$
Tin white	Stannic hydroxide	$Sn(OH)_4$
T. N. T.	Trinitrotoluene	$C_6H_2(CH_3)(NO_2)_3$ (1, 2, 4, 6)
Toluol	Toluene	$C_6H_5CH_3$
Trona	Natural sodium carbonate	$Na_2CO_3.NaHCO_3$ $3H_2O$
Turnbull's blue	Ferrous ferricyanide	$Fe_3[Fe(CN)_6]_2$
Ultramarine yellow	Barium chromate	$BaCrO_4$
Unslaked lime	Calcium oxide	CaO
Vanillin	Methyl ether of protocatechualdehyde	$C_6H_3(OH)(OCH_3)$-CHO(1, 2, 4)
Venetian red	Ferric oxide	Fe_2O_3
Verdigris	Basic copper acetate	$2Cu(C_2H_3O_2)_2 + CuO$(?)
Vermilion	Red mercuric sulfide	HgS
Vitriol	Sulfuric acid	H_2SO_4
"Vitriolate of"	"Sulfate of"	
Washing soda	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Water glass	Sodium silicates dissolved in water	
White acid	Hydrofluoric acid and ammonium fluoride	$H_2F_2 + NH_4F$
White arsenic	Arsenous oxide	As_2O_3
White lead	Basic lead carbonate	$2PbCO_3 + Pb(OH)_2$
White vitriol	Zinc sulfate	$ZnSO_4 \cdot 7H_2O$
Whiting	Calcium carbonate	$CaCO_3$
Witherite	Barium carbonate	$BaCO_3$
Wood alcohol	Methyl alcohol	CH_3OH
Wood naphtha		
Wood spirit		
Xylol	Xylene	$C_6H_4(CH_3)_2$
Yellow prussiate of potash	Potassium ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$
Zinc blende	Mineral zinc sulfide	ZnS
Zinc vitriol	Zinc sulfate	$ZnSO_4 \cdot 7H_2O$
Zinc white	Zinc oxide	ZnO

Pigments named in the above list refer to the pure substance and not to mixtures often sold under the same name.

TRADE NAMES OF DYESTUFF INTERMEDIATES

Trade Name	Chemical Name
A acid	1, 7-Dihydroxynaphthalene-3, 6-disulfonic acid
Alizarin	1, 2-dihydroxyanthraquinone
Amino-G acid	2-Naphthylamine-6, 8-disulfonic acid
Amino-R acid	2-Naphthylamine-3, 6-disulfonic acid
Andresen's acid	1-Naphthol-3, 8-disulfonic acid
Anisidine	o-Aminophenol methyl ether
Anthrachrysone	1, 3, 5, 7-Tetrahydroxyanthraquinone
Anthraflavic acid	2, 6-Dihydroxyanthraquinone
Anthranilic acid	o-Aminobenzoic acid
Anthrarufin	1, 5-Dihydroxyanthraquinone
Armstrong's acid	Naphthalene-1, 5-disulfonic acid
Badische acid	2-Naphthylamine-8-sulfonic acid
Bayer's acid	2-Naphthol-8-sulfonic acid
Benzidine	p, p′ -Diamino-diphenyl
Brönner's acid	2-Naphthylamine-6-sulfonic acid
β acid	Anthraquinone-2-sulfonic acid
Chromotrope acid	1, 8-Dihydroxynaphthalene-3, 6-disulfonic acid
Chrysazin	1, 8-Dihydroxyanthraquinone
Cleve's acids	1-Naphthylamine-6- and -7-sulfonic acids
Cleve's acid	1-Naphthylamine-5-sulfonic acid
Cleve's acid	1-Naphthylamine-6-sulfonic acid
Cleve's acid	1-Naphthylamine-3-sulfonic acid
Cleve's acid	1-Naphthylamine-7-sulfonic acid
Cresotic acids	Cresol carboxylic acids
Croceine acid	2-Naphthol-8-sulfonic acid
Dahl's acid	2-Naphthylamine-5-sulfonic acid
Dahl's acid II	1-Naphthylamine-4, 6-disulfonic acid
Dahl's acid III	1-Naphthylamine-4, 7-disulfonic acid
Disulpho acid S	1-Naphthylamine-4, 8-disulfonic acid
DTS	Dehydrothio-p-toluidine sulfonic acid
δ acid	1-Naphthol-4, 8-disulfonic acid 1-Naphthylamine-4, 8-disulfonic acid
Ebert and Merz's acid	Naphthalene-2, 7-disulfonic acid
Ebert and Merz's acid	Naphthalene-2, 6-disulfonic acid
Ewer and Pick's acid	Naphthalene-1, 6-disulfonic acid
ε acid	1-Naphthol-3, 8-disulfonic acid 1-Naphthylamine-3, 8-disulfonic acid
F acid	2-Naphthol-7-sulfonic acid
Freund's acid	1-Naphthylamine-3, 6-disulfonic acid
G acid	2-Naphthol-6, 8-disulfonic acid
Gallic acid	3, 4, 5-Trihydroxybenzoic acid
γ-acid	2-Amino-8-naphthol-6-sulfonic acid
H acid	1-Amino-8-naphthol-3, 6-disulfonic acid
Histazarin	2, 3-Dihydroxyanthraquinone
Isoanthraflavic acid	2, 7-Dihydroxyanthraquinone
J acid	2-Amino-5-naphthol-7-sulfonic acid
K acid	1-Amino-8-naphthol-4, 6-disulfonic acid
Kalle's acid	1-Naphthylamine-2, 7-disulfonic acid
Ketone base	Tetramethyldiaminobenzophenone
Koch's acid	1-Naphthylamine-3, 6, 8-trisulfonic acid
L acid	1-Naphthol-5-sulfonic acid
Laurent's acid	1-Naphthylamine-5-sulfonic acid
Lepidine	4-Methylquinoline
Leucotrope	Phenyldimethylbenzylammonium chloride
M acid	1-Amino-5-naphthol-7-sulfonic acid
Mesidine	2, 4, 6-Trimethylaniline
Metanilic acid	Aniline-m-sulfonic acid
Michler's ketone	Tetramethyldiaminobenzophenone
Naphthazarin	5, 8-Dihydroxy-1, 4-naphthoquinone
Naphthionic acid	1-Naphthylamine-4-sulfonic acid
o-Naphthionic	1-Naphthylamine-2-sulfonic acid
Naphthol A. S.	Anilide of -hydroxynaphthoic acid

TRADE NAMES OF DYESTUFF INTERMEDIATES
(Continued)

Trade Name	Chemical Name
Naphthoresorcin	1, 3-Dihydroxynaphthalene
Nevile and Winther's acid	1-Naphthol-4-sulfonic acid
Nigrotic acid	1, 7, 3, 6-Dihydroxysulfonaphthoic acid
Nitroso base	p-Nitrosodimethylaniline
NW acid	Nevile and Winther's acid
Peri acid	1-Naphthylamine-8-sulfonic acid
p-Phenetidine	p-Aminophenol ethyl ether
Phenyl-gamma acid	2-Phenylamino-8-naphthol-6-sulfonic acid
Phenyl Peri acid	Phenyl-1-naphthylamine-8-sulfonic acid
Phosgene	Carbonyl chloride
Phthalic acid	o-Benzenedicarboxylic acid
Picramic acid	2-Amino-4, 6-dinitrophenol
Picric acid	2, 4, 6-Trinitrophenol
Primuline base	p-Toluidine heated with sulfur.
Purpurin	1, 2, 4-Trihydroxyanthraquinone
Pyrogallol	1, 2, 3-Trihydroxybenzene
Quinaldine	2-Methylquinoline
Quinazarin	1, 4-Dihydroxyanthraquinone
R acid	2-Naphthol-3, 6-disulfonic acid
2 R acid	2-Amino-8-naphthol-3, 6-disulfonic acid
Red acid	1, 5-Dihydroxynaphthalene-3, 7-disulfonic acid
RG acid	1-Naphthol-3, 6-disulfonic acid
Resorcinol	1, 3-Dihydroxybenzene
S acid	1-Amino-8-naphthol-4-sulfonic acid
2 S acid	1-Amino-8-naphthol-2, 4-disulfonic acid
Salicylic acid	o-Hydroxybenzoic acid
Schäffer's acid	2-Naphthol-6-sulfonic acid
Schollkopf's acid	1-Naphthol-4, 8-disulfonic acid 1-Naphthylamine-4, 8-disulfonic acid 1-Naphthylamine-8-sulfonic acid
Sulfanilic acid	Aniline-p-sulfonic acid
Thiocarbanilide	Diphenylthiourea
Tobias acid	2-Naphthylamine-1-sulfonic acid
Tolidine	Di-p-aminoditolyl
Toluidine	Amino toluene
Xylidine	Amino xylene
Yellow acid	1, 3-Dihydroxynaphthalene-5, 7-disulfonic acid

THE PRONUNCIATION OF CHEMICAL WORDS

Reprinted by permission from a report of the Nomenclature, Spelling, and Pronunciation Committee of the American Chemical Society* as published in News Edition, Industrial and Engineering Chemistry, **12,** 202 (1934).

GENERALIZATIONS

(1) Accenting names of chemical substances on the final syllable is to be discouraged in all cases where the preference for such an accent is not emphatic. The names *amine, arsine, quinone,* and *sulfone* and words ending in these names (also the suffix *-phenone*) represent most of the exceptions. The general trend of the accent in the English language is recognized by authorities to be away from the end and toward the beginning of the word. However, when the last syllable of a word is a significant suffix, as *-al* for aldehydes, it is not slurred by chemists.

(2) In the interest of uniformity and in accordance with a general trend of English pronunciation in America, the ending *-ide* should be pronounced *-īd.* This appears to be uniformly the practice in inorganic chemistry. Many organic names are so pronounced also. Certain organic terms, however, are pronounced *-ĭd* by many, as *acetanilide, imide, phthalimide, lipide, amide,* and several words ending in *-amide.*

(3) For chemical names ending in *-ine,* usage is divided between the pronunciations *-ēn* and *-ĭn,* with a tendency in favor of *-ēn.* Since a distinction in spelling is made by many between names of bases ending in *-ine* and names of nonbases ending in *-in,* the pronunciation *-ēn* for the ending *-ine* is to be encouraged. (It is unfortunate that this conflicts in sound with the pronunciation of the ending *-ene,* but it is believed that this will cause confusion only with a very few words, as benzine and benzene, fluorine and fluorene. As to the pronunciation *-īn,* usage, at least in America, is very strongly against it, and it would conflict with the pronunciation of the new ending *-yne* adopted for names of acetylene hydrocarbons.) Quinine, because of strong popular usage, is an exception.

(4) The pronunciation *-ōl* for the ending of names of alcohols and phenols (except the word alcohol itself!), whether regrettable or not, seems firmly fixed and should be recognized. Emphasis on a significant ending is probably an influence in this practice. Chemical terms not belonging to the above classes, but generally pronounced *-ōl,* should be spelled with a final *e;* examples, *mole, pyrrole.* This is in accordance with the recommendation of the International Committee on Organic Nomenclature. For *sol* and words ending in *-sol,* the spelling *-ol* and the pronunciation *-ŏl* should be encouraged.

(5) The ending *-yl* should be pronounced *-ĭl.* The pronunciation *-ēl* is apparently a Germanism and, although still in use

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* The members of this committee are Austin M. Patterson, C. A. Jacobson, H. E. Howe, Arthur B. Lamb, E. J. Crane, *Chairman,* and the Board of Associate Editors of the *Journal of the Americal Chemical Society.*

THE PRONUNCIATION OF CHEMICAL WORDS (Continued)

to some extent is to be discouraged. The pronunciation *-īl*, apparently common in England, is seldom heard in the United States.

(6) The ending *-ile* (as in nitrile). Usage is divided among the pronunciations *-īl*, *-ĭl*, and *-ēl*. The second of these is identical with the pronunciation recommended for *-yl*, and the third is apparently a Germanism. The pronunciation *-īl* should be favored.

(7) The endings *-acic*, *-alic*, *-anic*, *-aric*, *-elic*, *enic*, *-eric*, *-etic*, *-idic*, *-ilic*, *-inic*, *-isic*, *-onic*, *-opic*, *-oric*. A rather extensive study of the pronunciation of such endings shows a preference for a *short* vowel preceding *-ic* in all but a few cases. This result is in accord with age-old general English usage and is to be approved. *Acetic* (ă-sē′tĭk) is a very emphatic exception. Other exceptions are *cetic* (sē′tĭk) and *ceric* (sē′rĭk) and adjectives derived from the names of unsaturated hydrocarbons (because of the influence of the significant *-ene* ending).

(8) The ending *-olic*. This ending is an exception to the rule for words ending in *-ic* [compare (7)], perhaps owing to the influence of words ending in *-ol*. Inasmuch as ten cases out of twelve studied favor the long *ō*, some of them by very large majorities, it is recommended that this ending be uniformly pronounced *-ō′lik.*

(9) Adjectives ending in *-ic* should be accented on the next to the last syllable, as glycer′ic, not gly′ceric. In names of salts the accent, following the trend indicated in (1) above, usually moves one syllable (occasionally more) towards the beginning of the word, as gly′cerate, sal′icylate.

(10) The ending *-ime.* In oxime, at least, this should be pronounced *-ēm,* to accord with usage, though this is contrary to the normal English trend.

(11) The ending *-oin* should be pronounced as two syllables, *-ô-ĭn,* with the accent coming on the preceding syllable (as, bĕn′zô-ĭn, fū′rô-ĭn). In certain words where the addition of a chemical suffix causes two vowels to come together there is a natural tendency to merge them and thus change their sound, as thebaine, linalool. While concession must be made to usage in particular cases, as cocaine, the pronunciation of such vowels separately is to be encouraged. The use of the dieresis is helpful, as linaloöl.

(12) Words ending in *-valent* should be so pronounced that the last two syllables are -vā′lĕnt; as trī-vā′lĕnt (not trĭv′â-lĕnt).

THE WORD LIST

The words listed below are, except for a few deletions, the ones on which the committee's study was based. After each word there is given one or more pronunciations (shown by respelling and the use of symbols as explained at the head of the list). When only a single pronunciation is shown this means that usage and perhaps other influences are so strongly in favor of it that no alternative is proposed. When more than one pronunciation is shown an attempt has been made to place these in the order of preference. The provision of two, occasionally three, pronunciations indicates that usage is divided without a marked show of preference (this is true of many words throughout the English language), or that there is some conflict between usage and the other influences properly taken into consideration. The word "usage" in parentheses following a pronunciation signifies that usage supports it to a considerable extent, notwithstanding other dictates.

Again let it be said that there is no attempt to proclaim "This pronunciation is right and this one is wrong." Usage, chemical nomenclature considerations, derivation, and the rules of good English (a compromise has sometimes been necessary) suggest certain preferences and these we have tried to ascertain.

KEY TO PRONUNCIATION

The symbols used in the respelling for pronunciation have the following values: āle, senâte, ăm, ăccount, ärm; ēve, êvent, ĕnd, recĕnt, makẽr; īce, ĭll; ōld, ôbey, ôrb, ŏdd, cŏnnect; ūse, ûnite, ûrn, ŭp, circŭs; fo͞od; oil; **ch**air; **g**o; **th**in.

abietic	ăb′ĭ-ĕt′ĭk	
acetal	ăs′ĕt-ăl	
acetaldehyde	ăs′ĕt-ăl′dê-hīd	
acetaldoxime	ăs′ĕt-ăl-dŏk′sēm	
acetamide	ăs′ĕt-ăm′īd	ăs′ĕt-ăm′ĭd (*usage*) ă-sĕt′ă-mīd
acetanilide	ăs′ĕt-ăn′ĭ-līd	ăs′ĕt-ăn′ĭ-lĭd (*usage*)
acetic	ă-sē′tĭk	
acetoacetate	ăs′ê-tô-ăs′ê-tāt	ă-sē′tô-ăs′ê-tāt
acetoacetic	ăs′ê-tô-ă-sē′tĭk	ă-sē′tô-ă-sē′tĭk
acetone	ăs′ê-tōn	
acetonitrile	ăs′ê-tô-nī′trīl	ăs′ê-tô-nī′trĭl (*usage*)
acetonyl	ă-sĕt′ô-nĭl	ăs′ê-tô-nĭl
acetophenone	ăs′ê-tô-fê-nōn′	ă-sē′tô-fê-nōn′
acetoxime	ăs′ĕt-ŏk′sēm	
acetyl	ăs′ê-tĭl	
acetylene	ă-sĕt′ĭ-lēn	
aci-	ăs′ĭ-	
acrolein	ă-krō′lê-ĭn	
acyclic	â-sī′klĭk	
acyl	ăs′ĭl	
adiabatic	ăd′ĭ-ă-băt′ĭk	
adrenaline	ăd-rĕn′ă-lēn	ăd-rĕn′ă-lĭn (*usage*)
alantolic	ăl′ăn-tō′lĭk	

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

alizarin	ȧ-lĭz′*ă*-rĭn	
alkaline	ăl′k*ă*-lĭn	ăl′k*ă*-līn
allotropy	*ă*-lŏt′rȯ-pĭ	ăl′ȯ-trō′pĭ
allylamine	ăl′ĭl-*ă*-mēn′	
aluminum	*ă*-lōō′mĭ-n*ŭ*m (*usage*)	*ă*-lū′mĭ-n*ŭ*m
amide	ăm′īd	ăm′ĭd (*usage*)
amido	*ă*-mē′dȯ	ăm′ĭ-dȯ
amine	*ă*-mēn′	
amino	*ă*-mē′nȯ	
ammine	ăm′ēn	
ammino	ăm′ĭ-nō	*ă*-mē′nō (*usage*)
amyl	ăm′ĭl	
anhydride	ăn-hī′drīd	
aniline	ăn′ĭ-lēn	ăn′ĭ-lĭn (*usage*)
anisic	*ă*-nĭs′ĭk	
anthranil	ăn′thr*ă*-nĭl	
anthranilate	ăn-thrăn′ĭ-lāt	
anthranilic	ăn′thr*ă*-nĭl′ĭk	
antimonic	ăn′tĭ-mŏn′ĭk	ăn′tĭ-mō′nĭk (*usage*)
antimonyl	ăn′tĭ-mȯ-nĭl	
aqua	ăk′wȧ	
aqueous	ā′kwė-*ŭ*s	
arabitol	*ă*-răb′ĭ-tōl	
arabonic	ăr′*ă*-bŏn′ĭk	
arachidic	ăr′*ă*-kĭd′ĭk	
arecoline	*ă*-rē′kȯ-lēn	*ă*-rē′kȯ-lĭn (*usage*)
arsenic (acid)	är-sĕn′ĭk	är′sė-nĭk (*usage*)
arsine	är-sēn′	
arsonic	är-sŏn′ĭk	
asphalt	ăs′fôlt	
assay	ăs′ā (*usage*)	*ă*-sā′
asymmetric	ā′sĭ-mĕt′rĭk	ăs′ĭ-mĕt′rĭk
atropine	ăt′rȯ-pēn	
auricyanide	ô′rī-sī′*ă*-nīd	ô′rĭ-sī′*ă*-nīd (*usage*)
avitaminosis	ȧ-vī′t*ă*-mĭn-ō′sĭs	
azelaic	ăz′ė-lā′ĭk	
azide	ăz′īd	
azine	ăz′ēn	
azobenzene	ăz′ȯ-bĕn′zēn	
barium	bā′rĭ-*ŭ*m	băr′ĭ-*ŭ*m
behenic	bė-hĕn′ĭk	
benzamide	bĕn-zăm′īd	bĕn-zăm′ĭd (*usage*)
benzanilide	bĕn-zăn′ĭ-līd	bĕn-zăn′ĭ-lĭd (*usage*)
benzene	bĕn′zēn	
benzil	bĕn′zĭl	
benzilic	bĕn-zĭl′ĭk	
benzine	bĕn′zēn	

benzohydrol	bĕn'zȯ-hī'drōl	bĕn'zȯ-hī-drōl' (*usage*)
benzoin	bĕn'zȯ-ĭn	
benzophenone	bĕn'zȯ-fė-nōn'	
benzoyl	bĕn'zȯ-ĭl	bĕn'zȯ-ēl (*usage*)
benzyl	bĕn'zĭl	
betaine	bē'tȧ-ēn	
betulinamaric	bĕt'u̇-lĭn-ă-măr'ĭk	
biuret	bī'u̇-rĕt' (*usage*)	bī'u̇-rĕt
bivalent	bī-vā'lĕnt	
borneol	bôr'nė-ōl	
boron	bō'rŏn	bôr'ŏn
bromal	brō'măl	
bromide	brō'mīd	
bromine	brō'mēn	
buret	bu̇-rĕt'	
butadiene	bū'tă-dī'ēn	
butanolide	bu̇-tăn'ȯ-līd	bu̇-tăn'ȯ-lĭd (*usage*)
butyl	bū'tĭl	
butyronitrile	bū'tĭ-rȯ-nī'trĭl	bū'tĭ-rȯ-nī'trĭl (*usage*)
cacodyl	kăk'ȯ-dĭl	
cacodylate	kăk'ȯ-dĭl-āt	kăk'ȯ-dĭl'āt
caffeine	kăf'ė-ēn	kăf'ė-ĭn (*usage*) kăf'ēn (*popular*)
calorimetric	kăl'ȯ-rĭ-mĕt'rĭk	
camphanic	kăm-făn'ĭk	
campholenic	kăm'fȯ-lē'nĭk	kăm'fȯ-lĕn'ĭk
campholic	kăm-fō'lĭk	
caproate	kăp'rȯ-āt	
caprylate	kăp'rĭ-lāt	
carbamate	kär'bă-māt	kär-băm'āt (*usage*)
carbamide	kär-băm'īd	kär-băm'ĭd (*usage*)
carbanilide	kär-băn'ĭ-līd	kär-băn'ĭ-lĭd (*usage*)
carbethoxy	kär'bĕth-ŏk'sĭ	
carbinol	kär'bĭ-nōl	
carbonyl	kär'bȯ-nĭl	
cataphoresis	kăt'ă-fȯ-rē'sĭs	
catechol	kăt'ė-chōl	kăt'ė-kōl (*usage*)
cerebroside	sĕr'ė-brȯ-sīd	sė-rē'brȯ-sīd
ceric	sē'rĭk	sĕr'ĭk
cetic	sē'tĭk	
cetyl	sē'tĭl	sĕt'ĭl
chalcone	kăl'kōn	chăl'kōn (*usage*)
chelidonic	kĕl'ĭ-dŏn'ĭk	kē'lĭ-dŏn'ĭk (*usage*)
chloral	klō'răl	
chloride	klō'rīd	
chlorophyllide	klō'rȯ-fĭl'īd	
cholesterol	kȯ-lĕs'tẽr-ōl	
cholic	kō'lĭk	

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

choline	kō′lēn	
choloidanic	kŏl′oi-dăn′ĭk	
chromyl	krō′mĭl	
cinene	sī′nen	sĭn′ēn
cinnamal	sĭn′*ă*-măl	
cinnamate	sĭn′*ă*-māt	sĭ-năm′āt
cinnamic	sĭ-năm′ĭk	
citrate	sĭt′rāt	
clupeine	klōō′pė-ēn	
cobalticyanide	kȯ-bôl′tī-sī′*ă*-nīd	kȯ-bôl′tĭ-sī′*ă*-nīd (*usage*)
cocaine	kȯ-kān′ (*popular*)	kō′kȧ-ēn
codeine	kō′dė-ēn	
colchicine	kŏl′chĭ-sēn (*usage*)	kŏl′kĭ-sēn
colloid	kŏl′oid	
comenic	kȯ-mĕn′ĭk	
coniceine	kȯ-nĭs′ė-ēn	
coniine	kō′nĭ-ēn	
constitutive	kŏn′stĭ-tū′tĭv	kŏn-stĭt′u̇-tĭv
convallamarin	kŏn-văl′*ă*-măr′ĭn	
coumaric	kōō-măr′ĭk	ku̇-măr′ĭk (*usage*)
coumarin	kōō′m*ă*-rĭn	kū′m*ă*-rĭn (*usage*)
creatine	krē′*ă*-tēn	krē′*ă*-tĭn (*usage*)
cresol	krē′sōl	
cresyl	krĕs′ĭl	krē′sĭl
crotonic	krȯ-tŏn′ĭk	
cyanamide	sī′ăn-ăm′īd	sī-ŭn′a-mĭd sī-ăn′*ă*-mīd
cyanogen	sī-ăn′ȯ-jĕn	
cyclic	sī′klĭk	
cyclohexane	sī′klȯ-hĕk′sān	
cysteine	sĭs′tė-ēn	
decyl	dĕs′ĭl	
decylene	dĕs′ĭ-lēn	
desoxy	dĕs-ŏk′sĭ	
diacetyl	dī-ăs′ė-tĭl	
diazo	dī-ăz′ȯ	
dichromate	dī-krō′māt	
diethylamine	dī-ĕth′ĭl-*ă*-mēn′	
dinaphthol	dī-năf′thōl	
dioxindole	dī′ŏk-sĭn′dōl	dī-ŏk′sĭn-dōl
diphenic	dī-fĕn′ĭk	
diphenylethane	dī-fĕn′ĭl-ĕth′ān	
dipropargyl	dī′prȯ-pär′jĭl	
distillate	dĭs′tĭ-lāt	dĭs′tĭ-lāt
dynamite	dī′n*ă*-mīt	
elaidic	ĕl′ȧ-ĭd′ĭk	
elemolic	ĕl′ė-mō′lĭk	
enol	ē′nōl	

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

enolic	ė-nō′lĭk	
enterokinase	ĕn′tẽr-ȯ-kī′nās	ĕn′tẽr-ȯ-kĭn′ās
enzyme	ĕn′zīm	
enzymic	ĕn-zī′mĭk	
ephedrine	ĕf′ė-drēn	ė-fĕd′rĭn (*usage*)
ergosterol	ẽr-gŏs′tẽr-ōl	
erythrose	ĕr′ĭ-thrōs	ė-rĭth′rōs
ethoxide	ĕth-ŏk′sīd	
ethyl	ĕth′ĭl	
ethylidene	ĕth-ĭl′ĭ-dēn	ĕth′ĭl-ĭ-dēn
ferricyanide	fĕr′ī-sī′*ă*-nīd	
fluorene	flo͞o′ȯ-rēn	
fluorescein	flo͞o′ȯ-rĕs′ė-ĭn	flo͞o-ôr′ē-sēn (*usage*)
fluorine	flo͞o′ȯ-rēn	
formamide	fôrm-ăm′īd	fôrm-ăm′ĭd (*usage*)
fructose	frŭk′tōs	
fulminic	fŭl-mĭn′ĭk	
fumaric	fu̇-măr′ĭk	
furan	fū′răn	
furfural	fûr′f*ŭ*r-ăl	
furoin	fū′rȯ-ĭn	
galalith	găl′*ă*-lĭth	
geraniol	jė-rā′nĭ-ōl	
gitogenic	jĭt′ȯ-jĕn′ĭk	
gluconic	glo͞o-kŏn′ĭk	
glucosamine	glo͞o′kōs-*ă*-mēn′	
glucoside	glo͞o′kȯ-sīd	
glutamic	glo͞o-tăm′ĭk	
glutaric	glo͞o-tăr′ĭk	
glutathione	glo͞o′t*ă*-thī′ōn	
glyceric	glĭ-sĕr′ĭk	
glycine	glī′sēn	glī-sēn′ (*usage*)
glycolic	glī-kō′lĭk	glī-kŏl′ĭk (*usage*)
glycyl	glī′sĭl	
glycyrrhetic	glĭs′ĭ-rĕt′ĭk	
glyoxal	glī-ŏk′săl	glī′ŏk-săl′ (*usage*)
glyoxyl	glī-ŏk′sĭl	
guaiacol	gwī′*ă*-kōl	
guanidine	gwä′nĭ-dēn	
guanine	gwä′nēn	
gulose	gū′lōs	
hafnium	hăf′nĭ-*ŭ*m	
halide	hăl′īd	hā′lĭd (*usage*)
halogen	hăl′ȯ-jĕn	
haloid	hăl′oid	hā′loid
haloquinonoid	hăl′ȯ-kwĭn′ȯ-noid	hăl′ȯ-kwĭ-nō′noid
hematin	hĕm′*ă*-tĭn (*usage*)	hē′m*ă*-tĭn
hemoglobin	hē′mȯ-glō′bĭn	hĕm′ȯ-glō′bĭn

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

heroine	hĕr′ȯ-ēn	hĕr′ȯ-ĭn (*usage*)
hydantoin	hī-dăn′tȯ-ĭn	
hydrazide	hī′dr*ă*-zīd	
hydrazine	hī′dr*ă*-zēn	
hydrazo	hī-drăz′ȯ	
hydrazoic	hī-dr*ă*-zō′ĭk	
hydriodic	hī′drĭ-ŏd′ĭk	
hydrofluoric	hī′drȯ-flo͞o-ŏr′ĭk	
hydroquinone	hī′drȯ-kwĭ-nōn′	
hydrosol	hī′drȯ-sŏl	
hydroxylamine	hī-drŏk′sĭl-*ă*-mēn′	
hyenic	hī-ĕn′ĭk	
hypoiodous	hī′pȯ-ī-ō′d*ŭ*s	
iatrochemistry	ī-ăt′rȯ-kĕm′ĭs-trĭ	
idose	ī′dōs	
illinium	ĭ-lĭn′ĭ-*ŭ*m	
imide	ĭm′īd	ĭm′ĭd (*usage*)
imido	ĭ-mē′dȯ	ĭm′ĭ-dȯ
imino	ĭ-mē′nȯ	ĭm′ĭ-nȯ
indigotin	ĭn-dĭg′ȯ-tĭn	ĭn′dĭ-gō′tĭn
indoxyl	ĭn-dŏk′sĭl	
inositol	ĭn-ō′sĭ-tōl	
iodine	ī′ȯ-dēn	
iodoso	ī′ȯ-dō′sȯ	
iodous	ī-ō′d*ŭ*s	
ionone	ī′ȯ-nōn′ (*usage*)	
irone	ī-rōn′ (*usage*)	
isatide	ī′s*ă*-tīd	
isatin	ī′s*ă*-tĭn	
iso	ī′sȯ	
isotropic	ī′sȯ-trŏp′ĭk	ī′sȯ-trō′pĭk
itaconic	ĭt′*ă*-kŏn′ĭk	
labile	lā′bĭl	
lauronolic	lô′rȯ-nō′lĭk	
leucine	lo͞o′sēn (*usage*)	lū′sēn
linaloöl	lĭn-ăl′ȯ-ōl	
linalyl	lĭn′*ă*-lĭl	
linoleic	lĭn′ȯ-lē′ĭk	
linolenic	lĭn′ȯ-lĕn′ĭk	lĭn′ȯ-lē′nĭk (*usage*)
lipase	lī′pās	
lipide	lī′pīd	lĭp′ĭd (*usage*)
lipoid	lī′poid	lĭp′oid (*usage*)
litharge	lĭth′ärj	
lutidine	lo͞o′tĭ-dēn (*usage*)	lū′tĭ-dēn
maleic	m*ă*-lē′ĭk	
malic	măl′ĭk	
malonic	m*ă*-lŏn′ĭk	m*ă*-lō′nĭk (*usage*)
malonyl	măl′ȯ-nĭl	

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

mandelic	măn-dĕl'ĭk	
manganese	măn'g*ă*-nēs	
manganic	măn-găn'ĭk	
mannonic	m*ă*-nŏn'ĭk	
margaric	mär-găr'ĭk	mär-gär'ĭk (*usage*)
meconic	mē̇-kŏn'ĭk	
melissyl	mē̇-lĭs'ĭl	
mellophanic	mĕl'ō̇-făn'ĭk	
menthol	mĕn'thōl	
mercaptal	mẽr-kăp'tăl	
mercaptan	mẽr-kăp'tăn	
mercuric	mẽr-kū'rĭk	
mercurous	mẽr-kū'r*ŭ*s	
mesaconic	mĕs'*ă*-kŏn'ĭk	
mesityl	mĕs'ĭ tĭl	
mesitylene	mē̇-sĭt'ĭl-ēn	
mesitylenic	mē̇-sĭt'ĭ-lē'nĭk	mē̇-sĭt'ĭ-lĕn'ĭk
mesotartaric	mĕs'ō̇-tär-tăr'ĭk	mĕs'ō̇-tär-tär'ĭk (*usage*)
mesothorium	mĕs'ō̇-thō'rĭ-*ŭ*m	
mesoxalic	mĕs'ŏk-săl'ĭk	mĕz'ŏk-săl'ĭk (*usage*)
metarsenic	mĕt'är-sĕn'ĭk	
methanol	mĕth'*ă*-nōl	
methyl	mĕth'ĭl	
methylal	mĕth'ĭl-ăl	mĕth'ĭl-ăl' (*usage*)
methylamine	mĕth'ĭl-*ă*-mēn'	
micro	mī'krō̇	
mole	mōl	
molecule	mŏl'ē̇-kūl	
monacetin	mŏn-ăs'ē̇-tĭn	mō̇-năs'ē̇-tĭn
mono	mŏn'ō̇	mō'nō̇
monoxide	mŏn-ŏk'sīd	mō̇-nŏk'sīd
morphine	môr'fēn	
naphthalide	năf'th*ă*-līd	năf'th*ă*-lĭd (*usage*)
naphthenic	năf-thē'nĭk	năf-thĕn'ĭk
naphthol	năf'thōl	
nascent	năs'*ĕ*nt	nā'sĕnt
neurine	nōō'rēn (*usage*)	nū'rēn
niton	nī'tŏn	
nitrato	nī-trā'tō̇	
nitrile	nī'trīl	nī'trĭl (*usage*)
nitro	nī'trō̇	
nitrosamine	nī'trō̇-s*ă*-mēn'	
nitrosyl	nī'trō̇-sĭl	nī-trō'sĭl (*usage*)
nitroxyl	nī-trŏk'sĭl	
nonane	nō'nān	
nucleic	nū̇-klē'ĭk	
nucleotide	nū'klē̇-ō̇-tīd	
oleic	ō̇-lē'ĭk	

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

orcinol	ôr'sĭ-nōl	
ortho	ôr'thȯ	
osazone	ō's*ă*-zōn	ō's*ă*-zōn' (*usage*)
osmium	ŏz'mĭ-*ŭ*m	
oxalic	ŏk-săl'ĭk	
oxazine	ŏk's*ă*-zēn	
oxide	ŏk'sīd	
oxime	ŏk'sēm	
oxindole	ŏk-sĭn'dōl	ŏk'sĭn-dōl
oxozonide	ŏk-sō'zȯ-nīd	
ozone	ō'zōn	
palladio	p*ă*-lā'dĭ-ȯ	
pelargonic	pĕl'är-gŏn'ĭk	
pentitol	pĕn'tĭ-tōl	
peptide	pĕp'tīd	
periodic (acid)	pûr'ī-ŏd'ĭk	
permutite	pûr'mû-tīt	
peroxide	pẽr-ŏk'sīd	
phenate	fē'nāt	fĕn'āt
phenazine	fĕn'*ă*-zēn	
phenetidine	fĕn-ĕt'ĭ-dēn	
phenol	fē'nōl	
phenolic	fė-nō'lĭk	
phenolphthalein	fē'nōl-thăl'ė-ĭn	fē'nōl-thăl'ēn (*usage*)
pheophorbide	fē'ȯ-fôr'bīd	
phloretic	flȯ-rĕt'ĭk	
phlorizin	flôr'ĭ-zĭn	
phosphatide	fŏs'f*ă*-tīd	
phosphorous	fŏs-fō'r*ŭ*s	fŏs'fȯ-r*ŭ*s (*usage*)
phthalein	thăl'ė-ĭn	thăl'ēn (*usage*)
phthalic	thăl'ĭk	
phthalide	thăl'īd	
phthalimide	thăl-ĭm'īd	thăl-ĭm'ĭd (*usage*)
phytol	fī'tōl	
phytosterol	fī-tŏs'tẽr-ōl	
picric	pĭk'rĭk	
pilocarpine	pī'lȯ-kär'pēn	
pimalic	pĭ-măl'ĭk	
pimaric	pĭ-măr'ĭk	
pimelic	pĭ-mĕl'ĭk	
pinacolone	pĭn-ăk'ȯ-lōn	
piperamide	pĭp'ẽr-ăm'īd	pĭp'ẽr-ăm'ĭd (*usage*) pĭ-pĕr'*ă*-mīd
piperidine	pĭ-pĕr'ĭ-dēn	pĭp'ẽr-ĭ-dēn
polymerism	pŏl'ĭ-mẽr-ĭz'm	pȯ-lĭm'ẽr-ĭz'm
polymerize	pŏl'ĭ-mẽr-īz	pȯ-lĭm'ẽr-īz
porphyrin	pôr'fĭ-rĭn	
praseodymium	prā'zė-ȯ-dĭm'ĭ-*ŭ*m	

THE PRONUNCIATION OF CHEMICAL WORDS
(Continued)

propiolic	prō'pĭ-ō'lĭk	
propionamide	prō'pĭ-ŏn-ăm'īd	prō'pĭ-ŏn-ăm'ĭd (*usage*)
propionic	prō'pĭ-ŏn'ĭk	
propionyl	prō'pĭ-ô-nĭl	
propyl	prō'pĭl	
propylidene	prô-pĭl'ĭ-dēn	prō'pĭl-ĭ-dēn
protein	prō'tê-ĭn	
ptomaine	tō'mān (*popular*)	tō'mâ-ēn
pyrazoline	pĭr-ăz'ô-lēn	
pyrogallol	pī'rô-găl'ōl	
pyrrole	pĭr'ōl	pĭr-ōl' (*usage*)
pyrrolidine	pĭ-rō'lĭ-dēn	pĭ-rŏl'ĭ-dēn
pyruvic	pī-rōō'vĭk	
quadrivalent	kwŏd'rĭ-vā'lĕnt	
quinine	kwī'nīn (*popular*)	kwĭn'ēn
quinone	kwĭn-ōn'	
quinonoid	kwĭn'ô-noid	kwĭ-nō'noid
racemize	răs'ê-mīz	
resorufin	rĕz'ô-rōō'fĭn	
rhamnitol	răm'nĭ-tōl	
ribonic	rĭ-bŏn'ĭk	
ribose	rī'bōs	
ricin	rī'sĭn	
rosaniline	rōz-ăn'ĭ-lēn	rōz-ăn'ĭ-lĭn (*usage*)
rosolic	rōz-ō'lĭk	rōz-ŏl'ĭk (*usage*)
sabinene	săb'ĭ-nēn	
saccharic	s*ă*-kăr'ĭk	
saccharide	săk'*ă*-rīd	
salicylate	săl'ĭ-sĭl-āt	s*ă*-lĭs'ĭ-lāt
saligenin	s*ă*-lĭj'ê-nĭn	
samarium	s*ă*-măr'ĭ-*ŭ*m	s*ă*-mā'rĭ-*ŭ*m
santalic	săn-tăl'ĭk	
sebacic	sê-băs'ĭk	
selenate	sĕl'ê-nāt	
selenic	sê-lĕn'ĭk	sê-lē'nĭk (*usage*)
selenide	sĕl'ê-nīd	
semicarbazide	sĕm'ĭ-kär'b*ă*-zīd	sĕm'ī-kär'b*ă*-zīd
serine	sĕr'ēn	
skatole	skā'tōl	
solute	sŏl'ūt	
stannonic	st*ă*-nŏn'ĭk	
stearic	stê-ăr'ĭk	
stearin	stē'*ă* rĭn	
stearolic	stē'-*ă*-rō'lĭk	
stibine	stĭb'ēn	
strontium	strŏn'shĭ-*ŭ*m	
strychnine	strĭk'nēn	strĭk'nĭn (*usage*)
styrene	stī'rēn	

THE PRONUNCIATION OF CHEMICAL WORDS
(Concluded)

sulfinic	sŭl-fĭn′ĭk	
sulfonal	sŭl′fȯ-năl	
sulfone	sŭl-fōn′	sŭl′fōn
sulfonic	sŭl-fŏn′ĭk	
sulfurous	sŭl-fū′r*ŭ*s	
sulfuryl	sŭl′fu̇-rĭl	
tartaric	tär-tăr′ĭk	tär-tär′ĭk (*usage*)
taurocholic	tô′rȯ-kō′lĭk	
terephthalic	tĕr′ĕf-thăl′ĭk	
tetrolic	tė-trō′lĭk	
thebaine	thē′bȧ-ēn	
theine	thē′ēn	
titanic	tī-tăn′ĭk	
titanium	tī-tā′nĭ-*ŭ*m	
titanous	tī-tăn′*ŭ*s	
titanyl	tī′t*ă*n-ĭl	
titer	tī′tẽr	
titrate	tī′trāt	
trional	trī′ō-năl	
trivalent	trī-vā′lĕnt	
univalent	ū′nĭ-vā′lĕnt	
uranyl	ū′r*ă*-nĭl	
urea	u̇-rē′ā	
ureide	ū′rė-īd	
valeric	v*ă*-lĕr′ĭk	
valine	văl′ēn	vā′lēn
vanadate	văn′*ă*-dāt	
vanillin	văn′ĭ-lĭn	
veratrole	vĕr′*ă*-trōl	
vinyl	vī′nĭl	
vitamin	vī′t*ă*-mĭn	
vitellin	vī-tĕl′ĭn	
xenon	zē′nŏn	
xylitol	zī′lĭ-tōl	

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FLAME AND BEAD TESTS

Flame Colorations

Violet

Potassium compounds. Purple red through blue glass. Easily obscured by sodium flame. Bluish green through green glass. Rubidium and Caesium compounds impart same flame as potassium compounds.

Blues

Azure.—Copper chloride. Copper bromide gives azure blue followed by green. Other copper compounds give same coloration when moistened with hydrochloric acid.

Light Blue.—Lead, Arsenic, Selenium.

Greens

Emerald.—Copper compounds except the halides, and when not moistened with hydrochloric acid.

Pure Green.—Compounds of thallium and tellurium.

Yellowish.—Barium compounds. Some molybdenum compounds. Borates, especially when treated with sulphuric acid or when burned with alcohol.

Bluish.—Phosphates with sulphuric acid.

Feeble.—Antimony compounds. Ammonium compounds.

Whitish.—Zinc.

Reds

Carmine.—Lithium compounds. Violet through blue glass. Invisible through green glass. Masked by barium flame.

Scarlet.—Strontium compounds. Violet through blue glass. Yellowish through green glass. Masked by barium flame.

Yellowish.—Calcium compounds. Greenish through blue glass. Green through green glass. Masked by barium flame.

Yellow

Yellow.—All sodium compounds. Invisible with blue glass.

Borax Beads

Abbreviations employed: s., saturated; s.s., supersaturated; n.s., not saturated; h., hot; c., cold.

Substance	Oxidizing flame	Reducing flame
Aluminum	Colorless (h.c., n.s.); opaque (s.s.)	Colorless; opaque (s.)
Antimony	Colorless; yellow or brownish (h., s.s.)	Gray and opaque
Barium	Colorless (n.s.)	....
Bismuth	Colorless; yellow or brownish (h., s.s.)	Gray and opaque
Cadmium	Colorless	Gray and opaque
Calcium	Colorless (n.s.)	....
Cerium	Red (h.)	Colorless (h.c.)
Chromium	Green (c.)	Green
Cobalt	Blue (h.c.)	Blue (h.c.)
Copper	Green (h.); blue (c.)	Red (c.): opaque (s.s.): colorless (h.)

FLAME AND BEAD TESTS (Continued)

Borax Beads (Continued)

Substance	Oxidizing flame	Reducing flame
Iron	Yellow or brownish red (h., n.s.)	Green (s.s.)
Lead	Colorless; yellow or brownish (h., s.s.)	Gray and opaque
Magnesium	Colorless (n.s.)	....
Manganese	Violet (h.c.)	Colorless (h.c.)
Molybdenum	Colorless	Yellow or brown (h.)
Nickel	Brown; red (c.)	Gray and opaque
Silicon	Colorless (h.c.); opaque (s.s.)	Colorless; opaque (s.)
Silver	Colorless (n.s.)	Gray and opaque
Strontium	Colorless (n.s.)	....
Tin	Colorless (h.c.); opaque (s.s.)	Colorless; opaque (s.)
Titanium	Colorless	Yellow (h.); violet (c.)
Tungsten	Colorless	Brown
Uranium	Yellow or brownish (h., n.s.)	Green
Vanadium	Colorless	Green

Beads of Microcosmic Salt
$NaNH_4HPO_4$

Substance	Oxidizing flame	Reducing flame
Aluminum	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Antimony	Colorless (n.s.)	Gray and opaque
Barium	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Bismuth	Colorless (n.s.)	Gray and opaque
Cadmium	Colorless (n.s.)	Gray and opaque
Calcium	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Cerium	Yellow or brownish red (h., s.)	Colorless
Chromium	Red (h., s.); green (c.)	Green (c.)
Cobalt	Blue (h.c.)	Blue (h.c.)
Copper	Blue (c.); green (h.)	Red and opaque (c.)
Iron	Yellow or brown (h., s.)	Colorless; yellow or brownish (h.)
Lead	Colorless (n.s.)	Gray and opaque
Magnesium	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Manganese	Violet (h.c.)	Colorless
Molybdenum	Colorless; green (h.)	Green (h.)
Nickel	Yellow (c.); red (h., s.)	Yellow (c.); red (h.); gray and opaque
Silicon	(Swims undissolved)	(Swims undissolved)
Silver	....	Gray and opaque
Strontium	Colorless; opaque (s.)	Colorless; not clear (s.s.)
Tin	Colorless; opaque (s.)	Colorless
Titanium	Colorless (n.s.)	Violet (c.); yellow or brownish (h.)
Uranium	Green; yellow or brownish (h., s.)	Green (h.)
Vanadium	Yellow	Green
Zinc	Colorless (n.s.)	Gray and opaque

Sodium Carbonate Bead

Manganese	Green	Colorless

PREPARATION OF REAGENTS

The following pages present directions for the preparation of various reagents. The collection has been prepared with the active collaboration of W. D. Bonner, R. K. Carleton, L. L. Carrick, Giles B. Cooke, E. J. Cragoe, Thos. De Vries, James L. Kassner, Thos. W. Mason, F. C. Mathers, M. G. Mellon, W. C. Pierce, J. H. Reedy, Arthur A. Vernon and S. R. Wood. Many others have contributed valuable suggestions.

Volumes have been stated in milliliters (ml) and liters (l). One milliliter is equivalent to 1.000027 cubic centimeters (cm^3 or cc.). Masses are indicated in grams (g).

The relation to molar solution (*M*) or normal solution (*N*) is indicated in many cases.

Distilled water should be used.

LABORATORY REAGENTS FOR GENERAL USE

DILUTE ACIDS, 3 molar. Use the amount of concentrated acid indicated and dilute to one liter.

Acetic acid, 3 *N*. Use 172 ml of 17.4 *M* acid (99–100%).

Hydrochloric acid, 3 *N*. Use 258 ml of 11.6 *M* acid (36% HCl).

Nitric acid, 3 *N*. Use 195 ml of 15.4 *M* acid (69% HNO_3).

Phosphoric acid, 9 *N*. Use 205 ml of 14.6 *M* acid (85% H_3PO_4).

Sulfuric acid, 6 *N*. Use 168 ml of 17.8 *M* acid (95% H_2SO_4).

DILUTE BASES.

Ammonium hydroxide, 3 *M*, 3 *N*. Dilute 200 ml of concentrated solution (14.8 *M*, 28% NH_3) to 1 liter.

Barium hydroxide, 0.2 *M*, 0.4 *N*. Saturated solution, 63 g per liter of $Ba(OH)_2.8H_2O$. Use some excess, filter off $BaCO_3$ and protect from CO_2 of the air with soda lime or ascarite in a guard tube.

Calcium hydroxide, 0.02 *M*, 0.04 *N*. Saturated solution, 1.5 g per liter of $Ca(OH)_2$. Use some excess, filter off $CaCO_3$ and protect from CO_2 of the air.

Potassium hydroxide, 3 *M*, 3 *N*. Dissolve 176 g of the sticks (95%) in water and dilute to 1 liter.

Sodium hydroxide, 3 *M*, 3 *N*. Dissolve 126 g of the sticks (95%) in water and dilute to 1 liter.

GENERAL REAGENTS. (See also *Standard Solutions for Volumetric Analysis*, and *Decinormal Solutions of Salts and Other Reagents.*)

Aluminum chloride, 0.167 *M*, 0.5 *N*. Dissolve 22 g of $AlCl_3$ in 1 liter of water.

Aluminum nitrate, 0.167 *M*, 0.5 *N*. Dissolve 58 g of $Al(NO_3)_3.7.5H_2O$ in 1 liter of water.

Aluminum sulfate, 0.083 *M*, 0.5 *N*. Dissolve 56 g of $Al_2(SO_4)_3.18H_2O$ in 1 liter of water.

Ammonium acetate, 3 *M*, 3 *N*. Dissolve 230 g of $NH_4C_2H_3O_2$ in water and dilute to 1 liter.

Ammonium carbonate, 1.5 *M*. Dissolve 144 g of the commercial salt (mixture of $(NH_4)_2CO_3.H_2O$ and $NH_4CO_2NH_2$) in 500 ml of 3 *N* NH_4OH and dilute to 1 liter.

Ammonium chloride, 3 *M*, 3 *N*. Dissolve 160 g of NH_4Cl in water. Dilute to 1 liter.

Ammonium molybdate.

1. 0.5 *M*, 1 *N*. Mix well 72 g of pure MoO_3 (or 81 g of H_2MoO_4) with 200 ml of water, and add 60 ml of conc. ammonium hydroxide. When solution is complete, filter and pour filtrate, *very slowly* and with *rapid stirring*, into a mixture of 270 ml of conc. HNO_3 and 400 ml of water. Allow to stand over night, filter and dilute to 1 liter.

2. The reagent is prepared as two solutions which are mixed as needed, thus always providing fresh reagent of proper strength and composition. Since ammonium molybdate is an expensive reagent, and since an acid solution of this reagent as usually prepared keeps for only a few days, the method proposed will avoid loss of reagent and provide more certain results for quantitative work.

Solution 1. Dissolve 100 g of ammonium molybdate (C.P. grade) in 400 ml of water and 80 ml of 15 *M* NH_4OH. Filter if necessary, though this seldom has to be done.

Solution 2. Mix 400 ml of 16 *M* nitric acid with 600 ml of water.

For use, mix the calculated amount of solution 1 with twice its volume of solution 2, adding solution 1 to solution 2 slowly, with vigorous stirring. Thus, for amounts of phosphorus up to 20 mg, 10 ml of solution 1 to 20 ml of solution 2 is adequate. Increase amount as needed.

Ammonium nitrate, 1 *M*, 1 *N*. Dissolve 80 g of NH_4NO_3 in 1 liter of water.

Ammonium oxalate, 0.25 *M*, 0.5 *N*. Dissolve 35.5 g of $(NH_4)_2C_2O_4.H_2O$ in water. Dilute to 1 liter.

Ammonium sulfate, 0.25 *M*, 0.5 *N*. Dissolve 33 g of $(NH_4)_2SO_4$ in 1 liter of water.

Ammonium sulfide, colorless.

1. 3 *M*. Treat 200 ml of conc. NH_4OH with H_2S until saturated, keeping the solution cold. Add 200 ml of conc. NH_4OH and dilute of 1 liter.

2. 6 *N*. Saturate 6 *N* ammonium hydroxide (40 ml conc. ammonia solution + 60 ml H_2O) with washed H_2S gas. The ammonium hydroxide bottle must be completely full and must be kept surrounded by ice while being saturated (about 48 hours for two liters). The reagent is best preserved in brown, completely filled, glass-stoppered bottles.

Ammonium sulfide, yellow. Treat 150 ml of conc. NH_4OH with H_2S until saturated, keeping the solution cool. Add 250 ml of conc. NH_4OH and 10 g of powdered sulfur. Shake the mixture until the sulfur is dissolved and dilute to 1 liter with water. In the solution the concentration of $(NH_4)_2S_2$, $(NH_4)_2S$ and NH_4OH are 0.625, 0.4 and 1.5 normal respectively. On standing, the concentration of $(NH_4)_2S_2$ increases and that of $(NH_4)_2S$ and NH_4OH decreases.

Antimony pentachloride, 0.1 *M*, 0.5 *N*. Dissolve 30 g of $SbCl_5$ in 1 liter of water.

Antimony trichloride, 0.167 *M*, 0.5 *N*. Dissolve 38 g of $SbCl_3$ in 1 liter of water.

Aqua regia. Mix 1 part concentrated HNO_3 with 3 parts of concentrated HCl. This formula should include one volume of water if the aqua regia is to be stored for any length of time. Without water, objectionable quantities of chlorine and other gases are evolved.

Barium chloride, 0.25 *M*, 0.5 *N*. Dissolve 61 g of $BaCl_2.2H_2O$ in water. Dilute to 1 liter.

Barium hydroxide, 0.1 *M*, about 0.2 *N*. Dissolve 32 g of $Ba(OH)_2.8H_2O$ in 1 liter of water.

Barium nitrate, 0.25 *M*, 0.5 *N*. Dissolve 65 g of $Ba(NO_3)_2$ in 1 liter of water.

Bismuth chloride, 0.167 *M*, 0.5 *N*. Dissolve 53 g of $BiCl_3$ in 1 liter of dilute HCl. Use 1 part HCl to 5 parts water.

Bismuth nitrate, 0.083 *M*, 0.25 *N*. Dissolve 40 g of $Bi(NO_3)_3.5H_2O$ in 1 liter of dilute HNO_3. Use 1 part of HNO_3 to 5 parts of water.

Cadmium chloride, 0.25 *M*, 0.5 *N*. Dissolve 46 g of $CdCl_2$ in 1 liter of water.

Cadmium nitrate, 0.25 *M*, 0.5 *N*. Dissolve 77 g of $Cd(NO_3)_2.4H_2O$ in 1 liter of water.

Cadmium sulfate, 0.25 *M*, 0.5 *N*. Dissolve 70 g of $CdSO_4.4H_2O$ in 1 liter of water.

Calcium chloride, 0.25 *M*, 0.5 *N*. Dissolve 55 g of $CaCl_2.6H_2O$ in water. Dilute to 1 liter.

Calcium nitrate, 0.25 *M*, 0.5 *N*. Dissolve 41 g of $Ca(NO_3)_2$ in 1 liter of water.

Chloroplatinic acid.

1. 0.0512 *M*, 0.102 *N*. Dissolve 26.53 g of $H_2PtCl_6.6H_2O$ in water. Dilute to 100 ml. Contains 0.100 g Pt per ml.

2. Make a 10% solution by dissolving 1 g of $H_2PtCl_6.6H_2O$ in 9 ml of water. Shake thoroughly to insure complete mixing. Keep in a dropping bottle.

Chromic chloride, 0.167 *M*, 0.5 *N*. Dissolve 26 g of $CrCl_3$ in 1 liter of water.

Chromic nitrate, 0.167 *M*, 0.5 *N*. Dissolve 40 g of $Cr(NO_3)_3$ in 1 liter of water.

Chromic sulfate, 0.083 *M*, 0.5 *N*. Dissolve 60 g of $Cr_2(SO_4)_3.18H_2O$ in 1 liter of water.

Cobaltous nitrate, 0.25 *M*, 0.5 *N*. Dissolve 73 g of $Co(NO_3)_2.6H_2O$ in 1 liter of water.

Cobaltous sulfate, 0.25 *M*, 0.5 *N*. Dissolve 70 g of $CoSO_4.7H_2O$ in 1 liter of water.

Cupric chloride, 0.25 *M*, 0.5 *N*. Dissolve 43 g of $CuCl_2.2H_2O$ in 1 liter of water.

Cupric nitrate, 0.25 *M*, 0.5 *N*. Dissolve 74 g of $Cu(NO_3)_2.6H_2O$ in 1 liter of water.

Cupric sulfate, 0.5 *M*, 1 *N*. Dissolve 124.8 g of $CuSO_4.5H_2O$ in water to which 5 ml of H_2SO_4 has been added. Dilute to 1 liter.

Ferric chloride, 0.5 *M*, 1.5 *N*. Dissolve 135.2 g of $FeCl_3.6H_2O$ in water containing 20 ml of conc. HCl. Dilute to 1 liter.

Ferric nitrate, 0.167 *M*, 0.5 *N*. Dissolve 67 g of $Fe(NO_3)_3.9H_2O$ in 1 liter of water.

Ferric sulfate, 0.25 *M*, 0.5 *N*. Dissolve 140.5 g of $Fe_2(SO_4)_3.9H_2O$ in water containing 100 ml of conc. H_2SO_4. Dilute to 1 liter.

Ferrous ammonium sulfate, 0.5 *M*, 1 *N*. Dissolve 196 g of $Fe(NH_4SO_4)_2.6H_2O$ in water containing 10 ml of conc. H_2SO_4. Dilute to 1 liter. Prepare fresh solutions for best results.

Ferrous sulfate, 0.5 *M*, 1 *N*. Dissolve 139 g of $FeSO_4.7H_2O$ in water containing 10 ml of conc. H_2SO_4. Dilute to 1 liter. Solution does not keep well.

Lead acetate, 0.5 *M*, 1 *N*. Dissolve 190 g of $Pb(C_2H_3O_2)_2.3H_2O$ in water. Dilute to 1 liter.

Lead nitrate, 0.25 *M*, 0.5 *N*. Dissolve 83 g of $Pb(NO_3)_2$ in 1 liter of water.

Lime water. See *Calcium hydroxide.*

Magnesium chloride, 0.25 *M*, 0.5 *N*. Dissolve 51 g of $MgCl_2.6H_2O$ in 1 liter of water.

Magnesium chloride reagent. Dissolve 50 g of $MgCl_2.6H_2O$ and 100 g of NH_4Cl in 500 ml of water. Add 10 ml of conc. NH_4OH, allow to stand over night and filter if a precipitate has formed. Make acid to methyl red with dilute HCl. Dilute to 1 liter. Solution contains 0.25 *M* $MgCl_2$ and 2 *M* NH_4Cl. Solution may also be diluted with 133 ml of conc. NH_4OH and water to make 1 liter. Such a solution will contain 2 *M* NH_4OH.

Magnesium nitrate, 0.25 *M*, 0.5 *N*. Dissolve 64 g of $Mg(NO_3)_2.6H_2O$ in 1 liter of water.

Magnesium sulfate, 0.25 *M*, 0.5 *N*. Dissolve 62 g of $MgSO_4.7H_2O$ in 1 liter of water.

Manganous chloride, 0.25 *M*, 0.5 *N*. Dissolve 50 g of $MnCl_2.4H_2O$ in 1 liter of water.

Manganous nitrate, 0.25 *M*, 0.5 *N*. Dissolve 72 g of $Mn(NO_3)_2.6H_2O$ in 1 liter of water.

Manganous sulfate, 0.25 *M*, 0.5 *N*. Dissolve 69 g of $MnSO_4.7H_2O$ in 1 liter of water.

Mercuric chloride, 0.25 *M*, 0.5 *N*. Dissolve 68 g of $HgCl_2$ in water. Dilute to 1 liter.

Mercuric nitrate, 0.25 *M*, 0.5 *N*. Dissolve 81 g of $Hg(NO_3)_2$ in 1 liter of water.

Mercuric sulfate, 0.25 *M*, 0.5 *N*. Dissolve 74 g of $HgSO_4$ in 1 liter of water.

Mercurous nitrate. Use 1 part $HgNO_3$, 20 parts water and 1 part HNO_3.

Nickel chloride, 0.25 *M*, 0.5 *N*. Dissolve 59 g of $NiCl_2 \cdot 6H_2O$ in 1 liter of water.

Nickel nitrate, 0.25 *M*, 0.5 *N*. Dissolve 73 g of $Ni(NO_3)_2 \cdot 6H_2O$ in 1 liter of water.

Nickel sulfate, 0.25 *M*, 0.5 *N*. Dissolve 66 g of $NiSO_4 \cdot 6H_2O$ in 1 liter of water.

Potassium bromide, 0.5 *M*, 0.5 *N*. Dissolve 60 g of KBr in 1 liter of water.

Potassium carbonate, 1.5 *M*, 3 *N*. Dissolve 207 g of K_2CO_3 in 1 liter of water.

Potassium chloride, 0.5 *M*, 0.5 *N*. Dissolve 37 g of KCl in 1 liter of water.

Potassium chromate, 0.25 *M*, 0.5 *N*. Dissolve 49 g of K_2CrO_4 in 1 liter of water.

Potassium cyanide, 0.5 *M*, 0.5 *N*. Dissolve 33 g of KCN in 1 liter of water.

Potassium dichromate, 0.125 *M*. Dissolve 37 g of $K_2Cr_2O_7$ in 1 liter of water.

Potassium ferricyanide, 0.167 *M*, 0.5 *N*. Dissolve 55 g of $K_3Fe(CN)_6$ in 1 liter of water.

Potassium ferrocyanide, 0.5 *M*, 2 *N*. Dissolve 211 g of $K_4Fe(CN)_6 \cdot 3H_2O$ in water. Dilute to 1 liter.

Potassium iodide, 0.5 *M*, 0.5 *N*. Dissolve 83 g of KI in 1 liter of water.

Potassium nitrate, 0.5 *M*, 0.5 *N*. Dissolve 51 g of KNO_3 in 1 liter of water.

Potassium sulfate, 0.25 *M*, 0.5 *N*. Dissolve 44 g of K_2SO_4 in 1 liter of water.

Silver nitrate, 0.5 *M*, 0.5 *N*. Dissolve 85 g of $AgNO_3$ in water. Dilute to 1 liter.

Sodium acetate, 3 *M*, 3 *N*. Dissolve 408 g of $NaC_2H_3O_2 \cdot 3H_2O$ in water. Dilute to 1 liter.

Sodium carbonate, 1.5 *M*, 3 *N*. Dissolve 159 g of Na_2CO_3, or 430 g of $Na_2CO_3 \cdot 10H_2O$ in water. Dilute to 1 liter.

Sodium chloride, 0.5 *M*, 0.5 *N*. Dissolve 29 g of NaCl in 1 liter of water.

Sodium cobaltinitrite, 0.08 *M* (reagent for potassium). Dissolve 25 g of $NaNO_2$ in 75 ml of water, add 2 ml of glacial acetic acid and then 2.5 g of $Co(NO_3)_2 \cdot 6H_2O$. Allow to stand for several days, filter and dilute to 100 ml. Reagent is somewhat unstable.

Sodium hydrogen phosphate, 0.167 *M*, 0.5 *N*. Dissolve 60 g of $Na_2HPO_4 \cdot 12H_2O$ in 1 liter of water.

Sodium nitrate, 0.5 *M*, 0.5 *N*. Dissolve 43 g of $NaNO_3$ in 1 liter of water.

Sodium sulfate, 0.25 *M*, 0.5 *N*. Dissolve 36 g of Na_2SO_4 in 1 liter of water.

Sodium sulfide, 0.5 *M*, 1 *N*. Dissolve 120 g of $Na_2S.9H_2O$ in water and dilute to 1 liter. Or, saturate 500 ml of 1 *M* NaOH (21 g of 95% NaOH sticks) with H_2S, keeping the solution cool, and dilute with 500 ml of 1 *M* NaOH.

Stannic chloride, 0.125 *M*, 0.5 *N*. Dissolve 33 g of $SnCl_4$ in 1 liter of water.

Stannous chloride, 0.5 *M*, 1 *N*. Dissolve 113 g of $SnCl_2.2H_2O$ in 170 ml of conc. HCl, using heat if necessary. Dilute with water to 1 liter. Add a few pieces of tin foil. Prepare solution fresh at frequent intervals.

Stannous chloride (for Bettendorf test). Dissolve 113 g of $SnCl_2.2H_2O$ in 75 ml of conc. HCl. Add a few pieces of tin foil.

Strontium chloride, 0.25 *M*, 0.5 *N*. Dissolve 67 g of $SrCl_2.6H_2O$ in 1 liter of water.

Zinc nitrate, 0.25 *M*, 0.5 *N*. Dissolve 74 g of $Zn(NO_3)_2.6H_2O$ in 1 liter of water.

Zinc sulfate, 0.25 *M*, 0.5 *N*. Dissolve 72 g of $ZnSO_4.7H_2O$ in 1 liter of water.

SPECIAL SOLUTIONS AND REAGENTS

Aluminon (qualitative test for aluminum). Aluminon is a trade name for the ammonium salt of aurin tricarboxylic acid. Dissolve 1 g of the salt in 1 liter of distilled water. Shake the solution well to insure thorough mixing.

Bang's reagent (for glucose estimation). Dissolve 100 g of K_2CO_3, 66 g of KCl and 160 g of $KHCO_3$ in the order given in about 700 ml of water at 30° C. Add 4.4 g of $CuSO_4$ and dilute to 1 liter after the CO_2 is evolved. This solution should be shaken only in such a manner as not to allow entry of air. After 24 hours 300 ml are diluted to 1 liter with saturated KCl solution, shaken gently and used after 24 hours; 50 ml equivalent to 10 mg glucose.

Barfoed's reagent (test for glucose). See *Cupric acetate.*

Baudisch's reagent. See *Cupferron.*

Benedict's solution (qualitative reagent for glucose). With the aid of heat, dissolve 173 g of sodium citrate and 100 g of Na_2CO_3 in 800 ml of water. Filter, if necessary, and dilute to 850 ml. Dissolve 17.3 g of $CuSO_4.5H_2O$ in 100 ml of water. Pour the latter solution, with constant stirring, into the carbonate-citrate solution, and make up to 1 liter.

Benzidine hydrochloride solution (for sulfate determination). Make a paste of 8 g of benzidine hydrochloride ($C_{12}H_8(NH_2)_2.2HCl$) and 20 ml of water, add 20 ml of HCl (sp. gr. 1.12) and dilute to 1 liter with water. Each ml of this solution is equivalent to 0.00357 g of H_2SO_4.

Bertrand's reagent (glucose estimation). Consists of the following solutions:

(a) Dissolve 200 g of Rochelle salts and 150 g of NaOH in sufficient water to make 1 liter of solution.

(b) Dissolve 40 g of $CuSO_4$ in enough water to make 1 liter of solution.

(c) Dissolve 50 g of $Fe_2(SO_4)_3$ and 200 g of H_2SO_4 (sp. gr 1.84) in sufficient water to make 1 liter of solution.

(d) Dissolve 5 g of $KMnO_4$ in sufficient water to make 1 liter of solution.

Bial's reagent (for pentose). Dissolve 1 g of orcinol ($CH_3.C_6H_3(OH)_2$) in 500 ml of 30 % HCl to which 30 drops of a 10 % solution of $FeCl_3$ has been added.

Boutron-Boudet soap solution.

(a) Dissolve 100 g of pure castile soap in about 2500 ml of 56 % ethyl alcohol.

(b) Dissolve 0.59 g of $Ba(NO_3)_2$ in 1 liter of water.

Adjust the castile soap solution so that 2.4 ml of it will give a permanent lather with 40 ml of solution (b). When adjusted, 2.4 ml of soap solution is equivalent to 220 parts per million of hardness (as $CaCO_3$) for a 40 ml sample.

See also *Soap solution.*

Brucke's reagent (protein precipitation). See *Potassium iodide-mercuric iodide.*

Clarke's soap solution (or A.P.H.A. standard method). Estimation of hardness in water.

(a) Dissolve 100 g of pure powdered castile soap in 1 liter of 80 % ethyl alcohol and allow to stand over night.

(b) Prepare a standard solution of $CaCl_2$ by dissolving 0.5 g of $CaCO_3$ in HCl (sp. gr. 1.19), neutralize with NH_4OH and make slightly alkaline to litmus, and dilute to 500 ml. One ml is equivalent to 1 mg of $CaCO_3$.

Titrate (a) against (b) and dilute (a) with 80 % ethyl alcohol until 1 ml of the resulting solution is equivalent to 1 ml of (b) after making allowance for the lather factor (the amount of standard soap solution required to produce a permanent lather in 50 ml of distilled water). One ml of the adjusted solution after subtracting the lather factor is equivalent to 1 mg of $CaCO_3$.

See also *Soap solution.*

Cobalticyanide paper (Rinnmann's test for Zn). Dissolve 4 g of $K_3Co(CN)_6$ and 1 g of $KClO_3$ in 100 ml of water. Soak filter paper in solution and dry at 100° C. Apply drop of zinc solution and burn in an evaporating dish. A green disk is obtained if zinc is present.

Cochineal. Extract 1 g of cochineal for four days with 20 ml of alcohol and 60 ml of distilled water. Filter.

Congo red. Dissolve 0.5 g of congo red in 90 ml of distilled water and 10 ml of alcohol.

Cupferron (Baudisch's reagent for iron analysis). Dissolve 6 g of the ammonium salt of nitroso-phenyl-hydroxylamine (cupferron) in 100 ml of H_2O. Reagent good for one week only and must be kept in the dark.

Cupric acetate (Barfoed's reagent for reducing monosaccharides). Dissolve 66 g of cupric acetate and 10 ml of glacial acetic acid in water and dilute to 1 liter.

Cupric oxide, ammoniacal; Schweitzer's reagent (dissolves cotton, linen and silk, but not wool).

1. Dissolve 5 g of cupric sulfate in 100 ml of boiling water, and add sodium hydroxide until precipitation is complete. Wash the precipitate well, and dissolve it in a minimum quantity of ammonium hydroxide.

2. Bubble a slow stream of air through 300 ml of strong ammonium hydroxide containing 50 g of fine copper turnings. Continue for one hour.

Cupric sulfate in glycerin-potassium hydroxide (reagent for silk). Dissolve 10 g of cupric sulfate, $CuSO_4.5H_2O$, in 100 ml of water and add 5 g of glycerin. Add KOH solution slowly until a deep blue solution is obtained.

Cupron (benzoin oxime). Dissolve 5 g in 100 ml of 95% alcohol.

Cuprous chloride, acidic (reagent for CO in gas analysis).

1. Cover the bottom of a two-liter flask with a layer of cupric oxide about one-half inch deep, suspend a bunch of copper wire so as to reach from the bottom to the top of the solution, and fill the flask with hydrochloric acid (sp. gr. 1.10). Shake occasionally. When the solution becomes nearly colorless, transfer to reagent bottles, which should also contain copper wire. The stock bottle may be refilled with dilute hydrochloric acid until either the cupric oxide or the copper wire is used up.

Copper sulfate may be substituted for copper oxide in the above procedure.

2. Dissolve 340 g of $CuCl_2.2H_2O$ in 600 ml of conc. HCl and reduce the cupric chloride by adding 190 ml of a saturated solution of stannous chloride or until the solution is colorless. The stannous chloride is prepared by treating 300 g of metallic tin in a 500 ml flask with conc. HCl until no more tin goes into solution.

3. (Winkler method). Add a mixture of 86 g of CuO and 17 g of finely divided metallic Cu, made by the reduction of CuO with hydrogen, to a solution of HCl, made by diluting 650 ml of conc. HCl with 325 ml of water. After the mixture has been added slowly and with frequent stirring, a spiral of copper wire is suspended in the bottle, reaching all the way to the bottom. Shake occasionally, and when the solution becomes colorless, it is ready for use.

Cuprous chloride, ammoniacal (reagent for CO in gas analysis).

1. The acid solution of cuprous chloride as prepared above is neutralized with ammonium hydroxide until an ammonia odor persists. An excess of metallic copper must be kept in the solution.

2. Pour 800 ml of acidic cuprous chloride, prepared by the Winkler method, into about 4 liters of water. Transfer the precipitate to a 250 ml graduate. After several hours, siphon off the liquid above the 50 ml mark and refill with 7.5% NH_4OH solution which may be prepared by diluting 50 ml of conc. NH_4OH with 150 ml of water. The solution is well shaken and allowed to stand for several hours. It should have a faint odor of ammonia.

Dichlorofluorescein indicator. Dissolve 1 g in 1 liter of 70% alcohol or 1 g of the sodium salt in 1 liter of water.

Dimethylglyoxime (diacetyl dioxime), 0.01 *N*. Dissolve 0.6 g of dimethylglyoxime, $(CH_3CNOH)_2$, in 500 ml of 95% ethyl alcohol. This is an especially sensitive test for nickel, a very definite crimson color being produced.

Diphenylamine (reagent for rayon). Dissolve 0.2 g in 100 ml of concentrated sulfuric acid.

Diphenylamine sulfonate (for titration of iron with $K_2Cr_2O_7$). Dissolve 0.32 g of the barium salt of diphenylamine sulfonic acid in 100 ml of water, add 0.5 g of sodium sulfate and filter off the precipitate of $BaSO_4$.

Diphenylcarbazide. Dissolve 0.2 g of diphenylcarbazide in 10 ml of glacial acetic acid and dilute to 100 ml with 95% ethyl alcohol.

Esbach's reagent (estimation of protein). To a water solution of 10 g of picric acid and 20 g of citric acid, add sufficient water to make one liter of solution.

Eschka's compound. Two parts of calcined ("light") magnesia are thoroughly mixed with one part of anhydrous sodium carbonate.

Fehling's solution (reagent for reducing sugars).

(a) Copper sulfate solution. Dissolve 34.66 g of $CuSO_4 \cdot 5H_2O$ in water and dilute to 500 ml.

(b) Alkaline tartrate solution. Dissolve 173 g of potassium sodium tartrate (Rochelle salts, $KNaC_4H_4O_6 \cdot 4H_2O$) and 50 g of NaOH in water and dilute when cold to 500 ml.

For use, mix equal volumes of the two solutions at the time of using.

Ferric-alum indicator. Dissolve 140 g of ferric-ammonium sulfate crystals in 400 ml of hot water. When cool, filter, and make up to a volume of 500 ml with dilute (6 *N*) nitric acid.

Folin's mixture (for uric acid). To 650 ml of water add 500 g of $(NH_4)_2SO_4$, 5 g of uranium acetate and 6 g of glacial acetic acid. Dilute to 1 liter.

Formaldehyde-sulfuric acid (Marquis' reagent for alkaloids). Add 10 ml of formaldehyde solution to 50 ml of sulfuric acid.

Froehde's reagent. See *Sulfomolybdic acid.*

Fuchsin (reagent for linen). Dissolve 1 g of fuchsin in 100 ml of alcohol.

Fuchsin-sulfurous acid (Schiff's reagent for aldehydes). Dissolve 0.5 g of fuchsin and 9 g of sodium bisulfite in 500 ml of water, and add 10 ml of HCl. Keep in well-stoppered bottles and protect from light.

Gunzberg's reagent (detection of HCl in gastric juice). Prepare as needed a solution containing 4 g of phloroglucinol and 2 g of vanillin in 100 ml of absolute ethyl alcohol.

Hager's reagent. See *Picric acid.*

Hanus solution (for iodine number). Dissolve 13.2 g of resublimed iodine in one liter of glacial acetic acid which will pass the dichromate test for reducible matter. Add sufficient bromine to double the halogen content, determined by titration (3 ml is about the proper amount). The iodine may be dissolved by the aid of heat, but the solution should be cold when the bromine is added.

Iodine, tincture of. To 50 ml of water add 70 g of I_2 and 50 g of KI. Dilute to 1 liter with alcohol.

Iodo-potassium iodide (Wagner's reagent for alkaloids). Dissolve 2 g of iodine and 6 g of KI in 100 ml of water.

Litmus (indicator). Extract litmus powder three times with boiling alcohol, each treatment consuming an hour. Reject the alcoholic extract. Treat residue with an equal weight of cold water and filter; then exhaust with five times its weight of boiling water, cool and filter. Combine the aqueous extracts.

Magnesia mixture (reagent for phosphates and arsenates). Dissolve 55 g of magnesium chloride and 105 g of ammonium chloride in water, barely acidify with hydrochloric acid, and dilute to 1 liter. The ammonium hydroxide may be omitted until just previous to use. The reagent, if completely mixed and stored for any period of time, becomes turbid.

Magnesium reagent. See *S and O reagent.*

Magnesium uranyl acetate. Dissolve 100 g of $UO_2(C_2H_3O_2)_2.2H_2O$ in 60 ml of glacial acetic acid and dilute to 500 ml. Dissolve 330 g of $Mg(C_2H_3O_2)_2.4H_2O$ in 60 ml of glacial acetic acid and dilute to 200 ml. Heat solutions to the boiling point until clear, pour the magnesium solution into the uranyl solution, cool and dilute to 1 liter. Let stand over night and filter if necessary.

Marme's reagent. See *Potassium-cadmium iodide.*

Marquis' reagent. See *Formaldehyde-sulfuric acid.*

Mayer's reagent (white precipitate with most alkaloids in slightly acid solutions). Dissolve 1.358 g of $HgCl_2$ in 60 ml of water and pour into a solution of 5 g of KI in 10 ml of H_2O. Add sufficient water to make 100 ml.

Methyl orange indicator. Dissolve 1 g of methyl orange in 1 liter of water. Filter, if necessary.

Methyl orange, modified. Dissolve 2 g of methyl orange and 2.8 g of xylene cyanole FF in 1 liter of 50% alcohol.

Methyl red indicator. Dissolve 1 g of methyl red in 600 ml of alcohol and dilute with 400 ml of water.

Methyl red, modified. Dissolve 0.50 g of methyl red and 1.25 g of xylene cyanole FF in 1 liter of 90% alcohol. Or, dissolve 1.25 g of methyl red and 0.825 g of methylene blue in 1 liter of 90% alcohol.

Millon's reagent (for albumins and phenols). Dissolve 1 part of mercury in 1 part of cold fuming nitric acid. Dilute with twice the volume of water and decant the clear solution after several hours.

Mixed indicator. Prepared by adding about 1.4 g of xylene cyanole FF to 1 g of methyl orange. The dye is seldom pure enough for these proportions to be satisfactory. Each new lot of dye should be tested by adding additional amounts of the dye until a test portion gives the proper color change. The acid color of this indicator is like that of permanganate; the neutral color is gray; and the alkaline color is green. Described by Hickman and Linstead, J. Chem. Soc. (Lon.), **121,** 2502 (1922).

Molisch's reagent. See *α-Naphthol.*

α-Naphthol (Molisch's reagent for wool). Dissolve 15 g of α-naphthol in 100 ml of alcohol or chloroform.

Nessler's reagent (for ammonia). Dissolve 50 g of KI in the smallest possible quantity of cold water (50 ml). Add a saturated solution of mercuric chloride (about 22 g in 350 ml of water will be needed) until an excess is indicated by the formation of a precipitate. Then add 200 ml of 5 N NaOH and dilute to 1 liter. Let settle, and draw off the clear liquid.

Nickel oxide, ammoniacal (reagent for silk). Dissolve 5 g of nickel sulfate in 100 ml of water, and add sodium hydroxide solution until nickel hydroxide is completely precipitated Wash the precipitate well and dissolve in 25 ml of concentrated ammonium hydroxide and 25 ml of water.

***p*-Nitrobenzene-azo-resorcinol** (reagent for magnesium). Dissolve 1 g of the dye in 10 ml of N NaOH and dilute to 1 liter.

Nitron (detection of nitrate radical). Dissolve 10 g of nitron ($C_{20}H_{16}N_4$, 4, 5-dihydro-1, 4-diphenyl-3, 5-phenylimino-1, 2, 4-triazole) in 5 ml of glacial acetic acid and 95 ml of water. The solution may be filtered with slight suction through an alundum crucible and kept in a dark bottle.

α-Nitroso-β-naphthol. Make a saturated solution in 50% acetic acid (1 part of glacial acetic acid with 1 part of water). Does not keep well.

Nylander's solution (carbohydrates). Dissolve 20 g of bismuth subnitrate and 40 g of Rochelle salts in 1 liter of 8% NaOH solution. Cool and filter.

Obermayer's reagent (for indoxyl in urine). Dissolve 4 g of $FeCl_3$ in one liter of HCl (sp. gr. 1.19).

Oxine. Dissolve 14 g of HC_9H_6ON in 30 ml of glacial acetic acid. Warm slightly, if necessary. Dilute to 1 liter.

Oxygen absorbent. Dissolve 300 g of ammonium chloride in one liter of water and add one liter of concentrated ammonium hydroxide solution. Shake the solution thoroughly. For use as an oxygen absorbent, a bottle half full of copper turnings is filled nearly full with the NH_4Cl-NH_4OH solution and the gas passed through.

Pasteur's salt solution. To one liter of distilled water add 2.5 g of potassium phosphate, 0.25 g of calcium phosphate, 0.25 g of magnesium sulfate and 12.00 g of ammonium tartrate.

Pavy's solution (glucose reagent). To 120 ml of Fehling's solution, add 300 ml of NH_4OH (sp. gr. 0.88) and dilute to 1 liter with water.

Phenanthroline ferrous ion indicator. Dissolve 1.485 g of phenanthroline monohydrate in 100 ml of 0.025 *M* ferrous sulfate solution.

Phenolphthalein. Dissolve 1 g of phenolphthalein in 50 ml of alcohol and add 50 ml of water.

Phenolsulfonic acid (determination of nitrogen as nitrate). Dissolve 25 g of phenol in 150 ml of conc. H_2SO_4, add 75 ml of fuming H_2SO_4 (15% SO_3), stir well and heat for two hours at 100° C.

Phloroglucinol solution (pentosans). Make a 3% phloroglucinol solution in alcohol. Keep in a dark bottle.

Phosphomolybdic acid (Sonnenschein's reagent for alkaloids).

1. Prepare ammonium phosphomolybdate and after washing with water, boil with nitric acid and expel NH_3; evaporate to dryness and dissolve in 2 *N* nitric acid.

2. Dissolve ammonium molybdate in HNO_3 and treat with phosphoric acid. Filter, wash the precipitate, and boil with aqua regia until the ammonium salt is decomposed. Evaporate to dryness. The residue dissolved in 10% HNO_3 constitutes Sonnenschein's reagent.

Phosphoric acid—sulfuric acid mixture. Dilute 150 ml of conc. H_2SO_4 and 100 ml of conc. H_3PO_4 (85%) with water to a volume of 1 liter.

Phosphotungstic acid (Scheibler's reagent for alkaloids).

1. Dissolve 20 g of sodium tungstate and 15 g of sodium phosphate in 100 ml of water containing a little nitric acid.

2. The reagent is a 10% solution of phosphotungstic acid in water. The phosphotungstic acid is prepared by evaporating a mixture of 10 g of sodium tungstate dissolved in 5 g of phosphoric acid (sp. gr. 1.13) and enough boiling water to effect solution. Crystals of phosphotungstic acid separate.

Picric acid (Hager's reagent for alkaloids, wool and silk). Dissolve 1 g of picric acid in 100 ml of water.

Potassium antimonate (reagent for sodium). Boil 22 g of potassium antimonate with 1 liter of water until nearly all of the salt has dissolved, cool quickly, and add 35 ml of 10% potassium hydroxide. Filter after standing over night.

Potassium-cadmium iodide (Marme's reagent for alkaloids). Add 2 g of CdI_2 to a boiling solution of 4 g of KI in 12 ml of water, and then mix with 12 ml of saturated KI solution.

Potassium hydroxide (for CO_2 absorption). Dissolve 360 g of KOH in water and dilute to 1 liter.

Potassium iodide-mercuric iodide (Brucke's reagent for proteins). Dissolve 50 g of KI in 500 ml of water, and saturate with mercuric iodide (about 120 g). Dilute to 1 liter.

Potassium pyrogallate (for oxygen absorption). For mixtures of gases containing less than 28 % oxygen, add 100 ml of KOH solution (50 g of KOH to 100 ml of water) to 5 g of pyrogallol. For mixtures containing more than 28 % oxygen the KOH solution should contain 120 g of KOH to 100 ml of water.

Pyrogallol, alkaline.

(a) Dissolve 75 g of pyrogallic acid in 75 ml of water.

(b) Dissolve 500 g of KOH in 250 ml of water. When cool, adjust until sp. gr. is 1.55.

For use, add 270 ml of solution (b) to 30 ml of solution (a).

Rosolic acid (indicator). Dissolve 1 g of rosolic acid in 10 ml of alcohol and add 100 ml of water.

S and O reagent (Suitsu and Okuma's test for Mg). Dissolve 0.5 g of the dye (*o-p*-dihydroxy-monazo-*p*-nitrobenzene) in 100 ml of 0.25 *N* NaOH.

Scheibler's reagent. See *Phosphotungstic acid.*

Schiff's reagent. See *Fuchsin-sulfurous acid.*

Schweitzer's reagent. See *Cupric oxide, ammoniacal.*

Soap solution (reagent for hardness in water). Dissolve 100 g of dry castile soap in 1 liter of 80 % alcohol (5 parts alcohol to 1 part water). Allow to stand several days and dilute with 70 % to 80 % alcohol until 6.4 ml produces a permanent lather with 20 ml of standard calcium solution. The latter solution is made by dissolving 0.2 g of $CaCO_3$ in a small amount of dilute HCl, evaporating to dryness and making up to 1 liter.

Sodium bismuthate (oxidation of manganese). Heat 20 parts of NaOH nearly to redness in an iron or nickel crucible and add slowly 10 parts of basic bismuth nitrate which has been previously dried. Add two parts of sodium peroxide, and pour the brownish-yellow fused mass on an iron plate to cool. When cold, break up in a mortar, extract with water, and collect on an asbestos filter.

Sodium hydroxide (for CO_2 absorption). Dissolve 330 g of NaOH in water and dilute to 1 liter.

Sodium nitroprusside (reagent for hydrogen sulfide and wool). Use a freshly prepared solution of 1 g of sodium nitroprusside in 10 ml of water.

Sodium oxalate, according to Sörensen (primary standard). Dissolve 30 g of the commercial salt in 1 liter of water, make slightly alkaline with sodium hydroxide, and let stand until perfectly clear. Filter and evaporate the filtrate to 100 ml. Cool and filter. Pulverize the residue and wash it several times with small volumes of water. The procedure is repeated until the mother liquor is free from sulfate and is neutral to phenolphthalein.

Sodium plumbite (reagent for wool). Dissolve 5 g of sodium hydroxide in 100 ml of water. Add 5 g of litharge and boil until dissolved.

Sodium polysulfide. Dissolve 480 g of $Na_2S.9H_2O$ in 500 ml of water, add 40 g of NaOH and 18 g of sulfur. Stir thoroughly and dilute to 1 liter with water.

Sonnenschein's reagent. See *Phosphomolybdic acid.*

Starch solution.

1. Make a paste with 2 g of soluble starch and 0.01 g of HgI_2 with a small amount of water. Add the mixture slowly to 1 liter of boiling water and boil for a few minutes. Keep in a glass stoppered bottle. If other than soluble starch is used, the solution will not clear on boiling; it should be allowed to stand and the clear liquid decanted.

2. A solution of starch which keeps indefinitely is made as follows: Mix 500 ml of saturated NaCl solution (filtered), 80 ml of glacial acetic acid, 20 ml of water and 3 g of starch. Bring slowly to a boil and boil for two minutes.

3. Make a paste with 1 g of soluble starch and 5 mg of HgI_2, using as little cold water as possible. Then pour about 200 ml of boiling water on the paste and stir immediately. This will give a clear solution if the paste is prepared correctly and the water actually boiling. Cool and add 4 g of KI. Starch solution decomposes on standing due to bacterial action, but this solution will keep a long time if stored under a layer of toluene.

Stoke's reagent. Dissolve 30 g of $FeSO_4$ and 20 g of tartaric acid in water and dilute to 1 liter. Just before using, add concentrated NH_4OH until the precipitate first formed is redissolved.

Sulfanilic acid (reagent for nitrites). Dissolve 0.5 g of sulfanilic acid in a mixture of 15 ml of glacial acetic acid and 135 ml of recently boiled water.

Sulfomolybdic acid (Froehde's reagent for alkaloids and glucosides). Dissolve 10 g of molybdic acid or sodium molybdate in 100 ml of conc. H_2SO_4.

Tannic acid (reagent for albumen, alkaloids and gelatin). Dissolve 10 g of tannic acid in 10 ml of alcohol and dilute with water to 100 ml.

Titration mixture. See *Zimmermann-Reinhardt reagent.*

***o*-Tolidine solution** (residual chlorine in water analysis). Prepare 1 liter of dilute HCl (100 ml of HCl (sp. gr. 1.19) in sufficient water to make 1 liter). Dissolve 1 g of *o*-tolidine in 100 ml of the dilute HCl and dilute to 1 liter with dilute HCl solution.

Trinitrophenol solution. See *Picric acid.*

Turmeric paper. Impregnate white, unsized paper with the tincture, and dry.

Turmeric tincture (reagent for borates). Digest ground turmeric root with several quantities of water which are discarded. Dry the residue and digest it several days with six times its weight of alcohol. Filter.

Uffelmann's reagent (turns yellow in presence of a lactic acid). To a 2% solution of pure phenol in water, add a water solution of $FeCl_3$ until the phenol solution becomes violet in color.

Wagner's reagent. See *Iodo-potassium iodide.*

Wagner's solution (used in phosphate rock analysis to prevent precipitation of iron and aluminum). Dissolve 25 g of citric acid and 1 g of salicylic acid in water and dilute to 1 liter. Use 50 ml of the reagent.

Wij's iodine monochloride solution (for iodine number). Dissolve 13 g of resublimed iodine in 1 liter of glacial acetic acid which will pass the dichromate test for reducible matter. Set aside 25 ml of this solution. Pass into the remainder of the solution dry chlorine gas (dried and washed by passing through H_2SO_4 (sp. gr. 1.84)) until the characteristic color of free iodine has been discharged. Now add the iodine solution which was reserved, until all free chlorine has been destroyed. A slight excess of iodine does little or no harm, but an excess of chlorine must be avoided. Preserve in well stoppered, amber colored bottles. Avoid use of solutions which have been prepared for more than 30 days.

Wij's special solution (for iodine number—Analyst **58,** 523–7, 1933). To 200 ml of glacial acetic acid that will pass the dichromate test for reducible matter, add 12 g of dichloroamine T (paratoluene-sulfonedichloroamide), and 16.6 g of dry KI (in small quantities with continual shaking until all the KI has dissolved). Make up to 1 liter with the same quality of acetic acid used above and preserve in a dark colored bottle.

Zimmermann-Reinhardt reagent (determination of iron). Dissolve 70 g of $MnSO_4.4H_2O$ in 500 ml of water, add 125 ml of conc. H_2SO_4 and 125 ml of 85% H_3PO_4, and dilute to 1 liter.

Zinc chloride solution, basic (reagent for silk). Dissolve 1000 g of zinc chloride in 850 ml of water, and add 40 g of zinc oxide. Heat until solution is complete.

Zinc uranyl acetate (reagent for sodium). Dissolve 10 g of $UO_2(C_2H_3O_2)_2.2H_2O$ in 6 g of 30% acetic acid with heat, if necessary, and dilute to 50 ml. Dissolve 30 g of $Zn(C_2H_3O_2)_2.$-$2H_2O$ in 3 g of 30% acetic acid and dilute to 50 ml. Mix the two solutions, add 50 mg of NaCl, allow to stand over night and filter.

STANDARD SOLUTIONS FOR VOLUMETRIC ANALYSIS

Acids

Hydrochloric acid, normal. (36.465 g per liter) (a) 180.15 g of constant boiling point (760 mm) acid diluted to 1 liter gives an exactly normal solution. (b) Concentrated HCl diluted to d 1.020 is approximately normal. (c) Concentrated HCl contains about one-third of its weight of HCl and 120 g diluted with water to 1 liter will give an acid slightly greater than normal. Solutions prepared as in (b) or (c) are most accurately standardized by precipitation as AgCl.

Hydrochloric acid solutions, standard, by the method of G. A. Hulett and W. D. Bonner. *Jour. Am. Chem. Soc.* **31,** 390 (1909). Standard HCl is easily prepared by starting with HCl of about d 1.10, made up with an ordinary hydrometer, distilling off and discarding the first three-fourths of the liquid taken; the distillate which is then collected does not differ by more than one part in 10,000 from the values in the table below. This constant boiling acid is not hygroscopic or noticeably volatile and is easily weighed in a small flask. By the use of a capillary pipette, to adjust the last amount of acid, it is a very simple matter to weigh out 180.15 g to less than 10 mg and this furnishes sufficient acid to make a liter of normal solution with an accuracy that is seldom attained even with very elaborate precautions.

Constant Boiling Hydrochloric Acid

Bonner-Titus, J.A C.S., **52,** 633, 1930; Bonner-Wallace, J.A.C.S., **52, 1747.**

Pressure	B.P.	Density	% HCl	Pressure	B.P.	Density	% HCl	g for 1 l of N sol.
100	62.4	1.1095	22.97	600	102.209	1.0980	20.638	176.52
200	75.9	1.1058	22.202	700	106.424	1.0966	20.360	178.93
300	84.9	1.1031	21.660	760	108.584	1.0959	20.222	180.15
400	92.080	1.1010	21.235	800	110.007	1.0955	20.155	180.74
500	97.578	1.0993	20.916	1000	116.185	1.0933	19.734	
				1200	122.38	1.0917	19.42	

Slightly different figures are given for a range near atmospheric pressure by Hollingsworth and Foulk.

Bar. pressure	% HCl by weight	Wt. HCl sol. for 1 mole HCl
770	20.197	180.407
760	20.221	180.193
750	20.245	179.979
740	20.269	179.766
730	20.293	179.555

Nitric acid, normal. (63.016 g per liter) Use a colorless acid, d 1.3 ±, free from chlorine and nitrous acid; a yellow color due to lower oxides of nitrogen is removed by adding about 2 volumes of water, boiling, cooling and then diluting to volume. 65 ml or 93 g of acid, d 1.42 diluted to 1 liter gives an acid slightly greater than normal. Standardize by titration with standard alkali.

Oxalic acid, normal. $H_2C_2O_4$ (63.023 g of $H_2C_2O_4.2H_2O$ or 45.008 g of $H_2C_2O_4$ per liter) Because of the uncertainty in the amount of water of crystallization, standards in dry climates cannot be prepared directly by dissolving a weighed quantity of acid. However, in a humid atmosphere finely ground oxalic acid crystals may be exposed to the air for a few hours, and brought to the proper composition. Unless this is done it is necessary to standardize the solution against alkali of known concentration using phenolphthalein as an indicator. Decinormal or less concentrated solutions are unstable and should be prepared fresh when needed; more concentrated solutions may deposit some of the acid when cooled to low temperatures but they are fairly stable at room temperature when protected from light.

Potassium acid phthalate, decinormal. ($KHC_8H_4O_4$, 10.207 g per 500 ml) This monobasic acid is recommended for the preparation of standard acid solutions, since it has a high equivalent weight, is anhydrous, stable, non-hygroscopic, and can be purchased with a purity factor of 99.95%. Spread 10–11 g of the salt in a thin layer on a watch glass and dry at 110–120° C in an electric oven for 2–3 hours. Cool in a desiccator and weigh to the nearest milligram. Transfer the salt to a 500 ml volumetric flask, with aid of a funnel, and reweigh the watch glass with any adhering powder. Dissolve the salt in the flask, dilute to volume, and mix thoroughly. Compute the normality of the solution by the equation

$$\text{Normality} = \frac{\text{Weight of salt} \times \text{purity}}{102.07}$$

Potassium acid phthalate is suitable for the titration of carbonate-free strong bases, using phenolphthalein indicator, but is not suitable for titration of ammonium hydroxide.

Succinic acid, decinormal. $H_2C_4H_4O_4$ (5.9023 g per liter) Dry 5–6 g of pure succinic acid in an open weighing bottle at 105° for about 10 hours; cool in a desiccator. Weigh out accurately 2.9512 g, brush into a 400 ml beaker and dissolve in 150–200 ml of water; pour the solution into a 500 ml graduated flask, rinsing out the beaker several times to insure complete transference of the acid. Dilute to exactly 500 ml and mix thoroughly. This prepares an exact decinormal solution.

Sulfuric acid, normal. (49.04 g per liter) Take 30 ml of pure, concentrated H_2SO_4, d 1.84 and pour it cautiously and slowly into about 3–4 volumes of water, cool, mix thoroughly and dilute to 1 liter. Standardize by titration with standard

NaOH or KOH solutions with phenolphthalein as indicator. For a decinormal solution use 3 ml H_2SO_4 per liter and proceed as above. Sulfuric acid is obtained easily in a pure form; the normal acid solution is not affected by boiling (advantage over similar HNO_3 or HCl solutions); when used with lime or similar compounds, it gives precipitates and for such cases HCl is preferable.

Bases

For the titration of weak acids, bases should be made free of carbonate and used with phenolphthalein indicator. Such solutions should be stored in siphon-equipped bottles and protected from carbon dioxide by a soda-lime tube on the air inlet. The burette used for the titration should be capped by a one-hole stopper bearing a small tube of soda lime. If a base is to be used only for the titration of strong acids, it is unnecessary to remove carbonate or to protect the solution from carbon dioxide, since absorption of the latter does not change the alkaline value of the solution. Bases containing carbonate should be used with methyl orange indicator.

Potassium hydroxide, normal. (56.108 g per liter) Dissolve 64 g of potassium hydroxide, of assay value 85 % or better, in water and dilute to 1 liter. Standardize as directed for sodium hydroxide.

Sodium hydroxide, decinormal. Carbonate free. Prepare the carbonate free solution by one of the following methods:

1. Dissolve 6 g of sodium hydroxide in 200 ml of water. heat to boiling, and slowly add to the boiling solution 5 ml of 5 % barium chloride solution. Allow the precipitate to settle, add a few drops of barium chloride solution and notice whether a fresh precipitate forms. If more precipitate is formed, add another 5 ml of the reagent, and again test for completeness of precipitation of carbonate. Continue in this manner until no further precipitate forms. Allow the precipitate to settle, decant off two-thirds of the clear solution, and dilute to 1 liter with freshly boiled water. Standardize by titrating weighed 0.6–0.8 g portions of dry potassium acid phthalate, dissolved in 100 ml of water. Use phenolphthalein indicator.

2. (Recommended method) Dissolve 7 g of sodium hydroxide in 7 ml of water and filter the viscous liquid through an asbestos mat in a Gooch crucible, with aid of suction. Catch the filtrate in a small dry test tube. Do not wash the residue. Pour off two-thirds of the clear filtrate and dilute to 1 liter with freshly boiled water.

3. Place within an empty vacuum desiccator a beaker of water and a dry beaker containing 2.3 g of sodium metal, cut into thin shavings. The sodium must be clean and free of oil. Connect the desiccator to a water aspirator pump and evacuate. In the atmosphere of water vapor thus formed, the sodium metal quickly reacts to form sodium hydroxide. Continue to evacuate the desiccator until all the metal has dissolved and a clear solution remains in the beaker. Dilute all this solution to 1 liter with freshly boiled water.

Sodium hydroxide, normal. (40.005 g per liter) Dissolve 42 g of sodium hydroxide sticks or pellets, of assay value 95 % or better, in water and dilute to 1 liter. Standardize with normal hydrochloric acid or sulfuric acid, using methyl orange indicator.

Oxidizing and Reducing Solutions

Arsenite, alkaline, decinormal. $As^{iii} \rightarrow As^{v}$ (4.9465 g As_2O_3 per liter; equivalent to 0.0126932 g I or 0.0035457 g Cl per ml) Dissolve 4.9465 g of pure sublimed As_2O_3 in a concentrated solution of 4 g of NaOH, add 100 ml of a saturated $NaHCO_3$ solution and dilute to 1 liter. Do not warm the solution above 60° C when dissolving the As_2O_3. Standardize against standard iodine solution with a starch indicator.

Ceric sulfate (oxidizing agent). Ceric sulfate is a strong oxidizing agent in acid solutions, is stable over a long period, can be used to titrate reducing agents in the presence of HCl and has only one valence change from 4 to 3. It can be used as a volumetric reagent in acid medium only since perceric compounds are formed in an alkaline medium. It cannot be used as its own indicator if the solution is colored.

1. The solution is made up for use by adding 64–66 g of ceric ammonium sulfate, $Ce(SO_4)_2.2(NH_4)_2SO_4.2H_2O$ or 35–40 g of ceric sulfate, $Ce(SO_4)_2$, to a solution of 500 ml of H_2O and 28 ml of concentrated H_2SO_4. The solution should be stirred until all is dissolved and 500 ml more of distilled water added.

2. Alternative method. To 35 g of ceric oxide in a 600 ml beaker, add 46 ml of concentrated H_2SO_4. Carefully add 50 ml of water and heat at boiling for five minutes. Cool somewhat and add, carefully, 450 ml of water. Digest until solution is complete. Filter, if necessary, dilute to 1000 ml and standardize.

The solution can be standardized against arsenious oxide dissolved in NaOH and acidified with H_2SO_4; against sodium oxalate or electrolytic iron by the Zimmermann-Reinhardt Method, using sodium diphenylamine sulfonate as indicator. The indicator acid is tri-ortho-phenanthroline ferrous sulfate, $(C_{12}H_8N_2.H_2O)FeSO_4$. The reaction involved in the standardization with sodium oxalate is $H_2C_2O_4 + 2Ce(SO_4)_2 = 2CO_2 + Ce_2(SO_4)_3 + H_2SO_4$.

An amount of sodium oxalate is weighed out which will require 25–35 ml of 0.1 *N* ceric sulfate solution for titration. To this is added 10–20 ml of concentrated HCl, 5 ml of 0.005 *M* iodine chloride and enough water to make a volume of 100 ml. The solution should be heated to 50° C, 1 drop of indicator added, and the solution titrated with ceric sulfate until the solution becomes pale blue in color and there is no return of any pink color after one minute. The temperature should not fall below 45° C.

Ceric sulfate may be used to titrate ferrous chloride according to the reaction: $2FeCl_2 + 2Ce(SO_4)_2 + 2HCl = 2FeCl_3 + Ce_2(SO_4)_3 + H_2SO_4$.

Calcium may be precipitated as the oxalate, dissolved in dilute HCl and titrated with ceric sulfate. Chromium, arsenic, ferrocyanide and hydrogen peroxide may be titrated with ceric sulfate.

Iodine, decinormal. $I_2 \rightarrow 2HI$ (12.6932 g per liter) Dissolve about 13.5 g of pure sublimed iodine in a solution of 24 g of KI in 200 ml of H_2O and dilute to 1 liter. The solution is standardized by adding the iodine to a known volume of standard thiosulfate with a few drops of starch solution for the indicator.

Potassium dichromate, decinormal. $Cr^{vi} \rightarrow Cr^{iii}$ (4.904 g per liter) Grind about 5 g of potassium dichromate, of the purest grade obtainable, spread in a thin layer on a watch glass, and dry in an electric oven at 120–140° C for 2–4 hours. Cool in a desiccator and weigh to the nearest milligram. Transfer the powder to a 1 liter volumetric flask, with the aid of a funnel, and reweigh the watch glass with any adhering powder. Add water to the flask, shake until the sample is dissolved, dilute to volume and mix thoroughly. Compute the normality from the equation

$$\text{Normality} = \frac{\text{Weight potassium dichromate}}{49.04}$$

If pure dichromate is not available the solution mav be standardized by iron wire or against an iron ore of known analysis. Weigh out three 0.2 g samples of clean, bright iron wire (prepared "for standardization", with purity factor of 99.8 %) and transfer each to a 500 ml Erlenmeyer flask. Dissolve the wire in 10 ml of concentrated hydrochloric acid, keeping the flask covered with a small watch glass until solution is complete. Disregard a small residue of carbon which may remain in the solution as black particles. Rinse off the watch glass, heat the solution nearly to boiling and add stannous chloride solution (5 g of salt dissolved in 10 ml of concentrated hydrochloric acid, and diluted to 100 ml) a drop at a time until the solution is colorless. *Avoid an excess of over one drop of stannous chloride.* Cool completely and pour in 10 ml of saturated mercuric chloride solution. Allow to stand 2 minutes, then add a well cooled solution of 5 ml of 85 % phosphoric acid in 200 ml of 3 N sulfuric acid (8:100). Add 6–8 drops of an indicator solution (containing 3 g of the sodium or barium salt of diphenylamine sulfonic acid per liter) and titrate with dichromate solution to the first appearance of a purple or violet tinge. The titration should be made slowly, since the reaction proceeds rather slowly. Run a blank. From the net volume of dichromate, compute the normality by the equation

$$\text{Normality} = \frac{\text{Weight of iron wire} \times \text{purity of iron}}{\text{Volume of dichromate} \times 0.05584}$$

Potassium permanganate, decinormal. $Mn^{vii} \rightarrow Mn^{ii}$ (3.1606 g per liter) Dissolve 3.3 g of dry $KMnO_4$ in 1 liter of distilled water and allow to stand at least 24 hours in a clean glass-stoppered bottle. The reasons for not using the freshly prepared solution are: 1st, the reducing agents in the water (dust, etc.) are thus all oxidized, and 2nd, any MnO_2 formed by this reduction is permitted to settle. The solution is then carefully siphoned through a clean glass tube into clean beakers, discarding the first 25 ml of solution and the last inch of the solution in the bottle which contains the precipitated MnO_2; the $KMnO_4$ solution should never be permitted to come in contact with rubber, filter paper or other organic matter. The solution in the beakers is now poured back into a clean bottle and standardized against sodium oxalate. Weigh out several 0.25–0.30 g samples of sodium oxalate having an assay value of 99.95 %, transfer each portion to a 600 ml beaker, and dissolve in 250 ml of dilute sulfuric acid (5:95). Stir until the oxalate has dissolved, then add rapidly* from a burette about 95 % of the amount of permanganate needed for complete oxidation of the sample (a preliminary titration is made with one sample to determine the approximate amount of permanganate needed). Allow the solution to stand until the permanganate is decolorized, then heat to 55–60° C and complete the titration at this temperature, stirring *gently* with a thermometer and allowing each drop to become decolorized before adding the next. The end point is shown by a faint pink tinge which persists for 30 seconds. Run a blank on 250 ml of dilute sulfuric acid, heated to 60° C. From the net volume of permanganate, compute the normality by the equation

$$\text{Normality} = \frac{\text{Weight sodium oxalate} \times \text{purity}}{\text{Volume permanganate} \times 0.067}$$

Sodium thiosulfate, decinormal. $2Na_2S_2O_3 \rightarrow Na_2S_4O_6$ (24.8192 g of $Na_2S_2O_3.5H_2O$ per liter) Do not dry the sodium thiosulfate in an oven as it can be obtained almost pure; weigh out 25.0 g and dilute to exactly 1 liter. After mixing thoroughly, the solution is allowed to stand two weeks. If free sulfur has separated, the clear liquid is siphoned off. The solution is standardized indirectly by titration with potassium dichromate (see above). Dissolve 5 g of KI and 4 g of $NaHCO_3$ in 300 ml of H_2O in a 500 ml Erlenmeyer flask at room temperature and then add HCl slowly, swirling the flask, until there is no more evolution of CO_2 and then add about 10 ml more acid; add 35 ml of 0.1 N $K_2Cr_2O_7$, mixing the solutions, rinse the sides of the flask with a few ml of water, allowing it to form a layer over the solution without mixing; stopper the flask and allow to stand about 10 minutes. Then with thorough mixing run in thiosulfate until the solution is a light yellow, add a few drops of starch solution and continue with a slow addition of thiosulfate until the bright blue color has disappeared and only the pale green color of $CrCl_3$ remains.

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* The method given for standardization is based upon the directions of Fowler and Bright, Bur. Stand. J. Res., **15**, 493 (1935)

ACID DILUTION BY VOLUME

The volume of pure acid (or water) which must be added to 50 cm^3 of water (or acid) to give solutions of specific gravity shown. Temperature 20°C. Taken from curves prepared by W. W. Stiles, based on experimental determinations. The values are approximate only.

Sulfuric Acid	
Sp. gr.	Acid cm^3
0.9982	0.0
1.01	0.2
1.02	0.5
1.03	0.9
1.04	1.3
1.05	1.7
1.06	2.2
1.07	2.7
1.08	3.2
1.09	3.7
1.10	4.3
1.11	4.9
1.12	5.5
1.13	6.2
1.14	6.9
1.15	7.6
1.16	8.3
1.17	9.0
1.18	9.7
1.19	10.5
1.20	11.3
1.21	12.1
1.22	12.9
1.23	13.7
1.24	14.5
1.25	15.3
1.26	16.1
1.27	16.9
1.28	17.8
1.29	18.7
1.30	19.6
1.31	20.6
1.32	21.6
1.33	22.7
1.34	23.8
1.35	25.0
1.36	26.2
1.37	27.4
1.38	28.6
1.39	29.8
1.40	31.1
1.41	32.5
1.42	33.9
1.43	35.4
1.44	36.8

Sulfuric Acid	
Sp. gr.	Acid cm^3
1.45	38.4
1.46	40.2
1.47	42.3
1.48	44.5
1.49	46.6
1.50	48.7
Sp. gr.	Water cm^3
1.51	49.3
1.52	47.2
1.53	45.2
1.54	43.3
1.55	41.4
1.56	39.5
1.57	37.7
1.58	36.0
1.59	34.3
1.60	32.8
1.61	31.4
1.62	30.0
1.63	28.6
1.64	27.2
1.65	25.9
1.66	24.6
1.67	23.3
1.68	22.0
1.69	20.7
1.70	19.4
1.71	18.1
1.72	16.9
1.73	15.6
1.74	14.3
1.75	13.0
1.76	11.7
1.77	10.4
1.78	9.1
1.79	7.6
1.80	6.0
1.81	4.4
1.82	2.8
1.83	.5

Hydrochloric acid	
Sp. gr.	Acid cm^3
0.9982	0.0
1.000	0.4
1.005	1.4
1.010	2.7
1.015	4.1
1.020	5.6
1.025	7.1
1.030	8.6
1.035	10.2
1.040	11.8
1.045	13.8
1.050	15.9
1.055	18.4
1.060	21.1
1.065	24.
1.070	26.8
1.075	30.
1.080	33.7
1.085	37.9
1.090	42.2
1.095	47.0
1.100	47.8
Sp. gr.	Water cm^3
1.105	42.2
1.110	37.6
1.115	33.7
1.120	30.0
1.125	26.4
1.130	23.2
1.135	20.0
1.140	17.2
1.145	14.8
1.150	12.4
1.155	10.
1.160	8.
1.165	5.9
1.170	3.9
1.175	2.1
1.180	0.6
1.185	0.0

Nitric acid	
Sp. gr.	Acid cm^3
0.9982	0.0
1.00	0.2
1.01	1.1
1.02	1.9
1.03	3.
1.04	4.1
1.05	5.2
1.06	6.4
1.07	7.7
1.08	9.1
1.09	10.6
1.10	12.
1.11	13.5
1.12	15.1
1.13	16.8
1.14	18.5
1.15	20.3
1.16	22.3
1.17	24.4
1.18	26.7
1.19	29.3
1.20	32.1
1.21	35.1
1.22	38.3
1.23	41.8
1.24	45.6
1.25	49.4
Sp. gr.	Water cm^3
1.26	46.9
1.27	43.2
1.28	39.3
1.29	35.5
1.30	31.7
1.31	28.2
1.32	24.9
1.33	21.8
1.34	18.8
1.35	15.9
1.36	12.9
1.37	9.9
1.38	7.1
1.39	4.5
1.40	2.1
1.408	0.0

ORGANIC ANALYTICAL REAGENTS

Compiled by John H. Yoe

Determination	Reagent	Reference
Acetate	*o*-Nitrobenzaldehyde	Feigl, p. 398 (8)
Aldehydes	Dimethyl-dihydroresorcin (Dimedon)	Ind. Eng. Chem., Anal. Ed. **3,** 365 (1931)
Aluminum	Alizarin S	J. Am. Chem. Soc. **50,** 748 (1928)
	Ammonium salt of aurin tricarboxylic acid ("Aluminon")	" " **49,** 2395 (1927) " " **55,** 2437 (1933)
	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Bull. soc. chim. Belg. **36,** 288 (1927)
	Eriochrome cyanine	Z. anal. Chem. **96,** 91 (1934)
	Hematoxylin	Ind. Eng. Chem. **16,** 233 (1924)
	8-Hydroxyquinoline	J. Am. Chem. Soc. **50,** 1900 (1928)
	Morin	Feigl, p. 142 (8) Ind. Eng. Chem., Anal. Ed. **12,** 229 (1940)
	Quinalizarine	J. Am. Pharm. Assoc. **17,** 260 (1928)
	Sodium or zinc salt of 4-sulfo-2 hydroxy-α-naphthalene-azo-β-naphthol (Pontachrome Blue Black R)	Sandell, p. 151 (10)
	Urea	Ind. Eng. Chem., Anal. Ed. **9,** 357 (1937)
Ammonia	Hematoxylin	Helv. Chim. Acta **12,** 730 (1929)
	p-Nitrobenzenediazonium chloride	Feigl, p. 182 (8)
	Phenol and sodium hypochloride	Snell, p. 658 (7)
	Tannin—$AgNO_3$	Snell, Vol. I, p. 659 (7)
	Thymol	J. Biol. Chem. **131,** 309 (1939)
	Zinc oxinate	Feigl, p. 674 (9)
Antimony	Hexamethylenetetramine	Z. anal. Chem. **67,** 298 (1925)
	9-Methyl-2,3,7-tryhydroxyfluorone	Helv. Chim. Acta **20,** 1427 (1937)
	Phenylthiohydantoic acid	Compt. rend. **176,** 1221 (1923)
	Pyridine	Analyst **53,** 373 (1928)
	Pyrogallol	Z. anal. Chem. **64,** 44 (1924)
	Rhodamine B	Z. anal. Chem. **70,** 400 (1927)
Arsenic	Cocaine-molybdate	Biochem. Z. **185,** 14 (1927)
	N-Ethyl-8-hydroxytetrahydroquinoline hydrochloride	Z. anal. Chem. **99,** 180 (1934)
	Quinine arsenomolybdate	Analyst **47,** 317 (1922)
	Strychnine-molybdate	Ann. chim. applicata **23,** 517 (1933)
Barium	Sodium rhodizonate	Feigl, p. 165 (8)
Beryllium	1-Amino-4-hydroxyanthraquinone	Ind. Eng. Chem., Anal. Ed. **13,** 809 (1941)
	Aurin trycarboxylic	J. Am. Chem. Soc. **48,** 2125 (1926); ibid., **50,** 353 (1928)
	Curcumin	J. Am. Chem. Soc. **50,** 393 (1928)
	1,4-Dihydroxyanthraquinone (Quinizarin)	Ind. Eng. Chem. Anal. Ed., **18,** 179 (1946)
	1.4-Dihydroxyanthraquinone-2-sulfonic acid (quinizarine-2-sulfonic acid)	Sandell, p. 205 (10)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Beryllium (Cont.)	8-Hydroxyquinoline	Bur. Standards J. Research **3,** 91 (1929)
	Morin	Ind. Eng. Chem., Anal. Ed. **12,** 674, 762 (1940)
	Naphthochrome Azurine 2B	Sandell, p. 205 (10)
	Naphthochrome Green G	Sandell, p. 205 (10)
	p-Nitrobenzeneazo-orcinol	Mikrochemie **14,** 315 (1934)
	1,2,5,8-Tetrahydroxyanthraquinone (Quinalizarin)	Siemens-Konzerns, Beryllium, p 25 (1932)
Bismuth........	Caffeine (as sulfate or nitrate)	Ind. Eng. Chem., Anal. Ed. **14,** 43 (1942)
	Cinchonine	Scott, p. 77 (1)
	Diethyldithiocarbamate	Sandell, p. 211 (10)
	Dimercaptothiodiazole	Z. anal. Chem. **98,** 184 (1934); ibid. **100,** 408 (1935)
	Dimethylglyoxime	Z. anal Chem. **72,** 11 (1927)
	Diphenylthiocarbazone	Z Angew. Chem. **47,** 685 (1934); Ind. Eng Chem., Anal. Ed. **7,** 285 (1935)
	8-Hydroxyquinoline	Z anal Chem. **72,** 177 (1927)
	Phenyldithiobiazolonethiol	J. Indian Chem. Soc., **21,** 240, 347 (1944)
	Pyrogallol	Z. anal. Chem. **65,** 448 (1925)
	Thiourea	Z. anal. Chem. **94,** 161 (1933)
Boron..........	Curcumin	Chem. News **87,** 27 (1903)
	Mannitol	Scott, p. 90 (1)
	Methyl alcohol	J. Am. Chem Soc. **50,** 1385 (1928)
	p-Nitrobenzeneazochromotropic acid (Chromotrope 2B)	Feigl, p. 258 (8)
	Quinalizarin	Ind. Eng. Chem., Anal. Ed. **11,** 540 (1939)
	Titan Yellow (Clayton Yellow)	Compt. rend. **138,** 1046 (1904)
	Turmeric	Ind. Eng. Chem., Anal. Ed. **4,** 180 (1932)
Bromine........	Fluorescein	Snell, Vol. I, p. 548 (7)
	Fuchsin	" p. 546 (7)
	Phenol red	" p. 549 (7)
Cadmium.......	Allylthiourea	Helvetica Chim. Acta. **12,** 718 (1929)
	Di-β-naphthylthiocarbazone	Ind. Eng Chem., Anal. Ed., **16,** 333 (1944)
	Dinitrodiphenylcarbazide	Feigl, p. 76 (8)
	Diphenylcarbazide	Feigl, p 78 (8)
	Diphenylthiocarbazone	Z. angew. Chem. **47,** 685 (1934); Ind. Eng. Chem., Anal. Ed. **11,** 364 (1939)
	Ethylenediamine	Z. anal. Chem. **77,** 340 (1929)
	Hexamethylenetetramine alliodide	C. A., **24,** 311 (1930)
	β-Naphthoquinoline	Analyst, **58,** 667 (1933)
	Nitrophenolarsinic acid	Mikrochemie **8,** 277 (1930)
	4-Nitrophthalene-diazo-aminobenzene-4-azobenzene (Cadion 2B)	C. A. **32,** 2871 (1938)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Cadmium (Cont.)	Phenyl-trimethyl-ammonium iodide	Analyst **58,** 667 (1933)
	Pyridine	Z. Anal. Chem. **73,** 279 (1928)
Calcium	Alizarin	Biochem. J. **16,** 494 (1922); Yoe, Vol. I, p. 139 (2)
	1-amino-2-naphthol-4-sulfonic acid	J. Biol. Chem. **81,** 1 (1929)
	Ammonium oxalate	Snell, Vol. I, p. 463 (7)
	Ammonium stearate	J. Biol. Chem. **29,** 169 (1917); Yoe, Vol. II, p. 119 (3)
	Antipyrine	Snell, Vol. I, p. 462 (7)
	2,5-Dichloro-3,6-dihydroxyquinone (Chloranilic acid)	Anal. Chem., **20,** 76 (1948)
	Dihydroxytartaric acid osazone (sodium salt)	Feigl, p. 170 (8)
	Picrolonic acid	Biochem. Z. **265,** 85 (1933)
	Potassium oleate	Sandell, p. 248 (10)
	Pyrogallol carboxylic acid	Sandell, p. 248 (10)
	Sodium sulforicinate	Biochem. Z. **137,** 157 (1923); Yoe, Vol. II, p. 125 (3)
Cerium	Benzidine	Feigl, p. 161 (8)
	Brucine	Sandell, p. 253 (10)
	Gallic acid	Snell, Vol. 1, p. 366 (7)
	8-Hydroxyquinoline	Analyst, **75,** 275 (1948)
	Malachite Green	C.A. **30,** 5143 (1936), **31,** 626 (1937)
	Morphine	Sandell, p. 253 (10)
	Sulfanilic acid	Sandell, p. 253 (10)
Cesium	Dipicrylamine (Hexanitrodiphenylamine)	Mikrochemie 18, 175 (1935)
Chlorate	Aniline hydrochloride	Snell, Vol. I, p. 588 (7)
Chlorine	Benzidine hydrochloride	Ind. Eng. Chem., Anal. Ed. **4,** 2 (1932)
	Dimethyl-*p*-phenylene-diamine	Chem. Weekblad. **23,** 203 (1926)
	Oleic acid	J. Soc. Chem. Ind. **42,** 427A (1923)
	Sodium sulforicinate	Biochem. Z., **137,** 157 (1923); Yoe, Vol. II, p. 125 (3)
	Thymolphthalein	Ind. Eng. Chem. **19,** 112 (1927)
	o-Tolidine	Yoe, Vol. I, p. 157 (2)
Chromium	Benzidine	Feigl, p. 131 (8)
	1,8-Dihydroxynaphthalene-3,6-Disulfonate	Ind. Eng. Chem. **5,** 298 (1913)
	s-Diphenylcarbazide	J. Am. Chem. Soc. **50,** 2363 (1928)
	Pyrogallol dimethyl ether	C. A. **4,** 3178 (1910)
	Serichrome Blue R	Ind. Eng. Chem., Amal. Ed., **4,** 245 (1932)
Cobalt	Anthranilic acid (*o*-aminobenzoic acid)	Z. anal. Chem. **93,** 241 (1933)
	Cysteine hydrochloride	J. Biol. Chem. **83,** 367 (1929)
	Dimethylglyoxime	J. Am. Chem. Soc. **43,** 482 (1921)
	3,5-Dimethylpyrazole	Ind. Eng. Chem., Anal. Ed. **2,** 38 (1930)
	Dinitrosoresorcinol	J. Am. Chem. Soc. **45,** 1439 (1923)
	Formaldoxime reagent	C. A. **27,** 927 (1933)
	o-Nitrosocresol	Sandell, p. 279 (10)
	α-Nitroso-β-naphthol	Chem. Zeit. **46,** 430 (1922)
	Nitroso-R-salt	J. Am. Chem. Soc. **43,** 746 (1921)

Determination	Reagent	Reference
Cobalt (Cont.)	β-Nitroso-α-naphthol	Ind. Eng. Chem., Anal. Ed. **12,** 405 (1940)
	o-Nitrosophenol	Sandell, p 279 (10)
	Phenylthiohydantoic acid	J. Am. Chem. Soc. **44,** 2219 (1922)
	Rubeanic acid (Dithio-oxamide)	Feigl, p. 112 (8)
	2,2′,2″-Terpyridyl	Ind. Eng. Chem., Anal. Ed., **15,** 74 (1943)
Columbium	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 109 (5)
Copper	Ammonium salt of nitrosophenyl-hydroxylamine ("Cupferron")	Ind. Eng. Chem. **3,** 629 (1911)
	m-Benzamino-semicarbazide	Snell, Vol. I, p. 166 (7)
	Benzidine	Z. anal. Chem. **67,** 31 (1925)
	α-Benzionoxime (Cupron)	Ber. **56,** 2083 (1923)
	Benzotriazole	Ind. Eng. Chem., Anal. Ed. **13,** 349 (1941)
	Diacetyl-dioxime	Analyst **54,** 333 (1929)
	Dihydroxyethyldithiocarbamic acid	Sandell, p. 309 (10)
	p-Dimethylaminobenzalrhodanine	J. Am. Chem. Soc **52,** 2222 (1930) " **47,** 1268 (1925)
	s-Diphenylcarbazide	Chem. Weekblad. **21,** 20 (1924)
	Diphenylthiocarbazone	J. Assoc. Official Agr. Chem. **18,** 192 (1935)
	Hydroquinone	Bull. soc. chim. **31,** 1176 (1922)
	Isatin	Rec trav. chim. 42, 199 (1923)
	Mercaptobenzothiazole	Z. anal. Chem. **102,** 24, 108 (1935)
	α-Naphthol	Bull. soc. chim. **31,** 1176 (1922)
	β-Naphthol	Am J. Pharm. **105,** 62 (1933)
	Phenolphthalein	Compt. rend. **173,** 1082 (1921)
	Phenylthiohydantoic acid	J. Am. Chem. Soc. **44,** 225 (1922)
	Piperidinium piperidyl-dithioformate	Analyst **56,** 736 (1931)
	Potassium ethyl xanthate	Yoe, Vol. I, p. 184 (2)
	Pyridine	Z. anal. Chem. **67,** 27 (1925)
	Rubeanic acid (Dithio-oxamide)	Z anal. Chem. **79,** 94 (1930)
	Salicylaldoxime	J. Chem. Soc. (1933) 314; Feigl, p 40 (8)
	Salicylic acid	Yoe, Vol. I, p. 183 (2)
	Sodium diethyldithiocarbamate	Analyst **54,** 650 (1929)
	o-Tolidine	Z. anal. Chem. **67,** 31 (1925)
	Urobilin	Chem. Weekblad. **27,** 552 (1930)
Cyanide	Benzidine	Feigl, p. 208 (8)
	Phenolphthalin	Analyst **60,** 294 (1935)
	Picric acid	Helv. Chim. Acta **12,** 713 (1929); J. Am. Chem. Soc. **51,** 1171 (1929)
Fluoride	Acetylacetone	Ind. Eng. Chem., Anal. Ed. **5,** 300 (1933)
	Alizarin sodium sulfonate—$Zr(NO_3)_4$	Ind. Eng. Chem., Anal. Ed. **7,** 23 (1935)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Fluoride (Cont.)	*p*-Dimethylaminoazophenylarsonic acid	Feigl, p. 204 (8)
	Triphenyltin chloride	J. Am. Chem. Soc. **54,** 4625 (1932)
	Quinalizarine—$Zr(NO_3)_4$	Ind. Eng. Chem., Anal. Ed. **6,** 61 (1934)
Gallium	8-Hydroxyquinoline	Ind. Eng. Chem., Anal. Ed. **13,** 844 (1941)
	Morin	Mikrochemie **20,** 194 (1936)
	Quinalizarin	J. Am Chem Soc **59,** 40 (1937)
Germanium	Benzidine	Mikrochemie **18,** 66 (1935)
	Quinalizarin	Mikrochemie **18,** 48 (1935)
Gold	Benzidine	Bull. Chim. Farm. **52,** 461 (1912)
	o-Dianisidine	Sandell, p. 352 (10)
	Dimethylaminobenzylidene rhodanine	Feigl, p 100 (8)
	Formaldehyde	Bull. soc. chim. **31,** 717 (1922)
	p-Fuchsine	Ind. Eng. Chem., Anal. Ed., **18,** 400 (1946)
	Malachite Green	Sandell, p. 352 (10)
	m-Phenylenediamine sulfate	Chem. Zeit. **36,** 934 (1912)
	Phenylhydrazine	Ann. chim. anal. **12,** 90 (1907)
	o-Tolidine	Analyst **44,** 94 (1919)
Hafnium	2-Hydroxy-5-methylazobenzene-4-sulfonic acid	Fleigl, p. 288 (9)
Hydrogen sulfide	*p*-phenylenedimethyldiamine sulfate	Yoe, Vol. I, p. 375 (2)
Indium	Diphenylthiocarbazone (Dithizone)	Sandell, p. 358 (10)
	8-Hydroxyquinoline	Z. anorg. allgem. Chem. **209,** 129 (1932)
	Morin	Mikrochim. Acta **2,** 287 (1937)
Iodine	Starch	Snell, Vol. I, p. 569 (7)
	o-Tolidine	J. Am Chem. Soc. **47,** 1000 (1925)
Iridium	Benzidine	Snell, Vol. I, p. 425 (7)
	Malachite Green, leuco base	C. A. **24,** 2689 (1930)
Iron	Acetylacetone	J. Am. Chem. Soc. **26,** 967 (1904)
	Alloxantin	Compt. rend. **180,** 519 (1925)
	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferon")	Ind. Eng. Chem. **3,** 629 (1911)
	Bis-*p*-chlorophenylphosphoric acid	Feigl, p. 294 (9)
	Cysteine	Biochem. Z. **187,** 255 (1927)
	Dimethyl glyoxime	Z. anorg. Chemie **89,** 401 (1914)
	Dinitrosoresorcinol	J. Am. Chem. Soc. **47,** 1268 (1925)
	Diisonitrosoacetone	Chem. Listy **23,** 496 (1929); C. A. **24,** 801 (1930)
	Dioximes (various)	Anal. Chem. **19,** 1017 (1947)
	Diphenylamine	J. Am. Chem. Soc. **46,** 263 (1924)
	α,α'-Dipyridyl	Snell, Vol. I, p. 310 (7)
	Disodium-1,2-dihydroxybenzene-3,5-disulfonate ("Tiron")	Ind. Eng. Chem., Anal. Ed. **16,** 111 (1944)
	Hexamethylenetetramine	Bull soc. chim. Rom. **2,** 89 (1921)
	8-Hydroxyquinoline	Bull. soc. chim. biol., **17,** 432 (1935)
	4-Hydroxybiphenyl-3-carboxylic acid	J. Am. Chem. Soc. **70,** 648 (1948)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Iron (Cont.)	7-Iodo-8-hydroxyquinoline-5-sulfonic acid	J. Am. Chem. Soc. **59,** 872 (1937)
	Isonitrosoacetophenone	Ber. **60,** 527 (1927)
	Isonitrosodimethyldihydroresorcinol	Anal. Chem., **20,** 1205 (1948)
	Kojic acid	Ind Eng Chem., Anal. Ed., **13,** 612 (1941)
	α-Nitroso-β-naphthol	Bull. soc. chim. **35,** 641 (1924)
	Nitroso-R salt	Ind. Chem., Anal. Ed., **14,** 756 (1942); **16,** 276 (1944)
	o-Phenanthroline	Ind. Eng. Chem., Anal Ed. **9,** 67 (1937)
	Protacatechvic acid	J. Biol. Chem., **137,** 417 (1941)
	Pyramidone	Pharm. Weekblad, **63,** 1121 (1926)
	Pyrocatechol	Helv chim. Acta **9,** 835 (1926)
	Salicylaldoxime	Ind Eng. Chem., Anal. Ed., **12,** 448 (1940)
	Salicylic acid	J. Chem. Soc. **93,** 93 (1908)
	Salicylsulfonic acid	Snell, Vol. I, p. 302 (7)
	Sulfosalicylic acid	Biochem. Z. **181,** 391 (1927)
	Thioglycollic acid	J. Am. Chem. Soc. **49,** 1916 (1927)
Lanthanum	8-Hydroxyquinoline	Z. anal. Chem. **107,** 191 (1936)
	Sodium alizarinesulfonate	J Am Chem. Soc., **53,** 1217 (1931)
Lead	Ammonium thiocyanate and pyridine	Z. anal. Chem. **72,** 289 (1927)
	Aniline	Ind. Eng. Chem. **11,** 1055 (1919); Yoe, Vol. I, p. 257 (2)
	Anthranilic acid	Z. anal. Chem. **101,** 85 (1935)
	Carminic acid	Mikrochemie **7,** 301 (1929)
	s-Diphenylcarbazide	Yoe, Vol. I, p 255 (2)
	Diphenylthiocarbazone (Dithizone)	Snell, Vol. I, p. 202 (7)
	Hematein	Yoe, Vol. I, p. 257 (2)
	Salicylaldoxime	Ind Eng. Chem., Anal. Ed. **14,** 359 (1942)
	Tetramethyldiamidodiphenylmethane	Snell, Vol. I, p. 200 (7)
	Thiourea	Z. anorg. Chem. **234,** 224 (1937)
Lithium	Ammonium stearate	J Am. Chem Soc. **52,** 2754 (1930)
Magnesium	Brilliant yellow	Sandell, p. 425 (10)
	Curcumin	Ind. Eng. Chem., Anal. Ed. **4,** 426 (1932)
	Dimethylamine	Z. anorg. Chem. **26,** 347 (1901)
	Hydroquinone	Yoe, Vol. I, p. 264 (2)
	8-Hydroxyquinoline	Z. anal. Chem. **71,** 122 (1927)
	p-Nitrobenzeneazo-α-naphthol	Feigl, p. 173 (8)
	p-Nitrobenzeneazoresorcinol	J. Am. Chem. Soc. **51,** 1456 (1929)
	Oleic acid	Yoe, Vol. I, p. 270 (2)
	Quinalizarin	Feigl, p. 172 (8)
	Thiazole yellow	Sandell, p. 425 (10)
	Titan yellow	C. A. **23,** 1838 (1929)
	Tropeoline OO	Rec. trav. chim., **61,** 849 (1942)
Manganese	Benzidine	Snell, Vol I, p. 343 (7)
	Formaldoxime	Ind. Eng. Chem., Anal. Ed. **9,** 445 (1937); **12,** 307 (1940)
	Tetramethyldiaminodiphenylmethane	Feigl, p. 134 (8); Snell, Vol. I, p. 342 (7)
	4,4-Tetramethyldiaminotriphenylmethane	J. Biol. Chem., **168,** 537 (1947)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Manganese (Cont.)	*o*-Tolidine	Snell, Vol. I, p. 341 (7)
Mercury	Anthranilic acid	Z. anal. Chem. **101,** 88 (1935)
	p-Dimethylaminobenzalrhodamine	J. Am. Chem. Soc. **52,** 2222 (1930)
	Di-β-naphthylthiocarbazone	Sandell, p. 446 (10)
	s-Diphenylcarbazide	Z. angew. Chem. **39,** 791 (1926)
	Diphenylthiocarbazone (Dithizone)	Z. anal. Chem. **103,** 241 (1935)
	Potassium diphenylcarbazone	Snell, Vol. I, p. 180 (7)
	Strychnine sulfate	" p. 185 (7)
Molybdenum	α-Benzoin-oxime (Cupron)	B. S. J. Research **9,** 1 (1932)
	Ethyl ether	Blair, 7th ed. p. 210 (4)
	4-Methyl-1,2-dimercaptobenzene (Dithiol)	J. Am. Pharm. Assoc., **37,** 255 (1948)
	Phenylhydrazine	Ber. **36,** 512 (1903)
	Potassium ethyl xanthate and chloroform	J. Am. Chem. Soc. **44,** 1462 (1922)
	Tannic acid	Chem. Eng. Mining Rev. **11,** 258 (1919)
Nickel	α-Benzil-dioxime	Analyst **38,** 316 (1913)
	Cyclohexanedione-dioxime	Ann. **437,** 148 (1925)
	Dicyandiamidine sulfate	Chem. Zeit. **31,** 335, 911 (1907)
	Diethyldithiocarbamate	Ind. Eng. Chem., Anal. Ed., **18,** 206 (1946)
	Dimethylglyoxime	Chem. Weekblad. **21,** 358 (1924)
	Formaldoxime	Snell, Vol. I, p. 319 (7)
	α-Furildioxime	J. Am. Chem. Soc. **47,** 918 (1925)
	Potassium dithiooxalate	J. Am. Chem. Soc. **54,** 1866 (1932)
	Rubianic acid (Dithio-oxamide)	Feigl, p. 117 (8)
Nitrate	Brucine	Yoe, Vol. I, p. 318 (2)
	Diphenylamine sulfonic acid	J. Am. Chem. Soc. **55,** 1448 (1933)
	Diphenylbenzidine	Yoe, Vol. I, p. 316 (2)
	Diphenyl-endo-anilohydrotriazole ("Nitron")	Fales, Inorg. Quant. Anal. p. 271 (1925)
	Phenoldisulfonic acid	Yoe, Vol. I, p. 313 (2)
	Pyrogallol	" p. 319 (2)
	Strychnine sulfate	" p. 320 (2)
	2:4-Xylenol	J. Assoc. Off. Agri. Chem. **18,** 459 (1935)
Nitrite	Antipyrin	Yoe, Vol. I, p. 311 (2)
	Dimethylaniline	" p. 311 (2)
	Dimethyl-α-Naphthylamine	Ind. Eng. Chem., Anal. Ed. **1,** 28 (1929)
	Diphenylamine sulfate	Yoe, Vol. I, p. 654 (2)
	α-Naphthylamine and β-Naphthylamine-6, 8-Disulfonic acid	J. Pharmacol. **51,** 398 (1934)
	α-Naphthylamine hydrochloride	Yoe, Vol. I, p. 309 (2)
	m-Phenylenediamine	Yoe, Vol. I, p. 310 (2)
	Sulfanilic acid and α-naphthylamine	Yoe, Vol. I, p. 308 (2)
Osmium	Thiourea	Compt. rend. **167,** 235 (1918)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Oxygen	Indigo carmine	Snell, Vol. I, p. 137 (7)
	Pyrogallol	Dennis, Gas Analysis, p. 174 (1929)
Palladium	Dimethylglyoxime	J. Am. Chem. Soc. **57,** 2565 (1935)
	p-Fuchsine	Ind. Eng. Chem., Anal. Ed., **18,** 400 (1946)
	β-Furfuraldoxime	Ind. Eng. Chem., Anal. Ed. **14,** 491 (1942)
	6-Nitroquinoline	J. Am. Chem. Soc. **50,** 3018 (1928)
	p-Nitrosodiphenylamine	J. Am. Chem. Soc. **61,** 2058 (1939)
	p-Nitrosodimethylaniline	J. Am. Chem. Soc. **63,** 3224 (1941)
	p-Nitrosodiethylaniline	Ibid.
Phosphate	1,2,4-Aminonaphthosulfonic acid	Yoe, Vol. I, p. 348 (2)
	Hydroquinone	Yoe, Vol. I, pp. 346 and 353 (2)
	Quinine-molybdate	Yoe, Vol. I, p. 343 (2)
	Strychnine-molybdate	Yoe, Vol. II, p. 142 (3)
Phosphorus	Hydrazine sulfate	Yoe, Vol. I, p. 341 (2)
Potassium	6-Chloro-5-nitrotoluene-3-sulfonic acid	Mikrochem. **14,** 368 (1934)
	Dipicrylamine	Z. angew. Chem. **49,** 827 (1936)
	Picric acid	J. Am. Chem. Soc. **53,** 539 (1931)
Ruthenium	5-Hydroxyquinoline-8-carboxylic acid	Canadian J. Research B25, **49,** (1945)
	Rubianic acid (Dithio-oxamide)	Mikrochemie **15,** 295 (1934)
	Thioglycolyl-β-amidonaphthalide (Thionalid)	Ind. Eng. Chem., Anal. Ed. **12,** 5611 (1940)
	Thiourea	Sandell, p. 528 (10)
Scandium	Morin	Mikrochem. Acta **2,** 9, 287 (1937)
Selenium	Codeine phosphate	Arch. Pharm. **252,** 161 (1914)
	Hydroquinone	Am. J. Sci. **15,** 253 (1928)
	Hydroxylamine hydrochloride	J. Am. Chem. Soc. **47,** 2456 (1925)
	Pyrrol	Snell, Vol. I, p. 604 (7)
	Thiourea	Ann. chim. applicata **17,** 357 (1927); Feigl, p. 231 (8)
Silver	Chromotropic acid	Helvetica Chim. Acta **12,** 714 (1929)
	Dichlorofluorescein	J. Am. Chem. Soc. **51,** 3273 (1929)
	p-Dimethylaminobenzalrhodamine	J. Am. Chem. Soc. **52,** 2222 (1930)
	Diphenylthiocarbazone (Dithizone)	Z. anal. Chem. **101,** 1 (1935)
	Formazylcarboxylic acid	J. Anal Chem. Russ., **2,** 131 (1934); abs. in Analyst, **73,** 352 (1948)
	Methylamine	Mikrochemie **7,** 233 (1929)
	2-Thio-5-keto-4-carbethoxy-1,3-dihydropyrimidine	Ind. Eng. Chem., Anal. Ed. **14,** 148 (1942)
Sodium	6,8-Dichlorobenzoylurea	J. Org. Chem. **3,** 414 (1938)
	Dihydroxy-tartaric acid	J. Russ. Phys. Chem. Soc. **60,** 661 (1928)
	Uranyl zinc acetate	J. Am. Chem. Soc. **51,** 1664 (1929)
Strontium	Sodium rhodizonate	Mikrochemie **2,** 187 (1924)
Sulfide	*p*-Aminodimethylaniline	Snell, Vol. I, p. 593 (7)
Sulfur	*p*-Phenylenedimethyldiamine hydrochloride	Yoe, Vol. I, p. 373 (2)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Tantalum	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 113 (5)
	Pyrogallol	Sandell, p. 294 (10)
Tellurium	Hydrazine hydrochloride	J. Am. Chem. Soc. **47,** 2456 (1925)
	Hydroquinone	Am. J. Sci. **15,** 253 (1928)
	Thiourea	Ann. chim. applicata **17,** 359 (1927)
Thallium	Diphenylthiocarbazone (Dithizone)	Analyst **60,** 394 (1935)
	Thionalid (Thioglycolyl-β-amidonaphthalide)	Z. angew. Chem. **48,** 430, 597 (1935)
Thorium	1-Amino-4-hydroxyanthraquinone	Ind. Eng. Chem., Anal. Ed. **13,** 809 (1941)
	Cupferron (Ammonium nitrosophenylhydroxylamine)	Chem. Ztg. **33,** 1298 (1908)
	8-Hydroxyquinoline	Z. anal. Chem. **100,** 98 (1935)
	Phenylarsonic acid	J. Am. Chem. Soc. **48,** 895 (1926)
Tin	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 113 (5)
	Cacotheline	Ind. Eng. Chem., Anal. Ed. **7,** 26 (1935)
	4-Chloro-1,2-dimercaptobenzene (1-chloro-benzene-3,4-dithiol)	J. Chem. Soc. **149,** 175 (1936)
	Hematoxylin	Sandell, p. 570 (10)
	Quinalizarin	Sandell, p. 570 (10)
	Toluene-3,4-dithiol (4-methyl-1,2-dimercaptobenzene)	Analyst **61,** 242 (1936); Ibid., **62,** 661 (1937)
Titanium	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 113 (5); Z. anal. Chem. **83,** 345 (1931)
	Chromotropic acid	Feigl, p. 151 (8)
	5,7-Dibromo-8-hydroxyquinoline	Z. anorg. Chem. **204,** 215 (1932)
	Dihydroxymaleic acid	Snell, Vol. I, p. 365 (7)
	Disodium 1,2-dihydroxybenzene-3,5-disulfonate ("Tiron")	Ind. Eng. Chem., Anal. Ed. **19,** 100 (1947)
	Gallic acid	Snell, Vol. I, p. 365 (7)
	p-Hydroxyphenylarsonic acid	Ind. Eng. Chem., Anal. Ed. **10,** 642 (1938)
	8-Hydroxyquinoline	Z. anal. Chem. **81,** 1 (1930)
	Resoflavine (Color Index 1015)	Anal. Chim. Acta, **1,** 244 (1947)
	Tannic acid	Analyst **55,** 605 (1930)
	Thymol	Yoe, Vol. I, p. 381 (2)
Tungsten (Wolfram)	Anti-1,5-di-(*p*-methoxyphenyl)-1-hydroxylamino-3-oximino-4-pentene ("Wolfron")	Ind. Eng. Chem., Anal. Ed. **16,** 45 (1944)
	Benzidine	Ber. **38,** 783 (1905)
	α-Benzoinoxime ("Cupron")	Bur. Std. J. Research **9,** 1 (1932)
	Cinchonine	Hillebrand and Lundell, p. 553 (5)
	Hydroquinone	Z. angew. Chem. **44,** 237 (1931)

ORGANIC ANALYTICAL REAGENTS (Continued)

Determination	Reagent	Reference
Tungsten (Cont.)	Phenylhydrazine	Bull. soc. chim. Belg. **38,** 385 (1929)
	Rhodamine B.	Snell, Vol. I, p. 379 (7)
	Toluene-3,4-dithiol	Analyst, **69,** 109 (1944); J. Am. Pharm. Assoc., **37,** 255 (1948)
	Uric acid	Ann. chim. anal. **9,** 371 (1904)
Uranium........	*o*-Hydroxybenzoic acid	Snell, Vol. I, p. 394 (7)
	α-Quinaldinic acid	Z. anal. Chem. **95,** 400 (1933)
	Sodium diethyldithiocarbamate	Sandell, p. 603 (10)
	Sodium salicylate	Chem. Zeit. **43,** 739 (1919)
	Thioglycolic acid (Mercapto acetic acid)	Anl. Chem., **21,** 1093 (1949)
Urea............	Xanthydrol	Mikrochem. **14,** 132 (1934)
Vanadium.......	Ammonium benzoate	C. A. **29,** 2880 (1935)
	Aniline	C. A. **24,** 567 (1930)
	Benzidine	J. Applied Chem. (U.S.S.R.) **17,** 83 (1944); C.A. **39,** 1115 (1945)
	Diphenylamine	Yoe, Vol. 1, p. 715 (2)
	Diphenylbenzidine	Ind. Eng. Chem. **20,** 764 (1928)
	8-Hydroxyquinoline	Feigl, p. 100 (8)
	Safranine	Vol. Anal., Vol. II, p. 326 (6)
	Strychnine	Yoe, Vol. I, p. 393 (2)
Wolfram........	See Tungsten	
Zinc	Anthranilic acid	Z. anal. Chem. **91,** 332 (1933)
	Di-β-napthylthiocarbazone	Sandell, p. 619 (10)
	Diphenylamine	J. Am. Chem. Soc. **49,** 2214 (1927)
	Diphenylbenzidine	J. Am. Chem. Soc. **49,** 356 (1927)
	Diphenylthiocarbazone (Dithizone)	Ind. Eng. Chem., Anal. Ed. **9,** 127 (1937)
	8-Hydroxyquinoline	Z. anal. Chem. **71,** 171 (1927)
	5-Nitroquinaldic acid	Ind. Eng. Chem., Anal. Ed. **10,** 335 (1938)
	Pyridine	Z. anal. Chem. **73,** 356 (1928)
	α-Quinaldinic acid	Z. anal. Chem. **100,** 324 (1935)
	Resorcinol	Yoe, Vol. I, p. 396 (2)
	Urobilin	J. Ind. Hyg. **7,** 273 (1925)
Zirconium.......	Ammonium salt of nitrosophenyl hydroxylamine ("Cupferron")	Hillebrand and Lundell, p. 109 (5)
	p-Dimethylaminoazophenylarsonic acid	Ind. Eng. Chem., Anal. Ed., **13,** 603 (1941)
	2-Hydroxy-5-methylazobenzene-4-sulfonic acid	Feigl, p. 288 (9)
	Morin	Sandell, p. 642 (10)
	Phenylarsonic acid	J. Am. Chem. Soc. **48,** 895 (1926)
	Sodium alizarin sulfonate (Alizarin S)	Chem. Weekblad **20,** 404 (1924); Feigl, p. 154 (8)

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(1) Scott, Standard Methods of Analysis, 1927.

(2) Yoe, Photometric Chemical Analysis, Vol. I, Colorimetry, 1928.

(3) Yoe, Photometric Chemical Analysis, Vol. II, Nephelometry, 1929.

(4) Blair, Chemical Analysis of Iron.

(5) Hillebrand and Lundell, Applied Inorganic Analysis, 1929.

(6) Kolthoff and Furman, Volumetric Analysis, 1929.

(7) Snell and Snell, Colorimetric Methods of Analysis, Vol. I, Inorganic, 1936.

(8) Feigl, Qualitative Analysis by Spot Tests, 3rd English Ed., translated by Oesper, 1946.

(9) Feigl, Chemistry of Specific, Selective and Sensitive Reactions, translated by Oesper, 1949.

(10) Sandell, Colorimetric Determination of Traces of Metals, 2nd Ed., 1950.

VOLUMETRIC PRIMARY STANDARDS

Compiled by John H. Yoe

The 1952 International atomic weights were used in computing the equivalent weights.

Primary standard	Formula	$\frac{\text{Eq. wt.}}{\text{mol. wt.}}$	Equivalent weight
A. Acidimetry			
s-Diphenylguanidine	$NH{:}C[NHC_6H_5]_2$	1	211.26
Mercuric oxide	HgO	$\frac{1}{2}$	108.31
Potassium acid carbonate	$KHCO_3$	1	100.12
Potassium iodate	KIO_3	$\frac{1}{6}$	35.67
Sodium carbonate	Na_2CO_3	$\frac{1}{2}$	53.00
Sodium oxalate (1)	$Na_2C_2O_4$	$\frac{1}{2}$	67.01
Sodium tetraborate (borax)	$Na_2B_4O_7.10H_2O$	$\frac{1}{2}$	190.72
B. Alkalimetry			
Benzoic acid (1)	C_6H_5COOH	1	122.12
Hydrazine sulfate	$N_2H_4.H_2SO_4$	$\frac{1}{2}$	65.07
Oxalic acid (cryst.) (2)	$H_2C_2O_4.2H_2O$	$\frac{1}{2}$	63.03
Potassium acid oxalate	KHC_2O_4	1	128.13
Potassium acid phthalate (1)	$KHC_8H_4O_4$	1	204.22
Potassium acid tartrate	$KHC_4H_4O_6$	1	188.18
Potassium tetraoxalate	$KH_3(C_2O_4)_2.2H_2O$	$\frac{1}{3}$	84.73
Sodium tetraborate (borax)	$Na_2B_4O_7.10H_2O$	$\frac{1}{2}$	190.72
C. Oxidimetry			
Ferrous sulfate (3)	$FeSO_4.7H_2O$	1	278.03
Ferrous ammonium sulfate (3)	$FeSO_4.(NH_4)_2SO_4.6H_2O$	1	392.14
Iron wire (4)	Fe	1	55.85
Oxalic acid (cryst.) (2)	$H_2C_2O_4.2H_2O$	$\frac{1}{2}$	63.03
Potassium ferrocyanide	$K_4Fe(CN)_6.3H_2O$	1	422.41
Potassium iodate	KIO_3	$\frac{1}{6}$	35.67
Silver	Ag	1	107.88
Sodium oxalate (1)	$Na_2C_2O_4$	$\frac{1}{2}$	67.01
D. Iodimetry			
Arsenious oxide (1)	As_2O_3	$\frac{1}{4}$	49.455
Copper	Cu	1	63.54
Hydrazine sulfate	$N_2H_4.H_2SO_4$	$\frac{1}{4}$	32.531
Iodine (resublimed) (5)	I	1	126.91
Iodine cyanide	ICN	$\frac{1}{2}$	76.469
Oxalic acid (cryst.) (2)	$H_2C_2O_4.2H_2O$	$\frac{1}{2}$	63.03
Potassium bromate	$KBrO_3$	$\frac{1}{6}$	27.836
Potassium dichromate	$K_2Cr_2O_7$	$\frac{1}{6}$	49.037
Potassium ferricyanide	$K_3Fe(CN)_6$	1	329.26
Potassium iodate	KIO_3	$\frac{1}{6}$	35.668
Sodium thiosulfate	$Na_2S_2O_3.5H_2O$	1	248.21

VOLUMETRIC PRIMARY STANDARDS (Continued)

Primary standard	Formula	$\frac{\text{Eq. wt.}}{\text{mol. wt.}}$	Equivalent weight
E. Silver Nitrate			
Potassium bromide	KBr	1	119.02
Potassium chloride	KCl	1	74.56
Sodium chloride	NaCl	1	58.45
F. Alkali Thiocyanates			
Mercury	Hg	$\frac{1}{2}$	100.31
Mercuric oxide	HgO	$\frac{1}{2}$	108.31
Silver	Ag	1	107.88
Silver nitrate	$AgNO_3$	1	169.89

G. Miscellaneous

For the determination of substances that must pass through complicated reactions, it is best to standardize against a standard sample of the substance that has been carried through all steps of the analysis. The U. S. Bureau of Standards can supply at a nominal fee a large number of standard samples of irons and steels (representing a wide range in composition), iron ores, manganese ore, zinc ore, etc.

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(1) May be obtained from the U. S. Bureau of Standards.

(2) Difficult to obtain with exactly two molecules of water but a valuable primary standard when carefully prepared.

(3) The pure salt is hard to obtain and to keep without slight oxidation or loss of water, hence other standards are recommended.

(4) Possesses many disadvantages and is not recommended.

(5) The last few drops of iodine are decolorized very slowly Titrate till the pale yellow color persists at least two minutes. Starch retards the reaction and should be avoided.

CORRECTION FOR CAPILLARY DEPRESSION OF MERCURY IN A GLASS TUBE

Correction to be added.

Diam. of tube.	Height of meniscus in centimeters.							
	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18
cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
0.4	0.083	0.122	0.154	0.198	0.237			
0.5	.047	.065	.086	.119	.145	0.180		
0.6	.027	.041	.056	.078	.098	.121	0.143	
0.7	.018	.028	.040	.053	.067	.082	.097	.113
0.8	....	.020	.029	.038	.046	.056	.065	0.077
0.9	....	0.015	0.021	0.028	0.033	0.040	0.046	0.052
1.0	....	.....	.015	.020	.025	.029	.033	.037
1.1	....	.....	.010	.014	.018	.021	.024	.027
1.2	....	.....	.007	.010	.013	.015	.018	.019
1.3	....	.....	.004	.007	.010	.012	.013	.014

TRUE CAPACITY OF GLASS VESSELS FROM THE WEIGHT OF THE CONTAINED WATER OR MERCURY WHEN WEIGHED IN AIR WITH BRASS WEIGHTS*

A glass vessel containing G grams of water at a temperature of t°C has, at the same temperature, a capacity $V = W_t \times G$ cubic centimeters. Similarly when filled with G grams of mercury at a temperature of t°C the capacity at the same temperature is given by $V = M_t \times G$ cubic centimeters.

A glass vessel containing G grams of water at a temperature of t°C has a capacity at a temperature of 18°C given by $V = W_{18°} \times G$ cubic centimeters. Simiiarly when filled with G grams of mercury at a temperature of t°C the capacity at a temperature of 18°C is given by $V = M_{18°} \times G$ cubic centimeters. The true volume at temperature of 25°C when the weighing is made at t° is similarly obtained by use of the values under $W_{25°}$ and $M_{25°}$ for water and mercury respectively.

t°C.	W_t	M_t	$W_{18°}$	$M_{18°}$	$W_{25°}$	$M_{25°}$
0	1.001193	0.0735501	1.001643	0.0735832	1.001818	0.0735960
1	1.001133	0.0735636	1.001559	0.0735949	1.001734	0.0736077
2	1.001092	0.0735771	1.001492	0.0736066	1.001668	0.0736194
3	1.001068	0.0735907	1.001443	0.0736183	1.001618	0.0736311
4	1.001060	0.0736037	1.001410	0.0736294	1.001586	0.0736423
5	1.001068	0.0736172	1.001394	0.0736411	1.001569	0.0736540
6	1.001092	0.0736308	1.001392	0.0736529	1.001568	0.0736657
7	1.001131	0.0736492	1.001406	0.0736695	1.001581	0.0736824
8	1.001184	0.0736628	1.001435	0.0736812	1.001610	0.0736941
9	1.001252	0.0736763	1.001477	0.0736929	1.001652	0.0737058
10	1.001333	0.0736894	1.001534	0.0737042	1.001709	0.0737171
11	1.001428	0.0736975	1.001603	0.0737104	1.001779	0.0737233
12	1.001536	0.0737111	1.001686	0.0737222	1.001862	0.0737351
13	1.001657	0.0737241	1.001782	0.0737333	1.001957	0.0737463
14	1.001790	0.0737377	1.001890	0.0737451	1.002066	0.0737581
15	1.001935	0.0737513	1.002010	0.0737569	1.002186	0.0737698
16	1.002092	0.0737644	1.002143	0.0737681	1.002318	0.0737810
17	1.002261	0.0737780	1.002286	0.0737798	1.002462	0.0737927
18	1.002441	0.0737911	1.002441	0.0737911	1.002617	0.0738039
19	1.002633	0.0738047	1.002608	0.0738028	1.002783	0.0738157
20	1.002835	0.0738183	1.002785	0.0738146	1.002960	0.0738275
21	1.003047	0.0738314	1.002972	0.0738258	1.003148	0.0738398
22	1.003271	0.0738450	1.003170	0.0738376	1.003346	0.0738505
23	1.003504	0.0738581	1.003379	0.0738489	1.003554	0.0738618
24	1.003748	0.0738717	1.003597	0.0738607	1.003773	0.0738736
25	1.004001	0.0738848	1.003825	0.0738719	1.004001	0.0738848
26	1.004264	0.0738985	1.004063	0.0738837	1.004239	0.0738966
27	1.004537	0.0739116	1.004310	0.0738950	1.004486	0.0739079
28	1.004819	0.0739253	1.004567	0.0739068	1.004743	0.0739197
29	1.005110	0.0739384	1.004833	0.0739181	1.005009	0.0739310
30	1.005410	0.0739520	1.005109	0.0739299	1.005284	0.0739428

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* Assuming 25×10^{-6} as the coefficient of cubic expansion for glass.

Reduction of Weighings to Vacuo

If the apparent mass of a body is m, its density d_m, the density of the weights d_w and the density of the air d_a the true mass in vacuo is,

$$M = m + md_a\left(\frac{1}{d_m} - \frac{1}{d_w}\right)$$

DECI-NORMAL SOLUTIONS OF SALTS AND OTHER REAGENTS

The weight in grams of the compound in 1 c.c. of the following deci-normal solutions is found by dividing the H equivalent in the last column by 1000

Name	Formula	At. or mol. wt.	Hydrogen equivalent	0.1 H equiv. in g.
Acetic acid	$HC_2H_3O_2$	60.03	$HC_2H_3O_2$	6.003
Ammonia	NH_3	17.03	NH_3	1.703
Ammonium	NH_4	18.04	NH	1.804
Ammonium chloride	NH_4Cl	53.50	NH_4Cl	5.350
Ammonium sulfate	$(NH_4)_2SO_4$	132.14	$\frac{1}{2}(NH_4)_2SO_4$	6.607
Ammonium sulfocyanate	NH_4CNS	76.11	NH_4CNS	7.611
Barium	Ba	137.36	$\frac{1}{2}Ba$	6.868
Barium carbonate	$BaCO_3$	197 36	$\frac{1}{2}BaCO_3$	9.868
Barium chloride	$BaCl_2.2H_2O$	244.31	$\frac{1}{2}BaCl_2\ 2H_2O$	12.216
Barium hydroxide	$Ba(OH)_2$	171.38	$\frac{1}{2}Ba(OH)_2$	8.569
Barium oxide	BaO	153.36	$\frac{1}{2}BaO$	7.668
Bromine	Br	79.92	Br	7 992
Calcium	Ca	40.08	$\frac{1}{2}Ca$	2.004
Calcium carbonate	$CaCO_3$	100.08	$\frac{1}{2}CaCO_3$	5.004
Calcium chloride	$CaCl_2$	110.99	$\frac{1}{2}CaCl_2$	5.550
Calcium chloride	$CaCl_2.6H_2O$	219.09	$\frac{1}{2}CaCl_2.6H_2O$	10.954
Calcium hydroxide	$Ca(OH)_2$	74.10	$\frac{1}{2}Ca(OH)_2$	3.705
Calcium oxide	CaO	56.08	$\frac{1}{2}CaO$	2.804
Chlorine	Cl	35.46	Cl	3.546
Citric acid	$C_6H_8O_7.H_2O$	210.08	$\frac{1}{3}C_6H_8O_7.H_2O$	7.003
Cobalt	Co	58.94	$\frac{1}{2}Co$	2.948
Copper	Cu	63.57	$\frac{1}{2}Cu$	3 179
Copper Oxide	CuO	79.57	$\frac{1}{2}CuO$	3.979
Copper sulfate	$CuSO_4\ 5H_2O$	249.71	$\frac{1}{2}CuSO_4.5H_2O$	12.485
Cyanogen	CN	26.01	CN	2.601
Hydrochloric acid	HCl	36.47	HCl	3.647
Hydrocyanic acid	HCN	27.02	HCN	2.702
Iodine	I	126.93	I	12.693
Lactic acid	$C_3H_6O_3$	90.05	$C_3H_6O_3$	9.005
Malic acid	$C_4H_6O_5$	134.05	$\frac{1}{2}C_4H_6O_5$	6.702
Magnesium	Mg	24.32	$\frac{1}{2}Mg$	1.216
Magnesium carbonate	$MgCO_3$	84.32	$\frac{1}{2}MgCO_3$	4.216
Magnesium chloride	$MgCl_2$	95.23	$\frac{1}{2}MgCl_2$	4.762
Magnesium chloride	$MgCl_2\ 6H_2O$	203.33	$\frac{1}{2}MgCl_2.6H_2O$	10.167
Magnesium oxide	MgO	40.32	$\frac{1}{2}MgO$	2.016
Manganese	Mn	54.93	$\frac{1}{2}Mn$	2.747
Manganese sulfate	$MnSO_4$	150.99	$\frac{1}{2}MnSO_4$	7.550
Mercuric chloride	$HgCl_2$	271.52	$\frac{1}{2}HgCl_2$	13.576
Nickel	Ni	58.69	$\frac{1}{2}Ni$	2.935
Nitric acid	HNO_3	63.02	HNO_3	6.302
Nitrogen	N	14.01	N	1 401
Nitrogen pentoxide	N_2O_5	108.02	$\frac{1}{2}N_2O_5$	5.401
Oxalic acid	$H_2C_2O_4$	90.02	$\frac{1}{2}H_2C_2O_4$	4.501
Oxalic acid	$H_2C_2O_4.2H_2O$	126.05	$\frac{1}{2}H_2C_2O_4.2H_2O$	6.302
Oxalic anhydride	C_2O_3	72.00	$\frac{1}{2}C_2O_3$	3.600
Phosphoric acid	H_3PO_4	98.04	$\frac{1}{3}H_3PO_4$	3.268
Potassium	K	39.10	K	3.910
Potassium bicarbonate	$KHCO_3$	100.11	$KHCO_3$	10.011
Potassium carbonate.	K_2CO_3	138.20	$\frac{1}{2}K_2CO_3$	6.910
Potassium chloride	KCl	74.56	KCl	7.456
Potassium cyanide	KCN	65.11	KCN	6.511
Potassium hydroxide	KOH	56.11	KOH	5.611
Potassium oxide	K_2O	94.20	$\frac{1}{2}K_2O$	4.710
Potassium permanganate for Co estimation	$KMnO_4$	158.03	$\frac{1}{6}KMnO_4$	2.634

DECI-NORMAL SOLUTIONS OF SALTS AND OTHER REAGENTS (Continued.)

Name	Formula	At. or mol. wt.	Hydrogen equivalent	0.1H equiv. in g.
Potassium permanganate for Mn estimation	$KMnO_4$	158.03	$\frac{1}{3}KMnO_4$	5.268
Potassium tartrate	$K_2H_4C_4O_6$	226.23	$\frac{1}{2}K_2H_4C_4O_6$	11.312
Silver	Ag	107.88	Ag	10.788
Silver nitrate	$AgNO_3$	169.89	$AgNO_3$	16.989
Sodium	Na	23.00	Na	2.300
Sodium bicarbonate	$NaHCO_3$	84.00	$NaHCO_3$	8.400
Sodium carbonate	Na_2CO_3	105.99	$\frac{1}{2}Na_2CO_3$	5.300
Sodium chloride	NaCl	58.45	NaCl	5.845
Sodium hydroxide	NaOH	40.00	NaOH	4.000
Sodium oxide	Na_2O	61.99	$\frac{1}{2}Na_2O$	3.100
Sodium sulfide	Na_2S	78.05	$\frac{1}{2}Na_2S$	3 903
Succinic acid	$H_2C_4H_4O_4$	118.05	$\frac{1}{2}H_2C_4H_4O_4$	5.902
Sulfuric acid	H_2SO_4	98.08	$\frac{1}{2}H_2SO_4$	4.904
Sulfur trioxide	SO_3	80.06	$\frac{1}{2}SO_3$	4.003
Tartaric acid	$C_4H_6O_6$	150.05	$\frac{1}{2}C_4H_6O_6$	7.502
Zinc	Zn	65.38	$\frac{1}{2}Zn$	3.269
Zinc sulfate	$ZnSO_4.7H_2O$	287.55	$\frac{1}{2}ZnSO_4.7H_2O$	14.377

REDUCTIONS OF WEIGHINGS IN AIR TO VACUO

When the weight M in grams of a body is determined in air, a correction is necessary for the buoyancy of the air. The following table is computed for an air density of 0.0012 The corrected weight = M + kM/1000, values of k being found in the table.

Density of body weighed	Correction factor, k.		
	Pt Ir weights	Brass weights	Quartz or Al weights
.5	+2.34	+2.26	+1.95
.6	+1.94	+1.86	+1.55
.7	+1.66	+1.57	+1.26
.75	+1.55	+1.46	+1.15
.80	+1.44	+1.36	+1.05
.85	+1.36	+1.27	+0.96
.90	+1.28	+1.19	+ .88
.95	+1.21	+1.12	+ .81
1.00	+1.14	+1.06	+ .75
1.1	+1.04	+0.95	+ .64
1.2	+0.94	+ .86	+ .55
1.3	+ .87	+ .78	+ .47
1.4	+ .80	+ .71	+ .40
1.5	+ .75	+ .66	+ .35
1.6	+ .69	+ .61	+ .30
1.7	+ .65	+ .56	+ .25
1.8	+ .62	+ .52	+ .21
1.9	+ .58	+ .49	+ .18
2.0	+ .54	+ .46	+ .15
2.5	+ .43	+ .34	+ .03
3.0	+ .34	+ .26	− .05
4.0	+ .24	+ .16	− .15
6.0	+ .14	+ .06	− .25
8.0	+ .09	+ .01	− .30
10.0	+ .06	− .02	− .33
15.0	+ .03	− .06	− .37
20.0	+ .004	− .08	− .39
22.0	− .001	− .09	− .40

DECI-NORMAL SOLUTIONS OF OXIDATION AND REDUCTION REAGENTS

Name	Formula	At. or mol. wt.	Hydrogen equivalent	0.1H equiv. in g.
Antimony	Sb	121.76	$\frac{1}{2}$Sb	6.089
Arsenic	As	74.93	$\frac{1}{2}$As	3.747
Arsenic trisulfide	As_2S_3	246.04	$\frac{1}{4}As_2S_3$	6.151
Arsenous oxide	As_2O_3	197.86	$\frac{1}{4}As_2O_3$	4.947
Barium peroxide	BaO_2	169.36	$\frac{1}{2}BaO_2$	8.468
Barium peroxide, hydrated	$BaO_2.8H_2O$	313.48	$\frac{1}{2}BaO_2.8H_2O$	15.674
Calcium	Ca	40.08	$\frac{1}{2}$Ca	2.004
Calcium carbonate	$CaCO_3$	100.08	$\frac{1}{2}CaCO_3$	5.004
Calcium hypochlorite	$Ca(ClO)_2$	142.99	$\frac{1}{4}Ca(ClO)_2$	3.574
Calcium oxide	CaO	56.08	$\frac{1}{2}$CaO	2.804
Chlorine	Cl	35.46	Cl	3.546
Chromium trioxide	CrO_3	100.01	$\frac{1}{3}CrO_3$	3.334
Ferrous ammonium sulfate	$FeSO_4(NH_4)_2SO_4.6H_2O$	392.13	$FeSO_4(NH_4)_2SO_4.6H_2O$	39.213
Hydroferrocyanic acid	$H_4Fe(CN)_6$	215.92	$H_4Fe(CN)_6$	21.592
Hydrogen peroxide	H_2O_2	34.02	$\frac{1}{2}H_2O_2$	1.701
Hydrogen sulfide	H_2S	34.08	$\frac{1}{2}H_2S$	1.704
Iodine	I	126.93	I	12.693
Iron	Fe	55 84	Fe	5.584
Iron oxide, ferrous	FeO	71.84	FeO	7.184
Iron oxide, ferric	Fe_2O_3	159.68	$\frac{1}{2}Fe_2O_3$	7.984
Lead peroxide	PbO_2	239.22	$\frac{1}{2}PbO_2$	11.961
Manganese peroxide	MnO_2	86.93	$\frac{1}{2}MnO_2$	4.347
Nitric acid	HNO_3	63.02	$\frac{1}{3}HNO_3$	2.101
Nitrogen trioxide	N_2O_3	76.02	$\frac{1}{4}N_2O_3$	1.800
Nitrogen pentoxide	N_2O_5	108.02	$\frac{1}{6}N_2O_5$	1.800
Oxalic acid	$C_2H_2O_4$	90.02	$\frac{1}{2}C_2H_2O_4$	4.501
Oxalic acid	$C_2H_2O_4.2H_2O$	126.05	$\frac{1}{2}C_2H_2O_4.2H_2O$	6.302
Oxygen	O	16.00	$\frac{1}{2}$O	0.800
Potassium bichromate	$K_2Cr_2O_7$	294.22	$\frac{1}{6}K_2Cr_2O_7$	4.904
Potassium chlorate	$KClO_3$	122.56	$\frac{1}{6}KClO_3$	2.043
Potassium chromate	K_2CrO_4	194 21	$\frac{1}{3}K_2CrO_4$	6.474
Potassium ferrocyanide	$K_4Fe(CN)_6$	368.29	$K_4Fe(CN)_6$	36.829
Potassium ferrocyanide	$K_4Fe(CN)_6.3H_2O$	422.33	$K_4Fe(CN)_6.3H_2O$	42.233
Potassium iodide	KI	166.03	KI	16.603
Potassium nitrate	KNO_3	101.11	$\frac{1}{3}KNO_3$	3 370
Potassium perchlorate	$KClO_4$	138 56	$\frac{1}{8}KClO_4$	1.732
Potassium permanganate	$KMnO_4$	158.03	$\frac{1}{5}KMnO_4$	3 161
Sodium chlorate	$NaClO_3$	106.45	$\frac{1}{6}NaClO_3$	1.774
Sodium nitrate	$NaNO_3$	85.01	$\frac{1}{3}NaNO_3$	2.834
Sodium thiosulfate	$Na_2S_2O_3.5H_2O$	248 19	$Na_2S_2O_3.5H_2O$	24.819
Stannous chloride	$SnCl_2$	189.61	$\frac{1}{2}SnCl_2$	9.481
Stannous oxide	SnO	134.70	$\frac{1}{2}$SnO	6.735
Sulfur dioxide	SO_2	64.06	$\frac{1}{2}SO_2$	3.203
Tin	Sn	118.70	$\frac{1}{2}$Sn	5.935

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS

Aluminum

(1) $Al_2(SO_4)_3 + 6KOH = 2Al(OH)_3 + 3K_2SO_4$

$$KOH = \frac{Al_2(SO_4)_3}{6} = \frac{Al_2O_3}{6} = \frac{Al}{3}$$

Antimony

(2) $SbCl_5 + 2KI = SbCl_3 + 2KCl + I_2$

$$I = \frac{Sb}{2} = \frac{Sb_2O_5}{4}$$

(3) $Sb_2O_3 + 2I_2 + 2H_2O = Sb_2O_5 + 4HI$

$$I = \frac{Sb_2O_3}{4} = \frac{Sb}{2}$$

(4) (a) $Sb_2S_3 + 6HCl = 2SbCl_3 + 3H_2S$
(b) $3H_2S + 3I_2 = 6HI + 3S$

$$I = \frac{H_2S}{2} = \frac{Sb_2S_3}{6} = \frac{Sb}{3}$$

(5) $5Sb_2(SO_4)_3 + 4KMnO_4 + 24H_2O = 10H_3SbO_4 + 2K_2SO_4 + 4MnSO_4 + 9H_2SO_4$

$$\frac{4KMnO_4}{20} = \frac{Sb_2(SO_4)_3}{4} = \frac{Sb_2O_3}{4} = \frac{Sb}{2}$$

Arsenic

(6) $As_2O_3 + 2H_2O + 2I_2 = As_2O_5 + 4HI$

$$I = \frac{As_2O_3}{4} = \frac{As}{2}$$

(7) $AsCl_3 + I_2 + 2HCl = AsCl_5 + 2HI$

$$I = \frac{AsCl_3}{2} = \frac{As}{2}$$

(8) As_2S_3 same as reaction 4

Boron

(9) (a) $Na_2B_4O_7 + 2HCl + 5H_2O = 2NaCl + 4H_3BO$
(b) $H_3BO_3 + NaOH = NaBO_2 + 2H_2O$

$$NaOH = H_3BO_3 = B$$

Cadmium

(10) $CdS + 2HCl + I_2 = CdCl_2 + 2HI + S$

$$I = \frac{CdS}{2} = \frac{Cd}{2} = \frac{S}{2}$$

Calcium

(11) $5CaC_2O_4 + 2KMnO_4 + 8H_2SO_4 = 5CaSO_4 + K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$

$$\frac{2KMnO_4}{10} = \frac{CaC_2O_4}{2} = \frac{CaCO_3}{2} = \frac{CaO}{2}$$

(12) $CaCO_3 + 2HCl = CaCl_2 + CO_2 + H_2O$

$$HCl = \frac{CaCO_3}{2} = \frac{CaO}{2}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Carbon

(13) $Na_2CO_3 + H_2SO_4 = Na_2SO_4 + H_2O + CO_2$

$$\frac{H_2SO_4}{2} = \frac{Na_2CO_3}{2}$$

(14) $2NaHCO_3 + H_2SO_4 = Na_2SO_4 + 2H_2O + 2CO_2$

$$\frac{H_2SO_4}{2} = \frac{NaHCO_3}{1}$$

(15) $KHC_2O_4 + KOH = K_2C_2O_4 + H_2O$

$$KOH = KHC_2O_4$$

(16) $H_2C_2O_4.2H_2O + 2NaOH = Na_2C_2O_4 + 4H_2O$

$$NaOH = \frac{H_2C_2O_4.2H_2O}{2}$$

(17) $C_6H_5COOH + NaOH = C_6H_5COONa + H_2O$

$$NaOH = C_6H_5COOH$$

(18) $5Na_2C_2O_4 + 2KMnO_4 + 8H_2SO_4 = 5Na_2SO_4 + K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{Na_2C_2O_4}{2}$$

Chlorine

(19) $NaCl + AgNO_3 = AgCl + NaNO_3$

$$NaCl = Cl$$

(20) (a) $Cl + KI = KCl + I$

(b) $I_2 + 2Na_2S_2O_3 = Na_2S_4O_6 + 2NaI$

$$I = Cl$$

(21) $CaOCl_2 + 2HCl = CaCl_2 + H_2O + Cl_2$

$$I = Cl = \frac{CaOCl_2}{2}$$

Chromium

(22) $K_2Cr_2O_7 + 6FeCl_2 + 14HCl = 6FeCl_3 + 2KCl + 2CrCl_3 + 7H_2O$

$$Fe = \frac{K_2Cr_2O_7}{6} = \frac{Cr_2O_3}{6} = \frac{Cr}{3}$$

(23) $K_2Cr_2O_7 + 6KI + 7H_2SO_4 = 4K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3I_2$

$$I = \frac{K_2Cr_2O_7}{6} = \frac{Cr_2O_3}{6} = \frac{Cr}{3}$$

Copper (KMnO$_4$ Method)

(24) (a) $2CuSO_4 + 2KCNS + H_2SO_3 + H_2O = 2CuCNS + K_2SO_4 + 2H_2SO_4$

(b) $CuCNS + NaOH = NaCNS + CuOH$

(c) $5NaCNS + 6KMnO_4 + 4H_2SO_4 = 3K_2SO_4 + 6MnSO_4 + 5NaCN + 4H_2O$

$$\frac{6KMnO_4}{30} = \frac{NaCNS}{6} = \frac{CuSO_4}{6} = \frac{Cu}{6}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

(25) (Iodide Method)

$$2CuSO_4 + 4KI = 2CuI + 2K_2SO_4 + I_2$$

$$I = CuSO_4 = Cu$$

(26) (KCN Method)

(a) $2CuSO_4 + 2NH_4OH = (NH_4)_2SO_4 + Cu_2SO_4(OH)_2$

(b) $Cu_2SO_4(OH)_2 + 6NH_3 + (NH_4)_2SO_4 = 2Cu(NH_3)_4SO_4.H_2O$

(c) $2Cu(NH_3)_4SO_4.H_2O + 7KCN = K_3NH_4Cu_2(CN)_6 + NH_4CNO + 2K_2SO_4 + 6NH_3 + H_2O$

$$\frac{KCN}{2} = \frac{Cu(NH_3)_4SO_4.H_2O}{7} = \frac{CuSO_4}{7} = \frac{Cu}{7}$$

Iodine

(27) $I_2 + 2Na_2S_2O_3 = Na_2S_4O_6 + 2NaI$

$$I = Na_2S_2O_3$$

(28) $KIO_3 + 5KI + 6HCl = 6KCl + 3H_2O + 3I_2$

$$I = \frac{KIO_3}{6} = \frac{5KI}{6}$$

(29) $10KI + 2KMnO_4 + 8H_2SO_4 = 6K_2SO_4 + 2MnSO_4 + 8H_2O + 5I_2$

$$\frac{2KMnO_4}{10} = I$$

Iron

(30) $6FeCl_2 + K_2Cr_2O_7 + 14HCl = 6FeCl_3 + 2KCl + 2CrCl_3 + 7H_2O$

$$\frac{K_2Cr_2O_7}{6} = \frac{6FeCl_2}{6} = \frac{Fe_2O_3}{2} = \frac{Fe}{1}$$

(31) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{10FeSO_4}{10} = \frac{Fe_2O_3}{2} = \frac{Fe}{1}$$

(32) $2FeCl_3 + 2KI = 2KCl + 2FeCl_2 + I_2$

$$I = FeCl_3 = Fe = \frac{Fe_2O_3}{2}$$

Lead

(33) $2Pb(C_2H_3O_2)_2 + K_2Cr_2O_7 + H_2O = 2PbCrO_4 + 2KC_2H_3O_2 + 2HC_2H_3O_2$

$\frac{2Pb}{4} = \frac{K_2Cr_2O_7}{4}$ (as precipitating agent for lead)

(34) $2PbCrO_4 + 6KI + 16HCl = 2PbCl_2 + 6KCl + 2CrCl_3 + 8H_2O + 3I_2$

$$I = \frac{PbCrO_4}{3} = \frac{Pb}{3} = \frac{K_2Cr_2O_7}{6}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Manganese

(35) $MnO_2 + H_2SO_4 + H_2C_2O_4 = MnSO_4 + 2CO_2 + 2H_2O$

$$\frac{2KMnO_4}{10} = \frac{C_2H_2O_4}{2} = \frac{MnO_2}{2} = \frac{Mn}{2}$$

(36) (Bismuthate Method)

(a) $2Mn(NO_3)_2 + 5NaBiO_3 + 16HNO_3 = 5NaNO_3 + 5Bi(NO_3)_3 + 7H_2O + 2HMnO_4$

(b) $2HMnO_4 + 5Na_3AsO_3 + 4HNO_3 = 5Na_3AsO_4 + 2Mn(NO_3)_2 + 3H_2O$

$$\frac{2HMnO_4}{10} = \frac{Na_3AsO_3}{2} = \frac{Mn}{5}$$

(37) (Persulfate Method)

(a) $2Mn(NO_3)_2 + 5(NH_4)_2S_2O_8 + 8H_2O = 5(NH_4)_2SO_4 + 4HNO_3 + 5H_2SO_4 + 2HMnO_4$

(b) $2HMnO_4 + 10FeSO_4 + 7H_2SO_4 = 5Fe_2(SO_4)_3 + 2MnSO_4 + 8H_2O$

$$\frac{2HMnO_4}{10} = \frac{10FeSO_4}{10} = \frac{Mn}{5}$$

(38) (Volhard's Method)

$3MnSO_4 + 2KMnO_4 + 2H_2O = 5MnO_2 + K_2SO_4 + 2H_2SO_4$ *or*

$6MnSO_4 + 5ZnSO_4 + 4KMnO_4 + 14H_2O = 4KHSO_4 + 7H_2SO_4 + 5Zn(OH)_2.2MnO_2$

$$\frac{2KMnO_4}{10} = \frac{3MnSO_4}{10} = \frac{3Mn}{10}$$

(39) (Ford Williams Method)

$MnO_2 + 2FeSO_4 + 2H_2SO_4 = MnSO_4 + Fe_2(SO_4)_3 + 2H_2O$

$$\frac{2FeSO_4}{2} = \frac{MnO_2}{2} = \frac{Mn}{2}$$

Molybdenum

(40) (a) $2MoO_3 + 3Zn = Mo_2O_3 + 3ZnO$

(b) $5Mo_2O_3 + 6KMnO_4 + 9H_2SO_4 = 10MoO_3 + 3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{Mo_2O_3}{6} = \frac{MoO_3}{3} = \frac{Mo}{3}$$

Nickel (KCN Method)

(41) (a) $2NiSO_4 + 12NH_4OH = 2Ni(NH_3)_6SO_4 + 12H_2O$

(b) $Ni(NH_3)_6SO_4 + 4KCN = K_2Ni(CN)_4 + K_2SO_4 + 6NH_3$

$$\frac{4KCN}{8} = \frac{Ni(NH_3)_6SO_4}{8} = \frac{Ni}{8}$$

Oxygen

(42) $5H_2O_2 + 2KMnO_4 + 4H_2SO_4 = 2KHSO_4 + 2MnSO_4 + 8H_2O + 5O_2$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

$$\frac{2KMnO_4}{10} = \frac{H_2O_2}{2}$$

Phosphorus

(43) (a) $H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 =$
$(NH_4)_3PO_4.12MoO_3 + 21NH_4NO_3 + 12H_2O$
(b) $2(NH_4)_3PO_4.12MoO_3 + 46NaOH + H_2O =$
$2(NH_4)_2HPO_4 + (NH_4)_2MoO_4 + 23Na_2MoO_4 + 23H_2O$

$$\frac{NaOH}{1} = \frac{2(NH_4)_3PO_4.12MoO_3}{46} = \frac{P_2O_5}{46} = \frac{P}{23}$$

(44) (a) $2(NH_4)_3PO_4.12MoO_3 + 46NH_4OH + H_2O =$
$24(NH_4)_2MoO_4 + 2(NH_4)_2HPO_4 + 23H_2O$
(b) $(NH_4)_2MoO_4 + H_2SO_4 = (NH_4)_2SO_4 + H_2MoO_4$
(c) $2MoO_3 + 3Zn + 3H_2SO_4 = 3ZnSO_4 + 3H_2O +$
Mo_2O_3
(d) $5Mo_2O_3 + 6KMnO_4 + 9H_2SO_4 = 10MoO_3 +$
$3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{Mo_2O_3}{6} = \frac{(NH_4)_3PO_4.12MoO_3}{36} = \frac{P}{36} = \frac{P_2O_5}{72}$$

(45) (No ferric alum present)
(a-b-c) as in Reaction 44
(d) $12Mo_2O_3 + O = Mo_{24}O_{37}$
(e) $Mo_{24}O_{37} + 14KMnO_4 + 21H_2SO_4 = 24MoO_3 +$
$7K_2SO_4 + 14MnSO_4 + 21H_2O$

$$\frac{14KMnO_4}{70} = \frac{Mo_{24}O_{37}}{70} = \frac{(NH_4)_3PO_4.12MoO_3}{35} = \frac{P}{35} = \frac{P_2O_5}{70}$$

Sulfur

(46) $H_2S + I_2 = 2HI + S$

$$I = \frac{H_2S}{2} = \frac{S}{2}$$

(47) $H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O$

$$NaOH = \frac{Na_2SO_4}{2}$$

(48) $NaHSO_4 + NaOH = Na_2SO_4 + H_2O$
$NaOH = NaHSO_4$

(49) $Na_2SO_3 + I_2 + H_2O = Na_2SO_4 + 2HI$

$$I = \frac{Na_2SO_3}{2} = \frac{SO_2}{2} = \frac{S}{2}$$

(50) $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$
$I = Na_2S_2O_3$

Tin

(51) $SnCl_2 + I_2 + 2HCl = SnCl_4 + 2HI$

$$I = \frac{SnCl_2}{2} = \frac{Sn}{2}$$

Titanium

(52) (a) $Ti_2(SO_4)_3 + Fe_2(SO_4)_3 = 2Ti(SO_4)_2 + 2FeSO_4$

(b) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{Ti_2(SO_4)_3}{2} = \frac{Ti}{1}$$

Tungsten

(53) $WO_3 + 2NaOH = Na_2WO_4 + H_2O$

$$\frac{NaOH}{1} = \frac{WO_3}{2} = \frac{W}{2}$$

Uranium

(54) (a) $U_3O_8 + 4H_2SO_4 = 2UO_2SO_4 + U(SO_4)_2 + 4H_2O$

(b) $5U(SO_4)_2 + 2KMnO_4 + 2H_2O = 2KHSO_4 + 2MnSO_4 + H_2SO_4 + 5UO_2SO_4$

$$\frac{2KMnO_4}{10} = \frac{U(SO_4)_2}{2} = \frac{UO_2}{2} = \frac{U}{2}$$

(c) $U_3O_8 = 2UO_3 + UO_2$

$$\frac{2KMnO_4}{10} = \frac{U_3O_8}{2} = \frac{3U}{2}$$

Vanadium

(55) (a) $V_2O_5 + SO_2 \rightleftarrows V_2O_4 + SO_3$

(b) $5V_2O_4 + 2KMnO_4 + 3H_2SO_4 = 5V_2O_5 + K_2SO_4 + 2MnSO_4 + 3H_2O$

$$\frac{2KMnO_4}{10} = \frac{V_2O_4}{2} = \frac{V_2O_5}{2} = \frac{V}{1}$$

(56) (a) $V_2O_5 + 3Zn + 3H_2SO_4 = V_2O_2 + 3H_2O + 3ZnSO_4$

(b) $V_2O_2 + 3Fe_2O_3 = 6FeO + V_2O_5$

(c) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{V_2O_5}{6} = \frac{V}{3}$$

57) (a) As in Reaction 56

(b) $5V_2O_2 + 6KMnO_4 + 9H_2SO_4 = 5V_2O_5 + 3K_2SO_4 + 6MnSO_4 + 9H_2O$

$$\frac{6KMnO_4}{30} = \frac{V_2O_5}{6} = \frac{V_2O_2}{6} = \frac{V}{3}$$

(58) $V_2O_5 + 2KI + 2HCl = V_2O_4 + 2KCl + H_2O + I_2$

$$I = \frac{V_2O_5}{2} = \frac{V}{1}$$

VOLUMETRIC QUANTITATIVE REACTIONS WITH GRAM EQUIVALENTS (Continued)

Zinc

(59) (a) $Fe_2(SO_4)_3 + Zn = ZnSO_4 + 2FeSO_4$

(b) $10FeSO_4 + 2KMnO_4 + 8H_2SO_4 = 5Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 8H_2O$

$$\frac{2KMnO_4}{10} = \frac{FeSO_4}{1} = \frac{Zn}{2}$$

(60) $3ZnCl_2 + 2K_4Fe(CN)_6 = K_2Zn_3(Fe(CN)_6)_2 + 6KCl$

$$\frac{K_4Fe(CN)_6}{3} = \frac{3ZnCl_2}{6} = \frac{Zn}{2}$$

EFFICIENCY OF DRYING AGENTS

Compiled by John H. Yoe

A. Drying agents depending upon chemical action (absorption) for their efficiency:*

Substance	Weights of residual water vapor in dried air—mg per liter	Authority
P_2O_5	Much less than 1 mg in 40,000 liters	Morley
$Mg(ClO_4)_2$ anh	Unweighable in 210 liters	Willard and Smith
$Mg(ClO_4)_2.3H_2O$	Unweighable in 57 liters	Willard and Smith
BaO	…	Booth and McIntire
$CaSO_4.\frac{1}{2}H_2O$	…	Smith
KOH (fused)	0.002	Baxter and Starkweather
H_2SO_4	0.003	Baxter and Starkweather
MgO	0.008	Dover and Marden
NaOH (fused)	0.16	Baxter and Starkweather
$CaBr_2$	0.2	Baxter and Warren
CaO	0.2	Dover and Marden
B_2O_3	…	Walton and Rosenbaum
$Ba(ClO_4)_2$ anh	…	Smith
$CaCl_2$ (granular)	0.14 to 0.25	McPherson
$CaCl_2$ (fused)	0.36	Baxter and Starkweather
$ZnCl_2$	0.8	Baxter and Warren
$ZnBr_2$	1.1	Baxter and Warren
$CuSO_4$ anh	1.4	Dover and Marden

B. Drying agents depending upon physical action (adsorption) for their efficiency:*—Alumina (low temperature fired), asbestos, charcoal, clay and porcelain (low temperature fired), glass wool, kieselguhr, silica gel, refrigeration.

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* It should be noted that the efficiency of some drying agents (*e. g.* $Al_2O_3.xH_2O$ and anhydrous $CaCl_2$, and probably also BaO, anhydrous $Mg(ClO_4)_2$, $Mg(ClO_4)_2\ 3H_2O$, anhydrous $Ba(ClO_4)_2$, and $CaSO_4.\frac{1}{2}H_2O$) depends upon both adsorption and absorption.

A METHOD OF BALANCING EQUATIONS FOR OXIDATION-REDUCTION REACTIONS

On the left-hand side of the equation write the formulae for all the compounds entering into the reaction. On the right-hand side write the formulae for all the compounds formed in the reaction.

Determine the L. C. M. (least common multiple) of the numbers representing the changes in valence per molecule of the oxidizing and reducing agents.

The quotient obtained in dividing the L. C. M. by the number representing the valence change per molecule is the number of molecules of that compound required, or formed.

The reaction between $FeSO_4$, $KMnO_4$, and H_2SO_4 serves to illustrate. Following the rule as given above we write, $KMnO_4 + FeSO_4 + H_2SO_4 \rightarrow K_2SO_4 + MnSO_4 + Fe_2(SO_4)_3 + H_2O$.

The valence change of manganese is five, that of iron is two per molecule of $Fe_2(SO_4)_3$. The L. C. M. of these two numbers is ten.

The quotient obtained by dividing the L. C. M. by the valence change of manganese is two. Therefore two molecules of $KMnO_4$ are required. The quotient obtained by dividing the L. C. M. by the valence change of iron per molecule of $Fe_2(SO_4)_3$ is five. Five molecules of $Fe_2(SO_4)_3$ are formed. Ten molecules of $FeSO_4$ are needed. From the two molecules of $KMnO_4$ used one molecule of K_2SO_4 is formed, as well as two molecules of $MnSO_4$.

Eighteen sulfate radicals are used in forming the salts; ten of these radicals are supplied by the $FeSO_4$ used, the other eight must be supplied by the free acid. The sixteen hydrogens form eight molecules of water.

The complete equation is, therefore,

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O.$$

SOLUBILITY CHART

SOLUBILITY

Abbreviations: W, soluble in water; A, insoluble in water but soluble in acids; w, sparingly
I, insoluble in both water and acids; d, decomposes in water. * Certain salts occur in two

No.		Al	NH_4	Sb	Ba	Bi	Cd	Ca
1	Acetates $-(C_2H_3O_2)$	**W** $Al(-)_3$	**W** $NH_4(-)$	....	**W** $Ba(-)_2$	**W** $Bi(-)_3$	**W** $Cd(-)_2$	**W** $Ca(-)_2$
2	Arsenate $-(AsO_4)$	**a** $Al(-)$	**W** $(NH_4)_3(-)$	**A** $Sb(-)$	**w** $Ba_3(-)_2$	**A** $Bi(-)$	**A** $Cd_3(-)_2$	**w** $Ca_3(-)_2$
3	Arsenite $-(AsO_3)$	....	**W** NH_4AsO_2	**A** $Sb(-)$	....	....	....	**w** $Ca_3(-)_2$
4	Benzoate $-(C_7H_5O_2)$	....	**W** $NH_4(-)$	....	**W** $Ba(-)_2$	**A** $Bi(-)_3$	**W** $Cd(-)_2$	**W** $Ca(-)_2$
5	Bromide	**W** $AlBr_3$	**W** NH_4Br	**d** $SbBr_3$	**W** $BaBr_2$	**d** $BiBr_3$	**W** $CdBr_2$	**W** $CaBr_2$
6	Carbonate	....	**W** $(NH_4)_2CO_3$	....	**w** $BaCO_3$	....	**A** $CdCO_3$	**w** $CaCO_3$
7	Chlorate $-(ClO_3)$	**W** $Al(-)_3$	**W** $NH_4(-)$	....	**W** $Ba(-)_2$	**W** $Bi(-)_3$	**W** $Cd(-)_2$	**W** $Ca(-)_2$
8	Chloride	**W** $AlCl_3$	**W** NH_4Cl	**W** $SbCl_3$	**W** $BaCl_2$	**d** $BiCl_3$	**W** $CdCl_2$	**W** $CaCl_2$
9	Chromate $-(CrO_4)$	....	**W** $(NH_4)_2(-)$	....	**A** $Ba(-)$	....	**A** $Cd(-)$	**W** $Ca(-)$
10	Citrate $-(C_6H_5O_7)$	**W** $Al(-)$	**W** $(NH_4)_3(-)$	....	**w** $Ba_3(-)_2$	**A** $Bi(-)$	**A** $Cd_3(-)_2$	**w** $Ca_3(-)_2$
11	Cyanide	....	**W** NH_4CN	....	**W** $Ba(CN)_2$	**w** $Bi(CN)_3$	**W** $Cd(CN)_2$	**W** $Ca(CN)_2$
12	Ferricy'de $-(Fe(CN)_6)$	....	**W** $(NH_4)_3(-)$	....	**w** $Ba_3(-)_2$	....	**A** $Cd_3(-)_2$	**W** $Ca_3(-)_2$
13	Ferrocy'de $-(Fe(CN)_6)$	**w** $Al_4(-)_3$	**W** $(NH_4)_4(-)$	....	**W** $Ba_2(-)$	....	**A** $Cd_2(-)$	**W** $Ca_2(-)$
14	Fluoride	**W** AlF_3	**W** NH_4F	**W** SbF_3	**w** BaF_2	**W** BiF_3	**W** CdF_2	**w** CaF_2
15	Formate $-(CHO_2)$	**W** $Al(-)_3$	**W** $NH_4(-)$	....	**W** $Ba(-)_2$	**W** $Bi(-)_3$	**W** $Cd(-)_2$	**W** $Ca(-)_2$
16	Hydroxide	**A** $Al(OH)_3$	**W** NH_4OH	....	**W** $Ba(OH)_2$	**A** $Bi(OH)_3$	**A** $Cd(OH)_2$	**W** $Ca(OH)_2$
17	Iodide	**W** AlI_3	**W** NH_4I	**d** SbI_3	**W** BaI_2	**A** BiI_3	**W** CdI_2	**W** CaI_2
18	Nitrate	**W** $Al(NO_3)_3$	**W** NH_4NO_3	....	**W** $Ba(NO_3)_2$	**d** $Bi(NO_3)_3$	**W** $Cd(NO_3)_2$	**W** $Ca(NO_3)_2$
19	Oxalate $-(C_2O_4)$	**A** $Al_2(-)_3$	**W** $(NH_4)_2(-)$	....	**w** $Ba(-)$	**A** $Bi_2(-)_3$	**w** $Cd(-)$	**A** $Ca(-)$
20	Oxide	**a** Al_2O_3	....	**w** Sb_2O_3	**W** BaO	**A** Bi_2O_3	**A** CdO	**w** CaO
21	Phosphate	**A** $AlPO_4$	**W** $NH_4H_2PO_4$	....	**A** $Ba_3(PO_4)_2$	**A** $BiPO_4$	**A** $Cd_3(PO_4)_2$	**w** $Ca_3(PO_4)_2$
22	Silicate, $-(SiO_3)$	**I** $Al_2(-)_3$	....	....	**W** $Ba(-)$	....	**A** $Cd(-)$	**w** $Ca(-)$
23	Sulfate	**W** $Al_2(SO_4)_3$	**W** $(NH_4)_2SO_4$	**A** $Sb_2(SO_4)_3$	**a** $BaSO_4$	**d** $Bi_2(SO_4)_3$	**W** $CdSO_4$	**w** $CaSO_4$
24	Sulfide	**d** Al_2S_3	**W** $(NH_4)_2S$	**A** Sb_2S_3	**d** BaS	**A** Bi_2S_3	**A** CdS	**w** CaS
25	Tartrate $-(C_4H_4O_6)$	**w** $Al_2(-)_3$	**W** $(NH_4)_2(-)$	**W** $Sb_2(-)_3$	**w** $Ba(-)$	**A** $Bi_2(-)_3$	**A** $Cd(-)$	**w** $Ca(-)$
26	Thiocy'te	....	**W** NH_4CNS	....	**W** $Ba(CNS)_2$	....	.. ....	**W** $Ca(CNS)_2$

CHART

soluble in water but soluble in acids; a, insoluble in water and only sparingly soluble in acids; modifications.

No.	Cr	Co	Cu	Au′	Au‴	H	Fe″	Fe‴
1	W $Cr(-)_3$	W $Co(-)_2$	W $Cu(-)_2$	....	....	W $C_2H_4O_2$	W $Fe(-)_2$	W $Fe_2(-)_6$
2	....	A $Co_3(-)_2$	A $Cu_3(-)_2$	....	....	W H_3AsO_4	A $Fe_3(-)_2$	A $Fe(-)$
3	....	A $Co_3H_6(-)_4$	A $CuH(-)$	....	....	....	....	....
4	....	W $Co(-)_2$	w $Cu(-)_2$	....	....	W $C_7H_6O_2$	W $Fe(-)_2$	A $Fe_2(-)_6$
5	W(I)* $CrBr_3$	W $CoBr_2$	W $CuBr_2$	w $AuBr$	W $AuBr_3$	W HBr	W $FeBr_2$	W $FeBr_3$
6	W $CrCO_3$	A $CoCO_3$	....	....	....	....	w $FeCO_3$	....
7	....	W $Co(-)_2$	W $Cu(-)_2$	....	....	W $HClO_3$	W $Fe(-)_2$	W $Fe(-)_3$
8	I $CrCl_3$	W $CoCl_2$	W $CuCl_2$	w $AuCl$	W $AuCl_3$	W HCl	W $FeCl_2$	W $FeCl_3$
9	....	A $Co(-)$	....	....	....	....	....	A $Fe_2(-)_3$
10	....	w $Co_3(-)_2$	....	....	....	W $C_6H_8O_7$	....	W $Fe(-)$
11	A $Cr(CN)_2$	A $Co(CN)_2$	A $Cu(CN)_2$	w $AuCN$	W $Au(CN)_3$	W HCN	a $Fe(CN)_2$	....
12	....	I $Co_3(-)_2$	I $Cu_3(-)_2$	....	....	W $H_3(-)$	I $Fe_3(-)_2$	....
13	....	I $Co_2(-)$	I $Cu_2(-)$	....	....	W $H_4(-)$	I $Fe_2(-)$	a $Fe_4(-)_3$
14	W(a)* CrF_3	W CoF_2	w CuF_2	....	....	W HF	w FeF_2	w FeF_3
15	....	W $Co(-)_2$	W $Cu(-)_2$	....	....	W CH_2O_2	W $Fe(-)_2$	W $Fe(-)_3$
16	A $Cr(OH)_3$	A $Co(OH)_2$	A $Cu(OH)_2$	W $AuOH$	A $Au(OH)_3$	....	A $Fe(OH)_2$	A $Fe(OH)_3$
17	W CrI_2	W CoI_2	a CuI	a AuI	a AuI_3	W HI	W FeI_2	W FeI_3
18	W $Cr(NO_3)_3$	W $Co(NO_3)_2$	W $Cu(NO_3)_2$	....	....	W HNO_3	W $Fe(NO_3)_2$	W $Fe(NO_3$
19	W $Cr(-)$	A $Co(-)$	A $Cu(-)$	....	....	W $C_2H_2O_4$	A $Fe(-)$	W $Fe_2(-$
20	a Cr_2O_3	A CoO	A CuO	Au_2O	A Au_2O_3	W H_2O_2	A FeO	A Fe_2O_3
21	w $Cr_2(PO_4)_2$	A $Co_3(PO_4)_2$	A $Cu_3(PO_4)_2$	....	....	W H_3PO_4	A $Fe_3(PO_4)_2$	w $FePO_4$
22	....	A Co_2SiO_4	A $Cu(-)$	....	....	I H_2SiO_3	....	....
23	W(I)* $Cr_2(SO_4)_3$	W $CoSO_4$	W $CuSO_4$	....	....	W H_2SO_4	W $FeSO_4$	w $Fe_2(SO_4)_3$
24	d Cr_2S_3	A CoS	A CuS	I Au_2S	I Au_2S_3	W H_2S	A FeS	d Fe_2S_3
25	....	w $Co(-)$	w $Cu(-)$	....	....	W $C_4H_6O_6$	w $Fe(-)$	W $Fe_2(-)_3$
26	....	W $Co(CNS)_2$	d $CuCNS$	....	....	W $CNSH$	W $Fe(CNS)_2$	W $Fe(CNS)_3$

No.		Pb	Mg	Mn	Hg′	Hg″	Ni	K
1	Acetate $-(C_2H_3O_2)$	**W** $Pb(-)_2$	**W** $Mg(-)_2$	**W** $Mn(-)_2$	**w** $Hg(-)$	**W** $Hg(-)_2$	**W** $Ni(-)_2$	**W** $K(-)$
2	Arsenate $-(AsO_4)$	**A** $PbH(-)$	**A** $Mg_3(-)$	**w** $MnH(-)$	**A** $Hg_3(-)$	**w** $Hg_3(-)_2$	**A** $Ni_3(-)_2$	**W** $K_3(-)$
3	Arsenite $-(AsO_3)$	....	**W** $Mg_3(-)_2$	**A** $Mn_3H_6(-)_4$	**A** $Hg_3(-)$	**A** $Hg_3(-)$	**A** $Ni_3H_6(-)_4$	**W** K_3AsO_3
4	Benzoate $-(C_7H_5O_2)$	**w** $Pb(-)_2$	**W** $Mg(-)_2$	**W** $Mn(-)_2$	**A** $Hg_2(-)_2$	**w** $Hg(-)_2$	**w** $Ni(-)_2$	**W** $K(-)$
5	Bromide	**W** $PbBr_2$	**W** $MgBr_2$	**W** $MnBr_2$	**A** $HgBr$	**W** $HgBr_2$	**W** $NiBr_2$	**W** KBr
6	Carbonate	**A** $PbCO_3$	**w** $MgCO_3$	**w** $MnCO_3$	**A** Hg_2CO_3	....	**w** $NiCO_3$	**W** K_2CO_3
7	Chlorate $-(ClO_3)$	**W** $Pb(-)_2$	**W** $Mg(-)_2$	**W** $Mn(-)_2$	**W** $Hg(-)$	**W** $Hg(-)_2$	**W** $Ni(-)_2$	**W** $K(-)$
8	Chloride	**W** $PbCl_2$	**W** $MgCl_2$	**W** $MnCl_2$	**a** $HgCl$	**W** $HgCl_2$	**W** $NiCl_2$	**W** KCl
9	Chromate $-(CrO_4)$	**A** $Pb(-)$	**W** $Mg(-)$	....	**w** $Hg_2(-)$	**w** $Hg(-)$	**A** $Ni(-)$	**W** $K_2(-)$
10	Citrate $-(C_6H_5O_7)$	**W** $Pb_3(-)_2$	**W** $Mg_3(-)_2$	**w** $MnH(-)$	**w** $Hg_3(-)$	....	**W** $Ni_3(-)_2$	**W** $K_3(-)$
11	Cyanide	**w** $Pb(CN)_2$	**W** $Mg(CN)_2$	....	**A** $HgCN$	**W** $Hg(CN)_2$	**a** $Ni(CN)_2$	**W** KCN
12	Ferricy'de $-Fe(CN)_6$	**w** $Pb_3(-)_2$	**W** $Mg_3(-)_2$	....	......	**A** $Hg_3(-)_2$	**I** $Ni_3(-)_2$	**W** $K_3(-)$
13	Ferrocy'de $-Fe(CN)_6$	**a** $Pb_2(-)$	**W** $Mg_2(-)$	**A** $Mn_2(-)$	......	**I** $Hg_2(-)$	**I** $Ni_2(-)$	**W** $K_4(-)$
14	Fluoride	**w** PbF_2	**w** MgF_2	**A** MnF_2	**d** HgF	**d** HgF_2	**w** NiF_2	**W** KF
15	Formate $-(CHO_2)$	**W** $Pb(-)_2$	**W** $Mg(-)_2$	**W** $Mn(-)_2$	**w** $Hg(-)$	**W** $Hg(-)_2$	**W** $Ni(-)_2$	**W** $K(-)$
16	Hydroxide	**w** $Pb(OH)_2$	**A** $Mg(OH)_2$	**A** $Mn(OH)_2$	......	**A** $Hg(OH)_2$	**w** $Ni(OH)_2$	**W** KOH
17	Iodide	**w** PbI_2	**W** MgI_2	**W** MnI_2	**A** HgI	**w** HgI_2	**W** NiI_2	**W** KI
18	Nitrate	**W** $Pb(NO_3)_2$	**W** $Mg(NO_3)_2$	**W** $Mn(NO_3)_2$	**W** $HgNO_3$	**W** $Hg(NO_3)_2$	**W** $Ni(NO_3)_2$	**W** KNO_3
19	Oxalate $-(C_2O_4)$	**A** $Pb(-)$	**w** $Mg(-)$	**w** $Mn(-)$	**a** $Hg_2(-)$	**A** $Hg(-)$	**A** $Ni(-)$	**W** $K_2(-)$
20	Oxide	**w** PbO	**A** MgO	**A** MnO	**A** Hg_2O	**w** HgO	**A** NiO	**W** K_2O
21	Phosphate	**A** $Pb_3(PO_4)_2$	**w** $Mg_3(PO_4)_2$	**w** $Mn_3(PO_4)_2$	**A** Hg_3PO_4	**A** $Hg_3(PO_4)_2$	**A** $Ni_3(PO_4)_2$	**W** K_3PO_4
22	Silicate $-(SiO_3)$	**A** $Pb(-)$	**A** $Mg(-)$	**I** $Mn(-)$	....	....	....	**W** $K_2(-)$
23	Sulfate	**w** $PbSO_4$	**W** $MgSO_4$	**W** $MnSO_4$	**w** Hg_2SO_4	**d** $HgSO_4$	**W** $NiSO_4$	**W** K_2SO_4
24	Sulfide	**A** PbS	**d** MgS	**A** MnS	**I** Hg_2S	**I** HgS	**A** NiS	**W** K_2S
25	Tartrate $-(C_4H_4O_6)$	**A** $Pb(-)$	**w** $Mg(-)$	**w** $Mn(-)$	**I** $Hg_2(-)$	....	**A** $Ni(-)$	**W** $K_2(-)$
26	Thiocy'te	**w** $Pb(CNS)_2$	**W** $Mg(CNS)_2$	**W** $Mn(CNS)_2$	**A** $HgCNS$	**w** $Hg(CNS)_2$	....	**W** $KCNS$

CHART (Continued)

No.	Ag	Na	Sn''''	Sn''	Sr	Zn	Pt
1	**w** $Ag(-)$	**W** $Na(-)$	**W** $Sn(-)_4$	**d** $Sn(-)_2$	**W** $Sr(-)_2$	**W** $Zn(-)_2$	....
2	**A** $Ag_3(-)$	**W** $Na_3(-)$	....	....	**w** $SrH(-)$	**A** $Zn_3(-)_2$	....
3	**A** $Ag_3(-)$	**W** $Na_2H(-)$	....	**A** $Sn_3(-)_2$	**w** $Sr_3(-)_2$	....	....
4	**w** $Ag(-)$	**W** $Na(-)$	....	....	....	**W** $Zn(-)_2$	....
5	**a** $AgBr$	**W** $NaBr$	**W** $SnBr_4$	**W** $SnBr_2$	**W** $SrBr_2$	**W** $ZnBr_2$	**w** $PtBr_4$
6	**A** Ag_2CO_3	**W** Na_2CO_3	....	....	**w** $SrCO_3$	**w** $ZnCO_3$	....
7	**W** $Ag(-)$	**W** $Na(-)$	....	**W** $Sn(-)_2$	**W** $Sr(-)_2$	**W** $Zn(-)_2$	....
8	**a** $AgCl$	**W** $NaCl$	**W** $SnCl_4$	**W** $SnCl_2$	**W** $SrCl_2$	**W** $ZnCl_2$	**W** $PtCl_4$
9	**w** $Ag_2(-)$	**W** $Na_2(-)$	**W** $Sn(-)_2$	**A** $Sn(-)$	**w** $Sr(-)$	**w** $Zn(-)$	....
10	**w** $Ag_3(-)$	**W** $Na_3(-)$	....	....	**A** $SrH(-)$	**w** $Zn_3(-)_2$	....
11	**a** $AgCN$	**W** $NaCN$	....	....	**W** $Sr(CN)_2$	**A** $Zn(CN)_2$	**I** $Pt(CN)_2$
12	**I** $Ag_3(-)$	**W** $Na_3(-)$	....	**A** $Sn_3(-)_2$	**W** $Sr_3(-)_2$	**A** $Zn_3(-)_2$	....
13	**I** $Ag_4(-)$	**W** $Na_4(-)$	....	**a** $Sn_2(-)$	**W** $Sr_2(-)$	**I** $Zn_2(-)$	....
14	**W** AgF	**W** NaF	**W** SnF_4	**W** SnF_2	**w** SrF_2	**w** ZnF_2	**W** PtF_4
15	**W** $Ag(-)$	**W** $Na(-)$	....	....	**W** $Sr(-)_2$	**W** $Zn(-)_2$	....
16	....	**W** $NaOH$	**w** $Sn(OH)_4$	**A** $Sn(OH)_2$	**W** $Sr(OH)_2$	**A** $Zn(OH)_2$	**A** $Pt(OH)_4$
17	**I** AgI	**W** NaI	**d** SnI_4	**W** SnI_2	**W** SrI_2	**W** ZnI_2	**I** PtI_2
18	**W** $AgNO_3$	**W** $NaNO_3$	....	**d** $Sn(NO_3)_2$	**W** $Sr(NO_3)_2$	**W** $Zn(NO_3)_2$	**W** $Pt(NO_3)_4$
19	**a** $Ag_2(-)$	**W** $Na_2(-)$	....	**A** $Sn(-)$	**w** $Sr(-)$	**A** $Zn(-)$	....
20	**w** Ag_2O	**d** Na_2O	**A** SnO_2	**A** SnO	**W** SrO	**w** ZnO	**A** PtO
21	**A** Ag_3PO_4	**W** Na_3PO_4	....	**A** $Sn_3(PO_4)_2$	**A** $Sr_3(PO_4)_2$	**A** $Zn_3(PO_4)_2$	....
22	....	**W** $Na_2(-)$	....	....	**A** $Sr(-)$	**A** $Zn(-)$	....
23	**w** Ag_2SO_4	**W** Na_2SO_4	**W** $Sn(SO_4)_2$	**W** $SnSO_4$	**w** $SrSO_4$	**W** $ZnSO_4$	**W** $Pt(SO_4)_2$
24	**A** Ag_2S	**W** Na_2S	**A** SnS_2	**A** SnS	**W** SrS	**A** ZnS	**I** PtS
25	**w** $Ag_2(-)$	**W** $Na_2(-)$	....	**W** $Sn(-)$	**w** $Sr(-)$	**w** $Zn(-)$	....
26	**I** $AgCNS$	**W** $NaCNS$	....	....	**W** $Sr(CNS)_2$	**W** $Zn(CNS)_2$	....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER

The table shows the number of grams of the anhydrous substance indicated in the first column which can be dissolved in 100 grams of water at the temperature in degrees Centigrade given at the top. When the formula is preceded by a * the solubility is stated in grams of anhydrous substance in 100 grams of saturated solution; when preceded by ** the solubility is stated in grams of anhydrous substance in 100 c.c. of the saturated solution. The column headed with S. P. shows the solid phase hydrated form in equilibrium with the saturated solution.

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
Ag_3AsO_3	....	....	....	1.15×10^{-3}	....	....	....	....	....	....	....	....
Ag_3AsO_4	....	....	....	8.5×10^{-4}	....	....	....	....	....	....	....	....
$AgBr$	....	....	....	8.4×10^{-6}	....	....	....	....	....	....	....	....
$AgC_2H_3O_2$	....	0.72	0.88	1.04	1.21	1.41	1.64	1.89	2.18	2.52	....	....
$AgCl$	....	....	8.9×10^{-5}	1.5×10^{-4}	....	....	5.23×10^{-4}	....	....	....	....	2.1×10^{-3}
$AgCN$	....	....	....	2.2×10^{-5}	....	....	....	....	....	....	....	....
Ag_2CO_3	....	....	....	3.2×10^{-3}	....	....	....	....	....	....	....	5×10^{-2}
Ag_2CrO_4	....	1.4×10^{-3}	....	....	3.6×10^{-3}	....	5.3×10^{-3}	....	8×10^{-3}	....	....	....
$Ag_3Fe(CN)_6$	....	....	....	6.6×10^{-5}	....	....	....	....	....	....	....	....
AgI	....	....	....	....	3×10^{-7}	....	....	3×10^{-6}	....	....	....	....
$AgIO_3$	....	....	3×10^{-3}	4×10^{-3}	....	....	....	1.9×10^{-2}	....	....	....	....
$AgNO_2$	....	1.55×10^{-1}	2.20×10^{-1}	3.40×10^{-1}	5×10^{-1}	7.15×10^{-1}	9.95×10^{-1}	13.63×10^{-1}	....	....	....	....
$AgNO_3$	....	122	170	222	300	376	455	525	....	669	....	952
Ag_2S	....	....	....	1.4×10^{-5}	....	....	....	....	....	....	....	....
*Ag_2SO_4	....	5.7×10^{-1}	6.9×10^{-1}	7.9×10^{-1}	8.8×10^{-1}	9.7×10^{-1}	10.7×10^{-1}	11.4×10^{-1}	12.1×10^{-1}	12.8×10^{-1}	13.4×10^{-1}	13.9×10^{-1}
*$AlCl_3$	....	....	$41.13^{15°}$	....	....	....	....	....	....	....	....	....
*$Al_2(SO_4)_3$	$18H_2O$	23.8	25.1	26.7	28.8	31.4	34.3	37.2	39.8	42.2	44.7	47.1
*As_2O_5	....	37.3	38.3	39.7	41	41.6	....	42.2	....	42.9	....	43.4
As_2S_3	....	....	....	5.17×10^{-5}	at 18°	....	....	....	....	....	....	....
B_2O_3	....	1.1	1.5	2.2	....	4.0	....	6.2	....	9.5	....	15.7
$BaBr_2$	....	98	101	104	109	114	118	123	128	135	....	149
*$Ba(BrO_3)_2$	....	2.86×10^{-1}	4.39×10^{-1}	6.52×10^{-1}	9.5×10^{-1}	13.1×10^{-1}	17.2×10^{-1}	22.71×10^{-1}	29.22×10^{-1}	35.21×10^{-1}	42.6×10^{-1}	54×10^{-1}
$Ba(C_2H_3O_2)_2$	$3H_2O$	59	63	71	....	....	....	....	....	....	....	....
$Ba(C_2H_3O_2)_2$	$1H_2O$	....	....	....	75	79	77	74	74	....	....	75
$BaCl_2$	....	31.6	33.3	35.7	38.2	40.7	43.6	46.4	49.4	52.4	....	58.8
*$Ba(ClO_3)_2$	....	16.90	21.23	25.26	29.43	33.16	....	40.05	....	45.90	....	51.2

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
*$Ba(ClO_4)_2$	....	67.3	....	74.3	....	78.2	....	81	....	83.2	....	84.9
$BaCO_3$	....	1.6×10^{-3}	at 8°; $2.2\times$	10^{-3} at 18°;	2.4×10^{-3} a	t 24.2°	....	....	....	....	....	....
*BaC_2O_4	....	5.8×10^{-3}	8.2×10^{-3}	....	17×10^{-3}	....	....	....	....	....	....	....
$BaCrO_4$	....	2×10^{-4}	2.8×10^{-4}	3.7×10^{-4}	4.6×10^{-4}	....	....	....	....	....	....	....
BaI_2	$6H_2O$	170.2	185.7	203.1	219.6	....	....	....	....	....	....	....
BaI_2	$2H_2O$	....	....	....	....	231.9	....	247.3	....	261.0	....	271.7
*$Ba(IO_3)_2$	....	8×10^{-3}	1.4×10^{-2}	2.2×10^{-2}	3.1×10^{-2}	4.1×10^{-2}	5.6×10^{-2}	7.4×10^{-2}	9.3×10^{-2}	11.5×10^{-2}	14.1×10^{-2}	19.7×10^{-2}
$BaMoO_4$	....	....	5.8×10^{-3}	at 23°	....	....	....	....	....	....	....	....
*$Ba(NO_2)_2$	$1H_2O$	....	....	40.3	....	....	....	....	....	67.3	....	75
$Ba(NO_3)_2$	....	5.0	7.0	9.2	11.6	14.2	17.1	20.3	....	27.0	....	34.2
$Ba(OH)_2$	....	1.67	2.48	3.89	5.59	8.22	13.12	20.94	....	101.40	....	....
$BaSO_4$	....	1.15×10^{-4}	2.0×10^{-4}	2.4×10^{-4}	2.85×10^{-4}	....	3.36×10^{-4}	....	....	....	....	4.13×10^{-4}
$BeKF_3$	....	....	....	2.0	....	....	....	....	....	....	....	5.2
$BeNaF_3$	....	....	....	1.4	....	....	....	....	....	....	....	2.8
$BeSO_4$	$6H_2O$	....	....	....	52	....	60.67	....	....	....	....	....
$BeSO_4$	$4H_2O$	....	....	....	43.78	46.74	....	....	62	....	83	100
$BeSO_4$	$2H_2O$	....	....	....	....	....	....	....	....	84.76	98	110
Br_2	....	4.22	3.4	3.20	3.13	....	....	....	....	....	....	....
Bi_2S_3	....	....	1.8×10^{-5}	at 18°	....	....	....	....	....	....	....	....
$CaBr_2$	$6H_2O$	125	132	143	....	....	....	....	....	....	....	....
$CaBr_2$	$4H_2O$	....	....	....	....	68.1	....	73.5	....	74.7	....	....
$Ca(C_2H_3O_2)_2$	$2H_2O$	37.4	36.0	34.7	33.8	33.2	....	32.7	....	33.5	....	....
$Ca(C_2H_3O_2)_2$	H_2O	....	....	....	....	....	....	....	....	....	31.1	29.7
$CaCl_2$	$6H_2O$	59.5	65.0	74.5	102	....	....	....	....	....	....	....
$CaCl_2$	$2H_2O$	....	....	....	....	....	....	136.8	141.7	147.0	152.7	159
CaC_2O_4	....	6.7×10^{-4}	at 13°; 6.8	$\times10^{-4}$ at 2	5°; 9.5×10	$^{-4}$ at 50°; 1	4.0×10^{-4} a	t 95°	....	....	....	....
CaF_2	....	1.6×10^{-3}	at 18°; 1.7	$\times10^{-3}$ at 2	6°	....	....	....	....	....	....	....
$Ca(HCO_3)_2$	....	.1615	....	.1660	....	.1705	....	.1750	....	.1795	....	.1840
*CaI_2	....	64.6	66.0	67.6	69	70.8	....	74	....	78	....	81
*$Ca(IO_3)_2$	$6H_2O$	0.10	0.17	....	0.42	0.61	0.89	1.36	....	....	....	....
*$Ca(IO_3)_2$	$1H_2O$	....	....	....	....	0.52	0.59	0.65	....	0.79	....	0.94

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
•$Ca(NO_2)_2$	$4H_2O$	38.3	....	43.4	....	....	....	....	....	....	....	....
•$Ca(NO_2)_2$	$2H_2O$	....	....	....	....	....	....	57	60.3	....	71	....
•$Ca(NO_3)_2$	$4H_2O$	50.50	53.55	56.39	60.41	66.21	....	....	....	....	....	....
•$Ca(NO_3)_2$	$3H_2O$	....	....	....	....	70.37	73.79	....	....	....	....	....
•$Ca(NO_3)_2$	....	....	....	....	....	....	....	....	....	78.2	....	78.43
$Ca(OH)_2$	....	1.85×10^{-1}	1.76×10^{-1}	1.65×10^{-1}	1.53×10^{-1}	1.41×10^{-1}	1.28×10^{-1}	1.16×10^{-1}	1.06×10^{-1}	9.4×10^{-2}	8.5×10^{-2}	7.7×10^{-2}
$CaSO_4$	....	1.759×10^{-1}	1.928×10^{-1}	....	2.09×10^{-1}	....	2.097×10^{-1}	2.047×10^{-1}	1.974×10^{-1}	....	....	1.619×10^{-1}
•$CdBr_2$	......	37.92	....	....	56.90	60.65	....	61.10	....	62.29	....	....
•$CdCl_2$	$4H_2O$	49.39	55.58	....	....	....	....	....	....	....	....	....
•$CdCl_2$	$2\frac{1}{2}H_2O$	47.37	....	....	56.91	....	....	....	....	....	....	....
•$CdCl_2$	H_2O	....	57.47	57.35	....	57.51	....	57.71	....	58.41	....	59.52
$Cd(CN)_2$	....	....	$1.7^{15°}$	....	....	....	....	....	....	....	....	....
CdI_2	....	79.8	83.2	86.2	89.7	93.8	97.4	....	....	....	....	127.6
$Cd(OH)_2$	....	....	2.6×10^{-4}	at 25°	....	....	....	....	....	....	....	....
CdS	....	....	9×10^{-7}	at 18°	....	....	....	....	....	....	....	....
•$Ce_2(SO_4)_3$	$9H_2O$	17.35	....	9.16	6.36	....	4.465	3.73	....	....	....	....
•$Ce_2(SO_4)_3$	$8H_2O$	15.95	....	8.69	....	5.613	....	3.88	....	....	....	....
•$Ce_2(SO_4)_3$	$5H_2O$	....	....	....	....	....	....	3.145	....	1.19	....	0.46
•$Ce_2(SO_4)_3$	$4H_2O$	....	....	....	....	5.71	3.31	2.3	....	1.0	....	0.42
Cl_2 760mm.	....	1.46	0.980	0.716	0.562	0.451	0.386	0.324	0.274	0.219	0.125	0
CO 760mm.	....	4.4×10^{-3}	3.5×10^{-3}	2.8×10^{-3}	2.4×10^{-3}	2.1×10^{-3}	1.8×10^{-3}	1.5×10^{-3}	1.3×10^{-3}	1.0×10^{-3}	6×10^{-4}	0
CO_2 760mm.	....	0.3346	0.2318	0.1688	0.1257	0.0973	0.0761	0.0576	....	....	....	....
•$CoCl_2$	$6H_2O$	29.5	31.5	33.5	35.5	....	....	....	....	....	....	....
•$CoCl_2$	H_2O	....	....	....	....	41.0	47.0	47.5	....	49.5	....	51.0
•CoI_2	....	58.0	61.5	65.2	70.0	75.0	79.0	....	....	80.0	....	....
•$Co(NO_3)_2$	$6H_2O$	45.66	....	50	....	55.9	....	....	....	....	....	....
•$Co(NO_3)_2$	$3H_2O$	....	....	....	....	....	....	62	64.89	68	77	....
CoS	....	3.79×10^{-4}	at 18°	....	....	....	....	....	....	....	....	....
$CoSO_4$	....	25.55	30.55	36.21	42.26	48.85	55.2	60.4	65.7	70	....	83
•CrO_3	....	62.24	....	....	....	63.50	64.55	....	....	....	68.5	67.4
CsCl	....	161.4	174.7	186.5	197.3	208.0	218.5	229.7	239.5	250.0	260.1	270.5

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$CsClO_3$	....	2.46	3.8	6.2	9.5	13.8	19.4	26.2	34.7	45.0	58.0	79.0
$CsClO_4$	....	0.8	1.0	1.6	2.6	4.0	5.4	7.3	9.8	14.4	20.5	30.0
CsF	$1\frac{1}{2}H_2O$	....	....	$366.6^{18°}$	....	....	....	....	....	....	....	....
$CsIO_3$	....	....	....	$2.6^{24°}$	....	....	....	....	....	....	....	....
$CsIO_4$	....	....	....	$2.15^{15°}$	....	....	....	....	....	....	....	....
$CsNO_3$	....	9.33	14.9	23.0	33.9	47.2	64.4	83.8	107.0	134.0	163.0	197.0
*$CsOH$	....	....	....	$79.41^{15°}$	....	....	....	....	....	....	....	....
Cs_2SO_4	....	167.1	173.1	178.7	184.1	189.9	194.9	199.9	205.0	210.3	214.9	220.3
$CuCl$	....	....	....	$1.52^{25°}$	....	....	....	....	....	....	....	....
*$CuCl_2$	....	41.4	42.45	43.5	44.55	45.6	46.65	47.7	....	49.8	....	51.9
CuI_2	....	....	....	1.107	....	....	....	....	....	....	....	....
*$Cu(NO_3)_2$	$6H_2O$	45	48.79	55.58	....	....	....	....	....	....	....	....
*$Cu(NO_3)_2$	$3H_2O$	....	....	....	....	61.51	....	64.17	....	67.51	....	....
CuS	....	....	3.3×10^{-5}	at 18°	....	....	....	....	....	....	....	....
$CuSO_4$	....	14.3	17.4	20.7	25	28.5	33.3	40	....	55	....	75.4
*$FeBr_2$	....	50.5	....	53.5	55.0	56.2	....	59.0	....	61.5	....	64.0
*$FeCl_2$	$4H_2O$	....	39.2	....	42.2	43.6	45.2	47.0	....	50.0	....	....
*$FeCl_2$	H_2O	....	....	....	....	....	....	....	....	....	51.3	51.4
$FeCl_3$	....	74.4	81.9	91.8	....	....	315.1	....	....	525.8	....	535.7
*$Fe(NO_3)_2$	$6H_2O$	41.53	....	45.6	....	....	....	62.5	....	....	....	....
FeS	....	6.16×10^{-4}	at 18°	....	....	....	....	....	....	....	....	....
$FeSO_4$	$7H_2O$	15.65	20.51	26.5	32.9	40.2	48.6	....	....	....	....	....
$FeSO_4$	H_2O	....	....	....	....	....	....	....	50.9	43.6	37.3	....
*H_3BO_3	....	2.59	3.45	4.8	6.30	8.02	10.35	12.90	15.70	19.11	23.30	28.7
HBr 760mm.	....	221.2	210.3	198	....	....	171.5	....	....	....	....	130
HCl 760mm.	....	82.3	....	....	67.3	63.3	59.6	56.1	....	....	....	....
*H_2SeO_3	....	47.4	55	62.5	70.2	77.5	79.2	79.3	79.3	79.3	79.4	....
H_2SeO_4	H_2O	81	....	85	....	....	....	....	....	....	....	....
H_2SeO_4	....	....	....	....	93	94.5	96.5	100	....	....	....	....
*H_2TeO_4	$6H_2O$	13.92	26.21	....	....	....	....	....	....	....	....	....
*H_2TeO_4	$2H_2O$	....	25.29	....	33.36	36.38	....	43.67	....	51.55	....	60.84

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
HgBr	....	....	3.9×10^{-6}	at 25°	....	....	....	....	....	....	....	....
$HgBr_2$	....	....	....	0.5	....	....	....	....	....	....	....	25
•HgCl	....	1.4×10^{-4}	....	2×10^{-4}	4×10^{-4}	....	....	....	....	....	....	....
•$HgCl_2$	....	3.5	4.6	6.1	7.7	9.3	....	14	....	23.1	....	38
$Hg(CN)_2$....	....		$9.3^{13.5°}$;	$53.85^{101.1°}$	....	....	....	....	....	....	....	....
HgI	....	....	2×10^{-8}	at 25°	....	....	....	....	....	....	....	....
HgI_2	....	....	5.91×10^{-3}	at 25°	....	....	....	....	....	....	....	....
I_2	....	....	....	2.9×10^{-2}	4.0×10^{-2}	5.6×10^{-2}	7.8×10^{-2}	....	....	....	....	....
KBr	....	53.5	59.5	65.2	70.6	75.5	80.2	85.5	90.0	95.0	99.2	104.0
$KBrO_3$......	....	3.1	4.8	6.9	9.5	13.2	17.5	22.7	....	34.0	....	50.0
$KC_2H_3O_2$ ...	$1\frac{1}{2}H_2O$	216.7	233.9	255.6	283.8	323.3	....	....	....	....	....	....
$KC_2H_3O_2$ ...	$\frac{1}{2}H_2O$	....	....	....	....	....	337.3	350	364.8	380.1	396.3	....
KCl	....	27.6	31.0	34.0	37.0	40.0	42.6	45.5	48.3	51.1	54.0	56.7
$KClO_3$	....	3.3	5	7.4	10.5	14	19.3	24.5	....	38.5	....	57
$KClO_4$	....	0.75	1.05	1.80	2.6	4.4	6.5	9	11.8	14.8	18	21.8
•KCNS	....	63.9	....	68.5	....	....	....	....	....	....	....	....
•K_2CO_3	$2H_2O$	51.3	52	52.5	53.2	53.9	54.8	55.9	57.1	58.3	59.6	60.9
K_2CrO_4	....	58.2	60.0	61.7	63.4	65.2	66.8	68.6	70.4	72.1	73.9	75.6
$K_2Cr_2O_7$	....	5	8.5	13.1	....	29.2	....	50.5	....	73.0	....	102.0
•$KHC_4H_4O_6$	....	0.32	0.40	0.53	0.9	1.3	1.8	2.4	....	4.4	....	6.5
•$KHCO_3$ ...	....	18.3	21.7	24.9	28.1	31.2	....	37.5	....	....	....	....
$KHSO_4$	....	36.3	....	51.4	....	67.3	....	....	....	....	....	121.6
KI	....	127.5	136	144	152	160	168	176	184	192	200	208
KIO_3	....	4.73	....	8.13	11.73	12.8	....	18.5	....	24.8	....	32.2
$KMnO_4$	....	2.83	4.4	6.4	9.0	12.56	16.89	22.2	....	....	....	....
•KNO_2	....	73.6	....	74.9	....	77	....	....	....	....	....	80.5
KNO_3......	....	13.3	20.9	31.6	45.8	63.9	85.5	110.0	138	169	202	246
KOH	$2H_2O$	97	103	112	126	....	....	....	....	....	....	....
KOH	H_2O	....	....	....	....	....	140	....	....	....	....	178
K_2PtCl_6 ...	....	0.74	0.90	1.12	1.41	1.76	2.17	2.64	3.19	3.79	4.45	5.18
K_2SO_4	....	7.35	9.22	11.11	12.97	14.76	16.50	18.17	19.75	21.4	22.8	24.1

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
**$K_2S_2O_8$ ...	....	1.62	2.60	4.49	7.19	9.89	....	....	....	....	....	....
$K_2SO_4.Al_2(SO_4)_3$	$24H_2O$	3.0	4.0	5.9	8.39	11.70	17.00	24.75	40.0	71.0	109.0	....
$La_2(SO_4)_3$ ...	....	3	....	....	1.9	....	1.5	....	....	....	....	0.69
LiBr	H_2O	....	....	....	....	....	214	224	....	245	....	266
LiBr	$2H_2O$	143	166	177	191	205	....	....	....	....	....	....
LiCl	....	67	72	78.5	84.5	90.5	97	103	....	115	....	127.5
Li_2CO_3	....	1.54	1.43	1.33	1.25	1.17	1.08	1.01	....	0.85	....	0.72
LiI	$3H_2O$	151	157	165	171	179	187	202	230	....	....	....
LiI	H_2O	....	....	....	....	....	....	....	....	435	....	481
*$LiNO_3$	$3H_2O$	34.8	37.9	....	57	....	....	....	....	....	....	....
*$LiNO_3$	$1\frac{1}{2}H_2O$	....	....	....	....	....	61	63.6	....	....	....	....
*$LiNO_3$	....	....	....	....	....	....	....	....	66	....	....	....
LiOH........	....	12.7	12.7	12.8	12.9	13	13.3	13.8	....	15.3	....	17.5
*Li_2SO_4	....	26.1	25.9	25.5	25.1	24.7	24.5	24.2	....	23.5	....	23
$MgBr_2$	$6H_2O$	91.0	94.5	96.5	99.2	101.6	104.1	107.5	....	113.7	....	120.2
$MgCl_2$	$6H_2O$	52.8	53.5	54.5	....	57.5	....	61.0	....	66.0	....	73.0
*MgI_2	$8H_2O$	97	....	140	....	172	....	....	....	....	....	....
*$Mg(NO_3)_2$.	$6H_2O$	....	....	....	....	....	....	....	....	....	65	....
$Mg(OH)_2$ ...	....	9×10^{-4} at 18°		....	....	....	....	....	....	....	....	....
*$MgSO_4$	$7H_2O$	....	23.6	26.2	29	31.3	....	....	....	....	....	....
*$MgSO_4$	$6H_2O$	29	29.7	30.8	31.2	....	33.5	35.5	37.3	39.1	40.8	42.5
*$MgSO_4$	H_2O	....	....	....	....	....	....	....	....	38.6	....	40.6
*$MnBr_2$	$4H_2O$	56.0	57.6	59.5	61.1	62.8	64.5	66.3	68.0	....	....	....
*$MnBr_2$	$2H_2O$	....	....	....	....	....	....	....	....	69.2	69.3	69.5
$MnCl_2$	$4H_2O$	63.4	68.1	73.9	80.71	88.59	98.15	....	....	....	....	....
$MnCl_2$	$2H_2O$	....	....	....	....	....	....	108.6	110.6	112.7	114.1	115.3
*$Mn(NO_3)_2$..	$6H_2O$	50.49	54.1	58.8	....	....	....	....	....	....	....	....
*$Mn(NO_3)_2$..	$3H_2O$	....	....	....	67.38	....	....	....	....	....	....	....
MnS	....	....	6.23×10^{-4} at 18°		....	....	....	....	....	....	....	....
$MnSO_4$	$7H_2O$	53.23	60.01	....	....	....	....	....	....	....	....	....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$MnSO_4$	$5H_2O$	....	59.5	62.9	67.76	....	....	....	....	....	....	....
$MnSO_4$	$4H_2O$	....	....	64.5	66.44	68.8	72.6	....	....	....	....	....
$MnSO_4$	H_2O	....	....	....	....	....	58.17	55.0	52.0	48.0	42.5	34.0
MoO_3	....	....	....	0.138	0.264	0.476	0.687	1.206	2.055	2.106	....	....
N_2O	....	....	0.1705	0.1211	....	....	....	....	....	....	....	....
NH_4Br	....	60.6	68	75.5	83.2	91.1	99.2	107.8	116.8	126	135.6	145.6
*NH_4CNS	....	54.5	59	63	67.5	....	....	....	....	....	....	....
*$(NH_4)_2C_2O_4$	....	2.1	3	4.2	5.6	7.4	9.3	....	....	....	....	....
$(NH_4)_2Cd(SO_4)_2$	....	....	....	72.3^{25°	....	....	....	....	....	....	....	....
NH_4Cl	....	29.4	33.3	37.2	41.4	45.8	50.4	55.2	60.2	65.6	71.3	77.3
**NH_4ClO_4	....	11.56	....	20.85	....	30.58	....	39.05	....	48.19	....	57.01
$(NH_4)_2CoSO_4$	....	6.0	9.5	13.0	17.0	22.0	27.0	33.5	40.0	49.0	....	....
*$(NH_4)_2CrO_4$	....	....	....	....	28.8	....	....	....	....	....	....	....
*$(NH_4)_2Cr_2O_7$	....	....	....	....	32.05	....	....	....	....	....	....	....
$(NH_4)_2Cr_2(SO_4)_4$	....	....	....	10.78^{25°	....	....	....	....	....	....	....	....
$(NH_4)_2Fe(SO_4)_2$	....	12.5	17.2	....	....	33.0	40	....	52	....	....	....
$(NH_4)_2Fe_2(SO_4)_4$	....	....	....	44.15^{25°	....	....	....	....	....	....	....	....
NH_4HCO_3	....	11.9	15.8	21	27	....	....	....	....	....	....	....
$NH_4H_2PO_3$	....	171	$190^{14.5^\circ}$	260^{31°	....	....	....	....	....	....	....	....
$(NH_4)_2HPO_4$	....	....	131^{15°	....	....	....	....	....	....	....	....	....
NH_4I	....	154.2	163.2	172.3	181.4	190.5	199.6	208.9	218.7	228.8	....	250.3
*NH_4LiSO_4	....	....	35.58	....	35.87	....	36.00	....	36.18	....	....	....
NH_4MgPO_4	....	0.023	....	0.052	....	0.036	0.030	0.040	0.016	0.019	....	....
NH_4MnPO_4	....	....	....	0	....	0	....	0	0.005	0.007	....	....
NH_4NO_3	....	118.3	....	192	241.8	297.0	344.0	421.0	499.0	580.0	740.0	871.0
$(NH_4)_2PtCl_6$	....	....	0.7	....	....	....	....	....	....	....	....	1.25
$(NH_4)_2SO_4$	....	70.6	73.0	75.4	78.0	81.0	....	88.0	....	95.3	....	103.3

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$(NH_4)_2SO_4.Al_2(SO_4)_3$	$24H_2O$	2.10	4.99	7.74	10.94	14.88	20.10	26.70	....	....	....	....
$(NH_4)_2S_2O_8$ ..	....	58.2	....	....	....	....	....	....	....	....	....	....
$^*(NH_4)_3SbS_4$	....	41.6	....	47.7	54.5	....	....	....	....	....	....	....
$(NH_4)_2SeO_4$	....	....	$1.22^{12°}$	....	....	....	....	....	....	....	....	....
NH_4VO_3 ...	....	....	....	4.8	8.4	13.2	17.8	....	30.5	....	....	....
NO 760mm. .	....	9.84×10^{-3}	7.57×10^{-3}	6.18×10^{-3}	5.17×10^{-3}	4.40×10^{-3}	3.76×10^{-3}	3.24×10^{-3}	2.67×10^{-3}	1.99×10^{-3}	1.14×10^{-3}	0
N_2O 760mm.	....	....	0.171	0.121	....	....	....	....	....	....	....	....
*NaBr	$2H_2O$	44.3	....	47.5	49.4	51.4	53.7	....	....	....	....	....
*NaBr	....	....	....	....	....	....	....	....	....	54.2	....	54.8
$Na_2B_4O_7$ ...	$10H_2O$	1.3	1.6	2.7	3.9	....	10.5	20.3	....	....	....	....
$Na_2B_4O_7$ ...	$5H_2O$	....	....	....	....	....	....	....	24.4	31.5	41	52.5
$NaBrO_3$.....	....	27.5	....	34.5	....	50.2	....	62.5	....	75.7	....	90.9
$NaC_2H_3O_2$ ..	$3H_2O$	36.3	40.8	46.5	54.5	65.5	83	139	....	....	....	....
$NaC_2H_3O_2$ ..	....	119	121	123.5	126	129.5	134	139.5	146	153	161	170
$Na_2C_2O_4$ ...	....	....	....	3.7	....	....	....	....	....	....	....	6.33
NaCl	....	35.7	35.8	36.0	36.3	36.6	37.0	37.3	37.8	38.4	39.0	39.8
$NaClO_3$	....	79	89	101	113	126	140	155	172	189	....	230
Na_2CO_3	$10H_2O$	7	12.5	21.5	38.8	....	....	....	....	....	....	....
Na_2CO_3	H_2O	....	....	....	50.5	48.5	....	46.4	....	45.8	....	45.5
$^*Na_2CrO_4$ ..	$10H_2O$	24.07	33.41	47	....	....	....	....	....	....	....	....
$^*Na_2CrO_4$ ..	$4H_2O$	....	....	....	47	48.97	51	53.4	....	....	....	....
$^*Na_2CrO_4$ ..	....	....	....	....	....	....	....	....	55.15	55.53	....	55.74
$^*Na_2Cr_2O_7$ ..	$2H_2O$	61.98	....	64	....	....	71	....	76	79	....	....
$Na_2Cr_2O_7$ ...	....	....	....	....	....	....	....	....	....	....	....	81
$Na_4Fe(CN)_6$	....	....	....	17.9	....	30	....	....	....	59	....	63
$NaHCO_3$ ...	....	6.9	8.15	9.6	11.1	12.7	14.45	16.4	....	....	....	....
NaH_2PO_4 ...	$2H_2O$	57.9	69.9	85.2	106.5	138.2	....	....	....	....	....	....
NaH_2PO_4 ...	H_2O	....	....	....	....	....	158.6	....	....	....	....	....
NaH_2PO_4 ...	....	....	....	....	....	....	....	179.3	190.3	207.3	225.3	246.6
Na_2HAsO_4 ..	....	7.3	15.5	26.5	37	47	....	65	....	85	....	....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
Na_2HPO_4	$12H_2O$	1.67	3.6	7.7	20.8	....	....	....	....	....	....	....
Na_2HPO_4	$7H_2O$	....	....	....	....	51.8	....	....	....	....	....	....
Na_2HPO_4....	$2H_2O$	....	....	....	....	....	80.2	82.9	88.1	92.4	102.9	....
Na_2HPO_4....	....	....	....	....	....	....	....	....	....	....	....	102.2
NaI	....	....	....	....	....	....	....	....	294	296	....	302
NaI	$2H_2O$	158.7	168.6	178.7	190.3	205.0	227.8	256.8	....	....	....	....
$NaIO_3$	....	2.5	....	9	....	15	....	21	....	27	....	34
*$NaNO_2$	....	41.9	43.8	45.8	47.8	49.6	51	....	....	57	....	62
$NaNO_3$	....	73	80	88	96	104	114	124	....	148	....	180
NaOH	$4H_2O$	42	....	....	....	....	....	....	....	....	....	....
NaOH	$3\frac{1}{2}H_2O$	....	51.5	....	....	....	....	....	....	....	....	....
NaOH	H_2O	....	....	109	119	129	145	174	....	....	....	....
NaOH	....	....	....	....	....	....	....	....	....	....	313	347
Na_3PO_4	$12H_2O$	1.5	4.1	11	20	31	43	55	....	81	....	108
$Na_4P_2O_7$	$10H_2O$	3.16	3.95	6.23	9.95	13.50	17.45	21.83	....	30.04	....	40.26
*Na_2S	$9H_2O$	....	13.36	15.8	18.4	22.2	....	....	....	....	....	....
*Na_2S	$5\frac{1}{2}H_2O$	....	....	....	....	....	28.48	29.92	31.38	33.95	37.20	....
*Na_2S	$6H_2O$	....	....	....	....	....	26.7	28.1	30.22	32.95	36.42	....
Na_2SO_3	$7H_2O$	13.9	20	26.9	36	....	....	....	....	....	....	....
Na_2SO_3	....	....	....	....	....	28.0	28.2	28.8	....	28.3	....	....
Na_2SO_4	$10H_2O$	5.0	9.0	19.4	40.8	....	....	....	....	....	....	....
Na_2SO_4	$7H_2O$	19.5	30	44	....	....	....	....	....	....	....	....
Na_2SO_4	....	....	....	....	....	48.8	46.7	45.3	....	43.7	....	42.5
$Na_2S_2O_3$	....	52.5	61.0	70.0	84.7	102.6	169.7	206.7	....	248.8	254.2	266.0
*Na_2SeO_4 ...	$10H_2O$	11.74	....	....	44.05	....	....	....	....	....	....	....
*Na_2SeO_4 ...	....	....	....	....	....	....	44.49	....	....	....	....	42.14
$NaVO_3$	$2H_2O$	....	....	....	....	30.2	....	68.4	....	....	....	....
$NaVO_3$	....	....	....	....	....	26.23	....	32.97	36.9	....	....	....
*Na_2WO_4 ...	$10H_2O$	36.54	....	....	....	....	....	....	....	....	....	....
*Na_2WO_4 ...	$2H_2O$	41.73	....	42	....	....	....	....	....	47.7	....	49.3
$Nd_2(SO_4)_3$...	....	9.5	....	....	5	....	3.7	....	....	2.7	....	....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
*$NiBr_2$	....	53	55	56.7	58	59.1	60	60.4	....	60.6	....	60.8
$NiCO_3$	....	....	9.25$\times$	10^{-3} at 25°	....	....	....	....	....	....	....	....
*$NiCl_2$	....	35	37.3	39.1	40.8	42.3	43.9	45.1	46	....	....	46.7
*NiI_2	....	55.4	57.5	59.7	61.7	63.5	64.7	64.8	65	65.2	65.3	....
*$Ni(NO_3)_2$	$6H_2O$	44.32	....	49.06	....	55	....	....	....	....	....	....
*$Ni(NO_3)_2$	$3H_2O$	....	....	....	....	....	....	61.99	63.95	....	70.16	....
NiS	....	....	3.6 $\times$	10^{-4} at 18°	....	....	....	....	....	....	....	....
$NiSO_4$	$7H_2O$	27.22	32	....	42.46	....	....	....	....	....	....	....
$NiSO_4$	$6H_2O$	....	....	....	....	....	50.15	54.80	59.44	63.17	....	76.7
O_3	....	3.9×10^{-3}	2.9×10^{-3}	2.1×10^{-3}	7×10^{-4}	4×10^{-4}	1×10^{-4}	0	....	....	....	....
$PbBr_2$	....	0.4554	....	0.85	1.15	1.53	1.94	2.36	....	3.34	....	4.75
$Pb(C_2H_3O_2)_2$	....	....	....	$55.04^{25°}$	....	....	....	....	....	....	....	....
$PbCO_3$	....	....	....	1.1×10^{-4}	....	....	....	....	....	....	....	....
$PbCl_2$	....	0.6728	....	0.99	1.20	1.45	1.70	1.98	....	2.62	....	3.34
$PbCrO_4$	....	....	....	7×10^{-6}	....	....	....	....	....	....	....	....
PbF_2	....	....	0.06	0.064	0.068	....	....	....	....	....	....	....
PbI_2	....	0.0442	....	0.068	0.090	0.125	0.164	0.197	....	0.302	....	0.436
$Pb(NO_3)_2$	....	38.8	48.3	56.5	66	75	85	95	....	115	....	138.8
PbS	....	....	....	8.6×10^{-5}	at 18°	....	....	....	....	....	....	....
$PbSO_4$	....	0.0028	0.0035	0.0041	0.0049	0.0056	....	....	....	....	....	....
$RbCl$	....	77	84.4	91.1	97.6	103.5	109.3	115.5	121.4	127.2	133.1	138.9
$RbClO_3$	....	2.14	....	5.4	8	....	15.98	....	....	....	....	62.8
$RbClO_4$	....	0.5	0.6	1.0	1.5	2.3	3.5	4.85	6.72	9.2	12.7	18
$RbNO_3$	....	19.5	33.0	53.3	81.3	116.7	155.6	200	251	309	375	452
Rb_2SO_4	....	36.4	42.6	48.2	53.5	58.5	63.1	67.4	71.4	75.0	78.7	81.8
SO_2 760mm.	....	22.83	16.21	11.29	7.81	5.41	4.5	....	....	....	....	....
$SbCl_3$	....	601.6	....	931.5	1068.0	1368.0	1917.0	4531.0	....	∞	....	....
SbF_3	....	384.7	....	444.7	563.6	....	....	....	....	....	....	....
Sb_2S_3	....	....	1.75$\times$	10^{-4} at 18°	....	....	....	....	....	....	....	....
$SnCl_2$	....	83.9	$269.8^{15°}$	....	....	....	....	....	....	....	....	....
SnI_2	....	....	....	1.0	1.2	1.4	1.7	2.1	2.5	3.0	3.4	4.0

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$SnSO_4$	....	....	....	19	....	....	....	....	....	....	....	18
$SrBr_2$	....	85.2	93	102.4	111.9	123.2	135.8	150	....	181.8	....	222.5
$Sr(C_2H_3O_2)_2$	$4H_2O$	36.9	43.61	....	....	....	....	....	....	....	....	....
$Sr(C_2H_3O_2)_2$	$\frac{1}{2}H_2O$	....	42.95	41.6	39.5	....	37.35	....	36.24	36.10	36.24	36.4
SrC_2O_4	....	0.0033	0.0044	0.0046	0.0057	....	....	....	....	....	....	....
$SrCl_2$	$6H_2O$	43.5	47.7	52.9	58.7	65.3	72.4	81.8	....	....	....	....
$SrCl_2$	$2H_2O$	....	....	....	....	....	....	....	85.9	90.5	....	100.8
SrI_2	$6H_2O$	165.3	....	177.8	....	191.5	....	217.5	....	270.4	....	....
SrI_2	$2H_2O$	....	....	....	....	....	....	....	....	....	365.2	383.1
*$Sr(NO_2)_2$	H_2O	34.5	....	39	....	....	45.6	49.3	....	....	56.6	58.1
$Sr(NO_3)_2$	$4H_2O$	40.1	....	70.5	....	....	....	....	....	....	....	....
$Sr(NO_3)_2$	....	....	....	....	88.6	90.1	....	93.8	96	98	100	....
$SrSO_4$	....	0.0113	....	0.0114	0.0114	....	....	....	....	....	....	....
$Th(SO_4)_2$	$9H_2O$	0.74	0.98	1.38	1.995	2.998	5.22	....	....	....	....	....
$Th(SO_4)_2$	$8H_2O$	1.0	1.25	1.62	....	....	....	....	....	....	....	....
$Th(SO_4)_2$	$6H_2O$	1.50	....	1.90	2.45	....	....	6.64	....	....	....	....
$Th(SO_4)_2$	$4H_2O$	....	....	....	....	4.04	2.54	1.63	1.09	....	....	....
$Th(SeO_4)_2$	....	0.498	....	....	....	....	....	....	....	....	....	....
$TlBr$	....	0.024	0.029	0.042	....	....	....	....	....	....	....	....
$TlBrO_3$	....	....	....	0.346	....	0.736	....	....	....	....	....	....
$TlCl$	....	0.21	0.25	0.33	0.42	0.52	0.63	0.8	....	1.2	....	1.8
$TlClO_3$	....	2	....	3.92	....	....	12.67	....	....	36.65	....	57.31
$TlClO_4$	....	6	8.04	....	19.72	....	39.62	....	65.32	81.49	....	166.6
TlI	....	....	0.0036	0.006	0.008	0.015	....	0.035	....	0.070	....	0.120
$TlIO_3$	....	....	....	0.058	....	....	....	....	....	....	....	....
$TlNO_3$	....	3.91	6.22	9.55	14.3	20.9	30.4	46.2	69.5	111.0	200.0	414.0
$TlOH$	....	25.44	....	....	39.9	49.5	....	73.8	....	106	126.1	148.3
Tl_2S	....	....	....	0.022	....	....	....	....	....	....	....	....
Tl_2SO_4	....	2.70	3.70	4.87	6.16	....	9.21	10.92	12.74	14.61	16.53	18.45
Tl_2SeO_4	....	....	2.13	2.8	....	....	....	....	....	....	....	....
*$UO_2(NO_3)_2$	$6H_2O$	49.5	52	55.7	....	....	67	....	....	....	....	....

SOLUBILITY OF INORGANIC COMPOUNDS IN WATER (Continued)

Substance	S. P.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$Yb_2(SO_4)_3$	....	44.2	....	38.4	....	21.0	....	10.4	7.22	6.92	5.83	4.67
*$ZnBr_2$	$2H_2O$	79.55	....	81.7	84.08	....	....	....	....	....	....	....
*$ZnBr_2$	....	....	....	....	....	85.53	....	86.08	....	86.57	....	87.05
*$Zn(ClO_3)_2$	$6H_2O$	59.19	60.4	....	....	....	....	....	....	....	....	....
*$Zn(ClO_3)_2$	$4H_2O$	....	....	66.7	67.66	69.06	73.2	....	....	....	....	....
*ZnI_2	$2H_2O$	81.16	82.06	82.9	....	....	....	....	....	....	....	....
*ZnI_2	....	81.11	....	....	....	81.66	....	82.37	....	83.05	....	83.62
*$Zn(NO_3)_2$	$6H_2O$	48.66	....	54.2	....	....	....	....	....	....	....	....
*$Zn(NO_3)_2$	$3H_2O$	....	....	....	....	67.42	....	....	....	....	....	....
$ZnSO_4$	$7H_2O$	41.9	47	54.4	....	....	....	....	....	....	....	....
$ZnSO_4$	$6H_2O$	..	....	....	....	41.2	43.5	....	....	....	....	....
$ZnSO_4$	....	.			....	....	....	....	....	46.4	45.5	44.7

α, the absorption coefficient, is the volume of gas when reduced to 0° and 760 mm., absorbed by one volume of water when the pressure of the gas itself, without the aqueous tension, amounts to 760 mm.

q is the weight of gas in grams dissolved in 100 grams of water when the total pressure (i.e., the sum of the partial pressure of the gas plus the aqueous tension at the given temperature) is 760 mm.

Temp.° C	Nitrogen*		Oxygen		Hydrogen		Carbon Dioxide	
	α	q	α	q	α	q	α	q
0	0.02354	0.002942	0.04889	0.006945	0.02148	0.0001922	1.713	0.3346
1	0.02297	0.002869	0.04758	0.006756	0.02126	0.0001901	1.646	0.3213
2	0.02241	0.002798	0.04633	0.006574	0.02105	0.0001881	1.584	0.3091
3	0.02187	0.002730	0.04512	0.006400	0.02084	0.0001862	1.527	0.2978
4	0.02135	0.002663	0.04397	0.006232	0.02064	0.0001843	1.473	0.2871
5	0.02086	0.002600	0.04287	0.006072	0.02044	0.0001824	1.424	0.2774
6	0.02037	0.002537	0.04180	0.005918	0.02025	0.0001806	1.377	0.2681
7	0.01990	0.002477	0.04080	0.005773	0.02007	0.0001789	1.331	0.2589
8	0.01945	0.002419	0.03983	0.005632	0.01989	0.0001772	1.282	0.2492
9	0.01902	0.002365	0.03891	0.005498	0.01972	0.0001756	1.237	0.2403
10	0.01861	0.002312	0.03802	0.005368	0.01955	0.0001740	1.194	0.2318
11	0.01823	0.002263	0.03718	0.005246	0.01940	0.0001725	1.154	0.2239
12	0.01786	0.002216	0.03637	0.005128	0.01925	0.0001710	1.117	0.2165
13	0.01750	0.002170	0.03559	0.005014	0.01911	0.0001696	1.083	0.2098
14	0.01717	0.002126	0.03486	0.004906	0.01897	0.0001682	1.050	0.2032
15	0.01685	0.002085	0.03415	0.004802	0.01883	0.0001668	1.019	0.1970
16	0.01654	0.002045	0.03348	0.004703	0.01869	0.0001654	0.985	0.1903
17	0.01625	0.002006	0.03283	0.004606	0.01856	0.0001641	0.956	0.1845
18	0.01597	0.001970	0.03220	0.004514	0.01844	0.0001628	0.928	0.1789
19	0.01570	0.001935	0.03161	0.004426	0.01831	0.0001616	0.902	0.1737
20	0.01545	0.001901	0.03102	0.004339	0.01819	0.0001603	0.878	0.1688
21	0.01522	0.001869	0.03044	0.004252	0.01805	0.0001588	0.854	0.1640
22	0.01498	0.001838	0.02988	0.004169	0.01792	0.0001575	0.829	0.1590
23	0.01475	0.001809	0.02934	0.004087	0.01779	0.0001561	0.804	0.1540
24	0.01454	0.001780	0.02881	0.004007	0.01766	0.0001548	0.781	0.1493
25	0.01434	0.001751	0.02831	0.003931	0.01754	0.0001535	0.759	0.1449
26	0.01413	0.001724	0.02783	0.003857	0.01742	0.0001522	0.738	0.1406
27	0.01394	0.001698	0.02736	0.003787	0.01731	0.0001509	0.718	0.1366
28	0.01376	0.001672	0.02691	0.003718	0.01720	0.0001496	0.699	0.1327
29	0.01358	0.001647	0.02649	0.003651	0.01709	0.0001484	0.682	0.1292
30	0.01342	0.001624	0.02608	0.003588	0.01699	0.0001474	0.665	0.1257
35	0.01256	0.001501	0.02440	0.003315	0.01666	0.0001425	0.592	0.1105
40	0.01184	0.001391	0.02306	0.003082	0.01644	0.0001384	0.530	0.0973
45	0.01130	0.001300	0.02187	0.002858	0.01624	0.0001341	0.479	0.0860
50	0.01088	0.001216	0.02090	0.002657	0.01608	0.0001287	0.436	0.0761
60	0.01023	0.001052	0.01946	0.002274	0.01600	0.0001178	0.359	0.0576
70	0.00977	0.000851	0.01833	0.001856	0.0160	0.000102	—	—
80	0.00958	0.000660	0.01761	0.001381	0.0160	0.000079	—	—
90	0.0095	0.00038	0.0172	0.00079	0.0160	0.000046	—	—
100	0.0095	0.00000	0.0170	0.00000	0.0160	0.000000	—	—

* Atmospheric Nitrogen 98.815% Vol. N_2 + 1.185% Vol. A

GASES IN WATER

l is the volume of gas in c.c. dissolved by one volume of water when the total pressure (i.e., the sum of the partial pressure of the gas plus the aqueous tension at the given temperature) is 760 mm.

	Carbon Monoxide		Hydrogen Sulfide		Sulfur Dioxide		Nitric Oxide		Air**	
	α	q	α	q	l	q	α	q	cc/1000cc	%O₂ in dissolved air
0	0.03537	0.004397	4.670	0.7066	79.789	22.83	0.07381	0.009833	29.18	34.91
1	0.03455	0.004293	4.522	0.6839	77.210	22.09	0.07184	0.009564	28.42	34.87
2	0.03375	0.004191	4.379	0.6619	74.691	21.37	0.06993	0.009305	27.69	34.82
3	0.03297	0.004092	4.241	0.6407	72.230	20.66	0.06809	0.009057	26.99	34.78
4	0.03222	0.003996	4.107	0.6201	69.828	19.98	0.06632	0.008816	26.32	34.74
5	0.03149	0.003903	3.977	0.6001	67.485	19.31	0.06461	0.008584	25.68	34.69
6	0.03078	0.003813	3.852	0.5809	65.200	18.65	0.06298	0.008361	25.06	34.65
7	0.03009	0.003725	3.732	0.5624	62.973	18.02	0.06140	0.008147	24.47	34.60
8	0.02942	0.003640	3.616	0.5446	60.805	17.40	0.05990	0.007943	23.90	34.56
9	0.02878	0.003559	3.505	0.5276	58.697	16.80	0.05846	0.007747	23.36	34.52
10	0.02816	0.003479	3.399	0.5112	56.647	16.21	0.05709	0.007560	22.84	34.47
11	0.02757	0.003405	3.300	0.4960	54.655	15.64	0.05587	0.007393	22.34	34.43
12	0.02701	0.003332	3.206	0.4814	52.723	15.09	0.05470	0.007233	21.87	34.38
13	0.02646	0.003261	3.115	0.4674	50.849	14.56	0.05357	0.007078	21.41	34.34
14	0.02593	0.003194	3.028	0.4540	49.033	14.04	0.05250	0.006930	20.97	34.30
15	0.02543	0.003130	2.945	0.4411	47.276	13.54	0.05147	0.006788	20.55	34.25
16	0.02494	0.003066	2.865	0.4287	45.578	13.05	0.05049	0.006652	20.14	34.21
17	0.02448	0.003007	2.789	0.4169	43.939	12.59	0.04956	0.006524	19.75	34.17
18	0.02402	0.002947	2.717	0.4056	42.360	12.14	0.04868	0.006400	19.38	34.12
19	0.02360	0.002891	2.647	0.3948	40.838	11.70	0.04785	0.006283	19.02	34.08
20	0.02319	0.002838	2.582	0.3846	39.374	11.28	0.04706	0.006173	18.68	34.03
21	0.02281	0.002789	2.517	0.3745	37.970	10.88	0.04625	0.006059	18.34	33.99
22	0.02244	0.002739	2.456	0.3648	36.617	10.50	0.04545	0.005947	18.01	33.95
23	0.02208	0.002691	2.396	0.3554	35.302	10.12	0.04469	0.005838	17.69	33.90
24	0.02174	0.002646	2.338	0.3463	34.026	9.76	0.04395	0.005733	17.38	33.86
25	0.02142	0.002603	2.282	0.3375	32.786	9.41	0.04323	0.005630	17.08	33.82
26	0.02110	0.002560	2.229	0.3290	31.584	9.06	0.04254	0.005530	16.79	33.77
27	0.02080	0.002519	2.177	0.3208	30.422	8.73	0.04188	0.005435	16.50	33.73
28	0.02051	0.002479	2.128	0.3130	29.314	8.42	0.04124	0.005342	16.21	33.68
29	0.02024	0.002442	2.081	0.3055	28.210	8.10	0.04063	0.005252	15.92	33.64
30	0.01998	0.002405	2.037	0.2983	27.161	7.80	0.04004	0.005165	15.64	33.60
35	0.01877	0.002231	1.831	0.2648	22.489	6.47	0.03734	0.004757		
40	0.01775	0.002075	1.660	0.2361	18.766	5.41	0.03507	0.004394		
45	0.01690	0.001933	1.516	0.2110	—	—	0.03311	0.004059		
50	0.01615	0.001797	1.392	0.1883	—	—	0.03152	0.003758		
60	0.01488	0.001522	1.190	0.1480	—	—	0.02954	0.003237		
70	0.01440	0.001276	1.022	0.1101	—	—	0.02810	0.002668		
80	0.01430	0.000980	0.917	0.0765	—	—	0.02700	0.001984		
90	0.0142	0.00057	0.84	0.041	—	—	0.0265	0.00113		
100	0.0141	0.00000	0.81	0.000	—	—	0.0263	0.00000		

** Cubic centimeters of air (free from CO_2 and NH_3) dissd. in 1000 c.c. H_2O with barometer at 760 mm. (total pressure).

SOLUBILITY OF AMMONIA IN WATER

Press. NH_3,mm	0°C		20°C		40°C	
	g/g	cm^3/cm^3	g/g	cm^3/cm^3	g/g	cm^3/cm^3
700	.....	....	0.497	652.9	.....	......
800	.....	....	0.544	714.6	0.329	429.6
900	0.997	1312	0.588	772.4	.....	......
1000	1.094	1440	0.629	826.2	0.386	504.0
1100	1.192	1569	0.669	878.8	.....	......
1200	1.288	1695	0.707	928.8	0.433	565.4
1300	1.388	1827	0.745	978.7	.....	......
1400	1.488	1958	0.781	1025.9	0.472	616.3
1500	1.588	2090	0.815	1070.6	.....	......
1600	1.688	2221	0.847	1112.6	0.508	663.3
1700	1.778	2340	0.877	1152.1	.....	......
1800	1.847	2431	0.906	1190.1	0.543	709.0
1900	.....	....	0.934	1226.9	.....	......
2000	.....	....	0.959	1259.7	0.577	753.4
2100	.....	....	0.984	1292.6	.....	......
2200	.....	....	1.007	1322.8	0.611	797.8
2300	.....	....	1.029	1351.7	.....	......
2400	.....	....	1.052	1381.8	0.644	840.9
2500	.....	....	1.074	1410.8	.....	......
2600	.....	....	1.096	1439.6	0.676	882.7
2700	.....	....	1.117	1467.3	.....	......
2800	.....	....	1.140	1497.4	0.706	921.7
2900	.....	....	1.162	1526.4	.....	......
3000	.....	....	1.185	1556.6	0.732	955.8
3100	.....	....	1.207	1585.5	.....	......
3200	.....	....	1.230	1615.7	0.758	989.8
3300	.....	....	.....	......	.....	......
3400	.....	....	.....	......	0.784	1023.7

SOLUBILITIES OF VARIOUS GASES IN WATER

Henry's Law Constant K

Compiled by Hardin B. Jones

Gas	$K \times 10^{-7}$ $K = P/X$ P = partial pressure mm. of Hg X = mole fraction									
References	$t = 0°$	10°	20°	30°	38°	40°	50°	60°	70°	80°
Argon.......... 1, 8, 14, 15, 17	1.65	2.18	2.58	3.02	3.41	3.49	3.76	3.92	4.12	4.25
Carbon dioxide.. 6, 7, 9, 12	.0555	.0788	.108	.139	.168	.173	.217	.258		
Helium......... 1, 3, 8, 12, 14, 15, 18, 21	10.0	10.5	10.9	11.1	11.0	10.9	10.5	10.3	9.88	
Hydrogen....... 6, 12	4.42	4.82	5.20	5.51	5.72	5.78	5.82	5.80	5.77	5.73
Krypton........ 2, 14, 15	0.853	1.20	1.52	1.85	2.13	2.18	2.43	2.66	2.83	2.94
Neon........... (2), 8	7.68	8.49	9.14	9.45	9.76	9.80	10.0			
Nitrogen........ 12, 16, 20, 22, 23, 24	4.09	4.87	5.75	6.68	7.51	7.60	8.20	8.70	9.20	
Oxygen......... 6, 10, 12, 13	1.91	2.48	2.95	3.52	4.04	4.14	4.50	4.84	5.13	5.28

SOLUBILITIES OF VARIOUS GASES IN WATER (Continued)

Gas References	$K \times 10^{-7}$ $K = P/X$ P = partial pressure mm. of Hg X = mole fraction									
	$t = 0°$	10°	20°	30°	38°	40°	50°	60°	70°	80°
Radon.......... 2, 14, 15	.186	.286	.391	.529	.651	.683	.839	.976	1.07	
Xenon.......... 2, 14, 15	.392	.555	.742	.945	1.12	1.16	1.31	1.46	1.59	1.66
Nitrous oxide... 6, 9, 10, 12	.074	.108	.155	.210	.242	.246	.279			
Acetylene....... 5, 25	.0555	.0716	.0900	.112	.131	.133				
Ethylene........ 5, 10	.370	.552	.753	1.00	1.21	1.23				

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R. T. Thomson's table, showing the hydrogen atoms replaced by NaOH or KOH when a compound neutral to the indicator is formed. The blank spaces indicate that the end-reaction is obscure.

(From Cohn's Indicators and Test-papers, John Wiley and Sons, publishers, by permission.)

Acid	Formula	Methyl-orange Cold	Phenolphthalein		Litmus	
			Cold	Boiling	Cold	Boiling
Sulphuric........	H_2SO_4	2	2	2	2	2
Hydrochloric....	HCl	1	1	1	1	1
Nitric..........	HNO_3	1	1	1	1	1
Thiosulphuric...	$H_2S_2O_3$	2	2	2	2	2
Carbonic........	H_2CO_3	0	1 dilute	0	..	0
Sulphurous......	H_2SO_3	1	2	..	..	..
Hydrosulphuric..	H_2S	0	1 dilute	0	..	0
Phosphoric......	H_3PO_4	1	2	..	..	..
Arsenic.........	H_3AsO_4	1	2	..	..	..
Arsenous........	H_3AsO_3	1	..	..	0	0
Nitrous.........	HNO_2	indicator destroyed	1	..	1	..
Silicic..........	H_4SiO_4	0	..	..	0	0
Boric...........	H_3BO_3	0	..	..	..	..
Chromic........	H_2CrO_4	1	2	2	..	..
Oxalic..........	$H_2C_2O_4$	..	2	2	2	2
Acetic..........	$HC_2H_3O_2$	..	1	..	1 nearly	..
Butyric.........	$HC_4H_7O_2$	..	1	..	1 nearly	..
Succinic........	$H_2C_4H_4O_4$	..	2	..	2 nearly	..
Lactic..........	$HC_3H_5O_3$	..	1	..	1	..
Tartaric........	$H_2C_4H_4O_6$	..	2	..	2	..
Citric..........	$H_3C_6H_5O_7$	..	3	..	..	..

TABLE OF INDICATORS

Due to hydrolysis of the salt formed, the composition of a weak acid solution titrated against a strong base is basic (when equivalent amounts of acid and base are present) and of a weak base against a strong acid is acid. A truly neutral titrated solution has the same concentration of hydrogen ions $[H^+]$ and hydroxyl ions $[OH^-]$ as water. Water has a concentration of $[H^+]$ ion of 10^{-7} and of $[OH^-]$ ion of 10^{-7} at 25°C. As an index of the acid intensity the expression pH is employed and is equal to the logarithm of the reciprocal of the hydrogen ion concentration; i. e., $pH = \log \frac{1}{[H^+]}$ per liter. From this it follows that the pH of a neutral solution is the same as that of water; viz., 7; an acid solution has a pH less than 7 and a basic solution has a pH greater than 7. Those indicators in the table below with a * are the Sörensen selected indicators; those with a # are the Clark and Lubs selected indicators; those with the ## are Cohen's supplement to the Clark and Lubs selection; those with the *E* are the Eastman indicators.

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Mauveine		0.1–2.9 *	
α-Naphtholbenzein		0–1 8–9 } E	
Methyl Red (para)		0–2 E	
Methyl Violet		0–2 E 0.1–3.1 *	
Iodeosin	Tetraiodofluorescein	0.3–0 } E 4–5 } E	
Benzoyl Auramine		0.1–1 E	
Quinaldine Red		1.2 E	
Diphenylamino-azo-benzene		1.2–2.1 *	
Tropeolin 00	Orange IV; diphenylamino azo-p-benzene sulfonic acid	1.4–2.6 * 1–3 E	
Metanil Yellow	Diphenylamino-azo-m-benzene sulfonic acid	1.2–2.3 *E	
Meta Cresol Purple		1.2–2.8 7.4–9.0 } ##	
Thymol Blue	Thymolsulfonphthalein	1.2–2.8 # 8.0–9.6	
Benzylaniline-azo-benzene sulfonic acid		1.9–3.3 *	
Ethyl Orange	Diethylaniline orange; sodium (or ammonium) diethylaniline-azo-benzene sulfonate	2–4 E	
Benzopurpurin 4B		2–4 E	
Benzylaniline-azo-benzene		2.3–3.3 *	
Red Cabbage Extract	Wild cabbage; sea cabbage; *Brassica oleracea*	2.4–4.5	Walbum
m-Chloro-diethyl aniline-azo-p-benzene sulfonic acid		2.6–4.0 *	
p-Dimethylamino-azo-benzene	Butter yellow; benzene-azo-dimethylaniline	2.9–4.0 * 3–4 E	
Congo Red	Sodium tetrazodiphenyl-naphthionate	3–5 E	Prideaux
2, 5-Dinitrohydroquinone		3–9	Henderson and Forbes
Bromophenol Blue	Tetrabromophenolsulfonphthalein	3.0–3.6 #E	
Methyl Orange[1]	Tropeolin D; orange III; Helianthine; Lunge's Indicator	2.9–4.0 E 3.1–4.4 *	
α-Naphthylamino-azo-p-benzene sulfonic acid		3.5–5.7 *	
α-Naphthylamino-azo-benzene		3.7–5.0 *	
Brom Cresol Green		3.8–5.4##	
p-Sulfo-o-methoxy-benzene-azo-dimethyl-α-napthylamine		4.0–4.6 E	
Iodeosin	*See iodeosin above*	4–5 0.3–0 } E	

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[1] Methyl Orange may be used in the presence of carbon dioxide or hydrogen sulfide.

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Dinitrohydroquinone Acetate		4–5 9–10 } E	
Sodium Alizarinsulfonate		4–5 5–6 } E	
Dichlorofluorescein		4–6 E	Hottinger
Lacmosol		4.4–5.5	
Methyl Red		4.4–6.0 # 4.2–6.3 E	
Lacmoid		4.4–6.2	Sörensen
Tetrabromo-m-cresol-sulfonphthalein		4.5–5.5 E	
Azolitmin (Litmus)		4.5–8.3	Sörensen
Cochineal	Dried female insect, *Coccus cacti* Lin.; carminic acid	4.7–6.2	Sörensen
Chlor Phenol Red		4.8–6.4##	
Propyl Red		4.8–6.4 E	Lubs and Clark
Hematoxylin	From logwood, *Haematoxylon campechia* L.	5–6 E	
p-Nitrophenol		5.0–7.0 * 5–6 E	
Sodium Alizarinsulfonate		4–5 5–6 E	
Brom Phenol Red		5.2–6.8 ##	
Bromocresol Purple	Dibromo-o-cresolsulfonphthalein	5.2–6.8 #E	
Alizarin	Roots of madder; *Rubia tinctorum*, Lin. Dihydroxyanthraquinone; Schaal's Indicator.	5.5–6.8 10.1–12.1 }	Sörensen
Dinitrobenzoyleneurea		7–8 E 6–8	 Bogart and Scatchard
Bromothymol Blue	Dibromothymolsulfonphthalein	6.0–7.6 #E	
Anisolesulfonphthalein		6–8 E	
Curcumin	Turmeric Yellow; curcummin; roots of *Curcuma longa* L.	6.8 E	
Brilliant Yellow		6–8 E	
Neutral Red	Toluylene Red	6.8–8.0 *E	
Phenol Red	Phenolsulfonphthalein	6.8–8.4 #E	
Rosolic acid	Aurin; aurin red; corallin; p-rosolic acid	6.9–8.0 *E	
Cyanin	Quinoline Blue; diamylcyanine iodide	7–8	Prideaux
β-Naphtholphthalein		7.2–8.6	Sörensen and Palitzsch
Cresol Red	o-Cresolsulfonphthalein	7–9 E 7.2–8.8 #E	
Meta Cresol Purple		7.4–9.0 1.2–2.8 } ##	
Tropeolin 000	Orange I; Orange B; sodium-naphthol-azo-benzene sulfonate; von Muller's indicator	7.6–8.9 *	

TABLE OF INDICATORS (Continued)

Indicator	Synonym	pH Range	Observer
Thymol Blue	*See thymol blue above*	8.0–9.6 1.2–2.8 #E	
a-Naphtholbenzein		8.9 E	
Cresolphthalein	o-Cresolphthalein	8.2–9.8 # 8–10 E	
Phenolphthalein[2]	Dihydroxyphthalophenone; Luck's indicator	8.3–10 *E	
Dinitrohydroquinone Acetate		9–10 E	
Alizarin Yellow R	Sodium p-nitrobenzene-azo-salicylate	9–10 E	
Tetranitrophenolsulfonphthalein		9–10 E	
Thymolphthalein		9.3–10.5 * 10–11 E	
Alizarin Yellow G	p-nitrobenzene-azo-salicylic acid	10.1–12.1 *	
Alizarin Blue S		11–13	Prideaux
Poirrier's Blue		11–13	Prideaux
Tropeolin 0	Resorcine-azo-benzene-sulfonic acid	11.1–12.7 *E	
Sodium Indigodisulfonate		12–14 E	
1,3,5-Trinitrobenzene		14–14.3 E	

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[2] Phenolphthalein may be used in the presence of weak acids.

PREPARATION OF CLARK AND LUBS INDICATOR SOLUTIONS

To prepare a 0.04% indicator reagent, 0.1 gram of the dry indicator is mixed in a mortar with the number of cubic centimeters of 0.01 *N* sodium hydroxide as given in the table below and the mixture diluted to 250 cc with water. Such solutions give satisfactory results when five drops of indicator are added to 10 cc of the solution to be tested.

Indicator	0.01 *N* NaOH cc	Indicator	0.01 *N* NaOH cc
Brom cresol green	14.3	Chlor phenol red	23.6
Brom cresol purple	18.5	Cresol red	26.2
Brom phenol blue	14.9	Meta cresol purple	26.2
Brom phenol red	19.5	Phenol red	28.2
Brom thymol blue	16.0	Thymol blue	21.5

CONVERSION FACTORS—pH TO E. M. F.

When the half-cell:

KCl (saturated)|KCl (0.1*N*), HgCl (s)|Hg is used as a standard of reference and it is assumed, arbitrarily that in the cell:

Pt, H_2 (1 atmosphere)$\underset{A}{|}$$H^+$ (unknown activity)$\underset{B}{|}$KCl (saturated)
$\underset{C}{|}$KCl (0.1*N*), HgCl (s)$\underset{D}{|}$Hg

the potential difference at **B** remains constant with variations of "H (unknown activity)" and that the sum of the potential differences at **B**, **C** and **D** is Σ as follows: (cf. Clark: *Determination of Hydrogen Ions*, 3d Ed., 1928).

t°C	18	20	25	30	35	38	40
Potential difference (Σ) volts	0.3380	0.3379	0.3376	0.3371	0.3365	0.3361	0.3358

then,

$$\text{pH} = \frac{\text{E. M. F.} - \Sigma}{0.00019832 \times T}$$ where *T* is the absolute temperature

CONVERSION FACTORS—pH TO E.M.F. (Continued)

CALOMEL ELECTRODE

The voltage of the calomel electrode at 25°C. is for the half cell:

$$\mathrm{Hg}|\mathrm{HgCl},\ (N)\ \mathrm{KCl}|| = +0.2822$$
$$\mathrm{Hg}|\mathrm{HgCl},\ (0.1N\ \mathrm{KCl})|| = +0.3376$$
$$\mathrm{Hg}|\mathrm{HgCl},\ (\text{saturated})\ \mathrm{KCl}|| = +0.2458$$

From this the relation of the E. M. F. and pH (of a cell composed of a hydrogen electrode and one of the calomel electrodes) is given by:

$$\mathrm{pH} = \frac{\text{E. M. F.} - \Sigma}{0.0591}\ (\text{at } 25°\text{C.})$$

QUINHYDRONE ELECTRODE

The normal electrode potential (E_h) of the quinhydrone electrode referred to the normal hydrogen electrode at t°C. is given by the expression:

$$E_h = 0.7177 - 0.00074t$$

McILVAINE'S STANDARD BUFFER SOLUTIONS

Stock solution A: 0.1 molar citric acid ($C_6H_8O_7$) solution.

Stock solution B: 0.2 molar disodium phosphate (Na_2HPO_4) solution.

pH	Soln. A cc	Soln. B cc	pH	Soln. A cc	Soln. B cc
2.2	19.60	0.40	5.2	9.28	10.72
2.4	18.76	1.24	5.4	8.85	11.15
2.6	17.82	2.18	5.6	8.40	11.60
2.8	16.83	3.17	5.8	7.91	12.09
3.0	15.89	4.11	6.0	7.37	12.63
3.2	15.06	4.94	6.2	6.78	13.22
3.4	14.30	5.70	6.4	6.15	13.85
3.6	13.56	6.44	6.6	5.45	14.55
3.8	12.90	7.10	6.8	4.55	15.45
4.0	12.29	7.71	7.0	3.53	16.47
4.2	11.72	8.28	7.2	2.61	17.39
4.4	11.18	8.82	7.4	1.83	18.17
4.6	10.65	9.35	7.6	1.27	18.73
4.8	10.14	9.86	7.8	0.85	19.15
5.0	9.70	10.30	8.0	0.55	19.45

pH VALUES FOR POTENTIOMETER READINGS

Harold V. Gaskill

The following table presents pH values for various potentiometer readings using the quinhydrone half-cell and saturated calomel half-cell at 25°C. The argument is potential in millivolts and the table entries are in terms of pH.

The table was constructed upon the following formula:

$$\text{pH} = \frac{0.4538 - E_q}{0.0591}$$

in which E_q is the observed potential in volts.[1]

The temperature factor is 0.77 millivolts per degree, to be added above 25°C and subtracted below 25°C.

Polarity is reversed above 7.68 pH.

Milli-volts	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	7.6785	7.6768	7.6751	7.6734	7.6717	7.6700	7.6683	7.6667	7.6650	7.6633
1	7.6616	7.6599	7.6582	7.6565	7.6548	7.6531	7.6514	7.6497	7.6480	7.6464
2	7.6447	7.6430	7.6413	7.6396	7.6379	7.6362	7.6345	7.6328	7.6311	7.6294
3	7.6277	7.6260	7.6244	7.6227	7.6210	7.6193	7.6176	7.6159	7.6142	7.6125
4	7.6108	7.6091	7.6074	7.6057	7.6040	7.6024	7.6007	7.5990	7.5973	7.5956
5	7.5939	7.5922	7.5905	7.5888	7.5871	7.5854	7.5837	7.5821	7.5804	7.5787
6	7.5770	7.5753	7.5736	7.5719	7.5702	7.5685	7.5668	7.5651	7.5634	7.5617
7	7.5601	7.5584	7.5567	7.5550	7.5533	7.5516	7.5499	7.5482	7.5465	7.5448
8	7.5431	7.5414	7.5398	7.5381	7.5364	7.5347	7.5330	7.5313	7.5296	7.5279
9	7.5262	7.5245	7.5228	7.5211	7.5194	7.5178	7.5161	7.5144	7.5127	7.5110
10	7.5093	7.5076	7.5059	7.5042	7.5025	7.5008	7.4991	7.4975	7.4958	7.4941
11	7.4924	7.4907	7.4890	7.4873	7.4856	7.4839	7.4822	7.4805	7.4788	7.4771
12	7.4755	7.4738	7.4721	7.4704	7.4687	7.4671	7.4653	7.4636	7.4619	7.4602
13	7.4585	7.4568	7.4551	7.4535	7.4518	7.4501	7.4484	7.4467	7.4450	7.4433
14	7.4416	7.4399	7.4382	7.4365	7.4348	7.4332	7.4315	7.4298	7.4281	7.4264
15	7.4247	7.4230	7.4213	7.4196	7.4179	7.4162	7.4145	7.4128	7.4112	7.4095
16	7.4078	7.4061	7.4044	7.4027	7.4010	7.3993	7.3976	7.3959	7.3942	7.3925
17	7.3909	7.3892	7.3875	7.3858	7.3841	7.3824	7.3807	7.3790	7.3773	7.3756
18	7.3739	7.3722	7.3705	7.3689	7.3672	7.3655	7.3638	7.3621	7.3604	7.3587
19	7.3570	7.3553	7.3536	7.3519	7.3502	7.3486	7.3469	7.3452	7.3435	7.3418
20	7.3401	7.3384	7.3367	7.3350	7.3333	7.3316	7.3299	7.3282	7.3266	7.3249
21	7.3232	7.3215	7.3198	7.3181	7.3164	7.3147	7.3130	7.3113	7.3096	7.3079
22	7.3062	7.3046	7.3029	7.3012	7.2995	7.2978	7.2961	7.2944	7.2927	7.2910
23	7.2893	7.2876	7.2859	7.2843	7.2826	7.2809	7.2792	7.2775	7.2758	7.2741
24	7.2724	7.2707	7.2690	7.2673	7.2656	7.2639	7.2623	7.2606	7.2589	7.2572
25	7.2565	7.2538	7.2521	7.2504	7.2487	7.2470	7.2453	7.2436	7.2420	7.2403
26	7.2386	7.2369	7.2352	7.2335	7.2318	7.2301	7.2284	7.2267	7.2250	7.2233
27	7.2216	7.2200	7.2183	7.2166	7.2149	7.2132	7.2115	7.2098	7.2081	7.2064
28	7.2047	7.2030	7.2013	7.1997	7.1980	7.1963	7.1946	7.1929	7.1912	7.1895
29	7.1878	7.1861	7.1844	7.1827	7.1810	7.1793	7.1777	7.1760	7.1743	7.1726
30	7.1709	7.1692	7.1675	7.1658	7.1641	7.1624	7.1607	7.1590	7.1573	7.1557
31	7.1540	7.1523	7.1506	7.1489	7.1472	7.1455	7.1438	7.1421	7.1404	7.1387
32	7.1370	7.1354	7.1337	7.1320	7.1303	7.1286	7.1269	7.1252	7.1235	7.1218
33	7.1201	7.1184	7.1167	7.1150	7.1134	7.1117	7.1100	7.1083	7.1066	7.1049
34	7.1032	7.1015	7.0998	7.0981	7.0964	7.0947	7.0931	7.0914	7.0897	7.0880

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[1] From formula number 1, p. 405, Clark, W. M., The determination of hydrogen ions, Baltimore, 1928; and, Baver, L. D., Soil Science, 1926, **21**, 3, 167–180.

pH VALUES FOR POTENTIOMETER READINGS
(Continued)

Millivolts	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
35	7.0863	7.0846	7.0829	7.0812	7.0795	7.0778	7.0761	7.0744	7.0727	7.0711
36	7.0694	7.0677	7.0660	7.0643	7.0626	7.0609	7.0592	7.0575	7.0558	7.0541
37	7.0524	7.0508	7.0491	7.0474	7.0457	7.0440	7.0423	7.0406	7.0389	7.0372
38	7.0355	7.0338	7.0321	7.0304	7.0288	7.0271	7.0254	7.0237	7.0220	7.0203
39	7.0186	7.0169	7.0152	7.0135	7.0118	7.0101	7.0084	7.0068	7.0051	7.0034
40	7.0017	7.0000	6.9983	6.9966	6.9949	6.9932	6.9915	6.9898	6.9881	6.9865
41	6.9848	6.9831	6.9814	6.9797	6.9780	6.9763	6.9746	6.9729	6.9712	6.9695
42	6.9678	6.9661	6.9645	6.9628	6.9611	6.9594	6.9577	6.9560	6.9543	6.9526
43	6.9509	6.9492	6.9475	6.9458	6.9442	6.9425	6.9408	6.9391	6.9374	6.9357
44	6.9340	6.9323	6.9306	6.9289	6.9272	6.9255	6.9238	6.9222	6.9205	6.9188
45	6.9171	6.9154	6.9137	6.9120	6.9103	6.9086	6.9069	6.9052	6.9035	6.9019
46	6.9002	6.8985	6.8968	6.8951	6.8934	6.8917	6.8900	6.8883	6.8866	6.8849
47	6.8832	6.8815	6.8799	6.8782	6.8765	6.8748	6.8731	6.8714	6.8697	6.8680
48	6.8663	6.8646	6.8629	6.8612	6.8595	6.8579	6.8562	6.8545	6.8528	6.8511
49	6.8494	6.8477	6.8460	6.8443	6.8426	6.8409	6.8392	6.8376	6.8359	6.8342
50	6.8325	6.8308	6.8291	6.8274	6.8257	6.8240	6.8223	6.8206	6.8189	6.8172
51	6.8156	6.8139	6.8122	6.8105	6.8088	6.8071	6.8054	6.8037	6.8020	6.8003
52	6.7986	6.7969	6.7953	6.7936	6.7919	6.7902	6.7885	6.7868	6.7851	6.7834
53	6.7817	6.7800	6.7783	6.7766	6.7749	6.7733	6.7716	6.7699	6.7682	6.7665
54	6.7648	6.7631	6.7614	6.7597	6.7580	6.7563	6.7546	6.7530	6.7513	6.7496
55	6.7479	6.7462	6.7445	6.7428	6.7411	6.7394	6.7377	6.7360	6.7343	6.7326
56	6.7310	6.7293	6.7276	6.7259	6.7242	6.7225	6.7208	6.7191	6.7174	6.7157
57	6.7140	6.7123	6.7106	6.7090	6.7073	6.7056	6.7039	6.7022	6.7005	6.6988
58	6.6971	6.6954	6.6937	6.6920	6.6903	6.6887	6.6870	6.6853	6.6836	6.6819
59	6.6802	6.6785	6.6768	6.6751	6.6734	6.6717	6.6700	6.6683	6.6667	6.6650
60	6.6633	6.6616	6.6599	6.6582	6.6565	6.6548	6.6531	6.6514	6.6497	6.6480
61	6.6464	6.6447	6.6430	6.6413	6.6396	6.6379	6.6362	6.6345	6.6328	6.6311
62	6.6294	6.6277	6.6260	6.6244	6.6227	6.6210	6.6193	6.6176	6.6159	6.6142
63	6.6125	6.6108	6.6091	6.6074	6.6057	6.6040	6.6024	6.6007	6.5990	6.5973
64	6.5956	6.5939	6.5922	6.5905	6.5888	6.5871	6.5854	6.5837	6.5821	6.5804
65	6.5787	6.5770	6.5753	6.5736	6.5719	6.5702	6.5685	6.5668	6.5651	6.5634
66	6.5617	6.5601	6.5584	6.5567	6.5550	6.5533	6.5516	6.5499	6.5482	6.5465
67	6.5448	6.5431	6.5414	6.5398	6.5381	6.5364	6.5347	6.5330	6.5313	6.5296
68	6.5279	6.5262	6.5245	6.5228	6.5211	6.5194	6.5178	6.5161	6.5144	6.5127
69	6.5110	6.5093	6.5076	6.5059	6.5042	6.5025	6.5008	6.4991	6.4975	6.4958
70	6.4941	6.4924	6.4907	6.4890	6.4873	6.4856	6.4839	6.4822	6.4805	6.4788
71	6.4771	6.4755	6.4738	6.4721	6.4704	6.4687	6.4670	6.4653	6.4636	6.4619
72	6.4602	6.4585	6.4568	6.4551	6.4535	6.4518	6.4501	6.4484	6.4467	6.4450
73	6.4433	6.4416	6.4399	6.4382	6.4365	6.4348	6.4332	6.4315	6.4298	6.4281
74	6.4264	6.4247	6.4230	6.4213	6.4196	6.4179	6.4162	6.4145	6.4128	6.4112
75	6.4095	6.4078	6.4061	6.4044	6.4027	6.4010	6.3993	6.3976	6.3959	6.3942
76	6.3925	6.3909	6.3892	6.3875	6.3858	6.3841	6.3824	6.3807	6.3790	6.3773
77	6.3756	6.3739	6.3722	6.3705	6.3689	6.3672	6.3655	6.3638	6.3621	6.3604
78	6.3587	6.3570	6.3553	6.3536	6.3519	6.3502	6.3486	6.3469	6.3452	6.3435
79	6.3418	6.3401	6.3384	6.3367	6.3350	6.3333	6.3316	6.3299	6.3282	6.3266
80	6.3249	6.3232	6.3215	6.3198	6.3181	6.3164	6.3147	6.3130	6.3113	6.3096
81	6.3079	6.3062	6.3046	6.3029	6.3012	6.2995	6.2978	6.2961	6.2944	6.2927
82	6.2910	6.2893	6.2876	6.2859	6.2843	6.2826	6.2809	6.2792	6.2775	6.2758
83	6.2741	6.2724	6.2707	6.2690	6.2673	6.2656	6.2639	6.2623	6.2606	6.2589
84	6.2572	6.2555	6.2538	6.2521	6.2504	6.2487	6.2470	6.2453	6.2436	6.2420

pH VALUES FOR POTENTIOMETER READINGS
(Continued)

Milli-volts	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
85	6.2403	6.2386	6.2369	6.2352	6.2335	6.2318	6.2301	6.2284	6.2267	6.2250
86	6.2233	6.2216	6.2200	6.2183	6.2166	6.2149	6.2132	6.2115	6.2098	6.2081
87	6.2064	6.2047	6.2030	6.2013	6.1997	6.1980	6.1963	6.1946	6.1929	6.1912
88	6.1895	6.1878	6.1861	6.1844	6.1827	6.1810	6.1793	6.1777	6.1760	6.1743
89	6.1726	6.1709	6.1692	6.1675	6.1658	6.1641	6.1624	6.1607	6.1590	6.1573
90	6.1557	6.1540	6.1523	6.1506	6.1489	6.1472	6.1455	6.1438	6.1421	6.1404
91	6.1387	6.1370	6.1354	6.1337	6.1320	6.1303	6.1286	6.1269	6.1252	6.1235
92	6.1218	6.1201	6.1184	6.1167	6.1150	6.1134	6.1117	6.1100	6.1083	6.1066
93	6.1049	6.1032	6.1015	6.0998	6.0981	6.0964	6.0947	6.0931	6.0914	6.0897
94	6.0880	6.0863	6.0846	6.0829	6.0812	6.0795	6.0778	6.0761	6.0744	6.0727
95	6.0711	6.0694	6.0677	6.0660	6.0643	6.0626	6.0609	6.0592	6.0575	6.0558
96	6.0541	6.0524	6.0508	6.0491	6.0474	6.0457	6.0440	6.0423	6.0406	6.0389
97	6.0372	6.0355	6.0338	6.0321	6.0304	6.0288	6.0271	6.0254	6.0237	6.0220
98	6.0203	6.0186	6.0169	6.0152	6.0135	6.0118	6.0101	6.0084	6.0068	6.0051
99	6.0034	6.0017	6.0000	5.9983	5.9966	5.9949	5.9932	5.9915	5.9898	5.9881
100	5.9865	5.9848	5.9831	5.9814	5.9797	5.9780	5.9763	5.9746	5.9729	5.9712
101	5.9695	5.9678	5.9661	5.9645	5.9628	5.9611	5.9594	5.9577	5.9560	5.9543
102	5.9526	5.9509	5.9492	5.9475	5.9458	5.9442	5.9425	5.9408	5.9391	5.9374
103	5.9357	5.9340	5.9323	5.9306	5.9289	5.9272	5.9255	5.9238	5.9222	5.9205
104	5.9188	5.9171	5.9154	5.9137	5.9120	5.9103	5.9086	5.9069	5.9052	5.9035
105	5.9019	5.9002	5.8985	5.8968	5.8951	5.8934	5.8917	5.8900	5.8883	5.8866
106	5.8849	5.8832	5.8815	5.8799	5.8782	5.8765	5.8748	5.8731	5.8714	5.8697
107	5.8680	5.8663	5.8646	5.8629	5.8612	5.8595	5.8579	5.8562	5.8545	5.8528
108	5.8511	5.8494	5.8477	5.8460	5.8443	5.8426	5.8409	5.8392	5.8376	5.8359
109	5.8342	5.8325	5.8308	5.8291	5.8274	5.8257	5.8240	5.8223	5.8206	5.8189
110	5.8172	5.8156	5.8139	5.8122	5.8105	5.8088	5.8071	5.8054	5.8037	5.8020
111	5.8003	5.7986	5.7969	5.7953	5.7936	5.7919	5.7902	5.7885	5.7868	5.7851
112	5.7834	5.7817	5.7800	5.7783	5.7766	5.7749	5.7733	5.7716	5.7699	5.7682
113	5.7665	5.7648	5.7631	5.7614	5.7597	5.7580	5.7563	5.7546	5.7530	5.7513
114	5.7496	5.7479	5.7462	5.7445	5.7428	5.7411	5.7394	5.7377	5.7360	5.7343
115	5.7326	5.7310	5.7293	5.7276	5.7259	5.7242	5.7225	5.7208	5.7191	5.7174
116	5.7157	5.7140	5.7123	5.7106	5.7090	5.7073	5.7056	5.7039	5.7022	5.7005
117	5.6988	5.6971	5.6954	5.6937	5.6920	5.6903	5.6887	5.6870	5.6853	5.6836
118	5.6819	5.6802	5.6785	5.6768	5.6751	5.6734	5.6717	5.6700	5.6683	5.6667
119	5.6650	5.6633	5.6616	5.6599	5.6582	5.6565	5.6548	5.6531	5.6514	5.6497
120	5.6480	5.6464	5.6447	5.6430	5.6413	5.6396	5.6379	5.6362	5.6345	5.6328
121	5.6311	5.6294	5.6277	5.6260	5.6244	5.6227	5.6210	5.6193	5.6176	5.6159
122	5.6142	5.6125	5.6108	5.6091	5.6074	5.6057	5.6040	5.6024	5.6007	5.5990
123	5.5973	5.5956	5.5939	5.5922	5.5905	5.5888	5.5871	5.5854	5.5837	5.5821
124	5.5804	5.5787	5.5770	5.5753	5.5736	5.5719	5.5702	5.5685	5.5668	5.5651
125	5.5634	5.5617	5.5601	5.5584	5.5567	5.5550	5.5533	5.5516	5.5499	5.5482
126	5.5465	5.5448	5.5431	5.5414	5.5398	5.5381	5.5364	5.5347	5.5330	5.5313
127	5.5296	5.5279	5.5262	5.5245	5.5228	5.5211	5.5194	5.5178	5.5161	5.5144
128	5.5127	5.5110	5.5093	5.5076	5.5059	5.5042	5.5025	5.5008	5.4991	5.4975
129	5.4958	5.4941	5.4924	5.4907	5.4890	5.4873	5.4856	5.4839	5.4822	5.4805
130	5.4788	5.4771	5.4755	5.4738	5.4721	5.4704	5.4687	5.4670	5.4653	5.4636
131	5.4619	5.4602	5.4585	5.4568	5.4551	5.4535	5.4518	5.4501	5.4484	5.4467
132	5.4450	5.4433	5.4416	5.4399	5.4382	5.4365	5.4348	5.4332	5.4315	5.4298
133	5.4281	5.4264	5.4247	5.4230	5.4213	5.4196	5.4179	5.4162	5.4145	5.4128
134	5.4112	5.4095	5.4078	5.4061	5.4044	5.4027	5.4010	5.3993	5.3976	5.3959

pH VALUES FOR POTENTIOMETER READINGS
(Continued)

Millivolts	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
135	5.3942	5.3925	5.3909	5.3892	5.3875	5.3858	5.3841	5.3824	5.3807	5.3790
136	5.3773	5.3756	5.3739	5.3722	5.3705	5.3689	5.3672	5.3655	5.3638	5.3621
137	5.3604	5.3587	5.3570	5.3553	5.3536	5.3519	5.3502	5.3486	5.3469	5.3452
138	5.3435	5.3418	5.3401	5.3384	5.3367	5.3350	5.3333	5.3316	5.3299	5.3282
139	5.3266	5.3249	5.3232	5.3215	5.3198	5.3181	5.3164	5.3147	5.3130	5.3113
140	5.3096	5.3079	5.3062	5.3046	5.3029	5.3012	5.2995	5.2978	5.2961	5.2944
141	5.2927	5.2910	5.2893	5.2876	5.2859	5.2843	5.2826	5.2809	5.2792	5.2775
142	5.2758	5.2741	5.2724	5.2707	5.2690	5.2673	5.2656	5.2639	5.2623	5.2606
143	5.2589	5.2572	5.2555	5.2538	5.2521	5.2504	5.2487	5.2470	5.2453	5.2436
144	5.2420	5.2403	5.2386	5.2369	5.2352	5.2335	5.2318	5.2301	5.2284	5.2267
145	5.2250	5.2233	5.2216	5.2200	5.2183	5.2166	5.2149	5.2132	5.2115	5.2098
146	5.2081	5.2064	5.2047	5.2030	5.2013	5.1997	5.1980	5.1963	5.1946	5.1929
147	5.1912	5.1895	5.1878	5.1861	5.1844	5.1827	5.1810	5.1793	5.1777	5.1760
148	5.1743	5.1726	5.1709	5.1692	5.1675	5.1658	5.1641	5.1624	5.1607	5.1590
149	5.1573	5.1557	5.1540	5.1523	5.1506	5.1489	5.1472	5.1455	5.1438	5.1421
150	5.1404	5.1387	5.1370	5.1354	5.1337	5.1320	5.1303	5.1286	5.1269	5.1252
151	5.1235	5.1218	5.1201	5.1184	5.1167	5.1150	5.1134	5.1117	5.1100	5.1083
152	5.1066	5.1049	5.1032	5.1015	5.0998	5.0981	5.0964	5.0947	5.0931	5.0914
153	5.0897	5.0880	5.0863	5.0846	5.0829	5.0812	5.0795	5.0778	5.0761	5.0744
154	5.0727	5.0711	5.0694	5.0677	5.0660	5.0643	5.0626	5.0609	5.0592	5.0575
155	5.0558	5.0541	5.0524	5.0508	5.0491	5.0474	5.0457	5.0440	5.0423	5.0406
156	5.0389	5.0372	5.0355	5.0338	5.0321	5.0304	5.0288	5.0271	5.0254	5.0237
157	5.0220	5.0203	5.0186	5.0169	5.0152	5.0135	5.0118	5.0101	5.0084	5.0068
158	5.0051	5.0034	5.0017	5.0000	4.9983	4.9966	4.9949	4.9932	4.9915	4.9898
159	4.9881	4.9865	4.9848	4.9831	4.9814	4.9797	4.9780	4.9763	4.9746	4.9729
160	4.9712	4.9695	4.9678	4.9661	4.9645	4.9628	4.9611	4.9594	4.9577	4.9560
161	4.9543	4.9526	4.9509	4.9492	4.9475	4.9458	4.9442	4.9425	4.9408	4.9391
162	4.9374	4.9357	4.9340	4.9323	4.9306	4.9289	4.9272	4.9255	4.9238	4.9222
163	4.9205	4.9188	4.9171	4.9154	4.9137	4.9120	4.9103	4.9086	4.9069	4.9052
164	4.9035	4.9019	4.9002	4.8985	4.8968	4.8951	4.8934	4.8917	4.8900	4.8883
165	4.8866	4.8849	4.8832	4.8815	4.8799	4.8782	4.8765	4.8748	4.8731	4.8714
166	4.8697	4.8680	4.8663	4.8646	4.8629	4.8612	4.8595	4.8579	4.8562	4.8545
167	4.8528	4.8511	4.8494	4.8477	4.8460	4.8443	4.8426	4.8409	4.8392	4.8376
168	4.8359	4.8342	4.8325	4.8308	4.8291	4.8274	4.8257	4.8240	4.8223	4.8206
169	4.8189	4.8172	4.8156	4.8139	4.8122	4.8105	4.8088	4.8071	4.8054	4.8037
170	4.8020	4.8003	4.7986	4.7969	4.7953	4.7936	4.7919	4.7902	4.7885	4.7868
171	4.7851	4.7834	4.7817	4.7800	4.7783	4.7766	4.7749	4.7733	4.7716	4.7699
172	4.7682	4.7665	4.7648	4.7631	4.7614	4.7597	4.7580	4.7563	4.7546	4.7530
173	4.7513	4.7496	4.7479	4.7462	4.7445	4.7428	4.7411	4.7394	4.7377	4.7360
174	4.7343	4.7326	4.7310	4.7293	4.7276	4.7259	4.7242	4.7225	4.7208	4.7191
175	4.7174	4.7157	4.7140	4.7123	4.7106	4.7090	4.7073	4.7056	4.7039	4.7022
176	4.7005	4.6988	4.6971	4.6954	4.6937	4.6920	4.6903	4.6887	4.6870	4.6853
177	4.6836	4.6819	4.6802	4.6785	4.6768	4.6751	4.6734	4.6717	4.6700	4.6683
178	4.6667	4.6650	4.6633	4.6616	4.6599	4.6582	4.6565	4.6548	4.6531	4.6514
179	4.6497	4.6480	4.6464	4.6447	4.6430	4.6413	4.6396	4.6379	4.6362	4.6345
180	4.6328	4.6311	4.6294	4.6277	4.6260	4.6244	4.6227	4.6210	4.6193	4.6176
181	4.6159	4.6142	4.6125	4.6108	4.6091	4.6074	4.6057	4.6040	4.6024	4.6007
182	4.5990	4.5973	4.5956	4.5939	4.5922	4.5905	4.5888	4.5871	4.5854	4.5837
183	4.5821	4.5804	4.5787	4.5770	4.5753	4.5736	4.5719	4.5702	4.5685	4.5668
184	4.5651	4.5634	4.5617	4.5601	4.5584	4.5567	4.5550	4.5533	4.5516	4.5499

pH VALUES FOR POTENTIOMETER READINGS
(Continued)

Millivolts	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
185	4.5482	4.5465	4.5448	4.5431	4.5414	4.5398	4.5381	4.5364	4.5347	4.5330
186	4.5313	4.5296	4.5279	4.5262	4.5245	4.5228	4.5211	4.5194	4.5178	4.5161
187	4.5144	4.5127	4.5110	4.5093	4.5076	4.5059	4.5042	4.5025	4.5008	4.4991
188	4.4975	4.4958	4.4941	4.4924	4.4907	4.4890	4.4873	4.4856	4.4839	4.4822
189	4.4805	4.4788	4.4771	4.4755	4.4738	4.4721	4.4704	4.4687	4.4670	4.4653
190	4.4636	4.4619	4.4602	4.4585	4.4568	4.4551	4.4535	4.4518	4.4501	4.4484
191	4.4467	4.4450	4.4433	4.4416	4.4399	4.4382	4.4365	4.4348	4.4332	4.4315
192	4.4298	4.4281	4.4264	4.4247	4.4230	4.4213	4.4196	4.4179	4.4162	4.4145
193	4.4128	4.4112	4.4095	4.4078	4.4061	4.4044	4.4027	4.4010	4.3993	4.3976
194	4.3959	4.3942	4.3925	4.3909	4.3892	4.3875	4.3858	4.3841	4.3824	4.3807
195	4.3790	4.3773	4.3756	4.3739	4.3722	4.3705	4.3689	4.3672	4.3655	4.3638
196	4.3621	4.3604	4.3587	4.3570	4.3553	4.3536	4.3519	4.3502	4.3486	4.3469
197	4.3452	4.3435	4.3418	4.3401	4.3384	4.3367	4.3350	4.3333	4.3316	4.3299
198	4.3282	4.3266	4.3249	4.3232	4.3215	4.3198	4.3181	4.3164	4.3147	4.3130
199	4.3113	4.3096	4.3079	4.3062	4.3046	4.3029	4.3012	4.2995	4.2978	4.2961

POLARITY REVERSED

0	7.6785	7.6802	7.6819	7.6836	7.6853	7.6870	7.6887	7.6903	7.6920	7.6937
1	7.6954	7.6971	7.6988	7.7005	7.7022	7.7039	7.7056	7.7073	7.7090	7.7106
2	7.7123	7.7140	7.7157	7.7174	7.7191	7.7208	7.7225	7.7242	7.7259	7.7276
3	7.7293	7.7310	7.7326	7.7343	7.7360	7.7377	7.7394	7.7411	7.7428	7.7445
4	7.7462	7.7479	7.7496	7.7513	7.7530	7.7546	7.7563	7.7580	7.7597	7.7614
5	7.7631	7.7648	7.7665	7.7682	7.7699	7.7716	7.7733	7.7749	7.7763	7.7783
6	7.7800	7.7817	7.7834	7.7851	7.7868	7.7885	7.7902	7.7919	7.7936	7.7953
7	7.7969	7.7986	7.8003	7.8020	7.8037	7.8054	7.8071	7.8088	7.8105	7.8122
8	7.8139	7.8156	7.8172	7.8189	7.8206	7.8223	7.8240	7.8257	7.8274	7.8291
9	7.8308	7.8325	7.8342	7.8359	7.8376	7.8392	7.8409	7.8426	7.8443	7.8460
10	7.8477	7.8494	7.8511	7.8528	7.8545	7.8562	7.8579	7.8595	7.8612	7.8629
11	7.8646	7.8663	7.8680	7.8697	7.8714	7.8731	7.8748	7.8765	7.8782	7.8799
12	7.8815	7.8832	7.8849	7.8866	7.8883	7.8900	7.8917	7.8934	7.8951	7.8968
13	7.8985	7.9002	7.9019	7.9035	7.9052	7.9069	7.9086	7.9103	7.9120	7.9137
14	7.9154	7.9171	7.9188	7.9205	7.9222	7.9238	7.9255	7.9272	7.9289	7.9306
15	7.9323	7.9340	7.9357	7.9374	7.9391	7.9408	7.9425	7.9442	7.9458	7.9475
16	7.9492	7.9509	7.9526	7.9543	7.9560	7.9577	7.9594	7.9611	7.9628	7.9645
17	7.9661	7.9678	7.9695	7.9712	7.9729	7.9746	7.9763	7.9780	7.9797	7.9814
18	7.9831	7.9848	7.9865	7.9881	7.9898	7.9915	7.9932	7.9949	7.9966	7.9983
19	8.0000	8.0017	8.0034	8.0051	8.0068	8.0084	8.0101	8.0118	8.0135	8.0152
20	8.0169	8.0186	8.0203	8.0220	8.0237	8.0254	8.0271	8.0288	8.0304	8.0321
21	8.0338	8.0355	8.0372	8.0389	8.0406	8.0423	8.0440	8.0457	8.0474	8.0491
22	8.0508	8.0524	8.0541	8.0558	8.0575	8.0592	8.0609	8.0626	8.0643	8.0660
23	8.0677	8.0694	8.0711	8.0727	8.0744	8.0761	8.0778	8.0795	8.0812	8.0829
24	8.0846	8.0862	8.0880	8.0897	8.0914	8.0931	8.0947	8.0964	8.0981	8.0998
25	8.1015	8.1032	8.1049	8.1066	8.1083	8.1100	8.1117	8.1134	8.1150	8.1167
26	8.1184	8.1201	8.1218	8.1235	8.1252	8.1269	8.1286	8.1303	8.1320	8.1337
27	8.1354	8.1370	8.1387	8.1404	8.1421	8.1438	8.1455	8.1472	8.1489	8.1506
28	8.1523	8.1540	8.1557	8.1573	8.1590	8.1607	8.1624	8.1641	8.1658	8.1675
29	8.1692	8.1709	8.1726	8.1743	8.1760	8.1777	8.1793	8.1810	8.1827	8.1844

APPROXIMATE pH VALUES

The following tables give approximate pH values for a number of substances such as acids, bases, foods, biological fluids, etc. All values are rounded off to the nearest tenth and are based on measurements made at 25° C. A few buffer systems with their pH values are also given.

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ACIDS

Hydrochloric, N	0.1	Formic, 0.1N	2.3
Hydrochloric, 0.1N	1.1	Lactic, 0.1N	2.4
Hydrochloric, 0.01N	2.0	Acetic, N	2.4
Sulfuric, N	0.3	Acetic, 0.1N	2.9
Sulfuric, 0.1N	1.2	Acetic, 0.01N	3.4
Sulfuric, 0.01N	2.1	Benzoic, 0.01N	3.1
Orthophosphoric, 0.1N	1.5	Alum, 0.1N	3.2
Sulfurous, 0.1N	1.5	Carbonic (saturated)	3.8
Oxalic, 0.1N	1.6	Hydrogen sulfide, 0.1N	4.1
Tartaric, 0.1N	2.2	Arsenious (saturated)	5.0
Malic, 0.1N	2.2	Hydrocyanic, 0.1N	5.1
Citric, 0.1N	2.2	Boric, 0.1N	5.2

BASES

Sodium hydroxide, N	14.0	Ammonia, N	11.6
Sodium hydroxide, 0.1N	13.0	Ammonia, 0.1N	11.1
Sodium hydroxide, 0.01N	12.0	Ammonia, 0.01N	10.6
Potassium hydroxide, N	14.0	Potassium cyanide, 0.1N	11.0
Potassium hydroxide, 0.1N	13.0	Magnesia (saturated)	10.5
Potassium hydroxide, 0.01N	12.0	Sodium sesquicarbonate, 0.1M	10.1
Sodium metasilicate, 0.1N	12.6	Ferrous hydroxide (saturated)	9.5
Lime (saturated)	12.4	Calcium carbonate (saturated)	9.4
Trisodium phosphate, 0.1N	12.0	Borax, 0.1N	9.2
Sodium carbonate, 0.1N	11.6	Sodium bicarbonate, 0.1N	8.4

BIOLOGIC MATERIALS

Blood, plasma, human	7.3–7.5	Duodenal contents, human	4.8–8.2
Spinal fluid, human	7.3–7.5	Feces, human	4.6–8.4
Blood, whole, dog	6.9–7.2	Urine, human	4.8–8.4
Saliva, human	6.5–7.5	Milk, human	6.6–7.6
Gastric contents, human	1.0–3.0	Bile, human	6.8–7.0

FOODS

Apples	2.9–3.3	Milk, cows	6.3–6.6
Apricots	3.6–4.0	Olives	3.6–3.8
Asparagus	5.4–5.8	Oranges	3.0–4.0
Bananas	4.5–4.7	Oysters	6.1–6.6
Beans	5.0–6.0	Peaches	3.4–3.6
Beers	4.0–5.0	Pears	3.6–4.0
Beets	4.9–5.5	Peas	5.8–6.4
Blackberries	3.2–3.6	Pickles, dill	3.2–3.6
Bread, white	5.0–6.0	Pickles, sour	3.0–3.4
Butter	6.1–6.4	Pimento	4.6–5.2
Cabbage	5.2–5.4	Plums	2.8–3.0
Carrots	4.9–5.3	Potatoes	5.6–6.0
Cheese	4.8–6.4	Pumpkin	4.8–5.2
Cherries	3.2–4.0	Raspberries	3.2–3.6
Cider	2.9–3.3	Rhubarb	3.1–3.2
Corn	6.0–6.5	Salmon	6.1–6.3
Crackers	6.5–8.5	Sauerkraut	3.4–3.6
Dates	6.2–6.4	Shrimp	6.8–7.0
Eggs, fresh white	7.6–8.0	Soft drinks	2.0–4.0
Flour, wheat	5.5–6.5	Spinach	5.1–5.7
Gooseberries	2.8–3.0	Squash	5.0–5.4
Grapefruit	3.0–3.3	Strawberries	3.0–3.5
Grapes	3.5–4.5	Sweet potatoes	5.3–5.6
Hominy (lye)	6.8–8.0	Tomatoes	4.0–4.4
Jams, fruit	3.5–4.0	Tuna	5.9–6.1
Jellies, fruit	2.8–3.4	Turnips	5.2–5.6
Lemons	2.2–2.4	Vinegar	2.4–3.4
Limes	1.8–2.0	Water, drinking	6.5–8.0
Maple syrup	6.5–7.0	Wines	2.8–3.8

APPROXIMATE pH VALUES (Continued)

BUFFER SYSTEMS

The following table gives some common buffer systems and the approximate pH of maximum buffer capacity. The zone of effective buffer action will vary with concentration but, for concentrations approximately 0.1 molar, the general average will be ± 1.0 pH from the value given.

Glycocoll-sodium chloride-hydrochloric acid	2.0
Potassium acid phthalate-hydrochloric acid	2.8
Primary potassium citrate	3.7
Acetic acid-sodium acetate	4.6
Potassium acid phthalate-sodium hydroxide	5.0
Secondary sodium citrate	5.0
Potassium acid phosphate-disodium phosphate	6.8
Potassium acid phosphate-sodium hydroxide	6.8
Boric acid-borax	8.5
Borax	9.2
Boric acid-sodium hydroxide	9.2
Sodium bicarbonate-sodium carbonate	10.2
Disodium phosphate-sodium hydroxide	11.5

FORMULAS FOR CALCULATING TITRATION DATA, *p*H VS. ML. OF REAGENT

A Substance Titrated V_0 ml. of solution M_0 its molarity	B Initial $[H^+]$ or $[OH^-]$	C Intermediate Points 10, 50, 99, etc., per cent neutralized, V_1 ml. of reagent of M_1 molarity added	D Equivalence Point	E Excess of Reagent V_1 volume reagent M_1 its molarity V_T total volume
(1) Strong Acid....................	$[H^+] = M_0$	$[H^+] = \frac{V_0M_0 - V_1M_1}{V_0 + V_1}$	$\sqrt{K_w}$	$[OH^-] = \frac{V_1M_1}{V_T}$
(2) Strong Base....................	$[OH^-] = M_0$	$[OH^-] = \frac{V_0M_0 - V_1M_1}{V_0 + V_1}$	$\sqrt{K_w}$	$[H^+] = \frac{V_1M_1}{V_T}$
(3) Weak Acid ($K_a = 10^{-5}$ to 10^{-8})....	$[H^+] = \sqrt{M_0K_a}$	$[H^+] = \frac{[Acid]}{[Salt]} K_a$	$[OH^-] = \sqrt{\frac{K_w}{K_a} c}$	$[OH^-] = \frac{V_1M_1}{V_T}$ (Value in column D to be added)
(4) Weak Base ($K_b = 10^{-5}$ to 10^{-8})....	$[OH^-] = \sqrt{M_0K_b}$	$[OH^-] = \frac{[Base]}{[Salt]} K_b$	$[H^+] = \sqrt{\frac{K_w}{K_b} c}$	$[H^+] = \frac{V_1M_1}{V_T}$ (Value in column D to be added)
(5) Salt of a Very Weak Acid (e.g. KCN)	$[OH^-] = \sqrt{\frac{K_w}{K_a} c}$	$[H^+] = \frac{[Acid]}{[Salt]} K_a$	$[H^+] = \sqrt{[Acid]K_a}$	$[H^+] = \frac{V_1M_1}{V_T}$ (Correct for value in column D)
(6) Salt of a Very Weak Base.........	$[H^+] = \sqrt{\frac{K_w}{K_b} c}$	$[OH^-] = \frac{[Base]}{[Salt]} K_b$	$[OH^-] = \sqrt{[Base]K_b}$	$[OH^-] = \frac{V_1M_1}{V_T}$ (Add to $[OH^-]$ found in column D)

POLAROGRAPHIC ANALYSIS

Half-Wave Potentials of Inorganic Substances

Compiled by Louis Meites

All half-wave potentials, $E_{\frac{1}{2}}$, in the following table are in volts *versus* the saturated calomel electrode at 25°. ">0" refers to a wave at a potential so positive that it merges with the anodic wave due to dissolution of the electrode mercury. "NR" indicates that no wave is observed; "w" and "i" signify that the wave is well- or ill-defined, respectively, and refer to the presence or absence of an accurately measurable plateau.

Symbol	Element	2 *M* acetic acid, 2 *M* NH_4 acetate	1 *M* NH_3, 1 *M* NH_4Cl	5 *M* $CaCl_2$	0.1 or 1 *M* KCl	1 *M* Na citrate, 0.1 *M* NaOH	1*M* KCN	0.1 *M* Na ethylenediaminetetraacetate, 2 *M* Na acetate	1 *M* NaF
Al^{+3}	Aluminum	NR			−1.75w	NR		NR	
Sb^{+3}	Antimony	−0.40w −0.59w				(−0.44) −1.24	−1.09		−0.68w
Sb^{+5}						NR			
As^{+3}	Arsenic	−0.92i	−1.7			(−0.31)w			
As^{+5}		NR							
Ba^{+2}	Barium	NR							
Be^{+2}	Beryllium				−1.8				
Bi^{+3}	Bismuth	−0.25				−0.8i −0.9i		−0.70	−0.07
Br^{-1}	Bromine								
Br^{+5}					−1.78				
Cd^{+2}	Cadmium	−0.65	−0.81w	−0.80	−0.64w	−1.46	−1.18w	−>1.2i	−0.63
Ca^{+2}	Calcium	NR							
Ce^{+3}	Cerium								
Ce^{+4}						−0.3i −0.4i −0.6i −0.8i			
Cs^{+1}	Cesium	NR							
Cl^{-1}	Chlorine								
Cr^{+2}	Chromium				(−0.40)		(−1.05) (−1.38)		
Cr^{+3}		−1.2i	−1.43 −1.71		−0.61 −0.85 −1.47	−1.45	−1.38		
Cr^{+6}			−0.2 −1.6		−0.3 −1.0 −1.55 −1.8	−0.83 −1.49			−0.26 −1.1
Co^{+2}	Cobalt	NR	−1.29	−0.82	−1.20w	−1.45w	−1.45	NR	−1.38
Co^{+3}			−0.3	−0.26	−0.26				

POLAROGRAPHIC ANALYSIS (Continued)

A value of $E_{\frac{1}{2}}$ enclosed in parentheses denotes an anodic (oxidation) wave. The supporting electrolyte in which a value was reported is not always identical in every detail with that described at the head of the column. In particular, gelatin, Triton X-100, or some other maximum suppressor was often present, at a concentration which could not be rigidly standardized for this table. For further details consult Appendix B of "Polarographic Techniques," by L. Meites (Interscience Publishers, 1955).

Symbol	1 *M* HCl	12 *M* HCl	1 *M* NaOH	0.1 *M* KNO_3	7.3 *M* H_3PO_4	0.1 *M* KH phthalate	0.1 *M* pyridine, 0.1 *M* pyridinium chloride	0.5 *M* Na tartrate, pH 9	0.1 *M* tetraalkylammonium chloride or hydroxide	1 *M* KSCN	0.3 *M* triethanolamine, 0.1 *M* KOH
Al^{+3}	NR	NR	NR		NR		NR				
Sb^{+3}	−0.15w	−0.52 −0.66	(−0.45) −1.15		−0.29w			−1.0i −1.2i		>0w	
Sb^{+5}	−0.35i	>0 −0.48 −0.57			NR					NR	
As^{+3}	−0.43 −0.67	>0 −0.55i	(−0.26)		−0.46w −0.71i					−0.68 −1.09 −1.56	
As^{+5}	NR	>0 −0.52	NR							NR	
Ba^{+2}	NR	NR			NR	NR	NR		−1.92		
Be^{+2}											
Bi^{+3}	−0.09w	−0.45 −0.57i	−0.6		−0.15w	−0.23		−0.7i		>0w	−0.74
Br^{-1}				(+0.12)							
Br^{+5}			−1.6								
Cd^{+2}	−0.64w	NR	−0.78	−0.58	−0.71i			−0.64		−0.65 −1.27	−0.82
Ca^{+2}	NR	NR			NR	NR	NR		−2.22		
Ce^{+3}									−2.0		
Ce^{+4}		>0 −0.68			>0					−0.53	
Cs^{+1}	NR	NR			NR	NR	NR		−2.09		
Cl^{-1}				(+0.25)							
Cr^{+2}									(−0.43) −1.58	(−0.80)	
Cr^{+3}		NR			−1.02		−0.95		−1.14 −1.58	−1.05	
Cr^{+6}		>0 −0.61	−0.85w		>0i					>0 −0.46 −0.94	
Co^{+2}		NR	−1.46		−1.20i	−1.24	−1.06			−1.08	
Co^{+3}				−0.24							

Symbol	Element	2 *M* acetic acid, 2 *M* NH_4 acetate	1 *M* NH_3, 1 *M* NH_4Cl	5 *M* $CaCl_2$	0.1 or 1 *M* KCl	1 *M* Na citrate, 0.1 *M* NaOH	1 *M* KCN	0.1 *M* Na ethylenediaminetetraacetate, 2 *M* Na acetate	1 *M* NaF
$Co(NH_3)_6^{+++}$			−1.3	−0.88	−1.20				
Cu^{+1}	Copper		(−0.22) −0.50				NR		
Cu^{+2}		−0.07w	−0.24w −0.51w	−0.33	+0.04 −0.22	−0.50	NR	−0.39	±0.00w
Ga^{+3}	Gallium	NR	−1.6		−1.1w		−1.29i		
Ge^{+4}	Germanium		−1.5 −1.7						
Au^{+3}	Gold	>0w					>0 −1.4		>0
H^{+1}	Hydrogen				−1.58				
In^{+3}	Indium	−0.71w			−0.56				
I^{-1}	Iodine								
I^{+5}					−1.16				
Ir^{+3}	Iridium		NR				NR		
Ir^{+4}			NR				NR		−1.4
Fe^{+2}	Iron	NR	(−0.34) −1.49		−1.3	(−0.30)i (−0.50)i (−0.95)i			(+0.1)
Fe^{+3}		>0		>0 −1.20	>0	−0.93i −1.45i −1.70i			−0.49
Pb^{+2}	Lead	−0.50w		−0.53	−0.40	−0.78 −1.5	−0.72		−0.41
Li^{+1}	Lithium	NR							
Mg^{+2}	Magnesium	NR							
Mn^{+2}	Manganese	NR	−1.66	−1.45	−1.51	NR	−1.33?	NR	−1.55
Hg^{+1}	Mercury				>0				>0
Hg^{+2}		>0			>0				>0
Mo^{+6}	Molybdenum	−0.6i −1.1i −1.2i				NR			
Ni^{+2}	Nickel	−1.1i	−1.10	−0.56	−1.1	NR	−1.36	NR	−1.12
Nb^{+5}	Niobium				−1.28				−1.9
N^{-3} (NH_4^+)	Nitrogen								
$N^{-1}(NH_2OH)$					NR				
$N^{+2}(NO)$									
$O^{-2}(OH^-)$	Oxygen								
O_2					−0.05 −0.9				

POLAROGRAPHIC ANALYSIS (Continued)

Symbol	1 *M* HCl	12 *M* HCl	1 *M* NaOH	0.1 *M* KNO_3	7.3 *M* H_3PO_4	0.1 *M* KH phthalate	0.1 *M* pyridine, 0.1 *M* pyridinium chloride	0.5 *M* Na tartrate, pH 9	0.1 *M* tetraalkyl ammonium chloride or hydroxide	1 *M* KSCN	0.3 *M* triethanolamine, 0.1 *M* KOH
$Co(NH_3)_6^{+++}$				−1.21							
Cu^{+1}											
Cu^{+2}	+0.04 −0.22	>0 −0.71	−0.41	+0.02	−0.09w	−0.10	+0.05 −0.25	−0.30		>0 −0.54	−0.53
Ga^{+3}			NR								
Ge^{+4}											
Au^{+3}			−0.6 −1.3								
H^{+1}									−1.58	−1.55	
In^{+3}	−0.60		−1.09								
I^{-1}				(−0.03)							
I^{+5}			−1.2			−0.3					
Ir^{+3}							NR			NR	
Ir^{+4}							NR			NR	
Fe^{+2}		NR	(−0.9) −1.46							−1.52	
Fe^{+3}	>0	>0 −0.65			+0.06			−1.20 −1.73		>0	−1.01
Pb^{+2}	−0.44	−0.90	−0.76	−0.38	−0.53	−0.40		−0.58		−0.44	−0.88
Li^{+1}	NR	NR			NR	NR	NR		−2.33		
Mg^{+2}	NR	NR			NR	NR	NR		−2.3i		
Mn^{+2}		NR	−1.70		NR		NR			−1.54	(−0.5) −1.61
Hg^{+1}	>0										
Hg^{+2}	>0										
Mo^{+6}		>0 −0.56i			±0.0i −0.49w					NR	
Ni^{+2}		−0.80			−1.18i	−1.14	−0.78	NR		−0.68	−1.40
Nb^{+5}		−0.46 −0.69		−1.03							
$N^{-3}(NH_4^+)$									−2.21		
$N^{-1}(NH_2OH)$											
N^{+2} (NO)	−0.9										
$O^{-2}(OH^-)$				(+0.08)							
O_2			−0.18 −1.0	−0.05 −0.9	−0.23 −0.64						

POLAROGRAPHIC ANALYSIS (Continued)

Symbol	Element	2 *M* acetic acid, 2 *M* NH_4 acetate	1 *M* NH_3, 1 *M* NH_4Cl	5 *M* $CaCl_2$	0.1 or 1 *M* KCl	1 *M* Na citrate, 0.1 *M* NaOH	1 *M* KCN	0.1 *M* Na ethylenediaminetetraacetate, 2 *M* Na acetate	1 *M* NaF
Pd^{+2}	Palladium	−0.6i	−0.75w				−1.77		
Pt^{+2}	Platinum		NR		−0.1 −1.35		NR		
K^{+1}	Potassium	NR							
Ra^{+2}	Radium	NR			−1.84				
Re^{+7}	Rhenium				−1.4				
Rh^{+3}	Rhodium		−0.93				−1.47		−0.1i −1.0i
Rb^{+1}	Rubidium	NR							
Ru^{+3} or Ru^{+4}	Ruthenium		NR				NR		
Se^{-2}	Selenium		(±0.0) (−0.8)						
Se^{+4}			−1.53		−1.8i				−0.80 −1.44
Se^{+6}			NR		NR				NR
Ag^{+1}	Silver	>0				>0i			>0
Na^{+1}	Sodium	NR							
Sr^{+2}	Strontium	NR							
$S^{-2}(S^{=})$	Sulfur								
SCN^{-}									
$S_2O_3^{=}$									
S^{+4}		−0.5							
Ta^{+5}	Tantalum								
Te^{-2}	Tellurium		(−1.1)w						
Te^{+4}			−0.67						−0.89
Te^{+6}		−1.2	−1.21		−1.1 −1.45	−1.54	−1.36		−1.50
Tl^{+1}	Thallium	−0.47w	−0.48w		−0.48w	−0.56	>0		−0.50
Tl^{+3}									
Sn^{+2}	Tin	(−0.16)w −0.62w				(−0.91) −1.12			(−0.20) −0.73
Sn^{+4}		−1.1i				−1.22			NR
Ti^{+3}	Titanium			(−0.1)					
Ti^{+4}				−0.1					

POLAROGRAPHIC ANALYSIS (Continued)

Symbol	1 *M* HCl	12 *M* HCl	1 *M* NaOH	0.1 *M* KNO_3	7.3 *M* H_3PO_4	0.1 *M* KH phthalate	0.1 *M* pyridine, 0.1 *M* pyridinium chloride	0.5 *M* Na tartrate, pH 9	0.1 *M* tetraalkyl ammonium chloride or hydroxide	1 *M* KSCN	0.3 *M* triethanolamine, 0.1 *M* KOH
Pd^{+2}											
Pt^{+2}							NR				
K^{+1}	NR	NR			NR	NR	NR		−2.14		
Ra^{+2}	NR	NR			NR	NR	NR				
Re^{+7}	−0.4		−1.5								
Rh^{+3}										−0.39	
Rb^{+1}	NR	NR			NR	NR	NR		−2.03		
Ru^{+3} or Ru^{+4}							NR			NR	
Se^{-2}	(−0.1) (−0.49)		(−0.94) (−1.02)								
Se^{+4}	>0 −0.1 −0.4 −0.5		NR								
Se^{+6}	NR		NR								
Ag^{+1}		>0 −0.65		>0							
Na^{+1}	NR	NR			NR	NR	NR		−2.12		
Sr^{+2}	NR	NR			NR	NR	NR		−2.11		
$S^{-2}(S^{-})$			(−0.76)								
SCN^{-}				(+0.18)							
$S_2O_3^{=}$				(−0.14)							
S^{+4}	−0.3			(+0.01)							
Ta^{+5}	−1.16		NR								
Te^{-2}	(−0.73)		(−0.4) (−1.2)								
Te^{+4}			−1.1 −1.19								
Te^{+6}	NR	>0i −0.43w −0.79w	−1.57		−0.87					−1.10 −1.46	
Tl^{+1}	−0.48	NR	−0.48	−0.46	−0.63					−0.52 −1.07	
Tl^{+3}	>0 −0.48										
Sn^{+2}	(−0.1)i −0.47	−0.83	(−0.73) −1.22		−0.58			(−0.33) −0.92		−0.46	
Sn^{+4}	−0.1 −0.47	−0.50 −0.83	NR		−0.65i			NR		−0.50	
Ti^{+3}	(−0.1)									(−0.5)	
Ti^{+4}	−0.8		NR							−0.5	

Symbol	Element	2 *M* acetic acid, 2 *M* NH_4 acetate	1 *M* NH_3, 1 *M* NH_4Cl	5 *M* $CaCl_2$	0.1 or 1 *M* KCl	1 *M* Na citrate 0.1 *M* NaOH	1 *M* KCN	0.1 *M* Na ethylenediaminetetraacetate, 2 *M* Na acetate	1 *M* NaF
W^{+6}	Tungsten	−0.70i	NR			NR		NR	
U^{+6}	Uranium	−0.45w	−0.8 −1.4			−0.98w		−0.41w	−0.94
V^{+2}	Vanadium	(−0.1) (−0.9)					NR		(+0.2)i (−0.15)i (−0.70)
V^{+4}		−1.2i	(−0.32) −1.28			(−0.47) −1.76i		−1.2	
V^{+5}		>0i	−0.96 −1.26			−1.70i		−1.2	
Zn^{+2}	Zinc	−1.1w	−1.35w		−1.00w	−1.43w	NR	NR	−1.14
Zr^{+4}	Zirconium	NR			−1.65				

POLAROGRAPHIC ANALYSIS (Continued)

Symbol	1 *M* HCl	12 *M* HCl	1 *M* NaOH	0.1 *M* KNO_3	7.3 *M* H_3PO_4	0.1 *M* KH phthalate	0.1 *M* pyridine, 0.1 *M* pyridinium chloride	0.5 *M* Na tartrate, pH 9	0.1 *M* tetraalkyl ammonium chloride or hydroxide	1 *M* KSCN	0.3 *M* triethanolamine, 0.1 *M* KOH
W^{+6}		>0 −0.55			−0.59w						
U^{+6}	−0.20 −0.9	>0 −0.63	−0.95w		−0.12 −0.58		−0.4i −1.1			−0.26 −1.32	
V^{+2}	(−0.50)									(−0.47)	
V^{+4}		>0 −0.62 −0.75	(−0.43)w		−0.6 −0.93						
V^{+5}			−1.7i		>0 −0.54i −0.91						
Zn^{+2}		NR	−1.53w	−1.00w	−1.13i	−1.01	−1.02	−1.15		−1.05	−1.57
Zr^{+4}											

POLAROGRAPHIC ANALYSIS (Continued)

Tangent Potentials of Organic Substances
(Concentrations, 10^{-4} N)

	pH	Volts
Acetaldehyde	3.9	−1.61
"	7	−1.83
Acetoin	2	−1.14
Acetone	2	−1.28
Acetophenone	2	−1.12
"	3.9	−1.32
Acetylacetone	2	−1.20
"	3.9	−1.24
Acetylene dicarboxylic acid	1	−0.45
Acetylene dicarboxylic acid	7	−1.90
Acotinic acid	1	−0.66
" "	7	−2.1
Albumin in ammonium ion	4	−1.60
Aminoazobenzene (*p*)	7	−0.48
Azobenzene	3.9	−0.18
Benzaldehyde	3.9	−1.26
Benzil	2	−0.20
Benzilidene acetone	3.9	−1.06
Benzoin	2	−0.95
"	3.9	−1.19
Benzophenone	3.9	−0.90
"	2	−1.01
Benzoylacetone	2	−0.95
Butyraldehyde	7	−1.7
Cinnamic acid	1.5	−1.10
" "	7	−1.8
Citraconic acid	1	−0.66
Crotonaldehyde	3.9	−1.34
Cystine	1	−0.4
"	7	−0.8
Diacetyl	2	−0.40
Dibenzoylmethane	2	−0.82
Dimethylaminoazobenzene	7	−0.56
Dinitrobenzene (*o*)	3.9	−0.15 & −0.31
" (*m*)	3.9	−0.20 & −0.33
" (*p*)	3.9	−0.18 & −0.35
Dinitrophenol:		
2:4:1	3.9	−0.13 & −0.31
2:5:1	3.9	−0.19
2:6:1	3.9	−0.12 & −0.23
Diphenyl triketone	2	−0.25
Formaldehyde	3.9	−1.50
"	7	−1.64
Fructose	7	−1.80
Fumaric acid	1	−0.54
Fumaric acid	3.9	−1.70
Furfurol	3.9	−1.23
Glyceric aldehyde	3.9	−1.45
Hematin	3.9	−1.37
Hymetomelanic acid	13	−1.4
Hydroxybenzaldehyde (*o*)	3.9	−1.26
Hydroxybenzophenone (*p*)	3.9	−1.2
Isovaleric aldehyde	3.9	−1.61
Maleic acid	1	−0.54
" "	7	−1.90
Mesaconic acid	1	−0.66
" "	7	−1.8
Methemoglobin	3.9	−1.26
Methylene blue	3.9	−0.11 & −1.2
Nicotinic acid	3.9	−1.03
* " "	7	−1.74
Nitraniline (*o*)	1	−0.193
" (*m*)	1	−0.112
" (*p*)	1	−0.183
Nitrobenzene	3.9	−0.35
Nitrophenol (*o*)	3.9	−0.32
" (*m*)	3.9	−0.33
" (*p*)	3.9	−0.40
Oxalic acid	1	−1.2
Oxyhemaglobin	3.9	−0.06
Propionic aldehyde	3.9	−1.61
Pyridine	3.9	−1.30
Pyroracemic acid	1	−0.39
" "	7	−1.4
Pyruvic acid	1	−0.4
" "	7	−1.4
Quinhydrone	3.9	−0.02
Quinine	13	−1.5
Quinoline	4	−1.07
* Riboflavin	7	−0.39
Saccharin	1	−1.0
"	7	−1.8
Sorbinic acid	7	−1.90
Sorbose	7	−1.80
* Thiamine	7	−1.29
Trimethyl azonium iodide	12.5	−1.7
Vitamin C	7	−1.80
Tetramethyl and tetraethyl ammonium ions, half wave potential −2.8		

* Half wave.

Anode Potentials in the Presence of Stated Anions At Normal Concentration

Chloride	0.0
Bromide	−0.12
Sulfate	+0.20
Nitrate	+0.30
Hydroxide	−0.16
Sulfite	−0.25
Iodide	−0.30
Cyanide	−0.58
Sulfide	−0.90

OXIDATION POTENTIALS OF ELEMENTS

VALUES, IN VOLTS, REFERRED TO THE HYDROGEN-HYDROGEN ION COUPLE AS ZERO, ARE FOR UNIT ACTIVITIES AND TEMPERATURE OF 25° C.

The following values are the standard oxidation potentials of many of the elements. The agreement of values given by independent workers is not always good due to differences of surface characteristics of electrodes. For difficulties met in measuring reversible electrode potentials one is referred to texts as written by Latimer and by Bockris.

Table 1

Element	Reaction	E^0_{ox}	Element	Reaction	E^0_{ox}
Li	$Li \rightarrow Li^+ + 1e$	+3.045	Nb	$Nb \rightarrow Nb^{+++} + 3e$	ca +1.1
K	$K \rightarrow K^+ + 1e$	+2.925	S	$S^{--} \rightarrow S + 2e$	+0.92
Rb	$Rb \rightarrow Rb^+ + 1e$	+2.925	Se	$Se^{--} \rightarrow Se + 2e$	+0.78
Cs	$Cs \rightarrow Cs + 1e$	+2.923	Zn	$Zn \rightarrow Zn + 2e$	+0.763
Ra	$Ra \rightarrow Ra^{++} + 2e$	+2.92	Cr	$Cr \rightarrow Cr^{+++} + 3e$	+0.74
Ba	$Ba \rightarrow Ba^{++} + 2e$	+2.90	Ga	$Ga \rightarrow Ga^{+++} + 3e$	+0.53
Sr	$Sr \rightarrow Sr^{++} + 2e$	+2.89	Te	$Te \rightarrow Te^{++} + 2e$	+0.51
Ca	$Ca \rightarrow Ca^{++} + 2e$	+2.87	Fe	$Fe \rightarrow Fe^{++} + 2e$	+0.44
Na	$Na \rightarrow Na^+ + 1e$	+2.714	Cd	$Cd \rightarrow Cd^{++} + 2e$	+0.403
La	$La \rightarrow La^{+++} + 3e$	+2.52	In	$In \rightarrow In^{+++} + 3e$	+0.342
Ce	$Ce \rightarrow Ce^{+++} + 3e$	+2.48	Tl	$Tl \rightarrow Tl^+ + 1e$	+0.336
Nd	$Nd \rightarrow Nd^{+++} + 3e$	+2.44	Co	$Co \rightarrow Co^{++} + 2e$	+0.277
Sm	$Sm \rightarrow Sm^{+++} + 3e$	+2.41	Ni	$Ni \rightarrow Ni^{++} + 2e$	+0.250
Gd	$Gd \rightarrow Gd^{+++} + 3e$	+2.40	Mo	$Mo \rightarrow Mo^{+++} + 3e$	ca +0.2
Mg	$Mg \rightarrow Mg^{++} + 2e$	+2.37	Sn	$Sn \rightarrow Sn^{++} + 2e$	+0.136
Y	$Y \rightarrow Y^{+++} + 3e$	+2.37	Pb	$Pb \rightarrow Pb^{++} + 2e$	+0.126
Am	$Am \rightarrow Am^{+++} + 3e$	+2.32	D_2	$\frac{1}{2}D_2 \rightarrow D^+ + 1e$	+0.003
Lu	$Lu \rightarrow Lu^{+++} + 3e$	+2.25	H_2	$\frac{1}{2}H_2 \rightarrow H^+ + 1e$	0.000
H	$H^- \rightarrow H + 1e$	+2.25	Cu	$Cu \rightarrow Cu^{++} + 2e$	−0.337
$H_{(g)}$	$H \rightarrow H^+ + 1e$	+2.10		$Cu \rightarrow Cu^+ + 1e$	−0.521
Sc	$Sc \rightarrow Sc^{+++} + 3e$	+2.08	I_2	$2I^- \rightarrow I_2 + 2e$	−0.536
Pu	$Pu \rightarrow Pu^{+++} + 3e$	+2.07	Hg	$2Hg \rightarrow Hg_2^+ + 2e$	−0.789
Th	$Th \rightarrow Th^{++++} + 4e$	+1.90	Ag	$Ag \rightarrow Ag^+ + 1e$	−0.7991
Np	$Np \rightarrow Np^{+++} + 3e$	+1.86	Rh	$Rh \rightarrow Rh^{+++} + 3e$	ca −0.8
Be	$Be \rightarrow Be^{++} + 2e$	+1.85	Pd	$Pd \rightarrow Pd^{++} + 2e$	−0.987
U	$U \rightarrow U^{+++} + 3e$	+1.80	Br_2	$2Br^- \rightarrow Br_{2(L)} + 2e$	−1.066
Hf	$Hf \rightarrow Hf^{++++} + 4e$	+1.70	Pt	$Pt \rightarrow Pt^{++} + 2e$	−1.2
Al	$Al \rightarrow Al^{+++} + 3e$	+1.66	Cl_2	$2Cl^- \rightarrow Cl_2 + 2e$	−1.36
Ti	$Ti \rightarrow Ti^{++} + 2e$	+1.63	Au	$Au \rightarrow Au^{+++} + 3e$	−1.50
Zr	$Zr \rightarrow Zr^{++++} + 4e$	+1.53		$Au \rightarrow Au^+ + 1e$	ca −1.68
Mn	$Mn \rightarrow Mn^{++} + 2e$	+1.18	F_2	$2F^- \rightarrow F_2 + 2e$	−2.85
V	$V \rightarrow V^{++} + 2e$	ca +1.18			

OXIDATION POTENTIALS OF IONS CONTAINING ONLY ONE ELEMENT

Table 2

Element	Reaction	E^0_{ox}	Element	Reaction	E^0_{ox}
U	$U^{+3} \rightarrow U^{+4} + 1e$	+0.61	Fe	$Fe^{+2} \rightarrow Fe^{+3} + 1e$	−0.771
Eu	$Eu^{+2} \rightarrow Eu^{+3} + 1e$	+0.43	Hg	$Hg_2^{+2} \rightarrow 2Hg^{+2} + 2e$	−0.920
Cr	$Cr^{+2} \rightarrow Cr^{+3} + 1e$	+0.41	Pu	$Pu^{+3} \rightarrow Pu^{+4} + 1e$	−0.97
Ti	$Ti^{+2} \rightarrow Ti^{+3} + 1e$	+0.37	Tl	$Tl^{+1} \rightarrow Tl^{+3} + 2e$	−1.25
V	$V^{+2} \rightarrow V^{+3} + 1e$	+0.255	Mn	$Mn^{+2} \rightarrow Mn^{+3} + 1e$	−1.51
Np	$Np^{+3} \rightarrow Np^{+4} + 1e$	−0.147	Ce	$Ce^{+3} \rightarrow Ce^{+4} + 1e$	−1.61
Sn	$Sn^{+2} \rightarrow Sn^{+4} + 2e$	−0.15	Co	$Co^{+2} \rightarrow Co^{+3} + 1e$	−1.82
Cu	$Cu^{+1} \rightarrow Cu^{+2} + 1e$	−0.153	Ag	$Ag^{+1} \rightarrow Ag^{+2} + 1e$	−1.98

OXIDATION POTENTIAL OF IONS OR COMPOUNDS CONTAINING MORE THAN ONE ELEMENT

Table 3

Metallic Element	Reaction	E^0_{ox}
Te	$H_2Te \rightarrow Te + 2H^+ + 2e$	+0.72
As	$AsH_3 \rightarrow As + 3H^+ + 3e$	+0.60
U	$UO_2^{+1} \rightarrow UO_2^{+2} + e$	−0.05
Fe	$Fe(CN)_6^{-4} \rightarrow Fe(CN)_6^{-3} + e$	−0.356
Mn	$MnO_4^{-2} \rightarrow MnO_4^{-1} + 1e$	−0.56
Pu	$PuO_2^{+1} \rightarrow PuO_2^{+2} + e$	−0.93
Cu	$Cu(CN)_2^{-1} \rightarrow Cu^{+2} + 2CN^- + e$	−1.12
H	$2H_2O \rightarrow O_2 + 4H^+ + 4e$	−1.229
H	$2NH_4^{+1} \rightarrow N_2H_5^{+1} + 3H^+ + 2e$	−1.275

OXIDATION POTENTIALS OF ELEMENTS AND IONS INVOLVING HYDROLYSIS

Table 4

Element	Reaction	E^0_{ox}
Ti	$Ti + H_2O \rightarrow TiO^{+2} + 2H^+ + 4e$	+0.89
B	$B + 3H_2O \rightarrow H_3BO_3 + 3H^+ + 3e$	+0.87
Si	$Si + 2H_2O \rightarrow SiO_2 + 4H^+ + 4e$	+0.86
Ta	$2Ta + 5H_2O \rightarrow Ta_2O_5 + 10H^+ + 10e$	+0.81
Nb	$2Nb + 5H_2O \rightarrow Nb_2O_5 + 10H^+ + 10e$	+0.65
P	$P + 2H_2O \rightarrow H_3PO_2 + H^+ + 1e$	+0.51
V	$V + 4H_2O \rightarrow V(OH)_4^+ + 4H^+ + 5e$	+0.253
Ge	$Ge + 2H_2O \rightarrow GeO_2 + 4H^+ + 4e$	+0.15
W	$W + 3H_2O \rightarrow WO_3 + 6H^+ + 6e$	+0.09
Ti	$Ti^{+3} + H_2O \rightarrow TiO^{+2} + 2H^+ + 1e$	−0.1
Sb	$2Sb + 3H_2O \rightarrow Sb_2O_3 + 6H^+ + 6e$	−0.152
As	$As + 2H_2O \rightarrow HAsO_2 + 3H^+ + 3e$	−0.247
Re	$Re + 2H_2O \rightarrow ReO_2 + 4H^+ + 4e$	−0.252
Bi	$Bi + H_2O \rightarrow BiO^+ + 2H^+ + 3e$	−0.32
U	$U^{+4} + 2H_2O \rightarrow UO_2^{+2} + 4H^+ + 2e$	−0.334
V	$V^{+3} + H_2O \rightarrow VO_2^{+2} + 2H^+ + e$	−0.361
Re	$Re + 4H_2O \rightarrow ReO_4^- + 8H^+ + 7e$	−0.363
S	$S + 3H_2O \rightarrow H_2SO_3 + 4H^+ + 4e$	−0.45
Te	$Te + 2H_2O \rightarrow TeO_2 + 4H^+ + 4e$	−0.529
	$Te + 2H_2O \rightarrow TeOOH^{+1} + 3H^+ + 4e$	−0.559
U	$U^{+4} + 2H_2O \rightarrow UO_2^{+2} + 4H^+ + 2e$	−0.62
Se	$Se + 3H_2O \rightarrow H_2SeO_3 + 4H^+ + 4e$	−0.74
Np	$Np^{+4} + 2H_2O \rightarrow NpO_2^{+1} + 4H^+ + 1e$	−0.75
Os	$Os + 4H_2O \rightarrow OsO_4 + 8H^+ + 8e$	−0.85
Pt	$Pt + 2H_2O \rightarrow Pt(OH)_2 + 2H^+ + 2e$	−0.98
Pu	$Pu^{+4} + 2H_2O \rightarrow PuO_2^{+2} + 4H^+ + 2e$	−1.04
	$Pu^{+4} + 2H_2O \rightarrow PuO_2^{+1} + 4H^+ + 1e$	−1.15
Mn	$Mn^{+2} + 2H_2O \rightarrow MnO_2 + 4H^+ + 2e$	−1.23
Cr	$Cr^{+3} + 7H_2O \rightarrow Cr_2O_7^{-2} + 14H^+ + 6e$	−1.33
Au	$Au + 3H_2O \rightarrow Au(OH)_3 + 3H^+ + 3e$	−1.45
I_2	$\frac{1}{2}I_2 + H_2O \rightarrow HIO + H^+ + 1e$	−1.45
Pb	$Pb^{+2} + 2H_2O \rightarrow PbO_2 + 4H^+ + 2e$	−1.455
Mn	$Mn^{+2} + 4H_2O \rightarrow MnO_4^- + 8H^+ + 5e$	−1.51
Br_2	$\frac{1}{2}Br_2 + 3H_2O \rightarrow BrO_3^- + 6H^+ + 5e$	−1.52
	$Br_2 + H_2O \rightarrow HBrO + H^+ + 1e$	−1.59
Cl_2	$\frac{1}{2}Cl_2 + H_2O \rightarrow HClO + H^+ + 1e$	−1.63
Ni	$Ni^{+2} + 2H_2O \rightarrow NiO_2 + 4H^+ + 2e$	−1.68
O_2	$O_2 + H_2O \rightarrow O_3 + 2H^+ + 2e$	−2.07
F_2	$2F^{-1} + H_2O \rightarrow F_2O + 2H^+ + 4e$	−2.1

OXIDATION POTENTIALS OF MISCELLANEOUS COUPLES IN ACIDS

Table 5

Reactions	E^0_{ox}	Reactions	E^0_{ox}
$Si + 6F^- \rightarrow SiF_6^{--} + 4e$	+1.2	$Hg + 4Br^- \rightarrow HgBr_4^{--} + 2e$	−0.21
$Ti + 6F^- \rightarrow TiF_6^{--} + 4e$	+1.19	$Ag + Cl^- \rightarrow AgCl + 1e$	−0.222
$Tl + Br^- \rightarrow TlBr + 1e$	+0.66	$Ag + IO_3^- \rightarrow AgIO_3 + 1e$	−0.35
$Pt + H_2S \rightarrow PtS + 2H^+ + 2e$	+0.30	$Ag + BrO_3^- \rightarrow AgBrO_3 + 1e$	−0.55
$Pb + 2Br^- \rightarrow PbBr_2 + 2e$	+0.28	$Pt + 4Br^- \rightarrow PtBr_4^{--} + 2e$	−0.58
$Pb + 2Cl^- \rightarrow PbCl_2 + 2e$	+0.27	$2Ag + SO_4^{--} \rightarrow Ag_2SO_4 + 2e$	−0.653
$Sn + 6F^- \rightarrow SnF_6^{--} + 4e$	+0.25	$Au + 4Br^- \rightarrow AuBr_4^- + 3e$	−0.87
$Ag + Br^- \rightarrow AgBr + 1e$	−0.095	$Au + 2Br^- \rightarrow AuBr_2^- + 1e$	−0.96
$Cu + Cl^- \rightarrow CuCl + 1e$	−0.137	$Au + 4Cl^- \rightarrow AuCl_4^- + 3e$	−1.00

MISCELLANEOUS OXIDATION-REDUCTION COUPLES IN BASIC SOLUTIONS

Table 6

Couple	E^0_{ox}
$Ca + 2OH^- \rightarrow Ca(OH)_2 + 2e^-$	+3.03
$Sr + 2OH^- + 8H_2O \rightarrow Sr(OH)_2 \cdot 8H_2O + 2e^-$	+2.99
$Ba + 8H_2O + 2OH^- \rightarrow Ba(OH) \cdot 8H_2O + 2e^-$	+2.97
$Mg + 2OH^- \rightarrow Mg(OH)_2 + 2e^-$	+2.69
$Al + 4OH^- \rightarrow H_2AlO_3^- + H_2O + 3e^-$	+2.35
$Mn + 2OH^- \rightarrow Mn(OH)_2 + 2e^-$	+1.55
$Zn + S^{--} \rightarrow ZnS + 2e^-$	+1.44
$Zn + 4CN^- \rightarrow Zn(CN)_4^{--} + 2e^-$	+1.26
$Zn + 4OH^- \rightarrow ZnO_2^{--} + 2H_2O + 2e^-$	+1.216
$Cd + S^{--} \rightarrow CdS + 2e^-$	+1.21
$Zn + CO_3^{--} \rightarrow ZnCO_3 + 2e^-$	+1.06
$Zn + 4NH_3 \rightarrow Zn(NH_3)_4^{++} + 2e^-$	+1.03
$Pb + S^{--} \rightarrow PbS + 2e^-$	+0.95
$Fe + 2OH^- \rightarrow Fe(OH)_2 + 2e^-$	+0.877
$Cd + 2OH^- \rightarrow Cd(OH)_2 + 2e^-$	+0.809
$2Ag + S^{--} \rightarrow Ag_2S + 2e^-$	+0.69
$Fe(OH)_2 + OH^- \rightarrow Fe(OH)_3 + e^-$	+0.56
$S^{--} \rightarrow S + 2e^-$	+0.48
$Ag + 2CN^- \rightarrow Ag(CN)_2^- + e^-$	+0.31
$Cu + 2NH_3 \rightarrow Cu(NH_3)_2^+ + e^-$	+0.12
$Mn(OH)_2 \rightarrow Mn(OH)_3 + e^-$	−0.1
$2Ag + 2OH^- \rightarrow Ag_2O + H_2O + 2e^-$	−0.344
$Ag + 2NH_3 \rightarrow Ag(NH_3)_2^+ + 2e^-$	−0.373

SOLUBILITY OF CANE SUGAR IN WATER

Grams of sugar in 100 grams of water, temperature in degrees Centigrade.

	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
$C_{12}H_{22}O_{11}$........	179.2	190.5	203.9	219.5	238.1	260.4	287.3	320.5	362.1	415.7	487.2

The values below give the per cent by weight of sugar in the final solution:

Temp., °C.	Per cent sugar	Temp., °C.	Per cent sugar	Temp., °C.	Per cent sugar
0	64.18	35	69.55	70	76.22
5	64.87	40	70.42	75	77.27
10	65.58	45	71.32	80	78.36
15	66.53	50	72.25	85	79.46
20	67.09	55	73.20	90	80.61
25	67.89	60	74.18	95	81.77
30	68.80	65	75.88	100	82.97

POTENTIALS OF ELECTROCHEMICAL REACTIONS AT 25° C

Compiled by Thomas De Vries

The reactions are alphabetically arranged according to the main element or radical in the reaction. A positive potential means that the reaction $M + H^{+} \rightarrow M^{+} + \frac{1}{2}H_2$ is spontaneous and that the cell M, M^{+}: H^{+}, H_2 has a positive potential.

Reaction	Potential, volts
$Ag=Ag^{+}+e$	−0.7996
$Ag^{+}=Ag^{++}+e$(4 m $HClO_4$)	−1.987
$Ag+Br^{-}=AgBr+e$	−0.0713
$Ag+BrO_3^{-}=AgBrO_3+e$	−0.680
$Ag+C_2H_3O_2^{-}=AgC_2H_3O_2+e$	−0.64
$Ag+Cl^{-}=AgCl+e$	−0.2221
$Ag+CN^{-}=AgCN+e$	+0.04
$Ag+2CN^{-}=Ag(CN)+2e$	+0.395
$Ag+Ag(CN)_2^{-}=Ag(Ag(CN)_2)+e$	+0.152
$Ag+CNS^{-}=AgCNS+e$	−0.0947
$Ag+CNO^{-}=AgCNO+e$	−0.41
$2Ag+CO_3^{--}=Ag_2CO+2e$	−0.4769
$2Ag+C_2O_4^{--}=AgC_2O_4+2e$	−0.4725
$2Ag+CrO_4^{--}=Ag_2CrO_4+2e$	−0.4463
$4Ag+Fe(CN)_6^{----}=Ag_4Fe(CN)_6+4e$	+0.1943
$Ag+I^{-}+AgI+e$	+0.1519
$Ag+IO_3^{-}+AgIO_3+e$	−0.3551
$2Ag+MoO_4^{--}=Ag_2MoO_4+2e$	−0.49
$Ag+HN_3=AgN_3+H^{+}+e$	−0.2912
$Ag+2NH_3(aq)=Ag(NH_3)_2^{+}+e$	−0.373
$Ag+NO_2^{-}=AgNO_2+e$	−0.59
$2Ag+2OH^{-}=Ag_2O+H_2O+2e$	−0.344
$2Ag+S^{--}=Ag_2S+2e$	+0.7051
$2Ag+H_2S(g)=Ag_2S+2H^{+}+2e$	+0.0366
$2Ag+SO_4^{--}=Ag_2SO_4+2e$	−0.653
$2Ag+WO_4^{--}=Ag_2WO_4+2e$	−0.53
$Al=Al^{+++}+3e$	+1.67
$Al(Hg)+3OH^{-}=Al(OH)_3+3e$	+1.62
$Al+6F^{-}=AlF_6^{---}+3e$	+2.13
$As+2H_2O=HAsO_2+3H^{+}+3e$	−0.2475
$As+4OH^{-}=AsO_2^{-}+2H_2O+3e$	+0.68
$As+3H_2O=As_2O_3+6H^{+}+6e$	−0.2340
$HAsO_2+2H_2O=H_3AsO_4+2H^{+}+2e$(1 m HCl)	−0.58
$AsO_2^{-}+4OH^{-}=AsO_4^{---}+2H_2O+2e$(1 m NaOH)	+0.08
$Au=Au^{+++}+3e$	−1.42
$Au+2Br^{-}=AuBr_2^{-}+e$	−0.96
$Au+4Br^{-}=AuBr_4^{-}+3e$	−0.87
$Au+4Cl^{-}=AuCl_4^{-}+3e$	−1.00
$Au+2CN^{-}=Au(CN)_2^{-}+e$	+0.60
$Au+2CNS^{-}=Au(CNS)_2^{-}+e$	−0.69
$Au+I^{-}=AuI+e$	−0.50
$Ba=Ba^{++}+2e$	+2.90
$Ba(Hg)=Ba^{++}+2e$	+1.5700
$Be=Be^{++}+2e$	+1.70
$Bi=Bi^{+++}+3e$	−0.277
$Bi+4Cl^{-}=BiCl_4^{-}+3e$	−0.1678
$Bi+Cl^{-}+H_2O=BiOCl+2H^{+}+3e$	−0.1583
$2Br^{-}=Br_2(1)+2e$	−1.0650
$2Br^{-}=Br_2(aq)+2e$	−1.087
$3Br^{-}=Br_3^{-}+3e$	−1.05
$Br^{-}+Cl^{-}=BrCl(g)+2e$	−1.20
$Br^{-}+\frac{1}{2}I_2=BrI(aq)+e$	−1.02
$Br^{-}+2OH^{-}=BrO^{-}+H_2O+e$(1 m NaOH)	−0.70
$Br+3H_2O=BrO_3^{-}+6H^{+}+6e$	−1.44
$Br^{-}+6OH^{-}=BrO_3^{-}+3H_2O+6e$	−0.61
$BrO^{-}+4OH^{-}=BrO_3^{-}+2H_2O+4e$	−0.54
$C_6H_4(OH)_2=C_6H_4O_2+2H^{+}+2e$	−0.6992
$Ca=Ca^{++}+2e$	+2.76
Calomel electrode, sat. KCl	−0.2415
Calomel electrode, normal KCl	−0.2807
Calomel electrode, molal KCl	−0.2800
Calomel electrode, 0.1 n KCl	−0.3337
Calomel electrodes used with buffers add −0.0028 to above values.	
$Cb^{+++}+H_2O=CbO^{+++}+2H^{+}+2e$(6 m HCl)	−0.344
$Cd=Cd^{++}+2e$	+0.4020
$Cd(Hg)=Cd^{++}+2e$	+0.3519
$Cd+CO_3^{--}=CdCO_3+2e$	+0.80
$Cd+4NH_3(aq)=Cd(NH_3)_4^{++}+2e$	+0.597
$Cd(Hg)+2OH^{-}=Cd(OH)_2+2e$	+0.761
$Cd(Hg)+CdSO_4$(sat'd-aq)$=CdSO_4\cdot\frac{8}{3}H_2O+2e$	+0.4346
$Ce(Hg)=Ce^{+++}+3e$	+1.4373
$Ce^{+++}+H_2O=CeOH^{+++}+H^{+}+e$	−1.7134
$2Cl^{-}=Cl_2(g)+2e$	−1.3583
$Cl^{-}+H_2O=HClO+H^{+}+2e$	−1.49
$Cl^{-}+2OH^{-}=ClO^{-}+2H_2O+2e$	−0.94
$Cl^{-}+2H_2O=HClO_2+3H^{+}+4e$	−1.57
$Cl^{-}+4OH^{-}=ClO_2^{-}+2H_2O+4e$	−0.77
$Cl^{-}+3H_2O=ClO_3^{-}+6H^{+}+6e$	−1.48
$Cl^{-}+4H_2O=ClO_4^{-}+8H^{+}+8e$	−1.36
$Cl^{-}+\frac{1}{2}I_2=ICl(aq)+e$	−1.19
$2HCN=C_2N_2(g)+2H^{+}+2e$	−0.33
$Co=Co^{++}+2e$	+0.277
$Co^{++}=Co^{+++}+e$(3 m HNO_3)	−1.842
$Co(CN)_6^{----}=Co(CN)_6^{---}+e$	+0.83
$Cr=Cr^{++}+2e$	+0.557
$Cr^{++}=Cr^{+++}+e$	+0.40
$Cr^{+++}+4H_2O=HCrO_4^{-}+7H^{+}+3e$	−1.195
$Cr^{+++}=Cr_2O_7^{--}+3e$(2 m H_2SO_4)	−1.10
$Cr^{+++}=CrO_4^{--}+3e$(1 m NaOH)	+0.12
$Cs=Cs^{+}+e$	+2.923
$Cu=Cu^{+}+e$	−0.522
$Cu=Cu^{++}+2e$	−0.3460
$Cu(Hg)=Cu^{++}+2e$	−0.3511
$Cu^{+}=Cu^{++}+e$	−0.170
$Cu+Br^{-}=CuBr+e$	−0.033
$Cu+Cl^{-}=CuCl+e$	−0.1287
$Cu+I^{-}=CuI+e$	+0.187
$D_2=2D^{+}+2e$	+0.044
$2F^{-}=F_2+2e$	−2.85

POTENTIALS OF ELECTROCHEMICAL REACTIONS AT 25° C (Continued)

Reaction	Potential, volts
$Fe = Fe^{++} + 2e$	+0.441
$Fe^{++} = Fe^{+++} + e$	−0.7701
$Fe(C_{12}H_8N_2)_3{}^{++} = Fe(phenanthroline)_3{}^{+++} + e$	−1.14
$Fe(CN)_6{}^{----} = Fe(CN)_6{}^{---} + e(1\ m\ H_2SO_4)$	−0.69
$Fe(CN)_6{}^{----} = Fe(CN_6{}^{---} + e(.01\ m\ NaOH)$	−0.46
$Ga = Ga^{+++} + 3e$	+0.52
$H_2 = 2H^+ + 2e$	0.0000
$H_2 + 2OH^- = 2H_2O + 2e$	+0.8277
$2Hg = Hg_2{}^{++} + 2e$	−0.7986
$Hg_2{}^{++} = 2Hg^{++} + 2e$	−0.905
$Hg = Hg^{++} + 2e$	−0.852
$2Hg + 2OAc^- = Hg(OAc)_2 + 2e$	−0.5109
$2Hg + 2Br^- = Hg_2Br_2 + 2e$	−0.1396
$2Hg + 2Cl^- = Hg_2Cl_2 + 2e$	−0.2677
$2Hg + CO_3{}^{--} = Hg_2CO_3 + 2e$	−0.32
$2Hg + C_2O_4{}^{--} = Hg_2C_2O_4 + 2e$	−0.4173
$2Hg + 2I^- = Hg_2I_2 + 2e$	+0.0405
$2Hg + 2IO_3{}^- = Hg_2(IO_3)_2 + 2e$	−0.3939
$2Hg + 2OH^- = Hg_2O + H_2O + 2e$	−0.123
$Hg + 2OH^- = HgO + 2H_2O + 2e$	−0.098
$2Hg + H_2PO_4{}^- = Hg_2HPO_4 + H^+ + 2e$	−0.639
$2Hg + SO_4{}^{--} = Hg_2SO_4 + 2e$	−0.6151
$Hg + 4Cl^- = HgCl_4{}^{--} + 2e$	−0.38
$Hg + 4Br^- = HgBr_4{}^{--} + 2e$	−0.21
$Hg + 4I^- = HgI_4{}^{--} + 2e$	+0.04
$Hg + 4CN^- = Hg(CN)_4{}^{--} + 2e$	+0.37
$Hg + 2IO_3{}^- = Hg(IO_3)_2 + 2e$	−0.40
$Hg, HgO, Ba(OH)_2, H_2O$	−0.1462
$Hg, HgO, Ca(OH)_2, H_2O$	−0.1923
$2H_2O = O_2 + 4H^+ + 4e$	−1.229
$H_2O = O(g) + 2H^+ + 2e$	−2.419
$2H_2O = H_2O_2 + 2H^+ + 2e$	−1.77
$H_2O_2 = O_2 + 2H^+ + 2e$	−0 682
$2I^- = I_2 + 2e$	−0.5356
$3I^- = I_3{}^- + 2e$	−0.5355
$I^- + H_2O = HIO + H^+ + 2e$	−0.99
$I^- + 2OH^- = IO^- + H_2O + 2e$	−0.49
$I^- + 3H_2O = IO_3{}^- + 6H^+ + 6e$	−1.085
$2I_2 + 3H_2O = IO_3{}^- + 6H^+ + 6e$	−1.195
$In = In^{+++} + 3e$	+0.340
$Ir + 6Cl^- = IrCl_6{}^{---} + 3e$	−0.72
$IrCl_6{}^{---} = IrCl_6{}^{--} + e$	−0.962
$IrBr_6{}^{---} = IrBr_6{}^{--} + e$	−0.947
$IrI_6{}^{---} = IrI_6{}^{--} + e$	−0.485
$K = K^+ + e$	+2.9241
$Li = Li^+ + e$	+2.9595
$Ma + 4H_2O = MaO_4{}^- + 8H^+ + 7e$	−0.41
$Mg = Mg^{++} + 2e$	+2.375
$Mg + 2OH^- = Mg(OH)_2 + 2e$	+2.67
$Mn = Mn^{++} + 2e$	+1.18
$Mn^{++} = Mn^{+++} + e$	−1.5
$Mn^{++} + 2H_2O = MnO_2 + 4H^+ + 2e$	−1.230
$Mn^{++} + 4H_2O = MnO_4{}^- + 8H^+ + 5e$	−1.50
$MnO_2 + 2H_2O = MnO_4{}^- + 4H^+ + 3e$	−1.68
$MnO_2 + 4OH^- = MnO_4{}^- + 2H_2O + 3e$	−0.58
$MnO_4{}^{--} = MnO_4{}^- + e$	−0.6
$Mn(CN)_6{}^{----} = Mn(CN)_6{}^{---} + e$	+0.22
$Mo(VI) = Mo(V) + e(0.1\ m\ KCl, pH = 3)$	−0.01
$Mo(V) = Mo(III) + 2e(0.1\ m\ KCl, pH = 3)$	+0.34
$Mo(CN)_6{}^{----} = Mo(CN)_6{}^{---} + e$	−0.726
$Na = Na^+ + e$	+2.7132
$Ni = Ni^{++} + 2e$	+0.23
$Ni(CN)_3{}^{--} + CN^- = Ni(CN)_4{}^{--} + e$	+0.82
$NH_3 + 9OH^- = NO_3{}^- + 6H_2O + 8e$	+0.12
$NH_4{}^+ + 2H_2O = HNO_2 + 7H^+ + 6e$	−0.86
$NO_2{}^- + 2OH^- = NO_3{}^- + H_2O + 2e$	0.0
$N_2O_4 + 2H_2O = 2NO_3{}^- + 4H^+ + 2e$	−0.9
$O_2 + H_2O = O_3 + 2H^+ + 2e$	+2.1
$OH^- + HO_2{}^- = O_2 + H_2O + 2e$	+0.075
$3OH^- = HO_2{}^- + H_2O + 2e$	−0.877
$4OH^- = O_2 + 2H_2O + 4e$	−0.401
$P + 2OH^- = H_2PO_2{}^- + e$	+1.82
$H_2PO_2{}^- + 3OH^- = HPO_3{}^{--} + 2H_2O + 2e$	+1.65
$H_3PO_2 + H_2O = H_3PO_3 + 2H^+ + 2e$	+0.59
$Pb = Pb^{++} + 2e$	+0.1263
$Pb + Hg = Pb(Hg)$	+0.0054
$Pb(Hg) + 2Br^- = PbBr_2 + 2e$	+0.275
$Pb(Hg) + 2Cl^- = PbCl_2 + 2e$	+0.2623
$Pb(Hg) + 2F^- = PbF_2 + 2e$	+0.3444
$Pb(Hg) + 2I^- = PbI_2 + 2e$	+0.3580
$Pb(Hg) + 2OH^- = Pb(OH)_2 + 2e$	+0.568
$Pb + 2OH^- = PbO + H_2O + 2e$	+0 576
$Pb + S^{--} = PbS + 2e$	+0.98
$Pb(Hg) + SO_4{}^{--} = PbSO_4 + 2e$	+0.3505
$Pb^{++} + 2H_2O = PbO_2 + 4H^+ + 2e$	−1.46
$PbSO_4 + 2H_2O = PbO_2 + SO_4{}^{--} + 4H^+ + 2e$	−1.685
$Pd = Pd^{++} + 2e(4\ m\ HClO_4)$	−0.987
$Pd + 4Cl^- = PdCl_4{}^{--} + 2e(1\ m\ HCl)$	−0.621
$PdCl_4{}^{--} + 2Cl^- = PdCl_6{}^{--} + 2e$	−1.288
$PdBr_4{}^{--} + 2Br^- = PdBr_6{}^{--} + 2e$	−0.994
$PdI_4{}^{--} + 2I^- = PdI_6{}^{--} + 2e$	−0.482
$PtBr_4{}^{--} + 2Br^- = PtBr_6{}^{--} + 2e$	−0.643
$PtCl_4{}^{--} + 2Cl^- = PtCl_6{}^{--} + 2e$	−0 758
$PtI_4{}^{--} + 2I^- = PtI_6{}^{--} + 2e$	−0.3925
$Pu(III) = Pu(IV) + e$	+0.72
Quinhydrone electrode, H^+, $a = 1$	−0.6992
$Rb = Rb^+ + e$	+2.9259
$Rh^{+++} + H_2O = RhO^{++} + 2H^+ + e$	−1.40
$RhO^{++} + 3H_2O = RhO_4{}^{--} + 6H^+ + 2e$	−1.46
$Ru(III) = Ru(IV) + e(HCl)$	−0.858
$S^{--} = S + 2e$	+0.51
$H_2S = S + 2H^+ + 2e$	−0.141
$S^{--} + 6OH^- = SO_3{}^{--} + 3H_2O + 6e$	+0.61
$H_2SO_3 + H_2O = SO_4{}^{--} + 4H^+ + 2e$	−0.20
$SO_3{}^{--} + 2OH^- = SO_4{}^{--} + H_2O + 2e$	+0.90
$2Sb + 3H_2O = Sb_2O_3 + 6H^+ + 6e$	−0.1445
$Sb + H_2O = SbO^+ + 2H^+ + 3e$	+0.212
$H_3SbO_3 + H_2O = H_3SbO_4 + 2H^+ + 2e$	−0.75
$Se^{--} = Se + 2e$	+0.78
$H_2Se = Se + 2H^+ + 2e$	+0.36
$Se + 3H_2O = H_2SeO_3 + 4H^+ + 4e$	−0.70
$H_2SeO_3 + H_2O = SeO_4{}^{--} + 4H^+ + 2e$	−1.15

POTENTIALS OF ELECTROCHEMICAL REACTIONS AT 25° C (Continued)

Reaction	Potential, volts
$SeO_3^{--}+2OH^-=SeO_4^{--}+H_2O+2e$	−0.03
$Sn=Sn^{++}+2e$	+0.1406
$Sn(II)=Sn(IV)+2e$(0.1 m HCl)	−0.070
$Sn(II)=Sn(IV)+2e$(2 m HCl)	−0.133
$Sr=Sr^{++}+2e$	+2.89
$Sr(Hg)=Sr^{++}+2e$	+1.7932
$Te^{--}=Te+2e$	+0.92
$H_2Te=Te+2H^++2e$	+0.69
$Te=Te^{++++}+4e$	−0.564
$Ti=Ti^{++}+2e$	+1.75
$Ti^{++}=Ti^{+++}+e$	+0.37
$Ti^{+++}+H_2O=TiO^{++}+2H^++e$	−0.04
$Tl=Tl^++e$	+0.3363
$Tl(Hg)=Tl^++e$	+0.3338
$Tl^+=Tl^{+++}+2e$	−1.247
$Tl(I)=Tl(III)+e$(1 m HCl)	−0.783
$Tl(Hg)+Br^-=TlBr+e$	+0.658
$Tl(Hg)+Cl^-=TlCl+e$	+0.555
$Tl(Hg)+I^-=TlI+e$	+0.772
$Tl(Hg)+N_3^-=TlN_3+e$	+0.629
$2Tl(Hg)+SO_4^{--}=Tl_2SO_4+2e$	+0.436
$U+2H_2O=UO_2^{++}+4H^++6e$	+0.82
$U^{+++}=U^{++++}+e$(1 m $HClO_4$)	+0.631
$U^{++++}+2H_2O=UO_2^{++}+4H^++2e$	−0.41
$UO_2^+=UO_2^{++}+e$(1 m $HClO_4$)	−0.063
$V^{++}=V^{+++}+e$	+0.255
$V^{+++}+H_2O=VO^{++}+2H^++2e$	−0.337
$VO^{++}+3H_2O=V(OH)_4^++2H^++e$	−0.9996
$V(IV)=V(V)+e$(1 m HCl)	−1.02
$V(IV)=V(V)+e$(1 m NaOH)	+0.74
$W(CN)_8^{----}=W(CN)_8^{---}+e$	−0.485
$Yb^{++}=Yb^{+++}+e$	−1.15
$Zn=Zn^{++}+2e$	+0.7628
$Zn(Hg)=Zn^{++}+2e$	+0.7628
$Zn+4CN^-=Zn(CN)_4^{--}+2e$	+1.26
$Zn+2OH^-=Zn(OH)_2+2e$	+1.245
$Zn(Hg)+SO_4^{--}$(in sat. $ZnSO_4.7H_2O$) $=ZnSO_4.7H_2O+2e$	+0.7993

DEGREE OF IONIZATION

IN NORMAL SOLUTION AT 18° UNLESS INDICATED

Acids

Nitric acid	0.82
Hydrochloric acid	0.784
Sulfuric acid	0.510
Hydrofluoric acid	0.070
* Oxalic acid	0.500
* Tartaric acid	0.082
Acetic acid	0.004
* Carbonic acid	0.0017
* Hydrogen sulfide	0.0007
* Boric acid	0.0001
* Hydrocyanic acid	0.0001
† Permanganic acid	0.933
† Hydriodic acid	0.901
† Hydrobromic acid	0.899
† Perchloric acid	0.880
† Chloric acid	0.878
† Hydrochloric acid	0.876
† Phosphoric acid	0.170

* In 0.1 M. solution; primary ionization.
† In N/2 solution, at 25°.

Bases

Potassium hydroxide	0.77
Sodium hydroxide	0.73
Barium hydroxide	0.69
Lithium hydroxide	0.63
Ammonium hydroxide	0.004
Tetramethyl ammonium hydroxide	0.96
‡ Strontium hydroxide	0.93
‡ Barium hydroxide	0.92
‡ Calcium hydroxide	0.90

‡ In N/64 solution, at 25°.

Salts

Approximate degree of ionization for active salts in N/10 solution:

Type R^+R^- (e.g. KCl)	0.86
Type R^{++} $(R^-)_2$ (e.g. $BaCl_2$)	0.72
Type $(R^+)_2R^{--}$ (e.g. K_2SO_4)	0.72
Type R^{++} R^{--} (e.g. $CuSO_4$)	0.45

SOLUBILITY PRODUCT

The solubility product (or ion product constant) is the product of the concentrations of the ions in the saturated solution of a difficultly soluble salt. The concentrations are expressed as moles per liter of solution. The number of cations (or anions) resulting from the dissociation of one molecule of the salt, appears in the formula for calculations of the solubility product as the exponent of the concentration of the cation (or anion).

If two solutions, each containing one of the ions of a difficultly soluble salt, are mixed, no precipitation takes place unless the product of the ion concentrations in the mixture is greater than the solubility product.

In a solution containing two salts which yield a common ion the ratio of solubilities of the two salts is the ratio of the solubility products.

Substance	Solubility product at temperature noted
Aluminum hydroxide	4×10^{-13} (15°)
Aluminum hydroxide	1.1×10^{-15} (18°)
Aluminum hydroxide	3.7×10^{-15} (25°)
Barium carbonate	7×10^{-9} (16°)
Barium carbonate	8.1×10^{-9} (25°)
Barium chromate	1.6×10^{-10} (18°)
Barium chromate	2.4×10^{-10} (28°)
Barium fluoride..	1.6×10^{-6} (9.5°)
Barium fluoride..	1.7×10^{-6} (18°)
Barium fluoride..	1.73×10^{-6} (25.8°)
Barium iodate, $Ba(IO_3)_2.2H_2O$	8.4×10^{-11} (10°)
Barium iodate, $Ba(IO_3)_2.2H_2O$	6.5×10^{-10} (25°)
Barium oxalate, $BaC_2O_4.3\frac{1}{2}H_2O$	1.62×10^{-7} (18°)
Barium oxalate, $BaC_2O_4.2H_2O$	1.2×10^{-7} (18°)
Barium oxalate, $BaC_2O_4.\frac{1}{2}H_2O$	2.18×10^{-7} (18°)
Barium sulfate...	0.87×10^{-10} (18°)
Barium sulfate...	1.08×10^{-10} (25°)
Barium sulfate...	1.98×10^{-10} (50°)
Cadmium oxalate $CdC_2O_4.3H_2O$	1.53×10^{-8} (18°)
Cadmium sulfide.	3.6×10^{-29} (18°)
Calcium carbonate (calcite)	0.99×10^{-8} (15°)
Calcium carbonate (calcite)	0.87×10^{-8} (25°)
Calcium fluoride	3.4×10^{-11} (18°)
Calcium fluoride	3.95×10^{-11} (26°)
Calcium iodate, $Ca(IO_3)_2.6H_2O$	22.2×10^{-8} (10°)
Calcium iodate, $Ca(IO_3)_2.6H_2O$	64.4×10^{-8} (18°)
Calcium oxalate, $CaC_2O_4.H_2O$	1.78×10^{-9} (18°)
Calcium oxalate, $CaC_2O_4.H_2O$	2.57×10^{-9} (25°)
Calcium sulfate..	1.95×10^{-4} (10°)
Calcium tartrate, $CaC_4H_4O_6.2H_2O$	0.77×10^{-6} (18°)
Cobalt sulfide....	3×10^{-26} (18°)
Cupric iodate....	1.4×10^{-7} (25°)
Cupric oxalate...	2.87×10^{-8} (25°)
Cupric sulfide....	8.5×10^{-45} (18°)
Cuprous bromide.	4.15×10^{-8} (18–20°)
Cuprous chloride.	1.02×10^{-6} (18–20°)
Cuprous iodide...	5.06×10^{-12} (18–20°)
Cuprous sulfide ..	2×10^{-47} (16–18°)
Cuprous thiocyanate	1.6×10^{-11} (18°)
Ferric hydroxide .	1.1×10^{-36} (18°)
Ferrous hydroxide	1.64×10^{-14} (18°)
Ferrous oxalate ..	2.1×10^{-7} (25°)
Ferrous sulfide...	3.7×10^{-19} (18°)
Lead carbonate ..	3.3×10^{-14} (18°)
Lead chromate...	1.77×10^{-14} (18°)
Lead fluoride	2.7×10^{-8} (9°)
Lead fluoride	3.2×10^{-8} (18°)
Lead fluoride	3.7×10^{-8} (26.6°)
Lead iodate......	5.3×10^{-14} (9.2°)
Lead iodate......	1.2×10^{-13} (18°)
Lead iodate......	2.6×10^{-13} (25.8°)
Lead iodide......	7.47×10^{-9} (15°)
Lead iodide......	1.39×10^{-8} (25°)
Lead oxalate.....	2.74×10^{-11} (18°)
Lead sulfate.....	1.06×10^{-8} (18°)
Lead sulfide	3.4×10^{-28} (18°)
Lithium carbonate	1.7×10^{-3} (25°)
Magnesium ammonium phosphate	2.5×10^{-13} (25°)

SOLUBILITY PRODUCT (Continued)

Substance	Solubility product at temperature noted
Magnesium carbonate	2.6×10^{-5} (12°)
Magnesium fluoride	7.1×10^{-9} (18°)
Magnesium fluoride	6.4×10^{-9} (27°)
Magnesium hydroxide	1.2×10^{-11} (18°)
Magnesium oxalate	8.57×10^{-5} (18°)
Manganese hydroxide	4×10^{-14} (18°)
Manganese sulfide	1.4×10^{-15} (18°)
Mercuric sulfide.	4×10^{-53} to 2×10^{-49} (18°)
Mercurous bromide	1.3×10^{-21} (25°)
Mercurous chloride	2×10^{-18} (25°)
Mercurous iodide	1.2×10^{-28} (25°)
Nickel sulfide....	1.4×10^{-24} (18°)
Potassium acid tartrate $[K^+][HC_4H_4O_6^-]$	3.8×10^{-4} (18°)
Silver bromate...	3.97×10^{-5} (20°)
Silver bromate...	5.77×10^{-5} (25°)
Silver bromide...	4.1×10^{-13} (18°)
Silver bromide...	7.7×10^{-13} (25°)
Silver carbonate.	6.15×10^{-12} (25°)
Silver chloride...	0.21×10^{-10} (4.7°)
Silver chloride...	0.37×10^{-10} (9.7°)
Silver chloride...	1.56×10^{-10} (25°)
Silver chloride...	13.2×10^{-10} (50°)
Silver chloride...	215×10^{-10} (100°)
Silver chromate..	1.2×10^{-12} (14.8°)
Silver chromate..	9×10^{-12} (25°)
Silver cyanide $[Ag^+][Ag(CN)^-_2]$	2.2×10^{-12} (20°)
Silver dichromate	2×10^{-7} (25°)
Silver hydroxide.	1.52×10^{-8} (20°)
Silver iodate.....	0.92×10^{-8} (9.4°)
Silver iodide.....	0.32×10^{-16} (13°)
Silver iodide.....	1.5×10^{-16} (25°)
Silver sulfide....	1.6×10^{-49} (18°)
Silver thiocyanate	0.49×10^{-12} (18°)
Silver thiocyanate	1.16×10^{-12} (25°)
Strontium carbonate	1.6×10^{-9} (25°)
Strontium fluoride	2.8×10^{-9} (18°)
Strontium oxalate	5.61×10^{-8} (18°)
Strontium sulfate	2.77×10^{-7} (2.9°)
Strontium sulfate	3.81×10^{-7} (17.4°)
Zinc hydroxide..	1.8×10^{-14} (18–20°)
Zinc oxalate, $ZnC_2O_4.2H_2O$	1.35×10^{-9} (18°)
Zinc sulfide......	1.2×10^{-23} (18°)

TABLE FOR TRANSFORMING EXPRESSION OF RESULTS OF WATER ANALYSIS

Compiled by Dr. R. E. Brewer. (Based on Equivalents of $CaCO_3$)

	Parts per 1,000,000	Parts per 100,000	mg per l	g per l	Grains per U. S. gal.	Grains per Eng. gal.	English or Clark degrees	French degrees	German degrees
p.p.m.	1	0.10	1.0	0.001	0.0583*	0.07	0.07	0.10	0.056
mg/l	1	0.10	1.0	0.001	0.0583	0.07	0.07	0.10	0.056
p./100,000	10	1.00	10.0	0.010	0.583	0.70	0.70	1.00	0.560
French degrees	10	1.00	10.0	0.010	0.583	0.70	0.70	1.00	0.560
g/l	1000	100.0	1000.0	1.000	58.300	70.00	70.00	100.00	56.000
Gr./U. S. gal	17.1	1.71	17.1	0.0171	1.000	1.2	1.2	1.71	0.958
Gr./Eng. gal	14.3	1.43	14.3	0.0143	0.829	1.00	1.00	1.43	0.80
Clark degrees	14.3	1.43	14.3	0.0143	0.829	1.00	1.00	1.43	0.80
German degrees	17.8	1.78	17.8	0.0178	1.044	1.24	1.24	1.78	1.00

*Variously reported.

DISSOCIATION CONSTANTS OF BASES IN AQUEOUS SOLUTIONS

Substance	K_a	pK_a	t°C.
2-Amino-pyridine	7.25×10^{-8}	7.14	25
Aniline	2.63×10^{-5}	4.58	25
o-Anisidine	3.24×10^{-5}	4.49	25
m-Anisidine	6.31×10^{-5}	4.20	25
p-Anisidine	5.13×10^{-6}	5.29	25
Atebrin pK_1	1.32×10^{-4}	3.88	20
Atebrin pK_2	3.39×10^{-7}	6.47	20
n-Butylamine	2.45×10^{-11}	10.61	25
1-Butylpiperidine	3.31×10^{-11}	10.48	25
p-Chloraniline	8.51×10^{-5}	4.07	25
Crystal violet	4.37×10^{-10}	9.36	25
Cyclohexylamine	2.29×10^{-11}	10.64	25
αω-Diaminopentane	1.66×10^{-11}	10.78	25
Diethanolamine	1.32×10^{-9}	8.88	25
Diethylamine	1×10^{-12}	11.00	25
Dimethylamine	2.00×10^{-11}	10.70	25
N-Dimethylaniline	6.17×10^{-6}	5.21	25
1:2 Dimethylpiperidine	5.50×10^{-11}	10.26	25
N-Dimethyl-*o*-toluidine	1.38×10^{-6}	5.86	25
1:2 Dimethyl-tetra-hydro-pyridine	3.80×10^{-12}	11.42	25
Diphenylamine	1.41×10^{-1}	0.85	20
Ethanolamine	3.63×10^{-10}	9.44	25
Ethylamine	2.14×10^{-11}	10.67	25
N-Ethylaniline	7.76×10^{-6}	5.11	25
1-Ethylpiperidine	3.89×10^{-11}	10.41	25
iso-Amylamine	2.51×10^{-11}	10.60	25
iso-Butylamine	3.80×10^{-11}	10.42	25
iso-Propylamine	2.34×10^{-11}	10.63	25
Methylamine	2.29×10^{-11}	10.64	25
N-Methylaniline	1.41×10^{-5}	4.85	25
N-Methylpyrrolidine	1.48×10^{-4}	3.83	25
N-Methyl-*o*-toluidine	2.57×10^{-5}	4.59	25
N-Methyl-*m*-toluidine	1.15×10^{-5}	4.94	25
N-Methyl-*p*-toluidine	4.68×10^{-6}	5.33	25
α-Naphthylamine	1.21×10^{-4}	3.92	25
β-Naphthylamine	7.76×10^{-5}	4.11	25
Piperidine	7.59×10^{-12}	11.12	25
Pyridine	6.46×10^{-6}	5.19	25
Pyrrole	3.98×10^{-1}	0.4	20
Pyrrolidine	1.26×10^{-3}	2.90	25
Propylamine	2.63×10^{-11}	10.58	25
Propylpiperidine	5.89×10^{-11}	10.23	25
Quinine pK_1	2.0×10^{-6}	5.70	20
Quinine pK_2	1.35×10^{-10}	9.87	20
Quinoline	8.71×10^{-6}	5.06	25
o-Toluidine	4.08×10^{-5}	4.39	25
m-Toluidine	2.04×10^{-5}	4.69	25
p-Toluidine	8.51×10^{-6}	5.07	25
Triethanolamine	1.70×10^{-8}	7.77	25
Triethylamine	1.91×10^{-11}	10.72	25
Trimethylamine	1.59×10^{-10}	9.80	25

DISSOCIATION CONSTANTS (K_b) OF AQUEOUS AMMONIA FROM 0 TO 50°C.

Temperature °C.	pK_b	K_b
0	4.862	1.374×10^{-5}
5	4.830	1.479×10^{-5}
10	4.804	1.570×10^{-5}
15	4.782	1.652×10^{-5}
20	4.767	1.710×10^{-5}
25	4.751	1.774×10^{-5}
30	4.740	1.820×10^{-5}
35	4.733	1.849×10^{-5}
40	4.730	1.862×10^{-5}
45	4.726	1.879×10^{-5}
50	4.723	1.892×10^{-5}

Values of K_b accurate to ±0.005; determined by e.m.f. method by: R. G. Bates and G. D. Pinching, J. Am. Chem. Soc., 1950, **72**, 1393.

IONIZATION CONSTANT FOR WATER (K_w)

$-\log_{10} K_w$	Temperature °C.	$-\log_{10} K_w$	Temperature °C.
14.9435	0	13.8330	30
14.7338	5	13.6801	35
14.5346	10	13.5348	40
14.3463	15	13.3960	45
14.1669	20	13.2617	50
14.0000	24	13.1369	55
13.9965	25	13.0171	60

DISSOCIATION CONSTANTS OF ACIDS IN AQUEOUS SOLUTIONS

Acid	Formula	Constant for the first hydrogen	Temp. °C.	Constant for the second hydrogen	Temp. °C.
Acetic	$C_2H_4O_2$	1.753×10^{-5}	25		
Acrylic	$C_3H_4O_2$	5.50×10^{-5}	25		
Adipic	$C_6H_{10}O_4$	3.72×10^{-5}	25		
α-Alanine	$C_3H_7O_2N$	9×10^{-10}	25		
Arsenic	H_3AsO_4	5.62×10^{-3}	18	1.70×10^{-7}	18
				2.95×10^{-12}	18
Arsenious	$HAsO_2$	6×10^{-10}	25		
Barbituric	$C_4H_4O_3N$	1.05×10^{-4}	25		
Benzoic	$C_7H_6O_2$	6.30×10^{-5}	25		
Boric	H_3BO_3	6.4×10^{-10}	25		
Bromacetic	$C_2H_3O_2Br$	1.38×10^{-3}	25		
o-Bromobenzoic	$C_7H_5O_2Br$	1.40×10^{-3}	25		
p-Bromobenzoic	$C_7H_5O_2Br$	1.07×10^{-4}	25		
o-Bromophenylacetic	$C_8H_7O_2Br$	8.84×10^{-5}	25		
p-Bromophenylacetic	$C_8H_7O_2Br$	6.49×10^{-5}	25		
α-Brompropionic	$C_3H_5O_2Br$	1.08×10^{-3}	25		
β-Brompropionic	$C_3H_5O_2Br$	9.8×10^{-5}	25		
Butyric	$C_4H_8O_2$	1.48×10^{-5}	25		
n-Butyric	$C_4H_8O_2$	1.506×10^{-5}	25		
Carbonic	H_2CO_3	4.31×10^{-7}	18	4.4×10^{-11}	25
Chloracetic	$C_2H_3O_2Cl$	1.4×10^{-3}	25		
Chloracetic, mono-	$C_2H_3O_2Cl$	1.396×10^{-3}	25		
o-Chlorobenzoic	$C_7H_5O_2Cl$	1.197×10^{-3}	25		
m-Chlorobenzoic	$C_7H_5O_2Cl$	1.506×10^{-4}	25		
p-Chlorobenzoic	$C_7H_5O_2Cl$	1.04×10^{-4}	25		
o-Chlorophenylacetic	$C_8H_7O_2Cl$	8.60×10^{-5}	25		
m-Chlorophenylacetic	$C_8H_7O_2Cl$	7.24×10^{-5}	25		
p-Chlorophenylacetic	$C_8H_7O_2Cl$	6.45×10^{-5}	25		
α-Chlorpropionic	$C_3H_5O_2Cl$	1.47×10^{-3}	25		
β-Chlorpropionic	$C_3H_5O_2Cl$	8.59×10^{-5}	25		
Citric	$C_6H_8O_7$	8.4×10^{-4}	25	1.8×10^{-5}	
				4×10^{-6} (3H)	
Dichloracetic	$C_2H_2O_2Cl_2$	5×10^{-2}	25		
Diethylmalonic	$C_7H_{12}O_4$	7.08×10^{-4}	25		
Dimethylmalonic	$C_5H_8O_4$	7.06×10^{-4}	25		
Di-*n*-propylmalonic	$C_9H_{16}O_4$	9.2×10^{-4}	25		
Ethylmalonic	$C_5H_8O_4$	1.09×10^{-4}	25		
Ethyl-n-propylmalonic	$C_8H_{14}O_4$	7.84×10^{-4}	25		
p-Fluorobenzoic	$C_7H_5O_2F$	7.22×10^{-5}	25		
Formic	CH_2O_2	1.76×10^{-4}	25		
Fumaric	$C_4H_4O_4$	1×10^{-3}	25	3×10^{-5}	25
Glutaric	$C_5H_8O_4$	4.54×10^{-5}	25		
Hippuric	$C_9H_9O_3N$	2.3×10^{-4}	25		
Hydrocyanic	CHN	7.2×10^{-10}	25		
Hydroquinone	$C_6H_6O_2$	1.1×10^{-10}	18		
Hydrosulfuric	H_2S	9.1×10^{-8}	18	1.2×10^{-15}	
Hydrazoic	HN_3	1.9×10^{-5}	25		
Hypochlorous	$HOCl$	3.7×10^{-8}	17		
Iodic	HIO_3	1.9×10^{-1}	25		
p-Iodophenylacetic	$C_8H_7O_2I$	6.64×10^{-5}	25		
Isobutyric	$C_4H_8O_2$	1.5×10^{-5}	25		
Isovaleric	$C_5H_{10}O_2$	1.7×10^{-5}	25		
Lactic	$C_3H_6O_3$	1.387×10^{-4}	25		
Maleic	$C_4H_4O_4$	1.5×10^{-2}	25	1.3×10^{-6}	25

DISSOCIATION CONSTANTS OF ACIDS IN AQUEOUS SOLUTIONS (Continued)

Acid	Formula	Constant for the first hydrogen	Temp. °C.	Constant for the second hydrogen	Temp. °C.
Malic	$C_4H_6O_5$	4×10^{-4}	25	9×10^{-6}	25
Malonic	$C_3H_4O_4$	1.397×10^{-3}	25	2.1×10^{-6}	25
Mandelic	$C_8H_8O_3$	4.29×10^{-4}	25		
p-Methoxyphenylacetic	$C_9H_{10}O_3$	4.36×10^{-5}	25		
Methylethylmalonic	$C_6H_{10}O_4$	1.54×10^{-4}	25		
Methylmalonic	$C_4H_6O_4$	8.47×10^{-5}	25		
α-Naphthoic	$C_{11}H_8O_2$	2×10^{-4}	25		
β-Naphthoic	$C_{11}H_8O_2$	6.8×10^{-5}	25		
Nicotinic	$C_6H_5O_2N$	1.4×10^{-5}	25		
Nitrous	HNO_2	4×10^{-4}	18		
Oxalic	$H_2C_2O_4$	6.5×10^{-2}	25	6.1×10^{-5}	25
Periodic	HIO_4	2.3×10^{-2}	25		
Phenol	C_6H_6O	1.3×10^{-10}	25		
Phenylacetic	$C_8H_8O_2$	4.88×10^{-5}	25		
Phenylmalonic	$C_9H_9O_4$	2.77×10^{-3}	25		
Phosphoric	H_3PO_4	1.1×10^{-2}	18	7.5×10^{-8}	18
				4.8×10^{-13} (3H)	18
Phosphorous	H_3PO_3	7×10^{-3}	25	2×10^{-5}	25
Phthalic	$C_8H_6O_4$	1.26×10^{-3}	25	3.1×10^{-6}	25
Picolinic	$C_6H_5O_2N$	3×10^{-6}	25		
Picric	$C_6H_3O_7N_3$	1.6×10^{-1}	18		
Pimelic	$C_7H_{12}O_4$	3.10×10^{-5}	25		
Propionic	$C_3H_6O_2$	1.343×10^{-5}	25		
n-Propylmalonic	$C_6H_{10}O_4$	1.03×10^{-4}	25		
Pyromucic (furoic)	$C_5H_4O_3$	7.1×10^{-4}	25		
Pyrophosphoric	$H_4P_2O_7$	1.4×10^{-1}	18	1.1×10^{-2}	18
				2.9×10^{-7} (3H)	18
				3.6×10^{-9} (4H)	18
Pyrotartaric	$C_5H_8O_4$	8.7×10^{-5}	25		
Salicylic	$C_7H_6O_3$	1.06×10^{-3}	25	1×10^{-13}	20
Selenious	H_2SeO_3	3×10^{-3}	25	5×10^{-8}	25
Suberic	$C_8H_{14}O_4$	2.99×10^{-5}	25		
Succinic	$C_4H_6O_4$	6.63×10^{-5}	25	2.8×10^{-6}	25
Sulfanilic	$C_6H_7O_3NS$	6.2×10^{-4}			
Sulfuric	H_2SO_4	....	....	2×10^{-2}	18
Sulfurous	H_2SO_3	1.7×10^{-2}	25	6.24×10^{-8}	25
Tartaric	$C_4H_6O_6$	1.1×10^{-3}	25	6.9×10^{-5}	25
Telluric	H_2TeO_4	6×10^{-7}	25	4×10^{-11}	25
Tellurous	H_2TeO_3	3×10^{-3}	25	2×10^{-8}	25
Trichloracetic	$C_2HO_2Cl_3$	2×10^{-1}	18		
Uric	$C_5H_4O_3N_4$	1.5×10^{-6}	25		
Valeric	$C_5H_{10}O_2$	1.6×10^{-5}	25		

IONIZATION CONSTANTS OF ACIDS

Acids		0°	5°	10°	15°
Formic	$K_A \cdot 10^4$	1.638	1.691	1.728	1.749
Acetic	$K_A \cdot 10^5$	1.657	1.700	1.729	1.745
Propionic	$K_A \cdot 10^5$	1.274	1.305	1.326	1.336
n-Butyric	$K_A \cdot 10^5$	1.563	1.574	1.576	1.569
Chloracetic	$K_A \cdot 10^3$	1.528	....	1.488	....
Lactic	$K_A \cdot 10^4$	1.287	....	....	....
Glycollic	$K_A \cdot 10^4$	1.334	....	....	....
Oxalic	$K_{2A} \cdot 10^5$	5.91	5.82	5.70	5.55
Malonic	$K_{2A} \cdot 10^6$	2.140	2.165	2.152	2.124
Phosphoric	$K_A \cdot 10^3$	8.968	....	....	....
Phosphoric	$K_{2A} \cdot 10^8$	4.85	5.24	5.57	5.89
Boric	$K_A \cdot 10^{10}$	....	3.63	4.17	4.72
Carbonic	$K_{1A} \cdot 10^7$	2.64	3.04	3.44	3.81
Phenol-sulfonic	$K_{2A} \cdot 10^{10}$	4.45	5.20	6.03	6.92
Glycine	$K_{1A} \cdot 10^7$	....	3.82	3.99	4.17
Citric	$K_{1A} \cdot 10^4$	6.03	6.31	6.69	6.92
	$K_{2A} \cdot 10^5$	1.45	1.54	1.60	1.65
	$K_{3A} \cdot 10^7$	4.05	4.11	4.14	4.13

Reproducibility between various workers is about ± $(0.01 - 0.02).10^5$.
All values are on the m-scale.

IN WATER AT VARIOUS TEMPERATURES

20°	25°	30°	35°	40°	45°	50°
1.765	1.772	1.768	1.747	1.716	1.685	1.650
1.753	1.754	1.750	1.728	1.703	1.670	1.633
1.338	1.336	1.326	1.310	1.280	1.257	1.229
1.542	1.515	1.484	1.439	1.395	1.347	1.302
....	1.379	....	....	1.230	....	....
....	1.374	....	....	....	....	1.270
....	1.475	....	....	....	....	1.415
5.40	5.18	4.92	4.67	4.41	4.09	3.83
2.076	2.014	1.948	1.863	1.768	1.670	1.575
....	7.516	....	....	....	....	5.495
6.12	6.34	6.46	6.53	6.58	6.59	6.55
5.26	5.79	6.34	6.86	7.38	....	8.32
4.16	4.45	4.71	4.90	5.04	5.13	5.19
7.85	8.85	9.89	10.94	12.00	13.09	14.16
4.32	4.46	4.57	4.66	4.73	4.77	4.79
7.21	7.45	7.66	7.78	7.96	7.99	8.04
1.70	1.73	1.76	1.77	1.78	1.76	1.75
4.09	4.02	3.99	3.78	3.69	3.45	3.28

PROPERTIES OF THE AMINO ACIDS

Compiled by M. S. Dunn
with the cooperation of Frank J. Ross and M. Palmer Stoddard

Data are given in the following tables for the DL, D, and L, forms of the amino acids which are considered to be constituents of native proteins. All of the naturally occurring forms of the amino acids have the "*l*" configuration around the alpha carbon atom. The values quoted are those considered to be most reliable.

Composition of the Amino Acids*

The molecular weights and percentage composition of the amino acids given in the following table were calculated from the 1939 International Atomic Weights.

Amino acid	Empirical formula	Molecular weight	Percentage Composition			
			Carbon	Hydrogen	Oxygen	Nitrogen
Alanine	$C_3H_7O_2N$	89.095	40.440	7.920	35.917	15.723
Arginine	$C_6H_{14}O_2N_4$	174.205	41.365	8.102	18.369	32.164
Aspartic acid	$C_4H_7O_4N$	133.105	36.092	5.302	48.082	10.524
Cystine[1]	$C_6H_{12}O_4N_2S_2$	240.29	29.989	5.034	26.634	11.659
Diiodotyrosine[2]	$C_9H_9O_3NI_2$	433.01	24.962	2.095	11.085	3.235
Glutamic acid	$C_5H_9O_4N$	147.131	40.814	6.167	43.499	9.521
Glycine	$C_2H_5O_2N$	75.068	31.998	6.715	42.628	18.660
Histidine	$C_6H_9O_2N_3$	155.157	46.443	5.848	20.624	27.085
Hydroxyproline	$C_5H_9O_3N$	131.131	45.794	6.919	36.605	10.682
Isoleucine	$C_6H_{13}O_2N$	131.173	54.935	9.991	24.395	10.679
Leucine	$C_6H_{13}O_2N$	131.173	54.935	9.991	24.395	10.679
Lysine	$C_6H_{14}O_2N_2$	146.189	49.292	9.654	21.889	19.164
Methionine[3]	$C_5H_{11}O_2NS$	149.21	40.245	7.432	21.446	9.388
Phenylalanine	$C_9H_{11}O_2N$	165.187	65.435	6.713	19.372	8.480
Proline	$C_5H_9O_2N$	115.131	52.158	7.881	27.794	12.167
Serine	$C_3H_7O_3N$	105.095	34.283	6.715	45.673	13.329
Threonine	$C_4H_9O_3N$	119.121	40.329	7.617	40.295	11.759
Thyroxine[4]	$C_{15}H_{11}O_4NI_4$	776.927	23.188	1.427	8.238	1.803
Tryptophan	$C_{11}H_{12}O_2N_2$	204.223	64.689	5.926	15.669	13.718
Tyrosine	$C_9H_{11}O_3N$	181.187	59.657	6.120	26.492	7.731
Valine	$C_5H_{11}O_2N$	117.147	51.260	9.466	27.316	11.958

[1] 26.68 per cent sulfur. [2] 58.622 per cent iodine. [3] 21.486 per cent sulfur. [4] 65.345 per cent iodine.

* Evidence advanced earlier that hydroxyglutamic acid (1) and norleucine (2) are constituents of proteins appears to be faulty.

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IONIZATION CONSTANTS AND pH VALUES AT THE ISOELECTRIC POINTS OF THE AMINO ACIDS IN WATER AT 25°C

The majority of the recorded values are true thermodynamic constants calculated from electrometric force measurements of cells without liquid junctions. The values for the constants given in the table were derived from the classical, the zwitterionic (Bjerrum), and the acidic (Brönsted) formulations of ionization and the corresponding mass law expressions. pH values at the isoelectric points were calculated from the expression, $pI = \frac{1}{2}(pk_{a1} + pk_w - pk_{b1})$. The error is approximately 0.5 per cent when this expression is used to calculate pI values for cystine, tyrosine, and diiodotyrosine.

Amino acid	Classical				Zwitterionic				Acidic				pI	Ref. no.
	pk_{a1}	pk_{a2}	pk_{b1}	pk_{b2}	pK_{A1}	pK_{A2}	pK_{B1}	pP_{B2}	pK_1	pK_2	pK_3	pK_4		
DL-Alanine	9.866	......	11.649	......	2.348	....	4.131	....	2.348	9.866	......	.....	6.107	1
L-Arginine	12.48	......	4.96	11.99	2.01	....	1.52	4.96	2.01	9.04	12.48	....	10.76	2
L-Aspartic acid	3.86	9.82	11.93	.....	2.10	3.86	4.18	....	2.10	3.86	9.82	.....	2.98	3
L-Cystine	8.00	10.25	11.95	12.96	1.04	2.05	3.75	6.00	1.04	2.05	8.00	10.25	5.02	4
Diiodo-L-tyrosine	6.48	7.82	11.88	.....	2.12	6.48	6.18	....	2.12	6.48	7.82	.....	4.29	5,6
L-Glutamic acid	4.07	9.47	11.90	.....	2.10	4.07	4.53	....	2.10	4.07	9.47	.....	3.08	7
Glycine	9.778	......	11.647	.....	2.350	....	4.219	....	2.350	9.778	.....	.....	6.064	8
L-Histidine	9.18	......	7.90	12.23	1.77	....	4.82	7.90	1.77	6.10	9.18	.....	7.64	3
Hydroxy-L-proline	9.73	......	12.08	.....	1.92	....	4.27	....	1.92	9.73	......	.....	5.82	9
DL-Isoleucine	9.758	......	11.679	.....	2.318	....	4.239	....	2.318	9.758	......	.....	6.038	1
DL-Leucine	9.744	......	11.669	.....	2.328	....	4.253	....	2.328	9.744	......	.....	6.036	1
L-Lysine	10.53	......	5.05	11.82	2.18	....	3.47	5.05	2.18	8.95	10.53	.....	9.47	2
DL-Methionine	9.21	......	11.72	.....	2.28	....	4.79	....	2.28	9.21	......	.....	5.74	10
DL-Phenylalanine	9.24	......	11.42	.....	2.58	....	4.76	....	2.58	9.24	......	.....	5.91	11
L-Proline	10.60	......	12.0	.....	2.00	....	3.40	....	2.00	10.60	......	.....	6.3	12
DL-Serine	9.15	......	11.79	.....	2.21	....	4.85	....	2.21	9.15	......	.....	5.68	9
L-Tryptophan	9.39	......	11.62	.....	2.38	....	4.61	....	2.38	9.39	......	.....	5.88	13
L-Tyrosine	9.11	10.07	11.80	.....	2.20	9.11	3.93	....	2.20	9.11	10.07	.....	5.63	6
DL-Valine	9.719	......	11.711	.....	2.286	....	4.278	....	2.286	9.719	......	.....	6.002	1

IONIZATION CONSTANTS AND pH VALUES AT THE ISOELECTRIC POINTS OF THE AMINO ACIDS IN WATER AT 25°C (Continued)

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Ionization Constants of the Amino Acids in Aqueous Ethanol Solutions

Amino acid	pK_1	pK_2	pK_3	Volume per cent ethanol	Temperature °C	Ref. No.
Alanine	3.55	10.02	.....	72	25	1
Arginine	3.34	9.40	14.1	72	25	1
Aspartic acid	2.85	5.20	10.51	72	25	1
Glutamic acid	3.16	5.63	10.75	72	25	2
Glycine	2.66	9.82	.....	10	19.5	2
	2.96	9.76	.....	40	19.5	2
	3.46	9.82	.....	72	25	1
	3.79	9.99	.....	90	19.5	2
Histidine	3.00	5.85	9.45	72	25	1
Isoleucine	3.69	9.81	.....	72	25	1
Lysine	2.75	8.95	10.53	48	25	1
	3.56	8.95	10.49	84	25	1
Proline	3.04	10.55	.....	72	25	1
Valine	3.60	9.73	.....	72	25	1

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Ionization Constants of the Amino Acids in Aqueous Formaldehyde Solution[a]

Amino acid	Mole per cent formaldehyde				
	0.99	3.95	5.60	10.0	17.9
DL-Alanine	8.36	7.42	6.96(b)	6.56	6.10
L-Arginine	....	3.45(c)	3.40(d)	....	....
L-Aspartic acid	....	....	7.21(d)	$\leqq$3.8(e) 6.85(f)	....
L-Glutamic acid	....	....	6.91(d)	$\leqq$4.2(e) 6.8(f)	....
Glycine	7.16	6.08	5.92(b)	5.34	5.04
L-Histidine	....	7.90(c)	7.90(d)	....	....
Hydroxy-L-Proline	....	....	7.19(d)	....	....
L-Leucine	8.44	7.50	6.92(d)	6.62	6.20
DL-Leucine	8.44	7.48	....	6.60	6.20
L-Lysine	....	7.35(c)	7.15(d)	....	....
L-Phenylalanine	....	....	6.62(d)	5.9(e)	....
DL-Phenylalanine	8.09	7.16	6.80(b)	6.35	6.13
L-Proline	....	....	7.78(d)	....	....
DL-Serine	6.66	5.74	5.63(b)	....	4.94
L-Tryptophan	....	....	6.88(d)	....	....
L-Tyrosine	....	....	7.50(d)	6.2(e) >9(f)	....
DL-Valine	8.52	7.65	7.47(b)	....	6.52

(a) Dunn and Weiner (1), pK_2 at 22°.
(b) Dunn and Loshakoff (2), pK_2 at 22°.
(c) Levy (3) pK_2 at 30° for arginine and pK_3 at 30° for histidine and lysine.
(d) Levy and Silberman (4), pK_2 at 30°, pK_3 at 30° for histidine and lysine.
(e) Harris (5), pK_2 at 25° for aspartic acid, glutamic acid, phenylalanine and tyrosine.
(f) Harris (5), pK_3 at 30° for aspartic acid, glutamic acid, and tyrosine.

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Specific Rotations of the Amino Acids Using Sodium Light (5893 Å)

Abbreviations

c—grams of solute per 100 ml. of solution.
d—density of the solution.
p—grams of solute per 100 grams of solution.
l—length of the tube in decimeters.
α—observed rotation in angular degrees.
[*α*]—specific rotation in angular degrees calculated from

$$[\alpha]_{\lambda}^{t} = \frac{\alpha \times 100}{c \times l} = \frac{\alpha \times 100}{p \times d \times l}$$ where t is temperature in °C and λ is wave length of the incident light in Ångstroms.

A—prepared from a protein or other naturally occurring material.
B—prepared by resolution of the inactive synthetic form.
C—prepared by resolution of the inactive racemized form.
D—prepared from the inactive synthetic form by a biological method.
E—prepared from the inactive racemized form by a biological method.
?—source not given.

Source	*c*	Solvent	*d*	*p*	Moles acid or base per mole amino acid	*l*	Temp. °C.	*α*	[*α*]	Ref. No.
		L-Alanine								
A	5.790	0.97 *N* HCl	1.033	5.605	1.5	2	15	+1.70	+14.7	1
A	10.3	Water	1.03	1.00	0	2	22	+0.55	+2.7	2
A	1.781	3 *N* NaOH	......	......	15	2	20	....	+3.0	3
		D-Alanine								
B	1.344	6 *N* HCl	......	......	39.4	2	30.4	−0.392	−14.6	4
		L-Arginine								
A	1.653	6.0 *N* HCl	......	......	63	4.001	23.4	+1.777	+26.9	5
A	3.48	Water	......	......	0	2	20	....	+12.5	6
A	0.87	0.50 *N* NaOH	......	......	10	2	20	....	+11.8	6
		L-Aspartic acid								
A	2.002	6.0 *N* HCl	......	......	39	4.001	24.0	+1.972	+24.6	7
A	1.3300	Water	......	......	0	3	18	....	+4.7	3
A	1.3300	3 *N* NaOH	......	......	30	3	18	....	−1.7	3
		D-Aspartic acid								
C	4.289	0.97 *N* HCl	1.032	4.156	3	1	20	−1.09	−25.5	8
		L-Cystine								
A	0.9974	1.02 *N* HCl	1.0181	0.9797	24.6	2	24.35	−4.277	−214.40	9
A	0.400	0.20 *N* NaOH	......	......	12	2	18.5	....	−70.0	3
		D-Cystine								
C	....	1 *N* HCl	......	1	24	.....	20	....	+223	10
		Diiodo-D-tyrosine								
A	5.08	1.1 *N* HCl	1.05	4.84	9.4	1	20	+0.15	+2.89	11
A	4.41	13.4 *N* NH_4OH	0.9779	4.51	132	1	20	+0.10	+2.27	11
		L-Glutamic acid								
A	1.002	6.0 *N* HCl	......	......	87	4.001	22.4	+1.25	+31.2	12
A	1.471	Water	......	......	0	2	18	....	+11.5	3
A	1.471	1 *N* NaOH	......	......	10	2	18	....	+10.96	3
		D-Glutamic acid								
C	5.425	0.37 *N* HCl	1.0233	5.3011	1	1	20	−1.63	−30.05	8
		L-Histidine								
A	1.480	6.0 *N* HCl	......	......	63	4.001	22.7	+0.766	+13.0	7
A	1.128	Water	1.0012	1.127	0	4	25.00	−1.714	−39.01	13
A	0.775	0.50 *N* NaOH	......	......	10	2	20	....	−10.9	6

Specific Rotations of the Amino Acids Using Sodium Light (5893 Å) (Continued)

Source	*c*	Solvent	*d*	*p*	Moles acid or base per mole amino acid	*l*	Temp. °C.	*α*	[*α*]	Ref. No.
					D-Histidine					
?	4.000	1.0 *N* HCl	......	......	4	1	20	−0.407	−10.2	14
B	2.66	Water	......	......	0	2	23	+2.11	+39.8	14
					Hydroxy-L-proline					
A	1.31	1.0 *N* HCl	......	......	10	2	20	....	−47.3	6
A	1.001	Water	......	......	0	4.001	22.5	−3.009	−75.2	7
A	0.655	0.50 *N* NaOH	......	......	10	2	20	....	−70.6	6
					Hydroxy-D-proline					
B	4.48	Water	1.03	4.35	0	1	21	+3.37	+75.2	16
					Allo-Hydroxy-L-proline					
B	2.617	Water	1.014	2.581	0	1	18	−1.52	−58.1	16
					Allo-Hydroxy-D-proline					
B	2.530	Water	1.013	2.998	0	1	17	+1.48	+58.5	16
					L-Isoleucine					
B	5.09	6.1 *N* HCl	1.098	4.64	15	1	20	+2.07	+40.61	17
B	3.10	Water	1.008	3.08	0	2	20	+0.70	+11.29	17
A	3.34	0.33 *N* NaOH	1.017	3.28	1.3	2	20	+0.74	+11.09	18
					D-Isoleucine					
B	4.53	6.1 *N* HCl	1.083	4.18	17	1	20	−1.85	−40.86	17
B	3.12	Water	1.006	3.10	0	2	20	−0.66	−10.55	17
					D-allo-Isoleucine					
D	5.14	6.0 *N* HCl	1.094	4.70	15.0	2	20	−3.80	−36.95	19
B	2.00	Water	......	......	0	1	20	−0.285	−14.2	20
					L-allo-Isoleucine					
B	3.97	6.0 *N* HCl	......	......	20	1	20	+1.50	+38.1	20
B	2.00	Water	......	......	0	1	20	+0.28	+14.0	20
					L-Leucine					
A	1.999	6.0 *N* HCl	......	......	38	4.001	25.9	+1.212	+15.1	5
A	2.001	Water	......	......	0	4.001	24.7	−0.863	−10.8	5
A	1.31	3.00 *N* NaOH	......	......	30	2	20	....	+7.6	3
					D-Leucine					
?	4.0	6.0 *N* HCl	1.1	3.664	19	2	20	+1.26	−15.6	21
?	....	Water	......	2.08	0	2	20	+0.43	+10.34	38
					L-Lysine					
A	2.00	6.0 *N* HCl	......	......	43	4	22.9	+1.652	+25.9	5
A	6.496	Water	......	......	0	2	20	+1.90	+14.6	22
					D-Lysine					
B	2.00	0.27 *N* HCl	......	......	2	2	20	−0.939	−23.48	23
					L-Methionine					
B	0.80	Water	......	......	0	2	25	−0.13	− 8.11	24
					D-Methionine					
B	0.80	0.2001 *N* HCl	......	......	4	2	25	−0.34	−21.18	24
B	0.80	Water	......	......	0	2	25	+0.13	+8.12	24
B	0.80	0.6 *N* $NaHCO_3$	......	......	11	2	25	−0.12	−7.47	24

Specific Rotations of the Amino Acids Using Sodium Light (5893 Å) (Continued)

Source	c	Solvent	d	p	Moles acid or base per mole amino acid	l	Temp. °C.	α	[α]	Ref. No.
L-Phenylalanine										
B	1.936	Water	1.0040	1.928	0	2	20	−1.36	−35.14	27
D-Phenylalanine										
B	3.814	5.4 *N* HCl	1.0895	3.501	23	2	20	+0.54	+7.07	28
B	2.043	Water	1.0045	2.034	0	2	20	+1.43	+35.0	27
L-Proline										
A	0.575	0.50 *N* HCl	......	......	10	2	20	......	−52.6	6
A	1.001	Water	......	......	0	4.001	23.4	−3.402	−85.0	7
B	2.42	0.6 *N* KOH	1.031	2.35	3	1	20	−2.25	−93.0	29
D-Proline										
B	3.90	Water	1.01	3.865	0	1	20	+3.18	+81.5	29
L-Serine										
B	9.344	1 *N* HCl	1.0465	8.929	1	1	25	+1.35	+14.45	30
B	10.414	Water	1.0414	9.997	0	2	20	−1.42	−6.83	30
D-Serine										
B	9.359	1 *N* HCl	1.0465	8.943	1	1	25	−1.34	−14.32	30
B	10.412	Water	1.0414	9.998	0	2	20	+1.43	+6.87	30
D-Threonine										
B	....	Water	......	1.092	0	2	26	−0.625	−28.3	31
L-Threonine										
B	....	Water	......	1.331	0	2	26	+0.780	+28.4	31
D-allo-Threonine*										
B	....	Water	......	1.634	0	2	26	−0.302	−9.1	31
L-allo-Threonine										
B	....	Water	......	1.643	0	2	26	+0.320	+9.6	31
L-Thyroxine										
A	....	0.13 *N* NaOH in 70% EtOH by weight	......	3	3	1	......	−0.147	−4.4	32
L-Tryptophan										
A	1.02	0.50 *N* HCl	......	......	10	2	20	....	+2.4	6
A	1.004	Water	......	......	0	4.001	22.7	−1.266	−31.5	7
A	2.426	0.5 *N* NaOH	1.0243	2.368	4.2	1	20	+0.15	+6.17	33
D-Tryptophan										
C	0.5024	Water	......	......	0	2	25	+0.326	+32.45	34
L-Tyrosine										
B	4.40	6.3 *N* HCl	1.116	3.94	28	2	20	−0.76	−8.64	35
A	0.906	3.0 *N* NaOH	......	......	60	3	18	....	−13.2	3
D-Tyrosine										
B	5.1484	6.3 *N* HCl	1.1175	4.6071	24	2	20	+0.89	+8.64	35

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* The levorotatory allothreonine probably belongs to the D family and its enantiomorph to the L family.

Specific Rotations of the Amino Acids Using Sodium Light (5893 Å) (Continued)

Source	c	Solvent	d	p	Moles acid or base per mole amino acid	l	Temp. °C.	α	$[\alpha]$	Ref. No.
					L-Valine					
B	3.4	6.0 *N* HCl	1.1	3.05	20	2	20	+1.93	+28.8	36
B	3.58	Water	1.007	3.56	0	2	20	+0.46	+6.42	36
					D-Valine					
B	3.2	6.0 *N* HCl	1.1	2.91	21	2	20	−1.86	−29.04	36
E	6.24	Water	1.00	6.24	0	1	20	−0.37	−6.06	37

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Solubilities of the Amino Acids in Grams per 100 Grams of Water

Amino acid	Temperature, °C.					Ref. No.
	0°	25°	50°	75°	100°	
DL-Alanine	12.11	16.72	23.09	31.89	44.04	1
L-Alanine	12.73	16.65	21.79	28.51	37.30	1
DL-Aspartic acid	0.262	0.778	2.000	4.456	8.594	1
L-Aspartic acid	0.209	0.500	1.199	2.875	6.893	1
L-Cystine‡ $\times 10^2$	0.502	1.096	2.394	5.229	11.42	2
Diiodo-DL-tyrosine $\times 10$	0.149	0.340	0.773	......	......	3
Diiodo-L-tyrosine $\times 10$	0.204	0.617	1.862	5.62	17.00	1
DL-Glutamic acid	0.855	2.054	4.934	11.86	28.49	1
L-Glutamic acid	0.341	0.864	2.186	5.532	14.00	1
Glycine	14.18	24.99	39.10	54.39	67.17	1
L-Histidine	......	4.19	......	......	......	4
Hydroxy-L-Proline	28.86	36.11	45.18	51.67*	......	5
DL-Isoleucine	1.826	2.229	3.034	4.607	7.802	1
L-Isoleucine	3.791	4.117	4.818	6.076	8.255	2
DL-Leucine	0.797	0.991	1.406	2.276	4.206	1
L-Leucine	2.270	2.426†	2.887†	3.823	5.638	1
DL-Methionine	1.818	3.381	6.070	10.52	17.60	2
DL-Phenylalanine	0.997	1.411	2.187	3.708	6.886	1
L-Phenylalanine	1.983	2.965	4.431	6.624	9.900	2
L-Proline $\times 10^{-1}$	12.74	16.23	20.67	23.90*	......	3
DL-Serine	2.204	5.023	10.34	19.21	32.24	2
L-Tryptophan	0.823	1.136	1.706	2.795	4.987	2
DL-Tyrosine $\times 10$	0.147	0.351	0.836	......	......	3
L-Tyrosine $\times 10$	0.196	0.453	1.052	2.438	5.650	1
D-Tyrosine $\times 10$	0.196	0.453	1.052	......	......	3
DL-Valine	5.98	7.09	9.11	12.61	18.81	1
L-Valine	8.34	8.85	9.62	10.24*	......	6

* Value at 65°.

† Dunn and Stoddard (7) report 2.19 g. at 25° for L-Leucine rendered methionine-free by repeated recrystallization from 6 *N* HCl. Hlynka (8) found 2.20 g. at 25° and 2.66 g. at 50° for L-Leucine rendered methionine-free [by S. W. Fox (9)] by fractional crystallization of the formyl derivative and identical values for D-Leucine obtained by resolution of the DL form.

‡ The following values were found by Loring and du Vigneaud (10): DL-Cystine (0.0049 g), D-Cystine (0.0108 g), and *meso*-cystine (0.0056 g) at 25°.

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Solubilities of the Amino Acids in Grams per 100 Grams of Water-Ethanol Mixtures

Per cent ethanol by volume	Temp. °C	Grams amino acid per 100 grams solvent	Ref. No.
DL-Alanine			
24.93	0.00	3.84	1
50.10	0.00	1.16	1
74.50	0.00	0.305	1
95.14	0.00	0.0167	1
10	25	12.25	2
24.93	24.97	7.09	1
50.10	24.97	2.52	1
74.20	24.97	0.573	1
95.14	25.09	0.0329	1
25.28	45.16	10.6	1
50.10	44.96	4.25	1
74.20	44.98	0.949	1
95.14	45.19	0.0545	1
24.93	64.96	15.9	1
50.10	64.94	6.68	1
74.20	64.94	1.48	1
95.09	65.15	0.0851	1
DL-Aspartic acid			
24.93	0.03	0.0703	1
50.10	0.03	0.0267	1
74.20	0.02	0.0111	1
24.55	25.06	0.266	1
50.25	25.06	0.0992	1
74.28	25.14	0.317	1
95.14	25.07	0.0020	1
24.74	45.25	0.680	1
50.18	45.25	0.255	1
74.28	45.27	0.0608	1
95.14	45.21	0.0042	1
24.93	64.91	1.53	1
50.10	64.91	0.588	1
74.20	65.07	0.132	1
95.14	65.00	0.0129	1
L-Aspartic acid			
20	25	0.204	3
50	25	0.0633	3
70	25	0.0224	3
90	25	0.0034	3
L-Glutamic acid			
24.74	0.01	0.0855	1
50.18	0.01	0.0371	1
74.28	0.03	0.0163	1
24.56	25.05	0.292	1
50.25	25.08	0.131	1
74.35	25.07	0.0370	1
95.14	25.04	0.0044	1
24.55	45.01	0.811	1
50.18	45.27	0.378	1
74.35	44.93	0.0885	1
95.14	45.20	0.0127	1

Per cent ethanol by volume	Temp. °C	Grams amino acid per 100 grams solvent	Ref. No.
Glycine			
24.93	0.02	3.95	1
50.10	0.02	1.03	1
74.50	0.02	0.200	1
95.09	0.01	0.0080	1
10	25	17.13	2
24.93	24.97	8.72	1
50.10	24.97	2.47	1
74.20	24.97	0.448	1
95.14	25.09	0.0172	1
24.93	44.98	15.0	1
50.10	44.98	4.62	1
74.20	44.97	0.756	1
95.14	45.19	0.0294	1
24.93	65.11	24.5	1
50.10	65.10	8.03	1
74.20	65.07	1.23	1
95.14	65.00	0.0488	1
L-Isoleucine			
80	20	0.46	4
80	78–80	1.16	4
L-allo-Isoleucine			
80	20	0.81	4
80	78–80	1.97	4
DL-Leucine			
24.93	0.00	0.251	1
50.10	0.00	0.118	1
74.50	0.00	0.0693	1
95.14	0.00	0.0116	1
10	25	0.771	2
24.93	24.97	0.493	1
50.10	24.97	0.318	1
74.20	24.97	0.175	1
95.14	25.09	0.0258	1
24.93	45.24	0.853	1
50.10	45.24	0.633	1
74.50	45.18	0.323	1
95.14	45.18	0.0471	1
24.93	65.16	1.45	1
50.10	65.20	1.16	1
74.20	65.15	0.584	1
95.09	65.07	0.0844	1
L-Leucine			
20	25	1.33	2
60	25	0.641	2
90	25	0.123	2

Solubilities of the Amino Acids in Grams per 100 Grams of Water-Ethanol Mixtures (Continued)

Per cent ethanol by volume	Temp. °C	Grams amino acid per 100 grams solvent	Ref. No.
L-Proline			
100	19	1.5	5
DL-Serine			
24.93	0.00	0.1530	1
50.10	0.00	0.146	1
74.50	0.00	0.0304	1
95.14	0.00	0.0008	1
24.93	25.14	1.54	1
50.10	25.14	0.461	1
74.50	25.10	0.0840	1
95.14	25.09	0.0028	1
24.93	45.15	3.14	1
50.10	45.04	0.985	1
74.20	45.04	0.185	1
95.14	45.18	0.0058	1
24.93	65.26	5.99	1
50.10	65.25	1.88	1
74.50	65.24	0.318	1
95.14	65.01	0.0152	1
DL-Threonine			
95	25	0.07*	6
DL-allo-Threonine			
95	25	0.03*	6
L-Tyrosine			
95	17	0.10	7

Per cent ethanol by volume	Temp. °C	Grams amino acid per 100 grams solvent	Ref. No.
DL-Tyrosine			
95.09	0.00	0.0031	8
25.28	24.85	0.0285	8
50.99	24.75	0.0226	8
74.63	24.75	0.0117	8
95.09	25.24	0.0032	8
25.28	45.15	0.0630	8
50.99	45.16	0.0513	8
74.63	44.93	0.0230	8
95.09	44.98	0.0035	8
95.09	65.06	0.0067	8
DL-Valine			
24.93	0.02	2.10	1
50.10	0.02	0.769	1
74.20	0.02	0.269	1
95.14	0.01	0.0277	1
10	25	5.50	2
25.28	24.85	3.30	1
50.99	24.85	1.53	1
74.35	24.93	0.570	1
95.14	25.04	0.0569	1
24.55	44.91	5.10	1
50.25	44.92	2.74	1
74.35	44.92	0.999	1
95.14	45.21	0.0979	1
24.55	65.07	7.44	1
50.10	64.94	4.49	1
74.20	64.34	1.62	1
95.09	65.15	0.167	1
L-Valine			
20	25	5.11	2
40	25	2.93	2
60	25	1.61	2
80	25	0.52	2

* Grams per 100 ml. of solution.

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Solubilities of the Amino Acids in Grams per 100 Grams of Organic Solvent

Solvent	Grams amino acid per 100 grams solvent	Temp. °C	Ref. No.
DL-Alanine			
Ethanol	0.0087	25	1
L-Aspartic acid			
Ethanol	0.000196	25	2
L-Glutamic acid			
Ethanol	0.000347	25	2
Ethanol	0.0056	44.93	3
Glycine			
Acetone	0.000291	25	4
Butanol	0.000892	25	4
Ethanol	0.0037	25	1
Formamide	0.558	25	4
Methanol	0.0407	25	4
L-Isoleucine			
Ethanol	0.09	20	5
Ethanol	0.13	78–80	5
L-allo-Isoleucine			
Ethanol	0.13	20	5
Ethanol	0.19	78–80	5
L-Leucine			
Ethanol	0.0217	25	1
L-Proline			
Ethanol	1.5	19	6
DL-Valine			
Ethanol	0.0136	0.03	3
Ethanol	0.019	25	1

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Densities of Crystalline Amino Acids

Amino acid	Density	Ref. No.
DL-Alanine	1.424	1
L-Alanine	1.401	2
β-Alanine	1.404	1
DL-α-Amino-*n*-butyric acid	1.231	1
α-Aminoisobutyric acid	1.278	1
L-Arginine	1.1	3
L-Aspartic acid	1.66	3
DL-Glutamic acid	1.460	4
L-Glutamic acid	1.538	4
Glycine*	1.601	3
	1.607	1
DL-Leucine	1.191	1
L-Leucine	1.165	1
DL-Methionine	1.340	5
DL-Serine	1.537	5
L-Tyrosine	1.456	1
DL-Valine	1.316	1
L-Valine	1.230	1

* The density of glycine at 50° is 1.5753 according to Houck (6) who concluded that the figure 1.1607, reported by Curtius (7) and reproduced in chemical handbooks, is a typographical error.

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2. Dalton, J. B., and Schmidt, C. L. A., J. Biol. Chem., **103,** 549 (1933).
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GENERAL RULES REGARDING BEHAVIOR OF METALS AND CERTAIN COMPOUNDS

1. **Action of Metals on Salts.**—Any metal will replace any other metal *below* it in the series thus:

$$
\begin{array}{l}
Mg + FeSO_4 \rightarrow MgSO_4 + Fe \\
Zn + CuSO_4 \rightarrow ZnSO_4 + Cu \\
Sn + 2AgNO_3 \rightarrow Sn(NO_3)_2 + 2Ag \\
Cu + Hg(NO_3)_2 \rightarrow Cu(NO_3)_2 + Hg
\end{array}
$$

This is the fundamental principle of the Daniell Cell. The voltage of such a cell depends upon the difference between the electrode potentials of the metals employed. Thus the Zn-Cu couple gives a greater E.M.F. than the Zn-Pb couple or the Fe-Cu couple.

2. **Action of Metals on Acids.**—Metals *above* H_2 react with HCl and dilute H_2SO_4, replacing the H_2

$$
\begin{array}{l}
Zn + \text{dil. } H_2SO_4 \rightarrow ZnSO_4 + H_2 \\
Sn + 2HCl \rightarrow SnCl_2 + H_2 \\
Cu + \text{dil. } H_2SO_4 \rightarrow \text{no reaction}
\end{array}
$$

Metals above Pt react with HNO_3 and *hot conc.* H_2SO_4

$$
\begin{array}{l}
2Ag + 2\text{ conc. } H_2SO_4 \rightarrow Ag_2SO_4 + SO_2 + 2H_2O \\
3Zn + 8\text{ conc. } HNO_3 \rightarrow 3Zn(NO_3)_2 + 2NO + 4H_2O \\
3Cu + 8\text{ dil. } HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O
\end{array}
$$

The acid first oxidizes the metal and the reaction may be explained as follows:

Some of the acid takes on water and ionizes thus:

$$2HNO_3 + 4H_2O \rightleftarrows 10OH^- + 2N^{+++}_{++}$$

Nitrogen gains 3 electrons and copper loses 2 electrons:

$$2(N^{+++}_{++} + 3e) + 3(Cu - 2e) \rightarrow 3Cu^{++} + 2N^{++}$$

Some of the acid ionizes as follows:

$$
\begin{array}{l}
6HNO_3 \rightleftarrows 6H^+ + 6NO_3^- \\
3Cu^{++} + 6NO_3^- \rightarrow 3Cu(NO_3)_2 \\
10OH^- + 6H^+ + 2N^{++} \rightarrow 2NO + 8H_2O
\end{array}
$$

added $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

3. **In Regard to Ease of Reduction of Oxides.**—The metallic oxides down to and including Mn can not be completely reduced to the metal state, even in a current of hydrogen. The oxides of Cd and succeeding metals are easily reduced, and far down the list, the oxides of silver, platinum, mercury, and gold are reduced (decomposed into metal and oxygen) even by heat alone.

4. **In Regard to Ease of Rusting. (Oxidation in the Air.)**—The alkali and alkaline-earth metals rust very rapidly and with considerable evolution of heat. All the metals down to copper rust with comparative ease. The metals below copper do not rust. Assuming the electrolytic theory of the process of rusting to be true, these facts are just about what might have been predicted.

5. **In Regard to the Occurrence of the Metals in the Free State in Nature.**—Natural waters are frequently dilute solutions of carbonic, nitric, humic, etc., acids. As such they contain displaceable hydrogen. Metals *above* hydrogen in the E.M.F. series scarcely, if ever, occur in the free state in nature, but are practically without exception found in the combined state, as sulfides, carbonates, etc. Metals *below* hydrogen are frequently found in the free state in nature. Thus gold is found in the form of nuggets of metallic gold. However, metals below hydrogen are also found in the combined state, as cinnabar, HgS, etc.

6. **In Regard to Action of the Metals on Water.**—The alkali and alkaline-earth metals displace hydrogen from water, even in the cold, and with evolution of much heat. Mg and succeeding metals will displace hydrogen from steam. Metals at the bottom of the list will not displace hydrogen from steam.

7. **In Regard to the Solubility and Stability of Hydroxides.**—The alkali metal oxides have great avidity for water, forming hydroxides. The alkaline-earth metal oxides react with less readiness, forming hydroxides. MgO reacts slowly and incompletely with water, forming the hydroxide. All the other metallic oxides and hydroxides are insoluble in water and have no perceptible reaction therewith. When a solution of NaOH acts on

GENERAL RULES REGARDING BEHAVIOR OF METALS AND CERTAIN COMPOUNDS (Continued)

solutions of salts of the metals, the alkali metal salts are not precipitated. The alkaline-earth metal salts are not precipitated unless in very concentrated solution. All the other metal solutions are acted upon, with precipitation of hydroxides, except in the case of copper which first gives copper hydroxide (blue), and which, on warming, changes to copper oxide (black). Also in the case of arsenic, no precipitate falls, sodium arsenite being formed. In the case of the last metals in the series, the *oxide* is precipitated, instead of the hydroxide, thus NaOH acting on salts of Sb, Hg, Ag, Pd, Pt, and Au, causes a precipitation of the *oxides* of these metals. Bismuth, as an exception, gives a normal hydroxide.

8. **In Regard to Carbonates.**—The alkali metals form normal stable, soluble carbonates, not easily decomposed on heating. The alkaline-earth metals form normal carbonates, which are insoluble in water, and which decompose upon heating, leaving the oxide, carbon dioxide being evolved. When sodium carbonate solution acts on solutions of all the other metals, as a rule, a basic carbonate is precipitated, being insoluble in water, and decomposed by heat into oxide and carbon dioxide. If the solution is cold, Ag, Hg, Cd, Fe, and Mn give normal carbonates. If the solution is warm, Sb, Hg, Ag, Pd, Pt, and Au give a precipitate of the *oxide*, instead of the carbonate, thus showing the instability of the carbonates of the lowest metals in the series.

9. **In Regard to Nitrates.**—The nitrates of the alkali metals decompose when strongly heated forming the *nitrite* and oxygen. The nitrates of the heavy metals, down to and including copper, decompose when heated forming the oxide of the metal, oxygen and nitrogen dioxide. Mercury nitrate when heated yields mercury, oxygen and nitrogen dioxide.

REDUCTION VALUES FOR GLUCOSE IN BLOOD

Amounts of Glucose Corresponding to Titration Values when 0.1 c.c. Blood is Used in the Method of Hagedorn and Jensen. Biochem. Zeit. 135, 46; 137, 92 (1923).

Milligrams of Glucose in 0.1 c.c. of Blood

c.c. of 0.005N $Na_2S_2O_3$	Hundredths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0.0	0.385	0.382	0.379	0.376	0.373	0.370	0.367	0.364	0.361	0.358
0.1	0.355	0.352	0.350	0.348	0.345	0.343	0.341	0.338	0.336	0.333
0.2	0.331	0.329	0.327	0.325	0.323	0.321	0.318	0.316	0.314	0.312
0.3	0.310	0.308	0.306	0.304	0.302	0.300	0.298	0.296	0.294	0.292
0.4	0.290	0.288	0.286	0.284	0.282	0.280	0.278	0.276	0.274	0.272
0.5	0.270	0.268	0.266	0.264	0.262	0.260	0.259	0.257	0.255	0.253
0.6	0.251	0.249	0.247	0.245	0.243	0.241	0.240	0.238	0.236	0.234
0.7	0.232	0.230	0.228	0.226	0.224	0.222	0.221	0.219	0.217	0.215
0.8	0.213	0.211	0.209	0.208	0.206	0.204	0.202	0.200	0.199	0.197
0.9	0.195	0.193	0.191	0.190	0.188	0.186	0.184	0.182	0.181	0.179
1.0	0.177	0.175	0.173	0.172	0.170	0.168	0.166	0.164	0.163	0.161
1.1	0.159	0.157	0.155	0.154	0.152	0.150	0.148	0.146	0.145	0.143
1.2	0.141	0.139	0.138	0.136	0.134	0.132	0.131	0.129	0.127	0.125
1.3	0.124	0.122	0.120	0.119	0.117	0.115	0.113	0.111	0.110	0.108
1.4	0.106	0.104	0.102	0.101	0.099	0.097	0.095	0.093	0.092	0.090
1.5	0.088	0.086	0.084	0.083	0.081	0.079	0.077	0.075	0.074	0.072
1.6	0.070	0.068	0.066	0.065	0.063	0.061	0.059	0.057	0.056	0.054
1.7	0.052	0.050	0.048	0.047	0.045	0.043	0.041	0.039	0.038	0.036
1.8	0.034	0.032	0.031	0.029	0.027	0.025	0.024	0.022	0.020	0.019
1.9	0.017	0.015	0.014	0.012	0.010	0.008	0.007	0.005	0.003	0.002

Procedure

Into a test tube (15×150 mm.) pipette 1 c.c. 0.1 normal NaOH and 5 c.c. 0.45% zinc sulfate solution; 0.1 c.c. of blood from a capillary pipette is added being washed out with the mixture in the test tube; heat for 3 minutes in a boiling water bath; filter through cotton into a test tube (30×90 mm.) and wash the filter with two 3 c.c. portions of water. Add 2 c.c. of alkaline ferricyanide solution (1.65 g potassium ferricyanide, 10.6 g anhydrous sodium carbonate in 1000 c.c. of water) and heat in a boiling water bath for 15 minutes; cool and add 3 c.c. of the iodide-sulfate solution (5 g potassium iodide, 10 g zinc sulfate, 50 g sodium chloride and sufficient water to make 200 c.c.) and 2 c.c. of 3% acetic acid solution. Titrate with 0.005 normal sodium thiosulfate using starch indicator. The method is based upon the reduction of alkaline ferricyanide by glucose and the subsequent titration of the excess unreduced ferricyanide according to the following equation: $2H_3Fe(CN)_6 + 2HI = 2H_4Fe(CN)_6 + I_2$

REDUCTION VALUES FOR GLUCOSE (Continued)

Amounts of Glucose Corresponding to Titration Values when 5 c.c. of 1:10 Blood Filtrate and 5 c.c. of Copper Reagent (Modified*) are Heated in a Water Bath for 15 Minutes. M. Somogyi, Jour. Biol. Chem. **70,** 599 (1926).

Milligrams of Glucose in 100 c.c. of Blood										
c.c. of 0.005N $Na_2S_2O_3$	Tenths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0			21	23	26	29	31	34	36	39
1	41	44	46	49	51	53	56	58	61	63
2	65	68	70	72	75	77	80	82	84	86
3	89	92	94	97	99	101	103	106	108	110
4	113	115	117	119	121	124	126	128	130	132
5	135	137	139	141	143	146	148	150	152	154
6	157	159	161	163	165	168	170	172	174	176
7	179	181	183	185	187	190	192	194	196	199
8	201	203	205	207	210	212	214	216	218	221
9	223	225	227	230	232	234	237	239	241	243
10	245	248	250	252	254	256	259	261	263	265
11	267	270	272	274	276	279	281	283	285	288
12	290	292	294	296	299	301	303	305	308	310
13	312	314	316	318	321	323	326	328	330	332
14	334	337	339	341	343	345	347	350	352	354
15	356	359	361	363	365	367	370	372	374	376
16	378	381	383	386	388	390	392	394	396	398
17	400	—	—	—	—	—	—	—	—	—

To 5 c.c. of the copper reagent in a test tube (250 × 25 mm) are added 5 c.c. of the sugar solution containing between 0.1 and 2.0 mg of glucose; mix; heat for 15 minutes in a boiling water bath; cool to 35°C; with mixing add 1 c.c. of 5N H_2SO_4 and 2 minutes later titrate with 0.005 normal $Na_2S_2O_3$. A blank titration using 5 c.c. of water in place of the blood is run at the same time.

Amounts of Glucose Corresponding to Titration Values when 2 c.c. of 1:15 Blood Filtrate and 2 c.c. of Copper Reagent (Modified*) are Heated in a Water Bath for 15 Minutes. M. Somogyi, Jour. Biol. Chem. **70,** 599 (1926)

Milligrams of Glucose in 100 c.c. of Blood										
c.c. of 0.005N $Na_2S_2O_3$	Tenths of 1 c.c. of 0.005 N Sodium Thiosulfate, $Na_2S_2O_3$									
	0	1	2	3	4	5	6	7	8	9
0	—	—	42	53	63	74	83	91	100	108
1	117	125	134	142	150	159	168	176	185	193
2	202	210	219	227	236	245	253	262	270	279
3	288	296	305	313	322	330	339	347	355	364
4	373	381	390	399	407	416	424	433	441	450
5	458	—	—	—	—	—	—	—	—	—

To 2 c.c. of 0.0667 normal H_2SO_4 in a test tube add 0.2 c.c. of blood, rinsing the pipette several times with the liquid in the test tube; add exactly 0.8 c.c. of 2.5 % sodium tungstate solution; centrifugate; fasten a small tuft of absorbent cotton over the end of a 2 c.c. pipette and with this pipette remove 2 c.c. of the blood filtrate in the test tube and deliver it into a 16 × 150 mm test tube; add exactly 2 c.c. of the sugar-copper reagent; mix; heat in a boiling water bath for 15 minutes; cool to 35°C; add 1 c.c. 2 normal H_2SO_4 and titrate with 0.005 normal $Na_2S_2O_5$. A blank using 0.2 c.c. of water in place of the blood is run at the same time.

* Modified tartrate-carbonate copper reagent.—Copper sulfate (crystalline) 6.5 g; Rochelle salt 12 g; sodium carbonate (anhydrous) 20 g; potassium iodide 10 g; potassium iodate 0.8 g; potassium oxalate 18 g, sodium bicarbonate 25 g; water sufficient to make one liter of solution.

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

(Munson and Walker, Jour. Amer. Chem. Soc. 28, 663 (1906.)

Add exactly 25 c.c. of Fehling Solution A and 25 c.c. of Fehling Solution B (see under *Special Solutions and Reagents*) to 50 c.c. of reducing sugar solution (if a smaller volume of sugar solution is used, add sufficient water to make the final solution 100 c.c.); heat the solution at such a rate that boiling begins in four minutes and continue boiling for exactly 2 minutes, keeping the beaker covered with a watch glass; filter immediately on a Gooch crucible using suction; wash thoroughly with water at 60°C., then with 10 c c. of alcohol and finally with 10 c.c. of ether; dry for 30 minutes in an oven at 100°C., cool in a desiccator and weigh as cuprous oxide.

(Expressed in Milligrams)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
10	4.0	4.5	3.8	5.9	50	21.3	22.3	30.1	37.6
11	4.5	5.0	4.5	6.7	51	21.7	22.8	30.7	38.4
12	4.9	5.4	5.1	7.5	52	22.2	23.2	31.4	39.2
13	5.3	5.8	5.8	8.3	53	22.6	23.7	32.1	40.0
14	5.7	6.3	6.4	9.1	54	23.0	24.1	32.7	40.8
15	6.2	6.7	7.1	9.9	55	23.5	24.6	33.4	41.6
16	6.6	7.2	7.8	10.6	56	23.9	25.0	34.0	42.4
17	7.0	7.6	8.4	11.4	57	24.3	25.5	34.7	43.2
18	7.5	8.1	9.1	12.2	58	24.8	25.9	35.4	44.0
19	7.9	8.5	9.7	13.0	59	25.2	26.4	36.0	44.8
20	8.3	8.9	10.4	13.8	60	25.6	26.8	36.7	45.6
21	8.7	9.4	11.0	14.6	61	26.1	27.3	37.3	46.3
22	9.2	9.8	11.7	15.4	62	26.5	27.7	38.0	47.1
23	9.6	10.3	12.3	16.2	63	27.0	28.2	38.6	47.9
24	10.0	10.7	13.0	17.0	64	27.4	28.6	39.3	48.7
25	10.5	11.2	13.7	17.8	65	27.8	29.1	40.0	49.5
26	10.9	11.6	14.3	18.6	66	28.3	29.5	40.6	50.3
27	11.3	12.0	15.0	19.4	67	28.7	30.0	41.3	51.1
28	11.8	12.5	15.6	20.2	68	29.2	30.4	41.9	51.9
29	12.2	12.9	16.3	21.0	69	29.6	30.9	42.6	52.7
30	12.6	13.4	16.9	21.8	70	30.0	31.3	43.3	53.5
31	13.1	13.8	17.6	22.6	71	30.5	31.8	43.9	54.3
32	13.5	14.3	18.3	23.3	72	30.9	32.3	44.6	55.1
33	13.9	14.7	18.9	24.1	73	31.4	32.7	45.2	55.9
34	14.3	15.2	19.6	24.9	74	31.8	33.2	45.9	56.7
35	14.8	15.6	20.2	25.7	75	32.2	33.6	46.6	57.5
36	15.2	16.1	20.9	26.5	76	32.7	34.1	47.2	58.2
37	15.6	16.5	21.5	27.3	77	33.1	34.5	47.9	59.0
38	16.1	16.9	22.2	28.1	78	33.6	35.0	48.5	59.8
39	16.5	17.4	22.8	28.9	79	34.0	35.4	49.2	60.6
40	16.9	17.8	23.5	29.7	80	34.4	35.9	49.9	61.4
41	17.4	18.3	24.2	30.5	81	34.9	36.3	50.5	62.2
42	17.8	18.7	24.8	31.3	82	35.3	36.8	51.2	63.0
43	18.2	19.2	25.5	32.1	83	35.8	37.3	51.8	63.8
44	18.7	19.6	26.1	32.9	84	36.2	37.7	52.5	64.6
45	19.1	20.1	26.8	33.7	85	36.7	38.2	53.1	65.4
46	19.6	20.5	27.4	34.4	86	37.1	38.6	53.8	66.2
47	20.0	21.0	28.1	35.2	87	37.5	39.1	54.5	67.0
48	20.4	21.4	28.7	36.0	88	38.0	39.5	55.1	67.8
49	20.9	21.9	29.4	36.8	89	38.4	40.0	55.8	68.5

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
90	38.9	40.4	56.4	69.3	140	61.3	63.6	89.5	109.0
91	39.3	40.9	57.1	70.1	141	61.8	64.0	90.2	109.8
92	39.8	41.4	57.8	70.9	142	62.2	64.5	90.8	110.5
93	40.2	41.8	58.4	71.7	143	62.7	65.0	91.5	111.3
94	40.6	42.3	59.1	72.5	144	63.1	65.4	92.2	112.1
95	41.1	42.7	59.7	73.3	145	63.6	65.9	92.8	112.9
96	41.5	43.2	60.4	74.1	146	64.0	66.4	93.5	113.7
97	42.0	43.7	61.1	74.9	147	64.5	66.9	94.2	114.5
98	42.4	44.1	61.7	75.7	148	65.0	67.3	94.8	115.3
99	42.9	44.6	62.4	76.5	149	65.4	67.8	95.5	116.1
100	43.3	45.0	63.0	77.3	150	65.9	68.3	96.1	116.9
101	43.8	45.5	63.7	78.1	151	66.3	68.7	96.8	117.7
102	44.2	46.0	64.4	78.8	152	66.8	69.2	97.5	118.5
103	44.7	46.4	65.0	79.6	153	67.2	69.7	98.1	119.3
104	45.1	46.9	65.7	80.4	154	67.7	70.1	98.8	120.0
105	45.5	47.3	66.4	81.2	155	68.2	70.6	99.5	120.8
106	46.0	47.8	67.0	82.0	156	68.6	71.1	100.1	121.6
107	46.4	48.3	67.7	82.8	157	69.1	71.6	100.8	122.4
108	46.9	48.7	68.3	83.6	158	69.5	72.0	101.5	123.2
109	47.3	49.2	69.0	84.4	159	70.0	72.5	102.1	124.0
110	47.8	49.6	69.7	85.2	160	70.4	73.0	102.8	124.8
111	48.2	50.1	70.3	86.0	161	70.9	73.4	103.4	125.6
112	48.7	50.6	71.0	86.8	162	71.4	73.9	104.1	126.4
113	49.1	51.0	71.6	87.6	163	71.8	74.4	104.8	127.2
114	49.6	51.5	72.3	88.4	164	72.3	74.9	105.4	128.0
115	50.0	51.9	73.0	89.2	165	72.8	75.3	106.1	128.8
116	50.5	52.4	73.6	90.0	166	73.2	75.8	106.8	129.6
117	50.9	52.9	74.3	90.7	167	73.7	76.3	107.4	130.3
118	51.4	53.3	75.0	91.5	168	74.1	76.8	108.1	131.1
119	51.8	53.8	75.6	92.3	169	74.6	77.2	108.8	131.9
120	52.3	54.3	76.3	93.1	170	75.1	77.7	109.4	132.7
121	52.7	54.7	76.9	93.9	171	75.5	78.2	110.1	133.5
122	53.2	55.2	77.6	94.7	172	76.0	78.7	110.8	134.3
123	53.6	55.7	78.3	95.5	173	76.4	79.1	111.4	135.1
124	54.1	56.1	78.9	96.3	174	76.9	79.6	112.1	135.9
125	54.5	56.6	79.6	97.1	175	77.4	80.1	112.8	136.7
126	55.0	57.0	80.3	97.9	176	77.8	80.6	113.4	137.5
127	55.4	57.5	80.9	98.7	177	78.3	81.0	114.1	138.3
128	55.9	58.0	81.6	99.4	178	78.8	81.5	114.8	139.1
129	56.3	58.4	82.2	100.2	179	79.2	82.0	115.4	139.8
130	56.8	58.9	82.9	101.0	180	79.7	82.5	116.1	140.6
131	57.2	59.4	83.6	101.8	181	80.1	82.9	116.7	141.4
132	57.7	59.8	84.2	102.6	182	80.6	83.4	117.4	142.2
133	58.1	60.3	84.9	103.4	183	81.1	83.9	118.1	143.0
134	58.6	60.8	85.5	104.2	184	81.5	84.4	118.7	143.8
135	59.0	61.2	86.2	105.0	185	82.0	84.9	119.4	144.6
136	59.5	61.7	86.9	105.8	186	82.5	85.3	120.1	145.4
137	60.0	62.2	87.5	106.6	187	82.9	85.8	120.7	146.2
138	60.4	62.6	88.2	107.4	188	83.4	86.3	121.4	147.0
139	60.9	63.1	88.9	108.2	189	83.9	86.8	122.1	147.8

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
190	84.3	87.2	122.7	148.6	240	108.0	111.5	156.1	188.1
191	84.8	87.7	123.4	149.3	241	108.4	112.0	156.7	188.9
192	85.3	88.2	124.1	150.1	242	108.9	112.5	157.4	189.7
193	85.7	88.7	124.7	150.9	243	109.4	113.0	158.1	190.5
194	86.2	89.2	125.4	151.7	244	109.9	113.5	158.7	191.3
195	86.7	89.6	126.1	152.5	245	110.4	114.0	159.4	192.1
196	87.1	90.1	126.7	153.3	246	110.8	114.5	160.1	192.9
197	87.6	90.6	127.4	154.1	247	111.3	115.0	160.7	193.6
198	88.1	91.1	128.1	154.9	248	111.8	115.4	161.4	194.4
199	88.5	91.6	128.7	155.7	249	112.3	115.9	162.1	195.2
200	89.0	92.0	129.4	156.5	250	112.8	116.4	162.7	196.0
201	89.5	92.5	130.0	157.3	251	113.2	116.9	163.4	196.8
202	89.9	93.0	130.7	158.1	252	113.7	117.4	164.1	197.6
203	90.4	93.5	131.4	158.8	253	114.2	117.9	164.7	198.4
204	90.9	94.0	132.0	159.6	254	114.7	118.4	165.4	199.2
205	91.4	94.5	132.7	160.4	255	115.2	118.9	166.1	200.0
206	91.8	94.9	133.4	161.2	256	115.7	119.4	166.8	200.8
207	92.3	95.4	134.0	162.0	257	116.1	119.9	167.4	201.6
208	92.8	95.9	134.7	162.8	258	116.6	120.4	168.1	202.3
209	93.2	96.4	135.4	163.6	259	117.1	120.9	168.8	203.1
210	93.7	96.9	136.0	164.4	260	117.6	121.4	169.4	203.9
211	94.2	97.4	136.7	165.2	261	118.1	121.9	170.1	204.7
212	94.6	97.8	137.4	166.0	262	118.6	122.4	170.8	205.5
213	95.1	98.3	138.0	166.8	263	119.0	122.9	171.4	206.3
214	95.6	98.8	138.7	167.5	264	119.5	123.4	172.1	207.1
215	96.1	99.3	139.4	168.3	265	120.0	123.9	172.8	207.9
216	96.5	99.8	140.0	169.1	266	120.5	124.4	173.5	208.7
217	97.0	100.3	140.7	169.9	267	121.0	124.9	174.1	209.5
218	97.5	100.8	141.4	170.7	268	121.5	125.4	174.8	210.3
219	98.0	101.2	142.0	171.5	269	122.0	125.9	175.5	211.0
220	98.4	101.7	142.7	172.3	270	122.5	126.4	176.1	211.8
221	98.9	102.2	143.4	173.1	271	122.9	126.9	176.8	212.6
222	99.4	102.7	144.0	173.9	272	123.4	127.4	177.5	213.4
223	99.9	103.2	144.7	174.7	273	123.9	127.9	178.1	214.2
224	100.3	103.7	145.4	175.5	274	124.4	128.4	178.8	215.0
225	100.8	104.2	146.0	176.2	275	124.9	128.9	179.5	215.8
226	101.3	104.6	146.7	177.0	276	125.4	129.4	180.2	216.6
227	101.8	105.1	147.4	177.8	277	125.9	129.9	180.8	217.4
228	102.2	105.6	148.0	178.6	278	126.4	130.4	181.5	218.2
229	102.7	106.1	148.7	179.4	279	126.9	130.9	182.2	218.9
230	103.2	106.6	149.4	180.2	280	127.3	131.4	182.8	219.7
231	103.7	107.1	150.0	181.0	281	127.8	131.9	183.5	220.5
232	104.1	107.6	150.7	181.8	282	128.3	132.4	184.2	221.3
233	104.6	108.1	151.4	182.6	283	128.8	132.9	184.8	222.1
234	105.1	108.6	152.0	183.4	284	129.3	133.4	185.5	222.9
235	105.6	109.1	152.7	184.2	285	129.8	133.9	186.2	223.7
236	106.0	109.5	153.4	184.9	286	130.3	134.4	186.9	224.5
237	106.5	110.0	154.0	185.7	287	130.8	134.9	187.5	225.3
238	107.0	110.5	154.7	186.5	288	131.3	135.4	188.2	226.1
239	107.5	111.0	155.4	187.3	289	131.8	135.9	188.9	226.9

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
290	132.3	136.4	189.5	227.6	340	157.3	162.0	223.2	267.1
291	132.7	136.9	190.2	228.4	341	157.8	162.5	223.8	267.9
292	133.2	137.4	190.9	229.2	342	158.3	163.1	224.5	268.7
293	133.7	137.9	191.5	230.0	343	158.8	163.6	225.2	269.5
294	134.2	138.4	192.2	230.8	344	159.3	164.1	225.9	270.3
295	134.7	138.9	192.9	231.6	345	159.8	164.6	226.5	271.1
296	135.2	139.4	193.6	232.4	346	160.3	165.1	227.2	271.9
297	135.7	140.0	194.2	233.2	347	160.8	165.7	227.9	272.7
298	136.2	140.5	194.9	234.0	348	161.4	166.2	228.5	273.5
299	136.7	141.0	195.6	234.8	349	161.9	166.7	229.2	274.3
300	137.2	141.5	196.2	235.5	350	162.4	167.2	229.9	275.0
301	137.7	142.0	196.9	236.3	351	162.9	167.7	230.6	275.8
302	138.2	142.5	197.6	237.1	352	163.4	168.3	231.2	276.6
303	138.7	143.0	198.3	237.9	353	163.9	168.8	231.9	277.4
304	139.2	143.5	198.9	238.7	354	164.4	169.3	232.6	278.2
305	139.7	144.0	199.6	239.5	355	164.9	169.8	233.3	279.0
306	140.2	144.5	200.3	240.3	356	165.4	170.4	233.9	279.8
307	140.7	145.0	201.0	241.1	357	166.0	170.9	234.6	280.6
308	141.2	145.5	201.6	241.9	358	166.5	171.4	235.3	281.4
309	141.7	146.1	202.3	242.7	359	167.0	171.9	236.0	282.2
310	142.2	146.6	203.0	243.5	360	167.5	172.5	236.7	282.9
311	142.7	147.1	203.6	244.2	361	168.0	173.0	237.3	283.7
312	143.2	147.6	204.3	245.0	362	168.5	173.5	238.0	284.5
313	143.7	148.1	205.0	245.8	363	169.0	174.0	238.7	285.3
314	144.2	148.6	205.7	246.6	364	169.6	174.6	239.4	286.1
315	144.7	149.1	206.3	247.4	365	170.1	175.1	240.0	286.9
316	145.2	149.6	207.0	248.2	366	170.6	175.6	240.7	287.7
317	145.7	150.1	207.7	249.0	367	171.1	176.1	241.4	288.5
318	146.2	150.7	208.4	249.8	368	171.6	176.7	242.1	289.3
319	146.7	151.2	209.0	250.6	369	172.1	177.2	242.7	290.0
320	147.2	151.7	209.7	251.3	370	172.7	177.7	243.4	290.8
321	147.7	152.2	210.4	252.1	371	173.2	178.3	244.1	291.6
322	148.2	152.7	211.0	252.9	372	173.7	178.8	244.8	292.4
323	148.7	153.2	211.7	253.7	373	174.2	179.3	245.4	293.2
324	149.2	153.7	212.4	254.5	374	174.7	179.8	246.1	294.0
325	149.7	154.3	213.1	255.3	375	175.3	180.4	246.8	294.8
326	150.2	154.8	213.7	256.1	376	175.8	180.9	247.5	295.6
327	150.7	155.3	214.4	256.9	377	176.3	181.4	248.1	296.4
328	151.2	155.8	215.1	257.7	378	176.8	182.0	248.8	297.2
329	151.7	156.3	215.8	258.5	379	177.3	182.5	249.5	297.9
330	152.2	156.8	216.4	259.3	380	177.9	183.0	250.2	298.7
331	152.7	157.3	217.1	260.0	381	178.4	183.6	250.8	299.5
332	153.2	157.9	217.8	260.8	382	178.9	184.1	251.5	300.3
333	153.7	158.4	218.4	261.6	383	179.4	184.6	252.2	301.1
334	154.2	158.9	219.1	262.4	384	180.0	185.2	252.9	301.9
335	154.7	159.4	219.8	263.2	385	180.5	185.7	253.6	302.7
336	155.2	159.9	220.5	264.0	386	181.0	186.2	254.2	303.5
337	155.8	160.5	221.1	264.8	387	181.5	186.8	254.9	304.2
338	156.3	161.0	221.8	265.6	388	182.0	187.3	255.6	305.0
339	156.8	161.5	222.5	266.4	389	182.6	187.8	256.3	305.8

CUPROUS OXIDE EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE (Continued)

Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$	Cuprous Oxide Cu_2O	Dextrose $C_6H_{12}O_6$	Invert Sugar	Lactose $C_{12}H_{22}O_{11}$	Maltose $C_{12}H_{22}O_{11}$
390	183.1	188.4	256.9	306.6	440	209.8	215.5	290.9	346.1
391	183.6	188.9	257.6	307.4	441	210.3	216.1	291.5	346.8
392	184.1	189.4	258.3	308.2	442	210.9	216.6	292.2	347.6
393	184.7	190.0	259.0	309.0	443	211.4	217.2	292.9	348.4
394	185.2	190.5	259.6	309.8	444	212.0	217.8	293.6	349.2
395	185.7	191.0	260.3	310.6	445	212.5	218.3	294.2	350.0
396	186.2	191.6	261.0	311.4	446	213.1	218.9	294.9	350.8
397	186.8	192.1	261.7	312.1	447	213.6	219.4	295.6	351.6
398	187.3	192.7	262.3	312.9	448	214.1	220.0	296.3	352.4
399	187.8	193.2	263.0	313.7	449	214.7	220.5	297.0	353.2
400	188.4	193.7	263.7	314.5	450	215.2	221.1	297.6	353.9
401	188.9	194.3	264.4	315.3	451	215.8	221.6	298.3	354.7
402	189.4	194.8	265.0	316.1	452	216.3	222.2	299.0	355.5
403	189.9	195.4	265.7	316.9	453	216.9	222.8	299.7	356.3
404	190.5	195.9	266.4	317.7	454	217.4	223.3	300.4	357.1
405	191.0	196.4	267.1	318.5	455	218.0	223.9	301.1	357.9
406	191.5	197.0	267.8	319.2	456	218.5	224.4	301.7	358.7
407	192.1	197.5	268.4	320.0	457	219.1	225.0	302.4	359.5
408	192.6	198.1	269.1	320.8	458	219.6	225.5	303.1	360.3
409	193.1	198.6	269.8	321.6	459	220.2	226.1	303.8	361.0
410	193.7	199.1	270.5	322.4	460	220.7	226.7	304.5	361.8
411	194.2	199.7	271.2	323.2	461	221.3	227.2	305.1	362.6
412	194.7	200.2	271.8	324.0	462	221.8	227.8	305.8	363.4
413	195.2	200.8	272.5	324.8	463	222.4	228.3	306.5	364.2
414	195.8	201.3	273.2	325.6	464	222.9	228.9	307.2	365.0
415	196.3	201.8	273.9	326.3	465	223.5	229.5	307.9	365.8
416	196.8	202.4	274.6	327.1	466	224.0	230.0	308.6	366.6
417	197.4	202.9	275.2	327.9	467	224.6	230.6	309.2	367.3
418	197.9	203.5	275.9	328.7	468	225.1	231.2	309.9	368.1
419	198.4	204.0	276.6	329.5	469	225.7	231.7	310.6	368.9
420	199.0	204.6	277.3	330.3	470	226.2	232.3	311.3	369.7
421	199.5	205.1	277.9	331.1	471	226.8	232.8	312.0	370.5
422	200.1	205.7	278.6	331.9	472	227.4	233.4	312.6	371.3
423	200.6	206.2	279.3	332.7	473	227.9	234.0	313.3	372.1
424	201.1	206.7	280.0	333.4	474	228.5	234.5	314.0	372.9
425	201.7	207.3	280.7	334.2	475	229.0	235.1	314.7	373.7
426	202.2	207.8	281.3	335.0	476	229.6	235.7	315.4	374.4
427	202.8	208.4	282.0	335.8	477	230.1	236.2	316.1	375.2
428	203.3	208.9	282.7	336.6	478	230.7	236.8	316.7	376.0
429	203.8	209.5	283.4	337.4	479	231.3	237.4	317.4	376.8
430	204.4	210.0	284.1	338.2	480	231.8	237.9	318.1	377.6
431	204.9	210.6	284.7	339.0	481	232.4	238.5	318.8	378.4
432	205.5	211.1	285.4	339.7	482	232.9	239.1	319.5	379.2
433	206.0	211.7	286.1	340.5	483	233.5	239.6	320.1	380.0
434	206.5	212.2	286.8	341.3	484	234.1	240.2	320.8	380.7
435	207.1	212.8	287.5	342.1	485	234.6	240.8	321.5	381.5
436	207.6	213.3	288.1	342.9	486	235.2	241.4	322.2	382.3
437	208.2	213.9	288.8	343.7	487	235.7	241.9	322.9	383.1
438	208.7	214.4	289.5	344.5	488	236.3	242.5	323.6	383.9
439	209.2	215.0	290.2	345.3	489	236.9	243.1	324.2	384.7
					490	237.4	243.6	324.5	385.5

DETERMINATION OF SUGAR

Factors for 10 ml of Soxhlet solution to be used in connection with the Lane and Eynon general volumetric method

Titer	Invert sugar (sucrose absent)	1 g of sucrose per 100 ml of invert sugar	5 g of sucrose per 100 ml of invert sugar	10 g of sucrose per 100 ml of invert sugar	25 g of sucrose per 100 ml of invert sugar	Dextrose	Levulose	Anhydrous maltose, $C_{12}H_{22}O_{11}$	Hydrated maltose, $C_{12}H_{22}O_{11}.H_2O$	Anhydrous lactose, $C_{12}H_{22}O_{11}$	Hydrated lactose, $C_{12}H_{22}O_{11}.H_2O$
ml											
15	50.5	49.9	47.6	46.1	43.4	49.1	52.2	77.2	81.3	64.9	68.3
16	50.6	50.0	47.6	46.1	43.4	49.2	52.3	77.1	81.2	64.8	68.2
17	50.7	50.1	47.6	46.1	43.4	49.3	52.3	77.0	81.1	64.8	68.2
18	50.8	50.1	47.6	46.1	43.3	49.3	52.4	77.0	81.0	64.7	68.1
19	50.8	50.2	47.6	46.1	43.3	49.4	52.5	76.9	80.9	64.7	68.1
20	50.9	50.2	47.6	46.1	43.2	49.5	52.5	76.8	80.8	64.6	68.0
21	51.0	50.2	47.6	46.1	43.2	49.5	52.6	76.7	80.7	64.6	68.0
22	51.0	50.3	47.6	46.1	43.1	49.6	52.7	76.6	80.6	64.6	68.0
23	51.1	50.3	47.6	46.1	43.0	49.7	52.7	76.5	80.5	64.5	67.9
24	51.2	50.3	47.6	46.1	42.9	49.8	52.8	76.4	80.4	64.5	67.9
25	51.2	50.4	47.6	46.0	42.8	49.8	52.8	76.4	80.4	64.5	67.9
26	51.3	50.4	47.6	46.0	42.8	49.9	52.9	76.3	80.3	64.5	67.9
27	51.4	50.4	47.6	46.0	42.7	49.9	52.9	76.2	80.2	64.4	67.8
28	51.4	50.5	47.7	46.0	42.7	50.0	53.0	76.1	80.1	64.4	67.8
29	51.5	50.5	47.7	46.0	42.6	50.0	53.1	76.0	80.0	64.4	67.8
30	51.5	50.5	47.7	46.0	42.5	50.1	53.2	76.0	80.0	64.4	67.8
31	51.6	50.6	47.7	45.9	42.5	50.2	53.2	75.9	79.9	64.4	67.8
32	51.6	50.6	47.7	45.9	42.4	50.2	53.3	75.9	79.9	64.4	67.8
33	51.7	50.6	47.7	45.9	42.3	50.3	53.3	75.8	79.8	64.4	67.8
34	51.7	50.6	47.7	45.8	42.2	50.3	53.4	75.8	79.8	64.4	67.9
35	51.8	50.7	47.7	45.8	42.2	50.4	53.4	75.7	79.7	64.5	67.9
36	51.8	50.7	47.7	45.8	42.1	50.4	53.5	75.6	79.6	64.5	67.9
37	51.9	50.7	47.7	45.7	42.0	50.5	53.5	75.6	79.6	64.5	67.9
38	51.9	50.7	47.7	45.7	42.0	50.5	53.6	75.5	79.5	64.5	67.9
39	52.0	50.8	47.7	45.7	41.9	50.6	53.6	75.5	79.5	64.5	67.9
40	52.0	50.8	47.7	45.6	41.8	50.6	53.6	75.4	79.4	64.5	67.9
41	52.1	50.8	47.7	45.6	41.8	50.7	53.7	75.4	79.4	64.6	68.0
42	52.1	50.8	47.7	45.6	41.7	50.7	53.7	75.3	79.3	64.6	68.0
43	52.2	50.8	47.7	45.5	41.6	50.8	53.8	75.3	79.3	64.6	68.0
44	52.2	50.9	47.7	45.5	41.5	50.8	53.8	75.2	79.2	64.6	68.0
45	52.3	50.9	47.7	45.4	41.4	50.9	53.9	75.2	79.2	64.7	68.1
46	52.3	50.9	47.7	45.4	41.4	50.9	53.9	75.1	79.1	64.7	68.1
47	52.4	50.9	47.7	45.3	41.3	51.0	53.9	75.1	79.1	64.8	68.2
48	52.4	50.9	47.7	45.3	41.2	51.0	54.0	75.1	79.1	64.8	68.2
49	52.5	51.0	47.7	45.2	41.1	51.0	54.0	75.0	79.0	64.8	68.2
50	52.5	51.0	47.7	45.2	41.0	51.1	54.0	75.0	79.0	64.9	68.3

DETERMINATION OF SUGAR (Continued)

Factors for 25 ml of Soxhlet solution to be used in connection with the Lane and Eynon general volumetric method

Titer	Invert sugar (sucrose absent)	1 g of sucrose per 100 ml of invert sugar	Dextrose	Levulose	Anhydrous maltose, $C_{12}H_{22}O_{11}$	Hydrated maltose, $C_{12}H_{22}O_{11}.H_2O$	Anhydrous lactose, $C_{12}H_{22}O_{11}$	Hydrated lactose, $C_{12}H_{22}O_{11}.H_2O$
ml								
15	123.6	122.6	120.2	127.4	197.8	208.2	163.9	172.5
16	123.6	122.7	120.2	127.4	197.4	207.8	163.5	172.1
17	123.6	122.7	120.2	127.5	197.0	207.4	163.1	171.7
18	123.7	122.7	120.2	127.5	196.7	207.1	162.8	171.4
19	123.7	122.8	120.3	127.6	196.5	206.8	162.5	171.1
20	123.8	122.8	120.3	127.6	196.2	206.5	162.3	170.9
21	123.8	122.8	120.3	127.7	195.8	206.1	162.0	170.6
22	123.9	122.9	120.4	127.7	195.5	205.8	161.8	170.4
23	123.9	122.9	120.4	127.8	195.1	205.4	161.6	170.2
24	124.0	122.9	120.5	127.8	194.8	205.1	161.5	170.0
25	124.0	123.0	120.5	127.9	194.5	204.8	161.4	169.9
26	124.1	123.0	120.6	127.9	194.2	204.4	161.2	169.7
27	124.1	123.0	120.6	128.0	193.9	204.1	161.0	169.5
28	124.2	123.1	120.7	128.0	193.6	203.8	160.8	169.3
29	124.2	123.1	120.7	128.1	193.3	203.5	160.7	169.2
30	124.3	123.1	120.8	128.1	193.0	203.2	160.6	169.0
31	124.3	123.2	120.8	128.1	192.8	202.9	160.5	168.9
32	124.4	123.2	120.8	128.2	192.5	202.6	160.4	168.8
33	124.4	123.2	120.9	128.2	192.2	202.3	160.2	168.6
34	124.5	123.3	120.9	128.3	191.9	202.0	160.1	168.5
35	124.5	123.3	121.0	128.3	191.7	201.8	160.0	168.4
36	124.6	123.3	121.0	128.4	191.4	201.5	159.8	168.2
37	124.6	123.4	121.1	128.4	191.2	201.2	159.7	168.1
38	124.7	123.4	121.2	128.5	191.0	201.0	159.6	168.0
39	124.7	123.4	121.2	128.5	190.8	200.8	169.5	167.9
40	124.8	123.4	121.2	128.6	190.5	200.5	159.4	167.8
41	124.8	123.5	121.3	128.6	190.3	200.3	159.3	167.7
42	124.9	123.5	121.4	128.6	190.1	200.1	159.2	167.6
43	124.9	123.5	121.4	128.7	189.8	199.8	159.2	167.6
44	125.0	123.6	121.5	128.7	189.6	199.6	159.1	167.5
45	125.0	123.6	121.5	128.8	189.4	199.4	159.0	167.4
46	125.1	123.6	121.6	128.8	189.2	199.2	159.0	167.4
47	125.1	123.7	121.6	128.9	189.0	199.0	158.9	167.3
48	125.2	123.7	121.7	128.9	188.9	198.9	158.8	167.2
49	125.2	123.7	121.7	129.0	188.8	198.7	158.8	167.2
50	125.3	123.8	121.8	129.0	188.7	198.6	158.7	167.1

OPTICAL ROTATION AND MELTING POINT OF CERTAIN SUGARS

There is no universally accepted nomenclature for the sugar derivatives, and therefore names have been selected to conform as far as possible with the general principles of established nomenclature for organic compounds. The alpha and beta modifications of the heptoses and higher sugars have been named according to the suggestion of Isbell, while the alpha and beta names in common use have been retained for the lower sugars.

Substance	Formula	Molecular weight	Melting point °C	α_D^{20}	M	Concentration g/100 *ml*
β-d-Allose	$C_6H_{12}O_6$	180.16	128–128.5	[1]−0.2 → +14.4	−40	5
β-l-Allose	$C_6H_{12}O_6$	180.16	128–129	−1.90 → −13.9	−350	4
β-d-Altrose	$C_6H_{12}O_6$	180.16	103–105	+32.6[2]	....	8
β-l-Altrose	$C_6H_{12}O_6$	180.16	107–109.5	−28.8 → −32.3	−5,180	4
β-l-Arabinose	$C_5H_{10}O_5$	150.13	160	+190.6 → +104.5	+28,610	..
β-Cellobiose	$C_{12}H_{22}O_{11}$	342.30	225	+14.2 → +34.6	+4,860	8
β-d-Fructose	$C_6H_{12}O_6$	180.16	102–104	−132.2 → −92.4	−23,820	4
α-l-Fucose	$C_6H_{12}O_5$	164.16	145	−152.6 → −75.9	−25,100	4
α-d-Galactose	$C_6H_{12}O_6$	180.16	167	+150.7 → +80.2	+27,150	5
β-d-Galactose	$C_6H_{12}O_6$	180.16	....	+52.8 → +80.2	+9,510	4
α-d-α-Galaheptose, H_2O	$C_7H_{16}O_8$	228.20	77–78	−25.2 → −14.0	−5,750	4
β-d-β-Galaheptose	$C_7H_{14}O_7$	210.18	197	−19.2 → −54.1	−4,040	4
β-d-α-Glucoheptose	$C_7H_{14}O_7$	210.18	193	−28.7 → −20.2	−6,030	4
d-β-Glucoheptose	$C_7H_{14}O_7$	210.18	121	−0.1 → −0.1[3]	−20	5
α-d-Glucomethylose	$C_6H_{12}O_5$	164.16	139–140	+73.3 → +29.7	+12,030	8
α-d-Glucose	$C_6H_{12}O_6$	180.16	146	+112.2 → +52.7	+20,210	4
α-d-Glucose, H_2O	$C_6H_{14}O_7$	198.17	83	+102.0 → +47.9[4]	....	..
β-d-Glucose	$C_6H_{12}O_6$	180.16	148–150	+18.7 → +52.7	+3,370	4
α-d-α-Guloheptose	$C_7H_{14}O_7$	210.18	127	−45.7 → −16.9	−9,610	4
α-d-β-Guloheptose	$C_7H_{14}O_7$	210.18	185–187	−120.5 → −65.1	−25,330	4
α-Lactose, H_2O	$C_{12}H_{24}O_{12}$	360.31	202	+85.0 → +52.6	+30,630	8
β-Lactose	$C_{12}H_{22}O_{11}$	342.30	252	+34.9 → +55.4	+11,950	4
α-d-Lyxose	$C_5H_{10}O_5$	150.13	106–107	+5.6 → −13.8	+840	4
β-d-Lyxose	$C_5H_{10}O_5$	150.13	117–118	−72.6 → −13.8	−10,900	4
β-Maltose, H_2O	$C_{12}H_{24}O_{12}$	360.31	102–103	+111.7 → +130.4	+40,250	4
α-d-α-Mannoheptose, H_2O	$C_7H_{16}O_8$	228.20	107	+120.0 → +64.7	+27,380	4
β-d-α-Mannoheptose, H_2O	$C_7H_{16}O_8$	228.20	104	+42.3 → +64.5	+9,650	4
α-d-β-Mannoheptose, H_2O	$C_7H_{14}O_8$	228.20	83	+45.7 → +14.5	+10,430	4
α-d-Mannose	$C_6H_{12}O_6$	180.16	133	+29.3 → +14.2	+5,280	4
β-d-Mannose	$C_6H_{12}O_6$	180.16	132	−17.0 → +14.2	−3,060	4
β-Melibiose, $2H_2O$	$C_{12}H_{26}O_{13}$	378.33	82–85	+111.7 → +129.5	+42,260	4
β-Neolactose	$C_{12}H_{22}O_{11}$	342.30	190	+33.8 → +35.5	+11,570	8
β-Neolactose phenylosazone	$C_{24}H_{32}O_9N_4$	520.54	195	....	....	..
Raffinose, $5H_2O$	$C_{18}H_{42}O_{21}$	594.52	80	+105.2	+62,540	4
α-l-Rhamnose, H_2O	$C_6H_{14}O_6$	182.17	93–94	−8.6 → +8.2	−1,570	4
β-l-Rhamnose	$C_6H_{12}O_5$	164.16	123–125	+38.4 → +8.9	+6,300	..
d-Ribose	$C_5H_{10}O_5$	150.13	87	−23.1 → −23.7[3] (1°)	−3,470	4
l-Sorbose	$C_6H_{12}O_6$	180.16	159–161	−43.7 → −43.4[5]	−7,870	12
Sucrose	$C_{12}H_{22}O_{11}$	342.30	188[6]	+66.53	+22,770	26
α-d-Talose	$C_6H_{12}O_6$	180.16	133–134	+68.0 → +20.8	+12,250	4
β-d-Talose	$C_6H_{12}O_6$	180.16	120–121	+13.2 → +21.0	+2,380	4
α-d-Xylose	$C_5H_{10}O_5$	150.13	145	+93.6 → +18.8	+14,050	4

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[1] Values extrapolated to zero time.

[2] Equilibrium rotation; no mutarotations recorded.

[3] Complex mutarotation.

[4] Calculated from values for anhydrous form.

[5] Small complex mutarotation.

[6] Crystallized from alcohol. Melting point depends upon solvent used in crystallization.

SPECIFIC ROTATION ($[\alpha]_D^{20}$) OF CERTAIN SUGARS AT VARIOUS CONCENTRATIONS

Concentration	Sucrose	Dextrose	Fructose	Maltose	Lactose hydrate
%					
5	66.500	52.607	−89.42	138.38	52.53
10	66.527	52.740	−90.72	138.29	
15	66.541	52.898	−92.01	138.20	
20	66.540	53.083	−93.30	138.11	
25	66.523	53.293	−94.59	138.02	
30	66.487	53.529	−95.88	137.92	Remains unchanged at all concentrations
35	66.432	53.791	−97.18	137.82	
40	66.351	54.079	−98.47	......	
45	66.245	54.393	....	......	
50	66.109	54.732	....	......	

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Eric A. Arnold

Compiled from the International atomic weights of 1954.

To facilitate the use of the table the group of substances weighed given under each element as well as the substances sought under each substance weighed are arranged in the alphabetical order of their formulae.

Weighed	Sought	Factor	Log of Factor + 10
Aluminum: $Al = 26.98$			
Al	Al_2O_3	1.8895	10.27636
	$AlPO_4$	4.5202	10.65516
Al_4C_3	Al_2O_3	1.4166	10.15124
$Al(C_9H_6ON)_3$	Al	0.058723	8.76881
	Al_2O_3	0.11045	9.04317
$AlCl_3$	Al_2O_3	0.38230	9.58240
AlF_3	CaF_2	1.3946	10.14446
Al_2O_3	Al	0.52923	9.72364
	Al_4C_3	0.70593	9.84876
	$AlCl_3$	2.6158	10.41760
	$AlPO_4$	2.3922	10.37880
	$Al_2(SO_4)_3$	3.3558	10.52580
	$Al_2(SO_4)_3 \cdot 18H_2O$	6.5363	10.81534
	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	9.3057	10.96875
	$(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	8.8926	10.94903
$AlPO_4$	Al	0.22123	9.34484
	Al_2O_3	0.41802	9.62120
	P_2O_5	0.58198	9.76491
$Al_2(SO_4)_3$	Al_2O_3	0.29799	9.47420
$Al_2(SO_4)_3 \cdot 18H_2O$	Al_2O_3	0.15299	9.18466
CaF_2	AlF_3	0.71704	9.85554
$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	Al_2O_3	0.10746	9.03125
$(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	Al_2O_3	0.11245	9.05097
P_2O_5	$AlPO_4$	1.7183	10.23509
Ammonium: $NH_4 = 18.040$			
Ag	NH_4Br	0.90801	9.95809
	NH_4Cl	0.49589	9.69539
	NH_4I	1.3436	10.12828
$AgBr$	NH_4Br	0.52161	9.71734
$AgCl$	NH_4Cl	0.37323	9.57197
AgI	NH_4I	0.61736	9.79054
$BaSO_4$	$(NH_4)_2SO_4$	0.56612	9.75290
Br	NH_4Br	1.2257	10.08840
Cl	NH_4	0.50879	9.70653
	NH_4Cl	1.5088	10.17863
HCl	NH_4Cl	1.4671	10.16645
I	NH_4I	1.1421	10.05772
$MgNH_4PO_4 \cdot 6H_2O$	NH_3	0.069396	8.84134
	NH_4	0.073503	8.86631
Ammonium:			
$MgNH_4PO_4 \cdot 6H_2O$	$(NH_4)_2O$	0.10610	9.02571
N	NH_3	1.2159	10.08489
	NH_4	1.2878	10.10986
	NH_4Cl	3.8190	10.58195
	NH_4NO_3	5.7145	10.75697
	$(NH_4)_2O$	1.8589	10.26926
	$(NH_4)_2SO_4$	4.7168	10.67365
NH_3	$MgNH_4PO_4 \cdot 6H_2O$	14.410	11.15866
	N	0.82245	9.91511
	NH_4	1.0592	10.02497
	NH_4Cl	3.1410	10.49706
	$(NH_4)_2CO_3$	2.8209	10.45039
	NH_4HCO_3	4.6418	10.66669
	NH_4NO_3	4.6999	10.67208
	$(NH_4)_2O$	1.5289	10.18438
	NH_4OH	2.0578	10.31340
	$(NH_4)_2PtCl_6$	13.036	11.11514
	$(NH_4)_2SO_4$	3.8793	10.58876
	N_2O_5	3.1710	10.50119
	Pt	5.7313	10.75825
	SO_3	2.3505	10.37115
NH_4	Cl	1.9655	10.29347
	$MgNH_4PO_4 \cdot 6H_2O$	13.605	11.13369
	N	0.77650	9.89014
	NH_3	0.94412	9.97503
	NH_4Cl	2.9655	10.47209
	$(NH_4)_2PtCl_6$	12.307	11.09017
	Pt	5.4110	10.73328
NH_4Br	Ag	1.1013	10.04191
	$AgBr$	1.9171	10.28266
	Br	0.81584	9.91160
NH_4Cl	Ag	2.0166	10.30461
	$AgCl$	2.6793	10.42803
	Cl	0.66278	9.82137
	HCl	0.68163	9.83355
	N	0.26185	9.41805
	NH_3	0.31837	9.50294
	NH_4	0.33722	9.52791
	$(NH_4)_2O$	0.48676	9.68731
	NH_4OH	0.65514	9.81633
	$(NH_4)_2PtCl_6$	4.1503	10.61807
	Pt	1.8247	10.26119
$(NH_4)_2CO_3$	NH_3	0.35450	9.54961
NH_4HCO_3	NH_3	0.21543	9.33331
NH_4I	Ag	0.74426	9.87172
	AgI	1.6198	10.20946
	I	0.87554	9.94228
NH_4NO_3	NH_3	0.21277	9.32792
	$(NH_4)_2PtCl_6$	2.7737	10.44305
	N_2O_5	0.67470	9.82911
	Pt	1.2195	10.08617

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Ammonium:			
$(NH_4)_2O$	$MgNH_4PO_4 \cdot 6H_2O$	9.4252	10.97429
	N	0.53794	9.73074
	NH_3	0.65407	9.81562
	NH_4Cl	2.0544	10.31269
	$(NH_4)_2PtCl_6$	8.5263	10.93076
	N_2O_5	2.0740	10.31682
	Pt	3.7487	10.57388
NH_4OH	N	0.39968	9.60171
	NH_3	0.48596	9.68660
	NH_4	0.51472	9.71157
	NH_4Cl	1.5264	10.18367
	$(NH_4)_2PtCl_6$	6.3349	10.80174
	Pt	2.7852	10.44485
$(NH_4)_2PtCl_6$	NH_3	0.076712	8.88486
	NH_4	0.081252	8.90983
	NH_4Cl	0.24095	9.38193
	NH_4NO_3	0.36054	9.55696
	$(NH_4)_2O$	0.11728	9.06924
	NH_4OH	0.15786	9.19826
	$(NH_4)_2SO_4$	0.29759	9.47362
$(NH_4)_2SO_4$	$BaSO_4$	1.7664	10.24710
	H_2SO_4	0.74222	9.87054
	N	0.21201	9.32635
	NH_3	0.25778	9.41124
	$(NH_4)_2PtCl_6$	3.3603	10.52638
	Pt	1.4774	10.16949
	SO_3	0.60589	9.78239
N_2O_5	NH_3	0.31536	9.49881
	NH_4NO_3	1.4822	10.17089
	$(NH_4)_2O$	0.48215	9.68318
Pt	NH_3	0.17448	9.24175
	NH_4	0.18481	9.26672
	NH_4Cl	0.54804	9.73881
	NH_4NO_3	0.82004	9.91383
	$(NH_4)_2O$	0.26676	9.42612
	NH_4OH	0.35904	9.55515
	$(NH_4)_2SO_4$	0.67687	9.83051
SO_3	NH_3	0.42545	9.62885
	$(NH_4)_2SO_4$	1.6505	10.21761
Antimony: $Sb = 121.76$			
$K(SbO)C_4H_4O_6 \cdot \frac{1}{2}H_2O$	Sb	0.36461	9.56183
	Sb_2O_3	0.43648	9.63996
	Sb_2O_4	0.46044	9.66317
	Sb_2S_3	0.50865	9.70641
Sb	$K(SbO)C_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.7426	10.43817
	Sb_2O_3	1.1971	10.07813
	Sb_2O_4	1.2628	10.10134
	Sb_2O_5	1.3285	10.12337
	Sb_2S_3	1.3950	10.14458
	Sb_2S_5	1.6584	10.21969
Antimony:			
Sb_2O_3	$K(SbO)C_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.2911	10.36004
	Sb	0.83535	9.92187
	Sb_2O_4	1.0549	10.02320
	Sb_2O_5	1.1098	10.04523
	Sb_2S_3	1.1653	10.06645
	Sb_2S_5	1.3853	10.14155
Sb_2O_4	$K(SbO)C_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.1719	10.33683
	Sb	0.79188	9.89866
	Sb_2O_3	0.94797	9.97680
	Sb_2O_5	1.0520	10.02203
	Sb_2S_3	1.1047	10.04325
	Sb_2S_5	1.3132	10.11835
Sb_2O_5	Sb	0.75272	9.87663
	Sb_2O_3	0.90109	9.95477
	Sb_2O_4	0.95054	9.97797
	Sb_2S_5	1.2483	10.09632
Sb_2S_3	$K(SbO)C_4H_4O_6 \cdot \frac{1}{2}H_2O$	1.9660	10.29359
	Sb	0.71683	9.85542
	Sb_2O_3	0.85812	9.93355
	Sb_2O_4	0.90522	9.95675
	Sb_2O_5	0.95232	9.97878
Sb_2S_5	Sb	0.60300	9.78031
	Sb_2O_3	0.72185	9.85845
	Sb_2O_4	0.76147	9.88165
	Sb_2O_5	0.80109	9.90368
Arsenic: $As = 74.91$			
As	As_2O_3	1.3204	10.12070
	As_2O_5	1.5340	10.18582
	As_2S_3	1.6421	10.21540
	As_2S_5	2.0702	10.31600
	$BaSO_4$	4.6741	10.66970
	$Mg_2As_2O_7$	2.0722	10.31644
	$Mg_2NH_4AsO_4 \cdot \frac{1}{2}H_2O$	2.5401	10.40485
AsO_3	$BaSO_4$	2.8487	10.45465
	$Mg_2As_2O_7$	1.2630	10.10139
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.5481	10.18980
AsO_4	$BaSO_4$	2.5206	10.40151
	$Mg_2As_2O_7$	1.1175	10.04824
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.3698	10.13666
As_2O_3	As	0.75736	9.87930
	As_2O_5	1.1618	10.06512
	As_2S_3	1.2436	10.09470
	As_2S_5	1.5678	10.19530
	$BaSO_4$	3.5400	10.54900
	$Mg_2As_2O_7$	1.5694	10.19574
	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O$	1.9237	10.28415
As_2O_5	As	0.65190	9.81418
	As_2O_3	0.86076	9.93488
	As_2S_3	1.0705	10.02958
	As_2S_5	1.3495	10.13018
	$BaSO_4$	3.0471	10.48388
	$Mg_2As_2O_7$	1.3509	10.13062

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Arsenic:			
As_2O_5	$MgNH_4AsO_4\cdot\frac{1}{2}H_2O$	1.6559	10.21903
As_2S_3	As	0.60898	9.78460
	As_2O_3	0.80409	9.90530
	As_2O_5	0.93416	9.97042
	As_2S_5	1.2607	10.10060
	$Mg_2As_2O_7$	1.2619	10.10104
As_2S_5	As	0.48306	9.68400
	As_2O_3	0.63782	9.80470
	As_2O_5	0.74100	9.86982
	As_2S_3	0.79322	9.89940
$BaSO_4$	As	0.21394	0.33030
	AsO_3	0.35103	9.54535
	AsO_4	0.39673	9.59849
	As_2O_3	0.28249	9.45100
	As_2O_5	0.32818	9.51612
$Mg_2As_2O_7$	As	0.48257	9.68356
	AsO_3	0.79179	9.89861
	AsO_4	0.89487	9.95176
	As_2O_3	0.63718	9.80426
	As_2O_5	0.74026	9.86938
	As_2S_3	0.79243	9.89896
$MgNH_4AsO_4\cdot\frac{1}{2}H_2O$	As	0.39369	9.59515
	AsO_3	0.64595	9.81020
	AsO_4	0.73004	9.86334
	As_2O_3	0.51982	9.71585
	As_2O_5	0.60391	9.78097
Barium:			
Ba = 137.36			
Ba	$BaCO_3$	1.4369	10.15742
	$BaCrO_4$	1.8446	10.26589
	$BaSiF_6$	2.0344	10.30844
	$BaSO_4$	1.6994	10.23029
$BaCl_2$	$BaCO_3$	0.94765	9.97665
	$BaCrO_4$	1.2165	10.08512
	$BaSO_4$	1.1208	10.04951
$BaCl_2\cdot 2H_2O$	$BaSO_4$	0.95547	9.98022
$BaCO_3$	Ba	0.69595	9.84258
	$BaCl_2$	1.0552	10.02335
	$BaCrO_4$	1.2837	10.10847
	$Ba(HCO_3)_2$	1.3143	10.11868
	BaO	0.77701	9.89043
	$BaSO_4$	1.1827	10.07287
	CO_2	0.22299	9.34828
$BaCrO_4$	Ba	0.54213	9.73411
	$BaCl_3$	0.82202	9.91488
	$BaCO_3$	0.77898	9.89153
	BaO	0.60528	9.78196
BaF_2	$BaSiF_6$	1.5936	10.20237
$Ba(HCO_3)_2$	$BaCO_3$	0.76088	9.88132
$Ba(NO_3)_2$	$BaSO_4$	0.89307	9.95088
BaO	$BaCO_3$	1.2870	10.10957
	$BaCrO_4$	1.6521	10.21804
	$BaSiF_6$	1.8222	10.26059
	$BaSO_4$	1.5221	10.18244
Barium:			
BaO	CO_2	0.28698	9.45785
BaO_2	$BaSO_4$	1.3783	10.13934
BaS	$BaSO_4$	1.3777	10.13917
$BaSiF_6$	Ba	0.49154	9.69156
	BaF_2	0.62752	9.79763
	BaO	0.54879	9.73941
$BaSO_4$	Ba	0.58845	9.76971
	$BaCl_2$	0.89225	9.95049
	$BaCl_2\cdot 2H_2O$	1.0466	10.01978
	$BaCO_3$	0.84554	9.92713
	$Ba(NO_3)_2$	1.1197	10.04912
	BaO	0.65700	9.81756
	BaO_2	0.72554	9.86066
	BaS	0.72582	9.86083
CO_2	$BaCO_3$	4.4846	10.65172
	BaO	3.4846	10.54215
Beryllium:			
Be = 9.013			
Be	BeO	2.7752	10.44330
$BeCl_2$	BeO	0.31295	9.49547
BeO	Be	0.36033	9.55670
	$BeCl_2$	3.1954	10.50453
	$BeSO_4\cdot 4H_2O$	7.0820	10.85016
$BeSO_4\cdot 4H_2O$	BeO	0.14120	9.14984
Bismuth:			
Bi = 209.00			
Bi	$BiAsO_4$	1.6646	10.22132
	Bi_2O_3	1.1148	10.04721
	BiOCl	1.2462	10.09559
	Bi_2S_3	1.2301	10.08995
$BiAsO_4$	Bi	0.60073	9.77868
	Bi_2O_3	0.66971	9.82589
$Bi(NO_3)_3\cdot 5H_2O$	Bi_2O_3	0.48031	9.68152
	BiOCl	0.53691	9.72990
Bi_2O_3	Bi	0.89700	9.95279
	$BiAsO_4$	1.4932	10.17411
	$Bi(NO_3)_3\cdot 5H_2O$	2.0820	10.31848
	BiOCl	1.1178	10.04838
	$BiONO_3$	1.2318	10.09054
	Bi_2S_3	1.1034	10.04274
BiOCl	Bi	0.80244	9.90441
	$Bi(NO_3)_3\cdot 5H_2O$	1.8625	10.27010
	Bi_2O_3	0.89458	9.95162
	$BiONO_3$	1.1019	10.04216
$BiONO_3$	Bi_2O_3	0.81182	9.90946
	BiOCl	0.90749	9.95784
Bi_2S_3	Bi	0.81292	9.91005
	Bi_2O_3	0.90627	9.95726
Boron:			
B = 10.82			
B	B_2O_3	3.2181	10.50760
	KBF_4	11.638	11.06587
BO_2	B_2O_3	0.81317	9.91018
BO_3	B_2O_3	0.59198	9.77230
B_2O_3	B	0.31074	9.49240
	BO_2	1.2298	10.08982
	BO_3	1.6893	10.22770

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Boron:			
B_2O_3	B_4O_7	1.1149	10.04723
	H_3BO_3	1.7761	10.24947
	KBF_4	3.6163	10.55827
	$Na_2B_4O_7 \cdot 10H_2O$	2.7385	10.43752
B_4O_7	B_2O_3	0.89696	9.95277
H_3BO_3	B_2O_3	0.56303	9.75053
	KBF_4	2.0361	10.30880
KBF_4	B	0.085928	8.93413
	B_2O_3	0.27652	9.44173
	H_3BO_3	0.49114	9.69120
	$Na_2B_4O_7 \cdot 10H_2O$	0.75727	9.87925
$Na_2B_4O_7 \cdot 10H_2O$	B_2O_3	0.36516	9.56248
	KBF_4	1.3205	10.12075
Bromine: Br = 79.916			
Ag	Br	0.74079	9.86969
	BrO_3	1.1857	10.07398
	HBr	0.75013	9.87514
AgBr	Br	0.42555	9.62895
	BrO_3	0.68114	9.83324
	HBr	0.43091	9.63439
AgCl	Br	0.55754	9.74628
Br	Ag	1.3499	10.13031
	AgBr	2.3499	10.37105
	AgCl	1.7936	10.25372
	O	0.10011	9.00046
BrO_3	Ag	0.84337	9.92602
	AgBr	1.4681	10.16676
HBr	Ag	1.3331	10.12486
	AgBr	2.3206	10.36561
O	Br	9.9895	10.99954
Cadmium: Cd = 112.41			
Cd	$CdCl_2$	1.6309	10.21241
	$Cd(NO_3)_2$	2.1032	10.32289
	CdO	1.1423	10.05779
	CdS	1.2853	10.10899
	$CdSO_4$	1.8546	10.26825
$CdCl_2$	Cd	0.61318	9.78759
	CdO	0.70045	9.84538
	CdS	0.78809	9.89658
	$CdSO_4$	1.1372	10.05584
$Cd(NO_3)_2$	Cd	0.47546	9.67711
	CdO	0.54313	9.73490
	CdS	0.61108	9.78610
	$CdSO_4$	0.88178	9.94536
CdO	Cd	0.87540	9.94221
	$CdCl_2$	1.4276	10.15462
	$Cd(NO_3)_2$	1.8412	10.26510
	CdS	1.1251	10.05120
	$CdSO_4$	1.6235	10.21046
CdS	Cd	0.77805	9.89101
	$CdCl_2$	1.2689	10.10342
	$Cd(NO_3)_2$	1.6364	10.21390
	CdO	0.88880	9.94880
	$CdSO_4$	1.4430	10.15926
$CdSO_4$	Cd	0.53920	9.73175
	$CdCl_2$	0.87935	9.94416
Cadmium:			
$CdSO_4$	$Cd(NO_3)_2$	1.1341	10.05464
	CdO	0.61595	9.78954
	CdS	0.69301	9.84074
Calcium: Ca = 40.08			
$BaSO_4$	CaS	0.30907	9.49006
	$CaSO_4$	0.58325	9.76586
	$CaSO_4 \cdot 2H_2O$	0.73761	9.86783
Ca	$CaCl_2$	2.7693	10.44237
	$CaCO_3$	2.4973	10.39747
	CaF_2	1.9481	10.28961
	CaO	1.3992	10.14588
	$CaSO_4$	3.3969	10.53108
	Cl	1.7693	10.24780
$Ca_3(AsO_4)_2$	$Mg_2As_2O_7$	0.77993	9.89206
$CaCl_2$	Ca	0.36110	9.55763
	$CaCO_3$	0.90177	9.95510
	CaO	0.50525	9.70351
	$CaSO_4$	1.2266	10.08871
	Cl	0.63890	9.80543
$CaCO_3$	Ca	0.40044	9.60253
	$CaCl_2$	1.1089	10.04490
	$Ca(HCO_3)_2$	1.6197	10.20944
	CaO	0.56029	9.74841
	$CaSO_4$	1.3602	10.13361
	$CaSO_4 \cdot 2H_2O$	1.7202	10.23558
	CO_2	0.43971	9.64317
	HCl	0.72864	9.86251
CaF_2	Ca	0.51332	9.71039
	$CaSO_4$	1.7437	10.24147
$Ca(HCO_3)_2$	$CaCO_3$	0.61740	9.79056
	CaO	0.34592	9.53898
$Ca(NO_3)_2$	N_2O_5	0.65825	9.81839
CaO	Ca	0.71469	9.85412
	$CaCl_2$	1.9792	10.29649
	$CaCO_3$	1.7848	10.25159
	CaF_2	1.3923	10.14373
	$Ca(HCO_3)_2$	2.8908	10.46102
	$Ca_3(PO_4)_2$	1.8437	10.26570
	$CaSO_4$	2.4277	10.38520
	$CaSO_4 \cdot 2H_2O$	3.0702	10.48717
	Cl	1.2645	10.10192
	CO_2	0.78479	9.89475
	MgO	0.71897	9.85671
	SO_3	1.4277	10.15464
$Ca_3(PO_4)_2$	CaO	0.54238	9.73430
	$CaSO_4$	1.3167	10.11950
	$Mg_2P_2O_7$	0.71759	9.85588
	$(NH_4)_3PO_4 \cdot 12MoO_3$	12.099	11.08275
	P_2O_5	0.45762	9.66051
CaS	$BaSO_4$	3.2355	10.50994
$CaSO_4$	$BaSO_4$	1.7145	10.23414
	Ca	0.29439	9.46892
	$CaCl_2$	0.81526	9.91129
	$CaCO_3$	0.73517	9.86639
	CaF_2	0.57350	9.75853
	CaO	0.41191	9.61480

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Calcium:			
$CaSO_4$	$Ca_3(PO_4)_2$	0.75945	9.88050
	SO_3	0.58809	9.76944
$CaSO_4\cdot 2H_2O$	$BaSO_4$	1.3557	10.13217
	$CaCO_3$	0.58132	9.76442
	CaO	0.32571	9.51283
	SO_3	0.46502	9.66747
$CaWO_4$	WO_3	0.80528	9.90595
Cl	Ca	0.56519	9.75220
	$CaCl_2$	1.5652	10.19457
	CaO	0.79082	9.89808
CO_2	$CaCO_3$	2.2742	10.35683
	CaO	1.2742	10.10525
HCl	$CaCO_3$	1.3724	10.13749
$Mg_2As_2O_7$	$Ca_3(AsO_4)_2$	1.2822	10.10794
MgO	CaO	1.3909	10.14329
$Mg_2P_2O_7$	$Ca_3(PO_4)_2$	1.3935	10.14412
$(NH_4)_3PO_4\cdot 12MoO_3$	$Ca_3(PO_4)_2$	0.082652	8.91725
N_2O_5	$Ca(NO_3)_2$	1.5192	10.18161
P_2O_5	$Ca_3(PO_4)_2$	2.1852	10.33949
SO_3	CaO	0.70042	9.84536
	$CaSO_4$	1.7004	10.23056
	$CaSO_4\cdot 2H_2O$	2.1505	10.33253
WO_3	$CaWO_4$	1.2418	10.09405
Carbon: $C = 12.011$			
Ag	CN	0.24118	9.38235
	HCN	0.25053	9.39886
	KCN	0.60362	9.78077
$AgCN$	CN	0.19432	9.28851
	HCN	0.20185	9.30502
	KCN	0.48633	9.68693
$AgCNS$	CNS	0.34998	9.54405
$BaCO_3$	C	0.060855	8.78430
	CO_2	0.22299	9.34828
	CO_3	0.30405	9.48295
BaO	CO_2	0.28698	9.45785
	CO_2 (bicarbonate)	0.57396	9.75888
$BaSO_4$	CNS	0.24884	9.39591
C	$BaCO_3$	16.433	11.21570
	CO_2	3.6642	10.56398
$CaCO_3$	CO_2	0.43971	9.64317
$Ca(HCO_3)_2$	CO_2	0.54295	9.73476
CaO	CO_2	0.78479	9.89475
	CO_2 (bicarbonate)	1.5696	10.19578
CN	Ag	4.1462	10.61765
	$AgCN$	5.1462	10.71149
CNS	$AgCNS$	2.8573	10.45595
	$BaSO_4$	4.0187	10.60409
	$CuCNS$	2.0939	10.32096
CO_2	$BaCO_3$	4.4846	10.65172
	$Ba(HCO_3)_2$	2.9470	10.46938
	BaO	3.4846	10.54215
	C	0.27291	9.43602
Carbon:			
CO_2	$CaCO_3$	2.2742	10.35683
	$Ca(HCO_3)_2$	1.8418	10.26524
	CaO	1.2742	10.10525
	CO_3	1.3635	10.13467
	Cs_2CO_3	7.4034	10.86943
	$CsHCO_3$	4.4064	10.64408
	$FeCO_3$	2.6325	10.42038
	$Fe(HCO_3)_2$	2.0209	10.30556
	K_2CO_3	3.1404	10.49698
	$KHCO_3$	2.2749	10.35696
	K_2O	2.1404	10.33049
	Li_2CO_3	1.6789	10.22503
	$LiHCO_3$	1.5441	10.18869
	Li_2O	0.67892	9.83182
	$MgCO_3$	1.9161	10.28243
	$Mg(HCO_3)_2$	1.6627	10.22083
	MgO	0.91613	9.96196
	$MnCO_3$	2.6119	10.41695
	$Mn(HCO_3)_2$	2.0106	10.30333
	MnO	1.6119	10.20733
	Na_2CO_3	2.4083	10.38172
	$NaHCO_3$	1.9088	10.28077
	Na_2O	1.4083	10.14870
	$(NH_4)_2CO_3$	2.1833	10.33912
	NH_4HCO_3	1.7963	10.25439
	$PbCO_3$	6.0717	10.78331
	Rb_2CO_3	5.2480	10.7200
	$RbHCO_3$	3.3287	10.52227
	Rb_2O	4.2480	10.62819
	$SrCO_3$	3.3546	10.52565
	$Sr(HCO_3)_2$	2.3820	10.37694
	SrO	2.3546	10.37192
CO_3	$BaCO_3$	3.2889	10.51705
	CO_2	0.73338	9.86533
Cs_2CO_3	CO_2	0.13507	9.13057
$CsHCO_3$	CO_2	0.22694	9.35592
$CuCNS$	CNS	0.47757	9.67904
$FeCO_3$	CO_2	0.37986	9.57962
$Fe(HCO_3)_2$	CO_2	0.49482	9.69444
HCN	Ag	3.9916	10.60114
	$AgCN$	4.9543	10.69498
KCN	Ag	1.6567	10.21923
	$AgCN$	2.0562	10.31307
K_2CO_3	CO_2	0.31843	9.50302
$KHCO_3$	CO_2	0.43959	9.64304
K_2O	CO_2	0.46721	9.66951
Li_2CO_3	CO_2	0.59562	9.77497
$LiHCO_3$	CO_2	0.64761	9.81131
Li_2O	CO_2	1.4729	10.16818
$MgCO_3$	CO_2	0.52188	9.71757
$Mg(HCO_3)_2$	CO_2	0.60142	9.77917
MgO	CO_2	1.0915	10.03804
$MnCO_3$	CO_2	0.38287	9.58305
$Mn(HCO_3)$	CO_2	0.49736	9.69667
MnO	CO_2	0.62040	9.79267
Na_2CO_3	CO_2	0.41523	9.61828

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Carbon:			
$NaHCO_3$	CO_2	0.52388	9.71923
Na_2O	CO_2	0.71006	9.85130
$(NH_4)_2CO_3$	CO_2	0.45801	9.66088
NH_4HCO_3	CO_2	0.55669	9.74561
$PbCO_3$	CO_2	0.16470	9.21669
Rb_2CO_3	CO_2	0.19055	9.28000
$RbHCO_3$	CO_2	0.30042	9.47773
Rb_2O	CO_2	0.23540	9.37181
$SrCO_3$	CO_2	0.29809	9.47435
$Sr(HCO_3)_2$	CO_2	0.41982	9.62306
SrO	CO_2	0.42469	9.62808
Cerium:			
Ce = 140.13			
Ce	$Ce_2(C_2O_4)_3 \cdot 3H_2O$	2.1351	10.32941
	$Ce(NO_3)_4$	2.7700	10.44248
	$Ce(NO_3)_4(NH_4NO_3)_2 \cdot H_2O$	4.0411	10.60650
	CeO_2	1.2284	10.08933
	Ce_2O_3	1.1713	10.06866
	$Ce_2(SO_4)_3$	2.0283	10.30714
$Ce_2(C_2O_4)_3 \cdot 3H_2O$	Ce	0.46837	9.67059
	$Ce_2(SO_4)_3$	0.95000	9.97773
$Ce(NO_3)_4$	Ce	0.36101	9.55752
	CeO_2	0.44345	9.64684
	Ce_2O_3	0.42284	9.62617
$Ce(NO_3)_4(NH_4NO_3)_2 \cdot H_2O$	Ce	0.24746	9.39350
	CeO_2	0.30397	9.48283
	Ce_2O_3	0.28984	9.46216
CeO_2	Ce	0.81409	9.91067
	$Ce(NO_3)_4$	2.2551	10.35316
	$Ce(NO_3)_4(NH_4NO_3)_2 \cdot H_2O$	3.2898	10.51717
	Ce_2O_3	0.95352	9.97933
Ce_2O_3	Ce	0.85377	9.93134
	$Ce(NO_3)_4$	2.3650	10.37383
	$Ce(NO_3)_4(NH_4NO_3)_2 \cdot H_2O$	3.4502	10.53784
	CeO_2	1.0487	10.02067
	$Ce_2(SO_4)_3$	1.7317	10.23848
$Ce_2(SO_4)_3$	Ce	0.49302	9.69286
	$Ce_2(C_2O_4)_3 \cdot 3H_2O$	1.0526	10.02227
	Ce_2O_3	0.57746	9.76152
Cesium:			
Cs = 132.91			
$AgCl$	$CsCl$	1.1746	10.06990
Cl	Cs	3.7485	10.57386
	$CsCl$	4.7485	10.67655
Cs	Cl	0.26677	9.42614
	$CsCl$	1.2668	10.10270
Cesium:			
Cs	Cs_2CO_3	1.2258	10.08840
	Cs_2O	1.0602	10.02538
	Cs_2PtCl_6	2.5348	10.40394
	Cs_2SO_4	1.3614	10.13398
$CsCl$	$AgCl$	0.85134	9.93010
	Cl	0.21059	9.32345
	Cs	0.78941	9.89730
	Cs_2O	0.83692	9.92268
	Cs_2PtCl_6	2.0010	10.30124
	Cs_2SO_4	1.0747	10.03128
Cs_2CO_3	Cs	0.81582	9.91160
	Cs_2PtCl_6	2.0679	10.31553
	Cs_2SO_4	1.1107	10.04558
$CsClO_4$	Cs	0.57198	9.75738
	$CsCl$	0.72457	9.86008
	Cs_2CO_3	0.70111	9.84579
	Cs_2O	0.60641	9.78277
	Cs_2SO_4	0.77869	9.89137
Cs_2O	Cs	0.94323	9.97462
	$CsCl$	1.1949	10.07732
	Cs_2PtCl_6	2.3909	10.37855
	Cs_2SO_4	1.2841	10.10860
	SO_3	0.28410	9.45348
Cs_2PtCl_6	Cs	0.39451	9.59606
	$CsCl$	0.49976	9.69876
	Cs_2CO_3	0.48358	9.68447
	Cs_2O	0.41826	9.62145
Cs_2SO_4	Cs	0.73454	9.86602
	$CsCl$	0.93050	9.96872
	Cs_2CO_3	0.90037	9.95442
	Cs_2O	0.77875	9.89140
SO_3	Cs_2O	3.5198	10.54652
	Cs_2SO_4	4.5198	10.65512
Chlorine:			
Cl = 35.457			
Ag	Cl	0.32867	9.51676
	HCl	0.33801	9.52894
$AgCl$	Cl	0.24737	9.39334
	ClO_3	0.58224	9.76510
	ClO_4	0.69387	9.84128
	HCl	0.25440	9.40552
$BaCrO_4$	Cl	0.27988	9.44698
Ca	Cl	1.7693	10.24780
Cl	Ag	3.0426	10.48324
	$AgCl$	4.0426	10.60666
	$BaCrO_4$	3.5729	10.55302
	Ca	0.56519	9.75220
	HCl	1.0284	10.01217
	K	1.1027	10.04247
	KCl	2.1027	10.32279
	Li	0.19573	9.29166
	Mg	0.34295	9.53523
	$MgCl_2$	1.3430	10.12806
	MnO_2	1.2260	10.08849
	Na	0.64842	9.81186
	$NaCl$	1.6484	10.21707
	NH_4	0.50879	9.70653
	$PbCrO_4$	4.5579	10.65877

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Chlorine:			
ClO_3	$AgCl$	1.7175	10.23490
	KCl	0.89336	9.95103
	$NaCl$	0.70034	9.84531
ClO_4	$AgCl$	1.4412	10.15872
	KCl	0.74964	9.87485
	$NaCl$	0.58767	9.76913
HCl	Ag	2.9585	10.47106
	$AgCl$	3.9308	10.59448
	NH_4Cl	1.4671	10.16645
	$(NH_4)_2SO_4$	1.8120	10.25815
K	Cl	0.90683	9.95753
KCl	Cl	0.47557	9.67721
	ClO_3	1.1194	10.04897
KCl	ClO_4	1.3340	10.12515
Li	Cl	5.1091	10.70834
Mg	Cl	2.9159	10.46477
$MgCl_2$	Cl	0.74463	9.87194
MnO_2	Cl	0.81567	9.91151
Na	Cl	1.5422	10.18814
$NaCl$	Cl	0.60664	9.78293
	ClO_3	1.4279	10.15469
	ClO_4	1.7016	10.23087
NH_4	Cl	1.9655	10.29347
NH_4Cl	HCl	0.68163	9.83355
$(NH_4)_2SO_4$	HCl	0.55189	9.74185
$PbCrO_4$	Cl	0.21940	9.34123
Chromium: $Cr = 52.01$			
$BaCrO_4$	Cr	0.20527	9.31233
	CrO_3	0.39472	9.59629
	CrO_4	0.45787	9.66074
	Cr_2O_3	0.30000	9.47712
	$Cr_2(SO_4)_3 \cdot 18H_2O$	1.4140	10.15043
	$PbCrO_4$	1.2757	10.10574
Cr	$BaCrO_4$	4.8716	10.68767
	Cr_2O_3	1.4614	10.16478
	$PbCrO_4$	6.2146	10.79341
CrO_3	$BaCrO_4$	2.5334	10.40371
	Cr	0.52005	9.71604
	Cr_2O_3	0.76002	9.88083
	K_2CrO_4	1.9419	10.28823
	$K_2Cr_2O_7$	1.4710	10.16760
	$PbCrO_4$	3.2319	10.50945
CrO_4	$BaCrO_4$	2.1840	10.33926
	$PbCrO_4$	2.7861	10.44500
Cr_2O_3	$BaCrO_4$	3.3334	10.52288
	Cr	0.68425	9.83522
	CrO_3	1.3157	10.11917
	CrO_4	1.5262	10.18362
	$PbCrO_4$	4.2523	10.62863
$Cr_2(SO_4)_3 \cdot 18H_2O$	$BaCrO_4$	0.70724	9.84957
	$PbCrO_4$	0.90221	9.95531
K_2CrO_4	CrO_3	0.51496	9.71177
	$PbCrO_4$	1.6643	10.22123
$K_2Cr_2O_7$	CrO_3	0.67983	9.83240
	$PbCrO_4$	2.1971	10.34186
$PbCrO_4$	Cr	0.16091	9.20659
Chromium:			
$PbCrO_4$	CrO_3	0.30942	9.49055
	CrO_4	0.35892	9.55500
	Cr_2O_3	0.23516	9.37137
	$Cr_2(SO_4)_3 \cdot 18H_2O$	1.1084	10.04469
	K_2CrO_4	0.60086	9.77877
	$K_2Cr_2O_7$	0.45514	9.65814
Cobalt: $Co = 58.94$			
Co	$Co(NO_3)_2 \cdot 6H_2O$	4.9381	10.69356
	$Co(NO_2)_3 \cdot (KNO_2)_3$	7.6737	10.88501
	CoO	1.2715	10.10430
	Co_3O_4	1.3620	10.13416
	$CoSO_4$	2.6299	10.41994
	$CoSO_4 \cdot 7H_2O$	4.7696	10.67848
	$(CoSO_4)_2(K_2SO_4)_3$	7.0649	10.84911
$Co(NO_3)_2 \cdot 6H_2O$	Co	0.20251	9.30644
$Co(NO_2)_3(KNO_2)_3$	Co	0.13032	9.11499
	CoO	0.16569	9.21930
CoO	Co	0.78650	9.89570
	$Co(NO_2)_3(KNO_2)_3$	6.0353	10.78070
	Co_3O_4	1.0712	10.02986
	$CoSO_4$	2.0684	10.31563
	$(CoSO_4)_2(K_2SO_4)_3$	5.5565	10.74480
Co_3O_4	Co	0.73424	9.86584
	CoO	0.93356	9.97014
$Co_2P_2O_7$	Co	0.40393	9.60631
	CoO	0.51359	9.71061
	Co_3O_4	0.55014	9.74047
	$CoSO_4$	1.0623	10.02625
	$CoSO_4 \cdot 7H_2O$	1.9266	10.28479
$CoSO_4$	Co	0.38024	9.58006
	CoO	0.48347	9.68437
$CoSO_4 \cdot 7H_2O$	Co	0.20966	9.32152
	CoO	0.26658	9.42583
$(CoSO_4)_2(K_2SO_4)_3$	Co	0.14154	9.15089
	CoO	0.17997	9.25520
Columbium	See Niobium (Nb)		
Copper: $Cu = 63.54$			
Cu	$Cu_2C_2H_3O_2 \cdot (AsO_2)_3$	3.9885	10.60081
	$CuCNS$	1.9141	10.28198
	CuO	1.2518	10.09754
	Cu_2O	1.1259	10.05150
	Cu_2S	1.2523	10.09772

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Copper:			
Cu	$CuSO_4{\cdot}5H_2O$	3.9296	10.59435
$CuC_2H_3O_2{\cdot}(AsO_2)_3$	Cu	0.25072	9.39919
	$Mg_2As_2O_7$	0.91878	9.96321
CuCNS	Cu	0.52243	9.71802
	CuO	0.65398	9.81556
CuO	Cu	0.79884	9.90246
	CuCNS	1.5291	10.18444
	Cu_2S	1.0004	10.00018
	$CuSO_4{\cdot}5H_2O$	3.1391	10.49681
Cu_2O	Cu	0.88817	9.94850
	CuO	1.1118	10.04604
	Cu_2S	1.1123	10.04622
Cu_2S	Cu	0.79851	9.90228
	CuO	0.99959	9.99982
	Cu_2O	0.89905	9.95378
	$CuSO_4{\cdot}5H_2O$	3.1378	10.49663
$CuSO_4{\cdot}5H_2O$	Cu	0.25448	9.40565
	CuO	0.31856	9.50319
	Cu_2S	0.31869	9.50337
$Mg_2As_2O_7$	$Cu_2C_2H_3O_2{\cdot}(AsO_2)_3$	1.0884	10.03679
Erbium: Er = 167.2			
Er	Er_2O_3	1.1435	10.05825
Er_2O_3	Er	0.87448	9.94175
Fluorine: F = 19.00			
BaF_2	$BaSiF_6$	1.5936	10.20237
$BaSiF_6$	BaF_2	0.62752	9.79763
	F	0.40794	9.61060
	HF	0.42959	9.63305
	H_2SiF_6	0.51568	9.71238
	SiF_4	0.37248	9.57110
	SiF_6	0.50846	9.70626
CaF_2	F	0.48668	9.68724
	6HF	0.51250	9.70969
	H_2SiF_6	0.61521	9.78902
	SiF_6	0.60660	9.78290
$CaSO_4$	F	0.27911	9.44578
	HF	0.29392	9.46823
F	$BaSiF_6$	2.4513	10.38940
	CaF_2	2.0547	10.31276
	$CaSO_4$	3.5828	10.55422
	H_2SiF_6	1.2641	10.10178
	K_2SiF_6	1.9324	10.28609
HF	$BaSiF_6$	2.3278	10.36695
	CaF_2	1.9512	10.29031
	$CaSO_4$	3.4023	10.53177
	K_2SiF_6	1.8350	10.26364
2HF	H_2SiF_6	3.6012	10.55645
6HF	H_2SiF_6	1.2004	10.07933
H_2SiF_6	$BaSiF_6$	1.9392	10.28762
	CaF_2	1.6255	10.21098
	F	0.79108	9.89822
	2HF	0.27768	9.44355
	6HF	0.83305	9.92067
	K_2SiF_6	1.5287	10.18431
Fluorine:			
H_2SiF_6	SiF_4	0.72232	9.85873
	SiF_6	0.98601	9.99388
2KF	K_2SiF_6	1.8958	10.27779
K_2SiF_6	F	0.51750	9.71391
	6HF	0.54495	9.73636
	H_2SiF_6	0.65417	9.81569
	KF	0.52749	9.72221
	SiF_6	0.64501	9.80957
Na_2SiF_6	F	0.60615	9.78258
	6HF	0.63831	9.80503
	H_2SiF_6	0.76623	9.88436
	2NaF	0.44654	9.64986
	SiF_4	0.55346	9.74308
	SiF_6	0.75551	9.87824
SiF_4	$BaSiF_6$	2.6847	10.42890
	H_2SiF_6	1.3844	10.14127
SiF_6	$BaSiF_6$	1.9667	10.29374
	CaF_2	1.6485	10.21710
	H_2SiF_6	1.0142	10.00612
	K_2SiF_6	1.5504	10.19043
Gallium: Ga = 69.72			
Ga	Ga_2O_3	1.3442	10.12847
	Ga_2S_3	1.6899	10.22786
Ga_2O_3	Ga	0.74392	9.87153
Ga_2S_3	Ga	0.59176	9.77214
Germanium: Ge = 72.60			
Ge	GeO_2	1.4408	10.15860
	K_2GeF_6	3.6474	10.56198
GeO_2	Ge	0.69407	9.84140
K_2GeF_6	Ge	0.27417	9.43802
Gold: Au = 197.0			
Au	$AuCl_3$	1.5400	10.18751
	$HAuCl_4{\cdot}4H_2O$	2.0909	10.32033
	$KAu(CN)_4{\cdot}H_2O$	1.8182	10.25965
$AuCl_3$	Au	0.64937	9.81249
$HAuCl_4{\cdot}4H_2O$	Au	0.47827	9.67967
$KAu(CN)_4{\cdot}H_2O$	Au	0.54998	9.74035
Hydrogen: H = 1.0080			
AgCNS	HCNS	0.35606	9.55152
$BaSO_4$	HCNS	0.25316	9.40339
CuCNS	HCNS	0.48586	9.68651
H	H_2O	8.9365	10.95117
	O	7.9365	10.89963
HCNS	AgCNS	2.8085	10.44848
	$BaSO_4$	3.9501	10.59661
	CuCNS	2.0582	10.31349
H_2O	H	0.11190	9.04883
O	H	0.12600	9.10037

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Indium: In = 114.76			
In	In_2O_3	1.2091	10.08247
	In_2S_3	1.4191	10.15202
In_2O_3	In	0.82704	9.91753
In_2S_3	In	0.70466	9.84798
Iodine: I = 126.91			
Ag	HI	1.1857	10.07399
	I	1.1764	10.07055
AgCl	I	0.88540	9.94714
AgI	HI	0.54482	9.73625
	I	0.54053	9.73282
	IO_3	0.74496	9.87213
	IO_4	0.81311	9.91015
	I_2O_5	0.71089	9.85180
	I_2O_7	0.77904	9.89156
HI	Ag	0.84335	9.92601
	AgI	1.8355	10.26375
	Pd	0.41706	9.62020
	PdI_2	1.4092	10.14897
	TlI	2.5899	10.41329
I	Ag	0.85005	9.92945
	AgCl	1.1294	10.05286
	AgI	1.8501	10.26718
	Pd	0.42038	9.62364
	PdI_2	1.4204	10.15240
	TlI	2.6105	10.41673
IO_3	AgI	1.3423	10.12787
	PdI_2	1.0306	10.01308
	TlI	1.8941	10.27741
IO_4	AgI	1.2298	10.08985
	PdI_2	0.94421	9.97507
	TlI	1.7354	10.23939
I_2O_5	AgI	1.4067	10.14820
	PdI_2	1.0800	10.03342
	TlI	1.9849	10.29774
I_2O_7	AgI	1.2836	10.10844
	PdI_2	0.98551	9.99366
	TlI	1.8113	10.25798
Pd	HI	2.3977	10.37980
	I	2.3788	10.37636
PdI_2	HI	0.70963	9.85103
	I	0.70404	9.84760
	IO_3	0.97032	9.98692
	IO_4	1.0591	10.02493
	I_2O_5	0.92594	9.96658
	I_2O_7	1.0147	10.00634
TlI	HI	0.38611	9.58671
	I	0.38307	9.58327
	IO_3	0.52795	9.72259
	IO_4	0.57625	9.76061
	I_2O_5	0.50380	9.70226
	I_2O_7	0.55210	9.74202
Iron Fe = 55.85			
Ag	$Fe_7(CN)_{18}$ Prussian Blue	0.44251	9.64593
CN	$Fe_7(CN)_{18}$	1.8348	10.26358

Weighed	Sought	Factor	Log of Factor + 10
Iron:			
CO_2	$FeCO_3$	2.6325	10.42038
	$Fe(HCO_3)_2$	2.0209	10.30556
	FeO	1.6325	10.21287
Fe	$Fe(HCO_3)_2$	3.1851	10.50312
	FeO	1.2865	10.10940
	Fe_2O_3	1.4297	10.15525
	$FePO_4$	2.7005	10.43145
	FeS	1.5741	10.19704
	$FeSO_4$	2.7201	10.43458
	$FeSO_4 \cdot 7H_2O$	4.9781	10.69707
	$FeSO_4 \cdot (NH_4)_2 SO_4 \cdot 6H_2O$	7.0216	10.84644
$FeAsO_4$	$Mg_2As_2O_7$	0.79703	9.90148
$FeCl_3$	Fe_2O_3	0.49223	9.69217
$Fe_7(CN)_{18}$	Ag	2.2598	10.35407
	CN	0.54503	9.73642
$FeCO_3$	CO_2	0.37986	9.57962
	FeO	0.62014	9.79249
	Fe_2O_3	0.68919	9.83834
$Fe(HCO_3)_2$	CO_2	0.49482	9.69445
	Fe	0.31396	9.49688
	FeO	0.40391	9.60628
	Fe_2O_3	0.44888	9.65213
FeO	CO_2	0.61254	9.78713
	Fe	0.77731	9.89060
	$FeCO_3$	1.6125	10.20751
	$Fe(HCO_3)_2$	2.4758	10.39372
	Fe_2O_3	1.1113	10.04585
	$FePO_4$	2.0992	10.32205
	FeS	1.2236	10.08764
	SO_3	1.1143	10.04702
Fe_2O_3	Fe	0.69944	9.84475
	$FeCl_3$	2.0316	10.30783
	$FeCO_3$	1.4510	10.16166
	$Fe(HCO_3)_2$	2.2278	10.34787
	$Fe(HCO_3)_3$	2.9919	10.47595
	FeO	0.89981	9.95415
	Fe_3O_4	0.96660	9.98525
	$FePO_4$	1.8889	10.27620
	FeS	1.1010	10.04179
	$FeSO_4$	1.0925	10.27933
	$FeSO_4 \cdot 7H_2O$	3.4819	10.54181
	$FeSO_4 \cdot (NH_4)_2 SO_4 \cdot 6H_2O$	4.9112	10.69119
	$Fe_2(SO_4)_3$	2.5041	10.39864
Fe_3O_4	Fe_2O_3	1.0345	10.01475
$FePO_4$	Fe	0.37030	9.56855
	FeO	0.47638	9.67795
	Fe_2O_3	0.52942	9.72380
FeS	Fe	0.63527	9.80296
	FeO	0.81726	9.91236
	Fe_2O_3	0.90825	9.95821
$FeSO_4$	Fe	0.36764	9.56542
	Fe_2O_3	0.52562	9.72067
	SO_3	0.52704	9.72184
$FeSO_4 \cdot 7H_2O$	Fe	0.20088	9.30293
	Fe_2O_3	0.28720	9.45819

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Iron:			
$FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	Fe	0.14242	9.15356
	Fe_2O_3	0.20362	9.30881
$Fe_2(SO_4)_3$	Fe_2O_3	0.39935	9.60136
$Mg_2As_2O_7$	$FeAsO_4$	1.2547	10.09852
SO_3	FeO	0.89738	9.95298
	$FeSO_4$	1.8974	10.27816
Lanthanum: La = 138.92			
La	La_2O_3	1.1728	10.06921
La_2O_3	La	0.85269	9.93079
Lead: Pb = 207.21			
$BaSO_4$	$PbSO_4$	1.2992	10.11369
Pb	$PbCl_2$	1.3422	10.12783
	$PbCO_3$	1.2896	10.11046
	$(PbCO_3)_2 \cdot Pb(OH)_2$	1.2478	10.09614
	$PbCrO_4$	1.5599	10.19309
	PbO	1.0772	10.03230
	PbO_2	1.1544	10.06237
	$Pb(OH)_2$	1.1642	10.06601
	PbS	1.1548	10.06249
	$PbSO_4$	1.4636	10.16543
$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	$PbCrO_4$	0.85204	9.93046
	$PbSO_4$	0.79946	9.90280
$PbCl_2$	Pb	0.74503	9.87217
	PbO	0.80256	9.90448
$PbCO_3$	Pb	0.77543	9.88954
	PbO	0.83530	9.92184
	$PbSO_4$	1.1349	10.05497
$(PbCO_3)_2 \cdot Pb(OH)_2$	Pb	0.80141	9.90386
	$PbCrO_4$	1.2501	10.09694
	$PbSO_4$	1.1730	10.06928
$PbCrO_4$	Pb	0.64108	9.80691
	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	1.1737	10.06954
	$(PbCO_3)_2 \cdot Pb(OH)_2$	0.79994	9.90306
	PbO	0.69058	9.83922
	Pb_3O_4	0.70708	9.84947
	$PbSO_4$	0.93830	9.97234
$Pb(NO_3)_2$	PbO	0.67389	9.82859
	PbO_2	0.72220	9.85865
	$PbSO_4$	0.91562	9.96171
PbO	Pb	0.92832	9.96770
	$PbCl_2$	1.2460	10.09552
	$PbCO_3$	1.1972	10.07816
	$PbCrO_4$	1.4481	10.16078
	$Pb(NO_3)_2$	1.4839	10.17141
	PbO_2	1.0717	10.03007
	PbS	1.0720	10.03019
	$PbSO_4$	1.3587	10.13312
Lead:			
PbO_2	Pb	0.86623	9.93763
	$Pb(NO_3)_2$	1.3847	10.14135
	PbO	0.93311	9.96993
	$PbSO_4$	1.2678	10.10306
Pb_3O_4	$PbCrO_4$	1.4143	10.15053
	$PbSO_4$	1.3270	10.12287
$Pb(OH)_2$	Pb	0.85899	9.93399
PbS	Pb	0.86599	9.93751
	PbO	0.93286	9.96981
	$PbSO_4$	1.2675	10.10294
$PbSO_4$	$BaSO_4$	0.76968	9.88631
	Pb	0.68324	9.83457
	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	1.2508	10.09720
	$PbCO_3$	0.88111	9.94503
	$(PbCO_3)_2 \cdot Pb(OH)_2$	0.85254	9.93072
	$PbCrO_4$	1.0658	10.02766
	$Pb(NO_3)_2$	1.0922	10.03829
	PbO	0.73600	9.86688
	PbO_2	0.78875	9.89694
	Pb_3O_4	0.75358	9.87713
	PbS	0.78897	9.89706
Lithium: Li = 6.940			
CO_2	Li_2CO_3	1.6789	10.22503
	$LiHCO_3$	1.5441	10.18869
	Li_2O	0.67892	9.83182
Li	LiCl	6.1091	10.78598
	Li_2CO_3	5.3236	10.72620
	Li_2O	2.1527	10.33299
	Li_3PO_4	5.5617	10.74521
	Li_2SO_4	7.9212	10.89879
LiCl	Li	0.16369	9.21402
	Li_2CO_3	0.87142	9.94023
	Li_2O	0.35238	9.54702
	Li_3PO_4	0.91040	9.95923
	Li_2SO_4	1.2966	10.11281
Li_2CO_3	CO_2	0.59562	9.77497
	Li	0.18784	9.27380
	LiCl	1.1476	10.05977
	$LiHCO_3$	1.8394	10.26469
	Li_2O	0.40438	9.60679
	Li_3PO_4	1.0447	10.01901
$LiHCO_3$	CO_2	0.64761	9.81131
	Li_2CO_3	0.54364	9.73531
	Li_2O	0.21984	9.34210
	Li_3PO_4	0.56797	9.75432
Li_2O	CO_2	1.4729	10.16818
	Li	0.46452	9.66701
	LiCl	2.8378	10.45298
	Li_2CO_3	2.4729	10.39321
	$LiHCO_3$	4.5488	10.65790
	Li_3PO_4	2.5836	10.41222
	Li_2SO_4	3.6796	10.56580
	SO_3	2.6796	10.42807
Li_3PO_4	Li	0.17980	9.25479
	LiCl	1.0984	10.04077
	Li_2CO_3	0.95718	9.98099
	$LiHCO_3$	1.7607	10.24568

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Lithium:			
Li_3PO_4	Li_2O	0.38706	9.58778
	Li_2SO_4	1.4242	10.15358
	$Li_2SO_4 \cdot H_2O$	1.6576	10.21948
$LiSO_4$	Li	0.12624	9.10121
	$LiCl$	0.77123	9.88719
	Li_2O	0.27177	9.43420
	Li_3PO_4	0.70213	9.84642
	SO_3	0.72823	9.86227
$LiSO_4 \cdot H_2O$	Li_3PO_4	0.60328	9.78052
SO_3	Li_2O	0.37319	9.57193
	Li_2SO_4	1.3732	10.13773
Magnesium: $Mg = 24.32$			
$BaSO_4$	$MgSO_4$	0.51574	9.71243
	$MgSO_4 \cdot 7H_2O$	1.0560	10.02366
Br	Mg	0.15216	9.18230
	$MgBr_2$	1.1522	10.06151
	$MgBr_2 \cdot 6H_2O$	1.8285	10.26209
Cl	Mg	0.34295	9.53523
	$MgCl_2$	1.3430	10.12806
	$MgCl_2 \cdot 6H_2O$	2.8673	10.45747
CO_2	$MgCO_3$	1.9161	10.28243
	MgO	0.91613	9.96196
I	Mg	0.095816	8.98144
	MgI_2	1.0958	10.03974
Mg	Br	6.5720	10.81770
	Cl	2.9159	10.46477
	I	10.437	11.01856
	$MgCO_3$	3.4676	10.54002
	MgO	1.6579	10.21956
	$Mg_2P_2O_7$	4.5763	10.66051
	$MgSO_4$	4.9501	10.69461
$MgBr_2$	Br	0.86794	9.93849
$MgBr_2 \cdot 6H_2O$	Br	0.54691	9.73791
$Mg(C_9H_6NO)_2$	Mg	0.077792	8.89093
Mg-oxinate	$MgBr_2$	0.58904	9.77015
	$MgBr_2 \cdot 6H_2O$	0.93480	9.97072
	$MgCO_3$	0.26975	9.43096
	$MgCl_2$	0.30462	9.48376
	$MgCl_2 \cdot 6H_2O$	0.65039	9.81317
	$Mg(HCO_3)_2$	0.46815	9.67039
	MgO	0.12897	9.11049
	$MgSO_4$	0.38507	9.58555
	$MgSO_4 \cdot 7H_2O$	0.78847	9.89678
$MgCl_2$	Cl	0.74463	9.87194
	$Mg_2P_2O_7$	1.1686	10.06768
$MgCl_2 \cdot 6H_2O$	Cl	0.34876	9.54253
	$Mg_2P_2O_7$	0.54736	9.73827
$MgCl_2 \cdot KCl \cdot 6H_2O$	$Mg_2P_2O_7$	0.40050	9.60261
$MgCO_3$	CO_2	0.52188	9.71757
	Mg	0.28839	9.45998
	$Mg(HCO_3)_2$	1.7355	10.23943
Magnesium:			
$MgCO_3$	MgO	0.47812	9.67953
	$Mg_2P_2O_7$	1.3197	10.12049
$Mg(HCO_3)_2$	$MgCO_3$	0.57620	9.76057
	MgO	0.27549	9.44010
	$Mg_2P_2O_7$	0.76043	9.88106
MgI_2	I	0.91256	9.96026
MgO	CO_2	1.0915	10.03804
	Mg	0.60317	9.78044
	$MgCO_3$	2.0915	10.32047
	$Mg(HCO_3)_2$	3.6299	10.55990
	$Mg_2P_2O_7$	2.7603	10.44096
	$MgSO_4$	2.9858	10.47506
	SO_3	1.9858	10.29793
$Mg_2P_2O_7$	Mg	0.21852	9.33949
	$MgCl_2$	0.85569	9.93232
	$MgCl_2 \cdot 6H_2O$	1.8269	10.26173
	$MgCl_2 \cdot KCl \cdot 6H_2O$	2.4969	10.39739
	$MgCO_3$	0.75773	9.87951
	$Mg(HCO_3)_2$	1.3150	10.11894
	MgO	0.36228	9.55904
	$MgSO_4$	1.0817	10.03410
	$MgSO_4 \cdot 7H_2O$	2.2148	10.34534
$MgSO_4$	$BaSO_4$	1.9390	10.28757
	Mg	0.20202	9.30539
	MgO	0.33492	9.52494
	$Mg_2P_2O_7$	0.92448	9.96590
	SO_3	0.66508	9.82287
$MgSO_4 \cdot 7H_2O$	$BaSO_4$	0.94697	9.97634
	$Mg_2P_2O_7$	0.45150	9.65466
	SO_3	0.32481	9.51163
SO_3	MgO	0.50358	9.70207
	$MgSO_4$	1.5036	10.17713
	$MgSO_4 \cdot 7H_2O$	3.0787	10.48837
Manganese: $Mn = 54.94$			
$BaSO_4$	$MnSO_4$	0.64691	9.81084
CO_2	$MnCO_3$	2.6119	10.41695
	MnO	1.6119	10.20733
Mn	$MnCO_3$	2.0923	10.32062
	MnO	1.2912	10.11100
	MnO_2	1.5825	10.19933
	Mn_2O_3	1.4368	10.15741
	Mn_3O_4	1.3883	10.14248
	$Mn_2P_2O_7$	2.5830	10.41214
$MnCO_3$	CO_2	0.38287	9.58305
	Mn	0.47794	9.67938
	$Mn(HCO_3)_2$	1.5396	10.18741
	MnO	0.61713	9.79038
	Mn_3O_4	0.66353	9.82186
	$Mn_2P_2O_7$	1.2346	10.09152
	MnS	0.75690	9.87904
	$MnSO_4$	1.3137	10.11848
$Mn(HCO_3)_2$	$MnCO_3$	0.64952	9.81259
	MnO	0.40084	9.60297
	Mn_3O_4	0.43098	9.63445

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Manganese:			
MnO	CO_2	0.62040	9.79267
	Mn	0.77446	9.88900
	$MnCO_3$	1.6204	10.20962
	$Mn(HCO_3)_2$	2.4948	10.39703
	Mn_2O_3	1.1128	10.04641
	Mn_3O_4	1.0752	10.03148
	$Mn_2P_2O_7$	2.0005	10.30114
	MnS	1.2265	10.08866
	$MnSO_4$	2.1286	10.32810
	SO_3	1.1286	10.05256
MnO_2	Mn	0.63193	9.80067
	Mn_3O_4	0.87731	9.94315
	$Mn_2P_2O_7$	1.6323	10.21279
Mn_2O_3	Mn	0.69597	9.84259
	MnO	0.89866	9.95359
	Mn_3O_4	0.96622	9.98508
Mn_3O_4	Mn	0.72030	9.85752
	$MnCO_3$	1.5071	10.17814
	$Mn(HCO_3)_2$	2.3203	10.36555
	MnO	0.93008	9.96852
	MnO_2	1.1398	10.05685
	Mn_2O_3	1.0350	10.01492
	$MnSO_4$	1.9798	10.29662
$Mn_2P_2O_7$	Mn	0.38713	9.58786
	$MnCO_3$	0.81000	9.90848
	MnO	0.49988	9.69888
	MnO_2	0.61264	9.78721
	$MnSO_4$	1.0641	10.02697
MnS	Mn	0.63145	9.80034
	$MnCO_3$	1.3212	10.12096
	MnO	0.81535	9.91134
	$MnSO_4$	1.7356	10.23944
$MnSO_4$	$BaSO_4$	1.5458	10.18916
	Mn	0.36383	9.56089
	MnO	0.46978	9.67190
	Mn_3O_4	0.50510	9.70338
	$Mn_2P_2O_7$	0.93980	9.97303
	MnS	0.57618	9.76056
	SO_3	0.53022	9.72445
SO_3	MnO	0.88602	9.94744
	$MnSO_4$	1.8860	10.27555
Mercury: Hg = 200.61			
Hg	HgCl	1.1767	10.07068
	$HgCl_2$	1.3535	10.13146
	HgO	1.0798	10.03333
	HgS	1.1598	10.06440
HgCl	Hg	0.84980	9.92932
	$HgCl_2$	1.1502	10.06077
	$HgNO_3$	1.1125	10.04629
	HgO	0.91758	9.96264
	Hg_2O	0.88369	9.94630
	HgS	0.98564	9.99372
$HgCl_2$	Hg	0.73883	9.86854
	HgCl	0.86942	9.93923
	HgS	0.85693	9.93294
$Hg(CN)_2$	HgS	0.92095	9.96424
$HgNO_3$	HgCl	0.89890	9.95371
	HgS	0.88599	9.94743
Mercury:			
$Hg(NO_3)_2$	HgS	0.71675	9.85537
$Hg(NO_3)_2 \cdot H_2O$	HgS	0.67906	9.83191
HgO	Hg	0.92613	9.96667
	HgCl	1.0898	10.03736
	HgS	1.0742	10.03107
Hg_2O	HgCl	1.1316	10.05370
	HgS	1.1154	10.04742
HgS	Hg	0.86219	9.93560
	HgCl	1.0146	10.00628
	$HgCl_2$	1.1670	10.06706
	$Hg(CN)_2$	1.0858	10.03576
	$HgNO_3$	1.1287	10.05257
	$Hg(NO_3)_2$	1.3952	10.14463
	$Hg(NO_3)_2 \cdot H_2O$	1.4726	10.16809
	HgO	0.93095	9.96893
	Hg_2O	0.89657	9.95258
	$HgSO_4$	1.2751	10.10553
$HgSO_4$	HgS	0.78428	9.89447
Molybdenum: Mo = 95.95			
Mo	MoO_3	1.5003	10.17617
	MoC	1.1252	10.05122
	MoS_3	2.0026	10.30159
	$PbMoO_4$	3.8266	10.58281
MoC	C	0.11125	9.04631
	Mo	0.88875	9.94878
MoO_3	Mo	0.66655	9.82383
	MoS_3	1.3348	10.12542
	$(NH_4)_2MoO_4$	1.3618	10.13411
	$(NH_4)_3PO_4 \cdot 12MoO_3$	1.0863	10.03595
	$PbMoO_4$	2.5506	10.40664
MoS_3	Mo	0.49935	9.69841
	MoO_3	0.74916	9.87458
	$(NH_4)_2MoO_4$	1.0202	10.00869
MoSi	Mo	0.77354	9.88848
	Si	0.22646	9.35499
$(NH_4)_2MoO_4$	MoO_3	0.73433	9.86589
	MoS_3	0.98020	9.99131
	$(NH_4)_3PO_4 \cdot 12MoO_3$	0.79771	9.90184
	$PbMoO_4$	1.8730	10.27253
$(NH_4)_3PO_4 \cdot 12MoO_3$	MoO_3	0.92055	9.96405
	$(NH_4)_2MoO_4$	1.2536	10.09816
$PbMoO_4$	Mo	0.26133	9.41719
	MoO_3	0.39206	9.59336
	$(NH_4)_2MoO_4$	0.53391	9.72747
Neodymium: Nd = 144.27			
Nd	Nd_2O_3	1.1664	10.06683
Nd_2O_3	Nd	0.85737	9.93317

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Nickel: Ni=58.69			
Ni	$Ni(C_4H_7N_2O_2)_2$ Ni-glyoxime	4.9228	10.69222
	$Ni(NO_3)_2 \cdot 6H_2O$	4.9549	10.69503
	NiO	1.2726	10.10470
	$NiSO_4$	2.6368	10.42108
	$NiSO_4 \cdot 7H_2O$	4.7856	10.67994
$Ni(C_4H_7N_2O_2)_2$	Ni	0.20313	9.30778
	NiO	0.25851	9.41248
$Ni(NO_3)_2 \cdot 6H_2O$	Ni	0.20182	9.30497
	NiO	0.25684	9.40967
	$NiSO_4$	0.53217	9.72605
NiO	Ni	0.78578	9.89530
	$Ni(C_4H_7N_2O_2)_2$	3.8683	10.58752
	$Ni(NO_3)_2 \cdot 6H_2O$	3.8935	10.59033
	$NiSO_4$	2.0720	10.31639
	$NiSO_4 \cdot 7H_2O$	3.7605	10.57524
$NiSO_4$	Ni	0.37924	9.57892
	$Ni(NO_3)_2 \cdot 6H_2O$	1.8791	10.27395
	NiO	0.48263	9.68362
	$NiSO_4 \cdot 7H_2O$	1.8149	10.25885
$NiSO_4 \cdot 7H_2O$	Ni	0.20896	9.32006
	NiO	0.26593	9.42476
	$NiSO_4$	0.55099	9.74115
Niobium: Nb= 92.91			
C	Nb	7.7354	10.88848
	NbC	8.7354	10.94128
	$\frac{1}{2}Nb_2O_5$	11.066	11.04398
Nb	C	0.12928	9.11152
	Nb_2O_5	1.4305	10.15550
NbC	C	0.11448	9.05872
	Nb	0.88552	9.94720
Nb_2O_5	Nb	0.69904	9.84450
Nitrogen: N= 14.008			
$AgNO_2$	HNO_2	0.30552	9.48504
	N_2O_3	0.24698	9.39267
HNO_2	$AgNO_2$	3.2731	10.51496
HNO_3	N	0.22229	9.34693
	NH_3	0.27028	9.43181
	NH_4Cl	0.84894	9.92888
	$(NH_4)_2PtCl_6$	3.5233	10.54695
	NO	0.47620	9.67779
	Pt	1.5491	10.19007
	SO_3	0.63528	9.80297
KNO_3	N_2O_5	0.53416	9.72767
N	HNO_3	4.4986	10.65307
	$NaNO_3$	6.0679	10.78304
	NH_3	1.2159	10.08489
	NH_4Cl	3.8190	10.58195
	$(NH_4)_2PtCl_6$	15.850	11.20003
	$(NH_4)_2SO_4$	4.7168	10.67365
	NO_2	3.2844	10.51646
Nitrogen:			
N	NO_3	4.4266	10.64607
	N_2O_3	2.7133	10.43350
	N_2O_5	3.8555	10.58608
	Pt	6.9685	10.84314
	SO_3	2.8579	10.45604
$NaNO_3$	N	0.16480	9.21696
	N_2O_5	0.63540	9.80304
NH_3	HNO_3	3.6999	10.56819
	N	0.82245	9.91511
	NO_3	3.6407	10.56118
	N_2O_5	3.1710	10.50119
NH_4Cl	HNO_3	1.1779	10.07112
	N	0.26185	9.41805
	NO_3	1.1591	10.06412
	N_2O_5	1.0096	10.00413
$(NH_4)_2PtCl_6$	HNO_3	0.28382	9.45305
	N	0.063092	8.79997
	NO_3	0.27928	9.44604
	N_2O_5	0.24325	9.38605
$(NH_4)_2SO_4$	N	0.21201	9.32635
	N_2O_5	0.81740	9.91243
NO	HNO_3	2.1000	10.32221
	NO_2	1.5332	10.18560
	NO_3	2.0664	10.31521
	N_2O_3	1.2666	10.10264
	N_2O_5	1.7998	10.25522
NO_2	N	0.30447	9.48354
	NO	0.65223	9.81440
NO_3	N	0.22591	9.35393
	NH_3	0.27467	9.43882
	NH_4Cl	0.86274	9.93588
	NO	0.48394	9.68479
	Pt	1.5742	10.19707
N_2O_3	$AgNO_2$	4.0488	10.60733
	N	0.36855	9.56650
	NO	0.78952	9.89736
N_2O_5	KNO_3	1.8721	10.27233
	N	0.25937	9.41392
	$NaNO_3$	1.5738	10.19696
	NH_3	0.31536	9.49881
	NH_4Cl	0.99054	9.99587
	$(NH_4)_2PtCl_6$	4.1110	10.61395
	$(NH_4)_2SO_4$	1.2234	10.08757
	NO	0.55562	9.74478
	Pt	1.8074	10.25706
	SO_3	0.74124	9.86996
Pt	HNO_3	0.64556	9.80993
	N	0.14350	9.15686
	NO_3	0.63523	9.80293
	N_2O_5	0.55328	9.74294
SO_3	HNO_3	1.5741	10.19703
	N	0.34991	9.54396
	N_2O_5	1.3491	10.13004
Osmium: Os=190.2			
Os	OsO_4	1.3365	10.12597
OsO_4	Os	0.74823	9.87403

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Palladium: Pd = 106.7			
K_2PdCl_6	Pd	0.26833	9.42867
	$PdCl_2 \cdot 2H_2O$	0.53728	9.73020
Pd	K_2PdCl_6	3.7267	10.57133
	$PdCl_2 \cdot 2H_2O$	2.0023	10.30153
	PdI_2	3.3788	10.52877
	$Pd(NO_3)_2$	2.1623	10.33491
$PdCl_2 \cdot 2H_2O$	K_2PdCl_6	1.8612	10.26980
	Pd	0.49942	9.69847
PdI_2	Pd	0.29596	9.47123
$Pd(NO_3)_2$	Pd	0.46247	9.66509
Phosphorus: P = 30.975			
Ag_3PO_4	P	0.073994	8.86920
	PO_4	0.22688	9.35579
	P_2O_5	0.16955	9.22929
$Ag_4P_2O_7$	P	0.10232	9.00995
	PO_4	0.31372	9.49655
	P_2O_5	0.23445	9.37004
Al_2O_3	P_2O_5	1.3922	10.14371
$AlPO_4$	PO_4	0.77877	9.89141
	P_2O_5	0.58198	9.76491
$Ca_3(PO_4)_2$	P_2O_5	0.45762	9.66051
$FePO_4$	PO_4	0.62970	9.79914
	P_2O_5	0.47058	9.67263
$Mg_2P_2O_7$	H_3PO_4	0.88053	9.94475
	Na_2HPO_4	1.2756	10.10571
	$Na_2HPO_4 \cdot 12H_2O$	3.2181	10.50760
	$NaNH_4HPO_4 \cdot 4H_2O$	1.8786	10.27383
	P	0.27831	9.44454
	PO_4	0.85336	9.93113
	P_2O_5	0.63772	9.80463
Na_2HPO_4	$Mg_2P_2O_7$	0.78396	9.89429
	P_2O_5	0.49995	9.69892
$Na_2HPO_4 \cdot 12H_2O$	$Mg_2P_2O_7$	0.31074	9.49240
	P_2O_5	0.19817	9.29703
$NaNH_4 \cdot HPO_4 \cdot 4H_2O$	$Mg_2P_2O_7$	0.53231	9.72617
	P_2O_5	0.33947	9.53080
$(NH_4)_3PO_4 \cdot 12MoO_3$	P	0.016507	8.21766
	PO_4	0.050613	8.70426
	P_2O_5	0.037823	8.57776
P	Ag_3PO_4	13.515	11.13080
	$Ag_4P_2O_7$	9.7735	10.99005
	$Mg_2P_2O_7$	3.5931	10.55546
	$(NH_4)_3PO_4 \cdot 12MoO_3$	60.581	11.78234
	P_2O_5	2.2914	10.36009
	$P_2O_5 \cdot 24MoO_3$	58.059	11.76387
	$U_2P_2O_{11}$	11.527	11.06171
Phosphorus:			
PO_4	Ag_3PO_4	4.4076	10.64421
	$Ag_4P_2O_7$	3.1875	10.50345
	$AlPO_4$	1.2841	10.10859
	$FePO_4$	1.5880	10.20086
	$Mg_2P_2O_7$	1.1718	10.06887
	$(NH_4)_3PO \cdot 12MoO_3$	19.758	11.29574
	$P_2O_5 \cdot 24MoO_3$	18.935	11.27727
	$U_2P_2O_{11}$	3.7594	10.57511
P_2O_5	Ag_3PO_4	5.8981	10.77071
	$Ag_4P_2O_7$	4.2654	10.62996
	Al_2O_3	0.71828	9.85629
	$AlPO_4$	1.7183	10.23509
	$Ca_3(PO_4)_2$	2.1852	10.33949
	$FeFO_4$	2.1250	10.32737
	$Mg_2P_2O_7$	1.5681	10.19537
	Na_2HPO_4	2.0002	10.30108
	$Na_2HPO_4 \cdot 12H_2O$	5.0462	10.70297
	$NaNH_4HPO_4 \cdot 4H_2O$	2.9458	10.46920
	$(NH_4)_3PO_4 \cdot 12MoO_3$	26.439	11.42224
	P	0.43642	9.63991
	$P_2O_5 \cdot 24MoO_3$	25.338	11.40377
	$U_2P_2O_{11}$	5.0306	10.70162
$P_2O_5 \cdot 24MoO_3$	P	0.017224	8.23613
	PO_4	0.052812	8.72273
	P_2O_5	0.039466	8.59623
$U_2P_2O_{11}$	P	0.087654	8.93829
	PO_4	0.26600	9.42489
	P_2O_5	0.19878	9.29838
Platinum: Pt = 195.23			
$H_2PtCl_6 \cdot 6H_2O$	K_2PtCl_6	0.93840	9.97239
	Pt	0.37683	9.57615
K_2PtCl_6	$H_2PtCl_6 \cdot 6H_2O$	1.0656	10.02761
	Pt	0.40157	9.60376
	$PtCl_4$	0.69329	9.84091
	$PtCl_4 \cdot 5H_2O$	0.87857	9.94378
$(NH_4)_2PtCl_6$	Pt	0.43966	9.64311
	$PtCl_4$	0.75905	9.88027
	$PtCl_6$	0.91875	9.96320
Pt	$H_2PtCl_6 \cdot 6H_2O$	2.6537	10.42385
	K_2O	0.48251	9.68350
	K_2PtCl_6	2.4903	10.39624
	$(NH_4)_2PtCl_6$	2.2745	10.35689
	$PtCl_4$	1.7265	10.23716
	$PtCl_4 \cdot 5H_2O$	2.1879	10.34002
$PtCl_4$	K_2PtCl_6	1.4424	10.15909
	$(NH_4)_2PtCl_6$	1.3174	10.11973
	Pt	0.57922	9.76284
$PtCl_4 \cdot 5H_2O$	K_2PtCl_6	1.1382	10.05622
	Pt	0.45707	9.65998

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Platinum:			
$PtCl_6$	K_2PtCl_6	1.1917	10.07616
	$(NH_4)_2PtCl_6$	1.0884	10.03680
Potassium: $K = 39.100$			
Ag	KBr	1.1032	10.04266
	KCl	0.69111	9.83955
	$KClO_3$	1.1360	10.05540
	$KClO_4$	1.2844	10.10869
	KCN	0.60362	9.78077
	KI	1.5388	10.18719
AgBr	KBr	0.63375	9.80192
	$KBrO_3$	0.88935	9.94907
AgCl	KCl	0.52015	9.71613
	$KClO_3$	0.85503	9.93198
	$KClO_4$	0.96665	9.98527
AgCN	KCN	0.48633	9.68693
AgI	KI	0.70706	9.84945
	KIO_3	0.91150	9.95975
$BaCrO_4$	K_2CrO_4	0.76651	9.88452
	$K_2Cr_2O_7$	0.58061	9.76389
$BaSO_4$	$KHSO_4$	0.58337	9.76594
	K_2S	0.47238	9.67429
	K_2SO_4	0.74656	9.87306
Br	K	0.48926	9.68954
	KBr	1.4893	10.17297
CaF_2	$KF \cdot 2H_2O$	2.4112	10.38223
$CaSO_4$	$KF \cdot 2H_2O$	1.3828	10.14076
Cl	K	1.1027	10.04247
	KCl	2.1027	10.32279
	$KClO_3$	3.4565	10.53864
	$KClO_4$	3.9077	10.59193
	K_2O	1.3284	10.12332
CO_2	$KHCO_3$	2.2748	10.35695
	K_2CO_3	3.1404	10.49698
	K_2O	2.1404	10.33049
I	KI	1.3081	10.11664
	KIO_3	1.6863	10.22694
K	Br	2.0439	10.31046
	Cl	0.90683	9.95753
	KBr	3.0439	10.48343
	KCl	1.9068	10.28031
	$KClO_3$	3.1345	10.49616
	$KClO_4$	3.5437	10.54945
	KI	4.2458	10.62796
	KNO_3	2.5859	10.41261
	K_2O	1.2046	10.08084
	K_2PtCl_6	6.2170	10.79358
	K_2SO_4	2.2285	10.34801
	Pt	2.4965	10.39734
K_3AsO_4	$Mg_2As_2O_7$	0.60587	9.78238
KBr	Ag	0.90643	9.95734
	AgBr	1.5779	10.19808
	Br	0.67147	9.82703
	K	0.32853	9.51657
	K_2O	0.39575	9.59742
$KBrO_3$	AgBr	1.1244	10.05093
KCl	Ag	1.4469	10.16045
	AgCl	1.9225	10.28387
	Cl	0.47557	9.67721
Potassium:			
KCl	K	0.52443	9.71969
	$KClO_3$	1.6438	10.21585
	$KClO_4$	1.8584	10.26914
	K_2CO_3	0.92688	9.96702
	$K_2Cr_2O_7$	1.9731	10.29515
	$KHCO_3$	1.3428	10.12802
	KNO_3	1.3561	10.13230
	K_2O	0.63173	9.80053
	K_2PtCl_6	3.2604	10.51327
	K_2SO_4	1.1687	10.06769
	Pt	1.3093	10.11703
$KClO_3$	Ag	0.88024	9.94460
	AgCl	1.1696	10.06802
	Cl	0.28931	9.46136
	KCl	0.60835	9.78415
$KClO_4$	Ag	0.77860	9.89131
	AgCl	1.0345	10.01473
	Cl	0.25590	9.40807
	K	0.28219	9.45055
	KCl	0.53810	9.73086
	K_2O	0.33993	9.53139
KCN	Ag	1.6567	10.21923
	AgCN	2.0562	10.31307
K_2CO_3	CO_2	0.31843	9.50302
	KCl	1.0789	10.03298
	K_2O	0.68157	9.83351
	KOH	0.81192	9.90951
	K_2PtCl_6	3.5176	10.54625
	K_2SO_4	1.2609	10.10067
K_2CrO_4	$BaCrO_4$	1.3046	10.11548
$K_2Cr_2O_7$	$BaCrO_4$	1.7223	10.23611
	KCl	0.50681	9.70485
	K_2O	0.32017	9.50538
$KF \cdot 2H_2O$	CaF_2	0.41474	9.61777
	$CaSO_4$	0.72317	9.85924
K_2HAsO_4	$Mg_2As_2O_7$	0.71168	9.85228
$KHCO_3$	KCl	0.74469	9.87198
	K_2O	0.47044	9.67250
	K_2PtCl_6	2.4280	10.38524
	K_2SO_4	0.87029	9.93967
$KHSO_4$	$BaSO_4$	1.7142	10.23406
	K_2SO_4	0.63987	9.80609
KI	Ag	0.64984	9.81281
	AgI	1.4143	10.15055
	I	0.76447	9.88336
	K	0.23553	9.37204
	K_2O	0.28372	9.45289
KIO_3	AgI	1.0971	10.04025
	I	0.59301	9.77306
$KMnO_4$	Mn_2O_3	0.49949	9.69853
	MnS	0.55053	9.74078
K_2MnO_4	Mn_2O_3	0.40043	9.60252
	MnS	0.44134	9.64477
KNO_2	K_2SO_4	1.0238	10.01021
	N_2O_3	0.44659	9.64990
KNO_3	K	0.38672	9.58739
	KCl	0.73740	9.86770
	K_2O	0.46584	9.66824
	K_2PtCl_6	2.4042	10.38097
	K_2SO_4	0.86178	9.93540

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Potassium:			
KNO_3	N	0.13854	9.14159
	NH_3	0.16845	9.22648
	NO	0.29679	9.47245
	N_2O_5	0.53416	9.72767
K_2O	Cl	0.75280	9.87668
	CO_2	0.46721	9.66951
	K	0.83015	9.91916
	KBr	2.5269	10.40258
	KCl	1.5830	10.19947
	$KClO_3$	2.6021	10.41532
	$KClO_4$	2.9418	10.46861
	K_2CO_3	1.4672	10.16649
	$K_2Cr_2O_7$	3.1234	10.49462
	$KHCO_3$	2.1257	10.32750
	KI	3.5246	10.54711
	KNO_3	2.1467	10.33176
	KOH	1.1913	10.07600
	K_2PtCl_6	5.1611	10.71274
	K_2SO_4	1.8500	10.26716
	N_2O_5	1.1467	10.05944
KOH	K_2CO_3	1.2317	10.09049
	K_2O	0.83945	9.92400
K_2PtCl_6	K	0.16085	9.20642
	KCl	0.30671	9.48673
	K_2CO_3	0.28428	9.45375
	$KHCO_3$	0.41187	9.61476
	KNO_3	0.41593	9.61903
	K_2O	0.19376	9.28726
	K_2SO_4	0.35845	9.55442
	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	1.9516	10.29039
	$K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$	2.0546	10.31272
K_2S	$BaSO_4$	2.1169	10.32571
	K_2SO_4	1.5804	10.19877
K_2SiO_3	SiO_2	0.38946	9.59046
K_2SO_4	$BaSO_4$	1.3395	10.12694
	K	0.44874	9.65199
	KCl	0.85567	9.93231
	K_2CO_3	0.79310	9.89933
	$KHCO_3$	1.1490	10.06033
	$KHSO_4$	1.5628	10.19391
	KNO_2	0.97676	9.98979
	KNO_3	1.1604	10.06460
	K_2O	0.54055	9.73284
	K_2PtCl_6	2.7898	10.44558
	K_2S	0.63275	9.80123
	SO_3	0.45945	9.66224
$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	K_2PtCl_6	0.51240	9.70961
$K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$	K_2PtCl_6	0.48672	9.68728
$Mg_2As_2O_7$	K_3AsO_4	1.6505	10.21762
	K_2HAsO_4	1.4051	10.14772
Mn_2O_3	$KMnO_4$	2.0020	10.30147
Mn_2O_2	K_2MnO_4	2.4973	10.39748
Potassium:			
MnS	$KMnO_4$	1.8164	10.25922
	K_2MnO_4	2.2658	10.35523
N	KNO_3	7.2179	10.85841
NH_3	KNO_3	5.9364	10.77352
NO	KNO_3	3.3694	10.52755
N_2O_3	KNO_2	2.2392	10.35010
N_2O_5	KNO_3	1.8721	10.27233
	K_2O	0.87209	9.94056
Pt	K	0.40055	9.60266
	KCl	0.76379	9.88297
SiO_2	K_2SiO_3	2.5676	10.40954
SO_3	K_2SO_4	2.1765	10.33776
Praseodymium:			
Pr = 140.92			
Pr	Pr_2O_3	1.1703	10.06830
Pr_2O_3	Pr	0.85448	9.93170
Rhodium:			
Rh = 102.91			
Na_3RhCl_6	Rh	0.26756	9.42742
Rh	Na_3RhCl_6	3.7375	10.57258
	$RhCl_3$	2.0336	10.30827
$RhCl_3$	Rh	0.49173	9.69173
Rubidium:			
Rb = 85.48			
AgCl	Rb	0.59636	9.77551
	RbCl	0.84373	9.92620
Cl	Rb	2.4108	10.38216
	RbCl	3.4108	10.53286
Rb	AgCl	1.6768	10.22449
	Cl	0.41480	9.61784
	RbCl	1.4148	10.15069
	Rb_2CO_3	1.3510	10.13066
	Rb_2O	1.0936	10.03885
	Rb_2PtCl_6	3.3864	10.52973
	Rb_2SO_4	1.5619	10.19366
RbCl	AgCl	1.1852	10.07380
	Cl	0.29319	9.46714
	Rb	0.70681	9.84931
	Rb_2CO_3	0.95492	9.97997
	Rb_2O	0.77296	9.88816
	Rb_2PtCl_6	2.3935	10.37904
	Rb_2SO_4	1.1040	10.04296
Rb_2CO_3	Rb	0.74018	9.86934
	RbCl	1.0472	10.02003
	$RbHCO_3$	1.2685	10.10331
	Rb_2PtCl_6	2.5065	10.39907
	Rb_2SO_4	1.1561	10.06300
$RbClO_4$	Rb	0.46221	9.66484
	Rb_2CO_3	0.62446	9.79550
	RbCl	0.65394	9.81554
	$RbHCO_3$	0.79216	9.89881
	Rb_2O	0.50547	9.70369
	Rb_2SO_4	0.72194	9.85850
$RbHCO_3$	Rb_2CO_3	0.78830	9.89669

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Rubidium:			
$RbHCO_3$	Rb_2PtCl_6	1.9759	10.29576
	Rb_2SO_4	0.91136	9.95969
Rb_2O	Rb	0.91442	9.96115
	RbCl	1.2937	10.11184
	Rb_2PtCl_6	3.0966	10.49088
	Rb_2SO_4	1.4283	10.15480
Rb_2PtCl_6	Rb	0.29530	9.47027
	RbCl	0.41779	9.62096
	Rb_2CO_3	0.39896	9.60093
	$RbHCO_3$	0.50610	9.70424
	Rb_2O	0.32294	9.50912
Rb_2SO_4	Rb	0.64024	9.80634
	RbCl	0.90581	9.95704
	Rb_2CO_3	0.86497	9.93700
	$RbHCO_3$	1.0973	10.04031
	Rb_2O	0.70016	9.84520
Selenium:			
Se = 78.96			
H_2SeO_3	Se	0.61221	9.78690
H_2SeO_4	Se	0.54464	9.73611
Se	H_2SeO_3	1.6334	10.21310
	H_2SeO_4	1.8361	10.26389
	SeO_2	1.4053	10.14776
	SeO_3	1.6079	10.20626
SeO_2	Se	0.71161	9.85224
SeO_3	Se	0.62193	9.79374
Silicon:			
Si = 28.09			
$BaSiF_6$	SiF_4	0.37248	9.57110
	SiO_2	0.21503	9.33250
H_2SiO_3	SiO_2	0.76934	9.88612
K_2SiF_6	SiF_4	0.47251	9.67441
	SiO_2	0.27278	9.43581
Si	SiO_2	2.1392	10.33025
SiC	C	0.29952	9.47642
	Si	0.70048	9.84540
SiF_4	$BaSiF_6$	2.6847	10.42890
	K_2SiF_6	2.1163	10.32559
	SiO_2	0.57729	9.76139
SiO_2	$BaSiF_6$	4.6505	10.66750
	H_2SiO_3	1.2998	10.11388
	K_2SiF_6	3.6660	10.56419
	Si	0.46747	9.66975
	SiF_4	1.7322	10.23861
	SiO_3	1.2663	10.10253
	SiO_4	1.5325	10.18541
	Si_2O	0.60060	9.77858
	$Si(OH)_4$	1.5996	10.20402
SiO_3	SiO_2	0.78972	9.89747
SiO_4	SiO_2	0.65251	9.81459
Si_2O	SiO_2	1.6650	10.22142
$Si(OH)_4$	SiO_2	0.62514	9.79598
Silver:			
Ag = 107.880			
Ag	AgBr	1.7408	10.24075
	AgCl	1.3287	10.12342
	AgCN	1.2412	10.09384
	AgI	2.1764	10.33774
Silver:			
Ag	$AgNO_3$	1.5748	10.19722
	Ag_2O	1.0742	10.03107
	Ag_3PO_4	1.2935	10.11175
	$Ag_4P_2O_7$	1.4031	10.14709
	Br	0.74079	9.86969
	Cl	0.32867	9.51676
	I	1.1764	10.07055
AgBr	Ag	0.57445	9.75925
	Br	0.42555	0.62895
AgCl	Ag	0 75263	9.87658
	$AgNO_3$	1.1852	10.07380
	Ag_2O	0.80844	9.90765
	Br	0.55754	9.74628
	Cl	0.24737	9.39334
AgCN	Ag	0.80568	9.90616
AgI	Ag	0.45947	9.66226
	I	0.54053	9.73282
$AgNO_3$	Ag	0.63501	9.80278
	AgCl	0.84371	9.92620
Ag_2O	Ag	0.93096	9.96893
	AgCl	1.2369	10.09235
Ag_3PO_4	Ag	0.77312	9.88825
$Ag_4P_2O_7$	Ag	0.71270	9.85291
Br	Ag	1.3499	10.13031
	AgBr	2.3499	10.37105
	AgCl	1.7936	10.25372
Cl	Ag	3.0426	10.48324
	AgCl	4.0426	10.60666
I	Ag	0.85005	9.92945
	AgI	1.8501	10.26718
Sodium:			
Na = 22.991			
Ag	NaBr	0.95390	9.97950
	NaCl	0.54179	9.73383
	NaI	1.3895	10.14286
AgBr	NaBr	0.54797	9.73876
AgCl	NaCl	0.40777	9.61041
	$NaClO_3$	0.74264	9.87078
	$NaClO_4$	0.85427	9.93159
AgI	NaI	0.63845	9.80512
$BaSO_4$	$NaHSO_4$	0.51436	9.71127
	$NaHSO_4 \cdot H_2O$	0.59154	9.77198
	Na_2S	0.33436	9.52421
	Na_2SO_3	0.53999	9.73239
	$Na_2SO_4 \cdot 7H_2O$	1.0803	10.03353
	Na_2SO_4	0.60854	9.78429
	$Na_2SO_4 \cdot 10H_2O$	1.3803	10.13999
B_2O_3	$Na_2B_4O_7$	1.4450	10.15987
	$Na_2B_4O_7 \cdot 10H_2O$	2.7385	10.43752
Br	Na	0.28769	9.45892
	NaBr	1.2877	10.10981
	Na_2O	0.38779	9.58860
$CaCl_2$	NaCl	1.0532	10.02250
$CaCO_3$	Na_2CO_3	1.0590	10.02488
CaF_2	NaF	1.0756	10.03165
CaO	Na_2CO_3	1.8900	10.27647
$CaSO_4$	Na_2CO_3	0.77852	9.89127
Cl	Na	0.64842	9.81186

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Sodium:			
Cl	NaCl	1.6484	10.21707
	Na_2O	0.87404	9.94153
CO_2	Na_2CO_3	2.4083	10.38172
	Na_2O	1.4083	10.14870
H_3BO_3	$Na_2B_4O_7$	0.81359	9.91040
	$Na_2B_4O_7\cdot 10H_2O$	1.5419	10.18805
I	Na	0.18116	9.25806
	NaI	1.1812	10.07231
	Na_2O	0.24420	9.38774
KBF_4	$Na_2B_4O_7$	0.39958	9.60161
	$Na_2B_4O_7\cdot 10H_2O$	0.75727	9.87925
$Mg_2As_2O_7$	Na_2HAsO_3	1.0945	10.03922
	Na_2HAsO_4	1.1976	10.07830
$MgCl_2$	NaCl	1.2275	10.08901
$Mg_2P_2O_7$	Na_2HPO_4	1.2756	10.10571
	$Na_2HPO_4\cdot 12H_2O$	3.2181	10.50760
	$NaNH_4HPO_4\cdot 4H_2O$	1.8786	10.27383
	Na_3PO_4	1.4731	10.16823
	$Na_4P_2O_7\cdot 10H_2O$	2.0040	10.30190
N	$NaNO_3$	6.0679	10.78304
Na	Br	3.4760	10.54108
	Cl	1.5422	10.18814
	I	5.5200	10.74194
	NaBr	4.4760	10.65089
	NaCl	2.5422	10.40521
	Na_2CO_3	2.3051	10.36269
	$NaHCO_3$	3.6540	10.56277
	NaI	6.5200	10.81425
	Na_2O	1.3480	10.12968
	Na_2SO_4	3.0892	10.48985
$Na_2B_4O_7$	B_2O_3	0.69203	9.84013
	H_3BO_3	1.2291	10.08960
	KBF_4	2.5026	10.39839
$Na_2B_4O_7\cdot 10H_2O$	B_2O_3	0.36516	9.56248
	H_3BO_3	0.64856	9.81195
	KBF_4	1.3205	10.12075
NaBr	Ag	1.0483	10.02050
	AgBr	1.8249	10.26124
	Br	0.77658	9.89019
	Na	0.22342	9.34911
	Na_2O	0.30116	9.47879
$NaC_2H_3O_2\cdot Mg(C_2H_3O_2)_2\cdot 3UO_2(C_2H_3O_2)_2\cdot 6\frac{1}{2}H_2O$	Na	0.015266	8.18372
	NaBr	0.068329	8.83461
	Na_2CO_3	0.035189	8.54641
	NaCl	0.038809	8.58893
	NaF	0.027882	8.44532
	$NaHCO_3$	0.055782	8.74649
	NaI	0.099533	8.99797
	$NaNO_3$	0.056439	8.75158
	Na_2O	0.020578	8.31340
	NaOH	0.026559	8.42421
	Na_2SO_4	0.047159	8.67357
Sodium:			
$NaC_2H_3O_2\cdot Zn(C_2H_3O_2)_2\cdot 3UO_2(C_2H_3O_2)_2\cdot 6H_2O$	Na	0.014948	8.17458
	NaBr	0.066906	8.82547
	Na_2CO_3	0.034456	8.53727
	NaCl	0.038001	8.57979
	NaF	0.027301	8.43618
	$NaHCO_3$	0.054620	8.73735
	NaI	0.097460	8.98883
	$NaNO_3$	0.055263	8.74243
	NaOH	0.026006	8.41507
	Na_2O	0.020149	8.30426
	Na_2SO_4	0.046177	8.66443
Na_2CO_3	$CaCO_3$	0.94432	9.97512
	CaO	0.52909	9.72353
	$CaSO_4$	1.2855	10.10873
	CO_2	0.41523	9.61828
	Na	0.43382	9.63731
	NaCl	1.1029	10.04252
	$NaHCO_3$	1.5852	10.20008
	NaOH	0.75475	9.87780
	Na_2O	0.58477	9.76699
	Na_2SO_4	1.3402	10.12716
$Na_2CO_3\cdot 10H_2O$	Na_2SO_4	0.49641	9.69584
NaCl	Ag	1.8457	10.26617
	AgCl	2.4524	10.38959
	Cl	0.60664	9.78293
	Na	0.39336	9.59479
	$NaClO_3$	1.8212	10.26037
	$NaClO_4$	2.0950	10.32118
	Na_2CO_3	0.90673	9.95748
	$NaHCO_3$	1.4373	10.15756
	Na_2HPO_4	1.2145	10.08438
	Na_2O	0.53023	9.72447
	Na_2SO_4	1.2152	10.08464
$NaClO_3$	AgCl	1.3465	10.12922
	NaCl	0.54908	9.73963
$NaClO_4$	AgCl	1.1706	10.06841
	NaCl	0.47733	9.67882
NaF	CaF_2	0.92972	9.96835
Na_2HAsO_3	$Mg_2As_2O_7$	0.91366	9.96078
Na_2HAsO_4	$Mg_2As_2O_7$	0.83502	9.92170
$NaHCO_3$	Na	0.27367	9.43723
	NaCl	0.69573	9.84244
	Na_2CO_3	0.63084	9.79992
	Na_2O	0.36890	9.56690
Na_2HPO_4	$Mg_2P_2O_7$	0.78396	9.89429
	NaCl	0.82341	9.91562
	Na_2O	0.43660	9.64008
	$Na_4P_2O_7$	0.93655	9.97153
	P_2O_5	0.49995	9.69892

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Sodium:			
$Na_2HPO_4 \cdot 12H_2O$	$Mg_2P_2O_7$	0.31074	9.49240
	$Na_4P_2O_7$	0.37123	9.56964
	P_2O_5	0.19817	9.29703
$NaHSO_3$	SO_2	0.61563	9.78932
$NaHSO_4$	$BaSO_4$	1.9442	10.28873
$NaHSO_4 \cdot H_2O$	$BaSO_4$	1.6905	10.22802
NaI	Ag	0.71968	9.85714
	AgI	1.5663	10.19488
	I	0.84663	9.92769
	Na	0.15337	9.18575
	Na_2O	0.20674	9.31543
$NaNH_4HPO_4 \cdot 4H_2O$	$Mg_2P_2O_7$	0.53231	9.72617
	NH_3	0.081462	8.91096
	P_2O_5	0.33947	9.53080
$NaNO_3$	N	0.16480	9.21696
	Na_2O	0.36460	9.56182
	NH_3	0.20038	9.30185
	NO	0.35304	9.54782
	N_2O_5	0.63540	9.80304
Na_2O	Br	2.5787	10.41140
	Cl	1.1441	10.05847
	CO_2	0.71006	9.85130
	I	4.0951	10.61226
	Na	0.74186	9.87032
	NaBr	3.3205	10.52121
	NaCl	1.8860	10.27553
	Na_2CO_3	1.7101	10.23301
	$NaHCO_3$	2.7108	10.43310
	Na_2HPO_4	2.2904	10.35992
	NaI	4.8369	10.68457
	$NaNO_3$	2.7427	10.43818
	NaOH	1.2907	10.11081
	Na_2SO_4	2.2918	10.36017
	N_2O_5	1.7427	10.24122
	SO_3	1.2918	10.11118
NaOH	Na_2CO_3	1.3249	10.12220
	Na_2O	0.77479	9.88919
$Na_4P_2O_7$	Na_2HPO_4	1.0678	10.02847
	$Na_2HPO_4 \cdot 12H_2O$	2.6938	10.43036
$Na_4P_2O_7 \cdot 10H_2O$	$Mg_2P_2O_7$	0.49900	9.69810
Na_2S	$BaSO_4$	2.9908	10.47579
Na_2SO_3	$BaSO_4$	1.8519	10.26761
	SO_2	0.50827	9.70609
$Na_2SO_3 \cdot 7H_2O$	$BaSO_4$	0.92571	9.96647
	SO_2	0.25407	9.40495
Na_2SO_4	$BaSO_4$	1.6433	10.21571
	Na	0.32371	9.51015
	NaCl	0.82293	9.91536
	Na_2CO_3	0.74618	9.87284
	$Na_2CO_3 \cdot 10H_2O$	2.0145	10.30416
	Na_2O	0.43635	9.63983
	SO_3	0.56365	9.75101
Sodium:			
$Na_2SO_4 \cdot 10H_2O$	$BaSO_4$	0.72446	9.86001
NH_3	$NaNH_4HPO_4 \cdot 4H_2O$	12.276	11.08904
	$NaNO_3$	4.9905	10.69815
NO	$NaNO_3$	2.8325	10.45218
N_2O_5	$NaNO_3$	1.5738	10.19696
	Na_2O	0.57382	9.75878
P_2O_5	Na_2HPO_4	2.0002	10.30108
	$Na_2HPO_4 \cdot 12H_2O$	5.0462	10.70297
	$NaNH_4HPO_4 \cdot 4H_2O$	2.9458	10.46920
SO_2	$NaHSO_3$	1.6243	10.21068
	Na_2SO_3	1.9675	10.29391
	$Na_2SO_3 \cdot 7H_2O$	3.9359	10.59505
SO_3	Na_2O	0.77414	9.88882
	Na_2SO_4	1.7741	10.24899
Strontium: Sr=87.63			
CO_2	$SrCO_3$	3.3546	10.52565
SO_3	SrO	1.2943	10.11204
	$SrSO_4$	2.2943	10.36065
Sr	$SrCO_3$	0.16848	9.22655
	$Sr(NO_3)_2$	2.4152	10.38296
	SrO	1.1826	10.07283
	$SrSO_4$	2.0963	10.32145
$SrCl_2$	$SrCO_3$	0.93123	9.96906
	SrO	0.65364	9.81534
	$SrSO_4$	1.1586	10.06395
$SrCO_3$	CO_2	0.29809	9.47435
	Sr	0.59353	9.77345
	$SrCl_2$	1.0738	10.03094
	$Sr(HCO_3)_2$	1.4201	10.15233
	$Sr(NO_3)_2$	1.4335	10.15640
	SrO	0.70191	9.84628
	$SrSO_4$	1.2442	10.09489
$Sr(HCO_3)_2$	$SrCO_3$	0.70417	9.84767
	SrO	0.49426	9.69395
$Sr(NO_3)_2$	Sr	0.41404	9.61704
	$SrCO_3$	0.69758	9.84360
	SrO	0.48964	9.68988
	$SrSO_4$	0.86794	9.93849
SrO	SO_3	0.77261	9.88796
	Sr	0.84560	9.92717
	$SrCl_2$	1.5299	10.18466
	$SrCO_3$	1.4247	10.15372
	$Sr(HCO_3)_2$	2.0232	10.30605
	$Sr(NO_3)_2$	2.0423	10.31012
	$SrSO_4$	1.7726	10.24861
$SrSO_4$	SO_3	0.43586	9.63935
	Sr	0.47704	9.67855
	$SrCl_2$	0.86308	9.93605
	$SrCO_3$	0.80372	9.90511
	$Sr(NO_3)_2$	1.1522	10.06151
	SrO	0.56414	9.75139
Sulfur: S=32.066			
As_2S_3	H_2S	0.41560	9.61868

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Sulfur:			
As_2S_3	S	0.39102	9.59220
$BaSO_4$	FeS_2	0.25700	9.40994
	H_2S	0.14601	9.16438
	H_2SO_3	0.35164	9.54610
	H_2SO_4	0.42018	9.62344
	S	0.13737	9.13790
	SO_2	0.27446	9.43848
	SO_3	0.34300	9.53530
	SO_4	0.41155	9.61442
CdS	H_2S	0.23590	9.37273
	S	0.22195	9.34625
FeS_2	$BaSO_4$	3.8910	10.59006
H_2S	As_2S_3	2.4061	10.38132
	$BaSO_4$	6.8490	10.83562
	CdS	4.2391	10.62727
	SO_3	2.3492	10.37092
H_2SO_3	$BaSO_4$	2.8438	10.45390
H_2SO_4	$BaSO_4$	2.3799	10.37656
	$(NH_4)_2SO_4$	1.3473	10.12946
	SO_3	0.81632	9.91186
$(NH_4)_2SO_4$	H_2SO_4	0.74222	9.87054
	SO_3	0.60589	9.78239
S	As_2S_3	2.5574	10.40780
	$BaSO_4$	7.2795	10.86210
	CdS	4.5056	10.65375
SO_2	$BaSO_4$	3.6435	10.56152
SO_3	$BaSO_4$	2.9154	10.46470
	H_2S	0.42567	9.62908
	$(NH_4)_2SO_4$	1.6505	10.21761
SO_4	$BaSO_4$	2.4299	10.38558
Tantalum:			
Ta = 180.95			
Ta	$TaCl_5$	1.9797	10.29661
	Ta_2O_5	1.2211	10.08674
TaC	C	0.062246	8.79411
	Ta	0.93775	9.97209
$TaCl_5$	Ta	0.50512	9.70339
	Ta_2O_5	0.61677	9.79013
Ta_2O_4	Ta_2O_5	1.0376	10.01602
Ta_2O_5	Ta	0.81896	9.91326
	$TaCl_5$	1.6213	10.20987
	Ta_2O_4	0.96379	9.98398
Tellurium:			
Te = 127.61			
H_2TeO_4	Te	0.65905	9.81892
$H_2TeO_4\cdot 2H_2O$	Te	0.55565	9.74480
Te	H_2TeO_4	1.5173	10.18108
	$H_2TeO_4\cdot 2H_2O$	1.7997	10.25520
	TeO_2	1.2508	10.09718
	TeO_3	1.3761	10.13866
	$(TeO_2)_2SO_3$	1.5645	10.19437
TeO_2	Te	0.79951	9.90282
TeO_3	Te	0.72667	9.86134
$(TeO_2)_2SO_3$	Te	0.63919	9.80563

Weighed	Sought	Factor	Log of Factor + 10
Thalium:			
Tl = 204.39			
Tl	TlCl	1.1735	10.06947
	Tl_2CO_3	1.1468	10.05949
	Tl_2CrO_4	1.2838	10.10850
	$TlHSO_4$	1.4749	10.16878
	TlI	1.6209	10.20976
	$TlNO_3$	1.3034	10.11507
	Tl_2O	1.0391	10.01667
	Tl_2PtCl_6	1.9980	10.30060
	Tl_2SO_4	1.2350	10.09167
TlCl	Tl	0.85217	9.93053
	Tl_2PtCl_6	1.7027	10.23113
Tl_2CO_3	Tl	0.87199	9.94051
	Tl_2PtCl_6	1.7423	10.24111
Tl_2CrO_4	Tl	0.77894	9.89150
$TlHSO_4$	Tl	0.67799	9.83122
TlI	Tl	0.61693	9.79024
	Tl_2PtCl_6	1.2326	10.09084
$TlNO_3$	Tl	0.76724	9.88493
	Tl_2PtCl_6	1.5330	10.18553
Tl_2O	Tl	0.96233	9.98333
	Tl_2PtCl_6	1.9228	10.28393
Tl_2PtCl_6	Tl	0.50049	9.69940
	TlCl	0.58732	9.76887
	Tl_2CO_3	0.57397	9.75889
	TlI	0.81126	9.90916
	$TlNO_3$	0.65234	9.81447
	Tl_2O	0.52008	9.71607
	Tl_2SO_4	0.61811	9.79107
Tl_2SO_4	Tl	0.80971	9.90833
	Tl_2PtCl_6	1.6178	10.20893
Thorium:			
Th = 232.05			
Th	ThO_2	1.1379	10.05610
$ThCl_4$	ThO_2	0.70625	9.84896
$Th(NO_3)_4\cdot 6H_2O$	ThO_2	0.44893	9.65218
ThO_2	Th	0.87881	9.94390
	$ThCl_4$	1.4159	10.15104
	$Th(NO_3)_4\cdot 6H_2O$	2.2275	10.34782
Tin:			
Sn = 118.70			
Sn	$SnCl_2$	1.5974	10.20342
	$SnCl_2\cdot 2H_2O$	1.9010	10.27898
	$SnCl_4$	2.1948	10.34140
	$SnCl_4\cdot(NH_4Cl)_2$	3.0962	10.49083
	SnO	1.1348	10.05492
	SnO_2	1.2696	10.10366
$SnCl_2$	Sn	0.62601	9.79658
	SnO_2	0.79477	9.90024
$SnCl_2\cdot 2H_2O$	Sn	0.52605	9.72102
	SnO_2	0.66786	9.82469
$SnCl_4$	Sn	0.45561	9.65860
	SnO_2	0.57844	9.76226

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS (Continued)

Weighed	Sought	Factor	Log of Factor + 10
Tin:			
$SnCl_4(NH_4Cl)_2$	Sn	0.32297	9.50917
	SnO_2	0.41004	9.61283
SnO	Sn	0.88122	9.94508
	SnO_2	1.1188	10.04875
SnO_2	Sn	0.78766	9.89634
	$SnCl_2$	1.2532	10.09976
	$SnCl_2 \cdot 2H_2O$	1.4973	10.17531
	$SnCl_4$	1.7288	10.23774
	$SnCl_4(NH_4Cl)_2$	2.4388	10.38717
	SnO	0.89383	9.95125
Titanium: Ti=47.90			
K_2TiF_6	F	0.47480	9.67651
	K	0.32570	9.51281
	Ti	0.19950	9.29994
	TiO_2	0.33278	9.52215
Ti	K_2TiF_6	5.0125	10.70006
	TiC	1.2508	10.09717
	TiO_2	1.6681	10.22221
TiC	C	0.20048	9.30207
	Ti	0.79952	9.90283
TiO_2	K_2TiF_6	3.0050	10.47785
	Ti	0.59950	9.77779
	TiC	0.74982	9.87496
Tungsten: W= 183.92			
$FeWO_4$	W	0.60546	9.78208
	WO_3	0.76347	9.88279
$MgWO_4$	W	0.67558	9.82968
	WO_3	0.85190	9.93039
$MnWO_4$	W	0.60728	9.78339
	WO_3	0.76577	9.88410
$PbWO_4$	W	0.40410	9.60649
	WO_3	0.50957	9.70720
W	W_2C	1.0327	10.01395
	WC	1.0653	10.02747
	WO_2	1.1740	10.06966
	WO_3	1.2610	10.10071
W_2C	C	0.031620	8.49997
	W	0.96838	9.98605
WC	C	0.061302	8.78748
	W	0.93870	9.97253
WO_2	W	0.85180	9.93034
WO_3	W	0.79303	9.89929
Uranium: U= 238.07			
U	UO_2	1.1344	10.05477
	U_3O_8	1.1792	10.07159
	$U_2P_2O_{11}$	1.4997	10.17602
UO_2	U	0.88151	9.94523
	U_3O_8	1.0395	10.01682
	$U_2P_2O_{11}$	1.3220	10.12125
U_3O_8	U	0.84802	9.92841
	UO_2	0.96200	9.98318
	$UO_2(NO_3)_2 \cdot 6H_2O$	1.7888	10.25256
$UO_2(NO_3)_2 \cdot 6H_2O$	U_3O_8	0.55903	9.74744
Uranium:			
$U_2P_2O_{11}$	U	0.66678	9.82398
	UO_2	0.75640	9.87875
Vanadium: V=50.95			
V	VC	1.2357	10.09193
	V_2O_5	1.7851	10.25166
VC	C	0.19077	9.28051
	V	0.80923	9.90807
VO_4	V_2O_5	0.79121	9.89829
V_2O_5	V	0.56020	9.74834
	VC	0.69226	9.84027
	VO_4	1.2639	10.10171
Ytterbium: Yb= 173.04			
Yb	Yb_2O_3	1.1387	10.05641
Yb_2O_3	Yb	0.87820	9.94359
Yttrium. Y=88.92			
Y	Y_2O_3	1.2699	10.10377
Y_2O_3	Y	0.78746	9.89623
Zinc: Zn=65.38			
$BaSO_4$	ZnS	0.41746	9.62061
	$ZnSO_4 \cdot 7H_2O$	1.2319	10.09058
Zn	$ZnNH_4PO_4$	2.7286	10.43594
	ZnO	1.2447	10.09507
	$Zn_2P_2O_7$	2.3303	10.36741
	ZnS	1.4905	10.17332
$ZnCl_2$	ZnO	0.59709	9.77604
$ZnCO_3$	ZnO	0.64901	9.81225
$ZnNH_4PO_4$	Zn	0.36649	9.56406
	ZnO	0.45618	9.65913
ZnO	Zn	0.80339	9.90493
	$ZnCl_2$	1.6748	10.22396
	$ZnCO_3$	1.5408	10.18775
	$ZnNH_4PO_4$	2.1921	10.34087
	$Zn_2P_2O_7$	1.8721	10.27234
	ZnS	1.1974	10.07825
	$ZnSO_4 \cdot 7H_2O$	3.5335	10.54821
$Zn_2P_2O_7$	Zn	0.42913	9.63259
	ZnO	0.53415	9.72766
ZnS	$BaSO_4$	2.3954	10.37939
	Zn	0.67094	9.82668
	ZnO	0.83513	9.92175
	$ZnSO_4 \cdot 7H_2O$	2.9509	10.46996
$ZnSO_4 \cdot 7H_2O$	$BaSO_4$	0.81175	9.90942
	ZnO	0.28300	9.45179
	ZnS	0.33887	9.53004
Zirconium: Zr=91.22			
K_2ZrF_6	Zr	0.32185	9.50766
	ZrF_4	0.59001	9.77086
	ZrF_6	0.72408	9.85979
	ZrO_2	0.43476	9.63825
Zr	ZrO_2	1.3508	10.13059
	ZrC	1.1317	10.05372
ZrC	C	0.11635	9.06577
	Zr	0.88365	9.94628
ZrO_2	Zr	0.74030	9.86941
	ZrC	0.83778	9.92313

HEAT OF FORMATION AND SOLUTION

The following table gives the heat of formation of compounds from the elements in their standard states (18° C, 1 atm.) and the heat of solution in water in kilogram calories (mean) per gram-formula weight. To convert to B.T.U. multiply by 3.9685. To convert to kilojoules multiply by 4.186.

Values given are for 18° C and 1 atm. unless otherwise indicated. The heat of solution is given in most cases for a definite number of water molecules to one of the substance. Where this is not stated the dilution is understood to be such that additional dilution produces a negligible thermal effect.

The symbol ∞ indicates that the substance is formed in an "infinite" amount of water.

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Acetic acid	$HC_2H_3O_2$	solid$^{7°}$	120.2	150	$-2.15^{7°}$
		liquid	117.71		
		200	118.07		
Acetylene	C_2H_2	gas	− 54.337		
Aluminum					
bromide	$AlBr_3$	solid	+126.6	3000	$+85.3^{9°}$
		dil. sol.	211.9		
carbide	Al_4C_3	solid	81.48		
chloride	$AlCl_3$	solid	166.8		+77.90
		600	244.68		
	$AlCl_3.6H_2O$	solid	641.82	450	$+13.1^{16°}$
fluoride	AlF_3	solid	329.03		
	$AlF_3.5H_2O$	solid	375.39		
hydroxide	$Al(OH)_3$	ppt.	304.66		
iodide	AlI_3	solid	71.21	2200	$+88.89^{9°}$
		dil. sol.	160.3		
nitride	AlN	solid	131.4		
oxide (corundum)	Al_2O_3	solid	399.05		
oxide (powder)	Al_2O_3	amorph.	389.49		
silicate	$Al_2Si_2O_7$	solid	767.5		
sulfate	$Al_2(SO_4)_3$	solid	714.46		
		dil. sol.	883.88		
	$Al_2(SO_4)_3.18H_2O$	solid	2106.6		+8.1
sulfide	Al_2S_3	solid	126.4		+75.03
Alum, see under appropriate metal					
Ammonia	NH_3	liquid	15.84		
		gas	10.94		
		200	19.43	200	$+8.459^{18°}$
Ammonium					
acetate	$NH_4C_2H_3O_2$	solid	150.25	200	$+0.250^{24°}$
bromide	NH_4Br	solid	64.708	200	$-4.444^{18°}$
	$NH_3 + HBr$	solid	45.5		
carbonate	$(NH_4)_2CO_3$	dil. sol.	223.4		
carbonate, acid	NH_4HCO_3	solid	203.1	1200	$-6.69^{15°}$
chloride	NH_4Cl	solid	75.080	200	$-3.895^{18°}$
		∞	71.279		
chloroplatinite	$(NH_4)_2PtCl_4$	solid	194.0		−8.411
chromate	$(NH_4)_2CrO_4$	solid	274.31	700	$-5.73^{18°}$
		dil. sol.	267.62		
cyanate	NH_4CNO	dil. sol.	68.9		
cyanide	NH_4CN	solid	0.956	400	−4.349
dichromate	$(NH_4)_2Cr_2O_7$	solid	420.07	550	$-12.8^{16°}$
		600	407.41		

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Ammonium					
ferrocyanide	$(NH_4)_4Fe(CN)_6.3H_2O$	solid	216.0		$-6.69^{14°}$
fluoride	NH_4F	solid	111.71		-1.51
		dil. sol.	110.20		
fluosilicate	$(NH_4)_2SiF_6$	solid	619.36	1200	$-8.36^{7°}$
hydroxide	NH_4OH	200	87.814		
iodide	NH_4I	solid	48.555	200	$-3.560^{18°}$
		200	44.994		
nitrate	NH_4NO_3	solid	87.93	200	$-6.332^{18°}$
nitrite	NH_4NO_2	solid	62.15	400	$-4.755^{12°}$
		400	57.491		
oxalate	$(NH_4)_2C_2O_4$	solid	267.15		-7.89
	$(NH_4)_2C_2O_4.H_2O$	solid	339.07		-11.5
oxalate, acid	$NH_4HC_2O_4$	400	226.69		
perchlorate	NH_4ClO_4	solid	78.304	220	$-6.356^{20°}$
persulfate	$(NH_4)_2S_2O_8$	solid	382.80	1000	$-9.08^{16°}$
phosphate, mono-	$NH_4H_2PO_4$	dil. sol.	339.07		
phosphate, ortho-	$(NH_4)_3PO_4$	dil. sol.	397.61		
selenide	$(NH_4)_2Se$	dil. sol.	38.95		
sulfate	$(NH_4)_2SO_4$	solid	277.66	400	$-2.39^{18°}$
		400	275.29		
sulfate, acid	NH_4HSO_4	solid	240.43	200	$-0.024^{18°}$
		800	240.98		
sulfhydrate	NH_4HS	solid	38.95		-3.3
		dil. sol.	35.675		
sulfide	$(NH_4)_2S$	200	55.245		
sulfide, penta-	$(NH_4)_2S_5$	solid	64.76		
		dil. sol.	56.15	1000	$-8.6^{13°}$
sulfite	$(NH_4)_2SO_3$	solid	210.20	440	$-1.53^{18°}$
		dil. sol.	208.70		
sulfite, acid	NH_4HSO_3	dil. sol.	179.2		
sulfocyanate	NH_4CNS	solid	19.4		$-5.663^{12°}$
Antimonic acid, ortho-	H_3SbO_4	dil. sol.	216.56		
Antimonous acid	H_3SbO_3	dil. sol.	166.8		
Antimony					
bromide	$SbBr_3$	solid	61.41		
		liquid	58.28		
chloride, tri-	$SbCl_3$	solid	91.398		
		liquid	88.292		
chloride, penta-	$SbCl_5$	solid	107.31		
		liquid	104.88		
		gas	93.812		
fluoride	SbF_3	solid	216.5	200	-1.67
		dil. sol.	214.3		
hydride (stibine)	SbH_3	gas	-34.815		
iodide	SbI_3	solid	$+44.21$		
oxide, tri-	Sb_2O_3	solid	165.4		
oxide, tetra	Sb_2O_4	solid	211.2		
oxide, penta-	Sb_2O_5	solid	230.8		
		dil. sol.	227.96		
oxychloride (ous)	$SbOCl$	solid	89.200		
sulfide (black)	Sb_2S_3	solid	35.84		
Arsenic					
acid, ortho-	H_3AsO_4	solid	214.98	300	$-0.406^{18°}$
		dil. sol.	214.6		
bromide (ous)	$AsBr_3$	solid	46.36		
		liquid	43.49		
chloride (ous)	$AsCl_3$	solid	72.40		
		liquid	71.390		

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Arsenic					
hydride (arsine)	AsH_3	gas	− 43.49	....	....
	$AsH_3.6H_2O$	solid$^{-10°}$	+366.79	....	....
iodide (ous)	AsI_3	solid	14.3	....	....
oxide, tri-	As_2O_3	solid	147.9	....	....
		dil. sol.	148.6	....	....
oxide, penta-	As_2O_5	solid	217.90	....	+5.998
		dil. sol.	223.9	....	....
oxide	As_4O_6	gas	267.86	....	....
sulfide, di-	As_2S_2	solid	19.1	....	....
Arsenious acid, ortho-	H_3AsO_3	dil. sol.	176.8	....	....
Auric, see *gold*					
Barium					
acetate	$Ba(C_2H_3O_2)_2$	solid	358.4	600	$+5.26^{11°}$
arsenate	$Ba_3(AsO_4)_2$	ppt.	817.69	....	....
bromide	$BaBr_2$	solid	180.4	400	$+4.97^{18°}$
		400	185.4	....	....
	$BaBr_2.2H_2O$	solid	326.4	400	$-4.182^{18°}$
carbonate	$BaCO_3$	ppt.	290.85	....	....
chlorate	$Ba(ClO_3)_2$	solid	174.[illegible]	600	$-6.69^{10°}$
	$Ba(ClO_3)_2.H_2O$	solid	246.8	600	$-11.23^{18°}$
chloride	$BaCl_2$	solid	205.33	400	$+2.08^{18°}$
		2000	207.55	....	....
	$BaCl_2.2H_2O$	solid	349.08	400	$-4.922^{18°}$
chromate	$BaCrO_4$	ppt.	334.05	....	....
cyanide	$Ba(CN)_2$	solid	57.11	....	$+1.768^{9°}$
		dil. sol.	59.02	....	....
ferrocyanide	$Ba_2Fe(CN)_6$	dil. sol.	135.0	....	....
	$Ba_2Fe(CN)_6.6H_2O$	solid	556.51	....	$-11.5^{14°}$
fluoride	BaF_2	ppt.	287.70	....	....
fluosilicate	$BaSiF_6$	solid	677.42	....	....
hydride	BaH_2	solid	40.86	....	....
hydroxide	$Ba(OH)_2$	solid	225.86	660	$+11.40^{15°}$
		400	237.49	....	....
	$Ba(OH)_2.8H_2O$	solid	799.05	660	$-14.5^{15°}$
hypobromite	$Ba(BrO)_2$	dil. sol.	174.4	....	....
hypochlorite	$Ba(ClO)_2$	dil. sol.	180.9	....	....
hypophosphite	$Ba(H_2PO_2)_2$	dil. sol.	414.10	....	....
	$Ba(H_2PO_2)_2.H_2O$	solid	482.20	400	$+0.287^{18°}$
iodate	$Ba(IO_3)_2$	solid	245.16	....	....
		dil. sol.	236.6	....	....
	$Ba(IO_3)_2.H_2O$	solid	316.37	....	....
iodide	BaI_2	solid	144.8	....	$+10.30^{16°}$
		dil. sol.	155.08	....	....
nitrate	$Ba(NO_3)_2$	solid	238.28	400	$-9.462^{18°}$
		1600	228.44	....	....
nitride	Ba_3N_2	solid	90.80	....	....
nitrite	$Ba(NO_2)_2$	solid	185.7	800	$-5.687^{12°}$
	$Ba(NO_2)_2.H_2O$	solid	256.87	800	$-8.60^{12°}$
oxalate	$BaC_2O_4.H_2O$	ppt.	397.37	....	....
oxide	BaO	solid	133.1	600	$+35.84^{15°}$
oxide, di-	BaO_2	solid	151.7	....	....
perchlorate	$Ba(ClO_4)_2$	solid	210.3	800	$-1.67^{10°}$
phosphate, mono-	$BaH_4(PO_4)_2$	solid	735.9	....	....
phosphate, di-	$BaHPO_4$	solid	424.6	....	....
phosphate, tri-	$Ba_3(PO_4)_2$	solid	991.64	....	....
platinochloride	$BaPtCl_6$	solid	284.83	5000	$+9.08^{19°}$
selenide	$BaSe$	solid	88.17	....	....

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Barium					
silicate	$BaSiO_3$	fused	356.04		
sulfate	$BaSO_4$	ppt.	345.28		
		dil. sol.	339.31		
sulfhydrate	$Ba(SH)_2$	dil. sol.	136.2		
sulfide	BaS	solid	111.1		
		dil. sol.	118.5		
sulfite	$BaSO_3$	ppt.	279.57		
Beryllium					
chloride	$BeCl_2$	solid	112.5		
	$BeCl_2.4H_2O$	solid	188.1		
fluoride	BeF_2	dil. sol.	240.84		
hydroxide	$Be(OH)_2$	ppt.	206.7		
iodide	BeI_2	sol.	67.38		
nitrate	$Be(NO_3)_2$	dil. sol.	184.7		
sulfate	$BeSO_4$	solid	276.47		
	$BeSO_4.4H_2O$	solid	567.51		$+1.10$
Bismuth					
chloride	$BiCl_3$	solid	90.61		
hydroxide	$Bi(OH)_3$	dil. sol.	171.1		
oxide	Bi_2O_3	solid	135.5		
oxychloride	$BiOCl$	solid	87.69		
Boric acid	H_3BO_3	solid	251.61	400	$-5.401^{18\circ}$
		dil. sol.	246.12		
Boron					
bromide	BBr_3	liquid	42.77	400	$+83.63$
chloride	BCl_3	liquid	93.67		
		gas	89.13		
fluoride	BF_3	gas	256.87		$+24.37$
oxide	B_2O_3	solid	279.81		
Bromic acid	$HBrO_3$	200	12.7		
Bromine (atomic)	Br	gas	$-$ 26.691		
Bromine	Br_2	solid	$+$ 2.581		
		gas	$-$ 7.646		
chloride	$BrCl$	liquid	0.700		
Bromous acid	$HBrO$	dil. sol.	25.57		
Cadmium					
bromide	$CdBr_2$	solid	75.79	400	$+0.43^{18\circ}$
		400	76.23		
carbonate	$CdCO_3$	ppt.	178.7		
chloride	$CdCl_2$	solid	92.999	400	$+3.106^{18\circ}$
		400	96.08		
	$CdCl_2.2\frac{1}{2}H_2O$	solid	269.99	400	$-2.939^{18\circ}$
cyanide	$Cd(CN)_2$	solid	$-$ 36.80		
fluoride	CdF_2	1200	172.50		
hydroxide (ord. ppt.)	$Cd(OH)_2$	ppt.	133.57		
iodide	CdI_2	solid	48.387		
		400	47.431	400	$-0.956^{19\circ}$
nitrate	$Cd(NO_3)_2$	400	117.06		
	$Cd(NO_3)_2.4H_2O$	solid	395.63	400	$-5.042^{19\circ}$
oxide	CdO	solid	65.23		
selenide	$CdSe$	solid	16.7		
		ppt.	22.		
sulfate	$CdSO_4$	solid	217.92	400	$+10.68^{18\circ}$
		400	228.61		
sulfide	CdS	solid	33.93		
telluride	$CdTe$	solid	15.8		
Caesium					
bromide	$CsBr$	solid	97.468	110	$-6.738^{25\circ}$
		dil. sol.	90.80		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Caesium					
carbonate	Cs_2CO_3	solid	273.14	220	$+11.83^{15\circ}$
		dil. sol.	285.21	......	......
carbonate, acid	$CsHCO_3$	solid	231.3	220	$-4.30^{15\circ}$
		dil. sol.	227.0	......	......
chloride	$CsCl$	solid	106.48	220	$-4.588^{19\circ}$
		400	101.77	......	......
fluoride	CsF	solid	131.97	110	$+8.363^{15\circ}$
		400	140.38	......	......
hydroxide	$CsOH$	solid	100.26	110	$+16.4^{15\circ}$
		400	116.82	......	......
iodide	CsI	solid	83.752	110	$-8.24^{15\circ}$
		dil. sol.	75.75	......	......
nitrate	$CsNO_3$	solid	121.79	400	$-9.606^{20\circ}$
		400	112.19	......	......
oxide, mono-	Cs_2O	solid	82.20	600	$+83.15^{18\circ}$
oxide, tetra-	Cs_2O_4	solid	137.64	......	......
sulfate	Cs_2SO_4	solid	340.98	220	$-4.97^{15\circ}$
		440	335.96	......	......
sulfate, acid	$CsHSO_4$	solid	275.27	220	$-3.728^{15\circ}$
		220	271.69	......	......
sulfide	Cs_2S	solid	87.46	......	$+27.24$
		dil. sol.	114.70	......	......
Calcium					
acetate	$Ca(C_2H_3O_2)_2$	solid	357.95	440	$+6.93^{16\circ}$
		dil. sol.	364.88	......	......
	$Ca(C_2H_3O_2)_2.H_2O$	solid	427.48	600	$+5.85^{17\circ}$
aluminate, mono-	$CaO.Al_2O_3$	fused	549.59	......	......
aluminate, di-	$2CaO.Al_2O_3$	fused	692.96	......	......
aluminate, tri-	$3CaO.Al_2O_3$	fused	836.33	......	......
aluminum silicate	$3CaO.Al_2O_3.2SiO_2$	solid	1486.3	......	......
arsenate	$Ca_3(AsO_4)_2$	ppt.	793.31	......	......
bromide	$CaBr_2$	solid	162.2	......	$+24.37$
		dil. sol.	186.9	......	......
	$CaBr_2.6H_2O$	solid	598.09	400	$-1.10^{20\circ}$
carbide	CaC_2	solid	14.6	......	......
carbonate	$CaCO_3$	colloid	287.93	......	......
chloride	$CaCl_2$	solid	190.7	400	$+17.99^{18\circ}$
	$CaCl_2.H_2O$	solid	265.23	300	$+11.71^{18\circ}$
	$CaCl_2.6H_2O$	solid	623.44	400	$-4.564^{18\circ}$
cyanamide	$CaCN_2$	solid	85.07	......	......
cyanide	$Ca(CN)_2$	dil. sol.	60.45	......	......
ferrocyanide	$Ca_2Fe(CN)_6.12H_2O$	solid	963.21	......	$-4.54^{10\circ}$
fluoride	CaF_2	ppt.	286.26	......	......
formate	$Ca(CHO_2)_2$	solid	326.88	360	$+0.669^{16\circ}$
hydride	CaH_2	solid	45.88	......	......
hydroxide	$Ca(OH)_2$	solid	236.1	......	......
		dil. sol.	238.76	......	......
hypochlorite	$Ca(ClO)_2$	dil. sol.	181.60	......	......
iodide	CaI_2	solid	128.6	400	$+27.69^{18\circ}$
		dil. sol.	156.3	......	......
	$CaI_2.8H_2O$	solid	701.56	......	$+1.74^{20\circ}$
nitrate	$Ca(NO_3)_2$	soiid	225.3	400	$+3.943^{19\circ}$
		400	229.15	......	......
	$Ca(NO_3)_2.4H_2O$	solid	509.92	400	$-7.24^{19\circ}$
nitride	Ca_3N_2	solid	109.0	......	......
nitrite	$Ca(NO_2)_2.4H_2O$	solid	405.50	......	......
oxalate	CaC_2O_4	ppt.	333.3	......	......
oxide	CaO	solid	151.71	......	......
peroxide	CaO_2	solid	155.8	......	......
	$CaO_2.8H_2O$	solid	718.52	......	......

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Calcium					
phosphate, mono-	$CaH_4(PO_4)_2$	ppt.	743.13		
phosphate, tri-	$Ca_3(PO_4)_2$	solid	982.1		
phosphate, acid	$CaHPO_4$	ppt.	432.50		
selenide	$CaSe$	solid	88.41		
silicate	$CaSiO_3$	fused	375.15		
silicide	$CaSi_2$	solid	224.6		
sulfate (anhydrite)	$CaSO_4$	solid	335.72		+5.26
	$CaSO_4.2H_2O$	solid	477.80		−0.24
sulfhydrate	$Ca(SH)_2$	dil. sol.	137.4		
sulfide	CaS	solid	113.50		
		dil. sol.	119.71		
thiosulfate	CaS_2O_3	∞	270.49		
Carbon					
dichloride	C_2Cl_4	liquid	6.0		
		gas	− 1.150		
dioxide	CO_2	gas	+ 94.385		
		sat.	99.140		+4.755
disulfide	CS_2	liquid	− 22.0		
		gas	− 28.67		
monoxide	CO	gas	+ 26.428		
oxybromide	$COBr_2$	gas	22.0		
oxychloride	$COCl_2$	gas	52.09		
		liquid	57.993		
tetrachloride	CCl_4	gas	25.400		
		liquid	33.190		
Carbonic acid	H_2CO_3	dil. sol.	167.53		
Cerium	Ce	dil. sol.	164.9		
chloride (ous)	$CeCl_3$	600	283.39		
oxide (ic)	CeO_2	solid	234.9		
sulfate (ous)	$Ce_2(SO_4)_3$	dil. sol.	792.84		
Chloric acid	$HClO_3$	400	19.1		
Chlorine (atomic)	Cl	gas	− 28.746		
oxide, mono-	Cl_2O	gas	− 18.26	800	+9.439$^{18°}$
oxide, di-	ClO_2	liquid	− 30.11		
		gas	− 23.49		
Chlorous acid, hypo-	$HClO$	200	+ 29.773		
Chromic acid	H_2CrO_4	dil. sol.	206.69		
Chromium					
bromide (ic) (blue)	$CrBr_3$	dil. sol.	146.5		
bromide (ic) (green)	$[CrBr_2]Br$	dil. sol.	135.0		
	$(Cr.4H_2O.Br_2)Br.2H_2O$	solid	544.57	250	+0.669
bromide (ic)	$(Cr.6H_2O)Br_3$	solid	542.42		−11.34
chloride (ic) (rose) (forms green solution)	$CrCl_3$	solid	139.55		+30.59
chloride (ic) (green)	$(CrCl_2.4H_2O)Cl.2H_2O$	solid	580.41	150	−0.048
chloride (ic) (gray)	$(Cr.6H_2O)Cl_3$	solid	577.30		+12.02
chloride (ic)	$(Cr.4H_2O.Cl)Cl_2.6H_2O$	solid	854.01		0
chloride (ic)	$(Cr.4H_2O.Cl)Cl_2$	solid	435.37		+8.36
chloride (ous)	$CrCl_2$	solid	99.64		+18.6
		dil. sol.	118.3		
	$CrCl_2.4H_2O$	solid	389.73		+1.9
hydroxide (ic)	$Cr(OH)_3$	ppt.	245.88		
oxide (ic)	Cr_2O_3	solid	267.39		
		amorph.	266.19		
oxide, tri-	CrO_3	solid	136.0	80	+2.461$^{18°}$

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal
Chromium					
sulfate (ic) (violet)	$Cr_2(SO_4)_3$	dil. sol.	753.89	....	....
sulfate (ic) (green)	$Cr_2(SO_4)_3$	dil. sol.	730.95	....	....
sulfate (ic) (violet)	$(Cr.6H_2O)_2(SO_4)_3.2H_2O$	solid	1701.1	....	+10.11
sulfate (ic)	$(Cr.6H_2O)_2(SO_4)_3.3H_2O$	solid	1771.1	....	+8.29
sulfate (ic) (green)	$Cr_2(SO_4)_3.6H_2O$	solid	1127.4	....	+13.4
Cobalt					
bromide (ous)	$CoBr_2$	solid	54.96	....	+18.4
		dil. sol.	73.36	....	....
	$CoBr_2$ $6H_2O$	solid	485.07	....	−1.29
chloride (ous)	$CoCl_2$	solid	76.942	400	$+18.45^{17\circ}$
fluoride (ous)	CoF_2	dil. sol.	172.81	....	....
hydroxide (ic)	$Co(OH)_3$	ppt.	219.36	....	....
hydroxide (ous)	$Co(OH)_2$	ppt.	128.32	....	....
iodide (ous)	CoI_2	dil. sol.	42.77	....	....
nitrate	$Co(NO_3)_2$	solid	104.2	300	$+11.95^{18\circ}$
	$Co(NO_3)_2.6H_2O$	solid	531.19	400	$-4.97^{18\circ}$
oxide (ous)	CoO	solid	57.49	....	....
		amorph.	50.18	....	....
oxide (ous) (ic)	Co_3O_4	solid	192.6	....	....
selenide	$CoSe$	solid	13.4	....	....
		ppt.	11.5	....	....
sulfate	$CoSO_4$	800	225.09	....	....
	$CoSO_4.7H_2O$	solid	707.29	800	$-3.560^{19\circ}$
sulfide	CoS	ppt.	19.8	....	....
telluride	$CoTe$	solid	11.5	....	....
Copper					
acetate (ic)	$Cu(C_2H_3O_2)_2$	solid	214.6	320	$+2.39^{16\circ}$
		dil. sol.	217.0	....	....
	$Cu(C_2H_3O_2)_2.H_2O$	solid	285.07	400	$+0.167^{18\circ}$
am. chloride (ic)	$CuCl_2.2NH_4Cl$	solid	197.6	550	$+4.78^{15\circ}$
	$CuCl_2.2NH_4Cl.2H_2O$	solid	332.86	....	−6.21
am. sulfate (ic)	$CuSO_4.4NH_3$	solid	295.10	....	....
bromide (ic)	$CuBr_2$	solid	32.02	400	$+8.244^{20\circ}$
		400	40.14	....	....
	$CuBr_2.4H_2O$	solid	315.18	....	−1.43
bromide (ous)	$CuBr$	solid	24.61	....	....
carbonate	$CuCO_3$	ppt.	141.5	....	....
chlorate (ic)	$Cu(ClO_3)_2$	400	22.2	....	....
chloride (ic)	$CuCl_2$	solid	51.422	600	$+11.11^{18\circ}$
		800	62.605	....	....
	$CuCl_2.2H_2O$	solid	195.03	200	$+3.704^{18\circ}$
chloride (ous)	$CuCl$	solid	32.50	....	....
cyanide (ous)	$CuCN$	solid	− 27.96	....	....
fluoride (ic)	CuF_2	400	+139.8	....	....
formate (ic)	$Cu(CHO_2)_2$	solid	179.5	600	$+0.526^{15\circ}$
		dil. sol.	179.9	....	....
	$Cu(CHO_2)_2.4H_2O$	solid	461.17	500	$-7.89^{10\circ}$
hydroxide (ic) (green)	$Cu(OH)_2$	ppt.	104.97	....	....
iodide (ic)	CuI_2	solid	3.10	....	....
		dil. sol.	9.08	....	....
iodide (ous)	CuI	solid	15.8	....	....
nitrate	$Cu(NO_3)_2$	solid	72.40	280	$+10.47^{8\circ}$
		200	82.796	....	....
	$Cu(NO_3)_2.3H_2O$	solid	290 56	....	−2.39
	$Cu(NO_3)_2.6H_2O$	solid	503.80	400	$-10.70^{18\circ}$
oxide (ic)	CuO	solid	34.89	....	....
oxide (ous)	Cu_2O	solid	39.90	....	....
oxychloride	$CuCl_2.3CuO$	solid	160.57	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Copper					
selenate	$CuSeO_4$	400	128.6	......	......
	$CuSeO_4.5H_2O$	solid	473.1	......	-2.652
selenide (ic)	$CuSe$	ppt.	4.78	......	......
selenide (ous)	Cu_2Se	solid	7.41	......	......
sulfate (ic)	$CuSO_4$	solid	178.7	800	$+15.89^{18°}$
		800	194.65	......	......
	$CuSO_4.5H_2O$	solid	539.33	800	$-2.796^{18°}$
sulfate (ous)	Cu_2SO_4	solid	173.5	......	......
sulfide (ic)	CuS	solid	11.61	......	......
sulfide (ous)	Cu_2S	solid	18.97	......	......
telluride	Cu_2Te	solid	4.06	......	......
Cyanic acid	$HCNO$	dil. sol.	36.56	......	......
Cyanogen	C_2N_2	liquid	$-$ 65.47	......	......
		gas	$-$ 70.73	......	......
chloride	$CNCl$	liquid	$-$ 28.20	......	......
		gas	$-$ 36.56	......	......
iodide	CNI	solid	$-$ 42.29	......	......
		dil. sol.	$-$ 44.92	100	$-2.77^{20°}$
Dysprosium					
sulfate	$Dy_2(SO_4)_3 + 8H_2O$	......	......	1200	$+6.3$
Erbium acetate	$Er(C_2H_3O_2)_3 + 4H_2O$	......	......	1500	$+0.7$
Ethane	C_2H_6	gas	23.4	......	......
Ethyl alcohol	C_2H_5OH	liquid	65.902	......	......
		gas	55.795	......	......
Ethylene	C_2H_4	gas	$-$ 9.56	......	......
Ferric and **Ferrous** salts, see under *Iron*					
Fluosilicic acid	H_2SiF_6	200	545.04	......	......
	$H_2SiF_6.4H_2O$	liquid	789.25	......	$+7.9$
Gold					
bromide (ic)	$AuBr_3$	solid	13.38	2000	$-3.752^{18°}$
bromide (ous)	$AuBr$	solid	4.54	......	......
chloride (ic)	$AuCl_3$	solid	27 00	900	$+4.444^{18°}$
chloride (ous)	$AuCl$	solid	10.27	......	......
iodide (ous)	AuI	solid	0.96	......	......
Hydrazine	N_2H_4	dil. sol.	$-$ 3.250	......	......
sulfate	$N_2H_4.H_2SO_4$	solid	$+224.37$	......	......
		dil. sol.	215.77	1200	$-8.531^{19°}$
Hydrazoic acid	HN_3	dil. sol.	$-$ 54.48	......	......
Hydrobromic acid	HBr	gas	$+$ 8.650	200	$+19.88^{18°}$
		∞	28.602	......	......
	$HBr.2H_2O$	solid$^{-15°}$	164.40	......	......
Hydrochloric acid	HCl	gas	22.03	......	......
		∞	39.558	200	$+17.44^{18°}$
Hydrocyanic acid	HCN	gas	$-$ 30.108	......	......
		dil. sol.	$-$ 23.90	......	$+5.97$
Hydroferricyanide acid	$H_3Fe(CN)_6$	dil. sol.	-148.1	......	......
Hydroferrocyanic acid	$H_4Fe(CN)_6$	solid	-122.8	200	$+0.406^{10°}$
		dil. sol.	-122.3	......	......
Hydrofluoric acid	HF	liquid	$+$ 94.86	......	$+4.54$
		600	75.699	......	......
		gas	63.991	......	......
Hydriiodic acid	HI	gas	$-$ 5.926	200	$+19.24^{18°}$
		∞	$+$ 13.333	......	......
Hydrogen (atomic)	H	gas	$-$ 50.42	......	......
oxide (water)	H_2O	liquid	$+68.387$	......	......
		gas	57.826	......	......

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Hydrogen					
peroxide	H_2O_2	liquid	44.516	200	$+0.454^{15^\circ}$
		gas	32.903		
		200	44.970		
selenide	H_2Se	dil. sol.	− 13.4		$+2.39^{18^\circ}$
		gas	− 15.8		
sulfide	H_2S	liquid	+ 9.56		
		gas	5.26		
		dil. sol.	9.869		+4.564
telluride	H_2Te	gas	− 33.93		
Hydrosulfurous acid	$H_2S_2O_4$	dil. sol.	+166.1		
Hydroxylamine	NH_2OH	solid	27.60		
Indium					
bromide	$InBr_3$	solid	97.25		
		dil. sol.	112.8		
chloride, mono-	$InCl$	solid	44.68		
chloride, di-	$InCl_2$	solid	86.74		
chloride, tri-	$InCl_3$	solid	128.6		
		dil. sol.	145.28		
iodide	InI_3	solid	32.50		
		dil. sol.	66.91		
oxide, sesqui-	In_2O_3	solid	239.0		
Iodic acid	HIO_3	solid	56.392		−2.15
Iodine (atomic)	I	gas	− 25.470		
Iodine	I_2	gas	− 15.1		
bromide, mono-	IBr	liquid	+ 2.63		
chloride, mono-	ICl	solid	6.69		
		liquid	4.54		
chloride, tri-	ICl_3	solid	16.7		
oxide, penta-	I_2O_5	solid	42.055	1500	-1.79^{18°
Iridium					
chloride, di-	$IrCl_2$	solid	20.5		
chloride, tri-	$IrCl_3$	solid	60.45		
oxide, di-	IrO_2	solid	50.2		
Iron					
acetate	$Fe(C_2H_3O_2)_3$	1800	357.23		
ammonium sulfate	$Fe_2(SO_4)_3.(NH_4)_2SO_4$	1000	458.55		
ammonium sulfate (ic)	$FeNH_4(SO_4)_2.12H_2O$	solid	1295.8		
ammonium sulfate (ous)	$FeSO_4.(NH_4)_2SO_4.6H_2O$	solid	927.36		
bromide (ic)	$FeBr_3$	1000	95.10		
bromide (ous)	$FeBr_2$	dil. sol.	77.90		
carbonate (ous)	$FeCO_3$	solid	185.2		
		ppt.	179.2		
chlorate (ic)	$Fe(ClO_3)_3$	600	67.38		
chloride (ic)	$FeCl_3$	solid	96.30		+31.78
	$FeCl_3\ 2\frac{1}{2}H_2O$	solid	277.90	1200	$+21.0^{18^\circ}$
	$FeCl_3\ 6H_2O$	solid	532.62	1200	$+5.73^{21^\circ}$
chloride (ous)	$FeCl_2$	solid	81.864	400	$+17.90^{18^\circ}$
	$FeCl_2\ 2H_2O$	solid	227.7	300	$+8.6^{20^\circ}$
	$FeCl_2\ 4H_2O$	solid	370.37	400	$+2.748^{18^\circ}$
ferrocyanide (ic)	$Fe_4[Fe(CN_6]_3$	ppt.	−319.00		
fluoride (ic)	FeF_3	150	+242.53		
fluoride (ous)	FeF_2	1200	177.1		
hydroxide (ic)	$Fe(OH)_3$	ppt.	197.37		
hydroxide (ous)	$Fe(OH)_2$	ppt.	135.87		
iodide (ic)	FeI_3	1000	49.46		
iodide (ous)	FeI_2	dil. sol.	47.55		
nitrate (ic)	$Fe(NO_3)_3$	800	158.4		
	$Fe(NO_3)_3\ 9H_2O$	solid	782.80	150	−9.08

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Iron					
nitrate (ous)	$Fe(NO_3)_2$	dil. sol.	120.2		
oxide (ic) (ordinary)	Fe_2O_3	solid	190.7		
oxide (ous)	FeO	solid	64.04		
oxide (ous) (ic) (fused)	Fe_3O_4	solid	265.95		
oxide (ous) (ic) (magnetite)	Fe_3O_4	solid	266.91		
selenide (ous)	FeSe	solid	19.1		
		ppt.	14.3		
silicate	$FeSiO_3$	solid	264.52		
sulfate (ic)	$Fe_2(SO_4)_3$	1200	641.77		
sulfate (ous)	$FeSO_4$	solid	217.23	110	$+14.901^{14^\circ}$
		400	231.95		
	$FeSO_4.7H_2O$	solid	715.11	200	-4.32^{14°
sulfide (ous)	FeS	solid	23.06		
sulfide, di- (pyrite)	FeS_2	solid	35.60		
telluride (ous)	FeTe	solid	7.65		
Lanthanum					
chloride	$LaCl_3$	solid	266.67	1200	$+31.30^{16^\circ}$
oxide	La_2O_3	solid	456.87		
sulfate	$La_2(SO_4)_3$	dil. sol.	987.10		
	$La_2(SO_4)_3.8H_2O$	solid	1530.0	2400	$+4.06^{8^\circ}$
sulfide, di-	LaS_2	solid	162.0		
sulfide	La_2S_3	solid	317.33		
Lead					
acetate	$Pb(C_2H_3O_2)_2$	solid	234.00	220	$+1.41^{11^\circ}$
	$Pb(C_2H_3O_2)_2.3H_2O$	solid	446.12	100	-5.50^{11°
bromide	$PbBr_2$	solid	66.261		
		dil. sol.	56.225	2500	-10.04^{18°
carbonate	$PbCO_3$	solid	168.9		
chloride	$PbCl_2$	solid	85.664		
		dil. sol.	79.116		−6.55
chromate	$PbCrO_4$	solid	218.2		
fluoride	PbF_2	solid	159.40		
hydroxide	$Pb(OH)_2$	ppt.	137 6		
iodide	PbI_2	solid	41.840		
nitrate	$Pb(NO_3)_2$	solid	108.292	400	-7.599^{18°
		400	100.67		
nitride	PbN_6	solid	−100.60		
oxalate	PbC_2O_4	solid	+206.2		
oxide, mono-	PbO	solid	52.473		
oxide, di-	PbO_2	solid	62.60		
oxide, sub-	Pb_2O	solid	51.255		
oxide, (red)	Pb_3O_4	solid	174.19		
oxybromide	$PbBr_2.PbO$	solid	119.7		
	$PbBr_2.2PbO$	solid	171.3		
oxychloride	$PbCl_2.PbO$	solid	142.65		
	$PbCl_2.2PbO$	solid	195.9		
	$PbCl_2.3PbO$	solid	247.79		
oxyiodide	$PbI_2 + PbO$	solid	3.6		
phosphite	$PbHPO_3$	solid	231.8		
selenide	PbSe	solid	12.4		
		ppt.	23.7		
sulfate	$PbSO_4$	solid	214.6		
sulfide	PbS	ppt.	22.2		
sulfocyanate	$Pb(CNS)_2$	solid	− 28.67		
telluride	PbTe	solid	+ 5.5		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Lead					
thiosulfate	PbS_2O_3	solid	147.2		
Lithium					
bromide	$LiBr$	solid	83.728	850	$+11.25^{14°}$
		200	95.064		
carbide	Li_2C_2	solid	13.6		$+37.04^{17°}$
carbonate	Li_2CO_3	solid	290.8	220	$+3.06^{15°}$
	Li_2CO_3	dil. sol.	293.91		
carbonate, acid	$LiHCO_3$	500	232.3		
chloride	$LiCl$	solid	97.420	200	$+8.507^{18°}$
		∞	106.04		
cyanide	$LiCN$	200	31.30		
fluoride	LiF	solid	145.54	110	$-1.03^{15°}$
		dil. sol.	144.49		
fluosilicate	Li_2SiF_6	solid	677.49	800	$+1.816$
		dil. sol.	679.31		
hydride	LiH	solid	21.5	2000	$+31.30^{18°}$
hydroxide	$LiOH$	solid	116.4	110	$+4.468^{24°}$
		∞	121.00		
iodide	LiI	solid	64.994	200	$+14.77^{18°}$
		200	79.759		
nitrate	$LiNO_3$	solid	115.82	400	$+0.430^{21°}$
		∞	116.27		
	$LiNO_3.3H_2O$	solid	328.32		
nitride	Li_3N	solid	45.88		$+131.2$
oxide	Li_2O	solid	141.7	220	$+31.30^{15°}$
selenide	Li_2Se	solid	95.34		$+10.66^{20°}$
		dil. sol.	106.1		
silicate	Li_2SiO_3	fused	372.76		
		solid	434.89		
sulfate	Li_2SO_4	solid	337.9		$+6.380$
	$Li_2SO_4.H_2O$	solid	409.08	400	$+3.417^{18°}$
sulfhydrate	$LiSH$	dil. sol.	64.11		
sulfide	Li_2S	dil. sol.	115.4		
Magnesium					
ammonium arsenate	$MgNH_4AsO_4.6H_2O$	solid	763.92		
ammonium phosphate	$MgNH_4PO_4.6H_2O$	solid	901.56		
ammonium sulfate	$MgSO_4.(NH_4)_2SO_4.6H_2O$	solid	1016.5		-9.80
ammonium sulfite	$3MgSO_3.(NH_4)_2SO_3.6H_2O$	solid	1375.6		
arsenate	$Mg_3(AsO_4)_2$	solid	731.43		
arsenate, acid	$MgHAsO_4$	dil. sol.	322.8		
bromide	$MgBr_2$	solid	124.0		$+43.25^{15°}$
		400	167.3		
carbonate	$MgCO_3$	solid	267.39		
chloride	$MgCl_2$	solid	153.2	800	$+35.986^{16°}$
	$MgCl_2.6H_2O$	solid	596.37	200	$+2.939^{18°}$
cyanamide	$MgCN_2$	solid	59.26		
cyanide	$Mg(CN)_2$	dil. sol.	40.38		
dithionate	$MgS_2O_6.6H_2O$	solid	797.38	400	$-2.963^{19°}$
fluoride	MgF_2	ppt.	263.80		
hydroxide (brucite)	$Mg(OH)_2$	solid	223.4		
hydroxide	$Mg(OH)_2$	ppt.	218.6		
iodide	MgI_2	solid	86.74		$+49.70$
		dil. sol.	136.7		
nitrate	$Mg(NO_3)_2$	400	209.51		
	$Mg(NO_3)_2.6H_2O$	solid	623.90	400	$-4.229^{18°}$
nitride	Mg_3N_2	solid	118.3		
oxide (bomb)	MgO		145.76		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Magnesium					
phosphate	$Mg_3(PO_4)_2$	colloid	915.18		
silicate	$MgSiO_3$	solid	346.48		
sulfate	$MgSO_4$	solid	301.08	400	$+20.3^{18°}$
		400	321.33		
	$MgSO_4.7H_2O$	solid	803.85	400	$-3.871^{18°}$
sulfide	MgS	solid	82.20		
sulfite	$MgSO_3$	solid	238.5		
	$MgSO_3.6H_2O$	solid	671.21		
sulfhydrate	$Mg(SH)_2$	dil. sol.	117.3		
Manganese					
acetate	$Mn(C_2H_3O_2)_2$	solid	272.88	500	$+12.2^{17°}$
		dil. sol.	285.31		
	$Mn(C_2H_3O_2)_2.4H_2O$	solid	556.99	600	$+1.67^{16°}$
bromide	$MnBr_2$	solid	90.80		
		dil. sol.	106.8		
carbide	Mn_3C	solid	12.4		
carbonate	$MnCO_3$	solid	212.9		
chloride	$MnCl_2$	solid	112.69	350	$+16.01^{18°}$
		400	128.79		
	$MnCl_2.4H_2O$	solid	400.72	400	$+1.53^{18°}$
dithionate	$MnS_2O_6.6H_2O$	solid	736.20	400	$-1.9^{18°}$
fluoride, di-	MnF_2	dil. sol.	206.0		
fluoride, sesqui-	MnF_3	dil. sol.	260.46		
formate	$Mn(CHO_2)_2$	solid	242.3	500	$+4.30^{24°}$
	$Mn(CHO_2)_2.2H_2O$	solid	386.38	300	$-2.87^{24°}$
hydroxide	$Mn(OH)_3$	ppt.	219.8		
hydroxide (ous)	$Mn(OH)_2$	ppt.	163.4		
iodide	MnI_2	dil. sol.	76.46		
nitrate	$Mn(NO_3)_2$	solid	136.2	300	$+12.69^{14°}$
		400	149.1		
	$Mn(NO_3)_2.6H_2O$	solid	565.59	400	$-6.141^{18°}$
oxalate	MnC_2O_4	ppt.	259.50		
oxide (ic)	Mn_2O_3	solid	227.0		
oxide (ous)	MnO	solid	90.8		
oxide, di-	MnO_2	solid	125.4		
oxide, di- (hydrated ppt.)	MnO_2	amorph.	115.89		
oxide (ous) (ic)	Mn_3O_4	solid	327.84		
phosphate	$Mn_3(PO_4)_2$	solid	733.10		
selenide	$MnSe$	ppt.	27.		
		solid	23.9		
silicate	$MnSiO_3$	solid	299.40		
sulfate (ous)	$MnSO_4$	solid	247.07	400	$+13.79^{18°}$
		400	261.01		
	$MnSO_4.H_2O$	solid	321.39	400	$+7.790^{18°}$
	$MnSO_4.5H_2O$	solid	602.87	400	$+0.0478^{18°}$
	$MnSO_4.7H_2O$	solid	744.81		
sulfide (ous)	MnS	ppt.	47.31		
		solid	60.		
Manganic acid	$HMnO_4$	dil. sol.	123.3		
Methane	CH_4	gas	19.1		
Methyl alcohol	CH_3OH	liquid	60.001		
		gas	50.896		
		dil. sol.	61.89		+2.01
Mercury					
acetate (ic)	$Hg(C_2H_3O_2)_2$	solid	198.1		
acetate (ous)	$Hg_2(C_2H_3O_2)_2$	solid	203.35		
bromide (ic)	$HgBr_2$	solid	41.58		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Mercury					
bromide (ous)	Hg_2Br_2	ppt.	49.22	......	......
chloride (ic)	$HgCl_2$	solid	53.429	300	$-3.321^{18°}$
chloride (ous)	Hg_2Cl_2	ppt.	63.01	......	......
cyanide (ic)	$Hg(CN)_2$	solid	−62.13	......	−3.11
dimercuri-diammonium chloride	$NHg_2Cl.NH_4Cl$	solid	141.5	......	......
dimercuri-tetra ammonium chloride	$NHg_2Cl.3NH_4Cl$	solid	289.6	......	......
fulminate (ic)	$HgC_2N_2O_2$	solid	−64.52	......	......
iodide (ic) (red)	HgI_2	solid	25.33	......	......
iodide (ic) (yellow)	HgI_2	solid	22.2	......	......
iodide (ous) (yellow)	Hg_2I_2	solid	28.865	......	......
nitrate (ic)	$Hg(NO_3)_2$	dil. sol.	58.1	......	......
nitrate (ous)	$Hg_2(NO_3)_2$	dil. sol.	59.499	......	......
	$Hg_2(NO_3)_2.2H_2O$	solid	207.9	......	......
nitride (ous)	Hg_2N_6	solid	−97.49	......	......
oxalate (ic)	HgC_2O_4	solid	160.10	......	......
oxide (ic) (red)	HgO	solid	21.7	......	......
oxide (ous)	Hg_2O	solid	21.5	......	......
oxybromide (ic)	$HgBr_2.HgO$	solid	64.52	......	......
	$HgBr_2.3HgO$	solid	108.2	......	......
oxychloride (ic)	$HgCl_2.HgO$	solid	75.75	......	......
	$HgCl_2.2HgO$	solid	97.73	......	......
	$HgCl_2.3HgO$	solid	118.5	......	......
	$HgCl_2.4HgO$	solid	139.3	......	......
selenide (ic)	$HgSe$	ppt.	5.26	......	......
sulfate (ic)	$HgSO_4$	solid	162.5	......	......
sulfate (ous)	Hg_2SO_4	solid	171.59	......	......
sulfide (red)	HgS	solid	10.90	......	......
sulfide (black)	HgS	amorph.	10.5	......	......
sulfocyanate	$Hg(CNS)_2$	solid	−50.42	......	......
Molybdenum					
oxide, di-	MoO_2	solid	131.4	......	......
oxide, tri-	MoO_3	solid	174.0	......	......
Molybdic acid	H_2MoO_4	solid	+247.07	......	......
		dil. sol.	246.60	......	......
Neodymium					
chloride	$NdCl_3$	solid	246.60	2000	+35.60
		dil. sol.	282.20	......	......
iodide	NdI_3	solid	155.3	2000	$+48.98^{19°}$
		dil. sol.	204.3	......	......
oxide	Nd_2O_3	solid	434.89	......	......
sulfate	$Nd_2(SO_4)_3$	solid	919.48	500	+36.56
		dil. sol.	956.04	......	......
sulfide	Nd_2S_3	solid	262.61	......	......
Nickel					
bromide	$NiBr_2$	solid	53.29	......	+18.9
		dil. sol.	72.40	......	......
bromide ammonia	$NiBr_2.6NH_3$	solid	221.7	......	......
chloride	$NiCl_2$	solid	74.983	400	$+19.16^{18°}$
		800	94.266	......	......
	$NiCl_2.6H_2O$	solid	505.55	400	$-1.15^{19°}$
chloride ammonia	$NiCl_2.6NH_3$	solid	248.75	......	......
cyanide	$Ni(CN)_2$	solid	−23.25	......	......
dithionate	NiS_2O_6	dil. sol.	+290.09	......	......
	$NiS_2O_6.6H_2O$	solid	702.75	400	$-2.413^{19°}$

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Nickel					
fluoride	NiF_2	dil. sol.	171.4	......	......
hydroxide (ic)	$Ni(OH)_3$	ppt.	196.66	......	......
hydroxide (ous)	$Ni(OH)_2$	ppt.	129.80	......	......
iodide	NiI_2	dil. sol.	41.82	......	......
nitrate	$Ni(NO_3)_2$	solid	102.7	280	$+11.7^{18\circ}$
	$Ni(NO_3)_2.6H_2O$	solid	532.26	400	$-7.479^{18\circ}$
oxide	NiO	solid	57.83	......	......
selenide	$NiSe$	solid	13.4	......	......
		ppt.	14.8	......	......
sulfate	$NiSO_4$	400	227.05	......	......
	$NiSO_4.7H_2O$	solid	710.11	800	$-4.253^{19\circ}$
sulfide	NiS	ppt.	20.8	......	......
telluride	$NiTe$	solid	10.8	......	......
Nitric acid	HNO_3	liquid	42.366	......	$+7.169^{10\circ}$
		gas	35.341	......	......
		∞	49.797	......	......
Nitrogen (atomic)	N	gas	−129.0	......	......
oxide (ic)	NO	gas	− 21.5	......	......
oxide (ous)	N_2O	gas	− 17.0	......	......
		liquid	− 18.73	......	......
oxide, tetra-	NO_2	gas (ideal)	− 7.431	......	......
	N_2O_4	gas (ideal)	− 1.86	......	......
oxide, penta-	N_2O_5	solid	+ 14.6	400	$+16.68^{10\circ}$
		gas	− 1.2	......	$+29.797^{10\circ}$
oxybromide	$NOBr$	gas	− 17.54	......	......
oxychloride	$NOCl$	gas	− 12.66	......	......
selenide	NSe	solid	− 42.29	......	......
sulfide	NS	solid	− 31.78	......	......
Nitrous acid	HNO_2	200	+ 28.91	......	......
Osmium					
oxide, tetra-	OsO_4	solid	93.43	......	......
		liquid$^{40\circ}$	90.036	......	......
Oxalic acid	$H_2C_2O_4$	solid	197.04	......	......
		dil. sol.	194.5	300	$-2.27^{18\circ}$
	$H_2C_2O_4.2H_2O$	solid	339.79	300	$-8.578^{20\circ}$
Oxygen (atomic)	O	gas	− 59.159	......	......
(ozone)	O_3	gas	− 34.41	......	......
		dil. sol.	− 32.50	......	+1.9
Palladium					
am. chloride	$PdCl_2.2NH_3$	solid	105.4	......	......
	$PdCl_2.4NH_3$	solid	158.2	......	......
am. iodide	$PdI_2.2NH_3$	solid	73.84	......	......
	$PdI_2.4NH_3$	solid	121.6	......	......
bromide	$PdBr_2$	solid	27.96	......	......
chloride	$PdCl_2$	solid	43.49	......	......
cyanide	$Pd(CN)_2$	solid	− 49.0	......	......
hydride	Pd_2H	solid	+ 17.7	......	......
hydroxide (ic)	$Pd(OH)_4$	ppt.	168.0	......	......
hydroxide (ous)	$Pd(OH)_2$	ppt.	91.76	......	......
iodide	PdI_2	solid	17.92	......	......
oxide, mono-	PdO	solid	21.5	......	......
Perchloric acid	$HClO_4$	liquid	19.4	500	$+20.3^{19\circ}$
		200	39.67	......	......
	$HClO_4.2H_2O$	solid	100.4	......	+7.65
Periodic acid	HIO_4	dil. sol.	45.40	......	......
Phosphonium					
bromide	$PH_3.HBr$	solid	25.57	......	−3.03
chloride	PH_3HCl	solid	31.06	......	......
iodide	$PH_3.HI$	solid	12.07	......	−4.78

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Phosphoric acid					
meta-	HPO_3	solid	224.90	....	+9.749
ortho-	H_3PO_4	solid	303.13	150	$+2.700^{19\circ}$
		liquid	300.74	200	$+5.352^{20\circ}$
		400	306.17	....	....
pyro	$H_4P_2O_7$	solid	531.64	....	+8.005
		liquid	529.37	....	+10.23
Phosphorous acid					
hypo-	H_3PO_2	solid	141.36	150	$-0.167^{12\circ}$
		liquid	139.02	150	$+2.17^{19\circ}$
ortho-	H_3PO_3	solid	228.94	150	$+0.119^{19\circ}$
		liquid	225.86	150	$+2.939^{19\circ}$
pyro-	$H_4P_2O_5$	dil. sol.	384.23	....	....
Phosphorus					
bromide, tri-	PBr_3	liquid	45.40	....	....
bromide, penta-	PBr_5	solid	60.69	....	....
chloride, tri-	PCl_3	liquid	76.94	1000	$+65.138^{19\circ}$
		gas	70.01	....	....
chloride, penta-	PCl_5	solid	106.6	1000	$+123.44^{22\circ}$
hydride (phosphine)	PH_3	gas	− 5.97	....	....
hydride (solid)	P_2H	solid	+ 11.9	....	....
iodide, tri-	PI_3	solid	11.0	....	....
iodide, tetra-	P_2I_4	solid	19.8	....	....
nitride	P_3N_5	solid	75.03	....	....
oxide, penta-	P_2O_5	solid	365.83	....	....
oxybromide	$POBr_3$	solid	106.8	....	....
oxychloride	$POCl_3$	liquid	147.15	1000	$+72.187^{20\circ}$
Platinic acid					
bromo-	H_2PtBr_6	dil. sol.	115.4	....	....
	$H_2PtBr_6.9H_2O$	solid	733.8	....	−2.87
chloro-	H_2PtCl_6	dil. sol.	165.6	....	....
	$H_2PtCl_6.6H_2O$	solid	571.57	500	+4.349
Platinum					
bromide	$PtBr_4$	solid	40.14	1000	+9.80
chloride, di-	$PtCl_2$	solid	35.84	....	....
chloride, tetra-	$PtCl_4$	solid	62.60	....	....
		dil. sol.	81.96	....	....
	$PtCl_4.5H_2O$	solid	425.81	400	−1.84
hydroxide	$Pt(OH)_2$	ppt.	87.69	....	....
iodide	PtI_4	solid	16.7	....	....
oxide, mono-	PtO	solid	17.0	....	....
Potassium					
acetate	$KC_2H_3O_2$	solid	174.48	200	$+3.35^{20\circ}$
aluminum sulfate	$KAl(SO_4)_2.12H_2O$	solid	1439.9	1200	$-10.11^{18\circ}$
arsenate (tribasic)	K_3AsO_4	400	389.73	....	....
arsenate (dibasic)	K_2HAsO_4	400	335.01	....	....
arsenate (monobasic)	KH_2AsO_4	dil. sol.	280.77	....	−4.78
		400	275.99	....	....
arsenite, ortho-	KH_2AsO_3	800	230.1	....	....
bromate	$KBrO_3$	solid	83.107	400	$-10.0^{18\circ}$
bromide	KBr	solid	94.027	200	$-5.066^{18\circ}$
		∞	88.889	....	....
bromopalladite	K_2PdBr_4	dil. sol.	208.4	....	....
bromoplatinate	K_2PtBr_6	solid	248.51	....	−12.26
		dil. sol.	236.1	....	....
bromoplatinite	K_2PtBr_4	solid	221.0	....	−10.56
		dil. sol.	210.5	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Potassium					
carbonate	K_2CO_3	solid	274.96	400	$+6.499^{16°}$
		400	281.46		
carbonate, acid	$KHCO_3$	solid	231.3	220	$-5.329^{15°}$
		200	225 8		
chlorate	$KClO_3$	solid	89.869	400	$-10.27^{18°}$
		∞	79.379		
chloride	KCl	solid	104.30	200	$-4.444^{18°}$
		∞	99.879		
chloriridate	K_2IrCl_6	solid	279.57		
		dil. sol.	266.91		-3.11
	K_3IrCl_6	solid	365.59		
chloropalladate	K_2PdCl_6	solid	290.09		-15.1
		dil. sol.	275.03		
chloropalladite	K_2PdCl_4	solid	261.41	300	$-13.62^{19°}$
		dil. sol.	247.79		
chloroplatinate	K_2PtCl_6	solid	299.64		
		dil. sol.	286.26		-13.76
chloroplatinite	K_2PtCl_4	solid	254.72		-12.11
		dil. sol.	242.53		
chromate	K_2CrO_4	solid	329.51	540	-5.26
		800	324.30		
cyanate	$KCNO$	solid	100.12	400	$-5.161^{20°}$
		dil. sol.	94.86		
cyanide	KCN	solid	28.20	200	$-2.87^{18°}$
		200	25.09		
dichromate	$K_2Cr_2O_7$	solid	481.72	1000	$-17.44^{18°}$
		∞	463.35		
dithionate, see under *thionate, di-*					
ferric sulfate	$KFe(SO_4)_2.12H_2O$	solid	1323 5		-16.0
ferricyanide	$K_3Fe(CN)_6$	solid	48 98	400	$-14.3^{13°}$
		dil. sol	34.41		
ferrocyanide	$K_4Fe(CN)_6$	solid	131.7	1000	$-12.4^{17°}$
		dil. sol.	119 24		
	$K_4Fe(CN)_6.3H_2O$	solid	340.98	1000	$-16.5^{17°}$
ferrous sulfate	$K_2Fe(SO_4)_2.6H_2O$	solid	985.19		-11.0
fluoride	KF	solid	134.10	110	$+4.110^{15°}$
		400	138.21		
	$KF.2H_2O$	solid	277 11	110	$-2.2^{15°}$
fluoride, acid	KHF_2	solid	219.36	400	$-5.97^{15°}$
fluosilicate	K_2SiF_6	solid	681.96		
		dil. sol.	667.63		
hydride	KH	solid	14.1		
hydroxide	KOH	solid	102.01	175	$+12.95^{21°}$
		∞	114.85		
hypochlorite	$KClO$	400	86.141		
hypophosphite	KH_2PO_2	dil. sol.	202.9		
iodate	KIO_3	solid	121.48	400	$-6.762^{18°}$
iodide	KI	solid	78.758	400	$-5.114^{18°}$
		∞	73.62		
iodide, tri-	KI_3	dil. sol.	71 92		
magnesium chloride (melt)	$KCl.MgCl_2$	solid	260.69		$+28.20^{18°}$
	$KCl.MgCl_2.6H_2O$	solid	702.27		$-3.08^{15°}$
magnesium sulfate	$K_2Mg(SO_4)_2$	solid	642.78	600	$+10.5^{19°}$
	$K_2Mg(SO_4)_2.6H_2O$	solid	1073.6	600	$-10.01^{18°}$
mercuric bromide	$KBr.HgBr_2$	solid	137.9		
	$2KBr.HgBr_2$	solid	229 9	660	$-9.749^{18°}$
mercuric chloride	$KCl.HgCl_2$	solid	159.9	700	$-9.56^{14°}$
	$2KCl.HgCl_2$	solid	266.67	1000	$-15.03^{14°}$
	$2KCl.HgCl_2.H_2O$	solid	336.44	600	$-16.39^{18°}$

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Potassium					
nitrate	KNO_3	solid	118.78	200	$-8.459^{18°}$
		∞	110.11		
nitrite	KNO_2	dil. sol.	85.78		
oxalate	$K_2C_2O_4$	solid	320.43		−4.78
oxalate, acid	KHC_2O_4	solid	264.52		−9.56
oxalate, tetra-	$KHC_2O_4.H_2C_2O_4$	solid	465.00		−15.8
oxide	K_2O	solid	86.26	300	$+75.03^{17°}$
perchlorate	$KClO_4$	dil. sol.	112.07		
		∞	99.236		
periodate	KIO_4	dil. sol.	97.73		
permanganate	$KMnO_4$	solid	194.3		
persulfate	$K_2S_2O_8$	solid	444.69	3300	$-14.6^{9°}$
		dil. sol.	430.11		
phos. ortho-	K_3PO_4	dil. sol.	479.33		
phos. hydrogen	K_2HPO_4	dil. sol.	426.05		
phos. dihydrogen	KH_2PO_4	solid	372.05		−4.78
		dil. sol.	367.27		
phosphite	K_2HPO_3	dil. sol.	350.06		
selenide	K_2Se	solid	85.3	1800	$+8.60^{13°}$
	$K_2Se.9H_2O$	solid	728.32	4000	$-19.1^{14°}$
	$K_2Se.14H_2O$	solid	1071.5	4000	$-20.3^{13°}$
	$K_2Se.19H_2O$	solid	1422.2		$-29.39^{14°}$
silver bromide	$AgBr + KBr$	solid	−0.4		
silver cyanide	$KAg(CN)_2$	solid	+6.69	400	$-8.554^{11°}$
silver iodide	$KI.AgI$	solid	97.49		
silver iodide	$3KI.AgI$	solid	255.92		
sulfate	K_2SO_4	solid	338.62	400	$-6.547^{18°}$
		∞	331.93		
sulfate, acid	$KHSO_4$	solid	272.88	200	$-3.799^{17°}$
		800	269.75		
sulfate, pyro-	$K_2S_2O_7$	solid	466.91		−3.82
		dil. sol.	463.09		
sulfhydrate	KHS	400	63.967		
	$KHS.\frac{1}{4}H_2O$	solid	80.29	1000	$+0.765^{17°}$
sulfide, mono-	K_2S	solid	88.17		+22.5
		400	110.59		
	$K_2S.2H_2O$	solid	243.49	1200	$+3.82^{18°}$
	$K_2S.5H_2O$	solid	457.59	1000	$-5.26^{16°}$
sulfide, tetra-	K_2S_4	solid	113.7	100	$+1.2^{10°}$
	$K_2S_4.\frac{1}{2}H_2O$	solid	151.3		$-2.20^{12°}$
sulfite	K_2SO_3	solid	265.95	300	$+1.4^{12°}$
		600	267.39		
	$K_2SO_3.H_2O$	solid	334.53		
sulfite, acid	$KHSO_3$	400	207.74		
sulfocyanate	$KCNS$	solid	54.24	100	−12.2
		dil. sol.	42.06		
tartrate	$K_2C_4H_4O_6$	solid	419.36	400	$-2.844^{18°}$
		dil. sol.	416.49		
	$K_2C_4H_4O_6.\frac{1}{2}H_2O$	solid	456.87	400	$-6.141^{18°}$
tartrate, acid	$KHC_4H_4O_6$	solid	369.18		
		dil. sol.	357.71		
thionate, di-	$K_2S_2O_6$	solid	407.91		
thionate, tri-	$K_2S_3O_6$	solid	394.27	500	$-12.45^{18°}$
thionate, tetra-	$K_2S_4O_6$	solid	395.46	500	$-13.14^{17°}$
thionate, penta-	$K_2S_5O_6$	solid	398.09		−10.0
		dil. sol.	388.05		
	$K_2S_5O_6.\frac{1}{2}H_2O$	solid	503.7	2000	$-13.14^{10°}$
thiosulfate	$K_2S_2O_3$	solid	266.67	800	$-5.02^{10°}$
		dil. sol.	261.65		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Potassium					
thiosulfate	$K_2S_2O_3.H_2O$	solid	336.20	....	$-6.21^{14°}$
zinc sulfate	$K_2Zn(SO_4)_2$	solid	572.05	600	$+7.909^{18°}$
	$K_2Zn(SO_4)_2.6H_2O$	solid	1002.2	600	$-11.80^{18°}$
Praseodymium					
chloride	$PrCl_3$	solid	240.38	2500	$+33.45^{18°}$
		dil. sol.	273.84	....	....
	$PrCl_3.7H_2O$	solid	747.20	2000	$+5.26^{17°}$
nitrate	$Pr(NO_3)_2$	dil. sol.	315.41	....	....
oxide	PrO_2	solid	215.1	....	....
oxide, tri-	Pr_2O_3	solid	416.97	....	....
Rubidium					
bromide	$RbBr$	solid	96.06	110	$-5.95^{15°}$
		400	89.61	....	....
carbonate	Rb_2CO_3	solid	273.84	....	+8.746
		dil. sol.	282.68	....	....
carbonate, acid	$RbHCO_3$	solid	230.6	110	$-4.731^{15°}$
		dil. sol.	225.8	....	....
chloride	$RbCl$	solid	104.97	400	$-4.23^{21°}$
		400	100.53	....	....
fluoride	RbF	solid	133.31	110	$+5.806^{16°}$
		400	139.12	....	....
hydroxide	$RbOH$	solid	101.20	110	$+14.27^{15°}$
iodide	RbI	solid	80.77	110	$-6.499^{15°}$
		dil. sol.	74.31	....	....
nitrate	$RbNO_3$	solid	119.62	400	$-8.769^{21°}$
		200	110.99	....	....
oxide, mono-	Rb_2O	solid	82.92	....	$+80.05^{19°}$
oxide, di-	Rb_2O_2	solid	107.05	....	....
oxide, tetra-	Rb_2O_4	solid	135.0	....	....
sulfate	Rb_2SO_4	solid	339.98	220	$-6.667^{18°}$
		440	333.45	....	....
sulfate, acid	$RbHSO_4$	solid	274.10	220	$-3.728^{15°}$
		330	270.32	....	....
sulfide	Rb_2S	solid	87.69	....	+24.61
		dil. sol.	112.31	....	....
sulfocyanate	$RbCNS$	solid	56.87	....	−14.3
		dil. sol.	42.77	....	....
Ruthenium					
chloride	$RuCl_3$	solid	62.84	....	....
oxide, di-	RuO_2	solid	52.57	....	....
Selenic acid	H_2SeO_4	solid	130.23	400	+13.36
		liquid	126.64	400	+16.7
Selenious acid	H_2SeO_3	solid	128.03	....	−4.110
		dil. sol.	123.92	....	....
Selenium	Se_2	gas	34.89	....	....
chloride, mono-	Se_2Cl_2	liquid	22.15	....	....
chloride, tetra-	$SeCl_4$	solid	46.165	....	....
hydride, see *hydrogen selenide*					
nitride, see *nitrogen selenide*					
oxide, di-	SeO_2	solid	56.416	....	−0.908
Silicic acid, ortho-	H_4SiO_4	colloid	333.81	....	....
Silicon					
bromide, tetra	$SiBr_4$	liquid	91.52	2000	$+19.8^{9°}$
carbide	SiC	solid	1.43	....	....
chloride, tetra	$SiCl_4$	liquid	149.1	....	....
		gas	142.7	....	....

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Silicon					
fluoride, tetra	SiF_4	gas	361.29	......	......
hydride	SiH_4	gas	11.9	......	......
iodide, tetra-	SiI_4	solid	27.72	12,000	$+20.5^{9°}$
oxide, di-	SiO_2	fused	198.3	......	......
oxide, di- (α quartz)	SiO_2	solid	201.34	......	......
sulfide (white)	SiS_2	solid	32.02	......	$+9.32^{10°}$
sulfide (yellow)	SiS_2	solid	28.91	......	$+10.8^{10°}$
Silver					
acetate	$AgC_2H_3O_2$	solid	97.01	......	−4.397
bromide	$AgBr$	solid	23.85	......	......
carbide	Ag_2C_2	solid	− 83.87	......	......
carbonate	Ag_2CO_3	solid	+120.9	......	......
chlorate	$AgClO_3$	solid	1.67	......	−7.53
		dil. sol.	− 5.73	......	......
chloride	$AgCl$	solid	+ 30.59	......	......
cyanate	$AgCNO$	solid	23.7	......	......
cyanide	$AgCN$	solid	− 33.45	......	......
fluoride	AgF	solid	+ 48.698	......	$+4.301^{10°}$
	$AgF.2H_2O$	solid	191.26	......	$-1.4^{10°}$
iodide	AgI	ppt.	14.93	......	......
nitrate	$AgNO_3$	solid	30.11	400	$-5.472^{18°}$
		400	24.66	......	......
nitride	AgN_3	solid	− 66.19	......	......
nitrite	$AgNO_2$	solid	+ 12.7	......	−8.84
oxalate	$Ag_2C_2O_4$	solid	159.6	......	......
oxide	Ag_2O	solid	6.953	......	......
oxide, per	Ag_2O_2	solid	5.400	......	......
perchlorate	$AgClO_4$	solid	12.23	......	+2.17
		dil. sol.	14.41	......	......
selenide	$AgSe$	ppt.	− 0.956	......	......
sulfate	Ag_2SO_4	solid	+166.1	......	......
		dil. sol.	161.5	......	......
sulfide	Ag_2S	solid	5.02	......	......
sulfocyanate	$AgCNS$	solid	− 21.03	......	......
Sodium					
acetate	$NaC_2H_3O_2$	solid	+171.16	200	$+3.943^{18°}$
		400	175.10	......	......
	$NaC_2H_3O_2.3H_2O$	solid	384.71	400	−4.588
aluminate	$NaAlO_2$	solid	271.69	......	......
amide	$NaNH_2$	solid	32.26	......	$+31.06^{21°}$
arsenate	Na_3AsO_4	solid	358.	......	......
		500	381.60	......	......
	$Na_3AsO_4.12H_2O$	solid	1214.8	600	$-12.7^{18°}$
arsenate (disodium)	Na_2HAsO_4	400	329.03	......	......
arsenate, acid	NaH_2AsO_4	300	273.12	......	......
arsenite	Na_2HAsO_3	400	271.69	......	......
borate	$NaBO_2$	300	231.5	......	......
borate, tetra-	$Na_2B_4O_7$	solid	742.18	......	+10.27
		dil. sol.	752.45	......	......
	$Na_2B_4O_7.10H_2O$	solid	1462.14	1600	$-25.854^{18°}$
bromide	$NaBr$	solid	86.333	200	$-0.191^{18°}$
		200	86.15	......	......
	$NaBr.2H_2O$	solid	227.72	300	$-4.71^{18°}$
bromoplatinate	Na_2PtBr_6	solid	220.8	800	$+9.940^{18°}$
		dil. sol.	230.8	......	......
	$Na_2PtBr_6.6H_2O$	solid	649.71	800	$-8.60^{18°}$
carbide	Na_2C_2	solid	−4.78	......	......
carbonate	Na_2CO_3	solid	+270.56	400	$+5.639^{18°}$
		400	276.18	......	......

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Sodium					
carbonate	$Na_2CO_3.H_2O$	solid	342.32	400	$+2.25^{18°}$
	$Na_2CO_3.10H_2O$	solid	976.16	400	$-16.15^{18°}$
carbonate, acid	$NaHCO_3$	solid	227.5	....	$-4.30^{15°}$
		200	223.35	....	....
chlorate	$NaClO_3$	solid	82.34	....	....
		dil. sol.	77.06	....	....
chloride	$NaCl$	solid	98.36	200	$-1.281^{18°}$
		∞	97.08	....	....
chloroplatinate	Na_2PtCl_6	solid	271.93	800	$+8.507^{18°}$
		dil. sol.	280.29	....	....
	$Na_2PtCl_6.6H_2O$	solid	701.32	900	$-10.61^{18°}$
chloroplatinite	Na_2PtCl_4	solid	227.0	....	$+10.04$
		dil. sol.	237.0	....	....
chromate	Na_2CrO_4	solid	316.61	600	$+2.39^{11°}$
		800	319.00	....	....
	$NaCrO_4.10H_2O$	solid	1018.4	1200	$-15.79^{11°}$
cyanate	$NaCNO$	solid	97.01	2000	$-4.803^{13°}$
		dil. sol.	92.23	....	....
cyanide	$NaCN$	solid	22.9	100	$-0.502^{9°}$
		200	22.5	....	....
	$NaCN.\frac{1}{2}H_2O$	solid	57.59	110	$-1.0^{6°}$
	$NaCN.2H_2O$	solid	163.7	100	$-4.421^{4°}$
dichromate	$Na_2Cr_2O_7$	dil. sol.	458.86	....	....
dithionate, see under *thionate, di-*					
fluoride	NaF	solid	136.30	400	$-0.478^{12°}$
		dil. sol.	135.70	....	....
formate	$NaCHO_2$	solid	157.01	150	$-0.526^{12°}$
		400	156.49	....	....
fluosilicate	Na_2SiF_6	solid	660.94	....	....
		dil. sol.	658.31	....	....
hydride	NaH	solid	13.14	200	$+26.05^{18°}$
hydroxide	$NaOH$	solid	101.91	160	$+10.30^{22°}$
		∞	112.04	....	....
	$NaOH.H_2O$	solid	173.24	180	$+7.192^{22°}$
hypochlorite	$NaOCl$	dil. sol.	83.39	....	....
iodide	NaI	solid	69.46	200	$+1.410^{18°}$
		200	70.870	....	....
	$NaI.2H_2O$	solid	211.64	200	$-4.014^{18°}$
iodoplatinate	Na_2PtI_6	dil. sol.	167.0	....	....
manganate	Na_2MnO_4	solid	267.62	....	....
manganese sulfate	$Na_2SO_4.MnSO_4$	solid	574.91	....	$+12.9$
molybdate	Na_2MoO_4	solid	361.77	....	....
nitrate	$NaNO_3$	solid	112.45	200	$-5.018^{17°}$
		∞	107.33	....	....
nitrite	$NaNO_2$	solid	86.50	250	-3.513
		dil. sol.	83.15	....	....
oxalate	$Na_2C_2O_4$	solid	316.01	1500	-5.50
		450	310.44	....	....
oxalate, acid	$NaHC_2O_4$	solid	257.83	300	-5.50
		400	252.33	....	....
	$NaHC_2O_4.H_2O$	solid	330.23	300	-9.56
oxide	Na_2O	solid	99.16	....	$+56.39$
perchlorate	$NaClO_4$	solid	100.60	400	$-3.58^{10°}$
		dil. sol.	97.25	....	....
peroxide	Na_2O_2	solid	118.42	....	....
phos. (trisod.)	Na_3PO_4	solid	447.08	....	....
		900	471.30	....	....
	$Na_3PO_4.12H_2O$	solid	1306.3	600	$-14.6^{18°}$

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Sodium					
phos. (disod.)	Na_2HPO_4	solid	414.98	400	$+5.639^{18\circ}$
		600	420.62	....	....
	$Na_2HPO_4.2H_2O$	solid	557.78	400	$-0.382^{18\circ}$
	$Na_2HPO_4.7H_2O$	solid	910.88	400	$-11.5^{18\circ}$
phos., pyro-	$Na_4P_2O_7$	solid	755.08	800	$+11.85^{18\circ}$
		1600	767.03	....	....
	$Na_4P_2O_7.10H_2O$	solid	1462.4	800	$-11.66^{18\circ}$
phos., pyro- (disod.)	$Na_2H_2P_2O_7$	solid	657.83	....	-2.27
		1200	655.68	....	....
	$Na_2H_2P_2O_7.6H_2O$	solid	1079.8	....	-13.91
phosphite	Na_2HPO_3	solid	335.44	500	$+9.152^{14\circ}$
		dil. sol.	344.57	....	....
	$Na_2HPO_3.5H_2O$	solid	344.57	500	$-4.588^{15\circ}$
phosphite, acid	NaH_2PO_3	solid	286.50	500	$+0.741^{15\circ}$
		600	287.22	....	....
	$NaH_2PO_3.2\frac{1}{2}H_2O$	solid	463.56	500	$-5.26^{15\circ}$
		300	364.61	....	....
selenate	Na_2SeO_4	solid	261.41	....	....
selenate, acid	$NaHSeO_4$	dil. sol.	201.84	....	....
selenide	Na_2Se	solid	69.53	200	$+18.59^{14\circ}$
	$Na_2Se.4\frac{1}{2}H_2O$	solid	403.83	....	-7.89
	$Na_2Se.9H_2O$	solid	714.22	....	-10.5
	$Na_2Se.16H_2O$	solid	1190.0	3000	$-22.0^{14\circ}$
selenide, acid	$NaHSe$	dil. sol.	44.68	....	....
silicate	Na_2SiO_3	solid	368.94	....	....
sulfate	Na_2SO_4	solid	326.31	400	$+0.55^{18\circ}$
		∞	326.67	....	....
	$Na_2SO_4.10H_2O$	solid	1029.6	400	$-18.90^{18\circ}$
sulfate, acid	$NaHSO_4$	solid	265.19	200	$+1.2^{17\circ}$
		800	266.86	....	....
sulfhydrate	$NaHS_2$	solid	57.11	600	$+4.30^{16\circ}$
		400	61.458	....	....
sulfhydrate	$NaHS.2H_2O$	solid	199.8	400	$-1.53^{18\circ}$
sulfide, mono-	Na_2S	solid	89.85	....	$+15.5$
		400	105.21	....	....
	$Na_2S.4\frac{1}{2}H_2O$	solid	417.92	1000	$-5.02^{17\circ}$
	$Na_2S.5H_2O$	solid	453.766	1000	$-6.69^{13\circ}$
	$Na_2S.9H_2O$	solid	737.40	1000	$-16.7^{13\circ}$
sulfide, di-	Na_2S_2	dil. sol.	105.62	....	....
sulfide, tri-	Na_2S_3	dil. sol.	107.3	....	....
sulfide, tetra-	Na_2S_4	solid	98.93	1200	$+9.80^{17\circ}$
sulfite	Na_2SO_3	solid	259.26	....	$+2.39^{10\circ}$
		800	261.89	....	....
	$Na_2SO_3.7H_2O$	solid	751.50	500	$-10.99^{10\circ}$
sulfite, acid	$NaHSO_3$	600	205.0	....	....
sulfocyanate	$NaCNS$	solid	42.77	100	$-3.321^{18\circ}$
tartrate	$Na_2C_4H_4O_6$	solid	412.19	....	-1.12
		dil. sol.	411.23	....	....
	$Na_2C_4H_4O_6.2H_2O$	solid	553.89	....	-5.878
tartrate, acid	$NaHC_4H_4O_6$	solid	360.58	....	-5.663
		dil. sol.	355.08	....	....
	$NaHC_4H_4O_6.H_2O$	solid	431.78	....	-8.531
thionate, di-	$Na_2S_2O_6$	solid	394.98	400	$-5.687^{19\circ}$
	$Na_2S_2O_6.2H_2O$	solid	537.64	....	-11.66
thionate, tri-	$Na_2S_2O_6$	dil. sol.	376.35	....	....
	$Na_2S_3O_6.3H_2O$	solid	591.40	1000	$-10.0^{11\circ}$
thionate, tetra-	$Na_2S_4O_6$	dil. sol.	377.06	....	....
	$Na_2S_4O_6.2H_2O$	solid	523.54	600	$-9.80^{10\circ}$

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Sodium					
thiosulfate	$Na_2S_2O_3$	solid	254.24	440	$+1.7^{15°}$
		dil. sol.	255.92		
	$Na_2S_2O_3.5H_2O$	solid	609.32	400	$-11.37^{18°}$
tungstate	Na_2WO_4	solid	388.05		
		dil. sol.	383.99		+4.06
uranate	Na_2UO_4	solid	420.31		
vanadate	Na_3VO_4	solid	449.23		
Stannic acid	SnO_2+H_2O	solid	133.5		
Stannic and **Stannous** salts, see under *Tin*					
Strontium					
acetate	$Sr(C_2H_3O_2)_2$	solid	359.62	200	$+5.568^{12°}$
		dil. sol.	365.35		
	$Sr(C_2H_3O_2)_2.\frac{1}{2}H_2O$	solid	394.27	220	$+52.57^{12°}$
arsenate	$Sr_3(AsO_4)_2$	ppt.	795.70		
bromide	$SrBr_2$	solid	171.09	400	$+16.0^{18°}$
		dil. sol.	187.34		
	$SrBr_2.6H_2O$	solid	604.07	400	$-6.452^{18°}$
carbonate	$SrCO_3$	ppt.	291.28		
chloride	$SrCl_2$	solid	197.85	400	$+11.16^{18°}$
		2000	209.14		
	$SrCl_2.6H_2O$	solid	626.81	400	$-7.503^{18°}$
cyanide	$Sr(CN)_2$	dil. sol.	60.69		
	$Sr(CN)_2.4H_2O$	solid	338.35	200	$-4.158^{8°}$
dithionate	SrS_2O_6	dil. sol.	404.54		
	$SrS_2O_6.4H_2O$	solid	687.22	400	$-9.247^{18°}$
fluoride	SrF_2	ppt.	288.89		
hydride	SrH_2	solid	42.06		
hydroxide	$Sr(OH)_2$	solid	228.7	1100	$+10.32^{15°}$
	$Sr(OH)_2.8H_2O$	solid	800.48	1100	$-14.27^{15°}$
iodide	SrI_2	solid	136.2		$+20.45^{12°}$
		dil. sol	156.8		
	$SrI_2.7H_2O$	solid	639.91		$-4.468^{15°}$
nitrate	$Sr(NO_3)_2$	solid	234.4	400	$-4.660^{18°}$
		1000	229.82		
	$Sr(NO_3)_2.4H_2O$	solid	515.65	400	$-12.31^{18°}$
oxide	SrO	solid	140.7	1100	$+29.99^{15°}$
peroxide	SrO_2	solid	153.2		
phosphate	$Sr_3(PO_4)_2$	ppt.	979.7		
selenide	$SrSe$	solid	90.08		
silicate	$SrSiO_3$	fused	363.20		
sulfate	$SrSO_4$	solid	341.22		
sulfhydrate	$Sr(SH)_2$	dil. sol.	137.9		
sulfide, mono-	SrS	solid	113.02		
Sulfocyanic acid	$HCNS$	dil. sol.	− 18.4		
Sulfur					
bromide, mono-	S_2Br_2	liquid	+ 2.01		
chloride, mono-	S_2Cl_2	liquid	14.34		
		gas	5.64		
chloride, di-	S_2Cl_4	liquid	14.		
iodide, mono-	S_2I_2	solid	0.0		
oxide, di-	SO_2	liquid	75.269		
		gas	69.3		
		2000	77.850		+ 8.554
oxide, tri-	SO_3	solid	103.2		+37 28
		liquid	101.1	1600	$+39.164^{20°}$
		gas	91.52		+49.22
		200	139.1		
oxychloride (ic)	SO_2Cl_2	liquid	87.69	800	+62.84
		gas	80.76		

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution Kilo-cal.
Sulfur					
oxychloride (ous)	$SOCl_2$	liquid	48.03		
		gas	41.58		
pentoxydichloride	$S_2O_5Cl_2$	liquid	161.8		
		gas	148.9		
Sulfuric acid	H_2SO_4	solid	192.24		
		liquid	189.75	200	$+17.75^{18°}$
		∞	210.28		
	$H_2SO_4.H_2O$	liquid	264.83		
per-	$H_2S_2O_8$	dil. sol.	309.92		
pyro-	$H_2SO_4.SO_3$	liquid	293.91		
thio-	$H_2S_2O_3$	1500	138.6		
Sulfurous acid	H_2SO_3	200	145.09		
(See also *thionic acids*)					
Tantalum					
oxide	Ta_2O_5	solid	500.12		
Telluric acid	H_2TeO_4	dil. sol.	169.2		
Tellurium					
chloride	$TeCl_4$	solid	77.42		
oxide, di-	TeO_2	solid	78.304		
	$TeO_2.H_2O$	solid	144.8		
oxide, tri-	TeO_3	solid	83.15		
Tellurous acid	H_2TeO_3	solid	145.6		
Thallium					
bromide, mono-	$TlBr$	solid	41.052		
bromide, tri-	$TlBr_3$	dil. sol.	56.416		
chloride, mono-	$TlCl$	solid	48.698		
		dil. sol.	38.47	4500	$-10.04^{18°}$
chloride, tri-	$TlCl_3$	solid	80.74	300	$+ 8.435$
		dil. sol.	89.176		
	$TlCl_3.4H_2O$	solid	364.90	300	$- 2.13$
fluoride	TlF	dil. sol.	77.300		
hydroxide (ic)	$Tl(OH)_3$	solid	145.07		
hydroxide (ous)	$TlOH$	solid	56.87	235	$- 3.154^{18°}$
iodide	TlI	solid	30.11		
nitrate (ous)	$TlNO_3$	solid	58.806	300	$- 9.964^{18°}$
		dil. sol.	48.841		
nitride	TlN_3	solid	− 54.72		
oxide (ous)	Tl_2O	solid	+ 42.151	570	$- 3.082^{18°}$
selenide	Tl_2Se	solid	11.9		
sulfate (ous)	Tl_2SO_4	solid	217.78	1600	$- 8.268^{18°}$
		800	209.51		
sulfide	Tl_2S	solid	22.0		
telluride	Tl_2Te	solid	7.17		
Thionic acid					
thionic, di-	$H_2S_2O_6$	400	274.31		
thionic, tri-	$H_2S_3O_6$	dil. sol.	261.89		
thionic, tetra-	$H_2S_4O_6$	dil. sol.	262.37		
thionic, penta-	$H_2S_5O_6$	dil. sol.	267.62		
(See also *sulfuric acids*)					
Thorium					
bromide	$ThBr_4$	solid	281.01		+70.180
		dil. sol.	351.26		
carbonate	$Th(CO_3)_2$		855.20		
chloride	$ThCl_4$	solid	335.01		$+56.63^{15°}$
		dil. sol.	392.12		
	$ThCl_4.2H_2O$	solid	487.70		+41.076.
hydroxide (dried ppt.)	$Th(OH)_4$	ppt.	336.20		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Thorium					
iodide	ThI_4	dil. sol.	291.76		
oxide	ThO_2	solid	330.95		
sulfate	$Th(SO_4)_2$	dil. sol.	661.89		
	$Th(SO_4)_2.4H_2O$	solid	930.23		$+ 5.02$
Tin					
bromide (ic)	$SnBr_4$	solid	95.10		$+16.5$
		liquid	92.23		
bromide (ous)	$SnBr_2$	solid	61.41		$- 1.67$
chloride (ic)	$SnCl_4$	liquid	127.4	250	$+29.917^{20°}$
chloride (ous)	$SnCl_2$	solid	81.147	300	$+ 0.358^{18°}$
	$SnCl_2.2H_2O$	solid	223.7	200	$- 5.28^{18°}$
hydroxide (ous)	$Sn(OH)_2$	colloid	136.37		
iodide (ous)	SnI_2	solid	35.84		
oxide (ic) (fused)	SnO_2	solid	138.1		
oxide (ous)	SnO	solid	69.77		
pot. chloride	K_2SnCl_6	solid	360.17	800	$- 3.369^{12°}$
		600	356.80		
Titanium					
chloride, tetra-	$TiCl_4$	liquid	183.5	2000	$+57.83^{18°}$
oxide, di-	TiO_2	solid	217.4		
		amorph.	214.1		
Tungsten					
oxide, di-	WO_2	solid	126.2		
oxide, tri-	WO_3	solid	191.4		
oxide, penta-	W_2O_5	solid	311.11		
Tungstic acid	H_2WO_4	solid	280.05		
		dil. sol.	280.05		
Uranium					
oxide, di-	UO_2	solid	256.63		
oxide, tri-	UO_3	solid	290.09		
oxide (ous) (ic)	U_3O_8	solid	845.17		
oxide, per	$UO_4.2H_2O$	solid	439.91		
Uranyl					
acetate	$UO_2(C_2H_3O_2)_2$	dil. sol	476.47		
	$UO_2(C_2H_3O_2)_2.2H_2O$	solid	617.69	1000	$- 4.30^{18°}$
nitrate	$UO_2(NO_3)_2$	solid	322.10	220	$+18.9^{12°}$
	$UO_2(NO_3)_2.6H_2O$	solid	756.75	220	$- 5.448^{12°}$
sulfate	UO_2SO_4	dil. sol.	449.46		
	$UO_2SO_4.3H_2O$	solid	649.94	1000	$+ 5.02^{18°}$
Vanadium					
chloride, di-	VCl_2	solid	147.2		
chloride, tri-	VCl_3	liquid	187.1		
chloride, tetra-	VCl_4	liquid	162.01		
oxide, di-	V_2O_2	solid	209.08		
oxide, tri-	V_2O_3	solid	349.58		
oxide, tetra-	V_2O_4	solid	409.08		
oxide, penta-	V_2O_5	solid	437.28		
oxytrichloride	$VOCl_3$	liquid	201.2		
Water, see *hydrogen oxide*					
Zinc					
acetate	$Zn(C_2H_3O_2)_2$	solid	261.17	720	$+ 9.80^{22°}$
	$Zn(C_2H_3O_2)_2.H_2O$	solid	332.62	800	$+ 6.93^{23°}$
	$Zn(C_2H_3O_2)_2.2H_2O$	solid	403.59	500	$+ 4.30^{10°}$
bromide	$ZnBr_2$	solid	77.90		$+15.03$
		400	92.95		
carbonate	$ZnCO_3$	ppt.	193.3		
chloride	$ZnCl_2$	solid	99.547	600	$+15.72^{18°}$
		400	115.27		

HEAT OF FORMATION AND SOLUTION (Cont.)

Name	Formula	Physical state	Heat of formation. Kilo-cal.	Water mols	Heat of solution. Kilo-cal.
Zinc					
cyanide	$Zn(CN)_2$	solid	− 16.2		
ethyl	ZnC_4H_{10}	liquid	+ 7.41		
fluoride	ZnF_2	dil. sol.	192.31		
dithionate	ZnS_2O_6	400	310.87		
	$ZnS_2O_6.6H_2O$	solid	723.54		−2.25
hydroxide	$Zn(OH)_2$	solid	158.4		
	$Zn(OH)_2.H_2O$	amorph	221.87		
	$ZnO_2.2H_2O$	solid	252.33		
iodide	ZnI_2	solid	49.70		+11.7
nitrate	$Zn(NO_3)_2$	400	136.11		
	$Zn(NO_3)_2.6H_2O$	solid	552.24	400	$-5.854^{18°}$
oxide (fused)	ZnO	solid	84.35		
selenide	$ZnSe$	solid	33.45		
		ppt.	31.30		
silicate	$ZnSiO_3$	solid	286.50		
sulfate	$ZnSO_4$	solid	229.51	400	$+18.54^{17°}$
		400	248.05		
	$ZnSO_4.6H_2O$	solid	659.26	400	$-0.836^{18°}$
	$ZnSO_4.7H_2O$	solid	731.00	400	$-4.277^{18°}$
sulfide	ZnS	solid	45.88		
telluride	$ZnTe$	solid	33.21		

HEAT OF FORMATION OF INORGANIC OXIDES

The ΔH_o values are given in gram calories per mole. The a, b, and I values listed here make it possible for one to calculate the ΔF and ΔS values by use of the following equations:

$$\Delta F_t = \Delta H_o + 2.303aT \log T + b \times 10^{-3}T^2 + c \times 10^5T^{-1} + IT$$
$$\Delta S_t = -a - 2.303a \log T - 2b \times 10^{-3}T + c \times 10^5T^{-2} - I$$

Ref: Bulletin 542, U. S. Bureau of Mines, 1954.

Coefficients in Free-Energy Equations

Reaction and temperature range of validity	ΔH_o	$2.303a$	b	c	I
$2\ Ac(c) + 3/2\ O_2(g) = Ac_2O_3(c)$ .... (298.16°–1,000° K.)	−446,090	−16.12	......	.....	+109.89
$2\ Al(c) + 1/2\ O_2(g) = Al_2O(g)$ .... (298.16°–931.7° K.)	−31,660	+14.97	......	.....	−72.74
$2\ Al(l) + 1/2\ O_2(g) = Al_2O(g)$ .... (931.7°–2,000° K.)	−38,670	+10.36	......	.....	−51.53
$Al(c) + 1/2\ O_2(g) = AlO(g)$ .... (298.16°–931.7° K.)	+10,740	+5.76	......	.....	−37.61
$Al(l) + 1/2\ O_2(g) = AlO(g)$ .... (931.7°–2,000° K.)	+8,170	+5.76	......	.....	−34.85
$2\ Al(c) + 3/2\ O_2(g) = Al_2O_3$ (*corundum*). (298.16°–931.7° K.)	−404,080	−15.68	+2.18	+3.935	+123.64
$2\ Al(l) + 3/2\ O_2(g) = Al_2O_3$ (*corundum*). (931.7°–2,000° K.)	−407,950	−6.19	−.78	+3.935	+102.37
$2\ Am(c) + 3/2\ O_2(g) = Am_2O_3(c)$ .... (298.16°–1,000° K.)	−422,090	−16.12	......	.....	+107.89
$Am(c) + O_2(g) = AmO_2(c)$ .... (298.16°–1,000° K.)	−240,600	−4.61	......	.....	+55.91
$2\ Sb(c) + 3/2\ O_2(g) = Sb_2O_3$ (*cubic*)..... (298.16°–842° K.)	−169,450	+6.12	−6.01	−.30	+52.21
$2\ Sb(c) + 3/2\ O_2(g) = Sb_2O_3$ (*orthorhombic*). (298.16°–903° K.)	−168,060	+6.12	−6.01	−.30	+50.56
$2\ Sb(l) + 3/2\ O_2(g) = Sb_2O_3$ (*orthorhombic*). (903°–928° K.)	−175,370	+15.29	−7.75	−.30	+33.12

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	2.303*a*	*b*	*c*	*I*
2 $Sb(l) + 3/2\ O_2(g) = Sb_2O_3(l)$ (928°–1,698° K.)	−173,940	−32.84	+.75	−.30	+166.52
2 $Sb(l) + 3/2\ O_2(g) = 1/2\ Sb_4O_6(g)$ (1,698°–1,713° K.)	−132,760	+10.91	+.75	−.30	+.96
2 $Sb(g) + 3/2\ O_2(g) = 1/2\ Sb_4O_6(g)$ (1,713°–2,000° K.)	−234,760	−.74	+.75	−.30	+98.17
2 $Sb(c) + 2\ O_2(g) = Sb_2O_4(c)$ (298.16°–903° K.)	−208,310	+6.31	−5.36	−.40	+73.02
2 $Sb(l) + 2\ O_2(g) = Sb_2O_4(c)$ (903°–1,500° K.)	−215,610	+15.47	−7.10	−.40	+55.61
6 $Sb(c) + 13/2\ O_2(g) = Sb_6O_{13}(c)$ (298.16°–903° K.)	−649,160	+38.46	−25.13	−1.30	+192.54
6 $Sb(c) + 13/2\ O_2(g) = Sb_6O_{13}(c)$ (903°–1,500° K.)	−691,370	+14.13	−30.35	−1.30	+315.93
2 $Sb(c) + 5/2\ O_2(g) = Sb_2O_5(c)$ (298.16°–903° K.)	−226,060	+37.12	−22.66	−.50	+18.61
2 $Sb(l) + 5/2\ O_2(g) = Sb_2O_5(c)$ (903°–1,500° K.)	−240,130	+29.01	−24.40	−.50	+59.74
2 $As(c) + 3/2\ O_2(g) = As_2O_3$ (*orthorhombic*). (298.16°–542° K.)	−154,870	+29.54	−21.33	−.30	−8.83
2 $As(c) + 3/2\ O_2(g) = As_2O_3$ (*monoclinic*). (298.16°–586° K.)	−150,760	+29.54	−21.33	−.30	−16.95
2 $As(c) + 3/2\ O_2(g) = As_2O_3(l)$ (542°–730.3° K.)	−156,260	−43.29	+2.97	−.30	+180.95
2 $As(c) + 3/2\ O_2(g) = 1/2\ As_4O_6(g)$ (730.3°–883° K.)	−135,930	+.46	+2.97	−.30	+26.88
1/2 $As_4(g) + 3/2\ O_2(g) = 1/2\ As_4O_6(g)$ (883°–2,000° K.)	−154,450	−2.90	+.75	−.30	+59.71
2 $As(c) + 2\ O_2(g) = As_2O_4(c)$ (298.16°–883° K.)	−173,690	+21.52	−13.42	−.40	+34.38
1/2 $As_4(g) + 2\ O_2(g) = As_2O_4(c)$ (883°–1,500° K.)	−192,210	+18.15	−15.64	−.40	+67.22
2 $As(c) + 5/2\ O_2(g) = As_2O_5(c)$ (298.16°–883° K.)	−217,080	+12.32	−4.65	−.50	+80.50
1/2 $As_4(g) + 5/2\ O_2(g) = As_2O_5(c)$ (883°–2,000° K.)	−235,600	+8.96	−6.87	−.50	+113.33
$Ba(\alpha) + 1/2\ O_2(g) = BaO(c)$ (298.16°–648° K.)	−134,590	−7.60	+.87	+.42	+45.76
$Ba(\beta) + 1/2\ O_2(g) = BaO(c)$ (648°–977° K.)	−134,140	−3.34	−.56	+.42	+34.01
$Ba(l) + 1/2\ O_2(g) = BaO(c)$ (977°–1,911° K.)	−135,900	−2.19	−.56	+.42	+32.37

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	$2.303a$	b	c	I
$Ba(g) + 1/2\ O_2(g) = BaO(c)$ .... (1,911°–2,000° K.)	−176,400	−8.01	−0.56	+0.42	+72.66
$Ba(\alpha) + O_2(g) = BaO_2(c)$ .... (298.16°–648° K.)	−154,830	−11.05	+.87	+.42	+74.48
$Ba(\beta) + O_2(g) = BaO_2(c)$ .... (648°–977° K.)	−154,380	−6.79	−.56	+.42	+62.73
$Ba(l) + O_2(g) = BaO_2(c)$ .... (977°–1,500° K.)	−156,140	−5.64	−.56	+.42	+61.09
$Be(c) + 1/2\ O_2(g) = BeO(c)$ .... (298.16°–1,556° K.)	−144,220	−1.91	−.46	+1.24	+30.64
$Be(l) + 1/2\ O_2(g) = BeO(c)$ .... (1,556°–2,000° K.)	−144,300	+6.06	−1.75	+1.485	+7.25
$Bi(c) + 1/2\ O_2(g) = BiO(c)$ .... (298.16°–544° K.)	−50,450	−4.61	......	.....	+35.51
$Bi(l) + 1/2\ O_2(g) = BiO(c)$ .... (544°–1,600° K.)	−52,920	−4.61	......	.....	+40.05
$2\ Bi(c) + 3/2\ O_2(g) = Bi_2O_3(c)$ .... (298.16°–544° K.)	−139,000	−11.56	+2.15	−.30	+96.52
$2\ Bi(l) + 3/2\ O_2(g) = Bi_2O_3(c)$ .... (544°–1,090° K.)	−142,270	+2.30	−3.25	−.30	+67.55
$2\ Bi(l) + 3/2\ O_2(g) = Bi_2O_3(l)$ .... (1,090°–1,600° K.)	−147,350	−32.84	+.75	−.30	+174.59
$2\ B(c) + 3/2\ O_2(g) = B_2O(c)$ .... (298.16°–723° K.)	−304,690	+11.72	−7.55	+.355	+34.25
$2\ B(c) + 3/2\ O_2(g) = B_2O_3(gl)$ .... (298.16°–723° K.)	−298,670	+26.57	−15.90	−.30	−10.40
$2\ B(c) + 3/2\ O_2(g) = B_2O_3(l)$ .... (723°–2,000° K.)	−308,100	−38.41	+5.15	−.30	+173.24
$Cd(c) + 1/2\ O_2(g) = CdO(c)$ .... (298.16°–594° K.)	−62,330	−2.05	+.71	−.10	+29.17
$Cd(l) + 1/2\ O_2(g) = CdO(c)$ .... (594°–1,038° K.)	−63,240	+2.07	−.76	−.10	+20.14
$Cd(g) + 1/2\ O_2(g) = CdO(c)$ .... (1,038°–2,000° K.)	−89,320	−2.83	−.76	−.10	+60.05
$Ca(\alpha) + 1/2\ O_2(g) = CaO(c)$ .... (298.16°–673° K.)	−151,850	−6.56	+1.46	+.68	+43.93
$Ca(\beta) + 1/2\ O_2(g) = CaO(c)$ .... (673°–1,124° K.)	−151,730	−4.14	+.41	+.68	+37.63
$Ca(l) + 1/2\ O_2(g) = CaO(c)$ .... (1,124°–1,760° K.)	−153,480	−1.36	−.29	+.68	+31.49
$Ca(g) + 1/2\ O_2(g) = CaO(c)$ .... (1,760°–2,000° K.)	−194,670	−7.18	−.29	+.68	+73.84
$Ca(\alpha) + O_2(g) = CaO_2(c)$ .... (298.16°–500° K.)	−158,230	−12.32	+1.46	+.68	+78.28
$C(graphite) + 1/2\ O_2(g) = CO(g)$ .... (298.16°–2,000° K.)	−25,400	+2.05	+.27	−1.095	−28.79

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	2.303*a*	*b*	*c*	*I*
C(*graphite*) + $O_2(g)$ = $CO_2(g)$ .... (298.16°–2,000° K.)	−93,690	+1.63	−.07	−.23	−5.64
2 Ce(*c*) + 3/2 $O_2(g)$ = $Ce_2O_3(c)$ .... (298.16°–1,048° K.)	−435,600	−4.60	......	.....	+92.84
2 Ce(*l*) + 3/2 $O_2(g)$ = $Ce_2O_3(c)$ .... (1,048°–1,900° K.)	−440,400	−4.60	......	.....	+97.42
Ce(*c*) + $O_2(g)$ = $CeO_2(c)$ .... (298.16°–1,048° K.)	−245,490	−6.42	+2.34	−.20	+67.79
Ce(*l*) + $O_2(g)$ = $CeO_2(c)$ .... (1,048°–2,000° K.)	−247,930	+.71	−.66	−.20	+51.73
2 Cs(*c*) + 1/2 $O_2(g)$ = $Cs_2O(c)$ .... (298.16°–301.5°K.)	−75,900	.....	......	.....	+36.60
2 Cs(*l*) + 1/2 $O_2(g)$ = $Cs_2O(c)$ .... (301.5°–763° K.)	−76,900	.....	......	.....	+39.92
2 Cs(*l*) + 1/2 $O_2(g)$ = $Cs_2O(l)$ .... (763°–963° K.)	−75,370	−9.21	......	.....	+64.47
2 Cs(*g*) + 1/2 $O_2(g)$ = $Cs_2O(l)$ .... (963°–1,500° K.)	−113,790	−23.03	......	.....	+145.60
2 Cs(*c*) + $O_2(g)$ = $Cs_2O_2(c)$ .... (298.16°–301.5° K.)	−96,500	−2.30	......	.....	+62.30
2 Cs(*l*) + $O_2(g)$ = $Cs_2O_2(c)$ .... (301.5°–870° K.)	−97,800	−4.61	......	.....	+72.34
2 Cs(*l*) + $O_2(g)$ = $Cs_2O_2(l)$ .... (870°–963° K.)	−96,060	−18.42	......	.....	+110.94
2 Cs(*g*) + $O_2(g)$ = $Cs_2O_2(l)$ .... (963°–1,500° K.)	−134,000	−31.08	......	.....	+188.11
2 Cs(*c*) + 3/2 $O_2(g)$ = $Cs_2O_3(c)$ .... (298.16°–301.5° K.)	−112,690	−11.51	......	.....	+110.10
2 Cs(*l*) + 3/2 $O_2(g)$ = $Cs_2O_3(c)$ .... (301.5°–775° K.)	−113,840	−12.66	......	.....	+116.77
2 Cs(*l*) + 3/2 $O_2(g)$ = $Cs_2O_3(l)$ .... (775°–963° K.)	−110,740	−26.48	......	.....	+152.70
2 Cs(*g*) + 3/2 $O_2(g)$ = $Cs_2O_3(l)$ .... (963°–1,500° K.)	−148,680	−39.14	......	.....	+229.87
Cs(*c*) + $O_2(g)$ = $CsO_2(c)$ .... (298.16°–301.5° K.)	−63,590	−11.51	......	.....	+72.29
Cs(*l*) + $O_2(g)$ = $CsO_2(c)$ .... (301.5°–705° K.)	−64,240	−12.66	......	.....	+77.30
Cs(*l*) + $O_2(g)$ = $CsO_2(l)$ .... (705°–963° K.)	−61,770	−18.42	......	.....	+90.20
Cs(*g*) + $O_2(g)$ = $CsO_2(l)$ .... (963°–1,500° K.)	−80,500	−24.18	......	.....	+126.83
$Cl_2(g)$ + 1/2 $O_2(g)$ = $Cl_2O(g)$ .... (298.16°–2,000° K.)	+17,770	−.71	−.12	+.49	+16.81
1/2 $Cl_2(g)$ + 1/2 $O_2(g)$ = $ClO(g)$ .... (298.16°–1,000° K.)	+33,000	.....	......	.....	−.24

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity		ΔH_o	2.303a	b	c	I
$1/2\ Cl_2(g) + O_2(g) = ClO_2(g)$	(298.16°–2,000° K.)	+24,150	−.76	−.105	−.665	+19.08
$1/2\ Cl_2(g) + 3/2\ O_2(g) = ClO_3(g)$	(298.16°–500° K.)	+37,740	+5.76	......	.....	+21.42
$Cl_2(g) + 7/2\ O_2(g) = Cl_2O_7(g)$	(298.16°–500° K.)	+65,040	+12.66	......	.....	+78.01
$2\ Cr(c) + 3/2\ O_2(g) = Cr_2O_3(\beta)$	(298.16°–1,823° K.)	−274,670	−14.07	+2.01	+.69	+105.65
$2\ Cr(l) + 3/2\ O_2(g) = Cr_2O_3(\beta)$	(1,823°–2,000° K.)	−278,030	+2.33	−.35	+1.57	+58.29
$Cr(c) + O_2(g) = CrO_2(c)$	(298.16°–1,000° K.)	−142,500	.....	......	.....	+42.00
$Cr(c) + 3/2\ O_2(g) = CrO_3(c)$	(298.16°–471° K.)	−141,590	−13.82	......	.....	+103.90
$Cr(c) + 3/2\ O_2(g) = CrO_3(l)$	(471°–600° K.)	−141,580	−32.24	......	.....	+153.14
$Co(\alpha, \beta) + 1/2\ O_2(g) = CoO(c)$	(298.16°–1,400° K.)	−56,910	+.69	......	.....	+16.03
$Co(\gamma) + 1/2\ O_2(g) = CoO(c)$	(1,400°–1,763° K.)	−58,160	−1.15	......	.....	+22.71
$Co(l) + 1/2\ O_2(g) = CoO(c)$	(1,763°–2,000° K.)	−65,680	−6.22	......	.....	+43.43
$3\ Co(\alpha, \beta, \gamma) + 2\ O_2(g) = Co_3O_4(c)$	(298.16°–1,500° K.)	−207,300	−2.30	......	.....	+90.56
$2\ Cu(c) + 1/2\ O_2(g) = Cu_2O(c)$	(298.16°–1,357° K.)	−40,550	−1.15	−1.10	−.10	+21.92
$2\ Cu(l) + 1/2\ O_2(g) = Cu_2O(c)$	(1,357°–1,502° K.)	−43,880	+8.47	−2.60	−.10	−3.72
$2\ Cu(l) + 1/2\ O_2(g) = Cu_2O(l)$	(1,502°–2,000° K.)	−37,710	−12.48	+.25	−.10	+54.44
$Cu(c) + 1/2\ O_2(g) = CuO(c)$	(298.16°–1,357° K.)	−37,740	−.64	−1.40	−.10	+24.87
$Cu(l) + 1/2\ O_2(g) = CuO(c)$	(1,357°–1,720° K.)	−39,410	+4.17	−2.15	−.10	+12.05
$Cu(l) + 1/2\ O_2(g) = CuO(l)$	(1,720°–2,000° K.)	−41,060	−11.35	+.25	−.10	+59.09
$F_2(g) + 1/2\ O_2(g) = F_2O(g)$	(298.16°–2,000° K.)	+5,070	−.41	−.15	+.535	+16.04
$2\ Ga(c) + 1/2\ O_2(g) = Ga_2O(c)$	(298.16°–302.7° K.)	−81,110	+10.32	−5.75	−.10	−3.66
$2\ Ga(l) + 1/2\ O_2(g) = Ga_2O(c)$	(302.7°–1,000° K.)	−83,360	+13.49	−5.75	−.10	−4.08
$2\ Ga(c) + 3/2\ O_2(g) = Ga_2O_3(c)$	(298.16°–302.7° K.)	−256,240	+14.64	−3.75	−.30	+32.23
$2\ Ga(l) + 3/2\ O_2(g) = Ga_2O_3(c)$	(302.7°–2,000° K.)	−258,490	+17.82	−3.75	−.30	+31.79

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)
Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity		ΔH_0	2.303a	b	c	I
$Ge(c) + 1/2\ O_2(g) = GeO(c)$	(298.16°–1,200° K.)	−60,900	+1.27	−1.49	−.10	+17.19
$Ge(c) + 1/2\ O_2(g) = GeO(g)$	(298.16°–1,200° K.)	−21,870	+6.72	−.075	−.10	−41.25
$Ge(c) + O_2(g) = GeO_2(gl)$	(298.16°–1,200° K.)	−127,830	+4.28	−2.52	−0.20	+30.54
$2\ Au(c) + 3/2\ O_2(g) = Au_2O_3(c)$	(298.16°–500° K.)	−2,160	−10.36	......	.....	+95.14
$Hf(c) + O_2(g) = HfO_2(monocl.)$	(298.16°–2,000° K.)	−268,380	−9.74	−.28	+1.54	+78.16
$H_2(g) + 1/2\ O_2(g) = H_2O(l)$	(298.16°–373.16° K.)	−70,600	−18.26	+.64	−.04	+91.67
$H_2(g) + 1/2\ O_2(g) = H_2O(g)$	(298.16°–2,000° K.)	−56,930	+6.75	−.64	−.08	−8.74
$D_2(g) + 1/2\ O_2(g) = D_2O(l)$	(298.16°–374.5° K.)	−72,760	−18.10	......	.....	+93.59
$D_2(g) + 1/2\ O_2(g) = D_2O(g)$	(298.16°–2,000° K.)	−58,970	+5.50	−.75	+.085	−3.74
$1/2\ H_2(g) + 1/2\ O_2(g) = OH(g)$	(298.16°–2,000° K.)	+10,350	+.90	+.005	−.26	−6.69
$H_2(g) + O_2(g) = H_2O_2(l)$	(298.16°–425° K.)	−47,140	−13.52	−7.13	.....	+99.39
$H_2(g) + O_2(g) = H_2O_2(g)$	(298.16°–1,500° K.)	−32,570	+4.77	−.96	+.97	+13.84
$2\ In(c) + 3/2\ O_2(g) = In_2O_3(c)$	(298.16°–429.6° K.)	−220,410	+5.43	−.50	−.30	+59.49
$2\ In(l) + 3/2\ O_2(g) = In_2O_3(c)$	(429.6°–2,000° K.)	−220,970	+13.22	−3.00	−.30	+41.36
$I_2(c) + 5/2\ O_2(g) = I_2O_5(c)$	(298.16°–386.8° K.)	−42,040	+2.30	......	.....	+113.71
$I_2(l) + 5/2\ O_2(g) = I_2O_5(c)$	(386.8°–456° K.)	−43,490	+16.12	......	.....	+81.70
$I_2(g) + 5/2\ O_2(g) = I_2O_5(c)$	(456°–500° K.)	−58,020	−6.91	......	.....	+174.79
$Ir(c) + O_2(g) = IrO_2(c)$	(298.16°–1,300° K.)	−39,480	+8.17	−6.39	−.20	+20.33
$0.947\ Fe(\alpha) + 1/2\ O_2(g) = Fe_{0.947}O(c)$	(298.16°–1,033° K.)	−65,320	−11.26	+2.61	+0.44	+48.60
$0.947\ Fe(\beta) + 1/2\ O_2(g) = Fe_{0.947}O(c)$	(1,033°–1,179° K.)	−62,380	+4.08	−.75	+.235	+3.00
$0.947\ Fe(\gamma) + 1/2\ O_2(g) = Fe_{0.947}O(c)$	(1,179°–1,650° K.)	−66,750	−8.04	+.67	−.10	+42.28
$0.947\ Fe(\gamma) + 1/2\ O_2(g) = Fe_{0.947}O(l)$	(1,650°–1,674° K.)	−64,200	−18.72	+1.67	−.10	+73.45
$0.947\ Fe(\delta) + 1/2\ O_2(g) = Fe_{0.947}O(l)$	(1,674°–1,803° K.)	−59,650	−6.84	+.25	−.10	+34.81

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)
Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	2.303a	b	c	I
0.947 Fe(l) + 1/2 O_2(g) = $Fe_{0.947}O$(l) (1,803°–2,000° K.)	−63,660	−7.48	+.25	−.10	+39.12
3 Fe(α) + 2 O_2(g) = Fe_3O_4 (*magnetite*) (298.16°–900° K.)	−268,310	+5.87	−12.45	+.245	+73.11
3 Fe(α) + 2 O_2(g) = Fe_3O_4(β) (900°–1,033° K.)	−272,300	−54.27	+11.65	+.245	+233.52
3 Fe(β) + 2 O_2(g) = Fe_3O_4(β) (1,033°–1,179° K.)	−262,990	−5.71	+1.00	−.40	+89.19
3 Fe(γ) + 2 O_2(g) = Fe_3O_4(β) (1,179°–1,674° K.)	−276,990	−44.05	+5.50	−.40	+213.52
3 Fe(δ) + 2 O_2(g) = Fe_3O_4(β) (1,674°–1,803° K.)	−262,560	−6.40	+1.00	−.40	+91.05
3 Fe(l) + 2 O_2(g) = Fe_3O_4(β) (1,803°–1,874° K.)	−275,280	−8.74	+1.00	−.40	+104.84
3 Fe(l) + 2 O_2(g) = Fe_3O_4(l) (1,874°–2,000° K.)	−257,240	−26.89	+1.00	−.40	+155.46
2 Fe(α) + 3/2 O_2(g) = Fe_2O_3 (*hematite*) (298.16°–950° K.)	−200,000	−13.84	−1.45	+1.905	+108.26
2 Fe(α) + 3/2 O_2(g) = Fe_2O_3(β) (950°–1,033° K.)	−202,960	−42.64	+7.85	+.13	+188.48
2 Fe(β) + 3/2 O_2(g) = Fe_2O_3(β) (1,033°–1,050° K.)	−196,740	−10.27	+.75	−.30	+92.26
2 Fe(β) + 3/2 O_2(g) = Fe_2O_3(γ) (1,050°–1,179° K.)	−193,200	−.39	−.13	−.30	+59.96
2 Fe(γ) + 3/2 O_2(g) = Fe_2O_3(γ) (1,179°–1,674° K.)	−202,540	−25.95	+2.87	−.30	+142.85
2 Fe(δ) + 3/2 O_2(g) = Fe_2O_3(γ) (1,674°–1,800° K.)	−192,920	−.85	−.13	−.30	+61.21
2 La(c) + 3/2 O_2(g) = La_2O_3(c) (298.16°–1,153° K.)	−431,120	−13.31	+.80	+1.34	+112.36
2 La(l) + 3/2 O_2(g) = La_2O_3(c) (1,153°–2,000° K.)	−434,330	−4.88	−.80	+1.34	+91.17
Pb(c) + 1/2 O_2(g) = PbO (*red*) (298.16°–600.5° K.)	−52,800	−2.76	−.80	−.10	+32.49
Pb(l) + 1/2 O_2(g) = PbO (*red*) (600.5°–762° K.)	−53,780	−.51	−1.75	−.10	+28.44
Pb(c) + 1/2 O_2(g) = PbO (*yellow*) (298.16°–600.5° K.)	−52,040	+.81	−2.00	−.10	+22.13
Pb(l) + 1/2 O_2(g) = PbO (*yellow*) (600.5°–1,159° K.)	−53,020	+3.06	−2.95	−.10	+18.08
Pb(l) + 1/2 O_2(g) = PbO(l) (1,159°–1,745° K.)	−53,980	−12.94	+.25	−.10	+64.22
Pb(c) + 1/2 O_2(g) = PbO(g) (298.16°–600.5° K.)	+10,270	+1.91	+1.08	+.295	−23.21
Pb(l) + 1/2 O_2(g) = PbO(g) (600.5°–2,000° K.)	+9,300	+4.17	+.13	+.295	−27.29

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)
Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	2.303a	b	c	I
$3\ Pb(c) + 2\ O_2(g) = Pb_3O_4(c)$ (298.16°–600.5° K.)	−174,920	+8.82	−8.20	−.40	+72.78
$3\ Pb(l) + 2\ O_2(g) = Pb_3O_4(c)$ (600.5°–1,000° K.)	−177,860	+15.59	−11.05	−.40	+60.57
$Pb(c) + O_2(g) = PbO_2(c)$ (298.16°–600.5° K.)	−66,120	+.64	−2.45	−.20	+45.58
$Pb(l) + O_2(g) = PbO_2(c)$ (600.5°–1,100° K.)	−67,100	+2.90	−3.40	−.20	+41.50
$2\ Li(c) + 1/2\ O_2(g) = Li_2O(c)$ (298.16°–452° K.)	−142,220	−3.06	+5.77	−.10	+34.19
$2\ Li(l) + 1/2\ O_2(g) = Li_2O(c)$ (452°–1,600° K.)	−141,380	+16.97	−2.63	−.10	−17.05
$2\ Li(c) + O_2(g) = Li_2O_2(c)$ (298.16°–452° K.)	−151,880	−1.38	......	.....	+54.83
$2\ Li(l) + O_2(g) = Li_2O_2(c)$ (452°–500° K.)	−153,260	−1.38	......	.....	+57.88
$Mg(c) + 1/2\ O_2(g) = MgO$ (*periclase*) (298.16°–923° K.)	−144,090	−1.06	+.13	+.25	+29.16
$Mg(l) + 1/2\ O_2(g) = MgO$ (*periclase*) (923°–1,393° K.)	−145,810	+1.84	−.62	+.64	+23.07
$Mg(g) + 1/2\ O_2(g) = MgO$ (*periclase*) (1,393°–2,000° K.)	−180,700	−3.75	−.62	+.64	+65.69
$Mg(c) + O_2(g) = MgO_2(c)$ (298.16°–500° K.)	−150,230	−9.12	+.13	+.25	+70.84
$Mn(\alpha) + 1/2\ O_2(g) = MnO(c)$ (298.16°–1,000° K.)	−92,600	−4.21	+.97	+.155	+29.66
$Mn(\beta) + 1/2\ O_2(g) = MnO(c)$ (1,000°–1,374° K.)	−91,900	+1.84	−.39	+.34	+12.15
$Mn(\gamma) + 1/2\ O_2(g) = MnO(c)$ (1,374°–1,410° K.)	−89,810	+7.30	−.72	+.34	−6.05
$Mn(\delta) + 1/2\ O_2(g) = MnO(c)$ (1,410°–1,517° K.)	−89,390	+8.68	−.72	+.34	−10.70
$Mn(l) + 1/2\ O_2(g) = MnO(c)$ (1,517°–2,000° K.)	−93,350	+7.99	−.72	+.34	−5.90
$3\ Mn(\alpha) + 2\ O_2(g) = Mn_3O_4(\alpha)$ (298.16°–1,000° K.)	−332,400	−7.41	+.66	+.145	+106.62
$3\ Mn(\beta) + 2\ O_2(g) = Mn_3O_4(\alpha)$ (1,000°–1,374° K.)	−330,310	+10.75	−3.42	+.70	+54.07
$3\ Mn(\gamma) + 2\ O_2(g) = Mn_3O_4(\alpha)$ (1,374°–1,410° K.)	−324,050	+27.12	−4.41	+.70	−.50
$3\ Mn(\delta) + 2\ O_2(g) = Mn_3O_4(\alpha)$ (1,410°–1,445° K.)	−322,800	+31.27	−4.41	+.70	−14.46
$3\ Mn(\delta) + 2\ O_2(g) = Mn_3O_4(\beta)$ (1,445°–1,517° K.)	−328,870	−4.56	+1.00	−.40	+95.20
$3\ Mn(l) + 2\ O_2(g) = Mn_3O_4(\beta)$ (1,517°–1,800° K.)	−340,730	−6.63	+1.00	−.40	+109.60

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)
Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	2.303a	b	c	I
2 $Mn(\alpha) + 3/2\ O_2(g) = Mn_2O_3(c)$ (298.16°–1,000° K.)	−230,610	−5.96	−.06	+.945	+80.74
2 $Mn(\beta) + 3/2\ O_2(g) = Mn_2O_3(c)$ (1,000°–1,374° K.)	−229,210	+6.15	−2.78	+1.315	+45.70
2 $Mn(\gamma) + 3/2\ O_2(g) = Mn_2O_3(c)$ (1,374°–1,410° K.)	−225,030	+17.06	−3.44	+1.315	+9.33
2 $Mn(\delta) + 3/2\ O_2(g) = Mn_2O_3(c)$ (1,410°–1,517° K.)	−224,200	+19.82	−3.44	+1.315	+0.05
2 $Mn(l) + 3/2\ O_2(g) = Mn_2O_3(c)$ (1,517°–1,700° K.)	−232,110	+18.44	−3.44	+1.315	+9.65
$Mn(\alpha) + O_2(g) = MnO_2(c)$ (298.16°–1,000° K.)	−126,400	−8.61	+.97	+1.555	+70.14
2 $Hg(l) + 1/2\ O_2(g) = Hg_2O(c)$ (298.16°–629.88° K.)	−22,400	−4.61	......	.....	+43.29
2 $Hg(g) + 1/2\ O_2(g) = Hg_2O(c)$ (629.88°–1,000° K.)	−53,800	−16.12	......	.....	+125.36
$Hg(l) + 1/2\ O_2(g) = HgO$ (*red*) (298.16°–629.88° K.)	−21,760	+.85	−2.47	−.10	+24.81
$Hg(g) + 1/2\ O_2(g) = HgO$ (*red*) (629.88°–1,500° K.)	−36,920	−2.92	−2.47	−.10	+59.42
$Mo(c) + O_2(g) = MoO_2(c)$ (298.16°–2,000° K.)	−132,910	−3.91	......	.....	+47.42
$Mo(c) + 3/2\ O_2(g) = MoO_3(c)$ (298.16°–1,068° K.)	−182,650	−8.86	−1.55	+1.54	+90.07
$Mo(c) + 3/2\ O_2(g) = MoO_3(l)$ (1,068°–1,500° K.)	−179,770	−36.34	+1.40	−.30	+167.61
2 $Nd(c) + 3/2\ O_2(g) =$ Nd_2O_3 (*hexagonal*). (298.16°–1,113° K.)	−435,150	−16.19	+3.21	+1.78	+125.68
2 $Nd(l) + 3/2\ O_2(g) =$ Nd_2O_3 (*hexagonal*). (1,113°–1,500° K.)	−437,090	+4.03	−2.13	+1.78	+71.77
$Np(c) + O_2(g) = NpO_2(c)$ (298.16°–913° K.)	−246,450	−3.45	......	.....	+52.44
$Np(l) + O_2(g) = NpO_2(c)$ (913°–1,500° K.)	−249,010	−4.61	......	.....	+58.68
$Ni(\alpha) + 1/2\ O_2(g) = NiO(c)$ (298.16°–633° K.)	−57,640	−4.61	+2.16	−.10	+34.41
$Ni(\beta) + 1/2\ O_2(g) = NiO(c)$ (633°–1,725° K.)	−57,460	−.14	−.46	−.10	+23.27
$Ni(l) + 1/2\ O_2(g) = NiO(c)$ (1,725°–2,000° K.)	−58,830	+7.23	−1.36	−.10	+1.76
2 $Nb(c) + 2\ O_2(g) = Nb_2O_4(c)$ (298.16°–2,000° K.)	−382,050	−9.67	......	.....	+116.23

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity		ΔH_0	2.303*a*	*b*	*c*	*I*
$2\,Nb(c) + 5/2\,O_2(g) = Nb_2O_5(c)$	(298.16°–1,785° K.)	−458,640	−16.14	−.56	+1.94	+157.66
$2\,Nb(c) + 5/2\,O_2(g) = Nb_2O_5(l)$	(1,785°–2,000° K.)	−463,630	−66.04	+2.21	−.50	+317.84
$N_2(g) + 1/2\,O_2(g) = N_2O(g)$	(298.16°–2,000° K.)	+18,650	−1.57	−.27	+.92	+23.47
$1/2\,N_2(g) + 1/2\,O_2(g) = NO(g)$	(298.16°–2,000° K.)	+21,590	−.28	+.45	−.03	−2.20
$N_2(g) + 3/2\,O_2(g) = N_2O_3(g)$	(298.16°–500° K.)	+17,390	−.35	.....	.....	+54.30
$1/2\,N_2(g) + O_2(g) = NO_2(g)$	(298.16°–2,000° K.)	+7,730	+.53	−.265	+.605	+13.74
$N_2(g) + 2\,O_2(g) = N_2O_4(g)$	(298.16°–1,000° K.)	+1,370	+2.14	−3.24	+1.38	+68.34
$N_2(g) + 5/2\,O_2(g) = N_2O_5(c)$	(298.16°–305° K.)	−10,200	.....	.....	.....	+131.70
$N_2(g) + 5/2\,O_2(g) = N_2O_5(g)$	(298.16°–500° K.)	+3,600	.....	.....	.....	+86.50
$Os(c) + 2\,O_2(g) = OsO_4$ (*yellow*)	(298.16°–329° K.)	−92,260	+14.97	.....	.....	+32.45
$Os(c) + 2\,O_2(g) = OsO_4$ (*white*)	(298.16°–315° K.)	−90,560	+14.97	.....	.....	+27.60
$Os(c) + 2\,O_2(g) = OsO_4(l)$	(315°–403° K.)	−88,970	+9.67	.....	.....	+35.78
$Os(c) + 2\,O_2(g) = OsO_4(g)$	(298.16°–1,000° K.)	−81,200	+8.17	−2.86	+1.94	+20.34
$3/2\,O_2(g) = O_3(g)$	(298.16°–2,000° K.)	+33,980	+2.03	−.48	+.36	+11.45
P (*white*) $+ 1/2\,O_2(g) = PO(g)$	(298.16°–317.4° K.)	−9,370	+2.53	.....	.....	−25.40
$P(l) + 1/2\,O_2(g) = PO(g)$	(317.4°–553° K.)	−9,390	+3.45	.....	.....	−27.63
$1/4\,P_4(g) + 1/2\,O_2(g) = PO(g)$	(553°–1,500° K.)	−12,640	+2.30	.....	.....	−18.61
$4\,P$ (*white*) $+ 5\,O_2(g) =$ P_4O_{10} (*hexagonal*).	(298.16°–317.4° K.)	−711,520	+95.67	−51.50	−1.00	−28.24
$4\,P(l) + 5\,O_2(g) = P_4O_{10}$ (*hex.*)	(317.4°–553° K.)	−711,800	+97.98	−51.50	−1.00	−33.13
$P_4(g) + 5\,O_2(g) = P_4O_{10}$ (*hex.*)	(553°–631° K.)	−725,560	+87.45	−51.07	−2.405	+20.87
$P_4(g) + 5\,O_2(g) = P_4O_{10}(g)$	(631°–1,500° K.)	−722,330	−43.45	+2.93	−2.405	+348.20
$Pu(c) + O_2(g) = PuO_2(c)$	(298.16°–1,500° K.)	−246,450	−3.45	.....	.....	+52.48

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity		ΔH_0	2.303a	b	c	I
$Po(c) + O_2(g) = PoO_2(c)$	(298.16°–900° K.)	−61,510	−9.21	.....	.....	+72.80
$2\ K(c) + 1/2\ O_2(g) = K_2O(c)$	(298.16°–336.4° K.)	−86,400	.....	.....	.....	+33.90
$2\ K(l) + 1/2\ O_2(g) = K_2O(c)$	(336.4°–1,049° K.)	−87,380	+1.15	.....	.....	+33.90
$2\ K(g) + 1/2\ O_2(g) = K_2O(c)$	(1,049°–1,500° K.)	−133,090	−16.12	.....	.....	+129.64
$2\ K(c) + O_2(g) = K_2O_2(c)$	(298.16°–336.4° K.)	−118,300	−2.30	.....	.....	+59.60
$2\ K(l) + O_2(g) = K_2O_2(c)$	(336.4°–763° K.)	−119,780	−4.61	.....	.....	+69.85
$2\ K(l) + O_2(g) = K_2O_2(l)$	(763°–1,049° K.)	−118,250	−18.42	.....	.....	+107.66
$2\ K(g) + O_2(g) = K_2O_2(l)$	(1,049°–1,500° K.)	−161,870	−31.08	.....	.....	+187.49
$2\ K(c) + 3/2\ O_2(g) = K_2O_3(c)$	(298.16°–336.4° K.)	−126,640	−12.66	.....	.....	+111.75
$2\ K(l) + 3/2\ O_2(g) = K_2O_3(c)$	(336.4°–703° K.)	−127,790	−12.66	.....	.....	+115.16
$2\ K(l) + 3/2\ O_2(g) = K_2O_3(l)$	(703°–1,000° K.)	−125,330	−27.63	.....	.....	+154.28
$K(c) + O_2(g) = KO_2(c)$	(298.16°–336.4° K.)	−68,940	−10.36	.....	.....	+66.45
$K(l) + O_2(g) = KO_2(c)$	(336.4°–653° K.)	−69,510	−10.36	.....	.....	+68.15
$K(l) + O_2(g) = KO_2(l)$	(653°–1,000° K.)	−67,880	−18.42	.....	.....	+88.34
$K(c) + 3/2\ O_2(g) = KO_3(c)$	(298.16°–336.4° K.)	−63,340	−10.36	.....	.....	+85.85
$K(l) + 3/2\ O_2(g) = KO_3(c)$	(336.4°–500° K.)	−63,910	−10.36	.....	.....	+87.55
$2\ Pr(c) + 3/2\ O_2(g) = Pr_2O_3(c,\ C\text{-}type)$	(298.16°–1,205° K.)	−440,600	−4.60	.....	.....	+78.38
$2\ Pr(l) + 3/2\ O_2(g) = Pr_2O_3(c,\ C\text{-}type)$	(1,205°–2,000° K.)	−446,100	−4.60	.....	.....	+82.94
$6\ Pr(c) + 11/2\ O_2(g) = Pr_6O_{11}(c)$	(298.16°–1,205° K.)	−1,374,000	.....	.....	.....	+241.04
$6\ Pr(l) + 11/2\ O_2(g) = Pr_6O_{11}(c)$	(1,205°–1,500° K.)	−1,390,500	.....	.....	.....	+254.73
$Pr(c) + O_2(g) = PrO_2(c)$	(298.16°–1,200° K.)	−230,990	−6.42	+2.34	−.20	+61.07
$Ra(c) + 1/2\ O_2(g) = RaO(c)$	(298.16°–1,000° K.)	−130,000	.....	.....	.....	+23.50
$Re(c) + 3/2\ O_2(g) = ReO_3(c)$	(298.16°–433° K.)	−149,090	−16.12	.....	.....	+110.49

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)
Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_o	2.303*a*	*b*	*c*	*I*
$Re(c) + 3/2\ O_2(g) = ReO_3(l)$ .... (433°–1,000° K.)	−146,750	−31.32	......	.....	+145.16
$2Re(c) + 7/2\ O_7(g) = Re_2O_7(c)$ .... (298.16°–569° K.)	−301,470	−34.54	......	.....	+250.57
$2\ Re(c) + 7/2\ O_7(g) = Re_2O_7(l)$ .... (569°–635.5° K.)	−295,810	−73.68	......	.....	+348.45
$2\ Re(c) + 7/2\ O_2(g) = Re_2O_7(g)$ .... (635.5°–1,500° K.)	−256,460	+3.45	......	.....	+70.33
$2\ Re(c) + 4\ O_2(g) = Re_2O_8(c)$ .... (298.16°–420° K.)	−313,870	−41.45	......	.....	+293.57
$2\ Re(c) + 4\ O_2(g) = Re_2O_8(l)$ .... (420°–600° K.)	−318,470	−87.50	......	.....	+425.32
$2\ Rh(c) + 1/2\ O_2(g) = Rh_2O(c)$ .... (298.16°–2,000° K.)	−23,740	−8.06	......	.....	+35.64
$Rh(c) + 1/2\ O_2(g) = RhO(c)$ .... (298.16°–1,500° K.)	−22,650	−7.37	......	.....	+40.54
$2\ Rh(c) + 3/2\ O_2(g) = Rh_2O_3(c)$ .... (298.16°–1,500° K.)	−70,060	−13.58	......	.....	+101.72
$2\ Rb(c) + 1/2\ O_2(g) = Rb_2O(c)$ .... (298.16°–312.2° K.)	−78,900	.....	......	.....	+32.20
$2\ Rb(l) + 1/2\ O_2(g) = Rb_2O(c)$ .... (312.2°–750° K.)	−79,950	.....	......	.....	+35.56
$2\ Rb(l) + 1/2\ O_2(g) = Rb_2O(l)$ .... (750°–952° K.)	−78,830	−10.36	......	.....	+63.85
$2\ Rb(g) + 1/2\ O_2(g) = Rb_2O(l)$ .... (952°–1,500° K.)	−120,290	−23.03	......	.....	+145.14
$2\ Rb(c) + O_2(g) = Rb_2O_2(c)$ .... (298.16°–312.2° K.)	−102,000	−2.30	......	.....	+57.40
$2\ Rb(l) + O_2(g) = Rb_2O_2(c)$ .... (312.2°–840° K.)	−103,360	−4.61	......	.....	+67.52
$2\ Rb(l) + O_2(g) = Rb_2O_2(l)$ .... (840°–952° K.)	−101,680	−18.42	......	.....	+105.91
$2\ Rb(g) + O_2(g) = Rb_2O_2(l)$ .... (952°–1,500 K.)	−143,130	−31.08	......	.....	+187.16
$2\ Rb(c) + 3/2\ O_2(g) = Rb_2O_3(c)$ .... (298.16°–312.2° K.)	−118,190	−11.51	......	.....	+104.70
$2\ Rb(l) + 3/2\ O_2(g) = Rb_2O_3(c)$ .... (312.2°–760° K.)	−119,400	−12.66	......	.....	+111.43
$2\ Rb(l) + 3/2\ O_2(g) = Rb_2O_3(l)$ .... (760°–952° K.)	−116,740	−27.63	......	.....	+151.06
$2\ Rb(g) + 3/2\ O_2(g) = Rb_2O_3(l)$ .... (952°–1,500° K.)	−157,720	−39.14	......	.....	+228.39
$Rb(c) + O_2(g) = RbO_2(c)$ .... (298.16°–312.2° K.)	−52,330	−10.36	......	.....	+66.25
$Rb(l) + O_2(g) = RbO_2(c)$ .... (312.2°–685° K.)	−65,120	−11.51	......	.....	+71.30

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity		ΔH_0	2.303a	b	c	I
$Rb(l) + O_2(g) = RbO_2(l)$	(685°–952° K.)	−63,070	−18.42	......	.....	+87.89
$Rb(g) + O_2(g) = RbO_2(l)$	(952°–1,500° K.)	−83,560	−24.18	......	.....	+126.57
$Ru(\alpha, \beta, \gamma) + O_2(g) = RuO_2(c)$	(298.16°–1,500° K.)	−57,290	−6.91	......	.....	+62.01
$2\ Sm(c) + 3/2\ O_2(g) = Sm_2O_3(c)$	(298.16°–1,623° K.)	−430,600	−4.60	......	.....	+78.38
$2\ Sm(l) + 3/2\ O_2(g) = Sm_2O_3(c)$	(1,623°–2,000° K.)	−438,000	−4.60	......	.....	+82.94
$2\ Sc(c) + 3/2\ O_2(g) = Sc_2O_3(c)$	(298.16°–1,673° K.)	−409,960	+7.78	−1.84	−0.30	+52.73
$2\ Sc(l) + 3/2\ O_2(g) = Sc_2O_3(c)$	(1,673°–2,000° K.)	−412,950	+18.47	−2.93	−.30	+21.88
$Se(c) + 1/2\ O_2(g) = SeO(g)$	(298.16°–490° K.)	+9,280	−3.04	+4.40	+.30	−14.78
$Se(l) + 1/2\ O_2(g) = SeO(g)$	(490°–1,027° K.)	+9,420	+8.70	......	+.30	−44.50
$1/2\ Se_2(g) + 1/2\ O_2(g) = SeO(g)$	(1,027°–2,000° K.)	−7,400	−.37	......	+.19	−.80
$Se(c) + O_2(g) = SeO_2(c)$	(298.16°–490° K.)	−53,770	+14.94	−9.41	−.20	+6.94
$Se(l) + O_2(g) = SeO_2(c)$	(490°–595° K.)	−53,640	+27.59	−14.31	.....	−25.05
$Se(l) + O_2(g) = SeO_2(g)$	(595°–1,027° K.)	−32,840	+6.79	......	.....	−10.80
$1/2\ Se_2(g) + O_2(g) = SeO_2(g)$	(1,027°–2,000° K.)	−49,000	−.74	......	.....	+27.61
$Si(c) + 1/2\ O_2(g) = SiO(g)$	(298.16°–1,683° K.)	−21,090	+3.84	+.16	−.295	−33.14
$Si(l) + 1/2\ O_2(g) = SiO(g)$	(1,683°–2,000° K.)	−30,170	−7.78	−.12	+.25	−40.01
$Si(c) + O_2(g) = SiO_2(\alpha\text{-quartz})$	(298.16°–848° K.)	−210,070	+3.98	−3.32	+.605	+34.59
$Si(c) + O_2(g) = SiO_2(\beta\text{-quartz})$	(848°–1,683° K.)	−209,920	−3.36	−.19	−.745	+53.44
$Si(l) + O_2(g) = SiO_2(\beta\text{-quartz})$	(1,683°–1,883° K.)	−219,000	+.58	−.47	−.20	+46.58
$Si(l) + O_2(g) = SiO_2(l)$	(1,883°–2,000° K.)	−228,590	−15.66	......	.....	+103.97
$Si(c) + O_2(g) = SiO_2(\alpha\text{-crist.})$	(298.16°–523° K.)	−207,330	+19.96	−9.75	−.745	−9.78
$Si(c) + O_2(g) = SiO_2(\beta\text{-crist.})$	(523°–1,683° K.)	−209,820	−3.34	−.24	−.745	+53.35
$Si(l) + O_2(g) = SiO_2(\beta\text{-crist.})$	(1,683°–2,000° K.)	−218,900	+.60	−.52	−.20	+46.49

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)
Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	$2.303a$	b	c	I
$Si(c) + O_2(g) = SiO_2(\alpha\text{-}trid.)$ (298.16°–390° K.)	−207,030	+22.29	−11.62	−.745	−15.64
$Si(c) + O_2(g) = SiO_2(\beta\text{-}trid.)$ (390°–1,683° K.)	−209,350	−1.59	−.54	−.745	+47.86
$Si(l) + O_2(g) = SiO_2(\beta\text{-}trid.)$ (1,683°–1,953° K.)	−218,430	+2.35	−.82	−.20	+41.00
$2\ Ag(c) + 1/2\ O_2(g) = Ag_2O(c)$ (298.16°–1,000° K.)	−7,740	−4.14	......	.....	+27.84
$2\ Ag(c) + O_2(g) = Ag_2O_2(c)$ (298.16°–500° K.)	−6,620	−3.22	......	.....	+52.17
$2\ Na(c) + 1/2\ O_2(g) = Na_2O(c)$ (298.16°–371° K.)	−99,820	−7.51	+5.47	−.10	+50.43
$2\ Na(l) + 1/2\ O_2(g) = Na_2O(c)$ (371°–1,187° K.)	−100,150	+4.97	−2.45	−.10	+22.19
$2\ Na(g) + 1/2\ O_2(g) = Na_2O(c)$ (1,187°–1,190° K.)	−156,200	−20.72	......	.....	+145.48
$2\ Na(g) + 1/2\ O_2(g) = Na_2O(l)$ (1,190°–2,000° K.)	−150,250	−23.03	......	.....	+147.58
$2\ Na(c) + O_2(g) = Na_2O_2(c)$ (298.16°–371° K.)	−122,500	−2.30	......	.....	+57.51
$2\ Na(l) + O_2(g) = Na_2O_2(c)$ (371°–733° K.)	−124,320	−5.76	......	.....	+71.30
$2\ Na(l) + O_2(g) = Na_2O_2(l)$ (733°–1,187° K.)	−123,220	−20.72	......	.....	+112.66
$2\ Na(g) + O_2(g) = Na_2O_2(l)$ (1,187°–1,500° K.)	−174,800	−31.08	......	.....	+187.97
$Na(c) + O_2(g) = NaO_2(c)$ (298.16°–371° K.)	−63,040	−8.06	......	.....	+56.98
$Na(l) + O_2(g) = NaO_2(c)$ (371°–1,000° K.)	−64,220	−11.51	......	.....	+69.04
$Sr(c) + 1/2\ O_2(g) = SrO(c)$ (298.16°–1,043° K.)	−142,410	−6.79	+.305	+.675	+44.33
$Sr(l) + 1/2\ O_2(g) = SrO(c)$ (1,043°–1,657° K.)	−143,370	−2.42	−.38	+.675	+32.77
$Sr(g) + 1/2\ O_2(g) = SrO(c)$ (1,657°–2,000° K.)	−181,180	−8.24	−.38	+.675	+74.32
$Sr(c) + O_2(g) = SrO_2(c)$ (298.16°–1,000° K.)	−155,510	−11.40	+.305	+.675	+75.44
$S(rh) + 1/2\ O_2(g) = SO(g)$ (298.16°–368.6° K.)	+19,250	−1.24	+2.95	+.225	−18.84
$S(mon) + 1/2\ O_2(g) = SO(g)$ (368.6°–392° K.)	+19,200	−1.29	+3.31	+.225	−18.72
$S(l\lambda,\mu) + 1/2\ O_2(g) = SO(g)$ (392°–718° K.)	+20,320	+10.22	−.17	+.225	−50.05
$1/2\ S_2(g) + 1/2\ O_2(g) = SO(g)$ (298.16°–2,000° K.)	+3,890	+.07	......	.....	−1.50

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	2.303a	b	c	I
$S(rh) + O_2(g) = SO_2(g)$ . . . . (298.16°–368.6° K.)	−70,980	+.83	+2.35	+.51	−5.85
$S(mon) + O_2(g) = SO_2(g)$ . . . . (368.6°–392° K.)	−71,020	+.78	+2.71	+.51	−5.74
$S(l\lambda,\mu) + O_2(g) = SO_2(g)$ . . . . (392°–718° K.)	−69,900	+12.30	−.77	+.51	−37.10
$1/2\ S_2(g) + O_2(g) = SO_2(g)$ . . . . (298.16°–2,000° K.)	−86,330	+2.42	−.70	+.31	+10.71
$S(rh) + 3/2\ O_2(g) = SO_3(c—I)$ . . . . (298.16°–335.4° K.)	−111,370	−6.45	. . . . .	. . . . .	+88.32
$S(rh) + 3/2\ O_2(g) = SO_3(c—II)$ . . . . (298.16°–305.7° K.)	−108,680	−11.97	. . . . .	. . . . .	+94.95
$S(rh) + 3/2\ O_2(g) = SO_3(l)$ . . . . (298.16°–335.4° K.)	−107,430	−21.18	. . . . .	. . . . .	+113.76
$S(rh) + 3/2\ O_3(g) = SO_3(g)$ . . . . (298.16°–368.6° K.)	−95,070	+1.43	+0.66	+1.26	+16.81
$S(mon) + 3/2\ O_2(g) = SO_3(g)$ . . . . (368.6°–392° K.)	−95,120	+1.38	+1.02	+1.26	+16.93
$S(l\lambda,\mu) + 3/2\ O_2(g) = SO_3(g)$ . . . . (392°–718° K.)	−94,010	+12.89	−2.46	+1.26	−14.40
$1/2\ S_2(g) + 3/2\ O_2(g) = SO_3(g)$ . . . . (298.16°–1,500° K.)	−110,420	+3.02	−2.39	+1.06	+33.41
$2\ Ta(c) + 5/2\ O_2(g) = Ta_2O_5(c)$ . . . . (298.16°–2,000° K.)	−492,790	−17.18	−1.25	+2.46	+161.68
$Tc(c) + O_2(g) = TcO_2(c)$ . . . . (298.16°–500° K.)	−103,400	. . . . .	. . . . .	. . . . .	+41.00
$Tc(c) + 3/2\ O_2(g) = TcO_3(c)$ . . . . (298.16°–500° K.)	−129,000	. . . . .	. . . . .	. . . . .	+64.50
$2\ Tc(c) + 7/2\ O_2(g) = Tc_2O_7(c)$ . . . . (298.16°–392.7° K.)	−266,000	. . . . .	. . . . .	. . . . .	+147.00
$2\ Tc(c) + 7/2\ O_2(g) = Tc_2O_7(l)$ . . . . (392.7°–500° K.)	−258,930	. . . . .	. . . . .	. . . . .	+129.00
$Te(c) + 1/2\ O_2(g) = TeO(g)$ . . . . (298.16°–723° K.)	+43,110	+1.91	+.84	+.315	−27.22
$Te(l) + 1/2\ O_2(g) = TeO(g)$ . . . . (723°–1,360° K.)	+39,750	+6.08	+.09	+.315	−33.94
$1/2\ Te_2(g) + 1/2\ O_2(g) = TeO(g)$ . . . . (1,360°–2,000° K.)	+23,730	−.90	+.09	+.315	−.29
$Te(c) + O_2(g) = TeO_2(c)$ . . . . (298.16°–723° K.)	−78,090	−2.10	−2.35	−.20	+51.27
$Te(l) + O_2(g) = TeO_2(c)$ . . . . (723°–1,006° K.)	−81,530	+1.84	−3.10	−.20	+45.30
$Te(l) + O_2(g) = TeO_2(l)$ . . . . (1,006°–1,300° K.)	−82,090	−21.74	+.50	−.20	+113.04
$2\ Tl(\alpha) + O_2(g) = Tl_2O(c)$ . . . . (298.16°–505.5° K.)	−44,110	−6.91	. . . . .	. . . . .	+42.30

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)

Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_0	2.303a	b	c	I
2 Tl(β) + $O_2(g)$ = $Tl_2O(c)$ (505.5°–573° K.)	−44,260	−6.91	......	.....	+42.60
2 Tl(β) + 1/2 $O_2(g)$ = $Tl_2O(l)$ (573°–576° K.)	−40,880	−13.82	......	.....	+55.76
2 Tl(l) + 1/2 $O_2(g)$ = $Tl_2O(l)$ (576°–773° K.)	−42,320	−11.51	......	.....	+51.89
2 Tl(l) + 1/2 $O_2(g)$ = $Tl_2O(g)$ (773°–1,730° K.)	−18,400	+11.51	......	.....	−45.55
2 Tl(g) + 1/2 $O_2(g)$ = $Tl_2O(g)$ (1,730°–2,000° K.)	−104,670	.....	......	.....	+41.59
2 Tl(α) + 3/2 $O_2(g)$ = $Tl_2O_3(c)$ (298.16°–505.5° K.)	−99,410	−16.12	......	.....	+119.09
2 Tl(β) + 3/2 $O_2(g)$ = $Tl_2O_3(c)$ (505.5°–576° K.)	−99,560	−16.12	......	.....	+119.39
2 Tl(l) + 3/2 $O_2(g)$ = $Tl_2O_3(c)$ (576°–990° K.)	−101,010	−13.82	......	.....	+115.55
2 Tl(l) + 3/2 $O_2(g)$ = $Tl_2O_3(l)$ (990°–1,500° K.)	−94,550	−27.63	......	.....	+150.39
2 Tl(α) + 2 $O_2(g)$ = $Tl_2O_4(c)$ (298.16°–505.5° K.)	−117,680	−23.03	......	.....	+161.19
2 Tl(β) + 2 $O_2(g)$ = $Tl_2O_4(c)$ (505.5°–576° K.)	−117,830	−23.03	......	.....	+161.49
2 Tl(l) + 2 $O_2(g)$ = $Tl_2O_4(c)$ (576°–1,000° K.)	−119,270	−20.72	......	.....	+157.63
Th(c) + $O_2(g)$ = $ThO_2(c)$ (298.16°–2,000° K.)	−294,350	−5.25	+.59	+.775	+62.81
Sn(c) + 1/2 $O_2(g)$ = $SnO(c)$ (298.16°–505° K.)	−68,600	−3.57	+1.65	−.10	+32.59
Sn(l) + 1/2 $O_2(g)$ = $SnO(c)$ (505°–1,300° K.)	−69,670	+3.06	−1.50	−.10	+18.39
Sn(c) + 1/2 $O_2(g)$ = $SnO(g)$ (298.16°–505° K.)	−1,000	−.97	+3.24	+.32	−17.41
Sn(l) + 1/2 $O_2(g)$ = $SnO(g)$ (505°–2,000° K.)	−2,070	+5.66	+.09	+.32	−31.62
Sn(c) + $O_2(g)$ = $SnO_2(c)$ (298.16°–505° K.)	−142,010	−14.00	+2.45	+2.38	+90.74
Sn(l) + $O_2(g)$ = $SnO_2(c)$ (505°–1,898° K.)	−143,080	−7.37	−.70	+2.38	+76.53
Sn(l) + $O_2(g)$ = $SnO_2(l)$ (1,898°–2,000° K.)	−139,130	−21.97	+.50	−.20	+120.11
Ti(α) + 1/2 $O_2(g)$ = TiO(α) (298.16°–1,150° K.)	−125,010	−4.01	−.29	+.83	+36.28
Ti(β) + 1/2 $O_2(g)$ = TiO(α) (1,150°–1,264° K.)	−125,040	+1.17	−1.55	+.83	+21.90
Ti(β) + 1/2 $O_2(g)$ = TiO(β) (1,264°–2,000° K.)	−125,210	−1.77	−1.25	−.10	+30.83

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)
Coefficients in Free-Energy Equations (Continued)

Reaction and temperature range of validity	ΔH_o	2.303a	b	c	I
$Ti(\alpha) + 1/2\ O_2(g) = TiO(g)$ .... (298.16°–1,150° K.)	+11,710	+3.71	+1.07	−.10	−35.50
$Ti(\beta) + 1/2\ O_2(g) = TiO(g)$ .... (1,150°–2,000° K.)	+11,680	+8.89	−.19	−.10	−49.88
$2\ Ti(\alpha) + 3/2\ O_2(g) = Ti_2O_3(\alpha)$ .... (298.16°–473° K.)	−360,660	+32.08	−23.49	−.30	−10.66
$2\ Ti(\alpha) + 3/2\ O_2(g) = Ti_2O_3(\beta)$ .... (473°–1,150° K.)	−369,710	−30.95	+2.62	+4.80	+162.79
$2\ Ti(\beta) + 3/2\ O_2(g) = Ti_2O_3(\beta)$ .... (1,150°–2,000° K.)	−369,760	−20.59	+.10	+4.80	+134.03
$3\ Ti(\alpha) + 5/2\ O_2(g) = Ti_3O_5(\alpha)$ .... (298.16°–450° K.)	−587,980	−4.19	−9.72	−.50	+131.05
$3\ Ti(\alpha) + 5/2\ O_2(g) = Ti_3O_5(\beta)$ .... (450°–1,150° K.)	−586,330	−18.31	+1.03	−.50	+159.98
$3\ Ti(\beta) + 5/2\ O_2(g) = Ti_3O_5(\beta)$ .... (1,150°–2,000° K.)	−586,420	−2.76	−2.75	−.50	+116.81
$Ti(\alpha) + O_2(g) = TiO_2$ (*rutile*) .... (298.16°–1,150° K.)	−228,360	−12.80	+1.62	+1.975	+82.81
$Ti(\beta) + O_2(g) = TiO_2$ (*rutile*) .... (1,150°–2,000° K.)	−228,380	−7.62	+.36	+1.975	+68.43
$W(c) + O_2(g) = WO_2(c)$ .... (298.16°–1,500° K.)	−137,180	−1.38	......	.....	+45.56
$4\ W(c) + 11/2\ O_2(g) = W_4O_{11}(c)$ .... (298,16°–1,700° K.)	−745,730	−32.70	......	.....	+321.84
$W(c) + 3/2\ O_2(g) = WO_3(c)$ .... (298.16°–1,743° K.)	−201,180	−2.92	−1.81	−.30	+70.89
$W(c) + 3/2\ O_2(g) = WO_3(l)$ .... (1,743°–2,000° K.)	−203,140	−35.74	+1.13	−.30	+173.27
$U(\alpha) + O_2(g) = UO_2(c)$ .... (298.16°–935° K.)	−262,880	−19.92	+3.70	+2.13	+100.54
$U(\beta) + O_2(g) = UO_2(c)$ .... (935°–1,045° K.)	−260,660	−4.28	−.31	+1.78	+55.50
$U(\gamma) + O_2(g) = UO_2(c)$ .... (1,045°–1,405° K.)	−262,830	−6.54	−.31	+1.78	+64.41
$U(l) + O_2(g) = UO_2(c)$ .... (1,405°–1,500° K.)	−264,790	−5.92	......	.....	+63.50
$3\ U(\alpha) + 4\ O_2(g) = U_3O_8(c)$ .... (298.16°–935° K.)	−863,370	−56.57	+10.68	+5.20	+330.19
$3\ U(\beta) + 4\ O_2(g) = U_3O_8(c)$ .... (935°–1,045° K.)	−856,720	−9.67	−1.35	+4.15	+195.12
$3\ U(\gamma) + 4\ O_2(g) = U_3O_8(c)$ .... (1,045°–1,405° K.)	−863,230	−16.44	−1.35	+4.15	+221.79
$3\ U(l) + 4\ O_2(g) = U_3O_8(c)$ .... (1,405°–1,500° K.)	−869,460	−10.91	−1.35	+4.15	+208.82
$U(\alpha) + 3/2\ O_2(g) = UO_3$ (*hex*) .... (298.16°–935° K.)	−294,090	−18.33	+3.49	+1.535	+114.94

HEAT OF FORMATION OF INORGANIC OXIDES (Continued)
Coefficient in Free-Energy Equations (Continued)

Reaction and temperature range of validity		ΔH_0	$2.303a$	b	c	I
$U(\beta) + 3/2\ O_2(g) = UO_3$ (*hex*)	(935°–1,045° K.)	−291,870	−2.69	−.52	+1.185	+69.90
$U(\gamma) + 3/2\ O_2(g) = UO_3$ (*hex*)	(1,045°–1,400° K.)	−294,040	−4.95	−.52	+1.185	+78.80
$V(c) + 1/2\ O_2(g) = VO(c)$	(298.16°–2,000° K.)	−101,090	−5.39	−.36	+.53	+38.69
$V(c) + 1/2\ O_2(g) = VO(g)$	(298.16°–2,000° K.)	+52,090	+1.80	+1.04	+.35	−28.42
$2\ V(c) + 3/2\ O_2(g) = V_2O_3(c)$	(298.16°–2,000° K.)	−299,910	−17.98	+.37	+2.41	+118.83
$2\ V(c) + 2\ O_2(g) = V_2O_4(\alpha)$	(298.16°–345° K.)	−342,890	−11.03	+3.00	−.40	+117.38
$2\ V(c) + 2\ O_2(g) = V_2O_4(\beta)$	(345°–1,818° K.)	−345,330	−24.36	+1.30	+3.545	+155.55
$2\ V(c) + 2\ O_2(g) = V_2O_4(l)$	(1,818°–2,000° K.)	−339,880	−59.59	+3.00	−0.40	+264.42
$6\ V(c) + 13/2\ O_2(g) = V_6O_{13}(c)$	(298.16°–1,000° K.)	−1,076,340	−95.33	......	.....	+557.61
$2\ V(c) + 5/2\ O_2(g) = V_2O_5(c)$	(298.16°–943° K.)	−381,960	−41.08	+5.20	+6.11	+228.50
$2\ V(c) + 5/2\ O_2(g) = V_2O_5(l)$	(943°–2,000° K.)	−365,840	−38.91	+3.25	−.50	+207.54
$2\ Y(c) + 3/2\ O_2(g) = Y_2O_3(c)$	(298.16°–1,773° K.)	−419,600	+2.76	−1.73	−.30	+66.36
$2\ Y(l) + 3/2\ O_2(g) = Y_2O_3(c)$	(1,773°–2,000° K.)	−422,850	+13.36	−2.75	−.30	+35.56
$Zn(c) + 1/2\ O_2(g) = ZnO(c)$	(298.16°–692.7° K.)	−84,670	−6.40	+.84	+.99	+43.25
$Zn(l) + 1/2\ O_2(g) = ZnO(c)$	(692.7°–1,180° K.)	−85,520	−1.45	−.36	+.99	+31.25
$Zn(g) + 1/2\ O_2(g) = ZnO(c)$	(1,180°–2,000° K.)	−115,940	−7.28	−.36	+.99	+74.94
$Zr(\alpha) + O_2(g) = ZrO_2(\alpha)$	(298.16°–1,135° K.)	−262,980	−6.10	+.16	+1.045	+65.00
$Zr(\beta) + O_2(g) = ZrO_2(\alpha)$	(1,135°–1,478° K.)	−264,190	−5.09	−.40	+1.48	+63.58
$Zr(\beta) + O_2(g) = ZrO_2(\beta)$	(1,478°–2,000° K.)	−262,290	−7.76	+.50	−.20	+69.50

THERMODYNAMIC PROPERTIES OF ELEMENTS AND OXIDES

THERMODYNAMIC PROPERTIES

Thermodynamic calculations over a wide range of temperatures are generally made with the aid of algebraic equations representing the characteristic properties of the substances being considered. The necessary integrations and differentiations, or other mathematical manipulations, are then most easily effected.

The most convenient starting point in making such calculations for a given substance is the heat capacity at constant pressure. From this quantity and a knowledge of the properties of any phase transitions, the other thermodynamic properties may be computed by the well-known equations given in standard texts on thermodynamics.

Empirical heat capacity equations are generally of the form of a power series with the absolute temperature T as the independent variable:

$$C_p = a' + (b' \times 10^{-3})T + (c' \times 10^{-6})T^2$$

or

$$C_p = a'' + (b'' \times 10^{-3})T + \frac{d \times 10^5}{T^2}.$$

Since both forms are used in the ensuing, let

$$C_p = a + (b \times 10^{-3})T + (c \times 10^{-6})T^2 + \frac{d \times 10^5}{T^2}.$$

The constants a, b, c, and d are to be determined either experimentally or by some theoretical or semi-empirical approach.

The heat content or enthalpy H is determined from the heat capacity by a simple integration over the range of temperatures for which (1) is applicable. Thus, if 298° K is taken as a reference temperature,

$$(2)\quad \begin{aligned} H_T - H_{298} &= \int_{298}^{T} C_p dT \\ &= a(T - 298) + \tfrac{1}{2}(b \times 10^{-3})(T^2 - 298^2) \\ &\qquad + \frac{1}{3}(c \times 10^{-6})(T^3 - 298^3) \\ &\qquad - (d \times 10^5)\left(\frac{1}{T} - \frac{1}{298}\right) \\ &= aT + \tfrac{1}{2}(b \times 10^{-3})T^2 + \frac{1}{3}(c \times 10^{-6})T^3 \\ &\qquad - \frac{d \times 10^5}{T} - A, \end{aligned}$$

where all the constants on the right hand side of the equation have been incorporated in the term $-A$.

In general, the enthalpy is given by a sum of terms such as (2) for each phase of the substance involved in the temperature range considered plus terms which represent the heats of transitions:

$$H_T - H_{298} = \sum \int_{T_1}^{T_2} C_p dT + \sum \Delta H_{tr.}$$

In a similar manner, the entropy S is obtained from (1) by performing the integration

$$\begin{aligned}
(3)\quad S_T - S_{298} &= \int_{298}^{T} (C_p/T)dt \\
&= a\ln(T/298) + (b \times 10^{-3})(T - 298) \\
&\qquad + \tfrac{1}{2}(c \times 10^{-6})(T^2 - 298^2) \\
&\qquad - \tfrac{1}{2}(d \times 10^5)\left(\frac{1}{T^2} - \frac{1}{298^2}\right) \\
&= a\ln T + (b \times 10^{-3})T \\
&\qquad + \tfrac{1}{2}(c \times 10^{-6})T^2 \frac{-\tfrac{1}{2}(d \times 10^5)}{T} - B'
\end{aligned}$$

or

$$(4)\quad S_T = 2.303 \log T + (b \times 10^{-3})T + \tfrac{1}{2}(c \times 10^6)T^2 - \frac{\tfrac{1}{2}(d \times 10^5)}{T} - B$$

where

$$(5)\qquad B = B' + S_{298}.$$

From the definition of free energy F:

$$F = H - TS$$

the quantity

$$F_T - H_{298} = (H - H_{298}) - TS$$

is obtained from (2) and (4):

$$\begin{aligned}
(6)\quad F_T - H_{298} &= 2.303aT \log T - \tfrac{1}{2}(b \times 10^3)T^2 \\
&\qquad - \frac{1}{6}(c \times 10^{-6})T^3 - \frac{\tfrac{1}{2}(d \times 10^5)}{T} \\
&\qquad - (B - a)T + A
\end{aligned}$$

and also the free energy function

$$\begin{aligned}
(7)\quad \frac{F_T - H_{298}}{T} &= -2.303 \log T - \tfrac{1}{2}(b \times 10^3)T \\
&\qquad - \frac{1}{6}(c \times 10^{-6})T^2 - \frac{\tfrac{1}{2}(d \times 10^5)}{T^2} \\
&\qquad - (B - a) + \frac{A}{T}
\end{aligned}$$

In the following two tables there has been collected values of the constants. The first column lists the element or the oxide. The second column gives the phase to which they are applicable. The third, fourth, and fifth columns specify the thermodynamic properties for the transition to the succeeding phase. In column 6, the value of the entropy at 298.16° K, the reference temperature, is given. The remaining columns, except for the last, give the values of the constants a, b, c, d, A, and B required in the thermodynamic equations.

All values throughout the table which represent estimates have been enclosed in parentheses.

The heat capacities at temperatures beyond the range of experimental determination were estimated by extrapolation. Where no experimental values were found, use of analogy with compounds of neighboring elements in the Periodic Table was employed.

THERMODYNAMIC PROPERTIES

Ref.: U. S. Atomic Energy Commission Report ANL-5750.

Element	Phase	Temperature of Transition (°K)	Heat of Transition (kcal/g atom)	Entropy of Transition (e.u.)	Entropy at 298°K (e.u.)
Ac	solid	(1090)	(2.5)	(2.3)	(13)
	liquid	(2750)	(70)	(25)	—
Ag	solid	1234	2.855	2.313	10.20
	liquid	2485	60.72	24.43	—
	gas	—	—	—	—
Al	solid	931.7	2.57	2.76	6.769
	liquid	2600	67.9	26	—
Am	solid	(1200)	(2.4)	(2.0)	(13)
	liquid	2733	51.7	18.9	—
As	solid	883	31/4	35.1/4	8.4
Au	solid	1336.16	3.03	2.27	11.32
	liquid	2933	74.21	25.30	—
B	solid	2313	(3.8)	(1.6)	1.42
	liquid	2800	75	27	—
Ba	solid, α	648	0.14	0.22	16
	solid, β	977	1.83	1.87	—
	liquid	1911	35.665	18.63	—
	gas	—	—	—	—
Be	solid	1556	2.335	1.501	2.28
	liquid	—	—	—	—
Bi	solid	544.2	2.63	4.83	13.6
	liquid	1900	41.1	21.6	—
	gas	—	—	—	—
C	solid	—	—	—	1.3609
Ca	solid, α	723	0.24	0.33	9.95
	solid, β	1123	2.2	1.96	—
	liquid	1755	38.6	22.0	—
	gas	—	—	—	—
Cd	solid	594.1	1.46	2.46	12.3
	liquid	1040	23.86	22.94	—
	gas	—	—	—	—
Ce	solid	1048	2.1	2.0	13.8
	liquid	2800	73	26	—
Cl_2	gas	—	—	—	53.286
Co	solid, α	723	0.005	0.007	6.8
	solid, β	1398	0.095	0.068	—
	solid, γ	1766	3.7	2.1	—
	liquid	3370	93	28	—
Cr	solid	2173	3.5	1.6	5.68
	liquid	2495	72.97	29.25	—
	gas	—	—	—	—
Cs	solid	301.9	0.50	1.7	19.8
	liquid	963	16.32	17.0	—
	gas	—	—	—	—
Cu	solid	1356.2	3.11	2.29	7.97
	liquid	2868	72.8	25.4	—
F_2	gas	—	—	—	48.58
Fe	solid, α	1033	0.410	0.397	6.491
	solid, β	1180	0.217	0.184	—
	solid, γ	1673	0.15	0.084	—
	solid, δ	1808	3.86	2.14	—
	liquid	3008	84.62	28.1	—
Ga	solid	302.94	1.335	4.407	9.82
	liquid	2700	—	—	—
Ge	solid	1232	8.3	6.7	10.1
	liquid	2980	68	23	—
H_2	gas	—	—	—	31.211
Hf	solid	(2600)	(6.0)	(2.3)	13.1
Hg	liquid	629.73	13.985	22.208	18.46
	gas	—	—	—	—

Element	a	b	c	d	A (kcal/g atom)	B (e.u.)
Ac	(5.4)	(3.0)	—	—	(1.743)	(18.7)
	(8)	—	—	—	(0.295)	(31.3)
Ag	5.09	1.02	—	0.36	1.488	19.21
	7.30	—	—	—	0.164	30.12
	(4.97)	—	—	—	(−66.34)	(−12.52)
Al	4.94	2.96	—	—	1.604	22.26
	7.0	—	—	—	0.33	30.83
Am	(4.9)	(4.4)	—	—	(1.657)	(16.2)
	(8.5)	—	—	—	(0.409)	(34.5)
As	5.17	2.34	—	—	1.646	21.8
Au	6.14	−0.175	0.92	—	1.831	23.65
	7.00	—	—	—	−0.631	26.99
B	1.54	4.40	—	—	0.655	8.67
	(6.0)	—	—	—	(−4.599)	(31.4)
Ba	5.55	1.50	—	—	1.722	16.1
	5.55	1.50	—	—	1.582	15.9
	(7.4)	—	—	—	(0.843)	(25.3)
	(4.97)	—	—	—	(−39.65)	(−11.7)
Be	5.07	1.21	—	−1.15	1.951	27.62
	5.27	—	—	—	−1.611	25.68
Bi	5.38	2.60	—	—	1.720	17.8
	7.60	—	—	—	−0.087	25.6
	(4.97)	—	—	—	(−46.19)	(−15.9)
C	4.10	1.02	—	−2.10	1.972	23.484
Ca	5.24	3.50	—	—	1.718	20.95
	6.29	1.40	—	—	1.689	26.01
	7.4	—	—	—	−0.147	30.28
	(4.97)	—	—	—	(−43.015)	(−9.88)
Cd	5.31	2.94	—	—	1.714	18.8
	7.10	—	—	—	0.798	26.1
	(4.97)	—	—	—	(−25.28)	(−11.7)
Ce	4.40	6.0	—	—	1.579	13.1
	(7.9)	—	—	—	(−0.148)	(29.1)
Cl_2	8.76	0.27	—	−0.65	2.845	−2.929
Co	4.72	4.30	—	—	1.598	21.4
	3.30	5.86	—	—	0.974	13.1
	9.60	—	—	—	3.961	50.5
	8.30	—	—	—	−2.034	38.7
Cr	5.35	2.36	—	−0.44	1.848	25.75
	9.40	—	—	—	1.556	50.13
	(4.97)	—	—	—	(−82.47)	(−13.8)
Cs	7.42	—	—	—	2.212	22.5
	8.00	—	—	—	1.887	24.1
	(4.97)	—	—	—	(−17.35)	(−13.6)
Cu	5.41	1.50	—	—	1.680	23.30
	7.50	—	—	—	0.024	34.05
F_2	8.29	0.44	—	−0.80	2.760	−0.76
Fe	3.37	7.10	—	0.43	1.176	14.59
	10.40	—	—	—	4.281	55.66
	4.85	3.00	—	—	0.396	19.76
	10.30	—	—	—	4.382	55.11
	10.00	—	—	—	−0.021	50.73
Ga	5.237	3.33	—	—	1.710	21.01
	(6.645)	—	—	—	(0.648)	(23.64)
Ge	5.90	1.13	—	—	1.764	23.8
	(7.3)	—	—	—	(−5.668)	(25.7)
H_2	6.62	0.81	—	—	2.010	6.75
Hf	(6.00)	(0.52)	—	—	(1.812)	(21.2)
Hg	6.61	—	—	—	1.971	19.20
	4.969	—	—	—	−13.048	−13.54

Element	Phase	Temperature of Transition (°K)	Heat of Transition (kcal/g atom)	Entropy of Transition (e.u.)	Entropy at 298°K (e.u.)
In	solid	430	0.775	1.80	13.88
	liquid	2440	53.8	22.0	—
	gas	—	—	—	—
Ir	solid	2727	6.6	2.4	8.7
K	solid	336.4	0.5575	1.657	15.2
	liquid	1052	18.88	17.95	—
	gas	—	—	—	—
La	solid	1153	(2.3)	(2.0)	13.7
	liquid	3000	80	27	—
Li	solid	459	0.69	1.5	6.70
	liquid	1640	32.48	19.81	—
	gas	—	—	—	—
Mg	solid	923	2.2	2.4	7.77
	liquid	1393	31.5	22.6	—
	gas	—	—	—	—
Mn	solid, α	1000	0.535	0.535	7.59
	solid, β	1374	0.545	0.397	—
	solid, γ	1410	0.430	0.305	—
	solid, δ	1517	3.5	2.31	—
	liquid	2368	53.7	22.7	—
	gas	—	—	—	—
Mo	solid	2883	(5.8)	(2.0)	6.83
N_2	gas	—	—	—	45.767
Na	solid	371	0.63	1.7	12.31
	liquid	1187	23.4	20.1	—
	gas	—	—	—	—
Nb	solid	2760	(5.8)	(2.1)	8.3
Nd	solid	1297	(2.55)	(1.97)	13.9
	liquid	(2750)	(61)	(22)	—
Ni	solid, α	626	0.092	0.15	7.137
	solid, β	1728	4.21	2.44	—
	liquid	3110	90.48	29.0	—
Np	solid	913	(2.3)	(2.5)	(14)
	liquid	(2525)	(55)	(22)	—
O_2	gas	—	—	—	49.003
Os	solid	2970	(6.4)	(2.2)	7.8
P_4	solid, white	317.4	0.601	1.89	42.4
	liquid	553	11.9	21.5	—
	gas	—	—	—	—
Pa	solid	(1825)	(4.0)	(2.2)	(13.5)
	liquid	(4500)	(115)	(26)	—
Pb	solid	600.6	1.141	1.900	15.49
	liquid	2023	42.5	21.0	—
	gas	—	—	—	—
Pd	solid	1828	4.12	2.25	8.9
	liquid	3440	89	26	—
Po	solid	525	(2.4)	(4.6)	13
	liquid	(1235)	(24.6)	(19.9)	—
	gas	—	—	—	—
Pr	solid	1205	(2.5)	(2.1)	(13.5)
	liquid	3563	—	—	—
Pt	solid	2042.5	5.2	2.5	10.0
	liquid	4100	122	29.8	—
Pu	solid	913	(2.26)	(2.48)	(13.0)
	liquid	—	—	—	—
Ra	solid	1233	(2.3)	(1.9)	(17)
	liquid	(1700)	(35)	(21)	—
	gas	—	—	—	—
Rb	solid	312.0	0.525	1.68	16.6
	liquid	952	18.11	19.0	—
	gas	—	—	—	—
Re	solid	3440	(7.9)	(2.3)	(8.89)

Element	a	b	c	d	A (kcal/g atom)	B (e.u.)
In	5.81	2.50	—	—	1.844	19.97
	7.50	—	—	—	1.564	27.34
	(4.97)	—	—	—	(−58.42)	(−14.46)
Ir	5.56	1.42	—	—	1.721	23.4
K	1.3264	19.405	—	—	1.258	−1.86
	8,8825	−4.565	2.9369	—	1.923	32.55
	(4.97)	—	—	—	(−19.689)	(−9.46)
La	6.17	1.60	—	—	1.911	21.9
	(7.3)	—	—	—	(−0.15)	(26.0)
Li	3.05	8.60	—	—	1.292	12.92
	7.0	—	—	—	1.509	32.00
	(4.97)	—	—	—	(−34.30)	(−2.84)
Mg	5.33	2.45	—	−0.103	1.733	23.39
	(8.0)	—	—	—	0.942	36.97
	(4.97)	—	—	—	(−34.78)	(−7.60)
Mn	5.70	3.38	—	−0.37	1.974	26.11
	8.33	0.66	—	—	2.672	41.02
	10.70	—	—	—	4.760	56.84
	11.30	—	—	—	5.176	60.88
	11.00	—	—	—	1.221	56.38
	6.26	—	—	—	−63.704	−3.13
Mo	5.48	1.30	—	—	1.692	24.78
N_2	6.76	0.606	0.13	—	2.044	−7.064
Na	5.657	3.252	0.5785	—	1.836	20.92
	8.954	−4.577	2.540	—	1.924	36.0
	(4.97)	—	—	—	(−24.40)	(−8.7)
Nb	5.66	0.96	—	—	1.730	24.24
Nd	5.61	5.34	—	—	1.910	19.7
	(9.1)	—	—	—	−0.606	35.8
Ni	4.06	7.04	—	—	1.523	18.095
	6.00	1.80	—	—	1.619	27.16
	9.20	—	—	—	0.251	45.47
Np	(5.3)	(3.4)	—	—	(1.731)	(17.9)
	(9.0)	—	—	—	(1.392)	(37.5)
O_2	8.27	0.258	—	−1.877	3.007	−0.750
Os	5.69	0.88	—	—	1.736	24.9
P_4	13.62	28.72	—	—	5.338	43.8
	19.23	0.51	—	−2.98	6.035	66.7
	(19.5)	(−0.4)	(1.3)	—	(−6.32)	(46.1)
Pa	(5.2)	(4.0)	—	—	(1.728)	(17.3)
	(8.0)	—	—	—	(−3.823)	(28.8)
Pb	5.64	2.30	—	—	1.784	17.33
	7.75	−0.73	—	—	1.362	27.11
	(4.97)	—	—	—	(−45.25)	(−13.6)
Pd	5.80	1.38	—	—	1.791	24.6
	(9.0)	—	—	—	(1.215)	(43.8)
Po	(5.2)	(3.2)	—	—	(1.693)	(17.6)
	(9.0)	—	—	—	(0.847)	(35.2)
	(4.97)	—	—	—	(−28.73)	(−13.5)
Pr	(5.0)	(4.6)	—	—	(1.705)	(16.4)
	(8.0)	—	—	—	(−0.519)	(30.0)
Pt	5.74	1.34	—	0.10	1.737	23.0
	(9.0)	—	—	—	(0.406)	(42.6)
Pu	(5.2)	(3.6)	—	—	(1.710)	(17.7)
	(8.0)	—	—	—	(0.506)	(31.0)
Ra	(5.8)	(1.2)	—	—	(1.783)	(16.4)
	(8.0)	—	—	—	(1.284)	(28.6)
	(4.97)	—	—	—	(−38.87)	(−14.5)
Rb	3.27	13.1	—	—	1.557	5.9
	7.85	—	—	—	1.814	26.5
	(4.97)	—	—	—	(−19.04)	(−12.3)
Re	(5.85)	(0.8)	—	—	(1.780)	(24.7)

Element	Phase	Temperature of Transition (°K)	Heat of Transition (kcal/g atom)	Entropy of Transition (e.u.)	Entropy at 298°K (e.u.)
Rh	solid	2240	(5.2)	(2.3)	7.6
	liquid	4150	127	30.7	—
Ru	solid, α	1308	0.034	0.026	6.9
	solid, β	1473	0	0	—
	solid, γ	1773	0.23	0.13	—
	solid, δ	2700	(6.1)	(2.3)	—
S	solid, α	368.6	0.088	0.24	7.62
	solid, β	392	0.293	0.747	—
	liquid	717.76	2.5	3.5	—
$\frac{1}{2}S_2$	gas	—	—	—	—
Sb	solid (α,β,γ)	903.7	4.8	5.3	10.5
	liquid	1713	46.665	27.3	—
$\frac{1}{2}Sb_2$	gas	—	—	—	—
Sc	solid	1670	(4.0)	(2.4)	(9.0)
	liquid	3000	80	27	—
Se	solid	490.6	1.25	2.55	10.144
	liquid	1000	14.27	14.27	—
Si	solid	1683	11.1	6.60	4.50
	liquid	2750	71	26	—
Sm	solid	1623	3.7	2.3	(15)
	liquid	(2800)	(70)	(25)	—
Sn	solid (α,β)	505.1	1.69	3.35	12.3
	liquid	2473	(55)	(22)	—
	gas	—	—	—	—
Sr	solid	1043	2.2	2.1	13.0
	liquid	1657	33.61	20.28	—
	gas	—	—	—	—
Ta	solid	3250	7.5	2.3	9.9
Tc	solid	(2400)	(5.5)	(2.3)	(8.0)
	liquid	(3800)	(120)	(32)	—
Te	solid, α	621	0.13	0.21	11.88
	solid, β	723	4.28	5.92	—
	liquid	1360	11.9	8.75	—
$\frac{1}{2}Te_2$	gas	—	—	—	—
Th	solid	2173	(4.6)	(2.1)	12.76
	liquid	4500	(130)	(29)	—
Ti	solid, α	1155	0.950	0.822	7.334
	solid, β	2000	(4.6)	(2.3)	—
	liquid	3550	(101)	(28)	—
Tl	solid, α	508.3	0.082	0.16	15.4
	solid, β	576.8	1.03	1.79	—
	liquid	1730	38.81	22.4	—
	gas	—	—	—	—
U	solid, α	938	0.665	0.709	12.03
	solid, β	1049	1.165	1.111	—
	solid, γ	1405	(3.0)	(2.1)	—
	liquid	3800	—	—	—
V	solid	2003	(4.0)	(2.0)	7.05
	liquid	3800	—	—	—
W	solid	3650	8.42	2.3	8.0
Y	solid	1750	(4.0)	(2.3)	(11)
	liquid	3500	(90)	(26)	—
Zn	solid	692.7	1.595	2.303	9.95
	liquid	1180	27.43	23.24	—
	gas	—	—	—	—
Zr	solid, α	1135	0.920	0.811	9.29
	solid, β	2125	(4.9)	(2.3)	—
	liquid	(3900)	(100)	(26)	—

OF THE ELEMENTS (Continued)

Element	a	b	c	d	A (kcal/g atom)	B (e.u.)
Rh	5.40	2.19	—	—	1.707	23.8
	(9.0)	—	—	—	(−0.923)	(44.4)
Ru	5.25	1.50	—	—	1.632	23.5
	7.20	—	—	—	2.867	35.5
	7.20	—	—	—	2.867	35.5
	7.50	—	—	—	3.169	37.6
S	3.58	6.24	—	—	1.345	14.64
	3.56	6.95	—	—	1.298	14.54
	5.4	5.0	—	—	1.576	24.02
$\frac{1}{2}\text{S}_2$	(4.25)	(0.15)	—	(−1.0)	(−2.859)	(9.57)
Sb	5.51	1.74	—	—	1.720	21.4
	7.50	—	—	—	−1.992	28.1
$\frac{1}{2}\text{Sb}_2$	4.47	—	—	−0.11	−53.876	−21.7
Sc	(5.13)	(3.0)	—	—	1.663	21.1
	(7.50)	—	—	—	(−2.563)	31.3
Se	3.30	8.80	—	—	1.375	11.28
	7.0	—	—	—	0.881	27.34
Si	5.70	1.02	—	−1.06	2.100	28.88
	7.4	—	—	—	−7.646	33.17
Sm	(6.7)	(3.4)	—	—	(2.149)	(24.2)
	(9.0)	—	—	—	(−2.296)	(33.4)
Sn	4.42	6.30	—	—	1.598	14.8
	7.30	—	—	—	0.559	26.2
	(4.97)	—	—	—	(−60.21)	(−14.3)
Sr	(5.60)	(1.37)	—	—	(1.731)	(19.3)
	(7.7)	—	—	—	(0.976)	(30.4)
	(4.97)	—	—	—	(−37.16)	(−10.2)
Ta	5.82	0.78	—	—	1.770	23.4
Tc	(5.6)	(2.0)	—	—	(1.759)	(24.5)
	(11)	—	—	—	(3.459)	(59.4)
Te	4.58	5.25	—	—	1.599	15.78
	4.58	5.25	—	—	1.469	15.57
	9.0	—	—	—	−0.988	34.96
$\frac{1}{2}\text{Te}_2$	4.47	—	—	−0.10	−19.048	−6.47
Th	8.2	−0.77	2.04	—	2.591	33.64
	(8.0)	—	—	—	(−7.602)	(26.84)
Ti	5.25	2.52	—	—	1.677	23.33
	7.50	—	—	—	1.645	35.46
	(7.8)	—	—	—	(−2.355)	(35.45)
Tl	5.26	3.46	—	—	1.722	15.6
	7.30	—	—	—	2.230	26.4
	7.50	—	—	—	1.315	25.9
	(4.97)	—	—	—	(−41.88)	(−15.4)
U	3.25	8.15	—	0.80	1.063	8.47
	10.28	—	—	—	3.493	48.27
	9.12	—	—	—	1.110	39.09
	(8.99)	—	—	—	(−2.073)	36.01
V	5.57	0.97	—	—	1.704	24.97
	(8.6)	—	—	—	1.827	44.06
W	5.74	0.76	—	—	1.745	24.9
Y	(5.6)	(2.2)	—	—	(1.767)	(21.6)
	(7.5)	—	—	—	(−2.277)	(29.6)
Zn	5.35	2.40	—	—	1.702	21.25
	7.50	—	—	—	1.020	31.35
	(4.97)	—	—	—	(−29.407)	(−9.81)
Zr	6.83	1.12	—	−0.87	2.378	30.45
	7.27	—	—	—	1.159	31.43
	(8.0)	—	—	—	(−2.190)	(34.7)

THERMODYNAMIC PROPERTIES

For description of headings and symbols see preceding table.
Ref.: U. S. Atomic Energy Report ANL-5750.

Oxide	Phase	Temperature of Transition (°K)	Heat of Transition kcal/mole	Entropy of Transition (e.u.)	Entropy at 298°K (e.u.)
Ac_2O_3	solid	(2250)	(20)	(8.9)	(36.5)
	liquid	—	—	—	—
Ag_2O	solid	dec. 460	—	—	29.09
Ag_2O_2	solid	dec	—	—	(20.4)
Al_2O_3	solid	2300	26	11	12.186
	liquid	dec.	—	—	—
Am_2O_3	solid	(2225)	(17)	(7.6)	(37)
	liquid	(3400)	(85)	(25)	—
AmO_2	solid	dec.	—	—	(20)
As_2O_3	solid, α	503	4.1	8.2	25.6
	solid, β	586	4.4	7.5	—
	liquid	730	7.15	9.79	—
	gas	—	—	—	—
AsO_2	solid	(1200)	(9.0)	(7.5)	(13)
	liquid	(dec.)	—	—	—
As_2O_5	solid	dec. >1100	—	—	25.2
Au_2O_3	solid	dec.	—	—	30
B_2O_3	solid	723	5.27	7.29	12.91
	liquid	2520	(55)	(22)	—
Ba_2O	solid	(880)	(5.2)	(5.9)	(23.5)
	liquid	(1040)	(20)	(19)	—
	gas	—	—	—	—
BaO	solid	2196	13.8	6.28	16.8
	liquid	3000	(62)	(21)	—
BaO_2	solid	723	(5.7)	(7.9)	(18.5)
	liquid	dec. 1110	—	—	—
BeO	solid	dec.	—	—	3.37
BiO	solid	(1175)	(3.7)	(3.1)	(15)
	liquid	(1920)	(54)	(28)	—
	gas	—	—	—	—
Bi_2O_3	solid	1090	6.8	6.2	36.2
	liquid	(dec.)	—	—	—
CO	gas	—	—	—	47.30
CO_2	gas	—	—	—	51.06
CaO	solid	2860	(18)	(6.3)	9.5
CdO	solid	dec.	—	—	13.1
Ce_2O_3	solid	1960	(20)	(10)	(33.5)
	liquid	(3500)	(80)	(23)	—
CeO_2	solid	3000	(19)	(6.3)	17.7
CoO	solid	2078	(12)	(5.8)	10.5
	liquid	(2900)	(61)	(21)	—
Co_3O_4	solid	dec., 1240	—	—	(35.5)
Cr_2O_3	solid	2538	(25)	(10)	19.4
CrO_2	solid	dec. 700	—	—	(11.5)
CrO_3	solid	460	(6.1)	(13)	(17.5)
	liquid	(1000)	(25)	(25)	—
	gas	—	—	—	—
Cs_2O	solid	763	(4.58)	(6.0)	(23)
	liquid	dec.	—	—	—
Cs_2O_2	solid	867	(5.5)	(6.3)	(40)
	liquid	dec.	—	—	—
Cs_2O_3	solid	775	(7.75)	(10)	(47)
	liquid	dec.	—	—	—
Cu_2O	solid	1503	13.4	8.92	22.44
	liquid	dec.	—	—	—
CuO	solid	1609	(8.9)	(5.5)	10.4
	liquid	dec.	—	—	—
FeO	solid	1641	7.5	4.6	12.9
	liquid	(2700)	(55)	(20)	—
Fe_3O_4	solid, α	900	(0)	(0)	35.0
	solid, β	dec.	—	—	—

Oxide	a	b	c	d	A (kcal/mole)	B (e.u.)
Ac_2O_3	(20.0)	(20.4)	—	—	(6.870)	(80.9)
	(40)	—	—	—	(−19.767)	(180.5)
Ag_2O	13.26	7.04	—	—	4.266	48.56
Ag_2O_2	(16.4)	(12.2)	—	—	(5.432)	(76.7)
Al_2O_3	26.12	4.388	—	−7.269	10.422	142.03
	(33)	—	—	—	(−11.655)	(174.1)
Am_2O_3	(20.0)	(15.6)	—	—	(6.657)	(81.6)
	(38.5)	—	—	—	(−7.796)	(181.8)
AmO_2	(14.0)	(6.8)	—	—	(4.477)	(61.8)
As_2O_3	8.37	48.6	—	—	4.656	36.6
	8.37	48.6	—	—	0.556	28.4
	(39)	—	—	—	(5.760)	(187.6)
	(21.5)	—	—	—	(−14.164)	(62.5)
AsO_2	(8.5)	(9.4)	—	—	(2.952)	(38.2)
	(21)	—	—	—	(2.184)	(108.0)
As_2O_5	(31.1)	(16.4)	—	(−5.4)	(11.813)	(159.9)
Au_2O_3	(23.5)	(4.8)	—	—	(7.220)	(105.3)
B_2O_3	8.73	25.40	—	−1.31	4.171	45.04
	30.50	—	—	—	7.822	161.59
Ba_2O	(20.0)	(2.2)	—	—	(6.061)	(91.1)
	(22)	—	—	—	(1.769)	(96.8)
	(15)	—	—	—	(−25.51)	(29.0)
BaO	12.74	1.040	—	−1.984	4.510	57.2
	(13.9)	—	—	—	(−9.341)	(57.5)
BaO_2	(13.6)	(2.0)	—	—	(4.144)	(59.6)
	(21)	—	—	—	(3.241)	(99.0)
BeO	8.69	3.65	—	−3.13	3.803	48.99
BiO	(9.7)	(3.0)	—	—	(3.025)	(41.2)
	(14)	—	—	—	(2.306)	(64.9)
	(8.9)	—	—	—	(−61.49)	(−1.8)
Bi_2O_3	23.27	11.05	—	—	7.429	99.7
	(35.7)	—	—	—	(7.614)	(168.3)
CO	6.60	1.2	—	—	2.021	−9.34
CO_2	7.70	5.3	−0.83	—	2.490	−5.64
CaO	10.00	4.84	—	−1.08	3.559	49.5
CdO	9.65	2.08	—	—	2.970	42.5
Ce_2O_3	(23.0)	(9.0)	—	—	(7.258)	(100.2)
	(37)	—	—	—	(−2.591)	(178.5)
CeO_2	15.0	2.5	—	—	4.579	68.5
CoO	(9.8)	(2.2)	—	—	(3.020)	(46.0)
	(15.5)	—	—	—	(−1.886)	(79.2)
Co_3O_4	(29.5)	(17.0)	—	—	(9.551)	(137.6)
Cr_2O_3	28.53	2.20	—	−3.736	9.857	145.9
CrO_2	(16.1)	(3.0)	—	(−3.0)	(5.946)	(82.8)
CrO_3	(18.1)	(4.0)	—	(−2.0)	(6.245)	(87.9)
	(27)	—	—	—	(3.381)	(127.0)
	(20)	—	—	—	(−28.62)	(53.6)
Cs_2O	(16.5)	(5.4)	—	—	(5.160)	(72.6)
	(22)	—	—	—	(3.205)	(99.0)
Cs_2O_2	(21.4)	(11.4)	—	—	(6.887)	(85.3)
	(29.5)	—	—	—	(4.125)	(123.8)
Cs_2O_3	(24.0)	(22.6)	—	—	(8.160)	(96.5)
	(35)	—	—	—	(2.148)	(142.2)
Cu_2O	(13.4)	(8.6)	—	—	(4.378)	(54.9)
	(21.5)	—	—	—	(3.721)	(96.0)
CuO	14.34	6.2	—	—	4.551	61.11
	(22)	—	—	—	(−4.339)	(98.91)
FeO	9.27	4.80	—	—	(2.977)	(43.8)
	(14.5)	—	—	—	(−3.721)	(69.2)
Fe_3O_4	12.38	1.62	—	−0.38	3.826	58.3
	(14.5)	—	—	—	(−2.399)	(66.7)

Oxide	Phase	Temperature of Transition (°K)	Heat of Transition kcal/mole	Entropy of Transition (e.u.)	Entropy at 298°K (e.u.)
Fe_2O_3	solid, α	950	0.16	0.17	21.5
	solid, β	1050	0	0	—
	solid, γ	dec.	—	—	—
Ga_2O	solid	(925)	(8.5)	(9.2)	(22.5)
	liquid	(1000)	(20)	(20)	—
	gas	—	—	—	—
Ga_2O_3	solid	2013	(22)	(11)	20.23
	liquid	(2900)	(75)	(26)	—
GeO	solid	983	(50)	(51)	(12.5)
	gas	—	—	—	—
GeO_2	solid (α,β)	1389	10.5	7.56	(12.5)
	liquid	(2625)	(61)	(23)	—
H_2O	liquid	373.16	9.770	26.18	16.716
	gas	—	—	—	—
HfO_2	solid	3063	(17)	(5.6)	14.18
Hg_2O	solid	dec.	—	—	(30)
HgO	solid	dec.	—	—	16.839
In_2O	solid	(600)	(4.5)	(7.5)	(28)
	liquid	(800)	(16)	(20)	—
	gas	—	—	—	—
InO	solid	(1325)	(4.0)	(3.0)	(14.5)
	liquid	(2000)	(60)	(30)	—
	gas	—	—	—	—
In_2O_3	solid	(2000)	(20)	(10)	30.1
	liquid	(3600)	(85)	(24)	—
Ir_2O_3	solid	(1450)	(10)	(6.8)	(26.5)
	liquid	(2250)	(50)	(22)	—
	gas	—	—	—	—
IrO_2	solid	dec. 1373	—	—	(15.9)
K_2O	solid	(980)	(6.8)	(6.9)	(23)
	liquid	dec.	—	—	—
K_2O_2	solid	763	(7.0)	(9.2)	(27)
	liquid	(1800)	(45)	(25)	—
	gas	—	—	—	—
K_2O_3	solid	703	(6.1)	(8.7)	(33.5)
	liquid	(975)	(25)	(26)	—
	gas	—	—	—	—
KO_2	solid	653	(4.9)	(7.5)	27.9
	liquid	dec.	—	—	—
La_2O_3	solid	2590	(18)	(7)	(36.5)
Li_2O	solid	2000	(14)	(7)	9.06
	liquid	2600	(56)	(22)	—
Li_2O_2	solid	dec. 470	—	—	(16.5)
MgO	solid	3075	18.5	5.8	6.4
MgO_2	solid	dec. 361	—	—	(20.5)
MnO	solid	2058	13.0	6.32	14.27
	liquid	dec.	—	—	—
Mn_3O_4	solid, α	1445	4.97	3.44	35.5
	solid, β	1863	(33)	(18)	—
	liquid	(2900)	(75)	(26)	—
Mn_2O_3	solid	dec. 1620	—	—	26.4
MnO_2	solid	dec. 1120	—	—	12.7
MoO_2	solid	(2200)	(16)	(7.3)	(14.5)
	liquid	dec. 2250	—	—	—
MoO_3	solid	1068	12.54	11.74	18.68
	liquid	1530	33	22	—
	gas	—	—	—	—
N_2O	gas	—	—	—	52.58
Na_2O	solid	1193	(7.1)	(6.0)	17.4
	liquid	dec.	—	—	—
Na_2O_2	solid	dec. 919	—	—	22.6

OF THE OXIDES (Continued)

Oxide	a	b	c	d	A (kcal/mole)	B (e.u.)
Fe_2O_3	21.88	48.20	—	—	8.666	104.0
	48.00	—	—	—	12.652	238.3
	23.49	18.6	—	−3.55	9.021	119.9
Ga_2O	36.00	—	—	—	11.979	187.6
	31.71	1.8	—	—	8.467	159.7
	(13.8)	(8.6)	—	—	(4.497)	(58.7)
Ga_2O_3	(21.5)	—	—	—	(−0.559)	(94.1)
	(14)	—	—	—	(−28.06)	(22.3)
GeO	11.77	25.2	—	—	(4.630)	(54.35)
	(35.5)	—	—	—	(−20.66)	(173.2)
GeO_2	(10.4)	(2.6)	—	(−0.5)	(3.384)	(47.8)
	(8.2)	(0.4)	—	(−0.2)	(−49.67)	(−20.2)
H_2O	11.2	7.17	—	—	(3.658)	(53.5)
	(21.7)	—	—	—	(1.149)	(111.9)
HfO_2	18.03	—	—	—	5.376	86.01
Hg_2O	7.17	2.56	—	−0.08	−8.290	−3.56
HgO	17.39	2.08	—	−3.48	6.445	87.48
	(15.6)	(28)	—	—	(4.776)	(59.7)
	(8.5)	(7.0)	—	—	(2.846)	(33.7)
In_2O	(14.7)	(7.8)	—	—	(4.730)	(58.1)
	(22)	—	—	—	(3.206)	(92.6)
	(15)	—	—	—	(−18.39)	(25.8)
InO	(10.0)	(3.2)	—	—	(3.124)	(43.4)
	(14)	—	—	—	(1.615)	(64.9)
	(9.0)	—	—	—	(−68.38)	(−3.1)
In_2O_3	(22.6)	(6.0)	—	—	(7.005)	(100.5)
	(35)	—	—	—	(−0.195)	(172.8)
Ir_2O_3	(21.8)	(14.4)	—	—	(7.140)	(102.0)
	(35)	—	—	—	(0.706)	(170.3)
	(20)	(10)	—	—	(−57.73)	(54.8)
IrO_2	9.17	15.20	—	—	3.410	40.9
K_2O	(15.9)	(6.4)	—	—	(5.025)	(69.5)
	(22)	—	—	—	(1.130)	(98.3)
K_2O_2	(20.8)	(5.4)	—	—	(6.442)	(93.1)
	(29)	—	—	—	(4.127)	(134.2)
	(20)	—	—	—	(−57.07)	(41.7)
K_2O_3	(19.1)	(23.2)	—	—	(6.750)	(82.2)
	(35.5)	—	—	—	(6.447)	(164.7)
	(20)	(5.0)	—	—	(−31.29)	(37.3)
KO_2	(15.0)	(12.0)	—	—	(5.006)	(61.1)
	(24)	—	—	—	(3.424)	(105.5)
La_2O_3	28.86	3.076	—	−3.275	9.840	(130.7)
Li_2O	(11.4)	(5.4)	—	—	(3.639)	(57.5)
	(21)	—	—	—	(−1.961)	(112.7)
Li_2O_2	(17.0)	(5.4)	—	—	(5.309)	(82.0)
MgO	10.86	1.197	—	−2.087	3.991	57.0
MgO_2	(12.1)	(2.4)	—	—	(3.714)	(49.2)
MnO	11.11	1.94	—	−0.88	3.689	50.10
	(13.5)	—	—	—	(−8.543)	(58.02)
Mn_3O_4	34.64	10.82	—	−2.20	11.312	166.3
	50.20	—	—	—	17.376	260.4
	(49)	—	—	—	(−17.86)	(233.4)
Mn_2O_3	24.73	8.38	—	−3.23	8.829	118.8
MnO_2	16.60	2.44	—	−3.88	6.359	84.8
MoO_2	(16.2)	(3.0)	—	(−3.0)	(5.973)	(80.4)
	(23)	—	—	—	(−2.463)	(118.4)
MoO_3	13.6	13.5	—	—	4.655	62.83
	(28.4)	—	—	—	(0.222)	(139.88)
	(18.1)	—	—	—	(−48.54)	(42.8)
N_2O	10.92	2.06	—	−2.04	4.032	11.40
Na_2O	15.70	5.40	—	—	4.921	73.7
	(22)	—	—	—	(1.494)	(105.9)
Na_2O_2	(20.2)	(3.8)	—	—	(6.192)	(93.6)

Oxide	Phase	Temperature of Transition (°K)	Heat of Transition kcal/mole	Entropy of Transition (e.u.)	Entropy at 298°K (e.u.)
NaO_2	solid	(825)	(6.2)	(7.5)	27.7
	liquid	(1300)	(28)	(22)	—
	gas	—	—	—	—
NbO	solid	(2650)	(16)	(6.0)	(12)
NbO_2	solid	(2275)	(16)	(7.0)	(12.7)
	liquid	(3800)	(85)	(22)	—
Nb_2O_5	solid	1733	(28)	(16)	32.8
	liquid	(3200)	(80)	(25)	—
Nd_2O_3	solid	2545	(22)	(8.8)	(35.3)
NiO	solid	2230	(12.1)	(5.43)	9.22
	liquid	dec.	—	—	—
NpO_2	solid	(2600)	(15)	(5.7)	19.19
Np_2O_5	solid	dec. 800–900°K	—	—	(43)
OsO_2	solid	dec. 923	—	—	(14.5)
OsO_4	solid	313.3	3.41	10.9	34.7
	liquid	403	9.45	23.4	—
	gas	—	—	—	—
P_2O_3	liquid	448.5	4.5	10	(34)
	gas	—	—	—	—
PO_2	solid	(350)	(2.7)	(7.7)	(11.5)
	liquid	(dec)	—	—	—
P_2O_5	solid	631	8.8	13.9	33.5
	gas	—	—	—	—
PaO_2	solid	(2560)	(20)	(7.8)	(17.8)
Pa_2O_5	solid	(2050)	(26)	(13)	(37.5)
	liquid	(3350)	(95)	(28)	—
PbO	solid, red	762	(0.4)	(0.5)	16.2
	solid, yellow	1159	2.8	2.4	—
	liquid	1745	51	29	—
	gas	—	—	—	—
Pb_3O_4	solid	dec.	—	—	50.5
PbO_2	solid	dec.	—	—	18.3
PdO	solid	dec. 1150	—	—	(9.1)
PoO_2	solid	(825)	(5.5)	(6.7)	(17)
	liquid	(dec.)	—	—	—
Pr_2O_3	solid	(2200)	(22)	(10)	(35.5)
	liquid	(4000)	(90)	(23)	—
PrO_2	solid	dec. 700	—	—	(17)
PtO	solid	dec. 780	—	—	(13.5)
Pt_3O_4	solid	(dec.)	—	—	(41)
PtO_2	solid	723	(4.6)	(6.4)	(16.5)
	liquid	dec. 750	—	—	—
PuO	solid	(1290)	(7.2)	(5.6)	(20)
	liquid	(2325)	(47)	(20)	—
	gas	—	—	—	—
Pu_2O_3	solid	(1880)	(16)	(8.5)	(38)
	liquid	(3250)	(75)	(23)	—
PuO_2	solid	(2400)	(15)	(6.2)	(19.7)
	liquid	(3500)	(90)	(26)	—
RaO	solid	(>2500)	—	—	(17)
Rb_2O	solid	(910)	(5.7)	(6.3)	(27)
	liquid	dec.	—	—	—
Rb_2O_2	solid	843	(7.3)	(8.7)	(27.5)
	liquid	(dec.)	—	—	—
Rb_2O_3	solid	762	(7.6)	(10)	(32.5)
	liquid	dec.	—	—	—
RbO_2	solid	685	(4.1)	(6.0)	(21.5)
	liquid	dec.	—	—	—
ReO_2	solid	(1475)	(12)	(8.1)	(15)
	liquid	(3250)	(80)	(25)	—
ReO_3	solid	433	5.2	12	19.8
	liquid	dec.	—	—	—

OF THE OXIDES (Continued)

Oxide	a	b	c	d	A (kcal/mole)	B (e.u.)
NaO_2	(16.2)	(3.6)	—	—	(4.990)	(65.7)
	(23)	—	—	—	(3.175)	(100.9)
	(15)	—	—	—	(−35.22)	(22.0)
NbO	(9.6)	(4.4)	—	—	(3.058)	(44.0)
NbO_2	(17.1)	(1.6)	—	(−2.8)	(6.109)	(84.6)
	(24)	—	—	—	(1.033)	(127.2)
Nb_2O_5	21.88	28.2	—	—	7.776	100.3
	(44.2)	—	—	—	(−24.09)	(201.6)
Nd_2O_3	28.99	5.760	—	(−4.159)	10.295	(133.9)
NiO	13.69	0.83	—	−2.915	5.097	70.67
	(14.3)	—	—	—	(−7.861)	(67.91)
NpO_2	(17.7)	(3.2)	—	(−2.6)	(6.292)	(84.08)
Np_2O_5	(32.4)	(12.6)	—	—	(10.22)	(145.4)
OsO_2	(11.5)	(6.0)	—	—	(3.696)	(52.8)
OsO_4	(16.4)	(23.1)	—	(−2.4)	(6.726)	(67.0)
	(33)	—	—	—	(6.612)	(143.0)
	16.46	8.60	—	−4.6	(−7.644)	(25.3)
P_2O_3	(34.5)	—	—	—	(10.287)	(162.6)
	(15)	(10)	—	—	(−1.953)	(38.0)
PO_2	(11.3)	(5.0)	—	—	(3.591)	(54.4)
	(20)	—	—	—	(3.640)	(95.9)
P_2O_5	8.375	5.40	—	—	4.897	30.3
	36.80	—	—	—	3.284	165.6
PaO_2	(14.4)	(2.6)	—	—	(4.409)	(65.0)
Pa_2O_5	(28.4)	(11.4)	—	—	(8.975)	(127.7)
	(48)	—	—	—	(−0.800)	(241.1)
PbO	10.60	4.00	—	—	3.338	45.4
	9.05	6.40	—	—	2.454	36.4
	(14.6)	—	—	—	1.788	65.7
	(8.1)	(0.4)	—	—	(−59.94)	(−11.0)
Pb_3O_4	(31.1)	(17.6)	—	—	(10.055)	(132.0)
PbO_2	12.7	7.80	—	—	4.133	56.4
PdO	3.30	14.2	—	—	1.615	(13.9)
PoO_2	(14.3)	(5.6)	—	—	(4.513)	(66.1)
	(22)	—	—	—	(3.460)	(106.5)
Pr_2O_3	(29.0)	(4.0)	—	(−4.0)	(10.166)	(133.2)
	(36)	—	—	—	(−6.298)	(168.3)
PrO_2	(17.6)	(3.4)	—	(−2.8)	(6.338)	(85.9)
PtO	(9.0)	(6.4)	—	—	(2.968)	(39.7)
Pt_3O_4	(30.8)	(17.4)	—	—	(9.957)	(139.7)
PtO_2	(11.1)	(9.6)	—	—	(3.736)	(49.6)
	(21)	—	—	—	(3.785)	(101.5)
PuO	(12.0)	(2.4)	—	—	(3.685)	(49.1)
	(14.5)	—	—	—	(−2.287)	(58.3)
	(8.9)	—	—	—	(−62.307)	(−5.3)
Pu_2O_3	(21.2)	(18.2)	—	—	(7.130)	(88.2)
	(40)	—	—	—	(−5.691)	(187.2)
PuO_2	(17.1)	(3.4)	—	(−2.6)	(6.122)	(80.2)
	(20.5)	—	—	—	(−10.62)	(92.2)
RaO	(10.5)	(2.0)	—	—	(3.220)	(43.4)
Rb_2O	(15.4)	(5.8)	—	—	(4.850)	(62.5)
	(22)	—	—	—	(2.754)	(95.9)
Rb_2O_2	(20.9)	(8.0)	—	—	(6.587)	(94.0)
	(29)	—	—	—	(3.273)	(133.2)
Rb_2O_3	(20.5)	(13.0)	—	—	(6.690)	(88.2)
	(34)	—	—	—	(5.603)	(157.8)
RbO_2	(13.8)	(6.4)	—	—	(4.399)	(59.0)
	(21)	—	—	—	(3.720)	(95.7)
ReO_2	(10.8)	(9.8)	—	—	(3.656)	(49.5)
	(24.5)	—	—	—	(1.204)	(127.0)
ReO_3	(18.0)	(5.8)	—	—	(5.625)	(84.5)
	29	—	—	—	(4.644)	(136.8)

Oxide	Phase	Temperature of Transition (°K)	Heat of Transition kcal/mole	Entropy of Transition (e.u.)	Entropy at 298°K (e.u.)
Re_2O_7	solid	569	15.8	27.8	44
	liquid	635.5	17.7	27.9	—
	gas	—	—	—	—
ReO_4	solid	420	(4.2)	(10)	(34.5)
	liquid	(460)	(9.3)	(20)	—
	gas	—	—	—	—
Rh_2O	solid	dec. 1400	—	—	(25.5)
RhO	solid	dec. 1394	—	—	(12)
Rh_2O_3	solid	dec. 1388	—	—	(23)
RuO_2	solid	dec. 1400	—	—	(12.5)
RuO_4	solid	300	(3.2)	(11)	(32.5)
	liquid	dec.	—	—	—
SO_2	gas	—	—	—	59.40
Sb_2O_3	solid	928	14.74	15.88	29.4
	liquid	1698	8.92	5.25	—
	gas	—	—	—	—
SbO_2	solid	dec.	—	—	15.2
Sb_2O_5	solid	dec.	—	—	29.9
Sc_2O_3	solid	(2500)	(23)	(9.3)	24.8
SeO	solid	(1375)	(7.6)	(5.5)	(11)
	liquid	(2075)	(45)	(22)	—
	gas	—	—	—	—
SeO_2	solid	603	(24.5)	(40.6)	(15)
	gas	—	—	—	—
SiO	solid	(2550)	(12)	(4.7)	(6.5)
SiO_2	solid, β	856	0.15	0.18	10.06
	solid, α	1883	2.04	1.08	—
	liquid	dec. 2250	—	—	—
Sm_2O_3	solid	(2150)	(20)	(9.3)	(36.5)
	liquid	(3800)	(80)	(21)	—
SnO	solid	(1315)	(6.4)	(4.9)	13.5
	liquid	(1800)	(60)	(33)	—
	gas	—	—	—	—
SnO_2	solid	1898	(11.39)	(5.95)	12.5
	liquid	(3200)	(75)	(23)	—
SrO	solid	2703	16.7	6.2	13.0
SrO_2	solid	dec. 488	—	—	(14.8)
Ta_2O_5	solid	2150	(16)	(7.4)	34.2
	liquid	—	—	—	—
TcO_2	solid	(2400)	(18)	(7.5)	(13.5)
	liquid	(4000)	(105)	(26)	—
TcO_3	solid	(dec. <1200)	—	—	(19.5)
Tc_2O_7	solid	392.7	(11)	(28)	(42.5)
	liquid	583.8	(14)	(24)	—
	gas	—	—	—	—
TeO	solid	(1020)	(7.1)	(7.0)	(13)
	liquid	(1775)	(50)	(28)	—
	gas	—	—	—	—
TeO_2	solid	1006	3.2	3.2	16.99
	liquid	dec.	—	—	—
ThO	solid	(2150)	(13)	(6.0)	(16)
	liquid	(3250)	(65)	(20)	—
ThO_2	solid	3225	(18)	(5.6)	15.59
TiO	solid, α	1264	0.82	0.65	8.31
	solid, β	dec. 2010	—	—	—
Ti_2O_3	solid, α	473	0.215	0.455	18.83
	solid, β	2400	(24)	(10)	—
	liquid	3300	—	—	—
Ti_3O_5	solid, α	450	2.24	4.98	30.92
	solid, β	(2450)	(50)	(20)	—
	liquid	(3600)	(85)	(24)	—
TiO_2	solid	2128	(16)	(7.5)	12.01
	liquid	dec. 3200	—	—	—

OF THE OXIDES (Continued)

Oxide	a	b	c	d	A (kcal/mole)	B (e.u.)
Re_2O_7	(41.8)	(14.8)	—	(−3.0)	(14.127)	(200.3)
	(65.7)	—	—	—	(9.203)	(314.7)
	(38.2)	—	—	—	(−25.97)	(109.3)
ReO_4	(21.4)	(10.8)	—	(−2.0)	(7.531)	(91.8)
	(33)	—	—	—	(6.775)	(146.7)
	(16.5)	(8.6)	—	(−5.0)	(−8.118)	(30.6)
Rh_2O	15.59	6.47	—	—	4.936	(65.3)
RhO	(9.84)	(5.53)	—	—	(3.179)	(45.7)
Rh_2O_3	20.73	13.80	—	—	6.794	(99.2)
RuO_2	(11.4)	(6.0)	—	—	3.666	(54.2)
RuO_4	(20)	—	—	—	(5.963)	(81.5)
	(33)	—	—	—	(6.663)	(144.9)
SO_2	11.4	1.414	—	−2.045	4.148	7.12
Sb_2O_3	19.10	17.1	—	—	6.455	84.5
	(36)	—	—	—	(0.035)	(168.2)
	(20.8)	—	—	—	(−34.70)	(49.9)
SbO_2	11.30	8.1	—	—	3.725	51.6
Sb_2O_5	(22.4)	(23.6)	—	—	(7.728)	(104.8)
Sc_2O_3	23.17	5.64	—	—	7.159	108.9
SeO	(9.1)	(3.8)	—	—	(2.882)	(42.0)
	(15.5)	—	—	—	(0.490)	(77.5)
	8.20	0.50	—	−0.80	(−58.54)	(0.7)
SeO_2	(12.8)	(6.1)	—	(−0.2)	(4.150)	(59.9)
	(14.5)	—	—	—	(−20.45)	(26.4)
SiO	(7.3)	(2.4)	—	—	(2.283)	(35.8)
SiO_2	11.22	8.20	—	−2.70	4.615	57.83
	14.41	1.94	—	—	4.602	73.67
	(20)	—	—	—	(9.649)	(111.08)
Sm_2O_3	(25.9)	(7.0)	—	—	(8.033)	(113.2)
	(36)	—	—	—	(−6.431)	(166.3)
SnO	9.40	3.62	—	—	2.964	41.1
	(14.5)	—	—	—	(0.141)	(68.1)
	(9.0)	—	—	—	(−69.76)	(−6.4
SnO_2	17.66	2.40	—	−5.16	7.103	91.7
	(22.5)	—	—	—	(0.304)	(117.7)
SrO	12.34	1.120	—	−1.806	4.335	58.7
SrO_2	(16.8)	(2.2)	—	(−3.0)	(6.113)	(83.3)
Ta_2O_5	29.2	10.0	—	—	9.151	135.2
	(46)	—	—	—	(6.158)	(235.1)
TcO_2	(10.4)	(9.2)	—	—	(3.510)	(48.6)
	(25)	—	—	—	(−5.946)	(132.7)
TcO_3	(19.4)	(5.2)	—	(−2.0)	(6.686)	(93.7)
Tc_2O_7	(39.1)	(18.6)	—	(−2.4)	(13.29)	(187.2)
	(64)	—	—	—	(10.02)	(299.8)
	(25)	(28)	—	—	(−21.98)	(43.8)
TeO	(8.6)	(6.2)	—	—	(2.840)	(37.8)
	(15.5)	—	—	—	(−0.448)	(72.3)
	(8.9)	—	—	—	(−62.16)	(−5.2)
TeO_2	13.85	6.87	—	—	4.435	63.97
	(20)	—	—	—	(3.940)	(96.4)
ThO	(11.0)	(2.4)	—	—	(3.386)	(47.4)
	(15)	—	—	—	(−6.561)	(66.9)
ThO_2	16.45	2.346	—	−2.124	5.721	80.03
TiO	10.57	3.60	—	−1.86	3.935	54.03
	11.85	3.00	—	—	4.108	61.71
Ti_2O_3	7.31	53.52	—	—	4.559	38.78
	34.68	1.30	—	−10.20	13.605	184.48
	(37.5)	—	—	—	(−7.796)	(193.2)
Ti_3O_5	35.47	29.50	—	—	11.887	179.98
	41.60	8.00	—	—	10.230	202.80
	(60)	—	—	—	(−18.701)	(306.4)
TiO_2	17.97	0.28	—	−4.35	6.829	92.92
	(21.4)	—	—	—	(−2.610)	(111.08)

Oxide	Phase	Temperature of Transition (°K)	Heat of Transition kcal/mole	Entropy of Transition (e.u.)	Entropy at 298°K (e.u.)
Tl_2O	solid	573	(5.0)	(8.7)	23.8
	liquid	773	(17)	(22)	—
	gas	—	—	—	—
Tl_2O_3	solid	990	(12.4)	(13)	(33.5)
	liquid	(dec)	—	—	—
UO	solid	(2750)	(14)	(5.1)	(16)
UO_2	solid	3000	—	—	18.63
U_3O_8	solid	dec.	—	—	(66)
UO_3	solid	dec. 925	—	—	23.57
VO	solid	(2350)	(15)	(6.4)	9.3
	liquid	(3400)	(70)	(21)	—
V_2O_3	solid	2240	(24)	(11)	23.58
	liquid	dec. 3300	—	—	—
V_3O_5	solid	(2100)	(42)	(20)	(32)
	liquid	(dec.)	—	—	—
VO_2	solid, α	345	1.02	2.96	12.32
	solid, β	1818	13.60	7.48	—
	liquid	dec. 3300	—	—	—
V_2O_5	solid	943	15.56	16.50	313
	liquid	(2325)	(63)	(27)	—
	gas	—	—	—	—
WO_2	solid	(1543)	(11.5)	(7.45)	(15)
	liquid	dec. 2125	—	—	—
WO_3	solid	1743	(17)	(9.8)	19.90
	liquid	(2100)	(43)	(20)	—
	gas	—	—	—	—
Y_2O_3	solid	(2500)	(25)	(10)	(29.5)
ZnO	solid	dec.	—	—	10.4
ZrO_2	solid, α	1478	1.420	0.961	12.03
	solid, β	2950	20.8	7.0	—

OF THE OXIDES (Continued)

Oxide	a	b	c	d	A (kcal/mole)	B (e.u.)
Tl_2O	(15.8)	(6.0)	—	(−0.3)	(5.078)	(68.2)
	(22.1)	—	—	—	(2.651)	(96.0)
	(13.7)	—	—	—	(−20.94)	(18.0)
Tl_2O_3	(23.0)	(5.0)	—	—	(7.080)	(99.0)
	(35.5)	—	—	—	(4.604)	(167.8)
UO	(10.6)	(2.0)	—	—	(3.249)	(45.0)
UO_2	19.20	1.62	—	−3.957	7.124	93.37
U_3O_8	(65)	(7.5)	—	(−10.9)	(23.37)	(312.7)
UO_3	22.09	2.54	—	−2.973	7.696	104.72
VO	11.32	1.61	—	−1.26	3.869	56.4
	(14.5)	—	—	—	(−8.157)	(70.9)
V_2O_3	29.35	4.76	—	−5.42	10.780	148.12
	(38)	—	—	—	(−6.028)	(193.4)
V_3O_5	(36)	(30)	—	—	(12.07)	(182.1)
	(55.6)	—	—	—	(−54.72)	(249.1)
VO_2	14.96	—	—	—	4.460	72.92
	17.85	1.70	—	−3.94	5.680	89.09
	25.50	—	—	—	2.962	135.87
V_2O_5	46.54	−3.90	—	−13.22	18.136	240.2
	45.60	—	—	—	2.122	220.1
	(40)	—	—	—	(−73.90)	(149.6)
WO_2	(17.6)	(4.2)	—	(−4.0)	(6.772)	(88.8)
	(24)	—	—	—	(−0.112)	(121.8)
WO_3	17.33	7.74	—	—	5.511	81.15
	(30)	—	—	—	(−1.162)	(152.5)
	(18)	—	—	—	(−69.36)	(40.2)
Y_2O_3	(26.0)	(8.2)	—	(−2.2)	(8.846)	(122.3)
ZnO	11.71	1.22	—	−2.18	4.277	57.88
ZrO_2	16.64	1.80	—	−3.36	6.168	85.21
	17.80	—	—	—	4.270	89.96

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES

All values of energy given in these tables are expressed, insofar as possible, in terms of the thermochemical calorie, now defined in terms of the absolute joule. 1 thermochemical calorie = 1 calorie = 4.1840 absolute joule = 4.1833 international joule. The notations used in these tables are as follows:

ΔHf° = the standard heat of formation of a given substance from its elements at 25°C.
ΔFf° = the standard free energy of formation of a given substance from its elements at 25°C.
$\log_{10} Kf$ = the logarithm of the equilibrium constant for the reaction for forming a given substance from its elements at 25°C.
S° = the entropy of the given substance in its thermodynamic reference state at the reference temperature at 25°C.
c = crystalline; in certain cases where a substance exists in more than one crystalline form there is an indication as to which form is concerned.
g = gaseous.
am = amorphous.
aq = aqueous; unless otherwise indicated the aqueous solution is taken as the hypothetical ideal state of unit molality.
gls = glass.
lq = liquid.
ppt = precipitate.

The values in these tables were taken from Circular of the National Bureau of Standards 500, "Selected Values of Chemical Thermodynamic Properties, issued February 1, 1952. **

Substance	State	ΔHf°	ΔFf°	$\log_{10} Kf$	S°
Aluminum					
Al	*g*	75.00	65.3	−47.86	39.303
	c	0.00	0.00	0.000	6.77
Al^{+++}	*aq*	1307.44	....	....	....
$AlBr_3$	*c*	−125.8	−120.7	88.47	44
	aq	−211.9	....	....	....
Al_4C_3	*c*	−30.9	−29.0	21.26	25
$Al(CH_3)_3$	*lq*	−26.9	....	....	....
Al_2Cl_6	*g*	−303.6	....	....	....
$AlCl_3$	*c*	−166.2	−152.2	111.56	40
	aq, 600	−245.5	....	....	....
$AlCl_3 \cdot 6H_2O$	*c*	−641.1	−542 4	397.57	90
AlF_3	*c*	−311	−294	215.5	23
$AlF_3 \cdot 3H_2O$	*c*	549.1	−490.4	359.46	50
	aq	−361.4	....	....	....
$AlF_3 \cdot \frac{1}{2}H_2O$	*c*	−357.4	−333.6	244.52	28
AlI_3	*c*	−75.2	−75.0	54.97	48
	aq	−165.8	....	....	....
AlN	*c*	−57.7	−50.1	36.72	5
$Al(NO_3)_3$	*aq*	−273.65	....	....	....
$Al(NO_3)_3 \cdot 6H_2O$	*c*	−680.65	−525.82	385.419	111.8
$Al(NO_3)_3 \cdot 9H_2O$	*c*	−897.34	−700.2	513.24	136
$Al_2 \cdot O_3(\alpha)$*	*c*	−399.09	−376.77	276.167	12.19
(γ)	*c*	−384.84	....	....	....
$Al_2O_3 \cdot H_2O$	*c*	−471	−435	318.8	23.15
$Al_2O_3 \cdot 3H_2O$†	*c*	−613.7	−547.9	401.60	33.51
$Al(OH)_3$	*am*	−304.2	....	....	....
Al_2S_3	*c*	−121.6	−117.7	86.27	23
$Al_2(SO_4)_3$	*c*	−820.98	−738.99	541.670	57.2
	aq	−897.1	....	....	....
$Al_2(SO_4)_3 \cdot 6H_2O$	*c*	−1268.14	−1105.14	810.054	112.1
$Al_2(SO_4)_3 18H_2O$	*c*	−2118.5	....	....	....
$AlNH_4(SO_4)_2$	*c*	−561.24	−485.95	356.195	51.7
	aq	−591.74	....	....	....
$AlNH_4(SO_4)_2 \cdot 12H_2O$	*c*	−1419.40	−1179.02	864.207	166.6
Ammonium					
NH_3	*g*	−11.04	−3.976	2.914	46.01
	aq	−19.32	−6.37	−4.669	26.3
	aq∞	−19.32	....	....	....
NH_4^+	*aq*	−31.74	−19.00	13.927	26.97

* Corundum.

† Hydrargillite.

** All values are expressed as kilo-cals.

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Ammonium					
NH_4OH	*aq*	−87.64	....	....	....
$NH_4H_2AsO_4$	*c*	−251.47	−197.24	144.574	41.12
	aq	247.9	....	....	....
$(NH_4)_2HAsO_4$	*c*	−280.24	....	....	....
	aq	−278.3	....	....	....
$(NH_4)_3AsO_4$	*c*	−306.11	....	....	....
	aq	−303	....	....	....
$(NH_4)_3AsO_4 \cdot 3H_2O$	*c*	−516.6	....	....	....
NH_4BO_2	*aq*	−215.2	....	....	....
NH_4BO_3	*aq*	−193.7	....	....	....
$NH_4BO_3 \cdot H_2O$	*c*	−270.8	....	....	....
$(NH_4)_2HBO_3$	*aq*	−305.5	....	....	....
NH_4Br	*c*	−64.61	....	....	....
	aq, ∞	−60.74	....	....	....
$(NH_4)_2CO_3$	*aq*	−225.11	−164.22	120.371	41.2
NH_4HCO_3	*c*	−203.7	....	....	....
	aq	−196.92	−159.31	116.772	49.7
$NH_4CO_2NH_2$	*c*	−154.21	−109.47	80.240	39.70
	aq	−150.4	....	....	....
NH_4CN	*c*	0.0	....	....	....
	aq	4.6	20.4	....	....
NH_4CNO	*c*	−74.7	....	....	....
	aq	−68.5	....	....	....
NH_4CNS	*c*	−20.0	....	....	....
	aq	−14.5	4.4	....	....
$NH_4C_2H_3O_2$	*c*	−147.8	....	....	....
	aq, 400	−148.1	....	....	....
$(NH_4)_2C_2O_4$	*c*	−268.72	....	....	....
	aq, 2100	−260.6	....	....	....
$(NH_4)_2C_2O_4 \cdot H_2O$	*c*	−340.62	....	....	....
$NH_4HC_2O_4$	*aq*	−227.02	....	....	....
NH_4Cl	*c*	−75.38	−48.73	35.718	22.6
	aq, ∞	−71.76	....	....	....
NH_4ClO_4	*c*	−69.42	....	....	....
NH_4F	*c*	−111.6	....	....	....
	aq, ∞	−110.40	....	....	....
NH_4I	*c*	−48.30	....	....	....
	aq, ∞	−45.11	....	....	....
NH_4NO_2	*c*	−63.1	....	....	....
	aq	−57.1	....	....	....
NH_4NO_3	*c*	−87.27	....	....	....
	aq	−81.11	....	....	....
$NH_4H_2PO_4$	*c*	−346.75	−290.46	212.903	36.32
	aq, 500	−342.91	....	....	....
$(NH_4)_2HPO_4$	*c*	−376.12	....	....	....
	aq, 500	−373.04	....	....	....
$(NH_4)_3PO_4$	*c*	−401.8	....	....	....
	aq, 660	−394.0	....	....	....
$(NH_4)_3PO_4 \cdot 3H_2O$	*c*	−612.8	....	....	....
$(NH_4)_2PtCl_4$	*c*	−195.3	....	....	....
	aq	−186.9	....	....	....
$(NH_4)_2S$	*aq*	−54.5	....	....	....
NH_4HS	*c*	−38.10	....	....	....
	aq	−35.1	....	....	....
NH_4S_4	*c*	−34.0	....	....	....
	aq	−29.7	....	....	....
$(NH_4)_2S_5$	*c*	−69.4	....	....	....
	aq	−65.4	....	....	....
$(NH_4)_2SO_3$	*c*	−212.0	....	....	....
	aq	−211.3	....	....	....
$(NH_4)_2SO_3 \cdot H_2O$	*c*	−284.22	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10} K_f$	S°
Ammonium					
NH_4HSO_3	*c*	−183.8	....	....	....
	aq	−181.5	....	....	....
$(NH_4)_2SO_4$	*c*	−281.86	−215.19	157.732	52.65
	aq, ∞	−280.38	....	....	....
NH_4HSO_4	*c*	−244.83	....	....	....
	aq	−245.6	....	....	....
$(NH_4)_2S_2O_8$	*c*	−396.4	....	....	....
	aq	−387.8	....	....	....
$(NH_4)_2Se$	*aq*	−26.2	....	....	....
NH_4HSe	*aq*	−5.6	....	....	....
$(NH_4)_2SiF_6$	*c*	−629.7	....	....	....
	aq	−622.0	....	....	....
NH_4VO_3	*c*	−251.2	−211.8	155.25	33.6
NH_2OH	*c*	−25.5	....	....	....
	aq	−21.7	....	....	....
$NH_2OH\cdot HCl$	*c*	−74.0	....	....	....
	aq	−70.7	....	....	....
$NH_2OH\cdot HNO_3$	*c*	−86.3	....	....	....
	aq	−80.5	....	....	....
$(NH_2OH)_2\cdot H_2SO_4$	*c*	−282.5	....	....	....
	aq	−276.7	....	....	....
$NH_2OH\cdot H_2SO_4$	*c*	−245.1	....	....	....
	aq	−244.4	....	....	....
N_2H_4	*lq*	12.05	....	....	....
	aq, 300	8.16	....	....	....
$N_2H_4\cdot H_2O$	*lq*	−57.95	....	....	....
$N_2H_4\cdot HCl$	*c*	−46.93	....	....	....
	aq	−41.7	....	....	....
$N_2H_4\cdot 2HCl$	*c*	−90.0	....	....	....
	aq	−84.0	....	....	....
$(N_2H_4)_2\cdot H_2SO_4$	*aq*	−217.8	....	....	....
$N_2H_4\cdot H_2SO_4$	*c*	−231.6	....	....	....
	aq	−223.4	....	....	....
HN_3	*g*	70.3	78.5	−57.54	56.74
	aq, 100	61.51	....	....	....
Antimony					
Sb	*g*	60.8	51.1	−37.46	43.06
	c, III	0.00	0.00	0.000	10.5
SbO^+	*aq*	....	−42.0	30.79	....
Sb_2	*g*	52.	40	−29.32	60.9
$SbBr_3$	*c*	−62.1	....	....	....
$SbCl_3$	*g*	−75.2	−72.3	52.99	80.8
	c	−91.34	−77.62	56.894	44.5
$SbCl_5$	*g*	−93.9	....	....	....
	lq	−104.8	....	....	....
$SbOCl$	*c*	−90.8	....	....	....
SbF_3	*c*	−217.2	....	....	....
	aq	−216.1	....	....	....
SbI_3	*c*	−23.0	....	....	....
	aq	−22.6	....	....	....
Sb_2O_3	*aq*	−166.5	....	....	....
Sb_2O_4	*c*	−214	−188	137.8	30.3
Sb_2O_5	*c*	−234.4	−200.5	146.96	29.9
	aq	−226.4	....	....	....
Sb_2O_6	*c*	−336.8	−298.0	218.43	59.8
Sb_2S_3 (black)	*c*	−43.5	....	....	....
(orange)	*am*	−36.0	....	....	....
$Sb_2(SO_4)_3$	*c*	575.3	....	....	....
H_3SbO_4	*aq*	−215.7	....	....	....
Argon					
A	*g*	0.00	0.00	0.000	36.983
$A\cdot 5H_2O$	*c*	−357.2	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
Arsenic					
As (gray)	*c*	0.00	0.00	0.000	8.4
(β)	*am*	1.0	....	....	....
(yellow)	*c*	3.53	....	....	....
AsO^+	*aq*	....	−39.1	28.69	....
As_2	*g*	29.6	17.5	−12.83	57.3
As_4	*g*	35.7	25.2	−18.47	69
$AsBr_3$	*c*	−46.61	....	....	....
$AsCl_3$	*g*	−71.5	−68.5	50.21	78.2
	lq	−80.2	−70.5	51.68	55.8
AsF_3	*g*	−218.3	−214.7	157.37	69.08
	lq	−226.8	−215.5	157.96	43.31
AsH_3	*g*	41.0	....	....	....
$AsH_3 \cdot 6H_2O$	*c*	−386.7	....	....	....
AsI_3	*c*	−13.7	....	....	....
As_2O_5	*c*	−218.6	−184.6	135.41	25.2
	aq	−224.6	....	....	....
$As_2O_5 \cdot 4H_2O$	*c*	−500.3	....	....	....
$3As_2O_5 \cdot 5H_2O$	*c*	−1007.5	....	....	....
$As_2O_3 \cdot As_2O_5$	*c*	−351.1	....	....	....
As_4O_6 (oct)	*c*	−313.94	−275.36	201.835	51.2
(mon)	*c*	−312.8	....	....	....
	aq	−299.4	....	....	....
As_2S_3	*c*	−35	....	....	....
H_3AsO_3	*aq*	−177.3	−152.9	112	47.0
H_3AsO_4	*c*	−215.2	....	....	....
	aq	−214.8	−183.8	134.72	49.3
Barium					
Ba	*g*	41.96	34.60	−25.361	40.699
	c	0.00	0.00	0.000	16
Ba^{++}	*aq*	−128.67	−134.0	98.22	3
$Ba_3(AsO_4)_2$	*c*	−817.8	....	....	....
$BaHAsO_4 \cdot H_2O$	*c*	−411.5	....	....	....
$Ba(H_2AsO_4)_2 \cdot 2H_2O$	*c*	−694.7	....	....	....
$Ba(C_2H_3O_2)_2$	*c*	−355.1	....	....	....
$Ba(C_2H_3O_2)_2 3H_2O$	*c*	−567.3	....	....	....
$BaBr_2$	*c*	−180.4	....	....	....
	aq	−186.47	−183.1	134.21	42
$BaBr_2 \cdot H_2O$	*c*	−254.9	....	....	....
$BaBr_2 \cdot 2H_2O$	*c*	−326.3	....	....	....
$BaOBr_2$	*aq*	−181.6	....	....	....
$Ba(HCO_2)_2$	*c*	−326.5	....	....	....
$Ba(CN)_2$	*c*	−47.9	....	....	....
	aq	−50.7	....	....	....
$Ba(CN)_2 \cdot H_2O$	*c*	−120.1	....	....	....
$Ba(CN)_2 \cdot 2H_2O$	*c*	−191.1	....	....	....
$BaCN_2$	*c*	−63.8	....	....	....
$Ba(CNO)_2$	*c*	−209.6	....	....	....
$BaCO_3$	*c*	−291.3	−272.2	199.52	26.8
	aq	−290.30	−260.2	190.72	−10
$Ba(HCO_3)_2$	*aq*	−459.0	−414.6	303.90	48
$BaC_2O_4 \cdot \frac{1}{2}H_2O$	*c*	−363.7	....	....	....
$BaC_2O_4 \cdot 2H_2O$	*c*	−470.1	....	....	....
$BaC_2O_4 \cdot 3\frac{1}{2}H_2O$	*c*	−575.3	....	....	....
$BaCl_2$	*c*	−205.56	−193.8	142.05	30
	aq	−208.72	−196.7	144.18	29
$BaCl_2 \cdot H_2O$	*c*	−278.4	−253.1	185.52	40
$BaCl_2 \cdot 2H_2O$	*c*	−349.35	−309.7	227.01	48.5
$BaOCl_2$	*aq*	−194.0	....	....	....
$Ba(OCl)_2$	*aq*	−176.1	....	....	....
$Ba(ClO_2)_2$	*c*	−158.2	....	....	....
$Ba(ClO_3)_2$	*c*	−181.7	....	....	....
	aq	−175.6	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log_{10} Kf	S°
Barium					
$Ba(ClO_3)_2{\cdot}H_2O$	*c*	−254.9	....	....	....
$Ba(ClO_4)_2$	*c*	−192.8	....	....	....
$Ba(ClO_4)_2{\cdot}3H_2O$	*c*	−405.4	....	....	....
$BaPtCl_6$	*c*	−286.8	....	....	....
	aq	−296.1	....	....	....
$BaPtCl_6{\cdot}6H_2O$	*c*	−707.2	....	....	....
$BaCrO_4$	*c*	−341.3	....	....	....
BaF_2	*c*	−286.9	....	....	....
	aq	−286.0	−265.3	....	....
$BaSiF_6$	*c*	−691.6	....	....	....
BaH	*g*	52	46	−33.7	52.97
BaH_2	*c*	−40.9	....	....	....
BaI_2	*c*	−144.0	....	....	....
	aq	−155.41	−158.7	116.32	55
$BaI_2{\cdot}H_2O$	*c*	−219.8	....	....	....
$BaI_2{\cdot}2H_2O$	*c*	−290.9	....	....	....
$BaI_2{\cdot}2\frac{1}{2}H_2O$	*c*	−326.0	....	....	....
$BaI_2{\cdot}7H_2O$	*c*	−640.1	....	....	....
$Ba(IO_3)_2$	*aq*	−238.4	....	....	....
$Ba(IO_3)_2{\cdot}H_2O$	*c*	−319.6	....	....	....
$BaMoO_4$	*c*	−373.8	....	....	....
$Ba(N_3)_2$	*c*	−8.0	....	....	....
	aq	0.2	....	....	....
Ba_3N_2	*c*	−86.9	....	....	....
$Ba(NO_2)_2$	*c*	−174.0	....	....	....
$Ba(NO_2)_2{\cdot}H_2O$	*c*	−254.5	....	....	....
$Ba(NO_3)_2$	*c*	−237.06	−190.0	139.27	51.1
	aq	−227.41	−186.8	136.92	73
BaO	*c*	−133.4	−126.3	92.58	16.8
BaO_2	*c*	−150.5	....	....	....
$BaO_2{\cdot}H_2O$	*c*	−223.5	....	....	....
$BaO_2{\cdot}8H_2O$	*c*	−719.3	....	....	....
$Ba(OH)_2$	*c*	−226.2	....	....	....
	aq	−238.58	−209.2	153.34	−2
$Ba(OH)_2{\cdot}H_2O$	*c*	−299.0	....	....	....
$Ba(OH)_2{\cdot}8H_2O$	*c*	−799.5	....	....	....
$Ba_3(PO_4)_2$	*c*	−998.0	....	....	....
$BaHPO_4$	*c*	−465.8	....	....	....
$Ba(H_2PO_4)_2$	*c*	−749.6	....	....	....
BaS	*g*	41	....	....	....
	c	−106.0	....	....	....
	aq	−118.4	....	....	....
$Ba(HS)_2$	*aq*	−134.8	....	....	....
$Ba(HSO_3)_2$	*aq*	−430.7	....	....	....
$BaSO_3$	*c*	−282.6	....	....	....
$BaSO_4$	*c*	−350.2	−323.4	237.05	31.6
	aq, ∞	−345.57	−311.3	228.18	7
BaS_2O_6	*aq*	−409.3	....	....	....
$BaS_2O_6{\cdot}2H_2O$	*c*	−552.5	....	....	....
BaS_2O_8	*aq*	−454.0	....	....	....
$BaS_2O_8{\cdot}4H_2O$	*c*	−738.7	....	....	....
BaS_4O_6	*aq*	−401.3	....	....	....
$BaS_4O_6{\cdot}2H_2O$	*c*	−554.5	....	....	....
$BaSe$	*c*	−142.0	....	....	....
$BaSeO_4$	*c*	−280.0	....	....	....
$BaSiO_3$	*c*	−359.5	....	....	....
Ba_2SiO_4	*c*	−496.8	....	....	....
$BaWO_4$	*c*	−407.7	....	....	....
Beryllium					
Be	*g*	76.63	67.60	−49.550	32.55
	c	0.00	0.00	0.000	2.28
Be^{++} (in acid solution)	*aq*	....	−93	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log_{10} Kf	S°
Beryllium					
$BeBr_2$	*c*	−88.4	....	....	....
$BeBr_2$ (in HCl)	*aq*	151	....	....	....
$BeCl_2$	*c*	−122.3	....	....	....
$BeCl_2$ (in HCl)	*aq*	173.4	....	....	....
$BeCl_2 \cdot 4H_2O$	*c*	−436.8	....	....	....
BeF_2	*aq*	−251.4	....	....	....
BeH	*g*	78.1	71.3	−52.26	40.84
BeI_2	*c*	−50.6	....	....	....
BeI_2 (in HCl)	*aq*	−120	....	....	....
$BeMoO_4$	*c*	−330	....	....	....
Be_3N_2	*c*	−135.7	−122.4	....	....
$Be(NO_3)_2$	*aq*	−188.3	....	....	....
BeO	*g*	11.8	5.7	−4.18	47.18
	c	−146.0	−139.0	101.88	3.37
$Be(OH)_2$	*c* (α)	−216.8	....	....	....
	c (β)	−216.1	....	....	....
BeS	*c*	−55.9	....	....	....
$BeSO_4$	*c*	−286.0	....	....	......
$BeSO_4 \cdot H_2O$	*c*	−361	....	....	....
$BeSO_4 \cdot 2H_2O$	*c*	−433.2	....	....	....
$BeSO_4 \cdot 4H_2O$	*c*	−576.3	....	....	....
$BeSO_4 \cdot 4BeO$	*c*	−871.4	....	....	....
Bismuth					
Bi	*g*	49.7	40.4	−29.61	44.67
	c	0.00	0.00	0.000	13.6
BiO^+	*aq*	....	−35.54	25.317	......
$BiCl_3$	*g*	−64.7	−62.2	45.59	85.3
	c	−90.61	−76.23	55.876	45.3
$BiCl_3$ (in HCl)	*aq*	−101.6	....	....	....
$BiOCl$	*c*	−87.3	−77.0	56.44	20.6
Bi_2O_3	*c*	−137.9	−118.7	87.01	36.2
$Bi(OH)_3$	*c*	−169.6	....	....	....
Bi_2S_3	*c*	−43.8	−39.4	28.88	35.3
Boron					
B	*g*	97.2	86.7	−63.55	36.649
	c	0.00	0.00	0.000	1.56
B	*am*	0.4	....	....	....
BBr_3	*g*	−44.6	−51.0	37.38	77.49
	lq	−52.8	−52.4	38.41	54.7
BCl_3	*g*	−94.5	−90.9	66.63	69.29
	lq	−100.0	−90.6	66.41	50.0
B_4C	*c*	....	....	....	6.47
$B(CH_3)_3$	*lq*	−31.4	....	....	....
BF_3	*g*	−265.4	−261.3	191.53	60.70
	aq	−289.8	....	....	....
BF_4^-	*aq*	−365	−347	251.4	40
HBF_4	*aq*	−365	....	....	....
BH	*g*	73.8	67.1	−49.18	39.62
B_2H_6	*g*	7.5	19.8	−14.51	55.66
B_5H_9	*g*	15.0	39.6	−29.03	65.88
$B_{10}H_{14}$	*c*	8	....	....	....
BN	*g*	90.6	....	....	....
	c	−32.1	−27.2	19.94	8
BO	*g*	−5.3	−11.6	8.50	47.22
B_2O_3	*c*	−302.0	−283.0	207.44	12.91
	gls	−297.6	−280.4	205.53	18.8
B_2S_3	*c*	−57.0	....	....	....
HBO_2	*c*	−186.9	−170.5	124.97	11
	aq	−186.9	....	....	....
HBO_3^-	*aq*	−251.8	−217.63	159.520	7.3
$H_2B_4O_7$	*c*	−676.5	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log_{10} Kf	S°
Boron					
H_3BO_3	*c*	−260.2	−230.2	168.73	21.41
	aq	−255.2	−230.24	168.762	38.2
Bromine					
Br_2	*g*	7.34	0.75	−0.551	58.64
	lq	0.00	0.00	0.000	36.4
	aq	−1.1	....	....	....
$Br_2\cdot 10H_2O$	*c*	−700	....	....	....
BrCl	*g*	3.51	−0.21	0.154	57.34
HBr	*g*	−8.66	−12.72	9.327	47.44
	aq, 1	−18.56	....	....	....
	aq, 3	−24.36	....	....	....
	aq	−28.90	−24.57	18.012	19.29
$HBrO_3$	*aq*	−11.63	5.00	....	....
Cadmium					
Cd	*g*	26.97	18.69	−13.700	40.07
(α)	*c*	0.00	0.00	0.000	12.3
(γ)	*c*	....	0.14	−0.103	....
$CdBr_2$	*c*	−75.15	−70.14	51.412	31.9
	aq	−75.822	−67.6	....	....
$CdBr_2\cdot 4H_2O$	*c*	−356.32	−297.64	218.166	74.7
$CdCl_2$	*c*	−93.00	−81.88	60.017	28.3
	aq	−97.39	−81.28	59.577	11.6
$CdCl_2\cdot H_2O$	*c*	−164.13	−140.13	102.713	40.8
$CdCl_2\cdot 2\frac{1}{2}H_2O$	*c*	−269.97	−225.47	165.266	55.6
$Cd(CH_3)_2$	*lq*	16.2	....	....	....
$Cd(C_2H_5)_2$	*lq*	14.7	....	....	....
$Cd(CN)_2$	*c*	39.0	....	....	....
	aq	30.3	....	....	....
$Cd(ONC)_2$	*c*	37.7	....	....	....
$CdCO_3$	*c*	−178.7	−160.2	117.42	25.2
CdF_2	*c*	−164.9	−154.8	113.47	27
	aq	−173.6	....	....	....
CdH	*g*	62.54	55.73	−40.849	50.76
CdI_2	*c*	−48.0	−48.00	35.183	40.2
	aq, ∞	−44.66	....	....	....
$Cd(N_3)_2$	*c*	107.8	....	....	....
Cd_3N_2	*c*	38.6	....	....	....
$Cd(NO_3)_2$	*c*	−107.98	....	....	....
	aq	−116.04	−71.41	52.342	20.4
$Cd(NO_3)_2\cdot 2H_2O$	*c*	−251.19	....	....	....
$Cd(NO_3)_2\cdot 4H_2O$	*c*	−394.02	....	....	....
CdO	*c*	−60.86	−53.79	39.427	13.1
$Cd(OH)_2$	*c*	−133.26	−112.46	82.432	22.8
CdS	*c*	−34.5	−33.6	24.63	17
$CdSO_4$	*c*	−221.36	−195.99	143.657	32.8
	aq	−234.20	−195.92	143.607	−10.47
$CdSO_4\cdot H_2O$	*c*	−294.37	−254.84	186.794	41.1
Cd_3Sb_2	*c*	7.83	1.59	−1.165	78.8
CdSe	*g*	1.6	....	....	....
CdTe	*c*	−24.30	−23.82	17.460	22.6
Calcium					
Ca	*g*	46.04	37.98	−27.839	36.99
	c	0.00	0.00	0.000	9.95
Ca^{++}	*aq*	−129.77	−132.18	96.886	−13.2
$2CaO\cdot Al_2O_3$	*c*	−704	....	....	....
$2CaOAl_2O_3\cdot 5H_2O$	*c*	−1078	....	....	....
$3CaO\cdot Al_2O_3$	*c*	−861	....	....	....
$3CaO\cdot Al_2O_3\cdot 6H_2O$	*c*	−1329	....	....	....
$4CaO\cdot Al_2O_3$	*c*	−1026	....	....	....
$Ca_3(AsO_4)_2$	*c*	−796	....	....	....
$CaHAsO_4$	*aq*	−344.1	....	....	....
$CaHAsO_4\cdot H_2O$	*c*	−410	−363	266.1	35

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Calcium					
$Ca(H_2AsO_4)_2$	*aq*	−560.8	....	....	....
$CaBr_2$	*c*	−161.3	−156.8	114.93	31
	aq	−187.57	−181.33	132.912	25.4
$CaBr_2 \cdot 6H_2O$	*c*	−597.2	....	....	....
$CaO \cdot B_2O_3$	*c*	−483.3	−457.7	335.49	25.1
$CaO \cdot 2B_2O_3$	*c*	−798.8	−752.4	551.50	32.2
$2CaO \cdot B_2O_3$	*c*	−651.6	−618.6	453.42	34.7
$3CaO \cdot B_2O_3$	*c*	−817.7	−777.1	569.60	43.9
CaC_2	*c*	−15.0	−16.2	11.87	16.8
$CaCO_3$ (calcite)	*c*	−288.45	−269.78	197.745	22.2
(aragonite)	*c*	−288.49	−269.53	197 562	21.2
$Ca(HCO_3)_2$	*aq*	−460.13	−412.80	302.577	32.2
$Ca(HCO_2)_2$	*c*	−323.5	....	....	....
CaC_2O_4	*c*	−332.2	....	....	....
$CaC_2O_4 \cdot H_2O$	*ppt*	−399.1	−360.6	264.31	37.28
$CaC_2O_4 \cdot 2H_2O$	*c*	−469.1	−416 9	305.58	47
$Ca(C_2H_3O_2)_2$	*c*	−355.0	....	....	....
	aq	−362.5	....	....	....
$Ca(C_2H_3O_2)_2H_2O$	*c*	−425.1	....	....	....
$Ca(CN)_2$	*c*	−44.2	....	....	....
	aq	....	−54	....	....
$CaCN_2$	*c*	−84.0	....	....	....
$CaCl_2$	*c*	−190.0	−179.3	131.42	27.2
$CaCl_2$	*aq*	−209.82	−194.88	142.884	13.1
$CaCl_2 \cdot H_2O$	*c*	−265.1	....	....	....
$CaCl_2 \cdot 2H_2O$	*c*	−335.5	....	....	....
$CaCl_2 \cdot 4H_2O$	*c*	−480.2	....	....	....
$CaCl_2 \cdot 6H_2O$	*c*	−623.15	....	....	....
$CaCl_2 \cdot 2CaO$	*c*	−505	....	....	....
$CaCl_2 \cdot 3CaO$	*c*	−654	....	....	....
$CaCl_2 \cdot 3CaO \cdot 3H_2O$	*c*	−910.6	....	....	....
$CaCl_2 \cdot 3CaO \cdot 16H_2O$	*c*	−1833	....	....	....
$CaCl_2 \cdot 3C_2H_5OH$	*c*	−399.8	....	....	....
$CaCl_2 \cdot 4C_2H_5OH$	*c*	−467.4	....	....	....
$CaOCl_2$	*c*	−178.6	....	....	....
	aq	−189.1	....	....	....
$CaOCl_2 \cdot H_2O$	*c*	−249.2	....	....	....
$Ca(OCl)_2$	*aq*	−180.0	....	....	....
$CaCrO_4$	*c*	−329.6	−305.3	223.78	32
	aq	−336.0	....	....	....
CaF_2	*c*	−290.3	−277.7	203.55	16.46
	aq	−287 09	−264.34	193.758	−17.8
CaH	*g*	58.7	....	....	....
CaH_2	*c*	−45.1	−35.8	26.24	10
CaI_2	*c*	−127.8	−126.6	92.80	34
	aq	−156.51	−156.88	114.991	39.1
$CaI_2 \cdot 8H_2O$	*c*	−700.7	....	....	....
CaN_6	*c*	75.8	....	....	....
Ca_3N_2	*c*	−103.2	−88.1	64.57	25
$Ca(NO_2)_2$	*c*	−178.3	....	....	....
	aq	−180.5	....	....	....
$Ca(NO_3)_2$	*c*	−224.0	−177.34	129.988	46.2
	aq	−228.51	−185.00	135.602	56.8
$Ca(NO_3)_2 \cdot 2H_2O$	*c*	−368.00	−293.51	215.139	64.3
$Ca(NO_3)_2 \cdot 3H_2O$	*c*	−437.18	−349.0	255.81	74
$Ca(NO_3)_2 \cdot 4H_2O$	*c*	−509.37	−406.5	297.96	81
C_2O	*c*	−151.9	−144.4	105.84	9.5
CaO_2	*c*	−157.5	....	....	....
$Ca(OH)_2$	*c*	−235.80	−214.33	157.101	18.2
	aq	−239.68	−207.37	152.000	−18.2
Ca_3P_2	*c*	−120.5	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log$_{10}$ Kf	S°
Calcium					
$Ca_3(PO_4)_2$	*c* (α)	−986.2	−929.7	681.46	57.6
	c (β)	−988.9	−932.0	683.14	56.4
$CaHPO_4$	*c*	−435.2	−401.5	294.29	21
$CaHPO_4 \cdot 2H_2O$	*c*	−576.0	−514.6	377.19	40
$Ca(H_2PO_4)_2$	*ppt*	−744.4	....	....	....
CaS	*c*	−115.3	−114.1	83.63	13.5
	aq	−119.8	....	....	....
$CaSO_3 \cdot 2H_2O$	*c*	−421.2	−374.1	274.21	44
$CaSO_4$ (anhydrite)	*c*	−342.42	−315.56	231.301	25.5
(soluble α)	*c*	−340.27	−313.52	229.806	25.9
(soluble β)	*c*	−339.21	−312.46	229.029	25.9
	aq	−346.67	−309.52	226.874	−9.1
$CaSO_4 \cdot \frac{1}{2}H_2O$	*c* (α)	−376.47	−343.02	251.429	31.2
	c (β)	−375.97	−342.78	251.253	32.1
$CaSO_4 \cdot 2H_2O$	*c*	−483.06	−429.19	314.590	46.36
CaS_2O_3	*aq*, 1000	−283 4	....	....	....
$CaS_2O_3 \cdot 6H_2O$	*c*	....	−602.2	441.40	....
$CaSe$	*c*	−74.7	−73.5	53.87	16
$CaSi_2$	*c*	−36	....	....	....
Ca_2Si	*c*	−50	....	....	....
Ca_2Si_2	*c*	−72	....	....	....
$CaSiO_3$*	*c* (α)	−377.4	−357.4	261.97	20.9
	c (β)	−378.6	−358.2	262.55	19.6
Ca_2SiO_4	*c* (β)	−538.0	....	....	....
	c (γ)	−539.0	....	....	....
Ca_3SiO_5	*c*	−688.4	....	....	....
$CaWO_4$	*c*	−392.5	....	....	....
Carbon**					
C	*g*	171.70	160.85	−117.897	37.76
C (diamond)	*c*	0.45	0.69	−0.502	0.58
(graphite)	*c*	0.00	0.00	0.000	1.36
CO_2	*g*	−94 05	−94.26	69.092	51.06
	aq	−98.69	−92.31	67.662	29.0
CO	*g*	−26.42	−32.81	24.048	47.30
Cerium					
Ce	*c*	0.00	0.00	0.000	13.8
Ce^{+++}	*aq*	−173.7	−170.5	124.97	−44
$CeCl_3$	*c* (α)	−260.3	....	....	....
	aq	−293.9	−264 5	193.87	−5
Ce_3H_8	*c*	−170	....	....	....
CeI_3	*c* (α)	−164.4	....	....	....
	aq	−213.9	−207.5	152.09	34
CeO_2	*c*	−233	....	....	....
$CeO_3 \cdot 2H_2O$	*c*	−389	....	....	....
CeS_2	*c*	−153.9	....	....	....
Ce_2S_3	*c*	−298.7	....	....	....
$Ce(SO_4)_2$	*c*	−560	....	....	....
$Ce_2(SO_4)_3$	*aq*	−998.3	−873.0	639.90	−76
$Ce_2(SO_4)_3 \cdot 5H_2O$	*c*	−1308	....	....	....
$Ce_2(SO_4)_3 \cdot 8H_2O$	*c*	....	−1340.2	982.35	....
$Ce_2(SO_4)_3 \cdot 9H_2O$	*c*	....	−1396.8	1023.83	....
Cesium					
Cs	*c*	0.00	0.00	0.000	19.8
Cs^+	*aq*	−59.2	−67.41	49.111	31.8
CsBr	*c*	−94.3	−91.6	67.142	29
	aq	−88.1	−91.98	67.420	51
Cs_2CO_3	*c*	−267.4	....	....	....
$CsHCO_3$	*c*	−228.4	....	....	....
	aq	−224.4	....	....	....

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* (α) Pseudowollastonite; (β) wollastonite.

** For the values of organic compounds see table following zirconium compounds.

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
Cesium					
CsCl	*c*	−103.5	....	....	....
	aq	−99.2	−88.76	65.060	45.0
$CsClO_4$	*c*	−103.86	−73.28	53.713	41.89
	aq	−90.6	−69.98	51.294	75.3
CsF	*c*	−126.9	....	....	....
	aq	−135.9	−133.49	97.846	29.5
Cs_2SiF_6	*c*	−669.5	....	....	....
CsH	*g*	29.0	24.3	−17.81	51.25
CsI	*c*	−80.5	−79.7	58.419	31
	aq	−72.6	−79.76	58.463	57.9
$CsNH_2$	*c*	−25.4	....	....	....
$CsNO_3$	*c*	−118.11	....	....	....
	aq	−108.6	−93.82	68.769	86.8
Cs_2O	*c*	−75.9	....	....	....
Cs_2O_2	*c*	−96.2	....	....	....
CsOH	*c*	−97.2	....	....	....
	aq	−114.2	−105.00	76.964	29.3
$CsOH \cdot H_2O$	*c*	−186.9	....	....	....
$CsReO_4$	*c*	−257.2	....	....	....
	aq	−249.5	....	....	....
Cs_2S	*c*	−81.1	....	....	....
	aq	−108.4	....	....	....
CsHS	*c*	−62.9	....	....	....
	aq	−63.2	....	....	....
Cs_2SO_4	*c*	−339.38	....	....	....
	aq	−335.3	−312.16	228.809	67.7
$CsHSO_4$	*c*	−274.0	....	....	....
CsHSe	*c*	−36.7	....	....	....
	aq	−34.6	....	....	....
Chlorine					
Cl_2	*g*	0.00	0.00	0.000	53.29
Cl^-	*aq*	−40.023	−31.350	22.98	13.17
ClF	*g*	−13.3	−13.6	9.97	52.05
ClO	*g*	33	....	....	....
ClO_2	*g*	24.7	29.5	−21.623	59.6
ClO_3	*g*	37.0	....	....	....
Cl_2O	*g*	18.20	22.40	−16.419	63.70
Cl_2O_7	*g*	63.4	....	....	....
HCl	*g*	−22.06	−22.77	16.690	44.62
	aq	−40.02	−31.35	22.979	13.17
HClO	*aq*, 400	−28.18	....	....	....
	aq, 1000	−27.83	....	....	....
$HClO_2$	*aq*	−14.0	....	....	....
$HClO_3$	*aq*	−23.50	....	....	....
$HClO_4$	*lq* (*lq*)	−11.1	....	....	....
	aq	−31.41	....	....	....
$HClO_4 \cdot H_2O$	*c*	−92.1	....	....	....
$HClO \cdot 2H_2O$	*lq*	−162.8	....	....	....
Chromium					
Cr	*g*	80.5	69.8	−51.16	41.64
	c	0.00	0.00	0.000	5.68
Cr^{+++}	*aq*	1310	....	....	....
Cr_3C_2	*c*	−21.0	−21.2	15.54	20.4
Cr_4C	*c*	−16.4	−16.8	12.31	25.3
Cr_7C_3	*c*	−42.5	−43.8	32.10	48.0
$CrCl_2$	*c*	−94.56	−85.15	62.414	27.4
	aq	−113.2	....	....	....
$CrCl_2 \cdot 2H_2O$	*c*	−237	....	....	....
$CrCl_2 \cdot 3H_2O$	*c*	−309.0	....	....	....
$CrCl_2 \cdot 4H_2O$	*c*	−384.5	....	....	....
$CrCl_3$	*c*	−134.6	−118.0	86.492	30.0
$CrCl_4$	*g*	−104.	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log$_{10}$ Kf	S°
Chromium					
CrO_2Cl_2	*lq*	−135.7	....	....	....
CrF_2	*c*	−181.0	....	....	....
CrF_3	*c*	−265.2	....	....	....
Cr_7H_2	*c*	−3.7	....	....	....
CrI_2	*c*	−54.2	....	....	....
	aq	−59.9	....	....	....
CrN	*c*	−29.8	....	....	....
Cr_2N	*c*	−23.4	....	....	....
Cr_2O_3	*c*	−269.7	−250.2	183.39	19.4
$Cr_2O_3 \cdot H_2O$	*c*	−358	....	....	....
$Cr_2O_3 \cdot 2H_2O$	*c*	−439	....	....	....
$Cr_2O_3 \cdot 3H_2O$	*c*	−517	....	....	....
$Cr(OH)_3$	*c*	−247.1	....	....	....
H_2CrO_4	*aq*	−213.3	−178.5	130.84	17.5
Cobalt					
Co	*g*	105	94	−68.9	42.88
	c	0.00	0.00	0.000	6.8
Co^{++}	*aq*	−16.1	−12.3	9.016	−37.1
$CoBr_2$	*c*	−55.5	....	....	....
	aq	−73.9	....	....	....
$CoBr_2 \cdot 6H_2O$	*c*	−485.1	....	....	....
Co_3C	*c*	9.5	7.1	−5.20	29.8
$CoCO_3$	*c*	−172.7	−155.36	....	....
$CoCl_2$	*c*	−77.8	−67.5	49.48	25.4
	aq	−96.1	....	....	....
$CoCl_2 \cdot 2H_2O$	*c*	−222.9	....	....	....
$CoCl_2 \cdot 4H_2O$	*c*	−367.2	....	....	....
$CoCl_2 \cdot 6H_2O$	*c*	−508.9	....	....	....
CoF_2	*c*	−159	....	....	....
	aq	−173.6	....	....	....
$CoF_2 \cdot 4H_2O$	*c*	....	−380.9	279.19	....
CoF_3	*c*	−187	....	....	....
CoH	*c*	−4.1	....	....	....
CoH_2	*c*	−10.2	....	....	....
CoI_2	*c*	−24.4	....	....	....
	aq	−42.8	....	....	....
$Co(IO_3)_2$	*c*	−124.3	....	....	....
	aq	−125.9	....	....	....
$Co(IO_3)_2 \cdot 2H_2O$	*c*	−264.9	....	....	....
$Co(IO_3)_2 \cdot 4H_2O$	*c*	−401.9	....	....	....
$Co(NO_3)_2$	*c*	−102.9	....	....	....
	aq	−114.8	....	....	....
$Co(NO_3)_2 \cdot 6H_2O$	*c*	−529.7	....	....	....
CoO	*c*	−57.2	−51.0	37.38	10.5
Co_3O_4	*c*	−210	....	....	....
$Co(OH)_2$	*c*	−131.2	−108.9	....	....
$Co(OH)_3$	*c*	−176.6	−142.0	....	....
CoP	*c*	−35	....	....	....
CoP_3	*c*	−65	....	....	....
Co_2P	*c*	−47.3	....	....	....
CoS	*c*	−20.2	−19.8	....	....
	ppt	−21.4	....	....	....
Co_2S_3	*c*	−51	....	....	....
$CoSO_4$	*c*	−207.5	−182.1	133.48	27.1
	aq	−232.0	....	....	....
$CoSO_4 \cdot 6H_2O$	*c*	−643.2	....	....	....
$CoSO_4 \cdot 7H_2O$	*c*	−713.8	....	....	....
Columbium (See Niobium)					
Copper					
Cu	*g*	81.52	72.04	−52.804	39.74
	c	0.00	0.00	0.000	7.96
Cu^+	*aq*	12.4	12.0	−8.796	−6.3

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Copper					
Cu^{++}	*aq*	15.39	15.53	−11.383	−23.6
$CuBr$	*g*	38	28	−20.5	59.22
	c	−25.1	−23.81	17.452	21.9
$CuBr_2$	*c*	−33.8	....	....	....
$CuBr_2 \cdot 4H_2O$	*c*	316.4	....	....	....
$CuCO_3$	*c*	−142.2	−123.8	90.744	21
$Cu(C_2H_3O_2)_2$	*c*	−213.2	....	....	....
$Cu(C_2H_3O_2)_2 \cdot H_2C$	*c*	−284.2	....	....	....
$CuONC$	*c*	26.3	....	....	....
$CuCl$	*g*	32	25	−18.3	56.50
	c	−32.5	−28.2	20.67	20.2
$CuCl_2$	*c*	−49.2	....	....	....
CuF	*g*	44	....	....	....
CuF_2	*c*	−126.9	....	....	....
$CuF_2 \cdot 2H_2O$	*c*	−274.5	−235.2	172.40	36.2
CuH	*g*	71	64	−46.9	46.89
CuI	*g*	62	50	−36.6	61.06
	c	−16.2	−16.62	12.182	23.1
CuI_2	*c*	−1.7	....	....	....
CuN_3	*c*	60.5	....	....	....
Cu_3N	*c*	17.8	....	....	....
$Cu(NO_3)_2$	*c*	−73.4	....	....	....
CuO	*g*	35	....	....	....
	c	−37.1	−30.4	22.28	10.4
Cu_2O	*c*	−39.84	−34.98	25.640	24.1
$Cu(OH)_2$	*c*	107.2	....	....	....
CuS	*c*	−11.6	−11.7	8.576	15.9
Cu_2S	*c*	−19.0	−20.6	15.10	28 9
$CuSO_4$	*c*	−184.00	−158.2	115.96	27.1
	aq	−201.51	−161 81	118.604	−19.5
$CuSO_4 \cdot H_2O$	*c*	−259.00	−219.2	160.67	35.8
$CuSO_4 \cdot 3H_2O$	*c*	−402.27	−334 6	245.26	53.8
$CuSO_4 \cdot 5H_2O$	*c*	−544 45	−449.3	329 33	73.0
Cu_2SO_4	*c*	−179.2	....	....	....
	aq	−190.8	....	....	....
$CuSe$	*c*	−15.1	....	....	....
Dysprosium					
Dy^{+++}	*aq*	−166.0	−161.2	118.16	....
$DyCl_3$	*c* (β)	−237.8	....	....	....
	c (γ)	−234.8	....	....	....
	aq	−286.1	−255.2	187.06	....
DyI_3	*c* (β)	−144.5	....	....	....
	aq	−206 1	−198.2	145.28	....
$Dy(OH)_3$	*c*	....	−305.8	224.15	....
$Dy_2(SO_4)_3$	*aq*	−982 7	−854.4	626.26	....
$Dy_2(SO_4)_3 \cdot 8H_2O$	*c*	....	−1322.0	969.01	....
Erbium					
Er^{+++}	*aq*	−162.3	−157.5	115.45	....
$ErCl_3$	*c* (γ)	−231.8	....	....	....
	aq	−282.4	−251.5	184.35	....
ErI_3	*c* (β)	−140.0	....	....	....
ErI_3	*aq*	−202.4	−194.5	142.57	....
$Er(OH)_3$	*c*	−340.5	....	....	....
$Er_2(SO_4)_3$	*aq*	−975.3	−847.0	620.84	....
$Er_2(SO_4)_3 \cdot 8H_2O$	*c*	....	−1313.9	963.07	....
Europium					
Eu^{+++}	*aq*	−169.3	−165.1	121.02	....
$EuCl_3$	*c* (α)	−247.1	....	....	....
	aq	−289.4	−259.2	189.99	....
$Eu_2(SO_4)_3$	*aq*	−989.3	−862.2	631.98	....
$Eu_2(SO_4)_3 \cdot 8H_2O$	*c*	....	−1331.0	975.60	....

Substance	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
Fluorine					
F_2	*g*	0.00	0.00	0.000	48.6
F^-	*aq*	−78.66	66.08	48.435	−2.3
F_2O	*g*	5.5	9.7	−7.126	58.95
HF	*g*	−64.2	−64.7	47.402	41.47
	aq	−78.66	−66.08	48.435	−2.3
Gadolinium					
Gd	*g*	87	77	−56.4	46.41
Gd^{+++}	*aq*	−168.8	−164.6	120.65	−47.1
$GdCl_3$	*c* (α)	−245.5	....	....	....
	aq	−288.9	−258.6	189.55	−7.6
GdI_3	*c* (β)	−147.6	....	....	....
	aq	−208.9	−201.6	147.77	−31.3
$Gd(OH)_3$	*c*	....	−308.1	225.83	....
$Gd_2(SO_4)_3$	*aq*	−988.3	−861.2	631.25	−81.9
$Gd_2(SO_4)_3 \cdot 8H_2O$	*c*	−1518.9	−1329.8	974.72	155.8
Gallium					
Ga	*g*	66.0	57.0	−41.78	40.38
Ga^{+++}	*aq*	50.4	36.6	26.83	−83
$GaBr_3$	*c*	−92.4	....	....	....
$GaCl_3$	*c*	−125.4	....	....	....
	aq	−170.5	−130.7	95.801	−43
GaI_3	*c*	−51.2	....	....	....
GaN	*c*	−25	....	....	....
GaO	*g*	66	....	....	....
Ga_2O	*c*	−82	....	....	....
Ga_2O_3	*c*	−258	....	....	....
$Ga(OH)_3$	*c*	....	−199	145.9	....
Germanium					
Ge	*g*	78.44	69.50	−50.943	40.11
	c	0.00	0.00	0.000	10.14
GeBr	*g*	34.8	....	....	....
GeCl	*g*	32.6	32.45	....	....
$GeCl_4$	*lq*	−130	....	....	....
GeH_4	*g*	....	....	....	51.21
Ge_3N_4	*c*	−14.8	....	....	....
GeO	*g*	−22.8	−28.2	20.63	52.56
GeO_2 (gls)	*am*	−128.3	....	....	....
(tetr.)	*c*	−128.3	....	....	....
GeS	*g*	1.35	....	....	....
H_2GeO_3	*aq*	−199.3	....	....	....
Gold					
Au	*g*	82.29	72.83	−53.383	43.12
AuO_3^{---}	*aq*	....	−5.8	4.25	....
$AuBr_3$	*c*	−13.0	....	....	....
	aq	−9.2	....	....	....
$HAuBr_4$	*aq*	−45.5	−38.1	27.93	75
$HAuBr_4 \cdot 5H_2O$	*c*	−398.5	....	....	....
$AuCl_3$	*c*	−28.3	....	....	....
	aq	−32.8	....	....	....
$AuCl_3 \cdot 2H_2O$	*c*	−167.7	....	....	....
$HAuCl_4$	*aq*	−77.8	−56.2	41.19	61
$HAuCl_4 \cdot 3H_2O$	*c*	−279.2	....	....	....
$HAuCl_4 \cdot 4H_2O$	*c*	−356.9	....	....	....
AuI	*c*	0.2	....	....	....
Au_2O_3	*c*	19.3	39.0	−28.6	30
$Au(OH)_3$	*c*	−100.0	−69.3	50.80	29
Hafnium					
Hf	*g*	....	....	....	44.65
	c	0.00	0.00	0.000	13.1
HfO_2	*c*	−271.5	....	....	....
Helium					
He	*g*	0.00	0.00	0.000	30.13

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Holmium					
Ho^{+++}	aq	−163.7	−159.2	116.69	....
$HoCl_3$	c (γ)	−232.8	....	....	....
	aq	−283.8	−253.2	185.59	....
HoI_3	c (β)	−141.7	....	....	....
	aq	−203.8	−196.2	143.81	....
$Ho_2(SO_4)_3$	aq	−978.1	−850.4	623.33	....
$Ho_2(SO_4)_3{\cdot}8H_2O$	c	....	−1318.0	966.08	....
Hydrogen					
H_2 (mass 1)*	g	0.00	0.00	0.000	31.21
(mass 2)**	g	0.00	0.00	0.000	34.602
H*	g	52.09	48.58	−35.60	27.39
H**	g	52.98	49.36	−36.18	29.46
H_2O*	g	−57.80	−54.64	40.047	45.11
	lq	−68.32	−56.69	41.553	16.72
H_2O**	g	−59.56	−56.07	41.096	47.38
	lq	−70.41	−58.21	42.664	18.16
H*H**O	g	−58.74	−55.83	40.921	47.66
	lq	−69.39	−57.93	42.459	18.85
H_2O_2	g	−31.83	....	....	....
	lq	−44.84	−28.2	....	....
	aq	−45.68	....	....	....
Indium					
In	g	58.2	49.6	−36.36	41.51
In^{+++}	aq	27.3	−32.0	23.46	−62
$InBr_3$	c	−96.5	....	....	....
InCl	g	−18	−23	16.9	59.3
	c	−44.5	....	....	....
$InCl_2$	c	−86.8	....	....	....
$InCl_3$	c	−128.4	....	....	....
InH	g	51	45	−33.0	49.6
InI	g	20	9	−6.6	63.8
InI_3	c	−55.0	....	....	....
InN	c	−4.8	....	....	....
InO	g	91	....	....	....
In_2O_3	c	−222.5	....	....	....
$In(OH)_3$	c	−214	−182	133.4	25
$In_2(SO_4)_3$	c	−695	....	....	....
Iodine					
I_2	g	14.88	4.63	−3.394	62.28
	c	0.00	0.00	0.000	27.9
I^-	aq	−13.37	−12.35	9.252	26.14
IBr	g	9.75	0.91	0.667	61.80
ICl	g	4.20	−1.32	0.968	59.12
ICl_3	c	−21.1	−5.36	3.929	41.1
HI	g	6.20	0.31	−0.227	49.31
	aq	−13.37	−12.35	9.052	26.14
I_2O_5	c	−42.34	....	....	....
HIO_3	c	−57.03	....	....	....
Iridium					
Ir	g	165	154	−112.9	46.25
	c	0.00	0.00	0.000	8.7
IrCl	c	−22.3	....	....	....
$IrCl_2$	c	−42.8	....	....	....
$IrCl_3$	c	−61.5	....	....	....
IrF_6	lq	−130	....	....	....
IrO_2	c	−40.1	....	....	....
IrS_2	c	−30	....	....	....
Ir_2S_3	c	−51	....	....	....
Iron					
Fe	g	96.68	85.76	−62.861	43.11
	c	0.00	0.00	0.000	6.49
Fe^{++}	aq	−21.0	−20.30	14.88	−27.1

* Atomic weight 1.0078.

** Atomic weight 2.0142.

Substance	State	ΔHf°	ΔFf°	Log_{10} Kf	S°
Iron					
Fe^{+++}	*aq*	−11.4	−2.52	1.847	−70.1
$FeBr_2$	*c*	−60.02	....	....	....
$FeBr_3$	*aq*	−98.1	....	....	....
Fe_3C (cementite)	*c*	5.0	3.5	−2.56	25.7
$Fe(CO)_5$	*lq*	−187.8	....	....	....
$FeCO_3$ (siderite)	*c*	−178.70	−161.06	118.055	22.2
$H_3Fe(CN)_6$	*aq*	153.	....	....	....
$H_4Fe(CN)_6$	*c*	127.8	....	....	....
	aq	127.4	....	....	....
$FeCl_2$	*c*	−81.5	−72.2	52.92	28.6
	aq	−101.0	....	....	....
$FeCl_2{\cdot}2H_2O$	*c*	−228.2	....	....	....
$FeCl_2{\cdot}4H_2O$	*c*	−370.7	....	....	....
$FeCl_3$	*c*	−96.8	....	....	....
	aq	−127.9	−96.5	....	....
$FeCl_3{\cdot}6H_2O$	*c*	−532.0	....	....	....
$FeCr_2O_4$	*c*	−341.9	−317.7	232.87	34.9
FeF_2	*aq*	−177.8	....	....	....
FeF_3	*aq*	−243.1	....	....	....
FeI_2	*c*	−29.98	....	....	....
	aq	−49.03	....	....	....
Fe_2N	*c*	−0.9	2.6	−1.91	24.2
Fe_4N	*c*	−2.55	0.89	−0.652	37.3
$Fe(NO_3)_2$	*aq*	−118.9	....	....	....
$Fe_{0.95}O$ "FeO" (wüstite)	*c*	−63.7	−58.4	42.81	12.9
Fe_2O_3 (hematite)	*c*	−196.5	−177 1	129.81	21.5
Fe_3O_4 (magnetite)	*c*	−267 0	−242.4	177 68	35.0
$Fe(OH)_2$	*c*	−135.8	−115.57	84.711	19
$Fe(OH)_3$	*c*	−197.0	....	....	....
FeP	*c*	−28	....	....	....
FeP_2	*c*	−42	....	....	....
Fe_2P	*c*	−36	....	....	....
Fe_3P	*c*	−40	....	....	....
$FePO_4$	*c*	−299.6	....	....	....
$FePO_4{\cdot}2H_2O$	*c*	−440.8	....	....	....
$FePO_4{\cdot}4H_2O$	*c*	−578.8	....	....	....
FeS	*c* (α)	−22.72	−23.32	17.093	16.1
	c (β)	−21.35	....	....	....
FeS_2 (pyrites)	*c*	−42.52	−39.84	29.202	12.7
(markasite)	*c*	−36.88	....	....	....
$FeSO_4$	*c*	−220 5	....	....	....
$FeSO_4H_2O$	*c*	−296.3	....	....	....
$FeSO_4{\cdot}4H_2O$	*c*	−507.5	....	....	....
$FeSO_4{\cdot}7H_2O$	*c*	−718.7	....	....	....
Fe_2SiO_4	*c*	−343.7	−319.8	234.41	35.4
Krypton					
Kr	*g*	0.00	0.00	0.000	39.19
$Kr{\cdot}5H_2O$	*c*	−357.1	....	....	....
Lanthanum					
La	*g*	88	79	−57.9	43.57
	c	0.00	0.00	0 000	13.7
La^{+++}	*aq*	−176.2	−172.9	126.73	−44
$La_2(CN_2)_3$	*c*	−229	....	....	....
$LaCl_3$	*c* (α)	−263.6	....	....	....
	aq	−296.3	−266.9	195.63	−5
LaI_3	*c* (α)	−167.4	....	....	....
	aq	−216.3	−209.9	153.85	34
LaN	*c*	−72.1	....	....	....
La_2O_3	*c*	−458.	....	....	....
$La(OH)_3$	*c*	....	−312.8	229.28	....
La_2S_3	*c*	−306.8	....	....	....
$La_2(SO_4)_3$	*aq*	−1003.1	−877.8	643.41	−76

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
Lanthanum					
$La_2(SO_4)_3 \cdot 9H_2O$	c	....	−1403.1	1028.45	....
Lead					
pb	g	46.34	38.47	−28.198	41.89
	c	0.00	0.00	0.000	15.51
Pb^{++}	aq	0.39	−5.81	4.259	5.1
$PbBr_2$	c	−66.21	−62.24	45.621	38.6
	aq	−57.41	−54.95	40.278	43.7
$PbCO_3$	c	−167.3	−149.7	109.73	31.3
$PbCO_3 \cdot PbO$	c	−220.0	−195.6	143.37	48.5
$PbCO_3 \cdot 2PbO$	c	−273	−242	177.4	65
PbC_2O_4	c	−205.1	....	....	....
$Pb(C_2H_3O_2)_2$	c	230.5	....	....	....
	aq	−232.6	....	....	....
$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	c	−443.1	....	....	....
$Pb(C_2H_5)_4$	lq	52	....	....	....
$PbCl_2$	c	−85.85	−75.04	55.003	32.6
	aq	−79.65	−68.51	50.217	31.4
PbF_2	c	−158.5	−148.1	108.55	29
PbF_4	c	−222.3	....	....	....
PbI_2	c	−41.85	−41.53	30.441	42.3
	aq	−26.35	−30.51	22.363	57.8
$Pb(N_3)_2$	c	104.3	....	....	....
$Pb(NO_3)_2$	c	−107.35	....	....	....
	aq	−98.35	−58.64	42.982	75.1
PbO	g	....	....	....	57.4
(red)	c	−52.40	−45.25	33.168	16.2
(yellow)	c	−52.07	−45.05	33.021	16.6
PbO_2	c	−66.12	−52.34	38.364	18.3
Pb_2O	c	−51.2	....	....	....
Pb_3O_4	c	−175.6	−147 6	108.19	50.5
$Pb(OH)_2$	c	−123.0	−100 6	73.738	21
$Pb_3(PO_4)_2$	c	−620.3	−581.4	426.16	84.45
PbS	c	−22.54	−22 15	16.236	21.8
$PbSO_4$	c	−219 50	−193 89	142.119	35.2
PbS_2O_3	c	−150.1	....	....	....
PbSe	c	−18	....	....	....
$PbSeO_4$	c	−148	....	....	....
$PbSiO_3$	c	−258 8	−239.0	175.18	27
Pb_2SiO_4	c	−312.7	−285.7	209.41	43
Lithium					
Li	g	37.07	29.19	−21.396	33.14
	c	0.00	0.00	0 000	6.70
Li^+	aq	−66 54	−70.22	51.470	3.4
LiBr	g	−41	−50	36.6	53.78
	c	−83.72	....	....	....
	aq	−95.45	−94.69	69.483	22.7
$LiBr \cdot H_2O$	c	−158.34	....	....	....
$LiBr \cdot 2H_2O$	c	−229.94	....	....	....
$LiBr \cdot 3H_2O$	c	−301.9	....	....	....
Li_2CO_3	c	−290.54	−270.66	198.390	21.60
	aq	−294.74	−266 66	195.458	−5.9
$LiHCO_3$	aq	−231.73	−210.53	154.316	29.5
LiCl	g	−53	−58	42.5	51.01
	c	−97.70	....	....	....
	aq	−106.58	−101.57	74.449	16.6
$LiCl \cdot H_2O$	c	−170.31	−151.2	110.83	24.8
$LiCl \cdot 2H_2O$	c	−242.1	....	....	....
$LiCl \cdot 3H_2O$	c	−313.5	....	....	....
LiF	c	−146.3	−139.5	102.32	8.57
	aq	−145.21	−136.30	99.906	1.1
LiH	g	30.7	25.2	−18.47	40.77
	c	−21.61	−16.72	12.255	5.9

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log_{10} Kf	S°
Lithium					
LiI	g	−16	−26	19.1	55.68
	c	−64.79	....	....	....
	aq	−79.92	−82.57	−60.523	29.5
LiI·½H_2O	c	−103.8	....	....	....
LiI·H_2O	c	−141.16	....	....	....
LiI·2H_2O	c	−213.03	....	....	....
LiI·3H_2O	c	−285.02	....	....	....
Li_3N	c	−47.2	....	....	....
$LiNO_2$	c	−96.6	....	....	....
$LiNO_3$	c	−115.28	....	....	....
	aq	−115.93	−96.63	70.828	38.4
$LiNO_3$·3H_2O	c	−328.6	....	....	....
Li_2O	c	−142.4	....	....	....
Li_2O_2	c	−151.7	....	....	....
	aq	−159.0	....	....	....
LiOH	c	−116.45	−106.1	77.77	12
	aq	−121.51	−107.82	79.031	0.9
LiOH·H_2O	c	−188.77	−164.8	120.80	22
Li_2SO_4	c	−342.83	....	....	....
	aq	−350.01	−317.78	232.928	10.9
Li_2SO_4·H_2O	c	−414.20	....	....	....
Lutetium					
Lu	g	87	....	....	44.14
	c	0.00	0.00	0.000	....
Lu^{++}	aq	−160.1	−155.0	113.61	....
$LuCl_3$	c (γ)	−227.9	....	....	....
	aq	−280.2	−249.0	182.51	....
LuI_3	c (β)	−133.2	....	....	....
	aq	−200.2	−192.0	140.73	....
$Lu_2(SO_4)_3$	aq, ∞	−970.9	−842.0	617.17	....
$Lu_2(SO_4)_3$·8H_2O	c	....	−1308.1	958.82	....
Magnesium					
Mg	g	35.9	27.6	−20.23	35.50
	c	0.00	0.00	0.000	7.77
Mg^{++}	aq	−110.41	−108.99	79.89	−28.2
$Mg_3(AsO_4)_2$	c	−731.3	....	....	....
$MgHAsO_4$	aq	−349.2	....	....	....
$Mg(H_2AsO_4)_2$	aq	−541.0	....	....	....
$Mg(NH_4)AsO_4$·6H_2O	c	−800.7	....	....	....
Mg_3Bi_2	c	−36.5	....	....	....
$MgBr_2$	c	−123.7	....	....	....
	aq	−168.21	−158.14	115.914	10.4
$MgBr_2$·6H_2O	c	−575.4	−491.0	359.90	95
$Mg(CN)_2$	aq	−31.9	....	....	....
$MgCN_2$	c	−60.3	....	....	....
$MgCO_3$	c	−266	−246	180.3	15.7
$MgCl_2$	c	−153.40	−141.57	103.769	21.4
	aq	−190.46	−171.69	125.846	−1.9
$MgCl_2$·H_2O	c	−231.15	−206.11	151.076	32.8
$MgCl_2$·2H_2O	c	−305.99	−267.32	195.942	43.0
$MgCl_2$·4H_2O	c	−454.00	−390.49	286.224	63.1
$MgCl_2$·6H_2O	c	−597.42	−305.65	370.635	87.5
Mg(OH)Cl	c	−191.3	−175.0	128.27	19.8
$Mg(ClO_4)_2$	c	−140.6	....	....	....
$Mg(ClO_4)_2$·2H_2O	c	−290.7	....	....	....
$Mg(ClO_4)_2$·4H_2O	c	−438.6	....	....	....
$Mg(ClO_4)_2$·6H_2O	c	−583.2	....	....	....
$MgCrO_4$	c	−318.3	....	....	....
	aq	−321.2	....	....	....
MgF_2	c	−263.5	−250.8	183.83	13.68
MgH	g	41	34	−24.9	47.61

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log_{10} Kf	S°
Magnesium					
MgI_2	*c*	−86.0	....	....	....
	aq	−137.15	−133.69	97.993	24.1
Mg_3N_2	*c*	−110.24	....	....	....
$Mg(NO_3)_2$	*c*	−188.72	−140.63	103.080	39.2
	aq	−209.15	−161.81	118.605	41.8
$Mg(NO_3)_2 \cdot 6H_2O$	*c*	−624.36	....	....	....
MgO	*c*	−143.84	−136.13	99.781	6.4
MgO_2	*c*	−148.9	....	....	....
$Mg(OH)_2$	*c*	−221.00	−199.27	146.062	15.09
$Mg_3(PO_4)_2$	*c*	−961.5	....	....	....
$Mg(NH_4)PO_4 \cdot 6H_2O$	*c*	−881.0	....	....	....
MgS	*c*	−83.0	....	....	....
$MgSO_4$	*c*	−305.5	−280.5	152.83	21.9
	aq	−327.31	−286.33	209.876	−24.0
$MgSO_4 \cdot 2H_2O$	*c*	−381.9	....	....	....
$MgSO_4 \cdot 4H_2O$	*c*	−595.5	....	....	....
$MgSO_4 \cdot 6H_2O$	*c*	−736.6	....	....	....
$MgSO_4 \cdot 7H_2O$	*c*	−808.7	....	....	....
Mg_3Sb_2	*c*	−68.1	....	....	....
$MgSiO_3$	*c*	−357.9	−337.2	247.16	16.2
$MgSiO_4$ (forsterite)	*c*	−488.2	−459.8	337.03	22.7
Mg_2Sn	*c*	−17.0	....	....	....
$MgWO_4$	*c*	−345.2	....	....	....
Manganese					
Mn	*g*	68.34	58.23	−42.682	41.49
	c (α)	0.00	0.00	0.000	7.59
	c (γ)	0.37	0.33	−0.242	7.72
Mn^{++}	*aq*	−52.3	−53.4	39.14	−20
$MnBr_2$	*c*	−90.7	....	....	....
	aq	−110.1	....	....	....
$MnBr_2 \cdot H_2O$	*c*	−164.4	....	....	....
$MnBr_2 \cdot 4H_2O$	*c*	−367.5	....	....	....
$MnBr_3$	*aq*	−111	....	....	....
Mn_3C	*c*	−1	−1	0.73	23.6
$MnCO_3$	*c*	−213.9	−195.4	143.23	20.5
	ppt	−211.0	....	....	....
	aq	−213.9	−179.6	131.64	−32.7
MnC_2O_4	*c*	−258.2	....	....	....
$MnC_2O_4 \cdot 2H_2O$	*c*	−388.6	....	....	....
$MnC_2O_4 \cdot 3H_2O$	*c*	−455.4	....	....	....
$Mn(C_2H_3O_2)_2$	*c*	−273.0	....	....	......
	aq	−285.2	....	....	....
$Mn(C_2H_3O_2)_2 \cdot 4H_2O$	*c*	−556.9	....	....	....
$MnCl_2$	*c*	−115.3	−105.5	77.330	28.0
$MnCl_2 \cdot H_2O$	*c*	−188.5	....	....	....
$MnCl_2 \cdot 2H_2O$	*c*	−276.7	....	....	....
$MnCl_2 \cdot 4H_2O$	*c*	−407.0	....	....	....
MnF_2	*c*	−189	−179	131.2	22.2
	aq	−209.2	....	....	....
MnI_2	*c*	−59.3	....	....	....
MnI_2	*aq*	−79.0	....	....	....
$MnI_2 \cdot H_2O$	*c*	−127.9	....	....	....
$MnI_2 \cdot 2H_2O$	*c*	−194.5	....	....	....
$MnI_2 \cdot 4H_2O$	*c*	−327.5	....	....	....
$MnI_2 \cdot 6H_2O$	*c*	−451	....	....	....
$Mn(N_3)_2$	*c*	92.2	....	....	....
Mn_5N_2	*c*	−57.8	....	....	....
Mn_3N_2	*c*	−81	....	....	....
$Mn(NO_3)_2$	*c*	−166.32	....	....	....
$Mn(NO_3)_2 \cdot 3H_2O$	*c*	−355.1	....	....	....
$Mn(NO_3)_2 \cdot 6H_2O$	*c*	−566.50	....	....	....

Substance	State	ΔHf°	ΔFf°	Log_{10} Kf	S°
Manganese					
MnO	*g*	34.6	....	....	.....
	c	−92.0	−86.8	63.62	14.4
MnO_2	*c*	−124.5	−111.4	81.655	12.7
Mn_2O_3	*c*	−232.1	....	....	.....
Mn_3O_4	*c*	−331.4	−306.0	224.29	35.5
$Mn(OH)_2$	*am*	−165.8	−145.9	106.94	21.1
$Mn(OH)_3$	*am*	−212	....	....	....
$Mn_3(PO_4)_2$	*c*	−771.	....	....	....
MnS (green)	*c*	−48.8	−49.9	36.58	18.7
(red)	*c*	−47 6	....	....	....
$MnSO_4$	*c*	−254.24	−228.48	167.473	26.8
$MnSO_4$	*aq*	−269.2	−230.7	169.10	−16
$MnSO_4 \cdot H_2O$	*c* (I)	−328.5	....	....	....
	c (II)	−322.4	....	....	... ..
$MnSO_4 \cdot 4H_2O$	*c*	−539.3	....	....	....
$MnSO_4\ 5H_2O$	*c*	−609.6	....	....	....
$MnSO_4 \cdot 7H_2O$	*c*	−750.0	....	....	......
$Mn_2(SO_4)_4$	*c*	−666.9	....	....	......
	aq	−699	....	....	......
$MnSiO_3$	*c*	−302.5	−283.3	207.65	21.3
	gls	−294.0	....	... ...	.....
Mercury					
Hg	*g*	14.54	7.59	−5.563	41.8
	lq	0.00	0.00	0.00	18.5
Hg^{++}	*aq*	....	39.38	−28.865	......
Hg_2^{++}	*aq*	....	36.79	−26.967	....
HgBr	*g*	23	18	−13.2	65.0
Hg_2Br_2	*c*	−49.42	−42.714	31.309	50.9
$HgBr_2$	*c*	−40.5	−38.8	....	....
$Hg(CN)_2$	*c*	62.5	....	....	....
$Hg(ONC)_2$	*c*	64	....	....	....
$Hg(CNS)_2$	*c*	48.0	....	....	....
HgC_2O_4	*c*	−161.8	....	....	....
$Hg(C_2H_3O_2)_2$	*c*	−199.4	....	....	....
$Hg_2(C_2H_3O_2)_2$	*c*	−201.1	....	....	....
$Hg(CH_3)_2$	*lq*	18.	....	....	.....
$Hg(C_2H_5)_2$	*lq*	15	....	....	....
HgCl	*g*	19	14	−10.3	62.2
Hg_2Cl_2	*c*	−63.32	−50.35	36.906	46.8
$HgCl_2$	*c*	−55.0	−42.2	....	....
HgF	*g*	14	....	....	....
HgH	*g*	58.06	52.60	−38.555	52.42
HgI	*g*	33	23	−16.9	67.1
Hg_2I_2 (yellow)	*c*	−28.91	−26.60	19.497	57.2
HgI_2 (red)	*c*	−25.2	....	....	....
(yellow)	*c*	−24.55	....	....	....
$Hg_2(N_3)_2$	*c*	133	....	....	....
$Hg(NO_3)_2 \cdot \frac{1}{2}H_2O$	*c*	−93.0	....	....	....
$Hg_2(NO_3)_2 \cdot 2H_2O$	*c*	−206.9	....	....	......
HgO (red)	*c*	−21.68	−13.990	10.255	17.2
(yellow)	*c*	−21.56	−13.959	10.232	17.5
Hg_2O	*c*	−21.8	−12.80	....	....
$Hg(OH)_2$	*aq*	....	−66 0	43.38	....
HgS (red)	*c*	−13.90	−11.67	8.554	18.6
(black)	*c*	−12.90	−11.05	8.100	19.9
$HgSO_4$	*c*	−168.3	....	....	......
Hg_2SO_4	*c*	−177.34	−149.12	109.303	47.98
Molybdenum					
Mo	*g*	155.5	144.2	−105.70	43.46
	c	0.00	0.00	0.000	6.83
$MoBr_2$	*c*	−29	....	....	....
$MoBr_3$	*c*	−41	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10} Kf$	S°
Molybdenum					
$MoBr_4$	*c*	−45	....	....	....
$MoBr_5$	*c*	−51	....	....	....
Mo_2C	*c*	4.3	2.9	−2.13	19.7
$MoCl_2$	*c*	−44	....	......	......
$MoCl_3$	*c*	−65	....	....	....
$MoCl_4$	*c*	−79	....	....	....
$MoCl_5$	*c*	−90.8	....	....	....
$MoCl_6$	*c*	−90	....	....	....
MoI_2	*c*	−12	....	....	....
MoI_3	*c*	−15	....	....	......
MoI_4	*c*	−18	....	....	....
MoI_5	*c*	−18	....	....	....
Mo_2N	*c*	−8.3	....	....	....
MoO_2	*c*	−130	....	....	....
MoO_3	*c*	−180.33	−161.95	118.707	18.68
	aq	−188.1	....	....	....
MoO_4	*aq*	−173.5	....	....	....
MoO_5	*aq*	−155.1	....	....	....
MoS_2	*c*	−55.5	−53.8	39.43	15.1
MoS_3	*c*	−61.2	....	....	....
H_2MoO_4 (white)	*c*	−256.9	....	....	....
$H_2MoO_4 \cdot H_2O$ (yellow)	*c*	−331.4	....	....	....
Neodymium					
Nd	*g*	87	....	....	....
	c	0.00	0.00	0.000	....
Nd^{+++}	*aq*	−171.2	−167.6	122.85	....
$NdCl_3$	*c* (*α*)	−254.3	....	....	....
	aq	−291.3	−261.6	191.75	....
$NdCl_3 \cdot 6H_2O$	*c*	−692.3	....	....	....
$Nd(OH)_3$	*c*	....	−309.6	226.93	....
NdI_3	*c* (*α*)	−158.9	....	....	....
	aq	−211.3	−204.6	149.97	....
Nd_2O_3	*c*	−442.0	....	....	....
Nd_2S_3	*c*	−281.8	....	....	....
$Nd_2(SO_4)_3$	*c*	−948.1	....	....	....
	aq	−993.1	−867.2	635.65	....
$Nd_2(SO_4)_3 \cdot 5H_2O$	*c*	−1318.4	....	....	....
$Nd_2(SO_4)_3 \cdot 8H_2O$	*c*	−1524.7	−1334.5	978.17	....
Neon					
Ne	*g*	0.00	0.00	0.000	34.95
Neptunium					
Np	*c*	0.00	0.00	0.000	....
$NpBr_3$	*c*	−174	....	....	....
$NpBr_4$	*c*	−183	....	....	....
$NpCl_3$	*c*	−216	....	....	....
$NpCl_4$	*c*	−237	....	....	....
$NpCl_5$	*c*	−246	....	....	....
NpF_3	*c*	−360	....	....	....
NpF_4	*c*	−428	....	....	....
NpI_3	*c*	−120	....	....	....
Nickel					
Ni	*g*	101.61	90.77	−66.533	43.59
	c	0.00	0.00	0.000	7.20
Ni^{++}	*aq*	−15.3	−11.1	8.136	−38.1
$NiBr_2$	*c*	−54.2	....	....	....
$NiBr_2 \cdot 3H_2O$	*c*	−277.8	....	....	....
Ni_3C	*c*	11.0	....	....	....
$Ni(CN)_2$	*c*	27.1	....	....	....
$NiCO_3$	*c*	....	−146.7	107.53	....
$NiCl_2$	*c*	−75.5	−65.1	47.72	25.6
$NiCl_2 \cdot 2H_2O$	*c*	−220.8	....	....	....
$NiCl_2 \cdot 4H_2O$	*c*	−364.7	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log$_{10}$ Kf	S°
Nickel					
$NiCl_2\cdot 6H_2O$	*c*	−505.8	−410.5	300.89	75.2
NiF_2	*c*	−159.5	....	....	....
$NiF_2\cdot 4H_2O$	*c*	....	−379.9	278.46	....
NiH	*g*	93	....	....	....
	c	−2.7	....	....	....
NiH_2	*c*	−6.2	....	....	....
NiI_2	*c*	−20.5	....	....	....
$Ni(IO_3)_2$	*c*	−124.5	....	....	....
$Ni(IO_3)_2\cdot 2H_2O$	*c* (I)	−264.9	....	....	....
	c (II)	−263.9	....	....	....
$Ni(IO_3)_2\cdot 4H_2O$	*c*	−401.7	....	....	....
$Ni(NO_3)_2$	*c*	−102.2	....	....	....
$Ni(NO_3)_2\cdot 6H_2O$	*c*	−531.4	....	....	....
NiO	*g*	59.3	51.8	−37.97	57
	c	−58.4	−51.7	37.90	9.22
$Ni(OH)_2$	*c*	−128.6	−108.3	79.382	19
$Ni(OH)_3$	*c*	−162.1	....	....	....
NiS	*c*	−17.5	....	....	....
$NiSO_4$	*c*	−213.0	−184.9	135.53	18.6
	aq	−232.2	−188.4	138.09	−34.0
$NiSO_4\cdot 6H_2O$ (green)	*c*	−644.98	....	....	....
(blue)	*c*	−642.5	−531.0	389.2	73.1
$NiSO_4\cdot 7H_2O$	*c*	−712.9	....	....	....
Niobium					
Nb	*g*	184.5	173.7	−127.32	44.49
	c	0.00	0.00	0.000	8.3
Nb_2O_4	*c*	−387.8	....	....	....
Nb_2O_5	*c*	−463.2	....	....	....
Nitrogen (NH_4OH; NH_2OH; N_2H_4; and N_3H; see under ammonia)					
N_2	*g*	0.00	0.00	0.000	45.77
$NOBr$	*g*	19.56	19.70	−14.44	65.16
$NOCl$	*g*	12.57	15.86	−11.625	63.0
NF_3	*g*	−27.2	....	....	....
NO	*g*	21.60	20.72	−15.187	50.34
NO_2	*g*	8.09	12.39	−9.082	57.47
N_2O_4	*g*	2.31	23.49	−17.219	72.73
N_2O	*g*	19.49	24.76	−18.149	52.58
N_2O_5	*g*	3.6	....	....	....
	c	−10.0	....	....	....
HNO_3	*lq*	−41.40	−19.10	14.000	37.19
	aq	−49.37	−26.41	19.36	35.0
$HNO_3\cdot H_2O$	*lq*	−112.96	−78.41	57.474	51.83
$HNO_3\cdot 3H_2O$	*lq*	−252.20	−193.70	141.980	82.92
Osmium					
Os	*g*	174	163	−119.5	45.97
	c	0.00	0.00	0.000	7.8
OsO_4	*g*	−79.9	−67.9	49.77	65.6
(white)	*c*	−91.7	−70.5	51.68	34.7
(yellow)	*c*	−93.4	−70.7	51.82	29.7
	aq	....	−68.59	50.276	....
OsS_2	*c*	−35	....	....	....
H_2OsO_5	*aq*	....	−125.28	91.829	....
Oxygen					
O_2	*g*	0.00	0.00	0.000	49.003
O_3	*g*	34.0	39.06	−28.631	56.8
OH^-	*aq*	−54.957	−37.595	27.56	−2.519
Palladium					
Pd	*g*	93	84	−61.6	39.91
	c	0.00	0.00	0.000	8.9
$PdBr_2$	*c*	−24.9	....	....	....
	aq	−205.6	....	....	....
$Pd(CN)_2$	*c*	52.1	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Palladium					
$PdCl_2$	*c*	−45.4	....	....	....
$PdCl_4^{--}$	*aq*	−128.3	−96.7	70.88	41.
H_2PdCl_4	*aq*	−129.3	....	....	....
Pd_2H	*c*	−8.9	....	....	....
PdO	*c*	−20.4	....	....	....
$Pd(OH)_2$	*c*	−92.1	....	....	....
$Pd(OH)_4$	*c*	−169.4	....	....	....
Phosphorus					
P	*g*	75.18	66.71	−48.897	38.98
(white)	*c*	0.00	0.00	0.000	10.6
(red)	*c*	−4.4	....	....	....
(black)	*c*	−10.3	....	....	....
P_2	*g*	33.82	24.60	−18.031	52.13
P_4	*g*	13.12	5.82	−4.266	66.90
PBr_3	*g*	−35.9	−41.2	30.19	83.11
PBr_5	*c*	−66	....	....	....
$POBr_3$	*c*	−114.6	....	....	....
PCl_3	*g*	−73.22	−68.42	50.151	74.49
PCl_5	*g*	−95.35	−77.59	56.872	84.3
$POCl_3$	*g*	−141.5	−130.3	95.508	77.59
PH_3	*g*	2.21	4.36	−3.196	50.2
PI_3	*c*	−10.9	....	....	....
PN	*g*	−20.2	−25.3	18.54	50.45
HPO_3	*c*	−228.2	....	....	....
	aq	−234.9	....	....	....
H_3PO_2	*c*	−145.5	....	....	....
	aq	−145.6	....	....	....
H_3PO_3	*c*	−232.2	....	....	....
	aq	−232.2	....	....	....
H_3PO_4	*c*	−306.2	....	....	....
$H_4P_2O_7$	*c*	−538.0	....	....	....
Platinum					
Pt	*g*	121.6	110.9	−81.288	45.96
	c	0.00	0.00	0.000	10.0
$PtBr_4$	*c*	−41.3	....	....	....
$H_2PtBr_6 \cdot 9H_2O$	*c*	−734.7	....	....	....
$PtCl_2$	*c*	−35.5	....	....	....
$PtCl_4$	*c*	−62.9	....	....	....
$PtCl_4^{--}$	*aq*	−123.4	−91.9	67.36	42.
$PtCl_4 \cdot 5H_2O$	*c*	−425.8	....	....	....
$PtCl_6^{--}$	*aq*	−167.4	123.1	90.231	52.6
H_2PtCl_6	*aq*	−167.3	....	....	....
$H_2PtCl_6 \cdot 6H_2O$	*c*	−572.9	....	....	....
PtI_4	*c*	−21.6	....	....	....
$Pt(OH)_2$	*c*	−87.2	−68.2	49.99	26.5
PtS	*c*	−20.8	....	....	....
PtS_2	*c*	−27.8	....	....	....
Plutonium					
$PuBr_3$	*c*	−187.2	....	....	....
$PuCl_3$	*c*	−230.0	....	....	....
PuOCl	*c*	−222.8	....	....	....
PuF_3	*aq*	−374.6	....	....	....
PuH_2	*c*	−31.7	....	....	....
PuI_3	*c*	−133	....	....	....
PuO_2	*c*	−251	....	....	....
Polonium					
PoO_2	*c*	....	−46.3	33.7	....
Potassium					
K	*g*	21.51	14.62	−10.716	38.30
	c	0.00	0.00	0.000	15.2
K^+	*aq*	−60.04	−67.466	49.452	24.5
$KAl(SO_4)_2$	*c*	−589.24	−534.29	391.627	48.9

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
Potassium					
$KAl(SO_4)_2\cdot 12H_2O$	*c*	−1447.74	−1227.8	899.96	164.3
KH_2AsO_4	*c*	−271.5	−237.0	173.72	37.08
KBr	*c*	−93.73	−90.63	66.430	23.05
	aq	−88.94	−92.04	67.464	43.8
$KBrO$	*aq*	−82.0	....	....	....
$KBrO_3$	*c*	−79.4	−58.2	42.66	35.65
	aq	69.6	−56.6	41.49	63.4
K_2CO_3	*c*	−273.93	....	....	....
$K_2CO_3\cdot \frac{1}{2}H_2O$	*c*	−210.43	....	....	....
$K_2CO_3\cdot 1\frac{1}{2}H_2O$	*c*	−283.40	....	....	....
$KHCO_3$	*c*	−229.3	....	....	....
$KC_2H_3O_2$	*c*	−173.2	....	....	....
$K_2C_2O_4$	*c*	−320.8	....	....	....
$K_2C_2O_4\cdot H_2O$	*c*	−392.17	....	....	....
KCN	*c*	−26.90	....	....	....
$KCNO$	*c*	−98.5	....	....	....
$KCNS$	*c*	−48.62	....	....	....
KCl	*g*	−51.6	−56.2	41.19	57.24
	c	−104.18	−97.592	71.534	19.76
	aq	−100.06	−98.82	72.431	37.7
$KClO$	*aq*	−85.4	....	....	....
$KClO_3$	*c*	−93.50	−69.29	50.789	34.17
	aq, 100	−84.09	....	....	....
	aq	−83.54	−68.09	49.909	63.5
$KClO_4$	*c*	−103.6	−72.7	53.29	36.1
	aq	−91.45	−70.04	51.338	68.0
K_2CrO_4	*c*	−330.49	....	....	....
$K_2Cr_2O_7$	*c*	−485.90	....	....	....
KF	*c*	−134.46	−127.42	93.397	15.91
$KF\cdot 2H_2O$	*c*	−277.0	−242.7	177.90	36
$KF\cdot 4H_2O$	*c*	−418.0	....	....	....
KHF_2	*c*	−219.98	−203.73	149.331	24.92
KI	*c*	−78.31	−77.03	56.462	24.94
	aq	−73.41	−79.82	58.504	50.6
KIO_3	*c*	−121.5	−101.7	74.54	36.20
	aq	−115.0	−99.9	73.22	52.2
KIO_4	*aq*, 1200	−97.6	....	....	....
$KMnO_4$	*c*	−194.4	−170.6	125.05	41.04
KNH_2	*c*	−28.3	....	....	....
KNO_2	*c*	−88.5	....	....	....
KNO_3	*c*	−117.76	−93.96	68.871	31.77
	aq	−109.41	−93.88	68.813	69.5
K_2O	*c*	−86.4	....	....	....
K_2O_2	*c*	−118	....	....	....
K_2O_4	*c*	−134	....	....	....
KOH	*c*	−101.78	....	....	....
	aq	−115.00	−105.06	77.008	22.0
K_2S	*c*	−100	....	....	....
K_2S_4	*c*	−113.0	....	....	....
K_2SO_3	*c*	−266.9	....	....	....
K_2SO_4	*c*	−342.66	−314.62	230.612	42.0
$KHSO_4$	*c*	−276.8	....	....	....
$K_2S_2O_6$	*c*	−413.6	....	....	....
$K_2S_2O_8$	*c*	−458.3	....	....	....
$K_2S_4O_6$	*c*	−422	....	....	....
K_2Se	*c*	−79.3	....	....	....
Praseodymium					
Pr	*g*	87	....	....	....
	c	0.00	0.00	0.000	....
Pr^{+++}	*aq*	−172.7	−169.1	123.95	....
$PrCl_3$	*c* (α)	−257.8	....	....	....
	aq	−292.8	−263.1	192.85	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Praseodymium					
$PrCl_3 \cdot H_2O$	c	−330.8	....	....	....
$PrCl_3 \cdot 7H_2O$	c	−764.5	....	....	....
PrI_3	c (α)	−162.0	....	....	....
	aq	−212.8	−206.1	151.07	....
PrO_2	c	−234.0	....	....	....
Pr_2O_3	c	−444.5	....	....	....
$Pr(OH)_3$	c	....	−310.7	227.74	....
$Pr_2(SO_4)_3$	aq	−996.1	−870.2	637.84	....
$Pr_2(SO_4)_3 \cdot 8H_2O$	c	....	−1337.0	980.00	....
Promethium					
Pm^{+++}	aq	−170.4	....	....	....
$PmCl_3$	c	−251.9	....	....	....
	aq	−290.5	....	....	....
Radium					
Ra	g	31	23	−16.8	42.15
	c	0.00	0.00	0.000	17
Ra^{++}	aq	−126.	−134.5	98.58	13
$RaCl_2 \cdot 2H_2O$	c	−351	−311.7	228.47	50
$Ra(NO_3)_2$	c	−237	−190.3	139.49	52
RaO	c	−125	....	....	....
$RaSO_4$	c	−352	−326.0	238.95	34
Radon					
Rn	g	0.00	0.00	0.000	42.10
Rhenium					
Re	g	189	179	−131.2	45.13
	c	0.00	0.00	0.000	10
ReF_6	g	−273	....	....	....
Re_2O_7	c	−297.5	....	....	....
Re_2O_8	c	−148.3	....	....	....
ReS_2	c	−44.3	....	....	....
ReO_4^-	aq	−190.3	....	....	....
Rhodium					
Rh	g	138	127	−93.09	44.39
	c	0.00	0.00	0.000	7.6
RhCl	c	−16	....	....	....
$RhCl_2$	c	−36	....	....	....
$RhCl_3$	c	−56	....	....	....
RhO	c	−21.7	....	....	....
RH_2O	c	−22.7	....	....	....
Rh_2O_3	c	−68.3	....	....	....
Rubidium					
Rb	g	20.51	13.35	−9.785	40.63
	c	0.00	0.00	0.000	16.6
Rb^{+++}	aq	−58.9	−67.45	47.974	29.7
RbBr	c	−93.03	−90.38	66.247	25.88
	aq	−87.8	−92.02	67.449	49.0
Rb_2CO_3	c	−269.6	....	....	....
$Rb_2CO_3 \cdot H_2O$	c	−344.2	....	....	....
$RbHCO_3$	c	−228.5	....	....	....
RbCNS	c	−54	....	....	....
	aq	−41.7	....	....	....
RbCl	c	−102.9	−98.48	....	....
	aq	−98.9	−98.80	72.419	42.9
$RbClO_3$	c	−93.8	−69.8	51.16	36.3
	aq	−82.4	−68.07	49.894	68.7
$RbClO_4$	c	−103.87	−73.19	53.647	38.4
	aq	−90.3	−70.02	51.324	73.2
RbF	c	−131.28	....	....	....
	aq	−137.6	−133.53	97.876	27.4
$RbHF_2$	c	−217.3	....	....	....
RbI	c	−78.5	−77.8	57.03	28.21
	aq	−72.3	−79.80	58.492	55.8

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Rubidium					
$RbNO_3$	*c*	−117.04	....	....	....
	aq	−108.5	−93.86	68.798	64.7
$RbNH_2$	*c*	−25.7	....	....	....
Rb_2O	*c*	−78.9	....	....	....
Rb_2O_2	*c*	−101.7	....	....	....
RbOH	*c*	−98.9	....	....	....
	aq	−113.9	−105.05	77.000	27.2
$RbOH{\cdot}H_2O$	*c*	−177.8	....	....	....
$RbOH{\cdot}2H_2O$	*c*	−250.8	....	....	....
Rb_2S	*c*	−83.2	....	....	....
RbHS	*c*	−62.4	....	....	....
$RbHSO_4$	*c*	−273.7	....	....	....
Rb_2SO_4	*c*	−340.50	....	....	....
	aq	−334.7	−312.24	228.868	33.8
Ruthenium					
Ru	*g*	160	149	−109.2	44.57
	c	0.00	0.00	0.000	6.9
$RuCl_3$	*c*	−63	....	....	....
RuO_2	*c*	−52.5	....	....	....
RuS_2	*c*	−48.1	−44.1	....	....
Samarium					
Sm	*g*	87	....	....	43.74
Sm^{+++}	*aq*	−169.8	−165.9	121.60	....
$SmCl_3$	*c* (α)	−249.8	....	....	....
	aq	−289.9	−259.9	190.50	....
SmI_3	*c* (β)	−153.4	....	....	....
	aq	−209.9	−202.9	148.72	....
$Sm(OH)_3$	*c*	....	−308.8	226.35	....
$Sm_2(SO_4)_3$	*aq*	−990.3	−863.8	633.15	....
$Sm_2(SO_4)_3{\cdot}8H_2O$	*c*	....	−1332.6	976.78	....
Scandium					
Sc	*g*	93	....	....	41.76
Sc^{+++}	*aq*	−148.8	−143.7	105.33	....
$ScBr_3$	*c*	−179.4	....	....	....
	aq	−235.5	−217.4	159.35	....
$ScCl_3$	*c*	−220.8	....	....	....
	aq	−268.9	−237.7	174.23	....
Selenium					
Se	*g*	48.37	38.77	−28.42	42.21
Se (gray, hex.)	*c*	0.00	0.00	0.000	10.0
(red, mon.)	*c*	0.2	....	....	....
	gls	1.05	....	....	....
	ppt	1.05	....	....	....
H_2Se	*g*	20.5	17	−12.468	52.9
	aq	18.1	18.4	−13.49	39.9
SeO_2	*c*	−55.00	....	....	....
H_2SeO_3	*c*	−126.5	....	....	....
	aq	−122.39	−101.8	74.622	45.7
H_2SeO_4	*c*	−128.6	....	....	....
	aq	−145.3	−105.42	77.276	5.7
Silicon					
Si	*g*	88.04	77.41	−56.740	40.12
	c	0.00	0.00	0.000	4.47
$SiBr_4$	*lq*	−95.1	....	....	....
SiC	*c*	−26.7	−26.1	19.13	3.94
$SiCl_4$	*g*	−145.7	−136.2	99.83	79.2
	lq	−153.0	−136.9	100.34	57.2
SiF_4	*g*	−370	−360	263.9	68.0
SiH_4	*g*	−14.8	−9.4	6.89	48.7
SiI_4	*c*	−31.6	....	....	....
Si_3N_4	*c*	−179.3	−154.7	113.39	22.4

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Silicon					
SiO_2 (quartz)	*c*	−205.4	−192.4	141.03	10.00
(cristobalite)	*c*	−205.0	−192.1	140.81	10.19
(tridymite)	*c*	−204.8	−191.9	140.66	10.36
	gls	−202.5	−190.9	139.92	11.2
	aq	−201.0	....	....	....
SiS_2 (white)	*c*	−34.7	....	....	....
H_2SiF_6	*aq*	−557.2	....	....	....
H_2SiO_3	*c*	−270.7	....	....	....
H_2SiO_4	*c*	−340.6	....	....	....
H_2SiO_5	*c*	−472.4	....	....	....
$H_6Si_2O_7$	*c*	−611.2	....	....	....
Silver					
Ag	*g*	69.12	59.84	−43.862	41.32
	c	0.00	0.00	0.000	10.21
Ag^+	*aq*	25.31	18.43	−13.51	17.67
AgBr	*c*	−23.78	−22.39	16.807	25.60
Ag_2CO_3	*c*	−120.97	−104.48	76.582	40.0
$AgC_2H_3O_2$	*c*	−93.41	....	....	....
AgCN	*c*	34.94	39.20	−28.733	20.0
AgCNO	*c*	−21.1	....	....	....
AgONC	*c*	43.2	....	....	....
AgCNS	*c*	21.0	....	....	....
AgCl	*g*	23.23	16.79	−12.307	58.5
	c	−30.36	−26.22	19.222	22.97
$AgClO_2$	*c*	0.00	16.0	−11.73	32.16
$AgClO_3$	*c*	−5.73	....	....	....
$AgClO_4$	*c*	−7.75	....	....	....
Ag_2CrO_4	*c*	−170.15	−148.57	108.90	51.8
AgF	*c*	−48.5	−44.2	32.40	20
	aq	−53.35	−47.65	34.927	15.4
AgH	*g*	67.7	60.8	−44.56	48.86
AgI	*c*	−14.91	−15.85	11.618	27.3
$AgIO_3$	*c*	−42.02	−24.08	....	35.7
AgN_3	*c*	66.8	....	....	....
$AgNO_2$	*c*	−10.61	4.74	−3.477	30.62
	aq	−0.09	9.79	−7.176	49.0
$AgNO_3$	*c*	−29.43	−7.69	5.637	33.68
	aq	−24.06	−7.98	5.849	52.67
Ag_2O	*c*	−7.31	−2.59	1.896	29.09
Ag_2O_2	*c*	−6.3	....	....	....
Ag_2S	*c* (α)	−7.60	−9.62	7.051	34.8
	c (β)	−7.01	−9.36	6.860	35.9
Ag_2SO_4	*c*	−170.50	−147.17	107.873	47.8
Sodium					
Na	*g*	25.98	18.67	−13.685	36.72
	c	0.00	0.00	0.000	12.2
Na^+	*aq*	−57.28	−62.59	45.88	14.4
Na_3AsO_4	*c*	−365	....	....	....
$Na_3AsO_4{\cdot}12H_2O$	*c*	−1213.9	....	....	....
$NaBO_2$	*c*	−253	....	....	....
$NaBO_3{\cdot}4H_2O$	*c*	−504.8	....	....	....
$Na_2B_4O_7$	*c*	−777.7	....	....	....
$Na_2B_4O_7{\cdot}4H_2O$	*c*	−1072.9	....	....	....
$Na_2B_4O_7{\cdot}5H_2O$	*c*	−1143.5	....	....	....
$Na_2B_4O_7{\cdot}10H_2O$	*c*	−1497.2	....	....	....
Na_3BiO_4	*c*	−288.	....	....	....
NaBr	*c*	−86.03	....	....	....
	aq	−86.18	−87.16	63.889	33.7
$NaBr{\cdot}2H_2O$	*c*	−227.25	....	....	....
NaCN	*c*	−21.46	....	....	....
$NaCN{\cdot}\frac{1}{2}H_2O$	*c*	−56.19	....	....	....
$NaCN{\cdot}2H_2O$	*c*	−162.25	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log$_{10}$ Kf	S°
Sodium					
NaCNO	*c*	−95.6	....	....	....
NaCNS	*c*	−41.73	....	....	....
	aq	−40.1	....	....	....
Na_2CO_3	*c*	−270.3	−250.4	183.53	32.5
$Na_2CO_3 \cdot H_2O$	*c*	−341.8	....	....	....
$Na_2CO_3 \cdot 7H_2O$	*c*	−765.1	....	....	....
$Na_2CO_3 \cdot 10H_2O$	*c*	−975.6	....	....	....
$NaHCO_3$	*c*	−226.5	−203.6	149.24	24.4
$NaC_2H_3O_2$	*c*	−169.8	....	....	....
$NaC_2H_3O_2 \cdot 3H_2O$	*c*	−383.50	....	....	....
$Na_2C_2O_4$	*c*	−314.3	....	....	....
NaCl	*g*	−43.50	....	....	....
	c	−98.23	−91.79	67.277	17.30
	aq	−97.302	−93.94	68.856	27.6
NaClO	*aq*	−82.7	....	....	....
$NaClO_2$	*c*	−72.65	....	....	....
$NaClO_3$	*c*	−85.73	....	....	....
	aq, 400	−80.74	−62.8	....	....
	aq, 1000	−80.73	....	....	....
	aq, 5000	−80.74	....	....	....
	aq	−80.78	−63.21	46.332	53.4
$NaClO_4$	*c*	−92.18	....	....	....
	aq	−88.69	−65.16	47.688	57.9
Na_2CrO_4	*c*	−317.6	....	....	....
$Na_2CrO_4 \cdot 4H_2O$	*c*	−601.3	....	....	....
$Na_2Cr_2O_7$	*aq*, 600	−463.4	....	....	....
NaF	*c*	−136.0	−129.3	94.78	14.0
	aq	−135.94	−128.67	94.313	12.1
$NaHF_2$	*c*	−216.6	....	....	....
NaH	*g*	29.88	24.78	−18.163	44.93
	c	−13.7	....	....	....
NaI	*g*	−20.94	....	....	....
	c	−68.84	....	....	....
	aq	−70.65	−70.94	51.998	40.5
$NaI \cdot 2H_2O$	*c*	−211.05	....	....	......
	aq, ∞	−112.3	....	....	....
$NaNH_2$	*c*	−28.4	....	....	....
$NaNO_2$	*c*	−85.9	....	....	....
$NaNO_3$	*c*	−101.54	−87.45	64.100	27.8
	aq	−106.65	−89.00	65 236	49.4
Na_2O	*c*	−99.4	−90.0	65.97	17.4
Na_2O_2	*c*	−120.6	....	....	......
NaOH	*c*	−101.99	....	....	....
	aq	−112.24	−100.184	73.434	11.9
$NaOH \cdot H_2O$	*c*	−175.17	−149.00	109.215	20.2
$NaPO_3$	*c*	−288.6	....	....	....
NaH_2PO_3	*c*	−289.4	....	....	....
$NaH_2PO_3 \cdot 2\frac{1}{2}H_2O$	*c*	−454.8	....	....	....
Na_2HPO_3	*c*	−338.0	....	....	....
$Na_2HPO_3 \cdot 5H_2O$	*c*	−684.2	....	....	....
NaH_2PO_4	*aq*, 300	−367.7	....	....	....
Na_2HPO_4	*c*	−417.4	....	....	....
$Na_2HPO_4 \cdot 2H_2O$	*c*	−560.2	....	....	....
$Na_2HPO_4 \cdot 7H_2O$	*c*	−913.3	....	....	....
$Na_2HPO_4 \cdot 12H_2O$	*c*	−1266.4	....	....	....
Na_3PO_4	*c*	−460	....	....	....
$Na_3PO_4 \cdot 12H_2O$	*c*	−1309.0	....	....	....
$NaNH_4HPO_4 \cdot 4H_2O$	*c*	−682.7	....	....	....
$NaH_3P_2O_7$	*c*	−602.7	....	....	....
$NaH_3P_2 \cdot O_7H_2O$	*c*	−670.6	....	....	....
$Na_2H_2P_2O_7$	*c*	−663.4	....	....	....
$Na_2H_2P_2O_7 \cdot 6H_2O$	*c*	−1085 5	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log10 Kf	S°
Sodium					
$Na_3HP_2O_7$	*c*	−711.4	....	....	....
$Na_3HP_2O_7 \cdot H_2O$	*c*	−788.2	....	....	....
$Na_3HP_2O_7 \cdot 6H_2O$	*c*	−1135.7	....	....	....
$Na_4P_2O_7$	*c*	−760.8	....	....	....
$Na_4P_2O_7 \cdot 10H_2O$	*c*	−1468.2	....	....	....
Na_2PbO_3	*c*	−205.	....	....	....
Na_2PtCl_6	*c*	−273.6	....	....	....
$Na_2PtCl_6 \cdot 2H_2O$	*c*	−418.5	....	....	....
$Na_2PtCl_6 \cdot 6H_2O$	*c*	−702.5	....	....	....
Na_2S	*c*	−89.2	....	....	....
$Na_2S \cdot 4\frac{1}{2}H_2O$	*c*	−416.9	....	....	....
$Na_2S \cdot 5H_2O$	*c*	−452.7	....	....	....
$Na_2S \cdot 9H_2O$	*c*	−736.7	....	....	....
Na_2S_4	*c*	−98.4	....	....	....
Na_2SO_3	*c*	−260.6	−239.5	175.55	34.9
$Na_2SO_3 \cdot 7H_2O$	*c*	−753.4	....	....	....
Na_2SO_4	*c*	−330.90	−302.78	221.934	35.73
	aq	−331.46	−302.52	221.743	32.9
$Na_2SO_4 \cdot 10H_2O$	*c*	−1033.48	−870.93	638.380	141.7
$NaHSO_4$	*c*	−269.2	....	....	....
$NaHSO_4 \cdot H_2O$	*c*	−339.2	....	....	....
$Na_2S_2O_3$	*c*	−267.0	....	....	....
$Na_2S_2O_3 \cdot 5H_2O$	*c* (I)	−621.89	....	....	....
	c (II)	−620.60	....	....	....
$Na_2S_2O_5$	*c*	−349.1	....	....	....
$Na_2S_2O_6$	*c*	−399.9	....	....	....
$Na_2S_2O_6 \cdot 2H_2O$	*c*	−542.5	....	....	....
$Na_2S_3O_6 \cdot 3H_2O$	*c*	−623.0	....	....	....
$Na_2S_4O_6 \cdot 2H_2O$	*c*	−550.0	....	....	....
Na_2Se	*c*	−63.0	....	....	....
$Na_2Se \cdot 4\frac{1}{2}H_2O$	*c*	−398.2	....	....	....
$Na_2Se \cdot 9H_2O$	*c*	−709.1	....	....	....
$Na_2Se \cdot 16H_2O$	*c*	−1199.4	....	....	....
$NaHSe$	*c*	−27.8	....	....	....
Na_2SeO_4	*c*	−258.	....	....	....
Na_2SiO_3	*c*	−363	−341	249.9	27.2
$Na_2SiO_3 \cdot 5H_2O$	*c*	−720.0	....	....	....
$Na_2SiO_3 \cdot 9H_2O$	*c*	−1002.0	....	....	....
Na_2SiF_6	*c*	−677	....	....	....
Na_2SnO_3	*c*	−276	....	....	....
Na_4SnO_4	*aq*, 1200	−455.5	....	....	....
Na_2UO_4	*c*	−501	....	....	....
$Na_2U_2O_7 \cdot 1\frac{1}{2}H_2O$	*c*	−880	....	....	....
Na_3VO_4	*c*	−420	....	....	....
Na_2WO_4	*c*	−395	....	....	....
Na_2ZnO_2	*c*	−188	....	....	....
Strontium					
Sr	*g*	39.2	26.3	−19.28	39.33
	c	0.00	0.00	0.000	13.0
Sr^{++}	*aq*	−130.38	−133.2	97.49	−9.4
$Sr_3(AsO_4)_2$	*c*	−800.7	....	....	....
$SrBr_2$	*c*	−171.1	....	....	....
	aq	−188.2	−182.1	133.48	29.2
$SrBr_2 \cdot H_2O$	*c*	−246.2	....	....	....
$SrBr_2 \cdot 6H_2O$	*c*	−604.4	....	....	....
$SrCO_3$	*c*	−291.2	−271.9	199.30	23.2
$Sr(HCO_3)_2$	*aq*	−460.7	−413.8	303.31	36.0
$Sr(C_2H_3O_2)_2$	*c*	−356.7	....	....	....
	aq	−362.7	−311.8	....	....
$Sr(C_2H_3O_2)_2 \cdot \frac{1}{2}H_2O$	*c*	−391.2	....	....	....
SrC_2O_4	*aq*	−327.4	−294.3	215.72	3
$SrC_2O_4 \cdot H_2O$	*c*	....	360.8	264.46	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
Strontium					
$SrC_2O_4 \cdot 2\frac{1}{2}H_2O$	*c*	−504.2	....	....	....
$Sr(CN)_2 \cdot 4H_2O$	*c*	−335.2	....	....	....
$SrCl_2$	*c*	−198.0	−186.7	136.85	28
	aq	−210.43	−195.7	143.45	16.9
$SrCl_2 \cdot H_2O$	*c*	−271.7	....	....	....
$SrCl_2 \cdot 2H_2O$	*c*	−343.7	....	....	....
$SrCl_2 \cdot 6H_2O$	*c*	−627.1	....	....	....
SrF_2	*c*	−290.3	....	....	....
SrH	*g*	52.4	45.8	−33.57	49.43
SrH_2	*c*	−42.3	....	....	....
SrI_2	*c*	−135.5	....	....	....
	aq	−157.1	−157.7	115.59	42.9
$SrI_2 \cdot H_2O$	*c*	−212.2	....	....	....
$SrI_2 \cdot 2H_2O$	*c*	−282.8	....	....	....
$SrI_2 \cdot 6H_2O$	*c*	−571.2	....	....	....
$Sr(N_3)_2$	*c*	48.9	....	....	....
Sr_3N_2	*c*	−93.4	....	....	....
$Sr(NO_2)_2$	*c*	−179.3	....	....	....
$Sr(NO_3)_2$	*c*	−233.25	....	....	....
	aq	−229.02	−185.8	136.19	60.06
$Sr(NO_3)_2 \cdot 4H_2O$	*c*	−514.5	....	....	....
SrO	*c*	−141.1	−133.8	98.07	13.0
SrO_2	*c*	−153.6	....	....	....
$SrO_2 \cdot 8H_2O$	*c*	−722.6	....	....	....
$Sr(OH)_2$	*c*	−229.3	....	....	....
	aq	−240.29	−208.2	152.61	−14.4
$Sr(OH)_2 \cdot H_2O$	*c*	−302.3	....	....	....
$Sr(OH)_2 \cdot 8H_2O$	*c*	−801.2	....	....	....
$Sr_3(PO_4)_2$	*c*	−987.3	....	....	....
$SrHPO_4$	*c*	−431.3	....	....	....
$Sr(H_2PO_4)_2 \cdot H_2O$	*c*	−819.4	....	....	....
SrS	*g*	19	....	....	....
	c	−108.1	....	....	....
$SrSO_4$	*c*	−345.3	−318.9	233.75	29.1
	aq	−347.38	−310.3	227.45	−5 3
Sulfur					
S	*g*	53.25	43.57	−31.9362	40.085
(rhb)	*c*	0.00	0.00	0.000	7.62
(mon)	*c*	0.071	0.023	−0.017	7.78
S_2Br_2	*lq*	−3.6	....	....	....
S_2Cl_2	*lq*	−14.4	....	....	....
S_2Cl_4	*lq*	−24.0	....	....	....
$SOCl_2$	*lq*	−49.2	....	....	....
SO_2Cl_2	*lq*	−93 0	−75	....	....
SF_6	*g*	−262	−237	173.7	69.5
H_2S	*g*	−4.815	−7.892	5.785	49.15
	aq	−9.4	−6.54	4.797	29.2
$H_2S \cdot 6H_2O$	*c*	−431.2	....	....	....
SO_2	*g*	−70.96	−71.79	52 621	59.40
SO_3	*g*	−94.45	−88.52	64.884	61.24
	lq	−104.67	....	....	....
S_2O_7	*c*	−194.3	....	....	....
H_2SO_3	*aq*, 200	−146.82	−128.54	....	....
	aq, 500	−147.17	....	....	....
	aq, 1000	−147.59	....	....	....
	aq, 5000	−148.73	....	....	....
H_2SO_4	*lq*	−193.91	....	....	....
	aq	−216.90	−177.34	129.99	4.1
S^{--}	*aq*	10	20	−14.660	5.3
SO_3^{--}	*aq*	−149.2	−118.8	87.08	10.4
SO_4^{--}	*aq*	−216.90	−177.34	129.99	4.1
$S_2O_3^{--}$	*aq*	−154.	−127.2	93.24	29.

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
Sulfur					
HS^-	*aq*	−4.22	3.01	−2.206	14.6
HSO_3^-	*aq*	−150.09	−126.03	92.378	31.64
HSO_4^-	*aq*	−211.70	−179.94	131.893	30.32
Tantalum					
Ta	*g*	185	175	−128.3	44.24
	c	0.00	0.00	0.000	9.9
TaN	*c*	−58.2	....	....	....
Ta_2O_5	*c*	−499.9	−470.6	344.94	34.2
Technetium					
Tc	*c*	0.00	0.00	0.000	9
Tellurium					
Te	*g*	47.6	38.1	−27.93	43.64
	c	0.00	0.00	0.000	11.88
	(*am. ppt*)	2.7	....	....	....
Te_2	*g*	41.0	29.0	−21.26	64.07
$TeBr_4$	*c*	−49.8	....	....	....
$TeCl_4$	*c*	−77.2	....	....	....
TeF_6	*g*	−315	−292	214.0	80.67
H_2Te	*g*	36.9	33.1	−24.26	56
TeO_2	*c*	−77.69	−64.60	47.353	16.99
H_2TeO_3	*c*	−144.7	−115.7	84.81	47.7
	aq	−144.7	....	....	....
H_2TeO_4	*aq*	−166.7	....	....	....
$H_2TeO_4 \cdot 2H_2O$	*c*	−306.6	−245.3	179.80	47
Terbium					
Tb	*g*	87	....	....	....
	c	0.00	0.00	0.000	....
Tb^{+++}	*aq*	−168.4	−163.9	120.14	....
$TbCl_3$	*c* (*β*)	−241.6	....	....	....
	aq	−288.5	−257.9	189.04	....
$Tb_2(SO_4)_3$	*aq*	−987.5	−859.8	630.22	....
$Tb_2(SO_4)_3 \cdot 8H_2O$	*c*	....	−1328.2	973.55	....
Thallium					
Tl	*g*	44.5	36.2	−26.53	43.23
	c	0.00	0.00	0.000	15.4
Tl^+	*aq*	1.38	−7.755	5.68	30.4
Tl^{+++}	*aq*	27.7	50.0	−36.65	−106
TlBr	*g*	−5.	−14	10.3	63.8
	c	−41.2	−39.7	29.10	26.6
	aq	−27.5	−32.3	23.68	49.7
$TlBr_3$	*c*	−59.0	....	....	....
$TlBr_3 \cdot 4H_2O$	*c*	−334.6	....	....	....
$TlBrO_3$	*c*	−24.0	....	....	....
	aq	−10.2	1.3	−0.953	68.6
TlCl	*g*	−16.	−22	16.1	61.1
	c	−48.99	−44.19	32.391	25.9
	aq	−38.64	−39.105	28.663	43.6
$TlCl_3$	*c*	−83.9	....	....	....
$TlCl_3 \cdot 4H_2O$	*c*	−367.7	....	....	....
TlF	*g*	−33	....	....	....
TlH	*g*	48	42	−30.8	51.39
TlI	*c* (II)	−29.7	−29.7	21.77	29.4
	aq	−12.0	−19.9	14.59	56.5
$TlIO_3$	*c*	....	−47.6	34.89	....
	aq	−53.5	−40.1	29.39	58.1
$TlNO_3$	*c*	−58.01	−36.07	26.439	38.2
	aq	−47.99	−34.22	25.083	65.6
Tl_2O	*c*	−41.9	−32.5	23.82	23.8
TlOH	*c*	−56.9	−45.5	33.35	17.3
$Tl(OH)_3$	*c*	−122.6	....	....	....
Tl_2S	*c*	−20.8	....	....	....
Tl_2SO_4	*c*	−221.7	....	....	....
	aq	−214.14	−192.85	141.356	65.1

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
Thorium					
Th	*c*	0.00	0.00	0.000	13.6
Th^{++++}	*aq*	−183.0	....	....	....
$ThBr_4$	*c*	−227.1	....	....	....
ThC_2	*c*	−45	....	....	....
$ThCl_4$	*c*	−285	....	....	....
ThF_4	*c*	−477	....	....	....
ThH_4	*c*	−43	....	....	....
ThI_4	*c*	−131	....	....	....
$Th(NO_3)_4$	*aq*, 100	−380.48	....	....	....
ThO_2	*c*	−292	....	....	....
$Th(OH)_4$	*c**	−421.5	....	....	....
Th_2S_3	*c*	−262.0	....	....	....
$Th(SO_4)_2$	*c*	−602	....	....	....
Thulium					
Tm	*c*	0.00	0.00	0.000	....
Tm^{+++}	*aq*	−161.3	−156.5	114.71	....
$TmCl_3$	*c* (γ)	−229.5	....	....	....
	aq	−281.4	−250.5	183.61	....
TmI_3	*c* (β)	−137.8	....	....	....
	aq	−201.4	−193.5	141.83	....
Tin					
Sn	*g*	72	64	−47.6	40.25
(gray), cubic	*c* (III)	0.6	1.1	−0.806	10.7
(tet), white	*c* (II)	0.00	0.00	0.000	12.3
$SnBr_2$	*c*	−63.6	....	....	....
$SnBr_4$	*c* (I)	−97.1	....	....	....
$SnBr_4·8H_2O$	*lq*	−656.6	....	....	....
$Sn(C_2H_5)_4$	*lq*	−49	....	....	....
$SnCl_2$	*c*	−83.6	....	....	....
$SnCl_2·2H_2O$	*c*	−225.9	....	....	....
$SnCl_4$	*lq*	−130.3	−113.3	83.047	61.8
$SnOCl_2$	*aq*	−147.5	....	....	....
SnI_2	*c*	−34.4	....	....	....
SnO	*c*	−68.4	−61.5	45.08	13.5
SnO_2	*c*	−138.8	−124.2	91.037	12.5
$Sn(OH)_2$	*c*	−138.3	−117.6	86.199	23.1
$Sn(OH)_4$	*c*	−270.5	....	....	....
SnS	*c*	−18.6	−19.7	14.44	23.6
$Sn(SO_4)_2$	*c*	−393.4	....	....	....
Titanium					
Ti	*g*	112	101	−74	43.07
	c	0.00	0.00	0.000	7.24
$TiBr_2$	*c*	−95	....	....	....
$TiBr_3$	*c*	−132	....	....	....
$TiBr_4$	*c*	−155	....	....	....
TiC	*c*	−54	−53	38.8	5.8
TiCl	*g*	122	....	....	....
$TiCl_2$	*c*	−114	....	....	....
$TiCl_3$	*c*	−165	....	....	....
$TiCl_4$	*g*	....	....	....	84.4
	lq	−179.3	−161.2	118.16	60.4
TiF_2	*c*	−198	....	....	....
TiF_3	*c*	−315	....	....	....
TiF_4	*c*	−370	....	....	....
H_2TiF_6	*lq*	−555.1	....	....	....
TiI_2	*c*	−61	....	....	....
TiI_3	*c*	−80	....	....	....
TiI_4	*c*	−102	....	....	....
TiN	*c*	−73.0	−66.1	48.45	7.2
TiO	*g*	43	....	....	....
	c (II)	....	....	....	8.31

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* Soluble.

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Titanium					
TiO_2 (rutile)	*c* (III)	−218.0	−203.8	149.38	12.01
(hydrated)	(*am. ppt*)	−207.	....	....	....
Ti_2O_3	*c* (II)	−367	−346	253.6	18.83
Ti_3O_5	*c*	−584	−550	403.1	30.92
Tungsten					
W	*g*	201.6	191.6	−140.44	41.55
	c	0.00	0.00	0.000	8.0
WC	*c*	−9.09	....	....	....
WO_2	*c*	−136.3	....	....	....
WO_3 (yellow)	*c*	−200.84	−182.47	133.748	19.90
$WO_3 \cdot H_2O$ (H_2WO_4)	*c*	−279.6	....	....	....
W_2O_5	*c*	−337.9	....	....	....
WS_2	*c*	−46.3	−46.2	33.86	23
Uranium					
U	*g*	125	....	....	....
	c (III)	0.00	0.00	0.000	12.03
U^{+++}	*aq*	−123.0	−124.4	91.18	−30
U^{++++}	*aq*	−146.7	−138.4	101.44	−78
UBr_3	*c*	−170.1	−164.7	120.72	49
UBr_4	*c*	−196.6	−188.5	138.17	58
UC_2	*c*	−42	−42	30.8	14
UCl_3	*c*	−213.0	−196.9	144.32	37.99
UCl_4	*c*	−251.2	−230.0	168.59	47.4
UCl_5	*c*	−262.1	−237.4	174.01	62
UCl_6	*c*	−272.4	−241.5	177.02	68.3
UF_3	*c*	−357	−339	248.5	26
UF_4	*c*	−443	−421	308.6	36.1
UF_5	*c*	−488	−461	337.9	43
UF_6	*g*	−505	−485	355.5	90.76
UH_3	*c*	−30.4	....	....	....
UI_3	*c*	−114.7	−115.3	84.51	56
UI_4	*c*	−127.0	−126.1	92.43	65
$UIBr_3$	*c*	−177.1	....	....	....
$UICl_3$	*c*	−219.9	−204.4	149.82	54
UN	*c*	−80	−75	55	18
U_2N_3	*c*	−213	−194	142.2	29
UO_2	*c*	−270	−257	188.4	18.6
UO_2^{+}	*aq*	−247.4	−237.6	174.16	12
UO_2^{++}	*aq*	−250.4	−236.4	173.28	−17
UO_3	*c*	−302	−283	207.4	23.57
$UO_3 \cdot H_2O$	*c*	−375.4	....	....	....
$UO_3 \cdot 2H_2O$	*c*	−446.2	....	....	....
$UO_4 2H_2O$	*c*	−436	....	....	....
U_3O_8	*c*	−898	....	....	....
$U(OH)_3^{+++}$	*aq*	−204.1	−193.5	141.83	−30
$U(SO_4)_2$	*c*	−563	....	....	....
UO_2Br_2	*aq* (dil)	−308.2	....	....	....
$UO_2(C_2H_3O_2)_2$	*aq* (dil)	−484.0	....	....	....
$UO_2(C_2H_3O_2)_2 \cdot 2H_2O$	*c*	−624.9	....	....	....
$UO_2(C_2H_3O_2)_2 \cdot NH_4C_2H_3O_2 \cdot 6H_2O$	*c*	−1045.8	....	....	....
UO_2Cl_2	*aq* (dil)	−331	....	....	....
UO_2CrO_4	*aq* (dil)	−456.7	....	....	....
$UO_2CrO_4 \cdot 5\frac{1}{2}H_2O$	*c*	−838.8	....	....	....
$UO_2(NO_3)_2$	*c*	−329.2	−273.1	200.18	66
	aq	−349.1	−289.2	211.98	53
$UO_2(NO_3)_2 \cdot H_2O$	*c*	−404.8	−335.3	245.77	76
$UO_2(NO_3)_2 \cdot 2H_2O$	*c*	−480.0	−396.6	290.70	85
$UO_2(NO_3)_2 \cdot 3H_2O$	*c*	−552.2	−454.7	333.29	94
$UO_2(NO_3) \cdot 6H_2O$	*c*	−764.3	−625.0	458.12	120.85
UO_2SO_4	*aq*	−467.3	−413.7	303.24	−13
$UO_2SO_4 \cdot 3H_2O$	*c*	−666.8	−586.0	429.53	63

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log₁₀ Kf	S°
Vanadium					
V	g	120	109	−79.90	43.55
	c	0.00	0.00	0.000	7.05
VCl_2	c	−108	−97	71.1	23.2
VCl_3	c	−137	−120	87.96	31.3
VCl_4	lq	−138	....	....	....
VN	c	−41	−35	25.7	8.91
VO	g	52	....	....	....
V_2O_2	c	−200	....	....	....
V_2O_3	c	−290	−271	198.6	23.58
V_2O_4	c (II)	−344	−318	233.1	24.65
V_2O_5	c	−373	−344	252.1	31.3
$VOCl_3$	c	−172	....	....	....
$VOSO_4$	c	−312.5	....	....	....
Wolfram (See Tungsten)					
Xenon					
Xe	g	0.00	0.00	0.000	40.53
$Xe \cdot 6H_2O$	c	−428	....	....	....
Ytterbium					
Yb	g	87	....	....	41.30
	c	0.00	0.00	0.000	....
Yb^{++}	aq	....	−129.0	94.56	....
Yb^{+++}	aq	−160.6	−155.5	113.98	....
$YbCl_3$	c (γ)	−228.7	....	....	....
	aq	−280.7	−249.5	182.88	....
$Yb_2(SO_4)_3$	aq	−971.9	−843.0	617.91	....
$Yb_2(SO_4)_3 \cdot 8H_2O$	c	....	−1308.8	959.33	....
Yttrium					
Y	g	103	....	....	42.87
	c	0.00	0.00	0.000	....
Y^{+++}	aq	−168.0	−164.1	120.28	....
YCl_3	c (γ)	−234.8	....	....	....
	aq	−288.1	−258.1	189.18	....
YI_3	c (β)	−143.2	....	....	....
	aq	−208.1	−201.1	147.40	....
$Y(OH)_3$	c	−337.6	−308.3	225.98	....
$Y_2(SO_4)_3$	aq	−986.7	−860.2	630.51	....
$Y_2(SO_4)_3 \cdot 8H_2O$	c	−1512.6	−1327.3	972.89	....
Zinc					
Zn	g	31.19	22.69	−16.631	38.45
	c	0.00	0.00	0.000	9.95
Zn^{++}	aq	−36.43	−35.184	25.79	−25.45
$ZnBr_2$	c	−78.17	−74.142	54.345	32.84
	aq	−94.23	−84.33	61.814	13.13
$ZnBr_2 \cdot 2H_2O$	c	−220.9	−190.6	139.71	56.2
$Zn(CN)_2$	c	18.4	....	....	....
$ZnCO_3$	c	−194.2	−174.8	128.13	19.7
$Zn(C_2H_3O_2)_2$	c	−258.1	....	....	....
$Zn(C_2H_3O_2)_2 \cdot H_2O$	c	−329.2	....	....	....
$Zn(C_2H_3O_2)_2 \cdot 2H_2O$	c	−398.8	....	....	....
$ZnC_2O_4 \cdot 2H_2O$	c	−373.8	....	....	....
$Zn(CH_3)_2$	lq	6.0	....	....	....
$Zn(C_2H_5)_2$	lq	5.0	....	....	....
$ZnCl_2$	c	−99.40	−88.26	64.690	25.9
	aq	−116.48	−97.88	71.748	0.89
ZnF_2	aq	−187.9	−166	....	....
ZnH	g	54.4	47.5	−34.82	48.70
ZnI_2	c	−49.98	−50.01	36.657	38.0
	aq	−63.17	−59.88	43.894	26.83
$Zn(NO_3)_2$	c	−115.12	....	....	....
$Zn(NO_3)_2 \cdot H_2O$	c	−191.99	....	....	....
$Zn(NO_3)_2 \cdot 2H_2O$	c	−264.94	....	....	....
$Zn(NO_3)_2 \cdot 4H_2O$	c	−405.76	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Substance	State	ΔHf°	ΔFf°	Log$_{10}$ Kf	S°
Zinc					
$Zn(NO_3)_2 \cdot 6H_2O$	*c*	−550.92	....	....	....
ZnO	*c*	−83.17	−76.05	55.744	10.5
$Zn(OH)_2$ (stable)	*c* (I)	−153.5	....	....	....
(unstable)	*c* (II)	−153.1	....	....	....
ZnS	*g*	−14.0	....	....	....
(sphalerite)	*c* (II)	−48.5	−47.4	34.74	13.8
(würtzite)	*c* (I)	−45.3	....	....	....
$ZnSO_4$	*c*	−233.88	−208.31	152.688	29.8
	aq	−253.33	−212.52	155.774	−21.3
$ZnSO_4 \cdot H_2O$	*c*	−310.6	−269.9	197.83	34.9
$ZnSO_4 \cdot 6H_2O$	*c*	−663.3	−555.0	406.81	86.8
$ZnSO_4 \cdot 7H_2O$	*c*	−735.1	−611.9	448.51	92.4
Zirconium					
Zr	*g*	125	115	−84.29	43.31
	c	0.00	0.00	0.000	9.18
$ZrBr_2$	*c*	−120	....	....	....
$ZrBr_3$	*c*	−174	....	....	....
$ZrBr_4$	*c*	−192	....	....	....
ZrC	*c*	−45	....	....	....
$ZrCl_2$	*c*	−145	....	....	....
$ZrCl_3$	*c*	−208	....	....	....
$ZrCl_4$	*c*	−230	−209	153.2	44.5
ZrF_2	*c*	−230	....	....	....
ZrF_3	*c*	−350	....	....	....
ZrF_4	*c*	−445	....	....	....
ZrI_2	*c*	−90	....	....	....
ZrI_3	*c*	−128	....	....	....
ZrI_4	*c*	−130	....	....	....
ZrN	*c*	−82.2	−75.4	55.27	9.23
$ZrO(NO_3)_2 \cdot 2H_2O$	*c*	−456.3	....	....	......
$ZrO(NO_3)_2 \cdot 3H_2O$	*c*	−527.3	....	....	......
$ZrO(NO_3)_2 \cdot 3\frac{1}{2}H_2O$	*c*	−562.8	....	....	....
$ZrO(NO_3)_2 \cdot 6H_2O$	*c*	−737.6	....	....	....
ZrO_2	*c*	−258.2	−244.4	179.14	12.03
$Zr(OH)_4$	*c*	−411.2	....	....	....
$Zr(OH)_4 \cdot H_2O$	*c*	−482.9	....	....	....
$Zr(OH)_4 \cdot 2H_2O$	*c*	−554.2	....	....	....
$Zr(SO_4)_2$	*c*	−597.4	....	....	....
$Zr(SO_4)_2 \cdot H_2O$	*c*	−677.9	....	....	....
$Zr(SO_4)_2 \cdot 4H_2O$	*c*	−893.1	....	....	....

Formula	Name	State	ΔHf°	ΔFf°	Log_{10} Kf	S°
C	Carbon	*g*	171.698	160.845	−117.897	37.761
	(diamond)	*c*	0.4532	0.6850	−0.5021	0.5829
	(graphite)	*c*	0.000	0.000	0.000	1.3609
CO	Carbon monoxide	*g*	−26.4157	−32.8079	24.048	47.301
CO_2	Carbon dioxide	*g*	−94.052	−94.260	69.091	51.061
		aq	−98.69	−92.31	67.662	29.0
CO_3^{--}	Carbonate ion	*aq*	−161.63	−126.22	92.517	−12.7
CH_3	Methyl	*g*	32.0	....	....	....
CH_4	Methane	*g*	−17.889	−12.140	8.8985	44.50
$HCOO^-$	Formate ion	*aq*	−98.0	−80.0	58.64	21.9
HCO_3^-	Bicarbonate ion	*aq*	−165.18	−140.31	102.845	22.7
CH_2O	Formaldehyde	*g*	−27.7	−26.3	19.28	52.26
CH_2O_2	Formic acid, monomer	*g*	−86.67	−80.24	58.815	60.0
	Formic acid	*lq*	−97.8	−82.7	60.62	30.82
		aq	−98.0	−85.1	62.38	39.1
H_2CO_3	Carbonic acid	*aq*	−167.0	−149.00	109.215	45.7
CH_3OH	Methanol	*g*	−48.08	−38.69	28.359	56.8
		lq	−57.02	−39.73	29.122	30.3
CF_4	Tetrafluoromethane	*g*	−162.5	−151.8	111.27	62.7
CCl_4	Tetrachloromethane	*g*	−25.5	−15.3	11.21	73.95
		lq	−33.3	−16.4	12.02	51.25
$COCl_2$	Carbonyl chloride	*g*	−53.30	−50.31	36.877	69.13
CH_3Cl	Chloromethane	*g*	−19.6	−14.0	10.26	55.97
CH_2Cl_2	Dichloromethane	*g*	−21.	−14.	10.3	64.68
		lq	−28	−15.1	11.07	42.7
$CHCl_3$	Trichloromethane	*g*	−24	−16	11.7	70.86
		lq	−31.5	−17.1	12.53	48.5
CBr_4	Tetrabromomethane	*g*	12.	8.6	−6.30	85.6
$CHBr_3$	Bromomethane	*g*	−8.5	−6.2	4.54	58.74
CH_2Br_2	Dibromomethane	*g*	−1.	−1.4	1.03	70.16
$CHBr_3$	Tribromomethane	*g*	6.	3.8	−2.78	79.18
		lq	−4.8	0.7	−0.51	53.0
CH_3I	Iodomethane	*g*	4.9	5.3	−3.88	60.85
		lq	−2.0	4.9	−3.59	38.9

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Formula	Name	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
CH_2I_2	Diodomethane	*lq*	15.9	....	....	....
CHI_3	Triodomethane	*c*	33.6	....	....	....
CS_2	Carbon disulfide	*g*	27.55	15.55	−11.398	56.84
		lq	21.0	15.2	−11.14	36.10
COS	Carbon oxysulfide	*g*	−32.80	−40.45	29.649	55.34
CN^-	Cyanide ion	*aq*	36.1	39.6	−29.03	28.2
CNO^-	Cyanate ion	*aq*	−33.5	−23.6	17.30	31.1
$C(NO_2)_4$	Tetranitromethane	*lq*	8.8	....	....	....
HCN	Hydrogen cyanide	*g*	31.2	28.7	−21.04	48.23
		lq	25.2	29.0	−21.26	26.97
	Hydrocyanic acid	*aq*	25.2	26.8	−19.64	30.8
CH_5N	Methyl amine	*g*	−6.7	6.6	−4.84	57.73
CH_2N_2	Cyanamide	*c*	9.2	....	....	....
CH_5N_3	Guanidine	*c*	−17.0	....	....	....
$HCNO$	Cyanic acid	*aq*	−35.1	−28.9	21.18	43.6
CH_3O_2N	Nitromethane	*lq*	−21.28	2.26	−1.656	41.1
CH_4ON_2	Urea	*c*	−79.634	−47.120	34.538	25.00
		aq	−76.30	−48.72	35.711	41.55
$CH_6O_2N_2$	Ammonium carbamate	*c*	−154.21	−109.47	80.240	39.70
$CNCl$	Cyanogen chloride	*g*	34.5	32.9	−24.12	56.31
CH_6NCl	Methylamine hydrochloride	*c*	−68.31	−35.09	25.720	33.13
CNI	Cyanogen iodide	*g*	54.6	47.7	−34.96	61.26
		c	40.4	42.6	−31.23	30.8
		aq	43.2	43.3	−31.74	37.9
CNS^-	Thiocyanate ion	*aq* (very dilute)	17.2	....	....	....
CH_4N_2S	Thiourea	*c*	−22.1	....	....	....
$C_2O_4^{--}$	Oxalate ion	*aq*	−197.0	−161.3	118.23	12.2
C_2H_2	Ethyne (acetylene)	*g*	54.194	50.000	−36.649	47.997
$C_2H_2{\cdot}6H_2O$	Ethyne hexahydrate	*c*	−371.1	....	....	....
C_2H_4	Ethene (ethylene)	*g*	12.496	16.282	−11.935	52.45
C_2H_6	Ethane	*g*	−20.236	−7.860	5.7613	54.85
$HC_2O_4^-$	Bioxalate ion	*aq*	−195.5	−167.1	122.48	36.7
C_2H_2O	Ketene	*g*	−14.6	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES (Continued)

Formula	Name	State	ΔHf°	ΔFf°	$\log_{10}$ Kf	S°
$C_2H_2O_2$	Glyoxal	*c*	−83.7	....	....	....
$C_2H_2O_4$	Oxalic acid	*c*	−197.6	−166.8	122.28	28.7
$C_2H_3O_2^-$	Acetate ion	*aq*	−116.843	....	....	....
C_2H_4O	Ethylene oxide	*g*	−12.19	−2.79	2.045	58.1
C_2H_4O	Acetaldehyde	*g*	−39.76	−31.96	23.426	63.5
$C_2H_4O_2$	Acetic acid	*lq*	−116.4	−93.8	68.75	38.2
$C_2H_4O_4$	Formic acid dimer	*g*	−187.7	−163.8	120.09	83.1
C_2H_6O	Ethanol	*g*	−56.24	−40.30	29.536	67.4
		lq	−66.356	−41.77	30.617	38.4
	Dimethyl ether	*g*	−44.3	−27.3	19.98	63.72
$C_2H_6O_2$	1-2 Ethanediol	*lq*	−108.58	−77.12	56.528	39.9
C_2H_5Cl	Chloroethane	*g*	−25.1	−12.7	9.331	65.90
$C_2H_4Cl_2$	1-2 Dichloroethane	*lq*	−39.7	−19.2	14.11	49.84
C_2HOCl_3	Chloral trichloroacetaldehyde	*lq*	−51.1	....	....	....
$C_2HO_2Cl_3$	Trichloroacetic acid	*c*	−122.8	....	....	....
C_2H_5Br	Bromoethane	*g*	−13.0	....	....	....
		lq	−20.4	....	....	....
$C_2H_4Br_2$	1-2 Dibromoethane	*lq*	−19.30	−4.94	3.621	53.37
C_2H_5I	Iodoethane	*lq*	−7.4	....	....	....
$C_2H_4I_2$	1-2 Diiodoethane	*c*	0.1	....	....	....
C_2H_6S	Ethanethiol	*lq*	−16.	....	....	....
	Dimethyl sulfide	*g*	−6.9	3.7	−2.74	68.28
		lq	−13.6	3.4	−2.50	46.94
C_2N_2	Cyanogen	*g*	73.60	70.81	−51.903	57.86
C_2H_3N	Acetonitrile	*g*	21.0	25.2	−18.47	58.18
		lq	12.7	24.0	−17.59	34.5
	Methyl isocyanide	*g*	35.9	40.0	−29.32	58.78
C_2H_7N	Ethylamine	*g*	−11.6	....	....	....
$C_2H_5O_2N$	Aminoacetic acid (glycine)	*c*	−126.33	−88.61	64.950	26.1
	Nitroethane	*lq*	−30.	....	....	....
C_2H_3SN	Methyl thiocyanate	*lq*	25.	....	....	....
	Methyl isothiocyanate	*c*	18.	....	....	....
$C_2H_7O_3SN$	2-Aminoethylsulfonic acid (taurine)	*c*	−181.66	....	....	....

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES OF HYDROCARBONS

The values in this table are from the American Petroleum Institute Research Project 44. The values are for the ideal gas state at 298.16°K and are expressed as calories per mole.

It is frequently possible to calculate values for compounds not listed since the following increments are known for an addition of a methylene group, CH_2, to the following types of compounds:

Normal alkyl cyclohexanes
Normal paraffins
Normal alkyl benzenes
Normal alkyl cyclopentanes
Normal monoolefins (1-alkenes)
Normal acetylenes (1-alkynes)

For each of the above types of compounds the increments per CH_2 group are:

ΔHf°	−4.926	cal/mole
ΔFf°	+2.048	"
Log$_{10}$ Kf	−1.5012	"
S°	+9.183	"

Compounds		ΔHf°	ΔFf°	Log$_{10}$ Kf	S°
CH_4	Methane	−17.889	−12.140	8.8985	44.50
C_2H_2	Ethyne (Acetylene)	54.194	50.000	−36.6490	47.997
C_2H_4	Ethene (Ethylene)	12.496	16.282	−11.9345	52.54
C_2H_6	Ethane	−20.236	− 7.860	5.7613	54.85
C_3H_4	Propadiene (Allene)	45.92	48.37	−35.4519	58.30
C_3H_4	Propyne (Methyl-acetylene)	44.319	46.313	−33.9469	59.30
C_3H_6	Propene (Propylene)	4.879	14.990	−10.9875	63.80
C_3H_8	Propane	−24.820	− 5.614	4.1150	64.51
C_4H_6	1,2-Butadiene	39.55	48.21	−35.3377	70.03
C_4H_6	1,3-Butadiene	26.75	36.43	−26.7004	66.62
C_4H_6	1-Butyne (Ethyl Acetylene)	39.70	48.52	−35.5616	69.51
C_4H_6	2-Butyne (Dimethylacetylene)	35.374	44.725	−32.7823	67.71
C_4H_8	1-Butene	0.280	17.217	−12.6199	73.48
C_4H_8	cis-2-Butene	− 1.362	16.046	−11.7618	71.90
C_4H_8	trans-2-Butene	− 2.405	15.315	−11.2255	70.86
C_4H_8	2-Methylpropane (Isobutene)	− 3.343	14.582	−10.6888	70.17
C_4H_{10}	*n*-Butane	−29.812	− 3.754	2.7516	74.10
C_4H_{10}	2-Methylpropane (Isobutane)	−31.452	− 4.296	3.1489	70.42
C_5H_8	1-Pentyne	34.50	50.17	−36.7712	79.10
C_5H_8	2-Pentyne	30.80	46.41	−34.0177	79.30
C_5H_8	3-Methyl-1-butyne	32.60	49.12	−36.0061	76.23
C_5H_8	1,2-Pentadiene	34.80	50.29	−36.861	79.7
C_5H_8	cis-1,3-Pentadiene (cis-piperylene)	18.70	34.88	−25.563	77.5
C_5H_8	trans-1,3-Pentadiene (trans-piperylene)	18.60	35.07	−25.707	76.4
C_5H_8	1,4-Pentadiene	25.20	40.69	−29.824	79.7
C_5H_8	2,3-Pentadiene	33.10	49.22	−36.074	77.6
C_5H_8	3-Methyl-1,2-butadiene	31.00	47.47	−34.657	76.4
C_5H_8	2-Methyl-1,3-butadiene (Isoprene)	18.10	34.87	−25.560	75.44
C_5H_{10}	1-Pentene	− 5.000	18.787	−13.7704	83.08
C_5H_{10}	cis-2-Pentene	− 6.710	17.173	−12.5874	82.76
C_5H_{10}	trans-2-Pentene	− 7.590	16.575	−12.1495	81.81
C_5H_{10}	2-Methyl-1-butene	− 8.680	15.509	−11.3680	81.73

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES OF HYDROCARBONS (Continued)

Compounds		ΔHf°	ΔFf°	Log₁₀ Kf	S°
C_5H_{10}	3-Methyl-1-butene	−6.920	17.874	−13.1017	79.70
C_5H_{10}	2-Methyl-2-butene	−10.170	14.267	−10.4572	80.90
C_5H_{10}	Cyclopentane	−18.46	9.23	−6.7643	70.00
C_5H_{12}	*n*-Pentane	−35.00	−1.96	1.4366	83.27
C_6H_6	Benzene	19.820	30.989	−22.7143	64.34
C_6H_{10}	1-Hexyne	29.55	52.19	−38.258	88.27
C_6H_{12}	1-Hexene	−9.96	20.80	−15.2491	92.25
C_6H_{12}	cis-2-Hexene	−11.56	19.18	−14.0549	92.35
C_6H_{12}	trans-2-Hexene	−12.56	18.46	−13.5291	91.40
C_6H_{12}	cis-3-Hexene	−11.56	19.66	−14.4094	90.73
C_6H_{12}	trans-3-Hexene	−12.56	18.86	−13.8262	90.04
C_6H_{12}	2-Methyl-1-pentene	−13.56	17.48	−12.8135	91.32
C_6H_{12}	3-Methyl-1-pentene	−11.02	20.28	−14.8655	90.45
C_6H_{12}	4-Methyl-1-pentene	−11.66	19.90	−14.5865	89.58
C_6H_{12}	2-Methyl-2-pentene	−14.96	16.34	−11.9780	90.45
C_6H_{12}	cis-3-Methyl-2-pentene	−14.32	16.98	−12.4471	90.45
C_6H_{12}	trans-3-Methyl-2-pentene	−14.32	16.74	−12.2697	91.26
C_6H_{12}	cis-4-Methyl-2-pentene	−13.26	18.40	−13.4903	89.23
C_6H_{12}	trans-4-Methyl-2-pentene	−14.26	17.77	−13.0216	88.02
C_6H_{12}	2-Ethyl-1-butene	−12.92	18.51	−13.5690	90.01
C_6H_{12}	2,3-Dimethyl-1-butene	−14.78	17.43	−12.7782	89.39
C_6H_{12}	3,3-Dimethyl-1-butene	−14.25	19.04	−13.9578	83.79
C_6H_{12}	2,3-Dimethyl-2-butene	−15.91	16.52	−12.1073	86.67
C_6H_{12}	Methylcyclopentane	−25.50	8.55	−6.2649	81.24
C_6H_{12}	Cyclohexane	−29.43	7.59	−5.5605	71.28
C_6H_{14}	*n*-Hexane	−39.96	10.05	0.037	92.45
C_7H_8	Methylbenzene (Toluene)	11.950	29.228	−21.4236	76.42
C_7H_{12}	1-Heptyne	24.62	54.24	−39.759	97.25
C_7H_{12}	1-Heptene	−14.85	22.84	−16.742	101.43
C_7H_{14}	Ethylcyclopentane	−30.37	10.59	−7 7632	90.62
C_7H_{14}	1,1-Dimethylcyclopentane	−33.05	9.33	−6.8372	85.87
C_7H_{14}	1,cis-2-Dimethylcyclopentane	−30.96	10.93	−8.0107	87.51
C_7H_{14}	1,trans-2-Dimethylcyclopentane	−32.67	9.17	−6.7224	87.67
C_7H_{14}	1,cis-3-Dimethylcyclopentane	−31.93	9.91	−7.2648	87.67
C_7H_{14}	1,trans-3-Dimethylcyclopentane	−32.47	9.37	−6.8690	87.67
C_7H_{14}	Methylcyclohexane	−36.99	6.52	−4.7819	82.06
C_7H_{16}	*n*-Heptane	−44.89	2.09	−1.532	101.64
C_8H_8	Ethenylbenzene (Styrene)	35.32	51.10	−37.4532	82.48
C_8H_{10}	Ethylbenzene	7.120	31.208	−22.8750	86.15
C_8H_{10}	1,2-Dimethylbenzene (*o*-Xylene)	4.540	29.177	−21.3860	84.31
C_8H_{10}	1,3-Dimethylbenzene (*m*-Xylene)	4.120	28.405	−20.8202	85.49
C_8H_{10}	1,4-Dimethylbenzene (*p*-Xylene)	4.290	28.952	−21.2214	84.23
C_8H_{14}	1-Octyne	19.70	56.29	−41.260	106.63
C_8H_{16}	1-Octene	−19.82	24.89	−18.244	110.61
C_8H_{16}	*n*-propylcyclopentane	−35.39	12.54	−9.195	99.80
C_8H_{16}	1,1-Dimethylcyclohexane	−43.26	8.42	−6.174	87.24
C_8H_{16}	cis-1,2-Dimethylcyclohexane	−41.15	9.85	−7.225	89.51
C_8H_{16}	trans-1,2-Dimethylcyclohexane	−43.02	8.24	−6.038	88.65
C_8H_{16}	cis-1,3-Dimethylcyclohexane	−44.16	7.13	−5.228	88.54
C_8H_{16}	trans-1,3-Dimethylcyclohexane	−42.20	8.68	−6.363	89.92
C_8H_{16}	cis-1,4-Dimethylcyclohexane	−42.22	9.07	−6.650	88.54
C_8H_{16}	trans-1,4-Dimethylcyclohexane	−44.12	7.58	−5.552	87.19
C_8H_{18}	*n*-Octane	−49.82	4.14	−3.035	110.82
C_8H_{18}	2-Methylheptane	−51.50	3.06	−2.243	108.81
C_8H_{18}	3-Methylheptane	−50.82	3.29	−2.412	110.32
C_8H_{18}	4-Methylheptane	−50.69	4.00	−2.932	108.35
C_8H_{18}	3-Ethylhexane	−50.40	3.95	−2.895	109.51
C_8H_{18}	2,2-Dimethylhexane	−53.71	2.56	−1.876	103.06

VALUES OF CHEMICAL THERMODYNAMIC PROPERTIES OF HYDROCARBONS (Continued)

Compounds		ΔHf°	ΔFf°	Log_{10} Kf	S°
C_8H_{18}	2,3-Dimethylhexane	−51.13	4.23	− 3.101	106.11
C_8H_{18}	2,4-Dimethylhexane	−52.44	2.80	− 2.052	106.51
C_8H_{18}	2,5-Dimethylhexane	−53.21	2.50	− 1.832	104.93
C_8H_{18}	3,3-Dimethylhexane	−52.61	3.17	− 2.324	104.70
C_8H_{18}	3,4-Dimethylhexane	−50.91	4.14	− 3.035	107.15
C_8H_{18}	2-Methyl-3-ethylpentane	−50.48	5.08	− 3.724	105.43
C_8H_{18}	3-Methyl-3-ethylpentane	−51.38	4.76	− 3.489	103.48
C_8H_{18}	2,2,3-Trimethylpentane	−52.61	4.09	− 2.998	101.62
C_8H_{18}	2,2,4-Trimethylpentane	−53.57	3.13	− 2.294	101.62
C_8H_{18}	2,3,3-Trimethylpentane	−51.73	4.52	− 3.313	103.14
C_8H_{18}	2,3,4-Trimethylpentane	−51.97	4.32	− 3.167	102.99
C_8H_{18}	2,2,3,3-tetramethylbutane	−53.99	4.88	− 3.577	94.34
C_9H_{10}	Isopropenylbenzene (α-Methylstyrene7 2-phenyl-1-propene)	27.00	49.84	−36.531	91.70
C_9H_{10}	1-Methyl-2-ethenylbenzene (*o*-Methylstyrene)	28.30	51.14	−37.484	91.70
C_9H_{10}	1-Methyl-3-ethenylbenzene (*m*-Methylstyrene)	27.60	50.02	−36.665	93.1
C_9H_{10}	1-Methyl-4-ethenylbenzene (*p*-Methylstyrene)	27.40	50.24	−36.825	91.7
C_9H_{12}	*n*-Propylbenzene	1.870	32.810	−24.049	95.74
C_9H_{12}	isopropylbenzene (Cumene)	0.940	32.738	−23.996	92.87
C_9H_{12}	1,3,5-trimethylbenzene (Mesitylene)	− 3.840	28.172	−20.6497	92.15
C_9H_{16}	1-Nonyne	14.77	58.34	−42.761	115.82
C_9H_{18}	1-Nonene	−24.74	26.94	−19.747	119.80
C_9H_{18}	*n*-Butylcyclopentane	−40.22	14.69	−10.768	108.99
C_9H_{20}	*n*-Nonane	−54.74	6.18	− 4.536	120.00
$C_{10}H_{14}$	*n*-Butylbenzene	− 3.30	34.62	−25.374	104.91
$C_{10}H_{18}$	1-Decyne	9.85	60.39	−44.262	125.00
$C_{10}H_{20}$	1-Decene	−29.67	28.99	−21.249	128.98
$C_{10}H_{22}$	*n*-Decane	−59.67	8.23	6.037	129.19
$C_{11}H_{22}$	1-Undecene	−34.60	31.03	−22.745	138.16
$C_{11}H_{24}$	*n*-Undecane	−65.60	10.28	− 7.539	138.37
$C_{12}H_{24}$	1-Dodecene	−39.52	33.08	−24.297	147.34

HEAT OF COMBUSTION

For Organic Compounds

The heat of combustion is given in kilogram calories per gram molecular weight of the substance when combustion takes place at atmospheric pressure and 20° C. The final products of combustion are gaseous carbon dioxide, liquid water and nitrogen gas for C, H, N compounds. For method of computing heats of formation see statement following this table.

Selections from a compilation by Kharasch, Bureau of Standards Journal of Research **2**, 359 (1929).

Name	Formula	Physical state	Heat of combustion, kg. calories
Acetaldehyde	CH_3CHO	liquid	279.0
Acetamide	CH_3CONH_2	solid	282.6
Acetanilide	$CH_3CONHC_6H_5$	solid	1,010.4
Acetic acid	CH_3CO_2H	liquid	209.4
Acetic anhydride	$(CH_3CO)_2O$	liquid	431.9
Acetone	$(CH_3)_2CO$	liquid	426.8
Acetonitrile	CH_3CN	liquid	302.4
Acetophenone	$C_6H_5COCH_3$	solid	988.9
Acetylacetone	$CH_3COCH_2COCH_3$	liquid	615.9
Acetylene	$(CH)_2$	gas	312.0
Acrolein	$CH_2{:}CHCHO$	liquid	389.6
Acrylic acid	$CH_2{:}CHCO_2H$	liquid	327.5
Adipic acid	$(CH_2)_4(CO_2H)_2$	solid	669.0
Alanine	$CH_3CH(NH_2)CO_2H$	solid	387.7
Aldol, *see β-hydroxybutyr-aldehyde*			
Alizarin, *see Dihydroxyanthraquinone*			
Allyl alcohol	$CH_2{:}CHCH_2OH$	liquid	442.4
Allylene	$CH_3C{:}CH$	gas	465.1
p-Aminoazobenzene	$H_2NC_6H_4N_2C_6H_5$	solid	1,574.0
p-Aminophenol	$HOC_6H_4NH_2$	solid	760.0
Amygdalin	$C_{20}H_{27}O_{11}N$	solid	2,348.4
Amyl acetate	$C_4H_9CO_2C_2H_5$	liquid	1,042.5
Amyl alcohol (ferm.)	$(CH_3)_2CH_2CH_2CH_2OH$	liquid	793.7
Amylene	C_5H_{10}	liquid	803.4
Anethole	$C_{10}H_{12}O$	solid	1,324.4
Aniline	$C_6H_5NH_2$	liquid	811.7
p-Anisidine	$CH_3OC_6H_4NH_2$	solid	924.0
Anisole	$C_6H_5OCH_3$	liquid	905.1
Anthracene	$C_6H_4{:}(CH)_2{:}C_6H_4$	solid	1,700.4
Anthraquinone	$C_{14}H_8O_2$	solid	1,544.5
Arabinose	$C_5H_{10}O_5$	solid	559.9
Arabitol	$C_5H_{12}O_5$	solid	661.2
Arachidic acid	$C_{20}H_{40}O_2$	solid	3,025.9
Azelaic acid	$(CH_2)_7(CO_2H)_2$	solid	,141.7
Azobenzene	$(C_6H_5N)_2$	solid	545.9
Azoxybenzene	$(C_6H_5N)_2O$	solid	1,534.5
Behenic acid	$C_{22}H_{44}O_2$	solid	3,338.4
Benzalacetone	$C_6H_5CH{:}CHCOCH_3$	solid	1,257.4
Benzaldehyde	C_6H_5CHO	liquid	841.3
Benzamide	$C_6H_5CONH_2$	solid	847.6
Benzanilide	$C_6H_5CONHC_6H_5$	solid	1,575.5
Benzene	C_6H_6	liquid	782.3
Benzenediazonium nitrate	$C_6H_5N_2NO_3$	solid	782.6
Benzidine	$(C_6H_4NH_2)_2$	solid	1,560.9
Benzil	$(C_6H_5CO)_2$	solid	1,624.6
* Benzoic acid	$C_6H_5CO_2H$	solid	771.2
Benzoic anhydride	$(C_6H_5CO)_2O$	solid	1,555.1
Benzoin	$C_6H_5.CHOH.COC_6H_5$	solid	1,671.4
Benzonitrile	C_6H_5CN	liquid	865.5
Benzophenone	$(C_6H_5)_2CO$	solid	1,556.5

* Accepted value by Int. Union of Pure and Appld. Chem., Lyons, 1923

HEAT OF COMBUSTION (Continued)

FOR ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion, kg. calories
Benzoyl chloride	C_6H_5COCl	liquid	782.8
Benzoyl peroxide	$(C_6H_5CO)_2O_2$	solid	1,551.7
Benzyl alcohol	$C_6H_5CH_2OH$	liquid	894.3
Benzylamine	$C_6H_5CH_2NH_2$	liquid	969.4
Benzyl carbylamine	$C_6H_5CH_2NC$	liquid	1,046.5
Benzyl chloride	$C_6H_5CH_2Cl$	liquid	886.4
Benzyl cyanide	$C_6H_5CH_2CN$	liquid	1,023.5
Borneol	$C_{10}H_{18}O$	liquid	1,469.6
Brucine	$C_{23}H_{26}O_4N_2$	solid	2,933.0
n-Butyl alcohol	C_4H_9OH	liquid	638.6
tert.-Butyl alcohol, *see Trimethyl carbinol*			
n-Butylamine	$C_4H_9NH_2$	liquid	710.6
sec.-Butylamine	$(CH_3)(C_2H_5):CHNH_2$	liquid	713.0
tert.-Butylamine	$(CH_3)_3CNH_2$	liquid	716.0
tert.-Butylbenzene	$C_6H_5C(CH_3)_3$	liquid	1,400.4
n-Butyramide	$C_3H_7CONH_2$	solid	596.0
n-Butyric acid	$C_3H_7CO_2H$	liquid	524.3
n-Butyronitrile	C_3H_7CN	liquid	613.3
Caffeine	$C_8H_{10}O_2N_4$	solid	1,014.2
Camphene	$C_{10}H_{16}$	solid	1,468.8
Camphor	$C_{10}H_{16}O$	solid	1,411.0
Cane sugar, *see Sucrose*			
Capric acid	$C_9H_{18}O_2$	solid	1,458.1
Caproic acid	$C_5H_{11}CO_2H$	liquid	831.0
Carbon disulfide	CS_2	liquid	246.6
Carbon subnitride	$(C.CN)_2$	solid	514.8
Carbon tetrachloride	CCl_4	liquid	37.3
Carbonyl sulfide	COS	gas	130.5
Carvacrol	$C_{10}H_{14}O$	liquid	1,354.5
Cetyl alcohol	$C_{16}H_{34}O$	solid	2,504.5
Cetyl palmitate	$C_{32}H_{64}O$	solid	4,872.8
Chloracetic acid	$ClCH_2CO_2H$	solid	171.0
o-Chlorobenzoic acid	$ClC_6H_4CO_2H$	solid	734.5
Chloroform	$CHCl_3$	liquid	89.2
Chrysene	$C_{14}H_{10}$	solid	2,139.1
Cinnamic acid (*trans*)	$C_6H_5CH:CHCO_2H$	solid	1,040.2
Cinnamic aldehyde	$C_6H_5CH:CHCHO$	liquid	1,112.3
Cinnamic anhydride	$C_{18}H_{14}O_3$	solid	2,091.3
d-Citrene	$C_{10}H_{16}$	liquid	1,473.0
Citric acid (anhydr.)	$C_6H_8O_7$	solid	474.5
Codeine	$C_{18}H_{21}O_3N.H_2O$	solid	2,327.6
Coniine	$C_8H_{17}N$	liquid	1,275.5
Creatine (anhydr.)	$C_4H_9O_2N_3$	solid	559.8
Creatinine	$C_4H_7ON_3$	solid	563.4
o-Cresol	$CH_3C_6H_4OH$	liquid	882.6
o-Cresol	$CH_3C_6H_4OH$	solid	879.5
m-Cresol	$CH_3C_6H_4OH$	liquid	880.5
p-Cresol	$CH_3C_6H_4OH$	liquid	882.5
p-Cresol	$CH_3C_6H_4OH$	solid	880.0
m-Cresolmethyl ether	$CH_3C_6H_4OCH_3$	liquid	1,057.0
Crotonaldehyde	C_3H_5CHO	liquid	542.1
Cyanoacetic acid	$NC\ CH_2CO_2H$	solid	298.8
Cyanogen	$(CN)_2$	gas	258.3
Cycloheptanol	$\underline{CH_2(CH_2)_5C}HOH$	liquid	1,050.2
Cyclohexanol	$\underline{CH_2(CH_2)_4C}HOH$	liquid	890.7
Cycloheptene	C_7H_{12}	liquid	1,049.9
Cycloheptane	$(CH_2)_7$	liquid	1,087.3

HEAT OF COMBUSTION (Continued)

FOR ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion, kg. calories
Cyclohexane	$(CH_2)_6$	liquid	937.8
Cyclohexene, *see Tetrahydrobenzene*			
Cyclopentane	$(CH_2)_5$	liquid	783.6
Cyclopropane, *see Trimethylene*			
Cymene	$C_6H_4(CH_3)(CH_3CHCH_3)$—(1, 4)	liquid	1,402.8
Decahydronaphthalene (*cis*)	$C_{10}H_{18}$	liquid	1,502.5
Decahydronaphthalene (*trons*)	$C_{10}H_{18}$	liquid	1,499.5
Decane	$C_{10}H_{22}$	liquid	1,610.2
Dextrose, *see Glucose*			
Diallyl	$(CH_3CH{:}CH_2)_2$	vapor	903.4
Diamyl ether	$(C_5H_{11})_2O$	liquid	1,609.3
Diamylene	$C_{10}H_{20}$	liquid	1,582.2
Dibenzyl	$(C_6H_5CH_2)_2$	solid	1,810.6
Dibenzyl amine	$(C_6H_5CH_2)_2NH$	solid	1,853.0
o-Dichlorobenzene	$C_6H_4Cl_2$	liquid	671.8
Diethylacetic acid	$(C_2H_5)_2CHCO_2H$	liquid	830.8
Diethyl amine	$(C_2H_5)_2NH$	liquid	716.9
Diethylaniline	$C_6H_5N(C_2H_5)_2$	liquid	1,451.6
Diethyl carbonate	$CO(OC_2H_5)_2$	liquid	647.9
Diethyl ether	$(C_2H_5)_2O$	liquid	651.7
Diethyl ketone	$(C_2H_5)_2CO$	liquid	735.6
Diethyl malonate	$CH_2(CO_2C_2H_5)_2$	liquid	860.4
Diethyl oxalate	$(CO_2C_2H_5)_2$	liquid	716.0
Diethyl succinate	$(CH_2CO_2C_2H_5)_2$	liquid	1,007.3
Dihydrobenzene	C_6H_8	liquid	847.8
Δ_1-Dihydronaphthalene	$C_{10}H_{10}$	liquid	1,296.3
Δ_1-Dihydronaphthalene	$C_{10}H_{10}$	solid	1,298.3
Dihydroxyanthraquinone	$C_{14}H_6O_2(OH)_2$—(1, 2)	solid	1,448.9
Diisoamyl	$[(CH_3)_2CHCH_2CH_2]_2$	liquid	1,615.8
Diisobutylene	$[(CH_3)_2CHCH_2]_2$	liquid	1,252.4
Diisopropyl	$[(CH_3)_2CH]_2$	vapor	993.9
Diisopropyl ketone	$[(CH_3)_2CH]_2CO$	liquid	1,045.5
Dimethyl amine	$(CH_3)_2NH$	liquid	416.7
Dimethylaniline	$C_6H_5N(CH_3)_2$	liquid	1,142.7
Dimethyl carbonate	$CO(OCH_3)_2$	liquid	340.8
Dimethyl ether	$(CH_3)_2O$	gas	347.6
Dimethylethyl carbinol	$C_2H_5(CH_3)_2CHOH$	liquid	784.6
Dimethyl fumarate	$(CHCO_2CH_3)_2$	solid	664.3
2, 5-Dimethylhexane	$(CH_3)_2CH.C_2H_4.CH(CH_3)_2$	liquid	1,303.3
3, 4-Dimethylhexane	$[(C_2H_5)(CH_3)CH]_2$	liquid	1,303.7
Dimethyl maleate	$(CHCO_2CH_3)_2$	solid	669.2
Dimethyl oxalate	$(CO_2CH_3)_2$	solid	401.9
2, 2-Dimethylpentane	$(CH_3)_3C.C_3H_7$	liquid	1,148.9
2, 3-Dimethylpentane	$(CH_3)_2CHCH(CH_3)C_2H_5$	liquid	1,148.9
2, 4-Dimethylpentane	$(CH_3)_2CHCH_2CH(CH_3)_2$	liquid	1,148.9
3, 3-Dimethylpentane	$(CH_3)_2C(C_2H_5)_2$	liquid	1,147.9
Dimethyl phthalate	$C_6H_4(CO_2CH_3)_2$	liquid	1,119.7
Dimethyl succinate	$(CH_2CO_2CH_3)_2$	solid	703.3
m-Dinitrobenzene	$C_6H_4(NO_2)_2$	solid	696.8
Dinitrophenol	$C_6H_3(OH)(NO_2)_2$—(1, 2, 4)	solid	648.0
Dinitrotoluene	$C_6H_3(CH_3)(NO_2)_2$—(1, 2, 4)	solid	852.8
Diphenyl	$(C_6H_5)_2$	solid	1,493.6
Diphenyl amine	$(C_6H_5)_2NH$	solid	1,536.2
Diphenyl carbinol	$(C_6H_5)_2CHOH$	solid	1,615.4
Diphenylmethane	$(C_6H_5)_2CH_2$	solid	1,655.0
Diphenylnitrosamine	$(C_6H_5)_2N.NO$	solid	1,532.6

HEAT OF COMBUSTION (Continued)

FOR ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion, kg. calories
Dipropargyl	$(CH{\vdots}C.CH_2)_2$	vapor	882.9
Dipropyl ketone	$(C_3H_7)_2CO$	liquid	1,050.5
Dulcitol	$C_6H_{14}O_6$	solid	729.1
Durene	$C_6H_2(CH_3)_4$—(1, 2, 4, 5)	solid	1,393.6
Eicosane	$C_{20}H_{42}$	solid	3,183.1
Erythritol	$C_4H_{10}O_4$	solid	504.1
Ethane	C_2H_6	gas	368.4
Ethine, *see Acetylene*			
Ethyl acetate	$CH_3CO_2C_2H_5$	liquid	536.9
Ethyl acetoacetate	$CH_3COCH_2CO_2C_2H_5$	liquid	690.8
Ethyl alcohol	C_2H_5OH	liquid	327.6
Ethyl amine	$C_2H_5NH_2$	liquid	408.5
Ethylaniline	$C_6H_5NHC_2H_5$	liquid	1,121.5
Ethylbenzene	$C_2H_5C_6H_5$	liquid	1,091.2
Ethyl benzoate	$C_6H_5CO_2C_2H_5$	liquid	1,098.7
Ethyl bromide	C_2H_5Br	vapor	340.5
Ethyl *n*-butyrate	$C_3H_7CO_2C_2H_5$	liquid	851.2
Ethyl carbylamine	C_2H_5NC	liquid	477.1
Ethyl chloride	C_2H_5Cl	vapor	316.7
Ethylcycloheptane	$C_2H_5C_7H_{13}$	liquid	1,406.8
Ethyl formate	$HCO_2C_2H_5$	liquid	391.7
3-Ethylhexane	$(C_2H_5)_2CH.C_3H_7$	liquid	1,302.3
Ethyl iodide	C_2H_5I	liquid	356.0
Ethyl isobutyrate	$(CH_3)_2CHCH_2CO_2C_2H_5$	liquid	845.7
Ethyl isocyanate	C_2H_5NCO	liquid	424.5
Ethyl nitrate	$C_2H_5ONO_2$	vapor	322.4
Ethyl nitrite	C_2H_5ONO	vapor	332.6
3-Ethylpentane	$(C_2H_5)_3CH$	liquid	1,149.9
Ethyl propionate	$C_2H_5CO_2C_2H_5$	liquid	690.8
Ethyl salicylate	$HOC_6H_4CO_2C_2H_5$	liquid	1,051.2
Ethyl valerate	$C_4H_9CO_2C_2H_5$	liquid	1,017.5
Ethylene	$CH_2{:}CH_2$	gas	331.6
Ethylene chloride	$(CH_2Cl)_2$	vapor	271.0
Ethylene diamine	$(CH_2NH_2)_2$	liquid	452.6
Ethylene glycol	$(CH_2OH)_2$	liquid	281.9
Ethylene iodide	$(CH_2I)_2$	solid	324.8
Ethylene oxide	$\underbrace{CH_2CH_2O}$	liquid	302.1
Ethylidene chloride	CH_3CHCl_2	liquid	267.1
Eugenol	$C_{10}H_{12}O_2$	liquid	1,286.6
Fenchane	$C_{10}H_{18}$	liquid	1,502.6
Fluorene	$(C_6H_4)_2{:}CH_2$	solid	1,584.9
Fluorobenzene	C_6H_5F	liquid	747.2
Formaldehyde	CH_2O	gas	134.1
Formamide	$HCONH_2$	solid	134.9
Formic acid	HCO_2H	liquid	62.8
l-Fructose	$C_6H_{12}O_6$	solid	675.6
Fumaric acid (*trans*)	$(CHCO_2H)_2$	solid	320.0
Furfural	C_4H_3OCHO	liquid	559.5
Galactose	$C_6H_{12}O_6$	solid	670.7
Gallic acid	$C_6H_2(OH)_3CO_2H$—(1, 3, 5, 6)	solid	633.7
d-Glucose	$C_6H_{12}O_6$	solid	673.0
Glutaric acid	$(CH_2)_3(CO_2H)_2$	solid	514.9
Glycerol	$(CH_2OH)_2CHOH$	liquid	397.0
Glyceryl tributyrate	$C_{15}H_{26}O_6$	liquid	1,941.1
Glycine	$H_2NCH_2CO_2H$	solid	234.5
Glycogen	$(C_6H_{10}O_5)x$ per kg	solid	4,186.8
Glycollic acid	CH_2OHCO_2H	solid	166.6
Glycylglycine	$C_4H_8O_3N_2$	solid	470.7

HEAT OF COMBUSTION (Continued)

FOR ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion, kg. calories
n-Heptaldehyde	$CH_3(CH_2)_5CHO$	liquid	1,062.4
n-Heptane	C_7H_{16}	liquid	1,149.9
Heptine-1	$CH{:}C(CH_2)_4CH_3$	liquid	1,091.2
n-Heptyl alcohol	$CH_3(CH_2)_5CH_2OH$	liquid	1,104.9
Heptyl amine	$C_7H_{15}NH_2$	liquid	1,178.9
Heptylic acid	$C_7H_{14}O_2$	liquid	986.1
n-Hexane	C_6H_{14}	liquid	989.8
Hexachlorbenzene	C_6Cl_6	solid	509.0
Hexachlorethane	C_2Cl_6	solid	110.0
Hexadecane	$C_{16}H_{34}$	solid	2,559.1
Hexahydronaphthalene	$C_{10}H_{14}$	liquid	1,419.3
Hexamethylbenzene	$C_6(CH_3)_6$	solid	1,711.9
Hexamethylenetetramine	$(CH_2)_6N_4$	solid	1,006.7
Hexamethylethane	$[(CH_3)_3C]_2$	solid	1,301.8
Hexyl amine	$C_6H_{13}NH_2$	liquid	1,022.2
Hexylene	C_6H_{12}	liquid	952.6
Hippuric acid	$C_6H_5CONHCH_2CO_2H$	solid	1,012.4
Hydantoic acid	$C_3H_6O_3N_2$	solid	308.6
Hydrazobenzene	$(C_6H_5NH)_2$	solid	1,597.3
Hydroquinol	$C_6H_4(OH)_2$	solid	683.7
Hydroquinoldimethyl ether	$(CH_3O)_2C_6H_4$	solid	1,014.7
p-Hydroxyazobenzene	$HOC_6H_4N_2C_6H_5$	solid	1,502.0
o-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	liquid	796.0
m-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	solid	788.7
p-Hydroxybenzaldehyde	$C_6H_4(OH)CHO$	solid	792.7
m-Hydroxybenzoic acid	$HOC_6H_4CO_2H$	solid	726.1
p-Hydroxybenzoic acid	$HOC_6H_4CO_2H$	solid	725.4
β-Hydroxybutyraldehyde	$CH_3CHOHCH_2CHO$	liquid	546.6
Indigo	$C_{16}H_{10}O_2N_2$	solid	1,815.0
Indole	C_8H_7N	solid	1,022.2
Inositol	$C_6H_{12}O_6$	solid	662.1
Iodoform	CHI_3	solid	161.9
Isoamyl amine	$(CH_3)_2CHC_2H_4NH_2$	liquid	866.8
Isobutane	$(CH_3)_3CH$	gas	683.4
Isobutyl alcohol	$(CH_3)_2CH_2CH_2OH$	liquid	638.2
Isobutyl amine	$C_4H_9NH_2$	liquid	713.6
Isobutylene	$(CH_3)_2C{:}CH_2$	gas	647.2
Isobutyraldehyde	$(CH_3)_2CHCHO$	vapor	596.8
Isobutyramide	$(CH_3)_2CHCONH_2$	solid	595.9
Isobutyric acid	$(CH_3)_2CHCO_2H$	liquid	517.4
Isoeugenol	$C_{10}H_{12}O_2$	liquid	1,277.6
Isopentane	C_5H_{12}	gas	843.5 (?)
Isopentane	C_5H_{12}	liquid	838.3 (?)
Isophthalic acid	$C_6H_4(CO_2H)_2$	solid	768.3
Isopropyl alcohol	$(CH_3)_2CHOH$	liquid	474.8
Isopropylbenzene	$(CH_3)_2CHC_6H_5$	liquid	1,247.3
Isopropyltoluene	$C_6H_4(CH_3)(CH_3CHCH_3)$—(1, 3)	liquid	1,409.5
Isopropyltoluene, *see Cymene*			
Isosafrole	$C_{10}H_{10}O_2$	liquid	1,233.9
Lactic acid	$CH_3CHOHCO_2H$	liquid	326.0
Lactose (anhydr.)	$C_{12}H_{22}O_{11}$	solid	1,350.8
Lauric acid	$C_{12}H_{24}O_2$	solid	1,771.7
Leucine	$C_6H_{13}O_2N$	solid	855.6
d-Limonene	$C_{10}H_{16}$	liquid	1,471.2
Maleic acid (*cis*)	$(CHCO_2H)_2$	solid	326.1
Maleic anhydride	$(CHCO)_2O$	solid	333.9
l-Malic acid	$(CHOHCH_2){:}(CO_2H)_2$	solid	320.1

HEAT OF COMBUSTION (Continued)

FOR ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion, kg. calories
Malonic acid	$CH_2(CO_2H)_2$	solid	207.2
Maltose	$C_{12}H_{22}O_{11}$	solid	1,350.2
Mandelic acid	$C_6H_5CHOHCO_2H$	solid	890.3
d-Mannitol	$C_6H_{14}O_6$	solid	727.6
Menthene	$C_{10}H_{18}$	liquid	1,523.2
Menthol	$C_{10}H_{20}O$	solid	1,508.8
Mesitylene	$(CH_3)_3C_6H_3$—(1, 3, 5)	liquid	1,243.6
Mesityl oxide	$(CH_3)_2C:CHCOCH_3$	liquid	846.7
Mesotartaric acid	$(CHOH)_2(CO_2H)_2$	solid	276.0
Methane	CH_4	gas	210.8
Methyl acetate	$CH_3CO_2CH_3$	liquid	381.2
Methyl alcohol	CH_3OH	liquid	170.9
Methyl amine	CH_3NH_2	liquid	256.1
Methylaniline	$C_6H_5NHCH_3$	liquid	973.5
Methyl benzoate	$C_6H_5CO_2CH_3$	liquid	943.5
Methyl bromide	CH_3Br	vapor	184.0
Methyl butyl ketone	$CH_3COC_4H_9$	liquid	895.2
Methyl *tert*-butyl ketone, *see Pinacoline*			
Methyl butyrate	$C_3H_7COC_2H_3$	liquid	692.8
Methyl carbylamine	CH_3NC	liquid	320.1
Methyl chloride	CH_3Cl	gas	164.2
Methyl cinnamate	$C_{10}H_{10}O_2$	solid	1,213.0
Methylcyclobutane	$CH_3CHCH_2CH_2CH_2$	liquid	784.2
Methylcycloheptane	$CH_3C_7H_{13}$	liquid	1,244.5
Methylcyclohexane	$CH_3C_6H_{11}$	liquid	1,091.8
Methylcyclopentane	$CH_3CH.C_3H_6.CH_2$	liquid	937.9
Methyldiethyl carbinol	$CH_3(C_2H_5)_2CHOH$	liquid	927.0
Methylene chloride	CH_2Cl_2	vapor	106.8
Methylene iodide	CH_2I_2	liquid	178.4
Methylethyl ether	$CH_3OC_2H_5$	vapor	503.4
Methylethyl ketone	$CH_3COC_2H_5$	liquid	582.3
Methyl formate	HCO_2CH_3	liquid	233.1
2-Methylheptane	$(CH_3)_2CH.C_6H_{11}$	liquid	1,306.1
2-Methylhexane	$(CH_3)_2CHC_4H_9$	liquid	1,148.9
3-Methylhexane	$(C_2H_5)(CH_3)CHC_3H_7$	liquid	1,148.9
Methylhexyl ketone	$CH_3COC_6H_{13}$	liquid	1,205.1
Methyl iodide	CH_3I	liquid	194.7
Methyl isobutyrate	$(CH_3)_2CHCO_2CH_3$	liquid	694.2
Methyl isocyanate	CH_3NCO	liquid	269.4
Methylisopropyl ketone	$CH_3COCH(CH_3)_2$	liquid	733.9
Methyl lactate	$CH_3CHOHCO_2CH_3$	liquid	497.2
Methyl propionate	$C_2H_5CO_2CH_3$	vapor	552.3
Methylpropyl ketone	$CH_3COC_3H_7$	liquid	735.6
Methyl salicylate	$HOC_6H_4CO_2CH_3$	liquid	898.3
Milk sugar, *see Lactose*			
Morphine	$C_{17}H_{19}O_3N.H_2O$	solid	2,146.3
Mucic acid	$C_6H_{10}O_8$	solid	483.6
Myristic acid	$C_{14}H_{23}O_2$	solid	2,085.8
Naphthalene	$C_{10}H_8$	solid	1,232.5
α-Naphthoic acid	$C_{10}H_7CO_2H$	solid	1,231.8
β-Naphthoic acid	$C_{10}H_7CO_2H$	solid	1,227.6
α-Naphthol	$C_{10}H_7OH$	solid	1,185.4
β-Naphthol	$C_{10}H_7OH$	solid	1,187.2
α-Naphthonitrile	$C_{10}H_7CN$	solid	1,326.2
β-Naphthonitrile	$C_{10}H_7CN$	solid	1,321.0
α-Naphthoquinone	$C_{10}H_6O_2$	solid	1,100.8
β-Naphthoquinone	$C_{10}H_6O_2$	solid	1,106.4
α-Naphthyl amine	$C_{10}H_7NH_2$	solid	1,263.5

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
β-Naphthyl amine	$C_{10}H_7NH_2$	solid	1,261.0
Narceine	$C_{23}H_{27}O_8N.2H_2O$	solid	2,802.9
Narcotine	$C_{22}H_{23}O_7N$	solid	2,644.5
Nicotine	$C_{10}H_{14}N_2$	liquid	1,427.7
o-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	765.8
m-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	765.2
p-Nitraniline	$C_6H_4(NH_2)(NO_2)$	solid	761.0
m-Nitrobenzaldehyde	$O_2NC_6H_4CHO$	solid	800.4
Nitrobenzene	$C_6H_5NO_2$	liquid	739.2
m-Nitrobenzoic acid	$O_2NC_6H_4CO_2H$	solid	729.1
Nitroethane	$C_2H_5NO_2$	liquid	322.2
Nitroglycerine, *see Trinitroglycerol*			
Nitromethane	CH_3NO_2	liquid	169.4
o-Nitrophenol	$HOC_6H_6NO_2$	solid	689.1
m-Nitrophenol	$HOC_5H_4NO_2$	solid	684.4
p-Nitrophenol	$HOC_6H_4NO_2$	solid	688.8
Nitropropane	$C_3H_7NO_2$	liquid	477.9
o-Nitrotoluene	$CH_3C_6H_4NO_2$	liquid	897.0
p-Nitrotoluene	$CH_3C_6H_6NO_2$	solid	888.6
Octahydronaphthalene	$C_{10}H_{16}$	liquid	1,461.7
n-Octane	C_8H_{18}	liquid	1,302.7
Octyl alcohol	$C_8H_{18}O$	liquid	1,262.0
Oleic acid	$C_{18}H_{34}O_2$	liquid	2,657.0
Oxalic acid	$(CO_2H)_2$	solid	60.2
Oxamide	$(CONH_2)_2$	solid	203.2
Palmitic acid	$C_{16}H_{32}O_2$	solid	2,398.4
Papaverine	$C_{20}H_{21}O_4N$	solid	2,478.1
Pentamethylbenzene	$C_6H(CH_8)_5$	solid	1,554.0
n-Pentane	C_5H_{12}	gas	838.3
n-Pentane	C_5H_{12}	liquid	833.4
Phenacetin	$C_{10}H_{13}O_2N$	solid	1,285.2
Phenanthraquinone	$C_{14}H_8O_2$	solid	1,544.0
Phenanthrene	$C_{14}H_{10}$	solid	1,692.5
Phenetole	$C_6H_5OC_2H_5$	liquid	1,060.3
Phenol	C_6H_5OH	solid	732.2
Phenylacetic acid	$C_6H_5CH_2CO_2H$	solid	930.2
Phenylacetylene	$C_6H_5C:CH$	liquid	1,024.2
Phenylalanine	$C_9H_{11}O_2N$	solid	1,111.3
p-Phenylenediamine	$C_6H_4(NH_2)_2$	solid	843.4
Phenylethylene, *see Styrene*			
Phenylglycine	$C_2H_5NHCH_2CO_2H$	solid	955.1
Phenylhydrazine	$C_6H_5N_2H_3$	solid	875.4
Phenylhydroxylamine	C_6H_5NHOH	liquid	803.7
Phenyl iodide	C_6H_5I	liquid	770.7
Phloroglucinol	$C_6H_3(OH)_3$	solid	635.7
Phthalic acid	$C_6H_4(CO_2H)_2$	solid	771.0
Phthalic anhydride	$C_6H_4(CO)_2O$	solid	783.4
Phthalimide	$C_8H_5O_2N$	solid	849.5
Picric acid	$C_6H_2(OH)(NO_2)_3$—(1, 2, 4, 6)	solid	611.8
Pinacoline	$CH_3COC(CH_3)_3$	solid	891.8
Piperidine	$C_5H_{11}N$	liquid	826.6
Piperonal	$C_8H_6O_3$	solid	870.7
Propane	C_3H_8	gas	526.3
Propine, *see Allylene*			
Propionaldehyde	C_2H_5CHO	liquid	434.2
Propionamide	$C_2H_5CONH_2$	solid	439.9
Propionic acid	$C_2H_5CO_2H$	liquid	367.2
Propionic anhydride	$(C_2H_5CO)_2O$	liquid	746.[illegible]

HEAT OF COMBUSTION (Continued)

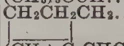
For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg. calories
Propionitrile	C_2H_5CN	liquid	456.4
n-Propyl alcohol	C_3H_7OH	liquid	480.5
Propyl amine	$C_3H_7NH_2$	liquid	558.3
n-Propylbenzene	$C_3H_7C_6H_5$	liquid	1,246.4
Propyl bromide	C_3H_7Br	vapor	497.3
Propyl carbylamine	C_3H_7NC	liquid	639.6
Propyl chloride	C_3H_7Cl	vapor	478.3
Propylene	$CH_3CH{:}CH_2$	gas	490.2
Propylene glycol	$CH_3CHOHCH_2OH$	liquid	431.0
n-Propyl iodide	C_3H_7I	liquid	514.3
n-Propyltoluene	$C_6H_4(CH_3)(C_3H_7)$—(1, 3)	liquid	1,405.4
Pseudocumene	$C_6H_3(CH_3)_3$—(1, 2, 4)	liquid	1,241.7
Pyridine	C_5H_5N	liquid	658.5
Pyrocatechol	$C_6H_4(OH)_2$	solid	684.8
Pyrogallol	$C_6H_3(OH)_3$	solid	638.7
Pyrrole	C_4H_5N	liquid	567.7
Quercitol	$C_6H_{12}O_5$	solid	704.2
Quinoline	C_9H_7N	liquid	1,123.5
Quinone	$O{:}C_6H_4{:}O$	solid	656.6
Raffinose	$C_{18}H_{32}O_{16}$	solid	2,025.5
Retene	$C_{18}H_{18}$	solid	2,306.8
Resorcinol	$C_6H_4(OH)_2$	solid	683.0
Resorcinoldimethyl ether	$(CH_3O)_2C_6H_4$	liquid	1,022.6
Rhamnose	$C_6H_{12}O_6$	solid	718.3
Safrole	$C_{10}H_{10}O_2$	liquid	1,244.1
Salicylaldehyde, *see o-Hydroxybenzaldehyde*			
* Salicylic acid	$HOC_6H_4CO_2H$—(1, 2)	solid	723.1
Sarcosine	$CH_3NHCH_2CO_2H$	solid	401.1
Sebacic acid	$(CH_2)_8(CO_2H)_2$	solid	1,297.3
Skatole	C_9H_9N	liquid	1,170.5
d-Sorbose	$C_6H_{12}O_6$	solid	668.3
Starch	$(C_6H_{10}O_5)x$ per kg	solid	4,178.8
Stearic acid	$C_{18}H_{36}O_2$	solid	2,711.8
Strychnine	$C_{21}H_{22}O_2N_2$	solid	2,685.7
Styrene	$C_6H_5CH{:}CH_2$	liquid	1,047.1
Suberic acid	$(CH_2)_6(CO_2H)_2$	solid	985.2
Succinic acid	$(CH_2CO_2H)_2$	solid	357.1
Succinic acid nitrile	$(CH_2CN)_2$	liquid	545.7
Succinic anhydride	$(CH_2CO)_2O$	solid	369.6
Succinimide	$C_4H_5O_2N$	solid	437.9
Sucrose	$C_{12}H_{22}O_{11}$	solid	1,349.6
Sylvestrene	$C_{10}H_{16}$	liquid	1,464.7
d-Tartaric acid	$(CHOH)_2(CO_2H)_2$	solid	275.1
d, l-Tartaric acid (anhydr.)	$(CHOH)_2(CO_2H)_2$	solid	278.4
Terephthalic acid	$C_6H_4(CO_2H)_2$	solid	770.4
Terpin hydrate	$C_{10}H_{22}O_3$	solid	1,451.0
Terpineol	$C_{10}H_{18}O$	solid	1,469.5
Tetrahydrobenzene	C_6H_{10}	liquid	891.9
Tetrahydronaphthalene	$C_{10}H_{12}$	liquid	1,352.4
Tetramethylmethane	$(CH_3)_4C$	gas	842.6
Tetraphenylmethane	$(C_6H_5)_4C$	solid	3,102.4
Tetryl	$C_7H_5N_5O_8$	solid	842.3
Thebaine	$C_{19}H_{21}O_3N$	solid	2,441.3
Thiophene	C_4H_4S	liquid	670.5
Thujane	$C_{10}H_{18}$	liquid	1,506.4
Thymol	$C_{10}H_{14}O$	liquid	1,353.4
Thymol	$C_{10}H_{14}O$	solid	1,349.7
Thymoquinone	$C_{10}H_{12}O_2$	solid	1,271.3

* Recommended as a secondary thermochemical standard.

HEAT OF COMBUSTION (Continued)

For Organic Compounds

Name	Formula	Physical state	Heat of combustion, kg calories
Toluene	$CH_3C_6H_5$	liquid	934.2
o-Toluic acid	$CH_3C_6H_4CO_2H$	solid	928.9
m-Toluic acid	$CH_3C_6H_4CO_2H$	solid	928.6
p-Toluic acid	$CH_3C_6H_4CO_2H$	solid	926.9
o-Toluidine	$CH_3C_6H_4NH_2$	liquid	964.3
m-Toluidine	$CH_3C_6H_4NH_2$	liquid	965.3
p-Toluidine	$CH_3C_6H_4NH_2$	solid	958.4
o-Tolunitrile	$CH_3C_6H_4CN$	liquid	1,030.3
Toluquinone	$C_7H_6O_2$	solid	803.2
Triaminotriphenyl carbinol	$(C_6H_4NH_2)_3COH$	solid	2,483.5
Tribenzyl amine	$(C_6H_5CH_2)_3N$	solid	2,762.1
Trichloracetic acid	$Cl_3C.CO_2H$	solid	92.8
Triethyl amine	$(C_2H_5)_3N$	liquid	1,036.8
Triethyl carbinol	$(C_2H_5)_3CHOH$	liquid	1,080.0
Triisoamyl amine	$[(CH_3)_2CHCH_2CH_2]_3N$	liquid	2,459.3
Triisobutyl amine	$[(CH_3)_2CHCH_2]_3N$	liquid	1,973.6
Trimethyl amine	$(CH_3)_3N$	liquid	578.6
2, 2, 3-Trimethylbutane	$(CH_3)_3C.CH(CH_3)_2$	liquid	1,147.9
Trimethyl carbinol	$(CH_3)_3COH$	liquid	629.3
Trimethylene	 $CH_2CH_2CH_2$	gas	496.8
Trimethylethylene	$(CH_3)_2C{:}CHCH_3$	liquid	796.0
Trimethylethylene	$(CH_3)_2C{:}CHCH_3$	vapor	803.6
2, 2, 4-Trimethylpentane	$(CH_3)_3C.CH_2CH(CH_3)_2$	liquid	1,303.9
Trinitrobenzene	$C_6H_3(NO_2)_3$—(1, 3, 5)	solid	663.7
Trinitroglycerol	$C_3H_5(NO_3)_3$	liquid	368.4
Trinitrotoluene	$C_6H_2(CH_3)(NO_2)_3$—(1, 2, 4, 6)	solid	820.7
Triphenyl amine	$(C_6H_5)_3N$	solid	2,267.8
Triphenylbenzene	$C_6H_3(C_6H_5)_3$—(1, 3, 5)	solid	2,936.7
Triphenyl carbinol	$(C_6H_5)_3CHOH$	solid	2,340.8
Triphenylmethane	$(C_6H_5)_3CH$	solid	2,388.7
Triphenyl methyl	$(C_6H_5)_3C$	solid	2,378.5
Tyrosine	$C_9H_{11}O_3N$	solid	1,070.2
Undecylic acid	$C_{11}H_{22}O_2$	solid	1,615.9
Urea	$(NH_2)_2CO$	solid	151.6
Urethane	$NH_2CO_2C_2H_5$	solid	397.2
Uric acid	$C_5H_4O_3N_4$	solid	460.2
n-Valeric acid	$C_4H_9CO_2H$	liquid	681.6
Vanillin	$C_6H_3(OH)(OCH_3)CHO$—(1, 2, 4)	solid	914.1
o-Xylene	$(CH_3)_2C_6H_4$	liquid	1,091.7
m-Xylene	$(CH_3)_2C_6H_4$	liquid	1,088.4
p-Xylene	$(CH_3)_2C_6H_4$	liquid	1,089.1
Xylose	$C_5H_{10}O_5$	solid	561.5

HEAT OF FORMATION

FOR ORGANIC COMPOUNDS

The heat of formation of a compound "A" is equal to the sum of the heats of formation of the products of combustion minus the heat of combustion (see preceding table) of the compound "A." The heat of formation of:

Free elements	0	kg-cal
CO_2 (gas)	94.38	"
$\frac{1}{2}H_2O$ (liquid from 1 H)	34.19	"
HF (dilute aqueous solution)	75.6	"
SO_2 (gas)	69.3	"
HBr (aqueous solution)	28.54	"
HCl (aqueous solution)	39.46	"
HNO_3 (aqueous solution)	49.80	"
H_2SO_4 (aqueous solution)	207.5	"

Example I

To calculate the heat of formation of methane (CH_4) where

Heat of combustion of methane = 210.8
Heat of formation of CO_2 = 94.38
Heat of formation of $\frac{1}{2}H_2O$ = 34.19

and where the combustion occurs according to the equation:

$$CH_4 + 2O_2 = CO_2 \text{ (gas)} + 2H_2O \text{ (liquid)}$$

Then the heat of formation of $CH_4 = 94.38 + 4(34.19) - 210.8 = +20.34$ kg-cal. per gram molecular weight.

Example II

To calculate the heat of formation of ethylene (C_2H_4) where

Heat of combustion of ethylene = 331.6

and the combustion occurs according to the equation:

$$C_2H_4 + 3O_2 = 2CO_2 + 2H_2O$$

The heat of formation of $C_2H_4 = 2(94.38) + 4(34.19) - 331.6 = -6.08$ kg-cal. per gram molecular weight.

Example III

To calculate the heat of formation of ethylamine ($C_2H_5NH_2$) where

Heat of combustion of ethylamine = 408.5

and the combustion occurs according to the equation:

$$C_2H_5NH_2 + 3.75O_2 = 2CO_2 + 3.5(H_2O) + 0.5N_2$$

The heat of formation of $C_2H_5NH_2 = 2(94.38) + 7(34.19) + O(N_2) - 408.5 = +19.59$ kg-cal. per gram molecular weight.

COMBUSTION CONSTANTS OF GASES

The flue products are based upon air with 21% oxygen and 79% nitrogen; flame temperatures are not corrected for dissociation; the high or gross heat value is one which would be obtained by burning in a Junker's calorimeter; it includes the heat of condensation of the water formed by combustion and assumes that all products of combustion are cooled to the initial temperature; the low or net heat value assumes that all of the products of combustion except water have been cooled to the initial temperature; the difference between the gross and the net is equal to the heat of vaporization of water at the initial temperature.

	Formula	Mol. wt.	Sp. gr. air 1	Lb. per cu. ft. dry	B.t.u. per lb.-mol. high (gross)	B.t.u. per lb.-mol. low (net)	B.t.u. per cu. ft. high (gross) 60° F. 30 in. satd. H_2O
Acetylene	C_2H_2	26.02	0.8981	0.06858	562,000	543,000	1456
Ammonia	NH_3	17.03	0.5878	0.04489	....	....	......
Benzene	C_6H_6	78.05	2.6940	0.2057	1,413,000	1,356,000	3658
Butane	C_4H_{10}	58.08	2.0047	0.15309	1,237,000	1,142,000	3204
Butylene	C_4H_8	56.06	1.9352	0.14778	1,171,000	1,095,000	3033
Carbon dioxide	CO_2	44.00	1.5288	0.11598	....	....	......
Carbon monoxide	CO	28.00	0.9665	0.07381	122,400	122,400	317.1
Ethane	C_2H_6	30.05	1.0371	0.07920	668,300	611,300	1731
Ethylene	C_2H_4	28.03	0.9676	0.07389	622,400	584,400	1613
Hydrogen	H_2	2.02	0.0695	0.00531	123,100	104,100	318.8
Hydrogen sulfide	H_2S	34.08	1.1767	0.08986	....	....	......
Methane	CH_4	16.03	0.5534	0.04226	384,000	346,000	995
Naphthalene	$C_{10}H_8$	128.06	......	....	2,219,000	2,143,000	......
Nitrogen	N_2	28.02	0.9671	0.07385	....	....	......
Oxygen	O_2	32.00	1.1046	0.08435	....	....	......
Propane	C_3H_8	44.06	1.5210	0.11615	952,000	876,000	2465
Propylene	C_3H_6	42.05	1.4513	0.11083	893,000	836,000	2313
Toluene	C_7H_8	92.06	3.1778	0.2427	1,685,000	1,609,000	4364
Xylene	C_8H_{10}	106.08	3.6616	0.27962	1,955,000	1,860,000	5064
Water	H_2O	18.02	0.6219	0.04749	....	....	.....

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HEAT OF COMBUSTION OF LIQUID FUELS

Fuel	B.t.u. per lb	Gram-calories per gram	Ultimate analysis					Lbs. per gallon	Specific gravity at 60° F
			C	H	S	N	O		
Alcohol, fuel or denatured	11,620	6,456	.....	.....	.....	.....	....	6.836	0.820
Crude oil, California	18,910	10,506	84.00	12.70	0.75	1.70	1.20	7.636	0.917
Kansas	19,130	10,628	84.15	13.00	1.90	0.45	....	7.670	0.921
Mexico	18,755	10,419	83.70	10.20	4.15	....	....	8.120	0.975
Oklahoma	19,502	10,834	85.70	13.11	0.40	0.30	....	7.236	0.869
Pennsylvania	19,505	10,836	86.06	13.88	0.06	0.00	0.00	6.769	0.813
Texas	19,460	10,811	85.05	12.30	1.75	0.70	0.00	7.286	0.875
Wyoming	19,510	10,839	.....	.....	....	....	....	7.228	0.868
Gas oil	19,200	10.667	.....	.....	....	....	....	7.184	0.863
Gasoline	20,750	11,528	84.90	14.76	0.08	....	....	6.152	0.739
Fuel oil, California	18,835	10.464	84.67	12.36	1.16	....	....	7.956	0.9554
Mexico	18.510	10,283	84.02	10.06	4.93	....	....	8.223	0.987
Mid-continent	19,376	10,764	85.62	11.98	0.35	0.50	0.60	7.428	0.892
Furnace oil	19,025	10,569	.....	.....	....	....	....	7.462	0.896
Kerosene	19,810	11,006	.....	.....	....	....	....	6.822	0.819

COMBUSTION CONSTANTS OF GASES (Continued)

							Cu. ft. per cu. ft. fuel gas or mol. per mol.	
							Required for combustion	
	B.t.u. per cu. ft. low (net) 60° F. 30 in. satd. H_2O	B.t.u. per cu. ft. high (gross) 60° F. 30 in. dry	B.t.u. per cu. ft. low (net) 60° F. 30 in. dry	B.t.u. per cu. ft. high (gross) 32° F. 30 in.	B.t.u. per cu. ft. low (net) 32° F. 30 in.	Theoretical flame temp. deg. F.	Oxygen	Air
Acetylene	1396	1499	1448	1567	1514	4770	2.5	11.90
Ammonia	......	......	......	......	......	....	....	.....
Benzene	3509	3751	3601	3933	3774	4110	7.5	35.70
Butane	2955	3370	3113	3445	3180	3870	6.5	30.95
Butylene	2834	3084	2885	3262	3050	4030	6.0	28.58
Carbon dioxide	......	......	......	......	......	....	....	.....
Carbon monoxide	317.1	322.6	341.0	341.0	341.0	4475	0.5	2.38
Ethane	1582	1792	1641	1862	1703	3820	3.5	16.67
Ethylene	1514	1613.8	1513.2	1734	1631	4250	3.0	14.29
Hydrogen	269.1	324.5	343.0	343.0	290.0	4010	0.5	2.38
Hydrogen sulfide	......	......	......	......	......	....	1.5	7.14
Methane	896	1013.2	913.1	1069	963	3750	2.0	9.52
Naphthalene	......	......	......	......	......	4100	12.0	57.10
Nitrogen	......	......	......	......	......	....	....	.....
Oxygen	......	......	......	......	......	....	....	.....
Propane	2266	2590	2385	2652	2440	3840	5.0	23.80
Propylene	2164	2336	2186	2487	2328	4090	4.5	21.43
Toluene	4165	4441	4693	4693	4481	4050	9.0	42.87
Xylene	4815	5153	5446	5446	5181	4010	10.5	50.00
Water	......	......	......	......	......	....	....	.....

Continued on next page.

	Cu. ft. per cu. ft. fuel gas or mol. per mol.			Ignition temp. at atmospheric pressure				Inflammability in air at atmospheric pressure and ordinary temp.	
	Flue products			In air		In oxygen			
	CO_2	H_2O	N_2	Deg. F.	Deg. C.	Deg. F.	Deg. C.	% lower limit mixture	% upper limit mixture
Acetylene	2.0	1.0	9.40	763–824	406–440	781–824	416–440	2.50	8.00
Ammonia	....	....	....	....	......	....	......	......	......
Benzene	6.0	3.0	28.20	1364	740	1224	662	1.40	7.10
Butane	4.0	5.0	24.45	....	......	....	......	1.86	8.41
Butylene	4.0	4.0	22.58	....	......	....	......	1.65	9.95
Carbon dioxide	....	....	....	....	......	....	......	......	......
Carbon monoxide	1.0	....	1.88	1191–1216	644–658	1179–1216	637–658	12.5	71.2
Ethane	2.0	3.0	13.17	968–1166	520–630	968–1166	520–630	3.00	12.50
Ethylene	2.0	2.0	11.29	1008–1018	542–547	932–966	500–519	2.75	28.60
Hydrogen	....	1.0	1.88	1076–1094	580–590	1076–1094	580–590	4.	74.20
Hydrogen sulfide	1.0 SO_2	1.0	5.64	....	......	....	......	......	......
Methane	1.0	2.0	7.52	1202–1382	650–750	1033–1292	556–700	5.00	15.00
Naphthalene	10.0	4.0	45.00	....	......	....	......	......	......
Nitrogen	....	....	....	....	......	....	......	......	......
Oxygen	....	....	....	....	......	....	......	......	......
Propane	3.0	4.0	18.80	....	......	914–1058	490–570	2.12	9.35
Propylene	3.0	3.0	16.93	....	......	....	......	2.00	11.10
Toluene	7.0	4.0	33.87	1490	810	1026	552	1.27	6.75
Xylene	8.0	5.0	39.50	....	......	....	......	1.00	6.00
Water	....	....	....	....	......	....	......	......	......

THERMAL CONVERSION FACTORS FOR COMPETITIVE FUELS

Solid Fuels	**Btu (Gross)**
Bituminous coal and lignite	26,200,000/net T
Anthracite (Pennsylvania)	25,400,000/net T
Coal coke	26,000,000/net T
Petroleum coke	30,120,000/net T
Briquets and packaged fuels	23,000,000/net T
Wood including mill wastes	20,960,000/cord
Liquid Fuels	
Crude oil	5,800,000/bbl
Kerosene and range oils	5,691,000/bbl
Distillate fuel oils (Grades 1–4)	5,824,980/bbl
Residual fuel oils (Grades 5–6)	6,322,260/bbl
Coal tars	6,300,000/bbl
Gaseous Fuels	
Natural gas, wet	1,075/cu ft
Natural gas, dry	1,050/cu ft
Manufactured gas	550/cu ft
Liquefied petroleum gas	95,500/gal
Miscellaneous fuels	
Electrical energy	3,412/kw.-hr

HEATS OF COMBUSTION AND COMPOSITION OF MANUFACTURED AND NATURAL GASES

Products of combustion, theoretical flame temperatures, air required and B.T.U. of gas-air mixture are based upon air with 21 % oxygen and 79 % nitrogen; heat values are calculated from the table as given under "Combustion Constants of Gases;" flame temperatures are not corrected for dissociation; carburetted water gas, coal gas, coke-oven gases and oil gas contain a small amount of benzene and oxygen.

	Combustion Values								Composition								
	Theoretical flame temp. ° F.	B.T.U. per cu. ft., high (gross) 60° F., 30 in. Hg, satd. H_2O	B.T.U. per cu. ft., low (net) 60° F., 30 in. Hg, satd. H_2O	Cu. ft. air required per cu. ft. gas	Cu. ft. CO_2 per cu. ft. of gas burned	Cu. ft. H_2O per cu. ft. of gas burned	Cu. ft. of N_2 per cu. ft. of gas burned	High (gross) B.T.U. per cu. ft. gas-air mixture	% CO_2	% CO	% C_2H_6 (ethane)	% C_2H_4 (ethylene)	% H_2	% CH_4 (methane)	% N_2	% O_2	% C_3H_8 (propane)
Blast-furnace gas	2660	93	91.6	0.70	0.392	0.032	0.55	54.7	13.0	26.2	....	....	3.2	....	57.6	...	....
Blue water gas	4167	310	285	2.28	0.469	0.518	1.81	94.5	3.5	43.4	....	....	51.8	....	1.3	...	....
Carburetted water gas	4090	578	529	4.85	0.758	0.904	3.85	98.8	1.5	33.9	....	12.8	35.2	14.8	1.8	...	....
Coal gas	3910	634	560	5.50	0.573	1.282	4.36	97.5	1.1	9.0	....	6.6	47.0	34.0	2.3	...	....
Coke-oven gas	3430	536	476	4.65	0.420	1.205	4.71	95.0	1.4	5.1	....	2.9	57.4	28.5	4.2	0.5	....
Coke-oven gas	3860	600	538	5.28	0.529	1.206	4.21	95.6	2.6	6.1	....	5.2	47.9	33.9	3.7	0.6	....
Natural gas at Follansbee, W. Va.	3835	2221	1970	21.55	2.667	3.662	17.00	98.6	....	....	31.8	....	....	....	0.5	...	67.7
Natural gas, Follansbee residual	3830	1868	1711	17.97	2.188	3.182	14.21	98.5	....	....	79.4	....	....	....	0.6	...	20.0
Natural gas at McKean County, Pa.	3770	1482	1350	14.25	1.663	2.756	11.29	97.3	....	....	67.0	....	....	32.3	0.7	...	....
Natural gas at Sandusky, Ohio	3740	1047	946	10.04	1.087	2.045	7.98	94.7	0.2	....	12.5	....	....	83.5	3.8	...	....
Oil gas	3970	516	461	4.25	0.458	1.129	3.39	98.3	2.8	10.6	....	2.7	53.5	27.0	3.4	...	....
Producer gas	3050	136	128	1.08	0.311	0.165	1.44	65.3	5.7	22.0	....	0.4	10.5	2.6	58.8	...	....

LIMITS OF INFLAMMABILITY

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The limits of inflammability given in the following tables were all determined at atmospheric pressure and room* temperature for upward propagation in a tube or bomb 2 inches or more in diameter. Values are on a percentage-by-volume basis.

LIMITS OF INFLAMMABILITY OF GASES AND VAPORS IN AIR

Compound	Empirical formula	Limits of inflammability	
		Lower	Upper
Paraffin hydrocarbons			
Methane	CH_4	5.00	15.00
Ethane	C_2H_6	3.00	12.50
Propane	C_3H_8	2.12	9.35
Butane	C_4H_{10}	1.86	8.41
Isobutane	C_4H_{10}	1.80	8.44
Pentane	C_5H_{12}	1.40	7.80
Isopentane	C_5H_{12}	1.32	.....
2,2-Dimethylpropane	C_5H_{12}	1.38	7.50
Hexane	C_6H_{14}	1.18	7.40
Heptane	C_7H_{16}	1.10	6.70
2,3-Dimethylpentane	C_7H_{16}	1.12	6.75
Octane	C_8H_{18}	0.95	.....
Nonane	C_9H_{20}	0.83	.....
Decane	$C_{10}H_{22}$	0.77	5.35
Olefins			
Ethylene	C_2H_4	2.75	28.60
Propylene	C_3H_6	2.00	11.10
Butene-1	C_4H_8	1.65	9.95
Butene-2	C_4H_8	1.75	9.70
Amylene	C_5H_{10}	1.42	8.70
Acetylenes			
Acetylene	C_2H_2	2.50	80.00
Aromatics			
Benzene	C_6H_6	1.40	7.10
Toluene	C_7H_8	1.27	6.75
o-Xylene	C_8H_{10}	1.00	6.00
Cyclic hydrocarbons			
Cyclopropane	C_3H_6	2.40	10.40
Cyclohexane	C_6H_{12}	1.26	7.75
Methylcyclohexane	C_7H_{14}	1.15	.....
Terpenes			
Turpentine	$C_{10}H_{16}$	0.80	.....
Alcohols			
Methyl alcohol	CH_4O	6.72	36.50
Ethyl alcohol	C_2H_6O	3.28	18.95
Allyl alcohol	C_3H_6O	2.50	18.00

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* The upper limits of some vapors were determined at somewhat higher temperatures because of their low vapor pressures.

LIMITS OF INFLAMMABILITY OF GASES AND VAPORS IN AIR (Continued)

Compound	Empirical formula	Limits of inflammability	
		Lower	Upper
n-Propyl alcohol	C_3H_8O	2.15	13.50
Isopropyl alcohol	C_3H_8O	2.02	11.80
n-Butyl alcohol	$C_4H_{10}O$	1.45	11.25
Isobutyl alcohol	$C_4H_{10}O$	1.68	.....
n-Amyl alcohol	$C_5H_{12}O$	1.19	.....
Isoamyl alcohol	$C_5H_{12}O$	1.20	.....
Aldehydes			
Acetaldehyde	C_2H_4O	3.97	57.00
Crotonic aldehyde	C_4H_6O	2.12	15.50
Furfural	$C_5H_4O_2$	2.10	.....
Paraldehyde	$C_6H_{12}O_3$	1.30	.....
Ethers			
Methylethyl ether	C_3H_8O	2.00	10.00
Diethyl ether	$C_4H_{10}O$	1.85	36.50
Divinyl ether	C_4H_6O	1.70	27.00
Ketones			
Acetone	C_3H_6O	2.55	12.80
Methylethyl ketone	C_4H_8O	1.81	9.50
Methylpropyl ketone	$C_5H_{10}O$	1.55	8.15
Methylbutyl ketone	$C_6H_{12}O$	1.35	7.60
Acids			
Acetic acid	$C_2H_4O_2$	5.40	.....
Hydrocyanic acid	HCN	5.60	40.00
Esters			
Methyl formate	$C_2H_4O_2$	5.05	22.70
Ethyl formate	$C_3H_6O_2$	2.75	16.40
Methyl acetate	$C_3H_6O_2$	3.15	15.60
Ethyl acetate	$C_4H_8O_2$	2.18	11.40
Propyl acetate	$C_5H_{10}O_2$	1.77	8.00
Isopropyl acetate	$C_5H_{10}O_2$	1.78	7.80
Butyl acetate	$C_6H_{12}O_2$	1.39	7.55
Amyl acetate	$C_7H_{14}O_2$	1.10	.....
Hydrogen			
Hydrogen	H_2	4.00	74.20
Nitrogen compounds			
Ammonia	NH_3	15.50	27.00
Cyanogen	C_2N_2	6.60	42.60
Pyridine	C_5H_5N	1.81	12.40
Ethyl nitrate	$C_2H_5NO_3$	3.80	.....
Ethyl nitrite	$C_2H_5NO_2$	3.01	50.00
Oxides			
Carbon monoxide	CO	12.50	74.20
Ethylene oxide	C_2H_4O	3.00	80.00
Propylene oxide	C_3H_6O	2.00	22.00
Dioxan	$C_4H_8O_2$	1.97	22.25
Diethyl peroxide	$C_4H_{10}O_2$	2.34	.....

LIMITS OF INFLAMMABILITY OF GASES AND VAPORS IN AIR (Continued)

Compound	Empirical formula	Limits of inflammability	
		Lower	Upper
Sulfides			
Carbon disulfide	CS_2	1.25	50.00
Hydrogen sulfide	H_2S	4.30	45.50
Carbon oxysulfide	COS	11.90	28.50
Chlorides			
Methyl chloride	CH_3Cl	8.25	18.70
Ethyl chloride	C_2H_5Cl	4.00	14.80
Propyl chloride	C_3H_7Cl	2.60	11.10
Butyl chloride	C_4H_9Cl	1.85	10.10
Isobutyl chloride	C_4H_9Cl	2.05	8.75
Allyl chloride	C_3H_5Cl	3.28	11.15
Amyl chloride	$C_5H_{11}Cl$	1.60	8.63
Vinyl chloride	C_2H_3Cl	4.00	21.70
Ethylene dichloride	$C_2H_4Cl_2$	6.20	15.90
Propylene dichloride	$C_3H_6Cl_2$	3.40	14.50
Bromides			
Methyl bromide	CH_3Br	13.50	14.50
Ethyl bromide	C_2H_5Br	6.75	11.25
Allyl bromide	C_3H_5Br	4.36	7.25
Amines			
Methyl amine	CH_5N	4.95	20.75
Ethyl amine	C_2H_7N	3.55	13.95
Dimethyl amine	C_2H_7N	2.80	14.40
Propyl amine	C_3H_9N	2.01	10.35
Diethyl amine	$C_4H_{11}N$	1.77	10.10
Trimethyl amine	C_3H_9N	2.00	11.60
Triethyl amine	$C_6H_{15}N$	1.25	7.90

LIMITS OF INFLAMMABILITY OF GASES AND VAPORS IN OXYGEN

Compound	Formula	Limits of inflammability	
		Lower	Upper
Hydrogen	H_2	4.65	93.9
Deuterium	D_2	5.00	95.0
Carbon monoxide	CO	15.50	93.9
Methane	CH_4	5.40	59.2
Ethane	C_2H_6	4.10	50.5
Ethylene	C_2H_4	2.90	79.9
Propylene	C_3H_6	2.10	52.8
Cyclopropane	C_3H_6	2.45	63.1
Ammonia	NH_3	13.50	79.0
Diethyl ether	$C_4H_{10}O$	2.10	82.0
Divinyl ether	C_4H_6O	1.85	85.5

HEATS OF COMBUSTION AND COMPOSITION OF REPRESENTATIVE COALS

Analysis on coal "as received." First name is that of the county, second name that of the mine.

	Type	B.t.u. per pound	Ultimate analysis					Proximate analysis			
			% C	% H	% N	% O	% S	% Moisture	% Volatile matter	% Fixed carbon	% Ash
Alabama:											
Bibb, Belle Ellen	Bituminous	14,140	78.3	5.3	1.4	7.6	1.2	3.2	31.0	59.6	6.2
Jefferson, Bessemer	“	14,620	81.7	4.7	1.5	6.5	0.7	2.4	24.4	68.4	4.8
Shelby, Aldrich	“	13,650	75.0	5.2	1.0	10.0	0.8	2.3	38.6	51.9	7.2
Alaska:											
Moose Creek	“	12,150	67.6	5.3	1.9	15.9	0.3	4.7	35.5	50.9	8.9
Arkansas:											
Hartford, Central No. 10	“	13,270	77.4	4.1	1.6	5.3	1.1	2.9	19.3	67.3	10.5
Huntington, No. 6 Central	Semi-bituminous	13,700	78.7	4.4	1.6	4.4	1.9	3.2	18.1	69.7	9.0
Colorado:											
Gunnison, Somerset	Bituminous	12,630	70.6	5.5	1.5	12.7	0.4	4.3	39.7	46.7	9.3
Weld, Erie	Sub-bituminous	9,520	54.8	6.3	1.2	33.8	0.3	24.6	29.8	42.0	3.6
Illinois:											
Christian, Pana	Bituminous	10,860	59.8	5.6	1.1	19.1	3.7	13.0	37.0	39.3	10.7
Franklin, Orient	“	12,160	69.0	5.4	1.6	15.0	1.0	7.3	36.7	47.9	8.1
Williamson, Herrin	“	11,860	67.1	5.2	1.5	16.7	0.9	9.4	33.0	49.0	8.6
Indiana:											
Green, Jasonville	“	11,540	64.5	5.8	1.5	19.8	1.1	13.5	36.3	42.9	7.3
Knox, South Bruceville	“	11,540	62.3	5.5	1.0	17.1	3.2	9.5	38.3	41.4	10.9
Sullivan, Vandalia	“	11,420	63.8	5.9	1.4	20.9	1.3	14.9	34.3	44.1	6.7
Iowa:											
Lucas, Chariton	“	10,240	55.8	5.7	1.1	21.5	3.2	15.4	30.5	41.5	12.6
Polk, Altoona	“	10,240	54.7	5.5	0.8	18.8	6.2	13.9	37.0	35.2	14.0
Kansas:											
Cherokee, Stone City	“	13,080	71.8	5.2	1.2	10.2	3.3	5.1	34.5	52.2	8.3
Crawford, Edison	“	12,500	68.8	4.9	1.2	8.7	4.6	3.9	34.2	50.1	11.8
Kentucky:											
Christian, Mannington	“	11,680	....	....	....	....	3.1	9.2	33.7	46.4	10.7
Webster	“	12,500	70.4	5.1	1.6	12.6	1.1	5.4	34.9	50.4	9.3
Maryland:											
Allegany, Frostburg	Semi-bituminous	13,430	76.9	4.3	1.9	4.9	1.1	2.2	17.2	69.1	10.9
Allegany, Ocean	Semi-bituminous	14,190	81.0	4.5	1.9	4.0	1.0	1.2	17.9	73.2	7.7
Montana:											
Carbon, Washoe	Sub-bituminous	10,550	59.8	5.6	1.3	21.0	1.1	10.5	34.7	43.7	11.2
Musselshell, Roundup	“	10,690	62.0	5.6	1.0	22.7	0.7	13.6	32.9	45.5	8.1
New Mexico:											
San Juan, Farmington	Bituminous	11,630	....	....	....	....	1.3	6.9	38.1	43.0	11.9
North Dakota:											
Ward, Burlington	Lignite	6,010	37.4	6.4	0.6	45.0	0.2	36.9	24.9	27.7	10.4
Williams, Wheelock	“	5,990	35.2	7.1	0.5	47.5	1.3	42.1	25.0	24.4	8.5
Ohio:											
Columbian, New Salisbury	Bituminous	12,730	69.9	5.2	1.4	8.3	4.3	3.5	36.7	48.9	10.9
Jefferson, Yellow Creek	“	12,720	69.7	5.2	1.4	8.0	5.1	3.4	36.3	49.6	10.7
Oklahoma:											
Coal, Lehigh	“	11,260	62.8	5.0	1.5	14.5	4.3	6.6	38.6	42.9	11.9
Latimer, Degnan	“	13.630	....	....	....	....	0.9	3.7	36.8	53.8	5.6
Pittsburg, Ridgway	“	13,280	73.8	5.4	1.8	9.6	1.7	3.8	38.0	50.6	7.6

HEATS OF COMBUSTION AND COMPOSITION OF REPRESENTATIVE COALS (Continued)

	Type	B.t.u. per pound	Ultimate analysis					Proximate analysis			
			% C	% H	% N	% O	% S	% Moisture	% Volatile matter	% Fixed carbon	% Ash
Oregon:											
Coos, Beaverhill	Sub-bituminous	9,030	51.1	5.5	1.2	28.2	0.8	16.1	31.1	39.6	13.2
Pennsylvania:											
Armstrong, Montgomeryville	Cannel	10,460	56.9	4.5	1.1	5.6	3.7	1.8	32.8	37.3	28.2
Armstrong, W. Kittanning	Bituminous	13,040	71.4	5.3	1.3	9.1	3.1	3.4	35.5	51.3	9.7
Bedford, Hopewell	"	13,810	77.4	4.1	1.4	3.4	1.0	1.6	16.3	70.0	12.1
Cambria, Bakerton	Semi-bituminous	14,460	....	...	...	....	1.1	2.2	22.2	70.3	5.3
Cambria, Nanty Glo	"	14,380	....	...	...	....	1.9	2.5	20.0	71.5	6.1
Cambria, Windber	"	14,620	83.9	4.3	1.3	2.4	1.2	2.6	17.0	73.7	6.9
Jefferson, Punxsutawney	Bituminous	13,860	76.6	5.1	1.2	7.2	2.0	2.6	30.4	59.1	7.9
Somerset, Seanor	Semi-bituminous	13,740	78.5	4.3	1.2	4.5	2.5	2.4	17.3	71.4	9.0
Rhode Island:											
Providence, Cranston	Anthracite	11,620	82.4	0.5	0.1	1.8	0.9	4.5	3.0	78.7	13.8
Texas:											
Webb, Dolores	Cannel	11,070	59.3	5.8	1.2	12.7	2.1	4.4	46.0	30.5	19.0
Virginia:											
Montgomery, Blacksburg	Semi-bituminous	12,740	75.3	3.6	0.9	4.8	0.5	1.9	14.0	68.9	15.2
Pulaski, Guntan Park	Semi-anthracite	10,960	....	...	...	....	0.8	3.8	9.4	62.2	24.0
Tazewell, Pocahontas	Semi-bituminous	14,610	84.0	4.7	1.2	5.2	0.5	3.0	20.3	72.2	4.5
Wise, Josephine	Bituminous	13,270	73.7	5.1	1.6	8.8	0.9	2.6	33.8	53.6	10.0
Washington:											
Kittitas, Ellensburg	"	11,010	61.3	5.5	1.5	14.4	1.4	10.3	30.4	43.4	15.9
Thurston, Tono	Sub-bituminous	8,700	49.9	6.3	0.9	32.4	1.2	21.7	34.8	33.3	10.3
West Virginia:											
Brook, Collier	Bituminous	12,940	72.1	5.3	1.4	10.5	2.6	4.4	37.4	50.1	8.1
Grant, Bismarck	Semi-bituminous	13,590	....	...	...	....	2.7	3.0	16.7	71.0	9.3
Mineral, Emoryville	"	12,600	....	...	...	....	2.5	2.4	16.1	65.9	15.6
Ohio, Elm Grove	Bituminous	13,200	72.8	5.3	1.4	8.8	3.6	3.0	41.4	45.6	8.1
Wyoming:											
Lincoln, Elkol	Sub-bituminous	10,080	57.8	6.3	0.9	31.1	0.7	20.8	35.4	40.6	3.2
Lincoln, Green River	Bituminous	13,310	74.5	5.3	1.3	12.5	1.0	3.6	38.4	52.5	5.5

HEAT OF COMBUSTION, VARIOUS SUBSTANCES

Approximate values of heat of combustion in kilogram calories per gram of substance. Products of combustion are gaseous unless otherwise stated.

Substance	Kg-cal. per gram of substance	Observer
Asphalt	9.530	Slossen, Colburn
Bagasse (refuse from sugar cane), 12% H_2O	4.045	Aufhäuser—1931, 1935
Bamboo, 10.5% H_2O	4.110	
Buckwheat hulls, 10% H_2O	4.219	Aufhäuser—1931, 1935
Butter	9.200	
Carbon:		
amorphous	8.080	Mean
charcoal	8.100	Mean
diamond	7.860	Berthelot
graphite	7.900	Berthelot
Casein	5.860	
Charcoal, 4% H_2O	7.260	
Coconut shells, 13% H_2O	4.200	Freise—1932
Copper (to CuO)	.590	Thomsen
Dynamite, 75%	1.290	Roux, Sarran
Egg white	5.700	
Egg yolk	8.100	
Fats, animal, mean	9.500	
Gunpowder	0.720–0.750	
Hemoglobin	5.900	
Hydrogen, to liquid	33.900	Mean
Hydrogen, to gas	29.150	Berthelot
Iron (to Fe_2O_3)	1.582	
Leather, cuttings 13.7% H_2O	4.729	Aufhäuser
Magnesium (to MgO)	6.080	
Nitrocellulose, 11.29% N	2.576	Ball—1931
Oak bark, 7% H_2O	4.522	Fieldner
Oil:		
cotton seed	9.500	
lard	9.300	Mean
linseed	9.434	Caldwell, Mattiello—1932
olive	9.400	Mean
paraffin	9.800	Mohler
petroleum:		
crude	11.500	Mean
heavy	10.200	Mean
light	10.000	Mean
rape	9.500	Stohmann
sperm	10.000	Gibson
Paraffin (to CO_2, H_2O l)	11.140	Stohmann
Paraffin (to CO_2, H_2O g)	10.340	Stohmann
Pitch	8.400	
Rubber	3.349	Aufhäuser
Sulfur:		
monoclinic	2.240	Thomsen
rhombic	2.200	Mean
Tallow	9.500	Stohmann
Woods:		
beech, 13% H_2O	4.170	Gottlieb
birch, 12% H_2O	4.210	Gottlieb
oak, 13% H_2O	3.990	Gottlieb
pine, 12% H_2O	4.420	Gottlieb

STEROID HORMONES

By Erwin Di Cyan

NATURE and FUNCTION: Secreted by the ductless glands and playing an immense role in the physical and metabolic development of man, the steroid hormones are characterized by the extremely minute quantities and indispensability of their need by the body. All of them have the cyclopentanophenanthrene nucleus, and although chemically very similar, a comparatively slight structural change is in many instances productive of physiologically dissimilar hormones, acting upon different physiologic systems, and having different *qualitative* as well as *quantitative* effects. Although originally isolated from natural sources (such as bulls' testes, mares' pregnancy urine, human pregnancy urine, etc), some steroid hormones have been synthetically prepared from cholesterol, bile acids or other steroid precursors; esters and other derivatives have been made from steroid hormones of synthetic, as well as natural sources. The hormones treated below, are those presently (1954) important in the treatment of endocrinologic dysfunctions or other diseases such as those of collagen nature in which they exert a characteristic ameliorative effect. They are administered on the basis of one or more of the following theories:

(a) To supplement the secretion of a specific hormone which progressively declines due to natural biologic aging of the organism; in the menopause as an example of such declining secretion, a female sex hormone is used for such supplementation.

(b) To make available to the body a specific hormone, the natural secretion of which is inhibited because of a functional congenital or developmental anomaly; in the case of the underdeveloped male secondary sex characteristics as an example of such an inhibited secretion, a male sex hormone is used.

(c) To cause a reversal of hormonal balance in the treatment of diseases peculiar to a sex; as examples, in the case of cancer of the female breast, a male sex hormone is administered, and in cancer of the prostate, a female sex hormone is used.

(d) To exert a therapeutic effect in certain disease states, in which the hormone has been found ameliorative, which disease states are not essentially endocrinologic in nature; for example cortisone and hydrocortisone in rheumatoid arthritis and osteoarthritis. With that development a changed concept has resulted, in that, the line of demarkation between diseases of endocrinologic and nonendocrinologic nature with respect to the use of hormones has been made fainter if not obliterated. Cortisone and hydrocortisone, steroid hormones in the fullest chemical sense, are used successfully in the treatment of diseases of the eye, skin and in other diseases only remotely related or apparently unrelated to the functioning of the ductless glands.

SOLUBILITY of HORMONES LISTED:

(a) *Water:* All hormones insoluble, except corticosterone, hydrocortisone and estrone slightly soluble.

(b) *Volatile Solvents:* All hormones soluble, except anhydrohydroxyprogesterone and desoxycorticosterone acetate slightly soluble; estradiol benzoate and estrone benzoate slightly soluble in ether, but soluble in other volatile solvents.

(c) *Vegetable Oils:* All hormones slightly soluble, except testosterone propionate soluble; since minimal quantities of hormones are required for effectiveness, this small order of solubility is often sufficient for usefulness.

SPECIFIC ROTATION of HORMONES LISTED: When determined in dioxane, 1% solution of the hormone employed, except estradiol benzoate and progesterone, in which a 2% solution in dioxane is employed, except when otherwise listed herein.

ASSAYS of HORMONES LISTED: All hormones are assayed biologically and chemical assays are often used conjunctively; in the case of synthetically produced hormones, chemical assays are commonly used solely.

USAGE of HORMONES LISTED:

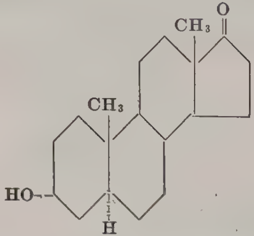
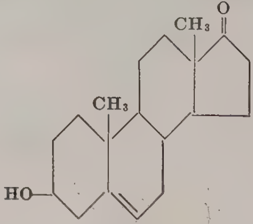
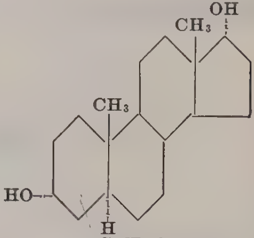
(a) *Androgenic* (Male), originally isolated from bulls' testes, now made synthetically. *In the male,* to supplement the supply of naturally secreted testosterone, the production of which lessens with advancing age, or the normal elaboration of which in the male is inhibited at puberty, due to an endocrinologic disorder. Used to stimulate development of male secondary sex characteristics, in treatment of eunuchoidism, undescended testes and as supportive treatment of symptoms of the male climateric. *In the female,* to suppress excessive menstrual bleeding, and in cancer of the breast. *Dosage:* 5 to 25 mgms. *Testosterone* is used intramuscularly as oil solution or as aqueous suspension of crystals, topically as ointment, sublingually as tablets, or by implantation of crystals under the skin. *Testosterone propionate* (oil solution) intramuscularly, has an effect more protracted than testosterone. *Methyl testosterone* (tablets) is orally active, and used orally or by inunction. *Androsterone, Dehydroandrosterone* or *Dihydroandrosterone* are now only rarely used if at all, since testosterone and its derivatives, being much more active, have replaced them. (See Charts.)

(b) *Cortical,* originally isolated from the cortex of the adrenal glands, now made synthetically. These hormones stimulate adrenal function. *Corticosterone* is used in shock, intramuscularly as oil or aqueous solution. *Desoxycorticosterone* most generally used as *Desoxycorticosterone acetate* (oil solution or by implantation of crystals) finds its chief use in Addison's disease. *Cortisone and Hydrocortisone* are used in an ever increasing number of entities, including rheumatoid arthritis, allergic manifestations, asthma, psoriasis and other skin diseases. Cortisone is used orally in doses of 50 mg. to 200 mg. daily, and the acetate parenterally or ophthalmically. Hydrocortisone is used orally in doses of 50 mg. to 200 mg. daily and the acetate intraarticularly and topically.

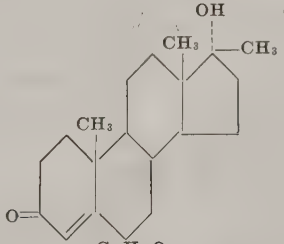
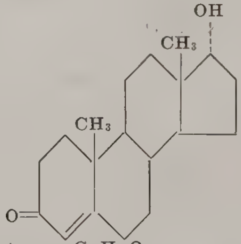
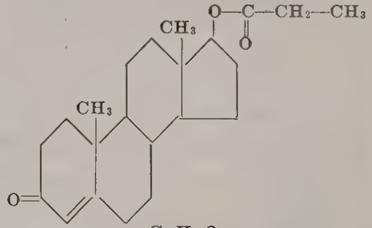
(c) *Estrogenic* (Female), isolated from pregnancy urines and most recently made synthetically. *In the female,* to supplement the supply of naturally secreted estrogens the production of which lessens with advancing age, or the normal elaboration of which in the female is inhibited at puberty due to an endocrinologic disorder. Used to stimulate the development of female secondary sex characteristics, but find their greatest use in the treatment of the symptoms associated with the menopause. The latter are extremely varied, and manifest themselves as symptoms of cardiac, vasomotor or neurologic nature. *In the male,* to inhibit or suppress the development of cancer of the prostate. *Dosage:* 10,000 to 50,000 IU. *Estradiol* is used intramuscularly as oil solution, topically as ointment, orally as tablets, vaginally as suppositories, or by implantation of crystals under the skin. *Estradiol benzoate* and *Estrone benzoate* (oil solution) have an effect more protracted than estradiol or estrone. *Estrone* is used intramuscularly (oil solution or aqueous suspension of crystals), and may be used orally, although it is not as active orally as estradiol. *Estriol* and *Ethinyl estradiol* are orally active and used orally. Diethylstilbestrol, dienestrol and hexestrol are used for the same purposes as the estrogenic hormones. They are chemicals having a hormonelike action and although they resemble the steroid hormones structurally *in some* part of their own structures, they are not considered here because firstly, they are not steroid hormones or secondly, they do not occur naturally.

(d) *Progestational* (Female), originally isolated from the corpus luteum, now made synthetically. *In the female,* to supplement the supply of naturally secreted progesterone. Used in the treatment of excessive menstrual bleeding (either by itself or in combination with estrogens), habitual or threatened abortion, and in premenstrual tension or dysmenorrhea. *Dosage:* 5 to 25 mgms. *Progesterone* is used intramuscularly as oil solution. *Anhydrohydroxyprogesterone* is orally active and used orally.

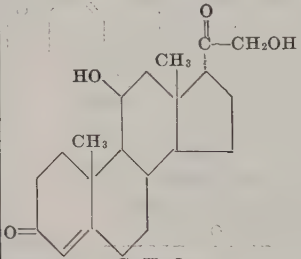
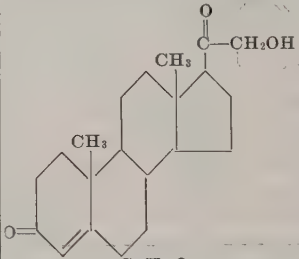
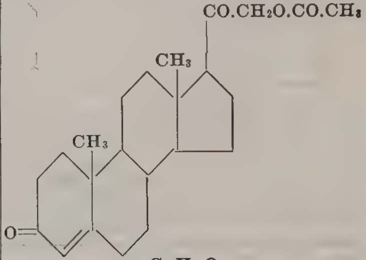
STEROID HORMONES—ANDROGENIC

NAMES: Common or official name; Synonyms; Chemical designations	ANDROSTERONE; cis-androsterone; 3-hydroxy-androstan-17-one; androstane-3-cis-ol-17-one	D*E*HYDROANDROSTERONE; dehydroisoandrosterone; transdehydroandrosterone; Δ^5-androstene-3-trans-ol-17-one; Δ^5-androstene-3-(β)-ol-17-one	D*I*HYDROANDROSTERONE; androstandiol; 3-cis-17-transandrostandiol
FORMULAE: Structural and empirical	 $C_{19}H_{30}O_2$	 $C_{19}H_{28}O_2$	 $C_{19}H_{32}O_2$
Molecular weights	290.4	288.4	292.4
Melting points (°C)	178–185	148	218–223
Specific rotation	$(\alpha)\frac{25}{D} + 85 - +90$ (dioxane)	$(\alpha)\frac{25}{D} + 10$ (alcohol)	$(\alpha)\frac{23}{D} + 12$

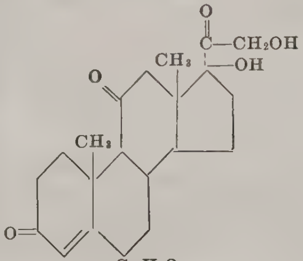
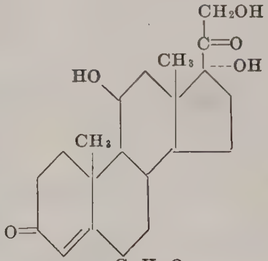
STEROID HORMONES—ANDROGENIC (Continued)

NAMES: Common or official name; Synonyms; Chemical designations	METHYL TESTOSTERONE; 17-methyl-Δ^4-androstene-17-trans-ol-3-one; 17-(β)-methyl-Δ^4-androstene-3-one-17-(α)-ol	TESTOSTERONE; Δ^4-androstene-17-trans-ol-3-one; Δ^4-etiocholen-17-(α)-ol-3-one; Δ^4-androstene-3-one-17-(α)-ol; Δ^4-androstene-one-3-ol-17; 17-hydroxy-Δ^4-androsten-3-one	TESTOSTERONE PROPIONATE; Δ^4-androstene-17-trans-ol-3-one-17-propionate
FORMULAE: Structural and empirical	 $C_{20}H_{30}O_2$	 $C_{19}H_{28}O_2$	 $C_{22}H_{32}O_3$
Molecular weights	302.44	288.41	344.48
Melting points (°C)	161–166	151–156	118–122
Specific rotation	$(\alpha)\,\frac{25}{D} + 69 - +75$ (dioxane)	$(\alpha)\,\frac{25}{D} + 104 - +106$ (dioxane)	$(\alpha)\,\frac{25}{D} + 83 - +90$ (dioxane)

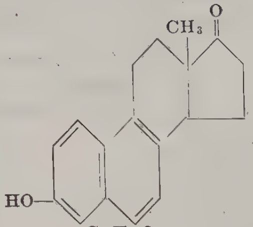
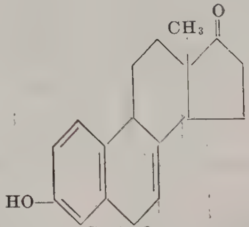
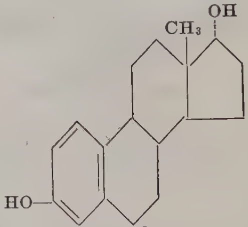
STEROID HORMONES—CORTICAL

NAMES: Common or official name, Synonyms; Chemical designations	CORTICOSTERONE; 11–21-dihydroxyprogesterone; 17-(β)-[1-keto-2-hydroxyethyl]-Δ⁴-androstene-3-one-11-(β)-ol	DESOXYCORTICOSTERONE; deoxycorticosterone; deoxycostone; 11-desoxycorticosterone; 21-oxyprogesterone; 21-hydroxyprogesterone; 17-(α)-[1-keto-2-hydroxyethyl]-Δ⁴-androstene-3-one; Δ⁴-21-hydroxypregnene-3,20-dione	DESOXYCORTICOSTERONE ACETATE; deoxycostone acetate; 11-desoxycorticosterone acetate; (see also desoxycorticosterone)
FORMULAE: Structural and empirical	 $C_{21}H_{30}O_4$	 $C_{21}H_{30}O_3$	 $C_{23}H_{32}O_4$
Molecular weights	346.36	330.2	372.49
Melting points (°C)	180–182	140–142	154–160
Specific rotation	$(\alpha)\ \frac{25}{D} + 222$ (alcohol)	$(\alpha)\ \frac{22}{D} + 176 - +178$ (alcohol)	$(\alpha)\ \frac{20}{D} + 168 - +178$ (dioxane)

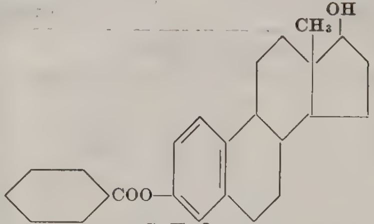
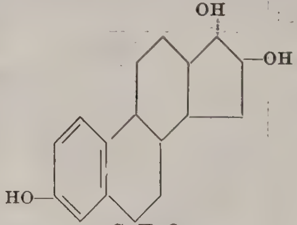
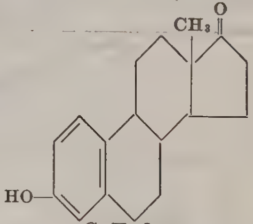
STEROID HORMONES—CORTICAL (Continued)

NAMES: Common or official name;	CORTISONE: 17-hydroxy-11-dehydrocorticosterone; 17 (α)-[1-keto-2-hydroxyethyl] Δ^4-androstene-3,11-dione-17-(β)-ol;	HYDROCORTISONE: 17-hydroxycorticosterone;
Synonyms;	Wintersteiner's Compound "F";	17-[1-keto-2-hydroxyethyl] Δ^4-androstene-11,17 (α)-diol-3-one;
Chemical designations	Kendall's "Compound E"	Kendall's "Compound F"
FORMULAE: Structural and empirical	 $C_{21}H_2O_5$	 $C_{21}H_{30}O_5$
Molecular weights	360.53	362.45
Melting points (°C)	208–217(?)	217–220°C
Specific rotation	$(\alpha)\ \frac{25}{D} + 195 - +209$ (alcohol)	$(\alpha)\ \frac{22}{D} + 167$ (abs. alcohol)

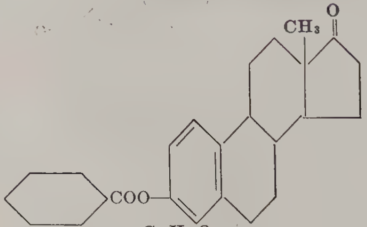
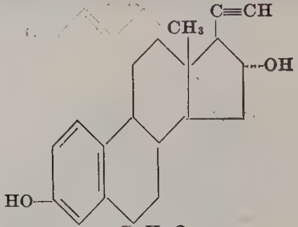
STEROID HORMONES—ESTROGENIC

NAMES: Common or official name; Synonyms; Chemical designations	EQUILENIN; 3-hydroxy-17-keto-$\Delta^{1,3,5-10,6,8}$ estrapentaene; $\Delta^{1,3,5-10,6,8}$-estrapentaene-3-ol-17-one	EQUILIN; 3-hydroxy-17-keto-$\Delta^{1,3,5-10,7}$ estratetraene; $\Delta^{1,3,5-10,7}$-estratetraene-3-ol-17-one	ESTRADIOL; α-estradiol; dihydrofolliculin; dihydrotheelin; dihydroxyestrin; 3,17-dihydroxy-$\Delta^{1,3,5-10}$-estratriene; $\Delta^{1,3,5-10}$-estratriene-3-17-trans-diol
FORMULAE: Structural and empirical	 $C_{18}H_{18}O_2$	 $C_{18}H_{20}O_2$	 $C_{18}H_{24}O_2$
Molecular weights	264.28	266.3	272.37
Melting points (°C)	258–259	236–240	173–179
Specific rotation	$(\alpha)\frac{25}{D} + 89$ (dioxane)	$(\alpha)\frac{25}{D} + 325$ (alcohol)	$(\alpha)\frac{25}{D} + 76 - +83$ (dioxane)

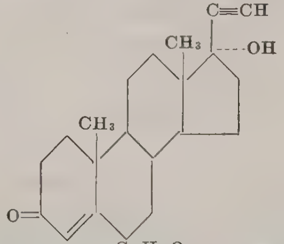
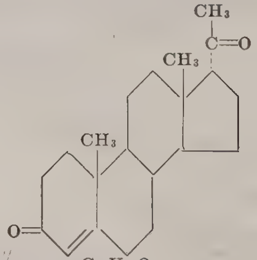
STEROID HORMONES—ESTROGENIC (Continued)

NAMES: Common or official name; Synonyms; Chemical designations	ESTRADIOL BENZOATE; 3-benzoxy-$\Delta^{1,3,5}$-estratriene-17-ol; (see also estradiol)	ESTRIOL; theelol; trihydroxyestrin; 3,16,17-trihydroxy-$\Delta^{1,3,5}$-estratriene; $\Delta^{1,3,5-10}$-estratriene-3-16-cis-17-trans-diol	ESTRONE; folliculine; ketohydroxyestrin; theelin; 3-hydroxy-17-keto-$\Delta^{1,3,5-10}$ estratriene; $\Delta^{1,3,5-10}$-estratriene-3-ol-17-one
FORMULAE: Structural and empirical	 $C_{25}H_{28}O_3$	 $C_{18}H_{24}O_3$	 $C_{18}H_{22}O_2$
Molecular weights	376.47	288.37	270.36
Melting points (°C)	191–196	282	258–262
Specific rotation	$(\alpha)\frac{25}{D}$ + 58 – +63 (dioxane)	$(\alpha)\frac{25}{D}$ + 53 – +63 (dioxane)	$(\alpha)\frac{25}{D}$ + 158 – +168 (dioxane)

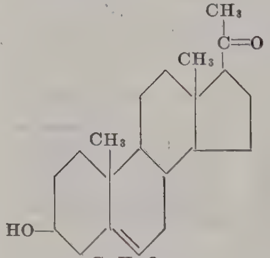
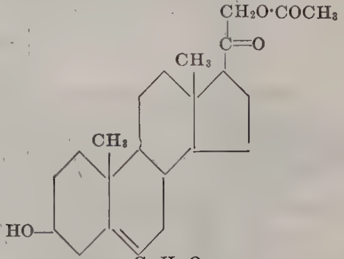
STEROID HORMONES—ESTROGENIC (Continued)

NAMES: Common or official name; Synonyms; Chemical designations	ESTRONE BENZOATE; 3-benzoxy-$\Delta^{1,3,5}$-estratriene-17-one; (see also estrone)	ETHINYL ESTRADIOL; 17-ethinyl estradiol; 17-ethenyl estradiol; 17-ethinyl-3,17-dihydroxy-$\Delta^{1,3,5-10}$-estratriene; 17-(β)-ethinyl-$\Delta^{1,3,5-10}$-estratriene-3,17-(α)-diol
FORMULAE: Structural and empirical	 $C_{25}H_{26}O_3$	 $C_{20}H_{24}O_2$
Molecular weights	374.47	296.4
Melting points (°C)	220	141–146
Specific rotation	$(\alpha)\frac{25}{D} + 120$ (dioxane)	$(\alpha)\frac{25}{D} + 1 - + 10$ (dioxane)

STEROID HORMONES—PROGESTATIONAL

NAMES: Common or official name; Synonyms; Chemical designations	ANHYDROHYDROXYPROGESTERONE; ethinyl testosterone; ethisterone; pregneninonol; pregneninolone; 17-(β)-ethinyl-Δ⁴-androstene-3-one-17-(α)-ol; Δ⁴-17-ethinyl-androsten-17-ol-3-one	PROGESTERONE; progestin; progestone; 17-(β) or (α)-[1-ketoethyl]-Δ⁴-androstene-3-one; pregnendione; Δ⁴-pregnen-3-20-dione
FORMULAE: Structural and empirical	 $C_{21}H_{2}.O_{2}$	 $C_{21}H_{30}O_{2}$
Molecular weights	312.43	314.45
Melting points (°C)	266–273	(β) isomer 121; (α) isomer 127–131
Specific rotation	$(\alpha)\ \frac{25}{D} + 18 - +28$ (dioxane)	$(\alpha)\ \frac{25}{D} + 172 - +182$ (dioxane)

STEROID HORMONES—PROGESTATIONAL (Continued)

NAMES: Common or official name; Synonyms; Chemical designations	PREGNENOLONE: Δ^5 pregnenolone; Δ^5 pregnene-3β-ol-20-one; 17(β)[1-ketoethyl]-Δ^5-androstene-3(β)-ol	ACETOXYPREGNENOLONE; 21-acetoxypregnenolone; Δ^5 pregnene-3(β)21-diol-20-one-21-monoacetate
FORMULAE: Structural and empirical	 $C_{21}H_{32}O_2$	 $C_{22}H_{35}O_4$
Molecular weights	308.43	366.45
Melting points (°C)	185–190	178–182
Specific rotation	$(\alpha)\frac{20}{D} + 28 - +30$ (alcohol)	$(\alpha)\frac{20}{D} + 37 - +43$ (dioxane)

CHARACTERISTICS AND FUNCTIONS OF THE VITAMINS

Compiled by H. J. Prebluda

Factor and synonyms	Description and properties	Importance	Deficiency symptoms	Chief natural sources
Vitamin A............ (animal sources) **Carotenes** (plant sources) (provitamin A) Fat soluble A Anti-Xerophthalmic vitamin	*Vitamin A_1* ($C_{20}H_{29}OH$) *Vitamin A_2* ($C_{22}H_{31}OH$) Pale, viscous, fat-soluble, heat and oxygen labile liquids found in fish liver oils. *Carotenes*—orange red pigments—Kryptoxanthin, alpha and beta carotene—found in plants and are precursors of vitamin A being changed to this vitamin in the human body. Have same fat soluble and labile properties of vitamin A especially to oxidation. One molecule of beta carotene has physiological potency of two molecules of vitamin A. Alpha carotene has 50% activity of beta carotene.	Vitamin A is essential for growth, normal vision and for maintenance of normal condition of epithelial tissue. Prevention of nyctalopia (night blindness) and regeneration of retinal visual purple bleached by light. Dried out epithelial tissue deficient in vitamin A seems to have less resistance to invasion by bacteria. Requirements are greatest during periods of rapid growth, pregnancy, lactation or illness.	Dryness and keratinization of the eye conjuctiva (xerophthalmia) hyperkeratosis of mucous membrane and dermal structures. Dryness of skin. Retardation of growth.	Leafy portions of green plants Salt water fish liver oils—A_1 Fresh water fish liver oils—A_2 Eggs Butter Cream Provitamin A found in pigmented plants such as carrots, sweet potatoes, yellow corn, etc. Apricots
Vitamin B_1............ Thiamin chloride Thiamin hydrochloride Aneurin Anti-beri-beri vitamin Anti-neuritic vitamin	A white crystalline powder having the formula $C_{12}H_{17}ON_4SCl.HCl$, soluble in alcohol and water. Heat and alkali labile stable to aeration.	Necessary in formation of enzymes participating in carbohydrate metabolism. Essential for maintenance of good appetite, normal	Retarded growth, loss of appetite, leg weakness, convulsive seizures associated with spastic paralysis and focal accumulation	Liver Yeast Milk Eggs Fruits Legumes

Characteristics and Functions of the Vitamins (Continued)

Factor and synonyms	Description and properties	Importance	Deficiency symptoms	Chief natural sources
	Molecular structure includes a pyridine and thiazole group which is broken down by sulfite treatment.	digestion and gastric tonicity. Necessary for lactation and reproduction. Lack of vitamin B_1 has been responsible for various forms of nerve disturbances and suboptimal growth of infants and children.	of pyruvic acid in central nervous systems with accompanying polyneuritis. Emotional instability and enlargement of heart.	Leafy vegetables Lean meat Embryos of cereal grains
Vitamin B_2............ (Member of the vitamin B Complex) Riboflavin Vitamin G Lactoflavin (from milk) Ovoflavin (from eggs) Hepatoflavin (from liver)	An orange yellow pigment ($C_{17}H_{20}N_4O_6$) containing an iso-alloxazine nucleus combined with *d*-ribose. Solutions of riboflavin exhibit a strong greenish-yellow fluorescence in ultra violet which is the basis for fluorometric assay of this vitamin. Riboflavin is water soluble, heat stable in acid or neutral solutions and readily destroyed in an alkaline medium. Visible light (blue and violet regions) destroys this vitamin.	Necessary for growth and respiration of all tissues and cells. Has been demonstrated to increase vitality and postpone senility in succeeding generations of experimental animals. Necessary for growth of domestic animals. Necessary for egg hatchability.	A reddening and slimy denuded appearance of the lips, waxy accumulations at the nasolabial folds of the skin, ocular lesions accompanied by burning sensation and light sensitivity, roughening of skin around the mouth and across tip of nose. Curled toe paralysis in chicks.	Milk Liver Eggs Wheat germ Fermentation by-products Meat Leafy vegetables
Niacin................. Nicotinic acid Pellagra preventive P-P factor	3-pyridine carboxylic acid which is somewhat soluble in hot water. The amide derivative is	A component of co-enzymes important in glycolysis and cellular respiration.	Pellagra with burning soreness of mouth, loss of appetite, loss of weight, and diges-	Liver Kidney Lean meat Peanuts

Characteristics and Functions of the Vitamins (Continued)

Factor and synonyms	Description and properties	Importance	Deficiency symptoms	Chief natural sources
Anti-black tongue factor (Member of vitamin B complex)	more soluble and called niacinamide. Relatively stable to heat.	Essential for health and growth. Necessary for maintaining normal function of skin and gastro-intestinal tract.	tive nervous disturbances.	Yeast Eggs Fish Bran Green leafy vegetables
Vitamin B$_6$............ (Member of vitamin B complex) Pyridoxin Adermin Rat acrodynia factor	Derivative of pyridine. Commercially available as hydrochloride—white powder ($C_8H_{11}NO_3.HCl$) which is stable in solution in absence of strong light. Acid solutions stable to autoclaving below pH5.	Significance in human nutrition not fully established. Has been found useful in alleviating certain nervous and muscular disorders. Probably plays role in unsaturated fatty acid utilization and liver metabolism. Important in chick, hog, and dog nutrition.	Microcytic hypochromic anemia in dogs, lack of coordination of gait of pigs. One of the vitamins lacking in individuals having multiple deficiencies in pellagra.	Liver Yeast Crude cane molasses Cereals Legumes Milk
Pantothenic Acid...... Pantothen Filtrate factor Chick anti-dermatitis factor Factor II (Member of vitamin B complex)	Beta-alanine derivative of a substituted butyryl lactone. A white solid not readily soluble in water. Commercially available as calcium salt $Ca(C_9H_{16}O_5N)_2$ which is water soluble. Stable to autoclaving, light oxidizing and reducing agents. Unstable to alkali.	Significance in human nutrition not established. Essential for certain bacteria, rats, chickens, and dogs, as well as humans. Necessary for maintaining normal adrenal activity. Thought to be one of several substances playing a role in preventing grey hair. Essential for growth and reproduction of chicks.	Dermatitis in chicks. Retarded growth and greying of hair in rats. Deficiency usually occurs along with pellagra.	Yeast Liver Kidney Eggs Cane Molasses Milk Wheat germ

Characteristics and Functions of the Vitamins (Continued)

Factor and synonyms	Description and properties	Importance	Deficiency symptoms	Chief natural sources
Choline (Member of vitamin B complex)	Hydroxyethyl trimethyl ammonium hydroxide—a colorless viscous liquid which has strong basic properties. Basic constituent of lecithin and the chloride is available commercially. The latter is a colorless crystalline hygroscopic solid—very soluble in water. Salty, bitter taste.	Essential in fat metabolism to mobilize fatty acids, supplies "labile" methyl groups.	Impairment of liver and renal functions. "Slipped tendon" of fowl.	Liver Egg yolk Brain Kidney Heart Sweet breads Yeast Cereal germs Legumes Green leafy vegetables Potatoes Milk
Vitamin C Ascorbic acid Anti-scorbutic vitamins Cevitamic acid	A hexuronic acid. A white crystalline solid soluble in water with sour acid taste. Insoluble in oils. Destroyed by exposure to air, light, and alkali. Deterioration accelerated by metals such as iron and copper. Strong reducing agent. Cannot be stored in the body.	Prevents and cures scurvy. Necessary for formation and maintenance of intercellular tooth and bone structure. Prevents capillary fragility. Increases resistance to bacterial toxins and infections. Infection increases vitamin C requirement of body.	Scurvy. Dental caries. Gum infections. Slow healing of wounds. Defective formation of bones and teeth.	Citrus fruits Alfalfa Cabbage Green and red peppers Raw turnip Tomato Pineapple
Vitamin D Anti-rachitic vitamin	At least ten active vitamin D sterols are known. The two important sterols are vitamin D_2 (activated ergosterol, calciferol) derived mainly from vegetable sources and vitamin	Regulation of calcification of bone structure. Regulates absorption and utilization of calcium and phosphorus.	Rickets. Poor bone development. Tooth decay. Osteomalacia.	Fish liver oils Mackerel Herring Sardines Egg yolk Tuna Liver

Characteristics and Functions of the Vitamins (Continued)

Factor and synonyms	Description and properties	Importance	Deficiency symptoms	Chief natural sources
	D_3 (activated 7-dehydrocholesterol) derived mainly from animal sources. Vitamin D is fat soluble, heat stable and not readily destroyed by oxidation. Can be produced in many foodstuffs by irradiation or exposure to sunlight. Light energy activates sterols present to active vitamin D. In similar fashion sterols beneath skin are activated to form vitamin D upon exposure to ultra violet or sunlight. Activated ergosterol dissolved in vegetable oils = viosterol.			
Vitamin E .... Alpha tocopherol Anti-sterility vitamin	Has chromane structure ($C_{20}H_{50}O_2$). Thick viscous oil-soluble in fat solvents. Heat stable and resistant to mild oxidation. Ferric salts and rancid fats destroy physiological activity. Obtained from natural sources in unsaponifiable fraction.	Has anti-oxidant properties. Has not been demonstrated to be effective in humans but has been shown to prevent sterility in male and female rats. Important in muscular and nervous systems.	No definite deficiency symptoms in humans. Has been used with success in habitual and threatened abortion as well as certain neuromuscular disorders.	Wheat germ oil Corn oil Lettuce Spinach Egg yolk Meat Legume Seeds

Characteristics and Functions of the Vitamins (Continued)

Factor and synonyms	Description and properties	Importance	Deficiency symptoms	Chief natural sources
Vitamin K............ Anti-hemorrhagic factor Coagulation vitamin	Natural product is naphthoquinone compound—oily liquid and insoluble in H_2O. Fat-soluble, stable to heat and reducing agents. Labile to alcoholic alkali, oxidizing agents, strong acids, and $AlCl_3$. Occurs in nature as a phytyl derivative (vitamin K_1) in green leaves. The difarnesyl derivative (vitamin K_2) is formed by putrefaction. A commercial synthetic 2, methyl 1,4 naphthoquinone has vitamin K activity and is called Menadione.	Aids in prevention of hemorrhage in newborn. Essential in promoting normal prothrombin content and clotting of blood.	Obstructive jaundice. Hemorrhagic tendency. Poor healing of wounds after postoperative conditions.	Alfalfa concentrate Spinach Cabbage Cauliflower Kale Carrot greens Tomatoes

VITAMINS (Continued)

Vitamin Unit Table

Vitamin A	1 International Unit = 1 USP Unit Activity of 0.6 micrograms* of beta-carotene
Vitamin B_1	1 International Unit = 1 USP Unit Activity of 3.0 micrograms of crystalline thiamin chloride
Riboflavin	Quantities expressed in micrograms or milligrams
Niacin Niacin amide	Quantities expressed in micrograms or milligrams
Pantothenic acid	Quantities expressed in micrograms or milligrams
Choline	Quantities expressed in milligrams
Pyridoxine	Quantities expressed in micrograms or milligrams
Vitamin C	Expressed in milligrams 1 International Unit = 1 USP Unit and is equal to activity of 0.05 milligrams of synthetic ascorbic acid.
Vitamin D (For humans and four-footed animals)	1 International Unit = 1 USP Unit Potency of 0.025 micrograms of pure Vitamin D_2 (calciferol) made by irradiation of ergosterol.
Vitamin E	Measured in micrograms or milligrams One I.U is the alpha tocopherol activity of 0.1 gm of the International standard solution containing 1 mg. of pure synthetic alpha tocopherol acetate.

* Note.—One microgram = 0.000001 grams

Abbreviations

A = Vitamin A
B = Vitamin B_1
C = Vitamin C
D = Vitamin D
E = Vitamin E
K = Vitamin K
N = Nicotinic Acid or Niacin
R = Riboflavin

Reaction indicates the type and degree of reaction of the food in the body. The relative acidity or basicity is indicated by the designation h, high; m, medium; and l, low.

RECOMMENDED DAILY DIETARY ALLOWANCES[1]

	Age Years	Weight kg. (lb.)	Height cm. (in.)	Calories	Protein gm.	Calcium gm.	Iron mg.	Vitamin A IU	Thiamine mg.	Riboflavin mg.	Niacin mg.	Ascorbic Acid mg.	Vitamin D IU
Men	25	65 (143)	170 (67)	3200[2]	65	0.8	12	5000	1.6	1.6	16	75	
	45	65 (143)	170 (67)	2900	65	0.8	12	5000	1.5	1.6	15	75	
	65	65 (143)	170 (67)	2600	65	0.8	12	5000	1.3	1.6	13	75	
Women	25	55 (121)	157 (62)	2300[2]	55	0.8	12	5000	1.2	1.4	12	70	
	45	55 (121)	157 (62)	2100	55	0.8	12	5000	1.1	1.4	11	70	
	65	55 (121)	157 (62)	1800	55	0.8	12	5000	1.0	1.4	10	70	
	Pregnant (3rd trimester)			Add 400	80	1.5	15	6000	1.5	2.0	15	100	400
	Lactating (850 ml. daily)			Add 1000	100	2.0	15	8000	1.5	2.5	15	150	400
Infants[3]	0–1/12[4]												
	1/12–3/12	6 (13)	60 (24)	kg. × 120	kg. × 3.5[3]	0.6	6	1500	0.3	0.4	3	30	400
	4/12–9/12	9 (20)	70 (28)	kg. × 110	kg. × 3.5[3]	0.8	6	1500	0.4	0.7	4	30	400
	10/12–1	10 (22)	75 (30)	kg. × 100	kg. × 3.5[3]	1.0	6	1500	0.5	0.9	5	30	400
Children	1–3	12 (27)	87 (34)	1200	40	1.0	7	2000	0.6	1.0	6	35	400
	4–6	18 (40)	109 (43)	1600	50	1.0	8	2500	0.8	1.2	8	50	400
	7–9	27 (59)	129 (51)	2000	60	1.0	10	3500	1.0	1.5	10	60	400
Boys	10–12	35 (78)	144 (57)	2500	70	1.2	12	4500	1.3	1.8	13	75	400
	13–15	49 (108)	163 (64)	3200	85	1.4	15	5000	1.6	2.1	16	90	400
	16–20	63 (139)	175 (69)	3800	100	1.4	15	5000	1.9	2.5	19	100	400
Girls	10–12	36 (79)	144 (57)	2300	70	1.2	12	4500	1.2	1.8	12	75	400
	13–15	49 (108)	160 (63)	2500	80	1.3	15	5000	1.3	2.0	13	80	400
	16–20	54 (120)	162 (64)	2400	75	1.3	15	5000	1.2	1.9	12	80	400

RECOMMENDED DAILY DIETARY ALLOWANCES[1] (Continued)

[1] Food and Nutrition Board, National Research Council, Revised 1953.

In planning practical dietaries, recommended allowances can be attained with a variety of common foods which will also provide other nutrient requirements less well known; the allowance levels are considered to cover individual variations among normal persons as they live in the United States subjected to ordinary environmental stresses.

[2] These calorie recommendations apply to the degree of activity for the average man and woman. For the urban "white-collar" worker they are probably excessive. In any case, the calorie allowance must be adjusted to the actual needs of the individual as required to achieve and maintain his desirable weight.

[3] The recommendations for infants pertain to nutrients derived primarily from cow's milk. If the milk from which the protein is derived is human milk or has been treated to render it more digestible, the allowance may be in the range of 2–3 gms. per kg. There should be no question that human milk is a desirable source of nutrients for infants even though it may not provide the levels recommended for certain nutrients.

[4] During the first month of life, desirable allowances for many nutrients are dependent upon maturation of excretory and endocrine functions. Therefore no specific recommendations are given.

COMPOSITION AND VALUE OF FOODS

Compiled mainly from the publications of the U. S. Department of Agriculture.

The proportions of **protein, fat, carbohydrate** and **mineral matter** are given as percent by weight of the food named. The fuel value is stated in kilogram calories per 100 grams.

The standard daily requirement for an average adult has been accepted as 3000 calories; 75 g of protein, 0.69 g of calcium, 1.32 g of phosphorus, 0.015 g of iron.

The relative value of the food as a source of **vitamins** is shown by letters indicating the vitamins present with subscripts showing the relative abundance. Symbol **N** is used to indicate nicotinic acid and **R,** riboflavin. The best sources are indicated as rich in the particular vitamin by the subscript $_{r}$. Other classifications are shown by the subscripts $_{e}$, $_{g}$ and $_{f}$ for excellent, good and fair respectively.

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins r = rich g = good e = excellent f = fair	Reaction h = high m = med. l = low
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron		
Animal Foods									
Cheese:									
American, pale	28.8	35.9	.3	453	.93	.68	.0013	A_r, R_f	Acid l
Camembert	21	22	.....	282	.93	.68	.0013	A_r	....
Cheddar	27.7	36.8	4.1	473	.92	.68	.0013	A_r, R_g	Acid l
Cottage	20.9	1.0	4.3	112	.11	.37	....	A_f, B_f, R_f	....
Cream, full	25.9	33.7	2.4	430	.92	.68	.0013	A_r, R_g	....
Neufchatel	18.7	27.4	1.5	337	.93	.68	.0013	A_r, R_f	....
Roquefort	22.6	29.5	1.8	375	.93	.68	.0013	A_e, R_f	....
Swiss	27.6	34.9	1.3	443	1.1	.81	.0014	A_g	....
Eggs:									
Plain	13.4	10.5	....	159	.067	.18	.0030	A_r, B_e, D_e, E_g, R_f	Acid m
Scrambled	12	18	....	210	.087	.24	.0041	A_r, B_f, D_e, E_g, R_f	Acid m
Whites, boiled	12.3	.2	....	55.1	.015	.014	.00010	R_f	Acid l
Yolks, boiled	15.7	33.3	....	376	.14	.53	.0086	A_r, B_e, D_e, E_g, R_f	Acid h
Fish:									
Caviar	30	20	....	300	.14	.18	....	A_g, B_g, D_g, E_g	....
Clams	6.5	.4	4.2	47.4	.11	.044	.0044	A_f, B_f, C_f, D_f, R_f	Acid
Codfish, salt, cooked	21.5	.3	....	90.4	.030	.32	.0015	A_f, B_f, D_f	Acid m
Crab, canned	15.8	1.5	.7	81.6	.018	.19	....	B_f	Acid
Haddock, fresh, raw	16.8	.3	....	73.9	.019	.19	.00090	A_f, B_g, R_f	Acid
Halibut, fresh	18.4	5.2	....	125	.021	.22	.0010	A_f, B_f	Acid m
smoked	20.6	15.0	....	225	.023	.24	.0013	A_f, B_f	Acid m
Herring, fresh	18.9	7.1	....	146	.021	.22	.0011	A_g, B_f, D_g	Acid
smoked	36.4	15.8	....	299	.039	.34	.0023	A_g, B_f, D_g	Acid

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins r = rich g = good e = excellent f = fair	Reaction h = high m = med. l = low
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron		
Animal Foods (Cont.)									
Fish: (Cont.)									
Lobster, canned	18.1	1.1	.5	86.0	.018	.18	.00090	B_f	Acid
Mackerel, fresh	11.4	3.5	....	80.5	.021	.22	.0010	A_g, B_f	Acid m
Oysters, raw	6.0	1.3	3.3	50.7	.051	.15	.0045	A_g, B_g, C_f, D_g, R_g	Acid m
Salmon, canned	21.8	12.1	....	202	.024	.25	.0012	A_g, B_f, D_g, N_f	Acid m
fresh	13.5	8.1	....	132	.024	.25	.0012	A_g, B_g, D_g, N_f	Acid m
Sardines, canned	22.4	19.7	....	278	.025	.28	.0013	A_g, B_f, D_g	Acid m
Shrimp, canned	25.4	1.0	.2	115	.094	.29	.0027	A_f	Acid
Trout, fresh	17.7	10.3	....	169	.019	.20	.0013	A_f, B_f	Acid m
Tuna, canned, oil	23.8	20.0	.6	287	.028	.29	.0014	A_f, B_f, D_f	Acid
fresh	17	3	....	95	.019	.20	.00090	A_f, B_f, D_f	Acid
Whitefish	22.1	6.5	....	154	......	......	......	A_f, B_f	Acid
Gelatin	84.2	.1	....	376	......	......	......	....	......
Meats:									
Beef:									
Chipped, dried	29.7	6.5	.4	185	.015	.32	.0045	A_f, B_f, E_f, R_g	Acid
Corned, cooked	15.3	26.2	....	308	.020	.36	.0051	A_f, B_f, E_f, R_g	Acid
Kidneys	16.9	4.8	.4	115	.0099	.19	.0024	A_g, B_f, C_f, E_f, N_g, R_g	Acid m
Liver	21.0	4.5	1.7	133	.017	.21	.0079	A_g, B_f, C_g, E_f, N_g, R_e	Acid m
Miscellaneous cuts, fat free	22.1	2.9	....	119	.015	.24	.0033	B_f, E_f, R_e	Acid m
Roast, loin	18.6	19.1	....	255	.0090	.18	.0025	A_f, B_f, E_f, R_g	Acid m
Rump, lean	19.6	18.7	....	213	.018	.29	.0031	A_f, B_f, E_f, R_g	Acid m
Steak, round	20.5	16.6	....	184	.013	.20	.0023	A_f, B_f, E_f, N_g, R_g	Acid m
sirloin	18.6	18.5	....	249	.014	.17	.0036	A_f, B_f, E_f, N_g, R_g	Acid m

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins r = rich g = good e = excellent f = fair	Reaction h = high m = med. l = low
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron		
Animal Foods (Cont.)									
Meats: (Cont.)									
Lamb:									
Chops, broiled	21.2	29.9	6.7	367	.016	.22	.0030	A_f, B_g, R_f	Acid m
Leg, roast	19.4	12.7	....	198	.0097	.23	.0033	A_f, B_g, R_f	Acid m
Miscellaneous:									
Bologna	18.4	17.6	.3	241	......	......	......	A_f, B_f, R_f	Acid
Frankfurters	19.7	18.6	1.1	258	.012	.22	.0031	A_f, B_f, R_f	Acid m
Mutton:									
Chop	23.9	18.5	....	270	.0097	.16	.0023	A_f, B_g, R_g	Acid m
Leg, roast	25.3	22.6	....	313	.0048	.27	.0023	A_f, B_g, R_g	Acid m
Pork:									
Bacon, smoked	9.9	64.8	....	646	.012	.22	.0030	A_f, B_g, R_f	Acid
Chop, loin, lean	19.7	19.0	....	260	.022	.032	.0005	A_f, B_g, R_f	Acid m
Ham, smoked, lean	20.2	20.8	...	274	.012	.22	.0030	A_f, B_e, R_f	Acid m
Liver	21.3	4.5	1.4	136	......	......	......	A_e, B_e, C_f, D_f, N_e, R_e	Acid
Roast	19.5	17.5	....	235	.0094	.17	.0025	B_g, R_g	Acid m
Veal:									
Chops	19.4	10.0	....	174	.012	.22	.0030	B_f, R_g	Acid m
Liver	20.4	5.3	....	127	......	......	......	A_g, B_f, C_g, E_f, N_e, R_e	Acid
Roast, leg	20.5	6.7	....	148	.013	.24	.0033	B_f, R_f	Acid m
Milk:									
Buttermilk, plain	3.0	.5	4.8	36.4	10	.095	.00030	A_f, B_g, R_g	Basic l
Condensed, sweetened	8.8	8.3	54.1	335	.30	.23	.00060	A_e, B_f, R_g	Basic l
unsweetened	9.6	9.3	11.2	172	.32	.24	.00070	A_e, B_f, R_g	Basic l

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins r = rich g = good e = excellent f = fair	Reaction h = high m = med. l = low
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron		
Animal Foods (Cont.)									
Milk: (Cont.)									
Cream, 18 per cent	2.5	18.5	4.5	201	.085	.069	.00020	A_r, B_f, D_f, R_f	Neutral
40 per cent	2.2	40	3	381	.085	.069	.00020	A_r, B_f, D_g, R_f	Neutral
Human	1.5	3.3	6.5	62	....	....	....	A_r, B_f, D_f, R_f	Basic
Ice cream, plain	5	12	20	208	.10	.088	.00020	A_g, B_f, D_f	Basic l
Skimmed	3.4	.3	5.1	37.5	.12	.096	.00030	B_f, R_g	Basic l
Whole	3.3	4.0	5.0	71.6	.12	.093	.00020	A_e, B_f, D_f, R_g	Basic l
Poultry:									
Chicken, broiled	21.6	2.5	....	111	.012	.23	.0032	B_f, R_e	Acid m
liver	22.4	4.2	2.4	141	....	....	....	A_e, B_g, C_f, D_g, E_g, N_g, R_e	Acid
roast	25	11.1	....	200	.011	.20	.0024	B_g, R_e	Acid m
Duck	18	19	....	243	.0099	.20	.0028	B_f, R_g	Acid
Goose	16.3	36.2	....	403	.0092	.18	.0025	B_f, R_f	Acid l
Quail	24	6.4	....	154	.015	.27	.00077	B_f, R_f	Acid
Squab	19	22	....	274	.012	.22	.0030	B_f, R_f	Acid
Turkey, liver	22.9	5.2	.6	144	....	....	....	A_e, B_g, C_f, D_g, E_g, N_g, R_e	Acid
roast	28.4	18.4	.....	285	.023	.43	.0060	B_f, R_f	Acid
Vegetable Foods									
Bread:									
Biscuits	9.3	13.7	52.6	381	.072	.14	.0015	....	Acid l
Brown	5.4	1.8	47.1	231	.11	.16	.0026	A_f, B_g	Basic
Corn	7.9	4.7	46.3	266	.082	.13	.00086	B_g, E_g	Acid l
Gluten	9.3	1.4	49.8	256	....	....	....	....	Acid l

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Vegetable Foods (Cont.)									
Bread: (Cont.)									
Graham	8.9	1.8	51.0	267	.050	.22	.0025	A_f, B_g, E_g	Acid l
Griddle cakes, plain	7	5	31.6	200	.075	.11	.00088	....	Acid l
Muffins, corn meal	8.5	7	44	273	.11	.20	.0017	A_g, B_f, E_f	Acid l
graham	8	4	46	252	.074	.17	.0016	A_g, B_g	Acid l
Rye	9.0	.6	52.7	260	.024	.14	.0016	A_f, B_g, R_f	Acid l
Rye and wheat	11.9	.3	51.5	262	.10	.17	.0015	A_f, B_g, R_f	Acid l
Toast, plain	11.5	1.6	61.2	313	.077	.21	.0018	A_f, B_f	Acid l
Waffles, plain	13.2	15.5	48	385	.077	.11	.0010	A_f, B_f	Acid l
Wheat, cracked	8.7	1.7	50	250	.063	.17	.0015	A_g, B_g, R_f	Acid l
white	9.3	1.2	52.2	266	.027	.092	.00090	A_f, B_f	Acid l
whole	9.7	.9	48.5	251	.048	.17	.0016	A_e, B_g, E_e, R_f	Acid l
Zwieback	9.8	9.9	73.5	434	.053	.14	.0016	B_f	Acid l
Cake:									
Angel food	9	.3	66	300	.030	.078	.00030	....	Acid l
Cream puffs	11	17	50	397	......	......	......	A_e, B_f	Acid
Devil's food	11.6	17	42.9	371	.12	.20	.0059	A_e, B_f	Acid l
Doughnuts	7.9	23.9	65.5	523.8	.11	.38	.001	A_g, B_f, R_f	Acid l
Fruit	5.9	10.9	64.1	388	.11	.17	.0052	A_g, B_f	Basic m
Gingerbread	5.8	9.0	62.6	368	.11	.059	.0038	A_f, B_f	Basic m
Sponge	6.3	10.7	65.9	396	.073	.22	.0033	A_g, B_f, E_f, R_f	Acid m
Cereals:									
Barley, pearl	8.5	1.1	77.5	364	.039	.18	.0020	A_f, B_e, E_g, R_g	Acid m
Bran, unwashed	16.3	8.5	54.4	359	.12	1.2	.0076	B_g, R_g	Acid
Corn flakes	8.2	.4	86.7	383	.0071	.11	.00075	....	Acid l

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Pro-tein	Fat	Carbo-hydrate		Cal-cium	Phos-phorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Vegetable Foods (Cont.)									
Cereals: (Cont.)									
Corn meal	8.4	4.7	74.0	381	.0048	.039	.00025	A_f, B_f, R_f	Acid
Cream of wheat, raw	11	.9	78.6	366	.021	.12	.00055	B_g	Acid
Farina, light	11.0	1.4	76.4	371	.0030	.020	.00010	B_f	Acid
Grapenuts	11.5	1	79	371	......	......	......	B_g	Acid
Macaroni	13.7	2.0	73.3	367	.040	.184	.0025	......	Acid
Noodles	11.7	1.0	75.2	367	......	......	......	A_f, E_f	Acid
Oats, rolled	16.6	6.6	65.2	387	.054	.442	.0041	B_g, E_f	Acid l
Pop corn	10.7	5.0	77.3	413	......	......	......	......	Acid l
Puffed rice	8.3	.3	83.7	370	.00092	.0088	.00010	......	Acid l
Puffed wheat	16.2	1.8	73.2	374	.028	.044	.0045	A_f, R_f	Acid l
Rice, cooked	2.8	.1	24.4	112	.0018	.044	.00025	......	Acid l
Spaghetti	12.1	.4	75.9	366	.0039	.031	.00022	......	Acid
Tapioca	.4	.1	87.9	364	.023	.088	.0016	......	Neutral
Wheatena, raw	11.5	1.47	70.6	342	.044	.42	.0050	B_r, E_g	Acid
Wheat germ meal	25.–30	8.–10	47	374	......	.130	......	B_r, E_e, R_g	......
Wheat, shredded	12.1	1.8	75.2	365	.041	.32	.0045	A_g, B_g, E_e, R_f	Acid
Chocolate, sweet	10	32.5	42.5	505	......	......	......	D_f	......
unsweetened	12.9	48.7	30.3	631	.092	.45	.0032	D_f	......
Cocoa	21.6	28.9	37.7	511	.092	.45	.0032	D_f	......
Cookies:									
Gingersnaps	6.5	8.6	75.3	418	.030	.031	.0016	......	Basic m
Hermits	8	12	64.8	400	.013	.014	.00020	A_f, B_f	Acid l
Macaroons	6.5	15.2	64.1	435	.016	.065	.00075	A_f, B_f	Acid l
Molasses	7.2	8.7	75.7	421	.099	.020	.0034	A_f, B_f	Basic h

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Vegetable Foods (Cont.)									
Cookies: (Cont.)									
Oatmeal	12	12	86	500	.045	.12	.0010	A_f, B_f	Acid l
Sugar	7.0	10.2	72.1	423	.014	.021	.00032	.....	Acid l
Vanilla wafers	6.6	14.0	71.3	451	.0041	.0097	.00011	.....	Acid l
Crackers:									
Boston	11.0	8.5	70.3	416	.....	.....	.....	.....	Acid
Butter	9.6	10.1	71.2	427	.....	.....	.....	.....	Acid
Educator	11.7	13.5	79	484	.....	.....	.....	.....	Acid
Graham	10.0	9.4	72.3	431	.020	.097	.0010	B_f	Acid
Oatmeal	11.8	11.1	67.1	434	.....	.....	.....	B_f	Acid
Oyster	11.3	10.5	70.3	433	.....	.....	.....	.....	Acid
Pretzels	9.7	3.9	72.3	375	.....	.....	.....	.....	Acid
Saltines	10.6	12.7	68.0	442	.023	.092	.0013	.....	Acid m
Soda	9.8	9.1	72.6	424	.023	.12	.00025	.....	Acid m
Flour:									
Arrowroot	....	....	97.5	400	.....	.....	.....	.....	Acid
Barley	10.5	2.2	66.3	362	.....	.....	.....	B_f	Acid
Buckwheat	6.4	1.2	77.5	357	.040	.23	.0012	.....	Acid
Corn flour	7.1	1.3	77.5	363	.....	.....	.....	B_f	Acid
starch	....	....	90.0	369	.....	.....	.....	.....	Acid
Gluten (high)	14.2	1.8	70.5	367	.....	.....	.....	.....	Acid
Graham	13.3	2.2	69.5	368	.040	.37	.0037	B_f	Acid m
Rice	8.6	6.1	51.9	370	.....	.....	.....	.....	Acid l
Rye	6.8	.9	78.3	359	.018	.29	.0013	B_f	Acid

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins r = rich e = excellent g = good f = fair	Reaction h = high m = med. l = low
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron		
Vegetable Foods (Cont.)									
Flour: (Cont.)									
Wheat, patent	10.8	1.1	74.6	362	.020	.088	.0010	B_f	Acid m
whole	13.8	1.9	71.0	369	.031	.24	.0025	B_g, R_f	Acid m
Fruits:									
Apple, baked	.2	.8	29.2	125	.0074	.013	.00030	A_f, R_f	Basic l
raw	.4	.5	13.0	63.9	.0074	.013	.00030	A_f, B_g, C_e, R_f	Basic l
sauce	.2	.8	37.2	161	.0058	.0097	.00020	A_f, R_f	Basic l
Apricots, canned	.9	....	17.3	75.0	.014	.025	.00030	A_e, C_f	Basic
fresh	1.1	....	13.4	59.5	.014	.025	.00030	A_e, C_e	Basic
Bananas	1.3	.6	21.0	101	.0062	.027	.00055	A_g, B_g, C_e, R_f	Basic l
Blackberries, canned	.8	2.1	56.4	254	.012	.026	.0005	A_g	Basic
Blueberries, canned	.6	.6	12.8	60.6	.020	.0084	.00090	A_f	Basic
Cantaloupe	.6	....	9.3	40	.018	.015	.0005	A_r, B_f, C_g	Basic m
Cherries, canned	1.1	.1	21.1	91.5	.020	.030	.00040	A_g, C_f	Basic
fresh	1.0	.8	16.5	80.5	.020	.030	.00040	A_g, C_g	Basic
Cranberries, raw	.4	.6	8.4	47.4	.020	.013	.00060	A_f, C_f	Acid
Cranberry sauce	.2	.2	62	250	.018	.012	.00060	C_f	Acid
Currants, fresh	1.5	....	12.8	58.4	.026	.038	.0005	C_g	Basic
Dates	2.1	2.8	78.4	356	.065	.056	.0030	A_g, B_f	Basic m
Figs, dried	4.3	.3	74.2	325	.16	.12	.0030	A_f, B_f, R_f	Basic m
fresh	1.5	....	18.8	83.8	.053	.037	....	A_f, B_f, R_f	Basic
Grapefruit	.8	.2	10.4	47	.028	.026	.00045	B_f, C_g, R_f	Basic
Grape juice	....	....	25	100	.011	.011	.00030	A_f, B_f, C_f	Basic
Grapes, Concord	1.3	1.6	14.9	99.2	.020	.031	.00030	A_f, B_f, C_f	Basic
Malaga	.8	1.4	20	96	.020	.031	.0023	A_f, B_f, C_f	Basic

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Vegetable Foods (Cont.)									
Fruits: (Cont.)									
Lemon juice	....	....	9.8	39.7	.0041	.0026	.000075	A_f, B_f, C_g	Basic l
Lemons	1.0	.7	7.4	45.2	.036	.022	.0005	A_g, B_f, C_r	Basic l
Loganberries	4.6	.6	7.2	53	....	....	....	B_f, C_g	Basic
Muskmelon	.6	....	7.2	40.8	.018	.015	.00030	A_r, B_g, C_r	Basic l
Nectarines	.6	....	15.9	67.2	....	....	....	C_g	Basic
Orange juice	....	....	10.8	43	.029	.016	.00020	A_g, B_f, C_r, R_f	Basic l
Oranges	.8	.2	11.6	52.9	.044	.020	.00020	A_g, B_f, C_r, R_f	Basic l
Peaches, canned	.7	.1	10.8	48.5	.012	.022	.00030	A_f, B_f, C_e, R_f	Basic l
fresh	.7	.1	5.8	41.9	.016	.023	.00036	A_g, B_g, C_e, R_f	Basic l
Pears, canned	.3	.3	18.0	78.3	.018	.031	.00030	A_f, B_f, C_f, R_f	Basic l
fresh	.6	.5	11.4	65.0	.018	.031	.00031	A_f, B_g, C_g, R_f	Basic l
Pineapple, canned	.4	.7	36.4	158	.018	.034	.0005	A_g, B_f, C_g, R_f	Basic
fresh	.4	.3	9.3	44.1	.032	.062	.0011	A_g, B_g, C_r, R_f	Basic l
Plums, fresh	1.0	....	20.1	87.1	.020	.032	.0005	C_f	Acid
Prunes, stewed	.5	.1	22.3	94.8	.025	.053	.0015	A_e, C_f, R_g	Acid
Raisins	2.6	3.3	76.1	354	.066	.13	.0021	A_f	Basic h
Raspberries, fresh	1.7	1.0	12.6	68.3	.049	.048	.00060	C_g	Basic l
Rhubarb	.6	.7	2.5	23.1	.047	.011	.0011	C_g	Basic m
cooked (with sugar)	.5	.4	66	272	....	....	....	C_f	Basic
Strawberries, cooked	.7	....	24.0	101	.041	.028	.00080	A_g, B_f, C_f	Basic
raw	1.0	.6	6.0	39.7	.041	.028	.00080	A_g, B_g, C_r	Basic
Tangerines	2	1	9	125	....	....	.00061	C_r	Basic
Watermelon	.4	.2	6.7	30.9	.011	.0026	.00030	A_f, B_f, C_g, R_f	Basic

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Vegetable Foods (Cont.)									
Nuts:									
Almonds	21.0	54.9	15.8	679	.24	.46	.0039	A_f, B_g	Basic m
Brazil	17.0	66.8	7.0	720	......	......	.0039	A_f, B_g	....
Butternuts	27.9	61.2	3.5	698	......	......	.0068	A_f, B_g	....
Chestnuts, dried	10.7	7.0	71.5	413	.034	.092	.00070	B_g	Basic l
Cocoanut, prepared	6.3	57.4	31.5	689	.059	.14	.0027	A_f, B_f, D_g	Basic m
Filberts	15.6	65.3	13.0	725	.29	.35	.0041	B_f	....
Hickory	15.4	67.4	11.4	737	......	......	.0029	B_f	....
Peanuts, shelled	25.8	38.6	21.9	564	.069	.40	.0023	B_g, N_g	Acid l
Pecans	9.6	70.5	15.3	757	.089	.35	.0026	A_g, B_f	....
Pine	33.9	49.4	6.9	627	......	......	......	....	....
Pistachios	22.3	54.0	16.3	660	......	......	.0079	....	....
Walnuts, black	27.6	56.3	10.0	685	......	......	.0060	A_f, B_g	....
English	18.4	64.4	11.6	728	.089	.36	.0021	A_f, B_g	Acid l
Pie:									
Apple	3.1	9.8	42.8	280	.011	.022	.00030	A_f, B_f, R_f	Basic
Custard	4.2	6.3	26.1	183	.14	.16	.0012	A_g, B_g	Acid
Lemon meringue	3.6	10.1	37.4	262	.014	.038	.00058	A_g, B_f, C_f, R_g	Acid
Mince	5.8	12.3	38.1	308	.083	.17	.0025	A_g, B_g	Acid
Pumpkin	4	5.4	34	200	.054	.081	.00079	A_e, B_g	Acid
Squash	4.4	8.4	21.7	185	.063	.073	.00059	A_f, B_g	Acid
Pudding:									
Apple tapioca	.3	.1	29.3	122	.0081	.020	.00041	B_f, E_f, R_f	Basic l
Bread	5.04	8.07	15.9	156	.11	.090	.000010	A_f, B_f, E_f	Acid l

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Vegetable Foods (Cont.)									
Pudding: (Cont.)									
Cottage	6	9	56.1	329	.16	.23	.0016	A_f, B_f	Acid l
Rice	4.0	4.6	31.4	182	.041	.042	.00023	....	Basic l
Tapioca, cream	3.3	3.2	28.2	159	.052	.053	.00032	A_g, B_f	Basic l
Vegetables:									
Artichoke, French	2.9	.4	8.7	62.8	.031	.087	.00095	A_e, B_g, C_g, R_g	Basic
Asparagus, canned	1.5	.1	2.3	18.7	.027	.039	.0010	A_g, B_g, C_g, R_g	Basic l
fresh	2.2	.2	3.2	26.2	.027	.039	.0010	A_g, B_e, C_g, R_g	Basic l
Beans, kidney, canned	7.0	.2	17.3	106	.039	.14	.0015	A_f, B_g, E_g, R_f	Basic l
lima, dried	18.1	1.5	65.9	358	.069	.33	.0075	A_g, B_g, E_g, R_f	Basic m
fresh	7.5	.8	22.0	131	.028	.13	.0020	A_g, B_g, E_g, R_f	Basic m
navy, dried	22.5	1.8	55.2	354	.17	.44	.0070	A_g, B_g, C_f, E_g, R_f	Basic l
string, fresh	2.3	.3	5.5	43.0	.046	.052	.0011	A_e, B_f, C_g, R_f	Basic l
Beet greens, cooked	2.2	3.4	3.2	54.0	.10	......	.00313	A_g, B_f, C_f, D_f, E_f, R_g	Basic
Beets, cooked	2.3	.1	7.4	40.8	.029	.038	.00059	A_f, B_f, C_f, R_f	Basic m
Brussel sprouts	4.4	.5	7.6	57.7	.031	.12	.0010	A_g, B_g, C_f	Acid
Cabbage	1.6	.3	4.5	31.9	.045	.029	.0013	A_f, B_f, C_e, R_f, K_g	Basic l
Carrots	1.1	.4	8.2	46.3	.055	.044	.00060	A_r, B_g, C_r, R_f	Basic m
Cauliflower	2.4	.2	4.0	31.0	.12	.057	.00075	A_f, B_g, C_f, R_f	Basic l
Celery	1.1	.1	3.3	18.7	.078	.037	.0005	A_g, B_f, C_g, E_g, R_f	Basic l
Chard, Swiss	1.4	.2	3.5	25.0	.15	.040	.0025	A_e, B_g, C_f, D_f, R_g	Basic m
Corn, canned	2.8	1.2	18.2	100	.0060	.10	.00080	A_g, B_f, C_f	Acid l
fresh on cob	3.1	1.1	19.2	104	.0060	.10	.00080	A_g, B_f, C_f	Acid l
Cucumbers	.8	.2	2.4	17.6	.016	.033	.00020	A_f, B_f, C_g	Basic l
Egg plant	1.2	.3	4.3	28.7	.011	.034	.0005	A_f, B_f, C_f	Basic

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Vegetable Foods (**Cont.**)									
Vegetables: (Cont.)									
Lentils, dried	25.7	1.0	59.2	357	.053	.25	.0043	A_g, B_e, E_g, R_g	Acid l
Lettuce, green leaf	1.2	.3	2.2	19.8	.043	.043	.0027	A_r, B_g, C_r, D_f, E_r, R_g	Basic l
Mushrooms	3.5	.4	6.0	46.3	.017	.11	.0031	B_g	Basic l
Okra	1.6	.2	4.0	38.6	.037	.037	.00063	A_g, B_f, C_g, R_f	Basic
Olives, green	1.1	27.6	11.6	309	.12	.014	.0029	A_g	Basic
ripe	1.7	25.9	4.3	266	.12	.014	.0029	A_g	Basic
Onions	1.6	.3	9.1	49.6	.035	.046	.00060	B_f, C_g, R_f	Basic l
Parsnips	1.6	.5	11.0	66.1	.061	.073	.00060	A_f, B_g	Basic m
Peas, canned	3.6	.2	8.6	56.2	.013	.064	.00083	A_e, B_g, C_f, E_g, R_g	Basic l
dried	24.6	1.0	57.5	365	.085	.40	.0057	A_f, B_f, E_f, R_g	Basic l
green	7.0	.5	15.2	103	.026	.13	.0017	A_f, B_g, C_f, E_g, R_g	Basic l
Potatoes, boiled	2.5	.1	20.3	97.0	.013	.057	.0013	A_g, B_f, C_f	Basic l
sweet	1.8	.7	26.1	126	.020	.045	.0005	A_r, B_f, C_f, R_f	Basic l
Pumpkin	1.0	.1	4.0	26.5	.023	.059	.00080	A_g, B_f, C_g	Basic l
Radishes	1.3	.1	5.1	29.8	.021	.029	.00060	B_g, C_g	Basic l
Rutabagas	1.3	.2	7.3	41.9	.077	.056	.0005	A_f, B_g, C_e, R_f	Basic m
Sauerkraut	1.7	.5	3.8	27.6	.046	.029	.0011	A_f, B_f, C_f, R_f	Basic
Spinach, cooked	2.1	4.1	2.6	57.3	.067	.066	.0036	A_r, B_g, C_g, D_g, E_f, K_e, R_f	Basic h
Squash	1.4	.5	8.2	47.4	.020	.030	.00060	A_g	Basic
Tomatoes, canned	1.2	.2	3.5	23.1	.011	.026	.00040	A_r, B_g, C_g, K_g, R_f	Basic l
fresh	.9	.4	3.3	23.1	.011	.026	.00040	A_r, B_e, C_r, K_g, R_f	Basic l
Turnips	1.3	.2	6.8	40.8	.064	.046	.0005	A_f, B_f, C_g, R_f	Basic l
Watercress	1.7	.3	2.8	22.7	.17	.0044	.0018	A_g, B_g, C_f, D_f, N_g, R_g	Basic
Yeast, compressed	11.7	.4	21.0	138	.011	.445	.0003	B_r, N_g, R_g	....

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Protein	Fat	Carbohydrate		Calcium	Phosphorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Miscellaneous									
Candy:									
Butterscotch	1	45	95	789	.031	.0066	.0014	A_f	Neutral
Chocolate creams	1.4	10.5	62.5	350	......	......	......	......	Neutral
fudge	2	9.6	76.2	400	.032	.039	.00014	A_f	Neutral
sweet milk	10	31	45	500	.21	.062	.0053	A_f, R_f	Neutral
Gum drops	10.5	....	77	350	......	......	......	......	Neutral
Marshmallows	6.66	....	80	346	......	......	......	......	....
Mints, after dinner	....	....	87.5	350	......	......	......	......	Neutral
Molasses candy	2.2	4.5	99.5	447	.086	.18	.0030	B_f	Basic
Nougat, chocolate	....	5	115	505	......	......	......	......	....
Nut bar	5.3	18.6	62	437	.067	.26	.0015	B_g	....
Peanut brittle	12	21	75	537	.12	.17	.0039	B_g	Acid
Fats:									
Butter	1.0	85.0	....	795	.015	.017	.00025	A_r, D_g, E_f	Neutral
Cod liver oil	....	100	....	900	......	......	......	A_r, D_r	Neutral
Corn oil	....	100	....	900	......	......	......	A_f, E_g	Neutral
Crisco	....	100	....	900	......	......	......	E_f	Neutral
Lard	....	100	....	930	......	......	......	A_f, E_e	Neutral
Oleomargarine	1.2	83.0	....	777	......	......	......	A_g, E_g	Neutral
Olive oil	....	100	....	900	......	......	......	A_f, E_f	Neutral
Peanut oil	....	100	....	900	......	......	......	A_f, E_f	Neutral
Jelly, cherry	1.1	....	77.2	321	.015	.010	.0005	A_g, C_f	Neutral
Salad dressing:									
Cream	7	21.7	31.5	350	.081	.12	.0010	A_g, B_f, D_f, R_f	Acid l
French	....	60	2	548	......	......	......	A_f, R_f	Neutral

COMPOSITION AND VALUE OF FOODS (Continued)

Food	Percent by weight			Fuel value, kg-cal. per 100 g	Mineral content, percent by weight			Vitamins	Reaction
	Pro-tein	Fat	Carbo-hydrate		Cal-cium	Phos-phorus	Iron	r = rich g = good e = excellent f = fair	h = high m = med. l = low
Miscellaneous (Cont.)									
Salad Dressing: (Cont.)									
Mayonnaise	4	80	4	752	.0092	.053	.00080	A_e, B_f, D_f, R_f	Acid l
Thousand Island	3.3	43	3.3	413	.043	.084	.0014	A_f, B_f, D_f, R_f	Acid
Soup:									
Asparagus, cream of	2.5	3.2	5.5	62.8	.13	.10	.00048	A_f, B_f, D_f, E_f	Basic l
Bouillon	2.2	.1	.2	11.0	......	......	......	....	......
Celery, cream of	2.1	2.8	5.0	55.1	.11	.076	.00030	A_f, B_f, D_f, E_f	Basic l
Chicken	10.5	.8	2.4	60.6	......	.0088	.00012	....	Acid
Chowder, clam	1.8	.8	6.7	43.0	.13	.11	.00051	A_g, B_f, R_f	Acid
corn	2.1	4.5	10.5	91	.11	.11	.00041	....	Acid
Consommé	2.5	....	.4	12.1	......	......	......	....	Neutral
Oyster stew	4.8	6.3	7.2	105	.14	.025	.00078	A_g, B_g, R_f	Acid l
Potato	3.2	3.6	10	85	.12	.099	.0005	A_f, B_f	Basic l
Tomato	1.8	1.1	5.6	40.8	.076	.064	.00015	A_g, B_g, C_f, R_g	Basic l
Vegetable	2.9	....	.5	14.3	......	......	......	A_g, B_g, R_g	Basic l
Sugar:									
Brown	....	....	95.0	389	......	......	......	....	Neutral
Granulated	....	....	100	394	......	......	......	....	Neutral
Maple	....	....	82.8	340	.11	.0092	.0030	....	Neutral
Syrup:									
Corn	....	....	85	340	.0060	.0092	.000060	....	Neutral
Honey	.4	....	81.2	335	.0041	.019	.00070	....	......
Maple	....	....	71.4	293	.11	.013	.0030	....	Neutral
Molasses	2.4	....	69.3	284	.22	.045	.0077	B_f	Basic

DEHYDRATION OF METALLIC SULFATES

Metallic sulphates.	Temp. of beginning of decomposition, °C.	Products formed.	Color of products.
$CaSO_4.2H_2O$	38	$CaSO_4.H_2O$	White
$CaSO_4.H_2O$	80	$2CaSO_4.H_2O$	White
$2CaSO_4.H_2O$	149	$CaSO_4$	White
$MgSO_4.7H_2O$	19	$MgSO_4.6H_2O$	White
$MgSO_4.6H_2O$	38	$MgSO_4.2H_2O$	White
$MgSO_4.2H_2O$	112	$MgSO_4.H_2O$	White
$MgSO_4.H_2O$	203	$MgSO_4$	White
$CdSO_4.\frac{8}{3}H_2O$	30	$CdSO_4.2H_2O$	White
$CdSO_4.2H_2O$	41	$CdSO_4.H_2O$	White
$CdSO_4.H_2O$	170	$CdSO_4$	White
$CoSO_4.7H_2O$	14	$CoSO_4.4H_2O$	Rose
$CoSO_4.4H_2O$	58	$CoSO_4.H_2O$	Lilac
$CoSO_4.H_2O$	276	$CoSO_4$	Lilac
$NiSO_4.7H_2O$	40	$NiSO_4.4H_2O$	Green
$NiSO_4.4H_2O$	106	$NiSO_4.H_2O$	Yellow
$NiSO_4.H_2O$	279	$NiSO_4$	Orange
$ZnSO_4.7H_2O$	25	$ZnSO_4.6H_2O$	White
$ZnSO_4.6H_2O$	28	$ZnSO_4.2H_2O$	White
$ZnSO_4.2H_2O$	115	$ZnSO_4.H_2O$	White
$ZnSO_4.H_2O$	225	$ZnSO_4$	White
$MnSO_4.5H_2O$	25	$MnSO_4.2H_2O$	Pale peach blossom
$MnSO_4.2H_2O$	60	$MnSO_4.H_2O$	Paler than above
$MnSO_4.H_2O$	152	$MnSO_4$	Paler than above
$CuSO_4.5H_2O$	27	$CuSO_4.3H_2O$	Blue
$CuSO_4.3H_2O$	93	$CuSO_4.H_2O$	Pale blue
$CuSO_4.H_2O$	155	$CuSO_4$	White
$Al_2(SO_4)_3.16H_2O$	51	$Al_2(SO_4)_3.13H_2O$	White
$Al_2(SO_4)_3.13H_2O$	82	$Al_2(SO_4)_3.10H_2O$	White
$Al_2(SO_4)_3.10H_2O$	97	$Al_2(SO_4)_3.7H_2O$	White
$Al_2(SO_4)_3.7H_2O$	109	$Al_2(SO_4)_3.4H_2O$	White
$Al_2(SO_4)_3.4H_2O$	180	$Al_2(SO_4)_3.H_2O$	White
$Al_2(SO_4)_3.H_2O$	316	$Al_2(SO_4)_3$	White
$FeSO_4.7H_2O$	21	$FeSO_4.4H_2O$	Light apple green
$FeSO_4.4H_2O$	80	$FeSO_4.H_2O$	White
$FeSO_4.H_2O$	406	Fe_2O_3, SO_3	Yellowish green

DECOMPOSITION OF ANHYDROUS METALLIC SULFATES

Metallic sulphate.	Temp. at beginning of decomposition, °C.	Temp. of energetic decomposition, °C.	Products of decomposition.	Color of product.
$FeSO_4$	167	480	Fe_2O_3, $2SO_4$	Yellow brown
Fe_2O_3, $2SO_3$	492	560	Fe_2O_3	Red
$Bi_2(SO_4)_3$	570	639	$5Bi_2O_3$, $4(SO_3)_3$.	White
$Al_2(SO_4)_3$	590	639	Al_2O_3	White
$PbSO_4$	637	705	$6PbO$, $5SO_3$	White
$CuSO_4$	653	670	$2CuO$, SO_3.	Ornage
$MnSO_4$	699	790	Mn_3O_4	Dark red to black
$ZnSO_4$	702	720	$3ZnO$, $2SO_3$	White
$2CuO$, SO_3	702	736	CuO	Black
$NiSO_4$	703	764	NiO	Brownish green
$CoSO_4$	720	770	CoO	Brown to black
$3ZnO$, $2SO_3$	755	767	ZnO	White
$CdSO_4$	827	846	$5CdO$, SO_3	White
$5Bi_2O_3$, $4(SO_3)_3$	870	890	Bi_2O_3(?)	Yellow
$5CdO$, SO_3	878	890	CdO	Brown
$MgSO_4$	890	972	MgO	White
Ag_2SO_4	917	925	Ag	Silver white
$6PbO$, $5SO_3$	952	962	$2PbO$, SO_3(?).	White to yellow
$CaSO_4$	1200	....	CaO	White
$BaSO_4$	1510	....	BaO	White

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

The following collections of tables gives the specific gravity, grams per liter, pounds per cubic foot, and pounds per gallon for a large number of substances in aqueous solution. The three latter quantities have been computed from the per cent of the substance in solution and the specific gravity, assuming the density of water at 4° C. as unity. The U. S. gallon, cubic foot, and pound avoirdupois equivalents were used. The degree Baumé corresponding to the specific gravity is given according to the relation,

$$\text{Bé.} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

The per cent by weight is indicated in every case.

The substances are arranged in alphabetical order. The specific gravity of alcohol solutions will be found in a separate group. Another table gives, with less detail, the specific gravity of solutions of many other substances.

Tables indicated by the symbol * have been computed on the basis of values for the specific gravity found in the International Critical Tables.

ACETIC ACID

Specific Gravity of Aqueous Acetic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $HC_2H_3O_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
.....	0.9982	0	....	....	......
.....	0.9996	1	9.996	0.6240	0.0834
0.2	1.0012	2	20.02	1.250	0.1671
0.4	1.0025	3	30.08	1.877	0.2510
0.6	1.0040	4	40.16	2.507	0.3351
0.8	1.0055	5	50.28	3.139	0.4196
1.0	1.0069	6	60.41	3.771	0.5042
1.2	1.0083	7	70.58	4.406	0.5890
1.4	1.0097	8	80.78	5.043	0.6741
1.6	1.0111	9	91.00	5.681	0.7594
1.8	1.0125	10	101.3	6.321	0.8450
2.0	1.0139	11	111.5	6.962	0.9307
2.2	1.0154	12	121.8	7.607	1.017
2.4	1.0168	13	132.2	8.252	1.103
2.6	1.0182	14	142.5	8.899	1.190
2.8	1.0195	15	152.9	9.547	1.276
3.0	1.0209	16	163.3	10.20	1.363
3.2	1.0223	17	173.8	10.85	1.450
3.3	1.0236	18	184.2	11.50	1.538
3.5	1.0250	19	194.8	12.16	1.625
3.7	1.0263	20	205.3	12.81	1.713
3.9	1.0276	21	215.8	13.47	1.801
4.1	1.0288	22	226.3	14.13	1.889
4.2	1.0301	23	236.9	14.79	1.977
4.4	1.0313	24	247.5	15.45	2.066
4.6	1.0326	25	258.2	16.12	2.154
4.7	1.0338	26	268.8	16.78	2.243
4.9	1.0349	27	279.4	17.44	2.332
5.1	1.0361	28	290.1	18.11	2.421
5.2	1.0372	29	300.8	18.78	2.510
5.4	1.0384	30	311.5	19.45	2.600
5.5	1.0395	31	322.2	20.12	2.689
5.7	1.0406	32	333.0	20.79	2.779
5.8	1.0417	33	343.8	21.46	2.869
6.0	1.0428	34	354.6	22.13	2.959
6.1	1.0438	35	365.3	22.81	3.049
6.2	1.0449	36	376.2	23.48	3.139
6.4	1.0459	37	387.0	24.16	3.229
6.5	1.0469	38	397.8	24.83	3.320
6.6	1.0479	39	408.7	25.51	3.411
6.8	1.0488	40	419.5	26.19	3.501

ACETIC ACID (Continued)

SPECIFIC GRAVITY OF AQUEOUS ACETIC ACID SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $HC_2H_3O_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
6.9	1.0498	41	430.4	26.87	3.592
7.0	1.0507	42	441.3	27.55	3.683
7.1	1.0516	43	452.2	28.23	3.774
7.2	1.0525	44	463.1	28.91	3.865
7.4	1.0534	45	474.0	29.59	3.956
7.5	1.0542	46	484.9	30.27	4.047
7.6	1.0551	47	495.9	30.96	4.138
7.7	1.0559	48	506.8	31.64	4.230
7.8	1.0567	49	517.8	32.32	4.321
7.9	1.0575	50	528.8	33.01	4.413
8.0	1.0582	51	539.7	33.69	4.504
8.1	1.0590	52	550.7	34.38	4.596
8.2	1.0597	53	561.6	35.06	4.687
8.3	1.0604	54	572.6	35.75	4.779
8.4	1.0611	55	583.6	36.43	4.870
8.4	1.0618	56	594.6	37.12	4.962
8.5	1.0624	57	605.6	37.80	5.054
8.6	1.0631	58	616.6	38.49	5.146
8.7	1.0637	59	627.6	39.18	5.237
8.8	1.0642	60	638.5	39.86	5.329
8.8	1.0648	61	649.5	40.55	5.420
8.9	1.0653	62	660.5	41.23	5.512
9.0	1.0658	63	671.5	41.92	5.603
9.0	1.0662	64	682.4	42.60	5.695
9.1	1.0666	65	693.3	43.28	5.786
9.1	1.0671	66	704.3	43.97	5.877
9.2	1.0675	67	715.2	44.65	5.969
9.2	1.0678	68	726.1	45.33	6.059
9.3	1.0682	69	737.1	46.01	6.151
9.3	1.0685	70	748.0	46.69	6.242
9.3	1.0687	71	758.8	47.37	6.332
9.4	1.0690	72	769.7	48.05	6.423
9.4	1.0693	73	780.6	48.73	6.514
9.4	1.0694	74	791.4	49.40	6.604
9.4	1.0696	75	802.2	50.08	6.695
9.5	1.0698	76	813.0	50.76	6.785
9.5	1.0699	77	823.8	51.43	6.875
9.5	1.0700	78	834.6	52.10	6.965
9.5	1.0700	79	845.3	52.77	7.054
9.5	1.0700	80	856.0	53.44	7.143
9.5	1.0699	81	866.6	54.10	7.232
9.5	1.0698	82	877.2	54.76	7.321
9.4	1.0696	83	887.8	55.42	7.409
9.4	1.0693	84	898.2	56.07	7.496
9.4	1.0689	85	908.6	56.72	7.582
9.3	1.0685	86	918.9	57.36	7.668
9.2	1.0680	87	929.2	58.00	7.754
9.2	1.0675	88	939.4	58.64	7.839
9.1	1.0668	89	949.5	59.27	7.923
9.0	1.0661	90	959.5	59.90	8.007
8.9	1.0652	91	969.3	60.51	8.089
8.8	1.0643	92	979.2	61.13	8.171
8.6	1.0632	93	988.8	61.73	8.252
8.5	1.0619	94	998.2	62.31	8.330
8.3	1.0605	95	1007	62.89	8.408
8.1	1.0588	96	1016	63.45	8.482
7.8	1.0570	97	1025	64.01	8.556
7.6	1.0549	98	1034	64.54	8.627
7.2	1.0524	99	1042	65.04	8.695
6.9	1.0498	100	1050	65.54	8.761

ALBUMEN

Specific Gravity of Aqueous Albumen Solutions at 15.5° C.

Bé.	Sp. gr.	Per cent Albumen	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.37	1.0026	1	10.03	0.6259	0.0837
0.77	1.0054	2	20.11	1.255	0.1678
1.12	1.0078	3	30.23	1.887	0.2523
1.85	1.0130	5	50.65	3.162	0.4227
3.66	1.0261	10	102.6	6.406	0.8563
5.32	1.0384	15	155.8	9.724	1.300
7.06	1.0515	20	210.3	13.13	1.755
8.72	1.0644	25	266.1	16.61	2.221
10.42	1.0780	30	323.4	20.19	2.699
13.12	1.0919	35	382.2	23.86	3.189
13.78	1.1058	40	442.3	27.61	3.691
15.48	1.1204	45	504.2	31.47	4.207
17.16	1.1352	50	567.6	35.43	4.737
18.90	1.1511	55	633.1	39.52	5.283

ALUMINUM CHLORIDE

Specific Gravity of Aqueous Aluminum Chloride Solutions at $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $AlCl_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0075	1	10.08	0.6290	0.0841
2.3	1.0164	2	20.33	1.269	0.1696
4.8	1.0344	4	41.38	2.583	0.3453
7.3	1.0526	6	63.16	3.943	0.5271
9.6	1.0711	8	85.69	5.349	0.7151
12.0	1.0900	10	109.0	6.805	0.9096
14.3	1.1093	12	133.1	8.310	1.111
16.6	1.1290	14	158.1	9.867	1.319
18.8	1.1491	16	183.9	11.48	1.534

ALUMINUM CHLORIDE

SPECIFIC GRAVITY OF ALUMINUM CHLORIDE SOLUTIONS AT 15° C. (GERLACH)

Bé.	Sp. gr.	Per cent Al_2Cl_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0072	1	10.07	0.6288	0.0841
2.1	1.0144	2	20.29	1.267	0.1693
3.1	1.0216	3	30.65	1.913	0.2558
4.1	1.0289	4	41.16	2.570	0.3437
5.0	1.0360	5	51.80	3.234	0.4323
6.0	1.0435	6	62.61	3.909	0.5225
7.0	1.0510	7	73.57	4.593	0.6140
8.0	1.0585	8	84.68	5.286	0.7067
9.0	1.0659	9	95.93	5.989	0.8006
9.9	1.0734	10	107.3	6.701	0.8958
10.9	1.0812	11	118.9	7.425	0.9925
11.9	1.0890	12	130.7	8.158	1.091
12.8	1.0968	13	142.6	8.901	1.190
13.7	1.1047	14	154.7	9.655	1.291
14.7	1.1125	15	166.9	10.42	1.393
15.6	1.1207	16	179.3	11.19	1.496
16.6	1.1290	17	191.9	11.98	1.602
17.5	1.1372	18	204.7	12.78	1.708
18.4	1.1455	19	217.6	13.59	1.816
19.3	1.1537	20	230.7	14.40	1.926
20.2	1.1623	21	244.1	15.24	2.037
21.2	1.1709	22	257.6	16.08	2.150
22.1	1.1795	23	271.3	16.94	2.264
23.0	1.1882	24	285.2	17.80	2.380
23.8	1.1968	25	299.2	18.68	2.497
24.8	1.2058	26	313.5	19.57	2.616
25.7	1.2149	27	328.0	20.48	2.737
26.5	1.2241	28	342.7	21.40	2.860
27.4	1.2331	29	357.6	22.32	2.984
28.3	1.2422	30	372.7	23.26	3.110
29.2	1.2518	31	388.1	24.23	3.238
30.1	1.2615	32	403.7	25.20	3.369
30.9	1.2712	33	419.5	26.19	3.501
31.8	1.2808	34	435.5	27.19	3.634
32.6	1.2905	35	451.7	28.20	3.769
33.5	1.3007	36	468.3	29.23	3.908
34.4	1.3109	37	485.0	30.28	4.048
35.2	1.3211	38	502.0	31.34	4.189
36.1	1.3313	39	519.2	32.41	4.333
36.9	1.3415	40	536.6	33.50	4.478
37.8	1.3522	41	554.4	34.61	4.627

ALUMINUM SULFATE

Specific Gravity of Aqueous Aluminum Sulfate Solutions at $\frac{15^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $Al_2(SO_4)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0093	1	10.09	0.6301	0.0842
2.8	1.0195	2	20.39	1.273	0.1702
5.6	1.0404	4	41.62	2.598	0.3473
8.4	1.0618	6	63.71	3.977	0.5317
11.2	1.0837	8	86.70	5.412	0.7235
13.9	1.1062	10	110.6	6.906	0.9232
16.6	1.1293	12	135.5	8.460	1.131
19.2	1.1529	14	161.4	10.08	1.347
21.8	1.1770	16	188.3	11.76	1.572
24.3	1.2017	18	216.3	13.50	1.805
26.8	1.2272	20	245.4	15.32	2.048
29.3	1.2534	22	275.7	17.21	2.301
31.7	1.2803	24	307.3	19.18	2.564
34.1	1.3079	26	340.1	21.23	2.838

Bé	Sp. gr.	Per cent $Al_2(SO_4)_3 + 18H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0093	1.948	19.66	1.227	0.1641
2.8	1.0195	3.896	39.72	2.479	0.3314
5.6	1.0404	7.791	81.06	5.060	0.6765
8.4	1.0618	11.69	124.1	7.747	1.036
11.2	1.0837	15.58	168.9	10.54	1.409
13.9	1.1062	19.48	215.5	13.45	1.798
16.6	1.1293	23.37	264.0	16.48	2.203
19.2	1.1529	27.27	314.4	19.63	2.624
21.8	1.1770	31.16	366.8	22.90	3.061
24.3	1.2017	35.06	421.3	26.30	3.516
26.8	1.2272	38.96	478.1	29.84	3.990
29.3	1.2534	42.85	537.1	33.53	4.482
31.7	1.2803	46.75	598.5	37.36	4.995
34.1	1.3079	50.64	662.4	41.35	5.528

ALUMINUM SULFATE

Specific Gravity of Aluminum Sulfate Solutions at 15° C. (Larsson)

Alum-maker's Table

Bé.	Sp. gr.	100 kg. of solution contain				
		Kg. Al_2O_3	Kg. SO_3	Kg. sulfate with 13 per cent Al_2O_3	Kg. sulfate with 14 per cent Al_2O_3	Kg. sulfate with 15 per cent Al_2O_3
0.7	1.005	0.14	0.32	1.1	1.0	0.9
1.4	1.010	0.27	0.64	2.1	2.0	1.8
2.3	1.016	0.41	0.95	3.1	2.9	2.7
3.0	1.021	0.55	1.27	4.2	3.9	3.6
3.7	1.026	0.68	1.59	5.3	4.9	4.6
4.4	1.031	0.81	1.89	6.3	5.8	5.4
5.0	1.036	0.94	2.20	7.3	6.7	6.3
5.6	1.040	1.07	2.50	8.3	7.7	7.2
6.2	1.045	1.20	2.80	9.3	8.6	8.0
6.9	1.050	1.33	3.11	10.3	9.5	8.9
7.6	1.055	1.46	3.40	11.2	10.4	9.7
8.1	1.059	1.58	3.69	12.2	11.3	10.6
8.7	1.064	1.71	3.98	13.1	12.2	11.4
9.2	1.068	1.83	4.27	14.1	13.1	12.2
9.9	1.073	1.96	4.56	15.1	14.0	13.1
10.5	1.078	2.08	4.84	16.0	14.8	13.9
11.0	1.082	2.20	5.12	16.9	15.7	14.6
11.6	1.087	2.32	5.40	17.8	16.5	15.4
12.2	1.092	2.44	5.67	18.7	17.4	16.2
12.7	1.096	2.55	5.95	19.6	18.3	17.0
13.3	1.101	2.67	6.22	20.5	19.1	17.8
13.8	1.105	2.78	6.49	21.4	19.9	18.6
14.4	1.110	2.90	6.76	22.3	20.7	19.3
14.8	1.114	3.01	7.02	23.2	21.5	20.1
15.4	1.119	3.13	7.29	24.1	22.4	20.9
15.9	1.123	3.24	7.55	24.9	23.1	21.6
16.5	1.128	3.35	7.81	25.8	23.9	22.3
16.9	1.132	3.46	8.06	26.6	24.7	23.1
17.5	1.137	3.57	8.32	27.5	25.5	23.8
17.9	1.141	3.68	8.58	28.3	26.3	24.5
18.4	1.145	3.79	8.83	29.1	27.1	25.3
18.9	1.150	3.89	9.07	30.0	27.8	26.0
19.4	1.154	4.00	9.32	30.8	28.6	26.7
19.9	1.159	4.11	9.57	31.6	29.3	27.4
20.3	1.163	4.21	9.82	32.4	30.1	28.1
20.9	1.168	4.32	10.06	33.2	30.8	28.9
21.3	1.172	4.42	10.29	34.0	31.6	29.5
21.7	1.176	4.52	10.53	34.8	32.3	30.1

ALUMINUM SULFATE (Continued)

SPECIFIC GRAVITY OF ALUMINUM SULFATE SOLUTIONS AT 15° C. (LARSSON)

Alum-maker's Table

Bé.	Sp. gr.	100 liters of solution contain				
		Kg. Al_2O_3	Kg. SO_3	Kg. sulfate with 13 per cent Al_2O_3	Kg. sulfate with 14 per cent Al_2O_3	Kg. sulfate with 15 per cent Al_2O_3
0.7	1.005	0.14	0.33	1.1	1	0.9
1.4	1.010	0.28	0.65	2.2	2	1.9
2.3	1.016	0.42	0.98	3.2	3	2.8
3.0	1.021	0.56	1.31	4.3	4	3.7
3.7	1.026	0.70	1.63	5.4	5	4.7
4.4	1.031	0.84	1.96	6.5	6	5.6
5.0	1.036	0.98	2.28	7.5	7	6.5
5.6	1.040	1.12	2.61	8.6	8	7.5
6.2	1.045	1.26	2.94	9.7	9	8.4
6.9	1.050	1.40	3.26	10.8	10	9.3
7.6	1.055	1.54	3.59	11.8	11	10.3
8.1	1.059	1.68	3.91	12.9	12	11.2
8.7	1.064	1.82	4.24	14.0	13	12.1
9.2	1.068	1.96	4.57	15.1	14	13.1
9.9	1.073	2.10	4.89	16.2	15	14.0
10.5	1.078	2.24	5.22	17.2	16	14.9
11.0	1.082	2.38	5.55	18.3	17	15.9
11.6	1.087	2.52	5.87	19.4	18	16.8
12.2	1.092	2.66	6.20	20.5	19	17.7
12.7	1.096	2.80	6.52	21.5	20	18.7
13.3	1.101	2.94	6.85	22.6	21	19.6
13.8	1.105	3.08	7.18	23.7	22	20.5
14.4	1.110	3.22	7.50	24.8	23	21.5
14.8	1.114	3.36	7.83	25.9	24	22.4
15.4	1.119	3.50	8.16	26.9	25	23.3
15.9	1.123	3.64	8.48	28.0	26	24.3
16.5	1.128	3.78	8.81	29.1	27	25.2
16.9	1.132	3.92	9.13	30.2	28	26.1
17.5	1.137	4.06	9.46	31.2	29	27.1
17.9	1.141	4.20	9.79	32.3	30	28.0
18.4	1.145	4.34	10.11	33.4	31	28.9
18.9	1.150	4.48	10.44	34.5	32	29.9
19.4	1.154	4.64	10.76	35.5	33	30.8
19.9	1.159	4.76	11.09	36.6	34	31.7
20.3	1.163	4.90	11.42	37.7	35	32.7
20.9	1.168	5.04	11.74	38.8	36	33.6
21.3	1.172	5.18	12.07	39.9	37	34.5
21.7	1.176	5.32	12.40	40.9	38	35.5

AMMONIA

Specific Gravity of Aqueous Ammonium Hydroxide Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent NH_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
10.9	0.9939	1	9.939	0.6205	0.0829
11.5	0.9895	2	19.79	1.235	0.1652
11.7	0.9811	4	39.24	2.450	0.3275
13.9	0.9730	6	58.38	3.644	0.4872
15.1	0.9651	8	77.21	4.820	0.6443
16.2	0.9575	10	95.75	5.977	0.7991
17.3	0.9501	12	114.0	7.117	0.9515
18.5	0.9430	14	132.0	8.242	1.102
19.5	0.9362	16	149.8	9.351	1.250
20.6	0.9295	18	167.3	10.44	1.396
21.7	0.9229	20	184.6	11.52	1.540
22.8	0.9164	22	201.6	12.59	1.682
23.8	0.9101	24	218.4	13.64	1.823
24.9	0.9040	26	235.0	14.67	1.961
25.9	0.8980	28	251.4	15.70	2.098
27.0	0.8920	30	267.6	16.71	2.233

Values Determined in Sealed Tubes, at $\frac{15^\circ}{4^\circ}$ C.

Bé.	Sp. gr.	Per cent NH_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
34.9	0.849	45	382.1	23.85	3.188
38.3	0.832	50	416.0	25.97	3.472
41.8	0.815	55	448.3	27.98	3.741
45.9	0.796	60	477.6	29.82	3.985
50.4	0.776	65	504.4	31.49	4.209
55.4	0.755	70	528.5	32.99	4.410
61.0	0.733	75	549.8	34.32	4.588
66.9	0.711	80	568.8	35.51	4.747
73.5	0.688	85	584.8	36.51	4.880
80.5	0.665	90	598.5	37.36	4.995
88.1	0.642	95	609.9	38.07	5.090
96.5	0.618	100	618.0	38.58	5.157

AMMONIUM HYDROXIDE

Specific Gravity of Aqueous Solutions at 15° C.

Specific gravity	Per cent NH_3	Total NH_3 g. per liter	Specific gravity	Per cent NH_3	Total NH_3 g. per liter
1.000	0.00	0.0	0.940	15.63	146.9
0.998	0.45	4.5	0.938	16.22	152.1
0.996	0.91	9.1	0.936	16.82	157.4
0.994	1.37	13.6	0.934	17.42	162.7
0.992	1.84	18.2	0.932	18.03	168.1
0.990	2.31	22.9	0.930	18.64	173.4
0.988	2.80	27.7	0.928	19.25	178.6
0.986	3.30	32.5	0.926	19.87	184.2
0.984	3.80	37.4	0.924	20.49	189.3
0.982	4.30	42.2	0.922	21.12	194.7
0.980	4.80	47.0	0.920	21.75	200.1
0.978	5.30	51.8	0.918	22.39	205.6
0.976	5.80	56.6	0.916	23.03	210.9
0.974	6.30	61.4	0.914	23.68	216.3
0.972	6.80	66.1	0.912	24.33	221.9
0.970	7.31	70.9	0.910	24.99	227.4
0.968	7.82	75.7	0.908	25.65	232.9
0.966	8.33	80.5	0.906	26.31	238.3
0.964	8.84	85.2	0.904	26.98	243.9
0.962	9.35	89.9	0.902	27.65	249.4
0.960	9.91	95.1	0.900	28.33	255.0
0.958	10.47	100.3	0.898	29.01	260.5
0.956	11.03	105.4	0.896	29.69	266.0
0.954	11.60	110.7	0.894	30.37	271.5
0.952	12.17	115.9	0.892	31.05	277.0
0.950	12.72	121.0	0.890	31.75	282.6
0.948	13.31	126.2	0.888	32.50	288.6
0.946	13.88	131.3	0.886	33.25	294.6
0.944	14.46	136.5	0.884	34.10	301.4
0.942	15.04	141.7	0.882	34.95	308.2

AQUA AMMONIA

Authority — W. C. Ferguson

This table has been approved and adopted as a standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = \frac{140}{\text{Sp. Gr.}} - 130.$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

The coefficient of expansion for Ammonia Solutions varying with the temperature, correction must be applied according to the following table:

Degrees Baumé	Corrections to be added for each degree below 60° F.		Corrections to be subtracted for each degree above 60° F.			
	40° F.	50° F.	70° F.	80° F.	90° F.	100° F.
14	0.015 Bé.	0.017 Bé.	0.020 Bé.	0.022 Bé.	0.024 Bé.	0.026 Bé.
16	0.021 "	0.023 "	0.026 "	0.028 "	0.030 "	0.032 "
18	0.027 "	0.029 "	0.031 "	0.033 "	0.035 "	0.037 "
20	0.033 "	0.036 "	0.037 "	0.038 "	0.040 "	0.042 "
22	0.039 "	0.042 "	0.043 "	0.045 "	0.047 "	
26	0.053 "	0.057 "	0.057 "	0.059 "		

Bé.°	Sp. gr.	Per cent NH_3.	Bé.°	Sp. gr.	Per cent NH_3.
10.00	1.0000	0.00	12.25	0.9842	3.73
10.25	0.9982	0.40	12.50	0.9825	4.16
10.50	0.9964	0.80	12.75	0.9807	4.59
10.75	0.9947	1.21	13.00	0.9790	5.02
11.00	0.9929	1.62	13.25	0.9773	5.45
11.25	0.9912	2.04	13.50	0.9756	5.88
11.50	0.9894	2.46	13.75	0.9739	6.31
11.75	0.9876	2.88	14.00	0.9722	6.74
12.00	0.9859	3.30	14.25	0.9705	7.17

AQUA AMMONIA (Continued)

Be.°	Sp. Gr.	Per cent NH_3.	Be.°	Sp. gr.	Per cent NH_3.
14.50	0.9689	7.61	22.00	0.9211	21.60
14.75	0.9672	8.05	22.25	0.9195	22.08
15.00	0.9655	8.49	22.50	0.9180	22.56
15.25	0.9639	8.93	22.75	0.9165	23.04
15.50	0.9622	9.38	23.00	0.9150	23.52
15.75	0.9605	9.83	23.25	0.9135	24.01
16.00	0.9589	10.28	23.50	0.9121	24.50
16.25	0.9573	10.73	23.75	0.9106	24.99
16 50	0.9556	11.18	24.00	0.9091	25.48
16.75	0.9540	11.64	24.25	0.9076	25.97
17.00	0.9524	12.10	24.50	0.9061	26.46
17.25	0.9508	12.56	24.75	0.9047	26.95
17.50	0.9492	13.02	25.00	0.9032	27.44
17.75	0.9475	13.49	25.25	0.9018	27.93
18.00	0.9459	13.96	25.50	0.9003	28.42
18.25	0.9444	14.43	25.75	0.8989	28.91
18.50	0.9428	14.90	26.00	0.8974	29.40
18.75	0.9412	15.37	26.25	0.8960	29.89
19.00	0.9396	15.84	26.50	0.8946	30.38
19.25	0.9380	16.32	26.75	0.8931	30.87
19.50	0.9365	16.80	27.00	0.8917	31.36
19.75	0.9349	17.28	27.25	0.8903	31.85
20.00	0.9333	17.76	27.50	0.8889	32.34
20.25	0.9318	18.24	27.75	0.8875	32.83
20.50	0.9302	18.72	28.00	0.8861	33.32
20.75	0.9287	19.20	28.25	0.8847	33.81
21.00	0.9272	19.68	28.50	0.8833	34.30
21.25	0.9256	20.16	28.75	0.8819	34.79
21.50	0.9241	20.64	29.00	0.8805	35.28
21.75	0.9226	21.12			

AMMONIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NH_4Cl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.2	1.0013	1	10.01	0.6251	0.0836
0.6	1.0045	2	20.09	1.254	0.1677
1.5	1.0107	4	40.43	2.524	0.3374
2.4	1.0168	6	61.01	3.809	0.5091
3.2	1.0227	8	81.82	5.108	0.6828
4.0	1.0286	10	102.9	6.421	0.8584
4.8	1.0344	12	124.1	7.749	1.036
5.6	1.0401	14	145.6	9.090	1.215
6.3	1.0457	16	167.3	10.44	1.396
7.1	1.0512	18	189.2	11.81	1.579
7.8	1.0567	20	211.3	13.19	1.764
8.5	1.0621	22	233.7	14.59	1.950
9.2	1.0674	24	256.2	15.99	2.138

AMMONIUM NITRATE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM NITRATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.3	1.0023	1	10.02	0.6257	0.0836
0.9	1.0064	2	20.13	1.257	0.1680
2.1	1.0147	4	40.59	2.534	0.3387
3.3	1.0230	6	61.38	3.832	0.5122
4.4	1.0313	8	82.50	5.150	0.6885
5.5	1.0397	10	104.0	6.491	0.8677
6.7	1.0482	12	125.8	7.852	1.050
7.8	1.0567	14	147.9	9.235	1.235
8.9	1.0653	16	170.4	10.64	1.422
10.0	1.0740	18	193.3	12.07	1.613
11.1	1.0828	20	216.6	13.52	1.807
12.2	1.0916	22	240.2	14.99	2.004
13.2	1.1005	24	264.1	16.49	2.204
14.3	1.1095	26	288.5	18.01	2.407
15.4	1.1186	28	313.2	19.55	2.614
16.4	1.1277	30	338.3	21.12	2.823
19.0	1.1512	35	402.9	25.15	3.362
21.6	1.1754	40	470.2	29.35	3.924
24.2	1.2003	45	540.1	33.72	4.508
26.7	1.2258	50	612.9	38.26	5.115

AMMONIUM NITRATE

Specific Gravity of Aqueous Ammonium Nitrate Solutions at 17.5° C. (Gerlach)

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0042	1	10.04	0.6269	0.0838
1.2	1.0085	2	20.17	1.259	0.1683
1.8	1.0127	3	30.38	1.897	0.2535
2.4	1.0170	4	40.68	2.540	0.3395
3.0	1.0212	5	51.06	3.188	0.4261
3.6	1.0255	6	61.53	3.841	0.5135
4.2	1.0297	7	72.08	4.500	0.6015
4.8	1.0340	8	82.72	5.164	0.6903
5.3	1.0382	9	93.44	5.833	0.7798
5.9	1.0425	10	104.3	6.508	0.8700
6.5	1.0468	11	115.1	7.188	0.9609
7.1	1.0512	12	126.1	7.875	1.053
7.6	1.0555	13	137.2	8.566	1.145
8.2	1.0599	14	148.4	9.263	1.238
8.8	1.0642	15	159.6	9.965	1.332
9.3	1.0686	16	171.0	10.67	1.427
9.9	1.0729	17	182.4	11.39	1.522
10.4	1.0773	18	193.9	12.11	1.618
10.9	1.0816	19	205.5	12.83	1.715
11.5	1.0860	20	217.2	13.56	1.813
12.6	1.0905	21	229.0	14.30	1.911
12.6	1.0950	22	240.9	15.04	2.010
13.1	1.0995	23	252.9	15.79	2.110
13.7	1.1040	24	265.0	16.54	2.211
14.2	1.1085	25	277.1	17.30	2.313
14.7	1.1130	26	289.4	18.07	2.415
15.2	1.1175	27	301.7	18.84	2.518
15.8	1.1220	28	314.2	19.61	2.622
16.3	1.1265	29	326.7	20.39	2.726
16.8	1.1310	30	339.3	21.18	2.832
17.3	1.1358	31	352.1	21.98	2.938
17.9	1.1406	32	365.0	22.79	3.046
18.4	1.1454	33	378.0	23.60	3.154
18.9	1.1502	34	391.1	24.41	3.264
19.5	1.1550	35	404.3	25.24	3.374
20.0	1.1598	36	417.5	26.07	3.484
20.5	1.1646	37	430.9	26.90	3.596
21.0	1.1694	38	444.4	27.74	3.708
21.5	1.1743	39	457.9	28.59	3.822
22.0	1.1790	40	471.6	29.44	3.936
22.5	1.1841	41	485.5	30.31	4.051
23.1	1.1892	42	499.5	31.18	4.168

AMMONIUM NITRATE (Continued)

Specific Gravity of Aqueous Ammonium Nitrate Solutions at 17.5° C. (Gerlach)

Bé.	Sp. gr.	Per cent NH_4NO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.6	1.1942	43	513.5	32.06	4.285
24.1	1.1994	44	527.7	32.94	4.404
24.6	1.2045	45	542.0	33.84	4.523
25.1	1.2096	46	556.4	34.74	4.643
25.6	1.2147	47	570.9	35.64	4.764
26.1	1.2198	48	585.5	36.55	4.886
26.6	1.2249	49	600.2	37.47	5.009
27.1	1.2300	50	615.0	38.39	5.132
27.6	1.2353	51	630.0	39.33	5.258
28.1	1.2407	52	645.2	40.28	5.384
28.6	1.2460	53	660.4	41.23	5.511
29.1	1.2514	54	675.8	42.19	5.639
29.6	1.2567	55	691.2	43.15	5.768
30.1	1.2621	56	706.8	44.12	5.898
30.6	1.2674	57	722.4	45.10	6.029
31.1	1.2728	58	738.2	46.09	6.161
31.6	1.2781	59	754.1	47.07	6.293
32.0	1.2835	60	770.1	48.08	6.427
32.5	1.2888	61	786.2	49.08	6.561
33.0	1.2942	62	802.4	50.09	6.696
33.5	1.3005	63	819.3	51.15	6.837
34.0	1.3059	64	835.8	52.17	6.975

AMMONIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS AMMONIUM SULFATE SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $(NH_4)_2SO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0041	1	10.04	0.6283	0.08379
1.5	1.0101	2	20.20	1.621	0.1686
3.1	1.0220	4	40.88	2.552	0.3412
4.7	1.0338	6	62.03	3.872	0.5176
6.3	1.0456	8	83.65	5.222	0.6981
7.9	1.0574	10	105.7	6.601	0.8824
9.4	1.0691	12	128.3	8.009	1.071
10.8	1.0808	14	151.3	9.446	1.263
12.3	1.0924	16	174.8	10.91	1.459
13.7	1.1039	18	198.7	12.40	1.658
15.0	1.1154	20	223.1	13.93	1.862
16.3	1.1269	22	247.9	15.48	2.069
17.6	1.1383	24	273.2	17.05	2.280
18.9	1.1496	26	298.9	18.66	2.494
20.1	1.1609	28	325.1	20.29	2.713
21.3	1.1721	30	351.6	21.95	2.934
24.2	1.2000	35	420.0	26.22	3.505
26.9	1.2277	40	491.1	30.66	4.098
29.5	1.2552	45	564.8	35.26	4.714
31.9	1.2825	50	641.3	40.03	5.351

AMMONIUM SULFATE

Specific Gravity of Aqueous Ammonium Sulfate Solutions at 19° C. (Schiff)

Bé.	Sp. gr.	Per cent $(NH_4)_2SO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	1	10.06	0.6278	0.0839
1.6	1.0115	2	20.23	1.263	0.1688
2.5	1.0172	3	30.52	1.905	0.2547
3.3	1.0230	4	40.92	2.555	0.3415
4.0	1.0287	5	51.44	3.211	0.4292
4.8	1.0345	6	62.07	3.875	0.5180
5.6	1.0403	7	72.82	4.546	0.6077
6.4	1.0460	8	83.68	5.224	0.6983
7.1	1.0518	9	94.66	5.909	0.7900
7.9	1.0575	10	105.8	6.602	0.8825
8.6	1.0632	11	117.0	7.301	0.9760
9.4	1.0690	12	128.3	8.008	1.071
10.1	1.0747	13	139.7	8.722	1.166
10.8	1.0805	14	151.3	9.443	1.262
11.5	1.0862	15	162.9	10.17	1.360
12.2	1.0920	16	174.7	10.91	1.458
12.9	1.0977	17	186.6	11.65	1.557
13.6	1.1035	18	198.6	12.40	1.658
14.3	1.1092	19	210.7	13.16	1.759
14.9	1.1149	20	223.0	13.92	1.861
15.6	1.1207	21	235.3	14.69	1.964
16.3	1.1265	22	247.8	15.47	2.068
16.9	1.1323	23	260.4	16.26	2.173
17.6	1.1381	24	273.1	17.05	2.279
18.2	1.1439	25	286.0	17.85	2.387
18.9	1.1496	26	298.9	18.66	2.494
19.5	1.1554	27	312.0	19.47	2.603
20.1	1.1612	28	325.1	20.30	2.713
20.8	1.1670	29	338.4	21.13	2.824
21.3	1.1724	30	351.7	21.96	2.935
21.9	1.1780	31	365.2	22.80	3.048
22.5	1.1836	32	378.8	23.64	3.161
23.1	1.1892	33	392.4	24.50	3.275
23.6	1.1948	34	406.2	25.36	3.390
24.2	1.2004	35	420.1	26.23	3.506
24.8	1.2060	36	434.2	27.10	3.623
25.3	1.2116	37	448.3	27.99	3.741
25.9	1.2172	38	462.5	28.87	3.860
26.4	1.2228	39	476.9	29.77	3.980
27.0	1.2284	40	491.4	30.67	4.101
27.5	1.2343	41	506.1	31.59	4.223
28.1	1.2402	42	520.9	32.52	4.347
28.6	1.2462	43	535.9	33.45	4.472
29.2	1.2522	44	551.0	34.40	4.598
29.8	1.2583	45	566.2	35.35	4.725
30.3	1.2644	46	581.6	36.31	4.854
30.9	1.2705	47	597.1	37.28	4.983
31.4	1.2766	48	612.8	38.25	5.114
32.0	1.2828	49	628.6	39.24	5.246
32.5	1.2890	50	644.5	40.23	5.378

ARSENIC ACID

SPECIFIC GRAVITY OF AQUEOUS ARSENIC ACID SOLUTIONS AT $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_3AsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	1	10.06	0.6278	0.0839
1.8	1.0124	2	20.25	1.264	0.1690
3.7	1.0260	4	41.04	2.562	0.3425
5.6	1.0398	6	62.39	3.895	0.5206
7.4	1.0538	8	84.30	5.263	0.7035
9.3	1.0681	10	106.8	6.668	0.8914
11.1	1.0826	12	129.9	8.110	1.084
12.9	1.0975	14	153.7	9.592	1.282
14.7	1.1128	16	178.0	11.12	1.486
16.5	1.1285	18	203.1	12.68	1.695
18.3	1.1447	20	228.9	14.29	1.911
20.2	1.1614	22	255.5	15.95	2.132
22.0	1.1785	24	282.8	17.66	2.360
23.8	1.1961	26	311.0	19.41	2.595
25.6	1.2143	28	340.0	21.23	2.837
27.4	1.2331	30	369.9	23.09	3.087
32.0	1.2829	35	449.0	28.03	3.747
36.6	1.3370	40	534.8	33.39	4.463
41.1	1.3959	45	628.2	39.21	5.242
45.7	1.4602	50	730.1	45.58	6.093
50.3	1.5304	55	841.7	52.55	7.024
54.8	1.6070	60	964.2	60.19	8.046
59.2	1.6904	65	1099	68.59	9.169
63.6	1.7811	70	1247	77.83	10.40

Bé.	Sp. gr.	Per cent As_2O_5	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0057	0.810	8.143	0.5083	0.0680
1.8	1.0124	1.62	16.39	1.023	0.1368
3.7	1.0260	3.24	33.23	2.074	0.2773
5.6	1.0398	4.86	50.51	3.153	0.4216
7.4	1.0538	6.48	68.26	4.261	0.5696
9.3	1.0681	8.10	86.48	5.399	0.7217
11.1	1.0826	9.72	105.2	6.566	0.8778
12.9	1.0975	11.3	124.4	7.766	1.038
14.7	1.1128	13.0	144.2	8.999	1.203
16.5	1.1285	14.6	164.5	10.27	1.373
18.3	1.1447	16.2	185.4	11.57	1.547
20.2	1.1614	17.8	206.9	12.91	1.726
22.0	1.1785	19.4	229.0	14.30	1.911
23.8	1.1961	21.1	251.8	15.72	2.101
25.6	1.2143	22.7	275.3	17.19	2.297
27.4	1.2331	24.3	299.5	18.70	2.500
32.0	1.2829	28.3	363.6	22.70	3.034
36.6	1.3370	32.4	433.0	27.03	3.614
41.1	1.3959	36.4	508.6	31.75	4.244
45.7	1.4602	40.5	591.1	36.90	4.933
50.3	1.5304	44.5	681.5	42.54	5.687
54.8	1.6070	48.6	780.7	48.74	6.515
59.2	1.6904	52.6	889.6	55.54	7.424
63.6	1.7811	56.7	1009	63.02	8.424

BARIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS BARIUM CHLORIDE SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $BaCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.3	1.0159	2	20.32	1.268	0.1696
4.8	1.0341	4	41.36	2.582	0.3452
7.3	1.0528	6	63.17	3.943	0.5272
9.8	1.0721	8	85.77	5.354	0.7158
12.2	1.0921	10	109.2	6.818	0.9114
14.7	1.1128	12	133.5	8.336	1.114
17.2	1.1342	14	158.8	9.913	1.325
19.6	1.1564	16	185.0	11.55	1.544
22.0	1.1793	18	212.3	13.25	1.771
24.5	1.2031	20	240.6	15.02	2.008
26.9	1.2277	22	270.1	16.86	2.254
29.3	1.2531	24	300.7	18.77	2.510
31.7	1.2793	26	332.6	20.76	2.776

Bé.	Sp. gr.	Per cent $BaCl_2 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.3	1.0159	2.346	23.83	1.488	0.1989
4.8	1.0341	4.692	48.52	3.029	0.4049
7.3	1.0528	7.038	74.10	4.626	0.6184
9.8	1.0721	9.384	100.6	6.281	0.8396
12.2	1.0921	11.73	128.1	7.997	1.069
14.7	1.1128	14.08	156.6	9.778	1.307
17.2	1.1342	16.42	186.3	11.63	1.554
19.6	1.1564	18.77	217.0	13.55	1.811
22.0	1.1793	21.11	249.0	15.54	2.078
24.5	1.2031	23.46	282.2	17.62	2.355
26.9	1.2277	25.81	316.8	19.78	2.644
29.3	1.2531	28.15	352.8	22.02	2.944
31.7	1.2793	30.50	390.2	24.36	3.256

CADMIUM NITRATE

Specific Gravity of Aqueous Cadmium Nitrate Solutions at $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Cd(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.2	1.0154	2	20.31	1.268	0.1695
4.6	1.0326	4	41.30	2.578	0.3447
6.9	1.0502	6	63.01	3.934	0.5259
9.3	1.0683	8	85.46	5.335	0.7132
11.6	1.0869	10	108.7	6.785	0.9070
13.9	1.1061	12	132.7	8.286	1.108
16.2	1.1261	14	157.7	9.842	1.316
18.6	1.1468	16	183.5	11.45	1.531
20.9	1.1682	18	210.3	13.13	1.755
23.2	1.1904	20	238.1	14.86	1.987
28.9	1.2488	25	312.2	19.50	2.605
34.5	1.3124	30	393.7	24.58	3.286
40.1	1.3822	35	483.8	30.20	4.037
45.6	1.4590	40	583.6	36.43	4.870
51.1	1.5438	45	694.7	43.37	5.797
56.4	1.6356	50	817.8	51.05	6.825

CALCIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS CALCIUM CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CaCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0148	2	20.30	1.267	0.1694
4.4	1.0316	4	41.26	2.576	0.3444
6.7	1.0486	6	62.92	3.928	0.5251
9.0	1.0659	8	85.27	5.323	0.7116
11.2	1.0835	10	108.4	6.764	0.9042
13.4	1.1015	12	132.2	8.252	1.103
15.5	1.1198	14	156.8	9.787	1.308
17.7	1.1386	16	182.2	11.37	1.520
19.8	1.1578	18	208.4	13.01	1.739
21.9	1.1775	20	235.5	14.70	1.965
27.0	1.2284	25	307.1	19.17	2.563
31.9	1.2816	30	384.5	24.00	3.209
36.6	1.3373	35	468.1	29.22	3.906
41.1	1.3957	40	558.3	34.85	4.659

Bé.	Sp. gr.	Per cent $CaCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0148	3.948	40.06	2.501	0.3343
4.4	1.0316	7.896	81.46	5.085	0.6800
6.7	1.0486	11.84	124.2	7.753	1.036
9.0	1.0659	15.79	168.3	10.51	1.405
11.2	1.0835	19.74	213.9	13.35	1.785
13.4	1.1015	23.69	260.9	16.29	2.177
15.5	1.1198	27.64	309.5	19.32	2.583
17.7	1.1386	31.58	359.6	22.45	3.001
19.8	1.1578	35.53	411.4	25.68	3.433
21.9	1.1775	39.48	465.9	29.02	3.879
27.0	1.2284	49.35	606.2	37.84	5.059
31.9	1.2816	59.22	759.0	47.38	6.334
36.6	1.3373	69.09	923.9	57.68	7.710
41.1	1.3957	78.96	1102.0	68.80	9.197

CHROMIC ACID

Specific Gravity of Aqueous Chromic Acid Solutions at $\frac{15^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent CrO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.2	1.045	6	62.70	3.914	0.5232
8.2	1.060	8	84.80	5.294	0.7077
10.2	1.076	10	107.6	6.717	0.8979
12.3	1.093	12	131.2	8.188	1.095
14.4	1.110	14	155.4	9.701	1.297
16.3	1.127	16	180.3	11.26	1.505
18.4	1.145	18	206.1	12.87	1.720
20.3	1.163	20	232.6	14.52	1.941
22.2	1.181	22	259.8	16.22	2.168
24.2	1.200	24	288.0	17.98	2.403
26.2	1.220	26	317.2	19.80	2.647
28.1	1.240	28	347.2	21.67	2.897
29.9	1.260	30	378.0	23.60	3.154
34.6	1.313	35	459.6	28.69	3.835
39.2	1.371	40	548.4	34.24	4.577
44.0	1.435	45	645.8	40.31	5.389
48.7	1.505	50	752.5	46.98	6.280
53.3	1.581	55	869.6	54.28	7.257
57.8	1.663	60	997.8	62.29	8.327

CHROMIUM SULFATE

Specific Gravity of Aqueous Chromium Sulfate Solutions at $\frac{15^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $Cr_2(SO_4)_3$ (green)	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0081	1	10.08	0.6293	0.0841
2.5	1.0172	2	20.34	1.270	0.1698
5.0	1.0358	4	41.43	2.586	0.3458
7.6	1.0551	6	63.31	3.952	0.5283
10.1	1.0751	8	86.01	5.369	0.7178
12.7	1.0958	10	109.6	6.841	0.9145
15.2	1.1172	12	134.1	8.369	1.119
17.7	1.1392	14	159.5	9.956	1.331
20.2	1.1618	16	185.9	11.60	1.551
22.7	1.1851	18	213.3	13.32	1.780
25.1	1.2091	20	241.8	15.10	2.018
27.5	1.2339	22	271.5	16.95	2.265
29.9	1.2594	24	302.3	18.87	2.522
32.2	1.2856	26	334.3	20.87	2.789
34.5	1.3125	28	367.5	22.94	3.067
36.8	1.3401	30	402.0	25.10	3.355
42.3	1.4123	35	494.3	30.86	4.125
47.6	1.4893	40	595.7	37.19	4.971

Bé.	Sp. gr.	Per cent $Cr_2(SO_4)_3$ (violet)	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0091	1	10.09	0.6300	0.084
2.7	1.0191	2	20.38	1.272	0.1701
5.5	1.0395	4	41.58	2.596	0.3470
8.3	1.0604	6	63.62	3.972	0.5310
11.0	1.0817	8	86.54	5.402	0.7222
13.6	1.1034	10	110.3	6.888	0.9208
16.2	1.1257	12	135.1	8.433	1.127
18.8	1.1486	14	160.8	10.04	1.342
21.3	1.1722	16	187.6	11.71	1.565
23.8	1.1966	18	215.4	13.45	1.797
26.3	1.2218	20	244.4	15.25	2.039
28.8	1.2479	22	274.5	17.14	2.291
31.3	1.2750	24	306.0	19.10	2.554
33.7	1.3032	26	338.8	21.15	2.828
36.2	1.3325	28	373.1	23.29	3.114

CITRIC ACID

SPECIFIC GRAVITY OF CITRIC ACID SOLUTIONS AT 15° C.
(GERLACH)

Bé.	Sp. gr.	Per cent $C_6H_8O_7 + H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0074	2	20.15	1.258	0.1681
2.1	1.0149	4	40.60	2.534	0.3388
3.2	1.0227	6	61.36	3.831	0.5121
4.3	1.0309	8	82.47	5.148	0.6883
5.5	1.0392	10	103.9	6.487	0.8672
6.5	1.0470	12	125.6	7.843	1.048
7.6	1.0549	14	147.7	9.220	1.232
8.6	1.0632	16	170.1	10.62	1.420
9.7	1.0718	18	192.9	12.04	1.610
10.8	1.0805	20	216.1	13.49	1.803
11.8	1.0889	22	239.6	14.95	1.999
12.8	1.0972	24	263.3	16.44	2.198
13.9	1.1060	26	287.6	17.95	2.400
15.0	1.1152	28	312.3	19.49	2.606
16.0	1.1244	30	337.3	21.06	2.815
17.1	1.1333	32	362.7	22.64	3.026
18.1	1.1422	34	388.3	24.24	3.241
19.1	1.1515	36	414.5	25.88	3.459
20.1	1.1612	38	441.3	27.55	3.682
21.2	1.1709	40	468.4	29.24	3.909
22.3	1.1814	42	496.2	30.98	4.141
23.1	1.1899	44	523.6	32.68	4.369
24.2	1.1998	46	551.9	34.45	4.606
25.2	1.2103	48	580.9	36.27	4.848
26.2	1.2204	50	610.2	38.09	5.092
27.2	1.2307	52	640.0	39.95	5.341
28.2	1.2410	54	670.1	41.83	5.592
29.1	1.2514	56	700.8	43.75	5.848
30.2	1.2627	58	732.4	45.72	6.112
31.2	1.2738	60	764.3	47.71	6.378
32.2	1.2849	62	796.6	49.73	6.648
33.1	1.2960	64	829.4	51.78	6.922
34.1	1.3071	66	862.7	53.85	7.199

COPPER NITRATE

Specific Gravity of Aqueous Cupric Nitrate Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $Cu(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.5	1.032	4	41.28	2.577	0.3445
6.9	1.050	6	63.00	3.933	0.5258
9.4	1.069	8	85.52	5.339	0.7137
11.7	1.088	10	108.8	6.792	0.9080
14.0	1.107	12	132.8	8.293	1.109
16.2	1.126	14	157.6	9.841	1.316
18.6	1.147	16	183.5	11.46	1.532
20.9	1.168	18	210.2	13.12	1.754
23.1	1.189	20	237.8	14.85	1.984
28.8	1.248	25	312.0	19.48	2.604

COPPER SULFATE

Specific Gravity of Aqueous Copper Sulfate Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1	10.09	0.6299	0.0842
2.7	1.019	2	20.38	1.272	0.1701
5.6	1.040	4	41.60	2.597	0.3472
8.5	1.062	6	63.72	3.978	0.5318
11.2	1.084	8	86.72	5.414	0.7237
14.0	1.107	10	110.7	6.911	0.9238
16.8	1.131	12	135.7	8.473	1.133
19.4	1.154	14	161.6	10.09	1.348
22.1	1.180	16	188.8	11.79	1.576
24.8	1.206	18	217.1	13.55	1.812

COPPER SULFATE (Continued)

Specific Gravity of Aqueous Copper Sulfate Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $CuSO_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1.564	15.78	0.9853	0.1317
2.7	1.019	3.129	31.88	1.990	0.2661
5.6	1.040	6.257	65.07	4.062	0.5431
8.5	1.062	9.386	99.68	6.223	0.8318
11.2	1.084	12.51	135.7	8.469	1.132
14.0	1.107	15.64	173.2	10.81	1.445
16.8	1.131	18.77	212.3	13.25	1.772
19.4	1.154	21.90	252.7	15.78	2.110
22.1	1.180	25.03	295.3	18.44	2.465
24.8	1.206	28.16	339.6	21.20	2.834

Specific Gravity of Aqueous Copper Sulfate Solutions at 18° C. (Schiff and Gerlach)

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	0.6393	6.433	0.4016	0.0537
1.8	1.0126	1.279	12.95	0.8082	0.1080
2.7	1.0190	1.918	19.54	1.220	0.1631
3.6	1.0254	2.557	26.22	1.637	0.2188
4.5	1.0319	3.196	32.98	2.059	0.2753
5.4	1.0384	3.836	39.83	2.486	0.3324
6.2	1.0450	4.475	46.76	2.919	0.3902
7.1	1.0516	5.114	53.78	3.357	0.4488
8.0	1.0582	5.753	60.88	3.801	0.5081
8.8	1.0649	6.393	68.08	4.250	0.5681
9.7	1.0716	7.032	75.35	4.704	0.6289
10.6	1.0785	7.671	82.73	5.165	0.6904
11.4	1.0854	8.311	90.20	5.631	0.7528
12.3	1.0923	8.950	97.76	6.103	0.8158
13.1	1.0993	9.589	105.4	6.581	0.8797
13.9	1.1063	10.23	113.2	7.064	0.9443
14.8	1.1135	10.87	121.0	7.554	1.010
15.6	1.1208	11.51	129.0	8.051	1.076
16.5	1.1281	12.15	137.0	8.554	1.143
17.3	1.1354	12.79	145.2	9.062	1.211
18.1	1.1427	13.42	153.4	9.577	1.280
18.9	1.1501	14.06	161.7	10.10	1.350
19.8	1.1585	14.70	170.3	10.63	1.421

COPPER SULFATE (Continued)

SPECIFIC GRAVITY OF AQUEOUS COPPER SULFATE SOLUTIONS AT 19° C. (SCHIFF AND GERLACH)

Bé.	Sp. gr.	Per cent $CuSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
20.6	1.1659	15.34	178.9	11.17	1.493
21.5	1.1738	15.98	187.6	11.71	1.566
22.3	1.1817	16.62	196.4	12.26	1.639
23.1	1.1898	17.26	205.4	12.82	1.714
24.0	1.1980	17.90	214.4	13.39	1.790
24.8	1.2063	18.54	223.6	13.96	1.866
25.6	1.2146	19.18	232.9	14.54	1.944

SPECIFIC GRAVITY OF AQUEOUS COPPER SULFATE SOLUTIONS AT 18° C. (SCHIFF AND GERLACH)

Bé.	Sp. gr.	Per cent $CuSO_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	1	10.06	0.6282	0.0840
1.8	1.0126	2	20.25	1.264	0.1690
2.7	1.0190	3	30.57	1.908	0.2551
3.6	1.0254	4	41.02	2.561	0.3423
4.5	1.0319	5	51.60	3.221	0.4306
5.4	1.0384	6	62.30	3.889	0.5199
6.2	1.0450	7	73.15	4.567	0.6105
7.1	1.0516	8	84.13	5.252	0.7021
8.0	1.0582	9	95.24	5.945	0.7948
8.8	1.0649	10	106.5	6.648	0.8887
9.7	1.0716	11	117.9	7.359	0.9837
10.6	1.0785	12	129.4	8.079	1.080
11.4	1.0854	13	141.1	8.809	1.178
12.3	1.0923	14	152.9	9.546	1.276
13.1	1.0993	15	164.9	10.29	1.376
13.9	1.1063	16	177.0	11.05	1.477
14.8	1.1135	17	189.3	11.82	1.580
15.6	1.1208	18	201.7	12.59	1.684
16.5	1.1281	19	214.3	13.38	1.789
17.3	1.1354	20	227.1	14.18	1.895
18.1	1.1427	21	240.0	14.98	2.003
18.9	1.1501	22	253.0	15.80	2.112
19.8	1.1585	23	266.5	16.63	2.224
20.6	1.1659	24	279.8	17.47	2.335
21.5	1.1738	25	293.5	18.32	2.449
22.3	1.1817	26	307.2	19.18	2.564
23.1	1.1898	27	321.2	20.05	2.681
24.0	1.1980	28	335.4	20.94	2.799
24.8	1.2063	29	349.8	21.84	2.919
25.6	1.2146	30	364.4	22.75	3.041

CUPRIC CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS CUPRIC CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.4	1.017	2	20.34	1.270	0.1697
5.0	1.036	4	41.44	2.587	0.3458
7.7	1.056	6	63.36	3.955	0.5288
10.1	1.075	8	86.00	5.369	0.7177
12.7	1.096	10	109.6	6.842	0.9146
15.2	1.117	12	134.0	8.368	1.119
17.6	1.138	14	159.3	9.946	1.330
20.0	1.160	16	185.6	11.59	1.549
22.3	1.182	18	212.8	13.28	1.776
24.7	1.205	20	241.0	15.04	2.011

SPECIFIC GRAVITY OF AQUEOUS CUPRIC CHLORIDE SOLUTIONS AT 17.5° C. (FRANZ)

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.0091	1	10.09	0.6300	0.0842
2.6	1.0182	2	20.36	1.271	0.1699
3.9	1.0273	3	30.82	1.924	0.2572
5.1	1.0364	4	41.46	2.588	0.3460
6.3	1.0455	5	52.28	3.263	0.4363
7.5	1.0548	6	63.29	3.951	0.5282
8.7	1.0641	7	74.49	4.650	0.6216
9.9	1.0734	8	85.87	5.361	0.7166
11.1	1.0827	9	97.44	6.083	0.8132
12.2	1.0920	10	109.2	6.817	0.9113
13.8	1.1049	11	121.5	7.587	1.014
15.3	1.1178	12	134.1	8.374	1.119
16.8	1.1307	13	147.0	9.176	1.227
18.2	1.1436	14	160.1	9.995	1.336
19.6	1.1565	15	173.5	10.83	1.448
21.0	1.1696	16	187.1	11.68	1.562
22.4	1.1827	17	201.1	12.55	1.678
23.7	1.1958	18	215.2	13.44	1.796
25.1	1.2089	19	229.7	14.34	1.917
26.4	1.2223	20	244.5	15.26	2.040
27.7	1.2362	21	259.6	16.21	2.166
29.0	1.2501	22	275.0	17.17	2.295

CUPRIC CHLORIDE (Continued)

Specific Gravity of Aqueous Cupric Chloride Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent $CuCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
30.3	1.2640	23	290.7	18.15	2.426
31.5	1.2779	24	306.7	19.15	2.559
32.8	1.2918	25	323.0	20.16	2.695
34.0	1.3058	26	339.5	21.19	2.833
35.1	1.3198	27	356.3	22.25	2.974
36.3	1.3338	28	373.4	23.31	3.117
37.4	1.3478	29	390.9	24.40	3.262
38.5	1.3618	30	408.5	25.50	3.409
39.8	1.3784	31	427.3	26.68	3.566
41.1	1.3950	32	446.4	27.87	3.725
42.3	1.4116	33	465.8	29.08	3.887
43.5	1.4287	34	485.8	30.32	4.054
44.6	1.4447	35	505.6	31.57	4.220
45.8	1.4615	36	526.1	32.85	4.391
46.9	1.4782	37	546.9	34.14	4.564
48.0	1.4949	38	568.1	35.46	4.741
49.1	1.5116	39	589.5	36.80	4.920
50.1	1.5284	40	611.4	38.17	5.102

FERRIC CHLORIDE

Specific Gravity of Aqueous Ferric Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $FeCl_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.5	1.032	4	41.28	2.577	0.3445
6.8	1.049	6	62.94	3.929	0.5253
9.1	1.067	8	85.36	5.329	0.7124
11.4	1.085	10	108.5	6.773	0.9055
13.7	1.104	12	132.5	8.270	1.106
15.9	1.123	14	157.2	9.815	1.312
18.0	1.142	16	182.7	11.41	1.525
20.2	1.162	18	209.2	13.06	1.745
22.3	1.182	20	236.4	14.76	1.973
27.5	1.234	25	308.5	19.26	2.574
32.7	1.291	30	387.3	24.18	3.232
37.8	1.353	35	473.6	29.56	3.952
42.7	1.418	40	567.2	35.41	4.733
47.4	1.485	45	668.3	41.72	5.577
51.5	1.551	50	775.5	48.41	6.472

FERRIC CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS FERRIC CHLORIDE SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.

Sp. gr.	Per cent $FeCl_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.010	1.164	11.76	0.7339	0.0981
1.020	2.329	23.76	1.483	0.1982
1.030	3.493	35.98	2.246	0.3002
1.040	4.658	48.44	3.024	0.4043
1.050	5.822	61.13	3.816	0.5102
1.060	6.987	74.06	4.623	0.6181
1.070	8.151	87.22	5.445	0.7278
1.080	9.316	100.6	6.281	0.8396
1.090	10.403	113.4	7.079	0.9463
1.100	11.441	125.9	7.856	1.050
1.110	12.478	138.5	8.646	1.156
1.120	13.516	151.4	9.450	1.263
1.130	14.554	164.5	10.27	1.372
1.140	15.592	177.7	11.10	1.483
1.150	16.629	191.2	11.94	1.596
1.160	17.651	204.8	12.78	1.709
1.170	18.606	217.7	13.59	1.817
1.180	19.561	230.8	14.41	1.926
1.190	20.515	244.1	15.24	2.037
1.200	21.470	257.6	16.08	2.150
1.210	22.424	271.3	16.94	2.264
1.220	23.379	285.2	17.81	2.380
1.230	24.334	299.3	18.68	2.498
1.240	25.257	313.2	19.55	2.614
1.250	26.146	326.8	20.40	2.727
1.260	27.036	340.7	21.27	2.843
1.270	27.925	354.6	22.14	2.960
1.280	28.777	368.3	22.99	3.074
1.290	29.611	382.0	23.85	3.188
1.300	30.446	395.8	24.71	3.303
1.310	31.280	409.8	25.58	3.420
1.320	32.114	423.9	26.46	3.538
1.330	32.948	438.2	27.36	3.657
1.340	33.710	451.7	28.20	3.770
1.350	34.472	465.4	29.05	3.884

FERRIC CHLORIDE (Continued)

Specific Gravity of Aqueous Ferric Chloride Solutions at $\frac{20^\circ}{4^\circ}$ C.

Sp. gr.	Per cent $FeCl_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.360	35.234	479.2	29.91	3.999
1.370	35.997	493.2	30.79	4.116
1.380	36.759	507.3	31.67	4.233
1.390	37.521	521.5	32.56	4.352
1.400	38.283	536.0	33.46	4.473
1.410	39.046	550.5	34.37	4.594
1.420	39.808	565.3	35.29	4.717
1.430	40.570	580.2	36.22	4.841
1.440	41.332	595.2	37.16	4.967
1.450	42.095	610.4	38.10	5.094
1.460	42.857	625.7	39.06	5.222
1.470	43.619	641.2	40.03	5.351
1.480	44.381	656.8	41.00	5.481
1.490	45.144	672.6	41.99	5.613
1.500	45.906	688.6	42.99	5.746

FERRIC NITRATE

Specific Gravity of Aqueous Ferric Nitrate Solutions at $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1	10.07	0.6283	0.0840
2.1	1.0144	2	20.29	1.267	0.1693
4.3	1.0304	4	41.22	2.573	0.3440
6.5	1.0468	6	62.81	3.921	0.5242
8.7	1.0636	8	85.09	5.312	0.7101
10.9	1.0810	10	108.1	6.748	0.9021
13.1	1.0989	12	131.9	8.232	1.101
15.2	1.1172	14	156.4	9.764	1.305
17.3	1.1359	16	181.7	11.35	1.517
19.5	1.1551	18	207.9	12.98	1.735
21.6	1.1748	20	235.0	14.67	1.961
26.9	1.2281	25	307.0	19.17	2.562

FERRIC NITRATE

Specific Gravity of Aqueous Ferric Nitrate Solutions at 17.5° C. (Franz)

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0080	1	10.08	0.6293	0.0841
2.3	1.0160	2	20.32	1.269	0.1696
3.4	1.0240	3	30.72	1.918	0.2564
4.5	1.0320	4	41.28	2.577	0.3445
5.6	1.0398	5	51.99	3.246	0.4339
6.5	1.0472	6	62.83	3.922	0.5244
7.5	1.0546	7	73.82	4.608	0.6161
8.5	1.0620	8	84.96	5.304	0.7090
9.4	1.0694	9	96.25	6.008	0.8032
10.4	1.0770	10	107.7	6.723	0.8988
11.4	1.0852	11	119.4	7.452	0.9962
12.4	1.0934	12	131.2	8.191	1.095
13.4	1.1016	13	143.2	8.940	1.195
14.3	1.1098	14	155.4	9.699	1.297
15.3	1.1182	15	167.7	10.47	1.400
16.3	1.1268	16	180.3	11.25	1.505
17.3	1.1354	17	193.0	12.05	1.611
18.3	1.1440	18	205.9	12.85	1.718
19.2	1.1526	19	219.0	13.67	1.828
20.1	1.1612	20	232.2	14.50	1.938
21.2	1.1712	21	246.0	15.35	2.053
22.2	1.1812	22	259.9	16.22	2.169
23 3	1.1912	23	274.0	17.10	2.286
24.3	1.2012	24	288.3	18.00	2.406
25.3	1.2110	25	302.8	18.90	2.527
26.3	1.2212	26	317.5	19.82	2.650
27.3	1.2314	27	332.5	20.76	2.775
28.2	1.2416	28	347.6	21.70	2.901
29.2	1.2518	29	363.0	22.66	3.029
30.1	1.2622	30	378.7	23.64	3.160
31.1	1.2730	31	394.6	24.64	3.293
32.1	1.2838	32	410.8	25.65	3.428
33.0	1.2946	33	427.2	26.67	3.565
33.9	1.3054	34	443.8	27.71	3.704
34.9	1.3164	35	460.7	28.76	3.845
35.8	1.3280	36	478.1	29.85	3.990
36.8	1.3396	37	495.7	30.94	4.136
37.7	1.3512	38	513.5	32.05	4.285
38.6	1.3628	39	531.5	33.18	4.435
39.5	1.3746	40	549.8	34.32	4.589
40.4	1.3864	41	568.4	35.49	4.744
41.3	1.3982	42	587.2	36.66	4.901

FERRIC NITRATE (Continued)

SPECIFIC GRAVITY OF AQUEOUS FERRIC NITRATE SOLUTIONS AT 17.5° C. (FRANZ)

Bé.	Sp. gr.	Per cent $Fe(NO_3)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
42.2	1.4100	43	606.3	37.85	5.060
43.0	1.4218	44	625.6	39.05	5.221
43.9	1.4338	45	645.2	40.28	5.384
44.8	1.4465	46	665.4	41.54	5.553
45.6	1.4592	47	685.8	42.81	5.723
46.5	1.4719	48	706.5	44.11	5.896
47.3	1.4846	49	727.5	45.41	6.071
48.2	1.4972	50	748.6	46.73	6.247
49.1	1.5122	51	771.2	48.15	6.436
50.1	1.5272	52	794.1	49.58	6.627
51.0	1.5422	53	817.4	51.03	6.821
51.9	1.5572	54	840.9	52.49	7.017
52.8	1.5722	55	864.7	53.98	7.216
53.8	1.5892	56	890.0	55.56	7.427
54.7	1.6062	57	915.5	57.15	7.640
55.7	1.6232	58	941.5	58.77	7.857
56.6	1.6402	59	967.7	60.41	8.076
57.5	1.6572	60	994.3	62.07	8.298
58.5	1.6764	61	1023	63.84	8.534
59.5	1.6956	62	1051	65.63	8.773
60.4	1.7148	63	1080	67.44	9.016
61.4	1.7340	64	1110	69.28	9.261
62.3	1.7532	65	1140	71.14	9.510

FERRIC SULFATE

SPECIFIC GRAVITY OF AQUEOUS FERRIC SULFATE SOLUTIONS AT $\frac{17.5°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Fe_2(SO_4)_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.7	1.033	4	41.32	2.579	0.3448
6.9	1.050	6	63.00	3.933	0.5258
9.1	1.067	8	85.36	5.329	0.7124
11.2	1.084	10	108.4	6.767	0.9046
13.5	1.103	12	132.4	8.263	1.105
15.8	1.122	14	157.1	9.806	1.311
17.9	1.141	16	182.6	11.40	1.524
20.1	1.161	18	209.0	13.05	1.744
22.2	1.181	20	236.2	14.75	1.971
28.2	1.241	25	310.3	19.37	2.590
34.1	1.307	30	392.1	24.48	3.272
39.6	1.376	35	481.6	30.06	4.019
44.9	1.449	40	579.6	36.18	4.837
50.1	1.528	45	687.6	42.92	5.738
55.1	1.613	50	806.5	50.35	6.730
59.9	1.703	55	936.7	58.47	7.817
64.4	1.798	60	1079	67.35	9.003

FERROUS SULFATE

SPECIFIC GRAVITY OF AQUEOUS FERROUS SULFATE SOLUTIONS AT $\frac{18°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $FeSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.1	1.0007	0.2	2.001	0.1249	0.0167
0.4	1.0028	0.4	4.011	0.2504	0.0335
0.7	1.0046	0.6	6.028	0.3763	0.0503
0.9	1.0065	0.8	8.052	0.5027	0.0672
1.2	1.0085	1.0	10.09	0.6296	0.0842
2.6	1.0180	2	20.36	1.271	0.1699
5.2	1.0375	4	41.50	2.591	0.3463
7.9	1.0575	6	63.45	3.961	0.5295
10.6	1.0785	8	86.28	5.386	0.7200
13.2	1.1000	10	110.0	6.867	0.9180
15.8	1.1220	12	134.6	8.405	1.124
18.3	1.1445	14	160.2	10.00	1.337
20.8	1.1675	16	186.8	11.66	1.559
23.2	1.1905	18	214.3	13.38	1.788
25.5	1.2135	20	242.7	15.15	2.025

Bé.	Sp. gr.	Per cent $FeSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.1	1.0007	0.366	3.663	0.2287	0.0306
0.4	1.0028	0.732	7.341	0.4583	0.0613
0.7	1.0046	1.10	11.03	0.6887	0.0921
0.9	1.0065	1.46	14.74	0.9200	0.1230
1.2	1.0085	1.83	18.46	1.152	0.1540
2.6	1.0180	3.66	37.26	2.326	0.3110
5.2	1.0375	7.32	75.95	4.742	0.6339
7.9	1.0575	11.0	116.1	7.249	0.9691
10.6	1.0785	14.6	157.9	9.858	1.318
13.2	1.1000	18.3	201.3	12.57	1.680
15.8	1.1220	22.0	246.4	15.38	2.056
18.3	1.1445	25.6	293.3	18.31	2.447
20.8	1.1675	29.3	341.9	21.34	2.853
23.2	1.1905	32.9	392.2	24.48	3.273
25.5	1.2135	36.6	444.2	27.73	3.707

FORMIC ACID

SPECIFIC GRAVITY OF AQUEOUS FORMIC ACID SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent HCO_2H	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
....	0.9982	0	......	......	......
0.3	1.0019	1	10.02	0.6255	0.0836
0.6	1.0044	2	20.09	1.254	0.1676
1.0	1.0070	3	30.21	1.886	0.2521
1.3	1.0093	4	40.37	2.520	0.3369
1.6	1.0115	5	50.58	3.157	0.4221
2.0	1.0141	6	60.85	3.798	0.5078
2.4	1.0170	7	71.19	4.444	0.5941
2.8	1.0196	8	81.57	5.092	0.6807
3.1	1.0221	9	91.99	5.743	0.7677
3.5	1.0246	10	102.5	6.396	0.8551
3.8	1.0271	11	113.0	7.053	0.9429
4.2	1.0296	12	123.6	7.713	1.031
4.5	1.0321	13	134.2	8.376	1.120
4.8	1.0345	14	144.8	9.041	1.209
5.2	1.0370	15	155.6	9.711	1.298
5.5	1.0393	16	166.3	10.38	1.388
5.8	1.0417	17	177.1	11.06	1.478
6.1	1.0441	18	187.9	11.73	1.568
6.4	1.0464	19	198.8	12.41	1.659
6.8	1.0488	20	209.8	13.09	1.750
7.1	1.0512	21	220.8	13.78	1.842
7.4	1.0537	22	231.8	14.47	1.935
7.7	1.0561	23	242.9	15.16	2.027
8.0	1.0585	24	254.0	15.86	2.120
8.3	1.0609	25	265.2	16.56	2.213
8.6	1.0633	26	276.5	17.26	2.307
8.9	1.0656	27	287.7	17.96	2.401
9.3	1.0681	28	299.1	18.67	2.496
9.6	1.0705	29	310.4	19.38	2.591
9.9	1.0729	30	321.9	20.09	2.686
10.2	1.0753	31	333.3	20.81	2.782
10.5	1.0777	32	344.9	21.53	2.878
10.7	1.0800	33	356.4	22.25	2.974
11.0	1.0823	34	368.0	22.97	3.071
11.3	1.0847	35	379.6	23.70	3.168
11.6	1.0871	36	391.4	24.43	3.266
11.9	1.0895	37	403.1	25.17	3.364
12.2	1.0919	38	414.9	25.90	3.463
12.5	1.0940	39	426.7	26.64	3.561
12.7	1.0963	40	438.5	27.38	3.660
13.1	1.0990	41	450.6	28.13	3.760
13.4	1.1015	42	462.6	28.88	3.861
13.6	1.1038	43	474.6	29.63	3.961
13.9	1.1062	44	486.7	30.38	4.062
14.2	1.1085	45	498.8	31.14	4.163
14.5	1.1108	46	511.0	31.90	4.264
14.7	1.1130	47	523.1	32.66	4.365
15.0	1.1157	48	535.5	33.43	4.469
15.4	1.1185	49	548.1	34.21	4.574
15.6	1.1207	50	560.4	34.98	4.676
15.8	1.1223	51	572.4	35.73	4.777
16.0	1.1244	52	584.7	36.50	4.879
16.3	1.1269	53	597.3	37.28	4.984
16.6	1.1295	54	609.9	38.08	5.090

FORMIC ACID (Continued)

Specific Gravity of Aqueous Formic Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCO_2H	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
16.9	1.1320	55	622.6	38.87	5.196
17.2	1.1342	56	635.2	39.65	5.300
17.4	1.1361	57	647.6	40.43	5.404
17.6	1.1381	58	660.1	41.21	5.509
17.8	1.1401	59	672.7	41.99	5.613
18.1	1.1424	60	685.4	42.79	5.720
18.3	1.1448	61	698.3	43.59	5.828
18.6	1.1473	62	711.3	44.41	5.936
18.8	1.1493	63	724.1	45.20	6.042
19.1	1.1517	64	737.1	46.01	6.151
19.4	1.1543	65	750.3	46.84	6.261
19.6	1.1565	66	763.3	47.65	6.370
19.8	1.1584	67	776.1	48.45	6.477
20.0	1.1604	68	789.1	49.26	6.585
20.3	1.1628	69	802.3	50.09	6.696
20.6	1.1655	70	815.9	50.93	6.808
20.8	1.1677	71	829.1	51.76	6.919
21.1	1.1702	72	842.5	52.60	7.031
21.4	1.1728	73	856.1	53.45	7.145
21.6	1.1752	74	869.6	54.29	7.257
21.8	1.1769	75	882.7	55.10	7.366
22.0	1.1785	76	895.7	55.91	7.474
22.1	1.1801	77	908.7	56.73	7.583
22.3	1.1818	78	921.8	57.55	7.693
22.5	1.1837	79	935.1	58.38	7.804
22.7	1.1860	80	948.8	59.23	7.918
22.9	1.1876	81	962.0	60.05	8.028
23.1	1.1896	82	975.5	60.90	8.141
23.3	1.1914	83	988.9	61.73	8.252
23.5	1.1929	84	1002	62.55	8.362
23.7	1.1953	85	1016	63.43	8.479
23.9	1.1976	86	1030	64.30	8.595
24.1	1.1994	87	1043	65.14	8.708
24.3	1.2012	88	1057	65.99	8.821
24.5	1.2028	89	1070	66.83	8.933
24.6	1.2044	90	1084	67.67	9.046
24.8	1.2059	91	1097	68.51	9.158
25.0	1.2078	92	1111	69.37	9.273
25.2	1.2099	93	1125	70.24	9.390
25.3	1.2117	94	1139	71.10	9.505
25.6	1.2140	95	1153	72.00	9.625
25.7	1.2158	96	1167	72.86	9.740
25.9	1.2170	97	1180	73.69	9.851
26.0	1.2183	98	1194	74.53	9.964
26.2	1.2202	99	1208	75.41	10.08
26.3	1.2212	100	1221	76.24	10.19

GLYCEROL

SPECIFIC GRAVITY OF AQUEOUS GLYCEROL (GLYCERIN) SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $C_3H_8O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
....	0.9982	0	....	....	....
0.1	1.0006	1	10.01	0.6246	0.0835
0.4	1.0030	2	20.06	1.252	0.1674
0.8	1.0053	3	30.16	1.883	0.2517
1.1	1.0077	4	40.31	2.516	0.3364
1.5	1.0101	5	50.51	3.153	0.4215
1.8	1.0125	6	60.75	3.792	0.5070
2.1	1.0149	7	71.04	4.435	0.5929
2.5	1.0173	8	81.38	5.081	0.6792
2.8	1.0197	9	91.77	5.729	0.7659
3.1	1.0221	10	102.2	6.381	0.8530
3.5	1.0246	11	112.7	7.036	0.9406
3.8	1.0271	12	123.3	7.694	1.029
4.1	1.0295	13	133.8	8.355	1.117
4.5	1.0320	14	144.5	9.019	1.206
4.8	1.0345	15	155.2	9.687	1.295
5.2	1.0370	16	165.9	10.36	1.385
5.5	1.0395	17	176.7	11.03	1.475
5.8	1.0420	18	187.6	11.71	1.565
6.2	1.0445	19	198.5	12.39	1.656
6.5	1.0470	20	209.4	13.07	1.747
6.8	1.0495	21	220.4	13.76	1.839
7.2	1.0520	22	231.4	14.45	1.931
7.5	1.0545	23	242.5	15.14	2.024
7.8	1.0571	24	253.7	15.84	2.117
8.2	1.0597	25	264.9	16.54	2.211
8.5	1.0622	26	276.2	17.24	2.305
8.8	1.0648	27	287.5	17.95	2.399
9.2	1.0674	28	298.9	18.66	2.494
9.5	1.0700	29	310.3	19.37	2.590
9.8	1.0727	30	321.8	20.09	2.686
10.2	1.0753	31	333.3	20.81	2.782
10.5	1.0780	32	345.0	21.53	2.879
10.8	1.0806	33	356.6	22.26	2.976
11.2	1.0833	34	368.3	22.99	3.074
11.5	1.0860	35	380.1	23.73	3.172
11.8	1.0887	36	391.9	24.47	3.271
12.1	1.0914	37	403.8	25.21	3.370
12.5	1.0941	38	415.8	25.95	3.470
12.8	1.0968	39	427.8	26.70	3.570
13.1	1.0995	40	439.8	27.46	3.670
13.4	1.1022	41	451.9	28.21	3.771
13.8	1.1049	42	464.1	28.97	3.873
14.1	1.1075	43	476.2	29.73	3.974
14.4	1.1102	44	488.5	30.49	4.077
14.7	1.1128	45	500.8	31.26	4.179
15.0	1.1155	46	513.1	32.03	4.282
15.3	1.1182	47	525.6	32.81	4.386
15.6	1.1209	48	538.0	33.59	4.490
16.0	1.1236	49	550.6	34.37	4.595
16.3	1.1263	50	563.2	35.16	4.700
16.6	1.1290	51	575.8	35.94	4.805
16.9	1.1317	52	588.5	36.74	4.911
17.2	1.1344	53	601.2	37.53	5.017
17.5	1.1371	54	614.0	38.33	5.124

GLYCEROL (Continued)

SPECIFIC GRAVITY OF AQUEOUS GLYCEROL (GLYCERIN) SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $C_3H_8O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
17.8	1.1398	55	626.9	39.13	5.232
18.1	1.1425	56	639.8	39.94	5.339
18.4	1.1452	57	652.8	40.75	5.447
18.7	1.1479	58	665.8	41.56	5.550
19.0	1.1506	59	678.9	42.38	5.665
19.3	1.1533	60	692.0	43.20	5.775
19.6	1.1560	61	705.2	44.02	5.885
19.9	1.1587	62	718.4	44.85	5.995
20.2	1.1614	63	731.7	45.68	6.106
20.5	1.1642	64	745.1	46.51	6.218
20.8	1.1670	65	758.6	47.35	6.330
21.0	1.1697	66	772.0	48.19	6.443
21.3	1.1724	67	785.5	49.04	6.555
21.6	1.1752	68	799.1	49.89	6.669
21.9	1.1780	69	812.8	50.74	6.783
22.2	1.1808	70	826.6	51.60	6.898
22.5	1.1836	71	840.4	52.46	7.013
22.8	1.1863	72	854.1	53.32	7.128
23.1	1.1890	73	868.0	54.18	7.243
23.3	1.1917	74	881.9	55.05	7.359
23.6	1.1944	75	895.8	55.92	7.476
23.9	1.1971	76	909.8	56.80	7.592
24.2	1.1998	77	923.8	57.67	7.710
24.4	1.2025	78	938.0	58.55	7.827
24.7	1.2052	79	952.1	59.44	7.945
25.0	1.2079	80	966.3	60.32	8.064
25.2	1.2106	81	980.6	61.22	8.183
25.5	1.2133	82	994.9	62.11	8.303
25.8	1.2160	83	1009	63.01	8.423
26.0	1.2187	84	1024	63.91	8.543
26.3	1.2214	85	1038	64.81	8.664
26.5	1.2241	86	1053	65.72	8.785
26.8	1.2268	87	1067	66.63	8.907
27.1	1.2294	88	1082	67.54	9.028
27.3	1.2320	89	1096	68.45	9.150
27.6	1.2347	90	1111	69.37	9.273
27.8	1.2374	91	1126	70.29	9.397
28.1	1.2401	92	1141	71.22	9.521
28.3	1.2428	93	1156	72.15	9.645
28.6	1.2455	94	1171	73.09	9.770
28.8	1.2482	95	1186	74.03	9.896
29.1	1.2508	96	1201	74.96	10.02
29.3	1.2534	97	1216	75.90	10.15
29.5	1.2559	98	1231	76.83	10.27
29.8	1.2584	99	1246	77.77	10.40
30.0	1.2609	100	1261	78.71	10.52

HYDROCHLORIC ACID

Specific Gravity of Aqueous Hydrochloric Acid Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0032	1	10.03	0.6263	0.0837
1.2	1.0082	2	20.16	1.259	0.1683
2.6	1.0181	4	40.72	2.542	0.3399
3.9	1.0279	6	61.67	3.850	0.5147
5.3	1.0376	8	83.01	5.182	0.6927
6.6	1.0474	10	104.7	6.539	0.8741
7.9	1.0574	12	126.9	7.921	1.059
9.2	1.0675	14	149.5	9.330	1.247
10.4	1.0776	16	172.4	10.76	1.439
11.7	1.0878	18	195.8	12.22	1.634
12.9	1.0980	20	219.6	13.71	1.833
14.2	1.1083	22	243.8	15.22	2.035
15.4	1.1187	24	268.5	16.76	2.241
16.6	1.1290	26	293.5	18.32	2.450
17.7	1.1392	28	319.0	19.91	2.662
18.8	1.1493	30	344.8	21.52	2.877
19.9	1.1593	32	371.0	23.16	3.096
21.0	1.1691	34	397.5	24.81	3.317
22.0	1.1789	36	424.4	26.49	3.542
23.0	1.1885	38	451.6	28.19	3.769
24.0	1.1980	40	479.2	29.92	3.999

HYDROCHLORIC ACID

Authority—W. C. Ferguson

This table has been approved and adopted as a standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

Baumé Hydrometers for use with this table must be graduated by the above formula which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

10° – 15° Bé.—1/40° Bé. or .0002 Sp. Gr. for 1° F.
15° – 22° Bé.—1/30° Bé. or .0003 " " " 1° F.
22° – 25° Bé.—1/28° Bé. or .00035 " " " 1° F.

Bé.°	Sp. gr.	Tw.°	Per cent HCl	Bé.°	Sp. gr.	Tw.°	Per cent HCl
1.00	1.0069	1.38	1.40	10.25	1.0761	15.22	15.22
2.00	1.0140	2.80	2.82	10.50	1.0781	15.62	15.62
3.00	1.0211	4.22	4.25	10.75	1.0801	16.02	16.01
4.00	1.0284	5.68	5.69	11.00	1.0821	16.42	16.41
5.00	1.0357	7.14	7.15	11.25	1.0841	16.82	16.81
5.25	1.0375	7.50	7.52	11.50	1.0861	17.22	17.21
5.50	1.0394	7.88	7.89	11.75	1.0881	17.62	17.61
5.75	1.0413	8.26	8.26	12.00	1.0902	18.04	18.01
6.00	1.0432	8.64	8.64	12.25	1.0922	18.44	18.41
6.25	1.0450	9.00	9.02	12.50	1.0943	18.86	18.82
6.50	1.0469	9.38	9.40	12.75	1.0964	19.28	19.22
6.75	1.0488	9.76	9.78	13.00	1.0985	19.70	19.63
7.00	1.0507	10.14	10.17	13.25	1.1006	20.12	20.04
7.25	1.0526	10.52	10.55	13.50	1.1027	20.54	20.45
7.50	1.0545	10.90	10.94	13.75	1.1048	20.96	20.86
7.75	1.0564	11.28	11.32	14.00	1.1069	21.38	21.27
8.00	1.0584	11.68	11.71	14.25	1.1090	21.80	21.68
8.25	1.0603	12.06	12.09	14.50	1.1111	22.22	22.09
8.50	1.0623	12.46	12.48	14.75	1.1132	22.64	22.50
8.75	1.0642	12.84	12.87	15.00	1.1154	23.08	22.92
9.00	1.0662	13.24	13.26	15.25	1.1176	23.52	23.33
9.25	1.0681	13.62	13.65	15.50	1.1197	23.94	23.75
9.50	1.0701	14.02	14.04	15.75	1.1219	24.38	24.16
9.75	1.0721	14.42	14.43	16.0	1.1240	24.80	24.57
10.00	1.0741	14.82	14.83	16.1	1.1248	24.96	24.73

HYDROCHLORIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HCl	Bé.°	Sp. gr.	Tw.°	Per cent HCl
16.2	1.1256	25.12	24.90	20.9	1.1684	33.68	33.12
16.3	1.1265	25.30	25.06	21.0	1.1694	33.88	33.31
16.4	1.1274	25.48	25.23	21.1	1.1703	34.06	33.50
16.5	1.1283	25.66	25.39	21.2	1.1713	34.26	33.69
16.6	1.1292	25.84	25.56	21.3	1.1722	34.44	33.88
16.7	1.1301	26.02	25.72	21.4	1.1732	34.64	34.07
16.8	1.1310	26.20	25.89	21.5	1.1741	34.82	34.26
16.9	1.1319	26.38	26.05	21.6	1.1751	35.02	34.45
17.0	1.1328	26.56	26.22	21.7	1.1760	35.20	34.64
17.1	1.1336	26.72	26.39	21.8	1.1770	35.40	34.83
17.2	1.1345	26.90	26.56	21.9	1.1779	35.58	35.02
17.3	1.1354	27.08	26.73	22.0	1.1789	35.78	35.21
17.4	1.1363	27.26	26.90	22.1	1.1798	35.96	35.40
17.5	1.1372	27.44	27.07	22.2	1.1808	36.16	35.59
17.6	1.1381	27.62	27.24	22.3	1.1817	36.34	35.78
17.7	1.1390	27.80	27.41	22.4	1.1827	36.54	35.97
17.8	1.1399	27.98	27.58	22.5	1.1836	36.72	36.16
17.9	1.1408	28.16	27.75	22.6	1.1846	36.92	36.35
18.0	1.1417	28.34	27.92	22.7	1.1856	37.12	36.54
18.1	1.1426	28.52	28.09	22.8	1.1866	37.32	36.73
18.2	1.1435	28.70	28.26	22.9	1.1875	37.50	36.93
18.3	1.1444	28.88	28.44	23.0	1.1885	37.70	37.14
18.4	1.1453	29.06	28.61	23.1	1.1895	37.90	37.36
18.5	1.1462	29.24	28.78	23.2	1.1904	38.08	37.58
18.6	1.1471	29.42	28.95	23.3	1.1914	38.28	37.80
18.7	1.1480	29.60	29.13	23.4	1.1924	38.48	38.03
18.8	1.1489	29.78	29.30	23.5	1.1934	38.68	38.26
18.9	1.1498	29.96	29.48	23.6	1.1944	38.88	38.49
19.0	1.1508	30.16	29.65	23.7	1.1953	39.06	38.72
19.1	1.1517	30.34	29.83	23.8	1.1963	39.26	38.95
19.2	1.1526	30.52	30.00	23.9	1.1973	39.46	39.18
19.3	1.1535	30.70	30.18	24.0	1.1983	39.66	39.41
19.4	1.1544	30.88	30.35	24.1	1.1993	39.86	39.64
19.5	1.1554	31.08	30.53	24.2	1.2003	40.06	39.86
19.6	1.1563	31.26	30.71	24.3	1.2013	40.26	40.09
19.7	1.1572	31.44	30.90	24.4	1.2023	40.46	40.32
19.8	1.1581	31.62	31.08	24.5	1.2033	40.66	40.55
19.9	1.1590	31.80	31.27	24.6	1.2043	40.86	40.78
20.0	1.1600	32.00	31.45	24.7	1.2053	41.06	41.01
20.1	1.1609	32.18	31.64	24.8	1.2063	41.26	41.24
20.2	1.1619	32.38	31.82	24.9	1.2073	41.46	41.48
20.3	1.1628	32.56	32.01	25.0	1.2083	41.66	41.72
20.4	1.1637	32.74	32.19	25.1	1.2093	41.86	41.99
20.5	1.1647	32.94	32.38	25.2	1.2103	42.06	42.30
20.6	1.1656	33.12	32.56	25.3	1.2114	42.28	42.64
20.7	1.1666	33.32	32.75	25.4	1.2124	42.48	43.01
20.8	1.1675	33.50	32.93	25.5	1.2134	42.68	43.40

SPECIFIC GRAVITY OF AQUEOUS HYDROCYANIC ACID SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HCN	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
54.4	0.759	80	607.2	37.91	5.067
56.2	0.752	82	616.6	38.49	5.146
57.9	0.745	84	625.8	39.07	5.222
59.7	0.738	86	634.7	39.62	5.297
61.5	0.731	88	643.3	40.16	5.368
63.4	0.724	90	651.6	40.68	5.438
65.3	0.717	92	659.6	41.18	5.505
66.9	0.711	94	668.3	41.72	5.577
68.9	0.704	96	675.8	42.19	5.640
70.9	0.697	98	683.1	42.64	5.700
72.6	0.691	100	691.0	43.14	5.767

SPECIFIC GRAVITY OF AQUEOUS HYDROCYANIC ACID SOLUTIONS AT $\frac{15°}{4°}$ C.

Bé.	Sp. gr.	Per cent HCN	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
10.3	0.998	1	9.98	0.6230	0.0833
10.6	0.996	2	19.92	1.244	0.1662
11.0	0.993	4	39.72	2.480	0.3315
11.4	0.989	6	59.34	3.704	0.4952
12.3	0.984	8	78.72	4.914	0.6569
13.2	0.978	10	97.80	6.105	0.8162
14.2	0.971	12	116.5	7.274	0.9724
15.2	0.964	14	135.0	8.425	1.126
16.4	0.956	16	153.0	9.549	1.276

HYDROFLUORIC ACID

Specific Gravity of Aqueous Hydrofluoric Acid Solution at $\frac{0^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent HF	Grams per liter	Lbs. per cu. ft.	Lbs. per gal.
2.8	1.020	5	51.00	3.184	0.4256
5.6	1.040	10	104.0	6.492	0.8679
8.2	1.060	15	159.0	9.926	1.327
10.7	1.080	20	216.0	13.48	1.803
13.1	1.099	25	274.8	17.15	2.293
15.4	1.119	30	335.7	20.96	2.801
17.7	1.139	35	398.7	24.89	3.327
19.9	1.159	40	463.6	28.94	3.869
21.9	1.178	45	530.1	33.09	4.424
24.0	1.198	50	599.0	37.39	4.999
25.9	1.217	55	669.4	41.78	5.586
27.6	1.235	60	741.0	46.26	6 184
28.8	1.248	65	811.2	50.64	6.770
29.7	1.258	70	880.6	54.97	7.349
30.0	1.261	72	907.9	56.68	7.577
30.1	1.262	74	933.9	58.30	7.793
30.1	1.262	76	959.1	59.87	8.004
30.0	1.261	78	983.6	61.40	8.208
29.8	1.259	80	1007	62.88	8.405
29.5	1.255	82	1029	64.24	8.588
28.6	1.246	84	1047	65.34	8.734
27.4	1.233	86	1060	66.20	8.849
25.5	1.213	88	1067	66.64	8.908
21.9	1.178	90	1060	66.18	8.848
11.9	1.089	95	1035	64.58	8.633
0.07	1.0005	100	1001	62.46	8.349

Specific Gravity of Aqueous Hydrofluoric Acid Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent HF	Grams per liter	Lbs. per cu. ft.	Lbs. per gal.
2.4	1.017	5	50.85	3.174	0.4244
4.9	1.035	10	103.5	6.461	0.8637
7.3	1.053	15	158.0	9.860	1.318
9.5	1.070	20	214.0	13.36	1.786
11.5	1.086	25	271.5	16.95	2.266
13.3	1.101	30	330.3	20.62	2.756
15.1	1.116	35	390.6	24.38	3.260
16.7	1.130	40	452.0	28.22	3.772
18.1	1.143	45	514.4	32.11	4.292
19.5	1.155	50	577.5	36.05	4.819

HYDROFLUOSILICIC ACID

SPECIFIC GRAVITY OF AQUEOUS HYDROFLUOSILICIC ACID SOLUTIONS AT 17.5° C. (STOLBA)

Bé.	Sp. gr.	Per cent H_2SiF_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0040	0.5	5.020	0.3134	0.0419
1.2	1.0080	1.0	10.08	0.6293	0.0841
1.7	1.0120	1.5	15.18	0.9476	0.1267
2.3	1.0161	2.0	20.32	1.269	0.1696
2.9	1.0201	2.5	25.50	1.592	0.2128
3.4	1.0242	3.0	30.73	1.918	0.2564
4.0	1.0283	3.5	35.99	2.247	0.3004
4.6	1.0324	4.0	41.30	2.578	0.3446
5.1	1.0366	4.5	46.65	2.912	0.3893
5.7	1.0407	5.0	52.04	3.248	0.4342
6.2	1.0449	5.5	57.47	3.588	0.4796
6.8	1.0491	6.0	62.95	3.930	0.5253
7.3	1.0533	6.5	68.46	4.274	0.5714
7.9	1.0576	7.0	74.03	4.622	0.6178
8.4	1.0618	7.5	79.64	4.971	0.6646
9.0	1.0661	8.0	85.29	5.324	0.7118
9.5	1.0704	8.5	90.98	5.680	0.7593
10.1	1.0747	9.0	96.72	6.038	0.8072
10.6	1.0791	9.5	102.5	6.400	0.8555
11.2	1.0834	10.0	108.3	6.763	0.9041
11.7	1.0878	10.5	114.2	7.130	0.9532
12.2	1.0922	11.0	120.1	7.500	1.003
12.8	1.0966	11.5	126.1	7.873	1.052
13.3	1.1011	12.0	132.1	8.249	1.103
13.8	1.1055	12.5	138.2	8.627	1.153
14.4	1.1100	13.0	144.3	9.008	1.204
14.9	1.1145	13.5	150.5	9.393	1.256
15.4	1.1190	14.0	156.7	9.780	1.307
16.0	1.1236	14.5	162.9	10.17	1.360
16.5	1.1281	15.0	169.2	10.56	1.412
17.0	1.1327	15.5	175.6	10.96	1.465
17.5	1.1373	16.0	182.0	11.36	1.519
18.0	1.1419	16.5	188.4	11.76	1.572
18.5	1.1466	17.0	194.9	12.17	1.627
19.0	1.1512	17.5	201.5	12.58	1.681
19.6	1.1559	18.0	208.1	12.99	1.736
20.1	1.1606	18.5	214.7	13.40	1.792
20.6	1.1653	19.0	221.4	13.82	1.848
21.1	1.1701	19.5	228.2	14.24	1.904
21.6	1.1748	20.0	235.0	14.67	1.961
22.1	1.1796	20.5	241.8	15.10	2.018
22.6	1.1844	21.0	248.7	15.53	2.076

HYDROFLUOSILICIC ACID (Continued)

Specific Gravity of Aqueous Hydrofluosilicic Acid Solutions at 17.5° C. (Stolba)

Bé.	Sp. gr.	Per cent H_2SiF_6	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.1	1.1892	21.5	255.7	15.96	2.134
23.6	1.1941	22.0	262.7	16.40	2.192
24.1	1.1989	22.5	269.8	16.84	2.251
24.6	1.2038	23.0	276.9	17.28	2.311
25.0	1.2087	23.5	284.0	17.73	2.370
25.5	1.2136	24.0	291.3	18.18	2.431
26.0	1.2186	24.5	298.6	18.64	2.492
26.5	1.2235	25.0	305.9	19.09	2.553
27.0	1.2285	25.5	313.3	19.56	2.614
27.5	1.2335	26.0	320.7	20.02	2.676
27.9	1.2385	26.5	328.2	20.49	2.739
28.4	1.2436	27.0	335.8	20.96	2.802
28.9	1.2486	27.5	343.4	21.44	2.865
29.3	1.2537	28.0	351.0	21.91	2.929
29.8	1.2588	28.5	358.8	22.40	2.994
30.3	1.2639	29.0	366.5	22.88	3.059
30.7	1.2691	29.5	374.4	23.37	3.124
31.2	1.2742	30.0	382.3	23.86	3.190
31.7	1.2794	30.5	390.2	24.36	3.256
32.1	1.2846	31.0	398.2	24.86	3.323
32.6	1.2898	31.5	406.3	25.36	3.391
33.0	1.2951	32.0	414.4	25.87	3.459
33.5	1.3003	32.5	422.6	26.38	3.527
34.0	1.3056	33.0	430.8	26.90	3.596
34.4	1.3109	33.5	439.2	27.41	3.665
34.8	1.3162	34.0	447.5	27.94	3.735

MAGNESIUM CHLORIDE

Specific Gravity of Aqueous Magnesium Chloride Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $MgCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0146	2	20.29	1.267	0.1693
4.4	1.0311	4	41.24	2.575	0.3442
6.6	1.0478	6	62.87	3.925	0.5247
8.8	1.0646	8	85.17	5.317	0.7107
10.9	1.0816	10	108.2	6.752	0.9026
13.1	1.0989	12	131.9	8.232	1.100
15.1	1.1164	14	156.3	9.757	1.304
17.2	1.1342	16	181.5	11.33	1.514
19.2	1.1523	18	207.4	12.95	1.731
21.1	1.1706	20	234.1	14.62	1.954
26.0	1.2184	25	304.6	19.02	2.542
30.7	1.2688	30	380.6	23.76	3.177

Bé.	Sp. gr.	Per cent $MgCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.1	1.0146	4.270	43.32	2.705	0.3616
4.4	1.0311	8.540	88.06	5.497	0.7349
6.6	1.0478	12.81	134.2	8.380	1.120
8.8	1.0646	17.08	181.8	11.35	1.518
10.9	1.0816	21.35	230.9	14.42	1.927
13.1	1.0989	25.62	281.6	17.58	2.350
15.1	1.1164	29.89	333.7	20.83	2.785
17.2	1.1342	34.16	387.5	24.19	3.233
19.2	1.1523	38.43	442.8	27.65	3.696
21.1	1.1706	42.70	499.9	31.21	4.172
26.0	1.2184	53.38	650.4	40.60	5.427
30.7	1.2688	64.05	812.7	50.73	6.782

MAGNESIUM CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS MAGNESIUM CHLORIDE SOLUTIONS AT 14° C. (OUDEMANS)

Bé.	Sp. gr.	Per cent $MgCl_2 + 6H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0033	1	10.03	0.6263	0.0837
1.1	1.0073	2	20.15	1.258	0.1681
1.6	1.0113	3	30.34	1.894	0.2532
2.2	1.0154	4	40.62	2.536	0.3390
2.8	1.0194	5	50.97	3.182	0.4254
3.3	1.0234	6	61.40	3.833	0.5124
3.9	1.0274	7	71.92	4.490	0.6002
4.4	1.0314	8	82.51	5.151	0.6886
5.0	1.0355	9	93.20	5.818	0.7777
5.5	1.0395	10	104.0	6.489	0.8675
6.0	1.0435	11	114.8	7.166	0.9579
6.6	1.0476	12	125.7	7.848	1.049
7.1	1.0517	13	136.7	8.535	1.141
7.7	1.0558	14	147.8	9.227	1.234
8.2	1.0599	15	159.0	9.925	1.327
8.7	1.0641	16	170.3	10.63	1.421
9.3	1.0682	17	181.6	11.34	1.515
9.8	1.0724	18	193.0	12.05	1.611
10.3	1.0765	19	204.5	12.77	1.707
10.8	1.0807	20	216.1	13.49	1.804
11.4	1.0849	21	227.8	14.22	1.901
11.9	1.0891	22	239.6	14.96	2.000
12.4	1.0933	23	251.5	15.70	2.098
12.9	1.0976	24	263.4	16.44	2.198
13.4	1.1018	25	275.5	17.20	2.299
13.9	1.1061	26	287.6	17.95	2.400
14.4	1.1103	27	299.8	18.71	2.502
14.9	1.1146	28	312.1	19.48	2.604
15.4	1.1189	29	324.5	20.26	2.708
15.9	1.1232	30	337.0	21.04	2.812
16.4	1.1275	31	349.5	21.82	2.917
16.9	1.1319	32	362.2	22.61	3.023
17.4	1.1363	33	375.0	23.41	3.129
17.9	1.1407	34	387.8	24.21	3.237
18.4	1.1451	35	400.8	25.02	3.345
18.9	1.1495	36	413.8	25.83	3.453
19.4	1.1540	37	427.0	26.66	3.563
19.8	1.1584	38	440.2	27.48	3.673
20.3	1.1628	39	453.5	28.31	3.784
20.8	1.1673	40	466.9	29.15	3.897
21.3	1.1718	41	480.4	29.99	4.009
21.7	1.1763	42	494.0	30.84	4.123
22.2	1.1809	43	507.8	31.70	4.238
22.7	1.1855	44	521.6	32.56	4.353
23.2	1.1901	45	535.5	33.43	4.469
23.6	1.1948	46	549.6	34.31	4.587
24.1	1.1995	47	563.8	35.19	4.705
24.6	1.2042	48	578.0	36.08	4.824

MAGNESIUM CHLORIDE (Continued)

SPECIFIC GRAVITY OF AQUEOUS MAGNESIUM CHLORIDE SOLUTIONS AT 14° C. (OUDEMANS)

Bé.	Sp. gr.	Per cent $MgCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0033	0.47	4.699	0.2934	0.0392
1.1	1.0073	0.94	9.436	0.5891	0.0787
1.6	1.0113	1.41	14.21	0.8871	0.1186
2.2	1.0154	1.87	19.02	1.188	0.1588
2.8	1.0194	2.34	23.87	1.490	0.1992
3.3	1.0234	2.81	28.76	1.795	0.2400
3.9	1.0274	3.28	33.68	2.103	0.2811
4.4	1 0314	3.75	38.65	2.413	0.3225
5.0	1.0355	4.22	43.65	2.725	0.3643
5.5	1.0395	4.68	48.69	3.039	0.4063
6.0	1 0435	5.15	53.76	3.356	0.4487
6.6	1.0476	5.62	58.88	3.676	0.4914
7.1	1.0517	6.09	64.04	3.998	0.5344
7.7	1.0558	6.56	69.23	4.322	0.5777
8.2	1.0599	7.03	74.46	4.649	0.6214
8.7	1.0641	7.49	79.74	4.978	0.6655
9.3	1.0682	7.96	85.05	5.310	0.7098
9.8	1.0724	8.43	90.41	5.644	0.7545
10.3	1.0765	8.90	95.80	5.980	0.7995
10.8	1.0807	9.37	101.2	6.320	0.8448
11.4	1.0849	9.84	106.7	6.661	0.8905
11.9	1.0891	10.3	112.2	7.006	0.9365
12.4	1.0933	10.8	117.8	7.352	0.9829
12.9	1.0976	11.2	123.4	7.702	1.030
13.4	1.1018	11.7	129.0	8.054	1.077
13.9	1.1061	12.2	134.7	8.409	1.124
14.4	1.1103	12.6	140.4	8.765	1.172
14.9	1.1146	13.1	146.2	9.125	1.220
15.4	1.1189	13.6	152.0	9.487	1.268
15.9	1.1232	14.1	157.8	9.862	1.317
16.4	1.1275	14.5	163.7	10.22	1.366
16.9	1.1319	15.0	169.6	10.59	1.416
17.4	1.1363	15.5	175.6	10.96	1.466
17.9	1.1407	15.9	181.7	11.34	1.516
18.4	1.1451	16.4	187.7	11.72	1.567
18.9	1.1495	16.9	193.8	12.10	1.617
19.4	1.1540	17.3	200.0	12.48	1.669
19.8	1.1584	17.8	206.2	12.87	1.721
20.3	1.1628	18.3	212.4	13.26	1.773
20.8	1.1673	18.7	218.7	13.65	1.825
21.3	1.1718	19.2	225.0	14.05	1.878
21.7	1.1763	19.7	231.4	14.45	1.931
22.2	1.1809	20.1	237.8	14.85	1.985
22.7	1.1855	20.6	244.3	15.25	2.039
23.2	1.1901	21.1	250.8	15.66	2.093
23.6	1.1948	21.5	257.4	16.07	2.148
24.1	1.1995	22.0	264.1	16.48	2.204
24.6	1.2042	22.5	270.7	16.90	2.259

MAGNESIUM SULFATE

Specific Gravity of Aqueous Magnesium Sulfate Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $MgSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.6	1.0186	2	20.37	1.272	0.1700
5.5	1.0392	4	41.57	2.595	0.3469
8.2	1.0602	6	63.61	3.971	0.5309
10.9	1.0816	8	86.53	5.402	0.7221
13.6	1.1034	10	110.3	6.889	0.9208
16.2	1.1256	12	135.1	8.432	1.127
18.7	1.1484	14	160.8	10.04	1.342
21.3	1.1717	16	187.5	11.70	1.564
23.3	1.1955	18	215.2	13.43	1.796
26.1	1.2198	20	244.0	15.23	2.036
28.5	1.2447	22	273.8	17.09	2.285
30.8	1.2701	24	304.8	19.03	2.544
33.1	1.2961	26	337.0	21.04	2.812

Bé.	Sp. gr.	Per cent $MgSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.6	1.0186	4.095	41.71	2.604	0.3481
5.5	1.0392	8.190	85.11	5.314	0.7103
8.2	1.0602	12.29	130.3	8.131	1.087
10.9	1.0816	16.38	177.2	11.06	1.479
13.6	1.1034	20.48	225.9	14.10	1.886
16.2	1.1256	24.57	276.6	17.27	2.308
18.7	1.1484	28.67	329.2	20.55	2.747
21.3	1.1717	32.76	383.9	23.96	3.203
23.3	1.1955	36.86	440.6	27.51	3.677
26.1	1.2198	40.95	499.5	31.18	4.169
28.5	1.2447	45.05	560.7	35.00	4.679
30.8	1.2701	49.14	624.2	38.96	5.209
33.1	1.2961	53.24	690.0	43.08	5.758

NICKEL CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS NICKEL CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $NiCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.008	1	10.08	0.6293	0.0841
2.6	1.018	2	20.36	1.271	0.1699
5.2	1.037	4	41.48	2.589	0.3462
7.8	1.057	6	63.42	3.959	0.5293
10.5	1.078	8	86.24	5.384	0.7197
13.1	1.099	10	109.9	6.861	0.9171
15.7	1.121	12	134.5	8.398	1.123
18.1	1.143	14	160.0	9.990	1.335
20.8	1.167	16	186.7	11.66	1.558
23.3	1.191	18	214.4	13.38	1.789
25.7	1.215	20	243.0	15.17	2.028
31.7	1.280	25	320.0	19.98	2.670
37.8	1.353	30	405.9	25.34	3.387

NICKEL NITRATE

SPECIFIC GRAVITY OF AQUEOUS NICKEL NITRATE SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $Ni(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.6	1.033	4	41.32	2.579	0.3448
6.9	1.050	6	63.00	3.933	0.5258
9.4	1.069	8	85.52	5.339	0.7137
11.7	1.088	10	108.8	6.792	0.9080
14.0	1.107	12	132.8	8.293	1.109
16.3	1.127	14	157.8	9.850	1.317
18.7	1.148	16	183.7	11.47	1.533
21.0	1.169	18	210.4	13.14	1.756
23.3	1.191	20	238.2	14.87	1.988
28.9	1.249	25	312.3	19.49	2.606
34.4	1.311	30	393.3	24.55	3.282
39.7	1.377	35	482.0	30.09	4.022

NICKEL SULFATE

SPECIFIC GRAVITY OF AQUEOUS NICKEL SULFATE SOLUTIONS AT $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $NiSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.3	1.009	1	10.09	0.6299	0.0842
2.8	1.020	2	20.40	1.274	0.1702
5.8	1.042	4	41.68	2.602	0.3478
8.6	1.063	6	63.78	3.982	0.5323
11.4	1.085	8	86.80	5.419	0.7244
14.3	1.109	10	110.9	6.923	0.9255
17.0	1.133	12	136.0	8.488	1.135
19.8	1.158	14	162.1	10.12	1.353
22.4	1.183	16	189.3	11.82	1.580
25.1	1.209	18	217.6	13.59	1.816

NITRIC ACID

SPECIFIC GRAVITY OF AQUEOUS NITRIC ACID SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent HNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0036	1	10.04	0.6265	0.0838
1.3	1.0091	2	20.18	1.260	0.1684
2.1	1.0146	3	30.44	1.900	0.2540
2.9	1.0201	4	40.80	2.547	0.3405
3.6	1.0256	5	51.28	3.201	0.4279
4.4	1.0312	6	61.87	3.862	0.5163
5.2	1.0369	7	72.58	4.531	0.6057
5.9	1.0427	8	83.42	5.207	0.6961
6.7	1.0485	9	94.37	5.891	0.7875
7.5	1.0543	10	105.4	6.582	0.8798
8.2	1.0602	11	116.6	7.280	0.9732
9.0	1.0661	12	127.9	7.986	1.068
9.8	1.0721	13	139.4	8.701	1.163
10.5	1.0781	14	150.9	9.422	1.260
11.3	1.0842	15	162.6	10.15	1.357
12.0	1.0903	16	174.4	10.89	1.456
12.8	1.0964	17	186.4	11.64	1.555
13.5	1.1026	18	198.5	12.39	1.656
14.2	1.1088	19	210.7	13.15	1.758
15.0	1.1150	20	223.0	13.92	1.861
15.7	1.1213	21	235.5	14.70	1.965
16.4	1.1276	22	248.1	15.49	2.070
17.1	1.1340	23	260.8	16.28	2.177
17.9	1.1404	24	273.7	17.09	2.284
18.6	1.1469	25	286.7	17.90	2.393
19.4	1.1534	26	299.9	18.72	2.503
20.0	1.1600	27	313.2	19.55	2.614
20.7	1.1666	28	326.6	20.39	2.726
21.4	1.1733	29	340.3	21.24	2.840
22.1	1.1800	30	354.0	22.10	2.954
22.8	1.1867	31	367.9	22.97	3.070
23.5	1.1934	32	381.9	23.84	3.187
24.2	1.2002	33	396.1	24.73	3.305
24.9	1.2071	34	410.4	25.62	3.425
25.6	1.2140	35	424.9	26.53	3.546
26.2	1.2205	36	439.4	27.43	3.667
26.8	1.2270	37	454.0	28.34	3.789
27.5	1.2335	38	468.7	29.26	3.912
28.1	1.2399	39	483.6	30.19	4.035
28.7	1.2463	40	498.5	31.12	4.160
29.3	1.2527	41	513.6	32.06	4.286
29.8	1.2591	42	528.8	33.01	4.413
30.4	1.2655	43	544.2	33.97	4.541
31.0	1.2719	44	559.6	34.94	4.670
31.6	1.2783	45	575.2	35.91	4.800
32.1	1.2847	46	591.0	36.89	4.932
32.7	1.2911	47	606.8	37.88	5.064
33.2	1.2975	48	622.8	38.88	5.197
33.8	1.3040	49	639.0	39.89	5.332
34.3	1.3100	50	655.0	40.89	5.466
34.8	1.3160	51	671.2	41.90	5.601
35.3	1.3219	52	687.4	42.91	5.736
35.8	1.3278	53	703.7	43.93	5.873
36.3	1.3336	54	720.1	44.96	6.010

NITRIC ACID (Continued)

SPECIFIC GRAVITY OF AQUEOUS NITRIC ACID SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent HNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
36.7	1.3393	55	736.6	45.98	6.147
37.2	1.3449	56	753.1	47.02	6.285
37.6	1.3505	57	769.8	48.06	6.424
38.1	1.3560	58	786.5	49.10	6.563
38.5	1.3614	59	803.2	50.14	6.703
38.9	1.3667	60	820.0	51.19	6.843
39.3	1.3719	61	836.9	52.24	6.984
39.7	1.3769	62	853.7	53.29	7.124
40.1	1.3818	63	870.5	54.34	7.265
40.4	1.3866	64	887.4	55.40	7.406
40.8	1.3913	65	904.3	56.46	7.547
41.1	1.3959	66	921.3	57.51	7.688
41.5	1.4004	67	938.3	58.57	7.830
41.8	1.4048	68	955.3	59.63	7.972
42.1	1.4091	69	972.3	60.70	8.114
42.4	1.4134	70	989.4	61.76	8.257
42.7	1.4176	71	1006	62.83	8.399
43.0	1.4218	72	1024	63.91	8.543
43.3	1.4258	73	1041	64.98	8.686
43.6	1.4298	74	1058	66.05	8.830
43.9	1.4337	75	1075	67.13	8.973
44.1	1.4375	76	1093	68.20	9.117
44.4	1.4413	77	1110	69.28	9.262
44.7	1.4450	78	1127	70.36	9.406
44.9	1.4486	79	1144	71.44	9.550
45.1	1.4521	80	1162	72.52	9.694
45.4	1.4555	81	1179	73.60	9.839
45.6	1.4589	82	1196	74.68	9.983
45.8	1.4622	83	1214	75.76	10.13
46.1	1.4655	84	1231	76.85	10.27
46.3	1.4686	85	1248	77.93	10.42
46.5	1.4716	86	1266	79.01	10.56
46.7	1.4745	87	1283	80.08	10.71
46.8	1.4773	88	1300	81.16	10.85
47.0	1.4800	89	1317	82.23	10.99
47.2	1.4826	90	1334	83.30	11.14
47.4	1.4850	91	1351	84.36	11.28
47.5	1.4873	92	1368	85.42	11.42
47.6	1.4892	93	1385	86.46	11.56
47.8	1.4912	94	1402	87.51	11.70
47.9	1.4932	95	1419	88.56	11.84
48.0	1.4952	96	1435	89.61	11.98
48.2	1.4974	97	1452	90.67	12.12
48.4	1.5008	98	1471	91.82	12.27
48.7	1.5056	99	1491	93.05	12.44
49.2	1.5129	100	1513	94.45	12.63

NITRIC ACID

Authority — W. C. Ferguson

This table has been approved and adopted as a Standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should *always* be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Allowance for Temperature

At 10°–20° Bé. — 1/30° Bé. or .00029 Sp. Gr. = 1° F.
20°–30° Bé. — 1/23° Bé. or .00044 " " = 1° F.
30°–40° Bé. — 1/20° Bé. or .00060 " " = 1° F.
40°–48.5° Bé. — 1/17° Bé. or .00084 " " = 1° F.

Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.	Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.
10.00	1.0741	14.82	12.86	15.25	1.1176	23.52	19.70
10.25	1.0761	15.22	13.18	15.50	1.1197	23.94	20.02
10.50	1.0781	15.62	13.49	15.75	1.1219	24.38	20.36
10.75	1.0801	16.02	13.81	16.00	1.1240	24.80	20.69
11.00	1.0821	16.42	14.13	16.25	1.1262	25.24	21.03
11.25	1.0841	16.82	14.44	16.50	1.1284	25.68	21.36
11.50	1.0861	17.22	14.76	16.75	1.1306	26.12	21.70
11.75	1.0881	17.62	15.07	17.00	1.1328	26.56	22.04
12.00	1.0902	18.04	15.41	17.25	1.1350	27.00	22.38
12.25	1.0922	18.44	15.72	17.50	1.1373	27.46	22.74
12.50	1.0943	18.86	16.05	17.75	1.1395	27.90	23.08
12.75	1.0964	19.28	16.39	18.00	1.1417	28.34	23.42
13.00	1.0985	19.70	16.72	18.25	1.1440	28.80	23.77
13.25	1.1006	20.12	17.05	18.50	1.1462	29.24	24.11
13.50	1.1027	20.54	17.38	18.75	1.1485	29.70	24.47
13.75	1.1048	20.96	17.71	19.00	1.1508	30.16	24.82
14.00	1.1069	21.38	18.04	19.25	1.1531	30.62	25.18
14.25	1.1090	21.80	18.37	19.50	1.1554	31.08	25.53
14.50	1.1111	22.22	18.70	19.75	1.1577	31.54	25.88
14.75	1.1132	22.64	19.02	20.00	1.1600	32.00	26.24
15.00	1.1154	23.08	19.36	20.25	1.1624	32.48	26.61

NITRIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.	Bé.°	Sp. gr.	Tw.°	Per cent HNO_3.
20.50	1.1647	32.94	26.96	31.50	1.2775	55.50	43.89
20.75	1.1671	33.42	27.33	31.75	1.2804	56.08	44.34
21.00	1.1694	33.88	27.67	32.00	1.2832	56.64	44.78
21.25	1.1718	34.36	28.02	32.25	1.2861	57.22	45.24
21.50	1.1741	34.82	28.36	32.50	1.2889	57.78	45.68
21.75	1.1765	35.30	28.72	32.75	1.2918	58.36	46.14
22.00	1.1789	35.78	29.07	33.00	1.2946	58.92	46.58
22.25	1.1813	36.26	29.43	33.25	1.2975	59.50	47.04
22.50	1.1837	36.74	29.78	33.50	1.3004	60.08	47.49
22.75	1.1861	37 22	30.14	33.75	1.3034	60.68	47.95
23.00	1.1885	37.70	30.49	34.00	1.3063	61.26	48.42
23.25	1.1910	38.20	30.86	34.25	1.3093	61.86	48.90
23.50	1.1934	38.68	31.21	34.50	1.3122	62.44	49.35
23.75	1.1959	39.18	31.58	34.75	1.3152	63.04	49.83
24.00	1.1983	39.66	31.94	35.00	1.3182	63.64	50.32
24.25	1.2008	40.16	32.31	35.25	1.3212	64.24	50.81
24.50	1.2033	40.66	32.68	35.50	1.3242	64.84	51.30
24.75	1.2058	41.16	33.05	35.75	1.3273	65.46	51.80
25.00	1.2083	41.66	33.42	36.00	1.3303	66.06	52.30
25.25	1.2109	42.18	33.80	36.25	1.3334	66.68	52.81
25.50	1.2134	42.68	34.17	36.50	1.3364	67.28	53.32
25.75	1.2160	43.20	34.56	36.75	1.3395	67.90	53.84
26.00	1.2185	43.70	34.94	37.00	1.3426	68.52	54.36
26.25	1.2211	44.22	35.33	37.25	1.3457	69.14	54.89
26.50	1.2236	44.72	35.70	37.50	1.3488	69.76	55.43
26.75	1.2262	45.24	36.09	37.75	1.3520	70.40	55.97
27.00	1.2288	45.76	36.48	38.00	1.3551	71.02	56.52
27.25	1.2314	46.28	36.87	38.25	1.3583	71.66	57.08
27.50	1.2340	46.80	37.26	38.50	1.3615	72.30	57.65
27.75	1.2367	47.34	37.67	38.75	1.3647	72.94	58.23
28.00	1.2393	47.86	38.06	39.00	1.3679	73.58	58.82
28.25	1.2420	48.40	38.46	39.25	1.3712	74.24	59.43
28.50	1.2446	48.92	38.85	39.50	1.3744	74.88	60.06
28.75	1.2473	49.46	39.25	39.75	1.3777	75.54	60.71
29.00	1.2500	50.00	39.66	40.00	1.3810	76.20	61.38
29.25	1.2527	50.54	40.06	40.25	1.3843	76.86	62.07
29.50	1.2554	51.08	40.47	40.50	1.3876	77.52	62.77
29.75	1.2582	51.64	40.89	40.75	1.3909	78.18	63.48
30.00	1.2609	52.18	41.30	41.00	1.3942	78.84	64.20
30.25	1.2637	52.74	41.72	41.25	1.3976	79.52	64.93
30.50	1.2664	53.28	42.14	41 50	1.4010	80.20	65.67
30.75	1.2692	53.84	42.58	41.75	1.4044	80.88	66.42
31.00	1.2719	54.38	43.00	42.00	1.4078	81.96	67.18
31.25	1.2747	54.94	43.44	42.25	1.4112	82.24	67.95

NITRIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent HNO₃.	Bé.°	Sp. gr.	Tw.°	Per cent HNO₃.
42.50	1.4146	82.92	68.73	45.50	1.4573	91.46	79.03
42.75	1.4181	83.62	69.52	45.75	1.4610	92.20	80.04
43.00	1.4216	84.32	70.33	46.00	1.4646	92.92	81.08
43.25	1.4251	85.02	71.15	46.25	1.4684	93.68	82.18
43.50	1.4286	85.72	71.98	46.50	1.4721	94.42	83.33
43.75	1.4321	86.42	72.82	46.75	1.4758	95.16	84.48
44.00	1.4356	87.12	73.67	47.00	1.4796	95.92	85.70
44.25	1.4392	87.84	74.53	47.25	1.4834	96.68	86.98
44.50	1.4428	88.56	75.40	47.50	1.4872	97.44	88.32
44.75	1.4464	89.28	76.28	47.75	1.4910	98.20	89.76
45.00	1.4500	90.00	77.17	48.00	1.4948	98.96	91.35
45.25	1.4536	90.72	78.07	48.25	1.4987	99.74	93.13
				48.50	1.5026	100.52	95.11

OXALIC ACID

Specific Gravity of Aqueous Oxalic Acid Solutions at 17.5° C. (Gerlach)

Bé.	Sp. gr.	Per cent $H_2C_2O_4 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0035	1	10.04	0.6265	0.0837
1.0	1.0070	2	20.14	1.257	0.1681
1.5	1.0105	3	30.32	1.892	0.2530
2.0	1.0140	4	40.56	2.532	0.3385
2.5	1.0175	5	50.88	3.176	0.4246
3.0	1.0210	6	61.26	3.824	0.5112
3.5	1.0245	7	71.72	4.477	0.5985
4.0	1.0280	8	82.24	5.134	0.6863
4.4	1.0315	9	92.84	5.795	0.7747
4.9	1.0350	10	103.5	6.461	0.8637
5.4	1.0385	11	114.2	7.131	0.9533
5.8	1.0420	12	125.0	7.806	1.043
6.3	1.0455	13	135.9	8.485	1.134

Bé.	Sp. gr.	Per cent $H_2C_2O_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.5	1.0035	0.71	7.166	0.4474	0.0598
1.0	1.0070	1.43	14.38	0.8979	0.1200
1.5	1.0105	2.14	21.65	1.351	0.1807
2.0	1.0140	2.86	28.97	1.808	0.2417
2.5	1.0175	3.57	36.33	2.268	0.3032
3.0	1.0210	4.28	43.75	2.731	0.3651
3.5	1.0245	5.00	51.21	3.197	0.4274
4.0	1.0280	5.71	58.73	3.666	0.4901
4.4	1.0315	6.43	66.30	4.139	0.5533
4.9	1.0350	7.14	73.91	4.614	0.6168
5.4	1.0385	7.86	81.58	5.093	0.6808
5.8	1.0420	8.57	89.30	5.574	0.7452
6.3	1.0455	9.28	97.06	6.059	0.8100

PERCHLORIC ACID

SPECIFIC GRAVITY OF AQUEOUS PERCHLORIC ACID SOLUTIONS AT $\frac{15°}{4°}$ C.*

Sp. gr.	Per cent $HClO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.005	1	10.05	.6274	.0839
1.011	2	20.22	1.262	.1687
1.023	4	40.91	2.554	.3414
1.035	6	62.09	3.876	.5181
1.047	8	83.77	5.229	.6991
1.060	10	106.0	6.615	.8843
1.073	12	128.7	8.035	1.074
1.086	14	152.0	9.490	1.269
1.100	16	175.9	10.98	1.468
1.114	18	200.4	12.51	1.673
1.128	20	225.6	14.08	1.882
1.143	22	251.4	15.69	2.098
1.158	24	277.9	17.35	2.319
1.174	26	305.2	19.05	2.547
1.190	28	333.2	20.80	2.781
1.207	30	362.0	22.60	3.021
1.224	32	391.6	24.45	3.268
1.242	34	422.2	26.36	3.523
1.260	36	453.7	28.32	3.786
1.279	38	486.2	30.35	4.057
1.299	40	519.6	32.44	4.336
1.352	45	608.4	37.98	5.078
1.410	50	705.2	44.02	5.885
1.473	55	810.3	50.58	6.762
1.539	60	923.3	57.64	7.705
1.606	65	1044.	65.16	8.711
1.674	70	1172.	73.13	9.777

SPECIFIC GRAVITY OF 65 TO 75% SOLUTION AT $\frac{25°}{4°}$ C.

Based on values reported by G. Frederick Smith and O. E. Goehler, Ind. and Eng. Chem. **3**, 61, 1931

1.597	65.0	1038.	64.79	8.661
1.603	65.5	1050.	65.56	8.764
1.610	66.0	1063.	66.34	8.868
1.617	66.5	1075.	67.12	8.973
1.624	67.0	1088.	67.91	9.078
1.630	67.5	1101.	68.70	9.184
1.637	68.0	1113.	69.50	9.290
1.644	68.5	1126.	70.30	9.397
1.651	69.0	1139.	71.10	9.504
1.657	69.5	1152.	71.91	9.613
1.664	70.0	1165.	72.72	9.722
1.671	70.5	1178.	73.54	9.831
1.678	71.0	1191.	74.36	9.940
1.684	71.5	1204.	75.18	10.05
1.691	72.0	1218.	76.01	10.16
1.698	72.5	1231.	76.84	10.27
1.704	73.0	1244.	77.68	10.38
1.711	73.5	1258.	78.52	10.50
1.718	74.0	1271.	79.36	10.61
1.725	74.5	1285.	80.21	10.72
1.731	75.0	1298.	81.06	10.84

PHOSPHORIC ACID

Specific Gravity of Aqueous Phosphoric Acid Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent H_3PO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0038	1	10.04	0.6266	0.0838
1.3	1.0092	2	20.18	1.260	0.1684
2.8	1.0200	4	40.80	2.547	0.3405
4.3	1.0309	6	61.85	3.861	0.5162
5.8	1.0420	8	83.36	5.204	0.6957
7.3	1.0532	10	105.3	6.575	0.8789
8.8	1.0647	12	127.8	7.976	1.066
10.3	1.0764	14	150.7	9.408	1.258
11.8	1.0884	16	174.1	10.87	1.453
13.3	1.1008	18	198.1	12.37	1.654
14.8	1.1134	20	222.7	13.90	1.858
16.3	1.1263	22	247.8	15.47	2.068
17.8	1.1395	24	273.5	17.07	2.282
19.2	1.1529	26	299.8	18.71	2.501
20.7	1.1665	28	326.6	20.39	2.726
22.2	1.1805	30	354.2	22.11	2.955
25.8	1.216	35	425.6	26.57	3.552
29.4	1.254	40	501.6	31.31	4.186
32.9	1.293	45	581.9	36.32	4.856
36.4	1.335	50	667.5	41.67	5.570
39.9	1.379	55	758.5	47.35	6.329
43.3	1.426	60	855.6	53.41	7.140
46.7	1.475	65	958.8	59.85	8.001
50.0	1.526	70	1068	66.68	8.914
53.2	1.579	75	1184	73.93	9.883
56.2	1.633	80	1306	81.55	10.90
59.2	1.689	85	1436	89.62	11.98
62.0	1.746	90	1571	98.10	13.11
63.1	1.770	92	1628	101.7	13.59
64.2	1.794	94	1686	105.3	14.07
65.3	1.819	96	1746	109.0	14.57
66.4	1.844	98	1807	112.8	15.08
67.5	1.870	100	1870	116.7	15.61

PHOSPHORIC ACID

Specific Gravity of Aqueous Phosphoric Acid Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent P_2O_5	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0038	0.72	7.271	0.4539	0.0607
1.3	1.0092	1.4	14.62	0.9128	0.1220
2.8	1.0200	2.9	29.56	1.845	0.2466
4.3	1.0309	4.3	44.81	2.797	0.3739
5.8	1.0420	5.8	60.39	3.770	0.5039
7.3	1.0532	7.2	76.29	4.763	0.6367
8.8	1.0647	8.7	92.55	5.778	0.7724
10.3	1.0764	10.1	109.2	6.815	0.9110
11.8	1.0884	11.6	126.1	7.875	1.053
13.3	1.1008	13.0	143.5	8.960	1.198
14.8	1.1134	14.5	161.3	10.07	1.346
16.3	1.1263	15.9	179.5	11.21	1.498
17.8	1.1395	17.4	198.1	12.37	1.653
19.2	1.1529	18.8	217.1	13.56	1.812
20.7	1.1665	20.3	236.6	14.77	1.975
22.2	1.1805	21.7	256.5	16.02	2.141
25.8	1.216	25.4	308.3	19.25	2.573
29.4	1.254	29.0	363.4	22.68	3.032
32.9	1.293	32.6	421.5	26.31	3.517
36.4	1.335	36.2	483.5	30.19	4.035
39.9	1.379	39.8	549.4	34.30	4.585
43.3	1.426	43.5	619.8	38.69	5.172
46.7	1.475	47.1	694.5	43.36	5.796
50.0	1.526	50.7	773.8	48.31	6.458
53.2	1.579	54.3	857.9	53.55	7.159
56.2	1.633	58.0	946.4	59.08	7.898
59.2	1.689	61.6	1040	64.92	8.679
62.0	1.746	65.2	1138	71.06	9.500
63.1	1.770	66.6	1180	73.64	9.844
64.2	1.794	68.1	1222	76.26	10.19
65.3	1.819	69.5	1265	78.97	10.56
66.4	1.844	71.0	1309	81.72	10.92
67.5	1.870	72.4	1355	84.57	11.30

POTASSIUM BROMIDE

Specific Gravity of Aqueous Potassium Bromide Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent KBr	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0054	1	10.05	0.6276	0.0839
1.8	1.0127	2	20.25	1.264	0.1690
3.9	1.0275	4	41.10	2.566	0.3430
5.9	1.0426	6	62.56	3.905	0.5220
8.0	1.0581	8	84.65	5.284	0.7064
10.0	1.0740	10	107.4	6.705	0.8963
12.0	1.0903	12	130.8	8.168	1.092
14.0	1.1070	14	155.0	9.675	1.293
16.0	1.1242	16	179.9	11.23	1.501
18.0	1.1419	18	205.5	12.83	1.715
20.0	1.1601	20	232.0	14.48	1.936
22.0	1.1788	22	259.3	16.19	2.164
24.0	1.1980	24	287.5	17.95	2.399
25.9	1.2178	26	316.6	19.77	2 642
27.9	1.2383	28	346.7	21.64	2.893
29.9	1.2593	30	377.8	23.58	3.153
34.7	1.3147	35	460.1	28.73	3.840
39.5	1.3746	40	549.8	34.32	4.589

POTASSIUM CARBONATE

Specific Gravity of Aqueous Potassium Carbonate Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent K_2CO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0072	1	10.07	0.6288	0.0841
2.3	1.0163	2	20.33	1.269	0.1696
4.8	1.0345	4	41.38	2.583	0.3453
7.3	1.0529	6	63.17	3.944	0.5272
9.7	1.0715	8	85.72	5.351	0.7154
12.0	1.0904	10	109.0	6.807	0.9100
14.3	1.1096	12	133.2	8.312	1.111
16.6	1.1291	14	158.1	9.868	1.319
18.8	1.1490	16	183.8	11.48	1.534
21.0	1.1692	18	210.5	13.14	1.756

POTASSIUM CARBONATE (Continued)

Specific Gravity of Aqueous Potassium Carbonate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2CO	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
23.1	1.1898	20	238.0	14.86	1.986
25.2	1.2107	22	266.4	16.63	2.223
27.3	1.2320	24	295.7	18.46	2.468
29.3	1.2536	26	325.9	20.35	2.720
31.3	1.2756	28	357.2	22.30	2.981
33.3	1.2979	30	389.4	24.31	3.249
38.0	1.3548	35	474.2	29.60	3.957
42.5	1.4141	40	565.6	35.31	4.720
46.8	1.4759	45	664.2	41.46	5.543
50.9	1.5404	50	770.2	48.08	6.427

POTASSIUM CHLORIDE

Specific Gravity of Aqueous Potassium Chloride Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0046	1	10.05	0.6271	0.0838
1.6	1.0110	2	20.22	1.262	0.1687
3.4	1.0239	4	40.96	2.557	0.3418
5.2	1.0369	6	62.21	3.884	0.5192
6.9	1.0500	8	84.00	5.244	0.7010
8.6	1.0633	10	106.3	6.638	0.8874
10.3	1.0768	12	129.2	8.067	1.078
12.0	1.0905	14	152.7	9.531	1.274
13.7	1.1043	16	176.7	11.03	1.475
15.4	1.1185	18	201.3	12.57	1.680
17.0	1.1328	20	226.6	14.14	1.891
18.6	1.1474	22	252.4	15.76	2.107
20.2	1.1623	24	279.0	17.41	2.328

POTASSIUM CHROME ALUM

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM CHROME ALUM SOLUTIONS AT $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $K_2Cr_2(SO_4)_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.8	1.034	4	41.36	2.582	0.3452
7.2	1.052	6	63.12	3.940	0.5267
9.5	1.070	8	85.60	5.344	0.7143
11.9	1.089	10	108.9	6.798	0.9088
14.3	1.109	12	133.1	8.308	1.111
16.6	1.129	14	158.1	9.867	1.319
18.9	1.150	16	184.0	11.49	1.536
21.2	1.171	18	210.8	13.16	1.759
23.5	1.193	20	238.6	14.90	1.991
25.8	1.216	22	267.5	16.70	2.233
28.0	1.239	24	297.4	18.56	2.482
30.2	1.263	26	328.4	20.50	2.740
32.5	1.289	28	360.9	22.53	3.012
34.7	1.315	30	394.5	24.63	3.292
40.2	1.383	35	484.1	30.22	4.040
45.4	1.456	40	582.4	36.36	4.860
50.4	1.533	45	689.9	43.07	5.757
55.2	1.615	50	807.5	50.41	6.739

Bé.	Sp. gr.	Per cent $K_2Cr_2(SO_4)_4 + 24H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1.763	17.76	1.108	0.1481
2.3	1.016	3.527	35.83	2.237	0.2991
4.8	1.034	7.053	72.93	4.553	0.6087
7.2	1.052	10.58	111.30	6.948	0.9287
9.5	1.070	14.11	150.9	9.423	1.260
11.9	1.089	17.63	192.0	11.99	1.603
14.3	1.109	21.16	234.7	14.65	1.958
16.6	1.129	24.69	278.7	17.40	2.326
18.9	1.150	28.21	324.4	20.25	2.708
21.2	1.171	31.74	371.7	23.20	3.102
23.5	1.193	35.27	420.7	26.26	3.511
25.8	1.216	38.79	471.7	29.45	3.937
28.0	1.239	42.32	524.3	32.73	4.376
30.2	1.263	45.85	579.0	36.15	4.832
32.5	1.289	49.37	636.4	39.73	5.311
34.7	1.315	52.90	695.3	43.43	5.805
40.2	1.383	61.72	853.5	53.28	7.123
45.4	1.456	70.53	1026.9	64.11	8.570
50.4	1.533	79.35	1216.4	75.94	10.15
55.2	1.615	88.17	1423.9	88.89	11.88

POTASSIUM CHROMATE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM CHROMATE SOLUTIONS AT $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0066	1	10.07	0.6284	0.0840
2.1	1.0147	2	20.29	1.267	0.1694
4.4	1.0311	4	41.24	2.575	0.3442
6.6	1.0477	6	62.86	3.924	0.5246
8.8	1.0647	8	85.18	5.317	0.7108
11.0	1.0821	10	108.2	6.755	0.9030
13.2	1.0999	12	132.0	8.240	1.101
15.3	1.1181	14	156.5	9.772	1.306
17.4	1.1366	16	181.9	11.35	1.518
19.5	1.1555	18	208.0	12.98	1.736
21.6	1.1748	20	235.0	14.67	1.961
23.6	1.1945	22	262.8	16.41	2.193
25.6	1.2147	24	291.5	18.20	2.433
27.6	1.2354	26	321.2	20.05	2.681
29.6	1.2566	28	351.8	21.96	2.936
31.6	1.2784	30	383.5	23.94	3.201

SPECIFIC GRAVITY OF POTASSIUM CHROMATE SOLUTIONS AT 19.5° C. (SCHIFF)

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0080	1	10.08	0.6293	0.0841
2.3	1.0161	2	20.32	1.269	0.1696
3.4	1.0243	3	30.73	1.918	0.2564
4.6	1.0325	4	41.30	2.578	0.3447
5.7	1.0408	5	52.04	3.249	0.4343
6.8	1.0492	6	62.95	3.930	0.5254
7.9	1.0576	7	74.03	4.622	0.6178
9.0	1.0663	8	85.30	5.325	0.7119
10.1	1.0750	9	96.75	6.040	0.8074
11.2	1.0837	10	108.4	6.765	0.9044
12.3	1.0925	11	120.2	7.502	1.003
13.4	1.1014	12	132.2	8.251	1.103
14.4	1.1104	13	144.4	9.011	1.205
15.5	1.1195	14	156.7	9.784	1.308

POTASSIUM CHROMATE (Continued)

Specific Gravity of Potassium Chromate Solutions at 19.5° C. (Schiff)

Bé.	Sp. gr.	Per cent K_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
16.5	1.1287	15	169.3	10.57	1.413
17.6	1.1380	16	182.1	11.37	1.519
18.6	1.1474	17	195.1	12.18	1.628
19.7	1.1570	18	208.3	13.00	1.738
20.7	1.1667	19	221.7	13.84	1.850
21.8	1.1765	20	235.3	14.69	1.964
22.8	1.1864	21	249.1	15.55	2.079
23.8	1.1964	22	263.2	16.43	2.197
24.8	1.2066	23	277.5	17.32	2.316
25.8	1.2169	24	292.1	18.23	2.437
26.9	1.2274	25	306.9	19.16	2.561
27.9	1.2379	26	321.9	20.09	2.686
28.9	1.2485	27	337.1	21.04	2.813
29.8	1.2592	28	352.6	22.01	2.942
30.8	1.2700	29	368.3	22.99	3.074
31.8	1.2808	30	384.2	23.99	3.207
32.8	1.2921	31	400.6	25.01	3.343
33.8	1.3035	32	417.1	26.04	3.481
34.7	1.3151	33	434.0	27.09	3.622
35.7	1.3268	34	451.1	28.16	3.765
36.7	1.3386	35	468.5	29.25	3.910
37.6	1.3505	36	486.2	30.35	4.057
38.6	1.3625	37	504.1	31.47	4.207
39.5	1.3746	38	522.3	32.61	4.359
40.4	1.3868	39	540.9	33.76	4.514
41.4	1.3991	40	559.6	34.94	4.670

POTASSIUM DICHROMATE

Specific Gravity of Aqueous Potassium Dichromate Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $K_2Cr_2O_7$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.7	1.0122	2	20.24	1.264	0.1689
3.7	1.0264	4	41.06	2.563	0.3426
5.7	1.0408	6	62.45	3.898	0.5211
7.6	1.0554	8	84.43	5.271	0.7046
9.5	1.0703	10	107.0	6.682	0.8932

POTASSIUM HYDROXIDE

Specific Gravity of Aqueous Potassium Hydroxide Solutions at $\frac{15^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent KOH	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	1	10.08	0.6295	0.0841
2.5	1.0175	2	20.35	1.270	0.1698
3.8	1.0267	3	30.80	1.923	0.2570
5.0	1.0359	4	41.44	2.587	0.3458
6.3	1.0452	5	52.26	3.262	0.4361
7.5	1.0544	6	63.26	3.949	0.5280
8.7	1.0637	7	74.46	4.648	0.6214
9.9	1.0730	8	85.84	5.359	0.7164
11.0	1.0824	9	97.42	6.081	0.8130
12.2	1.0918	10	109.2	6.816	0.9111
13.3	1.1013	11	121.1	7.563	1.011
14.5	1.1108	12	133.3	8.321	1.112
15.6	1.1203	13	145.6	9.092	1.215
16.7	1.1299	14	158.2	9.875	1.320
17.8	1.1396	15	170.9	10.67	1.427
18.8	1.1493	16	183.9	11.48	1.535
19.9	1.1590	17	197.0	12.30	1.644
20.9	1.1688	18	210.4	13.13	1.756
22.0	1.1786	19	223.9	13.98	1.869
23.0	1.1884	20	237.7	14.84	1.983
24.0	1.1984	21	251.7	15.71	2.100
25.0	1.2083	22	265.8	16.59	2.218
26.0	1.2184	23	280.2	17.49	2.339
27.0	1.2285	24	294.8	18.41	2.461
27.9	1.2387	25	309.7	19.33	2.584
28.9	1.2489	26	324.7	20.27	2.710
29.8	1.2592	27	340.0	21.22	2.837
30.8	1.2695	28	355.5	22.19	2.966
31.7	1.2800	29	371.2	23.17	3.098
32.6	1.2905	30	387.2	24.17	3.231
33.6	1.3010	31	403.3	25.18	3.366
34.5	1.3117	32	419.7	26.20	3.503
35.4	1.3224	33	436.4	27.24	3.642
36.2	1.3331	34	453.3	28.30	3.783
37.1	1.3440	35	470.4	29.37	3.926
38.0	1.3549	36	487.8	30.45	4.070
38.8	1.3659	37	505.4	31.55	4.218
39.7	1.3769	38	523.2	32.66	4.366
40.5	1.3879	39	541.3	33.79	4.517
41.4	1.3991	40	559.6	34.94	4.670
42.2	1.4103	41	578.2	36.10	4.825
43.0	1.4215	42	597.0	37.27	4.982
43.8	1.4329	43	616.1	38.46	5.142
44.6	1.4443	44	635.5	39.67	5.303
45.4	1.4558	45	655.1	40.90	5.467
46.2	1.4673	46	675.0	42.14	5.633
47.0	1.4790	47	695.1	43.39	5.801
47.7	1.4907	48	715.5	44.67	5.971
48.5	1.5025	49	736.2	45.96	6.144
49.2	1.5143	50	757.2	47.27	6.319
50.0	1.5262	51	778.4	48.59	6.496
50.7	1.5382	52	799.9	49.93	6.675

POTASSIUM IODIDE

Specific Gravity of Aqueous Potassium Iodide Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KI	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0055	1	10.06	0.6277	0.0839
1.9	1.0130	2	20.26	1.265	0.1691
4.0	1.0281	4	41.12	2.567	0.3432
6.1	1.0437	6	62.62	3.909	0.5226
8.2	1.0597	8	84.78	5.292	0.7075
10.3	1.0761	10	107.6	6.718	0.8980
12.3	1.0930	12	131.2	8.188	1.095
14.4	1.1104	14	155.5	9.705	1.297
16.5	1.1284	16	180.5	11.27	1.507
18.6	1.1469	18	206.4	12.89	1.723
20.6	1.1660	20	233.2	14.56	1.946
23.7	1.1857	22	260.9	16.28	2.177
24.8	1.2060	24	289.4	18.07	2.415
26.8	1.2270	26	319.0	19.92	2.662
28.9	1.2487	28	349.6	21.83	2.918
30.9	1.2712	30	381.4	23.81	3.183
36.0	1.3308	35	465.8	29.08	3.887
41.1	1.3959	40	558.4	34.86	4.660
46.2	1.4672	45	660.2	41.22	5.510
51.2	1.5458	50	772.9	48.25	6.450
56.2	1.6327	55	898.0	56.06	7.494

POTASSIUM NITRATE

Specific Gravity of Aqueous Potassium Nitrate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent KNO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0045	1	10.05	0.6271	0.0838
1.5	1.0108	2	20.22	1.262	0.1687
3.3	1.0234	4	40.94	2.556	0.3416
5.1	1.0363	6	62.18	3.882	0.5189
6.8	1.0494	8	83.95	5.241	0.7006
8.6	1.0627	10	106.3	6.634	0.8868
10.3	1.0762	12	129.1	8.062	1.078
12.0	1.0899	14	152.6	9.525	1.273
13.7	1.1039	16	176.6	11.03	1.474
15.3	1.1181	18	201.3	12.56	1.680
17.0	1.1326	20	226.5	14.14	1.890
18.6	1.1473	22	252.4	15.76	2.106
20.2	1.1623	24	279.0	17.41	2.328

POTASSIUM SULFATE

Specific Gravity of Aqueous Potassium Sulfate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent K_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0063	1	10.06	0.6282	0.0840
2.1	1.0145	2	20.29	1.267	0.1693
4.4	1.0310	4	41.24	2.574	0.3442
6.6	1.0477	6	62.86	3.924	0.5246
8.8	1.0646	8	85.17	5.317	0.7107
11.0	1.0817	10	108.17	6.753	0.9027

POTASSIUM TARTRATE

SPECIFIC GRAVITY OF AQUEOUS POTASSIUM TARTRATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $K_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0048	1	10.05	0.6273	0.0839
1.6	1.0114	2	20.23	1.263	0.1688
3.5	1.0248	4	40.99	2.559	0.3421
5.4	1.0383	6	62.30	3.889	0.5199
7.2	1.0519	8	84.15	5.253	0.7023
8.9	1.0657	10	106.6	6.653	0.8894
10.7	1.0798	12	129.6	8.089	1.081
12.5	1.0941	14	153.2	9.562	1.278
14.2	1.1087	16	177.4	11.07	1.480
16.0	1.1236	18	202.3	12.63	1.688
17.7	1.1387	20	227.7	14.22	1.901
19.4	1.1540	22	253.9	15.85	2.119
21.0	1.1696	24	280.7	17.52	2.343
22.7	1.1855	26	308.2	19.24	2.572
24.3	1.2017	28	336.5	21.01	2.808
26.0	1.2181	30	365.4	22.81	3.050
30.0	1.2606	35	441.2	27.54	3.682
33.9	1.3051	40	522.0	32.59	4.357
37.7	1.3516	45	608.2	37.97	5.076
41.4	1.4001	50	700.1	43.70	5.842

Bé.	Sp. gr.	Per cent $K_2C_4H_4O_6 + \frac{1}{2}H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0048	1.040	10.45	0.6522	0.0872
1.6	1.0114	2.080	21.03	1.313	0.1755
3.5	1.0248	4.159	42.62	2.661	0.3557
5.4	1.0383	6.239	64.78	4.044	0.5406
7.2	1.0519	8.319	87.50	5.462	0.7302
8.9	1.0657	10.40	110.8	6.918	0.9247
10.7	1.0798	12.48	134.7	8.411	1.124
12.5	1.0941	14.56	159.3	9.943	1.329
14.2	1.1087	16.64	184.5	11.52	1.539
16.0	1.1236	18.72	210.3	13.13	1.755
17.7	1.1387	20.80	236.8	14.78	1.976
19.4	1.1540	22.88	264.0	16.48	2.203
21.0	1.1696	24.96	291.9	18.22	2.436
22.7	1.1855	27.03	320.5	20.01	2.675
24.3	1.2017	29.12	349.9	21.84	2.920
26.0	1.2181	31.19	380.0	23.72	3.171
30.0	1.2606	36.39	458.8	28.64	3.829
33.9	1.3051	41.59	542.8	33.89	4.530
37.7	1.3516	46.79	632.4	39.48	5.278
41.4	1.4001	51.99	727.9	45.44	6.075

SODIUM ARSENATE

SPECIFIC GRAVITY OF AQUEOUS DI-SODIUM ARSENATE SOLUTIONS AT $\frac{14^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent Na_2HAsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	1	10.08	0.6295	0.0841
2.5	1.0175	2	20.35	1.270	0.1698
5.1	1.0365	4	41.46	2.588	0.3460
7.7	1.0563	6	63.38	3.957	0.5289
10.3	1.0768	8	86.14	5.378	0.7189
12.9	1.0980	10	109.8	6.854	0.9163
15.5	1.1197	12	134.4	8.388	1.121
18.0	1.1419	14	159.9	9.980	1.334
20.5	1.1645	16	186.3	11.63	1.555

Bé.	Sp. gr.	Per cent $Na_2HAsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0083	2.163	21.80	1.361	0.1819
2.5	1.0175	4.325	44.01	2.747	0.3672
5.1	1.0365	8.650	89.66	5.597	0.7482
7.7	1.0563	12.98	137.1	8.556	1.144
10.3	1.0768	17.30	186.3	11.63	1.555
12.9	1.0980	21.63	237.4	14.82	1.982
15.5	1.1197	25.95	290.6	18.14	2.425
18.0	1.1419	30.28	345.7	21.58	2.885
20.5	1.1645	34.60	402.9	25.15	3.363

SODIUM ARSENATE

SPECIFIC GRAVITY OF AQUEOUS DI-SODIUM ARSENATE SOLUTIONS AT 14° C. (SCHIFF)

Bé.	Sp. gr.	Per cent $Na_2HAsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0042	1	10.04	0.6269	0.0838
1.2	1.0084	2	20.17	1.259	0.1683
1.8	1.0126	3	30.38	1.896	0.2535
2.4	1.0168	4	40.67	2.539	0.3394
3.0	1.0212	5	51.06	3.188	0.4261
3.6	1.0256	6	61.54	3.842	0.5135
4.2	1.0300	7	72.10	4.501	0.6017
4.8	1.0344	8	82.75	5.166	0.6906
5.4	1.0389	9	93.50	5.837	0.7803
6.0	1.0434	10	104.3	6.514	0.8707
6.6	1.0479	11	115.3	7.196	0.9619
7.2	1.0525	12	126.3	7.885	1.054
7.8	1.0571	13	137.4	8.579	1.147
8.4	1.0618	14	148.7	9.280	1.241
9.0	1.0665	15	160.0	9.987	1.335
9.6	1.0712	16	171.4	10.70	1.430
10.2	1.0759	17	182.9	11.42	1.526
10.8	1.0807	18	194.5	12.14	1.623
11.4	1.0855	19	206.2	12.88	1.721
12.0	1.0904	20	218.1	13.61	1.820
12.6	1.0953	21	230.0	14.36	1.920
13.2	1.1002	22	242.0	15.11	2.020
13.8	1.1052	23	254.2	15.87	2.121
14.4	1.1102	24	266.4	16.63	2.224
15.0	1.1153	25	278.8	17.41	2.327
15.6	1.1204	26	291.3	18.19	2.431
16.2	1.1255	27	303.9	18.97	2.536
16.8	1.1306	28	316.6	19.76	2.642
17.3	1.1358	29	329.4	20.56	2.749
17.9	1.1410	30	342.3	21.37	2.857
18.5	1.1463	31	355.4	22.18	2.965
19.1	1.1516	32	368.5	23.01	3.075
19.7	1.1569	33	381.8	23.83	3.186
20.2	1.1623	34	395.2	24.67	3.298
20.8	1.1677	35	408.7	25.51	3.411
21.4	1.1731	36	422.3	26.36	3.524
22.0	1.1786	37	436.1	27.22	3.639
22.5	1.1838	38	449.1	28.03	3.748
23.1	1.1896	39	464.0	28.96	3.872
23.7	1.1952	40	478.1	29.85	3.990

SODIUM ARSENATE

SPECIFIC GRAVITY OF AQUEOUS TRI-SODIUM ARSENATE SOLUTIONS AT $\frac{17°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_3AsO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0097	1	10.10	0.6303	0.0843
2.9	1.0207	2	20.41	1.274	0.1704
6.0	1.0431	4	41.72	2.605	0.3482
9.0	1.0659	6	63.95	3.992	0.5337
11.9	1.0892	8	87.14	5.440	0.7272
14.7	1.1130	10	111.3	6.948	0.9288
17.5	1.1373	12	136.5	8.520	1.1389

Bé.	Sp. gr.	Per cent $Na_3AsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0097	2.040	20.59	1.286	0.1719
2.9	1.0207	4.079	41.64	2.599	0.3475
6.0	1.0431	8.158	85.10	5.313	0.7102
9.0	1.0659	12.237	130.4	8.143	1.089
11.9	1.0892	16.317	177.7	11.09	1.483
14.7	1.1130	20.396	227.0	14.17	1.894
17.5	1.1373	24.4752	278.4	17.38	2.323

SPECIFIC GRAVITY OF AQUEOUS TRI-SODIUM ARSENATE SOLUTIONS AT 17° C. (SCHIFF)

Bé.	Sp. gr.	Per cent $Na_3AsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0053	1	10.05	0.6276	0.0839
1.5	1.0107	2	20.21	1.262	0.1687
2.3	1.0161	3	30.48	1.903	0.2544
3.1	1.0215	4	40.86	2.551	0.3410
3.8	1.0270	5	51.35	3.206	0.4285
4.6	1.0325	6	61.95	3.867	0.5170
5.3	1.0380	7	72.66	4.536	0.6064

SODIUM ARSENATE (Continued)

Specific Gravity of Aqueous Tri-sodium Arsenate Solutions at 17° C. (Schiff)

Bé.	Sp. gr.	Per cent $Na_3AsO_4 + 12H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
6.0	1.0435	8	83.48	5.211	0.6967
6.8	1.0491	9	94.42	5.894	0.7880
7.5	1.0547	10	105.5	6.584	0.8802
8.3	1.0603	11	116.6	7.281	0.9733
9.0	1.0659	12	127.9	7.985	1.067
9.7	1.0716	13	139.3	8.697	1.163
10.4	1.0773	14	150.8	9.415	1.259
11.1	1.0830	15	162.5	10.14	1.356
11.8	1.0887	16	174.2	10.87	1.454
12.5	1.0945	17	186.1	11.62	1.553
13.2	1.1003	18	198.1	12.36	1.653
13.9	1.1061	19	210.2	13.12	1.754
14.6	1.1120	20	222.4	13.88	1.856
15.3	1.1179	21	234.8	14.66	1.959
16.0	1.1238	22	247.2	15.43	2.063

SODIUM BROMIDE

Specific Gravity of Aqueous Sodium Bromide Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent NaBr	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0060	1	10.06	0.6280	0.0840
2.0	1.0139	2	20.28	1.266	0.1692
4.2	1.0298	4	41.19	2.571	0.3438
6.4	1.0462	6	62.77	3.919	0.5238
8.6	1.0631	8	85.05	5.309	0.7097
10.8	1.0803	10	108.0	6.744	0.9015
13.0	1.0981	12	131.8	8.226	1.100
15.1	1.1164	14	156.3	9.757	1.304
17.3	1.1352	16	181.6	11.34	1.516
19.4	1.1546	18	207.8	12.97	1.734
21.5	1.1745	20	234.9	14.66	1.960
23.7	1.1951	22	262.9	16.41	2.194
25.8	1.2163	24	291.9	18.22	2.436
27.9	1.2382	26	321.9	20.10	2.687
30.0	1.2608	28	353.0	22.04	2.946
32.1	1.2841	30	385.2	24.05	3.215
37.3	1.3462	35	471.2	29.41	3.932
42.4	1.4138	40	565.5	35.30	4.719

SODIUM CARBONATE

Specific Gravity of Aqueous Sodium Carbonate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2CO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0086	1	10.09	0.6296	0.0842
2.7	1.0190	2	20.38	1.272	0.1701
5.6	1.0398	4	41.59	2.596	0.3471
8.3	1.0606	6	63.64	3.973	0.5311
10.9	1.0816	8	86.53	5.402	0.7221
13.5	1.1029	10	110.3	6.885	0.9204
16.0	1.1244	12	134.9	8.423	1.126
18.5	1.1463	14	160.5	10.02	1.339

Bé.	Sp. gr.	Per cent $Na_2CO_3 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.2	1.0086	2.70	27.23	1.700	0.2272
2.7	1.0190	5.40	55.02	3.435	0.4592
5.6	1.0398	10.80	112.3	7.010	0.9370
8.3	1.0606	16.20	171.8	10.72	1.434
10.9	1.0816	21.60	233.6	14.58	1.949
13.5	1.1029	27.00	297.7	18.59	2.485
16.0	1.1244	32.40	364.3	22.74	3.040
18.5	1.1463	37.80	433.3	27.05	3.616

SODIUM CHLORIDE

Specific Gravity of Aqueous Sodium Chloride Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent NaCl	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0053	1	10.05	0.6276	0.0839
1.8	1.0125	2	20.25	1.264	0.1690
3.8	1.0268	4	41.07	2.564	0.3428
5.8	1.0413	6	62.48	3.900	0.5214
7.7	1.0559	8	84.47	5.273	0.7049
9.6	1.0707	10	107.1	6.684	0.8935
11.5	1.0857	12	130.3	8.133	1.087
13.3	1.1009	14	154.1	9.622	1.286
15.1	1.1162	16	178.6	11.15	1.490
16.9	1.1319	18	203.7	12.72	1.700
18.7	1.1478	20	229.6	14.33	1.916
20.4	1.1640	22	256.1	15.99	2.137
22.2	1.1804	24	283.3	17.69	2.364
23.9	1.1972	26	311.3	19.43	2.598

SODIUM CHROMATE

Specific Gravity of Aqueous Sodium Chromate Solutions at $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent Na_2CrO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0074	1	10.07	0.6289	0.0841
2.3	1.0163	2	20.33	1.269	0.1696
4.8	1.0344	4	41.38	2.583	0.3453
7.3	1.0529	6	63.17	3.944	0.5272
9.7	1.0718	8	85.74	5.353	0.7156
12.1	1.0912	10	109.1	6.812	0.9106
14.5	1.1110	12	133.3	8.323	1.113
16.8	1.1312	14	158.4	9.886	1.322
19.1	1.1518	16	184.3	11.50	1.538
21.4	1.1728	18	211.1	13.18	1.762
23.6	1.1942	20	238.8	14.91	1.993
25.8	1.2160	22	267.5	16.70	2.233
27.9	1.2383	24	297.2	18.55	2.480
30.0	1.2611	26	327.9	20.47	2.736

SODIUM DICHROMATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM DICHROMATE SOLUTIONS AT $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2Cr_2O_7$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.06	0.6280	0.0840
2.0	1.014	2	20.26	1.265	0.1691
3.8	1.027	4	41.08	2.565	0.3428
6.1	1.044	6	62.46	3.899	0.5212
8.2	1.060	8	84.48	5.274	0.7050
10.2	1.076	10	107.0	6.680	0.8929
12.3	1.093	12	130.1	8.121	1.086
14.3	1.109	14	153.7	9.596	1.283
16.3	1.127	16	177.9	11.11	1.485
18.1	1.143	18	202.7	12.65	1.691
20.1	1.161	20	228.0	14.23	1.903
21.9	1.178	22	253.7	15.84	2.117
23.9	1.197	24	279.8	17.47	2.335
25.7	1.215	26	306.5	19.14	2.558
27.5	1.234	28	334.0	20.85	2.788
29.3	1.253	30	362.1	22.60	3.022
33.7	1.303	35	435.4	27.18	3.634
37.9	1.354	40	511.6	31.94	4.269
41.9	1.406	45	590.4	36.86	4.927
45.6	1.459	50	671.0	41.89	5.600

SODIUM HYDROXIDE

Specific Gravity of Aqueous Sodium Hydroxide Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent NaOH	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0095	1	10.10	0.6302	0.0842
2.9	1.0207	2	20.41	1.274	0.1704
4.5	1.0318	3	30.95	1.932	0.2583
6.0	1.0428	4	41.71	2.604	0.3481
7.4	1.0538	5	52.69	3.289	0.4397
8.8	1.0648	6	63.89	3.988	0.5332
10.2	1.0758	7	75.31	4.701	0.6284
11.6	1.0869	8	86.95	5.428	0.7256
12.9	1.0979	9	98.81	6.168	0.8246
14.2	1.1089	10	110.9	6.923	0.9254
16.8	1.1309	12	135.7	8.472	1.133
19.2	1.1530	14	161.4	10.08	1.347
21.6	1.1751	16	188.0	11.74	1.569
23.9	1.1972	18	215.5	13.45	1.798
26.1	1.2191	20	243.8	15.22	2.035
28.2	1.2411	22	273.0	17.05	2.279
30.2	1.2629	24	303.1	18.92	2.529
32.1	1.2848	26	334.0	20.85	2.788
34.0	1.3064	28	365.8	22.84	3.053
35.8	1.3279	30	398.4	24.87	3.324
37.5	1.3490	32	431.7	26.95	3.602
39.1	1.3696	34	465.7	29.07	3.886
40.7	1.3900	36	500.4	31.24	4.176
42.2	1.4101	38	535.8	33.45	4.472
43.6	1.4300	40	572.0	35.71	4.773
45.0	1.4494	42	608.7	38.00	5.080
46.3	1.4685	44	646.1	40.34	5.392
47.5	1.4873	46	684.2	42.71	5.709
48.8	1.5065	48	723.1	45.14	6.035
49.9	1.5253	50	762.7	47.61	6.364

SODIUM NITRATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM NITRATE SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $NaNO_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0049	1	10.05	0.6273	0.0839
1.7	1.0117	2	20.23	1.263	0.1689
3.6	1.0254	4	41.02	2.561	0.3423
5.5	1.0392	6	62.35	3.892	0.5203
7.3	1.0532	8	84.26	5.260	0.7031
9.2	1.0674	10	106.7	6.663	0.8908
11.0	1.0819	12	129.8	8.105	1.083
12.8	1.0967	14	153.5	9.585	1.281
14.6	1.1118	16	177.9	11.11	1.485
16.4	1.1272	18	202.9	12.67	1.693
18.1	1.1429	20	228.6	14.27	1.908
19.9	1.1589	22	255.0	15.92	2.128
21.6	1.1752	24	282.0	17.61	2.354
23.3	1.1917	26	309.8	19.34	2.586
25.0	1.2085	28	338.4	21.12	2.824
26.7	1.2256	30	367.7	22.95	3.068
30.8	1.2701	35	444.5	27.75	3.710
34.9	1.3175	40	527.0	32.90	4.398
39.0	1.3683	45	615.7	38.44	5.138

SODIUM NITRITE

SPECIFIC GRAVITY OF AQUEOUS SODIUM NITRITE SOLUTIONS AT $\frac{15^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $NaNO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0058	1	10.06	0.6279	0.0839
1.8	1.0125	2	20.25	1.264	0.1690
3.7	1.0260	4	41.04	2.562	0.3425
5.5	1.0397	6	62.38	3.894	0.5206
7.4	1.0535	8	84.28	5.261	0.7033
9.2	1.0675	10	106.8	6.664	0.8909
10.9	1.0816	12	129.8	8.103	1.083
12.7	1.0959	14	153.4	9.578	1.280
14.4	1.1103	16	177.6	11.09	1.483
16.1	1.1248	18	202.5	12.64	1.690
17.7	1.1394	20	227.9	14.23	1.902

SODIUM POTASSIUM TARTRATE

Specific Gravity of Aqueous Sodium Potassium Tartrate (Rochelle Salt) Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $NaKC_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0049	1	10.05	0.6273	0.0839
1.7	1.0116	2	20.23	1.263	0.1688
3.6	1.0252	4	41.01	2.560	0.3422
5.4	1.0390	6	62.34	3.892	0.5202
7.3	1.0530	8	84.24	5.259	0.7030
9.1	1.0673	10	106.7	6.663	0.8907
11.0	1.0818	12	129.8	8.104	1.083
12.8	1.0965	14	153.5	9.583	1.281
14.5	1.1114	16	177.8	11.10	1.484
16.3	1.1265	18	202.8	12.66	1.692
18.0	1.1419	20	228.4	14.26	1.906
19.7	1.1576	22	254.7	15.90	2.125
21.4	1.1735	24	281.6	17.58	2.350
23.1	1.1896	26	309.3	19.31	2.581
24.8	1.2059	28	337.7	21.08	2.818
26.4	1.2225	30	366.8	22.90	3.061
28.0	1.2394	32	396.6	24.76	3.310
29.6	1.2566	34	427.2	26.67	3.565
31.2	1.2742	36	458.7	28.64	3.828

Bé.	Sp. gr.	Per cent $NaKC_4H_4O_6 + 4H_2O$	G. per liter	Lbs. per cu. ft.	Lb. per gal.
0.7	1.0049	1.343	13.50	0.8425	0.1127
1.7	1.0116	2.686	27.17	1.696	0.2267
3.6	1.0252	5.372	55.07	3.438	0.4596
5.4	1.0390	8.058	83.72	5.227	0.6986
7.3	1.0530	10.74	113.1	7.063	0.9441
9.1	1.0673	13.43	143.3	8.948	1.196
11.0	1.0818	16.12	174.3	10.88	1.455
12.8	1.0965	18.80	206.2	12.87	1.721
14.5	1.1114	21.49	238.8	14.91	1.993
16.3	1.1265	24.17	272.3	17.00	2.273
18.0	1.1419	26.86	306.7	19.15	2.560
19.7	1.1576	29.55	342.0	21.35	2.854
21.4	1.1735	32.23	378.2	23.61	3.157
23.1	1.1896	34.92	415.4	25.93	3.466
24.8	1.2059	37.60	453.5	28.31	3.784
26.4	1.2225	40.29	492.5	30.75	4.110
28.0	1.2394	42.98	532.6	33.25	4.445
29.6	1.2566	45.66	573.8	35.82	4.788
31.2	1.2742	48.35	616.1	38.46	5.141

SODIUM SILICATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM SILICATE SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $Na_2O + 3.9SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.4	1.046	6	62.76	3.918	0.5237
8.6	1.063	8	85.04	5.309	0.7097
10.7	1.080	10	108.0	6.742	0.9013
12.9	1.098	12	131.8	8.225	1.100
14.6	1.116	14	156.2	9.754	1.304
17.1	1.134	16	181.4	11.33	1.514
19.2	1.153	18	207.5	12.96	1.732
21.3	1.172	20	234.4	14.63	1.956
23.3	1.191	22	262.0	16.36	2.187
25.3	1.211	24	290.6	18.14	2.425
27.3	1.232	26	320.3	20.00	2.673
29.3	1.253	28	350.8	21.90	2.928
31.3	1.275	30	382.5	23.88	3.192
33.3	1.298	32	415.4	25.93	3.466

Bé.	Sp. gr.	Per cent $Na_2O + 3.36SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
2.0	1.014	2	20.28	1.266	0.1692
4.2	1.030	4	41.20	2.572	0.3438
6.5	1.047	6	62.82	3.922	0.5243
8.9	1.065	8	85.20	5.319	0.7110
11.1	1.083	10	108.3	6.761	0.9038
13.3	1.101	12	132.1	8.248	1.103
15.5	1.120	14	156.8	9.789	1.309
17.7	1.139	16	182.2	11.38	1.521
19.9	1.159	18	208.6	13.02	1.741
22.0	1.179	20	235.8	14.72	1.968
24.2	1.200	22	264.0	16.48	2.203
26.3	1.222	24	293.3	18.31	2.447
28.4	1.244	26	323.4	20.19	2.699
30.6	1.267	28	354.8	22.15	2.961
32.6	1.290	30	387.0	24.16	3.230
34.7	1.314	32	420.5	26.25	3.509
36.7	1.339	34	455.3	28.42	3.799
38.8	1.365	36	491.4	30.68	4.101
40.9	1.393	38	529.3	33.05	4.417

SODIUM SILICATE

Specific Gravity of Aqueous Sodium Silicate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2O + 2.40SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.8	1.034	4	41.36	2.582	0.3452
7.2	1.052	6	63.12	3.940	0.5268
9.6	1.071	8	85.68	5.349	0.7150
12.0	1.090	10	109.0	6.805	0.9096
14.4	1.110	12	133.2	8.315	1.112
16.7	1.130	14	158.2	9.876	1.320
19.0	1.151	16	184.2	11.50	1.537

Bé.	Sp. gr.	Per cent $Na_2O + 2.44SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
32.2	1.285	28	359.8	22.46	3.003
34.2	1.309	30	392.7	24.52	3.277
36.3	1.334	32	426.9	26.65	3.562
38.4	1.360	34	462.4	28.87	3.859
40.5	1.387	36	499.3	31.17	4.167
42.5	1.415	38	537.7	33.57	4.487
44.7	1.445	40	578.0	36.08	4.824

Bé.	Sp. gr.	Per cent $Na_2O + 2.06SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.3	1.016	2	20.32	1.269	0.1696
4.9	1.035	4	41.40	2.584	0.3455
7.4	1.054	6	63.24	3.948	0.5278
9.9	1.073	8	85.84	5.359	0.7164
12.3	1.093	10	109.3	6.823	0.9121
14.7	1.113	12	133.6	8.338	1.115
17.1	1.134	14	158.8	9.911	1.325
19.6	1.156	16	185.0	11.55	1.544
21.9	1.178	18	212.0	13.24	1.770
24.2	1.200	20	240.0	14.98	2.003

SODIUM SILICATE (Continued)

Specific Gravity of Aqueous Sodium Silicate Solutions at $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2O + 2.06SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
26.4	1.223	22	269.1	16.80	2.245
28.7	1.247	24	299.3	18.68	2.498
30.9	1.271	26	330.5	20.63	2.758
33.1	1.296	28	362.9	22.65	3.028
35.2	1.321	30	396.3	24.74	3.307
37.3	1.346	32	430.7	26.89	3.594
39.2	1.371	34	466.1	29.10	3.890
41.2	1.397	36	502.9	31.40	4.197
43.1	1.423	38	540.7	33.76	4.513
45.0	1.450	40	580.0	36.21	4.840
49.6	1.520	45	684.0	42.70	5.708
54.0	1.594	50	797.0	49.75	6.651
58.3	1.673	55	920.2	57.44	7.679

Bé.	Sp. gr.	Per cent $Na_2O + 1.69SiO_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.4	1.017	2	20.34	1.270	0.1697
5.0	1.036	4	41.44	2.587	0.3458
7.7	1.056	6	63.36	3.955	0.5288
10.4	1.077	8	86.16	5.379	0.7190
12.9	1.098	10	109.8	6.854	0.9163
15.4	1.119	12	134.3	8.383	1.121
17.9	1.141	14	159.7	9.972	1.333
20.3	1.163	16	186.1	11.62	1.553
22.7	1.186	18	213.5	13.33	1.782
25.2	1.210	20	242.0	15.11	2.020
27.5	1.234	22	271.5	16.95	2.266
29.8	1.259	24	302.2	18.86	2.522
32.1	1.284	26	333.8	20.84	2.786
34.3	1.310	28	366.8	22.90	3.061
36.6	1.337	30	401.1	25.04	3.347
38.8	1.365	32	436.8	27.27	3.645
41.0	1.394	34	474.0	29.59	3.955
43.2	1.424	36	512.6	32.00	4.278
45.4	1.456	38	553.3	34.54	4.617

SODIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM SULFATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent Na_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0073	1	10.07	0.6288	0.0841
2.3	1.0164	2	20.33	1.269	0.1696
4.9	1.0348	4	41.39	2.584	0.3454
7.4	1.0535	6	63.21	3.946	0.5275
9.8	1.0724	8	85.79	5.356	0.7160
12.2	1.0915	10	109.2	6.814	0.9109
14.5	1.1109	12	133.3	8.322	1.112
16.8	1.1306	14	158.3	9.881	1.321
19.0	1.1506	16	184.1	11.49	1.536
21.2	1.1709	18	210.8	13.16	1.759
23.3	1.1915	20	238.3	14.88	1.989
25.4	1.2124	22	266.7	16.65	2.226
27.5	1.2336	24	296.1	18.48	2.471

Bé.	Sp. gr.	Per cent $Na_2SO_4 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0073	2.268	22.85	1.426	0.1907
2.3	1.0164	4.536	46.11	2.878	0.3848
4.9	1.0348	9.073	93.88	5.861	0.7835
7.4	1.0535	13.61	143.4	8.950	1.197
9.8	1.0724	18.15	194.6	12.15	1.624
12.2	1.0915	22.68	247.6	15.46	2.066
14.5	1.1109	27.22	302.4	18.88	2.523
16.8	1.1306	31.75	359.0	22.41	2.996
19.0	1.1506	36.29	417.6	26.07	3.485
21.2	1.1709	40.83	478.1	29.84	3.989
23.3	1.1915	45.36	540.5	33.74	4.511
25.4	1.2124	49.90	605.0	37.77	5.049
27.5	1.2336	54.44	671.5	41.92	5.604

SODIUM SULFATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM SULFATE SOLUTIONS AT 15° C. (GERLACH)

Bé.	Sp. gr.	Per cent $Na_2SO_4 + 10H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.004	1	10.04	0.6268	0.0838
1.2	1.008	2	20.16	1.259	0.1682
1.9	1.013	3	30.39	1.897	0.2536
2.3	1.016	4	40.64	2.537	0.3392
2.8	1.020	5	51.00	3.184	0.4256
3.4	1.024	6	61.44	3.836	0.5127
4.0	1.028	7	71.96	4.492	0.6005
4.5	1.032	8	82.56	5.154	0.6890
5.0	1.036	9	93.24	5.821	0.7781
5.6	1.040	10	104.0	6.492	0.8679
6.1	1.044	11	114.8	7.169	0.9584
6.5	1.047	12	125.6	7.843	1.048
7.2	1.052	13	136.8	8.538	1.141
7.7	1.056	14	147.8	9.229	1.234
8.2	1.060	15	159.0	9.926	1.327
8.7	1.064	16	170.2	10.63	1.421
9.4	1.069	17	181.7	11.34	1.517
9.9	1.073	18	193.1	12.06	1.612
10.4	1.077	19	204.6	12.77	1.708
11.0	1.082	20	216.4	13.51	1.806
11.5	1.086	21	228.1	14.24	1.903
12.0	1.090	22	239.8	14.97	2.001
12.5	1.094	23	251.6	15.71	2.100
12.9	1.098	24	263.5	16.45	2.199
13.5	1.103	25	275.8	17.21	2.301
14.0	1.107	26	287.8	17.97	2.402
14.5	1.111	27	300.0	18.73	2.503
15.1	1.116	28	312.5	19.51	2.608
15.5	1.120	29	324.8	20.28	2.711
16.1	1.125	30	337.5	21.07	2.817

SODIUM SULFATE

Specific Gravity of Aqueous Sodium Sulfate Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent Na_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.004	0.44	4.440	0.2772	0.0371
1.2	1.008	0.88	8.916	0.5566	0.0744
1.9	1.013	1.33	13.44	0.8390	0.1122
2.3	1.016	1.77	17.97	1.122	0.1500
2.8	1.020	2.21	22.55	1.408	0.1882
3.4	1.024	2.65	27.17	1.696	0.2268
4.0	1.028	3.10	31.82	1.987	0.2656
4.5	1.032	3.54	36.51	2.279	0.3047
5.0	1.036	3.98	41.24	2.574	0.3441
5.6	1.040	4.42	45.99	2.871	0.3838
6.1	1.044	4.86	50.79	3.171	0.4238
6.5	1.047	5.31	55.56	3.469	0.4637
7.2	1.052	5.75	60.48	3.776	0.5047
7.7	1.056	6.19	65.38	4.082	0.5456
8.2	1.060	6.63	70.32	4.390	0.5868
8.7	1.064	7.08	75.29	4.700	0.6283
9.4	1.069	7.52	80.37	5.017	0.6707
9.9	1.073	7.96	85.42	5.332	0.7128
10.4	1.077	8.40	90.50	5.650	0.7552
11.0	1.082	8.85	95.70	5.974	0.7987
11.5	1.086	9.29	100.9	6.296	0.8417
12.0	1.090	9.73	106.1	6.620	0.8850
12.5	1.094	10.2	111.3	6.947	0.9287
12.9	1.098	10.6	116.5	7.275	0.9726
13.5	1.103	11.1	122.0	7.613	1.018
14.0	1.107	11.5	127.3	7.946	1.062
14.5	1.111	11.9	132.7	8.282	1.107
15.1	1.116	12.4	138.2	8.627	1.153
15.5	1.120	12.8	143.6	8.967	1.199
16.1	1.125	13.3	149.3	9.318	1.246

SODIUM SULFIDE

Specific Gravity of Aqueous Sodium Sulfide Solutions at $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent Na_2S	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0098	1	10.10	0.6304	0.0843
3.0	1.0211	2	20.42	1.275	0.1704
6.1	1.0440	4	41.76	2.607	0.3485
9.1	1.0672	6	64.03	3.997	0.5344
12.1	1.0907	8	87.26	5.447	0.7282
14.9	1.1146	10	111.5	6.958	0.9302
17.7	1.1388	12	136.7	8.531	1.140
20.4	1.1634	14	162.9	10.17	1.359
23.0	1.1885	16	190.2	11.87	1.587
25.6	1.2140	18	218.5	13.64	1.824

SODIUM SULFITE

Specific Gravity of Aqueous Sodium Sulfite Solutions at $\frac{19^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent Na_2SO_3	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.1	1.0078	1	10.08	0.6291	0.0841
2.5	1.0172	2	20.34	1.270	0.1698
5.1	1.0363	4	41.45	2.588	0.3459
7.6	1.0556	6	63.34	3.954	0.5286
10.1	1.0751	8	86.01	5.369	0.7178
12.6	1.0948	10	109.5	6.835	0.9136
14.9	1.1146	12	133.8	8.350	1.116
17.2	1.1346	14	158.8	9.916	1.326
19.4	1.1549	16	184.8	11.54	1.542
21.7	1.1755	18	211.6	13.21	1.766

SODIUM SULFITE, ACID (BISULFITE)

SPECIFIC GRAVITY OF AQUEOUS SODIUM BISULFITE AND PROPORTION OF $NaHSO_3$ AT $\frac{15.6°}{15.6°}$ C.

Bé.	Sp. gr.	Per cent $NaHSO_3$	Grams per liter	Lbs. per cu. ft.	Lbs. per gal.
0	1.0000	0.00	0.00	0.0000	0.0000
1	1.0069	1.02	10.27	0.6411	0.0857
2	1.0140	2.04	20.69	1.291	0.1726
3	1.0211	3.06	31.25	1.951	0.2607
4	1.0284	4.08	41.96	2.619	0.3502
5	1.0357	5.11	52.92	3.304	0.4417
6	1.0432	6.15	64.16	4.005	0.5354
7	1.0507	7.19	75.55	4.716	0.6304
8	1.0584	8.24	87.21	5.444	0.7278
9	1.0662	9.30	99.16	6.190	0.8275
10	1.0741	10.36	111.3	6.947	0.9286
11	1.0821	11.42	123.6	7.714	1.031
12	1.0902	12.48	136.1	8.493	1.135
13	1.0985	13.56	149.0	9.299	1.243
14	1.1069	14.65	162.2	10.12	1.353
15	1.1154	15.75	175.7	10.97	1.466
16	1.1240	16.85	189.4	11.82	1.581
17	1.1328	17.96	203.5	12.70	1.698
18	1.1417	19.08	217.8	13.60	1.818
19	1.1508	20.20	232.5	14.51	1.940
20	1.1600	21.32	247.3	15.44	2.064
21	1.1694	22.44	262.4	16.38	2.190
22	1.1789	23.57	277.9	17.35	2.319
23	1.1885	24.71	293.7	18.33	2.451
24	1.1983	25.85	309.8	19.34	2.585
25	1.2083	26.99	326.1	20.36	2.722
26	1.2185	28.13	342.8	21.40	2.860
27	1.2288	29.27	359.7	22.45	3.001
28	1.2393	30.43	377.1	23.54	3.147
29	1.2500	31.57	394.6	24.63	3.293
30	1.2609	32.71	412.4	25.75	3.442
31	1.2719	33.86	430.7	26.88	3.594
32	1.2832	35.01	449.2	28.04	3.749
33	1.2946	36.25	469.3	29.30	3.916
34	1.3063	37.51	490.0	30.59	4.089
35	1.3182	38.78	511.2	31.91	4.266
36	1.3303	40.06	532.9	33.27	4.447
37	1.3426	41.30	554.5	34.61	4.627
38	1.3551	42.52	576.2	35.97	4.808
39	1.3680	43.72	598.1	37.34	4.991

SODIUM SULFITE, ACID (BISULFITE) (Continued)

Specific Gravity of Aqueous Sodium Bisulfite and Proportion of SO_2 at $\frac{15.6°}{15.6°}$ C.

Bé.	Sp. gr.	Per cent SO_2	Grams per liter	Lbs. per cu. ft.	Lbs. per gal.
0	1.0000	0.00	0.000	0.0000	0.0000
1	1.0069	0.63	6.323	0.3947	0.0528
2	1.0140	1.26	12.78	0.7976	0.1066
3	1.0211	1.88	19.20	1.198	0.1602
4	1.0284	2.51	25.81	1.611	0.2154
5	1.0357	3.15	32.62	2.037	0.2723
6	1.0432	3.79	39.54	2.468	0.3299
7	1.0507	4.43	46.55	2.906	0.3884
8	1.0584	5.07	53.66	3.350	0.4478
9	1.0662	5.72	60.99	3.807	0.5089
10	1.0741	6.38	68.53	4.278	0.5719
11	1.0821	7.03	76.07	4.749	0.6348
12	1.0902	7.68	83.73	5.227	0.6987
13	1.0985	8.35	91.72	5.726	0.7655
14	1.1069	9.02	99.84	6.233	0.8332
15	1.1154	9.70	108.2	6.754	0.9029
16	1.1240	10.37	116.6	7.276	0.9727
17	1.1328	11.06	125.3	7.821	1.046
18	1.1417	11.75	134.1	8.374	1.119
19	1.1508	12.43	143.0	8.930	1.194
20	1.1600	13.12	152.2	9.501	1.270
21	1.1694	13.81	161.5	10.08	1.348
22	1.1789	14.51	171.1	10.68	1.428
23	1.1885	15.21	180.8	11.28	1.509
24	1.1983	15.91	190.6	11.90	1.591
25	1.2083	16.61	200.7	12.53	1.675
26	1.2185	17.32	211.0	13.17	1.761
27	1.2288	18.02	221.4	13.82	1.848
28	1.2393	18.73	232.1	14.49	1.937
29	1.2500	19.43	242.9	15.16	2.027
30	1.2609	20.14	253.9	15.85	2.119
31	1.2719	20.84	265.1	16.55	2.212
32	1.2832	21.55	276.5	17.26	2.308
33	1.2946	22.31	288.8	18.03	2.410
34	1.3063	23.09	301.6	18.83	2.517
35	1.3182	23.87	314.7	19.64	2.626
36	1.3303	24.66	328.1	20.48	2.738
37	1.3426	25.42	341.3	21.31	2.848
38	1.3551	26.17	354.6	22.14	2.959
39	1.3680	26.91	368.1	22.98	3.072

SODIUM TARTRATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM TARTRATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $Na_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.8	1.0123	2	20.25	1.264	0.1690
3.8	1.0266	4	41.06	2.564	0.3427
5.7	1.0410	6	62.46	3.899	0.5212
7.6	1.0555	8	84.44	5.271	0.7047
9.5	1.0702	10	107.0	6.681	0.8931
11.4	1.0851	12	130.2	8.129	1.087
13.2	1.1002	14	154.0	9.616	1.285
15.0	1.1156	16	178.5	11.14	1.490
16.8	1.1313	18	203.6	12.71	1.699
18.6	1.1471	20	229.4	14.32	1.915
20.4	1.1633	22	255.9	15.98	2.136
22.1	1.1797	24	283.1	17.67	2.363
23.8	1.1963	26	311.0	19.42	2.596
25.5	1.2132	28	339.7	21.21	2.835

Bé.	Sp. gr.	Per cent $Na_2C_4H_4O_6 + 2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1.186	11.92	0.7441	0.0995
1.8	1.0123	2.371	24.01	1.499	0.2003
3.8	1.0266	4.743	48.69	3.040	0.4063
5.7	1.0410	7.114	74.06	5.623	0.6180
7.6	1.0555	9.486	100.1	6.250	0.8355
9.5	1.0702	11.86	126.9	7.922	1.059
11.4	1.0851	14.23	154.4	9.638	1.288
13.2	1.1002	16.60	182.6	11.40	1.524
15.0	1.1156	18.97	211.6	13.21	1.766
16.8	1.1313	21.34	241.4	15.07	2.015
18.6	1.1471	23.71	272.0	16.98	2.270
20.4	1.1633	26.09	303.5	18.94	2.532
22.2	1.1797	28.46	335.7	20.96	2.802
23.8	1.1963	30.83	368.8	23.02	3.078
25.5	1.2132	33.20	402.8	25.14	3.361

SODIUM THIOSULFATE

Specific Gravity of Aqueous Sodium Thiosulfate (Hypo) Solutions at $\frac{20^\circ}{4^\circ}$ C.*

Bé	Sp. gr.	Per cent $Na_2S_2O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1	10.07	0.6283	0.0840
2.1	1.0148	2	20.30	1.267	0.1694
4.4	1.0315	4	41.26	2.576	0.3443
6.7	1.0483	6	62.90	3.927	0.5249
8.9	1.0654	8	85.23	5.321	0.7113
11.1	1.0827	10	108.3	6.759	0.9035
13.2	1.1003	12	132.0	8.243	1.102
15.3	1.1182	14	156.5	9.773	1.306
17.4	1.1365	16	181.8	11.35	1.517
19.5	1.1551	18	207.9	12.98	1.735
21.5	1.1740	20	234.8	14.66	1.959
23.5	1.1932	22	262.5	16.39	2.191
25.4	1.2128	24	291.1	18.17	2.429
27.4	1.2328	26	320.5	20.01	2.675
29.3	1.2532	28	350.9	21.91	2.928
31.2	1.2739	30	382.2	23.86	3.189
35.8	1.3273	35	464.6	29.00	3.877
40.1	1.3827	40	553.1	34.53	4.616

Bé.	Sp. gr.	Per cent $Na_2S_2O_3 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.0065	1.570	15.80	0.9863	0.1318
2.1	1.0148	3.139	31.86	1.989	0.2659
4.4	1.0315	6.279	64.77	4.043	0.5405
6.7	1.0483	9.418	98.73	6.164	0.8239
8.9	1.0654	12.56	133.8	8.352	1.117
11.1	1.0827	15.70	170.0	10.61	1.418
13.2	1.1003	18.84	207.3	12.94	1.730
15.3	1.1182	21.98	245.7	15.34	2.051
17.4	1.1365	25.12	285.4	17.82	2.382
19.5	1.1551	28.25	326.4	20.37	2.724
21.5	1.1740	31.39	368.6	23.01	3.076
23.5	1.1932	34.53	412.1	25.72	3.439
25.4	1.2128	37.67	456.9	28.52	3.813
27.4	1.2328	40.81	503.1	31.41	4.199
29.3	1.2532	43.95	550.8	34.38	4.597
31.2	1.2739	47.09	599.9	37.45	5.006
35.8	1.3273	54.94	729.2	45.52	6.085
40.1	1.3827	62.79	868.2	54.20	7.245

SODIUM THIOSULFATE

SPECIFIC GRAVITY OF AQUEOUS SODIUM THIOSULFATE (HYPO) SOLUTIONS AT 19° C. (SCHIFF)

Bé.	Sp. gr.	Per cent $Na_2S_2O_3$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	0.637	6.404	0.3998	0.0534
1.5	1.0105	1.27	12.88	0.8038	0.1075
2.3	1.0158	1.91	19.41	1.212	0.1620
3.0	1.0211	2.55	26.02	1.624	0.2172
3.7	1.0264	3.19	32.69	2.041	0.2728
4.5	1.0317	3.82	39.44	2.462	0.3291
5.2	1.0370	4.46	46.24	2.887	0.3859
5.9	1.0423	5.10	53.12	3.316	0.4433
6.6	1.0476	5.73	60.07	3.750	0.5013
7.3	1.0529	6.37	67.08	4.187	0.5598
8.0	1.0584	7.01	74.17	4.630	0.6190
8.7	1.0639	7.65	81.33	5.077	0.6787
9.4	1.0695	8.28	88.58	5.529	0.7392
10.1	1.0751	8.92	95.89	5.986	0.8002
10.8	1.0807	9.56	103.3	6.447	0.8618
11.5	1.0863	10.2	110.7	6.912	0.9240
12.2	1.0919	10.8	118.3	7.382	0.9869
12.9	1.0975	11.5	125.9	7.857	1.050
13.6	1.1031	12.1	133.5	8.335	1.114
14.2	1.1087	12.7	141.3	8.819	1.179
14.9	1.1145	13.4	149.1	9.308	1.244
15.6	1.1204	14.0	157.0	9.803	1.310
16.3	1.1263	14.7	165.0	10.30	1.377
16.9	1.1322	15.3	173.1	10.81	1.445
17.6	1.1381	15.9	181.3	11.32	1.513
18.3	1.1440	16.6	189.5	11.83	1.581
18.9	1.1499	17.2	197.8	12.35	1.651
19.5	1.1558	17.8	206.2	12.87	1.721
20.2	1.1617	18.5	214.6	13.40	1.791
20.8	1.1676	19.1	223.2	13.93	1.862
21.5	1.1738	19.7	231.8	14.47	1.935
22.1	1.1800	20.4	240.6	15.02	2.008
22.8	1.1862	21.0	249.4	15.57	2.081
23.4	1.1924	21.7	258.3	16.12	2.155
24.0	1.1986	22.3	267.3	16.68	2.230
24.7	1.2048	22.9	276.3	17.25	2.306
25.3	1.2110	23.6	285.5	17.82	2.382
25.9	1.2172	24.2	294.7	18.40	2.459
26.5	1.2234	24.8	304.0	18.98	2.537
27.1	1.2297	25.5	313.4	19.56	2.615
27.7	1.2362	26.1	322.9	20.16	2.695
28.3	1.2427	26.8	332.5	20.76	2.775
28.9	1.2492	27.4	342.2	21.36	2.856
29.5	1.2558	28.0	352.0	21.98	2.938
30.1	1.2624	28.7	361.9	22.59	3.020
30.7	1.2690	29.3	371.9	23.22	3.103
31.3	1.2756	29.9	381.9	23.84	3.187
31.9	1.2822	30.6	392.1	24.48	3.272
32.5	1.2888	31.2	402.3	25.12	3.357
33.1	1.2954	31.9	412.6	25.76	3.443

SODIUM THIOSULFATE

Specific Gravity of Aqueous Sodium Thiosulfate Solutions at 19° C. (Schiff)

Bé.	Sp. gr.	Per cent $Na_2S_2O_3 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.8	1.0052	1	10.05	0.6275	0.0839
1.5	1.0105	2	20.21	1.262	0.1687
2.3	1.0158	3	30.47	1.902	0.2543
3.0	1.0211	4	40.84	2.550	0.3409
3.7	1.0264	5	51.32	3.204	0.4283
4.5	1.0317	6	61.90	3.864	0.5166
5.2	1.0370	7	72.59	4.532	0.6058
5.9	1.0423	8	83.38	5.205	0.6959
6.6	1.0476	9	94.28	5.886	0.7868
7.3	1.0529	10	105.3	6.573	0.8787
8.0	1.0584	11	116.4	7.268	0.9716
8.7	1.0639	12	127.7	7.970	1.065
9.4	1.0695	13	139.0	8.680	1.160
10.1	1.0751	14	150.5	9.396	1.256
10.8	1.0807	15	162.1	10.12	1.353
11.5	1.0863	16	173.8	10.85	1.450
12.2	1.0919	17	185.6	11.59	1.549
12.9	1.0975	18	197.6	12.33	1.649
13.6	1.1031	19	209.6	13.08	1.749
14.2	1.1087	20	221.7	13.84	1.850
14.9	1.1145	21	234.0	14.61	1.953
15.6	1.1204	22	246.5	15.39	2.057
16.3	1.1263	23	259.0	16.17	2.162
16.9	1.1322	24	271.7	16.96	2.268
17.6	1.1381	25	284.5	17.76	2.374
18.3	1.1440	26	297.4	18.57	2.482
18.9	1.1499	27	310.4	19.38	2.591
19.5	1.1558	28	323.6	20.20	2.701
20.2	1.1617	29	336.9	21.03	2.811
20.8	1.1676	30	350.3	21.87	2.923
21.5	1.1738	31	363.9	22.72	3.037
22.1	1.1800	32	377.6	23.57	3.151
22.8	1.1862	33	391.4	24.44	3.267
23.4	1.1924	34	405.4	25.31	3.383
24.0	1.1986	35	419.5	26.19	3.501
24.7	1.2048	36	433.7	27.08	3.620
25.3	1.2110	37	448.1	27.97	3.739
25.9	1.2172	38	462.5	28.87	3.860
26.5	1.2234	39	477.1	29.79	3.982
27.1	1.2297	40	491.9	30.71	4.105
27.7	1.2362	41	506.8	31.64	4.230
28.3	1.2427	42	521.9	32.58	4.356
28.9	1.2492	43	537.2	33.53	4.483
29.5	1.2558	44	552.6	34.49	4.611
30.1	1.2624	45	568.1	35.46	4.741
30.7	1.2690	46	583.7	36.44	4.871
31.3	1.2756	47	599.5	37.43	5.003
31.9	1.2822	48	615.5	38.42	5.136
32.5	1.2888	49	631.5	39.42	5.270
33.1	1.2954	50	647.7	40.43	5.405

STANNIC CHLORIDE

Specific Gravity of Aqueous Stannic Chloride Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $SnCl_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1	10.07	0.6286	0.0840
2.1	1.015	2	20.30	1.267	0.1694
4.4	1.031	4	41.24	2.574	0.3442
6.5	1.047	6	62.82	3.922	0.5243
8.7	1.064	8	85.12	5.314	0.7103
10.9	1.081	10	108.1	6.748	0.9021
13.1	1.099	12	131.9	8.233	1.101
15.2	1.117	14	156.4	9.762	1.305
17.2	1.135	16	181.6	11.34	1.515
19.4	1.154	18	207.7	12.97	1.733
21.4	1.173	20	234.6	14.65	1.958
23.4	1.192	22	262.2	16.37	2.188
25.4	1.212	24	290.9	18.16	2.427
27.4	1.233	26	320.6	20.01	2.675
29.5	1.255	28	351.4	21.94	2.933
31.5	1.278	30	383.4	23.93	3.200
36.6	1.337	35	468.0	29.21	3.905
41.7	1.403	40	561.2	35.03	4.683
46.7	1.475	45	663.8	41.44	5.539
51.8	1.555	50	777.5	48.54	6.488
56.8	1.644	55	904.2	56.45	7.546
61.8	1.742	60	1045	65.25	8.722
66.7	1.851	65	1203	75.11	10.04
71.4	1.971	70	1380	86.13	11.51

Bé.	Sp. gr.	Per cent $SnCl_4 + 5H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.007	1.35	13.55	0.8460	0.1131
2.1	1.015	2.69	27.32	1.705	0.2280
4.4	1.031	5.38	55.50	3.465	0.4632
6.5	1.047	8.07	84.54	5.278	0.7055
8.7	1.064	10.8	114.5	7.151	0.9560
10.9	1.081	13.5	145.5	9.082	1.214
13.1	1.099	16.1	177.5	11.08	1.481
15.2	1.117	18.8	210.4	13.14	1.756
17.2	1.135	21.5	244.4	15.26	2.039
19.4	1.154	24.2	279.5	17.45	2.333
21.4	1.173	26.9	315.8	19.71	2.635
23.4	1.192	29.6	352.9	22.03	2.945
25.4	1.212	32.3	391.5	24.44	3.267
27.4	1.233	35.0	431.4	26.93	3.600
29.5	1.255	37.7	472.9	29.52	3.946
31.5	1.278	40.4	516.0	32.21	4.306
36.6	1.337	47.1	629.7	39.31	5.255
41.7	1.403	53.8	755.2	47.15	6.303
46.7	1.475	60.6	893.2	55.78	7.454
51.8	1.555	67.3	1046	65.32	8.732
56.8	1.644	74.0	1217	75.96	10.15
61.8	1.742	80.7	1407	87.81	11.74
66.7	1.851	87.5	1619	101.1	13.51
71.4	1.971	94.2	1857	115.9	15.49

STANNOUS CHLORIDE

Specific Gravity of Aqueous Stannous Chloride Solutions at $\frac{15°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $SnCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0068	1	10.07	0.6285	0.0840
2.1	1.0146	2	20.29	1.267	0.1693
4.3	1.0306	4	41.22	2.573	0.3440
6.5	1.0470	6	62.82	3.922	0.5243
8.7	1.0638	8	85.10	5.313	0.7102
10.9	1.0810	10	108.1	6.748	0.9021
13.0	1.0986	12	131.8	8.230	1.100
15.2	1.1167	14	156.3	9.760	1.305
17.3	1.1353	16	181.6	11.34	1.516
19.4	1.1545	18	207.8	12.97	1.734
21.5	1.1743	20	234.9	14.66	1.960
23.6	1.1948	22	262.9	16.41	2.194
25.8	1.2159	24	291.8	18.22	2.435
27.8	1.2377	26	321.8	20.09	2.686
29.9	1.2603	28	352.9	22.03	2.945
32.0	1.2837	30	385.1	24.04	3.214
37.3	1.3461	35	471.1	29.41	3.932
42.5	1.4145	40	565.8	35.32	4.722
47.7	1.4897	45	670.4	41.85	5.594
52.8	1.5729	50	786.5	49.10	6.563
57.9	1.6656	55	916.1	57.19	7.645
63.1	1.7695	60	1062	66.28	8.860
68.1	1.8865	65	1226	76.55	10.23

Bé.	Sp. gr.	Per cent $SnCl_2$ + $2H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.0	1.0068	1.19	11.98	0.7480	0.1000
2.1	1.0146	2.38	24.15	1.508	0.2015
4.3	1.0306	4.76	49.06	3.063	0.4094
6.5	1.0470	7.14	74.76	4.667	0.6239
8.7	1.0638	9.52	101.3	6.322	0.8452
10.9	1.0810	11.9	128.6	8.031	1.074
13.0	1.0986	14.3	156.9	9.794	1.309
15.2	1.1167	16.7	186.0	11.61	1.553
17.3	1.1353	19.0	216.2	13.49	1.804
19.4	1.1545	21.4	247.3	15.44	2.064
21.5	1.1743	23.8	279.5	17.45	2.332
23.6	1.1948	26.2	312.8	19.53	2.610
25.8	1.2159	28.6	347.3	21.68	2.898
27.8	1.2377	30.9	383.0	23.91	3.196
29.9	1.2603	33.3	419.9	26.22	3.505
32.0	1.2837	35.7	458.3	28.61	3.825
37.3	1.3461	41.7	560.7	35.00	4.679
42.5	1.4145	47.6	673.3	42.03	5.619
47.7	1.4897	53.6	797.8	49.80	6.657
52.8	1.5729	59.5	935.9	58.43	7.810
57.9	1.6656	65.5	1090	68.06	9.098
63.1	1.7695	71.4	1263	78.87	10.54
68.1	1.8865	77.4	1459	91.10	12.18

SPECIFIC GRAVITY OF AQUEOUS SUGAR SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.

Bé.	Sp. gr.	Per cent $C_{12}H_{22}O_{11}$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
....	0.9982	0	....	......	......
0.3	1.0021	1	10.02	0.6256	0.0836
0.9	1.0060	2	20.12	1.256	0.1679
1.4	1.0099	3	30.30	1.891	0.2528
2.0	1.0139	4	40.56	2.532	0.3384
2.5	1.0179	5	50.89	3.177	0.4247
3.1	1.0219	6	61.31	3.827	0.5117
3.6	1.0259	7	71.81	4.483	0.5993
4.1	1.0299	8	82.40	5.144	0.6876
4.7	1.0340	9	93.06	5.810	0.7766
5.3	1.0381	10	103.8	6.481	0.8664
5.8	1.0423	11	114.7	7.157	0.9568
6.4	1.0465	12	125.6	7.839	1.048
7.0	1.0507	13	136.6	8.527	1.140
7.5	1.0549	14	147.7	9.220	1.232
8.1	1.0592	15	158.9	9.918	1.326
8.7	1.0635	16	170.2	10.62	1.420
9.2	1.0678	17	181.5	11.33	1.515
9.8	1.0721	18	193.0	12.05	1.611
10.3	1.0765	19	204.5	12.77	1.707
10.8	1.0810	20	216.2	13.50	1.804
11.4	1.0854	21	227.9	14.23	1.902
12.0	1.0899	22	239.8	14.97	2.001
12.5	1.0944	23	251.7	15.71	2.101
13.1	1.0990	24	263.8	16.47	2.201
13.6	1.1036	25	275.9	17.22	2.302
14.2	1.1082	26	288.1	17.99	2.404
14.7	1.1128	27	300.5	18.76	2.507
15.3	1.1175	28	312.9	19.53	2.611
15.8	1.1222	29	325.4	20.32	2.716
16.3	1.1270	30	338.1	21.11	2.821
16.9	1.1318	31	350.8	21.90	2.928
17.5	1.1366	32	363.7	22.71	3.035
18.0	1.1415	33	376.7	23.51	3.143
18.6	1.1463	34	389.8	24.33	3.253
19.1	1.1513	35	402.9	25.15	3.363
19.6	1.1562	36	416.2	25.98	3.474
20.1	1.1612	37	429.7	26.82	3.586
20.7	1.1663	38	443.2	27.67	3.698
21.2	1.1713	39	456.8	28.52	3.812
21.7	1.1764	40	470.6	29.38	3.927
22.3	1.1816	41	484.5	30.24	4.043
22.8	1.1868	42	498.4	31.12	4.160
23.3	1.1920	43	512.6	32.00	4.277
23.9	1.1972	44	526.8	32.89	4.396
24.4	1.2025	45	541.1	33.78	4.516
25.0	1.2079	46	555.6	34.69	4.637
25.5	1.2132	47	570.2	35.60	4.759
26.0	1.2186	48	584.9	36.52	4.882
26.5	1.2241	49	599.8	37.44	5.005
27.1	1.2296	50	614.8	38.38	5.131
27.6	1.2351	51	629.9	39.32	5.257
28.1	1.2406	52	645.1	40.27	5.384
28.7	1.2462	53	660.5	41.23	5.512
29.2	1.2519	54	676.0	42.20	5.641
29.7	1.2575	55	691.6	43.18	5.772
30.3	1.2632	56	707.4	44.16	5.904

SUCROSE (CANE SUGAR) (Continued)

SPECIFIC GRAVITY OF AQUEOUS SUGAR SOLUTIONS AT $\frac{20°}{4°}$ C.

Bé.	Sp. gr.	Per cent $C_{12}H_{22}O_{11}$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
30.8	1.2690	57	723.3	45.15	6.036
31.3	1.2748	58	739.4	46.16	6.170
31.8	1.2806	59	755.6	47.17	6.305
32.3	1.2865	60	771.9	48.19	6.441
32.8	1.2924	61	788.3	49.21	6.579
33.4	1.2983	62	804.9	50.25	6.717
33.9	1.3043	63	821.7	51.30	6.857
34.4	1.3103	64	838.6	52.35	6.998
34.8	1.3163	65	855.6	53.41	7.140
35.4	1.3224	66	872.8	54.49	7.284
35.9	1.3286	67	890.1	55.57	7.428
36.4	1.3347	68	907.6	56.66	7.574
36.9	1.3409	69	925.2	57.76	7.721
37.4	1.3472	70	943.0	58.87	7.870
37.9	1.3535	71	961.0	59.99	8.019
38.4	1.3598	72	979.0	61.12	8.170
38.9	1.3661	73	997.3	62.26	8.323
39.4	1.3725	74	1016.	63.41	8.476
39.9	1.3790	75	1034.	64.56	8.631
40.4	1.3854	76	1053.	65.73	8.787
40.9	1.3920	77	1072.	66.91	8.944
41.4	1.3985	78	1091.	68.10	9.103
41.8	1.4051	79	1110.	69.29	9.263
42.2	1.4117	80	1129.	70.50	9.425
42.7	1.4184	81	1149.	71.72	9.588
43.2	1.4251	82	1169.	72.95	9.752
43.7	1.4318	83	1188.	74.19	9.917
44.2	1.4386	84	1208.	75.44	10.08
44.7	1.4454	85	1229.	76.70	10.25
45.2	1.4522	86	1249.	77.97	10.42
45.6	1.4591	87	1269.	79.25	10.59
46.1	1.4660	88	1290.	80.54	10.77
46.6	1.4730	89	1311.	81.85	10.94

SULFURIC ACID

SPECIFIC GRAVITY OF AQUEOUS SULFURIC ACID SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent H_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.7	1.0051	1	10.05	0.6275	0.0839
1.7	1.0118	2	20.24	1.263	0.1689
2.6	1.0184	3	30.55	1.907	0.2550
3.5	1.0250	4	41.00	2.560	0.3422
4.5	1.0317	5	51.59	3.220	0.4305
5.4	1.0385	6	62.31	3.890	0.5200
6.3	1.0453	7	73.17	4.568	0.6106
7.2	1.0522	8	84.18	5.255	0.7025
8.1	1.0591	9	95.32	5.950	0.7955
9.0	1.0661	10	106.6	6.655	0.8897
9.9	1.0731	11	118.0	7.369	0.9851
10.8	1.0802	12	129.6	8.092	1.082
11.7	1.0874	13	141.4	8.825	1.180
12.5	1.0947	14	153.3	9.567	1.279
13.4	1.1020	15	165.3	10.32	1.379
14.3	1.1094	16	177.5	11.08	1.481
15.2	1.1168	17	189.9	11.85	1.584
16.0	1.1243	18	202.4	12.63	1 689
16.9	1.1318	19	215.0	13.42	1.795
17.7	1.1394	20	227.9	14.23	1.902
18.6	1.1471	21	240.9	15.04	2.010
19.4	1.1548	22	254.1	15.86	2.120
20.3	1.1626	23	267.4	16.69	2.231
21.1	1.1704	24	280.9	17.54	2.344
21.9	1.1783	25	294.6	18.39	2.458
22.8	1.1862	26	308.4	19.25	2.574
23.6	1.1942	27	322.4	20.13	2.691
24.4	1.2023	28	336.6	21.02	2.809
25.2	1.2104	29	351.0	21.91	2.929
26.0	1.2185	30	365.6	22.82	3.051
26.8	1.2267	31	380.3	23.74	3.173
27.6	1.2349	32	395.2	24.67	3.298
28.4	1.2432	33	410.3	25.61	3.424
29.1	1.2515	34	425.5	26.56	3.551
29.9	1.2599	35	441.0	27.53	3.680
30.7	1.2684	36	456.6	28.51	3.811
31.4	1.2769	37	472.5	29.49	3.943
32.2	1.2855	38	488.5	30.49	4.077
33.0	1.2941	39	504.7	31.51	4.212
33.7	1.3028	40	521.1	32.53	4.349
34.5	1.3116	41	537.8	33.57	4.488
35.2	1.3205	42	554.6	34.62	4.628
35.9	1.3294	43	571.6	35.69	4.770
36.7	1.3384	44	588.9	36.76	4.914
37.4	1.3476	45	606.4	37.86	5.061
38.1	1.3569	46	624.2	38.97	5.209
38.9	1.3663	47	642.2	40.09	5.359
39.6	1.3758	48	660.4	41.23	5.511
40.3	1.3854	49	678.8	42.38	5.665
41.1	1.3951	50	697.6	43.55	5.821
41.8	1.4049	51	716.5	44.73	5.979
42.5	1.4148	52	735.7	45.93	6.140
43.2	1.4248	53	755.1	47.14	6.302
44.0	1.4350	54	774.9	48.37	6.467

SULFURIC ACID (Continued)

SPECIFIC GRAVITY OF AQUEOUS SULFURIC ACID SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent H_2SO_4	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
44.7	1.4453	55	794.9	49.62	6.634
45.4	1.4557	56	815.2	50.89	6.803
46.1	1.4662	57	835.7	52.17	6.974
46.8	1.4768	58	856.5	53.47	7.148
47.5	1.4875	59	877.6	54.79	7.324
48.2	1.4983	60	899.0	56.12	7.502
48.9	1.5091	61	920.6	57.47	7.682
49.6	1.5200	62	942.4	58.83	7.865
50.3	1.5310	63	964.5	60.21	8.049
51.0	1.5421	64	986.9	61.61	8.236
51.7	1.5533	65	1010	63.03	8.426
52.3	1.5646	66	1033	64.46	8.618
53.0	1.5760	67	1056	65.92	8.812
53.7	1.5874	68	1079	67.39	9.008
54.3	1.5989	69	1103	68.87	9.207
55.0	1.6105	70	1127	70.38	9.408
55.6	1.6221	71	1152	71.90	9.611
56.3	1.6338	72	1176	73.44	9.817
56.9	1.6456	73	1201	74.99	10.02
57.5	1.6574	74	1226	76.57	10.24
58.1	1.6692	75	1252	78.15	10.45
58.7	1.6810	76	1278	79.75	10.66
59.3	1.6927	77	1303	81.37	10.88
59.9	1.7043	78	1329	82.99	11.09
60.5	1.7158	79	1355	84.62	11.31
61.1	1.7272	80	1382	86.26	11.53
61.6	1.7383	81	1408	87.90	11.75
62.1	1.7491	82	1434	89.54	11.97
62.6	1.7594	83	1460	91.16	12.19
63.0	1.7693	84	1486	92.78	12.40
63.5	1.7786	85	1512	94.38	12.62
63.9	1.7872	86	1537	95.95	12.83
64.2	1.7951	87	1562	97.49	13.03
64.5	1.8022	88	1586	99.01	13.23
64.8	1.8087	89	1610	100.5	13.43
65.1	1.8144	90	1633	101.9	13.63
65.3	1.8195	91	1656	103.4	13.82
65.5	1.8240	92	1678	104.8	14.00
65.7	1.8279	93	1700	106.1	14.19
65.8	1.8312	94	1721	107.5	14.36
65.9	1.8337	95	1742	108.7	14.54
66.0	1.8355	96	1762	110.0	14.70
66.0	1.8364	97	1781	111.2	14.87
66.0	1.8361	98	1799	112.3	15.02
65.9	1.8342	99	1816	113.4	15.15
65.8	1.8305	100	1831	114.3	15.28

TABLES OF THE MANUFACTURING CHEMISTS' ASSOCIATION

SULFURIC ACID

Authorities—W. C. FERGUSON; H. P. TALBOT

This table has been approved and adopted as a standard by the Manufacturing Chemists' Association of the United States.

Specific Gravity determinations were made at 60° F., compared with water at 60° F.

From the Specific Gravities the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}.$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should always be printed on the scale.

66° Baumé = Sp. Gr. 1.8354.

1 cu. ft. water at 60° F. weighs 62.37 lbs. av.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

H_2SO_4 = 100 per cent.

	H_2SO_4	O. V.	60°
O. V.	93.19	100.00	119.98
60°	77.67	83.35	100.00
50°	62.18	66.72	80.06

Acids stronger than 66° Bé. should have their percentage compositions determined by chemical analysis.

Bé.*	Sp. gr.	Tw.*	Per cent H_2SO_4	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu. ft.	* Freezing (melting) point.
0	1.0000	0.0	0.00	62.37	0.00	0.00	32.0° F.
1	1.0069	1.4	1.02	62.80	1.09	.68	31.2 "
2	1.0140	2.8	2.08	63.24	2.23	1.41	30.5 "
3	1.0211	4.2	3.13	63.69	3.36	2.14	29.8 "
4	1.0284	5.7	4.21	64.14	4.52	2.90	28.9 "
5	1.0357	7.1	5.28	64.60	5.67	3.66	28.1 "
6	1.0432	8.6	6.37	65.06	6.84	4.45	27.2 "
7	1.0507	10.1	7.45	65.53	7.99	5.24	26.3 "
8	1.0584	11.7	8.55	66.01	9.17	6.06	25.1 "
9	1.0662	13.2	9.66	66.50	10.37	6.89	24.0 "
10	1.0741	14.8	10.77	66.99	11.56	7.74	22.8 "
11	1.0821	16.4	11.89	67.49	12.76	8.61	21.5 "
12	1.0902	18.0	13.01	68.00	13.96	9.49	20.0 "
13	1.0985	19.7	14.13	68.51	15.16	10.39	18.3 "
14	1.1069	21.4	15.25	69.04	16.36	11.30	16.6 "

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* Calculated from Pickering's results, Journal of London Chemical Society, vol. 57, p. 363.

SULFURIC ACID (Continued)

Bé.*	Sp. gr.	Tw.*	Per cent H_2SO_4	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu.ft.	* Freezing (melting) point.
15	1.1154	23.1	16.38	69.57	17.58	12.23	14.7 F.
16	1.1240	24.8	17.53	70.10	18.81	13.19	12.6 "
17	1.1328	26.6	18.71	70.65	20.08	14.18	10.2 "
18	1.1417	28.3	19.89	71.21	21.34	15.20	7.7 "
19	1.1508	30.2	21.07	71.78	22.61	16.23	4.8 "
20	1.1600	32.0	22.25	72.35	23.87	17.27	+ 1.6 "
21	1.1694	33.9	23.43	72.94	25.14	18.34	− 1.8 "
22	1.1789	35.8	24.61	73.53	26.41	19.42	− 6.0 "
23	1.1885	37.7	25.81	74.13	27.69	20.53	−11 "
24	1.1983	39.7	27.03	74.74	29.00	21.68	−16 "
25	1.2083	41.7	28.28	75.36	30.34	22.87	−23 "
26	1.2185	43.7	29.53	76.00	31.69	24.08	−30 "
27	1.2288	45.8	30.79	76.64	33.04	25.32	−39 "
28	1.2393	47.9	32.05	77.30	34.39	26.58	−49 "
29	1.2500	50.0	33.33	77.96	35.76	27.88	−61 "
30	1.2609	52.2	34.63	78.64	37.16	29.22	−74 "
31	1.2719	54.4	35.93	79.33	38.55	30.58	−82 "
32	1.2832	56.6	37.26	80.03	39.98	32.00	−96 "
33	1.2946	58.9	38.58	80.74	41.40	33.42	−97 "
34	1.3063	61.3	39.92	81.47	42.83	34.90	−91 "
35	1.3182	63.6	41.27	82.22	44.28	36.41	−81 "
36	1.3303	66.1	42.63	82.97	45.74	37.95	−70 "
37	1.3426	68.5	43.99	83.74	47.20	39.53	−60 "
38	1.3551	71.0	45.35	84.52	48.66	41.13	−53 "
39	1.3679	73.6	46.72	85.32	50.13	42.77	−47 "
40	1.3810	76.2	48.10	86.13	51.61	44.45	−41 "
41	1.3942	78.8	49.47	86.96	53.08	46.16	−35 "
42	1.4078	81.6	50.87	87.80	54.58	47.92	−31 "
43	1.4216	84.3	52.26	88.67	56.07	49.72	−27 "
44	1.4356	87.1	53.66	89.54	57.58	51.56	−23 "
45	1.4500	90.0	55.07	90.44	59.09	53.44	−20 "
46	1.4646	92.9	56.48	91.35	60.60	55.36	−14 "
47	1.4796	95.9	57.90	92.28	62.13	57.33	−15 "
48	1.4948	99.0	59.32	93.23	63.65	59.34	−18 "
49	1.5104	102.1	60.75	94.20	65.18	61.40	−22 "

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* Calculated from Pickering's results. Journal of London Chemical Society, vol. 57, p. 363.

SULFURIC ACID (Continued)

Bé.°	Sp. gr.	Tw.°	Per cent H_2SO_4	Weight of 1 cu. ft. in lbs. av.	Per cent O. V.	Pounds O. V. in 1 cu.ft.	*Freezing (melting) point.
50	1.5263	105.3	62.18	95.20	66.72	63.52	−27 F.
51	1.5426	108.5	63.66	96.21	68.31	65.72	−33 "
52	1.5591	111.8	65.13	97.24	69.89	67.96	−39 "
53	1.5761	115.2	66.63	98.30	71.50	70.28	−49 "
54	1.5934	118.7	68.13	99.38	73.11	72.66	−59 "
55	1.6111	122.2	69.65	100.48	74.74	75.10	.. Below − 40
56	1.6292	125.8	71.17	101.61	76.37	77.60	..
57	1.6477	129.5	72.75	102.77	78.07	80.23	..
58	1.6667	133.3	74.36	103.95	79.79	82.95	..
59	1.6860	137.2	75.99	105.16	81.54	85.75	− 7
60	1.7059	141.2	77.67	106.40	83.35	88.68	+12.6 F.
61	1.7262	145.2	79.43	107.66	85.23	91.76	27.3 "
62	1.7470	149.4	81.30	108.96	87.24	95.06	39.1 "
63	1.7683	153.7	83.34	110.29	89.43	98.63	46.1 "
64	1.7901	158.0	85.66	111.65	91.92	102.63	46.4 "
64¼	1.7957	159.1	86.33	112.00	92.64	103.75	43.6 "
64½	1.8012	160.2	87.04	112.34	93.40	104.93	41.1 "
64¾	1.8068	161.4	87.81	112.69	94.23	106.19	37.9 "
65	1.8125	162.5	88.65	113.05	95.13	107.54	33.1 "
65¼	1.8182	163.6	89.55	113.40	96.10	108.97	24.6 "
65½	1.8239	164.8	90.60	113.76	97.22	110.60	13.4 "
65¾	1.8297	165.9	91.80	114.12	98.51	112.42	− 1 "
66	1.8354	167.1	93.19	114.47	100.0	114.47	−29 "

* Calculated from Pickering's results, Journal of London Chemical Society, vol. 57, p. 363.

APPROXIMATE BOILING POINTS

50° Bé. 295 F.
60° " 386 "
61° " 400 "
62° " 415 "
63° " 432 "
64° " 451 "
65° " 485 "
66° " 538 "

Per cent 60°	Pounds 60° in 1 cu. ft.	Per cent 50°	Pounds 50° in 1 cu. ft
61.93	53.34	77.36	66.63
63.69	55.39	79.56	69.19
65.50	57.50	81.81	71.83
67.28	59.66	84.05	74.53
69.09	61.86	86.30	77.27
70.90	64.12	88.56	80.10
72.72	66.43	90.83	82.98
74.55	68.79	93.12	85.93
76.37	71.20	95.40	88.94
78.22	73.68	97.70	92.03

Per cent 60°	Pounds 60° in 1 cu. ft.	Per cent 50°	Pounds 50° in 1 cu. ft
80.06	76.21	100.00	95.20
81.96	78.85	102.38	98.50
83.86	81.54	104.74	101.85
85.79	84.33	107.15	105.33
87.72	87.17	109.57	108.89
89.67	90.10	112.01	112.55
91.63	93.11	114.46	116.30
93.67	96.26	117.00	120.24
95.74	99.52	119.59	124.31
97.84	102.89	122.21	128.52
100.00	106.40	124.91	132.91
102.27	110.10	127.74	137.52
104.67	114.05	130.75	142.47
107.30	118.34	134.03	147.82
110.29	123.14	137.76	153.81
111.15	124.49	138.84	155.50
112.06	125.89	139.98	157.25
113.05	127.40	141.22	159.14
114.14	129.03	142.57	161.17
115.30	130.75	144.02	163.32
116.65	132.70	145.71	165.76
118.19	134.88	147.63	168.48
119.98	137.34	149.87	171.56

FIXED POINTS

Sp. gr.	Per cent H_2SO_4	Sp. gr.	Per cent H_2SO_4
1.0000	.00	1.5281	62.34
1.0048	.71	1.5440	63.79
1.0347	5.14	1.5748	66.51
1.0649	9.48	1.6272	71.00
1.0992	14.22	1.6679	74.46
1.1353	19.04	1.7044	77.54
1.1736	23.94	1.7258	79.40
1.2105	28.55	1.7472	81.32
1.2513	33.49	1.7700	83.47
1.2951	38.64	1.7959	86.36
1.3441	44.15	1.8117	88.53
1.3947	49.52	1.8194	89.75
1.4307	53.17	1.8275	91.32
1.4667	56.68	1.8354	93.19
1.4822	58.14		

ALLOWANCE FOR TEMPERATURE

At 10° Bé. .029° Bé. or .00023 Sp. Gr. = 1° F.

At 20° Bé. .036° Bé. or .00034 Sp. Gr. = 1° F.

At 30° Bé. .035° Bé. or .00039 Sp. Gr. = 1° F.

At 40° Bé. .031° Bé. or .00041 Sp. Gr. = 1° F.

At 50° Bé. .028° Bé. or .00045 Sp. Gr. = 1° F.

At 60° Bé. .026° Bé. or .00053 Sp. Gr. = 1° F.

At 63° Bé. .026° Bé. or .00057 Sp. Gr. = 1° F.

At 66° Bé. .0235° Bé. or .00054 Sp. Gr. = 1° F.

SULFURIC ACID, SO_3

SPECIFIC GRAVITY OF AQUEOUS SULFURIC ACID SOLUTIONS AT $\frac{20^\circ}{4^\circ}$ C. GIVING SO_3 CONTENT

Bé.	Sp. gr.	Per cent SO_3	G. per liter SO_3	Lbs. per cu. ft. SO_3	Lbs per gal. SO_3
0.7	1.0051	.8163	8.204	.5122	0.0685
1.7	1.0118	1.633	16.52	1.030	.1379
2.6	1.0184	2.449	24.94	1.557	.2082
3.5	1.0250	3.265	33.47	2.090	.2793
4.5	1.0317	4.082	42.11	2.628	.3514
5.4	1.0385	4.898	50.86	3.175	.4245
6.3	1.0453	5.714	59.73	3.729	.4984
7.2	1.0522	6.531	68.72	4.290	.5735
8.1	1.0591	7.347	77.81	4.857	.6494
9.0	1.0661	8.163	87.02	5.433	.7263
9.9	1.0731	8.979	96.32	6.015	.8042
10.8	1.0802	9.796	105.8	6.606	.8833
11.7	1.0874	10.612	115.4	7.204	.9633
12.5	1.0947	11.43	125.1	7.810	1.044
13.4	1.1020	12.24	134.9	8.424	1.126
14.3	1.1094	13.06	144.9	9.045	1.209
15.2	1.1168	13.88	155.0	9.673	1.293
16.0	1.1243	14.69	165.2	10.31	1.379
16.9	1.1318	15.51	175.5	10.95	1.465
17.7	1.1394	16.33	186.0	11.62	1.553
18.6	1.1471	17.14	196.6	12.28	1.641
19.4	1.1548	17.96	207.4	12.95	1.731
20.3	1.1626	18.78	218.3	13.62	1.821
21.1	1.1704	19.59	229.3	14.32	1.913
21.9	1.1783	20.41	240.5	15.01	2.007
22.8	1.1862	21.22	251.8	15.71	2.101
23.6	1.1942	22.04	263.2	16.43	2.197
24.4	1.2023	22.86	274.8	17.16	2.293
25.2	1.2104	23.67	286.5	17.89	2.391
26.0	1.2185	24.49	298.4	18.63	2.491
26.8	1.2267	25.31	310.4	19.38	2.590
27.6	1.2349	26.12	322.6	20.14	2.692
28.4	1.2432	26.94	334.9	20.91	2.795
29.1	1.2515	27.75	347.3	21.68	2.899
29.9	1.2599	28.57	360.0	22.47	3.003
30.7	1.2684	29.39	372.7	23.27	3.111
31.4	1.2769	30.20	385.7	24.07	3.219
32.2	1.2855	31.02	398.8	24.89	3.328
33.0	1.2941	31.84	412.0	25.72	3.438
33.7	1.3028	32.65	425.4	26.45	3.550
34.5	1.3116	33.47	439.0	27.40	3.664
35.2	1.3205	34.29	452.7	28.26	3.778
35.9	1.3294	35.10	466.6	29.13	3.894
36.7	1.3384	35.92	480.7	30.01	4.011
37.4	1.3476	36.73	495.0	30.91	4.131
38.1	1.3569	37.55	509.5	31.81	4.252
38.9	1.3663	38.37	524.2	32.73	4.375
39.6	1.3758	39.18	539.1	33.66	4.499
40.3	1.3854	40.00	554.1	34.50	4.624
41.1	1.3951	40.82	569.5	35.55	4.752
41.8	1.4049	41.63	584.9	36.51	4.881
42.5	1.4148	42.45	600.6	37.49	5.012
43.2	1.4248	43.26	616.4	38.48	5.144
44.0	1.4350	44.08	632.6	39.49	5.279
44.7	1.4453	44.90	648.9	40.51	5.415
45.4	1.4557	45.71	665.5	41.54	5.553

SULFURIC ACID SO_3 (Continued)

Specific Gravity of Aqueous Sulfuric Acid Solutions at $\frac{20°}{4°}$ C. Giving SO_3 Content

Bé.	Sp. gr.	Per cent SO_3	G. per liter SO_3	Lbs. per cu. ft. SO_3	Lbs. per gal. SO_3
46.1	1.4662	46.53	682.2	42.59	5.693
46.8	1.4768	47.35	699.2	43.65	5.835
47.5	1.4875	48.16	716.4	44.73	5.979
48.2	1.4983	48.98	733.9	45.81	6.124
48.9	1.5091	49.80	751.5	46.91	6.271
49.6	1.5200	50.61	769.3	48.02	6.420
50.3	1.5310	51.43	787.3	49.15	6.571
51.0	1.5421	52.24	805.6	50.29	6.723
51.7	1.5533	53.06	824.5	51.45	6.878
52.3	1.5646	53.88	843.3	52.62	7.035
53.0	1.5760	54.69	862.0	53.81	7.193
53.7	1.5874	55.51	880.8	55.01	7.353
54.3	1.5989	56.33	900.4	56.22	7.516
55.0	1.6105	57.14	920.0	57.45	7.680
55.6	1.6221	57.96	940.4	58.69	7.846
56.3	1.6338	58.77	960.0	59.95	8.014
56.9	1.6456	59.59	980.4	61.22	8.180
57.5	1.6574	60.41	1001	62.51	8.359
58.1	1.6692	61.22	1022	63.80	8.530
58.7	1.6810	62.04	1043	65.10	8.702
59.3	1.6927	62.86	1064	66.42	8.882
59.9	1.7043	63.67	1085	67.75	9.053
60.5	1.7158	64.49	1106	69.08	9.233
61.1	1.7272	65.31	1128	70.42	9.412
61.6	1.7383	66.12	1149	71.75	9.592
62.1	1.7491	66.94	1171	73.09	9.771
62.6	1.7594	67.75	1192	74.42	9.951
63.0	1.7693	68.57	1213	75.74	10.12
63.5	1.7786	69.39	1234	77.04	10.30
63.9	1.7872	70.20	1255	78.33	10.47
64.2	1.7951	71.02	1275	79.58	10.64
64.5	1.8022	71.84	1295	80.82	10.80
64.8	1.8087	72.65	1314	82.04	10.96
65.1	1.8144	73.47	1333	83.18	11.13
65.3	1.8195	74.28	1352	84.41	11.28
65.5	1.8240	75.10	1370	85.55	11.43
65.7	1.8279	75.92	1388	86.61	11.58
65.8	1.8312	76.73	1405	87.75	11.72
65.9	1.8337	77.55	1422	88.73	11.87
66.0	1.8355	78.37	1438	89.79	12.00
66.0	1.8364	79.18	1454	90.77	12.14
66.0	1.8361	80.00	1468	91.67	12.26
65.9	1.8342	80.82	1482	92.57	12.37
65.8	1.8305	81.63	1495	93.31	12.47

TANNIC ACID

SPECIFIC GRAVITY OF AQUEOUS TANNIC ACID SOLUTIONS AT 15° C. (TRAMMER)

Bé.	Sp. gr.	Per cent $C_{14}H_{10}O_9$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0040	1.0	10.04	0.6268	0.0838
0.6	1.0044	1.0	11.05	0.6897	0.0922
0.7	1.0048	1.2	12.06	0.7527	0.1006
0.8	1.0052	1.3	13.07	0.8158	0.1091
0.8	1.0056	1.4	14.08	0.8789	0.1175
0.9	1.0060	1.5	15.09	0.9420	0.1259
0.9	1.0064	1.6	16.10	1.005	0.1344
1.0	1.0068	1.7	17.12	1.068	0.1428
1.0	1.0072	1.8	18.13	1.132	0.1513
1.1	1.0076	1.9	19.14	1.195	0.1598
1.2	1.0080	2.0	20.16	1.259	0.1682
1.2	1.0084	2.1	21.18	1.322	0.1767
1.3	1.0088	2.2	22.19	1.385	0.1852
1.3	1.0092	2.3	23.21	1.449	0.1937
1.4	1.0096	2.4	24.23	1.513	0.2022
1.4	1.0100	2.5	25.25	1.576	0.2107
1.5	1.0104	2.6	26.27	1.640	0.2192
1.5	1.0108	2.7	27.29	1.704	0.2278
1.6	1.0112	2.8	28.31	1.768	0.2363
1.7	1.0116	2.9	29.34	1.831	0.2448
1.7	1.0120	3.0	30.36	1.895	0.2534
1.8	1.0124	3.1	31.38	1.959	0.2619
1.8	1.0128	3.2	32.41	2.023	0.2705
1.9	1.0132	3.3	33.44	2.087	0.2790
1.9	1.0136	3.4	34.46	2.151	0.2876
2.0	1.0140	3.5	35.49	2.216	0.2962
2.1	1.0144	3.6	36.52	2.280	0.3048
2.1	1.0148	3.7	37.55	2.344	0.3133
2.2	1.0152	3.8	38.58	2.408	0.3219
2.2	1.0156	3.9	39.61	2.473	0.3305
2.3	1.0160	4.0	40.64	2.537	0.3392
2.3	1.0164	4.1	41.67	2.601	0.3478
2.4	1.0168	4.2	42.71	2.666	0.3564
2.5	1.0172	4.3	43.74	2.731	0.3650
2.5	1.0176	4.4	44.77	2.795	0.3737
2.6	1.0180	4.5	45.81	2.860	0.3823
2.6	1.0184	4.6	46.85	2.924	0.3909
2.7	1.0188	4.7	47.88	2.989	0.3996
2.7	1.0192	4.8	48.92	3.054	0.4083
2.8	1.0196	4.9	49.96	3.119	0.4169
2.8	1.0200	5.0	51.00	3.184	0.4256
5.6	1.0401	10.0	104.0	6.493	0.8680

TARTARIC ACID

Specific Gravity of Aqueous Tartaric Acid (d) Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $H_2C_4H_4O_6$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.6	1.0045	1	10.05	0.6271	0.0838
1.3	1.0090	2	20.18	1.260	0.1684
2.6	1.0179	4	40.72	2.542	0.3398
3.9	1.0273	6	61.64	3.848	0.5144
5.2	1.0371	8	82.97	5.179	0.6924
6.5	1.0469	10	104.7	6.535	0.8737
7.8	1.0565	12	126.8	7.915	1.058
9.0	1.0661	14	149.3	9.317	1.246
10.3	1.0761	16	172.2	10.75	1.437
11.5	1.0865	18	195.6	12.21	1.632
12.8	1.0969	20	219.4	13.70	1.831
14.0	1.1072	22	243.6	15.21	2.033
15.2	1.1175	24	268.2	16.74	2.238
16.5	1.1282	26	293.3	18.31	2.448
17.7	1.1393	28	319.0	19.91	2.662
19.0	1.1505	30	345.2	21.55	2.880
20.2	1.1615	32	371.7	23.20	3.102
21.3	1.1726	34	398.7	24.89	3.327
22.5	1.1840	36	426.2	26.61	3.557
23.8	1.1959	38	454.4	28.37	3.792
25.0	1.2078	40	483.1	30.16	4.032
26.1	1.2198	42	512.3	31.98	4.275
27.3	1.2317	44	541.9	33.83	4.523
28.5	1.2441	46	572.3	35.73	4.776
29.6	1.2568	48	603.3	37.66	5.034
30.8	1.2696	50	634.8	39.63	5.298
32.0	1.2828	52	667.1	41.64	5.567
33.1	1.2961	54	699.9	43.69	5.841
34.3	1.3093	56	733.2	45.77	6.119

ZINC CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS ZINC CHLORIDE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $ZnCl_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.4	1.0167	2	20.33	1.269	0.1697
4.9	1.0350	4	41.40	2.584	0.3455
7.3	1.0532	6	63.19	3.945	0.5274
9.7	1.0715	8	85.72	5.351	0.7154
11.0	1.0819	10	108.2	6.754	0.9029
14.2	1.1085	12	133.0	8.304	1.110
16.4	1.1275	14	157.9	9.854	1.317
18.6	1.1468	16	183.5	11.45	1.531
20.7	1.1665	18	210.0	13.11	1.752
22.8	1.1866	20	237.3	14.82	1.980
27.9	1.2380	25	309.5	19.32	2.583
32.8	1.2928	30	387.8	24.21	3.237
37.8	1.3522	35	473.3	29.54	3.950
42.7	1.4173	40	566.9	35.39	4.731
47.6	1.4890	45	670.1	41.83	5.592
52.5	1.5681	50	784.1	48.95	6.543
57.4	1.655	55	910.3	56.82	7.596
62.1	1.749	60	1049	65.51	8.757
66.7	1.851	65	1203	75.11	10.05
71.1	1.962	70	1373	85.74	11.46

ZINC CHLORIDE

SPECIFIC GRAVITY OF AQUEOUS ZINC CHLORIDE SOLUTIONS AT $\frac{60°}{60°}$ F. (WHITNEY, HARTLE, SAKRYD)

Bé.	Sp. gr.	Per cent $ZnCl_2$	Weight of 1 cu. ft. in lbs.	Lbs. $ZnCl_2$ in 1 cu. ft.	Per cent 50 per cent $ZnCl_2$	Lbs. 50 per cent $ZnCl_2$ in 1 cu. ft.
0	1.0000	0	62.37	0	0	0
1	1.0069	.76	62.80	.4773	1.52	.9546
2	1.0140	1.53	63.24	.9676	3.06	1.9352
3	1.0211	2.29	63.69	1.4585	4.58	2.9170
4	1.0284	3.05	64.14	1.9563	6.10	3.9126
5	1.0357	3.81	64.60	2.4613	7.62	4.9226
6	1.0432	4.63	65.06	3.0123	9.26	6.0246
7	1.0507	5.45	65.53	3.5714	10.90	7.1428
8	1.0584	6.27	66.01	4.1388	12.54	8.2776
9	1.0662	7.09	66.50	4.7149	14.18	9.4298
10	1.0741	7.91	66.99	5.2980	15.82	10.5978
11	1.0821	8.78	67.49	5.9256	17.56	11.8512
12	1.0902	9.65	68.00	6.5620	19.30	13.1240
13	1.0985	10.52	68.51	7.2073	21.04	14.4146
14	1.1069	11.39	69.04	7.8637	22.78	15.7274
15	1.1154	12.26	69.57	8.5293	24.52	17.0586
16	1.1240	13.21	70.10	9.2602	26.42	18.5204
17	1.1328	14.15	70.65	9.9970	28.30	19.9940
18	1.1417	15.10	71.21	10.7527	30.20	21.5054
19	1.1508	16.04	71.78	11.5135	32.08	23.0270
20	1.1600	16.98	72.35	12.2850	33.96	24.5700
21	1.1694	17.96	72.94	13.1000	35.92	26.2000
22	1.1789	18.94	73.53	13.9266	37.88	27.8532
23	1.1885	19.92	74.13	14.7667	39.84	29.5334
24	1.1983	20.90	74.74	15.6207	41.80	31.2414
25	1.2083	21.88	75.36	16.4888	43.76	32.9776
26	1.2185	22.88	76.00	17.3888	45.76	34.7776
27	1.2288	23.88	76.64	18.3016	47.76	36.6032
28	1.2393	24.89	77.30	19.2400	49.78	38.4800
29	1.2500	25.89	77.96	20.1838	51.78	40.3676
30	1.2609	26.90	78.64	21.1542	53.80	42.3084
31	1.2719	27.91	79.33	22.1410	55.82	44.2820
32	1.2832	28.91	80.03	23.1367	57.82	46.2734
33	1.2946	29.92	80.74	24.1574	59.84	48.3148
34	1.3063	30.93	81.47	25.1987	61.86	50.3974
35	1.3182	31.93	82.22	26.2528	63.86	52.5056
36	1.3303	32.94	82.97	27.3303	65.88	54.6606
37	1.3426	33.95	83.74	28.4297	67.90	56.8594
38	1.3551	34.96	84.52	29.5482	69.92	59.0964
39	1.3679	35.97	85.32	30.6896	71.94	61.3792
40	1.3810	36.98	86.13	31.8509	73.96	63.7018
41	1.3942	38.02	86.96	33.0622	76.04	66.1244
42	1.4078	39.05	87.80	34.2859	78.10	68.5718
43	1.4216	40.09	88.67	35.5478	80.18	71.0956
44	1.4356	41.12	89.54	36.8188	82.24	73.6376
45	1.4500	42.16	90.44	38.1295	84.32	76.2590
46	1.4646	43.21	91.35	39.4723	86.42	78.9446
47	1.4796	44.26	92.28	40.8431	88.52	81.6862
48	1.4948	45.32	93.23	42.2518	90.64	84.5036
49	1.5104	46.37	94.20	43.6805	92.74	87.3610
50	1.5263	47.43	95.20	45.1534	94.86	90.3068
51	1.5426	48.48	96.21	46.6426	96.96	93.2852
52	1.5591	49.54	97.24	48.1727	99.08	96.3454

ZINC CHLORIDE (Continued)

SPECIFIC GRAVITY OF AQUEOUS ZINC CHLORIDE SOLUTIONS AT $\frac{60^\circ}{60^\circ}$ F. (WHITNEY, HARTLE, SAKRYD)

Bé.	Sp. gr.	Per cent $ZnCl_2$	Weight of 1 cu. ft. in lbs.	Lbs. $ZnCl_2$ in 1 cu. ft.	Per cent 50 per cent $ZnCl_2$	Lbs. 50 per cent $ZnCl_2$ in 1 cu. ft.
53	1.5761	50.60	98.30	49.7398	101.20	99.4796
54	1.5934	51.66	99.38	51.3397	103.32	102.6794
55	1.6111	52.72	100.48	52.9731	105.44	105.9462
56	1.6292	53.80	101.61	54.6662	107.60	109.3324
57	1.6477	54.88	102.77	56.4002	109.76	112.8004
58	1.6667	55.97	103.95	58.1808	111.94	116.3616
59	1.6860	57.06	105.16	60.0043	114.12	120.0086
60	1.7059	58.15	106.40	61.8716	116.30	123.7432
61	1.7262	59.23	107.66	63.7670	118.46	127.5340
62	1.7470	60.30	108.96	65.7029	120.60	131.4058
63	1.7683	61.37	110.29	67.6850	122.74	135.3700
64	1.7901	62.44	111.65	69.7143	124.88	139.4286
65	1.8125	63.52	113.05	71.8094	127.04	143.6188
66	1.8354	64.68	114.47	74.0392	129.36	148.0784
67	1.8590	65.85	115.95	76.3531	131.70	152.7062
68	1.8831	67.02	117.45	78.7150	134.04	157.4300
69	1.9079	68.19	119.90	81.1461	136.38	162.2922
70	1.9333	69.36	120.58	83.6343	138.72	167.2696

FIXED POINTS*

Bé.	Sp. gr.	Per cent $ZnCl_2$
5.08	1.0363	3.88
10.16	1.0754	8.05
15.35	1.1184	12.59
20.35	1.1633	17.32
25.14	1.1707	22.02
30.00	1.2609	26.90
35.07	1.3190	32.00
40.15	1.3829	37.14
44.99	1.4499	42.15
50.14	1.5285	47.58
55.05	1.6120	52.77
60.13	1.7085	58.29
65.11	1.8150	63.65
70.05	1.9345	69.42

APPROXIMATE ALLOWANCE FOR TEMPERATURE

At 5° Bé. = 0.024° Bé.
" 10° " = 0.029° "
" 15° " = 0.029° "
" 20° " = 0.033° "
" 25° " = 0.033° "
" 30° " = 0.033° "
" 35° " = 0.033° "
" 40° " = 0.033° "
" 45° " = 0.033° "
" 50° " = 0.030° "
" 55° " = 0.028° "
" 60° " = 0.027° "
" 65° " = 0.027° "
" 70° " = 0.024° "

For each 1° Fahrenheit

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*The percentage composition on all fixed points were determined by actual chemical analysis, both Zinc and Chlorine being determined.

ZINC NITRATE

Specific Gravity of Aqueous Zinc Nitrate Solutions at $\frac{18^\circ}{4^\circ}$ C.*

Bé.	Sp. gr.	Per cent $Zn(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.2	1.0154	2	20.31	1.268	0.1695
4.5	1.0322	4	41.29	2.577	0.3446
6.9	1.0496	6	62.98	3.931	0.5256
9.2	1.0675	8	85.40	5.331	0.7127
11.5	1.0859	10	108.6	6.779	0.9062
13.8	1.1048	12	132.6	8.276	1.106
16.0	1.1244	14	157.4	9.827	1.314
18.3	1.1445	16	183.1	11.43	1.528
20.6	1.1652	18	209.7	13.09	1.750
22.8	1.1865	20	237.3	14.81	1.980
28.3	1.2427	25	310.7	19.39	2.593
33.7	1.3029	30	390.9	24.40	3.262
39.0	1.3678	35	478.7	29.89	3.995
44.2	1.4378	40	575.1	35.90	4.799
49.2	1.5134	45	681.0	42.51	5.683
54.1	1.5944	50	797.2	49.77	6.653

ZINC NITRATE

SPECIFIC GRAVITY OF AQUEOUS ZINC NITRATE SOLUTIONS AT 17.5° (FRANZ)

Bé.	Sp. gr.	Per cent $Zn(NO_3)_2$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
1.4	1.0099	1	10.10	0.6305	0.0843
2.8	1.0198	2	20.40	1.273	0.1702
4.2	1.0297	3	30.89	1.928	0.2578
5.5	1.0396	4	41.58	2.596	0.3470
6.9	1.0496	5	52.48	3.276	0.4380
8.1	1.0590	6	63.54	3.967	0.5303
9.3	1.0684	7	74.79	4.669	0.6241
10.5	1.0778	8	86.22	5.383	0.7196
11.6	1.0872	9	97.85	6.108	0.8166
12.8	1.0968	10	109.7	6.847	0.9153
14.0	1.1070	11	121.8	7.602	1.016
15.2	1.1172	12	134.1	8.369	1.119
16.4	1.1274	13	146.6	9.149	1.223
17.5	1.1376	14	159.3	9.942	1.329
18.6	1.1476	15	172.1	10.75	1.437
19.9	1.1586	16	185.4	11.57	1.547
21.0	1.1696	17	198.8	12.41	1.659
22.2	1.1806	18	212.5	13.27	1.773
23.3	1.1916	19	226.4	14.13	1.889
24.4	1.2024	20	240.5	15.01	2.007
25.6	1.2147	21	255.1	15.92	2.129
26.8	1.2270	22	269.9	16.85	2.253
28.0	1.2393	23	285.0	17.79	2.379
29.1	1.2516	24	300.4	18.75	2.507
30.3	1.2640	25	316.0	19.73	2.637
31.4	1.2766	26	331.9	20.72	2.770
32.5	1.2892	27	348.1	21.73	2.905
33.6	1.3018	28	364.5	22.75	3.042
34.7	1.3144	29	381.2	23.80	3.181
35.7	1.3268	30	398.0	24.85	3.322
36.8	1.3396	31	415.3	25.92	3.466
37.8	1.3524	32	432.8	27.02	3.612
38.8	1.3652	33	450.5	28.12	3.760
39.8	1.3780	34	468.5	29.25	3.910
40.7	1.3906	35	486.7	30.38	4.062
41.7	1.4039	36	505.4	31.55	4.218
42.7	1.4172	37	524.4	32.73	4.376
43.6	1.4305	38	543.6	33.93	4.536
44.6	1.4438	39	563.1	35.15	4.699
45.5	1.4572	40	582.9	36.39	4.864
46.4	1.4707	41	603.0	37.64	5.032
47.3	1.4844	42	623.4	38.92	5 203
48.2	1.4981	43	644.2	40.21	5.376
49.1	1.5118	44	665.2	41.53	5.551
50.0	1.5258	45	686.6	42.86	5.730
50.9	1.5403	46	708.5	44.23	5.913
51.7	1.5548	47	730.8	45.62	6.098
52.6	1.5693	48	753.3	47.02	6.286
53.4	1.5838	49	776.1	48.45	6.476
54.3	1.5984	50	799.2	49.89	6.669

ZINC SULFATE

SPECIFIC GRAVITY OF AQUEOUS ZINC SULFATE SOLUTIONS AT $\frac{20°}{4°}$ C.*

Bé.	Sp. gr.	Per cent $ZnSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.7	1.0190	2	20.38	1.272	0.1701
5.6	1.0403	4	41.61	2.598	0.3473
8.5	1.0620	6	63.72	3.978	0.5318
11.3	1.0842	8	86.74	5.415	0.7238
14.0	1.1071	10	110.7	6.911	0.9239
16.8	1.1308	12	135.7	8.471	1.132
19.5	1.1553	14	161.7	10.10	1.350
22.2	1.1806	16	188.9	11.79	1.576

Bé.	Sp. gr.	Per cent $ZnSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
2.7	1.0190	3.562	36.30	2.266	0.3030
5.6	1.0403	7.125	74.12	4.627	0.6185
8.5	1.0620	10.69	113.5	7.085	0.9472
11.3	1.0842	14.25	154.5	9.645	1.289
14.0	1.1071	17.81	197.2	12.31	1.646
16.8	1.1308	21.37	241.7	15.09	2.017
19.5	1.1533	24.94	288.1	17.99	2.404
22.2	1.1806	28.50	336.5	21.00	2.808

ZINC SULFATE

Specific Gravity of Aqueous Zinc Sulfate Solutions at 15° C. (Gerlach)

Bé.	Sp. gr.	Per cent $ZnSO_4 + 7H_2O$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	1	10.06	0.6280	0.0840
1.9	1.013	2	20.26	1.265	0.1691
2.7	1.019	3	30.57	1.908	0.2551
3.4	1.024	4	40.96	2.557	0.3418
4.1	1.029	5	51.45	3.212	0.4294
4.9	1.035	6	62.10	3.877	0.5182
5.7	1.041	7	72.87	4.549	0.6081
6.5	1.047	8	83.76	5.229	0.6990
7.3	1.053	9	94.77	5.916	0.7909
8.1	1.059	10	105.9	6.611	0.8838
9.0	1.066	11	117.3	7.320	0.9786
9.9	1.073	12	128.8	8.038	1.075
10.6	1.079	13	140.3	8.757	1.171
11.4	1.085	14	151.9	9.483	1.268
12.1	1.091	15	163.7	10.22	1.366
12.8	1.097	16	175.5	10.96	1.465
13.5	1.103	17	187.5	11.71	1.565
14.4	1.110	18	199.8	12.47	1.667
15.1	1.116	19	212.0	13.24	1.770
16.0	1.124	20	224.8	14.03	1.876
16.7	1.130	21	237.3	14.81	1.980
17.5	1.137	22	250.1	15.62	2.087
18.1	1.143	23	262.9	16.41	2.194
18.9	1.150	24	276.0	17.23	2.303
19.7	1.157	25	289.3	18.06	2.414
20.4	1.164	26	302.6	18.89	2.526
21.2	1.171	27	316.2	19.74	2.639
22.0	1.179	28	330.1	20.61	2.755
22.6	1.185	29	343.7	21.45	2.868
23.5	1.193	30	357.9	22.34	2.987
24.2	1.200	31	372.0	23.22	3.104
25.1	1.209	32	386.9	24.15	3.229
25.8	1.216	33	401.3	25.05	3.349
26.5	1.224	34	416.2	25.98	3.473
27.2	1.231	35	430.9	26.90	3.560
28.1	1.240	36	446.4	27.87	3.725
28.6	1.246	37	461.0	28.78	3.847
29.5	1.255	38	476.9	29.77	3.980
30.2	1.263	39	492.6	30.75	4.111
30.9	1.271	40	508.4	31.74	4.243
31.7	1.280	41	524.8	32.76	4.380
32.4	1.288	42	541.0	33.77	4.514
33.0	1.295	43	556.9	34.76	4.647
33.8	1.304	44	573.8	35.82	4.788
34.3	1.310	45	589.5	36.80	4.920
35.2	1.320	46	607.2	37.91	5.067
36.0	1.330	47	625.1	39.02	5.217
36.6	1.337	48	641.8	40.06	5.356
37.3	1.346	49	659.5	41.17	5.504
37.8	1.353	50	676.5	42.23	5.646
38.5	1.362	51	694.6	43.36	5.797
39.2	1.370	52	712.4	44.47	5.945
39.9	1.380	53	731.4	45.66	6.104
40.7	1.390	54	750.6	46.86	6.264
41.4	1.399	55	769.5	48.03	6.421
41.9	1.406	56	787.4	49.15	6.571
42.6	1.416	57	807.1	50.39	6 736
43.2	1.425	58	826.5	51.60	6.897
44.0	1.435	59	846.7	52.85	7.065
44.7	1.445	60	867.0	54.12	7.235

ZINC SULFATE (Continued)

SPECIFIC GRAVITY OF AQUEOUS ZINC SULFATE SOLUTIONS AT 15° C. (GERLACH)

Bé.	Sp. gr.	Per cent $ZnSO_4$	G. per liter	Lbs. per cu. ft.	Lbs. per gal.
0.9	1.006	0.56	5.648	0.3526	0.0471
1.9	1.013	1.12	11.37	0.7101	0.0949
2.7	1.019	1.68	17.16	1.071	0.1432
3.4	1.024	2.25	23.00	1.436	0.1919
4.1	1.029	2.81	28.89	1.803	0.2411
4.9	1.035	3.37	34.86	2.177	0.2910
5.7	1.041	3.93	40.91	2.554	0.3414
6.5	1.047	4.49	47.03	2.936	0.3924
7.3	1.053	5.05	53.21	3.322	0.4440
8.1	1.059	5.61	59.46	3.712	0.4962
9.0	1.066	6.18	65.83	4.110	0.5494
9.9	1.073	6.74	72.29	4.513	0.6033
10.6	1.079	7.30	78.75	4.916	0.6572
11.4	1.085	7.86	85.28	5.324	0.7117
12.0	1.091	8.42	91.88	5.736	0.7667
12.8	1.097	8.98	98.54	6.152	0.8224
13.5	1.103	9.54	105.3	6.572	0.8786
14.4	1.110	10.1	112.2	7.003	0.9361
15.1	1.116	10.7	119.0	7.432	0.9935
16.0	1.124	11.2	126.2	7.879	1.053
16.7	1.130	11.8	133.2	8.317	1.112
17.5	1.137	12.4	140.4	8.767	1.172
18.1	1.143	12.9	147.6	9.214	1.232
18.9	1.150	13.5	155.0	9.673	1.293
19.7	1.157	14.0	162.4	10.14	1.355
20.4	1.164	14.6	169.9	10.61	1.418
21.2	1.171	15.2	177.5	11.08	1.481
22.0	1.179	15.7	185.3	11.57	1.547
22.6	1.185	16.3	192.9	12.04	1.610
23.5	1.193	16.8	200.9	12.54	1.677
24.2	1.200	17.4	208.9	13.04	1.743
25.1	1.209	18.0	217.2	13.56	1.813
25.8	1.216	18.5	225.3	14.06	1.880
26.5	1.224	19.1	233.6	14.59	1.950
27.2	1.231	19.7	241.9	15.10	2.019
28.1	1.240	20.2	250.6	15.65	2.092
28.6	1.246	20.8	258.8	16.16	2.160
29.5	1.255	21.3	267.7	16.71	2.234
30.2	1.263	21.9	276.5	17.26	2.308
30.9	1.271	22.5	285.4	17.82	2.382
31.7	1.280	23.0	294.6	18.39	2.459
32.4	1.288	23.6	303.7	18.96	2.535
33.0	1.295	24.1	312.6	19.52	2.609
33.8	1.304	24.7	322.1	20.11	2.688
34.3	1.310	25.3	331.0	20.66	2.762
35.2	1.320	25.8	340.9	21.28	2.845
36.0	1.330	26.4	350.9	21.91	2.929
36.6	1.337	26.9	360.3	22.49	3.007
37.3	1.346	27.5	370.3	23.12	3.090
37.8	1.353	28.1	379.8	23.71	3.170
38.5	1.362	28.6	390.0	24.35	3.254
39.2	1.370	29.2	400.0	24.97	3.338
39.9	1.380	29.8	410.6	25.63	3.427
40.7	1.390	30.3	421.4	26.31	3.517
41.4	1.399	30.9	432.0	26.97	3.605
41.9	1.406	31.4	442.0	27.60	3.689
42.6	1.416	32.0	453.1	28.29	3.782
43.2	1.425	32.6	464.0	28.97	3.872
44.0	1.435	33.1	475.3	29.67	3.967
44.7	1.445	33.7	486.8	30.39	4.062

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

THE SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS EXPRESSED IN GRAMS OF THE SUBSTANCE SHOWN BY THE FORMULA PER 100 GRAMS OF THE AQUEOUS SOLUTION

Per cent by weight	$AgNO_3$ $\frac{20^\circ}{4^\circ}$ C.	$Al(NO_3)_3$ $\frac{18^\circ}{4^\circ}$ C.	$AuCl_3$ $\frac{15^\circ}{4^\circ}$ C.	$Ba(C_2H_3O_2)_2$ $\frac{18^\circ}{4^\circ}$ C.	$BaBr_2$ $\frac{20^\circ}{4^\circ}$ C.
1	1.0070	1.0065	1.0060	1.0059	......
2	1.0154	1.0144	1.0132	1.0133	1.0156
3	......	......	......	......	......
4	1.0327	1.0305	1.0281	1.0282	1.0335
5	......	......	......	......	......
6	1.0506	1.0469	1.0434	1.0433	1.0519
7	......	......	......	......	......
8	1.0690	1.0638	1.0591	1.0587	1.0710
9	......	......	......	......	......
10	1.0882	1.0811	1.0750	1.0745	1.0907
11	......	......	......	......	......
12	1.1080	1.0989	......	1.0908	1.1111
13	......	......	......	......	......
14	1.1284	1.1171	......	1.1075	1.1323
15	......	......	......	......	......
16	1.1495	1.1357	......	1.1246	1.1543
17	......	......	......	......	......
18	1.1715	1.1549	......	1.1421	1.1770
19	......	......	......	......	......
20	1.1942	1.1745	......	1.1599	1.2006
21	......	......	......	......	......
22	......	1.1946	......	1.1782	......
23	......	......	......	......	......
24	......	1.2153	......	1.1970	......
25	1.2545	......	......	......	1.2634
26	......	1.2365	......	1.2161	......
27	......	......	......	......	......
28	......	1.2582	......	1.2356	......
29	......	......	......	......	......
30	1.3205	1.2805	......	1.2554	1.3325
31	......	......	......	......	......
32	......	1.3036	......	......	......
33	......	......	......	......	......
34	......	......	......	......	......
35	1.3931	......	......	1.3069	1.4087
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	1.4743	......	......	1.3608	1.4926
42	......	......	......	......	......
44	......	......	......	......	......
45	1.565	......	......	......	......
46	......	......	......	......	......
48	......	......	......	......	......
50	1.668	......	......	......	......
55	1.786	......	......	......	......
60	1.916	......	......	......	......
65	......	......	......	......	......
70	2.2333	......	......	......	......
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	BaI_2 $\frac{20°}{4°}$ C.	$Ba(NO_3)_2$ $\frac{18°}{4°}$ C.	$C_{12}H_{22}O_{11}$ Sucrose $\frac{20°}{4°}$ C.	$CaBr_2$ $\frac{20°}{4°}$ C.	$Ca(C_2H_3O_2)_2$ $\frac{18°}{4°}$ C.
1	......	......	1.0021	......	1.0043
2	1.0154	1.0151	1.0060	1.0152	1.0100
3	......	......	1.0099	......	......
4	1.0331	1.0320	1.0139	1.0326	1.0215
5	......	......	1.0179	......	......
6	1.0513	1.0494	1.0219	1.0504	1.0331
7	......	......	1.0259	......	......
8	1.0701	1.0674	1.0299	1.0688	1.0447
9	......	......	1.0340	......	......
10	1.0896	......	1.0381	1.0877	1.0563
11	......	......	1.0423	......	......
12	1.1099	......	1.0465	1.1071	1.0679
13	......	......	1.0507	......	......
14	1.1308	......	1.0549	1.1272	1.0795
15	......	......	1.0592	......	......
16	1.1525	......	1.0635	1.1480	1.0912
17	......	......	1.0678	......	......
18	1.1750	......	1.0722	1.1696	1.1029
19	......	......	1.0765	......	......
20	1.1984	......	1.0810	1.1919	1.1146
21	......	......	1.0854	......	......
22	......	......	1.0899	......	1.1263
23	......	......	1.0944	......	......
24	......	......	1.0990	......	......
25	1.2610	......	1.1036	1.2499	......
26	......	......	1.1082	......	......
27	......	......	1.1128	......	......
28	......	......	1.1175	......	......
29	......	......	1.1222	......	......
30	1.3289	......	1.1270	1.3125	......
31	......	......	1.1317	......	......
32	......	......	1.1366	......	......
33	......	......	1.1415	......	......
34	......	......	1.1464	......	......
35	1.404	......	1.1513	1.381	......
36	......	......	1.1563	......	......
37	......	......	1.1612	......	......
38	......	......	1.1663	......	......
39	......	......	1.1713	......	......
40	1.490	......	1.1765	1.457	......
42	......	......	1.1868	......	......
44	......	......	1.1973	......	......
45	1.587	......	1.2025	1.541	......
46	......	......	1.2079	......	......
48	......	......	1.2186	......	......
50	1.698	......	1.2296	1.635	......
55	1.825	......	1.2575	......	......
60	1.970	......	1.2865	......	......
65	......	......	1.3163	......	......
70	......	......	1.3472	......	......
75	......	......	1.3790	......	......
80	......	......	1.4117	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	CaI_2 $\frac{20^\circ}{4^\circ}$ C	$Ca(NO_3)_2$ $\frac{18^\circ}{4^\circ}$ C.	$CdBr_2$ $\frac{20^\circ}{4^\circ}$ C.	$CdCl_2$ $\frac{20^\circ}{4^\circ}$ C.	CdI_2 $\frac{20^\circ}{4^\circ}$ C.
1	......	......	......	......	......
2	1.0150	1.0137	1.0158	1.0159	1.0153
3	......	......	......	......	......
4	1.0323	1.0291	1.0339	1.0339	1.0328
5	......	......	......	......	......
6	1.0500	1.0448	1.0524	1.0524	1.0507
7	......	......	......	......	......
8	1.0683	1.0608	1.0714	1.0715	1.0690
9	......	......	......	......	......
10	1.0873	1.0771	1.0910	1.0912	1.0879
11	......	......	......	......	......
12	1.1069	1.0937	1.1112	1.1115	1.1075
13	......	......	......	......	......
14	1.1273	1.1106	1.1322	1.1324	1.1278
15	......	......	......	......	......
16	1.1485	1.1279	1.1540	1.1540	1.1489
17	......	......	......	......	......
18	1.1703	1.1455	1.1766	1.1762	1.1709
19	......	......	......	......	......
20	1.1928	1.1636	1.2000	1.1992	1.1937
21	......	......	......	......	......
22	......	......	......	......	......
23	......	......	......	......	......
24	......	......	......	......	......
25	1.2530	1.2106	1.2605	1.2604	1.2546
26	......	......	......	......	......
27	......	......	......	......	......
28	......	......	......	......	......
29	......	......	......	......	......
30	1.3195	1.260	1.3286	1.3273	1.3219
31	......	......	......	......	......
32	......	......	......	......	......
33	......	......	......	......	......
34	......	......	......	......	......
35	1.3928	1.311	1.4049	1.4010	1.3967
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	1.4734	1.365	1.4902	1.4833	1.4801
42	......	......	......	......	......
44	......	......	......	......	......
45	......	1.422	......	1.5748	1.5726
46	......	......	......	......	......
48	......	......	......	......	......
50	......	......	......	1.6762	......
55	......	......	......	......	......
60	......	......	......	......	......
65	......	......	......	......	......
70	......	......	......	......	......
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$CdSO_4$ $\frac{18^\circ}{4^\circ}$ C.	$CoCl_2$ $\frac{20^\circ}{4^\circ}$ C.	$Co(NO_3)_2$ $\frac{20^\circ}{4^\circ}$ C.	HBr $\frac{20^\circ}{4^\circ}$ C.	$HClO_4$ $\frac{15^\circ}{4^\circ}$ C.
1	1.0086	1.0073	1.0064	1.0053	1.0050
2	1.0182	1.0165	1.0145	1.0124	1.0109
3	......	......	......	......	......
4	1.0383	1.0350	1.0315	1.0269	1.0228
5	......	......	......	......	......
6	1.0590	1.0538	1.0485	1.0417	1.0348
7	......	......	......	......	......
8	1.0803	1.0735	1.0660	1.0568	1.0471
9	......	......	......	......	......
10	1.1023	1.0940	1.084	1.0723	1.0597
11	......	......	......	......	......
12	1.1250	1.1150	1.103	1.0883	1.0726
13	......	......	......	......	......
14	1.1485	1.1365	1.122	1.1048	1.0859
15	......	......	......	......	......
16	1.1729	1.1585	1.142	1.1219	1.0995
17	......	......	......	......	......
18	1.1982	1.1815	1.163	1.1396	1.1135
19	......	......	......	......	......
20	1.2243	1.2050	1.184	1.1579	1.1279
21	......	......	......	......	......
22	......	......	......	1.1767	1.1428
23	......	......	......	......	......
24	......	......	......	1.1961	1.1581
25	1.2940	......	1.239	......	......
26	......	......	......	1.2161	1.1738
27	......	......	......	......	......
28	......	......	......	1.2367	1.1900
29	......	......	......	......	......
30	1.3714	......	1.299	1.2580	1.2067
31	......	......	......	......	......
32	......	......	......	......	1.2239
33	......	......	......	......	......
34	......	......	......	......	1.2418
35	1.4551	......	......	1.3150	......
36	......	......	......	......	1.2603
37	......	......	......	......	......
38	......	......	......	......	1.2794
39	......	......	......	......	......
40	1.5470	......	......	1.3772	1.2991
42	......	......	......	......	......
44	......	......	......	......	......
45	......	......	......	1.4446	1.3521
46	......	......	......	......	......
48	......	......	......	......	......
50	......	......	......	1.5173	1.4103
55	......	......	......	1.5953	1.4733
60	......	......	......	1.6787	1.5389
65	......	......	......	1.7675	1.6059
70	......	......	......	......	1.6736
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	HF $\frac{20°}{4°}$ C.	HI $\frac{20°}{4°}$ C.	HIO_3 $\frac{18°}{4°}$ C.	HIO_4 $\frac{17°}{4°}$ C.	H_2O_2 $\frac{18°}{4°}$ C.
1	......	1.0054	1.0071	1.0076	1.0022
2	......	1.0127	1.0157	1.0165	1.0058
3	......	......	......	......	......
4	......	1.0277	1.0334	1.0349	1.0131
5	1.017	......	......	......	......
6	......	1.0431	1.0517	1.0539	1.0204
7	......	......	......	......	......
8	......	1.0589	1.0706	1.0737	1.0277
9	......	......	......	......	......
10	1.035	1.0751	1.0900	1.0944	1.0351
11	......	......	......	......	......
12	......	1.0918	1.1100	1.1161	1.0425
13	......	......	......	......	......
14	......	1.1091	1.1306	1.1388	1.0499
15	1.053	......	......	......	......
16	......	1.1270	1.1519	1.1623	1.0574
17	......	......	......	......	......
18	......	1.1456	1.1740	1.1865	1.0649
19	......	......	......	......	......
20	1.070	1.1649	1.1969	1.2116	1.0725
21	......	......	......	......	......
22	......	1.1850	1.2206	1.2376	1.0802
23	......	......	......	......	......
24	......	1.2059	1.2450	1.2647	1.0880
25	1.086	......	......	......	......
26	......	1.2277	1.2700	1.2931	1.0959
27	......	......	......	......	......
28	......	1.2503	1.2956	1.3230	1.1040
29	......	......	......	......	......
30	1.101	1.2737	1.3218	1.3545	1.1122
31	......	......	......	......	......
32	......	......	......	1.3875	......
33	......	......	......	......	......
34	......	......	......	......	......
35	1.116	1.3357	1.3900	......	1.1327
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	1.130	1.4029	1.4640	......	1.1536
42	......	......	......	......	......
44	......	......	......	......	......
45	1.143	1.4755	......	......	1.1749
46	......	......	......	......	......
48	......	......	......	......	......
50	1.155	......	......	......	1.1966
55	......	......	......	......	1.2188
60	......	......	......	......	1.2416
65	......	......	......	......	1.2652
70	......	......	......	......	1.2897
75	......	......	......	......	1.3149
80	......	......	......	......	1.3406

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	H_2SeO_4 $\frac{20°}{4°}$ C.	$HgCl_2$ $\frac{20°}{4°}$ C.	$KC_2H_3O_2$ $\frac{18°}{4°}$ C.	$KBrO_3$ $\frac{20°}{4°}$ C.	$KClO_3$ $\frac{20°}{4°}$ C.
1	1.0059	1.0065	1.0038	1.0056	1.0045
2	1.0136	1.0150	1.0089	1.0131	1.0109
3	......	1.0236	......	1.0206	1.0174
4	1.0291	1.0323	1.0191	1.0282	1.0241
5	......	1.0411	......	1.0359	......
6	1.0447	......	1.0293	......	......
7	......	......	......	......	......
8	1.0605	......	1.0395	......	......
9	......	......	......	......	......
10	1.0766	......	1.0497	......	......
11	......	......	......	......	......
12	1.0931	......	1.0599	......	......
13	......	......	......	......	......
14	1.1101	......	1.0703	......	......
15	......	......	......	......	......
16	1.1276	......	1.0808	......	......
17	......	......	......	......	......
18	1.1455	......	1.0914	......	......
19	......	......	......	......	......
20	1.1639	......	1.1022	......	......
21	......	......	......	......	......
22	1.1829	......	1.1131	......	......
23	......	......	......	......	......
24	1.2026	......	1.1241	......	......
25	......	......	......	......	......
26	1.2229	......	1.1353	......	......
27	......	......	......	......	......
28	1.2438	......	1.1466	......	......
29	......	......	......	......	......
30	1.2653	......	1.1579	......	......
31	......	......	......	......	......
32	1.2874	......	......	......	......
33	......	......	......	......	......
34	1.3101	......	......	......	......
35	......	......	1.1868	......	......
36	1.3334	......	......	......	......
37	......	......	......	......	......
38	1.3573	......	......	......	......
39	......	......	......	......	......
40	1.3819	......	1.2162	......	......
42	......	......	......	......	......
44	1.4073	......	......	......	......
45	1.4336	......	1.2460	......	......
46	1.4609	......	......	......	......
48	1.4892	......	......	......	......
50	1.5186	......	1.2761	......	......
55	......	......	1.3065	......	......
60	1.6850	......	1.3372	......	......
65	......	......	......	......	......
70	1.8870	......	......	......	......
75	......	......	......	......	......
80	2.1220	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	KF $\frac{18^\circ}{4^\circ}$ C.	$KHSO_4$ $\frac{20^\circ}{4^\circ}$ C.	$K_3Fe(CN)_6$ $\frac{20^\circ}{4^\circ}$ C.	$K_4Fe(CN)_6$ $\frac{20^\circ}{4^\circ}$ C.	KIO_3 $\frac{20^\circ}{4^\circ}$ C.
1	1.0072	1.0051	1.0034	1.0051	1.0068
2	1.0159	1.0120	1.0090	1.0119	1.0155
3	......	......	......	......	1.0243
4	1.0334	1.0260	1.0201	1.0256	......
5	......	......	......	......	......
6	1.0512	1.0403	1.0314	1.0395	......
7	......	......	......	......	......
8	1.0693	1.0549	1.0427	1.0536	......
9	......	......	......	......	......
10	1.0877	1.0698	1.0542	1.0678	......
11	......	......	......	......	......
12	1.1064	1.0850	1.0656	1.0823	......
13	......	......	......	......	......
14	1.1254	1.1004	1.0774	1.0971	......
15	......	......	......	......	......
16	1.1448	1.1161	1.0890	1.1120	......
17	......	......	......	......	......
18	1.1646	......	1.1010	......	......
19	......	......	......	......	......
20	1.1847	......	1.1130	......	......
21	......	......	......	......	......
22	1.2052	......	......	......	......
23	......	......	......	......	......
24	1.2260	......	......	......	......
25	......	......	......	......	......
26	1.2471	......	......	......	......
27	......	......	......	......	......
28	......	......	......	......	......
29	......	......	......	......	......
30	......	......	......	......	......
31	......	......	......	......	......
32	......	......	......	......	......
33	......	......	......	......	......
34	......	......	......	......	......
35	......	......	......	......	......
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	......	......	......	......	......
42	......	......	......	......	......
44	......	......	......	......	......
45	......	......	......	......	......
46	......	......	......	......	......
48	......	......	......	......	......
50	......	......	......	......	......
55	......	......	......	......	......
60	......	......	......	......	......
65	......	......	......	......	......
70	......	......	......	......	......
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	LiBr $\frac{20^\circ}{4^\circ}$ C.	LiCl $\frac{20^\circ}{4^\circ}$ C.	LiI $\frac{20^\circ}{4^\circ}$ C.	Li_2SO_4 $\frac{20^\circ}{4^\circ}$ C.	$MgBr_2$ $\frac{20^\circ}{4^\circ}$ C.
1	1.0055	1.0041	1.0056	1.0068	......
2	1.0128	1.0099	1.0131	1.0155	1.0151
3	......	......	......	......	......
4	1.0277	1.0215	1.0284	1.0329	1.0324
5	......	......	......	......	......
6	1.0429	1.0330	1.0442	1.0505	1.0501
7	......	......	......	......	......
8	1.0585	1.0444	1.0604	1.0684	1.0683
9	......	......	......	......	......
10	1.0746	1.0559	1.0771	1.0863	1.0871
11	......	......	......	......	......
12	1.0910	1.0675	1.0943	1.1044	1.1065
13	......	......	......	......	......
14	1.1079	1.0792	1.1120	1.1228	1.1265
15	......	......	......	......	......
16	1.1253	1.0910	1.1303	1.1411	1.1471
17	......	......	......	......	......
18	1.1432	1.1029	1.1492	1.1599	1.1683
19	......	......	......	......	......
20	1.1616	1.1150	1.1688	1.1789	1.1903
21	......	......	......	......	......
22	1.1806	1.1274	1.1890	1.1984	......
23	......	......	......	......	......
24	1.2002	1.1399	1.2099	1.2182	......
25	......	......	......	......	1.2482
26	1.2205	1.1527	1.2315	......	......
27	......	......	......	......	......
28	1.2414	1.1658	1.2540	......	......
29	......	......	......	......	......
30	1.2629	1.1791	1.2772	......	1.3110
31	......	......	......	......	......
32	......	......	......	......	......
33	......	......	......	......	......
34	......	......	......	......	......
35	1.3204	......	1.3393	......	1.3790
36	......	......	......	......	......
37	......	......	......	......	......
38	......	......	......	......	......
39	......	......	......	......	......
40	1.3836	......	1.4078	......	1.452
42	......	......	......	......	......
44	......	......	......	......	......
45	1.4535	......	1.4840	......	1.5320
46	......	......	......	......	......
48	......	......	......	......	......
50	......	......	1.5692	......	......
55	......	......	1.6654	......	......
60	......	......	1.7748	......	......
65	......	......	......	......	......
70	......	......	......	......	......
75	......	......	......	......	......
80	......	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	MgI_2 $\frac{20^\circ}{4^\circ}$ C.	$Mg(NO_3)_2$ $\frac{20^\circ}{4^\circ}$ C.	$MnBr_2$ $\frac{18^\circ}{4^\circ}$ C.	$MnCl_2$ $\frac{18^\circ}{4^\circ}$ C.
1	......	......	1.0071	1.0069
2	1.0149	1.0132	1.0157	1.0153
3	......	......	......	......
4	1.0321	1.0285	1.0332	1.0324
5	......	......	......	......
6	1.0498	1.0441	1.0511	1.0498
7	......	......	......	......
8	1.0680	1.0600	1.0695	1.0676
9	......	......	......	......
10	1.0869	1.0762	1.0886	1.0859
11	......	......	......	......
12	1.1065	1.0928	1.1083	1.1046
13	......	......	......	......
14	1.1268	1.1098	1.1287	1.1238
15	......	......	......	......
16	1.1478	1.1272	1.1498	1.1435
17	......	......	......	......
18	1.1695	1.1449	1.1716	1.1638
19	......	......	......	......
20	1.1920	1.1630	1.1942	1.1846
21	......	......	......	......
22	......	1.1815	1.2176	1.2061
23	......	......	......	......
24	......	1.2004	1.2419	1.2283
25	1.2519	......	......	......
26	......	......	1.2672	1.2511
27	......	......	......	......
28	......	......	1.2934	1.2746
29	......	......	......	......
30	1.3180	......	1.3206	1.2988
31	......	......	......	......
32	......	......	1.3489	......
33	......	......	......	......
34	......	......	......	......
35	1.3914	......	......	......
36	......	......	......	......
37	......	......	......	......
38	......	......	......	......
39	......	......	......	......
40	1.4730	......	......	......
42	......	......	......	......
44	......	......	......	......
45	......	......	......	......
46	......	......	......	......
48	......	......	......	......
50	......	......	......	......
55	......	......	......	......
60	......	......	......	......
65	......	......	......	......
70	......	......	......	......
75	......	......	......	......
80	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$Mn(NO_3)_2$ $\frac{18°}{4°}$ C.	$MnSO_4$ $\frac{20°}{4°}$ C.	NH_4Br $\frac{25°}{4°}$ C.	$NH_4C_2H_3O_2$ $\frac{25°}{4°}$ C.
1	1.0063	1.0080	1.0027	0.9992
2	1.0140	1.0178	1.0084	1.0013
3	......	......	......	......
4	1.0298	1.0378	1.0198	1.0055
5	......	......	......	......
6	1.0459	1.0583	1.0314	1.0096
7	......	......	......	......
8	1.0624	1.0794	1.0432	1.0136
9	......	......	......	......
10	1.0794	1.1012	1.0552	1.0176
11	......	......	......	......
12	1.0969	1.1236	1.0674	1.0216
13	......	......	......	......
14	1.1149	1.1467	1.0799	1.0255
15	......	......	......	......
16	1.1333	1.1705	1.0927	1.0294
17	......	......	......	......
18	1.1522	1.1950	1.1058	1.0331
19	......	......	......	......
20	1.1717	......	1.1191	1.0368
21	......	......	......	......
22	1.1918	......	1.1327	1.0404
23	......	......	......	......
24	1.2125	......	1.1466	1.0439
25	......	......	......	......
26	1.2338	......	1.1608	1.0473
27	......	......	......	......
28	1.2557	......	1.1753	1.0507
29	......	......	......	......
30	1.2781	......	1.1901	1.0540
31	......	......	......	......
32	......	......	1.2053	......
33	......	......	......	......
34	......	......	1.2209	......
35	1.3367	......	......	1.0618
36	......	......	1.2369	......
37	......	......	......	......
38	......	......	1.2533	......
39	......	......	......	......
40	1.3993	......	1.2702	1.0691
42	......	......	......	......
44	......	......	......	......
45	1.4662	......	......	1.0760
46	......	......	......	......
48	......	......	......	......
50	1.5378	......	......	......
55	1.6146	......	......	......
60	......	......	......	......
65	......	......	......	......
70	......	......	......	......
75	......	......	......	......
80	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	NH_4I $\frac{18°}{4°}$ C.	N_2H_4 $\frac{15°}{4°}$ C.	NH_2OH $\frac{20°}{4°}$ C.	$NaBrO_3$ $\frac{18°}{4°}$ C.
1	1.0050	1.0002	1.0002	1.0064
2	1.0114	1.0013	1.0023	1.0143
3	......	......	......	......
4	1.0244	1.0034	1.0065	1.0305
5	......	......	......	......
6	1.0377	1.0056	1.0107	1.0471
7	......	......	......	......
8	1.0513	1.0077	1.0149	1.0641
9	......	......	......	......
10	1.0652	1.0099	1.0192	1.0816
11	......	......	......	......
12	1.0795	1.0121	1.0235	1.0996
13	......	......	......	......
14	1.0942	1.0143	1.0278	1.1182
15	......	......	......	......
16	1.1093	1.0164	1.0322	1.1373
17	......	......	......	......
18	1.1248	1.0186	1.0366	1.1569
19	......	......	......	......
20	1.1407	1.0207	1.0410	1.1771
21	......	......	......	......
22	1.1570	1.0228	1.0454	1.1979
23	......	......	......	......
24	1.1737	1.0248	1.0499	1.2193
25	......	......	......	......
26	1.1908	1.0267	1.0545	......
27	......	......	......	......
28	1.2084	1.0286	1.0591	......
29	......	......	......	......
30	1.2265	1.0305	1.0637	......
31	......	......	......	......
32	......	......	......	......
33	......	......	......	......
34	......	......	......	......
35	1.2745	1.0350	1.0755	......
36	......	......	......	......
37	......	......	......	......
38	......	......	......	......
39	......	......	......	......
40	1.3264	1.0380	1.0875	......
42	......	......	......	......
44	......	......	......	......
45	1.3823	1.0420	1.0997	......
46	......	......	......	......
48	......	......	......	......
50	......	1.0440	1.1122	......
55	......	1.0460	1.1249	......
60	......	1.0470	......	......
65	......	1.0470	......	......
70	......	1.0460	......	......
75	......	1.0430	......	......
80	......	1.0400	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$NaC_2H_3O_2$ $\frac{20^\circ}{4^\circ}$ C	$NaClO_4$ $\frac{18^\circ}{4^\circ}$ C.	$Ni(NO_3)_2$ $\frac{18^\circ}{4^\circ}$ C.	$Pb(C_2H_3O_2)_2$ $\frac{18^\circ}{4^\circ}$ C.
1	1.0033	1.0051	1.0070	1.0061
2	1.0084	1.0116	1.0155	1.0137
3	......	......	......	......
4	1.0186	1.0247	1.0330	1.0290
5	......	......	......	......
6	1.0289	1.0381	1.0508	1.0446
7	......	......	......	......
8	1.0392	1.0517	1.0693	1.0605
9	......	......	......	......
10	1.0495	1.0656	1.0882	1.0768
11	......	......	......	......
12	1.0598	1.0798	1.1076	1.0936
13	......	......	......	......
14	1.0702	1.0943	1.1277	1.1109
15	......	......	......	......
16	1.0807	1.1090	1.1484	1.1283
17	......	......	......	......
18	1.0913	1.1241	1.1696	1.1473
19	......	......	......	......
20	1.1021	1.1396	1.1914	1.1663
21	......	......	......	......
22	1.1130	1.1554	......	1.1860
23	......	......	......	......
24	1.1240	1.1717	......	1.2063
25	......	......	1.2493	......
26	1.1351	1.1883	......	1.2273
27	......	......	......	......
28	1.1462	1.2053	......	1.2489
29	......	......	......	......
30	......	1.2227	1.3114	1.2711
31	......	......	......	......
32	......	1.2407	......	......
33	......	......	......	......
34	......	1.2591	......	......
35	......	......	1.3777	1.3304
36	......	1.2779	......	......
37	......	......	......	......
38	......	1.2969	......	......
39	......	......	......	......
40	......	......	......	1.3994
42	......	......	......	......
44	......	......	......	......
45	......	......	......	......
46	......	......	......	......
48	......	......	......	......
50	......	......	......	......
55	......	......	......	......
60	......	......	......	......
65	......	......	......	......
70	......	......	......	......
75	......	......	......	......
80	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	$Pb(NO_3)_2$ $\frac{18^\circ}{4^\circ}$ C.	SO_2 $\frac{15.5^\circ}{4^\circ}$ C	$SrBr_2$ $\frac{20^\circ}{4^\circ}$ C.	$SrCl_2$ $\frac{20^\circ}{4^\circ}$ C.
1	1.0074	1.0040	......	......
2	1.0163	1.0091	1.0157	1.0161
3	......	......	......	......
4	1.0344	1.0191	1.0337	1.0344
5	......	......	......	......
6	1.0529	1.0292	1.0522	1.0532
7	......	......	......	......
8	1.0720	1.0393	1.0712	1.0726
9	......	......	......	......
10	1.0918	1.0493	1.0907	1.0925
11	......	......	......	......
12	1.1123	......	1.1109	1.1130
13	......	......	......	......
14	1.1336	......	1.1317	1.1341
15	......	......	......	......
16	1.1557	......	1.1532	1.1558
17	......	......	......	......
18	1.1789	......	1.1757	1.1781
19	......	......	......	......
20	1.2030	......	1.1992	1.2010
21	......	......	......	......
22	1.2277	......	......	......
23	......	......	......	......
24	1.2529	......	......	......
25	......	......	1.2620	1.2600
26	1.2783	......	......	......
27	......	......	......	......
28	1.3037	......	......	......
29	......	......	......	......
30	1.3289	......	1.3300	1.3250
31	......	......	......	......
32	......	......	......	......
33	......	......	......	......
34	......	......	......	......
35	......	......	1.4050	1.3960
36	......	......	......	......
37	......	......	......	......
38	......	......	......	......
39	......	......	......	......
40	......	......	1.4890	......
42	......	......	......	......
44	......	......	......	......
45	......	......	1.5830	......
46	......	......	......	......
48	......	......	......	......
50	......	......	1.6860	......
55	......	......	......	......
60	......	......	......	......
65	......	......	......	......
70	......	......	......	......
75	......	......	......	......
80	......	......	......	......

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS
(Continued)

Per cent by weight	SrI_2 $\frac{20^\circ}{4^\circ}$ C.	$Sr(NO_3)_2$ $\frac{20^\circ}{4^\circ}$ C.	$ZnBr_2$ $\frac{20^\circ}{4^\circ}$ C.	ZnI_2 $\frac{20^\circ}{4^\circ}$ C.
1	......	......	......	......
2	1.0154	1.0150	1.0167	1.016
3	......	......	......	......
4	1.0331	1.0310	1.0354	1.034
5	......	......	......	......
6	1.0513	1.0480	1.0544	1.053
7	......	......	......	......
8	1.0701	1.0650	1.0738	1.072
9	......	......	......	......
10	1.0896	1.0830	1.0935	1.091
11	......	......	......	......
12	1.1099	1.1010	1.1135	1.111
13	......	......	......	......
14	1.1308	1.1190	1.1338	1.131
15	......	......	......	......
16	1.1526	1.1380	1.1544	1.152
17	......	......	......	......
18	1.1753	1.1580	1.1753	1.174
19	......	......	......	......
20	1.1990	1.179	1.1965	1.197
21	......	......	......	......
22	......	......	......	......
23	......	......	......	......
24	......	......	......	......
25	1.2608	1.233	1.2543	1.258
26	......	......	......	......
27	......	......	......	......
28	......	......	......	......
29	......	......	......	......
30	1.3295	1.290	1.3170	1.325
31	......	......	......	......
32	......	......	......	......
33	......	......	......	......
34	......	......	......	......
35	1.4058	1.352	1.3859	1.398
36	......	......	......	......
37	......	......	......	......
38	......	......	......	......
39	......	......	......	......
40	1.4904	1.419	1.4620	1.478
42	......	......	......	......
44	......	......	......	......
45	1.5844	......	1.5470	1.566
46	......	......	......	......
48	......	......	......	......
50	......	......	1.6430	1.663
55	......	......	1.7500	1.770
60	......	......	1.8690	1.893
65	......	......	2.0020	2.036
70	......	......	......	2.202
75	......	......	......	2.393
80	......	......	......	......

ETHYL ALCOHOL

SPECIFIC GRAVITY OF MIXTURES OF ETHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Giving the specific gravity of 15.56° C. referred to water at the same temperature. To reduce to specific gravity referred to water at 4° C. multiply by 0.99908.

(U. S. Department of Agriculture.)

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
1.00000	0.00	0.00	0.00	0.99431	3.90	3.12	3.10
0.99984	0.10	0.08	0.08	0.99417	4.00	3.20	3.18
0.99968	0.20	0.16	0.16	0.99403	4.10	3.28	3.26
0.99953	0.30	0.24	0.24	0.99390	4.20	3.36	3.34
0.99937	0.40	0.32	0.32	0.99376	4.30	3.44	3.42
0.99923	0.50	0.40	0.40	0.99363	4.40	3.52	3.50
0.99907	0.60	0.48	0.48	0.99349	4.50	3.60	3.58
0.99892	0.70	0.56	0.56	0.99335	4.60	3.68	3.66
0.99877	0.80	0.64	0.64	0.99322	4.70	3.76	3.74
0.99861	0.90	0.71	0.71	0.99308	4.80	3.84	3.81
0.99849	1.00	0.79	0.79	0.99295	4.90	3.92	3.89
0.99834	1.10	0.87	0.87	0.99281	5.00	4.00	3.97
0.99819	1.20	0.95	0.95	0.99268	5.10	4.08	4.05
0.99805	1.30	1.03	1.03	0.99255	5.20	4.16	4.13
0.99790	1.40	1.11	1.11	0.99241	5.30	4.24	4.21
0.99775	1.50	1.19	1.19	0.99228	5.40	4.32	4.29
0.99760	1.60	1.27	1.27	0.99215	5.50	4.40	4.37
0.99745	1.70	1.35	1.35	0.99202	5.60	4.48	4.44
0.99731	1.80	1.43	1.43	0.99189	5.70	4.56	4.52
0.99716	1.90	1.51	1.51	0.99175	5.80	4.64	4.60
0.99701	2.00	1.59	1.59	0.99162	5.90	4.72	4.68
0.99687	2.10	1.67	1.66	0.99149	6.00	4.80	4.76
0.99672	2.20	1.75	1.74	0.99136	6.10	4.88	4.84
0.99658	2.30	1.83	1.82	0.99123	6.20	4.96	4.92
0.99643	2.40	1.91	1.90	0.99111	6.30	5.05	5.00
0.99629	2.50	1.99	1.98	0.99098	6.40	5.13	5.08
0.99615	2.60	2.07	2.06	0.99085	6.50	5.21	5.16
0.99600	2.70	2.15	2.14	0.99072	6.60	5.29	5.24
0.99586	2.80	2.23	2.22	0.99059	6.70	5.37	5.32
0.99571	2.90	2.31	2.30	0.99047	6.80	5.45	5.40
0.99557	3.00	2.39	2.38	0.99034	6.90	5.53	5.48
0.99543	3.10	2.47	2.46	0.99021	7.00	5.61	5.56
0.99529	3.20	2.55	2.54	0.99009	7.10	5.69	5.64
0.99515	3.30	2.64	2.62	0.98996	7.20	5.77	5.72
0.99501	3.40	2.72	2.70	0.98984	7.30	5.86	5.80
0.99487	3.50	2.80	2.78	0.98971	7.40	5.94	5.88
0.99473	3.60	2.88	2.86	0.98959	7.50	6.02	5.96
0.99459	3.70	2.96	2.94	0.98947	7.60	6.10	6.04
0.99445	3.80	3.04	3.02	0.98934	7.70	6.18	6.11

ETHYL ALCOHOL (Continued)

Specific Gravity of Mixtures of Ethyl Alcohol and Water by Volume and by Weight

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.98922	7.80	6.26	6.19	0.98435	12.00	9.67	9.52
0.98909	7.90	6.34	6.27	0.98424	12.10	9.75	9.60
0.98897	8.00	6.42	6.35	0.98413	12.20	9.83	9.68
0.98885	8.10	6.50	6.43	0.98402	12.30	9.92	9.76
0.98873	8.20	6.58	6.51	0.98391	12.40	10.00	9.84
0.98861	8.30	6.67	6.59	0.98381	12.50	10.08	9.92
0.98849	8.40	6.75	6.67	0.98370	12.60	10.16	10.00
0.98837	8.50	6.83	6.75	0.98359	12.70	10.24	10.07
0.98825	8.60	6.91	6.83	0.98348	12.80	10.33	10.15
0.98813	8.70	6.99	6.91	0.98337	12.90	10.41	10.23
0.98801	8.80	7.07	6.99	0.98326	13.00	10.49	10.31
0.98789	8.90	7.15	7.07	0.98315	13.10	10.57	10.39
0.98777	9.00	7.23	7.14	0.98305	13.20	10.65	10.47
0.98765	9.10	7.31	7.22	0.98294	13.30	10.74	10.55
0.98754	9.20	7.39	7.30	0.98283	13.40	10.82	10.63
0.98742	9.30	7.48	7.38	0.98273	13.50	10.90	10.71
0.98730	9.40	7.56	7.46	0.98262	13.60	10.98	10.79
0.98719	9.50	7.64	7.54	0.98251	13.70	11.06	10.87
0.98707	9.60	7.72	7.62	0.98240	13.80	11.15	10.95
0.98695	9.70	7.80	7.70	0.98230	13.90	11.23	11.03
0.98683	9.80	7.88	7.78	0.98219	14.00	11.31	11.11
0.98672	9.90	7.96	7.85	0.98209	14.10	11.39	11.19
0.98660	10.00	8.04	7.93	0.98198	14.20	11.47	11.27
0.98649	10.10	8.12	8.01	0.98188	14.30	11.56	11.35
0.98637	10.20	8.20	8.09	0.98177	14.40	11.64	11.43
0.98626	10.30	8.29	8.17	0.98167	14.50	11.72	11.51
0.98614	10.40	8.37	8.25	0.98156	14.60	11.80	11.59
0.98603	10.50	8.45	8.33	0.98146	14.70	11.88	11.67
0.98592	10.60	8.53	8.41	0.98135	14.80	11.97	11.75
0.98580	10.70	8.61	8.49	0.98125	14.90	12.05	11.82
0.98569	10.80	8.70	8.57	0.98114	15.00	12.13	11.90
0.98557	10.90	8.78	8.65	0.98104	15.10	12.21	11.98
0.98546	11.00	8.86	8.73	0.98093	15.20	12.29	12.06
0.98535	11.10	8.94	8.81	0.98083	15.30	12.38	12.14
0.98524	11.20	9.02	8.89	0.98073	15.40	12.46	12.22
0.98513	11.30	9.11	8.97	0.98063	15.50	12.54	12.30
0.98502	11.40	9.19	9.05	0.98052	15.60	12.62	12.37
0.98491	11.50	9.27	9.13	0.98042	15.70	12.70	12.45
0.98479	11.60	9.35	9.21	0.98032	15.80	12.79	12.53
0.98468	11.70	9.43	9.29	0.98021	15.90	12.87	12.61
0.98457	11.80	9.51	9.36	0.98011	16.00	12.95	12.69
0.98446	11.90	9.59	9.44	0.98001	16.10	13.03	12.77

ETHYL ALCOHOL (Continued)

SPECIFIC GRAVITY OF MIXTURES OF ETHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.97991	16.20	13.12	12.85	0.97568	20.40	16.59	16.18
0.97980	16.30	13.20	12.93	0.97558	20.50	16.67	16.26
0.97970	16.40	13.29	13.01	0.97547	20.60	16.75	16.34
0.97960	16.50	13.37	13.09	0.97537	20.70	16.84	16.42
0.97950	16.60	13.45	13.17	0.97527	20.80	16.92	16.50
0.97940	16.70	13.53	13.25	0.97517	20.90	17.01	16.58
0.97929	16.80	13.62	13.33	0.97507	21.00	17.09	16.66
0.97917	16.90	13.70	13.41	0.97497	21.10	17.17	16.74
0.97909	17.00	13.78	13.49	0.97487	21.20	17.26	16.82
0.97899	17.10	13.86	13.57	0.97477	21.30	17.34	16.90
0.97889	17.20	13.94	13.65	0.97467	21.40	17.43	16.98
0.97879	17.30	14.03	13.73	0.97457	21.50	17.51	17.06
0.97869	17.40	14.11	13.81	0.97446	21.60	17.59	17.14
0.97859	17.50	14.19	13.89	0.97436	21.70	17.67	17.22
0.97848	17.60	14.27	13.96	0.97426	21.80	17.76	17.30
0.97838	17.70	14.35	14.04	0.97416	21.90	17.84	17.38
0.97828	17.80	14.44	14.12	0.97406	22.00	17.92	17.46
0.97818	17.90	14.52	14.20	0.97396	22.10	18.00	17.54
0.97808	18.00	14.60	14.28	0.97386	22.20	18.09	17.62
0.97798	18.10	14.68	14.36	0.97375	22.30	18.17	17.70
0.97788	18.20	14.77	14.44	0.97365	22.40	18.26	17.78
0.97778	18.30	14.85	14.52	0.97355	22.50	18.34	17.86
0.97768	18.40	14.94	14.60	0.97345	22.60	18.42	17.94
0.97758	18.50	15.02	14.68	0.97335	22.70	18.51	18.02
0.97748	18.60	15.10	14.76	0.97324	22.80	18.59	18.10
0.97738	18.70	15.18	14.84	0.97314	22.90	18.68	18.18
0.97728	18.80	15.27	14.92	0.97304	23.00	18.76	18.26
0.97718	18.90	15.38	15.00	0.97294	23.10	18.84	18.33
0.97708	19.00	15.43	15.08	0.97283	23.20	18.92	18.41
0.97698	19.10	15.51	15.15	0.97273	23.30	19.01	18.49
0.97688	19.20	15.59	15.23	0.97263	23.40	19.09	18.57
0.97678	19.30	15.68	15.31	0.97253	23.50	19.17	18.65
0.97668	19.40	15.76	15.39	0.97242	23.60	19.25	18.73
0.97658	19.50	15.84	15.47	0.97232	23.70	19.34	18.18
0.97648	19.60	15.93	15.55	0.97222	23.80	19.42	18.88
0.97638	19.70	16.01	15.63	0.97211	23.90	19.51	18.96
0.97628	19.80	16.09	15.71	0.97201	24.00	19.59	19.04
0.97618	19.90	16.18	15.79	0.97191	24.10	19.67	19.12
0.97608	20.00	16.26	15.87	0.97180	24.20	19.76	19.20
0.97598	20.10	16.34	15.95	0.97170	24.30	19.84	19.28
0.97588	20.20	16.42	16.03	0.97159	24.40	19.93	19.36
0.97578	20.30	16.51	16.10	0.97149	24.50	20.01	19.44

ETHYL ALCOHOL (Continued)

SPECIFIC GRAVITY OF MIXTURES OF ETHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.97139	24.60	20.09	19.52	0.96681	28.80	23.64	22.85
0.97128	24.70	20.18	19.60	0.96669	28.90	23.72	22.93
0.97118	24.80	20.26	19.68	0.96658	29.00	23.81	23.01
0.97107	24.90	20.35	19.76	0.96646	29.10	23.89	23.09
0.97097	25.00	20.43	19.84	0.96635	29.20	23.98	23.17
0.97086	25.10	20.51	19.92	0.96623	29.30	24.06	23.25
0.97076	25.20	20.60	20.00	0.96611	29.40	24.15	23.33
0.97065	25.30	20.68	20.08	0.96600	29.50	24.23	23.41
0.97055	25.40	20.77	20.16	0.96587	29.60	24.32	23.49
0.97044	25.50	20.85	20.24	0.96576	29.70	24.40	23.57
0.97033	25.60	20.93	20.32	0.96564	29.80	24.49	23.65
0.97023	25.70	21.02	20.40	0.96553	29.90	24.57	23.73
0.97012	25.80	21.10	20.47	0.96541	30.00	24.66	23.81
0.97001	25.90	21.19	20.55	0.96529	30.10	24.74	23.89
0.96991	26.00	21.27	20.63	0.96517	30.20	24.83	23.97
0.96980	26.10	21.35	20.71	0.96505	30.30	24.91	24.04
0.96969	26.20	21.44	20.79	0.96493	30.40	25.00	24.12
0.96959	26.30	21.52	20.87	0.96481	30.50	25.08	24.20
0.96949	26.40	21.61	20.95	0.96469	30.60	25.17	24.28
0.96937	26.50	21.69	21.03	0.96457	30.70	25.25	24.36
0.96926	26.60	21.77	21.11	0.96445	30.80	25.34	24.44
0.96915	26.70	21.86	21.19	0.96433	30.90	25.42	24.52
0.96905	26.80	21.94	21.27	0.96421	31.00	25.51	24.60
0.96894	26.90	22.03	21.35	0.96409	31.10	25.60	24.68
0.96883	27.00	22.11	21.43	0.96396	31.20	25.68	24.76
0.96872	27.10	22.20	21.51	0.96384	31.30	25.77	24.84
0.96861	27.20	22.28	21.59	0.96372	31.40	25.85	24.92
0.96850	27.30	22.37	21.67	0.96360	31.50	25.94	25.00
0.96839	27.40	22.45	21.75	0.96347	31.60	26.03	25.08
0.96828	27.50	22.54	21.83	0.96335	31.70	26.11	25.16
0.96816	27.60	22.62	21.90	0.96323	31.80	26.20	25.24
0.96805	27.70	22.71	21.98	0.96310	31.90	26.28	25.32
0.96794	27.80	22.79	22.06	0.96298	32.00	26.37	25.40
0.96783	27.90	22.88	22.14	0.96285	32.10	26.46	25.48
0.96772	28.00	22.96	22.22	0.96273	32.20	26.54	25.56
0.96761	28.10	23.04	22.30	0.96260	32.30	26.63	25.64
0.96749	28.20	23.13	22.38	0.96248	32.40	26.71	25.71
0.96738	28.30	23.21	22.45	0.96235	32.50	26.80	25.79
0.96726	28.40	23.30	22.53	0.96222	32.60	26.89	25.87
0.96715	28.50	23.38	22.61	0.96210	32.70	26.97	25.95
0.96704	28.60	23.47	22.69	0.96197	32.80	27.06	26.03
0.96692	28.70	23.55	22.77	0.96185	32.90	27.14	26.11

ETHYL ALCOHOL (Continued)

SPECIFIC GRAVITY OF MIXTURES OF ETHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.96172	33.00	27.23	26.19	0.95603	37.20	30.88	29.52
0.96159	33.10	27.32	26.27	0.95589	37.30	30.96	29.60
0.96146	33.20	27.40	26.35	0.95574	37.40	31.05	29.68
0.96133	33.30	27.49	26.43	0.95560	37.50	31.14	29.76
0.96120	33.40	27.57	26.51	0.95545	37.60	31.23	29.84
0.96108	33.50	27.66	26.59	0.95531	37.70	31.32	29.92
0.96095	33.60	27.75	26.67	0.95516	37.80	31.40	30.00
0.96082	33.70	27.83	26.75	0.95502	37.90	31.49	30.08
0.96069	33.80	27.92	26.82	0.95487	38.00	31.58	30.16
0.96056	33.90	28.00	26.90	0.95472	38.10	31.67	30.24
0.96043	34.00	28.09	26.98	0.95457	38.20	31.76	30.32
0.96030	34.10	28.18	27.06	0.95442	38.30	31.85	30.40
0.96016	34.20	28.26	27.14	0.95427	38.40	31.94	30.48
0.96003	34.30	28.35	27.22	0.95413	38.50	32.03	30.56
0.95990	34.40	28.43	27.30	0.95398	38.60	32.12	30.64
0.95977	34.50	28.52	27.38	0.95383	38.70	32.20	30.72
0.95963	34.60	28.61	27.46	0.95368	38.80	32.29	30.79
0.95950	34.70	28.70	27.54	0.95353	38.90	32.37	30.87
0.95937	34.80	28.78	27.62	0.95338	39.00	32.46	30.95
0.95923	34.90	28.87	27.70	0.95323	39.10	32.55	31.03
0.95910	35.00	28.96	27.78	0.95307	39.20	32.64	31.11
0.95896	35.10	29.05	27.86	0.95292	39.30	32.72	31.18
0.95883	35.20	29.13	27.94	0.95277	39.40	32.81	31.26
0.95869	35.30	29.22	28.02	0.95262	39.50	32.90	31.34
0.95855	35.40	29.30	28.09	0.95246	39.60	32.99	31.42
0.95842	35.50	29.38	28.17	0.95231	39.70	33.08	31.50
0.95828	35.60	29.48	28.25	0.95216	39.80	33.17	31.58
0.95814	35.70	29.57	28.33	0.95200	39.90	33.27	31.66
0.95800	35.80	29.65	28.41	0.95185	40.00	33.35	31.74
0.95787	35.90	29.74	28.49	0.95169	40.10	33.44	31.82
0.95773	36.00	29.83	28.57	0.95154	40.20	33.53	31.90
0.95759	36.10	29.92	28.65	0.95138	40.30	33.61	31.98
0.95745	36.20	30.00	28.73	0.95122	40.40	33.70	32.06
0.95731	36.30	30.09	28.81	0.95107	40.50	33.79	32.14
0.95717	36.40	30.17	28.88	0.95091	40.60	33.88	32.22
0.95703	36.50	30.26	28.96	0.95075	40.70	33.97	32.30
0.95688	36.60	30.35	29.04	0.95059	40.80	34.06	32.38
0.95674	36.70	30.44	29.12	0.95044	40.90	34.15	32.46
0.95660	36.80	30.52	29.20	0.95028	41.00	34.24	32.54
0.95646	36.90	30.61	29.29	0.95012	41.10	34.33	32.62
0.95632	37.00	30.70	29.36	0.94996	41.20	34.42	32.70
0.95618	37.10	30.79	29.44	0.94980	41.30	34.50	32.78

ETHYL ALCOHOL (Continued)

SPECIFIC GRAVITY OF MIXTURES OF ETHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.94964	41.40	34.59	32.86	0.94258	45.60	38.39	36.19
0.94948	41.50	34.68	32.93	0.94241	45.70	38.48	36.26
0.94932	41.60	34.77	33.01	0.94223	45.80	38.57	36.34
0.94916	41.70	34.86	33.09	0.94206	45.90	38.66	36.42
0.94900	41.80	34.95	33.17	0.94188	46.00	38.75	36.50
0.94884	41.90	35.04	33.25	0.94170	46.10	38.84	36.58
0.94868	42.00	35.13	33.33	0.94152	46.20	38.93	36.66
0.94852	42.10	35.22	33.41	0.94134	46.30	39.03	36.74
0.94835	42.20	35.31	33.49	0.94116	46.40	39.12	36.82
0.94810	42.30	35.40	33.57	0.94098	46.50	39.21	36.90
0.94802	42.40	35.49	33.65	0.94080	46.60	39.30	36.98
0.94786	42.50	35.58	33.73	0.94062	46.70	39.39	37.06
0.94770	42.60	35.67	33.81	0.94044	46.80	39.49	37.13
0.94753	42.70	35.76	33.89	0.94026	46.90	39.58	37.21
0.94737	42.80	35.85	33.97	0.94008	47.00	39.67	37.29
0.94720	42.90	35.94	34.04	0.93990	47.10	39.76	37.37
0.94704	43.00	36.03	34.12	0.93971	47.20	39.85	37.45
0.94687	43.10	36.12	34.20	0.93953	47.30	39.95	37.53
0.94670	43.20	36.21	34.28	0.93934	47.40	40.04	37.61
0.94654	43.30	36.30	34.36	0.93916	47.50	40.13	37.69
0.94637	43.40	36.39	34.44	0.93898	47.60	40.22	37.77
0.94620	43.50	36.48	34.52	0.93879	47.70	40.32	37.85
0.94603	43.60	36.57	34.60	0.93861	47.80	40.41	37.93
0.94586	43.70	36.66	34.68	0.93842	47.90	40.51	38.01
0.94570	43.80	36.75	34.76	0.93824	48.00	40.60	38.09
0.94553	43.90	36.84	34.84	0.93805	48.10	40.69	38.17
0.94536	44.00	36.93	34.91	0.93786	48.20	40.78	38.25
0.94519	44.10	37.02	34.99	0.93768	48.30	40.88	38.33
0.94502	44.20	37.11	35.07	0.93749	48.40	40.97	38.41
0.94484	44.30	37.21	35.15	0.93730	48.50	41.06	38.49
0.94467	44.40	37.30	35.23	0.93711	48.60	41.15	38.57
0.94450	44.50	37.39	35.31	0.93692	48.70	41.24	38.65
0.94433	44.60	37.48	35.39	0.93679	48.80	41.34	38.72
0.94416	44.70	37.57	35.47	0.93655	48.90	41.43	38.80
0.94398	44.80	37.66	35.55	0.93636	49.00	41.52	38.88
0.94381	44.90	37.76	35.63	0.93617	49.10	41.61	38.96
0.94364	45.00	37.84	35.71	0.93598	49.20	41.71	39.04
0.94346	45.10	37.93	35.79	0.93578	49.30	41.80	39.12
0.94329	45.20	38.02	35.87	0.93559	49.40	41.90	39.20
0.94311	45.30	38.12	35.95	0.93540	49.50	41.99	39.28
0.94294	45.40	38.21	36.03	0.93521	49.60	42.08	39.36
0.94276	45.50	38.30	36.11	0.93502	49.70	42.18	39.44

ETHYL ALCOHOL (Continued)

SPECIFIC GRAVITY OF MIXTURES OF ETHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.	Specific gravity.	Per cent alcohol by volume.	Per cent alcohol by weight.	Grams alcohol per 100 c.c.
0.93482	49.80	42.27	39.52	0.8773	75.00	....	....
0.93463	49.90	42.37	39.60	0.8747	76.00	....	....
0.9344	50.00	...*	....	0.8721	77.00	....	....
0.9325	51.00	....	....	0.8694	78.00	....	....
0.9305	52.00	....	....	0.8667	79.00	....	....
0.9285	53.00	....	....	0.8639	80.00	....	....
0.9264	54.00	....	....	0.8611	81.00	....	....
0.9244	55.00	....	....	0.8583	82.00	....	....
0.9222	56.00	....	....	0.8554	83.00	....	....
0.9201	57.00	....	....	0.8525	84.00	....	....
0.9180	58.00	....	....	0.8496	85.00	....	....
0.9158	59.00	....	....	0.8465	86.00	....	....
0.9136	60.00	....	....	0.8435	87.00	....	....
0.9113	61.00	....	....	0.8404	88.00	....	....
0.9091	62.00	....	....	0.8372	89.00	....	....
0.9068	63.00	....	....	0.8339	90.00	....	....
0.9044	64.00	....	....	0.8306	91.00	....	....
0.9021	65.00	....	....	0.8272	92.00	....	....
0.8997	66.00	....	....	0.8236	93.00	....	....
0.8974	67.00	....	....	0.8199	94.00	....	....
0.8949	68.00	....	....	0.8161	95.00	....	....
0.8925	69.00	....	....	0.8121	96.00	....	....
0.8900	70.00	....	....	0.8079	97.00	....	....
0.8876	71.00	....	....	0.8035	98.00	....	....
0.8850	72.00	....	....	0.7989	99.00	....	....
0.8825	73.00	....	....	0.7939	100.00	....	....
0.8799	74.00	....	....	......	......	....	....

* For specific gravity of mixtures by weight see following table.

ETHYL ALCOHOL

SPECIFIC GRAVITY OF MIXTURES OF ETHYL ALCOHOL AND WATER BY WEIGHT

The table gives the specific gravity at the temperature indicated referred to water at 4° C.

(U. S. Bureau of Standards.)

Per cent alcohol by weight.	15° C.	20° C.	25° C.	Per cent alcohol by weight.	15° C.	20° C.	25° C.
0	0.99913	0.99824	0.99708	51	0.91566	0.91164	0.90758
1	0.99725	0.99636	0.99521	52	0.91344	0.90940	0.90533
2	0.99543	0.99453	0.99338	53	0.91120	0.90715	0.90307
3	0.99366	0.99274	0.99159	54	0.90895	0.90488	0.90079
4	0.99197	0.99102	0.98984	55	0.90670	0.90262	0.89851
5	0.99033	0.98936	0.98815	56	0.90443	0.90034	0.89622
6	0.98877	0.98776	0.98651	57	0.90215	0.89805	0.89392
7	0.98726	0.98620	0.98491	58	0.89987	0.89576	0.89162
8	0.98581	0.98470	0.98336	59	0.89758	0.89346	0.88931
9	0.98442	0.98325	0.98185	60	0.89528	0.89115	0.88700
10	0.98307	0.98185	0.98038	61	0.89297	0.88883	0.88467
11	0.98176	0.98047	0.97893	62	0.89066	0.88651	0.88234
12	0.98049	0.97913	0.97752	63	0.88834	0.88418	0.88000
13	0.97925	0.97781	0.97612	64	0.88601	0.88185	0.87766
14	0.97803	0.97651	0.97474	65	0.88368	0.87950	0.87530
15	0.97683	0.97522	0.97336	66	0.88134	0.87716	0.87295
16	0.97563	0.97393	0.97199	67	0.87899	0.87480	0.87058
17	0.97444	0.97264	0.97061	68	0.87664	0.87244	0.86821
18	0.97324	0.97134	0.96922	69	0.87428	0.87008	0.86583
19	0.97203	0.97003	0.96782	70	0.87192	0.86770	0.86344
20	0.97080	0.96870	0.96640	71	0.86954	0.86532	0.86105
21	0.96956	0.96736	0.96497	72	0.86716	0.86292	0.85864
22	0.96829	0.96599	0.96352	73	0.86477	0.86052	0.85622
23	0.96699	0.96459	0.96203	74	0.86237	0.85812	0.85380
24	0.96566	0.96317	0.96052	75	0.85997	0.85570	0.85137
25	0.96430	0.96171	0.95897	76	0.85755	0.85328	0.84893
26	0.96289	0.96021	0.95739	77	0.85513	0.85084	0.84648
27	0.96145	0.95868	0.95577	78	0.85270	0.84840	0.84403
28	0.95997	0.95711	0.95412	79	0.85026	0.84595	0.84157
29	0.95845	0.95550	0.95244	80	0.84781	0.84349	0.83909
30	0.95688	0.95385	0.95071	81	0.84534	0.84101	0.83660
31	0.95526	0.95215	0.94894	82	0.84286	0.83852	0.83410
32	0.95360	0.95042	0.94713	83	0.84037	0.83602	0.83159
33	0.95191	0.94865	0.94529	84	0.83786	0.83350	0.82906
34	0.95017	0.94684	0.94342	85	0.83534	0.83097	0.82652
35	0.94839	0.94499	0.94152	86	0.83279	0.82842	0.82396
36	0.94657	0.94311	0.93957	87	0.83022	0.82583	0.82137
37	0.94471	0.94119	0.93760	88	0.82762	0.82323	0.81876
38	0.94282	0.93924	0.93560	89	0.82500	0.82060	0.81613
39	0.94089	0.93725	0.93356	90	0.82235	0.81795	0.81348
40	0.93893	0.93524	0.93151	91	0.81966	0.81527	0.81080
41	0.93694	0.93320	0.92943	92	0.81694	0.81255	0.80809
42	0.93491	0.93113	0.92732	93	0.81418	0.80979	0.80534
43	0.93286	0.92904	0.92519	94	0.81138	0.80700	0.80256
44	0.93078	0.92693	0.92305	95	0.80854	0.80417	0.79974
45	0.92868	0.92480	0.92088	96	0.80564	0.80129	0.79689
46	0.92655	0.92264	0.91870	97	0.80271	0.79838	0.79400
47	0.92441	0.92047	0.91650	98	0.79972	0.79541	0.79106
48	0.92225	0.91828	0.91429	99	0.79668	0.79240	0.78809
49	0.92006	0.91608	0.91207	100	0.79358	0.78933	0.78507
50	0.91787	0.91386	0.90983	.....	....	....	....

ETHYL ALCOHOL

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS REFERRED TO WATER AT THE SAME TEMPERATURE

Per cent alcohol	Sp. gr. $\frac{15^\circ}{15^\circ}$ C.	Sp. gr. $\frac{20^\circ}{20^\circ}$ C.	Sp. gr. $\frac{25^\circ}{25^\circ}$ C.	Per cent alcohol	Sp. gr. $\frac{15^\circ}{15^\circ}$ C.	Sp. gr. $\frac{20^\circ}{20^\circ}$ C.	Sp. gr. $\frac{25^\circ}{25^\circ}$ C.
0	1.00000	1.00000	1.00000	51	0.91635	0.91322	0.91026
1	0.99812	0.99813	0.99811	52	0.91412	0.91097	0.90799
2	0.99629	0.99629	0.99627	53	0.91189	0.90872	0.90571
3	0.99451	0.99451	0.99447	54	0.90964	0.90645	0.90343
4	0.99281	0.99279	0.99274	55	0.90738	0.90418	0.90113
5	0.99118	0.99113	0.99106	56	0.90512	0.90191	0.89883
6	0.98963	0.98955	0.98945	57	0.90285	0.89962	0.89654
7	0.98815	0.98802	0.98788	58	0.90058	0.89733	0.89423
8	0.98670	0.98653	0.98634	59	0.89830	0.89502	0.89191
9	0.98528	0.98505	0.98481	60	0.89601	0.89271	0.88959
10	0.98390	0.98361	0.98330	61	0.89371	0.89040	0.88725
11	0.98256	0.98221	0.98184	62	0.89139	0.88807	0.88491
12	0.98126	0.98084	0.98039	63	0.88907	0.88574	0.88256
13	0.97999	0.97948	0.97897	64	0.88674	0.88339	0.88020
14	0.97875	0.97816	0.97757	65	0.88441	0.88104	0.87783
15	0.97754	0.97687	0.97619	66	0.88207	0.87869	0.87547
16	0.97637	0.97560	0.97484	67	0.87971	0.87632	0.87309
17	0.97518	0.97431	0.97346	68	0.87736	0.87396	0.87071
18	0.97398	0.97301	0.97207	69	0.87500	0.87158	0.86833
19	0.97276	0.97169	0.97065	70	0.87263	0.86920	0.86593
20	0.97152	0.97036	0.96922	71	0.87025	0.86680	0.86352
21	0.97028	0.96901	0.96778	72	0.86785	0.86440	0.86110
22	0.96902	0.96763	0.96630	73	0.86545	0.86200	0.85869
23	0.96773	0.96624	0.96481	74	0.86304	0.85958	0.85626
24	0.96642	0.96483	0.96329	75	0.86063	0.85716	0.85383
25	0.96508	0.96339	0.96176	76	0.85822	0.85473	0.85140
26	0.96371	0.96190	0.96018	77	0.85579	0.85230	0.84895
27	0.96228	0.96037	0.95856	78	0.85336	0.84985	0.84650
28	0.96080	0.95880	0.95689	79	0.85092	0.84740	0.84404
29	0.95927	0.95717	0.95520	80	0.84846	0.84494	0.84157
30	0.95769	0.95551	0.95345	81	0.84599	0.84245	0.83909
31	0.95607	0.95381	0.95168	82	0.84350	0.83997	0.83659
32	0.95440	0.95207	0.94986	83	0.84101	0.83747	0.83408
33	0.95269	0.95028	0.94802	84	0.83850	0.83496	0.83156
34	0.95094	0.94847	0.94613	85	0.83598	0.83242	0.82902
35	0.94915	0.94662	0.94422	86	0.83343	0.82987	0.82646
36	0.94732	0.94473	0.94227	87	0.83086	0.82729	0.82389
37	0.94546	0.94281	0.94031	88	0.82826	0.82469	0.82128
38	0.94355	0.94086	0.93830	89	0.82564	0.82207	0.81865
39	0.94161	0.93886	0.93626	90	0.82299	0.81942	0.81600
40	0.93964	0.93684	0.93421	91	0.82030	0.81674	0.81331
41	0.93764	0.93479	0.93212	92	0.81759	0.81401	0.81060
42	0.93559	0.93272	0.93001	93	0.81484	0.81127	0.80785
43	0.93352	0.93062	0.92787	94	0.81205	0.80848	0.80507
44	0.93143	0.92849	0.92571	95	0.80922	0.80567	0.80225
45	0.92933	0.92636	0.92355	96	0.80636	0.80280	0.79939
46	0.92721	0.92421	0.92137	97	0.80344	0.79988	0.79648
47	0.92506	0.92204	0.91917	98	0.80045	0.79688	0.79349
48	0.92291	0.91986	0.91697	99	0.79739	0.79383	0.79045
49	0.92075	0.91766	0.91475	100	0.79429	0.79074	0.78736
50	0.91856	0.91546	0.91251	....	....	....	....

ETHYL ALCOHOL

Density of aqueous solutions at 20°C in g/ml. The concentration is expressed as per cent by weight.

Per cent		.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
0	0.99	823	804	785	766	748	729	710	692	673	655
1		636	618	599	581	562	544	525	507	489	471
2		453	435	417	399	381	363	345	327	310	292
3		275	257	240	222	205	188	171	154	137	120
4		103	087	070	053	037	020	003	*987	*971	*954
5	0.98	938	922	906	890	874	859	843	827	811	796
6		780	765	749	734	718	703	688	673	658	642
7		627	612	597	582	567	553	538	523	508	493
8		478	463	449	434	419	404	389	374	360	345
9		331	316	301	287	273	258	244	229	215	201
10		187	172	158	144	130	117	103	089	075	061
11		047	033	019	006	*992	*978	*964	*951	*937	*923
12	0.97	910	896	883	869	855	842	828	815	801	788
13		775	761	748	735	722	709	696	683	670	657
14		643	630	617	604	591	578	565	552	539	526
15		514	501	488	475	462	450	438	425	412	400
16		387	374	361	349	336	323	310	297	284	272
17		259	246	233	220	207	194	181	168	155	142
18		129	116	103	089	076	063	050	037	024	010
19	0.96	997	984	971	957	944	931	917	904	891	877
20		864	850	837	823	810	796	783	769	756	742
21		729	716	702	688	675	661	647	634	620	606
22		592	578	564	551	537	523	509	495	481	467
23		453	439	425	411	396	382	368	354	340	326
24		312	297	283	269	254	240	225	211	196	182
25		168	153	139	124	109	094	080	065	050	035
26		020	005	*990	*975	*959	*944	*929	*914	*898	*883
27	0.95	867	851	836	820	805	789	773	757	742	726
28		710	694	678	662	646	630	613	597	581	565
29		548	532	516	499	483	466	450	433	416	400
30		382	365	349	332	315	298	281	264	247	230
31		212	195	178	161	143	126	108	091	074	056
32		038	020	003	*985	*967	*950	*932	*914	*896	*878
33	0.94	860	842	824	806	788	770	752	734	715	697
34		679	660	642	624	605	587	568	550	531	512
35		494	475	456	438	419	400	382	363	344	325
36		306	287	268	249	230	211	192	172	153	134
37		114	095	075	056	036	017	*997	*978	*958	*939
38	0.93	919	899	879	859	840	820	800	780	760	740
39		720	700	680	660	640	620	599	579	559	539
40		518	498	478	458	437	417	396	376	356	335
41		314	294	273	253	232	212	191	170	149	129
42		107	086	065	044	023	002	*981	*960	*939	*918
43	0.92	897	876	855	834	812	791	770	749	728	707
44		685	664	642	621	600	579	557	536	515	493
45		472	450	429	408	386	365	343	322	300	279
46		257	236	214	193	171	150	128	106	085	063
47		041	019	*997	*976	*954	*932	*910	*889	*867	*845
48	0.91	823	801	780	758	736	714	692	670	648	626
49		604	582	560	538	516	494	472	450	428	406
50		384	361	339	317	295	272	250	228	206	183

ETHYL ALCOHOL (Continued)

Per cent		.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
50	0.91	384	361	339	317	295	272	250	228	206	183
51		160	138	116	093	071	049	026	004	*981	*959
52	0.90	936	914	891	869	846	824	801	779	756	734
53		711	689	666	644	621	598	576	553	531	508
54		485	463	440	417	395	372	349	327	304	281
55		258	236	213	190	167	145	122	099	076	054
56		031	008	*985	*962	*939	*917	*894	*871	*848	*825
57	0.89	803	780	757	734	711	688	665	643	620	597
58		574	551	528	505	482	459	436	413	390	367
59		344	321	298	275	252	229	206	183	160	137
60		113	090	067	044	021	*998	*975	*951	*928	*905
61	0.88	882	859	836	812	789	766	743	720	696	673
62		650	626	603	580	557	533	510	487	463	440
63		417	393	370	347	323	300	277	253	230	206
64		183	160	136	113	089	066	042	019	*995	*972
65	0.87	948	925	901	878	854	831	807	784	760	737
66		713	689	666	642	619	595	572	548	524	501
67		477	454	430	406	383	359	336	312	288	265
68		241	218	194	170	147	123	099	075	052	028
69		004	*981	*957	*933	*909	*885	*862	*838	*814	*790
70	0.86	766	742	718	694	671	647	623	599	575	551
71		527	503	479	455	431	407	383	359	335	311
72		287	263	239	215	191	167	143	119	095	071
73		047	022	*998	*974	*950	*926	*902	*878	*854	*830
74	0.85	806	781	757	733	709	685	661	636	612	588
75		564	540	515	491	467	443	419	394	370	346
76		322	297	273	249	225	200	176	152	128	103
77		079	055	031	006	*982	*958	*933	*909	*884	*860
78	0.84	835	811	787	762	738	713	689	664	640	615
79		590	566	541	517	492	467	443	418	393	369
80		344	319	294	270	245	220	196	171	146	121
81		096	072	047	022	*997	*972	*947	*923	*898	*873
82	0.83	848	823	798	773	748	723	698	674	649	624
83		599	574	549	523	498	473	448	423	398	373
84		348	323	297	272	247	222	196	171	146	120
85		095	070	044	019	*994	*968	*943	*917	*892	*866
86	0.82	840	815	789	763	738	712	686	660	635	609
87		583	557	531	505	479	453	427	401	375	349
88		323	297	271	245	219	193	167	140	114	088
89		062	035	009	*983	*956	*930	*903	*877	*850	*824
90	0.81	797	770	744	717	690	664	637	610	583	556
91		529	502	475	448	421	394	366	339	312	285
92		257	230	203	175	148	120	093	066	038	010
93	0.80	983	955	928	900	872	844	817	789	761	733
94		705	677	649	621	593	565	537	509	480	452
95		424	395	367	338	310	281	253	224	195	166
96		138	109	080	051	022	*993	*963	*934	*905	*875
97	0.79	846	816	787	757	727	698	668	638	608	578
98		547	517	487	456	426	396	365	335	305	274
99		243	213	182	151	120	089	059	028	*997	*966
100	0.78	934									

METHYL ALCOHOL

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Giving the specific gravity at 15°C referred to water at 4°C.

(Calculated from values by Doroshevski and Rozhdestvenski, Dittmar and Fawsitt.)

Per cent alcohol by weight	Per cent alcohol by volume	Specific gravity	Per cent alcohol by weight	Per cent alcohol by volume	Specific gravity
1	1.25	0.99727	51	58.74	0.91653
2	2.50	0.99543	52	59.76	0.91451
3	3.75	0.99370	53	60.77	0.91248
4	4.99	0.99198	54	61.78	0.91044
5	6.22	0.99029	55	62.78	0.90839
6	7.45	0.98864	56	63.78	0.90631
7	8.68	0.98701	57	64.77	0.90421
8	9.91	0.98547	58	65.75	0.90210
9	11.13	0.98394	59	66.73	0.89996
10	12.35	0.98241	60	67.69	0.89781
11	13.56	0.98093	61	68.65	0.89563
12	14.77	0.97945	62	69.61	0.89341
13	15.98	0.97802	63	70.55	0.89117
14	17.18	0.97660	64	71.49	0.88890
15	18.38	0.97518	65	72.42	0.88662
16	19.58	0.97377	66	73.34	0.88433
17	20.77	0.97237	67	74.26	0.88203
18	21.96	0.97096	68	75.17	0.87971
19	23.15	0.96955	69	7 .08	0.87739
20	24.33	0.96814	70	76.98	0.87507
21	25.51	0.96673	71	77.86	0.87271
22	26.69	0.96533	72	78.75	0.87033
23	27.86	0.96392	73	79.62	0.86792
24	29.03	0.96251	74	80.48	0.86546
25	30.19	0.96108	75	81.34	0.86300
26	31.35	0.95963	76	82.18	0.86051
27	32.51	0.95817	77	83.02	0.85801
28	33.66	0.95668	78	83.86	0.85551
29	34.81	0.95518	79	84.68	0.85300
30	35.95	0.95366	80	85.50	0.85048
31	37.09	0.95213	81	86.31	0.84794
32	38.22	0.95056	82	87.11	0.84536
33	39.35	0.94896	83	87.90	0.84274
34	40.48	0.94734	84	88.68	0.84009
35	41.59	0.94570	85	89.45	0.83742
36	42.71	0.94404	86	90.21	0.83475
37	43.82	0.94237	87	90.97	0.83207
38	44.92	0.94067	88	91.72	0.82937
39	46.02	0.93894	89	92.46	0.82667
40	47.11	0.93720	90	93.19	0.82396
41	48.20	0.93543	91	93.92	0.82124
42	49.28	0.93365	92	94.63	0.81849
43	50.35	0.93185	93	95.33	0.81568
44	51.42	0.93001	94	96.02	0.81285
45	52.49	0.92815	95	96.70	0.80999
46	53.54	0.92627	96	97.37	0.80713
47	54.60	0.92436	97	98.04	0.80428
48	55.64	0.92242	98	98.70	0.80143
49	56.68	0.92048	99	99.35	0.79859
50	57.71	0.91852	100	100.00	0.79577

METHYL ALCOHOL

Specific Gravity of Mixtures of Methyl Alcohol and Water by Volume and by Weight

Giving the specific gravity at 15.6° C. referred to water at the same temperature. To reduce to specific gravity of water at 4°C. multiply by 0.99908.

(Techn. Hogskolan, Stockholm.)

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
1.0000	0.00	0.00	0.9950	2.72	3.48	0.9900	5.72	7.13
0.9999	0.06	0.07	0.9949	2.78	3.55	0.9899	5.78	7.21
0.9998	0.11	0.13	0.9948	2.84	3.62	0.9898	5.85	7.28
0.9997	0.17	0.20	0.9947	2.89	3.70	0.9897	5.91	7.36
0.9996	0.22	0.27	0.9946	2.95	3.77	0.9896	5.97	7.44
0.9995	0.28	0.33	0.9945	3.01	3.84	0.9895	6.04	7.52
0.9994	0.33	0.40	0.9944	3.07	3.91	0.9894	6.10	7.59
0.9993	0.39	0.47	0.9943	3.13	3.98	0.9893	6.16	7.67
0.9992	0.44	0.53	0.9942	3.18	4.06	0.9892	6.23	7.75
0.9991	0.50	0.60	0.9941	3.24	4.13	0.9891	6.29	7.82
0.9990	0.55	0.67	0.9940	3.30	4.20	0.9890	6.36	7.90
0.9989	0.61	0.73	0.9939	3.36	4.27	0.9889	6.42	7.98
0.9988	0.66	0.80	0.9938	3.42	4.35	0.9888	6.48	8.05
0.9987	0.72	0.86	0.9937	3.48	4.42	0.9887	6.55	8.13
0.9986	0.77	0.93	0.9936	3.53	4.49	0.9886	6.61	8.21
0.9985	0.83	1.00	0.9935	3.59	4.57	0.9885	6.67	8.29
0.9984	0.88	1.06	0.9934	3.65	4.64	0.9884	6.74	8.36
0.9983	0.94	1.13	0.9933	3.71	4.71	0.9883	6.80	8.44
0.9982	0.99	1.20	0.9932	3.77	4.79	0.9882	6.86	8.52
0.9981	1.05	1.26	0.9931	3.83	4.89	0.9881	6.93	8.59
0.9980	1.10	1.33	0.9930	3.89	4.94	0.9880	6.99	8.67
0.9979	1.15	1.40	0.9929	3.94	5.01	0.9879	7.06	8.75
0.9978	1.20	1.47	0.9928	4.00	5.08	0.9878	7.12	8.83
0.9977	1.26	1.54	0.9927	4.06	5.16	0.9877	7.19	8.90
0.9976	1.31	1.62	0.9926	4.12	5.23	0.9876	7.25	8.98
0.9975	1.36	1.69	0.9925	4.18	5.30	0.9875	7.32	9.06
0.9974	1.41	1.76	0.9924	4.24	5.38	0.9874	7.38	9.14
0.9973	1.46	1.83	0.9923	4.29	5.45	0.9873	7.45	9.22
0.9972	1.52	1.90	0.9922	4.35	5.52	0.9872	7.51	9.29
0.9971	1.57	1.97	0.9921	4.41	5.60	0.9871	7.58	9.37
0.9970	1.62	2.05	0.9920	4.47	5.67	0.9870	7.64	9.45
0.9969	1.67	2.12	0.9919	4.53	5.74	0.9869	7.71	9.53
0.9968	1.72	2.19	0.9918	4.60	5.82	0.9868	7.77	9.61
0.9967	1.78	2.26	0.9917	4.66	5.89	0.9867	7.84	9.68
0.9966	1.83	2.33	0.9916	4.72	5.96	0.9866	7.90	9.76
0.9965	1.88	2.40	0.9915	4.78	6.04	0.9865	7.97	9.84
0.9964	1.93	2.47	0.9914	4.85	6.11	0.9864	8.03	9.92
0.9963	1.98	2.55	0.9913	4.91	6.18	0.9863	8.10	10.00
0.9962	2.04	2.62	0.9912	4.97	6.25	0.9862	8.16	10.07
0.9961	2.09	2.69	0.9911	5.03	6.33	0.9861	8.23	10.15
0.9960	2.14	2.76	0.9910	5.10	6.40	0.9860	8.29	10.23
0.9959	2.20	2.83	0.9909	5.16	6.47	0.9859	8.35	10.31
0.9958	2.26	2.90	0.9908	5.22	6.55	0.9858	8.42	10.38
0.9957	2.31	2.98	0.9907	5.28	6.62	0.9857	8.48	10.47
0.9956	2.37	3.05	0.9906	5.35	6.69	0.9856	8.55	10.55
0.9955	2.43	3.12	0.9905	5.41	6.77	0.9855	8.61	10.63
0.9954	2.49	3.19	0.9904	5.47	6.84	0.9854	8.68	10.71
0.9953	2.55	3.26	0.9903	5.53	6.91	0.9853	8.74	10.79
0.9952	2.60	3.34	0.9902	5.60	6.98	0.9852	8.81	10.87
0.9951	2.66	3.41	0.9901	5.66	7.06	0.9851	8.87	10.95

SPECIFIC GRAVITY OF MIXTURES OF METHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
0.9850	8.94	11.03	0.9796	12.55	15.46	0.9742	16.43	20.09
0.9849	9.00	11.10	0.9795	12.62	15.55	0.9741	16.51	20.17
0.9848	9.06	11.18	0.9794	12.69	15.63	0.9740	16.58	20.26
0.9847	9.13	11.26	0.9793	12.76	15.72	0.9739	16.65	20.35
0.9846	9.19	11.34	0.9792	12.83	15.80	0.9738	16.72	20.43
0.9845	9.26	11.42	0.9791	12.90	15.89	0.9737	16.79	20.52
0.9844	9.32	11.50	0.9790	12.97	15.97	0.9736	16.86	20.60
0.9843	9.39	11.58	0.9789	13.04	16.06	0.9735	16.93	20.69
0.9842	9.45	11.66	0.9788	13.11	16.14	0.9734	17.00	20.77
0.9841	9.52	11.74	0.9787	13.18	16.23	0.9733	17.07	20.86
0.9840	9.58	11.82	0.9786	13.25	16.31	0.9732	17.14	20.94
0.9839	9.65	11.90	0.9785	13.32	16.40	0.9731	17.21	21.03
0.9838	9.72	11.98	0.9784	13.39	16.48	0.9730	17.28	21.11
0.9837	9.78	12.06	0.9783	13.46	16.57	0.9729	17.35	21.20
0.9836	9.85	12.14	0.9782	13.53	16.65	0.9728	17.42	21.28
0.9835	9.92	12.23	0.9781	13.60	16.74	0.9727	17.49	21.37
0.9834	9.99	12.31	0.9780	13.67	16.82	0.9726	17.56	21.45
0.9833	10.06	12.39	0.9779	13.74	16.91	0.9725	17.63	21.54
0.9832	10.12	12.47	0.9778	13.82	16.99	0.9724	17.70	21.62
0.9831	10.19	12.55	0.9777	13.89	17.08	0.9723	17.77	21.71
0.9830	10.26	12.63	0.9776	13.96	17.16	0.9722	17.84	21.79
0.9829	10.33	12.71	0.9775	14.03	17.25	0.9721	17.91	21.88
0.9828	10.40	12.79	0.9774	14.11	17.33	0.9720	17.98	21.96
0.9827	10.46	12.87	0.9773	14.18	17.42	0.9719	18.05	22.05
0.9826	10.53	12.95	0.9772	14.25	17.50	0.9718	18.12	22.13
0.9825	10.60	13.04	0.9771	14.32	17.59	0.9717	18.19	22.22
0.9824	10.67	13.12	0.9770	14.40	17.68	0.9716	18.26	22.30
0.9823	10.74	13.20	0.9769	14.47	17.76	0.9715	18.33	22.39
0.9822	10.80	13.28	0.9768	14.54	17.85	0.9714	18.40	22.47
0.9821	10.87	13.36	0.9767	14.61	17.93	0.9713	18.47	22.56
0.9820	10.94	13.44	0.9766	14.69	18.02	0.9712	18.54	22.64
0.9819	11.01	13.52	0.9765	14.76	18.10	0.9711	18.61	22.73
0.9818	11.07	13.61	0.9764	14.83	18.19	0.9710	18.68	22.82
0.9817	11.14	13.69	0.9763	14.90	18.27	0.9709	18.75	22.90
0.9816	11.21	13.78	0.9762	14.98	18.36	0.9708	18.82	22.99
0.9815	11.27	13.86	0.9761	15.05	18.44	0.9707	18.89	23.07
0.9814	11.34	13.94	0.9760	15.12	18.53	0.9706	18.96	23.16
0.9813	11.41	14.03	0.9759	15.19	18.62	0.9705	19.03	23.24
0.9812	11.47	14.11	0.9758	15.27	18.70	0.9704	19.10	23.33
0.9811	11.54	14.20	0.9757	15.34	18.79	0.9703	19.17	23.41
0.9810	11.61	14.28	0.9756	15.41	18.88	0.9702	19.24	23.50
0.9809	11.67	14.36	0.9755	15.49	18.96	0.9701	19.31	23.58
0.9808	11.74	14.45	0.9754	15.56	19.05	0.9700	19.38	23.67
0.9807	11.80	14.53	0.9753	15.63	19.14	0.9699	19.45	23.75
0.9806	11.87	14.62	0.9752	15.70	19.22	0.9698	19.52	23.84
0.9805	11.94	14.70	0.9751	15.78	19.31	0.9697	19.59	23.92
0.9804	12.00	14.78	0.9750	15.85	19.40	0.9696	19.66	24.00
0.9803	12.07	14.87	0.9749	15.92	19.48	0.9695	19.73	24.09
0.9802	12.14	14.95	0.9748	16.00	19.56	0.9694	19.80	24.17
0.9801	12.20	15.04	0.9747	16.07	19.65	0.9693	19.87	24.25
0.9800	12.27	15.12	0.9746	16.14	19.74	0.9692	19.94	24.34
0.9799	12.34	15.21	0.9745	16.22	19.83	0.9691	20.01	24.42
0.9798	12.41	15.29	0.9744	16.29	19.91	0.9690	20.09	24.51
0.9797	12.48	15.38	0.9743	16.36	20.00	0.9689	20.16	24.59

METHYL ALCOHOL (Continued)

SPECIFIC GRAVITY OF MIXTURES OF METHYL ALCOHOL AND WATER BY VOLUME AND BY WEIGHT

Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.	Specific gravity	Per cent alcohol by wt.	Per cent alcohol by vol.
0.9688	20.23	24.67	0.9668	21.63	26.35	0.9648	23.03	27.99
0.9687	20.30	24.76	0.9667	21.70	26.43	0.9647	23.10	28.07
0.9686	20.37	24.84	0.9666	21.77	26.52	0.9646	23.17	28.18
0.9685	20.44	24.92	0.9665	21.84	26.60	0.9645	23.24	28.24
0.9684	20.51	25.01	0.9664	21.91	26.68	0.9644	23.31	28.32
0.9683	20.58	25.09	0.9663	21.98	26.77	0.9643	23.38	28.40
0.9682	20.65	25.17	0.9662	22.05	26.85	0.9642	23.45	28.48
0.9681	20.72	25.26	0.9661	22.12	26.94	0.9641	23.52	28.56
0.9680	20.79	25.34	0.9660	22.19	27.02	0.9640	23.59	28.64
0.9679	20.86	25.42	0.9659	22.26	27.10	0.9639	23.66	28.72
0.9678	20.93	25.51	0.9658	22.33	27.18	0.9638	23.75	28.80
0.9677	21.00	25.59	0.9657	22.40	27.26	0.9637	23.80	28.88
0.9676	21.07	25.68	0.9656	22.47	27.34	0.9636	23.88	28.96
0.9675	21.14	25.76	0.9655	22.54	27.43	0.9635	23.95	29.04
0.9674	21.21	25.84	0.9654	22.61	27.51	0.9634	24.02	29.11
0.9673	21.28	25.95	0.9653	22.68	27.59	0.9633	24.09	29.19
0.9672	21.33	26.01	0.9652	22.75	27.67	0.9632	24.16	29.27
0.9671	21.42	26.10	0.9651	22.82	27.75	0.9631	24.23	29.36
0.9670	21.49	26.18	0.9650	22.89	27.83	0.9630	24.31	29.43
0.9669	21.56	26.26	0.9649	22.96	27.91	0.9629	24.38	29.51

IMMERSION REFRACTOMETER READINGS OF METHYL AND ETHYL ALCOHOLS AT 20°C

By Leach and Lythgoe. Jour. Am. Chem. Soc. 27, 964 (1905)

% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol	% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol	% Alcohol by Weight	Methyl Alcohol	Ethyl Alcohol
0	14.5	14.5	35	35.8	75.8	70	33.0	100.0
1	14.8	16.0	36	36.3	76.9	71	32.3	100.2
2	15.4	17.6	37	36.8	78.0	72	31.7	100.4
3	16.0	19.1	38	37.3	79.1	73	31.1	100.6
4	16.6	20.7	39	37.7	80.2	74	30.4	100.8
5	17.2	22.3	40	38.1	81.3	75	29.7	101.0
6	17.8	24.1	41	38.4	82.3	76	29.0	101.0
7	18.4	25.9	42	38.8	83.3	77	28.3	100.9
8	19.0	27.8	43	39.2	84.2	78	27.6	100.9
9	19.6	29.6	44	39.3	85.2	79	26.8	100.8
10	20.2	31.4	45	39.4	86.2	80	26.0	100.7
11	20.8	33.2	46	39.5	87.0	81	25.1	100.6
12	21.4	35.0	47	39.6	87.8	82	24.3	100.5
13	22.0	36.9	48	39.7	88.7	83	23.6	100.4
14	22.6	38.7	49	39.8	89.5	84	22.8	100.3
15	23.2	40.5	50	39.8	90.3	85	21.8	100.1
16	23.9	42.5	51	39.7	91.1	86	20.8	99.8
17	24.5	44.5	52	39.6	91.8	87	19.7	99.5
18	25.2	46.5	53	39.6	92.4	88	18.6	99.2
19	25.8	48.5	54	39.5	93.0	89	17.3	98.9
20	26.5	50.5	55	39.4	93.6	90	16.1	98.6
21	27.1	52.4	56	39.2	94.1	91	14.9	98.3
22	27.8	54.3	57	39.0	94.7	92	13.7	97.8
23	28.4	56.3	58	38.6	95.2	93	12.4	97.2
24	29.1	58.2	59	38.3	95.7	94	11.0	96.4
25	29.7	60.1	60	37.9	96.2	95	9.6	95.7
26	30.3	61.9	61	37.5	96.7	96	8.2	94.9
27	30.9	63.7	62	37.0	97.1	97	6.7	94.0
28	31.6	65.5	63	36.5	97.5	98	5.1	93.0
29	32.2	67.2	64	36.0	98.0	99	3.5	92.0
30	32.8	69.0	65	35.5	98.3	100	2.0	91.0
31	33.5	70.4	66	35.0	98.7			
32	34.1	71.7	67	34.5	99.1			
33	34.7	73.1	68	34.0	99.4			
34	35.2	74.4	69	33.5	99.7			

Calculation of the percentage of ethyl and methyl alcohols in a mixture with water, assuming a distillate to have a sp. gr. of 0.97917 $\frac{15.56^\circ}{15.56^\circ}$ and a refraction of 30.0 at 20° on the immersion refractometer. — From the tables of sp. gr. for these alcohols the density is found to correspond to 13.70% and 12.83% by weight of ethyl and methyl alcohol respectively; from the table above, the refractometer readings corresponding to 13.70% ethyl and methyl alcohol are 38.16 and 22.42 respectively. Then $(38.16 - 30.0) / (38.16 - 22.42) \times 100 = 51.8\%$, or 51.8% of the alcohol in the distillate is methyl alcohol.

$(12.83 \times 0.518) + 13.70 \times (1 - 0.518) = 13.25$ which is the % by weight of the mixed alcohols in the distillate, of which 13.25×0.518 o 6.86 % is methyl alcohol and $13.25 \times (1 - 0.518)$ or 6.39 % is ethyl alcoho

DENSITY AND SPECIFIC GRAVITY OF GASES AND VAPORS

Name	Formula	Density g/l 0°C 760 mm	Density lbs./ft.^{3} 32°F, 1 atm.	Specific gravity Air = 1	Specific gravity O_2 = 1
Acetylene	C_2H_2	1.173	0.07323	0.9073	0.8208
Air	....	1.2929	.08071	1.0000	0.9047
Ammonia	NH_3	0.7710	.04813	0.5963	0.5395
Argon	A	1.7837	.11135	1.3796	1.2482
Arsenic fluoride	AsF_5	7.71*	.481*	5.96*	5.40*
Arsenic hydride	AsH_3	3.484*	.2175*	2.695*	2.438*
Boron fluoride	BF_3	2.99*	.187*	2.31*	2.09*
Butane (*n*)	C_4H_{10}	2.5190†	.15725†	2.0854†	1.8868†
Butane, *iso*-	C_4H_{10}	2.673	.1669	2.067	1.870
Carbon dioxide	CO_2	1.9769	.12341	1.5290	1.3834
Carbon monoxide	CO	1.2504	.07806	0.9671	0.8750
Carbon oxysulfide	COS	2.72	.170	2.10	1.90
Chlorine	Cl_2	3.214	.2006	2.486	2.249
Chlorine dioxide	ClO_2	3.09^{11}	$.193^{11}$	2.39^{11}	2.16^{11}
Chlorine monoxide	Cl_2O	3.89	.243	3.01	2.72
Cyanogen	C_2N_2	2.335*	.1458*	1.806*	1.634*
Dimethylamine	$(CH_3)_2NH$	1.966^{17}	$.1227^{17}$	1.521^{17}	1.376^{17}
Ethane	C_2H_6	1.3566	.08469	1.0493	0.9493
Ethylene	C_2H_4	1.2604	.07868	0.9749	0.8820
Fluorine	F_2	1.696	.1059	1.312	1.187
Germanium hydride (digermane)	Ge_2H_6	6.74^{20}	$.421^{20}$	5.21^{20}	4.72^{20}
Germanium tetrahydride	GeH_4	3.420	.2135	2.645	2.393
Helium	He	0.17847	.01114	0.13804	0.12489
Hydrogen	H_2	0.08988	.005611	0.06952	0.06290
Hydrogen bromide	HBr	3.6445	.2275	2.8189	2.5503
Hydrogen chloride	HCl	1.6392	.10233	1.2678	1.1471
Hydrogen iodide	HI	5.7891	.3614	4.4776	4.0510
Hydrogen selenide	H_2Se	3.670	.229	2.839	2.568
Hydrogen sulfide	H_2S	1.539	.09608	1.190	1.077
Hydrogen telluride	H_2Te	5.81	.363	4.49	4.07
Krypton	Kr	3.708	.2315	2.868	2.595
Methane	CH_4	0.7168	.04475	0.5544	0.5016
Methylamine	CH_3NH_2	1.396	.08715	1.080	0.9769
Methyl chloride	CH_3Cl	2.3076	.1441	1.7848	1.6148
Methyl ether	$(CH_3)_2O$	2.1098	.1317	1.6318	1.4764
Methyl fluoride	CH_3F	1.5452	.09646	1.1951	1.0813
Neon	Ne	0.90035	.05621	0.69638	0.63004
Nitric oxide	NO	1.3402	.08367	1.0366	0.9378
Nitrogen	N_2	1.25055	.07807	0.96724	0.87510
Nitrogen (atm.)	....	1.2568	.07846	0.9721	0.8795
Nitrosyl chloride	NOCl	2.992	.1868	2.314	2.094
Nitrosyl fluoride	NOF	2.176*	.1358*	1.683*	1.523*
Nitrous oxide	N_2O	1.9778	.1235	1.5297	1.3840
Nitroxyl chloride	NO_2Cl	2.57*	.160*	1.99*	1.798*
Nitroxyl fluoride	NO_2F	2.90	.181	2.24	2.03
Oxygen	O_2	1.42904	.08921	1.10527	1.0000
Ozone	O_3	2.144	.1338	1.658	1.500
Phosphine	PH_3	1.5294	.09548	1.1829	1.0702
Phosphorus fluoride	PF_3	3.907*	.2439*	3.022*	2.734*
Phosphorus oxyfluoride	POF_3	4.8	.30	3.7	3.4
Phosphorus pentafluoride	PF_5	5.81	.363	4.494	4.066
Propane	C_3H_8	2.0096	.1254	1.554	1.407

* Temperature not stated, probably 20°C.

† Both butane and air at 710 mm.

DENSITY AND SPECIFIC GRAVITY OF GASES AND VAPORS (Continued)

Name	Formula	Density g/l 0°C 760 mm	Density lbs./ft.^{3} 32°F, 1 atm.	Specific gravity Air = 1	Specific gravity O_2 = 1
Radon	Rn	9.73	.607	7.526	6.809
Silicane, chloro-	SiH_3Cl	3.03	.189	2.34	2.12
Silicane, chloromethyl	SiH_2ClCH_3	3.64	.227	2.82	2.55
Silicane, dichloromethyl	$SiHCl_2CH_3$	5.3	.33	4.1	3.7
Silicane, dimethyl	$SiH_2(CH_3)_2$	2.73	.170	2.11	1.91
Silicane, methyl	SiH_3CH_3	2.08	.130	1.61	1.46
Silicane, trifluoro-	$SiHF_3$	3.86	.241	2.99	2.70
Silicon fluoride	SiF_4	4.684	.2924	3.623	3.278
Silicon hexahydride	Si_2H_6	2.85	.178	2.204	1.994
Silicon tetrahydride	SiH_4	1.44	.0899	1.114	1.008
Stibine (15°C, 754 mm)	SbH_3	5.30	.331	4.10	3.71
Sulfur dioxide	SO_2	2.9269	.1827	2.2638	2.0482
Sulfur fluoride	SF_6	6.50*	.406*	5.03*	4.55*
Sulfuric oxyfluoride	SO_2F_2	3.72*	.232*	2.88*	2.60*
Trimethylamine	$(CH_3)_3N$	2.580	.1611	1.996	1.805
Trimethyl boron	$(CH_3)_3B$	2.52	.157	1.95	1.76
Tungsten fluoride	WF_6	12.9	.805	9.98	9.03
Xenon	Xe	5.851	.3653	4.525	4.094

* Temperature not stated, probably 20°C.

DENSITY OF ELEMENTS

The density is given in grams per cubic centimeter and pounds per cubic foot at the temperature stated. Where no temperature is given ordinary atmospheric temperature is understood.

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
Aluminum, hard drawn	20	2.699	168.5	Edwards, 1925
liquid	659	2.382	148.7	Moorman, 1921
Antimony, vacuo-distilled	20	6.618	413.1	Kahlbaum, 1902
compressed	20	6.691	417.7	Kahlbaum, 1902
amorphous	.....	6.22	388.3	Herard
Argon, liquid	−183	1.3845	86.4	Baly-Donnan
	−189	1.4233	88.9	Baly-Donnan
Arsenic, metallic	15	5.73	357.7	Lashchenko, 1922
amorphous, brown—black	.....	3.70	231.0	Guenther [1908
yellow	18	2.0	124.9	Erdmann & Reppert,
Barium	.....	3.78	236.0	Guntz
	25	3.5	218.5	Biltz & Hüttig, 1920
Beryllium	20	1.84	114.9	Fichter & Jablczynski,
Bismuth, electrolytic	.....	9.747	608.5	Classen, 1890 [1912
	20	9.80	611.8	Johnston & Adams,
vacuo-distilled	20	9.781	610.6	Kahlbaum, 1902
liquid	271	10.00	624.3	Vincentini-Omodei
	271	10.24	639.25	Plüss, 1915
solid	271	9.67	603.7	Vincentini-Omodei
Boron, crystal	.....	3.33	158.3	Wigand
amorphous	.....	2.34	152.9	Moissan
Bromine, liquid	.....	3.12	194.8	Richards-Stull
Cadmium, cast	20	8.648	539.9	Egerton & Lee, 1923
wrought	.....	8.67	541.2	
vacuo-distilled	20	8.648	539.9	Kahlbaum, 1902
solid	318	8.37	522.5	Vincentini-Omodei
liquid	318	7.99	498.8	Vincentini-Omodei
	349	7.94	495.7	Arpi, 1914
Calcium	.....	1.54	96.1	Brink
Carbon, crystal	.....	3.52	219.7	Wigand
graphite	.....	2.25	140.5	Wigand
Cerium, electrolytic	.....	6.79	423.9	Muthmann-Weiss
pure	.....	6.9	430.7	Muthmann-Weiss
Cesium	20	1.873	116.9	Richards-Brink
Chlorine, liquid	−33.6	1.507	94.1	Drugman-Ramsay
Chromium	.....	6.52–73	407.0–420.1	
pure	20	6.92	432.0	Moissan
	28	7.20	449.5	Brenner, 1948
Cobalt	21	8.71	543.7	Tilden [1915
	.....	8.9	555.6	Kalmus & Harper.
Columbium	15	8.4	524.4	Muthmann-Weiss
Copper, cast	.....	8.30–95	518.1–558.7	
annealed	20	8.89	555.0	Dellinger, 1911
wrought	.....	8.85–95	552.5–558.7	
hard-drawn	20	8.89	555.0	Dellinger, 1911
vacuo-distilled	20	8.9326	557.6	Kahlbaum, 1902
compressed	20	8.9376	558.0	Kahlbaum, 1902

DENSITY OF ELEMENTS (Continued)

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
liquid	.....	8.217	513.0	Roberts-Wrightson
Erbium	.....	4.77(?)	298.0	St. Meyer
Fluorine, liquid	−200	1.14	71.2	Moissan-Dewar
Gallium	25	5.903	369.1	Bur. of Stand., 1934
Germanium	20	5.46	340.9	Winkler [1913
Gold, cast	.....	19.3	1204.8	
cold rolled	20	19.296	1204.6	Rose, 1912
wrought	.....	19.33	1206.7	[1905
drawn annealed	20	19.26	1202.3	Kahlbaum & Sturm,
vacuo-distilled	20	18.88	1178.6	Kahlbaum, 1902
compressed	20	19.27	1203.0	Kahlbaum, 1902
Helium, liquid	−269	0.15	9.4	Onnes
Hydrogen, liquid	−252	0.07	4.4	Dewar, 1904
Indium	.....	7.28	454.5	Richards
Iridium	17	22.42	1399.6	Deville-Debray
Iodine	20	4.94	308.4	Richards-Stull
Iron, pure	.....	7.85–88	490.1–491.9	[1924
electrolytic, rolled	20	7.90	493.2	Tritton & Hanson,
gray cast	.....	7.03–13	438.9–445.1	
white cast	.....	7.58–73	473.2–482.6	
wrought	.....	7.80–90	486.9–493.2	
liquid	.....	6.88	429.5	Roberts-Austen
steel	.....	7.60–80	474.4–486.9	
Krypton, liquid	−146	2.16	134.8	Ramsay-Travers
Lanthanum	.....	6.15	383.9	Muthmann-Weiss
Lead, vacuo-distilled	20	11.342	708.0	Kahlbaum, 1902
compressed	20	11.347	708.4	Kahlbaum, 1902
solid	325	11.005	687.0	Vincentini-Omodei
liquid	325	10.645	664.5	Vincentini-Omodei
	400	10.597	661.5	Day, Sosman, 1914
	850	10.078	629.1	Day, Sosman, 1914
Lithium	20	0.534	33.3	Richards-Brink, 1907
Magnesium	.....	1.741	108.7	Voigt
Manganese	.....	7.42	463.2	Prelinger
Mercury, liquid	0	13.596	848.8	Regnault, Volkmann
	20	13.546	845.6	
	−38.8	13.690	854.6	Vincentini-Omodei
solid	−38.8	14.193	886.0	Vincentini-Omodei
	−188	14.383	897.9	Dewar, 1902
Molybdenum	.....	9.01	562.5	Moissan
	.....	10.2	636.8	Fink, 1910
Neodymium	.....	6.96	434.5	Muthmann-Weiss
Nickel	.....	8.60–90	536.9–555.6	
Nitrogen, liquid	−195	0.81	50.6	Baly-Donnan, 1902
	−205	0.854	53.3	Baly-Donnan, 1902
Osmium	.....	22.5	1404.6	Deville-Devray
Oxygen, liquid	−184	1.14	71.2	
Palladium	.....	12.16	759.1	Richards-Stull
Phosphorus, white	.....	1.83	114.2	
red	.....	2.20	137.3	
metallic	15	2.34	146.1	Hittorf
Platinum	20	21.37	1334.1	Richards-Stull
Potassium	20	0.87	54.3	Richards-Brink, 1907
solid	62.1	0.851	53.1	Vincentini-Omodei
liquid	62.1	0.83	51.8	Vincentini-Omodei
Praseodymium	.....	6.475	404.2	Muthmann-Weiss
Rhodium	.....	12.44	776.6	Holborn-Henning
Rubidium	20	1.532	95.6	Richards-Brink, 1907
Ruthenium	0	12.06	752.9	Toby
Samarium	.....	7.7–8	480.7–486.9	Muthmann-Weiss

DENSITY OF ELEMENTS (Continued)

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
Selenium	.....	4.3–8	268.4–299.6	
Silicon, crystal	20	2.42	151.1	Richards-Stull-Brink
amorphous	15	2.35	146.7	Vigoroux
Silver, cast	.....	10.42–53	650.5–657.4	
wrought	.....	10.6	661.7	
vacuo-distilled	20	10.492	655.0	Kahlbaum, 1902
compressed	20	10.503	655.7	Kahlbaum, 1902
liquid	.....	9.51	593.7	Wrightson
Sodium	20	0.9712	60.6	Richards-Brink, 1907
solid	97.6	0.9519	59.4	Vincentini-Omodei
liquid	97.6	0.9287	58.0	Vincentini-Omodei
solid	−188	1.0066	62.8	Dewar
Strontium	.....	2.50–58	156.1–161.1	Matthiessen
Sulfur	.....	2.0–1	124.9–131.1	
liquid	.....	1.811	112.1	Vincentini-Omodei
Tantalum	.....	16.6	1036.3	
Tellurium, crystal	.....	6.25	390.2	
amorphous	20	6.02	375.8	Beljankin
Thallium	.....	11.86	740.4	Richards-Stull [1925
Thorium	.....	11.3–11.7	705.4–730.4	Rentschler, Marden,
Tin, white cast	.....	7.29	455.1	Matthiessen
wrought	.....	7.30	455.7	
crystallized	.....	6.97–7.18	435.1–448.2	
solid	226	7.184	448.5	Vincentini-Omodei
liquid	226	6.99	436.4	Vincentini-Omodei
gray	.....	5.8	362.1	
Titanium	18	4.5	280.9	Mixter
Tungsten	.....	18.6–19.1	1161.1–1192.4	
Uranium	13	18.7	1167.4	Zimmermann
Vanadium	.....	5.69	355.3	Ruff-Martin
	20	5.96	372.1	Hull, 1922
Xenon, liquid	−109	3.52	219.7	Ramsay-Travers
Yttrium	.....	5.51	237.2	St. Meyer
Zinc, cast	.....	7.04–16	439.5–447.0	
wrought	.....	7.19	448.9	
vacuo-distilled	20	6.92	432.0	Kahlbaum, 1902
compressed	20	7.13	445.1	Kahlbaum, 1902
liquid	.....	6.48	404.5	Roberts-Wrightson
Zirconium	.....	6.44	402.0	

DENSITY OF ALLOYS

The density is given in grams per cubic centimeter at ordinary atmospheric temperatures.

Alloy.	Composition.	g./cm.^{3}	Pounds per cu. ft.
Aluminum and copper	10 Al, 90 Cu	7.69	480.06
	5 Al, 95 Cu	8.37	522.51
	3 Al, 97 Cu	8.69	542.49
Aluminum and zinc..	91 Al, 9 Zn	2.80	174.80
Bell metal...........	78 Cu, 22 Sn	8.70	543.11
Bismuth, lead and tin	53 Bi, 40 Pb, 7 Sn	10.56	659.23

DENSITY OF ALLOYS (Continued)

Alloy.	Composition.	g/cm.^{3}	Pounds per cu. ft.
Brass, yellow	70 Cu, 30 Zn cast	8.44	526.88
	rolled	8.56	534.38
	drawn	8.70	543.11
red	90 Cu, 10 Zn	8.60	536.87
white	50 Cu, 50 Zn	8.20	511.01
Bronze	90 Cu, 10 Sn(gun metal)	8.78	548.11
	85 Cu, 15 Sn	8.89	554.98
	80 Cu, 20 Sn	8.74	545.61
	75 Cu, 25 Sn	8.83	551.23
Cadmium and tin	32 Cd, 68 Sn	7.70	480.69
Constantan	60 Cu, 40 Ni	8.88	554.35
German silver	26.3 Cu, 36.6 Zn, 36.8 Ni	8.30	518.14
	52 Cu, 26 Zn, 22 Ni	8.45	527.51
	59 Cu, 30 Zn, 11 Ni	8.34	520.64
	63 Cu, 30 Zn, 6 Ni	8.30	518.14
Gold and copper	98 Au, 2 Cu	18.84	1176.12
	96 Au, 4 Cu	18.36	1146.16
	94 Au, 6 Cu	17.95	1120.56
	92 Au, 8 Cu	17.52	1093.72
	90 Au, 10 Cu	17.16	1071.25
	88 Au, 12 Cu	16.81	1049.40
	86 Au, 14 Cu	16.47	1028.17
Invar	63.8 Fe, 36 Ni, 0.2 C	8.00	499.42
Lead and tin	87.5 Pb, 12.5 Sn	10.60	661.73
	84 Pb, 16 Sn	10.33	644.87
	77.8 Pb, 22.2 Sn	10.05	627.39
	63.7 Pb, 36.3 Sn	9.43	588.69
	46.7 Pb, 53.3 Sn	8.73	544.99
	30.5 Pb, 69.5 Sn	8.24	514.40
Magnalium	90 Al, 10 Mg	2.50	156.07
	70 Al, 30 Mg	2.00	124.85
Manganese bronze	95 Cu, 5 Mn	8.80	549.36
Manganin	84 Cu, 12 Mn, 4 Ni	8.50	530.63
Monel metal	71 Ni, 27 Cu, 2 Fe	8.90	555.60
Nickelin		8.77	547.48
Phosphor bronze	79.7 Cu, 10 Sn, 9.5 Sb, 0.8 P	8.80	549.36
Platinum and iridium	90 Pt, 10 Ir	21.62	1349.67
	85 Pt, 15 Ir	21.62	1349.67
	66.67 Pt, 33.33 Ir	21.87	1365.28
	5 Pt, 95 Ir	22.38	1397.12
Speculum metal	67 Cu, 33 Sn	8.60	536.87
Steel	99 Fe, 1 C	7.83	488.80
manganese	86 Fe, 13 Mn, 1 C	7.81	487.55
Wood's metal	50 Bi, 25 Pb, 12.5 Cd, 12.5 Sn	9.70	659.23

DENSITY OF VARIOUS SOLIDS

The approximate density of various solids at ordinary atmospheric temperature.

In the case of substances with voids such as paper or leather the bulk density is indicated rather than the density of the solid portion.

(Selected principally from the Smithsonian Tables.)

Substance	Grams per cu. cm	Pounds per cu. ft.
Agate	2.5–2.7	156–168
Alabaster, carbonate	2.69–2.78	168–173
sulfate	2.26–2.32	141–145
Albite	2.62–2.65	163–165
Amber	1.06–1.11	66–69
Amphiboles	2.9–3.2	180–200
Anorthite	2.74–2.76	171–172
Asbestos	2.0–2.8	125–175
Asbestos slate	1.8	112
Asphalt	1.1–1.5	69–94
Basalt	2.4–3.1	150–190
Beeswax	0.96–0.97	60–61
Beryl	2.69–2.7	168–169
Biotite	2.7–3.1	170–190
Bone	1.7–2.0	106–125
Brick	1.4–2.2	87–137
Butter	0.86–0.87	53–54
Calamine	4.1–4.5	255–280
Calcspar	2.6–2.8	162–175
Camphor	0.99	62
Caoutchouc	0.92–0.99	57–62
Cardboard	0.69	43
Celluloid	1.4	87
Cement, set	2.7–3.0	170–190
Chalk	1.9–2.8	118–175
Charcoal, oak	0.57	35
pine	0.28–0.44	18–28
Cinnabar	8.12	507
Clay	1.8–2.6	112–162
Coal, anthracite	1.4–1.8	87–112
bituminous	1.2–1.5	75–94
Cocoa butter	0.89–0.91	56–57
Coke	1.0–1.7	62–105
Copal	1.04–1.14	65–71
Cork	0.22–0.26	14–16
Cork linoleum	0.54	34
Corundum	3.9–4.0	245–250
Diamond	3.01–3.52	188–220
Dolomite	2.84	177
Ebonite	1.15	72
Emery	4.0	250
Epidote	3.25–3.50	203–218
Feldspar	2.55–2.75	159–172
Flint	2.63	164
Fluorite	3.18	198
Galena	7.3–7.6	460–470
Gamboge	1.2	75
Garnet	3.15–4.3	197–268
Gas carbon	1.88	117
Gelatin	1.27	79
Glass, common	2.4–2.8	150–175
flint	2.9–5.9	180–370
Glue	1.27	79
Granite	2.64–2.76	165–172
Graphite	2.30–2.72	144–170
Gum arabic	1.3–1.4	81–87
Gypsum	2.31–2.33	144–145
Hematite	4.9–5.3	306–330
Hornblende	3.0	187
Ice	0.917	57.2
Ivory	1.83–1.92	114–120
Leather, dry	0.86	54
Lime, slaked	1.3–1.4	81–87
Limestone	2.68–2.76	167–171
Linoleum	1.18	74
Magnetite	4.9–5.2	306–324
Malachite	3.7–4.1	231–256
Marble	2.6–2.84	160–177
Meerschaum	0.99–1.28	62–80
Mica	2.6–3.2	165–200
Muscovite	2.76–3.00	172–187
Ochre	3.5	218
Opal	2.2	137
Paper	0.7–1.15	44–72
Paraffin	0.87–0.91	54–57
Peat blocks	0.84	52
Pitch	1.07	67
Porcelain	2.3–2.5	143–156
Porphyry	2.6–2.9	162–181
Pressed wood pulp board	0.19	12
Pyrite	4.95–5.1	309–318
Quartz	2.65	165
Resin	1.07	67
Rock salt	2.18	136
Rubber, hard	1.19	74
Rubber, soft		
commercial	1.1	69
pure gum	0.91–0.93	57–58
Sandstone	2.14–2.36	134–147
Serpentine	2.50–2.65	156–165
Silica, fused transparent	2.21	138
translucent	2.07	129
Slag	2.0–3.9	125–240

DENSITY OF VARIOUS SOLIDS (Continued)

Substance	Grams per cu. cm	Pounds per cu. ft.	Substance	Grams per cu. cm	Pounds per cu. ft.
Slate	2.6–3.3	162–205	elm	0.54–0.60	34–37
Soapstone	2.6–2.8	162–175	hickory	0.60–0.93	37–58
Spermaceti	0.95	59	holly	0.76	47
Starch	1.53	95	juniper	0.56	35
Sugar	1.59	99	larch	0.50–0.56	31–35
Talc	2.7–2.8	168–174	lignum vitae	1.17–1.33	73–83
Tallow, beef	0.94	59	locust	0.67–0.71	42–44
mutton	0.94	59	logwood	0.91	57
Tar	1.02	66	mahogany		
Topaz	3.5–3.6	219–223	Honduras	0.66	41
Tourmaline	3.0–3.2	190–200	Spanish	0.85	53
Wax, sealing	1.8	112	maple	0.62–0.75	39–47
Wood (seasoned)			oak	0.60–0.90	37–56
alder	0.42–0.68	26–42	pear	0.61–0.73	38–45
apple	0.66–0.84	41–52	pine, pitch	0.83–0.85	52–53
ash	0.65–0.85	40–53	white	0.35–0.50	22–31
balsa	0.11–0.14	7–9	yellow	0.37–0.60	23–37
bamboo	0.31–0.40	19–25	plum	0.66–0.78	41–49
basswood	0.32–0.59	20–37	poplar	0.35–0.5	22–31
beech	0.70–0.90	43–56	satinwood	0.95	59
birch	0.51–0.77	32–48	spruce	0.48–0.70	30–44
blue gum	1.00	62	sycamore	0.40–0.60	24–37
box	0.95–1.16	59–72	teak, Indian	0.66–0.88	41–55
butternut	0.38	24	African	0.98	61
cedar	0.49–0.57	30–35	walnut	0.64–0.70	40–43
cherry	0.70–0.90	43–56	water gum	1.00	62
dogwood	0.76	47	willow	0.40–0.60	24–37
ebony	1.11–1.33	69–83			

For the specific gravity of other substances the reader is referred to the following tables:

Physical Constants of Inorganic and Metal-Organic Compounds
Physical Constants of Organic Compounds
Constants of Vegetable and Animal Oils, Fats and Waxes
Physical and Chemical Constants of Resins, Oleo-Resins and Gum-Resins
Physical Constants of Minerals
Composition and Physical Properties of Alloys
Properties of Commercial Plastics
Physical Properties of Common Woods

DENSITY OF WATER

The temperature of maximum density for pure water, **fre** from air = **3.98**°C.

The density at this temperature = **0.999973** g/cm^3.

The density of water at 3.98° C is 1.000000 g/ml.

(International Bureau of Weights and Measures, 1910.)

WEIGHT OF 1 GALLON OF WATER

The weights in air are for dry air at the same temperature as the water up to 40°C. and at a (corrected) barometric pressure of 760 mm and against brass weights of 8.4 density at 0°C. Above 40°C. the temperature of the air is assumed to be 20°C., i. e., the water is allowed to cool to 20°C. before the weighings are made. The volumetric computations are based on the relation that 1 liter = 1.000027 cubic decimeters and 1 cubic decimeter = 61.023378 cubic inches.

Temperature °C.	Weight in vacuo		Weight in air	
	Grams	Pounds	Grams	Pounds
0	3784.833	8.34412	3780.520	8.33461
1	5.055	.34461	0.758	.33513
2	5.211	.34495	0.930	.33551
3	5.303	.34515	1.037	.33575
4	5.332	.34522	1.082	.33585
5	5.302	.34515	1.067	.33582
6	5.212	.34495	0.992	.33565
7	5.066	.34463	0.861	.33536
8	4.864	.34419	0.675	.33495
9	4.610	.34363	0.435	.33442
10	4.303	.34295	0.144	.33378
11	3.943	.34216	3779.798	.33302
12	3.534	.34125	9.403	.33215
13	3.076	.34025	8.960	.33117
14	2.574	.33914	8.472	.33009
15	2.026	.33793	7.939	.32892
(15 5/9) 60° F.	(3781.703)	(8.33722)	(3777.623)	(8.32823)
16	1.435	.33663	7.362	.32765
(16⅔) 62° F.	(3781.017)	(8.33571)	(3776.953)	(8.32675)
17	0.801	.33523	6.741	.32628
18	0.125	.33374	6.080	.32482
19	3779.407	.33216	5.375	.32327
20	8.649	.33049	4.630	.32162
21	7.850	.32872	3.845	.31989
22	7.012	.32688	3.021	.31808
23	6.135	.32494	2.157	.31617
24	5.220	.32293	1.256	.31419
25	4.268	.32083	0.317	.31212
26	3.279	.31865	3769.341	.30996
27	2.254	.31639	8.329	.30773
28	1.195	.31405	7.283	.30543
29	0.100	.31164	6.201	.30304
30	3768.972	.30915	5.086	.30058
31	7.812	.30659	3.938	.29805
32	6.618	.30396	2.757	.29545
33	5.393	.30126	1.545	.29278
34	4.137	.29849	0.301	.29003
35	2.851	.29566	3759.027	.28723
40	3755.995	.28054	2.232	.27225
45	3748.39	.2638	3744.40	.2550
50	3740.17	8.2457	3736.20	8.2369
55	3731.32	.2261	3727.35	.2174
60	3721.89	.2054	3717.93	.1966
65	3711.86	.1832	3707.91	.1745
70	3701.33	.1600	3697.40	.1514
75	3690.28	.1357	3686.36	.1270
80	3678.70	.1101	3674.79	.1015
85	3666.66	.0836	3662.76	.0750
90	3654.13	.0560	3650.25	.0474
95	3641.19	.0274	3637.32	.0189
100	3627.79	7.9979	3623.93	7.9894

TEMPERATURE CORRECTION FOR VOLUMETRIC SOLUTIONS

This table gives the correction to various observed volumes of water, measured at the designated temperatures to give the volume at the standard temperature, 20°C. Conversely, by subtracting the corrections from the volume desired at 20°C., the volume that must be measured out at the designated temperatures in order to give the desired volume at 20°C., will be obtained. It is assumed that the volumes are measured in glass apparatus having a coefficient of cubical expansion of 0.000025 per degree centigrade. The table is applicable to dilute aqueous solutions having the same coefficient of expansion as water.

Temperature of measurement, °C.	Capacity of apparatus in milliliters at 20°C.						
	2,000	1,000	500	400	300	250	150
	Correction in milliliters to give volume of water at 20°C.						
15	+1.54	+0.77	+0.38	+0.31	+0.23	+0.19	+0.12
16	+1.28	+ .64	+ .32	+ .26	+ .19	+ .16	+ .10
17	+ .99	+ .50	+ .25	+ .20	+ .15	+ .12	+ .07
18	+ .68	+ .34	+ .17	+ .14	+ .10	+ .08	+ .05
19	+ .35	+ .18	+ .09	+ .07	+ .05	+ .04	+ .03
21	− .37	− .18	− .09	− .07	− .06	− .05	− .03
22	− .77	− .38	− .19	− .15	− .12	− .10	− .06
23	−1.18	− .59	− .30	− .24	− .18	− .15	− .09
24	−1.61	− .81	− .40	− .32	− .24	− .20	− .12
25	−2.07	−1.03	− .52	− .41	− .31	− .26	− .15
26	−2.54	−1.27	− .64	− .51	− .38	− .32	− .19
27	−3.03	−1.52	− .76	− .61	− .46	− .38	− .23
28	−3.55	−1.77	− .89	− .71	− .53	− .44	− .27
29	−4.08	−2.04	−1.02	− .82	− .61	− .51	− .31
30	−4.62	−2.31	−1.16	− .92	− .69	− .58	− .35

In using the above table to correct the volume of certain standard solutions to 20°C. more accurate results will be obtained if the numerical values of the corrections are increased by the percentages given below:

Solution	Normality		
	N	N/2	N/10
HNO_3	50	25	6
H_2SO_4	45	25	5
NaOH	40	25	5
KOH	40	20	4

TEMPERATURE CORRECTION FOR GLASS VOLUMETRIC APPARATUS

This table gives the correction to be added to actual capacity (determined at certain temperatures) to give the capacity at the standard temperature, 20°C. Conversely, by subtracting the corrections from the indicated capacity of an instrument standard at 20°C. the corresponding capacity at other temperatures is obtained. The table assumes for the cubical coefficient of expansion of glass 0.000025 per degree centigrade. The coefficients of expansion of glasses used for volumetric instruments vary from 0.000023 to 0.000028.

Temperature in degrees C.	2,000 ml	1,000 ml	500 ml	400 ml	300 ml	250 ml
15	+0.25	+0.12	+0.06	+0.05	+0.04	+0.031
16	+ .20	+ .10	+ .05	+0.04	+ .03	+ .025
17	+ .15	+ .08	+ .04	+ .03	+ .02	+ .019
18	+ .10	+ .05	+ .02	+ .02	+ .02	+ .012
19	+ .05	+ .02	+ .01	+ .01	+ .01	+ .006
21	− .05	− .02	− .01	− .01	− .01	− .006
22	− .10	− .05	− .02	− .02	− .02	− .012
23	− .15	− .08	− .04	− .03	− .02	− .019
24	− .20	− .10	− .05	− .04	− .03	− .025
25	− .25	− .12	− .06	− .05	− .04	− .031
26	− .30	− .15	− .08	− .06	− .04	− .038
27	− .35	− .18	− .09	− .07	− .05	− .044
28	− .40	− .20	− .10	− .08	− .06	− .050
29	− .45	− .22	− .11	− .09	− .07	− .056
30	− .50	− .25	− .12	− .10	− .08	− .062

DENSITY OF VARIOUS LIQUIDS

(Selected from Smithsonian Tables.)

Liquid	Grams per cu. cm	Pounds per cu. ft.	Temp. ° C
Acetone	0.792	49.4	20°
Alcohol, ethyl	0.791	49.4	20
methyl	0.810	50.5	0
Benzene	0.899	56.1	0
Carbolic acid	0.950–0.965	59.2–60.2	15
Carbon disulfide	1.293	80.7	0
tetrachloride	1.595	99.6	20
Chloroform	1.489	93.0	20
Ether	0.736	45.9	0
Gasoline	0.66–0.69	41.0–43.0	..
Glycerin	1.260	78.6	0
Kerosene	0.82	51.2	..
Mercury	13.6	849.0	..
Milk	1.028–1.035	64.2–64.6	..
Naphtha, petroleum ether	0.665	41.5	15
wood	0.848–0.810	52.9–50.5	0
Oils:			
castor	0.969	60.5	15
cocoanut	0.925	57.7	15
cotton seed	0.926	57.8	16
creosote	1.040–1.100	64.9–68.6	15
linseed, boiled	0.942	58.8	15
olive	0.918	57.3	15
Sea water	1.025	63.99	15
Turpentine (spirits)	0.87	54.3	..
Water	1.00	62.43	4

DENSITY OF ALCOHOL

DENSITY OF ETHYL ALCOHOL IN GRAMS PER CUBIC CENTIMETER, COMPUTED FROM MENDELEEFF'S FORMULA

(Selected from Smithsonian Tables.)

Temp. ° C	0	1	2	3	4	5	6	7	8	9
0	.80625	.80541	.80457	.80374	.80290	.80207	.80123	.80039	.79956	.79872
10	.79788	.79704	.79620	.79535	.79451	.79367	.79283	.79198	.79114	.79029
20	.78945	.78860	.78775	.78691	.78606	.78522	.78437	.78352	.78267	.78182
30	.78097	.78012	.77927	.77841	.77756	.77671	.77585	.77500	.77414	.77329

HYDROMETERS AND DENSITY UNITS

Alcoholometer. — For testing alcoholic solutions; the scale shows the per cent of alcohol by volume; 0°–100° is the per cent.

Ammoniameter. — For testing ammonia solutions; scale 0°–40°; to convert to sp. gr. multiply by 3 and deduct from 1000.

Barktrometer or *Barkometer.* — For testing tanning liquor; scale 0°–80° Bk; the number to the right of the decimal point of the sp. gr. is the degree Bk; thus, 1.025 sp. gr. is 25° Bk.

Baumé. — There are two kinds in use; heavy Bé, for liquids heavier than water and light Bé for liquids lighter than water. In the former, 0° corresponds to a sp. gr. 1.000 (water at 4°C.) and 66° corresponds to a sp. gr. 1.842; in the lighter than water scale, 0° Bé is equivalent to the gravity of a 10% solution of sodium chloride and 60° Bé corresponds to a sp. gr. of 0.745. For Baumé degrees on the scale of densities greater than unity, the following equation gives the means of conversion:

Sp. gr. = $\frac{m}{m - d}$ where m = 145 (in the United States)
m = 144 (old scale used in Holland)
m = 146.78 (New scale or Gerlach scale)
d = Baumé reading

Beck's Hydrometer has 0° corresponding to sp. gr. 1.000 and 30° to sp. gr. 0.850; equal divisions on the scale are continued as far as required in both directions.

Brix Saccharometer or *Balling Saccharometer* shows directly the per cent of sugar (sucrose) by weight at the temperature indicated on the instrument, usually 17.5°C.; i.e., degrees Brix is the per cent sugar.

Cartier's Hydrometer floats in water at the 10° scale division and at 30° corresponds to 32° Bé.

Oleometer.—For vegetable and sperm oils; scale 50°–0° corresponds to sp. gr. 0.870–0.970.

Soxhlet's Lactometer, for determining the density of milk, has a scale from 25° (sp. gr. 1.025) to 35° (sp. gr. 1.035) divided into suitable scale divisions.

Twaddell Hydrometers have the scale so arranged that the reading multiplied by 5 and added to 1000 gives the sp. gr. with reference to water as 1000; it is always used for densities greater than water.

HYDROMETER CONVERSION TABLES

SHOWING THE RELATION BETWEEN DENSITY (C. G. S.) AND DEGREES BAUMÉ FOR DENSITIES LESS THAN UNITY.

Density.	Degrees Baumé.				
	.00	.01	.02	.03	.04
0.60	103.33	99.51	95.81	92.22	88.75
.70	70.00	67.18	64.44	61.78	59.19
.80	45.00	42.84	40.73	38.68	36.67
.90	25.56	23.85	22.17	20.54	18.94
1.00	10.00	.....	.....	.....	.....

Density.	Degrees Baumé.				
	.05	.06	.07	.08	.09
0.60	85.38	82.12	78.95	75.88	72.90
.70	56.67	54.21	51.82	49.49	47.22
.80	34.71	32.79	30.92	29.09	27.30
.90	17.37	15.83	14.33	12.86	11.41
1.00	......	.....	.....	.....	.....

HYDROMETER CONVERSION TABLES
(Continued)

Showing the Relation between Density (C. G. S.) and the Baumé and Twaddell Scales for Densities above Unity.

Density.	Degrees Baumé.	Degrees Twaddell.	Density.	Degrees Baumé.	Degrees Twaddell.
1.00	0.00	0	1.41	42.16	82
1.01	1.44	2	1.42	42.89	84
1.02	2.84	4	1.43	43.60	86
1.03	4.22	6	1.44	44.31	88
1.04	5.58	8	1.45	45.00	90
1.05	6.91	10	1.46	45.68	92
1.06	8.21	12	1.47	46.36	94
1.07	9.49	14	1.48	47.03	96
1.08	10.74	16	1.49	47.68	98
1.09	11.97	18	1.50	48.33	100
1.10	13.18	20	1.51	48.97	102
1.11	14.37	22	1.52	49.60	104
1.12	15.54	24	1.53	50.23	106
1.13	16.68	26	1.54	50.84	108
1.14	17.81	28	1.55	51.45	110
1.15	18.91	30	1.56	52.05	112
1.16	20.00	32	1.57	52.64	114
1.17	21.07	34	1.58	53.23	116
1.18	22.12	36	1.59	53.80	118
1.19	23.15	38	1.60	54.38	120
1.20	24.17	40	1.61	54.94	122
1.21	25.16	42	1.62	55.49	124
1.22	26.15	44	1.63	56.04	126
1.23	27.11	46	1.64	56.58	128
1.24	28.06	48	1.65	57.12	130
1.25	29.00	50	1.66	57.65	132
1.26	29.92	52	1.67	58.17	134
1.27	30.83	54	1.68	58.69	136
1.28	31.72	56	1.69	59.20	138
1.29	32.60	58	1.70	59.71	140
1.30	33.46	60	1.71	60.20	142
1.31	34.31	62	1.72	60.70	144
1.32	35.15	64	1.73	61.18	146
1.33	35.98	66	1.74	61.67	148
1.34	36.79	68	1.75	62.14	150
1.35	37.59	70	1.76	62.61	152
1.36	38.38	72	1.77	63.08	154
1.37	39.16	74	1.78	63.54	156
1.38	39.93	76	1.79	63.99	158
1.39	40.68	78	1.80	64.44	160
1.40	41.43	80	....	.....	...

ABSOLUTE DENSITY OF WATER

Density in Grams per Cubic Centimeter, Computed from the Relative Values by Thiesen, Scheel and Disselhorst (1900), and the Absolute Value at 3.98° C. by the International Bureau of Weights and Measures (1910).

Degrees	0	1	2	3	4	5	6	7	8	9
0	0.999841	847	854	860	866	872	878	884	889	895
1	900	905	909	914	918	923	927	930	934	938
2	941	944	947	950	953	955	958	960	962	964
3	965	967	968	969	970	971	972	972	973	973
4	973	973	973	972	972	972	970	969	968	966
5	965	963	961	959	957	955	952	950	947	944
6	941	938	935	931	927	924	920	916	911	907
7	902	898	893	888	883	877	872	866	861	855
8	849	843	837	830	824	817	810	803	796	789
9	781	774	766	758	751	742	734	726	717	709
10	700	691	682	673	664	654	645	635	625	615
11	605	595	585	574	564	553	542	531	520	509
12	498	486	475	463	451	439	427	415	402	390
13	377	364	352	339	326	312	299	285	272	258
14	244	230	216	202	188	173	159	144	129	114
15	099	084	069	054	038	023	007	*991	*975	*959
16	0.998943	926	910	893	877	860	843	826	809	792
17	774	757	739	722	704	686	668	650	632	613
18	595	576	558	539	520	501	482	463	444	424
19	405	385	365	345	325	305	285	265	244	224
20	203	183	162	141	120	099	078	056	035	013
21	0.997992	970	948	926	904	882	860	837	815	792
22	770	747	724	701	678	655	632	608	585	561
23	538	514	490	466	442	418	394	369	345	320
24	296	271	246	221	196	171	146	120	095	069
25	044	018	*992	*967	*941	*914	*888	*862	*836	*809
26	0.996783	756	729	703	676	649	621	594	567	540
27	512	485	457	429	401	373	345	317	289	261
28	232	204	175	147	118	089	060	031	002	*973
29	0.995944	914	885	855	826	796	766	736	706	676
30	646	616	586	555	525	494	464	433	402	371

RELATIVE DENSITY AND VOLUME OF WATER

The mass of one cubic centimeter of water at 4° C is taken as unity.

The values given are numerically equal to the absolute density in grams per milliliter.

(Smithsonian Tables, compiled from Various Authors.)

Temp. ° C.	Density.	Volume.	Temp. ° C.	Density.	Volume
−10	0.99815	1.00186	+35	0.99406	1.00598
−9	843	157	36	371	633
−8	869	131	37	336	669
−7	892	108	38	299	706
−6	912	088	39	262	743
−5	0.99930	1.00070	40	0.99224	1.00782
−4	945	055	41	186	821
−3	958	042	42	147	861
−2	970	031	43	107	901
−1	979	021	44	066	943
+0	0.99987	1.00013	45	0.99025	1.00985
1	993	007	46	0.98982	1.01028
2	997	003	47	940	072
3	999	001	48	896	116
4	1.00000	1.00000	49	852	162
5	0.99999	1.00001	50	0.98807	1.01207
6	997	003	51	762	254
7	993	007	52	715	301
8	988	012	53	669	349
9	981	019	54	621	398
10	0.99973	1.00027	55	0.98573	1.01448
11	963	037	60	324	705
12	952	048	65	059	979
13	940	060	70	0.97781	1.02270
14	927	073	75	489	576
15	0.99913	1.00087	80	0.97183	1.02899
16	897	103	85	0.96865	1.03237
17	880	120	90	534	590
18	862	138	95	192	959
19	843	157	100	0.95838	1.04343
20	0.99823	1.00177	110	0.9510	1.0515
21	802	198	120	0.9434	1.0601
22	780	221	130	0.9352	1.0693
23	756	244	140	0.9264	1.0794
24	732	268	150	0.9173	1.0902
25	0.99707	1.00294	160	0.9075	1.1019
26	681	320	170	0.8973	1.1145
27	654	347	180	0.8866	1.1279
28	626	375	190	0.8750	1.1429
29	597	405	200	0.8628	1.1590
30	0.99567	1.00435	210	0.850	1.177
31	537	466	220	0.837	1.195
32	505	497	230	0.823	1.215
33	473	530	240	0.809	1.236
34	440	563	250	0.794	1.259

DENSITY AND VOLUME OF MERCURY

Based on the Density of Mercury at 0° C. by Thiesen and Scheel (1898)

(Selected from Smithsonian Tables.)

Temp. ° C.	Mass in gr. per ml.	Vol. of 1 gr. in ml.	Temp. ° C.	Mass in gr. per ml.	Vol. in 1 gr. in ml.
−10	13.6202	0.0734205	30°	13.5217	0.0739552
−9	6177	4338	31	5193	9686
−8	6152	4472	32	5168	9820
−7	6128	4606	33	5144	9953
−6	6103	4739	34	5119	40087
−5	13.6078	0.0734873	35	13.5095	0.0740221
−4	6053	5006	36	5070	0354
−3	6029	5140	37	5046	0488
−2	6004	5273	38	5021	0622
−1	5979	5407	39	4997	0756
0	13.5955	0.0735540	40	13.4973	0.0740891
1	5930	5674	50	4729	2229
2	5906	5808	60	4486	3569
3	5881	5941	70	4244	4910
4	5856	6075	80	4003	6252
5	13.5832	0.0736209	90	13.3762	0.0747594
6	5807	6342	100	3522	8939
7	5782	6476	110	3283	50285
8	5758	6610	120	3044	1633
9	5733	6744	130	2805	2982
10	13.5708	0.0736877	140	13.2567	0.0754334
11	5684	7011	150	2330	5688
12	5659	7145	160	2093	7044
13	5634	7278	170	1856	8402
14	5610	7412	180	1620	9764
15	13.5585	0.0737546	190	13.1384	0.0761128
16	5561	7680	200	1148	2495
17	5536	7813	210	0913	3865
18	5512	7947	220	0678	5239
19	5487	8081	230	0443	6616
20	13.5462	0.0738215	240	13.0209	0.0767996
21	5438	8348	250	12.9975	9381
22	5413	8482	260	9741	70769
23	5389	8616	270	9507	2161
24	5364	8750	280	9273	3558
25	13.5340	0.0738883	290	12.9039	0.0774958
26	5315	9017	300	8806	6364
27	5291	9151	310	8572	7774
28	5266	9285	320	8339	9189
29	5242	9419	330	8105	80609
30	13.5217	0.0739552	340	12.7872	0.0782033
			350	7638	3464
			360	7405	4900

DENSITY OF MOIST AIR

The density of dry air may be determined by computation from the general relation $D = D_0(T_0/T)(P/P_0)$ where D_0 represents a known density at absolute temperature T_0 and pressure P_0 and D, the density at absolute temperature T and pressure P.

The density of **moist** air may be determined by a similar relation:

$D = 1.2929\ (273.13/T)\ [(B - 0.3783e)/760]$ where T is the absolute temperature; B, the barometric pressure in mm, and e the vapor pressure of the moisture in the air in mm. The density will then be the product of two terms, each of which may be found by use of the tables which follow.

The **first factor,** $1.2929\ (273.13/T)$, may be found directly in Table I for various temperatures. For convenience, temperatures are given in the table in °C although the values of the factor have been computed with absolute temperatures. The tabular values actually represent the density of dry air at various temperatures and 760 mm pressure.

The **second factor,** $[(B - 0.3783e)/760]$, must be obtained in two steps: **First**—the numerator of the expression is obtained by subtracting $0.3783e$ from the barometric pressure. The quantity $0.3783e$ may be found directly from the dew point in Table II. If the wet and dry bulb thermometer readings are known e may be found in the table Reduction of Psychrometric Observations given in the section Hygrometric and Barometric Tables. $0.3783e$ may then be found by calculation or read from the table. **Second**—the value of the whole factor for any value of $B - 0.3783e$ may be obtained from Table III.

The product of the above two factors will give the required density in g/l.

To facilitate obtaining **approximate values** of the density for ordinary pressures and temperatures, a table of products is given which may be entered with the temperature in °C and the corrected (for moisture) value of the barometric pressure in mm to obtain density.

As an illustration of the use of the tables, let it be desired to find the density of air for a barometric pressure of 750 mm, a dew point of 10° C, and air temperature of 20° C.

From the dew point, the value of $0.3783e$ is found in Table II to be 3.48 mm. $750 - 3.48 = 746.52$, the corrected pressure. The pressure factor for this value found in Table III by interpolation is 0.98226.

The temperature factor from Table I is 1.2047.

$$1.2047 \times 0.98224 = 1.1833 \text{ g/l.}$$

To obtain the value directly from Table IV, enter it for 20° C and 746.5 mm which gives by interpolation 1.183 g/l.

TABLE I

$(1.2929 \times 273.13/T)$

(Besides being a necessary part of the determination of the density of moist air, the values in this table are actually the density of dry air in g/l at 760 mm pressure for various temperatures.)

Temp. °C	0	1	2	3	4	5	6	7	8	9
−50	1.5 826	897	969	*042	*115	*189	*264	*339	*415	*491
−40	1.5 147	213	278	345	412	479	547	616	686	756
−30	1.4 524	584	645	706	767	829	892	955	*019	*083
−20	1.3 951	*006	*062	*118	*175	*232	*289	*347	*406	*465
−10	1.3 420	472	523	575	628	680	734	787	841	896
− 0	1.2 929	977	*024	*073	*121	*170	*219	*269	*319	*370
+ 0	1.2 929	882	835	789	742	697	651	606	561	517
10	1.2 472	428	385	342	299	256	214	171	130	088
20	1.2 047	006	*965	*925	*885	*845	*805	*766	*727	*688
30	1.1 649	611	573	535	498	460	423	387	350	314
40	1.1 277	242	206	170	135	100	065	031	*996	*962
50	1.0 928	895	861	828	795	762	729	697	664	632
60	1.0 600	569	537	506	475	444	413	382	352	322

DENSITY OF MOIST AIR (Continued)

TABLE II

Vapor Pressure—Value of 0.3783*e*

Dew point °C	Vap. press. *e* mm (ice)	0.3783*e*	Dew point °C	Vap. press. *e* mm (water)	0.3783*e*	Dew point °C	Vap. press. *e* mm (water)	0.3783*e*
−50	0.029	0.01	**0**	4.58	1.73	**30**	31.86	12.05
−45	.054	.02	1	4.92	1.86	31	33.74	12.76
−40	.096	.04	2	5.29	2.00	32	35.70	13.51
−35	.169	.06	3	5.68	2.15	33	37.78	14.29
−30	.288	.11	4	6.10	2.31	34	39.95	15.11
−25	0.480	0.18	**5**	6.54	2.47	**35**	42.23	15.98
−24	.530	.20	6	7.01	2.65	36	44.62	16.88
−23	.585	.22	7	7.51	2.84	37	47.13	17.83
−22	.646	.24	8	8.04	3.04	38	49.76	18.82
−21	.712	.27	9	8.61	3.26	39	52.51	19.86
−20	0.783	0.30	**10**	9.21	3.48	**40**	55.40	20.96
−19	.862	.33	11	9.85	3.73	41	58.42	22.10
−18	.947	.36	12	10.52	3.98	42	61.58	23.30
−17	1.041	.39	13	11.24	4.25	43	64.89	24.55
−16	1.142	.43	14	11.99	4.54	44	68.35	25.86
−15	1.252	0.47	**15**	12.79	4.84	**45**	71.97	27.23
−14	1.373	.52	16	13.64	5.16	46	75.75	28.66
−13	1.503	.57	17	14.54	5.50	47	79.70	30.15
−12	1.644	.62	18	15.49	5.86	48	83.83	31.71
−11	1.798	.68	19	16.49	6.24	49	88.14	33.34
−10	1.964	0.74	**20**	17.55	6.64	**50**	92.6	35.03
− 9	2.144	.81	21	18.66	7.06	51	97.3	36.81
− 8	2.340	.89	22	19.84	7.51	52	102.2	38.66
− 7	2.550	.96	23	21.09	7.98	53	107.3	40.59
− 6	2.778	1.05	24	22.40	8.47	54	112.7	42.63
− 5	3.025	1.14	**25**	23.78	9.00	**55**	118.2	44.72
− 4	3.291	1.24	26	25.24	9.55	56	124.0	46.91
− 3	3.578	1.35	27	26.77	10.13	57	130.0	49.18
− 2	3.887	1.47	28	28.38	10.74	58	136.3	51.56
− 1	4.220	1.60	29	30.08	11.38	59	142.8	54.02
0	4.580	1.73	**30**	31.86	12.05	**60**	149.6	56.59

DENSITY OF MOIST AIR (Continued)

TABLE III

Pressure Factor.—[$(B - 0.3783e)/760$]

The figures in the body of the table give values of the whole term $(B - 0.3783e)/760$] for various values of the numerator $(B - 0.3783e)$ expressed at the left and top.

Press. mm corr.	0	1	2	3	4	5	6	7	8	9
80	.10526	.10658	.10789	.10921	.11053	.11184	.11316	.11447	.11579	.11711
90	.11842	.11974	.12105	.12237	.12368	.12500	.12632	.12763	.12895	.13026
100	.13158	.13289	.13421	.13553	.13684	.13816	.13947	.14079	.14211	.14342
110	.14474	.14605	.14737	.14868	.15000	.15132	.15263	.15395	.15526	.15658
120	.15789	.15921	.16053	.16184	.16316	.16447	.16579	.16711	.16842	.16974
130	.17105	.17237	.17368	.17500	.17632	.17763	.17895	.18026	.18158	.18289
140	.18421	.18553	.18684	.18816	.18947	.19079	.19211	.19342	.19474	.19605
150	.19737	.19868	.20000	.20132	.20263	.20395	.20526	.20658	.20789	.20921
160	.21053	.21184	.21316	.21447	.21579	.21711	.21842	.21974	.22105	.22237
170	.22368	.22500	.22632	.22763	.22895	.23026	.23158	.23289	.23421	.23553
180	.23684	.23816	.23947	.24079	.24211	.24342	.24474	.24605	.24737	.24868
190	.25000	.25132	.25263	.25395	.25526	.25658	.25789	.25921	.26053	.26184
200	.26316	.26447	.26579	.26711	.26842	.26974	.27105	.27237	.27368	.27500
210	.27632	.27763	.27895	.28026	.28158	.28289	.28421	.28553	.28684	.28816
220	.28947	.29079	.29211	.29342	.29474	.29605	.29737	.29868	.30000	.30132
230	.30263	.30395	.30526	.30658	.30789	.30921	.31053	.31184	.31316	.31447
240	.31579	.31711	.31842	.31974	.32105	.32237	.32368	.32500	.32632	.32763
250	.32895	.33026	.33158	.33289	.33421	.33553	.33684	.33816	.33947	.34079
260	.34211	.34342	.34474	.34605	.34737	.34868	.35000	.35132	.35263	.35395
270	.35526	.35658	.35789	.35921	.36053	.36184	.36316	.36447	.36579	.36711
280	.36842	.36974	.37105	.37237	.37368	.37500	.37632	.37763	.37895	.38026
290	.38158	.38289	.38421	.38553	.38684	.38816	.38947	.39079	.39211	.39342
300	.39474	.39605	.39737	.39868	.40000	.40132	.40263	.40395	.40526	.40658
310	.40789	.40921	.41053	.41184	.41316	.41447	.41579	.41711	.41842	.41974
320	.42105	.42237	.42368	.42500	.42632	.42763	.42895	.43026	.43158	.43289
330	.43421	.43553	.43684	.43816	.43947	.44079	.44211	.44342	.44474	.44605
340	.44737	.44868	.45000	.45132	.45263	.45395	.45526	.45658	.45789	.45921
350	.46053	.46184	.46316	.46447	.46579	.46711	.46842	.46974	.47105	.47237
360	.47368	.47500	.47632	.47763	.47895	.48026	.48158	.48289	.48421	.48553
370	.48684	.48816	.48947	.49079	.49211	.49342	.49474	.49605	.49737	.49868
380	.50000	.50132	.50263	.50395	.50526	.50658	.50789	.50921	.51053	.51184
390	.51316	.51447	.51579	.51711	.51842	.51974	.52105	.52237	.52368	.52500
400	.52632	.52763	.52895	.53026	.53158	.53289	.53421	.53553	.53684	.53816
410	.53947	.54079	.54211	.54342	.54474	.54605	.54737	.54868	.55000	.55132
420	.55263	.55395	.55526	.55658	.55789	.55921	.56053	.56184	.56316	.56447
430	.56579	.56711	.56842	.56974	.57105	.57237	.57368	.57500	.57632	.57763
440	.57895	.58026	.58158	.58289	.58421	.58553	.58684	.58816	.58947	.59079
450	.59211	.59342	.59474	.59605	.59737	.59868	.60000	.60132	.60263	.60395
460	.60526	.60658	.60789	.60921	.61053	.61184	.61316	.61447	.61579	.61711
470	.61842	.61974	.62105	.62237	.62368	.62500	.62632	.62763	.62895	.63026
480	.63158	.63289	.63421	.63553	.63684	.63816	.63947	.64079	.64211	.64342
490	.64474	.64605	.64737	.64868	.65000	.65132	.65263	.65395	.65526	.65658
500	.65790	.65921	.66053	.66184	.66316	.66447	.66579	.66711	.66842	.66974
510	.67105	.67237	.67368	.67500	.67632	.67763	.67895	.68026	.68158	.68290
520	.68421	.68553	.68684	.68816	.68947	.69079	.69211	.69342	.69474	.69605
530	.69737	.69868	.70000	.70132	.70263	.70395	.70526	.70658	.70790	.70921
540	.71053	.71184	.71316	.71447	.71579	.71711	.71842	.71974	.72105	.72237

TABLE III (Continued)

Press. mm corr.	0	1	2	3	4	5	6	7	8	9
550	.72368	.72500	.72632	.72763	.72895	.73026	.73158	.73290	.73421	.73553
560	.73684	.73816	.73947	.74079	.74211	.74342	.74474	.74605	.74737	.74868
570	.75000	.75132	.75263	.75395	.75526	.75658	.75790	.75921	.76053	.76184
580	.76316	.76447	.76579	.76711	.76842	.76974	.77105	.77237	.77368	.77500
590	.77632	.77763	.77895	.78026	.78158	.78290	.78421	.78553	.78684	.78816
600	.78947	.79079	.79211	.79342	.79474	.79605	.79737	.79868	.80000	.80132
610	.80263	.80395	.80526	.80658	.80790	.80921	.81053	.81184	.81316	.81447
620	.81579	.81711	.81842	.81974	.82105	.82237	.82368	.82500	.82632	.82763
630	.82895	.83026	.83158	.83290	.83421	.83553	.83684	.83816	.83947	.84079
640	.84211	.84342	.84474	.84605	.84737	.84868	.85000	.85132	.85263	.85395
650	.85526	.85658	.85790	.85921	.86053	.86184	.86316	.86447	.86579	.86711
660	.86842	.86974	.87105	.87237	.87368	.87500	.87632	.87763	.87895	.88026
670	.88158	.88290	.88421	.88553	.88684	.88816	.88947	.89079	.89211	.89342
680	.89474	.89605	.89737	.89868	.90000	.90132	.90263	.90395	.90526	.90658
690	.90790	.90921	.91053	.91184	.91316	.91447	.91579	.91711	.91842	.91974
700	.92105	.92237	.92368	.92500	.92632	.92763	.92895	.93026	.93158	.93290
710	.93421	.93553	.93684	.93816	.93947	.94079	.94211	.94342	.94474	.94605
720	.94737	.94868	.95000	.95132	.95263	.95395	.95526	.95658	.95790	.95921
730	.96053	.96184	.96316	.96447	.96579	.96711	.96842	.96974	.97105	.97237
740	.97368	.97500	.97632	.97763	.97895	.98026	.98158	.98290	.98421	.98553
750	.98684	.98816	.98947	.99079	.99211	.99342	.99474	.99605	.99737	.99868
760	1.0000	1.0013	1.0026	1.0039	1.0053	1.0066	1.0079	1.0092	1.0105	1.0118
770	1.0132	1.0145	1.0158	1.0171	1.0184	1.0197	1.0211	1.0224	1.0237	1.0250
780	1.0263	1.0276	1.0289	1.0303	1.0316	1.0329	1.0342	1.0355	1.0368	1.0382
790	1.0395	1.0408	1.0421	1.0434	1.0447	1.0461	1.0474	1.0487	1.0500	1.0513

TABLE IV

Density of Moist Air

Values in the body of the table give the density of moist air in g/l for a limited range of temperatures and corrected pressure values ($B - 0.3783e$). The latter may be obtained by use of Table II.

°C	600	610	620	630	640	650	660	670	680	690
5	1.0024	1.0191	1.0358	1.0525	1.0692	1.0859	1.1026	1.1193	1.1361	1.1528
6	.99876	1.0154	1.0321	1.0487	1.0654	1.0820	1.0986	1.1153	1.1319	1.1486
7	.99521	1.0118	1.0284	1.0450	1.0616	1.0781	1.0947	1.1113	1.1279	1.1445
8	.99165	1.0082	1.0247	1.0412	1.0578	1.0743	1.0908	1.1074	1.1239	1.1404
9	.98818	1.0047	1.0211	1.0376	1.0541	1.0705	1.0870	1 1035	1.1199	1.1364
10	.98463	1.0010	1.0175	1.0339	1.0503	1.0667	1.0831	1.0995	1.1159	1.1323
11	.98115	.99751	1.0139	1.0302	1.0466	1.0629	1.0793	1.0956	1.1120	1.1283
12	.97776	.99406	1.0104	1.0267	1.0430	1.0592	1.0755	1.0918	1.1081	1.1244
13	.97436	.99061	1.0068	1.0231	1.0393	1.0556	1.0718	1.0880	1.1043	1.1205
14	.97097	.98715	1.0033	1.0195	1.0357	1.0519	1.0681	1.0843	1.1004	1.1166
15	.96757	.98370	.99983	1.0160	1.0321	1.0482	1.0643	1.0805	1.0966	1.1127
16	.96426	.98033	.99641	1.0125	1.0286	1.0446	1.0607	1.0768	1.0928	1.1089
17	.96086	.97688	.99290	1.0089	1.0249	1.0409	1.0570	1.0730	1.0890	1.1050
18	.95763	.97359	.98955	1.0055	1.0215	1.0374	1.0534	1.0694	1.0853	1.1013
19	.95431	.97022	.98613	1.0020	1.0179	1.0338	1.0497	1.0656	1.0816	1.0975

TABLE IV (Continued)

°C	600	610	620	630	640	650	660	670	680	690
20	.95107	.96693	.98278	.99864	1.0145	1.0303	1.0462	1.0620	1.0779	1.0937
21	.94784	.96364	.97944	.99524	1.0110	1.0294	1.0426	1.0584	1.0742	1.0900
22	.94460	.96035	.97609	.99184	1.0076	1.0233	1.0391	1.0548	1.0706	1.0863
23	.94144	.95714	.97283	.98852	1.0042	1.0199	1.0356	1.0513	1.0670	1.0827
24	.93829	.95393	.96957	.98521	1.0008	1.0165	1.0321	1.0478	1.0634	1.0790
25	.93513	.95072	.96630	.98189	.99748	1.0131	1.0286	1.0442	1.0598	1.0754
26	.93197	.94750	.96304	.97858	.99411	1.0096	1.0252	1.0407	1.0562	1.0718
27	.92889	.94437	.95986	.97534	.99083	1.0063	1.0218	1.0373	1.0528	1.0682
28	.92581	.94124	.95668	.97211	.98754	1.0030	1.0184	1.0338	1.0493	1.0647
29	.92273	.93811	.95350	.96888	.98426	.99963	1.0150	1.0304	1.0458	1.0612
30	.91965	.93498	.95031	.96564	.98097	.99629	1.0116	1.0270	1.0423	1.0576
31	.91665	.93193	.94721	.96249	.97777	.99304	1.0083	1.0236	1.0389	1.0542
32	.91365	.92888	.94411	.95934	.97457	.98979	1.0050	1.0203	1.0355	1.0507
33	.91065	.92583	.94101	.95619	.97137	.98654	1.0017	1.0169	1.0321	1.0473
34	.90773	.92286	.93800	.95313	.96826	.98338	.99851	1.0136	1.0288	1.0439
35	.90473	.91981	.93490	.94998	.96506	.98013	.99521	1.0103	1.0254	1.0405

°C	700	710	720	730	740	750	760	770	780	790
5	1.1695	1.1862	1.2029	1.2196	1.2363	1.2530	1.2697	1.2864	1.3031	1.3198
6	1.1652	1.1819	1.1985	1.2152	1.2318	1.2485	1.2651	1.2817	1.2984	1.3150
7	1.1611	1.1777	1.1943	1.2108	1.2274	1.2440	1.2606	1.2772	1.2938	1.3104
8	1.1569	1.1735	1.1900	1.2065	1.2230	1.2396	1.2561	1.2726	1.2892	1.3057
9	1.1529	1.1694	1.1858	1.2023	1.2188	1.2352	1.2517	1.2682	1.2846	1.3011
10	1.1487	1.1651	1.1816	1.1980	1.2144	1.2308	1.2472	1.2636	1.2800	1.2964
11	1.1447	1.1610	1.1774	1.1937	1.2101	1.2264	1.2428	1.2592	1.2755	1.2919
12	1.1407	1.1570	1.1733	1.1896	1.2059	1.2222	1.2385	1.2548	1.2711	1.2874
13	1.1368	1.1530	1.1692	1.1855	1.2017	1.2180	1.2342	1.2504	1.2667	1.2829
14	1.1328	1.1490	1.1652	1.1814	1.1975	1.2137	1.2299	1.2461	1.2623	1.2784
15	1.1288	1.1450	1.1611	1.1772	1.1933	1.2095	1.2256	1.2417	1.2579	1.2740
16	1.1250	1.1410	1.1571	1.1732	1.1893	1.2053	1.2214	1.2375	1.2535	1.2696
17	1.1210	1.1370	1.1530	1.1691	1.1851	1.2011	1.2171	1.2331	1.2491	1.2651
18	1.1172	1.1332	1.1492	1.1651	1.1811	1.1970	1.2130	1.2290	1.2449	1.2609
19	1.1134	1.1293	1.1452	1.1611	1.1770	1.1929	1.2088	1.2247	1.2406	1.2565
20	1.1096	1.1254	1.1413	1.1572	1.1730	1.1888	1.2047	1.2206	1.2364	1.2522
21	1.1058	1.1216	1.1374	1.1532	1.1690	1.1848	1.2006	1.2164	1.2322	1.2480
22	1.1020	1.1178	1.1335	1.1493	1.1650	1.1808	1.1965	1.2122	1.2280	1.2437
23	1.0984	1.1140	1.1297	1.1454	1.1611	1.1768	1.1925	1.2082	1.2239	1.2396
24	1.0947	1.1103	1.1259	1.1416	1.1572	1.1729	1.1885	1.2041	1.2198	1.2354
25	1.0910	1.1066	1.1222	1.1377	1.1533	1.1689	1.1845	1.2001	1.2157	1.2313
26	1.0873	1.1028	1.1184	1.1339	1.1494	1.1650	1.1805	1.1960	1.2116	1.2271
27	1.0837	1.0992	1.1147	1.1302	1.1456	1.1611	1.1766	1.1921	1.2076	1.2230
28	1.0801	1.0955	1.1110	1.1264	1.1418	1.1573	1.1727	1.1881	1.2036	1.2190
29	1.0765	1.0919	1.1073	1.1227	1.1380	1.1534	1.1688	1.1842	1.1996	1.2149
30	1.0729	1.0883	1.1036	1.1189	1.1342	1.1496	1.1649	1.1802	1.1956	1.2109
31	1.0694	1.0847	1.1000	1.1153	1.1305	1.1458	1.1611	1.1764	1.1917	1.2069
32	1.0659	1.0812	1.0964	1.1116	1.1268	1.1421	1.1573	1.1725	1.1878	1.2030
33	1.0624	1.0776	1.0928	1.1080	1.1231	1.1383	1.1535	1.1687	1.1839	1.1990
34	1.0590	1.0742	1.0893	1.1044	1.1195	1.1347	1.1498	1.1649	1.1801	1.1952
35	1.0555	1.0706	1.0857	1.1008	1.1158	1.1309	1.1460	1.1611	1.1762	1.1912

DENSITY OF DRY AIR

AT THE TEMPERATURE t, AND UNDER THE PRESSURE H CM OF MERCURY THE DENSITY OF AIR

$$= \frac{0.001293}{1+0.00367\,t}\,\frac{H}{76}.$$

Units of this table are grams per milliliter
(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

t	Pressure H in Centimeters					
	72.0	73.0	74.0	75.0	76.0	77.0
°						
10	0.001182	0.001198	0.001215	0.001231	0.001247	0.001264
11	178	193	210	227	243	259
12	173	190	206	222	239	255
13	169	186	202	218	234	251
14	165	181	198	214	230	246
15	0.001161	0.001177	0.001193	0.001210	0.001226	0.001242
16	157	173	189	205	221	238
17	153	169	185	201	217	233
18	149	165	181	197	213	229
19	145	161	177	193	209	225
20	0.001141	0.001157	0.001173	0.001189	0.001205	0.001221
21	137	153	169	185	201	216
22	134	149	165	181	197	212
23	130	145	161	177	193	208
24	126	142	157	173	189	204
25	0.001122	0.001138	0.001153	0.001169	0.001185	0.001200
26	118	134	149	165	181	196
27	115	130	146	161	177	192
28	111	126	142	157	173	188
29	107	123	138	153	169	184
30	0.001104	0.001119	0.001134	0.001150	0.001165	0.001180

Proportional Parts	17	16	15
cm			
0.1	2	2	1
0.2	3	3	3
0.3	5	5	4
0.4	7	6	6
0.5	8	8	7
0.6	10	10	9
0.7	12	11	10
0.8	14	13	12
0.9	15	14	13

DENSITY OF SATURATED VAPORS AT THE TEMPERATURE OF NORMAL EBULLITION

Vapor	Temp. ° C	Density
Acetic acid	118.5	0.00315
Benzene	80.2	0.00275
Chloroform	61.2	0.00443
Ether	34.6	0.00311
Ethyl alcohol	78.3	0.00164
Methyl alcohol	64.7	0.00121
Water	100.0	0.000596

DENSITY OF GASES IN LIQUID AND SOLID FORM

Temperatures marked * are the temperatures of normal ebullition

Gas	Liquid		Solid		Observer
	Temp. °C	D g/cm³	Temp. °C	D g/cm³	
Acetylene	− 23.5	0.52	.....	....	Mathias, 1909
	+ 30.3	0.40	.....	....	....
Air (20.9 % oxygen)	−147	0.92	.....	....	....
Ammonia	− 10.7	0.65	.....	....	Andreeff, 1859
	+ 16.3	0.61	.....	....	Andreeff, 1859
Argon	−187*	1.41	−233	1.65	Baly & Donnan, 1902
Carbon dioxide	− 60	1.19	− 79	1.53	Behn, 1910
	+ 20	0.77	.....	....	Amagat
Carbon monoxide	−190*	0.79	.....	....	....
	− 68	0.86	.....	....	Baly & Donnan
Chlorine	− 33.6*	1.56	.....	1.9	Knietsch, 1890
Chlorine	+ 20	1.41	.....	....	Knietsch, 1890
Ethane	− 88	0.546	.....	....	....
Ethylene	−102	0.566	.....	....	....
Ethylene	− 21	0.41	.....	....	Cailletet & Mathias, 1886
Ethylene	+ 10	0.21	.....	....	....
Fluorine	−187*	1.11	.....	1.3	....
Helium	−269*	0.122	.....	....	Kamerling-Onnes & Perrier, 1910
Hydrogen	−253*	0.07	−260	0.076	Dewar, 1904
Hydrogen chloride	− 85.8	1.194	.....	....	....
Hydrogen fluoride	+ 13.6	0.988	.....	....	....
Hydrogen phosphide (phosphine)	− 90	0.746	.....	....	....
Hydrogen sulfide	− 61	0.86	.....	....	....
Krypton	−146	2.6	.....	2.(?)	....
Methane	−164	0.415	.....	....	....
Methyl chloride	+ 18	0.920	.....	....	....
Neon	−245.9*	1.204	.....	1.0	....
Nitrogen	−196*	0.804	−253	1.03	Dewar, 1904
Nitrous oxide	− 20	1.0	.....	....	Cailletet & Mathias
Nitrous oxide	+ 17	0.80	.....	....	Villard, 1897
Oxygen	−123	0.89	.....	....	Cailletet & Hautefeuille, 1881
	−182.7*	1.14	−253	−1.41	Kamerling-Onnes & Perrier, 1910
	−205	1.25	.....	....	Baly & Donnan
Ozone, O_3	−183	1.71	.....	....	....
Sulfur dioxide	− 10*	1.46	.....	....	Pierre
	+ 20	1.38	.....	....	Cailletet & Mathias
Xenon	−109.1*	3.06	.....	2.7(?)	....

ELASTIC CONSTANTS FOR SOLIDS

The following table gives values for the yield point (or elastic limit, indicated by e.), ultimate tensile strength Young's modulus and the modulus of rigidity in kg/mm². The Brinell hardness number is also given, representing the ratio of load in kilograms on a sphere used to indent material to the spherical area of the indentation in square millimeters.

YIELD POINT, TENSILE STRENGTH, BRINELL HARDNESS

Material	Yield point		Ultimate tensile strength		Brinell hardness number
	Kg/mm²	Lbs./in.²	Kg/mm²	Lbs./in.²	
		×10³		×10³	
Aluminum 99.97, annealed	....	....	5.96	8.48	16
99.5, cast	....	....	7.95	11.31	....
hot rolled	10.2	14.51	11.34	16.13	....
cold "	13.2	18.77	14.71	20.92	....
99 3, rolled	....	....	19.7–24.6	28.02–34.99	39

ELASTIC CONSTANTS FOR SOLIDS (Continued)

YIELD POINT, TENSILE STRENGTH, BRINELL HARDNESS (Continued)

Material	Yield point		Ultimate tensile strength		Brinell hardness number
	Kg/mm²	Lbs./in.²	Kg/mm²	Lbs./in.²	
Aluminum-copper		×10³		×10³	
Cu .93, cold rolled	18.1	25.74	20.4	29.01	......
Cu 1.9 " drawn	22.1	31.43	23.62	33.59	......
Cu 4.97 cast	8.2	11.66	10.6	15.08	......
cold drawn	25	35.6	27.9	39.68	......
Cu 8.08, cast	10.2	14.51	11.65	16.57	......
cold drawn	24.3	34.56	25.9	36.84	......
Aluminum-iron Fe 11, rolled	......	......	12.6	17.92	44
Aluminum-magnesium Mg 6, rolled	......	......	28.4	40.39	69
Aluminum-manganese Mn 8, rolled	......	......	15	21.33	50
Aluminum-nickel Ni 10, rolled	......	......	16.5	23.47	53
Aluminum-zinc					
Zn 11%, hard drawn	14.3	20.34	15.4	21.90	......
20.15% " "	24.8	35.27	40.4	57.46	......
26.05% " "	34.7	49.35	42.2	60.02	......
Aluminum-zinc-copper Zn 23.48, Cu 2.67	31.7	45.09	46.6	66.28	......
Ambrac Ni 20, Zn 5	53 e.	75.4 e.	60	85.3	160
"30%" Ni 30, Zn 5	67 e.	95.3 e.	74	105.3	190
Antimony (wire)	......	......	1.1	1.56	......
Arsenic	......	......	......	......	147
Brass, *see* Cu-Zn					
Bronze, *see* Cu-Sn					
Cadmium, cast	......	......	8.5	12.09	21–24
Calcium, cast	......	......	6	8.5	42
Cerium	......	......	......	......	28
Chromel A, rolled hot Ni 82.5, Cr 15, Fe 1	42–56	59.7– 79.7	74–88	105.3–125.2	175–210
Chromel B, rolled hot Ni 77.5, Cr 20, Fe 1	49–63	69.7– 89.6	77–91	109.5–129.4	180–220
Chromel C, Ni 61, Cr 12, Fe 25, cast	28–42	39.8– 59.7	35–49	49.8– 69.7	130–180
rolled hot	35–49	49.8– 69.7	63–77	89.6–109.5	180–200
Chromium	......	......	49.2	70.0	70–130
Cobalt, annealed	......	......	26.0	37	48
cast	......	......	24	34.1	124
drawn	......	......	68	96.7	......
electrolytic	......	......	......	......	270–311
Constantan, Ni 55, Cu 43.9, Mn 1, C .1, annealed	14–21 e	19.9– 29.9e.	42–49	59.7– 69.7	100–120
cold rolled	21–88 e.	29.9–125.2e.	49–99	69.7–140.8	120–300
Copper, rolled	......	......	22.77	32.39	......
99.5 sheet "hard"	......	......	28.1	39.97	......
wire, hard drawn	......	......	34.5–47.1	49–67	......
" annealed	......	......	22.5–24.6	32–35	......
Copper-aluminum (aluminum bronze)					
Al 1.06, hard rolled	10.9	15.50	25	35.6	......
Al 4.05 " "	17.8	25.32	37.5	53.34	......
Al 9.9 " "	23.3	33.14	50.0	85.34	210
quenched	65.9	93.73	85.4	121.46	......
Al 11.73, hard rolled	19.9	28.30	53.3	75.81	269

ELASTIC CONSTANTS FOR SOLIDS (Continued)

YIELD POINT, TENSILE STRENGTH, BRINELL HARDNESS (Continued)

Material	Yield point		Ultimate tensile strength		Brinell hardness number
	Kg/mm²	Lbs./in.²	Kg/mm²	Lbs /in.²	
Copper-aluminum-nickel		×10³		×10³	
Al 5.34, Ni 7.34, cold rolled	81.1	115.35	84.1	119.62	180
Al 6.93, Ni 5.62, cold rolled	87.2	124.02	89.0	126.58	
Copper-nickel (nickel-silver)					
Ni 10, Zn 25, hard			63	89.6	
Ni 15, Zn 28 "			67	95.3	
Ni 25, Zn 20 "			77	109.5	208
Copper-tin					
Sn 4, cast and annealed			22.9	32.57	
Sn 10 " " "			30.4	43.24	
Sn 19 " " "			38.7	55.04	
Sn 25 " " "			17.7	25.17	
Copper-zinc (brass)					
Zn 10, rolled hard			39	55.5	120
Zn 20 " "			47	66.8	145
Zn 30 " "	47	66.8	47	66.8	145
Zn 40	39	55.5	47	66.8	150
Zn 50			16	22.8	95
Cupro-nickel Ni 15, hard			49	69.7	
soft			32	45.5	
Ni 25 "	13 e.	18 5 e.	37	52.6	
Delta metal	14.1 e.	20 e.	36.6	52	
Duralumin, cold rolled					
Al + Cu 3.5–5.5, Mn .5–.8, Mg .5	54	76.8	62.0	88.18	125
Gold, cast			17.6	25	
pure, hard drawn			25	35.6	
Au 90, Cu 10			45.8	65.1	
Gun metal			17.6–35.2	25–50	
Indium					1
Iridium, cast					172
Iron, cast	3.5– 4.2e.	5– 6 e.	10.5–12.7	15–18	
electrolytic, annealed	143	203.4	29.5	41.96	77
drawn	78	110.9	80.0	113.78	
wrought	14.8–18.3e.	21–26e.	29.5–36.6	42–52	
Lanthanum					37
Lead, cast			1.25	1.78	4.2
rolled			2.1	3.0	
Lead-antimony Sb 4.5			4.50	6.4	
Sb 9.9			5.39	7.67	
Lead-tin Sn 33.3			7.63	10.85	
Sn 50 (soft solder)			7.1	10.1	18
Magnesium, cast			10.7–14	15.22–19.9	
drawn, annealed	8–13	11.4–18.5	18–22	25.6 –31.3	29.4
Magnesium-aluminum					
Al 8 Dowmetal A, cast			21.8	31.01	60
Magnesium-Al-Cu-Cd					
Al 8.3, Cu 2, Cd 1, Zn .5, Mn .2, Dowmetal D			15.5	22.05	58
Al 8, Cu 1, Cd 1, Dowmetal R			16.5	23.47	54
Magnesium-cadmium					
Cd 5.5, drawn	12.4	17.64	20.6	29.30	51.9
Magnesium-copper					
Cu 12.7, drawn	21.9	31.2	24.6	34.99	

ELASTIC CONSTANTS FOR SOLIDS (Continued)

YIELD POINT, TENSILE STRENGTH, BRINELL HARDNESS (Continued)

Material	Yield point		Ultimate tensile strength		Brinell hardness number
	Kg/mm²	Lbs./in.²	Kg/mm²	Lbs./in.²	
Magnesium-silicon		×10³		×10³	
Si 1.2, drawn	22.2	31.58	29	41.3	....
Magnesium-zinc-Al					
Zn 3, Al .5, cold drawn	....	....	32	45.5	....
Manganese-bronze	21.1e.	30e.	45.7–59.8	65–85	....
Molybdenum, drawn	....	....	280	400	150–200
Monel metal, Ni 68.4, Cu 29, Fe 2, Mn .3, C .2, Si .1, cast	21– 28e.	29.9– 39.8e.	46– 56	65.4– 79.6	110–130
cold drawn or rolled	28–105e.	39.8–149.3e.	53–120	75.4–170.7	130–300
Nickel 99%, cast	14– 21	19.9– 29.9	35–49	49.8– 69.7	90–110
rolled cold	25–105	35.6–149.3	53–120	75.4–170.7	110–300
Nickel-iron C<.01					
Ni 1	....	....	42.1	59.88	....
Ni 5	....	....	51	72.5	....
Ni 10	....	....	62.8	89.32	....
Ni 18	....	....	127.7	181.63	....
Ni 25	....	....	73.3	104.25	....
Ni 50	....	....	76.3	108.52	....
Nickel-manganese Mn 3	....	....	52.1	74.10	....
Mn 9.24	....	....	58.9	83.77	....
Palladium, drawn	....	....	38	54.0	49
Phosphor-bronze					
Cu + Sn 3.77, P .16, drawn	41.7	59.31	56	79.6	....
Platinum, annealed	....	....	24.6	35	....
pure, drawn	....	....	34	48.4	64
Platinum-iridium, hard-worked					
Ir 10	....	....	....	....	220
Ir 20	....	....	100	142.2	330
Ir 30	....	....	140	199.1	400
Platinum-rhodium Rh 10	....	....	....	....	90
Potassium	....	....	....	....	.037
Praseodymium	....	....	....	....	25
Rhodium, cast	....	....	....	....	139
Ruthenium, cast	....	....	....	....	220
Silver, cast	....	....	28.1	40	....
hard drawn	....	....	31–36	44.1–51.2	....
Silver-copper					
Cu 7.5 (sterling silver) cast	12.8	18.21	22.2	31.58	60
hard drawn	....	....	43	61.2	....
Ag 75, Cu 25, hard drawn	....	....	91.4	130	....
Sodium	....	....	....	....	.07
Steel, castings	25.3– 27.4e.	36– 39e.	50.6– 54.8	72– 78	....
forgings	26.0– 31.6e.	37– 45e.	52.7– 63.3	75– 90	....
hard	24.6– 28.1e.	35– 40e.	49.2– 56.2	70– 80	....
medium	21.1– 24.6e.	30– 35e.	42.2– 49.2	60– 70	....
mild	17.6– 21.1e.	25– 30e.	35.2– 42.2	50– 60	16.0
spring, tempered	77.3–119.5e.	110–170e.	91.4–140.6	130–200	....
" untempered	35.2– 47.1e.	50– 67e.	71.0– 94.9	101–135	....
Steel-C					
C .08, annealed	....	....	32.5	46.22	120
quenched	....	....	49.0	69.69	....
.38, annealed	28.1	39.97	50.6	71.97	....
.49 "	....	....	49	69.7	....
.71 "	....	....	78.4	111.51	217
quenched	....	....	129	183.5	....

ELASTIC CONSTANTS FOR SOLIDS (Continued)

YIELD POINT, TENSILE STRENGTH, BRINELL HARDNESS (Continued)

Material	Yield point		Ultimate tensile strength		Brinell hardness number
	Kg/mm²	Lbs./in.²	Kg/mm²	Lbs./in.²	
Steel-C (Continued)		×10³		×10³	
C 1.00 quenched			150	213.3	402
1.40, annealed			68.6	97.57	202
quenched			131.9	187.60	460
Steel-Cr, quenched Cr 2, C .5, Mn .24			176.6	251.18	454
Steel-Cr-U, quenched, Cr .78, U .17, C .36, Mn .53, Si .25	143.4	203.96	170	241.8	
—Cr-V, quenched Cr 1.45, V .19, C .46, Mn .45, Si .18	140.9	200.40	169	240.4	444
—Cu, cold drawn, Cu .3, C .72, Mn .83, Si .03			207.6	295.27	
—Mn, forged Mn 8.68, C 1.27, Si .19			123.4	175.51	
—Ni, Ni 1.76, C .26, cast			67.5	96.01	
Ni 2.73, C .37, cast and forged			66.3	94.30	
Ni 3.59, C .20, quenched			138	196.3	354
—Ni-Cr, quenched, Ni 3.7–4.1, Cr .9, C .38, Mn .7, Si .15	106.5	151.47	194	275.9	
—Ni-Cr-U, quenched, Ni 1.63, Cr .61, U .20, C .36, Mn .78, Si .47	150	213.3	175	248.9	
—Ni-Cu, quenched, Ni 2.55, Cu .6, C .46, Mn .82, Si 1.3	196	278.8	230.5	327.84	555
—Ni-U, quenched, Ni 3.15, U .40, C .57, Mn .62, Si .58	183	260.3	209	297.3	
—Ni-V, quenched, Ni 3.15, V .32, C .6, Mn .79, Si 1.3	194.2	276.21	241.3	343.20	627
—Ti, low carbon, quenched, Ti 2.57, C .135, Mn .31, P .01, S .017, Si .14	45.2	64.29	66.2	94.16	143
—Ti, high carbon, quenched, Ti 8.71, C .65, Mn 45, P .016, S .011, Si .163	80.3	114.21	132.5	188.45	477
—U, quenched, U 2.20, C .25, Mn .65, Si .30	145	206.2	160.6	228.42	
—U, quenched, tempered, U .29, C .54, Mn .61	181	257.4	197	280.2	
—U, quenched, U .53, C .72, Mn .54, Si .75	197	280.2	233	331.4	
—V, rolled, V .8, C 1.04, Mn .05, Si .1	92.6	131.70	132.2	188.03	
Tantalum			93	132.3	
Thorium			56.3	80 08	
Tin, hard drawn			7.0	10	
rolled			2.5	3.56	
Tin-antimony-copper bearing alloy Sb 11, Cu 11			11.5	16 36	37
Tobin bronze	35.9–39.4e.	51–56e.	46.4–56.2	66–80	
Tungsten, drawn			420	597 4	350
Zinc, rolled	9	12.8	12–30	17.1–42.7	

ELASTIC CONSTANTS FOR SOLIDS (Continued)

Young's Modulus and Modulus of Rigidity (Torsional)

Material	Young's modulus		Modulus of rigidity	
	Dynes/cm²	Lbs./in.²	Dynes/cm²	Lbs./in.²
	$\times 10^{11}$	$\times 10^{6}$	$\times 10^{11}$	$\times 10^{6}$
Aluminum, cast	5.6 -7.7	8-11		
rolled	6.82-7.0	9.7-10		
99.3, rolled	6.96	10.10	2.37	3.44
Aluminum-bronze, forged Cu, 90, Al 10	11.81	16.8		
Aluminum-iron Fe 11, rolled	6.67	9.67		
Aluminum-magnesium Mg 6, rolled	6.18	8.96		
Aluminum-manganese Mn 8, rolled	6.47	9.39		
Aluminum-nickel Ni 10, rolled	6.47	9.39		
Ambrac (Ni 20)	13.14	19.06		
Antimony (wire)	7.80	11.31	1.98	2.87
Brass, cold rolled	9.02	13.09	3.53	5.12
Cadmium, cast	6.93	10.06	2.40	3.48
Chromium	24.8	36.0		
Constantan	14.51-15.89	21.05-23.04		
Copper, rolled	12.06-12.85	17.49-18.63	4.24	6.14
wire, hard drawn	10.19-12.0	14.5-17		
Cupro-nickel	8.24	11.95		
Delta metal	7.73	11		
Duralumin, cold rolled Al + Cu 3.5-5.5, Mn .5-.8, Mg .5	6.89	10.00	2.75	3.98
Gold, pure, hard drawn	7.85	11.38		
Gun metal	7.0	10		
Iridium, cast	5.17 (d)	7.50 (d)		
Iron, cast	8.4- 9.8	12-14		
electrolytic	20.6	29.9		
wrought	18.3-20.4	26-29		
Iron-cobalt Fe 70, Co 30	21.33	30.94		
Lead, rolled	1.47- 1.67	2.13- 2.42	0.54	0.78
Magnesium, drawn, annealed	4.18	6.06	1.67	2.42
Magnesium-aluminum Al 8 Dowmetal A, cast	4.18	6.06		
Molybdenum	29.4	42.7	14.7	21.3
Monel metal	16.48-17.95	23.89-26.03	6.18-6.86	8.96- 9.96
Nickel	20.01-21.38	29.01-31.01	7.06-7.55	10.24-10.95
Nickel-iron C<.01 Ni 5	21.28	30.86		
Ni 18	17.36 (19% Ni)	25.17		
Ni 25	18.14 (26% Ni)	26.31		
Palladium, drawn	11.77	17.07	4.41	6.40
Platinum, pure, drawn	16.67	24.18	6.42	9.32
Platinum-rhodium Rh 10			6.47	9.39
Rhodium, cast	29.42 (d)	42.67 (d)		
Silver, hard drawn	7.75	11.24	2.60	3.77
Steel-C C .08 annealed			7.79	11.31
drawn	19.22	27.88		
.38 annealed	20.01	29.01	8.11	11.76
.67 "	19.61	28.45	8.04	11.66
Tantalum	18.6	27.0		
Tin, rolled	3.92-5.39	5.69-7.82	1.67	2.42
Tobin bronze	10.	14.5		
Tungsten, drawn	35.5	51.49	14.81	21.48
Zinc, rolled	7.8-10.20	11.4-14.79	2.9-3.73	4.3-5.40

ISOTHERMAL COMPRESSIBILITY OF LIQUIDS

Compiled by John C. McGowan

The figures in this table are for isothermal compressibilities in c.g.s. units at one atmosphere. The effect of pressure (P) upon the isothermal compressibility (x_T) is usually well expressed by the empirical equation of Tait

$$x_T = \frac{C}{L + P}$$

C is a constant for a given substance. C is independent of temperature and is usually close to 0.1 (in some books instead of C, figures are given for 2.3026 C). For a given substance L is a constant at a given temperature.

Liquid	Temp °C	Isothermal compressibility (x_T) sq. cms. per dyne	C	L dynes per sq. cm.	Ref.
Acetic acid	15	8.75×10^{-11}	......	....	1
	20	9.08	......	....	1
	30	9.72	......	....	1
	40	10.37	......	....	1
	50	11.11	......	....	1
	60	11.91	......	....	1
	70	12.77	......	....	1
	80	13.68	......	....	1
Acetic acid, amyl ester	30.1	9.11	......	....	2
Acetic acid, benzyl ester	32.8	5.01	......	....	2
Acetic acid, ethyl ester	0	9.78	......	....	1
	10	10.36	......	....	1
	20	11.32	......	....	1
	30	12.37	......	....	1
	40	13.52	......	....	1
	50	14.78	......	....	1
	60	16.21	......	....	1
	70	17.90	......	....	1
Acetic anhydride	30	8.78	......	....	2
Acetone	20	12.75	......	....	3
	25	12.39	0.1023	8.26×10^{8}	4
	29.2	11.19	......	....	2
	40	15.61	......	....	3
Acetophenone	30	6.12	......	....	2
Amyl alcohol	29.2	8.93	......	....	2
Aniline	0	4.08	......	....	1
	10	4.30	......	....	1
	20	4.53	......	....	1
	25	4.67×10^{-11}	0.0938	20.07×10^{8}	5
	40	5.04	......	....	1
	45	5.22	0.0938	17.98	5
	50	5.33	......	....	1
	60	5.64	......	....	1
	65	5.84	0.0938	16.06	5
	70	5.97	......	....	1
	80	6.32	......	....	1
	85	6.56	0.0938	14.29	5
	90	6.70	......	....	1
Anisole	31.6	6.24	......	....	2
Benzene	0	8.09	......	....	1
	10	8.73	......	....	1
	10	8.64	......	....	3
	20	9.44	......	....	1
	20	9.37	......	....	3
	25	9.67	0.0938	9.70	6
	28.2	9.38	......	....	2
	30	10.18	......	....	1

ISOTHERMAL COMPRESSIBILITY OF LIQUIDS
(Continued)

Liquid	Temp °C	Isothermal compressibility (x_T) sq. cms. per dyne	C	L dynes per sq. cm.	Ref.
Benzene (cont.).....	30	10.12	......	....	3
	35	10.43	0.0938	8.99	6
	40	11.00	......	....	1
	40	10.96	......	....	3
	45	11.32	0.0938	8.29	6
	50	11.89	......	....	1
	50	11.83	......	....	3
	55	12.29	0.0938	7.63	6
	60	12.83	......	....	1
	65	13.39	0.0938	7.01	6
	70	14.13	......	....	1
	80	15.44	......	....	1
Benzene, bromo-....	25	6.68	0.0938	14.04	5
	45	7.52	0.0938	12.47	5
	65	8.50	0.0938	11.03	5
	85	9.65	0.0938	9.72	5
Benzene, chloro-....	0	6.61 × 10^{-11}	......	....	1
	10	7.02	......	....	1
	20	7.45	......	....	1
	20	7.38	......	....	3
	25	7.51	0.0938	12.49 × 10^8	5
	30	7.89	......	....	1
	30	7.84	......	....	3
	32.4	7.47	......	....	2
	40	8.39	......	....	1
	40	8.32	......	....	3
	45	8.55	0.0938	10.98	5
	50	8.92	......	....	1
	50	8.83	......	....	3
	60	9.50	......	....	1
	65	9.76	0.0938	9.61	5
	70	10.13	......	....	1
	80	10.79	......	....	1
	85	11.23	0.0938	8.35	5
Benzene, nitro-......	0	4.41	......	....	1
	10	4.67	......	....	1
	20	4.93	......	....	1
	25	5.03	0.0938	18.65	5
	30	5.23	......	....	1
	40	5.49	......	....	1
	45	5.59	0.0938	16.79	5
	65	6.24	0.0938	15.05	5
	85	6.99	0.0938	13.42	5
n-Butyl alcohol.....	29.4	8.50	......	....	2
Carbon disulphide...	0	8.04	......	....	1
	0	7.95	......	....	3
	10	8.64	......	....	1
	10	8.54	......	....	3
	20	9.26 × 10^{-11}	......	9.26 × 10^8	1
	20	9.19	......	....	3
	28	9.35	......	....	2
	30	9.92	......	....	1
	30	9.96	......	....	3
	40	10.65	......	....	1
	40	10.89	......	....	3
	50	11.48	......	....	1
	50	11.95	......	....	3
Carbon tetrachloride	0	8.98	......	....	1
	0	8.85	......	....	3
	10	9.70	......	....	1
	10	9.57	......	....	3

ISOTHERMAL COMPRESSIBILITY OF LIQUIDS
(Continued)

Liquid	Temp °C	Isothermal compressibility (x_T) sq. cms. per dyne	C	L dynes per sq. cm.	Ref.
Carbon tetrachloride (cont.)	20	10.46	......	....	1
	20	10.34	......	....	3
	25	10.67	0.0925	8.67	7
	28	11.29	......	....	2
	30	11.29	......	....	1
	30	11.18	......	....	3
	35	11.95	0.0925	8.01	7
	40	12.23	......	....	1
	40	12.16	......	....	3
	45	12.54	0.0925	7.38	7
	50	13.32	......	....	1
	50	13.26	......	....	3
	55	13.63	0.0925	6.79	7
	60	14.52	......	....	1
	65	14.87	0.0925	6.22	7
	70	15.77	......	....	1
Chloroform........	0	8.48	......	....	1
	0	8.55	......	....	3
	10	9.17×10^{-11}	......	....	1
	10	9.19	......	....	3
	20	9.98	......	....	1
	20	9.94	......	....	3
	25	9.74	0.1038	10.66×10^8	4
	30	10.86	......	....	1
	30	10.81	......	....	3
	30.4	10.68	......	....	2
	40	11.84	......	....	1
	40	11.79	......	....	3
	50	12.90	......	....	1
	60	14.06	......	....	1
Cyclohexane........	31	12.28	......	....	2
Cyclohexanol.......	31.9	6.56	......	....	2
Cyclohexanone......	30.8	7.52	......	....	2
Ethane 1,1,2,2-tetrachloro-......	25	6.17	0.0937	15.18×10^8	4
Ethyl alcohol.......	0	9.87	......	....	1
	0	9.63	......	....	3
	10	10.49	......	....	1
	10	10.30	......	....	3
	20	11.19	......	....	1
	20	10.98	......	....	3
	30	11.91	......	....	1
	30	11.80	......	....	3
	40	12.74	......	....	1
	40	12.61	......	....	3
	50	13.70	......	....	1
	50	13.60	......	....	3
	60	14.74	......	....	1
	70	15.93	......	....	1
	75	16.67	......	....	1
Ethyl bromide......	0	10.76×10^{-11}	......	....	1
	10	11.78	......	....	1
	20	12.94	......	....	1
	30	14.23	......	....	1
	40	15.52	......	....	1
Ethylene, 1,2-dichloro- (trans)....	25	11.19	0.0997	8.91×10^8	4
Ethylene, tetrachloro-	25	7.56	0.0962	12.72	4
Ethylene, trichloro-..	25	8.57	0.1053	12.29	4
Ethylene chloride...	0	6.91	......	....	1
	10	7.42	......	....	1
	20	7.97	......	....	1

ISOTHERMAL COMPRESSIBILITY OF LIQUIDS
(Continued)

Liquid	Temp °C	Isothermal compressibility (x_T) sq. cms. per dyne	C	L dynes per sq. cm.	Ref.
Ethylene chloride (cont.)	25	7.78	0.0970	12.47	4
	30	8.58	......	....	1
	40	9.25	......	....	1
	50	9.99	......	....	1
	60	10.83	......	....	1
	70	11.76	......	....	1
	80	12.79	......	....	1
Ethyl ether	0	15.10	......	....	1
	0	15.07	......	....	3
	10	16.81	......	....	1
	10	16.52	......	....	3
	20	18.65	......	....	1
	20	18.44	......	....	3
	30	20.90	......	....	1
	30	20.80	......	....	3
	35	24.15	......	....	1
Ethyl iodide	0	8.45	......	....	1
	10	9.12	......	....	1
	20	9.82	......	....	1
	30	10.59	......	....	1
	40	11.44 × 10^{-11}	......	....	1
	50	12.38	......	....	1
	60	13.40	......	....	1
	70	14.49	......	....	1
Glycol	25	3.72	0.0945	25.44 × 10^8	7
	45	4.00	0.0945	23.63	7
	65	4.32	0.0945	21.86	7
	85	4.70	0.0945	20.11	7
	105	5.14	0.0945	18.40	7
n-Heptane	0	11.80	0.0943	7.99	8
	25	14.24	0.0943	6.62	8
	27.6	12.90	......	....	2
	40	15.96	0.0943	5.91	8
	60	18.67	0.0943	5.05	8
n-Hexane	0	13.04	0.0943	7.23	8
	25	16.06	0.0943	5.87	8
	27.5	15.64	......	....	2
	40	18.31	0.0943	5.15	8
	60	21.93	0.0943	4.30	8
Isopropyl alcohol	30	11.24	......	....	2
Methanol	0	10.62	......	....	1
	0	10.78	......	....	3
	10	11.34	......	....	1
	10	11.45	......	....	3
	20	12.11	......	....	1
	20	12.18	......	....	3
	27.6	12.77	......	....	2
	30	12.93	......	....	1
	30	12.98	......	....	3
	40	13.85	......	....	1
	40	13.82	......	....	3
	50	14.76	......	....	3
Methylene chloride	25	9.74 × 10^{-11}	0.1038	10.66 × 10^5	4
n-Octane	0	9.99	0.0943	9.44	8
	25	11.98	0.0943	7.87	8
	40	13.36	0.0943	7.06	8
	60	15.53	0.0943	6.07	8
Paraldehyde	33.4	10.28	......	....	2
n-Propyl alcohol	28.0	10.54	......	....	2
Toluene	−59.29	5.27	......	....	9
	−41.05	5.93	......	....	9

ISOTHERMAL COMPRESSIBILITY OF LIQUIDS (Continued)

Liquid	Temp °C	Isothermal compressibility (x_T) sq. cms. per dyne	C	L dynes per sq. cm.	Ref.
Toluene (cont.)	−19.24	6.87	......	....	9
	0	7.83	......	....	1
	0	7.97	......	....	3
	0	7.84	......	....	9
	10	8.38	......	....	1
	10	8.44	......	....	3
	20	8.96	......	....	1
	20	8.94	......	....	3
	30	9.60	......	....	1
	30	9.49	......	....	3
	40	10.33	......	....	1
	40	10.14	......	....	3
	50	11.13	......	....	1
	50	10.90	......	....	3
	60	11.99	......	....	1
	70	12.95	......	....	1
Water	0	5.01	......	....	1
	0	5.04	......	....	9
	10	4.78	......	....	1
	20	4.58	......	....	1
	25	4.57	0.1368	29.96	7
	30	4.46	......	....	1
	30.8	4.35	......	....	2
	34.78	4.41 $\times 10^{-11}$	......	....	9
	35	4.48	0.1368	30.55 $\times 10^{8}$	7
	40	4.41	......	....	1
	45	4.44	0.1368	30.81	7
	50	4.40	......	....	1
	55	4.44	0.1368	30.78	7
	60	4.43	......	....	1
	65	4.48	0.1368	30.52	7
	70	4.49	......	....	1
	75	4.55	0.1368	30.05	7
	80	4.57	......	....	1
	85	4.65	0.1368	29.39	7
	90	4.68	......	....	1
	100	4.80	......	....	1
m-Xylene	0	7.44	......	....	1
	10	7.94	......	....	1
	20	8.46	......	....	1
	30	9.03	......	....	1
	40	9.63	......	....	1
	50	10.25	......	....	1
	60	11.01	......	....	1
	70	11.77	......	....	1
	80	12.56	......	....	1

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ELASTIC CONSTANTS FOR GASES

For short ranges of pressure, at a constant temperature, the volume of a gas is inversely proportional to the pressure or pressure × volume = a constant. (Boyle's Law.)

For high pressures, the table below shows the relative volumes at various temperatures. The volume at 0° C. and 76 cm. pressure (1 atmosphere) being taken as 1,000,000.

(From Smithsonian Tables.)

Atm.	Oxygen.			Air.		
	0°	99°.5	199°.5	0°	99°.4	200°.4
100	9265	......	......	9730		
200	4570	7000	9095	5050	7360	9430
300	3208	4843	6283	3658	5170	6622
400	2629	3830	4900	3036	4170	5240
500	2312	3244	4100	2680	3565	4422
600	2115	2867	3570	2450	3180	3883
700	1979	2610	3202	2288	2904	3502
800	1879	2417	2929	2168	2699	3219
900	1800	2268	2718	2070	2544	3000
1000	1735	2151	......	1992	2415	2828

Atm.	Nitrogen.			Hydrogen.		
	0°	99°.5	199°.6	0°	99°.3	200°.5
100	9910					
200	5195	7445	9532	5690	7567	9420
300	3786	5301	6715	4030	5286	6520
400	3142	4265	5331	3207	4147	5075
500	2780	3655	4515	2713	3462	4210
600	2543	3258	3973	2387	3006	3627
700	2374	2980	3589	2149	2680	3212
800	2240	2775	3300	1972	2444	2900
900	2149	2616	3085	1832	2244	2657
1000	2068	......	......	1720	2093	

COEFFICIENT OF FRICTION

(From Rankine's Compilation, 1858; Smithsonian Tables.)

Materials.	Coefficient of friction.	Angle of repose in degrees.
Wood on wood, dry	.25–.50	14.0–26.5
Wood on wood, soapy	.20	11.5
Metals on oak, dry	.50–.60	26.5–31.0
Metals on oak, wet	.24–.26	13.5–14.5
Metals on oak, soapy	.20	11.5
Metals on elm, dry	.20–.25	11.5–14.0
Hemp on oak, dry	.53	28.0
Hemp on oak, wet	.33	18.5
Leather on oak	.27–.38	15.0–19.5
Leather on metals, dry	.56	29.5
Leather on metals, wet	.36	20.0
Leather on metals, greasy	.23	13.0
Leather on metals, oily	.15	8.5
Metals on metals, dry	.15–.20	8.5–11.5
Metals on metals, wet	.3	16.5
Smooth surfaces occasionally greased	.07–.08	4.0–4.5
Smooth surfaces continually greased	.05	3.0
Smooth surfaces, best results	.03–.036	1.75–2.0
Steel on agate, dry	.20	11.5
Steel on agate, oiled	.107	6.1
Iron on stone	.30–.70	16.7–35.0
Wood on stone	about .40	22.0
Masonry and brick work, dry	.60–.70	33.0–35.0
Masonry and brick work, damp mortar	.74	36.5
Masonry on dry clay	.51	27.0
Masonry on moist clay	.33	18.25
Earth on earth	.25–1.00	14.0–45.0
Earth on earth, dry sand, clay and mixed earth	.38–.75	21.0–37.0
Earth on earth, damp clay	1.00	45.0
Earth on earth, wet clay	.31	17.0
Earth on earth, shingle and gravel	.81–1.11	39.0–48.0

RESISTANCE TO CRUSHING FOR VARIOUS MATERIALS

Approximate values in pounds per square inch.

Material.	Resistance to crushing in lbs. per sq. in.	Material.	Resistance to crushing in lbs. per sq. in.
Brick:		Granite	9700–34000
soft burned	3000–6000	Limestone	6000–25000
hard burned	4500–6500	Marble	7600–20700
vitrified	8500–25000	Sandstone	2400–29300
Brownstone	7300–23600	Tufa	7700–11600
Concrete	800–3800		

TENSILE STRENGTH OF METALS

(Selected from Smithsonian Tables.)

Given in pounds per square inch. The values can be considered only as approximations.

Metal	Tensile Strength in lbs. per sq. in.
Aluminum wire	30000–40000
Brass wire	50000–150000
Bronze wire, phosphor, hard drawn	110000–140000
Bronze wire, silicon, hard drawn	95000–115000
Bronze	60000–75000
Cobalt, cast	33000
Copper wire, hard drawn	60000–70000
German silver	40000–50000
Gold wire	20000
Iron, cast	13000–33000
Iron wire, hard drawn	80000–120000
Iron wire, annealed	50000–60000
Lead, cast or drawn	2600–3300
Magnesium, hard drawn	33000
Monel metal, cold drawn	80000–100000
Nickel, hard drawn	155000
Palladium	39000
Platinum wire	50000
Silver wire	42000
Steel	40000–330000
Steel wire, maximum	460000
Steel, specially treated nickel steel	250000
Steel, piano wire, 0.033 in. diam	357000–390000
Steel, piano wire, 0.051 in. diam	325000–337000
Tantalum	130000
Tin, cast or drawn	4000–5000
Tungsten, hard drawn	590000
Zinc, cast	7000–13000
Zinc, drawn	22000–30000

HARDNESS

MOHS' SCALE OF HARDNESS

1 Talc
2 Rock salt or gypsum
3 Calcite
4 Fluorite
5 Apatite
6 Feldspar
7 Quartz
8 Topaz
9 Corundum
10 Diamond

HARDNESS OF MATERIALS

Agate	6–7	Calcite	3
Alabaster	1.7	Calcium	1.5
Alum	2–2.5	Carbon	10.0
Aluminum	2–2.9	Carborundum	9–10
Alundum	9+	Cesium	0.2
Amber	2–2.5	Chromium	9.0
Andalusite	7.5	Copper	2.5–3
Anthracite	2.2	Corundum	9
Antimony	3.0–3.3	Diamond	10
Apatite	5	Diatomaceous earth	1–1.5
Aragonite	3.5	Dolomite	3.5–4
Arsenic	3.5	Emery	7–9
Asbestos	5	Feldspar	6
Asphalt	1–2	Flint	7
Augite	6	Fluorite	4
Barite	3.3	Galena	2.5
Bell-metal	4	Gallium	1.5
Beryl	7.8	Garnet	6.5–7
Bismuth	2.5	Glass	4.5–6.5
Boric acid	3	Gold	2.5–3
Boron	9.5	Graphite	0.5–1
Brass	3–4	Gypsum	1.6–2
Cadmium	2.0	Hematite	6
Calamine	5	Hornblende	5.5

HARDNESS (Continued)

Indium	1.2	Pyrite	6.3
Iridium	6–6.5	Quartz	7
Iridosmium	7	Rock salt (halite)	2
Iron	4–5	Ross' metal	2.5–3.0
Kaolinite	2.0–2.5	Rubidium	0.3
Lead	1.5	Ruthenium	6.5
Lithium	0.6	Selenium	2.0
Loess (0°)	0.3	Serpentine	3–4
Magnesium	2.0	Silicon	7.0
Magnetite	6	Silver	2.5–7
Manganese	5.0	Silver chloride	1.3
Marble	3–4	Sodium	0.4
Meerschaum	2–3	Steel	5–8.5
Mica	2.8	Stibnite	2
Opal	4–6	Strontium	1.8
Orthoclase	6	Sulfur	1.5–2.5
Osmium	7.0	Talc	1
Palladium	4.8	Tellurium	2.3
Phosphorus	0.5	Tin	1.5–1.8
Phosphorbronze	4	Topaz	8
Platinum	4.3	Tourmaline	7.3
Plat-iridium	6.5	Wax (0°)	0.2
Potassium	0.5	Wood's metal	3
Pumice	6	Zinc	2.5

COMPARISON OF HARDNESS VALUES OF VARIOUS MATERIALS ON MOHS AND KNOOP SCALES*

Compiled by Laurence S. Foster

Substance	Formula	Mohs value	Knoop value
Talc	$3MgO \cdot 4SiO_2 \cdot H_2O$	1	
Gypsum	$CaSO_4 \cdot 2H_2O$	2	32
Cadmium	Cd	..	37
Silver	Ag	..	60
Zinc	Zn	..	119
Calcite	$CaCO_3$	3	135
Fluorite	CaF_2	4	163
Copper	Cu	..	163
Magnesia	MgO	..	370
Apatite	$CaF_2 \cdot 3Ca_3(PO_4)_2$	5	430
Nickel	Ni	..	557
Glass (soda lime)	....	..	530
Feldspar (orthoclase)	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$	6	560
Quartz	SiO_2	7	820
Chromium	Cr	..	935
Zirconia	ZrO_2	..	1160
Beryllia	BeO	..	1250
Topaz	$(AlF)_2SiO_4$	8	1340
Garnet	$Al_2O_3 \cdot 3FeO \cdot 3SiO_2$	..	1360
Tungsten carbide alloy	WC, Co	..	1400–1800
Zirconium boride	ZrB_2	..	1550
Titanium nitride	TiN	9	1800
Tungsten carbide	WC	..	1880
Tantalum carbide	TaC	..	2000
Zirconium carbide	ZrC	..	2100
Alumina	Al_2O_3	..	2100
Beryllium carbide	Be_2C	..	2410
Titanium carbide	TiC	..	2470
Silicon carbide	SiC	..	2480
Aluminum boride	AlB	..	2500
Boron carbide	B_4C	..	2750
Diamond	C	10	7000

* Acknowledgment is made to N. W. Thibault, Norton Company, Worcester, Massachusetts, for many of Knoop hardness values. *Cf.* R. F. Geller, "A Study of Ceramics for Nuclear Reactors," Nucleonics, Vol. 7, No. 4, Table 1, pp. 8–9 (Oct. 1950). V. E. Lysaght, *Indentation Hardness Testing*, Reinhold 1949.

SURFACE TENSION

Compiled by T. Fraser Young and William D. Harkins

Meaning of Symbols

γ = the surface tension in dynes per centimeter.

$\Delta\gamma$ = the surface tension of a solution minus the surface tension of the pure solvent.

-- air, means that the liquid was in contact with air (saturated with its own vapor).

-- vapor, means that the liquid was in contact with its own vapor.

-- N_2 and -- H_2 have corresponding meanings.

-- also designates the surface between a pair of liquids at which the interfacial tension was determined.

% = weight % of the solute (i. e. the organic substance).

f = gram formula weights per 1000 grams of solvent (i. e. water).

°C = degrees Centigrade.

°K = degrees Kelvin or Absolute. Temperature in °C = Temperature in °K − 273.1.

M.P., at the melting point.

k_E = the Eötvös Constant, in erg mole$^{-\frac{2}{3}}$ degree^{-1}.

$$-k_E = \frac{d\,\Gamma}{d\,t} = \frac{d\,(M/d)^{\frac{2}{3}}\ \gamma}{d\,t}$$

where $\Gamma = \gamma\,(M/d)^{\frac{2}{3}}$

M = mass of one gram formula weight of the substance

d = density of the substance.

SURFACE TENSION (Continued)

LIQUIDS AGAINST AIR

Substance	°C	Surface tension, γ	°C	Surface tension, γ	k_E
Acetic acid	20	27.6	50	24.7	......
Acetone	20	23.7	60	18.6	1.9
Benzene	20	28.88	50	25.0	2.22
Benzophenone	20	45.1	50	41.8	2.9
n-Butyric acid	20	26.8	50	24.0	......
Carbon tetrachloride	20	26.8	50	23.1	2.21
Chlorobenzene	20	33.2	50	29.6	2.2
Chloroform	20	27.1	60	21.7	2.1
Cyclohexane	20	25.3	....	....	......
Ethyl acetate	20	23.9	50	20.2	2.3
Ethyl alcohol	20	22.3	50	19.8	......
Ethyl ether	20	17.0	..	....	2.25
n-Hexane	20	18.4	40	16.3	......
Methyl alcohol	20	22.6	50	20.1	......
n-Octane	20	21.8	60	17.9	2.3
n-Octyl alcohol	20	27.5	..	....	......
Phenol	20	40.9	50	37.7	1.85
n-Propylamine	20	22.4	45	19.4	1.9
Toluene	20	28.43	50	25.0	2.2
Triphenyl-phosphine	45.7	42.0	95.9	36.9	3.3
Tristearin	60	29.6	130	24.7	5.5

Water.—See special table below.

LIQUIDS AGAINST THEIR VAPORS

Formula	°C	γ	°C	γ	k_E
Cl_2 - -vapor	20.	18.	50.	13.	......
CO_2 - -vapor	–25.	9.1	20.	1.2	......
N_2O_4 - -vapor	1.6	31.	19.8	28.	2.2
NH_3 - -vapor	11.1	23.	59.0	13.	1.3
PCl_3 - -vapor	20.	29.1	50.	25.2	2.2
Substance	**°K**	**γ**	**°K**	**γ**	**k_E**
Hydrogen - -vapor	14.68	2.882	20.40	1.912	1.36
Neon - -vapor	24	5.90	28	4.45	2.0
Nitrogen - -vapor	70.0	10.5	90.0	6.2	2.0
Oxygen - -vapor	70.0	18.3	90.0	13.2	1.9

AQUEOUS SOLUTIONS AGAINST AIR

INORGANIC

(f = gram formula weights per 1000 grams of solvent.)

For the following aqueous solutions the values of $\Delta\gamma$ are given. $\Delta\gamma$ is the difference between the surface tension of the solution and that of the solvent at the same temperature. Positive values of $\Delta\gamma$ mean that the surface tension of the solution is greater than that of the solvent. Negative values, the reverse. For convenience in computing the surface tension, the current accepted value for the surface tension of water at the stated temperature is given in the second column.

Formula	°C (γH_2O)		$\Delta\gamma$ for concentrations indicated							
$CaCl_2$	25	f	.1	.5	1.0	2.0	3.0	5.0	11.2	
	(71.97)	$\Delta\gamma$	.35	1.5	3.2	6.9	11.0	18.4	35.	
HCl	20	f		.5	1.0	2.0	4.0	6.0	9.0	17.7
	(72.75)	$\Delta\gamma$		–.2	–.3	–.5	–.9	–1.3	–2.2	–7.
NH_4OH	18	f		.5	1.0	1.5	3.0	6.0	15.0	34.0
	(73.05)	$\Delta\gamma$		–1.4	–2.4	–3.1	–5.2	–7.8	–12.0	–16.0
HNO_3	20	f		.7	1.5	2.8			8.5	
	(72.75)	$\Delta\gamma$		–.6	–1.1	–1.8			–4.	
KCl	20	f	.1	.5	1.0	2.0	3.0	4.0	4.4	
	(72.75)	$\Delta\gamma$	.16	.70	1.4	2.8	4.2	5.5	6.0	

Formula	°C (γH_2O)		Δγ for concentrations indicated							
KOH	18	f		.5	1.0	2.0	3.8			
	(73.05)	Δγ		.9	1.8	3.5	6.7			
$MgCl_2$	20	f	.1	.5	1.0	2.0	3.0	3.65		
	(72.75)	Δγ	.32	1.52	3.0	6.4	10.2	13.0		
$MgSO_4$	20	f	.1	.5	1.0	2.0	2.7			
	(72.75)	Δγ	.26	1.03	2.1	4.6	6.5			
NaBr	20	f		.5	1.0	1.5	2.9			
	(72.75)	Δγ		.7	1.3	2.0	3.8			
NaCl	20	f	.1	.5	1.0	2.0	3.0	5.0	6.0	
	(72.75)	Δγ	.17	.82	1.64	3.3	4.9	8.2	9.8	
Na_2CO_3	20	f	.25	.5	1.0	1.5				
	(72.75)	Δγ	.7	1.3	2.7	4.0				
$NaNO_3$	20	f	.1	.5	1.0	2.0	3.0	5.0	7.0	12.2
	(72.75)	Δγ	.12	.60	1.2	2.4	3.5	5.6	7.5	11.3
NaOH	18	f		.7	1.5			5.0	11.0	14.0
	(73.05)	Δγ		1.3	2.8			10.0	23.	28.
Na_2SO_4	20	f	.2	.5	1.0					
	(72.75)	Δγ	.5	1.4	2.7					

AQUEOUS SOLUTIONS AGAINST AIR

ORGANIC

Substance	°C		Surface tension for concentrations indicated							
Acetic acid	30	%	1.000	2.475	5.001	10.01	30.09	49.96	69.91	100.00
		γ	68.0	64.4	60.1	54.6	43.6	38.4	34.3	26.6
Acetone	25	%	5.00	10.00	20.00	25.00	50.00	75.0	95.0	100.00
		γ	55.5	48.9	41.1	38.3	30.4	26.8	24.2	23.0
n-Butyric acid	25	%	.14	.31	1.05	3.83	8.6	25.	79.	100.
		γ	69.	65.	56.	42.	33.	28.	27.	26.
Ethyl alcohol	30	%	.979	2.143	4.994	10.39	25.00	50.00	75.06	100.00
		γ	66.1	61.6	54.2	45.9	34.1	27.5	24.7	21.5
Glycerol	18	%	5.0	10.0	15.0	20.0	30.0	50.0	85.0	100.0
		γ	72.9	72.9	72.7	72.4	72.	70.	66.	63.
Methyl alcohol	30	%	1.011	2.500	4.997	9.994	25.00	50.00	75.00	100.00
		γ	68.4	65.3	61.0	54.6	43.0	32.9	27.1	21.8
Phenol	20	%	.024	.047	.118	.471	.941	1.881	3.76	5.62
		γ	72.6	72.2	71.3	66.5	61.1	54.0	46.0	42.3
Propionic acid	25	%	.988	1.91	5.84	9.8	21.7	49.8	73.9	100.0
		γ	64.	60.	49.	44.	36.	32.	30.	26.
Sucrose	25	%	10.0	20.0	30.0	40.0	55.0			
		γ	72.5	73.0	73.4	74.1	75.7			

SURFACE TENSION (Continued)

WATER AGAINST AIR

Temperature °C	Surface tension dynes/cm.	Temperature °C	Surface tension dynes/cm.	Temperature °C	Surface tension dynes/cm.
−8	77.0	15	73.49	40	69.56
−5	76.4	18	73.05	50	67.91
0	75.6	20	72.75	60	66.18
5	74.9	25	71.97	70	64.4
10	74.22	30	71.18	80	62.6
				100	58.9

INTERFACIAL TENSION

Surface Tension at the Interface Between Two Liquids
(Each liquid saturated with the other)

Liquids	Temperature °C	γ	Liquids	Temperature °C	γ
Benzene--Mercury	20	357	Water--Heptylic acid	20	7.0
Ethyl ether--Mercury	20	379	Water--n-Hexane	20	51.1
Water--Benzene	20	35.00	Water--Mercury	20	375.
Water--Carbon tetrachloride	20	45.	Water-n-Octane	20	50.8
Water--Ethyl ether	20	10.7	Water-n-Octyl alcohol	20	8.5

SURFACE TENSION OF METALS

Substance		Gas	Temperature °C	Surface tension	References
Name	Symbol				
Aluminum	Al	--air	700	840	CR(1)
Antimony	Sb	--H_2	750	368	ZA(4)
"	Sb	--H_2	640	350	PM(1)
Bismuth	Bi	--H_2	300	388	PM(1)
"	Bi	--H_2	583	354	ZA(4)
"	Bi	--CO	700–800	346	AdP(2)
Cadmium	Cd	--H_2	320	630	AC(10)
Copper	Cu	--H_2	1131	1103	ZA(4)
Gallium	Ga	--CO_2	30	358	AC(30)
Gold	Au	--H_2	1070	580–1000	AdP(1) AdP(2) JI(1)
Lead	Pb	--H_2	350	453	PM(1)
"	Pb	--H_2	750	423	ZA(4)
Mercury	Hg	--vac.	0	480.3	AC(7)
"	Hg	--air	15	487	AC(9) AdP(5) AdP(6) CR(2)
"	Hg	--H_2	19	470	PM(1)
"	Hg	--vac.	60	467.1	AC(7)
Platinum	Pt	--air	2000	1819	AdP(2)
Potassium	K	--CO_2	62	411	AdP(3)
Silver	Ag	--air	970	800	AdP(2) AdP(4) JI(1)
Sodium	Na	--CO_2	90	294	AdP(3)
"	Na	--vac.	100	206.4	PR(1)
"	Na	--vac.	250	199.5	PR(1)
Tin	Sn	--H_2	253	526	PM(1)
"	Sn	--H_2	878	508	ZA(4)
Zinc	Zn	--H_2	477	753	AC(10)
"	Zn	--air	590	708	JI(1)

SURFACE TENSION OF FUSED SALTS

Substance		Gas	Temperature °C	Surface tension γ	References
Name	Formula				
Barium chloride	$BaCl_2$	--air	M.P.	171	ZA(2)
Bismuth tribromide	$BiBr_3$	--nitrogen	442	46.2	ZA(1)
" "	$BiBr_3$	--nitrogen	250	66.5	ZA(1)
" trichloride	$BiCl_3$	--nitrogen	382	52.0	ZA(1)
" "	$BiCl_3$	--nitrogen	271	66.2	ZA(1)
Calcium chloride	$CaCl_2$	--air	M.P.	152	ZA(2)
Cesium bromide	CsBr	--nitrogen	658	81.8	ZA(1)
" chloride	CsCl	--nitrogen	664	89.2	ZA(1)
" fluoride	CsF	--nitrogen	723	104.5	ZA(1)
" iodide	CsI	--nitrogen	654	73.1	ZA(1)
" nitrate	CsNO	--nitrogen	426	91.8	ZA(1)
" sulfate	Cs_2SO_4	--nitrogen	1036	111.3	ZA(1)
Lead chloride	$PbCl_2$	--air	490	138	BD(1)
" "	$PbCl_2$	--air	539	131	BD(1)
Lithium chloride	LiCl	--nitrogen	614	137.8	ZA(1)
" "	LiCl	--nitrogen	1075	104.8	ZA(1)
" fluoride	LiF	--nitrogen	868.5	249.5	ZA(1)
" "	LiF	--nitrogen	1270	201.1	ZA(1)
" nitrate	$LiNO_3$	--nitrogen	359	111.5	ZA(1)
" "	$LiNO_3$	--nitrogen	609	96.2	ZA(1)
" sulfate	Li_2SO_4	--nitrogen	860	223.8	ZA(1)
" "	Li_2SO_4	--nitrogen	1214	200.3	ZA(1)
Potassium *meta*borate	KBO_2	--nitrogen	992	123.5	ZA(1)
" bromide	KBr	--nitrogen	775	85.7	ZA(1)
" "	KBr	--air	M.P.	91.0	ZA(2)
" "	KBr	--nitrogen	887	77.8	ZA(1)
" chloride	KCl	--nitrogen	909	88.0	ZA(1)
" "	KCl	--nitrogen	1054	77.2	ZA(1)
" "	KCl	--nitrogen	1167	69.6	ZA(1)
" "	KCl	--air	M.P.	98.4	ZA(2)
" cyanide	KCN	--air	M.P.	96.1	ZA(2)
" dichromate	$K_2Cr_2O_7$	--nitrogen	420	140.1	ZA(1)
" "	$K_2Cr_2O_7$	--nitrogen	535	135.0	ZA(1)
" fluoride	KF	--nitrogen	913	138.4	ZA(1)
" "	KF	--nitrogen	1310	104.9	ZA(1)
" molybdate	K_2MoO_4	--nitrogen	931	150.5	ZA(1)
" "	K_2MoO_4	--nitrogen	1522	112.5	ZA(1)
" nitrate	KNO_3	--nitrogen	380	110.4	ZA(1)
" "	KNO_3	--air	414	100.7	ZA(2)
" *meta*phosphate	KPO_3	--nitrogen	897	155.5	ZA(1)
" " "	KPO_3	--nitrogen	1205	133.5	ZA(1)
" " "	KPO_3	--nitrogen	1536	100.3	ZA(1)
" sulfate	K_2SO_4	--nitrogen	1070	143.7	ZA(1)
" "	K_2SO_4	--nitrogen	1306	128.8	ZA(1)
" "	K_2SO_4	--nitrogen	1656	106.8	ZA(1)
" tungstate	K_2WO_4	--nitrogen	925	161.0	ZA(1)
" "	K_2WO_4	--nitrogen	1520	105.6	ZA(1)
Rubidium bromide	RbBr	--nitrogen	729	87.7	ZA(1)
" chloride	RbCl	--nitrogen	750	95.7	ZA(1)
" "	RbCl	--nitrogen	933	79.9	ZA(1)
" "	RbCl	--nitrogen	1150	61.4	ZA(1)
" fluoride	RbF	--nitrogen	803	127.2	ZA(1)
" iodide	RbI	--nitrogen	673	79.4	ZA(1)
" nitrate	$RbNO_3$	--nitrogen	327	107.5	ZA(1)
" sulfate	Rb_2SO_4	--nitrogen	1086	132.5	ZA(1)
Silver bromide	AgBr	--air	M.P.	121.4	AdP(4)
" chloride	AgCl	--air	452	125.5	ZA(3)
" "	AgCl	--air	494	121.6	ZA(3)
Sodium bromide	NaBr	--nitrogen	985	90.0	ZA(1)
" "	NaBr	--air	M.P.	102.8	ZA(2)
" tetraborane deriv.	$NaBO_2$	--nitrogen	1016	193.7	ZA(1)
" chloride	NaCl	--nitrogen	803	113.8	ZA(1)
" "	NaCl	--nitrogen	908	106.4	ZA(1)

SURFACE TENSION OF FUSED SALTS (Continued)

Substance		Gas	Temperature °C	Surface tension γ	References
Name	Formula				
Sodium chloride	NaCl	- -nitrogen	996	99.7	ZA(**1**)
" "	NaCl	- -nitrogen	1080	94.0	ZA(**1**)
" "	NaCl	- -nitrogen	1172	88.0	ZA(**1**)
" fluoride	NaF	- -nitrogen	1010	199.5	ZA(**1**)
" "	NaF	- -nitrogen	1263	173.1	ZA(**1**)
" "	NaF	- -nitrogen	1546	143.5	ZA(**1**)
" iodide	NaI	- -air	M.P.	93.9	ZA(**2**)
" "	NaI	- -nitrogen	861	77.6	ZA(**1**)
" molybdate	Na_2MoO_4	- -nitrogen	699	214.0	ZA(**1**)
" nitrate	$NaNO_3$	- -nitrogen	322	119.7	ZA(**1**)
" "	$NaNO_3$	- -nitrogen	602	103.4	ZA(**1**)
" "	$NaNO_3$	- -nitrogen	738	93.7	ZA(**1**)
" "	$NaNO_3$	- -nitrogen	513	108.9	ZA(**1**)
" *meta*phosphate	$NaPO_3$	- -nitrogen	827	197.5	ZA(**1**)
" "	$NaPO_3$	- -nitrogen	1517	147.5	ZA(**1**)
" sulfate	Na_2SO_4	- -nitrogen	900	194.8	ZA(**1**)
" "	Na_2SO_4	- -nitrogen	1077	184.7	ZA(**1**)
" tungstate	Na_2WO_4	- -nitrogen	710	203.3	ZA(**1**)
Sulfur	S	- -air	445	38.97	JS(**1**)
Tin chloride	$SnCl_2$	- -nitrogen	307	97.0	ZA(**1**)
" "	$SnCl_2$	- -nitrogen	405	89.0	ZA(**1**)
" "	$SnCl_2$	- -nitrogen	480	81.6	ZA(**1**)

SURFACE TENSION OF VARIOUS LIQUIDS

Substance		In contact with	Temperature °C	Surface tension dynes/cm.	References
Name	Formula				
Acetaldehyde	C_2H_4O	vapor	20	21.2	AC(**12**)
Acetaldoxime	C_2H_5NO	vapor	35	30.1	JP(**1**); JSG(**1**)
Acetamide	C_2H_5NO	vapor	85	39.3	JS(**3**)
Acetanilide	C_2H_5NO	vapor	120	35.6	JS(**3**)
Acetic acid	$C_2H_4O_2$	vapor	10	28.8	AC(**22, 23, 25**); GC(**1**); JS(**14**); tPRS(**1**); ZC(**1, 6**)
" "	C_2H_4O	vapor	20	27.8	
" "	C_2H_4O	vapor	50	24.8	
Acetic anhydride	$C_4H_6O_3$	vapor	20	32.7	GC(**1**); JS(**4**)
Acetone	C_3H_6O	air or vapor	0	26.21	AC(**20, 24, 25**); AdC(**1**); BF(**1**); JP(**5**); JS(**4, 14**); ZC(**6**)
"	C_3H_6O	air or vapor	20	23.70	
"	C_3H_6O	air or vapor	40	21.16	
Acetonitrile	C_2H_3N	vapor	20	29.30	AC(**16**); BF(**1**); GC(**1**); JP(**5**)
Acetophenone	C_8H_8O	vapor	20	39.8	AC(**27**); AS(**1**); JP(**2**)
Acetyl chloride	C_2H_3ClO	vapor	14.8	26.7	JS(**4**)
Acetylene	C_2H_2	vapor	−70.5	16.4	AC(**14**)
Acetylsalicylic acid	$C_9H_8O_4$	vapor	25.9	60.06	GC(**2**)
Allyl alcohol	C_3H_6O	air or vapor	20	25.8	AC(**27**); AdC(**1**); JS(**4**)
Allyl isothiocyanate	C_4H_5NS	air or vapor	20	34.5	AC(**16**); GC(**1**)
Ammonia	NH_3	vapor	11.1	23.4	JP(**7**)
"	NH_3	vapor	34.1	18.1	JP(**7**)
Aniline	C_6H_7N	air	10	44.10	AC(**6, 17, 28**); GC(**1**); JP(**5**); JS(**12**)
"	C_6H_7N	vapor	20	42.9	
"	C_6H_7N	air	50	39.4	
Argon	A	vapor	−188	13.2	JS(**15**)
Azoxybenzene	$C_{12}H_{10}N_2O$	vapor	51	43.34	JS(**5**)
Benzaldehyde	C_7H_6O	air	20	40.04	AC(**6, 24**)
Benzene	C_6H_6	air	10	30.22	AC(**3, 5, 31, 32, 34**); BF(**2**); JP(**5**); JS(**4, 9, 10, 11, 14**); PRS(**2**); tRIA(**1**); tPRS(**1**); ZC(**4, 5**)
"	C_6H_6	air	20	28.85	
"	C_6H_6	saturated with vapor	20	28.89	
"	C_6H_4	air	30	27.56	

SURFACE TENSION OF VARIOUS LIQUIDS (Continued)

Substance		In contact with	Temperature °C	Surface tension dynes/cm.	References
Name	Formula				
Benzonitrile	C_7H_5N	air	20	39.05	AC(28); AS(2); GC(1); JP(5); JS(3)
Benzophenone	$C_{13}H_{10}O$	air or vapor	20	45.1	AC(27); AS(1); ZC(5)
Benzylamine	C_7H_9N	vapor	20	39.5	JS(3)
Benzyl alcohol	C_7H_8O	air or vapor	20	39.0	AC(33); JS(6); PRS(1)
Bromine	Br_2	air or vapor	20	41.5	AC(17); AdP(3); GC(1)
Bromobenzene	C_6H_5Br	air	20	36.5	AC(8, 17); GC(1); JS(12)
Bromoform	$CHBr_3$	vapor	20	41.53	AC(8); JP(2)
p-Bromophenol	C_6H_5BrO	vapor	74.4	42.36	JS(6)
d-sec-Butyl alcohol	$C_4H_{10}O$	vapor	10	23.5	JS(7)
n-Butyl alcohol	$C_4H_{10}O$	air or vapor	0	26.2	AC(27, 33); JS(4)
" " "	$C_4H_{10}O$	air or vapor	20	24.6	AC(27, 33); JS(4)
" " "	$C_4H_{10}O$	air or vapor	50	22.1	AC(27, 33); JS(4)
tert-Butyl alcohol	$C_4H_{10}O$	air or vapor	20	20.7	AC(33); JS(8)
n-Butylamine	$C_4H_{11}N$	nitrogen	41	19.7	ZA(1)
n-Butyric acid	$C_4H_8O_2$	air	20	26.8	AC(27); GC(1); JS(4)
Carbon bisulfide	CS_2	vapor	20	32.33	AC(17, 28); GC(1); BF(2); JS(14); PRS(2); ZC(6)
Carbon dioxide	CO_2	vapor	20	1.16	VK(1, 2)
" "	CO_2	vapor	−25	9.13	VK(1, 2)
Carbon tetrachloride	CCl_4	vapor	20	26.95	AC(3, 5, 6, 28, 31); PRS(1, 2); ZC(5)
" "	CCl_4	vapor	100	17.26	
" "	CCl_4	vapor	200	6.53	
Carbon monoxide	CO	vapor	−193	9.8	JS(15)
" "	CO	vapor	−203	12.1	JS(15)
Chloral	C_2HCl_3O	vapor	19.4	25.34	JS(4)
Chlorine	Cl_2	vapor	20	18.4	AC(11); JP(3)
"	Cl_2	vapor	−30	25.4	AC(11); JP(3)
"	Cl_2	vapor	−40	27.3	AC(11); JP(3)
"	Cl_2	vapor	−50	29.2	AC(11); JP(3)
"	Cl_2	vapor	−60	31.2	AC(11); JP(3)
Chloroacetic acid	$C_2H_2Cl_2O_2$	nitrogen	25.7	35.4	ZA(1)

SURFACE TENSION OF VARIOUS LIQUIDS (Continued)

Substance		In contact with	Temperature °C	Surface tension dynes/cm.	References
Name	Formula				
Chlorobenzene	C_4H_5Cl	--vapor	20	33.56	AC(**6, 20, 28**); JP(**5**); JS(**11**); PRS(**2**); tRIA(**1**); tPRS(**1**); ZC(**5**)
Chloroform	$CHCl_3$	--air	20	27.14	AC(**6, 28, 31**); AdC(**1**); PRS(**2**); tRIA(**1**); ZC(**6**)
o-Chlorophenol	C_6H_5ClO	--vapor	12.7	42.25	JS(**6**)
Cyclohexane	C_6H_{12}	--air	20	25.5	PRS(**1**); ZA(**1**)
Dichloroacetic acid	$C_2H_2Cl_2O_2$	--nitrogen	25.7	35.4	ZA(**1**)
Dichloroethane	$C_2H_4Cl_2$	--air	35.0	23.4	AC(**17**); AdC(**1**)
Diethylamine	$C_4H_{11}N$	--air	56	16.4	GC(**1**)
Diethylaniline	$C_{10}H_{15}N$	--vapor	20	34.2	AC(**31**); AS(**1**); MfC(**1**)
Diethyl carbonate	$C_5H_{10}O$	--air	20	26.31	AC(**4**); JS(**5**)
Diethyl oxalate	$C_6H_{10}O_4$	--vapor	20	32.0	AC(**16**); GC(**1**)
Diethyl phthalate	$C_{12}H_{14}O_4$	--vapor	20	37.5	AC(**21**); PRS(**1**); ZA(**5**)
Diethyl sulfate	$C_4H_{12}O_4S$	--air	13	34.61	JS(**5**)
Dimethylamine	C_2H_7N	--nitrogen	0	18.1	ZA(**1**)
"	C_2H_7N	--nitrogen	5	17.7	ZA(**1**)
Dimethylaniline	C_8H_{11}	--air or vapor	20	36.6	AC(**4, 17, 31**); JP(**5**)
1,5-Dimethyl-2-phenyl-3-pyrazolone	$C_{11}H_{12}N_2O$	--vapor	25.9	63 63	GC(**2**)
Dimethyl sulfate	$C_2H_6O_4S$	--air	18	40.12	JS(**5**)
Diphenylamine	$C_{12}H_{11}N$	--air or vapor	80	37.7	JP(**2, 9**); JS(**3**); ZA(**1**)
Ethyl acetate	$C_4H_8O_2$	--air	0	26.5	AC(**26, 33**); AdC(**1**); AS(**2**); JP(**5**); tPRS(**1**); ZC(**6**)
" "	$C_4H_8O_2$	--air	20	23.9	
" "	$C_4H_8O_2$	--air	50	20.2	
Ethyl acetoacetate	$C_6H_{10}O_3$	--air or vapor	20	32.51	AC(**16**); BD(**2**); GC(**1**); JS(**4**)
Ethyl alcohol	C_2H_6O	--air	0	24.05	AC(**22, 23, 25, 32**); BF(**2**); JP(**5**); tRIA(**1**); tPRS(**1**)
" "	C_2H_6O	--vapor	10	23.61	
" "	C_2H_6O	--vapor	20	22.75	
" "	C_2H_6O	--vapor	30	21.89	
Ethylamine	C_2H_7N	--nitrogen	0	21.3	PRA(**4**); ZA(**1**)
"	C_2H_7N	--nitrogen	9.9	20.4	PRA(**4**); ZA(**1**)
Ethylaniline	$C_8H_{11}N$	--air or vapor	20	36.6	AC(**17, 33**); AS(**1**); MfC(**1**)

SURFACE TENSION OF VARIOUS LIQUIDS (Continued)

Substance		In contact with	Temperature °C	Surface tension dynes/cm.	References
Name	Formula				
Ethylbenzene	C_8H_{10}	--vapor	20	29.20	AC(**17, 33, 34**); AdC(**1**); PRS(**1**)
Ethylbenzoate	$C_9H_{10}O_2$	--vapor	20	35.5	GC(**1**); ZA(**1**); MfC(**1**)
Ethyl bromide	C_2H_5Br	--vapor	20	24.15	AC(**6, 33**); GC(**1**)
Ethyl chloroformate	$C_3H_5ClO_2$	--vapor	15.1	27.5	JS(**4**)
Ethyl Cinnamate	$C_{11}H_{12}O_2$	--air	20	38.37	AC(**16**); PRS(**1**); ZC(**5**)
Ethylene bromide	$C_2H_4Br_2$	--vapor	20	38.37	AC(**5, 28, 33**); GC(**1**); JP(**2**); PRS(**2**); tRIA(**1**)
Ethylene chloride	$C_2H_4Cl_2$	--air	20	24.15	AC(**17, 33**); AdC(**1**); JS(**14**); ZC(**6**)
Ethylene oxide	C_2H_4O	--vapor	−20	30.8	
" "	C_2H_4O	--vapor	0.0	27.6	
" "	C_2H_4O	--vapor	20	24.3	
Ethyl ether	$C_4H_{10}O$	--vapor	20	17.01	AC(**4, 15, 28, 31**); AdC(**1**); tPRS(**1**)
" "	$C_4H_{10}O$	--vapor	50	13.47	
Ethyl formate	$C_3H_6O_2$	--air or vapor	20	23.6	AC(**20, 26**); AdC(**1**); PRS(**2**)
Ethyl iodide	C_2H_5I	--vapor	20	29.4	AC(**33**); GC(**1**); JS(**4**); PRS(**1**); ZC(**6**)
Ethyl nitrate	$C_2H_5NO_3$	--air or vapor	20	28.7	AC(**27**); GC(**1**)
dl-Ethyl lactate	$C_5H_{10}O_3$	--air	20	29.9	AC(**20, 21**); JP(**8**)
Ethyl mercaptan	C_2H_6S	--air or vapor	20	22.5	AC(**4, 16**); JS(**4**)
Ethyl salicylate	$C_9H_{10}O_3$	--vapor	20.5	38.33	JS(**6**)
Formamide	CH_3NO	--vapor	20	58.2	AC(**27**); JS(**3**); ZC(**4**)
Formic acid	CH_2O_2	--air	20	37.6	AC(**23, 27**); GC(**1**); JS(**4**); MfC(**1**); ZA(**1**)
Furfural	$C_5H_4O_2$	--air or vapor	20	43.5	AC(**27**); GC(**1**)
Gelatin solution (1%)		--water	2.85	8.3	ZK(**1**)
Glycerol	$C_3H_8O_3$	--air	20	63.4	JR(**1**); MB(**1**); ZA(**1**); ZC(**3**)
"	$C_3H_8O_3$	--air	90	58.6	
"	$C_3H_8O_3$	--air	150	51.9	
Glycol	$C_2H_6O_2$	--air or vapor	20	47.7	AC(**29**); JS(**4**)
Helium	He	--vapor	−269	.12	cUL(**2**); PRA(**2**)
"	He	--vapor	−270	.239	cUL(**2**); PRA(**2**)
"	He	--vapor	−271.5	.353	cUL(**2**); PRA(**2**)

SURFACE TENSION OF VARIOUS LIQUIDS (Continued)

Substance		In contact with	Temperature °C	Surface tension dynes/cm.	References
Name	Formula				
n-Hexane	C_6H_{14}	--air	20	18.43	AC(**5, 6, 16**); AdC(**1**); AS(**1**)
Hydrazine	N_2H_4	--vapor	25	91.5	AC(**1**)
Hydrogen	H_2	--vapor	−255	2.31	cUL(**1**); PRA(**1**)
Hydrogen cyanide	HCN	--vapor	17	18.2	ZE(**1**)
Hydrogen peroxide	H_2O_2	--vapor	18.2	76.1	AC(**13**)
Isobutyl alcohol	$C_4H_{10}O$	--vapor	20	23.0	AC(**4, 27, 32**); AdC(**1**); JP(**5**); JS(**4**)
Isobutylamine	$C_4H_{11}N$	--air	68	17.6	GC(**1**)
Isobutyl chloride	C_4H_9Cl	--air	20	21.94	AC(**6**); GC(**1**)
Isobutyric acid	$C_4H_8O_2$	--air or vapor	20	25.2	AC(**27**); GC(**1**); JS(**4**)
Isopentane	C_5H_{12}	--air	20	13.72	AC(**6**)
Isopropyl alcohol	C_3H_8O	--air or vapor	20	21.7	JS(**4**); AdC(**1**)
Methyl acetate	$C_3H_6O_2$	--air or vapor	20	24.6	AC(**26, 33**); AdC(**1**); PRS(**2**)
Methyl alcohol	CH_4O	--air	0	24.49	AC(**22, 23, 25, 32**); tPRS(**1**)
" "	CH_4O	--air	20	22.61	
" "	CH_4O	--vapor	50	20.14	
Methylamine	CH_3NH_2	--nitrogen	−12	22.2	PRA(**1**); ZA(**1**)
"	CH_3NH_2	--vapor	−20	23.0	PRA(**1**); ZA(**1**)
"	CH_3NH_2	--nitrogen	−70	29.2	PRA(**1**); ZA(**1**)
N-Methylaniline	C_7H_9N	--air or vapor	20	39.6	AC(**17, 32**); AS(**1**)
Methyl benzoate	$C_8H_8O_2$	--air or vapor	20	37.6	GC(**1**); JP(**5**)
Methyl chloride	CH_3Cl	--air	20	16.2	WN(**1**)
Methyl ether	C_2H_6O	--vapor	−10	16.4	AC(**12**)
" "	C_2H_6O	--vapor	−40	21	AC(**12**)
Methylene chloride	CH_2Cl_2	--air	20	26.52	AC(**6**)
Methylene iodide	CH_2I_2	--air	20	50.76	AC(**8**)
Methyl ethyl ketone	C_4H_8O	--air or vapor	20	24.6	AC(**24**); AS(**1**)
Methyl formate	$C_2H_4O_2$	--vapor	20	25.08	AC(**26**); tPRS(**1**); GC(**1**)
Methyl iodide	CH_3I	--air	43.5	25.8	GC(**1**)
Methyl propionate	$C_4H_8O_2$	--air or vapor	20	24.9	AC(**20, 26**); AdC(**1**); PRS(**2**)
Methyl salicylate	$C_8H_8O_3$	--nitrogen	94	31.9	ZA(**1**)
Methyl sulfide	C_2H_9S	--vapor	11.1	26.50	JP(**6**)

SURFACE TENSION OF VARIOUS LIQUIDS (Continued)

Substance		In contact with	Temperature °C	Surface tension dynes/cm.	References
Name	Formula				
Naphthalene	$C_{10}H_8$	air or vapor	127	28.8	AS(**1**); JP(2)
Neon	Ne	vapor	−248	5.50	cUL(**3**); PRA(**3**)
Nitric acid (98.8 %)	HNO_3	air	11.6	42.7	JS(2)
Nitrobenzene	$C_6H_5NO_2$	air or vapor	20	43.9	AC(**6, 23**); AS(**2**); BF(**2**); GC(**1**); JS(**4, 12**)
Nitroethane	$C_2H_5NO_2$	air or vapor	20	32.2	GC(**1**); JS(**4**)
Nitrogen	N_2	vapor	−183	6.6	JS(**15**)
"	N_2	vapor	−193	8.27	JS(**15**)
"	N_2	vapor	−203	10.53	JS(**15**)
Nitrogen tetra oxide	N_2O_4	vapor	19.8	27.5	JS(**4**)
Nitromethane	CH_3NO_2	vapor	20	36.82	AC(**6, 27**); GC(**1**)
Nitrous oxide	N_2O	vapor	20	1.75	VK(**1**)
n-Octane	C_8H_{18}	vapor	20	21.80	AC(**4, 5, 34**); JS(4)
n-Octyl alcohol	$C_8H_{18}O$	air	20	27.53	AC(**4, 5**)
Oleic acid	$C_{18}H_{34}O_2$	air	20	32.50	PRS(**1**); AC(**4**)
Oxygen	O_2	vapor	−183	13.2	JS(**15**)
Oxygen (65 %)	O_2	air	−190.5	12.2	AD(**1**)
"	O_2	vapor	−193	15.7	JS(**15**)
"	O_2	vapor	−203	18.3	JS(**15**)
Paraldehyde	$C_6H_{12}O_3$	air	20	25.9	AC(**27**); AdC(**1**)
Phenetole	$C_8H_{10}O$	vapor	20	32.74	AC(**6, 28**); GC(**1**); JP(**5**)
Phenol	C_6H_6O	air or vapor	20	40.9	AC(**18, 19, 25**); JS(**2, 6, 13**); JP(**4**)
"	C_6H_6O	air or vapor	30	39.88	
Phenylhydrazine	$C_6H_8N_2$	vapor	20	46.1	JS(3)
Phosphorus tribromide	PBr_3	air	24	45.8	JS(**5**)
Phosphorus trichloride	PCl_3	vapor	20	29.1	AC(**17**); GC(**1**); JP(**2**); JS(**4**)
Phosphorus triiodide	PI_3	vapor	75.3	56.5	ZA(**1**)
Propionic acid	$C_3H_6O_2$	vapor	20	26.7	AC(**27**); GC(**1**); JS(**4**)
n-Propyl acetate	$C_5H_{10}O_2$	air or vapor	20	24.3	AC(**20, 26**); AdC(**1**); PRS(**2**)
n-Propyl alcohol	C_3H_8O	vapor	20	23.78	AC(**24, 33**); AdC(**1**); JP(**5**); JS(**4**)
n-Propylamine	C_3H_9N	air	20	22.4	GC(**1**); JS(**3**)

SURFACE TENSION OF VARIOUS LIQUIDS (Continued)

Substance		In contact with	Temperature °C	Surface tension dynes/cm.	References
Name	Formula				
n-Propyl bromide	C_3H_7Br	--vapor	71	19.65	GC(**1**)
n-Propyl chloride	C_3H_7Cl	--air	47	18.2	AdC(**1**)
n-Propyl formate	$C_4H_8O_2$	--vapor	20	24.5	AC(**26**, **33**); AdC(**1**); PRS(**2**)
Pyridine	C_8H_5N	--air	20	38.0	AC(**17**, **26**, **28**); GC(**1**); JP(**5**); JS(**4**, **14**)
Quinoline	C_9H_7N	--air	20	45.0	AC(**17**, **22**); GC(**1**); JP(**4**, **5**)
Ricinoleic acid	$C_{18}H_{34}O_3$	--air	16	35.81	PRS(**1**)
Selenium	Se	--air	217	92.4	AdP(**3**)
Styrene	C_8H_8	--air	19	32.14	PRS(**1**)
Sulfuric acid (98.5 %)	H_2SO_4	--air or vapor	20	55.1	AC(**17a**); AdP(**7**); JS(**2**)
Tetrabromoethane 1,1,2,2-	$C_2H_2Br_4$	--air	20	49.67	AC(**6**); ZC(**2**)
Tetrachloroethane 1,1,2,2-	$C_2H_2Cl_4$	--air	22.5	36.03	ZC(**2**)
Tetrachloroethylene	C_2Cl_4	--vapor	20	31.74	AC(**8**); GC(**1**)
Toluene	C_7H_8	--vapor	10	27.7	AC(**4**, **17**, **20**, **31**
"	C_7H_8	--vapor	20	28.5	AdC(**1**); BF(**2**)
"	C_7H_8	--vapor	30	27.4	JP(**5**); PRS(**2**); ZC(**5**, **6**)
m-Toluidine	C_7H_9N	--vapor	20	36.9	AC(**33**)
o-Toluidine	C_7H_9N	--air or vapor	20	40.0	AC(**27**, **33**); AS(**1**, **3**); ZA(**1**)
p-Toluidine	C_7H_9N	--air	50	34.6	AC(**27**); AS(**1**); JS(**12**)
Trichloroacetic acid	$C_2HCl_3O_2$	--nitrogen	80.2	27.8	ZA(**1**)
Trichloroethane 1,1,2-	$C_2H_3Cl_3$	--air	114	22.0	GC(**1**)
Triethyl phosphate	$C_6H_{15}O_4P$	--air	15.5	30.61	JS(**5**)
Trimethylamine	C_3H_9N	--nitrogen	−4	17.3	ZA(**1**)
Triphenylcarbinol	$C_{19}H_{16}O$	--vapor	165.8	30.38	JS(**6**)
Vinyl acetate	$C_4H_6O_2$	--vapor	20	23.95	
" "	$C_4H_6O_2$	--vapor	25	23.16	
" "	$C_4H_6O_2$	--vapor	30	22.54	
Water	H_2O	--air	18	73.05	
m-Xylene	C_8H_{10}	--vapor	20	28.9	AC(**4**, **33**, **34**); AdC(**1**); JP(**5**); ZC(**5**)
o-Xylene	C_8H_{10}	--air	20	30.10	AC(**6**, **17**, **34**)
p-Xylene	C_8H_{10}	--vapor	20	28.37	AC(**6**, **17**, **33**, **34**); AdC(**1**)

REFERENCE KEY

AC—American Chemical Society Journal. (**1**) Baker and Gilbert, 62. 2479–2480; 40. (**2**) H. Brown, 56: 2564–2568; 38. (**3**) Harkins and Brown, 41: 449; 19. (**4**) Harkins, Brown and Davies, 39: 354; 17. (**5**) Harkins and Cheng, 43: 35; 21. (**6**) Harkins, Clark and Roberts, 42: 700; 20. (**7**) Harkins and Ewing, 42: 2539; 20. (**8**) Harkins and Feldman, 44: 2665; 22. (**9**) Harkins and Grafton, 42: 2534; 20. (**10**) Hogness, 43: 1621; 21. (**11**) Johnson and McIntosh, 31: 1139; 09. (**12**) Maass and Boomer, 44: 1709; 22. (**13**) Maass and Hatcher, 42: 2548; 20. (**14**) Maass and McIntosh, *36*, 741 (1914). (**15**) Maass and Wright, 43: 1098; 21. (**16**) Morgan and Chazel, 35: 1821; 13. (**17**) Morgan and Daghlian, 33: 672; 11. (**17a**) Morgan and Davis, 38: 555; 16. (**18**) Morgan and Egloff, 38: 844; 16. (**19**) Morgan and Evans, 39: 2151; 17. (**20**) Morgan and Griggs, 39: 2261; 17. (**21**) Morgan and Kramer, 35: 1834; 13. (**22**) Morgan and McAfee, 33: 1275; 11. (**23**) Morgan and Neidle, 35: 1856; 13. (**24**) Morgan and Owen, 33: 1713; 11. (**25**) Morgan and Scarlett, 39, 2275; 17. (**26**) Morgan and Schwartz, 33: 1041; 11. (**27**) Morgan and Stone, 35: 1505; 13. (**28**) Morgan and Thomssen, 33: 657; 11. (**29**) Morgan and Woodward, 35: 1249; 13. (**30**) Richards and Boyer, 43: 274; 21. (**31**) Richards and Carver 43: 827; 21. (**32**) Richards and Coombs, 37: 1656; 15. (**33**) Richards and Matthews, 30: 8; 08. (**34**) Richards, Speyers and Carver, 46: 1196; 24.

AD—Atti della reale accademia nazionale dei Lincei. (**1**) Magini, 19 II: 184; 10.

AdC—Annalen der Chemie, Justus Liebig's. (**1**) Schiff, 223: 47; 84.

AdP—Annalen der Physik. (**1**) Heydweiller, 62: 694; 97. (**2**) Quincke, 134: 356; 68. (**3**) Quincke, 135: 621; 68. (**4**) Gradenwitz, 67: 467; 99. (**5**) Meyer, 66: 523; 98. (**6**) Stöckle 66: 499; 98. (**7**) Röntgen and Schneider, 29: 165; 86.

AS—Archives des sciences physicques at naturellas. (**1**) Dutoit and Friederich, 9: 105; 00. (**2**) Guye and Baud, 11: 449; 01. (**3**) Herzen, 14: 232; 02.

BD—Berichte der deutschen Chemischen Gesellschaft. (**1**) Lorenz and Kauffier, 41: 3727; 08. (**2**) Schenck and Ellenberger, 37: 3443; 04.

BF—Bulletin de la societe Chimique de France. (**1**) Dutoit and Frederich, 19: 321; 98. (**2**) Santis Ann. Univ. Grenoble, 27: 593; 04.

CR—Comptes Rendus. (**1**) A Portevin and P. Bastien, 202; 1072–1074; 36. (**2**) Popesco, 172: 1474; 21.

cUL—Communications from the Physical Laboratory at the University of Leiden. (**1**) No. 142. (**2**) No. 179a. (**3**) No. 182b.

GC—Gazzetta chimica italiana. (**1**) Schiff, 14: 368; 84. (**2**) A. Giacolone and D. DiMaggio, 3: 198–206; 39.

JI—Journal of the Institute of Metals, London. (**1**) Smith, 12: 168; 14.

JP—Journal de Chemie physique. (**1**) Dutoit and Fath, 1: 358; 03. (**2**) Dutoit and Mojoiu, 7: 169; 09. (**3**) Marchand, 11: 573; 13. (**4**) Bolle and Guye, 3: 38; 05. (**5**) Renard and Guye, 5: 81; 07. (**6**) Berthoud, 21: 143; 24. (**7**) Berthoud, 16: 429; 18. (**8**) Homfray and Guye, 1: 505; 03. (**9**) Przyluska, 7: 511; 09.

JR—Journal of the Russian Physico Chem. Soc. (Chem. part). (**1**) Elisseev and Kurbatov, 41: 1426; 09.

JS—Journal of the Chemical Society of London. (**1**) Kellas, 113: 903; 18. (**2**) Aston and Ramsay, 65: 167; 94. (**3**) Turner and Merry, 97: 2069; 10. (**4**) Ramsay and Shields, 63: 1089; 93. (**5**) Sugden, Reed and Wilkins, 127: 1525; 25. (**6**) Hewitt and Winmill, 91: 441; 07. (**7**) Smith, 105: 1703; 14. (**8**) Atkins, 99: 10; 11. (**9**) Sugden, 119: 1483; 21. (**10**) Sugden, 121: 858; 22. (**11**) Sugden, 125: 32; 24. (**12**) Sugden, 125: 1167; 24. (**13**) Worley, 105; 260; 14. (**14**) Worley, 105: 273; 14. (**15**) Baly and Donnan, 81: 907; 02.

JSG—Jahresb. Schles. Ges. Vaterl. Kultur. (**1**) Wilborn, 1912: 56.

MB—Metron. Beit. (**1**) Weinstein, No. 6; 89.

MfC—Monatshefte für Chemie und verwandte Teile anderer Wissenschaften. (**1**) Kremann and Meingast, 35: 1323; 14.

PM—Philosophical Magazine and Journal of Science, Lond, Edinburg and Dublin. (**1**) Bircumshaw, 2: 341; 26. 3: 1286; 27. (**2**) R. C. Brown, 13: 578–584; 32. (**3**) A. E. Bate, 28: 252–255; 39.

PR—The Physical Review. (**1**) Poindexter, 27: 820; 26.

PRA—Proceedings of the Royal Academy of Sciences of Amsterdam. (**1**) Kamerlingh Onnes and Kuypers, 17: 528; 14. (**2**) Van Urk, Keesom and Onnes, 28: 958; 25. (**3**) Van Urk, Keesom and Nijhoff, 29: 914; 26. (**4**) Jaeger and Kahn, 18: 75; 15.
PRS—Proceedings of the Royal Society, London. (**1**) Hardy, 88: 303; 13. (**2**) Ramsay and Aston, 56: 162; 182; 94.
tPRS—Philosophical Transactions Royal Society of London, Series A. (**1**) Ramsay and Shields, 184: 647; 93.
tRIA—Royal Irish Academy Transactions. (**1**) Ramsay and Aston, 32A: 93; 02.
VK—Verslag koninklijke Akademie van Wetenschappen te Amsterdam. (**1**) Verschaffelt, No. 18; 1895; 74. (**2**) Verschaffelt, No. 28, 1896; 94.
WN—Wissenschaftliche Natuurk, Tydschr. (**1**) Verschaffelt, 2: 231, 25.
ZA—Zeitschrift fur anorganische and allegeime Chemie. (**1**) Jaeger, 101: 1; 17. (**2**) Motylewski, 38: 410; 04. (**3**) Lorenz, Liebmann and Hochberg, 94: 301; 16. (**4**) Sauerwald and Drath, 154: 79; 26.
ZC—Zeitschrift fur physikelische Chemie. (**1**) Bennett and Mitchell, 84: 475; 13. (**2**) Walden and Swinne, 82: 271; 13. (**3**) Drucker, 52: 641; 05. (**4**) Walden, 75: 555; 10. (**5**) Walden and Swinne, 79: 700; 12. (**6**) Whatmough, 39: 129; 02.
ZE—Zeitschrift fur Elektrochemie und angewandte physikalische Chemie. (**1**) Bredig and Tiechmann, 31: 449; 25.
ZK—Zeitschrift Kolloid. (**1**) N. Jermolanko, 48: 14–146, 29.

VISCOSITY

The **viscosity** of a substance is defined as the tangential force per unit area of either of two horizontal planes at unit distance apart, one of which is fixed, while the other moves with unit velocity, the space being filled with the substance.

In the case of a liquid flowing slowly through a long tube of small diameter, the volume V of liquid which escapes in a time t is given by the equation,

$$V = \frac{\pi p r^4}{8 l \eta} t$$

where p is the difference in pressure between the two ends of the tube; r, its radius; l, its length, and η, the viscosity. (Law of Poiseuille.)

A more complete equation is now generally used:

$$\eta = \frac{\pi d g r^4 t}{8Q(l + \lambda)} \left(h - \frac{mv^2}{g} \right)$$

where η is the viscosity; d, the density in g/cm^3; r, the radius, and l, the length, of the tube in cm; Q, the volume in cm^3 discharged in t sec.; λ, a correction to the length of the tube; h, the average head in cm; m, the coefficient of the kinetic energy correction, mv^2/g; g, the acceleration due to gravity in cm/sec.^{2}; v, the mean velocity in cm/sec. See Technologic Papers of the Bureau of Standards 100 and 112, 1917 and 1918, for a full discussion.

Viscosity is expressed in dyne-seconds per cm^2 or poises. The centipoise (cp) is 0.01 poise.

Specific viscosity is the ratio of the viscosity of any substance to that of water at 0° C or other specified temperature. Since the viscosity of water at 20° C is 1.0050 centipoises, the viscosity of any substance expressed in centipoises is approximately equal to its specific viscosity referred to water at 20° C.

Kinematic viscosity is the ratio of the viscosity to the density.

Fluidity is the reciprocal of viscosity.

VISCOSITY OF WATER BELOW 0° C

White-Twining, 1914

Temperature	Viscosity centipoises	Temperature	Viscosity centipoises
0° C	1.798	−7.23	2.341
−2.10	1.930	−8.48	2.458
−4.70	2.121	−9.30	2.549
−6.20	2.250		

ABSOLUTE VISCOSITY OF WATER AT 20°C

Swindells, J. R. Coe, Jr., and T. B. Godfrey, Journal of Research, National Bureau of Standards **48,** 1, 1952.

The value found for the viscosity of water at 20°C was 0.010019 ± 0.000003 poise.

The value **0.01002** poise is to be used as the absolute value of the viscosity of water for calibration purposes.

VISCOSITY CONVERSION TABLE

Poise = c.g.s. unit of absolute viscosity = $\frac{\text{gm}}{\text{sec} \times \text{cm}}$

Stoke = c.g.s. unit of kinematic viscosity = $\frac{\text{gm}}{\text{sec} \times \text{cm} \times \text{density}_{(t°\text{F})}}$

Centipoise = 0.01 poise
Centistoke = 0.01 stoke
Centipoises = Centistokes × density (at given temperature)

To convert poises to $\frac{\text{lb}}{\text{sec} \times \text{ft}}$ or $\frac{\text{lb}}{\text{hr} \times \text{ft}}$ multiply by 0.0672 or 242 respectively.

Centi-stokes	Saybolt Seconds at			Redwood Seconds at			Engler Degrees at all temps.
	100°F	130°F	210°F	70°F	140°F	200°F	
2.0	32.6	32.7	32.8	30.2	31.0	31.2	1.14
3.0	36.0	36.1	36.3	32.7	33.5	33.7	1.22
4.0	39.1	39.2	39.4	35.3	36.0	36.3	1.31
5.0	42.3	42.4	42.6	37.9	38.5	38.9	1.40
6.0	45.5	45.6	45.8	40.5	41.0	41.5	1.48
7.0	48.7	48.8	49.0	43.2	43.7	44.2	1.56
8.0	52.0	52.1	52.4	46.0	46.4	46.9	1.65
9.0	55.4	55.5	55.8	48.9	49.1	49.7	1.75
10.0	58.8	58.9	59.2	51.7	52.0	52.6	1.84
11.0	62.3	62.4	62.7	54.8	55.0	55.6	1.93
12.0	65.9	66.0	66.4	57.9	58.1	58.8	2.02
14.0	73.4	73.5	73.9	64.4	64.6	65.3	2.22
16.0	81.1	81.3	81.7	71.0	71.4	72.2	2.43
18.0	89.2	89.4	89.8	77.9	78.5	79.4	2.64
20.0	97.5	97.7	98.2	85.0	85.8	86.9	2.87
22.0	106.0	106.2	106.7	92.4	93.3	94.5	3.10
24.0	114.6	114.8	115.4	99.9	100.9	102.2	3.34
26.0	123.3	123.5	124.2	107.5	108.6	110.0	3.58
28.0	132.1	132.4	133.0	115.3	116.5	118.0	3.82
30.0	140.9	141.2	141.9	123.1	124.4	126.0	4.07
32.0	149.7	150.0	150.8	131.0	132.3	134.1	4.32
34.0	158.7	159.0	159.8	138.9	140.2	142.2	4.57
36.0	167.7	168.0	168.9	146.9	148.2	150.3	4.83
38.0	176.7	177.0	177.9	155.0	156.2	158.3	5.08
40.0	185.7	186.0	187.0	163.0	164.3	166.7	5.34
42.0	194.7	195.1	196.1	171.0	172.3	175.0	5.59
44.0	203.8	204.2	205.2	179.1	180.4	183.3	5.85
46.0	213.0	213.4	214.5	187.1	188.5	191.7	6.11
48.0	222.2	222.6	223.8	195.2	196.6	200.0	6.37
50.0	231.4	231.8	233.0	203.3	204.7	208.3	6.63
60.0	277.4	277.9	279.3	243.5	245.3	250.0	7.90
70.0	323.4	324.0	325.7	283.9	286.0	291.7	9.21
80.0	369.6	370.3	372.2	323.9	326.6	333.4	10.53
90.0	415.8	416.6	418.7	364.4	367.4	375.0	11.84
*100.0	462.0	462.9	465.2	404.9	408.2	416.7	13.16

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* At higher values use the same ratio as above for 100 centistokes; e.g., 110 centistokes = 100 × 4.620 Saybolt seconds at 100°F.

To obtain the Saybolt Universal viscosity equivalent to a kinematic viscosity determined at t°F, multiply the equivalent Saybolt Universal viscosity at 100°F by $1 + (t - 100)0.000064$; e.g., 10 centistokes at 210°F are equivalent to 58.8 × 1.0070, or 59.2 Saybolt Universal seconds at 210°F.

VISCOSITY AND FLUIDITY OF WATER
0–100° C

Bingham and Jackson, Bull. Bur. Stds. **14,** 75 (1918)

Temp. °C	Fluidity 1/poises	Viscosity centi-poises	Specific viscosity (0° C)	Temp. °C	Fluidity 1/poises	Viscosity centi-poises	Specific viscosity (0° C)
0	55.80	1.7921	1.0000	50	182.00	0.5494	0.3066
1	57.76	1.7313	.9661	51	185.05	.5404	.3015
2	59.78	1.6728	.9334	52	188.14	.5315	.2966
3	61.76	1.6191	.9035	53	191.23	.5229	.2918
4	63.80	1.5674	.8746	54	194.34	.5146	.2871
5	65.84	1.5188	.8475	55	197.45	.5064	.2826
6	67.90	1.4728	.8218	56	200.62	.4985	.2782
7	70.01	1.4284	.7971	57	203.78	.4907	.2738
8	72.15	1.3860	.7734	58	206.95	.4832	.2696
9	74.28	1.3462	.7512	59	210.13	.4759	.2656
10	76.47	1.3077	.7297	60	213.33	.4688	.2616
11	78.66	1.2713	.7094	61	216.54	.4618	.2577
12	80.89	1.2363	.6899	62	219.80	.4550	.2539
13	83.14	1.2028	.6712	63	223.07	.4483	.2502
14	85.40	1.1709	.6534	64	226.34	.4418	.2465
15	87.69	1.1404	.6363	65	229.64	.4355	.2430
16	90.00	1.1111	.6200	66	232.94	.4293	.2396
17	92.35	1.0828	.6042	67	236.25	.4233	.2362
18	94.71	1.0559	.5892	68	239.57	.4174	.2329
19	97.10	1.0299	.5747	69	242.91	.4117	.2297
20*	99.50	1.0050	.5608	70	246.26	.4061	.2266
21	101.94	.9810	.5474	71	249.63	.4006	.2235
22	104.40	.9579	.5345	72	253.02	.3952	.2205
23	106.86	.9358	.5222	73	256.42	.3900	.2176
24	109.38	.9142	.5101	74	259.82	.3849	.2148
25	111.91	.8937	.4987	75	263.25	.3799	.2120
26	114.45	.8737	.4875	76	266.67	.3750	.2093
27	117.03	.8545	.4768	77	270.12	.3702	.2066
28	119.62	.8360	.4665	78	273.57	.3655	.2040
29	122.25	.8180	.4564	79	277.04	.3610	.2014
30	124.89	.8007	.4468	80	280.53	.3565	.1989
31	127.54	.7840	.4375	81	284.03	.3521	.1965
32	130.22	.7679	.4285	82	287.53	.3478	.1941
33	132.93	.7523	.4198	83	291.03	.3436	.1917
34	135.66	.7371	.4113	84	294.54	.3395	.1894
35	138.40	.7225	.4032	85	298.06	.3355	.1872
36	141.15	.7085	.3953	86	301.63	.3315	.1850
37	143.95	.6947	.3876	87	305.21	.3276	.1828
38	146.76	.6814	.3802	88	308.78	.3239	.1807
39	149.60	.6685	.3730	89	312.35	.3202	.1787
40	152.45	.6560	.3661	90	315.92	.3165	.1766
41	155.30	.6439	.3593	91	319.53	.3130	.1747
42	158.20	.6321	.3527	92	323.13	.3095	.1727
43	161.11	.6207	.3464	93	326.74	.3060	.1707
44	164.02	.6097	.3402	94	330.38	.3027	.1689
45	167.00	.5988	.3341	95	334.01	.2994	.1671
46	169.97	.5883	.3283	96	337.65	.2962	.1653
47	172.95	.5782	.3226	97	341.30	.2930	.1635
48	175.95	.5683	.3171	98	344.96	.2899	.1618
49	178.95	.5588	.3118	99	348.63	.2868	.1600
50	182.00	.5494	.3066	100	352.30	.2838	.1584

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* The viscosity of water at 20.20° C is 1.0000 centipoise.

VISCOSITY OF WATER
Above 100° C

Pressure is that of the saturated vapor at the temperature indicated.

T °C	Viscosity cp	T °C	Viscosity cp	T °C	Viscosity cp
101	0.282	106	.267	120	.232
102	.279	107	.264	130	.212
103	.276	108	.262	140	.196
104	.273	109	.259	150	.184
105	.270	110	.256	160	.174

VISCOSITY OF LIQUIDS

Viscosity of liquids in centipoises (cp) including elements, inorganic and organic compounds and mixtures.

Liquid	Temp. °C	Viscosity cp	Ref.
Acetaldehyde...	0	.2797	16
	10	.2557	16
	20	.22	26
Acetanilide.....	120	2.22	2
	130	1.90	11
Acetic acid.....	15	1.31	79
	18	1.30	22
	25.2	1.155	63
	30	1.04	79
	41	1.00	22
	59	.70	22
	70	.60	22
	100	.43	22
anhydride....	0	1.24	22
	15	.971	79
	18	.90	22
	30	.783	79
	100	.49	22
Acetone........	−92.5	2.148	62
	−80.0	1.487	62
	−59.6	.932	62
	−42.5	.695	62
	−30.0	.575	62
	−20.9	.510	62
	−13.0	.470	22
	−10 0	.450	22
	0	.399	62
	15	.337	72
	25	316	60
	30	.295	72
	41	.280	22
Acetonitrile... .	0	.442	16
	15	.375	79
	25	.345	31
Acetophenone...	11.9	2.28	39
	23.5	1.59	96
	25.0	1.617	48
	50.0	1 246	48
	80.0	.734	19
Air, liq...... ..	−192.3	.172	40
Alcohol. See *Ethyl*, *Methyl*, etc.			
Allyl alcohol....	0	2.145	11
	15	1.49	99
	20	1.363	11
	30	1.07	99
	40	.914	11
	70	.553	11
Allylamine......	130	.506	26
Allyl chloride...	15	.347	99
	30	.300	99
Ammonia.......	−69	.475	76
	−50	.317	85
	−40	.276	85
	−33.5	.255	85
n-Amyl acetate.	11	1.58	35
	45	.805	27
alcohol.......	15	4.65	99
	30	2.99	99
ether.........	15	1.188	72
Aniline.........	−6	13.8	55
	0	10.2	55
	5	8.06	55
	10	6.50	55
	15	5.31	55
	20	4.40	55
	25	3.71	55
	30	3.16	55
	35	2.71	55
	40	2.37	55
	50	1.85	55
	60	1.51	55
	70	1.27	55
	80	1 09	55
	90	.935	55
	100	.825	55
Anisol	0	1 78	86
	20	1.32	86
	40	1.12	86
Antimony, liq...	645	1 55	105
	700	1.26	105
	800	1 08	105
	850	1.05	105
Benzaldehyde...	25	1.39	89
Benzene	0	.912	45

VISCOSITY OF LIQUIDS (Continued)

Liquid	Temp. °C	Viscosity cp	Ref.	Liquid	Temp. °C	Viscosity cp	Ref.
Benzene	10	.758	45	Butyric acid	20	1.540	11
	20	.652	45		40	1.120	11
	30	.564	45		50	.975	11
	40	.503	45		70	.760	11
	50	.442	45		100	.551	11
	60	.392	45	Cadmium, liq	349	1.44	32
	70	.358	45		506	1.18	32
	80	.329	45		603	1.10	32
Benzonitrile	25	1.24	69	Carbolic acid See *Phenol.*			
Benzophenone	55	4.79	77				
	120	1.38	77	Carbon dioxide, liq., pressure that of saturated vapor	0	.099	8
Benzyl alcohol	20	5.8	53		10	.085	8
Benzylamine	25	1.59	26		20	.071	8
Benzylaniline	33	2.18	14		30	.053	8
	130	1.20	26				
Benzyl ether	0	10.5	91	disulfide	−13	.514	22
	20	5.33	91		−10	.495	22
	40	3.21	91		0	.436	72
Bismuth	285	1.61	38		5	.380	72
	304	1.662	57		20	.363	72
	365	1.46	38		40	.330	11
	451	1.280	57	Carbon tetrachloride	0	1.329	59
	600	.998	57		15	1.038	59
Bromine, liq	−4.3	1.31	52		20	.969	65
	0	1.241	52		30	.843	65
	12.6	1.07	52		40	.739	65
	16	1 0	11		50	.651	65
	19.5	.995	52		60	.585	65
	28.9	.911	52		70	.524	65
o-Bromoaniline	40	3.19	102		80	.468	65
m-Bromoaniline	20	6.81	102		90	.426	65
	40	3.70	102		100	.384	65
	80	1.70	102	Cetyl alcohol	50	13.4	82
p-Bromoaniline	80	1.81	102	Chlorine, liq	−76.5	.729	52
Bromobenzene	15	1.196	59		−70.5	.680	52
	30	.985	59		−60 2	616	52
Bromoform	15	2.152	72		−52 4	.566	52
	25	1 89	94		−35.4	.494	52
	30	1.741	72		0	385	52
Butyl acetate	0	1.004	90	Chlorobenzene	15	.900	95
	20	.732	90		20	.799	65
	40	.563	90		40	.631	65
n-Butyl alcohol	−50.9	36.1	88		80	.431	65
	−30.1	14.7	88		100	367	65
	−22.4	11.1	88	Chloroform	−13	.855	22
	−14 1	8.38	88		0	.700	36
	0	5.186	11		8.1	.643	49
	15	3.379	72		15	.596	59
	20	2.948	11		20	58	50
	30	2.30	80		25	.542	51
	40	1.782	11		30	.514	59
	50	1.411	11		39	500	22
	70	.930	11	*o*-Chlorophenol	25	4.11	30
	100	.540	11		50	2 015	30
sec-Butyl alcohol	15	4.21	72	*m*-Chlorophenol	25	11.55	30
n-Butyl bromide	15	.626	54	*p*-Chlorophenol	50	4 99	30
n-Butyl chloride	15	.469	79	Copper, liq	1,085	3.36	105
Butyl chloride, tertiary	15	.543	108		1,100	3 33	105
					1,150	3.22	105
n-Butyl formate	0	.940	90		1,200	3.12	105
	20	689	90	*o*-Cresol	40	4.49	86
Butyric acid	0	2.286	11	*m*-Cresol	10	43.9	86
	15	1.81	99		20	20.8	86

VISCOSITY OF LIQUIDS (Continued)

Liquid	Temp. °C	Viscosity cp	Ref.	Liquid	Temp. °C	Viscosity cp	Ref.
m-Cresol	40	6.18	86	Ethyl alcohol	10	1.466	1
p-Cresol	40	7.00	86		20	1.200	1
Creosote	20	12.0	53		30	1.003	1
Cycloheptane	13.5	1.64	84		40	.834	1
Cyclohexane	17	1.02	95		50	.702	1
Cyclohexanol	20	68	83		60	.592	1
Cyclohexene	13.5	.696	84		70	.504	1
	20	.66	53	alcohol, anh.	−148	8,470	58
Cyclooctane	13.5	2.35	84		−146	5,990	58
Cyclopentane	13.5	.493	84		−130	467	58
n-Decane	20	.92	75	aniline	25	2.04	26
Diethylamine	25	.346	24	Ethylbenzene	17	.691	95
	25	.367	26	benzoate	20	2.24	43
Diethylaniline	.5	3.84	42	bromide	−120	5.6	56
	20.0	2.18	42		−100	2.89	56
	25.0	1.95	26		−80	1.81	56
Diethylcarbinol	15.0	7.34	99		0	.487	11
Diethylketone	15	.493	99		10	.441	11
Dimethylaniline	10	1.69	42		15	.418	59
	20	1.41	42		20	.402	11
	25	1.285	26		30	.348	59
	30	1.17	74	*n*-Ethyl butyrate	15	.711	99
	40	1.04	42	Ethyl carbonate	15	.868	79
	50	.91	42	Ethylene bromide	0	2.438	11
					17	1.95	95
Dimethyl-α-naphthylamine	130	.868	26		20	1.721	11
					40	1.286	11
Dimethyl-β-naphthylamine	130	.952	26		67.3	.922	17
Diphenyl	70	1.49	75		70	.903	11
	100	.97	75		82.2	.750	17
Diphenylamine	130	1.04	26		99.0	.648	17
Dodecane	25	1.35	87	chloride	0	1.077	22
Ether (diethyl-)	−100	1.69	1		15	.887	72
	−80	.958	1		19.4	.800	22
	−60	.637	1		40	.652	11
	−40	.461	1		50	.565	22
	−20	.362	1		70	.479	11
	0	.2842	1	glycol	20	19.9	75
	17	.240	95		40	9.13	75
	20	.2332	1		60	4.95	75
	25	.222	51		80	3.02	75
	40	.197	1		100	1.99	75
	60	.166	1	oxide	−49.8	.577	46
	80	.140	1		−38.2	.488	46
	100	.118	1		−21.0	.394	46
Ethyl acetate	0	.582	11		0	.320	46
	8.96	.516	49	Ethyl formate	20	.402	
	10	.512	11	iodide	0	.727	11
	15	.473	79		15	.617	72
	20	.455	11		20	.592	11
	25	.441	48		40	.495	11
	30	.400	79		70	.391	11
	50	.345	48	malate	24.7	3.016	27
	75	.283	48	oxalate	15	2.31	79
alcohol	−98.11	44.0	73	propionate	15	.564	79
	−89.8	28.4	73	Eugenol	0	29 9	91
	−71.5	13.2	73		20	9.22	91
	−59 42	8.41	73		40	4 22	91
	−52 58	6.87	73	Fluorobenzene	20	.598	65
	−32 01	3 84	73		40	.478	65
	−17.59	2.68	73		60	.389	65
	−.30	1.80	73		80	.329	65
	0	1.773	1		100	.275	65

VISCOSITY OF LIQUIDS (Continued)

Liquid	Temp. °C	Viscosity cp	Ref.
Formamide	0	7.55	39
	25	3.30	33
Formic acid	7.59	2.3868	5
	10	2.262	5
	20	1.804	5
	30	1.465	5
	40	1.219	11
	70	.780	11
	100	.549	11
Furfurol	0	2.48	16
	25	1.49	31
Glucose	22	9.1×10^{15}	107
	30	6.6×10^{13}	107
	40	2.8×10^{11}	107
	60	9.3×10^{7}	107
	80	6.6×10^{5}	107
	100	2.5×10^{4}	107
Glycerin	−42	6.71×10^{6}	58
	−36	2.05×10^{6}	58
	−25	2.62×10^{5}	58
	−20	1.34×10^{5}	58
	−15.4	6.65×10^{4}	58
	−10.8	3.55×10^{4}	58
	−4.2	1.49×10^{4}	58
	0	12,110	68
	6	6,260	68
	15	2,330	68
	20	1,490	68
	25	954	68
	30	629	68
Glycerin trinitrate	10	69.2	78
	20	36.0	78
	30	21.0	78
	40	13.6	78
	60	6.8	78
Heptane	0	.524	11
	17	.461	95
	20	.409	71
	25	.386	87
	40	.341	11
	70	.262	11
n-Heptyl alcohol	15	8.53	81
Hexadecane	20	3.34	28
Hexane	0	.401	11
	17	.374	95
	20	.326	11
	25	.294	87
	40	.271	11
	50	.248	11
Hydrazin	1	1.29	101
	10	1.12	101
	20	.97	101
Hydrogen, liq.	....	.011	40
Iodine, liq.	116	2.27	52
Iodobenzene	15	1.74	99
Iron, 2.5% carbon, liq.	1,400	2.25	64
Isoamyl acetate	8.97	1.030	49
	19.91	.872	49
alcohol	10	6.20	19
amine	25	.724	26
Isobutyl alcohol	15	4.703	72
amine	25	.553	26
Isobutyric acid	15	1.44	108
	30	1.13	108
Isoeugenol	25	26.72	21
Isoheptane	0	.481	11
	20	.384	11
	40	.315	11
Isohexane	0	.376	11
	20	.306	11
	40	.254	11
Isopentane	0	.273	11
	20	.223	11
Isopropyl alcohol	15	2.86	108
	30	1.77	108
Isoquinoline	25	3.57	26
Isosafrol	25	3.981	21
Lead, liq.	350	2.58	105
	400	2.33	105
	441	2.116	61
	500	1.84	105
	551	1.70	61
	600	1.38	105
	703	1.349	61
	844	1.185	61
Menthol, liq.	55.6	6.29	17
	74.6	2.47	17
	99.0	1.04	17
Mercury	−20	1.855	66
	−10	1.764	66
	0	1.685	66
	10	1.615	66
	19.02	1.56	98
	20	1.554	66
	20.2	1.55	98
	30	1.499	66
	40	1.450	66
	40.8	1.45	98
	41.86	1.44	98
	50	1.407	66
	60	1.367	66
	70	1.331	66
	80	1.298	66
	90	1.268	66
	100	1.240	66
	150	1.130	66
	200	1.052	66
	250	.995	66
	300	.950	66
	340	.921	66
Methyl acetate	0	.484	11
	20	.381	65
	40	.320	11
Methyl alcohol (Methanol)	−98.30	13.9	100
	−84.23	6.8	100
	−72.55	4.36	100
	−44.53	1.98	100
	−22.29	1.22	100
	0	.82	100
	15	.623	79
	20	.597	18
	25	.547	1
	30	.510	79
	40	.456	11
	50	.403	11

VISCOSITY OF LIQUIDS (Continued)

Liquid	Temp. °C	Viscosity cp	Ref.
Methyl amine	0	.236	23
aniline	25	2.02	26
	30	1.55	74
chloride	20	.1834	10
Methylene bromide	15	.109	99
	30	.092	99
chloride	15	.449	99
	30	.393	99
Methyl iodide	0	.606	11
	15	.518	108
	20	.500	11
	30	.460	108
	40	.424	11
Naphthalene	80	.967	77
	100	.776	77
Nitric acid	0	2.275	
	10	1.770	
Nitrobenzene	2.95	2.91	103
	5.69	2.71	93
	5.94	2.71	103
	9.92	2.48	103
	14.94	2.24	103
	20.00	2.03	103
Nitromethane	0	.853	97
	25	.620	97
o-Nitrotoluene	0	3.83	102
	20	2.37	102
	40	1.63	102
	60	1.21	102
m-Nitrotoluene	20	2.33	102
	40	1.60	102
	60	1.18	102
p-Nitrotoluene	60	1.20	102
n-Nonane	20	.711	75
n-Octane	0	.706	11
	16	.574	95
	20	.542	11
	40	.433	11
Octodecane	40	2.86	28
n-Octylalcohol	15	10.6	81
Oil, castor	10	2,420	41
	20	986	41
	30	451	41
	40	231	41
	100	16.9	41
cottonseed	20	70.4	53
cylinder, filtered	37.8	240.6	20
	100	18.7	20
cylinder, dark	37.8	422.4	20
	100	24.0	20
linseed	30	33.1	29
	50	17.6	29
	90	7.1	29
machine, light	15.6	113.8	20
	37.8	34.2	20
	100	4.9	20
machine, heavy	15.6	660.6	20
	37.8	127.4	20
olive	10	138.0	34
	20	84.0	34
	40	36.3	34
	70	12.4	34
rape	0	2,530	3
Oil, rape	10	385	3
	20	163	3
	30	96	3
soya bean	20	69.3	53
	30	40.6	29
	50	20.6	29
	90	7.8	29
sperm	15.6	42.0	20
	37.8	18.5	20
	100.0	4.6	20
Oleic acid	30	25.6	80
Pentadecane	22	2.81	9
Pentane	0	.289	11
	20	.240	11
o-Phenetidine	0	16.5	102
	20	6.08	102
	30	4.22	102
m-Phenetidine	30	12.9	102
p-Phenetidine	20	12.9	102
	30	8.3	102
Phenol	18.3	12.7	13
	50	3.49	92
	60	2.61	92
	70	2.03	92
	90	1.26	13
Phenylcyanide	.28	1.96	42
	20.0	1.33	42
Phosphorus, liq.	21.5	2.34	104
	31.2	2.01	104
	43.2	1.73	104
	50.5	1.60	104
	60.2	1.45	104
	69.7	1.32	104
	79.9	1.21	104
Potassium bromide, liq.	745	1.48	25
	775	1.34	25
	805	1.19	25
nitrate, liq.	334	2.1	25
	358	1.7	25
	333	2.97	25
	418	2.00	25
Propionic acid	10	1.289	11
	15	1.18	79
	20	1.102	11
	40	.845	11
Propyl acetate	10	.66	7
	20	.59	7
	40	.44	7
n-Propyl alcohol	0	3.883	11
	15	2.52	108
	20	2.256	11
	30	1.72	108
	40	1.405	11
	50	1.130	11
	70	.760	11
Propyl aldehyde	10	.47	11
	20	.41	11
	40	.33	11
bromide	0	.651	11
	20	.524	11
	40	.433	11
chloride	0	.436	11
	20	.352	11

VISCOSITY OF LIQUIDS (Continued)

Liquid	Temp. °C	Viscosity cp	Ref.	Liquid	Temp. °C	Viscosity cp	Ref.
Propyl chloride..	40	.291	11	Tetradecane....	20	2.18	28
n-Propyl ether..	15	.448	79	Tin, liq.........	240	2.12	105
Pyridine.......	20	.974	47		280	1.678	4
Salicylic acid...	10	3.20	6		300	1.73	105
	20	2.71	6		301	1.680	57
	40	1.81	6		400	1.43	105
Salol..........	45	.746	77		450	1.270	57
Sodium bromide	762	1.42	25		500	1.20	105
	780	1.28	25		600	1.08	105
chloride, liq...	841	1.30	25		604	1.045	57
	896	1.01	25		750	.905	57
	924	.97	25	Toluene........	0	.772	11
nitrate, liq....	308	2.919	25		17	.61	95
	348	2.439	25		20	.590	11
	398	1.977	25		30	.526	74
	418	1.828	25		40	.471	11
Stearic acid.....	70	11.6	75		70	.354	11
Sucrose (cane sugar)	109	2.8×10^6	12	*o*-Toluidine.....	20	4.39	42
	124.6	1.9×10^5	12	*m*-Toluidine....	20	3.81	91
Sulfur (gas free)	123.0	10.94	44	*p*-Toluidine.....	50	1.80	30
	135.5	8.66	44	Triacetin.......	17	28.0	95
	149.5	7.09	44	Tributyrin......	20	11.6	53
	156.3	7.19	44	Trichlorethane..	20	1.2	70
	158.2	7.59	44	Tridecane......	23.3	1.55	9
	159.2	9.48	44	Triethylcarbinol	20	6.75	90
	159.5	14.45	44	Tripalmitin.....	70	16.8	67
	160.0	22.83	44	Tristearin......	75	18.5	67
	160.3	77.32	44	Turpentine.....	0	2.248	11
	165.0	500.0	44		10	1.783	11
	171.0	4,500.0	44		20	1.487	11
	184.0	16,000.00	44		30	1.272	11
	190.5	19,700.0	44		40	1.071	11
	197.5	21,300.0	44		70	.728	11
	200.0	21,500.0	44	Turpentine, Venice.......	17.3	1.3×10^5	15
	210.0	20,500.0	44	*n*-Undecane.....	20	1.17	75
	217.0	19,100.0	44	*o*-Xylene (xylol)	0	1.105	11
	220.0	18,600.0	44		16	.876	95
Sulfur dioxide, liq.	−33.5	.5508	23		20	.810	11
	−10.5	.4285	23		40	627	11
	0.1	.3936	23	*m*-Xylene (xylol)	0	.806	11
Sulfuric acid....	0	48.4	1		15	.650	79
	15	32.8	106		20	.620	11
	20	25.4	106		40	.497	11
	30	15.7	106	*p*-Xylene (xylol)	16	.696	95
	40	11.5	106		20	.648	11
	50	8.82	106		40	.513	11
	60	7.22	106	Zinc, liq........	280	1.68	38
	70	6.09	106		357	1.42	38
	80	5.19	106		389	1.31	38
Tetrachloroethane.......	15	1.844	59				

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VISCOSITY OF LIQUIDS (Continued)

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VISCOSITY OF GASES

Gas or vapor	Temp. °C	Viscosity micropoises	Ref.
Acetic acid, vap.	119.1	107.0	3
Acetone, vap.	100	93.1	8
	119.0	99.1	34
	190.4	118.6	34
	247.7	133.4	34
	306.4	148.1	34
Acetylene	0	93.5	12
Air	−194.2	55.1	30
	−183.1	62.7	30
	−104.0	113.0	30
	−69.4	133.3	30
	−31.6	153.9	30
	0	170.8	30
Air	18	182.7	32
	40	190.4	32
	54	195.8	32
	74	210.2	32
	229	263.8	32
	334	312.3	32
	357	317.5	32
	409	341.3	32
	466	350.1	32
	481	358.3	32
	537	368.6	32
	565	375.0	32
	620	391.6	32

Gas or vapor	Temp. °C	Viscosity micropoises	Ref.
Air	638	401.4	32
	750	426.3	32
	810	441.9	32
	923	464.3	32
	1034	490.6	32
	1134	520.6	32
Alcohol. See *Ethyl*, *Methyl*, etc.			
Ammonia	−78.5	67.2	12, 16
	0	91.8	
	20	98.2	27
	50	109.2	27
	100	127.9	27
	132.9	139.9	27
	150	146.3	27
	200	164.6	27
	250	181.4	27
	300	198.7	27
Argon	0	209.6	1
	20	221.7	21
	100	269.5	21
	200	322.3	21
	302	368.5	23
	401	411.5	23
	493	448.4	23
	584	481.5	23
	714	525.7	23
	827	563.2	23
Arsenic hydride (Arsine)	0	145.8	16
	15	114.0	16
	100	198.1	16
Benzene, vap	14.2	73.8	8, 18
	131.2	103.1	34
	194.6	119.8	34
	252.5	134.3	34
	312.8	148.4	34
Bromine, vap	12.8	151	9
	65.7	170	9
	99.7	188	9
	139.7	208	9
	179.7	227	9
	220.3	248	9
Bromoform, vap.	151.2	253.0	4
Butyl alcohol, *n*, vap	116.9	143	4
tert, vap	82.9	160	4
chloride, *n*, vap	78	149.5	4
iodide, vap	130	202	4
β-Butylene	18.8	74.4	37
	100.4	94.5	37
	200	119.2	37
Butyric acid, vap	161.7	130.0	3
Carbon dioxide	−97.8	89.6	30
	−78.2	97.2	30
	−60.0	106.1	30
	−40.2	115.5	30
	−21	129.4	7
	−19.4	126.0	30
	0	139.0	7
	0	142	14
Carbon dioxide	1.3	136.1	30
	15	145.7	7
	19	149.9	32
	20	148.0	10
	30	153	10
	32	155	10
	35	156	10
	40	157	10
	99.1	186.1	7
	104	188.9	32
	182.4	222.1	7
	235	241.5	32
	302.0	268.2	7
	490	330.0	32
	685	380.0	32
	850	435.8	32
	1052	478.6	32
disulfide, vap	0	91.1	18
	14.2	96.4	18
	114.3	130.3	34
	190.2	156.1	34
	309.8	196.6	34
monoxide	−191.5	56.1	12, 17
	−78.5	127	
	0	166	
	15	172	
	21.7	175.3	22
	126.7	218.3	22
	227.0	254.8	22
	276.9	271.4	22
tetrachloride, vap.	76.7	195.0	4
	127.9	133.4	34
	200.2	156.2	34
	314.9	190.2	34
Chlorine	12.7	129.7	9
	20	132.7	38
	50	146.9	38
	100	167.9	38
	150	187.5	38
	200	208.5	38
	250	227.6	38
Chloroform, vap.	0	93.6	1
	14.2	98.9	1
	100	129	1
	121.3	135.7	34
	189.1	157.9	34
	250.0	177.6	34
	307.5	194.7	34
Cyanogen	0	92.8	16
	17	98.7	16
	100	127.1	16
Ethane	−78.5	63.4	12
	0	84.8	12
	17.2	90.1	25
	50.8	100.1	25
	100.4	114.3	25
	200.3	140.9	25
Ether (diethyl), vap.	0	67.8	1
	14.2	71.6	1
	100	95.5	1

VISCOSITY OF GASES (Continued)

Gas or vapor	Temp. °C	Viscosity micropoises	Ref.	Gas or vapor	Temp. °C	Viscosity micropoises	Ref.
Ether (diethyl), vap.	121.8	98.3	34	Hydrogen	129.4	108.6	24
	159.4	107.9	34		229.1	126.0	24
	189.9	115.2	34		299	138.1	23
	251.0	130.0	34		412	155.4	23
	277.8	135.8	34		490	167.2	23
Ethyl acetate, vap.	0	68.4	1		601	182.9	23
	100	94.3	1		713	198.2	23
	128.1	101.8	34		825	213.7	23
	158.6	109.8	34	bromide	18.7	181.9	15
	192.9	119.5	34		100.2	234.4	15
	212.5	126	1	chloride	12.5	138.5	15
alcohol, vap.	100	108	8		16.5	140.7	20
	130.2	117.3	34		18	142.6	20
	170.7	129.3	34		100.3	182.2	15
	191.8	135.5	34	iodide	20	165.5	38
	212.5	140	8		50	201.8	38
	251.7	151.9	34		100	231.6	38
	308.7	167.0	34		150	262.7	38
bromide, vap.	38.4	186.5	4		200	292.4	38
butyrate, vap.	119.8	160.0	3		250	318.9	38
chloride, vap.	0	93.7	12	phosphide	0	106.1	16
Ethylene	−75.7	69.9	11		15	112.0	16
	−44.1	76.9	11		100	143.8	16
	−38.6	78.5	11	sulfide	0	116.6	16
	0	90.7	11		17	124.1	16
	13.8	95.4	11		100	158.7	16
	20	100.8	27	Iodine, vap.	124.0	184	9
	50	110.3	27		170.0	204	9
	100	125.7	27		205.4	220	9
	150	140.3	27		247.1	240	9
	200	154.1	27	Isobutyl acetate, vap.	16.1	76.4	6
	250	166.6	27		116.4	155.0	6
bromide, vap.	131.6	221.0	4	alcohol, vap.	108.4	144.5	4
chloride, vap.	83.5	168.0	4	bromide, vap.	92.3	179.5	4
Ethyl formate, vap.	99.8	92	15	butyrate, vap.	156.9	167.0	3
iodide, vap.	72.3	216.0	4	chloride, vap.	68.5	150.0	4
Helium	−257.4	27.0	19	iodide, vap.	120	204.7	4
	−252.6	35.0	19	Isopentane, vap.	25	69.5	31
	−191.6	87.1	19		100	86.0	31
	0	186.0	19				
	20	194.1	21	Isopropyl alcohol, vap.	99.8	109	13
	100	228.1	21		120.3	103.1	34
	200	267.2	21		198.4	124.8	34
	250	285.3	21		293.1	148.8	34
	282	299.2	23	bromide, vap.	60	176.0	4
	407	343.6	23	chloride, vap.	37.0	148.5	4
	486	370.6	23	iodide, vap.	89.3	201.5	4
	606	408.7	23	Krypton	0	232.7	9
	676	430.3	23		15	246	9
	817	471.3	23	Mercury, vap.	273	494	5
Hydrogen	−257.7	5.7	19		313	551	5
	−252.5	8.5	19		369	641	24
	−198.4	33.6	30		380	654	24
	−183.4	38.8	30	Methane	−181.6	34.8	12, 16
	−113.5	57.2	30		−78.5	76.0	
	−97.5	61.5	30		0	102.6	
	−31.6	76.7	30		20	108.7	25
	0	83.5	30		100.0	133.1	25
	20.7	87.6	30		200.5	160.5	25
	28.1	89.2	24		284	181.3	23

VISCOSITY OF GASES (Continued)

Gas or vapor	Temp. °C	Viscosity micropoises	Ref.
Methane	380	202.6	23
	499	226.4	23
Methyl acetate, vap.	99.8	98	8, 13
	100	100	
	143.3	113.9	34
	218.5	134.8	34
alcohol, vap.	66.8	135.0	4
	111.3	125.9	34
	217.5	162.0	34
	311.5	192.1	34
chloride	−15.3	92	7, 12
	0	96.9	
	15.0	104	
	99.1	137	
	182.4	168	
	302.0	211	
iodide, vap.	44	232	4
Neon	0	297.3	9
	20	311.1	21
	100	364.6	21
	200	424.8	21
	250	453.2	21
	285	470.8	23
	429	545.4	23
	502	580.2	23
	594	623.0	23
	686	662.6	23
	827	721.0	23
Nitric oxide (NO)	0	178	12
	20	187.6	36
	100	227.2	36
	200	268.2	36
Nitrogen	−21.5	156.3	2
	10.9	170.7	2
	27.4	178.1	22
	127.2	219.1	22
	226.7	255.9	22
	299	279.7	23
	490	337.4	23
	825	419.2	23
Nitrosyl chloride	15	113.9	36
	100	150.4	36
	200	192.0	36
Nitrous oxide (N_2O)	0	135	12
	26.9	148.8	24
	126.9	194.3	24
n-Nonane, vap.	100.3	63.3	28
	202.1	78.1	28
n-Octane, vap.	100.4	67.5	28
	202.2	84.8	28
Oxygen	0	189	14
	19.1	201.8	22
	127.7	256.8	22
Oxygen	227.0	301.7	22
	283	323.3	23
	402	369.3	23
	496	401.3	23
	608	437.0	23
	690	461.2	23
	829	501.2	23
n-Pentane, vap.	25	67.6	31
	100	84.1	31
Propane	17.9	79.5	25
	100.4	100.9	25
	199.3	125.1	25
n-Propyl alcohol, vap.	99.9	93	13
	121.7	102.5	34
	209.7	126.7	34
	273.0	143.4	34
bromide, vap.	99.8	119	13
Propylene	16.7	83.4	37
	49.9	93.5	37
	100.1	107.6	37
	199.4	133.8	37
Propyl iodide, vap.	102	210.0	4
Sulfur dioxide	−75.0	85.8	29
	−20.0	107.8	29
	0	115.8	29
	0	117	12, 17
	18	124.2	
	20.5	125.4	29
	100.4	161.2	26
	199.4	203.8	26
	293	244.7	23
	490	311.5	23
Trimethylbutane. (2,2,3-), vap.	70.3	73.4	33
	132.2	82.7	33
	262.1	104.8	33
Trimethylethylene, vap.	25	70.1	31
	100	86.9	31
Water, vap.	100	125.5	35
	150	144.5	35
	200	163.5	35
	250	182.7	35
	300	202.4	35
	350	221.8	35
	400	241.2	35
Xenon	0	210.1	9
	16.5	223.5	27
	20	226.0	27
	127	300.9	27
	177	335.1	27
	227	365.2	27
	277	395.4	27

VISCOSITY OF GASES (Continued)

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1. Mean of several observers.
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15. Harle—1921.
16. Rankine, Smith—1921.
17. Smith—1922–1924.
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19. Günther—1924.
20. Jung, Schmick—1930.
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28. Melaven, Mack—1932.
29. Stewart, Maass—1932.
30. Sutherland, Maass—1932.
31. Bleakney—1932–1933.
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34. Titani—1933.
35. Schugajew—1934.
36. Trautz, Freytag—1934.
37. Trautz, Husseini—1934.
38. Trautz, Ruf—1934.

VISCOSITY OF SOLIDS

Substance	Temp. °C	Viscosity poises	Observer
Glass, soda	575	11×10^{12}	Trouton and Andrews, 1904
Ice, glacier	.. ..	12×10^{13}	Deelev, 1908
Menthol	14.9	2×10^{12}	Heydweiller, 1897
Pitch	0	51×10^{10}	Trouton and Andrews, 1904
	15	1.3×10^{10}	Trouton and Andrews, 1904
Wax, shoe makers'	8	4.7×10^{6}	Trouton and Andrews, 1904

VISCOSITY OF ALCOHOL-WATER MIXTURES

Bingham and Jackson, Bull. Bur. Stds. **14,** 59 (1918–1919)

Giving the viscosity in centipoises of mixtures of ethyl alcohol and water. For densities see table Ethyl Alcohol—Density of aqueous solutions at 20° C.

% by wt.	10	20	30	40	50	60	70	80	90	100
% by vol.	12.36	24.09	35.23	45.83	55.93	65.56	74.80	83.59	92.01	100
Temp. °C										
0	3.311	5.319	6.94	7.14	6.58	5.75	4.762	3.690	2.732	1.773
5	2.577	4.065	5.29	5.59	5.26	4.63	3.906	3.125	2.309	1.623
10	2.179	3.165	4.05	4.39	4.18	3.77	3.268	2.710	2.101	1.466
15	1.792	2.618	3.26	3.53	3.44	3.14	2.770	2.309	1.802	1.332
20	1.538	2.183	2.71	2.91	2.87	2.67	2.370	2.008	1.610	1.200
25	1.323	1.815	2.18	2.35	2.40	2.24	2.037	1.748	1.424	1.096
30	1.160	1.553	1.87	2.02	2.02	1.93	1.767	1.531	1.279	1.003
35	1.006	1.332	1.58	1.72	1.72	1.66	1.529	1.355	1.147	.914
40	.907	1.160	1.368	1.482	1.499	1.447	1.344	1.203	1.035	.834
45	.812	1.015	1.189	1.289	1.294	1.271	1.189	1.081	.939	.764
50	.734	.907	1.050	1.132	1.155	1.127	1.062	.968	.848	.702
55	.663	.814	.929	.998	1.020	.997	.943	.867	.764	.644
60	.609	.736	.834	.893	.913	.902	.856	.789	.704	.592
65	.554	.666	.752	.802	.818	.806	.766	.711	.641	.551
70	.514	.608	.683	.727	.740	.729	.695	.650	.589	.504
75	.476	.559	.624	.663	.672	.663	.636	.600	.546	.471
80	.430	.505	.567	.601	.612	.604				

VISCOSITY OF AQUEOUS SUCROSE SOLUTIONS

Bingham and Jackson, Bull. Bur Stds. **14,** 59 (1918–19)

Giving the viscosity in centipoises for 20, 40 and 60% by weight sucrose solutions for each 5° C from 0 to 100° C. For densities see table Sucrose—Specific gravity of aqueous sugar solutions.

Temp. °C	Viscosity, cp			Temp. °C	Viscosity, cp		
	20%	40%	60%		20%	40%	60%
0	3.804	14.77	238	55	0.884	2.219	11.67
5	3.154	11.56	156	60	.808	1.982	9.83
10	2.652	9.794	109.8	65	.742	1.778	8.34
15	2.267	7.468	74.6	70	.685	1.608	7.15
20	1.960	6.200	56.5	75	.635	1.462	6.20
25	1.704	5.187	43.86	80	.590	1.334	5.40
30	1.504	4.382	33.78	85	.550	1.221	4.73
35	1.331	3.762	26.52	90	.....	1.123	4.15
40	1.193	3.249	21.28	95	.....	1.037	3.72
45	1.070	2.847	17.18	100	.....	.960	3.34
50	.970	2.497	14.01				

VISCOSITY OF AQUEOUS GLYCEROL SOLUTIONS

Temperature °C

Glycerol, % Wt.	0	10	20	30	40	50	60	70	80	90	100
	Viscosity, Centipoise										
0*	1.792	1.308	1.005	0.8007	0.6560	0.5494	0.4688	0.4061	0.3565	0.3165	0.2838
10	2.44	1.74	1.31	1.03	0.826	0.680	0.575	0.500	....	....	....
20	3.44	2.41	1.76	1.35	1.07	0.879	0.731	0.635	....	....	....
30	5.14	3.49	2.50	1.87	1.46	1.16	0.956	0.816	0.690	....	....
40	8.25	5.37	3.72	2.72	2.07	1.62	1.30	1.09	0.918	0.763	0.668
50	14.6	9.01	6.00	4.21	3.10	2.37	1.86	1.53	1.25	1.05	0.910
60	29.9	17.4	10.8	7.19	5.08	3.76	2.85	2.29	1.84	1.52	1.28
65	45.7	25.3	15.2	9.85	6.80	4.89	3.66	2.91	2.28	1.86	1.55
67	55.5	29.9	17.7	11.3	7.73	5.50	4.09	3.23	2.50	2.03	1.68
70	76.0	38.8	22.5	14.1	9.40	6.61	4.86	3.78	2.90	2.34	1.93
75	132	65.2	35.5	21.2	13.6	9.25	6.61	5.01	3.80	3.00	2.43
80	255	116	60.1	33.9	20.8	13.6	9.42	6.94	5.13	4.03	3.18
85	540	223	109	58.0	33.5	21.2	14.2	10.0	7.28	5.52	4.24
90	1310	498	219	109	60.0	35.5	22.5	15.5	11.0	7.93	6.00
91	1590	592	259	126	68.1	39.8	25.1	17.1	11.9	8.62	6.40
92	1950	729	310	147	78.3	44.8	28.0	19.0	13.1	9.46	6.82
93	2400	860	367	172	89.9	51.5	31.6	21.2	14.4	10.3	7.54
94	2930	1040	437	202	105	58.4	35.4	23.6	15.8	11.2	8.19
95	3690	1270	523	237	121	67.0	39.9	26.4	17.5	12.4	9.08
96	4600	1585	624	281	142	77.8	45.4	29.7	19.6	13.6	10.1
97	5770	1950	765	340	166	88.9	51.9	33.6	21.9	15.1	10.9
98	7370	2460	939	409	196	104	59.8	38.5	24.8	17.0	12.2
99	9420	3090	1150	500	235	122	69.1	43.6	27.8	19.0	13.2
100	12070	3900	1412	612	284	142	81.3	50.6	31.9	21.3	14.8

* Viscosity of water taken from Bingham and Jackson.

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DIFFUSION

Gases into Air

Gas or vapor	Temp. °C	Coefficient of diffusion, sq. cm/sec	Observer
Alcohol, vapor	40.4	0.137	Winkelmann
Carbon dioxide	0.0	0.139	Mean of various
Carbon disulfide	19.9	0.102	Winkelmann
Ether, vapor	19.9	0.089	Winkelmann
Hydrogen	0.0	0.634	Obermayer
Oxygen	0.0	0.178	Obermayer
Water, vapor	8.0	0.239	Guglielmo

Aqueous Solutions into Pure Water

Concentration in gram-molecules per liter.

Substance	Concentration	Temp. °C	Diffusion sq. cm/day	Observer
Acetic acid	0.2	13.5	0.77	Scheffer
	1.0	12	0.74	Arrhenius
	2.0	12	0.69	Arrhenius
	3.0	12	0.68	
	4.0	12	0.66	Arrhenius
Ammonia	1.0	15.23	1.54	Abegg
Barium chloride	0.2	8	0.66	Scheffer
Bromine	0.1	12	0.8	Euler
Cadmium sulfate	2.0	19.04	0.246	Seitz
Calcium chloride	2.0	10	0.68	Schuhmeister
Chlorine	0.1	12	1.22	Euler
Copper sulfate	0.1	17	0.39	Thovert
Formic acid	1.0	12	0.97	Abegg
Glycerine	0.1	10.14	0.357	Heimbrodt
	0.2	10.1	0.355	Heimbrodt
	1.0	10.14	0.339	Heimbrodt
Hydrochloric acid	0.1	19.2	2.21	Thovert
	1.0	12	2.09	Arrhenius
	2.0	12	2.21	Arrhenius
Iodine	0.1	12	(0.5)	Euler
Magnesium sulfate	1.0	7	0.30	Scheffer
Nitric acid	0.1	19.5	2.07	Thovert
Potassium bromide	1.0	10	1.13	Schuhmeister
carbonate	3.0	10	0.60	Schuhmeister
chloride	0.1	17.5	1.38	Thovert
chloride	4.0	10	1.27	Schuhmeister
hydrate	0.1	13.5	1.72	Thovert
	1.0	12	1.72	Arrhenius
	3.0	12	1.89	Arrhenius
Silver nitrate	0.1	12	0.985	Thovert
Sodium acetate	0.2	12	0.67	Kawalki
chloride	0.1	15	0.94	Thovert
	0.2	15	0.94	Thovert
	1.0	15	0.94	Thovert
	1.0	14.3	0.964	Heimbrodt
hydrate	1.0	12	1.11	Thovert
iodide	1.0	10	0.80	Schuhmeister
	2.0	10	0.90	Schuhmeister
Sugar	1.0	12	0.254	Arrhenius
Sulfuric acid	1.0	12	1.12	Arrhenius
	2.0	12	1.16	Arrhenius
Urea	0.1	14.8	0.97	Heimbrodt
	0.2	14.8	0.969	Heimbrodt
Zinc acetate	2.0	18.05	0.210	Seitz
	2.0	0.04	0.120	Seitz
sulfate	1.0	14.8	0.236	Seitz

OSMOTIC PRESSURE OF AQUEOUS SOLUTIONS

FOR A MEMBRANE OF FERROCYANIDE OF COPPER

Dissolved Substance.	Gms. substance in 1 cm.^{3} sol.	Temp. ° C.	Pressure, cm. Hg.	Observer.
Glycerine..........	.00199	0	36.7	
Gum arabic........	0.0099	15.5	7.0	Pfeffer
Gum arabic........	0.164	15.6	119.3	Pfeffer
Phenol (carbolic acid)	.00127	0	23.3	Naccari
	Gm.-mol. substance per gm. sol.		Pressure in atm.	
Glucose............	.0001	10.2	2.39	Morse, 1911
	.0005	10.2	11.55	Morse, 1911
	.0010	10.0	23.80	Morse, 1911
Saccharose (cane sugar)...........	.0001	10.0	2.50	Morse, 1911
	.0005	10.0	12.30	Morse, 1911
	.0010	10.0	25.69	Morse, 1911
	Gm.-mol. substance in 1 ccm.^{3} sol.			
Potassium carbonate	.00005	15	1.17	Adie, 1891
ferrocyanide......	.00005	15	3.44	Adie, 1891
nitrate...........	.00005	15	1.56	Adie, 1891
Sodium citrate (acid)	.00005	15	4.32	Adie, 1891

PHYSICAL CONSTANTS OF OZONE AND OXYGEN

Armour Research Foundation, 1958

Physical Constant	Ozone (O_3)	Oxygen (O_2)
Molecular Weight	48.0 g/g mol	32.0 g/g mol
Boiling Point (760 mm)	−111.9 ± 0.3°C	−182.96°C
Melting Point	−192.7 ± 0.2°C	−218.4°C
Critical Temperature	−12.1 ± 0.1°C	−118.8°C
Critical Pressure	54.6 atm	49.7 atm
Critical Density	0.437 g/cc	0.430 g/cc
Critical Volume	147.1 cc/mol	74.5 cc/mol
Gas Density (0°C) (760 mm pressure)	2.144 g/liter	1.429 g/liter
Liquid Density		
−112°C	1.358 g/cc	
−183°C	1.571 g/cc	1.14 g/cc
−195.4°C	1.614 g/cc	1.201 g/cc
Surface Tension		
−195°C	43.8 ± 0.1 dyne/cm	
−182.7°C	38.1 ± 0.2 dyne/cm	
−183.0°C	38.4 ± 0.7 dyne/cm	13.2 dyne/cm
Heat Capacity of Liquid		
−183 to −145°C	0.45 cal/g°C	
Heat Capacity of Gas		
−173°C	7.95 cal/g mol°C	
0°C	9.10 cal/g mol°C	
25°C	9.37 cal/g mol°C	
100°C		6.979 cal/g mol°C
127°C	10.44 cal/g mol°C	
Viscosity of Liquid		
−195.6°C	4.14 ± 0.05 cp	
−183.0°C	1.57 ± 0.02 cp	0.189 cp
Heat of Vaporization		
−112°C	75.6 cal/g	
−182.9°C		50.9 cal/g

PHYSICAL CONSTANTS OF OZONE AND OXYGEN (Continued)

Physical Constant	Ozone (O_3)	Oxygen (O_2)
Heat of Formation		
25°C	−34.4 Kg cal/mol	
Free Energy		
25°C	32.4 Kg cal/mol	
Van der Waals Constant (a)	3.545 atm $liter^2/mol^2$	1.36 atm $liter^2/mol^2$
Van der Waals Constant (b)	0.04903 liter/mol	0.03803 liter/mol
Magnetic Susceptibility		
gas ($\times 10^{-6}$)	0.002 cgs units	10.6.2 cgs units
liq ($\times 10^{-6}$)	0.150 cgs units	260.0 cgs units
Thermal Conductivity of Liquid		
−195.8°C	5.21 cal/sec cm°C $\times 10^4$	
−183.0°C	5.31 cal/sec cm°C $\times 10^4$	
−165.0°C	5.42 cal/sec cm°C $\times 10^4$	
−128.0°C	5.52 cal/sec cm°C $\times 10^4$	

Phase Boundaries—Ozone-Oxygen System

−183°C	29.8 and 72.4 wt % O_3
−195.4°C	9 and 90.8 wt %O_3

Consolute Temperature—Ozone-Oxygen System

−180 ± 0.5°C

Coefficient of Thermal Expansion for Liquid Ozone

Temp. °C	α
−195.6	1.62
−183.0	1.58
−148.0	1.47
−123.0	1.41
−112.0	1.35
− 98.8	1.31

These pages are reserved for future expansion and revision of Section III.

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COEFFICIENT OF THERMAL EXPANSION

LINEAR

The coefficient given is the increase in length per unit length (measured at 0° C.) per degree Centigrade.

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Aluminum	−191 to +16	18.35	Henning, 1907
	20	25.5	Voigt, 1893
	40	23.13	Fizeau, 1869
	600	31.50	Chatelier
99.95%	20–100	23.8	Hidnert, 1925
	20–300	25.7	"
	20–600	28.7	"
commercial	20–100	24.0	"
	20–300	26.7	"
	20–600	28.7	"
Aluminum-bronze	20	17.0	National Physical Laboratory
Aluminum-beryllium alloy			
10% Be	20–100	21.4	Hidnert & Sweeney, 1927
	20–300	23.3	" "
	20–500	25.4	" "
32.7% Be	20–100	17.9	" "
	20–300	20.6	" "
	20–500	22.3	" "
Aluminum-copper alloy			
10% Cu	20–100	22.4	Hidnert, 1925
	20–300	28.3	
	20–500	27.7	
Aluminum-silicon alloy 10% Si	20–100	21.1	
	20–300	22.9	
Aluminum-zinc alloy 12% Zn	20–100	24.9	
	20–300	28.1	
97% Zn	20–100	27.5	
	20–200	29.6	
Antimony	−180 to +13	10.23	Gruneisen, 1910
	20	12.	Fizeau, 1869
	15–101	10.88	Gruneisen, 1910
parallel to axis	10–90	17.30	Fizeau, 1869
perpendicular to axis	10–90	8.28	"
Arsenic	10–90	3.86	"
*Bakelite-dilecto	20–60	22.	Souder & Hidnert, 1919
micarta 32X	25–50	33.	" "
Beryllium 98.9%	20–100	12.3	Hidnert, 1925
	20–300	14.0	"
	20–700	16.8	"
Bismuth	−180 to +15	12.98	
	19–101	13.45	
parallel to axis	10–90	15.37	
perpendicular to axis	10–90	10.84	
Brass			
cast	0–100	18.75	Smeaton
wire	0–100	19.30	"
66Cu, 34Zn	20	18.9	National Physical Laboratory

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* See Scientific Paper of Bureau of Standards No. 352.

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Primer gilding 97Cu, 2.97Zn	25–100	16.9	Hidnert, 1921 Scientific Paper No. 410 Bureau of Standards
.01Pb, .02Fe, cold rolled	25–300	17.7	
cast	25–100	17.2	
commercial bronze 90.26Cu	25–100	17.5	
9.7Zn, .01Pb, .03Fe	25–300	18.1	
cold rolled			
cast	25–100	17.4	
Low brass 80.02Cu	25–100	18.0	
19.89Zn, .05Pb, .03Fe	25–300	19.1	
cold rolled			
cast	25–100	17.9	
Spring brass, 72.02Cu	25–100	18.5	
27.95Zn, .01Pb, .02Fe	25–300	19.8	
cold rolled			
cast	25–100	18.3	
Commercial brass, 64.81Cu	25–100	19.0	
34.92Zn, .24Pb, .03Fe	25–300	20.2	
cold rolled			
cast	25–100	18.9	
Leaded bronze 88.3Cu	25–100	17.5	
10.Zn, 1.68Pb, .02Fe	25–300	18.3	
cold rolled			
cast	25–100	17.6	
Free turning rod 62.33Cu	25–100	19.1	
35.04Zn, 2.57Pb, .06Fe	25–300	20.4	
cold rolled			
cast	25–100	19.0	
Brick	....	9.5	National Physical Laboratory
Bronze			
3Cu, 1Sn	16.6–100	18.44	Daniell
	16.6–350	21.16	"
	16.6–957	17.37	"
93.5Cu, 6.5Sn	16–100	17.5	Bein, 1912
90Cu, 10Sn	0–900	22.0	Le Chatelier, 1889
80Cu, 20Sn	0–800	27.0	" "
70Cu, 30Sn	0–700	29.5	" "
phosphor			
97, 6Cu, 2Sn, 0.2P	0–85	16.8	Mean
Cadmium	−183 to +14	44.6	Gruneisen, 1901
	20	28.8	Matthiessen, 1866
	0–100	31.59	"
	10–90	29.39	Fizeau
	315	31.6	Vicentini & Omodie
Calcite, parallel to axis	0–85	25.14	Benoit, 1888
perpendicular to axis	0–85	−5.58	"
Caoutchouc	....	65.7–68.6	Various
	17–25	77.0	Kohlrausch
Carbon			
diamond	40	1.18	Fizeau, 1869
gas carbon	40	5.40	"
graphite	40	7.86	"
Celluloid	20–70	109.	Souder & Hidnert, 1919
Cement and concrete	....	10.–14.	Fizeau
Chromium	20–100	6.8	Hidnert, 1931
Cobalt	40	12.36	Fizeau
*Condesite (No. 100)	16–79	44.0	Souder & Hidnert, 1919
(No. 128)	18–56	20.0	" "
Constantan	4–29	15.23	....
60Cu, 40Ni	20	17.0	National Physical Laboratory

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* See Scientific Paper Bureau of Standards No. 352.

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Constantan	−191 to +16	12.02	Henning, 1907
	0–38	14.48	Guillaume, 1896
	0–500	14.81	Holborn & Day, 1900
Copper	−191 to +16	14.09	Henning, 1907
electrolytic	25–100	16.8	Hidnert, 1921
	25–300	17.8	“
	0–625	16.07	Dittenberger, 1902
Diamond, *see Carbon*			
Duralumin, cast	20–100	23.6	Hidnert, 1925
	20–300	26.0	“
	20–500	27.3	“
cold rolled	20–100	23.7	“
	20–300	26.4	“
	20–500	27.3	“
Ebonite	25–35	84.2	Kohlrausch
Emerald, parallel to axis	0–85	−1.35	Benoit
perpendicular to axis	0–85	1.00	
Fluor spar, CaF_2	0–100	19.5	Pfaff
Formica	20–60	30.0	Souder & Hidnert, 1919
Galena		19.9	
German silver	0–100	18.36	Pfaff
60Cu, 15Ni, 25Zn			
Glass			
tube	0–100	8.33	Fizeau
soft		8.5	Schott
hard		9.7	“
plate	0–100	8.91	Lavoisier & Laplace
crown	0–100	8.97	“ “
flint	50–60	7.88	Pulfrich
Jena thermometer			
16^{III} normal	0–100	8.1	Schott
59^{III}	0–100	5.8	“
59^{III}	−191 to +16	4.24	Henning, 1907
Gold	−183 to +16	13.2	Gruneisen, 1910
	16–100	14.3	“
Gold-copper	0–100	15.52	Matthiessen
2Au, 1Cu			
Gold-platinum	0–100	15.23	“
2Au, 1Pt.			
Granite		8.3	
Gun Metal		18.3	National Physical Laboratory
Gutta percha		198.3	Russner, 1882
Hard Rubber	20–60	80.	Souder & Hidnert, 1919
Ice	−20 to −1	51.0	
	−10 to 0	50.7	Vincent, 1902
Indium	40	41.7	Fizeau, 1869
Invar, *see Nickel steel*			
Iodine	−188 to 16	83.7	Dewar, 1902
Iridium	−183 to +19	5.71	Gruneisen, 1910
Iron	−190 to +17	9.07	Henning, 1907
soft	40	12.10	Fizeau, 1869
cast	40	10.61	“
cast	−190 to +16	8.50	Henning, 1907
wrought	−18 to +100	11.40	Andrews
steel	40	13.22	Fizeau, 1869
steel, annealed	40	10.95	“
steel, 1.2% C	0–100	10.5	Le Chatelier, 1899
“	100–200	11.5	“
“	200–300	13.	“

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Iron, steel	300–400	15.	Le Chatelier, 1899
"	400–500	14.	"
"	500–600	16.	"
"	600–700	16.	"
"	above 900	29.	"
Lead	−183 to +14	27.08	Gruneisen, 1910
	18–100	29.40	"
Lead-tin 2Pb, 1Sn	0–100	25.08	Smeaton
Magnesium	−183 to +15	21.40	Gruneisen, 1910
	18–100	26.08	"
	20–100	26.0	Hidnert & Sweeney, 1928
	20–200	27.9	" "
	20–500	29.8	" "
cast	20–100	26.96	C. D. H., 1917
wrought	20–100	26.73	"
Magnalium 96Al, 4Mg,	0–13	22.	Guillaume, 1902
86Al, 14Mg	12–39	23.8	Stadhagen, 1901
Marble	15–100	11.7	Frohlich
* Rutland blue (Vt) heated in air	25–100	15.	Souder & Hidnert, 1919
	100–200	23.	" "
	200–300	28.	" "
cooled	300–200	15.	" "
	200–100	9.	" "
	100–25	4.	" "
* Silver gray (Ga.) cooled	25–0	13.	" "
	0 to −60	10.	" "
heated in air	20–65	1.0	" "
cooled	65–20	.5	" "
Masonry	....	4.–7.	....
Mercury	−183 to −39	30.	Dewar, 1902
	−78 to −38	41.	Grunmach, 1901
Molybdenum	25–100	4.9	Hidnert & Gero, 1924
	25–500	5.5	" "
Monel metal	25–100	13.7–14.5	Souder & Hidnert
	25–300	14.9–15.2	" "
	25–600	15.9–16.7	" "
Nickel	−191 to +16	10.12	Henning, 1907
	40	12.79	Fizeau
	16–250	13.97	Holborn & Day, 1901
	375–1000	13.46	Holborn & Day, 1901
commercial	25–100	12.9 13.5	Souder & Hidnert, 1921
Nickel steel 10% Ni	20	13.0	Nat. Phys. Lab.
20	20	19.5	" " "
30	20	12.	" " "
36 (Invar)	20	.9	" " "
40	20	6.0	" " "
50	20	9.7	" " "
80	20	12.5	" " "
Osmium	40	6.57	Fizeau
Palladium	40	11.76	"
	0–100	11.04	Matthiessen
Paraffine	0–16	106.6	Rodwell
	16–38	130.3	"
	38–49	477.1	"
Phosphorus	0–44	124.	Laduc, 1891

* For full details and data on other samples see Scientific Paper 352 Bureau of Standards

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Phosphor bronze, *see Bronze*			
Platinum	40	8.99	Fizeau
Platinum iridium	40	8.84	"
10 Pt. 1Ir			
Platinum silver	0–100	15.23	Matthiessen
33Pt, 67Ag			
Porcelain	20–790	4.13	Braun
Berlin	0–100	3.1	Holborn & Gruneisen
Bayeux	0	2.5	Tutton, 1902
	1000–1400	5.53	Deville & Troost
Clay .50, flint .15			
beryl .35	20–200	1.6	Souder & Hidnert, 1919
	400–540	3.6	" "
clay .80, feldspar	20–200	2.9	" "
.85, whiting .015	200–400	4.0	" "
clay .70, feldspar	20–200	3.3	" "
.19, flint .095, whiting 1.5	200–400		
		4.0	" "
clay .50, feldspar	20–200	4.7	" "
.16, flint .34	200–400	4.6	" "
Quartz (crystal)	−190 to +16	5.21	Scheel
parallel to axis	0–80	7.97	Benoit, 1888
perpendicular to axis	0–80	13.37	"
fused	−191 to +16	.256	Henning, 1907
	0–30	.42	Chappius, 1903
	0–100	.50	Scheel, 1907
	0–800	.546	Randall, 1910
	0–1200	.585	"
Rhodium	40	8.5	Fizeau
Rock salt	40	40.40	"
Rubidium	2–17	86.2	Elsa Deuss, 1911
Ruthenium	40	9.63	Fizeau
Sandstone	20	7.–12.	....
Selenium	−180 to 0	37.2	Dorsey, 1908
	40	36.80	Fizeau
Silicon	40	7.63	"
Silver	−191 to +16	17.04	Henning, 1907
	20	18.8	Voigt, 1893
Slate	20	6.–10.	....
Solder, *see Lead-tin*			
Speculum metal	20	19.3	Smeaton
68Cu, 32Sn			
Sodium	−188 to +17	62.2	Dewar, 1902
Stainless steel			
hardened	20–100	17.28	Souder & Hidnert, 1921
	20–200	17.64	" "
	20–600	20.16	" "
annealed	20–100	18.54	" "
	20–200	19.26	" "
	20–600	21.78	" "
Stellite, soft	20–100	14.1	Souder & Hidnert, 1921
80Co, 20Cr	20–300	15.2	" "
	20–600	16.1	" "
hard, 55Co, 40Cr	20–100	13.4	" "
3W, 2C	20–300	15.0	" "
	20–600	16.5	" "
"No. 2" 55Co, 35Cr	20–100	11.0	" "
10W	20–300	12.4	" "
Sulphur, crystal	40	64.13	Fizeau, 1869
Tantalum, annealed	20–100	6.7	Hidnert, 1927
Tellurium	40	16.75	Fizeau, 1869

COEFFICIENT OF THERMAL EXPANSION (Continued)

LINEAR

Substance	Temp. °C.	Coefficient	Observer
		$\times 10^{-6}$	
Thallium	40	30.21	Fizeau, 1869
Thorium	0–100	12.3	Rentschler, Marden, 1925
Tin	−183 to +16	22.57	Gruneisen, 1910
	18–100	26.92	"
Topaz, axis a	0–100	8.32	Pfaff
" b	0–100	8.36	"
" c	0–100	4.72	"
Tourmaline			
parallel to axis	0–100	9.37	"
perpendicular to axis	0–100	7.73	"
Tungsten 99.978%	−100–0	4.2	Hidnert & Sweeney, 1925
	0–100	4.3	" "
	0–300	4.5	" "
	0–500	4.6	" "
filament	1000–2000	6.1	Worthen, 1916
Type metal	17–254	19.52	Daniell
Vulcanite	0–18	63.60	Mayer
Wood			
parallel to fiber			
ash	0–100	9.51	Glatzel
beech	2–34	2.57	Villari
chestnut	2–34	6.49	"
elm	2–34	5.65	"
mahogany	2–34	3.61	"
maple	2–34	6.38	"
oak	2–34	4.92	"
pine	2–34	5.41	"
walnut	2–34	6.58	"
across fiber			
beech	2–34	61.4	"
chestnut	2–34	32.5	"
elm	2–34	44.3	"
mahogany	2–34	40.4	"
maple	2–34	48.4	"
oak	2–34	54.4	"
pine	2–34	34.1	"
walnut	2–34	48.4	"
Zinc	−180 to 0	26.4	Dorsey, 1908
	10–100	26.28	Thiesen, 1895
Alundum, Al_2O_3	25–900	8.7	Boeck, 1912
Bauxite brick	25–100	4.4	Wilkes
Caoutchouc	16.7–25.3	77.0	Kohlrausch
Carborundum, SiC	25–100	6.58	Boeck, 1912
	100–900° C.	4.74	
Corundum	....	6.76	Pfaff
Fire clay brick	25–100	8.1±3	
Flint, SiO_2	15–1000	17.4	Houldsworth & Cobb, 1924
Limestone, Oolitic, (Ind.)	25–100	9	Souder & Hidnert, 1919
Magnesium oxide	25–100	9.7–11.4	
Rubber, "Red Antimony" tubing	10–100	111	Napier & Prettyman, 1932

THERMAL EXPANSION OF GLASSES

The following table gives the mean coefficient of linear expansion for various types of glass as determined by Peters and Cragoe of the Bureau of Standards. 1920.

Glass sample	Temp. interval	Coefficient	Temp. interval	Coefficient
		$\times 10^{-4}$		$\times 10^{-4}$
1 Barium flint	22–494	0.088	519–550	0.331
4 Plate, American	20–508	.108	540–560	.401
6 German	21–496	.099	564–589	.477
7 French	21–513	.094	597–613	.424
8 Light crown	24–422	.104	494–507	.548
10 Borosilicate crown	22–498	.090	539–562	.393
11 Barium crown	23–499	.090	589–610	.649
12 Medium flint	23–402	.097	452–478	.396
13 Light flint	22–451	.088	494–512	.347
16 Commercial glass	23–445	.107	510–534	.309
20 McBeth-Evans flask	22–449	.069	567–586	.454
21 Pyrex	21–471	.036	552–571	.151
22 Schott-Genossen flask	19–414	.056	540–562	.404
23 Soda tubing	21–372	.120	506–525	.234
24 Lead tubing	21–338	.091	464–483	.236
26 Fluorite tubing	22–364	.098	510–551	.284
29 Fusing in glass, German	23–383	.090	456–481	.283
30 Fusing in glass, Corning	22–376	.083	460–485	.258
Chemical glassware*				
Glasbake	20–300	.037		
Kimble	20–300	.049		
Pyrex	20–300	.033		
Vycor	20–300	.008		

More complete data, including the composition of the samples named above, will be found in Scientific Paper No. 393, Bureau of Standards.

* Wichers, Finn, Clabaugh, Jour. Res. N.B.S. 26, 539, 1941.

EQUATION FOR THE LINEAR EXPANSION OF SOLIDS

If l_0 is the length at 0° C the length at t° C is $l_t = l_0\ (1+\alpha t+\beta t^2)$. The table gives the values of these coefficients.

Substance	Temp. limits ° C	α	β	Observer
Aluminum	10–90	$.2221 \times 10^{-4}$	$.114 \times 10^{-7}$	Fizeau
Brass	10–90	.1781	.098	Fizeau
Copper	10–90	.1596	.102	Fizeau
Gold	10–90	.1410	.042	Fizeau
Iron, pure	0–38	.1145	.071	Guillaume
Lead	10–90	.2829	.120	Fizeau
Nickel	0–38	.1255	.057	Guillaume
Platinum	0–1000	.0868	.013	Holborn and Valentine
Silver	10–90	.1862	.074	Fizeau
Tin	10–90	.2094	.175	Fizeau
Zinc	10–90	.2969	−.0635	Fizeau

CUBICAL EXPANSION OF SOLIDS

The coefficient of cubical expansion for a solid is approximately three times the linear coefficient.

The experimental values for various solids are given in the following table. The coefficient is the increase in volume per unit volume per degree Centigrade.

Substance	Temp. ° C	Coefficient	Observer
Antimony	0–100	0.3167×10^{-4}	Matthiessen
Asphalt	....	5–7	....
Beryl	0–100	0.3167	Pfaff
Bismuth	....	0.4000	Kopp
Diamond	40	0.0354	Fizeau
Emerald	40	0.0168	Fizeau
Fiber, vulcanized	....	0.27	....
Fluor spar	14–47	0.6235	Kopp
Galena	0–100	0.558	Pfaff
Glass, white tube	0–100	0.2648	Regnault
green tube	0–100	0.2299	Regnault
Jena	0–100	0.2533	Reichsanstalt
Ice	−20 to −1	1.1250	Brunner
Iceland spar	50–60	0.1447	Pulfrich
Iron	0–100	0.3550	Dulong and Petit
Marble	....	0.3–0.6	....
Paraffin	20	5.88	Russner
Platinum	0–100	0.265	....
Porcelain	0–100	0.1080	Deville and Troost
Quartz	50–60	0.3530	Pulfrich
Rock salt	50–60	1.2120	Pulfrich
Silver	0–100	0.5831	Matthiessen
Slate	....	0.15–0.3	....
Sulfur	13.2–50.3	2.23	Kopp
Tar	....	6.–8.	....
Tin	0–100	0.6889	Matthiessen
Zinc	0–100	0.8928	Matthiessen

CUBICAL EXPANSION OF LIQUIDS

(From Smithsonian Tables)

The table gives the values of the coefficients α, β and γ in the equation $V_t = V_o(1 + \alpha t + \beta t^2 + \gamma t^3)$ and also the true coefficient at 20°C.

Liquid	Temp. Range °C	$\alpha \times 10^3$	$\beta \times 10^6$	$\gamma \times 10^8$	True coeff. at 20 C $\times 10^3$
Acetic acid	16–107	1.0630	0.12636	1.0876	1.071
Acetone	0–54	1.3240	3.8090	−0.87983	1.487
Alcohol:					
Amyl	−15–80	0.9001	0.6573	1.18458	0.902
Ethyl, 30% by vol.	18–39	0.2928	10.790	−11.87	....
" 50% "	0–39	0.7450	1.85	0.730	....
" 99.3% "	27–46	1.012	2.20	....	1.12
" 500 atmos. press.	0–40	0.866	....	....	....
" 3000 " "	0–40	0.524	....	....	....
Methyl	0–61	1.1342	1.3635	0.8741	1.199
Benzene	11–81	1.17626	1.27776	0.80648	1.237
Bromine	0–59	1.06218	1.87714	−0.30854	1.132
Calcium chloride:					
5.8% solution	18–25	0.07878	4.2742	....	0.250
40.9% "	17–24	0.42383	0.8571	....	0.458
Carbon disulphide	−34–60	1.13980	1.37065	1.91225	1.218
500 atmos. pressure	0–50	0.940	....	....	....
3000 " "	0–50	0.581	....	....	....
Carbon tetrachloride	0–76	1.18384	0.89881	1.35135	1.236
Chloroform	0–63	1.10715	4.66473	−1.74328	1.273
Ether	−15–38	1.51324	2.35918	4.00512	1.656
Glycerine	....	0.4853	0.4895	....	0.505
Hydrochloric acid:					
33.2% solution	0–33	0.4460	0.215	....	0.455
Mercury	0–100	0.18182	0.0078	....	0.18186
Olive oil	....	0.6821	1.1405	−0.539	0.721
Pentane	0–33	1.4646	3.09319	1.6084	1.608
Potassium chloride:					
24.3% solution	16–25	0.2695	2.080	....	0.353
Phenol	36–157	0.8340	0.10732	0.4446	1.090
Petroleum:					
Density 0.8467	24–120	0.8994	1.396	....	0.955
Sodium chloride:					
20.6% solution	0–29	0.3640	1.237	....	0.414
Sodium sulphate:					
24% solution	11–40	0.3599	1.258	....	0.410
Sulphuric acid:					
10.9% solution	0–30	0.2835	2.580	....	0.387
100.0%	0–30	0.5758	−0.432	....	0.558
Turpentine	−9–106	0.9003	1.9595	−0.44998	0.973
Water	0–33	−0.06427	8.5053	−6.7900	0.207

COEFFICIENTS OF EXPANSION OF GASES AT CONSTANT PRESSURE

Change in volume per unit volume per degree Centigrade.

(From Smithsonian Tables.)

Gas.	Temp. ° C.	Pressure in cm. of mercury	Coefficient.	Observer.
Acetylene............	0	76.	.003772	Leduc, 1912
Acetylene............	0–100	76.	3739	Leduc, 1912
Air..................	0–100	76.	3670	Regnault, 1842
Air..................	0–100	100.1	36728	Chappuis, 1903
Ammonia..............	0	76.	3860	Leduc, 1912
Ammonia..............	0–100	76.	3800	Leduc, 1912
Carbon dioxide........	0	76.	3751	Leduc, 1912
Carbon dioxide........	0–100	76.	3723	Leduc, 1912
Carbon dioxide........	0–20	51.8	37128	Chappuis, 1903
Carbon dioxide........	0–40	51.8	37100	Chappuis, 1903
Carbon dioxide........	0–100	51.8	37073	Chappuis, 1903
Carbon dioxide........	0–20	99.8	37602	Chappuis, 1903
Carbon dioxide........	0–100	99.8	37410	Chappuis, 1903
Carbon dioxide........	0–20	137.7	37972	Chappuis, 1903
Carbon dioxide........	0–100	137.7	37703	Chappuis, 1903
Carbon dioxide........	0–7.5	2621.	1097	Baly-Ramsay, 1894
Carbon dioxide........	64–100	2621.	6574	Baly-Ramsay, 1894
Carbon monoxide......	0–100	76.	3669	Regnault, 1842
Chlorine..............	0	76.	3900	Leduc, 1912
Chlorine..............	0–100	76.	3830	Leduc, 1912
Cyanogen.............	0	76.	396	Leduc, 1912
Cyanogen.............	0–100	76.	387	Leduc, 1912
Hydrochloric acid......	0	76.	3770	Leduc, 1912
Hydrochloric acid......	0–100	76.	3734	Leduc, 1912
Hydrogen.............	0–100	100.0	36600	Chappuis, 1903
Hydrogen.............	0–100	200. atm	332	Amagat, 1890
Hydrogen.............	0–100	400. atm	295	Amagat, 1890
Hydrogen.............	0–100	600. atm	261	Amagat, 1890
Hydrogen.............	0–100	800. atm	242	Amagat, 1890
Nitrogen..............	0	76.	3673	Leduc, 1912
Nitrogen..............	0–100	76.	3671	Leduc, 1912
Nitrous oxide..........	0–100	76.	3719	Regnault, 1842
Oxygen...............	0–100	100. atm	486	Amagat
Oxygen...............	0–100	200. atm	534	Amagat
Oxygen...............	0–100	400. atm	459	Amagat
Oxygen...............	0–100	600. atm	357	Amagat
Oxygen...............	0–100	800. atm	288	Amagat
Oxygen...............	0–100	1000. atm	241	Amagat
Sulphur dioxide........	0–100	76.	3903	Regnault, 1842
Sulphur dioxide........	......	98.	3980	Regnault, 1842
Water vapor...........	0–119	76.	4187	Hirn, 1862
Water vapor...........	0–141	76.	4189	Hirn, 1862
Water vapor...........	0–162	76.	4071	Hirn, 1862
Water vapor...........	0–200	76.	3938	Hirn, 1862
Water vapor...........	0–247	76.	3799	Hirn, 1862

COEFFICIENT OF EXPANSION OF GASES AT CONSTANT VOLUME

Change in pressure per unit pressure per degree Centigrade.

(From Smithsonian Tables.)

Gas.	Temp. ° C.	Pressure cm. of Hg.	Coefficient.	Observer.
Acetylene	0	76.	.003741	Leduc, 1912
Acetylene	0–100	76.	3726	Leduc, 1912
Air	....	.6	37666	Meleander, 1890–92
Air	....	1.3	37127	Meleander, 1890–92
Air	...	10.0	36630	Meleander, 1890–92
Air	.....	25.4	36580	Meleander, 1890–92
Air	..	75.2	36660	Meleander, 1890–92
Air	0–100	100.1	36744	Chappuis, 1903
Air	....	76.0	36650	Regnault, 1842
Air	....	200.0	36903	Regnault, 1842
Air	...	2000.	38866	Regnault, 1842
Air	....	10000	4100	Regnault, 1842
Ammonia	0	76.	3800	Leduc, 1912
Ammonia	0–100	76.	3770	Leduc, 1912
Argon	...	51.7	3668	Keunen-Randall, 1896
Carbon dioxide	0–20	51.8	36985	Chappius, 1903
Carbon dioxide	0–40	51.8	36972	Chappuis, 1903
Carbon dioxide	0–100	51.8	36981	Chappuis, 1903
Carbon dioxide	0–20	99.8	37335	Chappuis, 1903
Carbon dioxide	0–100	99.8	37262	Chappuis, 1903
Carbon dioxide	0–100	100.0	37248	Chappuis, 1892
Carbon dioxide	0	76	3724	Leduc, 1912
Carbon dioxide	0–100	76	3714	Leduc, 1912
Carbon monoxide	.....	76.	36667	Regnault, 1842
Cyanogen	0	76.	3870	Leduc, 1912
Cyanogen	0–100	76.	3830	Leduc, 1912
Ethane	0	76	3780	Leduc, 1912
Ethane	0–100	76.	3750	Leduc, 1912
Helium	....	56.7	3665	Keunen-Randall, 1896
Hydrochloric acid	.....	76.	3740	Leduc, 1912
Hydrochloric acid	0–100	76	3721	Leduc, 1912
Hydrogen	0	76.	3663	Leduc, 1912
Hydrogen	0–100	76.	3664	Leduc, 1912
Hydrogen	16–132	.0077	3328	Baly-Ramsay, 1894
Hydrogen	15–132	.025	3623	Baly-Ramsay, 1894
Hydrogen	12-105	.47	3656	Baly-Ramsay, 1894
Hydrogen	0–100	100.0	36626	Chappuis, 1903
Methane	0	76.	3680	Leduc, 1912
Methane	0–100	76.	3678	Leduc, 1912
Nitrogen	0	76.	3672	Leduc, 1912
Nitrogen	0–100	76.	3672	Leduc, 1912
Nitrogen	13–132	.06	3021	Baly-Ramsay, 1894
Nitrogen	9–133	.53	3290	Baly-Ramsay, 1894
Nitrogen	0–20	100.2	36754	Chappuis, 1903
Nitrogen	0–100	100.2	36744	Chappuis, 1903
Oxygen	0	76.	3673	Leduc, 1912
Oxygen	0–100	76.	3672	Leduc, 1912
Oxygen	11–132	007	4161	Baly-Ramsay, 1894
Oxygen	9–132	.25	3984	Baly-Ramsay, 1894
Oxygen	11–132	.51	3831	Baly-Ramsay, 1894
Oxygen	.....	1.9	36683	Meleander, 1891
Oxygen	.....	18.5	36690	Meleander, 1891
Nitrous oxide	.....	76.	3676	Regnault, 1842
Sulphur dioxide, SO_2	.....	76.	3845	Regnault, 1842

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS

Factors and their logarithms for reducing a gas volume to normal conditions, 0° C., 760 mm pressure.

The volume of *dry* gas measured at any temperature 10–35° C. inclusive and pressure 690–784 mm of Hg may be reduced to the volume at 0° C. (273.18° K.) and 760 mm of Hg pressure by multiplying by the factor found in the table.

In case the volume of gas is measured in the presence of water vapor the pressure of the aqueous vapor must be subtracted from the value of the total or barometric pressure before entering the table. In the case of atmospheric air the vapor pressure may be found by determining the dew point or temperature of saturation. The pressure of water vapor may then be read from the small table below. If gas volumes are measured over water, the vapor pressure will be that of saturated aqueous vapor at the temperature used. A table giving the pressure of saturated aqueous vapor over water is given below.

Pressure of Saturated Water Vapor

°C.	mm	°C.	mm	°C.	mm
9	8.6	18	15.5	27	26.7
10	9.2	19	16.5	28	28.3
11	9.8	20	17.5	29	30.0
12	10.5	21	18.7	30	31.8
13	11.2	22	19.8	31	33.7
14	12.0	23	21.1	32	35.7
15	12.8	24	22.4	33	37.7
16	13.6	25	23.8	34	39.9
17	14.5	26	25.2	35	42.2

Factors and Logarithms

T°C.	690		692		694		696		697		698	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.8758	.9424	.8783	.9437	.8809	.9449	.8834	.9462	.8847	.9468	.8860	.9474
11	.8727	.9409	.8752	.9421	.8778	.9434	.8803	.9446	.8816	.9453	.8828	.9459
12	.8696	.9393	.8722	.9406	.8747	.9419	.8772	.9431	.8785	.9437	.8797	.9443
13	.8666	.9378	.8691	.9391	.8716	.9403	.8741	.9416	.8754	.9422	.8767	.9428
14	.8636	.9363	.8661	.9376	.8686	.9388	.8711	.9401	.8723	.9407	.8736	.9413
15	.8606	.9348	.8631	.9361	.8656	.9373	.8681	.9386	.8693	.9392	.8706	.9398
16	.8576	.9333	.8601	.9345	.8626	.9358	.8651	.9370	.8663	.9377	.8675	.9383
17	.8546	.9318	.8571	.9330	.8596	.9343	.8621	.9355	.8633	.9362	.8646	.9368
18	.8517	.9303	.8542	.9315	.8566	.9328	.8591	.9341	.8603	.9347	.8616	.9353
19	.8488	.9288	.8512	.9301	.8537	.9313	.8562	.9326	.8574	.9332	.8586	.9338
20	.8459	.9273	.8483	.9286	.8508	.9298	.8532	.9311	.8545	.9317	.8557	.9323
21	.8430	.9258	.8455	.9271	.8479	.9283	.8503	.9296	.8516	.9302	.8528	.9308
22	.8402	.9244	.8426	.9256	.8450	.9269	.8475	.9281	.8487	.9287	.8499	.9294
23	.8373	.9229	.8397	.9241	.8422	.9254	.8446	.9266	.8458	.9273	.8470	.9279
24	.8345	.9214	.8369	.9227	.8393	.9239	.8417	.9252	.8430	.9258	.8442	.9264
25	.8317	.9200	.8341	.9212	.8365	.9225	.8389	.9237	.8401	.9243	.8413	.9250
26	.8289	.9185	.8313	.9198	.8337	.9210	.8361	.9223	.8373	.9229	.8385	.9235
27	.8261	.9171	.8285	.9183	.8309	.9196	.8333	.9208	.8345	.9214	.8357	.9221
28	.8234	.9156	.8258	.9169	.8282	.9181	.8306	.9194	.8318	.9200	.8329	.9206
29	.8207	.9142	.8230	.9154	.8254	.9167	.8278	.9179	.8290	.9186	.8302	.9192
30	.8180	.9127	.8203	.9140	.8227	.9152	.8251	.9165	.8263	.9171	.8274	.9177
31	.8153	.9113	.8176	.9126	.8200	.9138	.8224	.9151	.8235	.9157	.8247	.9163
32	.8126	.9099	.8149	.9111	.8173	.9124	.8197	.9136	.8208	.9143	.8220	.9149
33	.8099	.9085	.8123	.9097	.8146	.9110	.8170	.9122	.8182	.9128	.8193	.9135
34	.8073	.9070	.8096	.9083	.8120	.9095	.8143	.9108	.8155	.9114	.8167	.9120
35	.8047	.9056	.8070	.9069	.8093	.9081	.8117	.9094	.8128	.9100	.8140	.9106

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	699		700		701		702		703		704	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.8872	.9480	.8885	.9487	8898	.9493	.8910	.9499	.8923	.9505	8936	.9511
11	.8841	.9465	.8854	.9471	.8866	.9477	.8879	.9484	.8892	.9490	.8904	.9496
12	.8810	.9450	.8823	.9456	.8835	.9462	.8848	.9468	.8860	.9474	8873	9481
13	.8779	.9434	.8792	.9441	8804	.9447	.8817	.9453	.8829	9459	.8842	9465
14	.8748	.9419	.8761	.9426	8774	.9432	.8786	.9438	.8799	.9444	8811	.9450
15	.8718	.9404	8731	.9410	.8743	.9417	.8756	.9423	.8768	.9429	8780	9435
16	.8688	.9389	.8700	.9395	.8713	.9402	.8725	.9408	.8738	.9414	8750	9420
17	.8658	.9374	.8670	.9380	8683	.9387	.8695	.9393	.8707	.9399	8720	9405
18	.8628	.9359	8641	.9365	.8653	.9372	.8665	.9378	.8678	.9384	8690	9390
19	.8599	.9344	8611	.9350	.8623	.9357	.8636	.9363	.8648	.9369	8660	9375
20	.8569	.9329	.8582	.9336	.8594	.9342	.8606	.9348	.8618	.9354	.8631	9360
21	.8540	.9315	8552	.9321	.8565	.9327	.8577	.9333	.8589	.9339	8601	9346
22	8511	.9300	.8523	.9306	8535	.9312	.8548	.9318	.8560	.9325	8572	.9331
23	.8482	.9285	.8494	.9291	.8507	.9298	.8519	.9304	.8531	.9310	.8543	.9316
24	.8454	.9271	.8466	.9277	.8478	.9283	.8490	.9289	.8502	.9295	.8514	.9301
25	.8425	.9256	.8437	.9262	.8449	.9268	.8462	.9275	.8474	.9281	.8486	.9287
26	8397	.9241	.8409	.9248	8421	.9254	.8433	.9260	.8445	.9266	.8457	.9272
27	.8369	.9227	.8381	.9233	.8393	.9239	.8405	.9245	.8417	.9252	8429	9258
28	.8341	.9212	.8353	.9219	.8365	.9225	.8377	.9231	.8389	.9237	.8401	.9243
29	.8314	.9198	.8326	.9204	.8338	.9210	.8349	.9217	.8361	.9223	.8373	.9229
30	.8286	.9184	.8298	.9190	.8310	.9196	.8322	.9202	.8334	.9208	8346	9215
31	.8259	.9169	.8271	.9175	.8283	.9182	.8294	.9188	.8306	.9194	8318	.9200
32	.8232	.9155	.8244	.9161	.8255	.9167	8267	.9174	.8279	.9180	.8291	9186
33	.8205	.9141	.8217	.9147	.8228	.9153	.8240	.9159	.8252	.9165	.8264	.9172
34	8178	.9127	.8190	.9133	8202	.9139	.8213	.9145	8225	.9151	8237	9158
35	.8152	.9112	.8163	.9119	.8175	.9125	.8187	.9131	.8198	.9137	.8210	.9143

T°C.	705		706		707		708		709		710	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.8948	.9517	.8961	.9524	.8974	.9530	.8986	.9536	.8999	.9542	9012	.9548
11	.8917	.9502	.8929	.9508	.8942	.9514	.8955	.9521	.8967	.9527	.8980	.9533
12	.8886	.9487	.8898	.9493	.8911	.9499	.8923	.9505	.8936	.9511	8949	.9518
13	8854	.9472	.8867	.9478	8880	.9484	.8892	.9490	.8905	.9496	.8917	.9502
14	.8824	.9456	.8836	.9463	.8849	.9469	.8861	.9475	.8874	.9481	.8886	.9487
15	.8793	.9441	8805	.9447	.8818	.9454	.8830	.9460	.8843	.9466	.8855	.9472
16	.8762	.9426	.8775	.9432	.8787	.9439	.8800	.9445	.8812	.9451	.8825	.9457
17	.8732	.9411	.8745	.9417	.8757	.9424	.8769	.9430	.8782	.9436	8794	.9442
18	.8702	.9396	.8715	.9402	.8727	.9409	.8739	.9415	.8752	.9421	8764	.9427
19	.8672	.9381	8685	.9388	.8697	.9394	.8709	.9400	.8722	.9406	.8734	.9412
20	.8643	.9367	.8655	.9373	.8667	.9379	.8680	.9385	.8692	.9391	.8704	.9397
21	.8613	.9352	.8626	.9358	.8638	.9364	.8650	.9370	.8662	.9376	.8674	.9382
22	.8584	.9337	.8596	.9343	.8609	.9349	.8621	.9355	.8633	.9362	8645	.9368
23	.8555	.9322	.8567	.9328	.8579	.9335	.8592	.9341	.8604	.9347	8616	.9353
24	.8526	.9308	.8538	.9314	.8551	.9320	.8563	.9326	.8575	.9332	8587	9338
25	.8498	.9293	.8510	.9299	.8522	.9305	.8534	.9311	.8546	.9318	.8558	.9324
26	.8469	.9278	.8481	.9285	.8493	.9291	.8505	.9297	.8517	.9303	8529	.9309
27	.8441	.9264	8453	.9270	.8465	.9276	.8477	.9282	.8489	.9289	8501	.9295
28	.8413	.9249	.8425	.9256	.8437	.9262	.8449	.9268	.8461	.9274	8473	.9280
29	8385	.9235	.8397	.9241	.8409	9247	.8421	.9254	.8433	.9260	.8445	.9266
30	8357	.9221	.8369	.9227	.8381	.9233	.8393	.9239	.8405	.9245	8417	.9251
31	.8330	.9206	.8342	.9213	.8354	.9219	.8365	.9225	.8377	.9231	8389	.9237
32	.8303	.9192	.8314	.9198	.8326	.9204	.8338	.9211	.8350	.9217	8361	.9223
33	.8275	.9178	.8287	.9184	.8299	.9190	.8311	.9196	.8322	.9202	.8334	.9209
34	.8248	.9164	8260	.9170	.8272	.9176	.8284	.9182	8295	.9188	8307	.9194
35	8222	.9150	.8233	.9156	.8245	.9162	.8257	.9168	8268	.9174	.8280	.9180

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

r°C.	711		712		713		714		715		716	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9025	.9554	.9037	.9560	.9050	.9566	.9063	.9573	.9075	.9579	.9088	.9585
11	.8993	.9539	.9005	.9545	.9018	.9551	.9031	.9557	.9043	.9563	.9056	.9569
12	.8961	.9524	.8974	.9530	.8986	.9536	.8999	.9542	.9012	.9548	.9024	.9554
13	.8930	.9508	.8942	.9515	.8955	.9521	.8967	.9527	.8980	.9533	.8993	.9539
14	.8899	.9493	.8911	.9499	.8924	.9505	.8936	.9512	.8949	.9518	.8961	.9524
15	.8868	.9478	.8880	.9484	.8893	.9490	.8905	.9496	.8918	.9503	.8930	.9509
16	.8837	.9463	.8849	.9469	.8862	.9475	.8874	.9481	.8887	.9487	.8899	.9494
17	.8807	.9448	.8819	.9454	.8831	.9460	8844	.9466	.8856	.9472	8869	.9479
18	.8776	.9433	.8789	.9439	.8801	.9445	.8813	.9451	.8826	.9457	.8838	.9464
19	.8746	.9418	.8759	.9424	.8771	.9430	.8783	.9436	.8795	.9443	.8808	.9449
20	.8716	.9403	.8729	.9409	.8741	.9416	.8753	.9422	.8765	.9428	.8778	.9434
21	.8687	.9389	.8699	.9395	.8711	.9401	.8723	.9407	.8736	.9413	8748	.9419
22	.8657	.9374	8669	.9380	.8682	.9386	.8694	.9392	.8706	.9398	8718	.9404
23	.8628	.9359	.8640	.9365	.8652	.9371	.8664	.9377	.8677	.9383	8689	.9390
24	.8599	.9344	.8611	.9351	8623	.9357	.8635	.9363	.8647	.9369	.8659	.9375
25	.8570	.9330	.8582	.9336	.8594	.9342	.8606	.9348	.8618	.9354	.8630	.9360
26	.8541	.9315	.8553	.9321	8565	.9327	.8577	.9334	.8589	.9340	.8601	.9346
27	.8513	.9301	.8525	.9307	.8537	.9313	8549	.9319	.8561	.9325	.8573	.9331
28	.8485	.9286	.8497	.9292	.8508	.9299	.8520	.9305	.8532	.9311	.8544	.9317
29	8456	.9272	.8468	.9278	.8480	.9284	.8492	.9290	.8504	.9296	.8516	.9302
30	.8429	.9258	.8440	.9264	.8452	.9270	.8464	.9276	.8476	.9282	.8488	.9288
31	.8401	.9243	.8413	.9249	.8424	.9255	.8436	.9261	.8448	.9268	.8460	.9274
32	.8373	.9229	8385	.9235	.8397	.9241	.8409	.9247	.8420	.9253	.8432	.9259
33	.8346	.9215	.8358	.9221	.8369	.9227	.8381	.9233	.8393	.9239	.8405	.9245
34	.8319	.9201	8330	.9207	.8342	.9213	.8354	.9219	.8365	.9225	.8377	.9231
35	8292	.9186	.8303	.9193	.8315	.9199	.8327	.9205	.8338	.9211	.8350	.9217

T°C.	717		718		719		720		721		722	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9101	.9591	.9113	.9597	.9126	.9603	.9139	.9609	.9151	9615	.9164	.9621
11	.9069	.9575	.9081	.9581	.9094	.9588	.9107	.9594	.9119	.9600	.9132	.9606
12	.9037	.9560	.9049	.9566	.9062	.9572	.9075	.9578	.9087	.9584	.9100	.9590
13	.9005	.9545	.9018	.9551	.9030	.9557	.9043	.9563	.9055	.9569	.9068	.9575
14	.8974	.9530	.8986	.9536	.8999	.9542	.9011	.9548	.9024	.9554	.9036	.9560
15	.8943	.9515	.8955	.9521	.8968	.9527	.8980	.9533	.8992	.9539	.9005	.9545
16	.8912	.9500	.8924	.9506	.8936	.9512	.8949	.9518	8961	.9524	.8974	.9530
17	.8881	.9485	8893	.9491	.8906	.9497	.8918	.9503	.8930	.9509	.8943	.9515
18	.8850	.9470	.8863	.9476	.8875	.9482	.8887	.9488	.8900	.9494	.8912	.9500
19	.8820	.9455	.8832	.9461	8845	.9467	.8857	.9473	.8869	.9479	.8882	9485
20	.8790	.9440	.8802	.9446	.8814	.9452	.8827	.9458	.8839	.9464	.8851	.9470
21	.8760	.9425	.8772	.9431	.8784	.9437	.8797	.9443	.8809	.9449	.8821	9455
22	.8730	.9410	.8742	.9416	.8755	.9422	.8767	.9428	.8779	.9434	8791	.9440
23	.8701	.9396	8713	.9402	.8725	.9408	.8737	.9414	8749	.9420	.8761	.9426
24	8671	.9381	.8684	.9387	.8696	.9393	.8708	.9399	.8720	.9405	.8732	9411
25	.8642	.9366	.8654	.9372	.8666	.9378	.8679	.9384	.8691	.9390	.8703	.9397
26	.8613	.9352	.8625	.9358	.8637	.9364	.8649	.9370	8661	.9376	8674	9382
27	8585	.9337	.8597	.9343	.8609	.9349	.8621	.9355	.8633	.9361	.8645	.9367
28	.8556	.9323	.8568	.9329	.8580	.9335	.8592	.9341	.8604	.9347	.8616	.9353
29	.8528	.9308	.8540	.9314	.8552	.9320	.8564	.9327	.8575	.9333	.8587	.9339
30	.8500	.9294	.8512	.9300	.8523	.9306	.8535	.9312	8547	.9318	.8559	.9324
31	.8472	.9280	.8484	.9286	.8495	.9292	.8507	.9298	8519	.9304	8531	.9310
32	.8444	.9265	.8456	.9271	.8467	.9278	8479	.9284	.8491	.9290	.8503	.9296
33	.8416	.9251	.8428	.9257	.8440	.9263	.8452	.9269	8463	.9275	.8475	.9281
34	.8389	.9237	.8401	.9243	.8412	.9249	.8424	.9255	8436	.9261	8447	.9267
35	.8362	.9223	.8373	.9229	.8385	.9235	.8397	.9241	8408	.9247	.8420	.9253

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	723		724		725		726		727		728	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9177	.9627	.9190	.9633	.9202	.9639	.9215	.9645	.9228	.9651	.9240	.9657
11	.9144	.9612	.9157	.9618	.9170	.9624	.9182	.9630	.9195	.9636	.9208	.9642
12	.9112	.9596	.9125	.9602	.9138	.9608	.9150	.9614	.9163	.9620	9175	.9626
13	.9081	.9581	.9093	.9587	.9106	.9593	.9118	.9599	.9131	.9605	9143	.9611
14	.9049	.9566	.9061	.9572	.9074	.9578	.9086	.9584	.9099	.9590	.9111	.9596
15	.9017	.9551	.9030	.9557	.9042	.9563	.9055	.9569	.9067	.9575	9080	.9581
16	.8986	.9536	.8999	.9542	.9011	.9548	.9023	.9554	.9036	.9560	9048	.9566
17	8955	.9521	.8968	.9527	.8980	.9533	.8992	.9539	.9005	.9545	.9017	.9551
18	.8924	.9506	.8937	.9512	.8949	.9518	.8961	.9524	.8974	.9530	.8986	.9536
19	.8894	.9491	.8906	.9497	.8918	.9503	.8931	.9509	.8943	.9515	.8955	.9521
20	.8863	.9476	.8876	.9482	.8888	.9488	.8900	.9494	.8913	.9500	.8925	.9506
21	.8833	.9461	.8846	.9467	.8858	.9473	.8870	.9479	.8882	.9485	8894	.9491
22	.8803	.9446	.8816	.9452	.8828	.9458	.8840	.9464	.8852	.9470	8864	.9476
23	.8774	.9432	.8786	.9438	.8798	.9444	.8810	.9450	.8822	.9456	.8834	.9462
24	.8744	.9417	.8756	.9423	.8768	.9429	.8780	.9435	.8792	9441	.8805	.9447
25	.8715	.9403	.8727	.9409	.8739	.9415	.8751	.9420	.8763	.9426	.8775	.9432
26	.8686	.9388	.8698	.9394	.8710	.9400	.8722	.9406	.8734	.9412	.8746	.9418
27	.8657	.9373	.8669	.9379	.8680	.9385	.8692	.9391	.8704	.9397	.8716	.9403
28	.8628	.9359	.8640	.9365	.8652	.9371	.8664	.9377	.8676	.9383	.8687	.9389
29	.8599	.9345	.8611	.9351	.8623	.9357	.8635	.9363	.8647	.9369	.8659	.9375
30	.8571	.9330	.8583	.9336	.8595	.9342	.8606	.9348	.8618	.9354	.8630	.9360
31	.8543	.9316	8554	.9322	.8566	.9328	.8578	.9334	.8590	.9340	.8602	.9346
32	.8515	.9302	.8526	.9308	.8538	.9314	.8550	.9320	.8562	.9326	.8573	.9332
33	.8487	.9287	.8498	.9293	.8510	.9299	.8522	.9305	.8534	.9311	.8545	.9317
34	.8459	.9273	8471	.9279	.8482	.9285	.8494	.9291	.8506	.9297	.8518	.9303
35	.8432	.9259	.8443	.9265	.8455	.9271	.8467	.9277	.8478	.9283	.8490	9289

T°C.	729		730		731		732		733		734	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9253	.9663	.9266	.9669	.9278	.9675	.9291	.9681	.9304	.9687	.9316	.9693
11	.9220	.9647	.9233	.9653	.9246	.9659	.9258	.9665	.9271	.9671	.9284	.9677
12	.9188	.9632	.9201	.9638	.9213	.9644	.9226	.9650	.9238	.9656	9251	.9662
13	.9156	.9617	.9168	.9623	.9181	.9629	.9194	.9635	.9206	.9641	9219	.9647
14	.9124	.9602	.9136	.9608	.9149	.9614	.9162	.9620	.9174	.9626	9187	.9632
15	.9092	.9587	.9105	.9593	.9117	.9599	.9130	.9605	.9142	.9610	9155	9616
16	.9061	.9572	.9073	.9578	.9086	.9584	.9098	.9589	.9110	.9595	9123	.9601
17	.9030	.9557	.9042	.9563	9054	.9569	.9067	.9574	.9079	.9580	9091	.9586
18	8998	.9542	.9011	.9548	.9023	.9554	.9036	.9560	.9048	.9565	9060	9571
19	.8968	.9527	.8980	.9533	.8992	.9539	.9005	.9545	.9017	.9551	9029	.9556
20	.8937	.9512	.8949	.9518	.8962	.9524	.8974	.9530	.8986	.9536	8998	.9542
21	.8907	.9497	.8919	.9503	.8931	.9509	.8943	.9515	.8955	.9521	.8968	.9527
22	.8876	.9482	.8889	.9488	.8901	.9494	.8913	.9500	.8925	.9506	.8937	.9512
23	.8846	.9468	.8859	.9474	.8871	.9480	.8883	.9486	.8895	.9491	.8907	.9497
24	.8817	.9453	.8829	.9459	8841	.9465	.8853	.9471	.8865	.9477	8877	.9483
25	.8787	.9438	.8799	.9444	8811	.9450	.8823	.9456	.8835	.9462	.8847	.9468
26	.8758	.9424	.8770	.9430	.8782	.9436	.8794	.9442	.8806	.9448	.8818	.9454
27	.8728	.9409	.8740	.9415	.8752	.9421	.8764	.9427	.8776	.9433	.8788	.9439
28	.8699	.9395	.8711	.9401	.8723	.9407	.8735	.9413	8747	.9419	.8759	.9425
29	.8671	.9380	.8682	.9386	.8694	.9392	8706	.9398	8718	.9404	.8730	.9410
30	.8642	.9366	.8654	.9372	.8666	.9378	.8677	.9384	.8689	.9390	.8701	.9396
31	.8613	.9352	.8625	.9358	.8637	.9364	.8649	.9370	.8661	.9376	.8673	.9381
32	.8585	.9338	.8597	.9343	.8609	.9349	.8621	.9355	.8632	.9361	.8644	.9367
33	.8557	.9323	.8569	.9329	.8581	.9335	.8592	.9341	.8604	.9347	.8616	.9353
34	.8529	.9309	.8541	.9315	8553	.9321	.8564	.9327	.8576	.9333	.8588	.9339
35	.8502	.9295	.8513	.9301	.8525	.9307	.8537	.9313	.8548	.9319	.8560	.9325

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	735		736		737		738		739		740	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9329	.9698	.9342	.9704	.9355	.9710	.9367	.9716	.9380	.9722	.9393	.9728
11	9296	.9683	.9309	.9689	.9322	.9695	.9334	.9701	.9347	.9707	.9360	9713
12	9264	.9668	9276	.9674	9289	.9680	.9301	.9686	.9314	.9691	.9327	.9697
13	.9231	.9653	.9244	.9659	.9256	.9664	.9269	.9670	.9281	.9676	.9294	.9682
14	.9199	.9637	9212	.9643	.9224	.9649	.9237	.9655	.9249	.9661	9262	.9667
15	9167	.9622	.9180	.9628	.9192	.9634	.9205	.9640	.9217	.9646	.9229	.9652
16	9135	.9607	9148	.9613	.9160	.9619	.9173	.9625	.9185	.9631	.9198	.9637
17	9104	.9592	.9116	.9598	.9129	.9604	.9141	.9610	.9153	.9616	.9166	.9622
18	.9073	.9577	.9085	.9583	.9097	.9589	.9110	.9595	.9122	.9601	.9134	.9607
19	9041	.9562	.9054	.9568	.9066	.9574	.9078	.9580	.9091	.9586	.9103	.9592
20	9011	.9548	.9023	.9553	.9035	.9559	.9047	.9565	.9060	.9571	.9072	.9577
21	.8980	.9533	8992	.9539	.9004	.9545	.9017	.9550	.9029	.9556	.9041	.9562
22	.8949	.9518	.8962	.9524	.8974	.9530	.8986	.9536	.8998	.9542	9010	.9547
23	.8919	.9503	.8931	.9509	.8943	.9515	8956	.9521	.8968	.9527	.8980	.9533
24	.8889	.9489	.8901	.9495	.8913	.9500	.8925	.9506	.8938	.9512	8950	.9518
25	.8859	.9474	.8871	.9480	.8883	.9486	.8895	.9492	8908	.9498	.8920	.9503
26	.8830	.9459	.8842	.9465	8854	.9471	.8866	.9477	.8878	.9483	8890	.9489
27	8800	.9445	.8812	.9451	.8824	.9457	.8836	.9463	.8848	.9469	8860	9474
28	.8771	.9430	8783	.9436	.8795	.9442	.8807	.9448	.8819	.9454	.8831	.9460
29	.8742	.9416	.8754	.9422	.8766	.9428	.8778	.9434	.8789	.9440	.8801	.9446
30	.8713	.9402	.8725	.9408	.8737	.9414	.8749	.9419	.8760	.9425	.8772	.9431
31	8684	.9387	.8696	.9393	.8708	.9399	.8720	.9405	.8732	.9411	.8743	.9417
32	.8656	.9373	.8668	.9379	.8679	.9385	.8691	.9391	.8703	.9397	.8715	.9403
33	8628	.9359	.8639	.9365	.8651	.9371	.8663	.9377	.8675	.9382	.8686	.9388
34	8599	.9345	.8611	.9351	.8623	.9357	.8635	.9362	.8646	.9368	.8658	.9374
35	.8572	.9331	.8583	.9336	8595	.9342	.8607	.9348	.8618	.9354	.8630	.9360

T°C.	741		742		743		744		745		746	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9405	.9734	.9418	.9740	.9431	.9745	.9443	.9751	.9456	.9757	.9469	.9763
11	.9372	.9718	.9385	.9724	.9397	.9730	.9410	.9736	.9423	.9742	.9435	.9748
12	.9339	.9703	.9352	.9709	.9364	.9715	.9377	.9721	.9390	.9727	.9402	.9732
13	.9307	.9688	.9319	.9694	.9332	.9700	.9344	.9705	.9357	.9711	.9369	.9717
14	9274	.9673	.9287	.9679	.9299	.9684	.9312	.9690	.9324	.9696	9337	.9702
15	9242	.9658	.9254	.9663	.9267	.9669	.9279	.9675	.9292	.9681	.9304	.9687
16	.9210	.9643	.9222	.9648	.9235	.9654	.9247	.9660	.9260	.9666	.9272	.9672
17	.9178	.9628	9191	.9633	.9203	.9639	.9215	.9645	.9228	.9651	.9240	.9657
18	.9147	.9613	9159	.9618	.9171	.9624	.9184	.9630	.9196	.9636	.9208	.9642
19	.9115	.9598	.9128	.9604	.9140	.9609	.9152	.9615	.9164	.9621	.9177	.9627
20	9084	.9583	.9096	.9589	.9109	.9595	.9121	.9600	.9133	.9606	.9145	.9612
21	.9053	.9568	.9065	.9574	.9078	.9580	.9090	.9586	.9102	.9591	9114	.9597
22	.9023	.9553	.9035	.9559	.9047	.9565	.9059	.9571	9071	.9577	.9083	.9582
23	.8992	.9539	9004	.9544	.9016	.9550	.9028	.9556	.9041	.9562	9053	.9568
24	.8962	.9524	.8974	.9530	.8986	.9536	.8998	.9541	.9010	.9547	.9022	.9553
25	.8932	.9509	.8944	.9515	.8956	.9521	.8968	.9527	.8980	.9533	.8992	.9539
26	.8902	.9495	.8914	.9501	.8926	.9506	.8938	.9512	.8950	.9518	.8962	.9524
27	.8872	.9480	.8884	.9486	.8896	.9492	.8908	.9498	.8920	.9504	8932	.9509
28	.8843	.9466	.8855	.9472	.8866	.9477	.8878	.9483	.8890	.9489	.8902	.9495
29	.8813	.9451	.8825	.9457	.8837	.9463	8849	.9469	.8861	.9475	.8873	.9481
30	8784	.9437	.8796	.9443	.8808	.9449	.8820	.9455	.8832	.9460	.8843	.9466
31	.8755	.9423	.8767	.9429	.8779	.9434	.8791	.9440	.8803	9446	.8814	.9452
32	.8727	.9408	8738	.9414	.8750	.9420	.8762	.9426	8774	9432	.8785	.9438
33	.8698	.9394	.8710	.9400	8721	.9406	.8733	.9412	8745	.9418	.8757	.9423
34	.8670	.9380	.8681	.9386	.8693	.9392	.8705	.9398	8716	.9403	.8728	.9409
35	.8642	.9366	.8653	.9372	.8665	.9378	.8676	.9383	8688	.9389	.8700	.9395

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	747		748		749		750		751		752	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9481	.9769	.9494	.9775	.9507	.9780	.9520	.9786	.9532	.9792	.9545	9798
11	9448	.9753	.9461	.9759	.9473	.9765	9486	.9771	.9499	.9777	9511	.9782
12	9415	.9738	.9427	.9744	.9440	9750	.9453	.9756	.9465	.9761	9478	.9767
13	9382	.9723	.9395	.9729	.9407	.9735	.9420	.9740	9432	.9746	9445	.9752
14	.9349	.9708	.9362	.9714	.9374	.9719	9387	.9725	.9399	.9731	9412	.9737
15	.9317	.9693	.9329	.9698	.9342	.9704	9354	.9710	.9367	.9716	9379	.9722
16	.9285	.9678	.9297	.9683	.9309	.9689	.9322	.9695	.9334	.9701	.9347	9707
17	.9252	.9663	.9265	.9668	.9277	.9374	9290	.9380	.9302	.9686	.9314	9692
18	.9221	.9648	.9233	.9653	.9245	.9659	.9258	.9665	.9270	.9671	.9282	.9677
19	9189	.9633	.9201	.9639	.9214	.9644	.9226	.9650	9238	.9656	.9251	.9662
20	.9158	.9618	.9170	.9624	.9182	.9629	9194	.9635	.9207	.9641	.9219	.9647
21	.9127	.9603	.9139	.9609	9151	.9615	.9163	.9320	.9175	.9626	.9188	.9632
22	.9096	.9588	.9108	.9594	.9120	.9600	.9132	9606	.9144	.9611	.9156	.9617
23	.9065	.9574	9077	.9579	.9039	.9585	.9101	.9591	.9113	.9597	9126	.9603
24	.9034	.9559	.9046	.9565	.9058	.9571	.9071	.9576	.9083	.9582	9095	.9588
25	.9004	.9544	.9016	.9550	.9028	.9556	.9040	.9562	.9052	.9568	9064	.9573
26	.8974	.9530	.8986	.9536	.8998	.9541	.9010	.9547	.9022	.9553	.9034	9559
27	.8944	.9515	.8956	.9521	8968	.9527	.8980	.9533	.8992	.9538	.9004	.9544
28	.8914	.9501	.8926	.9507	8938	.9512	.8950	.9518	.8962	.9524	8974	.9530
29	.8885	.9486	.8897	.9492	.8908	.9498	8920	.9504	.8932	.9510	.8944	.9515
30	.8855	.9472	.8867	.9478	.8879	.9484	8891	.9489	.8903	.9495	.8915	.9501
31	.8826	.9458	.8838	.9464	.8850	.9469	8862	.9475	.8873	.9481	.8885	.9487
32	.8797	.9443	.8809	.9449	.8821	.9455	8833	9461	.8844	.9467	.8856	.9472
33	.8768	.9429	.8780	.9435	.8792	.9441	8804	.9447	.8815	.9452	.8827	.9458
34	.8740	.9415	.8752	.9421	.8763	.9427	.8775	.9432	.8787	.9438	.8798	.9444
35	8711	.9401	.8723	.9407	8735	.9413	.8746	.9418	8758	.9424	.8770	.9430

T°C	753		754		755		756		757		758	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9558	.9803	9570	.9809	.9583	.9815	.9596	.9821	.9608	.9827	9621	.9832
11	.9524	.9788	.9537	.9794	.9549	.9800	.9562	.9805	.9575	.9811	.9587	.9817
12	.9491	.9773	9503	.9779	.9516	.9784	.9528	.9790	.9541	.9796	9554	.9802
13	.9457	.9758	.9470	.9763	.9482	.9769	.9495	.9775	.9508	.9781	.9520	.9786
14	.9424	.9743	.9437	.9748	.9449	.9754	.9462	.9760	.9474	.9766	9487	.9771
15	.9392	.9727	.9404	.9733	.9417	.9739	.9429	.9745	.9441	.9750	9454	.9756
16	.9359	.9712	.9372	.9718	.9384	.9724	.9396	.9730	.9409	.9735	.9421	.9741
17	.9327	.9697	.9339	.9703	.9352	.9709	.9364	.9715	.9376	.9720	9389	9726
18	.9295	.9682	.9307	.9688	.9319	.9694	9332	.9700	.9344	.9705	9356	.9711
19	.9263	.9667	.9275	.9673	.9287	.9679	.9300	.9685	.9312	.9690	.9324	.9696
20	.9231	.9653	.9244	.9658	9256	.9664	9268	.9670	.9280	.9676	9293	.9681
21	.9200	.9638	.9212	.9644	9224	.9649	.9236	.9355	.9249	.9361	9261	.9667
22	.9167	.9323	.9181	.9629	.9193	.9635	.9205	.9340	.9217	.9646	9230	.9652
23	.9138	.9608	.9150	.9314	.9162	.9320	9174	.9326	.9186	.9331	.9198	.9637
24	.9107	.9594	9119	.9599	.9131	.9605	.9143	.9611	.9155	.9617	.9167	.9622
25	.9076	.9579	.9088	.9585	.9100	.9591	.9112	.9596	.9124	.9602	9137	.9608
26	.9046	.9565	9058	.9570	.9070	.9576	.9082	.9582	.9094	9588	9106	9593
27	.9016	.9550	.9028	.9556	.9040	.9562	.9052	.9567	.9064	.9573	.9076	.9579
28	.8986	.9536	.8998	.9541	.9010	.9547	.9022	.9553	9034	.9559	.9045	.9564
29	.8956	.9521	.8968	.9527	.8980	.9533	.8992	.9538	.9004	.9544	.9015	.9550
30	8926	.9507	8938	.9513	.8950	.9518	.8962	.9524	.8974	.9530	.8986	.9536
31	.8897	.9492	.8909	.9498	.8921	.9504	.8933	.9510	.8944	.9515	.8956	.9521
32	.8868	.9478	.8880	.9484	.8891	9490	.8903	.9495	.8915	.9501	8927	.9507
33	.8839	.9464	.8851	.9470	8862	.9475	.8874	.9481	.8886	.9487	8898	.9493
34	.8810	.9450	.8822	.9456	.8833	.9461	.8845	.9467	.8857	.9473	8869	.9479
35	8781	.9436	.8793	.9441	.8805	.9447	.8816	.9453	.8828	.9459	8840	.9464

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	759		760		761		762		763		764	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9634	.9838	.9646	.9844	.9659	.9849	.9672	.9855	.9685	.9861	.9697	.9866
11	.9600	.9823	.9612	.9828	.9625	.9834	.9638	.9840	.9650	.9845	.9663	.9851
12	.9566	.9807	.9579	.9813	.9591	.9819	.9604	.9824	.9617	.9830	.9629	.9836
13	.9533	.9792	.9545	.9798	.9558	.9804	.9570	.9809	.9583	.9815	.9595	.9821
14	.9499	.9777	.9512	.9783	.9524	.9788	.9537	.9794	.9549	.9800	.9562	.9805
15	.9466	.9762	.9479	.9768	.9491	.9773	.9504	.9779	.9516	.9785	.9529	.9790
16	.9434	.9747	.9446	.9753	.9459	.9758	.9471	.9764	.9483	.9770	.9496	.9775
17	.9401	.9732	.9413	.9738	.9426	.9743	.9438	.9749	.9451	.9755	.9463	.9760
18	.9369	.9717	.9381	.9723	.9393	.9728	.9406	.9734	.9418	.9740	.9431	.9745
19	.9337	.9702	.9349	.9708	.9361	.9713	.9374	.9719	.9386	.9725	.9398	.9730
20	.9305	.9687	.9317	.9693	.9329	.9698	.9342	.9704	.9354	.9710	.9366	.9716
21	.9273	.9672	.9285	.9678	.9298	.9684	.9310	.9689	.9322	.9695	.9334	.9701
22	.9242	.9658	.9254	.9663	.9266	.9669	.9278	.9675	.9290	.9680	.9303	.9686
23	.9210	.9643	9223	.9649	.9235	.9654	.9247	.9660	.9259	.9666	.9271	.9671
24	.9179	.9628	.9192	.9634	.9204	.9640	.9216	.9645	.9228	.9651	.9240	.9657
25	.9149	.9614	.9161	.9619	.9173	.9625	.9185	.9631	.9197	.9636	.9209	.9642
26	.9118	.9599	9130	.9605	.9142	.9610	.9154	.9616	.9166	.9622	.9178	.9628
27	.9088	.9584	.9100	.9590	.9112	.9596	.9123	.9602	.9135	.9607	.9147	.9613
28	.9057	.9570	.9069	.9576	.9081	.9581	.9093	.9587	.9105	.9593	9117	.9599
29	.9027	.9556	.9039	.9561	.9051	.9567	.9063	.9573	.9075	.9578	.9087	.9584
30	.8998	.9541	9009	.9547	.9021	.9553	.9033	.9558	.9045	.9564	.9057	.9570
31	.8968	.9527	.8980	.9533	.8992	.9538	.9003	.9544	.9015	.9550	.9027	.9555
32	8939	.9513	.8950	.9518	.8962	.9524	.8974	.9530	.8986	.9535	.8997	.9541
33	8909	.9498	.8921	.9504	.8933	.9510	.8945	.9516	.8956	.9521	.8968	.9527
34	.8880	.9484	.8892	.9490	.8904	.9496	.8915	.9501	.8927	.9507	.8939	.9513
35	.8851	.9470	.8863	.9476	.8875	.9482	.8886	.9487	.8898	.9493	.8910	.9499

T°C.	765		766		767		768		769		770	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9710	.9872	.9723	.9878	.9735	.9883	.9748	.9889	.9761	.9895	.9773	.9900
11	9676	.9857	.9688	.9863	.9701	.9868	.9714	.9874	.9726	.9879	.9739	.9885
12	9642	.9842	.9654	.9847	.9667	.9853	.9680	.9859	.9692	.9864	.9705	.9870
13	9608	.9826	.9621	.9832	.9633	.9838	.9646	.9843	.9658	.9849	9671	.9855
14	.9575	.9811	.9587	.9817	.9600	.9823	.9612	.9828	.9625	.9834	.9637	.9839
15	.9541	.9796	.9554	.9802	.9566	.9807	.9579	.9813	.9591	.9819	.9604	.9824
16	9508	.9781	9521	.9787	.9533	.9792	.9546	.9798	.9558	.9804	.9570	.9809
17	9475	.9766	.9488	.9772	.9500	.9777	.9513	.9783	.9525	.9789	.9537	.9794
18	.9443	.9751	9455	.9757	.9468	.9762	.9480	.9768	.9492	.9774	.9505	.9779
19	9410	.9736	.9423	.9742	.9435	.9747	.9447	.9753	.9460	.9759	9472	.9764
20	.9378	.9721	.9391	.9727	.9403	.9733	.9415	.9738	.9427	.9744	.9440	.9750
21	.9346	.9706	.9359	.9712	.9371	.9718	.9383	.9723	.9395	.9729	.9408	.9735
22	.9315	.9692	9327	.9697	.9339	.9703	.9351	.9709	.9363	.9714	.9376	.9720
23	9283	.9677	.9295	.9683	.9308	.9688	.9320	.9694	.9332	.9700	.9344	.9705
24	9252	.9662	.9264	.9668	.9276	.9674	.9288	.9679	.9300	.9685	.9312	.9691
25	.9221	.9648	9233	.9653	.9245	.9659	.9257	.9665	.9269	.9670	.9281	.9676
26	.9190	.9633	9202	.9639	.9214	.9645	.9226	.9650	.9238	.9656	.9250	.9661
27	9159	.9619	.9171	.9624	.9183	.9630	.9195	.9636	.9207	.9641	.9219	.9647
28	9129	.9604	.9141	.9610	.9153	.9616	.9165	.9621	.9177	.9627	.9189	.9633
29	.9099	.9590	.9111	.9595	.9123	.9601	.9134	.9607	.9146	.9612	.9158	.9618
30	.9069	.9575	.9081	.9581	.9092	.9587	.9104	.9592	.9116	.9598	.9128	.9604
31	9039	.9561	.9051	.9567	.9062	.9572	.9074	.9578	.9086	.9584	.9098	.9589
32	.9009	.9547	.9021	.9553	.9033	.9558	9045	.9564	.9056	.9570	.9068	.9575
33	.8980	.9533	.8991	.9538	.9003	.9544	.9015	.9550	9027	.9555	.9038	.9561
34	.8950	.9518	8962	.9524	.8974	.9530	.8986	.9535	.8997	.9541	.9009	.9547
35	.8921	.9504	.8933	.9510	.8945	.9516	.8956	.9521	.8968	.9527	.8980	.9533

REDUCTION OF GAS VOLUME TO NORMAL CONDITIONS (Continued)

T°C.	771		772		773		774		775		776	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9786	.9906	.9799	.9912	.9811	.9917	.9824	.9923	.9837	.9929	9850	.9934
11	.9752	.9891	.9764	.9896	.9777	.9902	.9790	.9908	.9802	.9913	.9815	.9919
12	.9717	.9875	.9730	.9881	.9743	.9887	.9755	.9892	.9768	.9898	9780	.9904
13	.9683	.9860	.9696	.9866	.9708	.9872	.9721	.9877	.9734	.9883	.9746	.9888
14	.9650	.9845	.9662	.9851	.9675	.9856	.9687	.9862	.9700	.9868	.9712	.9873
15	.9616	.9830	.9629	.9836	.9641	.9841	.9654	.9847	.9666	.9852	.9678	.9858
16	.9583	.9815	.9595	.9821	.9608	.9826	.9620	.9832	.9633	.9837	.9645	.9843
17	.9550	.9800	.9562	.9806	.9575	.9811	.9587	.9817	.9599	.9822	.9612	.9828
18	.9517	.9785	.9529	.9791	.9542	.9796	.9554	.9802	.9566	.9807	9579	.9813
19	.9484	.9770	.9497	.9776	.9509	.9781	.9521	.9787	.9534	.9793	.9546	.9798
20	.9452	.9755	.9464	.9761	.9476	.9766	.9489	.9772	.9501	.9778	.9513	.9783
21	.9420	.9740	.9432	.9746	.9444	.9752	.9456	.9757	.9469	.9763	.9481	.9768
22	.9388	.9726	.9400	.9731	.9412	.9737	.9424	.9742	.9437	.9748	.9449	.9754
23	.9356	.9711	.9368	.9717	.9380	.9722	.9392	.9728	.9405	.9733	.9417	.9739
24	.9325	.9696	.9337	.9702	.9349	.9708	.9361	.9713	.9373	.9719	.9385	.9724
25	.9293	.9682	.9305	.9687	9317	.9693	.9329	.9699	.9341	.9704	.9354	.9710
26	.9262	.9667	.9274	.9673	.9286	.9678	.9298	.9684	.9310	.9690	.9322	.9695
27	.9231	.9653	.9243	.9658	.9255	.9664	.9267	.9669	.9279	.9675	.9291	.9681
28	.9201	.9638	.9213	.9644	.9224	.9649	.9236	.9655	.9248	.9661	.9260	.9666
29	.9170	.9624	.9182	.9629	.9194	.9635	.9206	.9641	.9218	.9646	.9230	.9652
30	.9140	.9609	.9152	.9615	.9164	.9621	.9175	.9626	.9187	.9632	.9199	.9637
31	.9110	.9595	.9122	.9601	.9133	.9606	.9145	.9612	.9157	.9618	.9169	.9623
32	.9080	.9581	.9092	.9586	.9103	.9592	.9115	.9598	.9127	.9603	.9139	.9609
33	.9050	.9567	.9062	.9572	.9074	.9578	.9085	.9583	9097	.9589	.9109	.9595
34	.9021	.9552	.9032	.9558	.9044	.9564	.9056	.9569	.9067	.9575	.9079	.9580
35	.8991	.9538	.9003	.9544	.9015	.9550	.9026	.9555	.9038	.9561	.9050	.9566

T°C.	777		778		779		780		782		784	
	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log	Value	Log
10	.9862	.9940	.9875	.9945	.9888	.9951	.9900	.9956	.9926	.9968	.9951	.9979
11	.9827	.9924	.9840	.9930	.9853	.9936	.9865	.9941	.9891	.9952	.9916	.9963
12	.9793	.9909	.9806	.9915	.9818	.9920	.9831	.9926	.9856	.9937	.9881	.9948
13	.9759	.9894	.9771	.9900	.9784	.9905	.9796	.9911	.9822	.9922	.9847	.9933
14	.9725	.9879	.9737	.9884	.9750	.9890	.9762	.9896	.9787	.9907	.9812	.9918
15	.9691	.9864	.9703	.9869	.9716	.9875	.9728	.9880	.9753	.9892	.9778	.9903
16	.9657	.9849	.9670	.9854	.9682	.9860	.9695	.9865	.9720	.9876	.9744	.9888
17	.9624	.9834	.9636	.9839	.9649	.9845	.9661	.9850	.9686	.9861	.9711	.9873
18	.9591	.9819	.9603	.9824	.9616	.9830	.9628	.9835	.9653	.9846	.9677	.9858
19	.9558	.9804	.9570	.9809	.9583	.9815	.9595	.9820	.9620	.9832	.9644	.9843
20	.9525	.9789	.9538	.9794	.9550	.9800	.9562	.9806	.9587	.9817	.9611	.9828
21	.9493	.9774	.9505	.9780	.9517	.9785	.9530	.9791	.9554	.9802	9579	.9813
22	.9461	.9759	.9473	.9765	.9485	.9770	.9497	.9776	.9522	.9787	.9546	.9798
23	.9429	.9745	.9441	.9750	.9453	.9756	.9465	.9761	.9490	.9772	.9514	.9784
24	.9397	.9730	.9409	.9736	.9421	.9741	.9433	.9747	.9458	.9758	.9482	.9769
25	.9366	.9715	.9378	.9721	.9390	.9727	.9402	.9732	.9426	.9743	9450	.9754
26	.9334	.9701	.9346	.9706	.9358	.9712	.9370	.9718	9394	.9729	.9418	.9740
27	9303	.9686	.9315	.9692	.9327	.9697	.9339	.9703	.9363	.9714	.9387	.9725
28	.9272	.9672	.9284	.9677	.9296	.9683	.9308	.9689	.9332	.9700	9356	.9711
29	.9241	.9657	.9253	.9663	.9265	.9669	.9277	.9674	.9301	.9685	.9325	.9696
30	.9211	.9643	.9223	.9649	.9235	.9654	.9247	.9660	.9270	.9671	9294	.9682
31	.9181	.9629	.9192	.9634	.9204	.9640	.9216	.9645	.9240	.9657	.9263	.9668
32	.9151	.9614	.9162	.9620	.9174	.9626	.9186	.9631	.9209	.9642	.9233	.9653
33	.9121	.9600	.9132	.9606	.9144	.9611	.9156	.9617	.9179	.9628	.9203	.9639
34	.9091	.9586	.9103	.9592	.9114	.9597	.9126	.9603	.9149	.9614	9173	.9625
35	.9061	.9572	.9073	.9578	.9085	.9583	.9096	.9589	.9120	.9600	.9143	.9611

REDUCTION OF GAS VOLUME

Values of (1 + at) for Temperatures from 0 to 120° C.

T	0	1	2	3	4	5	6	7	8	9
00	1.0000	1.0037	1.0073	1.0110	1.0147	1.0183	1.0220	1.0257	1.0294	1.0330
10	1.0367	1.0404	1.0440	1.0477	1.0514	1.0550	1.0587	1.0624	1.0661	1.0697
20	1.0734	1.0771	1.0807	1.0844	1.0881	1.0917	1.0954	1.0991	1.1028	1.1064
30	1.1101	1.1138	1.1174	1.1211	1.1248	1.1284	1.1321	1.1358	1.1395	1.1431
40	1.1468	1.1505	1.1541	1.1578	1.1615	1.1651	1.1688	1.1725	1.1762	1.1798
50	1.1835	1.1872	1.1908	1.1945	1.1982	1.2018	1.2055	1.2092	1.2129	1.2165
60	1.2202	1.2239	1.2275	1.2312	1.2349	1.2385	1.2422	1.2459	1.2496	1.2532
70	1.2569	1.2606	1.2642	1.2679	1.2716	1.2752	1.2789	1.2826	1.2863	1.2899
80	1.2936	1.2973	1.3009	1.3046	1.3083	1.3119	1.3156	1.3193	1.3230	1.3266
90	1.3303	1.3340	1.3376	1.3413	1.3450	1.3486	1.3523	1.3560	1.3597	1.3633
100	1.3670	1.3707	1.3743	1.3780	1.3817	1.3853	1.3890	1.3927	1.3964	1.4000
110	1.4037	1.4074	1.4110	1.4147	1.4184	1.4220	1.4257	1.4294	1.4331	1.4367
120	1.4404									

Values of H/760 for Pressures from 700 to 780 mm of Mercur

H	0	1	2	3	4	5	6	7	8	9
700	0.9211	0.9224	0.9237	0.9250	0.9263	0.9276	0.9289	0.9303	0.9316	0.9329
710	0.9342	0.9355	0.9368	0.9382	0.9395	0.9408	0.9421	0.9434	0.9447	0.9461
720	0.9474	0.9487	0.9500	0.9513	0.9526	0.9539	0.9553	0.9566	0.9579	0.9592
730	0.9605	0.9618	0.9632	0.9645	0.9658	0.9671	0.9684	0.9697	0.9711	0.9724
740	0.9737	0.9750	0.9763	0.9776	0.9789	0.9803	0.9816	0.9829	0.9842	0.9855
750	0.9868	0.9882	0.9895	0.9908	0.9921	0.9934	0.9947	0.9961	0.9974	0.9987
760	1.0000	1.0013	1.0026	1.0039	1.0053	1.0066	1.0079	1.0092	1.0105	1.0118
770	1.0132	1.0145	1.0158	1.0171	1.0184	1.0197	1.0211	1.0224	1.0237	1.0250
780	1.0263									

MECHANICAL EQUIVALENT OF HEAT

Observer.	Ergs per calorie (15°).	Observer.	Ergs per calorie (15°).
Joule, 1878	4.177×10^7	Callendar and Barnes, 1900	4.186×10^7
Rowland, 1879	4.188	Dieterici, 1905	4.1879
Griffiths, 1893	4.196	Blousfield, 1912	4.1791
Schuster and Gannon, 1898	4.196	Jaeger and Steinwehr, 1921	4.184

Accepted Values

1 gram calorie (20°C) = 4.181 joules
1 gram calorie (15°C) = 4.185 joules
1 gram calorie (mean) = 4.186 joules
1 British thermal unit (39°F) = 1060.4 joules
1 British thermal unit (60°F) = 1054.6 joules
1 British thermal unit (mean) = 1054.8 joules

SPECIFIC HEAT OF WATER

Specific Heat of Ice—Cal./g/°C

Temp. °C	Specific heat	Observer	Temp. °C.	Specific heat	Observer
−252 to −188	.146	Dieterici, 1903	−31.8	.4454	Dickinson-Osborne, 1915
−250	.0361		−23.7	.4599	Dickinson-Osborne, 1915
−200	.162	Mean	−24.5	.4605	Dickinson-Osborne, 1915
−188 to −78	.285	Dieterici, 1903	−20.8	.4668	Dickinson-Osborne, 1915
−180	.199	Nernst, 1910	−14.8	.4782	Dickinson-Osborne, 1915
−160	.230	Nernst, 1910	−14.6	.4779	Dickinson-Osborne, 1915
−150	.246		−11.0	.4861	Dickinson-Osborne, 1915
−140	.262	Nernst, 1910	− 8.1	.4896	Dickinson-Osborne, 1915
−100	.329	Mean	− 4.3	.4989	Dickinson-Osborne, 1915
− 78 to −18	.463	Dieterici, 1903	− 4.5	.4984	Dickinson-Osborne, 1915
− 60	.392		− 4.9	.4932	Dickinson-Osborne, 1915
− 38.3	.4346	Dickinson-Osborne, 1915	− 2.6	.5003	Dickinson-Osborne, 1915
− 34.3	.4411	Dickinson-Osborne, 1915	− 2.2	.5018	Dickinson-Osborne, 1915
− 30.6	.4488	Dickinson-Osborne, 1915			
		Water Below 0°C			
− 6	1.0119	Martinetti, 1890	− 3	1.0102	Martinetti, 1890
− 5	1.0155	Barnes, 1902	− 2	1.0097	Martinetti, 1890
− 5	1.0113	Martinetti, 1890	− 1	1.0092	Martinetti, 1890
− 4	1.0105	Martinetti, 1890			

Heat Capacity of Air-free Water 0°–100°C at 1 Atmosphere Pressure

The heat capacity of air-free water is given in international steam table calories per gram and in absolute joules per gram. (1 absolute joule—0.238846 I.T. Cal.).

The enthalpy or heat content is given for air-free water in I.T. Cal. per gram and in absolute joules per gram.

From Osborne, Stimson and Ginnings; B. of S. Jour. Res. **23**. 238, 1939.

Temp. °C	Thermal Capacity		Enthalpy	
	Cal./g/°C	Joules/g/°C	Cal./g	Joules/g
0	1.00738	4.2177	0.0245	0.1026
1	1.00652	4.2141	1.0314	4.3184
2	1.00571	4.2107	2.0376	8.5308
3	1.00499	4.2077	3.0429	12.7400
4	1.00430	4.2048	4.0475	16.9462
5	1.00368	4.2022	5.0515	21.1498
6	1.00313	4.1999	6.0549	25.3508
7	1.00260	4.1977	7.0578	29.5496
8	1.00213	4.1957	8.0602	33.7463
9	1.00170	4.1939	9.0621	37.9410
10	1.00129	4.1922	10.0636	42.1341
11	1.00093	4.1907	11.0647	46.3255
12	1.00060	4.1893	12.0654	50.5155
13	1.00029	4.1880	13.0659	54.7041
14	1.00002	4.1869	14.0660	58.8916

SPECIFIC HEAT OF WATER (Continued)

Heat Capacity of Air-free Water 0°–100°C at 1 Atmosphere Pressure
(Continued)

Temp. °C	Thermal Capacity		Enthalpy	
	Cal./g/°C	Joules/g/°C	Cal./g	Joules/g
15	.99976	4.1858	15.0659	63.0779
16	.99955	4.1849	16.0655	67.2632
17	.99933	4.1840	17.0650	71.4476
18	.99914	4.1832	18.0642	75.6312
19	.99897	4.1825	19.0633	79.8141
20	.99883	4.1819	20.0622	83.9963
21	.99869	4.1813	21.0609	88.1778
22	.99857	4.1808	22.0596	92.3589
23	.99847	4.1804	23.0581	96.5395
24	.99838	4.1800	24.0565	100.7196
25	.99828	4.1796	25.0548	104.8994
26	.99821	4.1793	26.0530	109.0788
27	.99814	4.1790	27.0512	113.2580
28	.99809	4.1788	28.0493	117.4369
29	.99804	4.1786	29.0474	121.6157
30	.99802	4.1785	30.0455	125.7943
31	.99799	4.1784	31.0435	129.9727
32	.99797	4.1783	32.0414	134.1510
33	.99797	4.1783	33.0394	138.3293
34	.99795	4.1782	34.0374	142.5076
35	.99795	4.1782	35.0353	146.6858
36	.99797	4.1783	36.0333	150.8641
37	.99797	4.1783	37.0312	155.0423
38	.99799	4.1784	38.0292	159.2207
39	.99802	4.1785	39.0272	163.3991
40	.99804	4.1786	40.0253	167.5777
41	.99807	4.1787	41.0233	171.7563
42	.99811	4.1789	42.0214	175.9351
43	.99816	4.1791	43.0195	180.1141
44	.99819	4.1792	44.0177	184.2933
45	.99826	4.1795	45.0159	188.4726
46	.99830	4.1797	46.0142	192.6522
47	.99835	4.1799	47.0125	196.8320
48	.99842	4.1802	48.0109	201.0120
49	.99847	4.1804	49.0094	205.1923
50	.99854	4.1807	50.0079	209.3729
51	.99862	4.1810	51.0065	213.5538
52	.99871	4.1814	52.0051	217.7350
53	.99878	4.1817	53.0039	221.9166
54	.99885	4.1820	54.0027	226.0984

SPECIFIC HEAT OF WATER (Continued)

Heat Capacity of Air-free Water 0°–100°C at 1 Atmosphere Pressure
(Continued)

Temp. °C	Thermal Capacity		Enthalpy	
	Cal/g/°C	Joules/g/°C	Cal/g	Joules/g
55	.99895	4.1824	55.0016	230.2806
56	.99905	4.1828	56.0006	234.4632
57	.99914	4.1832	56.9997	238.6462
58	.99924	4.1836	57.9989	242.8296
59	.99933	4.1840	58.9982	247.0134
60	.99943	4.1844	59.9975	251.1976
61	.99955	4.1849	60.9970	255.3822
62	.99964	4.1853	61.9966	259.5673
63	.99976	4.1858	62.9963	263.7529
64	.99988	4.1863	63.9962	267.9390
65	1.00000	4.1868	64.9961	272.1256
66	1.00014	4.1874	65.9962	276.3127
67	1.00026	4.1879	66.9964	280.5003
68	1.00041	4.1885	67.9967	284.6885
69	1.00053	4.1890	68.9972	288.8772
70	1.00067	4.1896	69.9977	293.0665
71	1.00081	4.1902	70.9985	297.2564
72	1.00096	4.1908	71.9994	301.4469
73	1.00112	4.1915	73.0004	305.6381
74	1.00127	4.1921	74.0016	309.8299
75	1.00143	4.1928	75.0030	314.0224
76	1.00160	4.1935	76.0045	318.2155
77	1.00177	4.1942	77.0062	322.4094
78	1.00194	4.1949	78.0080	326.6039
79	1.00213	4.1957	79.0101	330.7992
80	1.00229	4.1964	80.0123	334.9952
81	1.00248	4.1972	81.0147	339.1920
82	1.00268	4.1980	82.0172	343.3897
83	1.00287	4.1988	83.0200	347.5881
84	1.00308	4.1997	84.0230	351.7873
85	1.00327	4.2005	85.0262	355.9874
86	1.00349	4.2014	86.0295	360.1883
87	1.00370	4.2023	87.0331	364.3902
88	1.00392	4.2032	88.0369	368.5929
89	1.00416	4.2042	89.0410	372.7966
90	1.00437	4.2051	90.0452	377.0012
91	1.00461	4.2061	91.0497	381.2068
92	1.00485	4.2071	92.0545	385.4135
93	1.00509	4.2081	93.0594	389.6211
94	1.00535	4.2092	94.0647	393.8297

SPECIFIC HEAT OF WATER (Continued)

Heat Capacity of Air-free Water 0°–100°C at 1 Atmosphere Pressure
(Continued)

Temp. °C	Thermal Capacity		Enthalpy	
	Cal/g/°C	Joules/g/°C	Cal/g	Joules/g
95	1.00561	4.2103	95.0701	398.0395
96	1.00588	4.2114	96.0759	402.2503
97	1.00614	4.2125	97.0819	406.4622
98	1.00640	4.2136	98.0882	410.6753
99	1.00669	4.2148	99.0947	414.8895
100	1.00697	4.2160	100.1015	419.1049

Enthalpy of Air-saturated Water 1 Atmosphere Pressure 0–100°C

Temp. °C	Enthalpy		Temp.	Enthalpy	
	Cal/g	Joules/g	°C	Cal/g	Joules/g
0	0	0	75	74.9907	313.9712
5	5.0276	21.0496	80	80.0019	334.9519
10	10.0402	42.0363	85	85.0180	355.9532
15	15.0431	62.9826	90	90.0395	376.9773
20	20.0400	83.9034	95	95.0671	398.0270
25	25.0332	104.8089	100	100.1016	419.1053
30	30.0244	125.7063			
35	35.0149	146.6003			
40	40.0055	167.4949			
45	44.9968	188.3928			
50	49.9896	209.2964			
55	54.9842	230.2077			
60	59.9811	251.1289			
65	64.9808	272.0619			
70	69.9839	293.0087			

SPECIFIC HEAT OF WATER (Continued)

Specific Heat of Water Above 100°C

Mean specific heat of water in 15°C calories between 0°C and the temperature stated.

Heat content (Enthalpy) in joules per gram between 0°C and the temperature stated.

From data by Osborne, Stimson and Fiock, B of S Jour. Res. 5, 411, 1930.

Temp. °C	Specific heat mean 0–t°C	Heat content 0–t joules/g	Temp. °C	Specific heat mean 0–t°C	Heat content 0–t joules/g
100	1.0008	418.75	190	1.0153	807.15
110	1.0015	460.97	200	1.0181	852.02
120	1.0025	503.36	210	1.0212	897.35
130	1.0037	545.93	220	1.0247	943.24
140	1.0050	588.71	230	1.0285	989.75
150	1.0067	631.75	240	1.0326	1036.97
160	1.0083	675.06	250	1.0376	1084.97
170	1.0103	718.66	260	1.0423	1133.87
180	1.0127	762.72	270	1.0483	1184.32

Specific Heat of Super-heated Steam

Specific heat of steam under constant pressure given in atmospheres and at temperatures above saturation in cal./g./°C.

Temp. °C	Pressure in atmospheres						
	1	2	4	6	8	10	12
110	0.481						
120	0.477	0.498					
130	0.475	0.494					
140	0.473	0.489					
150	0.472	0.486	0.519				
160	0.471	0.483	0.512	0.549			
170	0.470	0.481	0.507	0.538			
180	0.469	0.479	0.502	0.528	0.561	0.602	
190	0.469	0.478	0.498	0.522	0.549	0.583	0.625
200	0.469	0.478	0.495	0.515	0.539	0.567	0.601
210	0.470	0.477	0.493	0.510	0.531	0.555	0.584
220	0.470	0.477	0.491	0.506	0.524	0.545	0.569
230	0.471	0.477	0.489	0.504	0.519	0.537	0.557
240	0.472	0.477	0.488	0.501	0.515	0.530	0.548
250	0.473	0.477	0.488	0.499	0.512	0.525	0.540
260	0.474	0.478	0.487	0.498	0.509	0.521	0.534
270	0.474	0.478	0.487	0.497	0.507	0.518	0.529
280	0.475	0.479	0.487	0.496	0.505	0.515	0.525
290	0.476	0.480	0.487	0.495	0.504	0.513	0.523
300	0.477	0.481	0.488	0.495	0.503	0.511	0.519

SPECIFIC HEAT OF WATER (Continued)

Specific Heat of Super-heated Steam (Continued)

Temp. °C	Pressure in atmospheres 1	2	4	6	8	10	12
310	0.478	0.482	0.488	0.495	0.502	0.510	0.518
320	0.480	0.483	0.489	0.496	0.502	0.509	0.516
330	0.482	0.484	0.490	0.496	0.502	0.508	0.515
340	0.483	0.485	0.491	0.496	0.502	0.507	0.513
350	0.484	0.486	0.492	0.497	0.502	0.507	0.512
360	0.485	0.487	0.492	0.497	0.502	0.507	0.511
370	0.486	0.488	0.493	0.498	0.503	0.507	0.511
380	0.488	0.490	0.494	0.498	0.503	0.507	0.511
390	0.489	0.491	0.495	0.499	0.503		
400	0.490	0.492	0.496	0.500	0.504		
410	0.492	0.494	0.497	0.501	0.505		
420	0.494	0.496	0.498	0.502	0.506		
430	0.495	0.497	0.500	0.504	0.507		
440	0.497	0.499	0.501	0.505	0.508		
450	0.498	0.500	0.503	0.506	0.509		
460	0.500	0.501	0.505	0.507	0.510		
470	0.502	0.503	0.506	0.508	0.512		
480	0.504	0.505	0.507	0.509	0.513		
490	0.505	0.506	0.509	0.511	0.514		
500	0.506	0.508	0.510	0.512	0.515		

HEAT CAPACITY OF MERCURY

The specific heat of solid mercury is given in relation to water at 15°C The values are from Carpenter and Stoodley, Phil. Mag. **10,** 249, 1930. Heat capacity is given in calories per gram and in calories per gram atom (1 cal = 4.1840 absolute joules and the atomic weight of mercury 200.61). Values for the liquid and vapor are from Douglas, Ball and Ginnings, Jour of Res. Bureau of Standards **46,** 334, 1951.

Temp. °C	Specific heat	Heat capacity cal/g-atom
	Solid	Solid
−75.6	.0319	6.3995
−72.9	.0324	6.4998
−65.4	.0324	6.4998
−59.5	.0324	6.4998
−44.9	.0336	6.7405
−42.2	.0336	6.7405
−40.0	.0337	6.7606
Temp. °C	**Heat capacity cal/g**	**Heat capacity cal/g-atom**
	Liquid	Liquid
−38.88	.033686	6.7578
−20	.033534	6.7272
0	.033382	6.6967
20	.033240	6.6683
25	.033206	6.6615
40	.033109	6.6419
60	.032987	6.6176
80	.032877	6.5954
100	.032776	6.5752
120	.032686	6.5571
140	.032606	6.5410
160	.032535	6.5270
180	.032476	6.5150

Temp. °C	Heat capacity cal/g	Heat capacity cal/g-atom
	Liquid	Liquid
200	.032426	6.5050
220	.032386	6.4970
240	.032356	6.4910
260	.032336	6.4869
280	.032325	6.4847
300	.032322	6.4843
320	.032330	6.4858
340	.032346	6.4890
356.58	.032366	6.4930
360	.032371	6.4940
380	.032404	6.5005
400	.032445	6.5087
420	.032494	6.5186
440	.032550	6.5298
460	.032614	6.5426
480	.032684	6.5567
500	.032762	6.5723
	Vapor	Vapor
0	.02476	4.968
100	.02476	4.968
200	.02477	4.969
300	.02480	4.975
400	.02489	4.993
500	.02507	5.030

SPECIFIC HEAT OF ELEMENTS

Element	Temp. °C	Sp. ht., cal./g
Aluminum	−250	0.0039
	−240.6	0.0092
	−233	0.0165
	−200	0.076
	−150	0.1367
	−100	0.1676
	−50	0.1914
	0	0.2079
	20	0.214
	100	0.225
	300	0.248
	600	0.277
liquid	660	0.25
Antimony	−207.1	0.0322
	−150	0.0412
	−100	0.0448
	−50	0.0476
	0	0.0494
	20–100	0.0504
	100	0.0513
	200	0.0520
	300	0.0537
	500	0.054
Argon, solid	−223	0.155
liquid	−100	0.134
Arsenic	−216	0.032
	−117.6	0.0666
	18	0.078
gray, crystal	0–100	0.0822
blk., amor	0–100	0.0861
Barium	−185 to +20	0.068
Beryllium	−202	0.017
	0–46	0.397
	0–100	0.425
	0–300	0.505
Bismuth	−150	0.0264
	−100	0.0273
	−50	0.0282
	0	0.0291
	20	0.0294
	100	0.0304
liquid	297	0.0292
	400	0.035
Boron	−191 to −78	0.071
	−76 to 0	0.168
	0–100	0.307
	100	0.287
	500	0.472
	900	0.510
Bromine, solid	−253.1	0.0205
	−173.1	0.0659
	−73.1	0.080
	−13.1	0.088
Bromine, liquid	13–45	0.107
Cadmium	−263	0.0019
	−203.1	0.0415
	−103.1	0.0518
	27.9	0.0552
	107.9	0.0569
	277	0.060
liquid	321	0.077
Calcium	−185 to +20	0.157
	0–20	0.145
	24	0.168
Calcium (continued)	100	0.1625
	300	0.1832
	600	0.188
Carbon, charcoal	0–24	0.165
diamond	−233	0.0005
	−185	0.0025
	−188 to −78	0.019
	−78 to +18	0.079
	0	0.1044
	20	0.12
	140	0.222
	223	0.264
	247	0.303
	606	0.441
	823	0.428
carbon, amor	26–76	0.168
graphite	−243	0.005
	−203	0.0175
	−191 to −79	0.057
	−66	0.053
	20	0.17
	85	0.177
	138	0.254
	642	0.445
	896	0.454
Cerium	−253 to −196	0.033
	0–100	0.0423
	20–100	0.0511
Cesium, solid	20	0.052
	0–26	0.0482
liquid	50	0.058
Chlorine	−113	0.19
liquid	0–24	0.226
Chromium	−150	0.0599
	−100	0.0797
	−50	0.0941
	0	0.1044
	20	0.11
	18–100	0.111
	100	0.112
	400	0.133
	500	0.150
	600	0.187
Cobalt	−150	0.0672
	−100	0.0809
	−50	0.0914
	0	0.1028
	20	0.1001
	100	0.1067
	200	0.1134
	300	0.121
	*508	0.145 0.125
	800	0.160
	1000	0.184
	*1112	0.270 0.170
Copper	−253	0.0031
	−189	0.0506
	−150	0.0574
	−100	0.0783
	−50	0.0862
	0	0.0910

* Temperatures of transformation.

SPECIFIC HEAT OF ELEMENTS (Continued)

Element	Temp °C	Sp. ht., cal /g
Copper (continued)	20	0.0921
	15–100	0.09305
	100	0.0939
	200	0.0963
	900	0.1259
	18–100	0.0928
liquid	1084	0.101
Gallium	−258.1	0.0049
	−213.1	0.044
	−73.1	0.084
	12–23	0.079
liquid	13–110	0.080
	119	0.079
Germanium	0–100	0.074
Gold	−258.1	0.0018
	−209.5	0.0211
	−150	0.0266
	−100	0.0281
	−50	0.0293
	0	0.0302
	18	0.0312
	0–100	0.0316
	100	0.0314
liquid	1100	0.0327
Hydrogen, solid	−260.6	0.57
liquid	−252	0.231
Indium	−186 to −79	0.0263
	−79 to +18	0.0303
	0–100	0.057
Iodine	−263.2	0.0037
	−255.9	0.0118
	−221.1	0.0353
	−90 to +17	0.0485
	20	0.0523
liquid	107–180	0.108
Iridium	−186 to +18	0.0282
	18–100	0.0323
	0–900	0.0371
Iron, cast	20–100	0.1189
wrought	15–100	0.1152
hard drawn	20–100	0.1146
pure	−256.2	0.00067
	−214.0	0.0194
	−172.6	0.0512
	−67.5	0.0939
	0	0.1043
	20	0.107
α, β, γ	100	0.115
	500	0.163
	760	0.320
	1000	0.162
γ	100	0.127
	700	0.157
	1000	0.162
Lanthanum	0–100	0.0448
Lead	−270	0.00001
	−267	0.00086
	−259	0.0073
	−150	0.0279
	−100	0.0283
	−50	0.0289
	0	0.0297
	20	0.0306
	100	0.0320
Lead (continued)	300	0.0356
liquid	360	0.0375
	500	0.0370
Lithium	−183	0.3
	−100	0.600
	0	0.79
	50	0.96
	100	1.0407
	190	1.374
Magnesium	−150	0.1767
	−100	0.2025
	−50	0.2228
	0	0.2316
	20	0.246
	100	0.257
	300	0.279
	600	0.311
liquid	650–775	0.284
Manganese	−188 to −79	0.0820
	−100	0.0979
	0	0.1072
	20–100	0.1211
	60	0.1211
	325	0.1783
Mercury, solid	−263.3	0.00552
	−259.8	0.00783
	−245.6	0.0172
	−220.2	0.0255
	−163.7	0.0298
	−81.4	0.0324
	−43.1	0.0337
liquid	−33.1	0.0338
	0	0.03346
	20	0.03325
	40	0.03308
	60	0.03294
	100	0.03269
	200	0.0323
	250	0.0321
Molybdenum	−257	0.0004
	−239.1	0.0034
	−181.5	0.0300
	−152.7	0.0399
	−34.5	0.0561
	0	0.0589
	20–100	0.065
	250	0.0632
	475	0.0750
Neodymium	0–100	0.045
Nickel	−258	0.0008
	−247.9	0.0024
	−201.2	0.0363
	−150	0.0660
	−100	0.0817
	−50	0.0940
	0	0.1032
	20	0.105
	100	0.1146
	500	0.1270
	800	0.1413
liquid	1452	0.13
Nitrogen, solid	−212	0.39
liquid	−200	0.474

SPECIFIC HEAT OF ELEMENTS (Continued)

Element	Temp. °C	Sp. ht., cal./g
Osmium	19-98	0.0311
Oxygen, solid	−221.8	0.336
liquid	−200	0.394
Palladium	−180 to +18	0.0528
	0	0.0538
	100	0.0564
	500	0.0653
	900	0.0717
	1500	0.0766
Phosphorus, yellow	−136	0.124
	−40	0.165
	9	0.189
red	−136	0.107
	−40	0.182
	9	0.190
Platinum	−255.6	0.00123
	−237.7	0.0073
	−191.7	0.0211
	−152.1	0.0261
	−64.8	0.0307
	0	0.03162
	20	0.0324
	500	0.0349
	750	0.0365
	1000	0.0381
	1300	0.0400
Potassium	−258.4	0.032
	−255.8	0.045
	−201.3	0.140
	−53.1	0.172
	14	0.18
	22-56	0.192
liquid	63	0.18
	78-100	0.217
	90	0.200
	181	0.196
Praseodymium	0-100	0.046
Rhenium	0-20	0.035
Rhodium	10-97	0.058
Rubidium, solid	0	0.0802
liquid	50	0.0908
Ruthenium	0-100	0.0611
Selenium	−188 to +18	0.068
	3	0.072
	20.5	0.077
	29.5	0.085
	32	0.127
	38	0.131
Silicon	−212	0.029
	−143.3	0.087
	−86.2	0.126
	13.9	0.168
	18.2-99.1	0.181
	18.0-900.6	0.210
Silver	−238	0.0146
	−150	0.0461
	−100	0.0505
	−50	0.0537
	0	0.0557
	20	0.0558
	100	0.0564
Silver (continued)	500	0.0581
	800	0.076
liquid	900	0.0685
Sodium	−256.1	0.026
	−238.5	0.108
	−155.5	0.245
	−40	0.279
	20	0.295
liquid	100	0.32
Sulfur	−188 to +18	0.137
rhombic	15-96	0.176
monocl	0-52	0.181
liquid	115-160	0.220
Tantalum	−201.7	0.0205
	20	0.036
	380	0.035
	900	0.036
	1100	0.043
	1400	0.044
Tellurium	−188 to +18	0.047
cryst	15-100	0.0483
	15-200	0.0487
Thallium	−185 to +20	0.038
	28	0.0311
	20-100	0.0326
Thorium	−253 to −196	0.0197
	0-100	0.0276
Tin	−186 to −79	0.0486
	−186.7	0.0422
	−150	0.0450
	−100	0.0483
	−50	0.0512
	0	0.0536
	18	0.0542
	100	0.0577
liquid	1100	0.0758
gray	20	0.515
Titanium	−185 to +20	0.082
	0-100	0.1125
Tungsten	−247.1	0.0012
	−218.4	0.0098
	−173.1	0.0205
	−73.1	0.0288
	20-100	0.034
	100	0.0320
	500	0.0344
	1000	0.0367
	1500	0.0390
Uranium, *α*	0	0.0275
	100	0.02919
	200	0.03135
	400	0.03681
	600	0.04521
, *β*	700	0.04262
, *γ*	800	0.03843
Vanadium	0-100	0.1153
Zinc	−201.3	0.0573
	−100	0.0814
	0	0.0913
	20	0.0925
	100	0.0957
Zirconium	0-100	0.068

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS

Specific heat is given in calories (15°) per gram per degree Centigrade. To change to joules per gram per degree Centigrade multiply by 4.185.

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Aluminum chloride	$AlCl_3$		.188
chloride	$AlCl_3 6H_2O$	35	.313
fluoride	AlF_3	35	.229
fluoride	$2AlF_3 \cdot 7H_2O$	35	.342
hydroxide	$Al(OH)_3$	0	.177
		50	.202
oxide	Al_2O_3	0	.174
		50	.198
sulfate	$Al_2(SO_4)_3$	50	.184
sulfate	$Al_2(SO_4)_3 \cdot 18H_2O$	34	.354
Ammonia	NH_3	−103 to −188	.502
Ammonium bromide	NH_4Br	20	.210
chloride	NH_4Cl	−200	.121
		−100	.263
		0	.357
		50	.389
iodide	NH_4I	0	.111
		50	.118
nitrate	NH_4NO_3	−100	.306
		0	.397
		100	.428
sulfate	$(NH_4)_2SO_4$	−100	.283
		0	.337
		50	.345
Antimony trisulfide	Sb_2S_3	0	.0829
Arsenous oxide	As_2O_3	0	.117
Barium carbonate	$BaCO_3$	0	.0999
		100	.110
chlorate	$Ba(ClO_3)_2 \cdot H_2O$	32	.158
chloride	$BaCl_2 \cdot 2H_2O$	0	.140
nitrate	$Ba(NO_3)_2$	47	.148
sulfate	$BaSO_4$	0	.111
thiosulfate	BaS_2O_3	58	.162
Beryllium oxide	BeO	50	.260
sulfate	$BeSO_4$	50	.198
Bismuth sulfide	Bi_2S_3	50	.0600
trioxide	Bi_2O_3	50	.0569
Cadmium nitrate	$Cd(NO_3)_2 \cdot 4H_2O$	40	.260
sulfate	$3CdSO_4 \cdot 8H_2O$	0	.195
		20	.200
sulfide	CdS	0	.0882
		50	.0922
Calcium carbonate	$CaCO_3$	0	.203
		100	.214
chloride	$CaCl_2$	61	.164
chloride	$CaCl_2 \cdot 6H_2O$	0	.320
fluoride	CaF_2	0	.204
		40	.212
formate	$Ca(HCO_2)_2$	0	.238
hydroxide	$Ca(OH)_2$	0	.260
		50	.288
molybdate	$CaMoO_4$	15	.165
oxide	CaO	0	.177
		100	.197

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Calcium			
sulfate	$CaSO_4{\cdot}2H_2O$	36	.265
tungstate	$CaWO_4$	15	.104
Carbon dioxide, solid	CO_2	−225	.124
monoxide, solid	CO	−220	.417
		−206	.457
Ceric oxide	CeO_2	0	.0870
		50	.0946
sulfate	$Ce(SO_4)_2$	50	.117
sulfate	$CeSO_4{\cdot}5H_2O$	50	.201
Chromic oxide	Cr_2O_3	0	.168
		50	.189
sulfate	$Cr_2(SO_4)_3$	50	.172
sulfate	$Cr_2(SO_4)_3{\cdot}5H_2O$	50	.200
Cobaltous nitrate	$Co(NO_3)_2{\cdot}6H_2O$	32	.373
sulfate	$CoSO_4{\cdot}7H_2O$	48	.342
Columbium pentoxide	Cb_2O_5	50	.101
Copper ammonium sulfate	$CuSO_4{\cdot}(NH_4)_2SO_4{\cdot}6H_2O$	0	.256
Copper sulfate	$CuSO_4{\cdot}H_2O$	0	.172
		50	.191
sulfate	$CuSO_4{\cdot}3H_2O$	9	.228
sulfate	$CuSO_4 5H_2O$	0	.253
		50	.287
Cupric carbonate	$2CuO{\cdot}CO_2{\cdot}H_2O$	57	.177
chloride	$CuCl_2$	58	.139
oxide	CuO	0	.125
		100	.144
sulfide	CuS	0	.129
		100	.151
Cuprous iodide	CuI	0	.0658
		50	.0671
oxide	Cu_2O	0	.110
		100	.116
selenide	Cu_2Se	60	.104
sulfide	Cu_2S	0	.148
		50	.166
Erbium oxide	Er_2O_3	50	.0650
Ferric oxide	Fe_2O_3	0	.148
		100	.182
Ferrosoferric oxide (magnetite)	Fe_3O_4	0	.151
		100	.179
Ferrous carbonate	$FeCO_3$	54	.194
sulfate	$FeSO_4$	45	.167
sulfate	$FeSO_4{\cdot}4H_2O$	9	.284
sulfate	$FeSO_4{\cdot}7H_2O$	0	.325
		10	.337
sulfide	FeS	0	.135
Gallium sesqui-oxide	Ga_2O_3	50	.105
Gold iodide	AuI	0	.0404
		50	.0432
Hydrogen peroxide	H_2O_2	−25	.471
Indium sesquioxide	In_2O_3	50	.0808
Iron diarsenide	$FeAs_2$	50	.0860
disulfide	FeS_2	0	.118
		50	.128
Lanthanum sesquioxide	La_2O_3	50	.0750

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Lead ammonium chloride	$2PbCl_2 \cdot NH_4Cl$	10	.0865
Lead borate	PbB_2O_4	57	.0903
Lead bromide	$PbBr_2$	0	.0502
		50	.0530
carbonate	$PbCO_3$	32	.0800
chloride	$PbCl_2$	0	.0649
		100	.0681
chromate	$PbCrO_4$	35	.0908
dioxide	PbO_2	0	.0619
		50	.0650
iodide	PbI_2	0	.0417
		100	.0437
molybdate	$PbMoO_4$	15	.100
monoxide	PbO	0	.0483
		50	.0509
nitrate	$Pb(NO_3)_2$	45	.115
pyrophosphate	$Pb_2P_2O_7$	55	.0820
silicate	$PbSiO_3$	60	.0779
sulfate	$PbSO_4$	45	.0839
sulfide	PbS	0	.0502
		100	.0511
thiosulfate	PbS_2O_3	58	.0918
tungstate	$PbWO_4$	15	.0769
Lithium chloride	$LiCl$	55	.282
fluoride	LiF	10	.373
hydride	LiH	0	.980
		50	1.07
hydroxide	$LiOH$	0	.327
		50	.356
nitrate	$LiNO_3$	210	.387
thiosulfate	$Li_2S_2O_3$	58	.0920
Magnesium carbonate	$MgCO_3$	25	.200
chloride	$MgCl_2 \cdot 6H_2O$	44	.378
chloride	$MgCl_2$	48	.194
nitrate	$Mg(NO_3)_2 \cdot 6H_2O$	55	.887
oxide	MgO	0	.209
		50	.232
sulfate	$MgSO_4 \cdot 7H_2O$	12	.361
sulfate	$MgSO_4 \cdot 6H_2O$	9	.349
sulfate	$MgSO_4H_2O$	9	.239
sulfate	$MgSO_4$	61	.222
Manganese dioxide	MnO_2	0	.152
		50	.163
nitrate	$Mn(NO_3)_2 \cdot 6H_2O$	47	.373
Manganic oxide	Mn_2O_3	58	.162
oxide	$Mn_2O_3 \cdot 3H_2O$	38	.177
Manganous oxide	MnO	58	.158
sulfate	$MnSO_4 \cdot 5H_2O$	32	.323
sulfate	$MnSO_4$	61	.182
Mercuric chloride	$HgCl_2$	0	.0640
		100	.0669
cyanide	$Hg(CN)_2$	29	.100
iodide	HgI_2 (red)	0	.0404
		50	.0413
oxide	HgO	0	.0485
		50	.0521
sulfide	HgS	0	.0506
		50	.0520

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Mercurous chloride	$HgCl$	0	.0499
		50	.0512
sulfate	Hg_2SO_4	0	.0616
		50	.0680
Molybdenum trioxide	MoO_3	54	.134
Nickel nitrate	$Ni(NO_3)_2 \cdot 6H_2O$	80	.473
sulfate	$NiSO_4 \cdot 6H_2O$	35	.313
sulfate	$NiSO_4$	58	.225
sulfide	NiS	0	.116
		100	.128
Nitrogen pentoxide	N_2O_5	−80 to −5	.239
Potassium acetate	$KC_2H_3O_2$	20	.272
	$KHSO_4$	35	.244
aluminum sulfate, (alum)	$K_2SO_4Al_2(SO_4)_3 \cdot 24H_2O$	0	.324
		50	.360
Potassium arsenate, acid	KH_2AsO_4	31	.174
Potassium bromide	KBr	0	.104
		100	.108
	K_2CO_3	47	.210
chlorate	$KClO_3$	0	.191
		50	.205
chloride	KCl	0	.162
		100	.168
chloroplatinate	K_2PtCl_6	30	.112
chromate	K_2CrO_4	46	.186
dichromate	$K_2Cr_2O_7$	0	.178
ferricyanide	$K_3Fe(CN)_6$	26	.232
ferrocyanide	$K_4Fe(CN)_6$	0	.210
		50	.225
ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$	0	.267
		50	.285
fluoride	KF	0	.199
		50	.204
metaborate	$K_2B_2O_4$	57	.225
nitrate	KNO_3	0	.214
		100	.240
perchlorate	$KClO_4$	30	.189
phosphate, dihydrogen	KH_2PO_4	33	.208
pyrophosphate	$K_4P_2O_7$	58	.191
thiosulfate	$K_2S_2O_3$	60	.196
Silicon carbide	SiC	0	.143
		100	.194
Silver bromide	$AgBr$	0	.0695
		100	.0734
chloride	$AgCl$	0	.0848
		50	.0906
cyanate	$AgCNO$	40	.124
iodide	AgI	0	.0548
		100	.0593
nitrate	$AgNO_3$	50	.146
selenide	Ag_2Se	37 to 187	.0693
sulfide	Ag_2S	0	.0719
		50	.0748
Sodium acetate	$NaC_2H_3O_2$	38	.339
acetate	$NaC_2H_3O_2 \cdot 3H_2O$	0	.344
		40	.602

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Sodium bromide	$NaBr$	0	.118
		100	.124
carbonate	Na_2CO_3	45	.256
chloride	$NaCl$	0	.204
		100	.217
fluoride	NaF	0	.258
		100	.279
formate	$NaHCO_2$	46	.306
iodide	NaI	0	.0829
		50	.0848
metaborate	$Na_2B_2O_4$	57	.253
nitrate	$NaNO_3$	0	.247
		50	.270
phosphate, di-	$Na_2HPO_4 \cdot 12H_2O$	0	.404
		50	.464
phosphate, di-	$Na_2HPO_4 \cdot 7H_2O$	0	.351
		50	.406
pyrophosphate	$Na_4P_2O_7$	50	.227
sulfate	Na_2SO_4	0	.202
		100	.220
tetraborate	$Na_2B_4O_7$	45	.234
tetraborate (borax)	$Na_2B_4O_7 \cdot 10H_2O$	35	.385
thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	21	.346
thiosulfate	$Na_2S_2O_3$	9	.220
Stannic oxide	SnO_2	45	.0898
sulfide	SnS_2	54	.119
Stannous chloride	$SnCl_2$	60	.102
sulfide	SnS	56	.0839
Strontium molybdate	$SrMoO_4$	15	.148
nitrate	$Sr(NO_3)_2$	32	.182
sulfate	$SrSO_4$	48	.143
Sulfuric acid	H_2SO_4	−30	.239
		0	.270
Sulfur dioxide	SO_2	−185 to −103	.229
Thallium monochloride	$TlCl$	0	.0520
		100	.0542
Thorium chloride	$ThCl$	30	.406
dioxide	ThO_2	0	.0571
		50	.0589
sulfate	$Th(SO_4)_2$	50	.0980
Tin see under Stannous and Stannic			
Titanium dioxide	TiO_2	0	.168
Tungsten trioxide	WO_3	0	.0743
		50	.0832
Uranium oxide (ous-ic)	U_3O_8	0	.0671
		50	.0750
Uranium trichloride	UCl_3	100	.07167
Uranium tetrachloride	UCl_4	100	.07923
Water, solid	H_2O	−250	.0361
		−200	.156
		−150	.246
		−100	.332
		−40	.435
		0	.492
Yttrium oxide	Y_2O_3	57	.112
Zinc chloride	$ZnCl_2$	60	.136

SPECIFIC HEAT OF SOLID INORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Zinc nitrate	$Zn(NO_3)_2 \cdot 6H_2O$	30	.318
oxide	ZnO	0	.114
		100	.129
sulfate	$ZnSO_4 \cdot 7H_2O$	0	.322
sulfate	$ZnSO_4 \cdot 6H_2O$	9	.299
sulfate	$ZnSO_4 \cdot H_2O$	9	.194
sulfate	$ZnSO_4$	50	.174
sulfide	ZnS	0	.116
		100	.118
Zirconium dioxide	ZrO_2	0	.103

SPECIFIC HEAT OF LIQUID INORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Specific Heat Cal. (15°)/g
Ammonia	NH_3	−60	1.047
		0	1.098
		20	1.125
		100	1.48
Calcium chloride	$CaCl_2 \cdot 6H_2O$	33–99	.552
Hydrogen peroxide	H_2O_2	0	.578
Lead bromide	$PbBr_2$	550	.0779
chloride	$PbCl_2$	540	.121
Lithium nitrate	$LiNO_3$	280	.390
Potassium dichromate	$K_2Cr_2O_7$	397	.0335
nitrate	KNO_3	380	.0332
Silver bromide	$AgBr$	500	.0760
chloride	$AgCl$	490	.129
nitrate	$AgNO_3$	250	.187
Sodium acetate	$NaC_2H_3O_2$	61.8	.846
chlorate	$NaClO_3$	280	.325
nitrate	$NaNO_3$	350	.430
thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	13–98	.570
Stannic chloride	$SnCl_4$	14–98	.148
Sulfur dioxide	SO_2	−20	.313
		0	.318
		20	.327
		100	.418
Sulfuric acid	H_2SO_4	10	.339
acid pyro-	$H_2S_2O_7$	35	.334
Water	H_2O See special table		

MEAN SPECIFIC HEATS OF LIQUID METALS AND LIQUID SALTS

(National Bureau of Standards)
(In calories per mean-gram-atom deg. C)

Composition	Freezing Point (°C)	Mean Specific Heat	Temperature (°C.)	Temperature Coefficient (% per degree C.)
Metals and Alloys				
Li	181	7.10	181–400	−0.019
Na	98	7.29	100–400	−0.026
$2Na + 1K$	25	7.3_1	25–400	−0.02
$3Na + 2K$	10	7.35	10–400	−0.028
$1Na + 2K$	−10	7.33	0–400	−0.023
K	63	7.34	63–400	−0.020
Pb	327	7.10	327–900	−0.010
$9Pb + 11Bi$	125	7.0_8	125–800	-0.0_2
Hg	−39	6.68	−39–100	−0.024
Salts				
NaOH	319	6.7	319–700	−0.007
LiF	848	7.7^8	848–900	0.0
LiCl	607	7.75^6	607–900	−0.010
$3LiCl + 2KCl$	352	8.66	352–800	−0.014
KCl	771	8.79	771–900	0.00

SPECIFIC HEAT OF SOLID ORGANIC COMPOUNDS

Specific heat is given in calories (15°) per gram per degree Centigrade. To change to joules per gram per degree Centigrade multiply by 4.185.

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Acetic acid	CH_3CO_2H	0	.487
Acetone	$(CH_3)_2CO$	−210	.540
o-Aminobenzoic acid	$H_2NC_6H_4CO_2H$	85	.254
m-Aminobenzoic acid		120	.253
p-Aminobenzoic acid		128	.287
Aniline	$C_6H_5NH_2$	?	.741
Anthracene	$C_{14}H_{10}$	50	.308
		100	.350
Anthraquinone	$(C_6H_4)_2(CO)_2$	0	.258
Azobenzene	$(C_6H_5N)_2$	28	.330
Benzene	C_6H_6	−250	.0399
		−200	.124
		−100	.227
		−50	.299
Benzoic acid	$C_6H_5CO_2H$	20	.287
Benzophenone	$(C_6H_5)_2CO$	−150	.115
		−50	.220
		0	.275
		20	.303
Betol	$HOC_6H_4CO_2C_{10}H_7$	−150	.129
		−100	.167
o-Bromochlorobenzene	C_6H_4BrCl	−34	.192
m-Bromochlorobenzene		−52	.150
p-Bromochlorobenzene		−40	.150
		0	.170
o-Bromoiodobenzene	C_6H_4BrI	−50	.143
m-Bromoiodobenzene		−75 to −15	.143
p-Bromoiodobenzene		−40	.116
β-Bromonaphthalene	$C_{10}H_7Br$	41	.260
Bromophenol	HOC_6H_4Br	32	.263
Camphene	$C_{10}H_{16}$	35	.380
Capric acid	$CH_3(CH_2)_8CO_2H$	8	.695
Caprylic acid	$CH_3(CH_2)_6CO_2H$	−2	.628
Carbon tetrachloride	CCl_4	−200	.0812
		−80	.182
		−40	.201
Catechol	$C_6H_4(OH)_2$	163	.278
Chloral alcoholate	$CCl_3CHO\cdot C_2H_5OH$	78	.509
hydrate	$CCl_3CHO\cdot H_2O$	32	.213
Chloroacetic acid	CH_2ClCO_2H	60	.363
p-Chlorobenzoic acid	$ClC_6H_4CO_2H$	80	.228
m-Chlorobenzoic acid		94	.232
p-Chlorobenzoic acid		180	.242
Crotonic acid	$CH_3CHCHCO_2H$	38	.520
Cyamelide	$C_3H_3O_3N_3$	40	.263
Cyanuric acid	$(HNCO)_3$	40	.318
Dextrose	$C_6H_{12}O_6$	−250	.0155
		0	.277
		20	.275
Dextrin	$(C_6H_{10}O_5)x$	0 to 90	.292
o-Dibromobenzene	$C_6H_4Br_2$	−36	.249
m-Dibromobenzene		−25	.134
p-Dibromobenzene		−50	.139
Dichloroacetic acid	$CHCl_2CO_2H$	solid	.406
o-Dichlorobenzene	$C_6H_4Cl_2$	−48.5	.185

SPECIFIC HEAT OF SOLID ORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
m-Dichlorobenzene		−52	.186
p-Dichlorobenzene		−50	.219
Dicyandiamide	$C_2H_4N_4$	0 to 204	.456
Dulcitol	$C_6H_8(OH)_6$	20	.282
m-Diiodobenzene	$C_6H_4I_2$	−52	.100
p-Diiodobenzene		−50	.101
Dibenzyl	$(C_6H_5CH_2)_2$	28	.363
Dimethyl oxalate	$(CO_2CH_3)_2$	10	.212
Dimethylpyrone	$(CH_3)_2C_5H_2O_2$	50	.368
o-Dinitrobenzene	$C_6H_4(NO_2)_2$	−160	.252
m-Dinitrobenzene		−160	.248
p-Dinitrobenzene		119	.259
Diphenyl	$(C_6H_5)_2$	40	.385
Diphenylamine	$(C_6H_5)_2NH$	26	.337
Ethyl alcohol (crystalline)	C_2H_5OH	−190	.232
(vitreous)		−190	.260
Erythritol	$(CHOHCH_2OH)_2$	60	.351
Formic acid	HCO_2H	−22	.387
		0	.430
Glutaric acid	$(CH_2)_3(CO_2H)_2$	20	.299
Glyceral	$C_3H_5(OH)_3$	−250	.0471
		−200	.115
		−100	.217
		0	.330
Glycol	$(CH_2OH)_2$	40	.528
Hexadecane	$C_{16}H_{34}$	19	.495
Iodobenzene	C_6H_5I	40	.191
Lactose	$C_{12}H_{22}O_{11}$	20	.287
	$C_{12}H_{22}O_{11}\cdot H_2O$	20	.299
Lauric acid	$C_{11}H_{23}CO_2H$	−30	.430
Levulose	$C_6H_{12}O_6$	20	.275
Malonic acid	$CH_2(CO_2H)_2$	20	.275
Maltose	$C_{12}H_{22}O_{11}$	20	.320
Mannitol	$C_6H_8(OH)_6$	0	.313
Melamine	$C_3H_6N_6$	40	.351
Myristic acid	$C_{13}H_{27}CO_2H$	0	.381
Naphthalene	$C_{10}H_8$	−130	.281
α-Naphthol	$C_{10}H_7OH$	50	.240
β-Naphthol		61	.252
α-Naphthylamine	$C_{10}H_7NH_2$	0	.270
m-Nitroaniline	$H_2NC_6H_4NO_2$	−160	.275
o-Nitroaniline		−160	.269
p-Nitroaniline		−160	.276
Nitrobenzene	$C_6H_5NO_2$	20	.349
		100	.356
o-Nitrobenzoic acid	$NO_2C_6H_4CO_2H$	−163	.256
m-Nitrobenzoic acid		−160	.247
Nitronaphthalene	$C_{10}H_7NO_2$	0	.236
Oxalic acid	$(CO_2H)_2\cdot 2H_2O$	0	.338
		50	.385
Palmitic acid	$C_{15}H_{31}CO_2H$	−180	.167
		−100	.251
		−50	.306
		0	.382
		20	.430

SPECIFIC HEAT OF SOLID ORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Picric acid	$HOC_6H_2(NO_2)_3$	−100	.165
		0	.240
		50	.263
Phthalic acid	$C_6H_4(CO_2H)_2$	20	.232
Propionic acid	$C_2H_5CO_2H$	−33	.726
n-Propyl alcohol	C_3H_7OH	−200	.170
		−130	.497
iso-Propyl alcohol	C_3H_7OH	−200	.0507
Pyrotartaric acid	$C_5H_8O_4$	20	.301
Quinhydrone	$C_{12}H_{10}O_4$	−250	.0165
		−200	.0980
		0	.256
Quinol	$C_6H_4(OH)_2$	−250	.0246
		−150	.268
Quinone	$C_6H_4O_2$	−250	.0311
		−200	.113
		−150	.282
Resorcinol	$C_6H_4(OH)_2$	−160	.269
Salol	$HOC_6H_4CO_2C_6H_5$	32	.289
Stearic acid	$C_{17}H_{35}CO_2H$	15	.399
Succinic acid	$(CH_2CO_2H)_2$	0	.248
Sucrose	$C_{12}H_{22}O_{11}$	20	.299
Tartaric acid	$H_2C_4H_4O$	36	.287
		0	.308
		50	.366
Thymol	$C_{10}H_{14}O$	0	.315
Trichloroacetic acid	CCl_3CO_2H	solid	.459
Trimethyl carbinol	$(CH_3)_3COH$	−4	.559
Trinitrotoluene	$CH_3C_6H_2(NO_2)_3$	−100	.170
		0	.311
		100	.385
Trinitroxylene	$(CH_3)_2C_6H(NO_2)_3$	20 to 50	.423
Triphenylmethane	$(C_6H_5)_3CH$	0	.189
o-Toluic acid	$CH_3C_6H_4CO_2H$	54	.277
m-Toluic acid		54	.239
p-Toluic acid		130	.271
p-Toluidine	$CH_3C_6H_4NH_2$	0	.337
		20	.387
Urea	$(NH_2)_2CO$	20	.320

SPECIFIC HEAT OF HEAVY WATER

% D_2O	Temp. °C.	Specific Heat cal./g	Molar Heat cal./mol.	Observer
99.7	−20.5– 0 (solid)	0.408	8.18	Bartholomé and Clusius
97.7	0 (solid)	0.51	10.2	Jacobs
98	4 −26 (liquid)	1.018	20.4	Brown, Barnes, & Maass
98	26 −45 (liquid)	1.003	20.1	" " " "
98	26 −65 (liquid)	1.008	20.2	" " " "

SPECIFIC HEAT OF LIQUID ORGANIC COMPOUNDS

Specific heat is given in calories (15°) per gram per degree Centigrade. To change to joules per gram per degree Centigrade multiply by 4.185.

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Acetic acid	CH_3COOH	0	.468
Acetone	$(CH_3)_2CO$	0	.506
		20	.528
Acetonitrile	CH_3CN	21–76	.541
Acetophenone	$C_6H_5COCH_3$	20–193	.474
Acetyl chloride	CH_3COCl	0	.339
Allyl acetate	$CH_3CO_2C_3H_5$	0	.431
alcohol	C_3H_5OH	21–96	.665
benzoate	$C_6H_5CO_2C_3H_5$	20	.388
butyrate	$C_3H_7CO_2C_3H_5$	20	.451
chloride	CH_2CHCH_2Cl	0	.313
isobutyrate	$C_3H_7CO_2C_3H_5$	20	.448
propionate	$C_2H_5CO_2C_3H_5$	20	.451
valerate	$C_4H_9CO_2C_3H_5$	20	.451
o-Aminobenzoic acid	$H_2NC_6H_4CO_2H$	145	.435
m-Aminobenzoic acid		174	.435
p-Aminobenzoic acid		186	.444
iso-Amyl acetate	$CH_3CO_2C_5H_{11}$	20	.459
alcohol	$C_5H_{11}OH$	0	.502
		20	.535
		75.5	.688
d-prim.-Amyl alcohol	$C_5H_{11}OH$	22–125	.712
tert.-Amyl alcohol		20–99	.753
iso-Amyl butyrate	$C_3H_7CO_2C_5H_{11}$	20	.459
formate	$HCO_2C_5H_{11}$	20	.459
isobutyrate	$C_3H_7CO_2C_5H_{11}$	20	.459
propionate	$C_2H_5CO_2C_5H_{11}$	20	.459
succinate	$(CH_2CO_2C_5H_{11})_2$	0	.449
valerate	$C_4H_9CO_2C_5H_{11}$	20	.459
iso-Amylamine	$C_5H_{11}NH_2$	22–91	.614
Amylene	C_5H_{10}	0	.282
Anethol	$C_9H_9OCH_3$	22.48	.551
Aniline	$C_6H_5 \cdot NH_2$	0	.478
		50	.521
		100	.547
Anisol	$C_6H_5OCH_3$	20–152	.483
Benzaldehyde	C_6H_5CHO	22–172	.428
Benzene	C_6H_6	5	.389
		20	.406
		60	.444
		90	.473
Benzoic acid	$C_6H_5CO_2H$	0	.424
Benzonitrile	C_6H_5CN	22–186	.441
β-Benzophenone	$(C_6H_5)_2CO$	3–40	.383
Benzyl alcohol	$C_6H_5CH_2OH$	20–100	.511
chloride	$C_6H_5CH_2Cl$	0	.323
Betol	$HOC_6H_4CO_2C_{10}H_7$	19–63	.356
Bromobenzene	C_6H_5Br	20	.231
o-Bromochlorobenzene	C_6H_4BrCl	0	.215
m-Bromochlorobenzene		0	.212
o-Bromoiodobenzene	C_6H_4BrI	5–100	.160
m-Bromoidobenzene		5–100	.158
Bromophenol	HOC_6H_4Br	18–77	.316
n-Butane	C_4H_{10}	0	.550
iso-Butane		0	.550
iso-Butyl acetate	$CH_3CO_2C_4H_9$	20	.459

SPECIFIC HEAT OF LIQUID ORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
n-Butyl alcohol	C_4H_9OH	2.3	.526
		19.2	.563
iso-Butyl alcohol		21–109	.716
Butyl butyrate	$C_3H_7CO_2C_4H_9$	20	.459
iso-Butyl butyrate		20	.459
n-Butyl chloride	C_4H_9Cl	20	.451
formate	$HCO_2C_4H_9$	20	.459
Butyl propionate	$C_2H_5CO_2C_4H_9$	20	.459
iso-Butyl succinate	$(CH_2CO_2C_4H_9)_2$	0	.442
Butyl valerate	$C_4H_9CO_2C_4H_9$	20	.459
n-Butyric acid	$C_3H_7CO_2H$	20–100	.515
iso-Butyric acid	$C_4H_8O_2$	20	.450
n-Butyronitrile	C_3H_7CN	21–113	.547
Caproic acid	$C_5H_{11}CO_2H$	29–105	.533
Capronitrile	$C_5H_{11}CN$	18–156	.542
Carbon tetrachloride	CCl_4	0	.198
		20	.201
Carvacrol	$C_9H_{13}OH$	24–233	.577
Catechol	$C_6H_4(OH)_2$	0	.462
Chloral	CCl_3CHO	17–53	.250
hydrate	$CCl_3CHO \cdot H_2O$	55–88	.470
Chlorobenzene	C_6H_5Cl	20	.309
o-Chlorobenzoic acid	$ClC_6H_4CO_2H$	0	.392
m-Chlorobenzoic acid		0	.266
p-Chlorobenzoic acid		226	.547
Chloroform	$CHCl_3$	0	.232
		15	.226
		20	.234
o-Chlorophenol	HOC_6H_4Cl	0–20	.401
Chlorotoluene	$CH_3C_6H_4Cl$	0	.316
o-Cresol	$CH_3C_6H_4OH$	0–20	.499
m-Cresol		0–20	.479
p-Cresyl methyl ether	$CH_3C_6H_4OCH_3$	0	.405
Crotonic acid	$C_3H_5CO_2H$	71.4	.500
Cyclohexanol	$C_6H_{11}OH$	15–18	.417
Cyclohexanone	$C_6H_{10}O$	15–18	.433
o-Cymene	$C_3H_7C_6H_4CH_3$	0	.400
Decylene-2	$C_{10}H_{20}$	0–50	.469
Diallyl oxalate	$(CO_2C_3H_5)_2$	20	.426
succinate	$(CH_2CO_2C_3H_5)_2$	20	.452
Diamylene	$C_{10}H_{20}$	20–130	.545
o-Dibromobenzene	$C_6H_4Br_2$	0	.180
m-Dibromobenzene		0	.175
Dibutyl oxalate	$(CO_2C_4H_9)_2$	20	.441
Dichloroacetic acid	Cl_2CHCO_2H	21–106	.350
o-Dichlorobenzene	$C_6H_4Cl_2$	0	.270
m-Dichlorobenzene		0	.270
p-Dichlorobenzene		53–99	.298
Diethylamine	$(C_2H_5)_2NH$	22.5	.518
Diethylaniline	$C_6H_5N(C_2H_5)_2$	20	.452
Diethyl carbonate	$CO(OC_2H_5)_2$	20–100	.464
ketone	$(C_2H_5)_2CO$	20–98.5	.557
malate	$HOC_2H_3(CO_2C_2H_5)_2$	24–186	.475
malonate	$CH_2(CO_2C_2H_5)_2$	20	.433
oxalate	$(CO_2C_2H_5)_2$	20	.433
succinate	$(CH_2CO_2C_2H_5)_2$	20	.452
Diiodobenzene	$C_6H_4I_2$	0	.136

SPECIFIC HEAT OF LIQUID ORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
m-Diiodobenzene		34.2–99.6	.140
Diisoamyl	$C_{10}H_{22}$	21.5–155	.590
oxalate	$(CO_2C_5H_{11})_2$	20	.449
Diisobutylamine	$(C_4H_9)_2NH$	22–130	.571
Dimethylaniline	$C_6H_5N(CH_3)_2$	0–20	.418
Dimethyl carbonate	$CO(OCH_3)_2$	19.8–88	.452
o-Dinitrobenzene	$C_6H_4(NO_2)_2$	0	.349
m-Dinitrobenzene		90	.405
p-Dinitrobenzene		0	.279
Diphenylamine	$(C_6H_5)_2NH$	53	.464
Diphenyl oxide	$(C_6H_5)_2O$	30	.399
Dipropylamine	$(C_3H_7)_2NH$	22–100	.597
Dipropyl ketone	$(C_3H_7)_2CO$	20–140	.552
malonate	$CH_2(CO_2C_3H_7)_2$	20	.433
succinate	$(CH_2CO_2C_3H_7)_2$	20	.452
Di-n-propyl oxalate	$(CO_2C_3H_7)_2$	20	.433
Dodecane	$C_{12}H_{26}$	0–50	.500
Dodecylene	$C_{12}H_{24}$	0–50	.457
Ether	$(C_2H_5)_2O$	−50	.517
		0	.529
		30	.547
		120	.803
		180	1.041
Ethyl acetate	$CH_3CO_2C_2H_5$	20	.459
acetoacetate	$CH_3COCH_2CO_2C_2H_5$	20–100	.477
alcohol	$C_2H_5.OH$	−100	.456
		0	.535
		25	.581
		100	.824
benzene	$C_6H_5C_2H_5$	30	.409
benzoate	$C_6H_5CO_2C_2H_5$	20	.389
bromide	C_2H_5Br	5–10	.216
		15–20	.215
butyrate	$C_3H_7CO_2C_2H_5$	20	.459
chloride	C_2H_5Cl	0	.368
chloroacetate	$ClCH_2CO_2C_2H_5$	9–138	.418
dichloroacetate	$Cl_2CHCO_2C_2H_5$	20	.329
formate	$HCO_2C_2H_5$	14–49	.510
iodide	C_2H_5I	0	.162
isobutyrate	$C_3H_7CO_2C_2H_5$	20	.459
propionate	$C_2H_5CO_2C_2H_5$	20	.459
sulfide	$(C_2H_5)_2S$	0	.470
		15–20	.477
trichloroacetate	$CCl_3CO_2C_2H_5$	10–81	.295
valerate	$C_4H_9CO_2C_2H_5$	20	.459
Ethylene bromide	$(CH_2Br)_2$	20	.174
chloride	$(CH_2Cl)_2$	20	.301
		60	.319
Formamide	$HCONH_2$	19	.551
Formic acid	HCO_2H	0	.437
		15.5	.511
		20–100	.526
Furfural	$(C_4H_3O)CHO$	20–100	.418
Glycerol, (glycerine)	$HOCH_2 \cdot CHOH.\text{-}CH_2OH$	0	.540
		50	.600
		100	.669
Glycol	$(CH_2OH)_2$	0	.544
		14.9	.571

SPECIFIC HEAT OF LIQUID ORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Heptaldehyde	$C_6H_{13}CHO$	0	.365
n-Heptane (B. P. 98°)	C_7H_{16}	20	.490
iso-Heptane		0–50	.501
Heptylene (B. P., 98°)	C_7H_{14}	0–50	.488
Heptylic acid	$C_6H_{13}CO_2H$	9	.558
n-Hexadecane (B.P., 275°)	$C_{16}H_{34}$	0–50	.496
1, 5-Hexadiene	C_6H_{10}	0	.407
o-Hexahydrocresol	$CH_3C_6H_{10}OH$	15–18	.418
m-Hexahydrocresol		15–18	.422
p-Hexahydrocresol		15–18	.423
n-Hexane	C_6H_{14}	20–100	.600
Hexylene	C_6H_{12}	0–50	.506
Lauric acid	$C_{11}H_{23}CO_2H$	57	.515
Mesitylene	$C_6H_3(CH_3)_3$	0	.393
Mesityl oxide	$C_6H_{10}O$	21–121	.521
Methyl acetate	$CH_3CO_2CH_3$	15	.468
alcohol	CH_3OH	0	.566
		20	.600
Methyl aniline	$C_6H_5NHCH_3$	20–197	.513
benzoate	$C_6H_5CO_2CH_3$	0	.363
butyl ketone	$CH_3COC_4H_9$	21–127	.553
n-butyrate	$C_3H_7CO_2CH_3$	20	.459
chloroacetate	$ClCH_2CO_2CH_3$	20	.382
dichloroacetate	$Cl_2CHCO_2CH_3$	20	.311
ethyl ketone	$CH_3COC_2H_5$	20–78	.549
ethyl ketoxime	$(CH_3)(C_2H_5)CNOH$	22–152	.650
formate	HCO_2CH_3	13–29	.516
hexyl ketone	$CH_3COC_6H_{13}$	22–168	.552
isobutyl ketone	$CH_3COC_4H_9$	20	.459
isopropyl ketone	$CH_3COC_3H_7$	20–91	.525
propionate	$C_3H_7CO_2CH_3$	20	.459
trichloroacetate	$Cl_3CCO_2CH_3$	20	.267
valerate	$C_4H_9CO_2CH_3$	20	.459
o-Methylcyclohexanone	$C_7H_{12}O$	15–18	.436
m-Methycyclohexanone		15–18	.441
p-Methylcyclohexanone		15–18	.441
Methylene chloride	CH_2Cl_2	15–40	.288
Myristic acid	$C_{13}H_{27}CO_2H$	56–100	.539
Naphthalene	$C_{10}H_8$	0	.313
α-Naphthol	$C_{10}H_7OH$	0	.389
β-Naphthol		0	.403
α-Naphthylamine	$C_{10}H_7NH_2$	53.2	.475
o-Nitraniline	$H_2NC_6H_4NO_2$	0	.400
m-Nitraniline		0	.392
p-Nitraniline		0	.427
Nitrobenzene	$C_6H_5NO_2$	30	.339
		120	.394
o-Nitrobenzoic acid	$O_2NC_6H_4CO_2H$	0	.314
m-Nitrobenzoic acid		0	.405
p-Nitrobenzoic acid		238	.449
Nitromethane	CH_3NO_2	17	.412
α-Nitronaphthalene	$C_{10}H_7NO_2$	58.6	.365
Nonane	C_9H_{20}	0–50	.503
Nonylene	C_9H_{18}	0–50	.485
n-Octane	C_8H_{18}	20–123	.578
Octylene	C_8H_{16}	0–50	.486
Olive oil		6.6	.471
Palmitic acid	$C_{15}H_{31}CO_2H$	65–104	.653

SPECIFIC HEAT OF LIQUID ORGANIC COMPOUNDS
(Continued)

Name	Formula	Temperature, °C.	Specific Heat Cal. 15°/g/°C.
Paraldehyde	$(CH_3CHO)_3$	0	.436
Pentadecane	$C_{15}H_{32}$	0–50	.497
Pentadecylene	$C_{15}H_{30}$	0–50	.471
iso-Pentane	C_5H_{12}	8	.527
Petroleum		21–58	.511
Phenetole	$C_6H_5OC_2H_5$	20	.446
Phenol	C_6H_5OH		.561
Piperidine	$C_5H_{11}N$	20–98	.523
Propane	C_3H_8	0	.576
Propionaldehyde	C_2H_5CHO	0	.522
Propionic acid	$C_2H_5CO_2H$	20–137	.560
Propionitrile	C_2H_5CN	19–95	.538
n-Propyl acetate	$CH_3CO_2C_3H_7$	20	.459
Propyl alcohol	$C_3H_7{\cdot}OH$	−100	.435
		0	.526
		25	.586
benzene	$C_6H_5C_3H_7$	0	.400
Propyl benzoate	$C_6H_5CO_2C_3H_7$	20	.398
butyrate	$C_3H_7CO_2C_3H_7$	20	.459
chloroacetate	$CH_2ClCO_2C_3H_7$	20	.414
n-Propyl formate	$HCO_2C_3H_7$	20	.459
Propyl isobutyrate	$C_3H_7CO_2C_3H_7$	20	.459
phenyl ether	$C_6H_5OC_3H_7$	0	.429
propionate	$C_2H_5CO_2C_3H_7$	20	.459
valerate	$C_4H_9CO_2C_3H_7$	20	.459
Pseudocumene	$C_6H_3(CH_3)_3$	20	.414
Pyridine	C_5H_5N	21–108	.431
Quinol	$C_6H_4(OH)_2$	0	.492
Quinoline	C_9H_7N	0–20	.352
Quinone	$C_6H_4O_2$	0	.324
Resorcinol	$C_6H_4(OH)_2$	0	.452
Salicylaldehyde	HOC_6H_4CHO	18	.382
Salol	$HOC_6H_4CO_2C_6H_5$	44.1	.391
Stearic acid	$C_{17}H_{35}CO_2H$	74–137	.550
Tetrachloroethylene	C_2Cl_4	20	.211
Tetradecane	$C_{14}H_{30}$	0–50	.497
Tetradecylene	$C_{14}H_{28}$	0–50	.453
m-Thymol	$C_9H_{13}OH$	50	.567
Toluene	$C_6H_5CH_3$	0	.386
		50	.421
		100	.470
o-Toluic acid	$CH_3C_6H_4CO_2H$	0	.422
m-Toluic acid		0	.503
p-Toluic acid		0	.316
o-Toluidine	$CH_3C_6H_4NH_2$	22–195	.524
p-Toluidine		43	.598
Trichloroethylene	C_2HCl_3	20	.223
Tridecane	$C_{13}H_{28}$	0–50	.499
Tridecylene	$C_{13}H_{26}$	0–50	.457
Trinitrotoluene (2, 4, 6)	$CH_3C_6H_2(NO_2)_3$	?	.335
Turpentine, oil		0	.411
Undecane	$C_{11}H_{24}$	0–50	.501
Undecylene	$C_{11}H_{22}$	0–50	.482
Valeronitrile	C_4H_9CN	23–121	.520
iso-Valeric acid	$C_4H_9CO_2H$	23–93	.590
o-Xylene	$(CH_3)_2C_6H_4$	30	.411
m-Xylene		16–35	.387
p-Xylene		30	.397

SPECIFIC HEAT OF ALLOYS AND VARIOUS SOLIDS

Values given in calories per gram.

Substance.	Temp. ° C.	Sp. heat.	Observer.
Alloys			
aluminum bronze, 88.7 Cu, 11.3 Al	20–100	0.104	Louguinine
antimony bismuth tin, 21.6Sb, 36.7Bi, 41.7Sn	22–99	.046	Regnault
antimony lead, 37.1Sb, 62.9Pb	10–98	.0388	“
bell metal, 80Cu, 20Sn	14–98	.0862	“
Bismuth tin, 63.8Bi, 36.2Sn	20–99	.0400	“
46.9Bi, 53.1Sn	20–99	.0450	“
56.9Bi, 43.1Sn	17–99	.0450	Person
brass, 60Cu, 40Zn	−186– −79	.0743	Behn
	−79– +18	.0873	“
	20–100	.0917	Voigt
72Cu, 28Zn	14–98	.094	Regnault
bronze, 80Cu, 20Sn	15–98	.086	“
88Cu, 12Sn, 0.94P	20–100	.0874	Voigt
constantan	0	.098	Jaeger, Diesselhorst
	100	.102	“ “
German silver	0	.094	Tomlinson
	100	.095	“
invar, 64Fe, 36Ni	−182– +15	.095	“
	15–100	.120	“
	15–600	.126	“
lead bismuth, 39.9Pb, 60.1Bi	16–99	.0317	Person
lead bismuth tin,			
32.5Pb, 49.0Bi, 18.5Sn	14–80	.0600n	Person
31.8Pb, 32.0Bi, 36.2Sn	11–98	.0448	Regnault
lead tin, 63.7Pb, 36.3Sn	12–99	.0407	“
46.7Pb, 53.3Sn	10–99	.0451	“
Lipowitz alloy, 24.97Pb, 10.13Cd, 50.66Bi, 14.24Sn	5–50	.0345	Mazotto
manganin	0	.097	Jaeger, Diesselhorst
	100	.095	“ “
platinum iridium, 90Pt, 10Ir	20–100	.0323	Pionchon
Rose alloy, 27.5Pb, 48.9Bi, 23.6 Sn	20–89	.0552	Schüz
solder, *see* lead tin			
steel, ordinary (.004C)	20	0.107	Regnault
	100	.117	“
Wood's alloy, 25.85Pb, 6.99Cd, 52.43Bi, 14.73Sn	5–50	.0352	Mazotto
Amalgams			
50.8Pb, 49.2Hg	23–99	.0383	Regnault
78.3Pb, 37.1Sn, 62.9Hg	22–99	.0729	“
54.1Sn, 45.9Hg	25–99	.0659	Schüz
Asbestos	20–98	.195	Ulrich
Basalt	20–100	.20	Mean
Calcspar	0–100	.2005	Lindner
Carborundum	3–44	.162	
Cellulose, dry	....	.37	Mean
Cement, powder	200–10	.20	
Chalk	20–99	.214	Regnault
Charcoal	10	.16	Weber, 1875
Clay, dry	20–100	.22	Mean
Ebonite	20–100	.40	Louguinine, 1882
Glass, normal thermometer	19–100	.1988	Wachsmuth
crown	10–50	.161	H. Meyer
flint	10–50	.117	H. Meyer

SPECIFIC HEAT OF ALLOYS AND VARIOUS SOLIDS
(Continued)

Values given in calories per gram

Substance.	Temp. ° C.	Sp. heat.	Observer.
Carboloy	....	.052	
Granite	12–100	.192	Joly
Ice	−200	.168	Nernst, 1910
	−180	.199	“ “
	−160	.230	“ “
	−140	.262	“ “
	−100	.325	“ “
	− 60	.392	“ “
	− 20	.480	“ “
	− 10	.530	“ “
India rubber (Para)	?–100	.481	Gee and Terry
Leather, dry	....	.36	
Marble	0–100	.21	
Mica (Mg)	20–98	.2061	Ulrich
Paraffin	0–20	.6939	R. W. Weber
Porcelain	15–950	.26	Harker, 1905
Quartz	12–100	.188	Joly
Rock-salt	13–45	.219	Kopp
Rubber, Synthetic (Government rubber—Styrene Type)	−253	.02692	Rands, Ferguson, Prather, 1944
	−223	.08075	
	−173	.1462	
	− 73	.2685	
	− 53	.4009	
	− 33	.4123	
	− 3	.4319	
	7	.4391	
	17	.4465	
	27	.4539	
	47	.4697	
Sugar	20	.274	Hess, 1888
Vulcanite	20–100	.3312	A. M. Mayer
Wood	....	.42	

COLOR SCALE OF TEMPERATURE

This table is the result of an effort to interpret in terms of thermometric readings, the common expressions used in describing temperatures. It is obvious that the values are only approximations.

Color.	Temperature, °C.
Incipient red heat	500–550
Dark red heat	650–750
Bright red heat	850–950
Yellowish red heat	1050–1150
Incipient white heat	1250–1350
White heat	1450–1550

SPECIFIC HEAT OF AQUEOUS SOLUTIONS

Giving the specific heat referred to that of water at the same temperatures. Concentration of the solutions is stated as the number of molecules of water to each molecule of the solutes (anhydrous).

Values from Marignac, Thomsen and others.

Substance	Temp. °C.	Concentration		
		25	50	100
Acetic acid	21–52	0.957	0.977	0.987
Aluminum sulfate	21–53	.....	.....	0.870
Ammonium acetate	17.5	0.911	0.951	0.976
chloride	18	0.881	0.937	0.966
hydroxide	18	.....	0.999	.....
nitrate	18	0.880	0.929	0.962
sulfate	19–51	0.803	0.879	0.933
Barium chloride	22–27	....	0.780	0.875
Cadmium sulfate	12	0.696	0.813	0.893
Calcium acetate	22–52	.....	0.896	0.939
chloride	21–51	0.754	0.851	0.917
nitrate	21–51	0.760	0.846	0.911
Chromic acid	21–53	0.825	0.896	0.942
Copper chloride	19–51	0.779	0 864	0.920
nitrate	18–50	.....	0 826	0.899
sulfate	18–23	.....	0.841	0.908
Ferric chloride	0–98	0.666	0.750	0.854
Hydrochloric acid	18	.....	0.932	0.964
Lactic acid	16.5	0.947	0.970	0.982
Lead acetate	18–51	0.682	0.794	0.881
nitrate	18–51	.....	0.750	0.851
Lithium chloride	11	.....	0.941	0.973
hydroxide	13	.....	0.958	0.978
Magnesium chloride	22–52	0.772	0.866	0.923
nitrate	19–51	.....	0.832	0.903
sulfate	18	.....	0.857	0.917
Manganese chloride	0–98	0.787	0.861	0.914
nitrate	19–51	.....	0.832	0.903
sulfate	19–51	.....	0.844	0.912
Nickel chloride	24–55	0.735	0.831	0.902
nitrate	24–55	0.717	0.823	0.895
sulfate	25–56	.....	0.837	0.910
Nitric acid	18	.....	0.930	0.963
Oxalic acid	20–52	.....	0.942	0.965
Potassium bromide	20–51	0.769	0.864	0.925
carbonate	21–52	0.760	0.851	0.916
chloride	18	0.828	0.904	0.948
chromate	20–51	.....	0.810	0.890
hydroxide	18	.....	0.916	0.954
iodide	20–51	0.715	0.830	0.906
nitrate	18–23	0.832	0.900	0.943

SPECIFIC HEAT OF AQUEOUS SOLUTIONS
(Continued)

Giving the specific heat referred to that of water at the same temperatures. Concentration of the solutions is stated as the number of molecules of water to each molecule of the solutes (anhydrous).

Values from Marignac, Thomsen and others.

Substance	Temp. °C.	Concentration		
		25	50	100
Potassium oxalate	21–52	.....	0.839	0.908
sulfate	19–52	.....	.....	0.902
Silver nitrate	25–52	0.750	0.849	0.913
Sodium acetate	18	.....	0.938	0.965
bromide	20–52	0.809	0.886	0.939
carbonate	21–52	0.865	0.907	0.943
chloride	18	0.880	0.931	0.962
chromate	21–52	0.781	0.856	0.913
hydroxide	18	0.908	0.942	0.968
iodide	20–51	0.749	0.850	0.917
nitrate	18	0.863	0.918	0.950
sulfate	21–52	0.819	0.878	0.960
Strontium chloride	21–26	.....	0.814	0.894
nitrate	19–51	.....	0.817	0.890
Sulfuric acid	20	0.963	0.982	0.991
Zinc chloride	19–51	0.796	0.884	0.933
nitrate	20–52	0.718	0.823	0.899
sulfate	20–52	.....	0.842	0.911

SPECIFIC HEAT OF GASES

The following table gives values of the specific heat at constant pressure in calories per gram and the value of γ, the ratio of the specific heat at constant pressure to that at constant volume. Values are given for pressures of one atmosphere except where otherwise stated.

Gas or vapor	Sp. ht., const. press.			Value of γ		
	Temp. °C	Sp. ht. cal./g	Obs.	Temp. °C	γ	Obs.
Acetaldehyde, C_2H_4O	......	......	......	30	1.14	39
Acetic acid, $C_2H_4O_2$	118–140	1.50	1	136	1.15	30
	140–180	1.27	1	......	......	.....
Acetone, C_3H_6O	26–110	0.3470	23	......	......	.....
	130–230	0.4119	23	......	......	.....
Acetylene, C_2H_2	−71	0.3509	26	−71	1.31	26
	+15	0.3832	......	+15	1.26	.....
Air	−120 (10 atm.)	0.2719	......	−118	1.415	3
	(20 atm.)	0.3221	......	−78	1.408	3
	(40 atm.)	0.4791	......	+17	1.403	3
	(70 atm.)	0.7771	......	......	......	.....
	−50 (10 atm.)	0.2440	......	......	......	.....
	(20 atm.)	0.2521	......	......	......	.....
	(40 atm.)	0.2741	......	......	......	.....
	(70 atm.)	0.3121	......	......	......	.....
(Data for air compiled from various observers: 2, 6, 10, 19, 21)	+50 (20 atm.)	0.2480	......	......	......	.....
	(100 atm.)	0.2719	......	......	......	.....
	(220 atm.)	0.2961	......	......	......	.....
	100 (1 atm.)	0.2404	......	100	1.401	
	(20 atm.)	0.2471	......	......	......	.....
	(100 atm.)	0.2600	......	......	......	.....
	(220 atm.)	0.2841	......	......	......	.....
	400	0.2430	......	400	1.393	.....
	1000	0.2570	......	1000	1.365	.....
	1400	0.2699	......	1400	1.341	.....
	1800	0.2850	......	1800	1.316	.....
Ammonia, NH_3	15	0.5232	......	15	1.310	27
Amylene, C_5H_{10}	*ca.* 210	0.631	9	......	......	.....
Argon, A	−180	0.133	26	−180	ca. 1.76	26
	+15	0.1253	......	+15	1.668	.....
Benzene, C_6H_6	80	0.260	14	......	......	.....
	34–115	0.301	37	......	......	.....
	120–220	0.370	23	......	......	.....
Bromine, Br	19–388	0.055	31	20–350 (0.3–1.5 atm.)	1.32	31
Carbon dioxide, CO_2	−75	0.184	26	−75	1.37	26
	+15	0.1989	......	+15	1.304	.....
Carbon disulfide, CS_2	80–190	0.157	23	......	......	.....
Carbon monoxide, CO	−180	0.259	26	−180	1.41	26
	+15	0.2478	......	+15	1.404	.....
Carbon tetrachloride, CCl_4	0	0.140	16	20 (0.1 atm.)	1.13	4, 34
	30	0.132	16	......	......	.....
	70	0.115	16	......	......	.....
Chlorine, Cl_2	15	0.1149	......	15	1.355	.....
Chloroform, $CHCl_3$	27–118	0.145	37	100	1.15	30
	120–230	0.157	23	......	......	.....
Cyanogen, CN	15	0.4095	......	15	1.256	.....
Ethane, C_2H_6	−82	0.3475	26	−82	1.28	26
	+15	0.3861	......	+15	1.22	.....
				50	1.21	7
Ethyl acetate, $C_4H_8O_2$	35–189	0.3711	37	......	......	.....
Ethyl alcohol, C_2H_6O	90	0.406	8, 18	90	1.13	8, 18
	100–223	0.454	23	......	......	.....
Ethyl bromide, C_2H_5Br	28–116	0.161	37	14 (0.3 atm.)	1.19	4
Ethyl chloride, C_2H_5Cl	10–170	0.2750	23	16 (0.3–0.5 atm.)	1.19	4
Ethyl cyanide, C_3H_5N	114–223	0.4260	23	......	......	.....
Ethyl ether, $C_4H_{10}O$	27–189	0.4619	37	......	......	.....
	35	0.4449	14	35	1.08	14

SPECIFIC HEAT OF GASES (Continued)

Gas or vapor	Sp. ht., const. press.			Value of γ		
	Temp. °C	Sp. ht. cal./g	Obs.	Temp. °C	γ	Obs.
Ethylene, C_2H_4	−91	0.3086	26	−91	1.35	26
	+15	0.3592	.....	+15	1.255	.....
	15–100	0.399	23, 37	100	1.18	39
	25–200	0.430	37	.....	.....	.....
Ethylene chloride, $C_2H_4Cl_2$	111–221	0.23	23	.....	.....	.....
Helium, He	−180	1.25	26	−180	1.660	26
Hydriodic acid, HI	.....	.....	.....	+20–100	1.40	31
Hydrobromic acid, HBr	+11–100	0.082	23	.....	.....	.....
Hydrochloric acid, HCl	10–190	0.185	23	.....	.....	.....
	15	0.1939	.....	15	1.41	.....
				100	1.40	31
Hydrocyanic acid, HCN	.....	.....	.....	65	1.31	35
Hydrogen, H_2	.....	.....	.....	−185	1.605	3
	−181	2.64	26	−181	1.597	26
				−118	1.480	3
				−78	1.443	3
	−76	3.15	26	−76	1.453	26
				−21	1.420	3
	+15	3.389	.....	+15	1.410	.....
	100	3.429	.....	100	1.404	.....
	200	3.463	.....	200	1.398	.....
(Data for hydrogen compiled from various observers: 5, 21, 29)	400	3.533	.....	400	1.387	.....
	600	3.602	.....	600	1.377	.....
	800	3.672	.....	800	1.367	.....
	1000	3.741	.....	1000	1.358	.....
	2000	4.088	.....	2000	1.318	.....
Hydrogen sulfide, H_2S	−57	0.292	26	−57	1.29	26
	−45	0.279	26	−45	1.30	26
	+10–190	0.243	33	.....	.....	.....
	15	0.2533	.....	+15	1.32	.....
				18	1.30	32
Iodine, I	206–377	0.034	31	185	1.30	30
Krypton, Kr	.....	.....	.....	19	1.68	22
Mercury, Hg	.....	.....	.....	360 (0.5–1 atm.)	1.67	13
Methane, CH_4	−115	0.4502	15	−115	1.41	15
	−80	0.5038	26	−80	1.34	26
	−74	0.4979	15	−74	1.35	15
	+10–200	0.5931	6, 23	.....	.....	.....
	15	0.5284	.....	+15	1.31	.....
Methyl alcohol, CH_4O	77	0.390	8	77	1.203	8
	100–223	0.4581	23	.....	.....	.....
Methyl ether, C_2H_6O	.....	.....	.....	6–30	1.11	17
Neon, Ne	.....	.....	.....	19	1.64	22
Nitric oxide, NO	−80	0.2445	26	−80	1.38	26
	−45	0.2389	26	−45	1.39	26
	+10–180	0.232	23	.....	.....	.....
	15	0.2329	.....	+15	1.400	.....
Nitrogen, N_2	−181	0.256	26	−181	1.47	26
	+15	0.2477	.....	+15	1.404	.....
Nitrogen peroxide, NO_2	27–67	1.620	1, 15	.....	.....	.....
Nitrous oxide N_2O	−70	0.1900	26	−70	1.34	23
	−30	0.1998	26	−30	1.31	26
				0	1.32	39
	+15	0.2004	.....	+15	1.303	.....
	25–100	0.212	23	.....	.....	.....
Oxygen, O_2	−181	0.2285	26	−181	1.45	26
	−76	0.2143	26	−76	1.415	26
	+15	0.2178	.....	+15	1.401	.....
	100	0.2181	20	100	1.399	20
	200	0.2187	20	200	1.396	20

SPECIFIC HEAT OF GASES (Continued)

Gas or vapor	Sp. ht., const. press.			Value of γ		
	Temp. °C	Sp. ht. cal./g	Obs.	Temp. °C	γ	Obs.
Oxygen, O_2 (*Con't*)......	400	0.2213	20	400	1.391	20
	600	0.2241	20	600	1.383	20
	800	0.2278	20	800	1.375	20
	1000	0.2325	20	1000	1.365	20
	2000	0.2669	20	2000	1.303	20
Phosphorus, P...........	....	......	......	300	1.17	28
Phosphorus trichloride, PCl_3..................	110–250	0.135	23	....	....	.....
Potassium, K...........	....	......	......	850	1.77	36
				680–1000	1.69	24
Propane, C_3H_8...........	....	......	......	16 (0.5 atm.)	1.13	4
Silicon tetrachloride, $SiCl_4$	90–230	0.132	23	....	....	.....
Sodium, Na...........	....	......	......	750–920	1.68	24
Stannic chloride, $SnCl_4$...	149–273	0.094	23	....	....	.....
Sulfur dioxide, SO_2.......	10–190	0.134	23	....	....	.....
	15	0.1516	......	15	1.29	.....
				20	1.27	27
Water, H_2O..............	100	0.4820	......	100	1.324	.....
	120	0.4769	......	....	....	.....
	140	0.4741	......	....	....	.....
	160	0.4719	......	....	....	.....
(Data for water compiled from various observers: 11, 12, 20)	180	0.4710	......	....	....	.....
	200	0.4710	......	200	1.310	.....
	300	0.4769	......	300	1.304	.....
	400	0.4901	......	400	1.301	.....
	500 (1 atm.)	0.5071	......	500	1.296	.....
	(10 atm.)	0.5159	......	....	....	.....
	(20 atm.)	0.5259	......	....	....	.....
Xenon, Xe..............	....	......	......	19	1.66	22

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BOILING POINT OF WATER

(Hydrogen Scale)

Pressure mm.	Tenths of millimeters									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
700	97.714	718	722	725	729	733	737	741	745	749
701	753	757	761	765	769	773	777	781	785	789
702	792	796	800	804	808	812	816	820	824	828
703	832	836	840	844	847	851	855	859	863	867
704	871	875	879	883	887	891	895	899	902	906
705	97.910	914	918	922	926	930	934	938	942	946
706	949	953	957	961	965	969	973	977	981	985
707	989	993	996	*000	*004	*008	*012	*016	*020	*024
708	98.028	032	036	040	043	047	051	055	059	063
709	067	071	075	079	082	086	090	094	098	102
710	98.106	110	114	118	121	125	129	133	137	141
711	145	149	153	157	160	164	168	172	176	180
712	184	188	192	195	199	203	207	211	215	219
713	223	227	230	234	238	242	246	250	254	258
714	261	265	269	273	277	281	285	289	292	296
715	98.300	304	308	312	316	320	323	327	331	335
716	339	343	347	351	355	358	362	366	370	374
717	378	382	385	389	393	397	401	405	409	412
718	416	420	424	428	432	436	440	443	447	451
719	455	459	463	467	470	474	478	482	486	490
720	98.493	497	501	505	509	513	517	520	524	528
721	532	536	540	544	547	551	555	559	563	567
722	570	574	578	582	586	590	593	597	601	605
723	609	613	617	620	624	628	632	636	640	643
724	647	651	655	659	662	666	670	674	678	682
725	98.686	689	693	697	701	705	709	712	716	720
726	724	728	732	735	739	743	747	751	755	758
727	762	766	770	774	777	781	785	789	793	797
728	800	804	808	812	816	819	823	827	831	835
729	838	842	846	850	854	858	861	865	869	873
730	98.877	880	884	888	892	896	899	903	907	911
731	915	918	922	926	930	934	937	941	945	949
732	953	956	960	964	968	972	975	979	983	987
733	991	994	998	*002	*006	*010	*013	*017	*021	*025
734	99.029	032	036	040	044	048	051	055	059	063
735	99.067	070	074	078	082	085	089	093	097	101
736	104	108	112	116	119	123	127	131	135	138
737	142	146	150	153	157	161	165	169	172	176
738	180	184	187	191	195	199	203	206	210	214
739	218	221	225	229	233	236	240	244	248	252
740	99.255	259	263	267	270	274	278	282	285	289
741	293	297	300	304	308	312	316	319	323	327
742	331	334	338	342	346	349	353	357	361	364
743	368	372	376	379	383	387	391	394	398	402
744	406	409	413	417	421	424	428	432	436	439
745	99.443	447	451	454	458	462	466	469	473	477
746	481	484	488	492	495	499	503	507	510	514
747	518	522	525	529	533	537	540	544	548	551
748	555	559	563	566	570	574	578	581	585	589
749	592	596	600	604	607	611	615	619	622	626

For lower pressures see under Vapor Tension of Water

BOILING POINT OF WATER (Continued)

(Hydrogen Scale)

Pressure mm	Tenths of millimeters									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
750	99.630	633	637	641	645	648	652	656	659	663
751	667	671	674	678	682	686	689	693	697	700
752	704	708	712	715	719	723	726	730	734	738
753	741	745	749	752	756	760	764	767	771	775
754	778	782	786	790	793	797	801	804	808	812
755	99.815	819	823	827	830	834	838	841	845	849
756	852	856	860	863	867	871	875	878	882	886
757	889	893	897	900	904	908	911	915	919	923
758	926	930	934	937	941	945	948	952	956	959
759	963	967	970	974	978	982	985	989	993	996
760	100.000	004	007	011	015	018	022	026	029	033
761	037	040	044	048	052	055	059	063	066	070
762	074	077	081	085	088	092	096	099	103	107
763	110	114	118	121	125	129	132	136	140	143
764	147	151	154	158	162	165	169	173	176	180
765	100.184	187	191	195	198	202	206	209	213	216
766	220	224	227	231	235	238	242	246	249	253
767	257	260	264	268	271	275	279	283	286	290
768	293	297	300	304	308	311	315	319	322	326
769	330	333	337	341	344	348	352	355	359	363
770	100.366	370	373	377	381	384	388	392	395	399
771	403	406	410	414	417	421	424	428	432	435
772	439	442	446	450	453	457	461	464	468	472
773	475	479	483	486	490	493	497	501	504	508
774	511	515	519	522	526	530	533	537	540	544
775	100.548	551	555	559	562	566	569	573	577	580
776	584	588	591	595	598	602	606	609	613	616
777	620	624	627	631	634	638	642	645	649	653
778	656	660	663	667	671	674	678	681	685	689
779	692	696	689	703	707	710	714	718	721	725
780	100.728	732	735	739	743	746	750	753	757	761
781	764	768	772	775	779	782	786	789	793	797
782	800	804	807	811	815	818	822	825	829	833
783	836	840	843	847	851	854	858	861	865	869
784	872	876	879	883	886	890	894	897	901	904
785	100.908	912	915	919	922	926	929	933	937	940
786	944	947	951	954	958	962	965	969	972	976
787	979	983	987	990	994	997	*001	*005	*008	*012
788	101.015	019	022	026	029	033	037	040	044	047
789	051	054	058	062	065	069	072	076	079	083
790	101.087	090	094	097	101	104	108	112	115	119
791	122	126	129	133	136	140	144	147	151	154
792	158	161	165	168	172	176	179	183	186	190
793	193	197	200	204	207	211	215	218	222	225
794	229	232	236	239	243	246	250	254	257	261
795	101.264	268	271	275	278	282	286	289	293	296
796	300	303	307	310	314	317	321	324	328	332
797	335	339	342	346	349	353	356	360	363	367
798	370	374	377	381	385	388	392	395	399	402
799	406	409	413	416	420	423	427	430	434	437
800	101.441	. . .	. . .	. . .	. . . . .	. . .	. . .	. . .	. . .	. . .

MELTING AND BOILING POINTS OF THE ELEMENTS

Element	Melting Point °C	Boiling Point °C
Actinium	1600 (computed)	....
Aluminum	659.7	2057
Americium	....	....
Antimony	630.5	1380
Argon	−189.2	−185.7
Arsenic	$814^{36\text{ atm}}$	615 (sublimes)
Astatine	....	....
Barium	850	1140
Berkelium	....	....
Beryllium	1278 ± 5	2970^{760}
Bismuth	271.3	1560 ± 5^{760}
Boron	2300	2550
Bromine	−7.2	58.78
Cadmium	320.9	767 ± 2
Calcium	842–8	1240
Californium	....	....
Carbon	>3550	4200
Cerium	804	1400
Cesium	28.5	670
Chlorine	−103 ± 5	−34.6
Chromium	1890	2480
Cobalt	1495	2900
Columbium (see *Niobium*)		
Copper	1083	2336
Curium	....	....
Dysprosium	....	....
Einsteinium	....	....
Erbium	....	....
Europium	1150 ± 50	....
Fermium	....	....
Fluorine	−223	−188
Francium	....	....
Gadolinium	....	....
Gallium	29.78	1983
Germanium	958.5	(2700)
Gold	1063	2600
Hafnium	1700 (computed)	>3200
Helium	$-272^{26\text{ atm}}$	−268.9
Holmium	....	....
Hydrogen	−259.14	−252.8
Indium	156.4	2000 ± 10
Iodine	113.7	184.35
Iridium	2454	>4800
Iron	1535	3000
Krypton	−156.6	−152.9
Lanthanum	826	....
Lead	327.43	1620
Lithium	186	1336 ± 5
Lutetium	....	....
Magnesium	651	1107
Manganese	1260	1900
Mendelevium	....	....
Mercury	−38.87	356.58
Molybdenum	2620 ± 10	4800
Neodymium	840	....
Neon	−248.67	−245.9
Neptunium	....	....
Nickel	1455	2900
Niobium (*Columbium*)	2500 ± 50	3700
Nitrogen	−209.86	−195.8
Osmium	2700	>5300
Oxygen	−218.4	−182.86

MELTING AND BOILING POINTS OF THE ELEMENTS (Continued)

Element	Melting Point °C	Boiling Point °C
Ozone	−192.7 ± 2	−111.9
Palladium	1549.4	2200
Phosphorus (yel.)	44.1 (ign. 34)	280
Platinum	1773.5	4300
Plutonium	...	...
Polonium	...	...
Potassium	62.3	760
Praseodymium	940	...
Promethium	...	...
Protactinium	...	...
Radium	700	1140
Radon	−71	−61.8
Rhenium	3167 ± 60	...
Rhodium	1966 ± 3	>2500
Rubidium	38.5	700
Ruthenium	2450	2700
Samarium	>1300	...
Scandium	1200	2400
Selenium, gray trig	217	688
Silicon	1420	2355
Silver	960.8	1950
Sodium	97.5	880
Strontium	757 frz (800)	1150
Sulfur (rhomb)	112.8	444.6
(monoclinic)	119.25	444.6
Tantalum	2996 ± 50	ca. 4100
Technetium	...	...
Tellurium	452	1390
Terbium	327 ± 5	...
Thallium	302	1457 ± 10
Thorium	1845	4500
Thulium	...	...
Tin	231.89	2270
Titanium	1800	>3000
Tungsten (Wolfram)	3370	5900
Uranium	ca. 1133	ign.
Vanadium	1710	3000
Xenon	−112	−107.1
Ytterbium	1800	...
Yttrium	1490	2500
Zinc	419.47	907
Zirconium	1857	>2900

MELTING POINTS OF MIXTURES OF METALS

(Smithsonian Physical Tables)

Melting-points, °C.

Metals	Percentage of metal in second column.										
	0%[*]	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Pb. Sn.	326	295	276	262	240	220	190	185	200	216	232
Bi.	322	290	...	...	179	145	126	168	205	...	268
Te.	322	710	790	880	917	760	600	480	410	425	446
Ag.	328	460	545	590	620	650	705	775	840	905	959
Na.	...	360	420	400	370	330	290	250	200	130	96
Cu.	326	870	920	925	945	950	955	985	1005	1020	1084
Sb.	326	250	275	330	395	440	490	525	560	600	632
Al. Sb.	650	750	840	925	945	950	970	1000	1040	1010	632
Cu.	650	630	600	560	540	580	610	755	930	1055	1084
Au.	655	675	740	800	855	915	970	1025	1055	675	1062
Ag.	650	625	615	600	590	580	575	570	650	750	954
Zn.	654	640	620	600	580	560	530	510	475	425	419
Fe.	653	860	1015	1110	1145	1145	1220	1315	1425	1500	1515
Sn.	650	645	635	625	620	605	590	570	560	540	232
Sb. Bi.	632	610	590	575	555	540	520	470	405	330	268
Ag.	630	595	570	545	520	500	505	545	680	850	959
Sn.	622	600	570	525	480	430	395	350	310	255	232
Zn.	632	555	510	540	570	565	540	525	510	470	419
Ni. Sn.	1455	1380	1290	1200	1235	1290	1305	1230	1060	800	232
Na. Bi.	96	425	520	590	645	690	720	730	715	570	268
Cd.	96	125	185	245	285	325	330	340	360	390	322
Cd. Ag.	322	420	520	610	700	760	805	850	895	940	954
Tl.	321	300	285	270	262	258	245	230	210	235	302
Zn.	322	280	270	295	313	327	340	355	370	390	419
Au. Cu.	1063	910	890	895	905	925	975	1000	1025	1060	1084
Ag.	1064	1062	1061	1058	1054	1049	1039	1025	1006	982	963
Pt.	1075	1125	1190	1250	1320	1380	1455	1530	1610	1685	1775
K. Na.	62	17.5	−10	−3.5	5	11	26	41	58	77	97.5
Hg.	...	...	...	...	...	90	110	135	162	265	...
Tl.	62.5	133	165	188	205	215	220	240	280	305	301
Cu. Ni.	1080	1180	1240	1290	1320	1355	1380	1410	1430	1440	1455
Ag.	1082	1035	990	945	910	870	830	788	814	875	960
Sn.	1084	1005	890	755	725	680	630	580	530	440	232
Zn.	1084	1040	995	930	900	880	820	780	700	580	419
Ag. Zn.	959	850	755	705	690	660	630	610	570	505	419
Sn.	959	870	750	630	550	495	450	420	375	300	232
Na. Hg.	96.5	90	80	70	60	45	22	55	95	215	...

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[*] The data in this table are compiled from various sources,— hence the variations in the melting point of the metals as shown in this column.

MELTING AND BOILING TEMPERATURES

Temperature of Fusion for Various Substances for Atmospheric Pressure

For the melting- and boiling-points of the chemical elements and of inorganic compounds see under Physical Constants of the Elements, and Physical Constants of Inorganic Compounds.

Substance.	Temp. of fusion ° C.	Substance.	Temp. of fusion ° C.
Acetylene	−81	German silver	1000.
Alcohol, ethyl	−130.	Glass	1100.
Brass	900.	Glycerine	17.
Butter	31–31.5	Olive oil	2–6
Camphor	177.7	Paraffin	55.
Caoutchouc, pure gum	120.	Resin	135.
Chloroform	−63.2	Sea water	−2.5
Ether	−117.6	Sugar (cane)	160.

Boiling-point for Various Substances

Giving the boiling-point at atmospheric pressure and the variation per cm. pressure near 76 cm.

Substance.	Temp. ° C.	Variation.
Acetone	57.	0.39
Acetylene	−72.2	
Alcohol, ethyl	78.3	0.34
methyl	64.7	0.35
Amyl acetate	148.	
Benzene	80.	0.43
Camphor	205.	0.56
Chloroform	61.2	0.41
Ether	34.6	0.40
Gasoline	70–90.	
Glycerine	291.	
Turpentine	159.	

MELTING POINT OF ICE—VARIATION WITH PRESSURE

(From Tamann, 1900, by permission.)

Pressure in kg. per sq.cm.	Temp. ° C.	Pressure in kg. per sq.cm.	Temp. ° C.
1	0.0	1410	−12.5
336	− 2.5	1625	−15.0
615	− 5.0	1835	−17.5
890	− 7.5	2042	−20.0
1155	−10.0	2200	−22.1

BOILING POINTS OF WATER-ALCOHOL MIXTURES

(P. N. Evans, Journal of Industrial and Engineering Chemistry.)

Boiling point, °C.	Weight per cent alcohol in		Boiling point, °C.	Weight per cent alcohol in	
	Liquid.	Vapor.		Liquid.	Vapor.
78.2	91	92	86.5	18	71
78.4	85	89	87.0	17	70
78.6	82	88	87.5	16	69
78.8	80	87	88.0	15	68
79.0	78	86	88.5	13	67
79.2	76	85	89.0	12	65
79.4	74	85	89.5	11	63
79.6	72	84	90.0	10	61
79.8	69	84	90.5	10	59
80.0	67	83	91.0	9	57
80.2	64	83	91.5	8	55
80.4	62	82	92.0	8	53
80.6	59	82	92.5	7	51
80.8	56	81	93.0	6	49
81.0	53	81	93.5	6	46
81.2	50	80	94.0	5	44
81.4	47	80	94.5	5	42
81.6	45	80	95.0	4	39
81.8	43	79	95.5	4	36
82.0	41	79	96.0	3	33
82.5	36	78	96.5	3	30
83.0	33	78	97.0	2	27
83.5	30	77	97.5	2	23
84.0	27	76	98.0	1	19
84.5	25	75	98.5	1	15
85.0	23	74	99.0	0	10
85.5	21	73	99.5	0	5
86.0	20	72	100.0	0	0

MOLECULAR ELEVATION OF THE BOILING POINT

(Most values from Hoyt, C.S. and Fink, C.K., Journal of Physical Chemistry, Vol. 41, No. 3., March, 1937.)

Molecular elevation of the boiling point showing the elevation of the boiling point in degrees C due to the addition of one gram molecular weight of the dissolved substance to 1000 grams of any one of the solvents below. The correction in the last column gives the number of degrees to be subtracted for each mm. of difference between the barometric reading and 760 mm.

Solvent	K_B	Barometric Correction per mm.
Acetic acid	3.07	0.0008
Acetone	1.71	0.0004
Aniline	3.52	0.0009
Benzene	2.53	0.0007
Bromobenzene	6.26	0.0016
Carbon bisulfide	2.34	0.0006
Carbon tetrachloride	5.03	0.0013
Chloroform	3.63	0.0009
Cyclohexane	2.79	0.0007
Ethanol (ethyl alcohol)	1.22	0.0003
Ethyl acetate	2.77	0.0007
Ethyl ether	2.02	0.0005
n-Hexane	2.75	0.0007
Methanol (methyl alcohol)	0.83	0.0002
Methyl acetate	2.15	0.0005
Nitrobenzene	5.24	0.0013
n-Octane	4.02	0.0010
Phenol	3.56	0.0009
Toluene	3.33	0.0008
Water	0.512	0.0001

MOLECULAR DEPRESSION OF THE FREEZING POINT

Showing the depression of the freezing point due to the addition of one gram molecular weight of dissolved substance, for various solvents.

Solvent	Depression for one gram molecular weight dissolved in 100 gms. °C
Acetic acid	39.0
Benzene	49.0
Benzophenone	98.0
Diphenyl	80.0
Diphenylamine	86.0
Ethylene dibromide	118.0
Formic acid	27.7
Naphthalene	68–69
Nitrobenzene	70.0
Phenol	74.0
Stearic acid	45.0
Triphenyl methane	124.5
Urethane	51.4
Water	18.5–18.7

LOWERING OF FREEZING POINT FOR AQUEOUS SOLUTIONS

The concentration of the solutions is expressed as the number of gram formula weights per 1,000 grams of water. The table gives the molal lowering of freezing point in °C for the concentration stated.

Solute	Concentration										
	0.001	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1.0	2.0	5.0
$AgNO_3$	.....	.....	3.60	3.54	3.42	3.32	3.20	2.96	2.63	2.16	....
$AlCl_3$*	.....	.....	7.10	6.62	6.02	5.68	5.76	7.06	9.45	.....	....
$Al(NO_3)_3$*	.....	.....	.....	.....	6.3	6.1	6.5	7.9	10.6	.....	....
$Al_2(SO_4)_3$	.....	.....	.....	.....	.....	.....	3.92	4.19	.....	.....	....
$BaCl_2$	5.30	5.120	5.034	4.938	4.796	4.698	4.64	.....	5.20	.....	....
$Ba(NO_3)_2$	5.39	.....	5.01	4.87	.....	4.25	3.79	.....	.....	.....	....
Br_2	.....	.....	1.95	1.90	1.875	1.870	.....	.....	.....	.....	....
$CaCl_2$	.....	.....	5.112	.....	4.886	4.832	4.78	4.98	5.85	7.68	....
$Ca(NO_3)_2$	.....	.....	.....	.....	4.7	4.58	4.50	.....	4.59	4,86	....
$CdBr_2$	.....	4.76	4.47	.....	3.65	3.22	.....	.....	.....	.....	....
$CdCl_2$	.....	4.79	4.71	.....	4.12	3.84	3.57	3.24	.....	.....	....
CdI_2	.....	4.06	3.86	.....	2.69	2.27	2.1	2.1	2.25	.....	....
$Cd(NO_3)$	.....	5.28	5.20	5.15	.....	5.08	5.08	.....	5.42	6.2	....
$CdSO_4$	.....	2.916	2.744	.....	2.3	2.1	1.93	.....	1.79	.....	....
Cl_2	.....	.....	4.0	3.816	3.145	.....	.....	.....	.....	.....	....
$CoCl_2$	.....	5.208	5.107	.....	4.918	4.882	4.946	.....	6.31	8.51	....
$Co(NO_3)_2$	.....	.....	.....	.....	.....	4.6	4.5	.....	5.5	.....	....
$CoSO_4$	.....	.....	.....	.....	.....	.....	2.02	1.75	.....	.....	....
$Cr_2(SO_4)_3$*	.....	.....	.....	.....	4.6	4.2	.....	.....	.....	.....	....
$Cu(NO_3)_2$	.....	.....	.....	.....	.....	5.1	5.0	.....	5.7	6.7	....
$CuSO_4$	.....	2.871	2.703	.....	2.266	2.085	1.912	1.722	1.715	.....	....
$FeCl_3$	.....	.....	.....	6.93	6.28	6.01	6.02	6.55	8.18	12.45	....
$Fe(NO_3)_3$	.....	.....	.....	.....	.....	6.30	6.48	.....	9.4	.....	....
$FeSO_4$	.....	.....	.....	.....	.....	2.39	2.10	.....	.....	.....	....
HCl	3.690	3.635	3.601	3.568	3.532	3.523	3.54	3.68	3.94	4.43	....
HF	.....	.....	.....	.....	.....	1.98	1.91	.....	1.93	2.03	....
HI	.....	.....	.....	.....	.....	3.50	3.56	.....	4.09	4.75	7.70
HIO_3	.....	.....	.....	.....	3.12	2.95	2.71	2.21	1.72	1.16	0.75
HNO_3	.....	3.67	3.64	3.61	3.55	3.51	3.47	.....	3.58	3.79	....
H_2O_2	.....	.....	.....	.....	.....	1.84	1.84	1.86	1.88	1.91	1.96
H_3PO_4	.....	3.1	2.95	2.75	.....	2.36	2.23	.....	2.14	2.41	....
H_2SO_3	.....	.....	.....	.....	.....	2.8	2.6	.....	2.35	.....	....
H_2SO_4	.....	4.814	4.584	.....	4.112	3.940	3.790	.....	4.04	5.07	....
$H_2S_2O_6$*	.....	.....	.....	.....	5.06	5.04	5.14	.....	.....	.....	....
KBr	.....	.....	.....	.....	3.500	3.452	3.400	3.330	3.290	3.275	....
$KC_2H_3O_2$	.....	.....	.....	.....	.....	.....	.....	3.78	3.92	4.22	....
KCN	.....	.....	.....	.....	3.49	3.41	3.34	3.27	3.25	3.27	3.44
$KCNS$	.....	.....	.....	.....	.....	3.44	3.37	3.25	.....	.....	....
$K_2C_2O_4$*	.....	.....	.....	.....	.....	4.46	.....	4.18	.....	.....	....
K_2CO_3	.....	.....	5.20	5.00	4.74	4.56	4.42	4.39	4.51	5.01	....
KCl	3.66	3.648	3.610	3.566	3.503	3.451	3.394	3.314	3.250	3.220	....
$KClO_3$	.....	.....	3.556	3.513	3.435	3.334	.....	.....	.....	.....	....
K_2CrO_4	.....	.....	.....	.....	3.0	3.3	3.6	.....	.....	3.6	....
$K_2Cr_2O_7$	7.06	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
KF	.....	.....	.....	.....	.....	3.39	3.35	3.36	3.39	.....	....
$K_3Fe(CN)_6$	7.10	6.53	6.26	5.98	5.60	5.30	5.00	4.55	.....	.....	....
$K_4Fe(CN)_6$	.....	.....	.....	.....	5.72	5.18	.....	.....	.....	.....	....
$KHCO_3$	.....	.....	.....	.....	.....	.....	.....	3.09	2.91	2.68	....
KH_2PO_4	.....	.....	.....	3.59	3.47	3.34	3.19	.....	.....	.....	....
KI	.....	.....	.....	.....	.....	3.54	3.44	3.38	3.37	3.40	3.50
KNO_3	.....	3.638	3.590	3.537	3.431	3.314	3.154	2.882	2.56	.....	....
KOH	.....	3.66	3.65	3.62	3.50	3.42	3.39	3.44	3.60	3.96	5.77
K_2SO_4	5.280	5.150	5.010	.....	4.559	4.319	4.044	.....	.....	.....	....
$LiCl$	.....	3.612	3.598	3.582	3.553	3.52	3.50	3.58	3.80	4.41	....
$MgCl_2$	.....	.....	5.144	.....	4.974	4.938	4.977	5.38	6.35	8.8	....

* Concentration stated as gram formula weights per liter.

LOWERING OF FREEZING POINT (Continued)

Solute	Concentration										
	0.001	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1.0	2.0	5.0
$Mg(NO_3)_2$	.....	.....	.....	.....	.....	4.74	4.78	5.08	5.78	7.0	....
$MgSO_4$	3.38	3.02	2.85	.....	2.420	2.252	2.090	.....	2.02	.....	....
$MnCl_2$	.....	.....	.....	.....	.....	4.86	4.90	.....	6.05	.....	....
$Mn(NO_3)_2$	.....	.....	.....	.....	.....	.....	4.92	.....	6.00	6.64	....
$MnSO_4$	.....	.....	.....	.....	.....	.....	2.14	.....	2.02	2.5	....
NH_3	.....	.....	.....	.....	.....	.....	.....	.....	1.94	1.94	2.06
NH_4Cl	.....	3.617	3.582	3.544	3.489	3.442	3.392	3.34	3.33	3.34	....
NH_4NO_3	.....	.....	3.572	3.535	3.470	3.396	3.296	3.11	2.92	2.65	2.17
$NaBr$	.....	.....	.....	3.611	3.551	3.507	3.468	3.456	3.51	3.68	....
$NaC_2H_3O_2$	.....	.....	.....	.....	.....	3.59	3.58	.....	3.78	4.14	....
Na_2CO_3	.....	.....	5.12	4.93	.....	4.44	4.17	.....	.....	.....	....
$NaCl$	3.66	.....	3.604	3.570	.....	3.478	3.424	.....	3.37	3.45	....
$NaClO_3$	3.682	.....	3.588	3.547	.....	3.433	.....	.....	.....	.....	....
Na_2CrO_4	.....	.....	.....	.....	.....	4.49	4.23	.....	3.71	.....	....
$NaHCO_3$	.....	.....	.....	.....	.....	3.65	3.51	.....	.....	.....	....
Na_2HPO_4	.....	.....	4.99	4.85	4.61	4.34	.....	.....	.....	.....	....
NaI	.....	.....	.....	.....	.....	3.68	3.52	.....	3.66	3.97	....
$NaNH_4HPO_4$	.....	.....	4.95	4.78	4.51	4.23	3.87	.....	.....	.....	....
$NaNO_3$	.....	.....	3.55	3.53	.....	3.406	3.327	.....	3.02	2.79	....
$NaOH$	.....	.....	3.55	3.51	3.46	3.42	3.41	3.40	3.44	3.58	....
Na_3PO_4	.....	.....	7.15	6.85	6.11	5.69	.....	.....	.....	.....	....
Na_2S*	.....	.....	.....	.....	.....	7.12	7.06	.....	6.87	.....	....
Na_2SiO_3	.....	.....	6.6	6.42	.....	5.32	4.71	4.02	.....	.....	....
Na_2SO_3	.....	.....	.....	.....	.....	.....	4.36	.....	.....	.....	....
Na_2SO_4	.....	5.2	5.04	4.874	.....	4.344	4.057	.....	.....	.....	....
$NiCl_2$	.....	.....	.....	5.58	5.41	5.38	5.43	5.69	6.22	8.67	....
$Ni(NO_3)_2$	.....	.....	.....	.....	.....	4.91	4.91	.....	5.86	.....	....
$NiSO_4$	.....	3.036	2.832	2.63	2.37	2.20	2.05	.....	1.94	.....	....
$Pb(C_2H_3O_2)_2$	.....	.....	.....	.....	3.63	2.85	2.37	.....	.....	.....	....
$Pb(NO_3)_2$	5.368	5.090	4.898	4.657	4.276	3.955	3.560	2.940	2.435	.....	....
$SrCl_2$	.....	.....	5.3	5.10	.....	4.82	4.80	.....	5.83	7.54	....
$Sr(NO_3)_2$	.....	.....	5.7	5.35	.....	4.63	4.40	.....	3.90	.....	....
$UO_2(NO_3)_2$	.....	.....	.....	.....	5.16	5.00	4.92	.....	6.15	.....	....
$Zn(C_2H_3O_2)_2$	.....	.....	.....	.....	.....	4.74	4.37	.....	.....	.....	....
$ZnCl_2$	.....	5.28	5.15	5.04	.....	4.94	4.96	.....	5.21	5.49	....
$Zn(NO_3)_2$	.....	.....	.....	.....	.....	4.89	4.89	.....	5.83	7.12	....
$ZnSO_4$	.....	.....	2.80	2.65	.....	2.29	2.12	.....	1.87	.....	....

ORGANIC COMPOUNDS

Solute	0.005	0.01	0.02	0.05	0.1	0.2	0.5	1.0	2.0	5.0	10.0
Acetic acid	.....	.....	.....	.....	1.90	.....	.....	1.79	.....	1.6	1.4
Acetone	.....	.....	1.86	.....	1.85	.....	.....	1.79	.....	.....	....
Aniline	.....	1.85	.....	1.82	1.79	1.73	.....	.....	.....	.....	....
Citric acid	.....	2.26	2.14	2.08	2.03	.....	1.93	1.94	2.00	.....	....
Dextrose	.....	.....	.....	1.86	1.86	1.87	.....	1.92	.....	.....	....
Ethyl acetate	.....	.....	.....	.....	1.85	1.83	1.82	.....	.....	.....	....
Ethylalcohol	.....	.....	1.83	.....	1.83	.....	.....	1.83	1.84	.....	2.2
Ethyl ether	.....	1.67	1.67	1.70	1.72	1.70	.....	.....	.....	.....	....
Glycerol	.....	1.86	.....	.....	.....	1.87	1.89	1.92	.....	2.1	....
Methyl alcohol	.....	1.82	.....	.....	1.81	1.81	.....	.....	1.86	.....	2.00
Oxalic acid	.....	.....	3.40	3.04	2.84	2.64	.....	.....	.....	.....	....
Phenol	.....	.....	.....	.....	1.81	1.83	1.63	.....	.....	.....	....
Picric acid	3.82	3.63	3.28	.....	.....	.....	.....	.....	.....	.....	....
n-Propyl alcohol	.....	1.86	.....	1.84	1.83	.....	.....	1.79	1.79	1.76	....
Sucrose	1.86	.....	.....	1.87	1.88	1.90	1.96	2.06	2.3	.....	....
d-Tartaric acid	.....	2.34	.....	2.12	2.05	1.98	1.94	.....	.....	2.35	....

CORRECTION OF BOILING POINTS TO STANDARD PRESSURE

By H. B. Hass and R. F. Newton

This correction may be made by using the equation:

$$\Delta t = \frac{(273.1 + t)(2.8808 - \log p)}{\phi + .15(2.8808 - \log p)} \qquad (1)$$

where Δt = degrees C to be added to the observed boiling point.
t = the observed boiling point.
$\log p$ = the logarithm of the observed pressure in millimeters of mercury.
ϕ = the entropy of vaporization at 760 mm.

The value of ϕ may be estimated from the graph and the table. Substances not included in the table may be classified by grouping them with compounds which bear a close physical or structural resemblance to them.

Example 1. Benzene boils at 20°C. at 75 mm pressure. What is its normal boiling point? We do not find benzene in the table but we find hydrocarbons in group 2, and a group 2 compound with a boiling point of 20° has a ϕ of 4.6.

Substituting in the equation:

$$\Delta t = \frac{(273.1 + 20)(2.8808 - 1.8751)}{4.60 + .15(2.8808 - 1.8751)} = 62°$$

Adding this to 20° gives 82° as a first approximation.

The graph shows that the ϕ for a compound of group 2 boiling at 82° is 4.72 instead of 4.60 which we originally used. Since ϕ is in the denominator, this increase will lower our Δt by the ratio, $\frac{4.60}{4.72}$, or the corrected Δt is $62 \times \frac{4.60}{4.72} = 60.4$. Adding Δt to t, gives 80.4° as a second approximation.

The formula can best be used in a slightly different form when the reverse calculation is desired, *i.e.*, when one calculates the vapor pressure at a given temperature, lower than the normal boiling point.

$$2.8808 - \log p = \frac{\phi \Delta t}{273.1 + t - .15\Delta t} \qquad (2)$$

Example 2. Alcohol boils at 78.4°C. What is its vapor pressure at 20°C.? Substituting in equation 2:

$$2.8808 - \log p = \frac{6.06 \times 58.4}{293.1 - (.15 \times 58.4)} = 1.245$$

$$\log p = 2.8808 - 1.245 = 1.6358$$

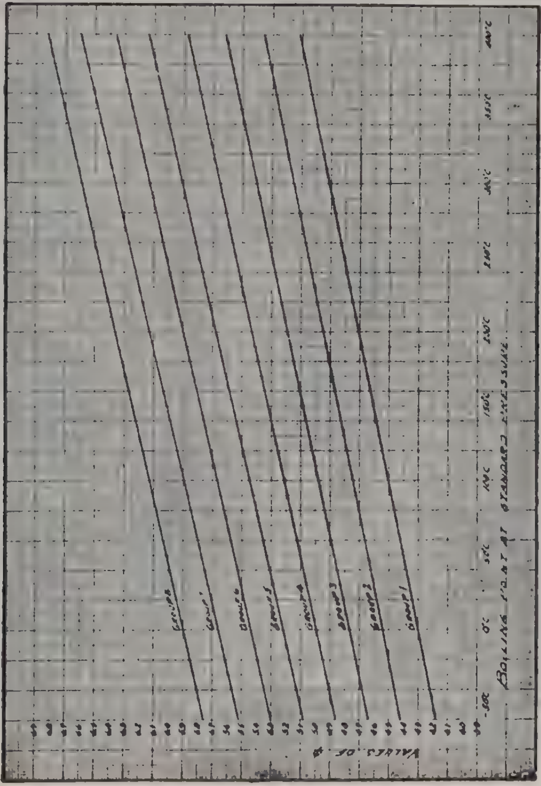
$$p = 43.2 \text{ mm.}$$

Here no second approximation is necessary, since the correct value of ϕ was taken immediately, the normal boiling point having been known.

Compound	Group	Compound	Group
Acetaldehyde	3	Carbon sulfoselenide	2
Acetic acid	4	*m.p.* Chloroanilines	3
Acetic anhydride	6	Chlorinated derivatives	Same group as though Cl was H
Acetone	3		
Acetophenone	4		
Amines	3	*o.m.p.* Cresols	4
n-Amyl alcohol	8	Cyanogen	4
Anthracene	1	Cyanogen chloride	3
Anthraquinone	1	Dibenzyl ketone	2
Benzaldehyde	2	Dimethyl amine	4
Benzoic acid	5	Dimethyl oxalate	4
Benzonitrile	2	Dimethyl silicane	2
Benzophenone	2	Esters	3
Benzyl alcohol	5	Ethanol	8
Butylethylene	1	Ethers	2
Butyric acid	7	Ethylamine	4
Camphor	2	Ethylene glycol	7
Carbon monoxide	1	Ethylene oxide	3
Carbon oxysulfide	2	Formic acid	3
Carbon suboxide	2	Glycol diacetate	4

CORRECTION OF BOILING POINTS (Continued)

Compound	Group	Compound	Group
Halogen derivatives....	Same group as though halogen were hydrogen.	Methyl formate........	4
		Methyl salicylate......	2
		Methyl silicane.........	1
		α, β Naphthols.........	3
		Nitrobenzene...........	3
Heptylic acid..........	7	Nitromethane..........	3
Hydrocarbons..........	2	o.m.p. Nitrotoluenes....	2
Hydrogen cyanide......	3	o.m.p. Nitrotoluidines..	2
Isoamyl alcohol........	7	Phenanthrene..........	1
Isobutyl alcohol.......	8	Phenol.................	5
Isobutyric acid........	6	Phosgene..............	2
Isocaproic acid........	7	Phthalic anhydride.....	2
Methane..............	1	Propionic acid..........	5
Methanol..............	7	*n*-Propyl alcohol.......	8
Methyl amine..........	5	Quinoline..............	2
Methyl benzoate.......	3	Sulfides...............	2
Methyl ether..........	3	Tetranitromethane.....	3
Methyl ethyl ether.....	3	Trichloroethylene......	1
Methyl ethyl ketone....	2	Valeric acid...........	7
Methyl fluoride........	3	Water.................	6



CRITICAL CONSTANTS FOR GASES

Name	Formula	Temp., ° C.	Pressure, atm.	Density gms. per cm.^{3}
Acetaldehyde	CH_3CHO	188	...	...
Acetic acid	CH_3CO_2H	321.6	57.2	0.351
Acetic anhydride	$(CH_3CO)_2O$	296	46	...
Acetone	$(CH_3)_2CO$	235.0	47	0.268
Acetonitrile	CH_3CN	274.7	47.7	0.240
Acetylene	C_2H_2	36	62	0.231
Air	...	−140.7	37.2	0.35;* 0.31†
Allyl alcohol	C_3H_5OH	272	...	...
Allyl sulfide	$(C_3H_5)_2S$	380	...	...
Allylene	CH_3CCH	128	...	...
Ammonia	NH_3	132.4	111.5	0.235
iso-Amyl acetate	$CH_3CO_2C_5H_{11}$	326	...	...
iso-Amyl alcohol	$C_5H_{11}OH$	307	...	...
tert.-Amyl alcohol	$C_5H_{11}OH$	272	...	...
iso-Amyl butyrate	$C_3H_7CO_2C_5H_{11}$	346	...	...
iso-Amyl formate	$HCO_2C_5H_{11}$	303	34	0.282
iso-Amyl mercaptan	$C_5H_{11}SH$	321	...	...
iso-Amyl propionate	$C_2H_5CO_2C_5H_{11}$	338	...	...
iso-Amyl sulfide	$(C_5H_{11})_2S$	391	...	...
Aniline	$C_6H_5NH_2$	426	52.4	...
Anisole	$C_6H_5OCH_3$	369	41.3	...
Argon	A	−122	48	0.531
Benzene	C_6H_6	288.5	47.7	0.304
Benzonitrile	C_6H_5CN	426	41.6	...
Bromine	Br_2	302	...	...
Bromobenzene	C_6H_5Br	397	44.6	0.486
n-Butane	C_4H_{10}	153	36	...
iso-Butane	C_4H_{10}	134	37	...
n-Butyl acetate	$CH_3CO_2C_4H_9$	306	...	...
iso-Butyl acetate	$CH_3CO_2C_4H_9$	288	31	0.281
n-Butyl alcohol	C_4H_9OH	287	48.4	...
iso-Butyl alcohol	C_4H_9OH	265	48	...
sec.-Butyl alcohol	C_4H_9OH	265	...	...
tert.-Butyl alcohol	C_4H_9OH	235	...	...
iso-Butyl butyrate	$C_3H_7CO_2C_4H_9$	338	...	...
iso-Butyl formate	$HCO_2C_4H_9$	278	38	0.288
iso-Butyl isobutyrate	$C_3H_7CO_2C_4H_9$	329	...	...
iso-Butyl isovalerate	$C_4H_9CO_2C_4H_9$	348	...	...
iso-Butyl propionate	$C_2H_5CO_2C_4H_9$	319	...	...
n-Butyric acid	$C_3H_7CO_2H$	355	...	0.302
iso-Butyric acid	$C_3H_7CO_2H$	336	...	0.304
Butyronitrile	C_3H_7CN	309	37.4	...
Capronitrile	$C_5H_{11}CN$	349	32.2	...
Carbon dioxide	CO_2	31.1	73.0	0.460
Carbon disulfide	CS_2	273	76	...
Carbon monoxide	CO	−139	35	0.311
Carbon oxysulfide	COS	105	61	...
Carbon tetrachloride	CCl_4	283.1	45.0	0.558
Chlorine	Cl_2	144.0	76.1	0.573
Chlorobenzene	C_6H_5Cl	359	44.6	0.365
Chloroform	$CHCl_3$	263	...	0.516
m-Cresol	C_7H_7OH	432	45.0	...
o-Cresol	C_7H_7OH	422	49.4	...
p-Cresol	C_7H_7OH	426	50.8	...
Cyanogen	C_2N_2	128	59	...
Cyclohexane	C_6H_{12}	281.0	40.4	0.270
Diethyl amine	$(C_2H_5)_2NH$	223.5	36.2	0.246

* Plait point. † Critical point of contact.

CRITICAL CONSTANTS FOR GASES (Continued)

Name	Formula	Temp., ° C.	Pressure, atm.	Density gms. per cm.^{3}
Diisobutyl	C_8H_{18}	277	24.5	0.237
Diisopropyl	C_6H_{14}	227.4	30.6	0.241
Dimethyl amine	$(CH_3)_2NH$	164.6	51.7	....
Dimethyl aniline	$C_6H_5N(CH_3)_2$	415	35.8	....
Dimethyl-*o*-toluidine	$C_7H_7N(CH_3)_2$	395	30.8	....
Dipropyl amine	$(C_3H_7)_2NH$	277	31	....
Ethane	C_2H_6	32.1	48.8	0.21
Ethyl acetate	$CH_3CO_2C_2H_5$	250.1	37.8	0.308
Ethyl alcohol	C_2H_5OH	243.1	63.1	0.2755
Ethyl allyl ether	$C_2H_5OC_3H_5$	245	....	....
Ethyl amine	$C_2H_5NH_2$	183.2	55.5	....
Ethyl bromide	C_2H_5Br	231	....	0.513
Ethyl butyrate	$C_3H_7CO_2C_2H_5$	293	30	0.276
Ethyl caprylate	$C_7H_{15}CO_2C_2H_5$	386	....	....
Ethyl chloride	C_2H_5Cl	187.2	52	0.33
Ethyl chloroformate	$ClCO_2C_2H_5$	<235	....	....
Ethyl crotonate	$C_3H_5CO_2C_2H_5$	326	....	....
Ethyl disulfide	$(C_2H_5)_2S_2$	369	....	....
Ethyl ether	$(C_2H_5)_2O$	193.8	35.5	0.2625
Ethyl formate	$HCO_2C_2H_5$	235.3	46.65	0.323
Ethyl isobutyrate	$C_3H_7CO_2C_2H_5$	280	30	0.276
Ethyl isovalerate	$C_4H_9CO_2C_2H_5$	315	....	....
Ethyl mercaptan	C_2H_5SH	225.5	54.2	0.301
Ethyl nonylate	$C_8H_{17}CO_2C_2H_5$	400	....	....
Ethyl propionate	$C_2H_5CO_2C_2H_5$	272.9	33.0	0.2965
Ethyl propyl ether	$C_2H_5OC_3H_7$	227.4	32.1	0.258
Ethyl sulfide	$(C_2H_5)_2S$	283.8	39.1	0.279
Ethyl valerate	$C_4H_9CO_2C_2H_5$	297	....	....
Ethylene	C_2H_4	9.7	50.9	0.22
Ethylene oxide	$(CH_2)_2O$	192.0	....	....
Fluorobenzene	C_6H_5F	286	44.6	0.354
Germanium tetrachloride	$GeCl_4$	277	38	....
Helium	He	−267.9	2.26	0.0693
n-Heptane	C_7H_{16}	266.8	26.8	0.234
n-Heptyl alcohol	$C_7H_{15}OH$	365	....	....
n-Hexane	C_6H_{14}	234.8	29.5	0.234
Hydrazine	N_2H_4	380	145	....
Hydrogen	H_2	−239.9	12.8	0.0310
Hydrogen bromide	HBr	90	84	....
Hydrogen chloride	HCl	51.4	81.6	0.42
Hydrogen cyanide	HCN	183.5	50	0.20
Hydrogen iodide	HI	151	82	....
Hydrogen selenide	H_2Se	138	88	....
Hydrogen sulfide	H_2S	100.4	88.9	....
Iodine	I_2	553	....	....
Iodobenzene	C_6H_5I	448	44.6	0.581
Krypton	Kr	−63	54	0.78
Mercury	Hg	>1550	>200	4–5
Methane	CH_4	−82.5	45.8	0.162
Methyl acetate	$CH_3CO_2CH_3$	233.7	46.3	0.325
Methyl alcohol	CH_3OH	240.0	78.7	0.272
Methyl amine	CH_3NH_2	156.9	73.6	....
Methyl aniline	$C_6H_5NHCH_3$	429	51.3	....
Methyl butyrate	$C_3H_7CO_2CH_3$	281.3	34.2	0.300
Methyl chloride	CH_3Cl	143.1	65.8	0.37
Methyl ethyl ether	$C_2H_5OCH_3$	164.7	43.4	0.270
Methyl ethyl sulfide	$CH_3SC_2H_5$	260	42	....
Methyl fluoride	CH_3F	44.9	62.0	....
Methyl formate	HCO_2CH_3	214.0	59.15	0.349
Methyl isobutyrate	$C_3H_7CO_2CH_3$	267.55	33.7	0.301

CRITICAL CONSTANTS FOR GASES (Continued)

Name	Formula	Temp., ° C.	Pressure, atm.	Density gms. per cm.^{3}
Methyl mercaptan	CH_3SH	196.8	71.4	0.323
Methyl oxalate	$(CO_2CH_3)_2$	260	9.48	....
Methyl propionate	$C_2H_5CO_2CH_3$	257.4	39.3	0.312
Methyl sulfide	$(CH_3)_2S$	229.9	54.6	0.306
Methyl valerate	$C_4H_9CO_2CH_3$	294d	32	0.279
Methylal	$H_2C(OCH_3)_2$	224	....	....
Neon	Ne	−228.7	25.9	0.484
Nitric oxide	NO	−94	65	0.52
Nitrogen	N_2	−147.1	33.5	0.3110
Nitrogen tetroxide	N_2O_4	158	99	....
Nitrous oxide	N_2O	36.5	71.7	0.45
n-Octane	C_8H_{18}	296	24.6	0.234
n-Octyl alcohol	$C_8H_{17}OH$	385	....	....
sec.-Octyl alcohol	$C_8H_{17}OH$	364	....	....
Oxygen	O_2	−118.8	49.7	0.430
Paraldehyde	$C_6H_{12}O_3$	290	....	....
n-Pentane	C_5H_{12}	197.2	33.0	0.232
iso-Pentane	C_5H_{12}	187.8	32.8	0.234
Phenetole	$C_6H_5OC_2H_5$	374	33.8	....
Phenol	C_6H_5OH	419	60.5	....
Phosgene	$COCl_2$	182	56	0.52
Phosphine	PH_3	51	64	0.30
Phosphonium chloride	PH_4Cl	49	73	....
Propane	C_3H_8	95.6	43	....
Propionic acid	$C_2H_5CO_2H$	339.5	53.0	0.315
Propionitrile	C_2H_5CN	291.2	41.3	0.241
Propyl acetate	$CH_3CO_2C_3H_7$	276.2	32.9	0.296
n-Propyl alcohol	C_3H_7OH	263.7	49.95	0.273
iso-Propyl alcohol	C_3H_7OH	235	53	....
Propyl amine	$C_3H_7NH_2$	223.8	46.3	....
Propyl butyrate	$C_3H_7CO_2C_3H_7$	327	....	....
n-Propyl chloride	C_3H_7Cl	230	45.2	....
Propyl formate	$HCO_2C_3H_7$	264.85	40.1	0.309
Propyl isobutyrate	$C_3H_7CO_2C_3H_7$	316	....	....
Propyl isovalerate	$C_4H_9CO_2C_3H_7$	336	....	....
Propyl propionate	$C_2H_5CO_2C_3H_7$	305	....	....
Propylene	C_3H_6	92.3	45.0	....
Pyridine	C_5H_5N	344	60.0	....
Quinoline	C_9H_7N	>520	....	....
Radon	Rn	104	62	....
Silicon tetrafluoride	SiF_4	−1.5	50	....
Silicon tetrahydride	SiH_4	−3.5	48	....
Stannic chloride	$SnCl_4$	318.7	37.0	0.742
Sulfur	S	1040	....	....
Sulfur dioxide	SO_2	157.2	77.7	0.52
Sulfur trioxide	SO_3	218.3	83.6	0.630
Thiophene	C_4H_4S	317	48	....
Thymol	$C_{10}H_{13}OH$	425	....	....
Toluene	$C_6H_5CH_3$	320.6	41.6	0.292
Tolunitrile	C_7H_7CN	450	....	....
Triethyl amine	$(C_2H_5)_3N$	262	30	0.251
Trimethyl amine	$(CH_3)_3N$	161	41	....
n-Valeric acid	$C_4H_9CO_2H$	379	....	....
iso-Valeric acid	$C_4H_9CO_2H$	361	....	....
Water	H_2O	374.0	217.72	0.4
Xenon	Xe	16.6	58.2	1.155

VAN DER WAALS' CONSTANTS FOR GASES

(Calculated from Amagat units in Landbolt-Bornstein Physical Chemical Tables)

Van der Waals' equation is an equation of state for real gases. It may be written

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT \text{ for one mole.}$$

or

$$\left(P + \frac{n^2a}{V^2}\right)(V - nb) = nRT \text{ for } n \text{ moles.}$$

The term a is a measure of the attractive force between the molecules. The term b is due to the finite volume of the molecules and to their general incompressibility. It is known that a and b vary to some extent with temperature.

The values for a and b in the following table are those to be used when the pressure is in atmospheres and the volume is in liters. Thus R in the above equation will be 0.08206 liter atmospheres per mole per degree. T is degrees Kelvin.

Name	Formula	a	b
		$\frac{(\text{liters})^2 \times \text{atm.}}{(\text{mole})^2}$	$\frac{\text{liters}}{\text{mole}}$
Acetic acid	CH_3CO_2H	17.59	0.1068
Acetic anhydride	$(CH_3CO)_2O$	19.90	0.1263
Acetone	$(CH_3)_2CO$	13.91	0.0994
Acetonitrile	CH_3CN	17.58	0.1168
Acetylene	C_2H_2	4.390	0.05136
Ammonia	NH_3	4.170	0.03707
Amyl formate	$HCO_2C_5H_{11}$	27.58	0.1730
Amylene	C_5H_{10}	15.90	0.1207
*Iso*amylene	C_5H_{10}	18.08	0.1405
Aniline	$C_6H_5NH_2$	26.50	0.1369
Argon	A	1.345	0.03219
Benzene	C_6H_6	18.00	0.1154
Benzonitrile	C_6H_5CN	33.39	0.1724
Bromobenzene	C_6H_5Br	28.56	0.1539
n-Butane	C_4H_{10}	14.47	0.1226
iso-Butane	C_4H_{10}	12.87	0.1142
iso-Butyl acetate	$CH_3CO_2C_4H_9$	28.50	0.1833
iso-Butyl alcohol	C_4H_9OH	17.03	0.1143
iso-Butyl benzene	$C_6H_5C_4H_9$	38.59	0.2144
iso-Butyl formate	$HCO_2C_4H_9$	22.54	0.1476
Butyronitrile	C_3H_7CN	25.72	0.1596
Capronitrile	$C_5H_{11}CN$	34.16	0.1984
Carbon dioxide	CO_2	3.592	0.04267
Carbon disulfide	CS_2	11.62	0.07685
Carbon monoxide	CO	1.485	0.03985
Carbon oxysulfide	COS	3.933	0.05817
Carbon tetrachloride	CCl_4	20.39	0.1383
Chlorine	Cl_2	6.493	0.05622
Chlorobenzene	C_6H_5Cl	25.43	0.1453
Chloroform	$CHCl_3$	15.17	0.1022
m-Cresol	$CH_3C_6H_4OH$	31.38	0.1607
Cyanogen	C_2N_2	7.667	0.06901
Cyclohexane	C_6H_{12}	22.81	0.1424
Cymene	$C_{10}H_{14}$	42.16	0.2336
Decane	$C_{10}H_{12}$	48.55	0.2905
Di-isobutyl	C_8H_{18}	34.97	0.2296
Diethylamine	$(C_2H_5)_2NH$	19.15	0.1392
Dimethylamine	$(CH_3)_2NH$	10.38	0.08570
Dimethylaniline	$C_6H_5N(CH_3)_2$	37.49	0.1970
Diphenyl	$(C_6H_5)_2$	52.79	0.2480
Diphenyl methane	$(C_6H_5)_2CH_2$	38.20	0.2240

VAN DER WAALS' CONSTANTS FOR GASES
(Continued)

Name	Formula	a	b
		$\frac{(\text{liters})^2 \times \text{atm.}}{(\text{mole})^2}$	$\frac{\text{liters}}{\text{mole}}$
Dipropylamine	$(C_2H_7)_2NH$	27.72	0.1820
Di-isopropyl	$(C_3H_7)_2$	23.13	0.1669
Durene	$C_{10}H_{14}$	45.32	0.2424
Ethane	C_2H_6	5.489	0.06380
Ethyl acetate	$CH_3CO_2C_2H_5$	20.45	0.1412
Ethyl alcohol	C_2H_5OH	12.02	0.08407
Ethylamine	$C_2H_5NH_2$	10.60	0.08409
Ethyl benzene	$C_2H_5C_6H_5$	28.60	0.1667
Ethyl butyrate	$C_3H_7CO_2C_2H_5$	30.07	0.1919
Ethyl isobutyrate	$C_3H_7CO_2C_2H_5$	28.87	0.1994
Ethyl chloride	C_2H_5Cl	10.91	0.08651
Ethyl ether	$(C_2H_5)_2O$	17.38	0.1344
Ethyl formate	$HCO_2C_2H_5$	14.80	0.1056
Ethyl mercaptan	C_2H_5SH	11.24	0.08098
Ethyl propionate	$C_2H_5CO_2C_2H_5$	24.39	0.1615
Ethyl sulfide	$(C_2H_5)_2S$	18.75	0.1214
Ethylene	C_2H_4	4.471	0.05714
Ethylene bromide	$(CH_2Br)_2$	13.98	0.08664
Ethylene chloride	$(CH_2Cl)_2$	16.91	0.1086
Ethylidene chloride	CH_3CHCl_2	15.50	0.1073
Fluorobenzene	C_6H_5F	19.93	0.1286
Germanium tetrachloride	$GeCl_4$	22.60	0.1485
Helium	He	0.03412	0.02370
n-Heptane	C_7H_{16}	31.51	0.2654
n-Hexane	C_6H_{14}	24.39	0.1735
Hydrogen	H_2	0.2444	0.02661
Hydrogen bromide	HBr	4.451	0.04431
Hydrogen chloride	HCl	3.667	0.04081
Hydrogen selenide	H_2Se	5.268	0.04637
Hydrogen sulfide	H_2S	4.431	0.04287
Iodobenzene	C_6H_5I	33.08	0.1656
Krypton	Kr	2.318	0.03978
Mercury	Hg	8.093	0.01696
Mesitylene	$(CH_3)_3C_6H_3$	34.32	0.1979
Methane	CH_4	2.253	0.04278
Methyl acetate	$CH_3CO_2CH_3$	15.29	0.1091
Methyl alcohol	CH_3OH	9.523	0.06702
Methylamine	CH_3NH_2	7.130	0.05992
Methyl butyrate	$C_3H_7CO_2CH_3$	23.94	0.1569
Methyl isobutyrate	$C_3H_7CO_2CH_3$	24.50	0.1637
Methyl chloride	CH_3Cl	7.471	0.06483
Methyl ether	$(CH_3)_2O$	8.073	0.07246
Methyl ethyl ether	$CH_3OC_2H_5$	11.95	0.09775
Methyl ethyl sulfide	$CH_3SC_2H_5$	19.23	0.1304
Methyl fluoride	CH_3F	4.631	0.05264
Methyl formate	HCO_2CH_3	10.84	0.08068
Methyl propionate	$C_2H_5CO_2CH_3$	19.91	0.1360
Methyl sulfide	$(CH_3)_2S$	12.87	0.09213
Methyl valerate	$C_4H_9CO_2CH_3$	28.96	0.1845
Naphthalene	$C_{10}H_8$	39.74	0.1937
Neon	Ne	0.2107	0.01709
Nitric oxide	NO	1.340	0.02789
Nitrogen	N_2	1.390	0.03913
Nitrogen dioxide	NO_2	5.284	0.04424
Nitrous oxide	N_2O	3.782	0.04415
n-Octane	C_8H_{18}	37.32	0.2368
Oxygen	O_2	1.360	0.03183
n-Pentane	C_5H_{12}	19.01	0.1460

VAN DER WAALS' CONSTANTS FOR GASES
(Continued)

Name	Formula	a	b
		$\frac{(\text{liters})^2 \times \text{atm.}}{(\text{mole})^2}$	$\frac{\text{liters}}{\text{mole}}$
iso-Pentane	C_5H_{12}	18.05	0.1417
Phenetole	$C_6H_5OC_2H_5$	35.16	0.1963
Phosphine	PH_3	4.631	0.05156
Phosphonium chloride	PH_4Cl	4.054	0.04545
Phosphorus	P	52.94	0.1566
Propane	C_3H_8	8.664	0.08445
Propionic acid	$C_2H_5CO_2H$	20.11	0.1187
Propionitrile	C_2H_5CN	16.44	0.1064
Propyl acetate	$CH_3CO_2C_3H_7$	24.63	0.1619
Propyl alcohol	C_3H_7OH	14.92	0.1019
Propylamine	$C_3H_7NH_2$	14.99	0.1090
Propyl benzene	$C_6H_5C_3H_7$	35.85	0.2028
iso-Propyl benzene	$C_6H_5C_3H_7$	35.64	0.2025
Propyl chloride	C_3H_7Cl	15.91	0.1141
Propyl formate	$HCO_2C_3H_7$	18.95	0.1280
Propylene	C_2H_6	8.379	0.08272
Pseudo-cumene	$C_6H_3(CH_3)_3$	36.61	0.2021
Silicon fluoride	SiF_4	4.195	0.05571
Silicon tetrahydride	SiH_4	4.320	0.05786
Stannic chloride	$SnCl_4$	26.91	0.1642
Sulfur dioxide	SO_2	6.714	0.05636
Thiophene	C_4H_4S	20.72	0.1270
Toluene	$C_6H_5CH_3$	24.06	0.1463
Triethylamine	$(C_2H_5)_3N$	27.17	0.1831
Trimethylamine	$(CH_3)_3N$	13.02	0.1084
Xenon	Xe	4.194	0.05105
m-Xylene	$C_6H_4(CH_3)_2$	30.36	0.1772
o-Xylene	$C_6H_4(CH_3)_2$	29.98	0.1755
p-Xylene	$C_6H_4(CH_3)_2$	30.93	0.1809
Water	H_2O	5.464	0.03049

FREEZING MIXTURES

A is the proportion of the substance named in the first column to be added to the proportion of the substance given in column *B*. The table gives the temperature of the separate ingredients and the temperature attained by the mixture.

(From Smithsonian Tables.)

Substance.	*A*	*B*	Initial Temp. ° C.	Temp. ° C. attained by mixt.
$NaC_2H_3O_2$ (cryst.)	85	H_2O 100	10.7	− 4.7
NH_4Cl	30	H_2O 100	13.3	− 5.1
$NaNO_3$	75	H_2O 100	13.2	− 5.3
$Na_2S_2O_3$ (cryst.)	110	H_2O 100	10.7	− 8.0
KI	140	H_2O 100	10.8	−11.7
$CaCl_2$ (cryst.)	250	H_2O 100	10.8	−12.4
NH_4NO_3	60	H_2O 100	13.6	−13.6
$CaCl_2$	30	* Snow 100	− 1	−10.9
NH_4Cl	25	Snow 100	− 1	−15.4
NH_4NO_3	45	Snow 100	− 1	−16.75
$NaNO_3$	50	Snow 100	− 1	−17.75
NaCl	33	Snow 100	− 1	−21.3
$H_2SO_4+H_2O$ (66.1% H_2SO_4)	1	Snow 1.097	− 1	−37.0
	1	Snow 2.52	− 1	−30.0
	1	Snow 4.32	− 1	−25.0
	1	Snow 7.92	− 1	−20.0
	1	Snow 13.08	− 1	−16.0
$CaCl_2+6H_2O$	1	Snow .49	0	−19.7
	1	Snow .61	0	−39.0
	1	Snow .70	0	−54.9
	1	Snow .81	0	−40.3
	1	Snow 1.23	0	−21.5
	1	Snow 2.46	0	− 9.0
	1	Snow 4.92	0	− 4.0
Alcohol at 4°	77	Snow 73.	0	−30.0
	..	CO_2 solid	......	−72.0
Chloroform	....	CO_2 solid	......	−77.0
Ether	....	CO_2 solid	......	−77.0
Liquid SO_2	....	CO_2 solid	......	−82.0
NH_4NO_3	1	H_2O .94	20	− 4.0
	1	Snow .94	0	− 4.0
	1	H_2O 1.20	10	−14.0
	1	Snow 1.20	0	−14.0
	1	H_2O 1.31	10	−17.5
	1	Snow 1.31	0	−17.5

* Or finely pulverized ice.

FREEZING POINTS, DENSITIES, AND CONCENTRATIONS OF THE CALCIUM CHLORIDE BRINES

Specific gravity 60/60°F.	°Baumé at 60°F. (Am. Std.)	Salimeter reading at 60°F.	Weight of brine at 60°F.		% $CaCl_2$ actual	Freezing point °F.
			Lbs. per gallon	Lbs. per cu. ft.		
1.000	0.0	0.0	8.34	62.37	0	+32.0
1.009	1.3	5.2	8.41	62.93	**1.0**	+31.1
1.010	1.4	5.6	8.42	62.99	1.2	+31.0
1.018	2.5	10.0	8.49	63.49	**2.0**	+30.4
1.020	2.8	11.2	8.50	63.61	2.3	+30.2
1.026	3.7	14.8	8.55	63.99	**3.0**	+29.5
1.030	4.2	16.8	8.59	64.24	3.5	+29.1
1.034	4.8	19.2	8.62	64.49	**4.0**	+28.6
1.040	5.6	22.4	8.67	64.86	4.6	+28.0
1.043	6.0	24.0	8.70	65.05	**5.0**	+27.7
1.050	6.9	27.6	8.75	65.48	5.9	+27.0
1.052	7.1	28.4	8.77	65.61	**6.0**	+26.8
1.060	8.2	32.8	8.84	66.11	**7.0**	+25.9
1.069	9.4	37.6	8.91	66.67	**8.0**	+24.6
1.070	9.5	38.0	8.92	66.73	8.1	+24.6
1.078	10.5	42.0	8.99	67.23	**9.0**	+23.5
1.080	10.7	42.8	9.00	67.36	9.2	+23.2
1.087	11.6	46.4	9.06	67.79	**10.0**	+22.3
1.090	12.0	48.0	9.09	67.98	10.3	+21.9
1.096	12.7	50.8	9.14	68.35	**11.0**	+20.8
1.100	13.2	52.8	9.17	68.60	11.4	+20.3
1.105	13.8	55.2	9.21	68.92	**12.0**	+19.3
1.110	14.3	57.2	9.25	69.23	12.4	+18.7
1.115	15.0	60.0	9.30	69.54	**13.0**	+17.6
1.120	15.5	62.0	9.34	69.85	13.5	+16.5
1.125	16.1	64.4	9.38	70.16	**14.0**	+15.5
1.130	16.7	66.8	9.42	70.47	14.5	+14.5
1.135	17.2	68.8	9.46	70.79	**15.0**	+13.5
1.140	17.8	71.2	9.50	71.10	15.6	+12.2
1.145	18.4	73.6	9.55	71.41	**16.0**	+11.2
1.150	18.9	75.6	9.59	71.72	16.6	+ 9.7
1.155	19.4	77.6	9.63	72.03	**17.0**	+ 8.6
1.160	20.0	80.0	9.67	72.35	17.6	+ 7.0
1.165	20.5	82.0	9.71	72.66	**18.0**	+ 5.9
1.170	21.1	84.4	9.75	72.97	18.6	+ 4.1
1.175	21.6	86.4	9.80	73.28	**19.0**	+ 2.8
1.180	22.1	88.4	9.84	73.59	19.5	+ 1.2
1.186	22.7	90.8	9.89	73.97	**20.0**	− 0.4
1.190	23.2	92.8	9.92	74.22	20.6	− 2.0
1.195	23.7	94.8	9.96	74.53	**21.0**	− 3.9
1.200	24.2	96.8	10.00	74.84	21.5	− 5.8
1.206	24.8	99.2	10.05	75.21	**22.0**	− 7.8
1.210	25.2	100.8	10.09	75.46	22.4	− 9.4
1.218	25.9	103.6	10.15	75.96	**23.0**	−11.9
1.220	26.2	104.8	10.17	76.09	23.3	−13.2
1.228	26.9	107.6	10.24	76.59	**24.0**	−16.2
1.230	27.1	108.4	10.25	76.71	24.2	−17.1
1.239	28.0	112.0	10.33	77.27	**25.0**	−21.0
1.240	28.1	112.4	10.34	77.33	25.1	−21.5
1.250	29.0	116.0	10.42	77.96	**26.0**	−25.8

FREEZING POINTS, DENSITIES, AND CONCENTRATIONS OF THE CALCIUM CHLORIDE BRINES (Continued)

Specific gravity 60/60°F.	°Baumé at 60°F. (Am. Std.)	Salimeter reading at 60°F.	Weight of brine at 60°F.		% $CaCl_2$ actual	Freezing point °F.
			Lbs. per gallon	Lbs. per cu. ft.		
1.260	29.9	119.6	10.50	78.58	**27.0**	−31.2
1.270	30.8	.....	10.59	79.21	27.8	−37.1
1.272	31.0	.....	10.60	79.33	**28.0**	−37.8
1.280	31.7	.....	10.67	79.83	28.7	−44.3
1.283	32.0	.....	10.70	80.02	**29.0**	−49.4
1.290	32.6	.....	10.75	80.45	29.6	−59.8
1.295	33.0	.....	10.80	80.76	**30.0**	−50.8
1.300	33.5	.....	10.84	81.08	30.5	−41.8
1.306	34.0	.....	10.89	81.45	**31.0**	−33.2
1.310	34.3	.....	10.92	81.70	31.3	−29.2
1.317	34.9	.....	10.98	82.14	**32.0**	−19.5
1.320	35.1	.....	11.01	82.32	32.2	−17.0
1.328	35.8	.....	11.07	82.82	**33.0**	− 6.9
1.330	36.0	.....	11.09	82.95	33.2	− 4.7
1.340	36.8	.....	11.17	83.57	**34.0**	+ 4.3
1.350	37.6	.....	11.26	84.19	34.9	+14.3
1.351	37.7	.....	11.26	84.26	**35.0**	+14.4
1.360	38.4	.....	11.34	84.82	35.8	+21.7
1.363	38.6	.....	11.36	85.01	**36.0**	+24.1
1.370	39.0	.....	11.42	85.44	36.4	+30.0
1.374	39.5	.....	11.46	85.69	**37.0**	+33.4
1.380	39.9	.....	11.51	86.07	37.4	+37.0
1.386	40.4	.....	11.56	86.44	**38.0**	+42.1
1.390	40.7	.....	11.59	86.69	38.3	+44.4
1.398	41.3	.....	11.66	87.19	**39.0**	+49.6
1.400	41.4	.....	11.67	87.31	39.2	+50.9
1.410	42.2	.....	11.76	87.94	**40.0**	+55.9

PERCENTAGE COMPOSITION OF ANTI-FREEZE SOLUTIONS

Ethyl Alcohol and Water Solutions

% alcohol by weight	Sp. gr. 20°/4° C. (68° F.)	Point of crystallization	
		Deg. C.	Deg. F.
2.5	0.99363	−1.0	30.2
4.8	0.98971	−2.0	28.4
6.8	0.98658	−3.0	26.6
11.3	0.98006	−5.0	23.0
13.8	0.97670	−6.1	21.0
16.4	0.97336	−7.5	18.5
17.5	0.97194	−8.7	16.3
18.8	0.97024	−9.4	15.1
20.3	0.96823	−10.6	12.9
22.1	0.96578	−12.2	10.0
24.2	0.96283	−14.0	6.8
26.7	0.95914	−16.0	3.2
29.9	0.95400	−18.9	−2.0
33.8	0.94715	−23.6	−10.5
39.0	0.93720	−28.7	−19.7
46.3	0.92193	−33.9	−29.0
56.1	0.90008	−41.0	−41.8
71.9	0.86311	−51.3	−60.3

Glycerol (Glycerine) and Water Solutions*

% glycerol by weight	Sp. gr. 15°/15° C. (59° F.)	Sp. gr. 20°/20° C. (68° F.)	Freezing point	
			Deg. C.	Deg. F.
10	1.02415	1.02395	−1.6	29.1
20	1.04935	1.04880	−4.8	23.4
30	1.07560	1.07470	−9.5	14.9
40	1.10255	1.10135	−15.4	4.3
50	1.12985	1.12845	−23.0	−9.4
60	1.15770	1.15605	−34.7	−30.5
70	1.18540	1.18355	−38.9	−38.0
80	1.21290	1.21090	−20.3	−5.5
90	1.23950	1.23755	−1.6	29.1
100	1.26557	1.26362	17.0	62.6

* Bosart and Snoddy, Jour. Ind. Eng. Chem. 19, 506 (1927); Lane, ibid. 17, 924 (1925). The Chemical Division of the Proctor and Gamble Co. suggest that a correction of +2° F. be added to all temperatures below zero degree Fahrenheit.

Ethylene Glycol (Prestone) and Water Solutions

% glycol by volume	Sp. gr. 15.6° C. (60° F.)	Freezing point	
		Deg. C.	Deg. F.
12.5	1.019	−3.9	25
17.0	1.026	−6.7	20
25.0	1.038	−12.2	10
32.5	1.048	−17.8	0
38.5	1.056	−23.3	−10
44.0	1.063	−28.9	−20
49.0	1.069	−34.4	−30
52.5	1.073	−40.0	−40

HEAT OF FUSION

ELEMENTS AND INORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g*
Aluminum	Al	658	76.8
Ammonia	NH_3	−75	108.1
		−77.6	83.9
Antimony bromide	$SbBr_3$	94	9.76
trichloride	$SbCl_3$	73.2	13.3
trisulfide	Sb_2S_3	540	17.6
Argon	A	−190	6.71
Arsenous bromide	$AsBr_3$	31	8.94
Barium chloride	$BaCl_2$	958.9	27.5
Bismuth	Bi	268	12.64
Bromine	Br	−7.32	16.2
Cadmium	Cd	320.7	13.66
nitrate	$Cd(NO_3)_2 \cdot 4H_2O$	59.5	25.3
Calcium chloride	$CaCl_2$	773.9	54.3
chloride	$CaCl_2 \cdot 6H_2O$	29	40.7
nitrate	$Ca(NO_3)_2 \cdot 4H_2O$	42.1	34.0
Carbon dioxide	CO_2	−56.2	45.3
monoxide	CO	−206	8.00
Cesium hydroxide	CsOH	272.3	10.8
Chlorine	Cl	−103.5	23.0
Cobalt nitrate	$Co(NO_3)_2 \cdot 6H_2O$	....	30.2
Copper	Cu	1083	42.
Cupric nitrate	$Cu(NO_3)_2 \cdot 6H_2O$	24.4	29.4
Gold	Au	1064	15.8
Hydriodic acid	HI	−53	5.68
Hydrobromic acid	HBr	−86	7.67
Hydrochloric acid	HCl	−114	13.9
acid	$HCl \cdot 2H_2O$	−18.5	34.6
Hydrogen	H	....	14.0
peroxide	H_2O_2	−1.7	74.1
Iodine	I	....	11.71
Iron, gray cast	Fe	....	5.50
white cast	....	....	7.89
slag	....	....	11.9
Lead	Pb	327	5.86
bromide	$PbBr_2$	490	12.3
chloride	$PbCl_2$	485	20.9
iodide	PbI_2	375	11.5
Lithium nitrate	$LiNO_3$	250	88.5
silicate	Li_2SiO_3	....	80.2
silicate	$Li_2SiO_3 \cdot Li_2O$	....	62.1
Magnesium chloride	$MgCl_2 \cdot 6H_2O$	116.7	41.2
nitrate	$Mg(NO_3)_2 \cdot 6H_2O$	90	38.2
Manganese nitrate	$Mn(NO_3)_2 \cdot 6H_2O$	25.8	28.8
Mercuric bromide	$HgBr_2$	235	12.8
iodide	HgI_2	250	9.80
Mercury	Hg	−39	2.82
Nickel	Ni	1435	73.8
nitrate	$Ni(NO_3)_2 \cdot 6H_2O$	56.7	36.4
Nitric acid	HNO_3	−47	9.55
Nitrogen	N	−210	6.09
dioxide	NO	−163	18.4
pentoxide	N_2O_5	29.5	76.7
tetroxide	N_2O_4	−10.14	32.3 to 37.2
Oxygen	O	−219	3.30
Palladium	....	1545	36.3

* Gram calories (15° C.) per gram.

HEAT OF FUSION (Continued)

Elements and Inorganic Compounds

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
Platinum	Pt	1755	27.2
Potassium	K	62	15.7
chloride	KCl	772.3	74.1
dichromate	$K_2Cr_2O_7$	397	29.7
fluoride	KF	859.9	108.
hydroxide	KOH	360.4	28.6
nitrate	KNO_3	308	25.4
Phosphorous acid, hypo.	H_3PO_2	17.4	35.0
Phosphorus	P	44.2	5.03
oxychloride	$POCl_3$	2	19.8
Rubidium chloride	$RbCl$	....	38.0
hydroxide	$RbOH$	301	15.8
Silicon tetrachloride	$SiCl_4$	70.3	10.9
Silver	Ag	961	21.07
bromide	$AgBr$	430	12.5
chloride	$AgCl$	451	30.7
		455	21.3
nitrate	$AgNO_3$	208	17.7
Sodium	Na	97	31.7
chlorate	$NaClO_3$	255	49.0
chloride	$NaCl$	804.3	124.
chromate	$Na_2CrO_4 \cdot 10H_2O$	23	39.2
fluoride	NaF	992.2	186.
hydroxide	$NaOH$	318.4	40.0
nitrate	$NaNO_3$	333	45.3
phosphate, dibasic	$Na_2HPO_4 \cdot 12H_2O$	36.1	66.8
sulfate	$Na_2SO_4 \cdot 10H_2O$	31	51.3
thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	....	47.8
Stannic bromide	$SnBr_4$	25.5	6.26
chloride	$SnCl_4$	−33	8.40
Strontium chloride	$SrCl_2$	872.3	25.4
Sulfur	S	119	13.2
trioxide	SO_3	−30	24.0
Sulfuric acid	$H_2SO_4 \cdot H_2O$	8.56	39.1
acid	H_2SO_4	10.352	24.0
acid, pyro-	$H_2S_2O_7$	35	17.9
Thallium bromide	$TlBr$	460	12.7
monochloride	$TlCl$	427	16.6
Tin	Sn	232	14.0
Titanium tetrachloride	$TiCl_4$	−25	11.8
Water	H_2O	0	79.71
Zinc		419	28.13
nitrate	$Zn(NO_3)_2 \cdot 6H_2O$	36.4	31.1

HEAT OF FUSION (Continued)

ORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
Acetic acid	CH_3CO_2H	16.58	44.7
		16.7	43.2
Acetone	$(CH_3)_2CO$	−95.5	23.4
		−94.6	19.6
Acrylic acid	$C_2H_3CO_2H$	13	37.0
Allocinnamic acid	$C_6H_5C_2H_2CO_2H$	58	27.4
o-Aminobenzoic acid	$H_2NC_6H_4CO_2H$	145	35.5
m-Aminobenzoic acid		180	38.0
p-Aminobenzoic acid		188.5	36.5
tert.-Amyl alcohol	$C_5H_{11}OH$		12.5
Anethole	$C_3H_5C_6H_4OCH_3$	21.5	25.8
Aniline	$C_6H_5NH_2$	−7.03	21.0
Anthracene	$C_{14}H_{10}$	216.55	38.7
Anthraquinone	$(C_6H_4)_2(CO)_2$	282	37.5
Azobenzene	$(C_6H_5N)_2$	69.1	28.9
		66	28.0
		68	32.4
Azoxybenzene	$(C_6H_5)_2ON_2$	34.6	21.6
Benzene	C_6H_6	5.42	30.3
		5.40	30.2
Benzil	$(C_6H_5CO)_2$	94.94	22.2
Benzoic acid	$C_6H_5CO_2H$	121.8	33.9
Benzophenone	$(C_6H_5)_2CO$	48.25	23.5
Benzylaniline	$C_6H_5NHC_7H_7$	36	21.9
Bromal hydrate	$CBr_3CHO \cdot H_2O$	46	16.9
Bromocamphor	$C_{10}H_{15}BrO$		41.6
o-Bromochlorobenzene	C_6H_4BrCl	−12.6	15.4
m-Bromochlorobenzene		−21.2	15.3
p-Bromochlorobenzene		64.6	23.4
o-Bromoiodobenzene	C_6H_4BrI	21	12.2
m-Bromoiodobenzene		−9.3	10.3
p-Bromoiodobenzene		90.1	16.6
p-Bromophenol	HOC_6H_4Br	64	20.5
p-Bromotoluene	$CH_3C_6H_4Br$	27.6	20.9
n-Butyl alcohol	C_4H_9OH	−89.2	29.9
tert.-Butyl alcohol	C_4H_9OH	25.45	21.0
		25.4	21.9
n-Butyric acid	$C_3H_7CO_2H$	−5.7	30.1
n-Capric acid	$C_9H_{19}CO_2H$	31.2	38.9
n-Caprylic acid	$C_7H_{15}CO_2H$	16.34	35.4
Carbazole	$C_{12}H_9N$	236	42.1
Carbon tetrachloride	CCl_4	−24	4.16
Carvoxime (d)	$C_{10}H_{14}NOH$	71.5	23.3
Carvoxime (l)		71	23.4
Carvoxime (dl)		91	24.6
Catechol	$C_6H_4(OH)_2$	104.3	49.4
Cetyl alcohol	$C_{16}H_{33}OH$	47	33.8
Cinnamic acid	$C_6H_5C_2H_2CO_2H$	133	36.5
anhydride	$(C_6H_5C_2H_4CO)_2O$	48	28.1
Chloral alcoholate	$CCl_3CHO \cdot C_2H_5OH$	9	24.0
hydrate	$CCl_3CHO \cdot H_2O$		33.2
Chloroacetic acid (α)	$ClCH_2CO_2H$	61.2	31.1
acid (β)		56	35.1
p-Chloroaniline	$H_2NC_6H_4Cl$	69	37.2
o-Chlorobenzoic acid	$ClC_6H_4CO_2H$	140.2	39.3
m-Chlorobenzoic acid		154.25	36.4
p-Chlorobenzoic acid		239.7	49.2

HEAT OF FUSION (Continued)

ORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
m-Chloronitrobenzene	$ClC_6H_4NO_2$	43.8	29.4
		44.16	31.5
p-Chloronitrobenzene	...	82	21.4
p-Cresol	$CH_3C_6H_4OH$	34	26.3
Cyanamide	H_2NCN	42.9	49.8
Cyclohexanol	$C_6H_{11}(OH)$	23.2	4.19
Dibenzyl	$(C_6H_5CH_2)_2$	51	31.0
o-Dibromobenzene	$C_6H_4Br_2$	18	12.8
m-Dibromobenzene	...	−6.9	13.4
p-Dibromobenzene	...	86	20.5
Dibromophenol (2, 4)	$HOC_6H_3Br_2$	12	14.0
Dichloroacetic acid	Cl_2CHCO_2H	10.8	14.2
o-Dichlorobenzene	$C_6H_4Cl_2$	−17.5	21.0
m-Dichlorobenzene	...	−24.4	20.5
p-Dichlorobenzene	...	52.7	29.7
o-Diiodobenzene	$C_6H_4I_2$	23.4	10.2
m-Diiodobenzene	...	34.2	11.6
p-Diiodobenzene	...	129	16.2
Dimethyl tartrate (d)	$(CHOH)_2(CO_2CH_3)_2$	49	21.5
Dimethyl tartrate (dl)	...	87	35.1
o-Dinitrobenzene	$C_6H_4(NO_2)_2$	116.93	32.3
m-Dinitrobenzene	...	90.08	24.7
p-Dinitrobenzene	...	173.5	40.0
Dinitrotoluene (2, 4)	$CH_3C_6H_3(NO_2)_3$	70	26.4
Diphenyl	$(C_6H_5)_2$	71	26.1
Diphenylamine	$(C_6H_5)_2NH$	53.4	25.2
Diphenylmethane	$(C_6H_5)_2CH_2$	26.3	25.2
Ethyl alcohol	C_2H_5OH	−114.4	24.9
Ethylene dibromide	$(CH_2Br)_2$	9.55	13.5
Elaidic acid	$C_{17}H_{33}CO_2H$	47	52.1
Formic acid	HCO_2H	8.0	58.9
Glutaric acid	$(CH_2)_3(CO_2H)_2$	99.3	37.4
Glycerol	$C_3H_5(OH)_3$	18	47.5
Glycol	$(CH_2OH)_2$	−11.5	43.3
		−12.3	41.6
Hydrazobenzene	$(C_6H_5NH)_2$	134	22.9
Hydrocinnamic acid	$C_6H_5C_2H_4CO_2H$	48	28.1
p-Iodotoluene	$IC_6H_4CO_2H$	34	18.8
n-Lauric acid	$C_{11}H_{23}CO_2H$	43.85	43.7
Levulinic acid	$CH_3CO(CH_2)_2CO_2H$	33	19.0
α-Menthol (l)	$C_{10}H_{19}OH$	42	18.6
Methane	CH_4	−182.6	14.5
Methyl alcohol	CH_3OH	−97	16.4
		−97.8	22.0
cinnamate	$C_6H_5C_2H_2CO_2CH_3$	34.5	26.5
fumarate	$(CHCO_2CH_3)_2$	102	57.9
oxalate	$(CO_2CH_3)_2$	49.5	42.7
phenylpropiolate	$C_6H_5C_2CO_2CH_3$	18	22.9
succinate	$(CH_2CO_2CH_3)_2$	18	35.7
Myristic acid	$C_{13}H_{27}CO_2H$	...	47.5
Naphthalene	$C_{10}H_8$	79.9	35.6
α-Naphthol	$C_{10}H_7OH$	95	38.9
β-Naphthol	...	120.6	31.3
α-Naphthylamine	$C_{10}H_7NH_2$	47.5	22.3
		48.9	22.0
		50.1	24.9
o-Nitroaniline	$H_2NC_6H_4NO_2$	69.3	27.9

HEAT OF FUSION (Continued)

ORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Heat of Fusion Cal. (15°)/g
m-Nitroaniline	$H_2NC_6H_4NO_2$	111.8	41.0
p-Nitroaniline		147.5	36.5
Nitrobenzene	$C_6H_5NO_2$	5.72	22.5
o-Nitrobenzoic acid	$O_2NC_6H_4CO_2H$	145.8	40.1
m-Nitrobenzoic acid		141.1	27.6
p-Nitrobenzoic acid		239.2	52.8
α-Nitronaphthalene	$C_{10}H_7NO_2$	56	25.4
o-Nitrophenol	$HOC_6H_4NO_2$	42.8	26.8
		44.51	30.9
Palmitic acid	$C_{15}H_{31}CO_2H$	55	39.2
Paraffin		52.40	35.10
Paraldehyde	$(CH_3CHO)_3$	12.6	25.0
Phenanthrene	$C_{14}H_{10}$	98.2	24.3
Phenol	C_6H_5OH	25.37	29.0
Phenylacetic acid	$C_6H_5CH_2CO_2H$	74.9	25.4
		76.58	30.0
		77	32.0
Phenylhydrazine	$C_6H_5N_2H_3$	22.1	36.3
iso-Propyl alcohol	C_3H_7OH	−88.5	21.0
Quinol	$C_6H_4(OH)_2$	172.3	58.8
Quinone	$C_6H_4O_2$	112.85	40.9
Resorcinol	$C_6H_4(OH)_2$	109.65	46.2
Spermaceti		43.9	36.98
Stearic acid	$C_{17}H_{35}CO_2H$	64	47.6
Stilbene	$(C_6H_5CH)_2$	124	39.9
Succinic anhydride	$(CH_2CO)_2O$	119	48.7
Succinonitrile	$(CH_2CN)_2$	54.5	11.7
Thymol	$C_{10}H_{13}OH$	48.5	27.5
Tolane	$(C_6H_5C)_2$	60	28.7
o-Toluic acid	$CH_3C_6H_4CO_2H$	103.7	35.4
m-Toluic acid		108.75	27.6
p-Toluic acid		179.6	39.9
p-Toluidine	$CH_3C_6H_4NH_2$	40.01	39.9
Tribromoaniline (2, 4, 6)	$H_2NC_6H_2Br_3$	122	16.8
Tribromophenol (2, 4, 6)	$HOC_6H_2Br_3$	93	13.4
Trichloroacetic acid	CCl_3CO_2H	59.1	8.6
Trinitroglycerol	$C_3H_5(NO_3)_3$	12.3	23.0
metastable form		13	33.2
stable form		....	5.21
Trinitrotoluene (T. N. T.) (2, 4, 6)	$CH_3C_6H_2(NO_2)_3$	79	22.3
Triphenylmethane	$(C_6H_5)_3CH$	92.3	17.8
Tristearin	$(C_{17}H_{35}CO_2)_3C_3H_5$	56	45.6
n-Undecylic acid (α)	$C_{10}H_{21}CO_2H$	28.25	32.2
n-Undecylic acid (β)		....	42.9
Urethane	$H_2NCO_2C_2H_5$	48.7	40.9
Veratrol (1, 2)	$C_6H_4(OCH_3)_2$	22.7	27.5
Wax (Bees')		61.8	42.3
p-Xylene	$C_6H_4(CH_3)_2$	16	39.3

HEAT OF VAPORIZATION

ELEMENTS AND INORGANIC COMPOUNDS

Name	Formula	Temperature, °C	Heat of Vaporization Cal. (15°)/g*
Air			50.97
Ammonia	NH_3	−33.4	327.1
		−20	317.6
		−10	309.7
		0	301.6
Ammonium chloride	NH_4Cl (solid)	350	78.9
Argon	A	−186	37.6
Boron chloride	BCl_3	10	38.2
Bromine	Br	63	43.7
Carbon dioxide	CO_2	−60	87.2
		−50	83.4
		−40	79.6
		−30	71.4
		−20	66.9
		−10	61.4
		0	55.0
		10	46.6
		20	35.1
		30	11.9
Carbon monoxide	CO	−192	50.4
Chlorosulfonic acid	$ClSO_3H$	151	110.2
Helium	He	−268.6	6.
Hydriodic acid	HI	−37.2	33.9
Hydrobromic acid	HBr	−69.9	48.7
Hydrochloric acid	HCl	−84.3	98.7
Hydrofluoric acid	HF	17	360.8
Hydrogen	H_2	−252.8	108.
sulfide	H_2S	−61.4	131.9
Iodine		184	23.95
Mercury		356.58	70.6
Nitric acid	HNO_3	86.0	114.9
Nitrogen	N_2	−195.55	47.6
tetroxide	N_2O_4	18	93.4
Oxygen	O_2	−182.9	50.9
Phosphorus	P	287	130.
Phosphorus trichloride	PCl_3	78	51.4
Silicon tetrachloride	$SiCl_4$	57	36.1
Stannic chloride	$SnCl_4$	112	30.3
Sulfur chloride	S_2Cl_2	138	49.5
dioxide	SO_2	−10.08	94.9
		0	91.3
		10	87.7
		20	84.1
		30	80.8
		40	71.2
		50	73.8
		60	70.3
pentoxydichloride	$S_2O_5Cl_2$	140	61.2
trioxide	SO_3	53	118.5
Sulfuric acid	H_2SO_4	326	122.1
oxychloride	SO_2Cl_2	69.1	49.4
Sulfurous oxychloride	$SOCl_2$	82	54.5
Water	H_2O	0	595.9
		10	590.4
		20	584.9
		30	579.5

* Gram calories (15°C) per gram

ELEMENTS AND INORGANIC COMPOUNDS

Name	Formula	Temperature, °C	Heat of Vaporization Cal. (15°)/g
Water	H_2O	40	574.0
		50	568.5
		60	563.2
		70	557.5
		80	551.7
		90	545.8
		100	539.55
		110	532.9
		120	525.7
		130	518.5
		140	511.1
		150	503.5
		160	495.6
		170	487.2
		180	478.6

HEAT OF VAPORIZATION OF MERCURY

From Douglas, Ball and Ginnings,
Jour. of Res. Bureau of Standards, **46,** 334, 1951
(1 cal. = 4.1840 abs. joules)

Temp. °C	Heat of Vaporization cal/g	Heat of Vaporization cal/g-atom	Temp. °C	Heat of Vaporization cal/g	Heat of Vaporization cal/g-atom
−38.88	73.779	14800.8	200	71.826	14409.0
−20.00	73.612	14767.3	220	71.672	14378.2
0	73.433	14732.4	240	71.519	14347.4
20	73.267	14698.1	260	71.365	14316.6
25	73.225	14689.7	280	71.212	14285.8
40	73.099	14664.4	300	71.057	14254.8
60	72.934	14631.2	320	70.902	14223.7
80	72.770	14598.4	340	70.745	14192.1
100	72.609	14566.1	356.58	70.613	14165.7
120	72.449	14534.1	360	70.636	14160.2
140	72.292	14502.4	380	70.424	14127.8
160	72.135	14471.1	400	70.260	14094.9
180	71.980	14439.9			

HEAT OF VAPORIZATION (Continued)

ORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Heat of Vaporization Cal. (15°)/g
Acetaldehyde	CH_3CHO	21	136.
Acetic acid	CH_3CO_2H	118.3	96.8
anhydride	$(CH_3CO)_2O$	137	92.2
Acetone	$(CH_3)_2CO$	56.1	124.5
Acetonitrile	CH_3CN	80	174.
Acetyl chloride	CH_3COCl	51	78.9
Allyl alcohol	C_3H_5OH	96	163.
n-Amyl alcohol	$C_5H_{11}OH$	131	120.2
iso-Amyl alcohol	…	130.2	119.8
n-Amyl bromide	$C_5H_{11}Br$	129	48.3
n-Amyl ether	$(C_5H_{11})_2O$	170	69.5
n-Amyl iodide	$C_5H_{11}I$	155	47.6
iso-Amyl isobutyrate	$C_3H_7CO_2C_5H_{11}$	168	57.6
iso-Amyl n-valerate	$C_4H_9CO_2C_5H_{11}$	187	56.2
Amylene	C_5H_{10}	12.5	75.0
p-Anethole	$C_9H_9OCH_3$	232	71.4
Benzene	C_6H_6	80.2	94.3
Butane	C_4H_{10}	0	91.5
iso-Butane	…	10	82.4
		−10	87.5
n-Butyl alcohol	C_4H_9OH	116.8	141.
iso-Butyl alcohol	…	106.9	138.
sec.-Butyl alcohol	…	98.1	134.
tert-Butyl alcohol	…	83	130.5
n-Butyl formate	$HCO_2C_4H_9$	105.1	86.8
iso-Butyl formate	…	97.0	78.5
n-Butyl iodide	C_4H_9I	129.5	45.9
iso-Butyl n-valerate	$C_4H_9CO_2C_4H_9$	169	57.8
iso-Butyl isovalerate	…	169	60.5
n-Butyric acid	$C_3H_7CO_2H$	163.5	114.0
iso-Butyric acid	$C_3H_7CO_2H$	154	111.6
n-Butyronitrile	C_3H_7CN	117.4	114.9
Carbon disulfide	CS_2	46.25	84.1
tetrachloride	CCl_4	76.75	46.4
Carvacrol	$C_{10}H_{13}OH$	237	68.1
Chloral	CCl_3CHO	…	54.0
hydrate	$Cl_3CCHO \cdot H_2O$	96	132.
Chloroform	$CHCl_3$	61.5	59.0
Cyanogen	$(CN)_2$	0	10.3
chloride	$ClCN$	13	135.
p-Cymene	$C_{10}H_{14}$	176	67.6
Dichloroacetic acid	Cl_2CHCO_2H	194.4	77.2
n-Decane	$C_{10}H_{22}$	160	60.2
Diethyl carbonate	$CO(OC_2H_5)_2$	126	73.1
ketone	$(C_2H_5)_2CO$	101	90.8
Diethylamine	$(C_2H_5)_2NH$	58	91.0
Dimethyl carbonate	$CO(OCH_3)_2$	90	88.2
Ethane	C_2H_6	0	75.0
		−20	87.0
		−40	97.5
		−90	127.
Ethyl acetate	$CH_3CO_2C_2H_5$	0.0	102.0
alcohol	C_2H_5OH	78.3	204.
bromide	C_2H_5Br	38.4	59.9
caprylate	$C_7H_{15}CO_2C_2H_5$	207	60.5
chloride	C_2H_5Cl	4.7	92.95
		15.0	92.5
		20.0	92.2
		25.0	92.0

HEAT OF VAPORIZATION (Continued)

ORGANIC COMPOUNDS

Name	Formula	Temperature, °C.	Heat of Vaporization Cal. (15°)/g
Ethyl			
ether	$(C_2H_5)_2O$	34.6	89.3
formate	$HCO_2C_2H_5$	53.3	97.2
iodide	C_2H_5I	71.2	45.6
nonylate	$C_8H_{17}CO_2C_2H_5$	227	58.1
propionate	$C_2H_5CO_2C_2H_5$	97.6	80.1
Ethylene bromide	$(CH_2Br)_2$	130.8	46.2
chloride	$(CH_2Cl)_2$	0.0	85.3
		82.3	77.3
oxide	$(CH_2)_2O$	13	139.
Ethylamine	$C_2H_5NH_2$	15	14.6
Ethylidene chloride	CH_3CHCl_2	0.0	76.7
		60	67.1
Formic acid	HCO_2H	101	120.0
Furane	$(CH)_4O$	31	95.3
Furfural	C_4H_3OCHO	160.5	107.5
Glycol	$(CH_2OH)_2$	197	191.
Hydrocyanic acid	HCN	20	210.
Methane	CH_4	−159	138.
Methyl acetate	$CH_3CO_2CH_3$	0.0	114.0
		56.3	98.1
alcohol	CH_3OH	64.7	262.8
n-butyrate	$C_3H_7CO_2CH_3$	102.6	79.8
chloride	CH_3Cl	−23.8	102.3
		20.0	95.3
ethyl ketone	$CH_3COC_2H_5$	78.2	106.0
ethyl ketoxime	C_4H_8NOH	182	115.9
formate	HCO_2CH_3	31.3	112.4
iodide	CH_3I	42	45.9
isobutyrate	$C_3H_7CO_2CH_3$	91.1	78.1
isopropyl ketone	$C_4H_{10}CO$	92	89.8
propionate	$C_2H_5CO_2CH_3$	79.0	87.6
Methylene chloride	CH_2Cl_2	40.5	78.6
Naphthalene	$C_{10}H_8$	218	75.5
Nitromethane	CH_3NO_2	99.9	135.
iso-Pentane	C_5H_{12}	13	88.7
Piperidine	$C_5H_{11}N$	106	89.4
Propane	C_3H_8	20	83.4
		0	89.6
		−20	95.3
		−30	98.0
Propionic acid	$C_2H_5CO_2H$	139.3	98.8
Propionitrile	C_2H_5CN	97	134.
n-Propyl acetate	$CH_3CO_2C_3H_7$	100.4	80.3
n-Propyl alcohol	C_3H_7OH	97.2	164.
iso-Propyl alcohol		82.3	159.
n-Propyl formate	$HCO_2C_3H_7$	80.0	88.1
Pyridine	C_5H_5N	114.1	107.4
Tetrachloroethane-1, 1, 2, 2	$(CHCl_2)_2$	145.0	55.1
Tetrachloroethylene	$(CCl_2)_2$	120.7	50.1
Trichloroethylene	C_2HCl_3	85.7	57.3
Turpentine	$C_{10}H_{16}$	156	68.6
n-Valeric acid	$C_4H_9CO_2H$	184.6	103.2
iso-Valeric acid		176.3	101.1
n-Valeronitrile	C_4H_9CN	129	96.3

CHANGE IN VOLUME DUE TO FUSION

The table gives the variation in volume expressed in c.cm. for one gram of the substance.

Substance.	Variation, cm.^{3}/g	Observer.
Aluminum.	+0.019	Toepler, 1894
Bismuth.	−0.0034	Toepler, 1894
Cadmium.	+0.0064	Toepler, 1894
Iron.	−0.0085	Wrightson, Roberts, 1881
Lead.	+0.0034	Toepler, 1894
Tin.	+0.0039	Toepler, 1894
Water	−0.083*	Toepler, 1894
Zinc.	+0.0105	Toepler, 1894

*For one cubic centimeter.

FIXED TEMPERATURE FOR THERMOMETER CALIBRATION

Corrections for pressure are indicated by equations in which p indicates pressure in millimeters of mercury. and t the boiling point at normal pressure.

Points designated by an asterisk (*) are suggested by E. F. Mueller as base points to be used in defining a Standard Working Scale.

Substance	Point	Temperature thermodynamic scale °C	Condition or correction
Hydrogen.	Boiling	−252.75	$+0.0044\ (p-760)$
Nitrogen.	Vapor pressure	−195.80	$+0.0109\ (p-760)$
Liquid O_2*.	Vapor pressure	−183.00	$+0.0126\ (p-760)$ $-0.0000065\ (p-760)^2$
Isopentane.	Freezing	−159.6	
Methylcyclohexane. . . .	Freezing	−126.3	
Ether.	Rapid freezing or slow melting	−116.3	
Carbon disulfide.	Freezing	−111.6	
Toluene.	Freezing	− 95.1	
Ethyl acetate.	Freezing	− 83.6	
Solid CO_2*.	Vapor pressure	− 78.51	$+0.01595\ (p-760)$ $-0.000011\ (p-760)^2$
Chloroform.	Freezing	− 63.5	
Chlorobenzene.	Freezing	− 45.2	
Mercury*.	Freezing	− 38.87	
Carbon tetrachloride. . .	Freezing	− 22.9	
Ice*.	Melting	0.000	
Sodium sulfate.	Transition	32.384	
Ethyl alcohol.	Boiling	78.26	76 cm. variation 0.34° per cm.
Benzene.	Boiling	80.0	76 cm. variation 0.43° per cm.

FIXED TEMPERATURE FOR THERMOMETER CALIBRATION (Continued)

Substance	Point	Temperature thermodynamic scale °C	Condition or correction
Water*	Boiling	100.000	$+0.0367\ (p-760)-0.000023\ (p-760)^2$
Chlorobenzene	Boiling	132.	76 cm. variation 0.50° per cm.
Xylene (m.)	Boiling	138.8	76 cm. variation 0.50° per cm.
Aniline	Boiling	184.51	76 cm. variation 0.51° per cm.
Toluidine (o.)	Boiling	199.7	76 cm. variation 0.58° per cm.
Naphthalene	Condensing	217.96	$+0.2075\ (t+273.1)\log_{10}(p/760)$
Tin	Freezing	231.85	
Diphenylamine	Boiling	302.	
Benzophenone	Condensing	305.9	$+0.194\ (t+273.1)\log_{10}(p/760)$
Cadmium	Freezing	320.9	
Lead	Freezing	327.4	
Mercury	Boiling	356.9	
Potassium dichromate	Melting	397.5	
Zinc	Freezing	419.45	
Sulfur*	Condensing	444.60	$+0.0909\ (p-760)-0.000048\ (p-760)^2$
Potassium sulfate	Inversion	583.0	
Antimony*	Freezing	630.5	Approx. To be determined with resistance thermometer.
30.5 NaCl+69.5 Na_2SO_4	Melting	637.0	
Aluminum (99.85%)	Freezing	658.9	
Potassium chloride	Melting	770.3	
Sodium chloride	Melting	800.4	
Sodium sulfate	Melting	884.7	
Silver*	Freezing	960.5	(reducing atmosphere)
Gold*	Freezing	1063.	
Potassium sulfate	Melting	1069.1	
Copper	Freezing	1083.	(reducing atmosphere)
Lithium metasilicate	Melting	1202.	
Diopside	Melting	1395.	
Nickel	Melting or freezing	1452.	
Palladium	Freezing	1555. ±2	
Anorthite	Melting	1555.	
Platinum	Melting	1755. ±6	
Alumina	Melting	2000.	
Tungsten	Melting	3370. ±30	

EMERGENT STEM CORRECTION FOR LIQUID-IN-GLASS THERMOMETERS

Accurate thermometers are calibrated with the entire stem immersed in the bath which determines the temperature of the thermometer bulb. However, for reasons of convenience it is common practice when using a thermometer to permit its stem to extend out of the apparatus. Under these conditions both the stem and the mercury in the exposed stem are at a temperature different from that of the bulb. This introduces an error into the observed temperature. Since the coefficient of thermal expansion of glass is less than that of mercury, the observed temperature will be less than the true temperature if the bulb is hotter than the stem and greater than the true temperature, providing the thermal gradient is reversed. For exact work the magnitude of this error can only be determined by experiment. However, for most purposes it is sufficiently accurate to apply the following equation which takes into account the difference of the thermal expansion of glass and mercury:

$$T_c = T_o + F \times L(T_o - T_m)$$

Where T_c = corrected temperature
T_o = observed temperature
T_m = mean temperature of exposed stem. The mean temperature of the exposed stem may be determined by fastening the bulb of a second thermometer against the midpoint of the exposed liquid column.
L = the length of the exposed column in degrees above the surface of the substance whose temperature is being determined.
F = correction factor. For approximate work and when the liquid in the thermometer is mercury a value for F of 0.00016 is generally used. For more accurate work with mercury filled thermometers values as given in the following table are used. For thermometers filled with organic liquids it is customary to use 0.001 for the value of F.

Values of F for various glasses

Tm°C.	Corning 0041	Corning 8800	Corning 8810	Jena 16 III	Jena 59 III
50	0.000157	0.000166	0.000156	0.000158	0.000164
150	0.000159	0.000167	0.000157	0.000158	0.000165
250	0.000163	0.000168	0.000161	0.000161	0.000170
350	0.000168	0.000173	0.000166	....	0.000177

PRESSURE OF AQUEOUS VAPOR

Vapor Pressure of Ice

Pressure of aqueous vapor over ice in mm of Hg for temperatures from −98 to 0°C.

Temp. °C	0	2	4	6	8
−90	.000070	.000048	.000033	.000022	.000015
−80	.00040	.00029	.00020	.00014	.00010
−70	.00194	.00143	.00105	.00077	.00056
−60	.00808	.00614	.00464	.00349	.00261
−50	.02955	.0230	.0178	.0138	.0106
−40	.0966	.0768	.0609	.0481	.0378
−30	.2859	.2318	.1873	.1507	.1209

Temp. °C	0.0	0.2	0.4	0.6	0.8
−29	0.317	0.311	0.304	0.298	0.292
−28	0.351	0.344	0.337	0.330	0.324
−27	0.389	0.381	0.374	0.366	0.359
−26	0.430	0.422	0.414	0.405	0.397
−25	0.476	0.467	0.457	0.448	0.439
−24	0.526	0.515	0.505	0.495	0.486
−23	0.580	0.569	0.558	0.547	0.536
−22	0.640	0.627	0.615	0.603	0.592
−21	0.705	0.691	0.678	0.665	0.652
−20	0.776	0.761	0.747	0.733	0.719
−19	0.854	0.838	0.822	0.806	0.791
−18	0.939	0.921	0.904	0.887	0.870
−17	1.031	1.012	0.993	0.975	0.956
−16	1.132	1.111	1.091	1.070	1.051
−15	1.241	1.219	1.196	1.175	1.153
−14	1.361	1.336	1.312	1.288	1.264
−13	1.490	1.464	1.437	1.411	1.386
−12	1.632	1.602	1.574	1.546	1.518
−11	1.785	1.753	1.722	1.691	1.661
−10	1.950	1.916	1.883	1.849	1.817
− 9	2.131	2.093	2.057	2.021	1.985
− 8	2.326	2.285	2.246	2.207	2.168
− 7	2.537	2.493	2.450	2.408	2.367
− 6	2.765	2.718	2.672	2.626	2.581
− 5	3.013	2.962	2.912	2.862	2.813
− 4	3.280	3.225	3.171	3.117	3.065
− 3	3.568	3.509	3.451	3.393	3.336
− 2	3.880	3.816	3.753	3.691	3.630
− 1	4.217	4.147	4.079	4.012	3.946
− 0	4.579	4.504	4.431	4.359	4.287

VAPOR PRESSURE OF WATER BELOW 100°C

Pressure of aqueous vapor over water in mm of Hg for temperatures from −15.8 to 100°C. Values for fractional degrees between 50 and 89 were obtained by interpolation.

Temp. °C	0.0	0.2	0.4	0.6	0.8
−15	1.436	1.414	1.390	1.368	1.345
−14	1.560	1.534	1.511	1.485	1.460
−13	1.691	1.665	1.637	1.611	1.585
−12	1.834	1.804	1.776	1.748	1.720
−11	1.987	1.955	1.924	1.893	1.863
−10	2.149	2.116	2.084	2.050	2.018
− 9	2.326	2.289	2.254	2.219	2.184
− 8	2.514	2.475	2.437	2.399	2.362
− 7	2.715	2.674	2.633	2.593	2.553
− 6	2.931	2.887	2.843	2.800	2.757
− 5	3.163	3.115	3.069	3.022	2.976
− 4	3.410	3.359	3.309	3.259	3.211
− 3	3.673	3.620	3.567	3.514	3.461
− 2	3.956	3.898	3.841	3.785	3.730
− 1	4.258	4.196	4.135	4.075	4.016
− 0	4.579	4.513	4.448	4.385	4.320
0	4.579	4.647	4.715	4.785	4.855
1	4.926	4.998	5.070	5.144	5.219
2	5.294	5.370	5.447	5.525	5.605
3	5.685	5.766	5.848	5.931	6.015
4	6.101	6.187	6.274	6.363	6.453
5	6.543	6.635	6.728	6.822	6.917
6	7.013	7.111	7.209	7.309	7.411
7	7.513	7.617	7.722	7.828	7.936
8	8.045	8.155	8.267	8.380	8.494
9	8.609	8.727	8.845	8.965	9.086
10	9.209	9.333	9.458	9.585	9.714
11	9.844	9.976	10.109	10.244	10.380
12	10.518	10.658	10.799	10.941	11.085
13	11.231	11.379	11.528	11.680	11.833
14	11.987	12.144	12.302	12.462	12.624
15	12.788	12.953	13.121	13.290	13.461
16	13.634	13.809	13.987	14.166	14.347
17	14.530	14.715	14.903	15.092	15.284
18	15.477	15.673	15.871	16.071	16.272
19	16.477	16.685	16.894	17.105	17.319

VAPOR PRESSURE OF WATER BELOW 100°C (Continued)

Temp. °C	0.0	0.2	0.4	0.6	0.8
20	17.535	17.753	17.974	18.197	18.422
21	18.650	18.880	19.113	19.349	19.587
22	19.827	20.070	20.316	20.565	20.815
23	21.068	21.324	21.583	21.845	22.110
24	22.377	22.648	22.922	23.198	23.476
25	23.756	24.039	24.326	24.617	24.912
26	25.209	25.509	25.812	26.117	26.426
27	26.739	27.055	27.374	27.696	28.021
28	28.349	28.680	29.015	29.354	29.697
29	30.043	30.392	30.745	31.102	31.461
30	31.824	32.191	32.561	32.934	33.312
31	33.695	34.082	34.471	34.864	35.261
32	35.663	36.068	36.477	36.891	37.308
33	37.729	38.155	38.584	39.018	39.457
34	39.898	40.344	40.796	41.251	41.710
35	42.175	42.644	43.117	43.595	44.078
36	44.563	45.054	45.549	46.050	46.556
37	47.067	47.582	48.102	48.627	49.157
38	49.692	50.231	50.774	51.323	51.879
39	52.442	53.009	53.580	54.156	54.737
40	55.324	55.91	56.51	57.11	57.72
41	58.34	58.96	59.58	60.22	60.86
42	61.50	62.14	62.80	63.46	64.12
43	64.80	65.48	66.16	66.86	67.56
44	68.26	68.97	69.69	70.41	71.14
45	71.88	72.62	73.36	74.12	74.88
46	75.65	76.43	77.21	78.00	78.80
47	79.60	80.41	81.23	82.05	82.87
48	83.71	84.56	85.42	86.28	87.14
49	88.02	88.90	89.79	90.69	91.59
50	92.51	93.5	94.4	95.3	96.3
51	97.20	98.2	99.1	100.1	101.1
52	102.09	103.1	104.1	105.1	106.2
53	107.20	108.2	109.3	110.4	111.4
54	112.51	113.6	114.7	115.8	116.9
55	118.04	119.1	120.3	121.5	122.6
56	123.80	125.0	126.2	127.4	128.6
57	129.82	131.0	132.3	133.5	134.7
58	136.08	137.3	138.5	139.9	141.2
59	142.60	143.9	145.2	146.6	148.0

VAPOR PRESSURE OF WATER BELOW 100°C (Continued)

Temp. °C	0.0	0.2	0.4	0.6	0.8
60	149.38	150.7	152.1	153.5	155.0
61	156.43	157.8	159.3	160.8	162.3
62	163.77	165.2	166.8	168.3	169.8
63	171.38	172.9	174.5	176.1	177.7
64	179.31	180.9	182.5	184.2	185.8
65	187.54	189.2	190.9	192.6	194.3
66	196.09	197.8	199.5	201.3	203.1
67	204.96	206.8	208.6	210.5	212.3
68	214.17	216.0	218.0	219.9	221.8
69	223.73	225.7	227.7	229.7	231.7
70	233.7	235.7	237.7	239.7	241.8
71	243.9	246.0	248.2	250.3	252.4
72	254.6	256.8	259.0	261.2	263.4
73	265.7	268.0	270.2	272.6	274.8
74	277.2	279.4	281.8	284.2	286.6
75	289.1	291.5	294.0	296.4	298.8
76	301.4	303.8	306.4	308.9	311.4
77	314.1	316.6	319.2	322.0	324.6
78	327.3	330.0	332.8	335.6	338.2
79	341.0	343.8	346.6	349.4	352.2
80	355.1	358.0	361.0	363.8	366.8
81	369.7	372.6	375.6	378.8	381.8
82	384.9	388.0	391.2	394.4	397.4
83	400.6	403.8	407.0	410.2	413.6
84	416.8	420.2	423.6	426.8	430.2
85	433.6	437.0	440.4	444.0	447.5
86	450.9	454.4	458.0	461.6	465.2
87	468.7	472.4	476.0	479.8	483.4
88	487.1	491.0	494.7	498.5	502.2
89	506.1	510.0	513.9	517.8	521.8
90	525.76	529.77	533.80	537.86	541.95
91	546.05	550.18	554.35	558.53	562.75
92	566.99	571.26	575.55	579.87	584.22
93	588.60	593.00	597.43	601.89	606.38
94	610.90	615.44	620.01	624.61	629.24
95	633.90	638.59	643.30	648.05	652.82
96	657.62	662.45	667.31	672.20	677.12
97	682.07	687.04	692.05	697.10	702.17
98	707.27	712.40	717.56	722.75	727.98
99	733.24	738.53	743.85	749.20	754.58
100	760.00	765.45	770.93	776.44	782.00
101	787.57	793.18	798.82	804.50	810.21

VAPOR PRESSURE OF WATER ABOVE 100° C.

Based on values given by Keyes in the International Critical Tables.

Temp. °C	Pressure		Temp. °F	Temp. °C	Pressure		Temp. °F
	mm	Pounds per sq. in.			mm	Pounds per sq. in.	
100	760.	14.696	212.0	145	3116.76	60.268	293.0
101	787.51	15.228	213.8	146	3203.40	61.944	294.8
102	815.86	15.776	215.6	147	3292.32	63.663	296.6
103	845.12	16.342	217.4	148	3382.76	65.412	298.4
104	875.06	16.921	219.2	149	3476.24	67.220	300.2
105	906.07	17.521	221.0	150	3570.48	69.042	302.0
106	937.92	18.136	222.8	151	3667.00	70.908	303.8
107	970.60	18.768	224.6	152	3766.56	72.833	305.6
108	1004.42	19.422	226.4	153	3866.88	74.773	307.4
109	1038.92	20.089	228.2	154	3970.24	76.772	309.2
110	1074.56	20.779	230.0	155	4075.88	78.815	311.0
111	1111.20	21.487	231.8	156	4183.80	80.901	312.8
112	1148.74	22.213	233.6	157	4293.24	83.018	314.6
113	1187.42	22.961	235.4	158	4404.96	85.178	316.4
114	1227.25	23.731	237.2	159	4519.72	87.397	318.2
115	1267.98	24.519	239.0	160	4636.00	89.646	320.0
116	1309.94	25.330	240.8	161	4755.32	91.953	321.8
117	1352.95	26.162	242.6	162	4876.92	94.304	323.6
118	1397.18	27.017	244.4	163	5000.04	96.685	325.4
119	1442.63	27.896	246.2	164	5126.96	99.139	327.2
120	1489.14	28.795	248.0	165	5256.16	101.638	329.0
121	1536.80	29.717	249.8	166	5386.88	104.165	330.8
122	1586.04	30.669	251.6	167	5521.40	106.766	332.6
123	1636.36	31.642	253.4	168	5658.20	109.412	334.4
124	1687.81	32.637	255.2	169	5798.04	112.116	336.2
125	1740.93	33.664	257.0	170	5940.92	114.879	338.0
126	1795.12	34.712	258.8	171	6085.32	117.671	339.8
127	1850.83	35.789	260.6	172	6233.52	120.537	341.6
128	1907.83	36.891	262.4	173	6383.24	123.432	343.4
129	1966.35	38.023	264.2	174	6538.28	126.430	345.2
130	2026.16	39.180	266.0	175	6694.08	129.442	347.0
131	2087.42	40.364	267.8	176	6852.92	132.514	348.8
132	2150.42	41.582	269.6	177	7015.56	135.659	350.6
133	2214.64	42.824	271.4	178	7180.48	138.848	352.4
134	2280.76	44.103	273.2	179	7349.20	142.110	354.2
135	2347.26	45.389	275.0	180	7520.20	145.417	356.0
136	2416.34	46.724	276.8	181	7694.24	148.782	357.8
137	2488.16	48.113	278.6	182	7872.08	152.221	359.6
138	2560.67	49.515	280.4	183	8052.96	155.719	361.4
139	2634.84	50.950	282.2	184	8236.88	159.275	363.2
140	2710.92	52.421	284.0	185	8423.84	162.890	365.0
141	2788.44	53.920	285.8	186	8616.12	166.609	366.8
142	2867.48	55.448	287.6	187	8809.92	170.356	368.6
143	2948.80	57.020	289.4	188	9007.52	174.177	370.4
144	3031.64	58.622	291.2	189	9208.16	178.057	372.2

VAPOR PRESSURE OF WATER ABOVE 100° C.
(Continued)

Temp. °C	Pressure		Temp. °F
	mm	Pounds per sq. in.	
190	9413.36	182.025	374.0
191	9620.08	186.022	375.8
192	9831.36	190.107	377.6
193	10047.20	194.281	379.4
194	10265.32	198.499	381.2
195	10488.76	202.819	383.0
196	10715.24	207.199	384.8
197	10944.76	211.637	386.6
198	11179.60	216.178	388.4
199	11417.48	220.778	390.2
200	11659.16	225.451	392.0
201	11905.40	230.213	393.8
202	12155.44	235.048	395.6
203	12408.52	239.942	397.4
204	12666.16	244.924	399.2
205	12929.12	250.008	401.0
206	13197.40	255.196	402.8
207	13467.96	260.428	404.6
208	13742.32	265.733	406.4
209	14022.76	271.156	408.2
210	14305.48	276.623	410.0
211	14595.04	282.222	411.8
212	14888.40	287.895	413.6
213	15184.80	293.626	415.4
214	15488.04	299.490	417.2
215	15792.80	305.383	419.0
216	16104.40	311.408	420.8
217	16420.56	317.522	422.6
218	16742.04	323.738	424.4
219	17067.32	330.028	426.2
220	17395.64	336.377	428.0
221	17731.56	342.872	429.8
222	18072.80	349.471	431.6
223	18417.84	356.143	433.4
224	18766.68	362.888	435.2
225	19123.12	369.781	437.0
226	19482.60	376.732	438.8
227	19848.92	383.815	440.6
228	20219.80	390.987	442.4
229	20596.76	398.276	444.2
230	20978.28	405.654	446.0
231	21365.12	413.134	447.8
232	21757.28	420.717	449.6
233	22154.00	428.388	451.4
234	22558.32	436.207	453.2
235	22967.96	444.128	455.0
236	23382.92	452.152	456.8
237	23802.44	460.264	458.6
238	24229.56	468.523	460.4
239	24661.24	476.871	462.2
240	25100.52	485.365	464.0
241	25543.60	493.933	465.8
242	25994.28	502.647	467.6
243	26449.52	511.450	469.4
244	26912.36	520.400	471.2
245	27381.28	529.467	473.0
246	27855.52	538.638	474.8
247	28335.84	547.926	476.6
248	28823.76	557.360	478.4
249	29317.00	566.898	480.2
250	29817.84	576.583	482.0
251	30324.00	586.370	483.8
252	30837.76	596.305	485.6
253	31356.84	606.342	487.4
254	31885.04	616.556	489.2
255	32417.80	626.858	491.0
256	32957.40	637.292	492.8
257	33505.36	647.888	494.6
258	34059.40	658.601	496.4
259	34618.76	669.417	498.2
260	35188.00	680.425	500.0
261	35761.80	691.520	501.8
262	36343.20	702.763	503.6
263	36932.20	714.152	505.4
264	37529.56	725.703	507.2
265	38133.00	737.372	509.0
266	38742.52	749.158	510.8
267	39361.92	761.135	512.6
268	39986.64	773.215	514.4
269	40619.72	785.457	516.2
270	41261.16	797.861	518.0
271	41910.20	810.411	519.8
272	42566.08	823.094	521.6
273	43229.56	835.923	523.4
274	43902.16	848.929	525.2
275	44580.84	862.053	527.0
276	45269.40	875.367	528.8
277	45964.04	888.799	530.6
278	46669.32	902.437	532.4
279	47382.20	916.222	534.2

VAPOR PRESSURE OF WATER ABOVE 100° C.
(Continued)

Temp. °C	Pressure		Temp. °F	Temp. °C	Pressure		Temp. °F
	mm	Pounds per sq. in.			mm	Pounds per sq. in.	
280	48104.20	930.183	536.0	330	96512.40	1866.245	626.0
281	48833.80	944.291	537.8	331	97758.80	1890.346	627.8
282	49570.24	958.532	539.6	332	99020.40	1914.742	629.6
283	50316.56	972.963	541.4	333	100297.20	1939.431	631.4
284	51072.76	987.586	543.2	334	101581.60	1964.267	633.2
285	51838.08	1002.385	545.0	335	102881.20	1989.398	635.0
286	52611.76	1017.345	546.8	336	104196.00	2014.822	636.8
287	53395.32	1032.497	548.6	337	105526.00	2040.540	638.6
288	54187.24	1047.810	550.4	338	106871.20	2066.552	640.4
289	54989.04	1063.314	552.2	339	108224.00	2092.710	642.2
290	55799.20	1078.980	554.0	340	109592.00	2119.163	644.0
291	56612.40	1094.705	555.8	341	110967.60	2145.763	645.8
292	57448.40	1110.871	557.6	342	112358.40	2172.657	647.6
293	58284.40	1127.036	559.4	343	113749.20	2199.550	649.4
294	59135.60	1143.496	561.2	344	115178.00	2227.179	651.2
295	59994.40	1160.102	563.0	345	116614.40	2254.954	653.0
296	60860.80	1176.856	564.8	346	118073.60	2283.171	654.8
297	61742.40	1193.903	566.6	347	119532.80	2311.387	656.6
298	62624.00	1210.950	568.4	348	121014.80	2340.044	658.4
299	63528.40	1228.439	570.2	349	122504.40	2368.848	660.2
300	64432.80	1245.927	572.0	350	124001.60	2397.799	662.0
301	65352.40	1263.709	573.8	351	125521.60	2427.191	663.8
302	66279.60	1281.638	575.6	352	127049.20	2456.730	665.6
303	67214.40	1299.714	577.4	353	128599.60	2486.710	667.4
304	68156.80	1317.937	579.2	354	130157.60	2516.837	669.2
305	69114.40	1336.454	581.0	355	131730.80	2547.258	671.0
306	70072.00	1354.971	582.8	356	133326.80	2578.119	672.8
307	71052.40	1373.929	584.6	357	134945.60	2609.422	674.6
308	72048.00	1393.181	586.4	358	136579.60	2641.018	676.4
309	73028.40	1412.139	588.2	359	138228.80	2672.908	678.2
310	74024.00	1431.390	590.0	360	139893.20	2705.093	680.0
311	75042.40	1451.083	591.8	361	141572.80	2737.571	681.8
312	76076.00	1471.070	593.6	362	143275.20	2770.490	683.6
313	77117.20	1491.203	595.4	363	144992.80	2803.703	685.4
314	78166.00	1511.484	597.2	364	146733.20	2837.357	687.2
315	79230.00	1532.058	599.0	365	148519.20	2871.892	689.0
316	80294.00	1552.632	600.8	366	150320.40	2906.722	690.8
317	81373.20	1573.501	602.6	367	152129.20	2941.698	692.6
318	82467.60	1594.663	604.4	368	153960.80	2977.116	694.4
319	83569.60	1615.972	606.2	369	155815.20	3012.974	696.2
320	84686.80	1637.575	608.0	370	157692.40	3049.273	698.0
321	85819.20	1659.472	609.8	371	159584.80	3085.866	699.8
322	86959.20	1681.516	611.6	372	161507.60	3123.047	701.6
323	88114.40	1703.854	613.4	373	163468.40	3160.963	703.4
324	89277.20	1726.339	615.2	374	165467.20	3199.613	705.2
325	90447.60	1748.971	617.0				
326	91633.20	1771.897	618.8				
327	92826.40	1794.969	620.6				
328	94042.40	1818.483	622.4				
329	95273.60	1842.291	624.2				

VAPOR PRESSURE OF MERCURY

Vapor pressure of mercury in mm. of Hg for temperatures from −38 to 400°C. Note that the values for the first four lines only, are to be multiplied by 10^{-6}.

Temp. °C	0	2	4	6	8
	10^{-6}	10^{-6}	10^{-6}	10^{-6}	10^{-6}
−30	4.78	3.59	2.66	1.97	1.45
−20	18.1	14.0	10.8	8.28	6.30
−10	60.6	48.1	38.0	29.8	23.2
− 0	185.	149.	119.	95.4	76.2
+ 0	.000185	.000228	.000276	.000335	.000406
+10	.000490	.000588	.000706	.000846	.001009
20	.001201	.001426	.001691	.002000	.002359
30	.002777	.003261	.003823	.004471	.005219
40	.006079	.007067	.008200	.009497	.01098
50	.01267	.01459	.01677	.01925	.02206
60	.02524	.02883	.03287	.03740	.04251
70	.04825	.05469	.06189	.06993	.07889
80	.08880	.1000	.1124	.1261	.1413
90	.1582	.1769	.1976	.2202	.2453
100	.2729	.3032	.3366	.3731	.4132
110	.4572	.5052	.5576	.6150	.6776
120	.7457	.8198	.9004	.9882	1.084
130	1.186	1.298	1.419	1.551	1.692
140	1.845	2.010	2.188	2.379	2.585
150	2.807	3.046	3.303	3.578	3.873
160	4.189	4.528	4.890	5.277	5.689
170	6.128	6.596	7.095	7.626	8.193
180	8.796	9.436	10.116	10.839	11.607
190	12.423	13.287	14.203	15.173	16.200
200	17.287	18.437	19.652	20.936	22.292
210	23.723	25.233	26.826	28.504	30.271
220	32.133	34.092	36.153	38.318	40.595
230	42.989	45.503	48.141	50.909	53.812
240	56.855	60.044	63.384	66.882	70.543
250	74.375	78.381	82.568	86.944	91.518
260	96.296	101.28	106.48	111.91	117.57
270	123.47	129.62	136.02	142.69	149.64
280	156.87	164.39	172.21	180.34	188.79
290	197.57	206.70	216.17	226.00	236.21
300	246.80	257.78	269.17	280.98	293.21
310	305.89	319.02	332.62	346.70	361.26
320	376.33	391.92	408.04	424.71	441.94
330	459.74	478.13	497.12	516.74	537.00
340	557.90	579.45	601.69	624.64	648.30
350	672.69	697.83	723.73	750.43	777.92
360	806.23	835.38	865.36	896.23	928.02
370	960.66	994.34	1028.9	1064.4	1100.9
380	1138.4	1177.0	1216.6	1257.3	1299.1
390	1341.9	1386.1	1431.3	1477.7	1525.2
400	1574.1	....	....	....	....

VAPOR PRESSURE OF CARBON DIOXIDE

SOLID

From Bureau of Standards Journal of Research

(Mercury column, density = 13.5951 g/cm³, g = 980.665)

Pressure in microns of mercury

°C	0	1	2	3	4	5	6	7	8	9
−180	0.013	0.008	0.006	0.004	0.003	0.0017	0.0011	0.0007	0.0005	0.0003
−170	.37	.27	.20	.14	.10	.074	.052	.037	.026	.018
−160	5.9	4.6	3.6	2.7	2.1	1.58	1.19	.90	.67	.50
−150	60.5	48.8	39.2	31.4	25.1	19.9	15.8	12.4	9.8	7.6
−140	431	359	298	247	204	168	138	113	92	75

Pressure in mm of mercury

−130	2.31	1.97	1.68	1.43	1.22	1.03	0.87	0.73	0.61	0.51
−120	9.81	8.57	7.46	6.49	5.63	4.88	4.22	3.64	3.13	2.69
−110	34.63	30.76	27.27	24.14	21.34	18.83	16.58	14.58	12.80	11.22
−100	104.81	94.40	84.91	76.27	68.43	61.30	54.84	48.99	43.71	38.94
− 90	279.5	254.7	231.8	210.8	191.4	173.6	157.3	142.4	128.7	116.2
− 80	672.2	618.3	568.2	521.7	478.5	438.6	401.6	367.4	335.7	306.5
− 70	1486.1	1377.3	1275.6	1180.5	1091.7	1008.9	931.7	859.7	792.7	730.3
− 60	3073.1	2865.1	2669.7	2486.3	2314.2	2152.8	2001.5	1859.7	1726.9	1602.5
− 50	......	......	......	......	......	......	......	3780.9	3530.2	3294.6

LIQUID

°C	0	1	2	3	4	5	6	7	8	9
−50	5127.8	4922.7	4723.9	4531.1	4344.3	4163.2	3987.9	3818.2*	3653.9*	3495.0*
−40	7545	7271	7005	6746	6494	6250	6012	5781	5557	5339
−30	10718	10363	10017	9679	9350	9029	8716	8412	8115	7826
−20	14781	14331	13891	13461	13040	12630	12229	11838	11455	11082
−10	19872	19312	18764	18228	17703	17189	16686	16194	15712	15241
− 0	26142	25457	24786	24127	23482	22849	22229	21622	21026	20443
0	26142	26840	27552	28277	29017	29771	30539	31323	32121	32934
10	33763	34607	35467	36343	37236	38146	39073	40017	40980	41960
20	42959	43977	45014	46072	47150	48250	49370	50514	51680	52871
30	54086	55327	......	......	......	......	......	......	......	......

* Undercooled liquid.

Critical temperature = 31.0°C. Triple point, −56.602 ± 0.005°C; 3885.2 ± 0.4 mm.

VAPOR PRESSURE

The following table is an abridged form of the very extensive compilation by Daniel R. Stull and published in Industrial and Engineering Chemistry **39**, 517 (1947).

The table gives the temperatures in degrees centigrade at which the vapor of the compound listed at the left has the pressure indicated at the top of the column. Organic compounds are listed in the order of their empirical formulae and inorganic compounds in the alphabetic order of their names. Pressures greater than one atmosphere are listed in separate tables.

Abbreviations:
d = decomposes
d = dextrorotatory
dl = inactive (50% *d* and 50% *l*)
e = explodes
l = levorotatory
M.P. = melting point
p = polymerizes
s = solid

INORGANIC COMPOUNDS
Pressures Less than One Atmosphere

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Aluminum	Al	1284	1487	1635	1749	1947	2056	660	(153, 229, 469)
Aluminum borohydride	AlB_3H_{12}	s	-42.9	-20.9	-3.9	+28.1	45.9	-64.5	(386)
Aluminum bromide	$AlBr_3$	81.3_s	118.0	150.6	176.1	227.0	256.3	97.5	(9, 127, 229)
Aluminum chloride	$AlCl_3$	100.0_s	123.8_s	139.9_s	152.0_s	171.6_s	180.2_s	192.4	(127, 130, 229, 264, 409, 410, 457)
Aluminum fluoride	AlF_3	1238	1324	1378	1422	1496	1537	1040	(362)
Aluminum iodide	AlI_3	178.0_s	225.8	265.0	294.5	354.0	385.5	....	(127, 229)
Aluminum oxide	Al_2O_3	2148	2385	2549	2665	2874	2977	2050	(229, 359, 369)
Ammonia	NH_3	-109.1_s	-91.9_s	-79.2_s	-68.4	-45.4	-33.6	-77.7	(23, 25, 33, 49, 62, 82, 142, 175, 192, 223, 231, 279, 305, 334, 420)
Deutero ammonia	ND_3	s	s	s	-67.4	-45.4	-33.4	-74.0	(443)
Ammonium azide	NH_4N_3	29.2_s	59.2_s	80.1_s	95.2_s	120.4_s	133.8_s	....	(131)
Ammonium bromide	NH_4Br	198.3_s	252.0_s	290.0_s	320.0_s	370.9_s	396.0_s	....	(403)
Ammonium carbamate	$NH_4CO_2NH_2$	-26.1_s	-2.9_s	$+14.0_s$	26.7_s	48.0_s	58.3_s	....	(48, 107)
Ammonium chloride	NH_4Cl	160.4_s	209.8_s	245.0_s	271.5_s	316.5_s	337.8_s	520	(333, 403)
Ammonium hydrogen sulfide	NH_4HS	-51.1	-28.7	-12.3	0.0	+21.8	33.3	....	(200)
Ammonium iodide	NH_4I	210.9_s	263.5_s	302.8_s	331.8_s	381.0_s	404.9_s	....	(403)
Ammonium cyanide	NH_4CN	-50.6_s	-28.6_s	-12.6_s	-0.5_s	$+20.5_s$	31.7_s	36	(201)
Antimony	Sb	886	1033	1141	1223	1364	1440	630.5	(153, 229, 255, 348, 485)
Antimony tribromide	$SbBr_3$	93.9	142.7	177.4	203.5	250.2	275.0	96.6	(9, 102)
Antimony trichloride	$SbCl_3$	49.2_s	85.2	117.8	143.3	192.2	219.0	73.4	(8, 9, 43, 102, 229, 264)
Antimony pentachloride	$SbCl_5$	22.7	61.8	91.0	114.1	....	....	2.8	(8, 9, 43, 229)

INORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Antimony triiodide	SbI_3	163.6_s	223.5	267.8	303.5	368.5	401.0	167	(9, 102)
Antimony trioxide	Sb_2O_3	574_s	666	812	957	1242	1425	656	(183, 229)
Argon	A	-218.2_s	-210.9_s	-204.9_s	-200.5_s	-190.6_s	−185.6	−189.2	(41, 83, 84, 85, 193, 229, 295, 329, 466)
Arsenic (metallic)	As	372_s	437_s	483_s	518_s	579_s	610_s	814	(143, 194, 229, 322, 348, 367)
Arsenic tribromide	$AsBr_3$	41.8	85.2	118.7	145.2	193.6	220.0	......	(9)
Arsenic trichloride	$AsCl_3$	−11.4	+23.5	50.0	70.9	109.7	130.4	−18	(9, 20, 229, 264)
Arsenic trifluoride	AsF_3	s	s	−2.5	+13.2	41.5	56.3	−5.9	(376)
Arsenic pentafluoride	AsF_5	-117.9_s	-103.1_s	-92.4_s	-84.3_s	−64.0	−52.8	−79.8	(229, 352)
Arsenic hydride (arsine)	AsH_3	-142.6_s	-124.7_s	−110.2	−98.0	−75.2	−62.1	−116.3	(215)
Arsenic trioxide	As_2O_3	212.5_s	259.7_s	299.2_s	332.5	412.2	457.2	312.8	(229, 287, 373, 402, 405, 418, 479)
Barium	Ba	s	1049	1195	1301	1518	1638	850	(167, 229, 355)
Beryllium borohydride	BeB_2H_8	$+1.0_s$	28.1_s	46.2_s	58.6_s	79.7_s	90.0_s	123	(60)
Beryllium bromide	$BeBr_2$	289_s	342_s	379_s	405_s	451_s	474_s	490	(229, 326)
Beryllium chloride	$BeCl_2$	291_s	346_s	384_s	411	461	487	405	(229, 326)
Beryllium iodide	BeI_2	283_s	341_s	382_s	411_s	461_s	487_s	488	(229, 326)
Bismuth	Bi	1021	1136	1217	1271	1370	1420	271	(17, 153, 154, 155, 229, 255, 348)
Bismuth tribromide	$BiBr_3$	s	282	327	360	425	461	218	(116, 229)
Bismuth trichloride	$BiCl_3$	s	264	311	343	405	441	230	(116, 229, 264)
Borine carbonyl	BH_3CO	−139.2	−121.1	−106.6	−95.3	−74.8	−64.0	−137.0	(59)
Boron tribromide	BBr_6	−41.4	−10.1	+14.0	33.5	70.0	91.7	−45	(229, 421)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Boron trichloride	BCl_3	−91.5	−66.9	−47.8	−32.4	−3.6	+12.7	−107	(229, 308, 334, 430)
Boron trifluoride	BF_3	−154.6	−141.3$_s$	−131.0$_s$	−123.0	−108.3	−110.7	−126.8	(39, 118, 229, 319, 352)
Dihydrodiborane	B_2H_6	−159.7	−144.3	−131.6	−120.9	−99.6	−86.5	−169	(229, 419, 423)
Diborane hydrobromide	B_2BrH_5	−93.3	−66.3	−45.4	−29.0	0.0	+16.3	−104.2	(229, 424)
Triborine triamine	$B_3H_6N_3$	−63.0$_s$	−35.3	−13.2	+4.0	34.3	50.6	−58.2	(229, 427)
Tetrahydrotetraborane	B_4H_{10}	−90.9	−64.3	−44.3	−28.1	+0.8	16.1	−119.9	(229, 423, 425, 426)
Dihydropentaborane	B_5H_9	s	−30.7	−8.0	+9.6	40.8	58.1	−47.0	(229, 423)
Tetrahydropentaborane	B_5H_{11}	−50.2	−19.9	+2.7	20.1	51.2	67.0	....	(229, 426)
Dihydrodecaborane	$B_{10}H_{14}$	60.0$_s$	90.2$_s$	117.4	142.3	d	....	99.6	(229, 428)
Bromine	Br_2	−48.7$_s$	−25.0$_s$	−8.0$_s$	+9.3	41.0	58.2	−7.3	(88, 102, 171, 203, 217, 229, 281, 331, 345, 381, 458, 487)
Bromine pentafluoride	BrF_5	−69.3$_s$	−41.9	−21.0	−4.5	+25.7	40.0	−61.4	(229, 365)
Cadmium	Cd	394	484	553	611	711	765	320.9	(17, 42, 61, 109, 111, 129, 163, 181, 210, 229, 243, 348)
Cadmium chloride	$CdCl_2$	s	656	736	797	908	967	568	(156, 229, 264)
Cadmium fluoride	CdF_2	1112	1286	1400	1486	1651	1751	520	(362)
Cadmium iodide	CdI_2	416	512	584	640	742	796	385	(229, 387)
Cadmium oxide	CdO	1000$_s$	1149$_s$	1257$_s$	1341$_s$	1484$_s$	1559$_s$	....	(119, 184, 229)
Calcium	Ca	s	983	1111	1207	1388	1487	851	(167, 229, 318, 346, 355)
Carbon	C	3586$_s$	3946$_s$	4196$_s$	4373$_s$	4660$_s$	4827$_s$	....	(4, 176, 177, 229, 241, 242, 266, 377, 445, 480)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Carbon tetrabromide	CBr_4	s	s	96.3	119.7	163.5	189.5	90.1	(38)
Carbon tetrachloride	CCl_4	−50.0$_s$	−19.6	+4.3	23.0	57.8	76.7	−22.6	(104, 179, 279, 334, 335, 413, 495)
Carbon tetrafluoride	CF_4	−184.6$_s$	−169.3	−158.8	−150.7	−135.5	−127.7	−183.7	(229, 270)
Carbon dioxide	CO_2	−134.3$_s$	−119.5$_s$	−108.6$_s$	−100.2$_s$	−85.7$_s$	−78.2$_s$	−57.5	(5, 46, 117, 172, 175, 211, 229, 272, 292, 302, 334, 420, 464, 467, 477, 497)
Carbon suboxide	C_3O_2	−94.8	−71.0	−52.0	−36.9	−8.9	+6.3	−107	(237, 435)
Carbon disulfide	CS_2	−73.8	−44.7	−22.5	−5.1	+28.0	46.5	−110.8	(175, 229, 265, 328, 334, 335, 420, 467, 490)
Carbon subsulfide	C_3S_2	14.0	54.9	85.6	109.9	p	....	+0.4	(229, 429)
Carbon selenosulfide	CSSe	−47.3	−16.0	+8.6	28.3	65.2	85.6	−75.2	(229, 436)
Carbon monoxide	CO	−222.0$_s$	−215.0$_s$	−210.0$_s$	−205.7$_s$	−196.3	−191.3	−205.0	(16, 67, 77, 78, 87, 229, 293, 463)
Carbonyl chloride	$COCl_2$	−92.9	−69.3	−50.3	−35.6	−7.6	+8.3	−104	(14, 135, 229, 288, 309)
Carbonyl selenide	COSe	−117.1	−95.0	−76.4	−61.7	−35.6	−21.9	....	(325)
Carbonyl sulfide	COS	−132.4	−113.3	−98.3	−85.9	−62.7	−49.9	−138.8	(196, 229, 230, 422)
Chloropicrin	CCl_3NO_2	−25.5	+7.8	33.8	53.8	91.8	111.9	−64	(20, 31)
Chlorotrifluoromethane	$CClF_3$	−149.5	−134.1	−121.9	−111.7	−92.7	−81.2	....	(102, 447)
Cyanogen	C_2N_2	−95.8$_s$	−76.8$_s$	−62.7$_s$	−51.8$_s$	−33.0	−21.0	−34.4	(74, 83, 102, 118, 313, 444)

INORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Cyanogen bromide	CBrN	− 35.7$_s$	− 10.0$_s$	+ 8.6$_s$	22.6$_s$	46.0$_s$	61.5	58	(20, 229)
Cyanogen chloride	CClN	− 76.7$_s$	− 53.8$_s$	− 37.5$_s$	− 24.9$_s$	− 2.3	+ 13.1	− 6.5	(229, 334)
Cyanogen fluoride	CFN	−134.4$_s$	−118.5$_s$	−106.4$_s$	− 97.0$_s$	− 80.5$_s$	− 72.6$_s$	....	(80, 229)
Cyanogen iodide	CIN	25.2$_s$	57.7$_s$	80.3$_s$	97.6$_s$	126.1$_s$	141.1$_s$	....	(229, 493)
Deuterocyanic acid	CDN	− 68.9$_s$	− 46.7$_s$	− 30.1$_s$	− 17.5$_s$	+ 10.0	26.2	− 12	(258)
Dichlorodifluoromethane	CCl_2F_2	−118.5	− 97.8	− 81.6	− 68.6	− 43.9	− 29.8	....	(102, 144)
Dichlorofluoromethane	$CHCl_2F$	− 91.3	− 67.5	− 48.8	− 33.9	− 6.2	+ 8.9	−135	(233)
Chlorodifluoromethane	$CHClF_2$	−122.8	−103.7	− 88.6	− 76.4	− 53.6	− 40.8	−160	(40, 233)
Trichlorofluoromethane	CCl_3F	− 84.3	− 59.0	− 39.0	− 23.0	+ 6.8	23.7	....	(233)
Cesium	Cs	279	375	449	509	624	690	28.5	(35, 132, 161, 229, 246, 251, 357, 394, 462)
Cesium bromide	CsBr	748	887	993	1072	1221	1300	636	(229, 367, 475)
Cesium chloride	CsCl	744	884	989	1069	1217	1300	646	(122, 229, 367, 475)
Cesium fluoride	CsF	712	844	947	1025	1170	1251	683	(229, 370, 371, 475)
Cesium iodide	CsI	738	873	976	1055	1200	1280	621	(229, 367, 475)
Chlorine	Cl_2	−118.0$_s$	−101.6$_s$	− 84.5	− 71.7	− 47.3	− 33.8	−100.7	(139, 166, 171, 214, 229, 239, 312, 452)
Chlorine fluoride	ClF	s	−139.0	−128.8	−120.8	−107.0	−100.5	−145	(229, 361)
Chlorine trifluoride	ClF_3	s	− 71.8	− 51.3	− 34.7	− 4.9	+ 11.5	− 83	(229, 360)
Chlorine monoxide	Cl_2O	− 98.5	− 73.1	− 54.3	− 39.4	− 12.5	+ 2.2	−116	(147, 229)
Chlorine dioxide	ClO_2	s	− 59.0	− 42.8	− 29.4	− 4.0	+ 11.1	− 59	(229, 234)
Dichlorine hexoxide	Cl_2O_6	+ 7.5	42.0	68.0	87.7	123.8	142.0	3.5	(149)
Chlorine heptoxide	Cl_2O_7	− 45.3	− 13.2	+ 10.3	29.1	62.2	78.8	− 91	(148, 229)
Chlorosulfonic acid	HSO_3Cl	32.0	64.0	87.6	105.3	136.1	151.0$_d$	− 80	(9)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Chromium	Cr	1616	1845	2013	2139	2361	2482	1615	(153, 229)
Chromium carbonyl	$Cr(CO)_6$	36.0	68.3	91.2	108.0	137.2	151.0	....	(484)
Chromyl chloride	CrO_2Cl_2	−18.4	+13.8	38.5	58.0	95.2	117.1	....	(229, 276)
Cobaltous chloride	$COCl_2$	s	s	770	843	974	1050	735	(229, 264)
Cobalt nitrosyl tricarbonyl	$Co(CO)_2NO$	s	s	+11.0	29.0	62.0	80.0	−11	(30)
Columbium pentafluoride	CbF_5	s	86.3	121.5	148.5	198.0	225.0	75.5	(229, 368)
Copper	Cu	1628	1879	2067	2207	2465	2595	1083	(153, 154, 155, 165, 218, 229, 262, 348, 359, 469)
Cuprous bromide	Cu_2Br_2	572	718	844	951	1189	1355	504	(209, 229, 474)
Cuprous chloride	Cu_2Cl_2	546	702	838	960	1249	1490	422	(229, 264, 474)
Cuprous iodide	Cu_2I_2	s	656	786	907	1158	1336	605	(156, 209, 229, 474)
Ferric chloride	$FeCl_2$	194.0_s	235.5_s	256.8_s	272.5_s	298.0_s	319.0	304	(208, 229, 264)
Ferrous chloride	$FeCl_2$	....	700	779	842	961	1026	....	(229, 264)
Fluorine	F_2	−223.0	−214.1	−207.7	−202.7	−193.2	−187.9	−223	(65, 229)
Fluorine monoxide	F_2O	−196.1	−182.3	−173.0	−165.8	−151.9	−144.6	−223.9	(229, 363, 364)
Gallium	Ga	1349	1541	1680	1784	1974	2071	30	(165, 229)
Gallium trichloride	$GaCl_3$	48.0_s	76.5_s	107.5	132.0	176.3	200.0	77.0	(126, 253)
Germanium hydride	GeH_4	−163.0	−145.3	−131.6	−120.3	−100.2	−88.9	−165	(79, 229, 307, 383)
Germanium bromide	$GeBr_4$	s	56.8	88.1	113.2	161.6	189.0	26.1	(45, 229)
Germanium chloride	$GeCl_4$	−45.0	−15.0	+8.0	27.5	63.8	84.0	−49.5	(229, 254, 289)
Trichlorogermane	$GeHCl_3$	−41.3	−13.0	+8.8	26.5	58.3_d	75.0_d	−71.1	(94, 229)
Tetramethylgermanium	$Ge(CH_3)_4$	−73.2	−45.2	−23.4	−6.3	+26.0	44.0	−88	(93, 229)
Digermane	Ge_2H_6	−88.7	−60.1	−38.2	−20.3	+13.3	31.5	−109	(92, 229)
Trigermane	Ge_3H_8	−36.9	−0.9	+26.3	47.9	88.6	110.8	−105.6	(92, 229)

INORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Gold	Au	1869	2154	2363	2521	2807	2966	1063	(165 229, 348, 359, 469)
Helium	He	−271.7	−271.3	−270.7	−270.3	−269.3	−268.6	......	(227, 228, 229 300, 301)
Hydrogen	H_2	−263.3$_s$	−261.3$_s$	−259.6$_s$	−257.9	−254.5	−252.5	−259.1	(58, 71, 173, 225, 229, 298, 299, 396, 454, 455)
Hydrogen deuteride	HD	.....	−259.8	−258.2	−256.6	−253.0	−251.0	....	(395)
Hydrogen bromide	HBr	−138.8$_s$	−121.8$_s$	−108.3$_s$	− 97.7$_s$	− 78.0	− 66.5	− 87.0	(18, 103, 169, 229, 415, 416)
Hydrogen chloride	HCl	−150.8$_s$	−135.6$_s$	−123.8$_s$	−114.0	− 95.3	− 84.8	−114.3	(50, 69, 103, 118, 141, 169, 175, 223, 229, 416, 420)
Hydrogen cyanide	HCN	− 71.0$_s$	− 47.7$_s$	− 30.9$_s$	− 17.8$_s$	+ 10.2	25.9	− 13.2	(44, 164, 229, 258, 314, 397, 401)
Hydrogen fluoride	HF	$_s$	− 65.8	− 45.0	− 28.2	+ 2.5	19.7	− 83.7	(76, 229, 398, 400)
Hydrogen iodide	HI	−123.3$_s$	−102.3$_s$	− 85.6$_s$	− 72.1$_s$	− 48.3	− 35.1	− 50.9	(103, 169, 229, 415, 416)
Hydrogen peroxide	H_2O_2	15.3	50.4	77.0	97.9	137.4$_d$	158.0$_d$	− 0.9	(229, 260)
Hydrogen selenide	H_2Se	−115.3$_s$	− 97.9$_s$	− 84.7$_s$	− 74.2$_s$	− 53.6	− 41.1	− 64	(57, 90, 91, 229, 292, 417)
Hydrogen sulfide	H_2S	−134.3$_s$	−116.3$_s$	−102.3$_s$	− 91.6$_s$	− 71.8	− 60.4	− 85.5	(118, 137, 229, 235, 236, 292, 334, 415, 416)
Hydrogen disulfide	H_2S_2	− 43.2	− 15.2	+ 6.0	22.0	49.6	64.0	− 89.7	(64, 229)

INORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Hydrogen teluride	H_2Te	− 96.4$_s$	− 75.4$_s$	− 59.1$_s$	− 45.7	− 17.2	− 2.0	− 49.0	(56, 229, 417)
Hydroxylamine	NH_2OH	$_s$	47.2	64.6	77.5	99.2	110.0	34.0	(9, 55, 259)
Iodine	I_2	38.7$_s$	73.2$_s$	97.5$_s$	116.5	159.8	183.0	112.9	(10, 21, 22, 96, 136, 145, 159, 229, 282, 331, 336, 440, 483, 486)
Iodine pentafluoride	IF_5	− 15.2	+ 8.5	32.2	50.0	81.2	97.0	8.0	(351)
Iodine heptafluoride	IF_7	− 87.0$_s$	− 63.0$_s$	− 45.3$_s$	− 31.9$_s$	− 8.3$_s$	+ 4.0$_s$	5.5	(229, 358)
Iron	Fe	1787	2039	2224	2360	2605	2735	1535	(153, 218, 229, 350)
Iron pentacarbonyl	$Fe(CO)_5$	....	+ 4.6	30.3	50.3	86.1	105.0	− 21	(229, 450)
Krypton	Kr	−199.3$_s$	−187.2$_s$	−178.4$_s$	−171.8$_s$	−159.0$_s$	−152.0	−156.7	(3, 221, 229, 315, 317, 329)
Lead	Pb	973	1162	1309	1421	1630	1744	327.5	(110, 153, 154, 155, 165, 197, 229, 255, 341, 342, 348, 469, 471)
Lead bromide	$PbBr_2$	513	610	686	745	856	914	373	(156, 229, 465, 474)
Lead chloride	$PbCl_2$	547	648	725	784	893	954	501	(105, 156, 207, 229, 465, 474)
Lead fluoride	PbF_2	$_s$	904	1003	1080	1219	1293	855	(229, 474)
Lead iodide	PbI	479	571	644	701	807	872	402	(156, 209, 229)
Lead oxide	PbO	943	1085	1189	1265	1402	1472	890	(119, 229)
Lead sulfide	PbS	852$_s$	975$_s$	1048$_s$	1108$_s$	1221	1281	1114	(229, 382)
Lithium	Li	723	881	1003	1097	1273	1372	186	(36, 37, 167, 229, 257)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Lithium bromide	LiBr	748	888	994	1076	1226	1310	547	(229, 367, 475)
Lithium chloride	LiCl	783	932	1045	1129	1290	1382	614	(229, 264, 367, 475)
Lithium fluoride	LiF	1047	1211	1333	1425	1591	1681	870	(229, 371, 475)
Lithium iodide	LiI	723	841	927	993	1110	1171	446	(229, 367, 475)
Magnesium	Mg	621$_s$	743	838	909	1034	1107	651	(153, 167, 229, 355, 469)
Magnesium chloride	$MgCl_2$	778	930	1050	1142	1316	1418	712	(229, 264)
Manganese	Mn	1292	1505	1666	1792	2029	2151	1260	(133, 153, 229, 349)
Manganous chloride	$MnCl_2$	s	778	879	960	1108	1190	650	(229, 264)
Mercury	Hg	126.2	184.0	228.8	261.7	323.0	357.0	− 38.9	(26, 34, 109, 134, 159, 178, 181, 182, 185, 210, 222, 229, 240, 243, 271, 273, 277, 285, 316, 320, 330, 334, 342, 348, 439, 460, 494)
Mercuric bromide	$HgBr_2$	136.5$_s$	179.8$_s$	211.5$_s$	237.8	290.0	319.0	237	(212, 220, 229, 324, 465, 483)
Mercuric chloride	$HgCl_2$	136.2$_s$	180.2$_s$	212.5$_s$	237.0$_s$	275.5$_s$	304.0	277	(124, 212, 229, 324, 336, 387, 438, 483)
Mercuric iodide	HgI_2	157.5$_s$	204.5$_s$	238.2$_s$	261.8	324.2	354.0	259	(98, 212, 229, 324, 339, 438, 483)
Molybdenum	Mo	3102	3535	3859	4109	4553	5560	2622	(218, 229, 252)

INORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Molybdenum hexafluoride	MoF_6	-65.5_s	-40.8_s	-22.1_s	-8.0_s	+17.2	36.0	17	(229, 347)
Molybdenum trioxide	MoO_3	734_s	814	892	955	1082	1151	795	(120, 205, 229)
Neon	Ne	-257.3_s	-254.6_s	-252.6_s	-251.0_s	−248.1	−246.0	−248.7	(71, 229, 297, 455)
Nickel	Ni	1810	2057	2234	2364	2603	2732	1452	(218, 229, 349)
Nickel chloride	$NiCl_2$	671_s	759_s	821_s	866_s	945_s	987_s	1001	(125, 229, 264)
Nickel carbonyl	$Ni(CO)_4$	s	s	−23.0	−6.0	+25.8	42.5	−25	(7, 96, 97, 229, 274)
Nitrogen	N_2	-226.1_s	-219.1_s	-214.0_s	−209.7	−200.9	−195.8	−210.0	(15, 70, 86, 100, 123, 138, 173, 174, 193, 229, 292, 321, 463, 467, 489)
Nitrogen trifluoride	NF_3	s	−170.7	−160.2	−152.3	−137.4	−129.0	−183.7	(229, 270)
Nitric oxide	NO	-184.5_s	-178.2_s	-171.7_s	-166.0_s	-156.8_s	−151.7	−161	(1, 146, 170, 216, 229, 279, 292, 294)
Nitrous oxide	N_2O	-143.4_s	-128.7_s	-118.3_s	-110.3_s	-96.2_s	−88.5	−90.9	(29, 32, 53, 62, 115, 188, 229, 247, 327, 464)
Nitrogen tetroxide	N_2O_4	-55.6_s	-36.7_s	-23.9_s	-14.7_s	+8.0	21.0	−9.3	(19, 108, 158, 229, 275, 317, 332, 374, 380, 385)
Nitrogen pentoxide	N_2O_5	-36.8_s	-16.7_s	-2.9_s	$+7.4_s$	24.4_s	32.4	30	(89, 229, 375)
Nitrosyl chloride	NOCl	s	s	−60.2	−46.3	−20.3	−6.4	−64.5	(52, 229, 451)
Nitrosyl fluoride	NOF	−132.0	−114.3	−100.3	−88.8	−68.2	−56.0	−134	(366)
Nitroxyl fluoride	NO_2F	-143.7_s	−126.2	−112.8	−102.3	−83.2	−72.0	−139	(366)
Osmium tetroxide (white)	OSO_4	-5.6_s	$+26.0_s$	50.5	71.5	109.3	130.0	42	(229, 245, 290, 372, 468)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Osmium tetroxide (yellow)	OsO_4	3.2_s	31.3_s	51.7_s	71.5	109.3	130.0	56	(229, 245, 290, 372, 468)
Oxygen	O_2	-219.1_s	−210.6	−204.1	−198.8	−188.8	−182.96	−218.4	(15, 28, 53, 70, 86, 100, 114, 172, 174, 226, 229, 292, 296, 420, 456, 467, 488)
Ozone	O_3	−180.4	−163.2	−150.7	−141.0	−122.5	−111.9	−192.1 ± .1	(229, 337, 338, 414)
Phosphorus (yellow)	P	76.6	128.0	166.7	197.3	251.0	280.0	44.1	(72, 186, 219, 229, 263, 322)
Phosphorus (violet)	P	237_s	287_s	323_s	349_s	391_s	417_s	590	(186, 229, 286, 406, 408)
Phosphorus (black)	P	290_s	338_s	371_s	393_s	432_s	453_s	....	(47, 186, 229, 236, 408)
Phosphorus tribromide	PBr_3	7.8	47.8	79.0	103.6	149.7	175.3	− 40	(9)
Phosphorus trichloride	PCl_3	− 51.6	− 21.3	+ 2.3	21.0	56.9	74.2	−111.8	(229, 334)
Phosphorus pentachloride	PCl_5	55.5_s	83.2_s	102.5_s	117.0_s	147.2_s	162.0_s	....	(403)
Phosphorus hydride (Phosphene)	PH_3	s	s	−129.4	−118.8	− 98.3	− 87.5	−132.5	(50, 175, 229, 416, 420)
Phosphonium bromide	PH_4Br	-43.7_s	-21.2_s	-5.0_s	$+7.4_s$	28.0_s	38.3_d	....	(202, 213)
Phosphonium chloride	PH_4Cl	-91.0_s	-74.0_s	-61.5_s	-52.0_s	-35.4_s	-27.0_s	− 28.5	(50, 442)
Phosphonium iodide	PH_4I	-25.2_s	-1.1_s	16.1_s	29.3_s	51.6_s	62.3_s	....	(213, 403)
Phosphorus trioxide	P_2O_3	s	53.0	84.0	108.3	150.3	173.1	22.5	(229, 384, 461)
Phosphorus oxychloride	$POCl_3$	s	2.0	27.3	47.4	84.3	105.1	2	(12, 13, 229)
Phosphorus pentoxide (stable form)	P_2O_5	384_s	442_s	481_s	510_s	556_s	591	569	(187, 229, 407)
Phosphorus pentoxide (Metastable form)	P_2O_5	189	236	270	294	336	358	....	(187, 229, 407)
Phosphorus thiobromide	$PSBr_3$	50.0	83.6	108.0	126.3	157.8	175.0_d	38	(9)

INORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Phosphorus thiochloride	$PSCl_3$	− 18.3	+ 16.1	42.7	63.8	102.3	124.0	− 36.2	(9)
Platinum	Pt	2730	3146	3469	3714	4169	4407	1755	(218, 229, 252)
Potassium	K	341	443	524	586	708	774	62.3	(106, 122, 161, 163, 181, 229, 246, 257, 285, 357, 478)
Potassium bromide	KBr	795	982	1050	1137	1297	1383	730	(122, 229, 367, 473)
Potassium chloride	KCl	821	968	1078	1164	1322	1407	790	(122, 156, 162, 195, 204, 229, 243, 367, 473)
Potassium fluoride	KF	885	1039	1156	1245	1411	1502	880	(229, 371, 475)
Potassium hydroxide	KOH	719	863	976	1064	1233	1327	380	(204, 229, 475)
Potassium iodide	KI	745	887	995	1080	1238	1324	723	(122, 156, 229, 365, 475)
Radon	Rn	-144.2_s	-126.3_s	-111.3_s	-99.0_s	-75.0_s	− 61.8	− 71	(152, 229, 244)
Rhenium heptoxide	Re_2O_7	212.5_s	248.0_s	272.0_s	289.0_s	336.0	362.4	296	(229, 291)
Rubidium	Rb	297	389	459	514	620	679	38.5	(161, 229, 357, 394)
Rubidium bromide	RbBr	781	923	1031	1114	1267	1352	682	(229, 367, 475)
Rubidium chloride	RbCl	792	937	1047	1133	1294	1381	715	(229, 367, 475)
Rubidium fluoride	RbF	921	1016	1096	1168	1322	1408	760	(229, 371, 475)
Rubidium iodide	RbI	748	884	991	1072	1223	1304	642	(229, 367, 475)
Selenium	Se	356	442	506	554	637	680	217	(99, 206, 229, 322)
Selenium dioxide	SeO_2	157.0_s	202.5_s	234.1_s	258.0_s	297.7_s	317.0_s	340	(6, 206, 229)
Selenium hexafluoride	SeF_6	-118.6_s	-98.9_s	-84.7_s	-73.9_s	-55.2_s	-45.8_s	− 34.7	(229, 238, 491)
Selenium oxychloride	$SeOCl_2$	34.8	71.9	98.0	118.0	151.7	168.0	8.5	(229, 256)
Selenium tetrachloride	$SeCl_4$	74.0_s	107.4_s	130.1_s	147.5_s	176.4_s	191.5_d	......	(492)
Silane	SiH_4	−179.3	−163.0	−150.3	−140.5	−122.0	−111.5	−185	(2, 229, 431)
Silicon	Si	1724	1888	2000	2083	2220	2287	1420	(229, 359, 470)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Silicon dioxide	SiO_2	s	1732	1867	1969	2141	2227	1710	(229, 369)
Silicon tetrachloride	$SiCl_4$	− 63.4	− 34.4	− 12.1	+ 5.4	38.4	56.8	− 68.8	(24, 224, 229, 334, 434)
Silicon tetrafluoride	SiF_4	−144.0s	−130.4s	−120.8s	−113.3s	−100.7s	− 94.8s	− 90	(40, 229, 310, 347)
Bromosilane	SiH_3Br	s	− 77.3	− 57.8	− 42.3	− 13.3	+ 2.4	− 93.9	(229, 431)
Chlorosilane	SiH_3Cl	−117.8	− 97.7	− 81.8	− 68.5	− 44.5	− 30.4	....	(431)
Fluorosilane	SiH_3F	−153.0	−141.2	−130.8	−122.4	−106.8	− 98.0	....	(112)
Iodosilane	SiH_3I	s	− 43.7	− 21.8	− 4.4	+ 27.9	45.4	− 57.0	(112)
Bromodichlorofluorosilane	$SiBrCl_2F$	− 86.5	− 59.0	− 37.0	− 19.5	+ 15.4	35.4	−112.3	(389)
Bromotrifluorosilane	$SiBrF_3$	s	s	s	s	− 55.9	− 41.7	− 70.5	(388)
Chlorotrifluorosilane	$SiClF_3$	−144.0s	−127.0	−112.8	−101.7	− 81.0	− 70.0	−142	(40, 229, 392)
Dibromochlorofluorosilane	$SiBr_2ClF$	− 65.2	− 35.6	− 12.0	+ 6.3	43.0	59.5	− 99.3	(389)
Dibromodifluorosilane	$SiBr_2F_2$	s	− 66.8	− 47.4	− 31.9	− 2.6	+ 13.7	− 66.9	(389)
Dibromosilane	SiH_2Br_2	− 60.9	− 29.4	− 5.2	+ 14.1	50.7	70.5	− 70.2	(229, 432)
Dichlorodifluorosilane	$SiCl_2F_2$	−124.7	−102.9	− 85.0	− 70.3	− 45.0	− 31.8	−139.7	(40, 229, 392)
Difluorosilane	SiH_2F_2	−146.7	−130.4	−117.6	−107.3	− 87.6	− 77.8	....	(112)
Diiodosilane	SiH_2I_2	s	18.0	52.6	79.4	125.5	149.5	− 1.0	(113)
Disilane	Si_2H_6	−114.8	− 91.4	− 72.8	− 57.5	− 29.0	− 14.3	−132.6	(229, 431, 434)
Disiloxane	$(SiH_3)_2O$	−112.5	− 88.2	− 70.4	− 55.9	− 29.3	− 15.4	−144.2	(229, 434)
Fluorotrichlorosilane	$SiCl_3F$	− 92.6	− 68.3	− 48.8	− 33.2	− 4.0	+ 12.2	−120.8	(40)
Hexachlorodisilane	Si_2Cl_6	+ 4.0	38.8	65.3	85.4	120.6	139.0	− 1.2	(229, 267)
Hexachlorodisiloxane	$(SiCl_3)_2O$	− 5.0	+ 29.4	55.2	75.4	113.6	135.6	− 33.2	(229, 434)
Hexafluorodisilane	Si_2F_6	− 81.0s	− 63.1s	− 50.6s	− 41.7s	− 26.4s	− 18.9s	− 18.6	(229, 391, 392)
Octachlorotrisilane	Si_3Cl_8	46.3	89.3	121.5	146.0	189.5	211.4	....	(229, 267)
Tetrasilane	Si_4H_{10}	− 27.7	+ 4.3	28.4	47.4	81.7	100.0	− 93.6	(229, 431)
Tribromofluorosilane	$SiBr_3F$	− 46.1	− 15.1	+ 9.2	28.6	64.6	83.8	− 82.5	(388)
Tribromosilane	$SiHBr_3$	− 30.5	+ 3.4	30.0	51.6	90.2	111.8	− 73.5	(390)
Trichlorosilane	$SiHCl_3$	− 80.7	− 53.4	− 32.9	− 16.4	+ 14.5	31.8	−126.6	(229, 437)
Trifluorosilane	$SiHF_3$	−152.0s	−138.2s	−127.3	−118.7	−102.8	− 95.0	−131.4	(112)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Trisilane	Si_3H_8	− 68.9	− 40.0	− 16.9	+ 1.6	35.5	53.1	−117.2	(229, 431)
Disilazane	$(SiH_3)_3N$	− 68.7	− 40.4	− 18.5	− 1.1	+ 31.0	48.7	−105.7	(229, 433)
Silver	Ag	1357	1575	1743	1865	2090	2212	960.5	(153, 154, 155, 163, 165, 218, 229, 348, 469, 471)
Silver chloride	AgCl	912	1074	1200	1297	1467	1564	455	(229, 264, 474)
Silver iodide	AgI	820	983	1111	1210	1400	1506	552	(209, 229)
Sodium	Na	439	549	633	701	823	892	97.5	(106, 134, 150, 160, 161, 163, 181, 229, 248, 257, 340, 343, 344, 357, 446, 472, 478)
Sodium bromide	NaBr	806	952	1063	1148	1304	1392	755	(229, 367, 473)
Sodium chloride	NaCl	865	1017	1131	1220	1379	1465	800	(122, 156, 162, 195, 229, 243, 264, 362, 367, 473)
Sodium cyanide	NaCN	817	983	1115	1214	1401	1497	564	(198, 229)
Sodium fluoride	NaF	1077	1240	1363	1455	1617	1704	992	(229, 371, 475)
Sodium hydroxide	NaOH	739	897	1017	1111	1286	1378	318	(229, 473)
Sodium iodide	NaI	767	903	1005	1083	1225	1304	651	(156, 229, 367, 475)
Stannic bromide	$SnBr_4$	s	72.7	105.5	131.0	177.7	204.7	31.0	(9)
Stannic chloride	$SnCl_4$	− 22.7	+ 10.0	35.2	54.7	92.1	113.0	− 30.2	(229, 279, 481, 494, 496)
Stannic hydride	SnH_4	−140.0	−118.5	−102.3	− 89.2	− 65.2	− 52.3	−149.9	(229, 306)
Stannic iodide	SnI_4	s	175.8	218.8	254.2	315.5	348.0	144.5	(283)
Stannous chloride	$SnCl_2$	316	391	450	493	577	623	246.8	(229, 264)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Strontium	Sr	s	898	1018	1111	1285	1384	800	(167, 229, 355)
Strontium oxide	SrO	2068_s	2262_s	2410_s	....	....	....	2430	(75, 229)
Sulfur	S	183.8	243.8	288.3	327.2	399.6	444.6	112.8	(17, 34, 54, 66, 73, 157, 191, 229, 268, 278, 284, 323, 334, 353, 354, 482)
Sulfur hexafluoride	SF_6	-132.7_s	-114.7_s	-101.5_s	-90.9_s	-72.6_s	-63.5_s	-50.2	(229, 238)
Sulfur dioxide	SO_2	-95.5_s	-76.8_s	-60.5	-46.9	-23.0	-10.0	-73.2	(25, 33, 51, 63, 68, 140, 142, 175, 229, 261, 280, 334, 385, 415, 420)
Sulfur monochloride	S_2Cl_2	-7.4	$+27.5$	54.1	75.3	115.4	138.0	-80	(168, 229, 453)
Sulfuryl chloride	SO_2Cl_2	s	-24.8	-1.0	$+17.8$	51.3	69.2	-54.1	(229, 448, 449)
Sulfur trioxide (α)	SO_3	-39.0_s	-16.5_s	-1.0_s	$+10.5_s$	32.6	44.8	16.8	(27, 151, 229, 411, 412)
Sulfur trioxide (β)	SO_3	-34.0_s	-12.3_s	$+3.2_s$	14.3_s	32.6	44.8	32.3	(27, 151, 229, 411, 412)
Sulfur trioxide (γ)	SO_3	-15.3_s	$+4.3_s$	17.9_s	28.0_s	44.0_s	51.6_s	62.1	(27, 151, 229, 411, 412)
Sulfuric acid	H_2SO_4	145.8	194.2	229.7	257.0	305.0	330.0_d	10.5	(9)
Thionyl bromide	$SOBr_2$	-6.7	$+31.0$	58.8	80.6	119.2	139.5	-52.2	(229, 269)
Thionyl chloride	$SOCl_2$	-52.9	-21.9	$+2.2$	21.4	56.5	75.4	-104.5	(11, 13, 229)
Tantalum pentafluoride	TaF_5	s	s	s	130.0	194.0	230.0	96.8	(229, 368)
Tellurium	Te	520	650	753	838	997	1087	452	(101, 229)
Tellurium tetrachloride	$TeCl_4$	s	233	273	304	360	392	224	(229, 399)
Tellurium hexafluoride	TeF_6	-111.3_s	-92.4_s	-78.4_s	-67.9_s	-48.2_s	-38.6_s	-37.8	(229, 238, 491)
Thallium	Tl	825	983	1103	1196	1364	1457	303.5	(143, 229, 255, 469)

INORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature, °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Thallium bromide	$TlBr$	s	522	598	653	759	819	460	(229, 465, 474)
Thallium chloride	$TlCl$	s	517	589	645	748	807	430	(229, 465, 474)
Thallium iodide	TlI	440	531	607	663	763	823	440	(229, 465, 474)
Tin	Sn	1492	1703	1855	1968	2169	2270	231.9	(153, 154, 155, 165, 229, 348, 469, 471)
Titanium tetrachloride	$TiCl_4$	-13.9	$+21.3$	48.4	71.0	112.7	136.0	-30	(11, 229)
Tungsten	W	3990	4507	4886	5168	5666	5927	3370	(218, 229, 250, 498, 499)
Tungsten hexafluoride	WF_6	-71.4_s	-49.2_s	-33.0_s	-20.3_s	$+1.2$	17.3	-0.5	(229, 347)
Uranium hexafluoride	UF_6	-38.8_s	-13.8_s	$+4.4_s$	18.2_s	42.7_s	55.7_s	69.2	(229, 356)
Vanadyl trichloride	$VOCl_3$	-23.2	$+12.2$	40.0	62.5	103.5	127.2	....	(128)
Water	H_2O	-17.3_s	$+11.3$	34.1	51.6	83.0	100.0	0.0	(81, 95, 104, 121, 189, 190, 217, 222, 229, 232, 303, 304, 378, 379, 404, 476, 481)
Xenon	Xe	-168.5_s	-152.8_s	-141.2_s	-132.8_s	-117.1_s	-108.0	-111.6	(3, 180, 229, 311, 315, 329)
Zinc	Zn	487	593	673	736	844	907	419.4	(17, 42, 61, 109, 154, 155, 163, 181, 210, 229, 255, 342, 348)
Zinc chloride	$ZnCl_2$	428	508	566	610	689	732	365	(208, 229, 264)
Zinc fluoride	ZnF_2	970	1086	1175	1254	1417	1497	872	(362)
Zirconium tetrabromide	$ZrBr_4$	207_s	250_s	281_s	301_s	337_s	357_s	450	(229, 326)
Zirconium tetrachloride	$ZrCl_4$	190_s	230_s	259_s	279_s	312_s	331_s	437	(229, 326)
Zirconium tetraiodide	ZrI_4	264_s	311_s	344_s	369_s	409_s	431_s	499	(229, 326)

INORGANIC COMPOUNDS (Continued)
Pressures Greater than One Atmosphere

Name	Formula	Temperature, °C							Citation No.
		1 atm.	2 atm.	5 atm.	10 atm.	20 atm.	40 atm.	60 atm.	
Ammonia	NH_3	-33.6	-18.7	+4.7	25.7	50.1	78.9	98.3	(23, 25, 33, 49, 62, 82, 142, 175, 192, 223, 231, 279, 305, 334, 420)
Argon	A	-185.6	-179.0	-166.7	-154.9	-141.3	-124.9	....	(41, 83, 193, 229, 295, 329, 466)
Boron trichloride	BCl_3	12.7	33.2	66.0	96.7	135.4	....	....	(229, 308, 334, 430)
Boron trifluoride	BF_3	-100.7	-89.4	-72.6	-57.7	-40.0	-19.0	....	(39, 118, 229, 319, 352)
Bromine	Br_2	58.2	78.8	110.3	139.8	174.0	216.0	243.5	(88, 102, 171, 203, 217, 229, 281, 331, 345, 381, 458, 487)
Carbontetrachloride	CCl_4	76.7	102.0	141.7	178.0	222.0	276.0	....	(104, 179, 279, 334, 335, 413, 495)
Carbon dioxide	CO_2	-78.2_s	-69.1_s	-56.7	-39.5	-18.9	+5.9	22.4	(5, 46, 117, 172, 175, 211, 229, 272, 292, 302, 334, 420, 464, 467, 477, 497)
Carbon disulfide	CS_2	46.5	69.1	104.8	136.3	175.5	222.8	256.0	(175, 229, 265, 328, 334, 335, 420, 467, 490)
Carbon monoxide	CO	-191.3	-183.5	-170.7	-161.0	-149.7	....	....	(16, 67, 77, 78, 87, 229, 293, 463)
Carbonyl chloride	$COCl_2$	+8.3	27.3	57.2	85.0	119.0	159.8	....	(14, 135, 229, 288, 309)
Chlorotrifluoromethane	$CClF_3$	-81.2	-66.7	-42.7	-18.5	+12.0	52.8	....	(102, 447)
Cyanogen	C_2N_2	-21.0	-4.4	+21.4	44.6	72.6	106.5	....	(74, 83, 102, 118, 313, 444)
Dichlorodifluoromethane	CCl_2F_2	-29.8	-12.2	+16.1	42.4	74.0	....	....	(102, 144)
Dichlorofluoromethane	$CHCl_2F$	8.9	28.4	59.0	87.0	121.2	162.6	....	(233)
Chlorodifluoromethane	$CHClF_2$	-40.8	-24.7	+0.3	24.0	52.0	85.3	....	(40, 233)
Trichlorofluoromethane	CCl_3F	23.7	44.1	77.3	108.2	146.7	194.0	....	(233)
Chlorine	Cl_2	-33.8	-16.9	+10.3	35.6	65.0	101.6	127.1	(139, 166, 171, 214, 229, 239, 312, 452)
Helium	He	-268.6	-268.0	....	....	....	....	....	(227, 228, 229, 300, 301)

INORGANIC COMPOUNDS (Continued)
Pressures Greater than One Atmosphere (Continued)

Name	Formula	Temperature, °C							Citation No.
		1 atm.	2 atm.	5 atm.	10 atm.	20 atm.	40 atm.	60 atm.	
Hydrogen	H_2	−252.5	−250.2	−246.0	−241.8	......	......	......	(58, 71, 173, 225, 229, 298, 299, 396, 454, 455)
Hydrogen bromide	HBr	− 66.5	− 51.5	− 29.1	− 8.4	+ 16.8	48.1	70.6	(18, 103, 169, 229, 415, 416)
Hydrogen chloride	HCl	− 84.8	− 71.4	− 50.5	− 31.7	− 8.8	+ 17.8	36.2	(50, 69, 103, 118, 141, 169, 175, 223, 229, 416, 420)
Hydrogen cyanide	HCN	25.9	45.8	75.8	102.7	135.0	169.9	......	(44, 164, 229, 258, 314, 397, 401)
Hydrogen iodide	HI	− 35.1	− 18.9	+ 7.3	32.0	62.2	100.7	127.5	(103, 169, 229, 415, 416)
Hydrogen sulfide	H_2S	− 60.4	− 45.9	− 22.3	− 0.4	+ 25.5	55.8	76.3	(118, 137, 229, 235, 236, 292, 334, 415, 416)
Hydrogen selenide	H_2Se	− 41.1	− 25.2	0.0	+ 23.4	50.8	84.6	108.7	(57, 90, 91, 229, 292, 417)
Krypton	Kr	−152.0	−143.5	−130.0	−118.0	−101.7	− 78.4	......	(3, 221, 229, 315, 317, 329)
Neon	Ne	−246.0	−243.8	−239.9	−236.0	−230.8	......	......	(71, 229, 297, 455)
Nitrogen	N_2	−195.8	−189.2	−179.1	−169.8	−157.6	......	......	(15, 70, 86, 100, 123, 138, 173, 174, 193, 229, 292, 321, 463, 467, 489)
Nitric oxide	NO	−151.7	−145.1	−135.7	−127.3	−116.8	−103.2	− 94.8	(1, 146, 170, 216, 229, 279, 292, 294)
Nitrous oxide	N_2O	− 88.5	− 76.8	− 58.0	− 40.7	− 18.8	+ 8.0	27.4	(29, 32, 53, 62, 115, 188, 229, 247, 327, 464)
Nitrogen tetroxide	N_2O_4	21.0	37.3	59.8	79.4	100.3	121.4	132.2	(19, 108, 158, 229, 275, 317, 332, 374, 380, 385)
Oxygen	O_2	−183.1	−176.0	−164.5	−153.2	−140.0	−124.1	......	(15, 28, 58, 70, 86, 100, 114, 172, 174, 226, 229, 292, 296, 420, 456, 467, 488)
Silicon tetrafluoride	SiF_4	-94.8_s	− 84.4	− 67.9	− 52.6	− 33.4	......	......	(40, 229, 310, 347)
Chlorotrifluorosilane	$SiClF_3$	− 70.0	− 57.3	− 37.2	− 18.6	+ 4.1	......	......	(40, 229, 392)
Dichlorodifluorosilane	$SiCl_2F_2$	− 31.8	− 15.1	+ 11.6	36.6	66.2	......	......	(40, 229, 392)

INORGANIC COMPOUNDS (Continued)
Pressures Greater than One Atmosphere (Continued)

Name	Formula	Temperature, °C							Citation No.
		1 atm.	2 atm.	5 atm.	10 atm.	20 atm.	40 atm.	60 atm.	
Fluorotrichlorosilane	$SiCl_3F$	12.2	32.4	64.6	94.2	131.8	....	....	(40)
Stannic chloride	$SnCl_4$	113.0	141.3	184.3	223.0	270.0	....	....	(229, 279, 481, 494, 496)
Sulfur dioxide	SO_2	-10.0	+6.3	32.1	55.5	83.8	118.0	141.7	(25, 33, 51, 63, 68, 140, 142, 175, 229, 261, 280, 334, 385, 415, 420)
Sulfur trioxide	SO_3	44.8	60.0	82.5	104.0	138.0	175.0	198.0	(27, 151, 229, 411, 412)
Water	H_2O	100.0	120.1	152.4	180.5	213.1	251.1	276.5	(81, 95, 104, 121, 189, 190, 217, 222, 229, 232, 303, 304, 378, 379, 404, 476, 481)

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Inorganic Compounds

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Inorganic Compounds

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ORGANIC COMPOUNDS

Pressures Less than One Atmosphere

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Cyanogen bromide	$CBrN$	-35.7_s	-10.0_s	$+8.6_s$	22.6_s	46.0_s	61.5	58	(26, 208)
Carbon tetrabromide	CBr_4	s	s	96.3	119.7	163.5	189.5	90.1	(48)
Chlorotrifluoromethane	$CClF_3$	−149.5	−134.1	−121.9	−111.7	−92.7	−81.2	....	(113, 430)
Cyanogen chloride	$CClN$	-76.7_s	-53.8_s	-37.5_s	-24.9_s	−2.3	+13.1	−6.5	(208, 344)
Dichlorodifluoromethane	CCl_2F_2	−118.5	−97.8	−81.6	−68.6	−43.9	−29.8	....	(113, 146)
Carbonyl chloride	CCl_2O	−92.9	−69.3	−50.3	−35.6	−7.6	+8.3	−104	(20, 145, 208, 305, 311)
Trichlorofluoromethane	CCl_3F	−84.3	59.0	−39.0	−23.0	+6.8	23.7	....	(212)
Trichloronitromethane	CCl_3NO_2	−25.5	+7.8	33.8	53.8	91.8	111.9	−64	(26, 46, 47)
Carbontetrachloride	CCl_4	-50.0_s	−19.6	+4.3	23.0	57.8	76.7	−22.6	(115, 175, 289, 343, 352, 394, 481)
Cyanogen fluoride	CFN	-134.4_s	-118.5_s	-106.4_s	-97.0_s	-80.5_s	-72.6_s	....	(94, 208)
Carbontetrafluoride	CF_4	-184.6_s	−169.3	−158.8	−150.7	−135.5	−127.7	....	(208, 271)
Tribromomethane	$CHBr_3$	s	34.0	63.6	85.9	127.9	150.5	8.5	(113, 201)
Chlorodifluoromethane	$CHClF_2$	−122.8	−103.7	−88.6	−76.4	−53.6	−40.8	−160	(50, 212)
Dichlorofluoromethane	$CHCl_2F$	−91.3	−67.5	−48.8	−33.9	−6.2	+8.9	−135	(212)
Trichloromethane	$CHCl_3$	−58.0	−29.7	−7.1	+10.4	42.7	61.3	−63.5	(32, 115, 175, 345, 352, 365)
Hydrocyanic acid	CHN	-70.8_s	-48.2_s	-31.3_s	-18.8_s	+9.8	25.8	−14	(252)
Dibromomethane	CH_2Br_2	−35.1	−2.4	+23.3	42.3	79.0	98.6	−52.8	(113, 352)
Dichloromethane	CH_2Cl_2	−70.0	−43.3	−22.3	−6.3	24.1	40.7	−96.7	(317, 352)
Formaldehyde	CH_2O	s	−88.0	−70.6	−57.3	−33.0	−19.5	−92	(264, 399)
Formic acid	CH_2O_2	-20.0_s	$+2.1_s$	24.0	43.8	80.3	100.6	8.2	(7, 91, 203, 219, 246, 353, 373)
Dichloromethylarsine	CH_3ASCl_2	−11.1	+24.3	51.5	73.0	112.7	134.5	−59	(26)
Borine carbonyl	CH_3BO	−139.2	−121.1	−106.6	−95.3	−74.8	−64.0	....	(64)
Methyl bromide	CH_3Br	-96.3_s	−72.8	−54.2	−39.4	−11.9	+3.6	−93	(117, 323)
Methyl chloride	CH_3Cl	s	−92.4	−76.0	−63.0	−38.0	−24.0	−97.7	(54, 182, 241, 350, 451)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Trichloromethylsilane	CH_3Cl_3Si	− 60.8	− 30.7	− 7.0	+ 12.1	47.0	66.4	− 90	(113)
Methyl fluoride	CH_3F	−147.3	−131.6	−119.1	−109.0	− 89.5	78.2	....	(89, 113, 281)
Methyl iodide	CH_3I	s	− 45.8	− 24.2	− 7.0	+ 25.3	42.4	− 64.4	(351, 352, 363)
Formamide	CH_3NO	70.5	109.5	137.5	157.5	193.5	210.5$_d$	....	(11, 113)
Nitromethane	CH_3NO_2	− 29.0	+ 2.8	27.5	46.6	82.0	101.2	− 29	(154, 470)
Methane	CH_4	−205.9$_s$	−195.5$_s$	−187.7$_s$	−181.4	−168.8	−161.5	−182.5	(6, 72, 73, 93, 123, 206, 359, 407)
Dichloromethylsilane	CH_4Cl_2Si	− 75.0	− 47.8	− 26.2	− 9.0	+ 23.7	41.9	....	(113, 114, 410)
Methanol	CH_4O	− 44.0	− 16.2	+ 5.0	21.2	49.9	64.7	− 97.8	(111, 289, 319, 338, 353)
Methanethiol	CH_4S	− 90.7	− 67.5	− 49.2	− 34.8	− 7.9	+ 6.8	−121	(39)
Chloromethylsilane	CH_5ClSi	− 95.0	− 71.0	− 51.7	− 36.4	− 7.8	+ 8.7	....	(410)
Methylamine	CH_5N	− 95.8$_s$	− 73.8	− 56.9	− 43.7	− 19.7	− 6.3	− 93.5	(19, 38, 130, 186, 324)
Methylsilane	CH_6Si	−138.5	−120.0	−104.8	− 93.0	− 70.3	− 56.9	....	(410)
2-Methyldisilazane	CH_9NSi_2	− 76.3	− 50.1	− 29.6	− 13.1	+ 17.2	34.0	....	(118)
Cyanogen iodide	CIN	25.2$_s$	57.7$_s$	80.3$_s$	97.6$_s$	126.1$_s$	141.1$_s$	....	(208, 476)
Tetranitromethane	CN_4O_8	s	22.7	48.4	68.9	105.9	125.7$_d$	13	(272)
Carbon monoxide	CO	−222.0$_s$	−215.0$_s$	−210.0$_s$	−205.7$_s$	−196.3	−191.3	−205.0	(23, 72, 73, 82, 83, 102, 208, 306, 447)
Carbonyl sulfide	COS	−132.4	−113.3	− 98.3	− 85.9	− 62.7	− 49.9	−138.8	(190, 208, 209, 408)
Carbonyl selenide	$COSe$	−117.1	− 95.0	− 76.4	− 61.7	− 35.6	− 21.9	....	(330)
Carbon dioxide	CO_2	−134.3$_s$	−119.5$_s$	−108.6$_s$	−100.2$_s$	− 85.7$_s$	− 78.2$_s$	− 57.5	(4, 5, 53, 124, 167, 168, 196, 208, 242, 275, 307, 308, 343, 407, 448, 454, 463, 493)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Carbon Selenosulfide	CSSe	-47.3	-16.0	+8.6	28.3	65.2	85.6	-75.2	(208, 412)
Carbon disulfide	CS_2	-73.8	-44.7	-22.5	-5.1	+28.0	46.5	-110.8	(168, 208, 263, 331, 343, 352, 407, 454, 475)
Trichloroacetyl bromide	C_2BrCl_3O	-7.4	+29.3	57.2	79.5	120.2	143.0	....	(11)
1-Chloro-1,2,2-trifluoroethylene	C_2ClF_3	-116.0	-95.9	-79.7	-66.7	-41.7	-27.9	-157.5	(49, 50, 113)
1,2-Dichloro-1,2-difluoroethylene	$C_2Cl_2F_2$	-82.0	-57.3	-38.2	-23.0	+5.0	20.9	-112	(49, 113)
1,2-Dichloro-1,1,2,2-tetrafluoroethane	$C_2Cl_2F_4$	-95.4	-72.3	-53.7	-39.1	-12.0	+3.5	-94	(212)
1,1,2-Trichloro-1,2,2-trifluoroethane	$C_2Cl_3F_3$	-68.0_s	-40.3_s	-18.5	-1.7	+30.2	47.6	-35	(212)
Tetrachloroethylene	C_2Cl_4	-20.6_s	+13.8	40.1	61.3	100.0	120.8	-19.0	(113, 175, 176)
1,1,2,2-Tetrachloro-1,2-difluoroethane	$C_2Cl_4F_2$	-37.5_s	-5.0_s	$+19.8_s$	38.6	73.1	92.0	26.5	(113, 184)
Hexachloroethane	C_2Cl_6	32.7_s	73.5_s	102.3_s	124.2_s	163.8_s	185.6_s	186.6	(296, 402)
Tribromoacetaldehyde	C_2HBr_3O	18.5	58.0	87.8	110.2	151.6	174.0_d	....	(113, 201)
Trichloroethylene	C_2HCl_3	-43.8	-12.4	+11.9	31.4	67.0	86.7	-73	(113, 175)
Trichloroacetaldehyde	C_2HCl_3O	-37.8	-5.0	20.2	40.2	77.5	97.7	-57	(113, 280)
Trichloroacetic acid	$C_2HCl_3O_2$	51.0_s	88.2	116.3	137.8	175.2	195.6	57	(11)
Pentachloroethane	C_2HCl_5	+1.0	39.8	69.9	93.5	137.2	160.5	-22	(175, 296, 402)
Acetylene	C_2H_2	-142.9_s	-128.2_s	-116.7_s	-107.9_s	-92.0_s	-84.0_s	-81.5	(12, 66, 67, 69, 217, 449)
1,1,1,2-Tetrabromoethane	$C_2H_2Br_4$	58.0	95.7	123.2	144.0	181.0	200.0_d	....	(11)
1,1,2,2-Tetrabromoethane	$C_2H_2Br_4$	65.0	110.0	144.0	170.0	217.5	243.5	....	(11, 113)
cis-1,2-Dichloroethylene	$C_2H_2Cl_2$	-58.4	-29.9	-7.9	+9.5	41.0	59.0	-80.5	(113, 175, 176)
trans-1,2-Dichloroethylene	$C_2H_2Cl_2$	-65.4_s	-38.0	-17.0	-0.2	+30.8	47.8	-50.0	(113, 175, 176)
1,1-Dichloroethene	$C_2H_2Cl_2$	-77.2	-51.2	-31.1	-15.0	+14.8	31.7	-122.5	(113)
Dichloroacetic acid	$C_2H_2Cl_2O_2$	44.0	82.6	111.8	134.0	173.7	194.4	9.7	(11, 313)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
1,1,1,2-Tetrachloroethane	$C_2H_2Cl_4$	− 16.3	+ 19.3	46.7	68.0	108.2	130.5	− 68.7	(113, 402)
1,1,2,2-Tetrachloroethane	$C_2H_2Cl_4$	− 3.8	+ 33.0	60.8	83.2	124.0	145.9	− 36	(113, 175, 296, 402)
1-Bromoethylene	C_2H_3Br	− 95.4	− 68.8	− 48.1	− 31.9	− 1.1	+ 15.8	−138	(378)
Bromoacetic acid	$C_2H_3BrO_2$	54.7	94.1	124.0	146.3	186.7	208.0	49.5	(11)
1,1,2-Tribromoethane	$C_2H_3Br_3$	32.6	70.6	100.0	123.5	165.4	188.4	− 26	(9, 11)
1-Chloroethylene	C_2H_3Cl	−105.6	− 83.7	− 66.8	− 53.2	− 28.0	− 13.8	−153.7	(104, 113)
Chloroacetic acid	$C_2H_3ClO_2$	43.0$_s$	81.0	109.2	130.7	169.0	189.5	61.2	(203, 204, 313)
1,1,1-Trichloroethane	$C_2H_3Cl_3$	− 52.0	− 21.9	+ 1.6	20.0	54.6	74.1	− 30.6	(113, 361, 402)
1,1,2-Trichloroethane	$C_2H_3Cl_3$	− 24.0	+ 8.3	35.2	55.7	93.0	113.9	− 36.7	(113, 402)
Trichloroacetaldehyde hydrate	$C_2H_3Cl_3O_2$	− 9.8$_s$	+ 19.5$_s$	39.7$_s$	55.0	82.1	96.2$_d$	51.7	(113)
1-Fluoroethylene	C_2H_3F	−149.3	−132.2	−118.0	−106.2	− 84.0	− 72.2	−160.5	(75)
Acetonitrile	C_2H_3N	− 47.0$_s$	− 16.3	+ 7.7	27.0	62.5	81.8	− 41	(159)
Methyl thiocyanate	C_2H_3NS	− 14.0	+ 21.6	49.0	70.4	110.8	132.9	− 51	(11)
Methyl isothiocyanate	C_2H_3NS	− 34.7$_s$	+ 5.4$_s$	38.2	59.3	97.8	119.0	35.5	(25)
Ethylene	C_2H_4	−168.3	−153.2	−141.3	−131.8	−113.9	−103.7	−169	(6, 57, 66, 93, 116, 244, 359, 407, 448, 453)
1-Bromo-1-chloroethane	C_2H_4BrCl	− 36.0$_s$	− 9.4$_s$	+ 10.4$_s$	28.0	63.4	82.7	16.6	(113, 402)
1-Bromo-2-chloroethane	C_2H_4BrCl	− 28.8$_s$	+ 4.1	29.7	49.5	86.0	106.7	− 16.6	(113, 402)
1,2-Dibromoethane	$C_2H_4Br_2$	− 27.0$_s$	+ 18.6	48.0	70.4	110.1	131.5	10	(11, 31, 113, 349, 351, 438)
1,1-Dichloroethane	$C_2H_4Cl_2$	− 60.7	− 32.3	− 10.2	+ 7.2	39.8	57.4	− 96.7	(113, 352, 402)
1,2-Dichloroethane	$C_2H_4Cl_2$	− 44.5$_s$	− 13.6	+ 10.0	29.4	64.0	82.4	− 35.3	(113, 133, 315, 352, 402)
1,1-Difluoroethane	$C_2H_4F_2$	−112.5	− 91.7	− 75.8	− 63.2	− 39.5	− 26.5	−117	(75)
Acetaldehyde	C_2H_4O	− 81.5	− 56.8	− 37.8	− 22.6	+ 4.9	20.2	−123.5	(113, 147, 248)
Ethylene oxide	C_2H_4O	− 89.7	− 65.7	− 46.9	− 32.1	− 4.9	+ 10.7	−111.3	(260)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Acetic acid	$C_2H_4O_2$	− 17.2$_s$	+ 17.5	43.0	63.0	99.0	118.1	16.7	(113, 203, 246, 258, 289, 335, 353, 373, 480)
Methyl formate	$C_2H_4O_2$	− 74.2	− 48.6	− 28.7	− 12.9	16.0	32.0	− 99.8	(297, 491)
Mercaptoacetic acid	$C_2H_4O_2S$	60.0	101.5	131.8	154.0$_d$	....	....	− 16.5	(113)
Ethyl bromide	C_2H_5Br	− 74.3	− 47.5	− 26.7	− 10.0	+ 21.0	38.4	−117.8	(113, 347, 391, 438)
Ethyl chloride	C_2H_5Cl	− 89.8	− 65.8	− 47.0	− 32.0	− 3.9	+ 12.3	−139	(38, 113, 195, 346, 402)
2-Chloroethanol	C_2H_5ClO	− 4.0	+ 30.3	56.0	75.0	110.0	128.8	− 69	(11, 113)
Trichloroethylsilane	$C_2H_5Cl_3Si$	− 27.9	+ 3.6	27.9	46.3	80.3	99.5	− 40	(114)
Trichloroethoxysilane	$C_2H_5Cl_2OSi$	− 32.4	0.0	+ 25.3	45.2	82.2	102.4	....	(114)
Ethyl fluoride	C_2H_5F	−117.0	− 97.7	− 81.8	− 69.3	− 45.5	− 32.0	....	(50)
Ethyltrifluorosilane	$C_2H_5F_3Si$	− 95.4	− 73.7	− 56.8	− 43.6	− 19.1	− 5.4	....	(119)
Ethyl Iodide	C_2H_5I	− 54.4	− 24.3	− 0.9	+ 18.0	52.3	72.4	−105	(113, 348, 351, 352, 394)
Acetamide	C_2H_5NO	65.0$_s$	105.0	135.8	158.0	200.0	222.0	81	(11)
Acetaldoxime	C_2H_5NO	− 5.8$_s$	+ 25.8	48.6	66.2	98.0	115.0	47	(11)
Nitroethane	$C_2H_5NO_2$	− 21.0	+ 12.5	38.0	57.8	94.0	114.0	− 90	(31, 90)
Di(nitrosomethyl)amine	$C_2H_5N_3O_2$	+ 3.2	40.0	68.2	90.3	131.3	153.0	....	(11)
Ethane	C_2H_6	−159.5	−142.9	−129.8	−119.3	− 99.7	− 88.6	−183.2	(6, 30, 65, 84, 93, 153, 261, 262, 359, 453)
Dichlorodimethylsilane	$C_2H_6Cl_2Si$	− 53.5	− 23.8	− 0.4	+ 17.5	51.9	70.3	− 86.0	(113)
Ethanol	C_2H_6O	− 31.3	− 2.3	+ 19.0	34.9	63.5	78.4	−112	(32, 113, 115, 202, 273, 289, 329, 337, 343, 365, 374, 394)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Dimethyl ether	C_2H_6O	−115.7	− 93.3	− 76.2	− 62.7	− 37.8	− 23.7	−138.5	(55, 74, 211, 260, 350)
1,2-Ethanediol	$C_2H_6O_2$	53.0	92.1	120.0	141.8	178.5	197.3	− 15.6	(11, 71, 113, 136, 141)
Dimethyl sulfide	C_2H_6S	− 75.6	− 49.2	− 28.4	− 12.0	+ 18.7	36.0	− 83.2	(39)
Ethanethiol	C_2H_6S	− 76.7	− 50.2	− 29.8	− 13.0	+ 17.7	35.5	−121	(39)
Dimethylantimony	C_2H_6Sb	44.0	86.0	118.3	143.5	187.2	211.0	....	(309)
Ethylamine	C_2H_7N	-82.3_s	− 58.3	− 39.8	− 25.1	+ 2.0	16.6	− 80.6	(38)
Dimethylamine	C_2H_7N	− 87.7	− 64.6	− 46.7	− 32.6	− 7.1	+ 7.4	− 96	(38, 390, 467)
1,2-Ethanediamine	$C_2H_8N_2$	-11.0_s	+ 21.5	45.8	62.5	99.0	117.2	8.5	(181)
Dimethylsilane	C_2H_8Si	−115.0	− 93.1	− 75.7	− 61.4	− 35.0	− 20.1	....	(410)
Dimethyldiborane	$C_2H_{10}B_2$	−106.5	− 82.1	− 62.4	− 47.0	− 18.8	− 2.6	−150.2	(371)
2-Ethyldisilazane	$C_2H_{11}NSi_2$	− 62.0	− 32.2	− 8.3	+ 10.4	45.9	65.9	−127	(118)
Cyanogen	C_2N_2	-95.8_s	-76.8_s	-62.7_s	-51.8_s	− 33.0	− 21.0	− 34.4	(79, 101, 113, 125, 318, 426)
Acrylonitrile	C_3H_3N	− 51.0	− 20.3	+ 3.8	22.8	58.3	78.5	− 82	(113)
Propadiene	C_3H_4	−120.6	−101.0	− 85.2	− 72.5	− 48.5	− 35.0	−136	(113, 244, 255)
Propyne	C_3H_4	-111.0_s	− 90.5	− 74.3	− 61.3	− 37.2	− 23.3	−102.7	(113, 165, 262, 286)
2,3-Dibromopropene	$C_3H_4Br_2$	− 6.0	+ 30.0	57.8	79.5	119.5	141.2	....	(113, 204)
Methyl dichloroacetate	$C_3H_4Cl_2O_2$	3.2	38.1	64.7	85.4	122.6	143.0	....	(11)
2-Propenal	C_3H_4O	− 64.5	− 36.7	− 15.0	+ 2.5	34.5	52.5	− 87.7	(283)
Acrylic acid	$C_3H_4O_2$	$+3.5_s$	39.0	66.2	86.1	122.0	141.0	14	(342)
Pyruvic acid	$C_3H_4O_3$	21.4	57.9	85.3	106.5	144.7	165.0_d	13.6	(11)
1,2,3-Tribromopropene	$C_3H_5Br_3$	47.5	90.0	122.8	148.0	195.0	220.0	16.5	(113)
1-Chloropropene	C_3H_5Cl	− 81.3	− 54.1	− 32.7	− 15.1	+ 18.0	37.0	− 99.0	(113)
3-Chloropropene	C_3H_5Cl	− 70.0	− 42.9	− 21.2	− 4.5	+ 27.5	44.6	−136.4	(113, 192)
Epichlorohydrine	C_3H_5ClO	− 16.5	+ 16.6	42.0	62.0	98.0	117.9	− 25.6	(11)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Methyl chloroacetate	$C_3H_5ClO_2$	− 2.9	+ 30.0	54.5	73.5	109.5	130.3	− 31.9	(113, 297)
1,1,1-Trichloropropane	$C_3H_5Cl_3$	− 28.8	+ 4.2	29.9	50.0	87.5	108.2	− 77.7	(113)
1,2,3-Trichloropropane	$C_3H_5Cl_3$	+ 9.0	46.0	74.0	96.1	137.0	158.0	− 14.7	(11)
Allyltrichlorosilane	$C_3H_5Cl_3Si$	− 20.7	+ 13.2	39.2	59.3	97.1	118.0	....	(114)
Propionitrile	C_3H_5N	− 35.0	− 3.0	+ 22.0	41.4	77.7	97.1	− 91.9	(159)
3-Hydroxypropionitrile	C_3H_5NO	58.7	102.0	134.1	157.7	200.0	221.0	....	(113, 210)
Ethylisothiocyanate	C_3H_5NS	− 13.2$_s$	+ 22.8	50.8	71.9	110.1	131.0	− 5.9	(25)
Nitroglycerine	$C_3H_5N_3O_9$	127	188	235	e	....	....	11	(100, 268)
Propylene	C_3H_6	−131.9	−112.1	− 96.5	− 84.1	− 60.9	− 47.7	−185	(6, 66, 67, 137, 244, 262, 359, 382)
Cyclopropane	C_3H_6	−116.8	− 97.5	− 82.3	− 70.0	− 46.9	− 33.5	−126.6	(113)
2-Bromo-2-nitrosopropane	C_3H_6BrNO	− 33.5	− 4.3	+ 17.9	35.2	66.2	83.0	....	(321)
1,2-Dibromopropane	$C_3H_6Br_2$	− 7.0	+ 29.4	57.2	78.7	118.5	141.6	− 55.5	(11, 113, 204)
1,3-Dibromopropane	$C_3H_6Br_2$	+ 9.7	48.0	77.8	101.3	144.1	167.5	− 34.4	(113, 204)
2,3-Dibromo-1-propanol	$C_3H_6Br_2O$	57.0	98.2	129.8	153.0	196.0	219.0	....	(11)
1,2-Dichloropropane	$C_3H_6Cl_2$	− 38.5	− 6.1	+ 19.4	39.4	76.0	96.8	....	(301)
1,3-Dichloro-2-propanol	$C_3H_6Cl_2O$	28.0	64.7	93.0	114.8	153.5	174.3	....	(11, 199, 201)
Acetone	C_3H_6O	− 59.4	− 31.1	− 9.4	+ 7.7	39.5	56.5	− 94.6	(29, 115, 129, 343, 364)
Allyl alcohol	C_3H_6O	− 20.0	+ 10.5	33.4	50.0	80.2	96.6	−129	(25, 291)
Propylene oxide	C_3H_6O	− 75.0	− 49.0	− 28.4	− 12.0	+ 17.8	34.5	−112.1	(113)
Propionic acid	$C_3H_6O_2$	4.6	39.7	65.8	85.8	122.0	141.1	− 22	(203, 204, 353, 373)
Methyl acetate	$C_3H_6O_2$	− 57.2	− 29.3	− 7.9	+ 9.4	40.0	57.8	− 98.7	(113, 491)
Ethyl formate	$C_2H_6O_2$	− 60.5	− 33.0	− 11.5	+ 5.4	37.1	54.3	− 79	(297, 491)
Methyl glycolate	$C_2H_6O_3$	+ 9.6	45.3	72.3	93.7	131.7	151.5	....	(113)
Methoxyacetic acid	$C_3H_6O_3$	52.5	92.0	122.0	144.5	184.2	204.0	....	(113)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
1-Bromopropane	C_3H_7Br	−53.0	−23.3	−0.3	+18.0	52.0	71.0	−109.9	(113, 352)
2-Bromopropane	C_3H_7Br	−61.8	−32.8	−10.1	+8.0	41.5	60.0	−89.0	(113, 352)
1-Chloropropane	C_3H_7Cl	−68.3	−41.0	−19.5	−2.5	+29.4	46.4	−122.8	(38, 113, 160, 352)
2-Chloropropane	C_3H_7Cl	−78.8	−52.0	−31.0	−13.7	+18.0	36.5	−117	(113, 352)
Trichloroisopropylsilane	$C_3H_7Cl_3Si$	−24.3	+9.9	36.5	57.8	96.8	118.5	......	(114)
1-Iodopropane	C_3H_7I	−36.0	−2.4	+23.6	43.8	81.8	102.5	−98.8	(352)
2-Iodopropane	C_3H_7I	−43.3	−11.7	+13.2	32.8	69.5	89.5	−90	(352)
Propionamide	C_3H_7NO	65.0$_s$	105.0	134.8	156.0	194.0	213.0	79	(11, 113)
1-Nitropropane	$C_3H_7NO_2$	−9.6	+25.3	51.8	72.3	110.6	131.6	−108	(90)
2-Nitropropane	$C_3H_7NO_2$	−18.8	+15.8	41.8	62.0	99.8	120.3	−93	(90)
Ethyl Carbamate	$C_3H_7NO_2$	s	77.8	105.6	126.2	164.0	184.0	49	(11)
Propane	C_3H_8	−128.9	−108.5	−92.4	−79.6	−55.6	−42.1	−187.1	(6, 30, 66, 93, 137, 153, 262, 359)
Dichloroethoxymethylsilane	$C_3H_8Cl_2OSi$	−33.8	−1.3	+24.4	44.1	80.3	100.6	......	(114)
1-Propanol	C_3H_8O	−15.0	+14.7	36.4	52.8	82.0	97.8	−127	(113, 289, 340, 374)
2-Propanol	C_3H_8O	−26.1	+2.4	23.8	39.5	67.8	82.5	−85.8	(310)
Ethyl methyl ether	C_3H_8O	−91.0	−67.8	−49.4	−34.8	−7.8	+7.5	......	(39)
1,2-Propanediol	$C_3H_8O_2$	45.5	83.2	111.2	132.0	168.1	188.2	......	(71, 113, 368)
1,3-Propanediol	$C_3H_8O_2$	59.4	100.6	131.0	153.4	193.8	214.2	......	(113, 141, 368)
2-Methoxyethanol	$C_3H_8O_2$	−13.5	+22.0	47.8	68.0	104.3	124.4	......	(141)
Glycerol	$C_3H_8O_3$	125.5	167.2	198.0	220.1	263.0	290.0	17.9	(11, 71, 134, 205, 353, 403)
1-Propanethiol	C_3H_8S	−56.0	−26.3	−3.2	+15.3	49.2	67.4	−112	(422)
Trimethylborine	C_3H_9B	−118.0	−92.4	−74.7	−60.8	−34.7	−20.1	......	(413)
Chlorotrimethylsilane	C_3H_9ClSi	−62.8	−34.0	−11.4	+6.0	39.4	57.9	......	(113, 424)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Trimethylgallium	C_3H_9Ga	− 62.3$_s$	− 31.7$_s$	− 9.0	+ 8.0	39.0	55.6	− 19	(240)
Propylamine	C_3H_9N	− 64.4	− 37.2	− 16.0	+ 0.5	31.5	48.5	− 83	(38)
Trimethylamine	C_3H_9N	− 97.1	− 73.8	− 55.2	− 40.3	− 12.5	+ 2.9	−117.1	(18, 390, 418, 467)
Trimethyl phosphate	$C_3H_9O_4P$	26.0	67.8	100.0	124.0	167.8	192.7	....	(77)
Trimethyldiborane	$C_3H_{12}B_2$	− 74.0	− 44.8	− 22.0	− 4.4	+ 27.8	45.5	−122.9	(371)
Carbon suboxide	C_3O_2	− 94.8	− 71.0	− 52.0	− 36.9	− 8.9	+ 6.3	−107	(411)
Carbon subsulfide	C_3S_2	14.0	54.9	85.6	109.9	....	....	+ 0.4	(208, 409)
Trichloroacetic anhydride	$C_4Cl_6O_3$	56.2	99.6	131.2	155.2	199.8	223.0	....	(11)
1,3-Butadiyne	C_4H_2	− 82.5$_s$	− 61.2$_s$	− 45.9$_s$	− 34.0	− 6.1	+ 9.7	− 34.9	(414, 421)
α,β-Dibromomaleic anhydride	$C_4H_2Br_2O_3$	50.0	92.0	123.5	147.7	192.0	215.0	....	(11)
trans-Fumaryl chloride	$C_4H_2Cl_2O_2$	+ 15.0	51.8	79.5	101.0	140.0	160.0	....	(11)
Maleic anhydride	$C_4H_2O_3$	44.0$_s$	78.7	111.8	135.8	179.5	202.0	58	(11, 189)
2-Nitrothiophene	$C_4H_3NO_2S$	48.2	92.0	125.8	151.5	199.6	224.5	46	(22)
Butenyne	C_4H_4	− 93.2	− 70.0	− 51.7	− 37.1	− 10.1	+ 5.3	....	(304)
Succinyl chloride	$C_4H_4Cl_2O_2$	39.0	78.0	107.5	130.0	170.0	192.5	17	(11)
Chloroacetic anhydride	$C_4H_4Cl_2O_3$	67.2	108.0	138.2	159.8	197.0	217.0	46	(313)
Succinic anhydride	$C_4H_4O_3$	92.0$_s$	128.2	163.0	189.0	237.0	261.0	119.6	(11, 234)
1,4-Dioxane-2,6-dione	$C_4H_4O_4$	s	116.6	148.6	173.2	217.0	240.0	97	(11)
Thiophene	C_4H_4S	− 40.7$_s$	− 10.9	+ 12.5	30.5	64.7	84.4	− 38.3	(113, 127)
Selenophene	C_4H_4Se	− 39.0	− 4.0	+ 24.1	47.0	89.8	114.3	....	(56)
α-Chlorocrotonic acid	$C_4H_5ClO_2$	70.0	108.0	135.6	155.9	193.2	212.0	....	(11)
Ethyl chloroglyoxylate	$C_4H_5ClO_3$	− 5.1	+ 29.9	56.0	76.6	114.7	135.0	....	(11)
Ethyl trichloroacetate	$C_4H_5Cl_3O_2$	20.7	57.7	85.5	107.4	146.0	167.0	....	(11)
3-Butenenitrile	C_4H_5N	− 19.6	+ 14.1	40.0	60.2	98.0	119.0	....	(159)
Methacrylonitrile	C_4H_5N	− 44.5	− 12.5	+ 12.8	32.8	32.8	90.3	....	(113)
cis-Crotononitrile	C_4H_5N	− 29.0	+ 4.0	30.0	50.1	88.0	108.0	....	(159)
trans-Crotononitrile	C_4H_5N	− 19.5	+ 15.0	41.8	62.8	101.5	122.8	....	(159)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Succinimide	$C_4H_5NO_2$	115.0_s	157.0	192.0	217.4	263.5	287.5	125.5	(11)
Allylisothiocyanate	C_4H_5NS	-2.0	+38.3	67.4	89.5	129.8	150.7	-80	(11, 25, 299, 201)
1,2-Butadiene	C_4H_6	-89.0	-64.2	-44.3	-28.3	+1.8	18.5	....	(113)
1,3-Butadiene	C_4H_6	-102.8	-79.7	-61.3	-46.8	-19.3	-4.5	-108.9	(52, 162, 189, 445)
Cyclobutene	C_4H_6	-99.1	-75.4	-56.4	-41.2	-12.2	+2.4	....	(163)
1 Butyne	C_4H_6	-92.5	-68.7	-50.0	-34.9	-6.9	+8.7	-130	(286)
2-Butyne	C_4H_6	-73.0_s	-50.5_s	-33.9_s	-18.8	+10.6	27.2	-32.5	(164, 287)
Ethyl dichloroacetate	$C_4H_6Cl_2O_2$	9.6	46.3	74.0	96.1	135.9	156.5	....	(11)
2-Chloroethyl chloroacetate	$C_4H_6Cl_2O_2$	46.0	86.0	116.0	140.0	182.2	205.0	....	(113)
cis-Crotonic acid	$C_4H_6O_2$	33.5	69.0	96.0	116.3	152.2	171.9_d	15.5	(11)
trans-Crotonic acid	$C_4H_6O_2$	s	80.0	107.8	128.0	165.5	185.0	72	(11)
Methyl acrylate	$C_4H_6O_2$	-43.7	-13.5	+9.2	28.0	61.8	80.2_p	....	(113)
Methacrylic acid	$C_4H_6O_2$	25.5	60.0	86.4	106.6	142.5	161.0	15	(342)
Vinyl acetate	$C_4H_6O_2$	-48.0	-18.0	+5.3	23.3	55.5	72.5	....	(267)
Acetic anhydride	$C_4H_6O_3$	1.7	36.0	62.1	82.2	119.8	139.6	-73	(33, 113, 201)
Dimethyl oxalate	$C_4H_6O_4$	20.0	56.0	83.6	104.8	143.3	163.3	....	(11, 97, 144)
cis-1 Bromo-1-butene	C_4H_7Br	-44.0	-12.8	+11.5	30.8	66.8	86.2	....	(250)
trans-1-Bromo-1-butene	C_4H_7Br	-38.4	-6.4	+18.4	38.1	75.0	94.7	-100.3	(250)
2-Bromo-1-butene	C_4H_7Br	-47.3	-16.8	+7.2	26.3	61.9	81.0	-133.4	(250)
cis-2-Bromo-2-butene	C_4H_7Br	-39.0	-7.2	+17.7	37.5	74.0	93.0	-111.2	(250)
trans-2-Bromo-2-butene	C_4H_7Br	-45.0	-13.8	+10.5	29.9	66.0	85.5	-114.6	(250)
1-Bromo-2-Butanone	C_4H_7BrO	+6.2	41.8	68.2	89.2	126.3	147.0	....	(285)
2-Methylpropionyl bromide	C_4H_7BrO	13.5	50.6	79.4	101.6	141.7	163.0	....	(11)
1,1,2-Tribromobutane	$C_4H_7Br_3$	45.0	87.8	120.2	146.0	192.0	216.2	....	(250)
1,2,2-Tribromobutane	$C_4H_7Br_3$	41.0	83.2	116.0	141.8	188.0	213.8	....	(250)
2,2,3-Tribromobutane	$C_4H_7Br_3$	38.2	79.8	111.8	136.3	182.2	206.5	....	(250)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Ethyl chloroacetate	$C_4H_7ClO_2$	+1.0	37.5	65.2	86.0	123.8	144.2	−26	(11, 298)
1,2,3-Trichlorobutane	$C_4H_7Cl_3$	+0.5	40.0	71.5	96.2	143.0	169.0	....	(285)
Butyronitrile	C_4H_7N	−20.0	+13.4	38.4	59.0	96.8	117.5	....	(159)
Diacetamide	$C_4H_7NO_2$	70.0_s	108.0	138.2	160.6	202.0	223.0	78.5	(11, 171)
1-Butene	C_4H_8	−104.8	−81.6	−63.4	−48.9	−21.7	−6.3	−130	(6, 84, 112, 244, 359)
cis-2-Butene	C_4H_8	−96.4	−73.4	−54.7	−39.8	−12.0	+3.7	−138.9	(6, 84, 213, 244, 359)
trans-2-Butene	C_4H_8	−99.4	−76.3	−57.6	−42.7	−14.8	+0.9	−105.4	(6, 213, 244, 359)
2-Methylpropene	C_4H_8	−105.1	−81.9	−63.8	−49.3	−22.2	−6.9	−140.3	(6, 84, 85, 86, 113, 244, 359)
Cyclobutane	C_4H_8	-92.0_s	-67.9_s	−48.4	−32.8	−3.4	+12.9	−50	(113, 163)
Methylcyclopropane	C_4H_8	−96.0	−72.8	−54.2	−39.3	−11.3	+4.5	....	(110)
2-Bromoethyl 2-chloroethyl ether	C_4H_8BrClO	36.5	76.3	106.6	129.8	172.3	195.8	....	(113)
1,2-Dibromobutane	$C_4H_8Br_2$	7.5	46.1	76.0	99.8	143.5	166.3	−64.5	(250)
dl-2,3-Dibromobutane	$C_4H_8Br_2$	+5.0	41.6	72.0	95.3	138.0	160.5	....	(250)
meso-2,3-Dibromobutane	$C_4H_8Br_2$	+1.5	39.3	68.2	91.7	134.2	157.3	−34.5	(250)
1,4-Dibromobutane	$C_4H_8Br_2$	32.0	72.4	104.0	128.7	173.8	197.5	−20	(113)
1,2-Dibromo-2-methylpropane	$C_4H_8Br_2$	−28.8	+10.5	42.3	68.8	119.8	149.0	−70.3	(11, 86)
1,3-Dibromo-2-methylpropane	$C_4H_8Br_2$	14.0	53.0	83.5	107.4	150.6	174.6	....	(113)
Di(2-bromoethyl) ether	$C_4H_8Br_2O$	47.7	88.5	119.8	144.0	188.0	212.5	....	(113)
1,2-Dichlorobutane	$C_4H_8Cl_2$	−23.6	+11.5	37.7	60.2	100.8	123.5	....	(285)
2,3-Dichlorobutane	$C_4H_8Cl_2$	−25.2	+8.5	35.0	56.0	94.2	116.0	−80.4	(437)
1,1-Dichloro-2-methylpropane	$C_4H_8Cl_2$	−31.0	+2.6	28.2	48.2	85.4	-106.0_d	....	(113)
1,2-Dichloro-2-methylpropane	$C_4H_8Cl_2$	−25.8	+6.7	32.0	51.7	87.8	108.0	....	(113)
1,3-Dichloro-2-methylpropane	$C_4H_8Cl_2$	−3.0	+32.0	58.6	78.8	115.4	135.0	....	(113)
di(2-chloroethyl) ether	$C_4H_8Cl_2O$	23.5	62.0	91.5	114.5	155.4	178.5	....	(113, 133, 141)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
1,2-Epoxy-2-methylpropane......	C_4H_8O	− 69.0	− 40.3	− 17.3	+ 1.2	36.0	55.5	....	(113)
2-Butanone.	C_4H_8O	− 48.3	− 17.7	+ 6.0	25.0	60.0	79.6	− 85.9	(113)
1,4-Dioxane..................	$C_4H_8O_2$	− 35.8$_s$	− 1.2$_s$	+ 25.2	45.1	81.8	101.1	10	(141, 173)
Butyric acid..................	$C_4H_8O_2$	25.5	61.5	88.0	108.0	144.5	163.5	− 4.7	(204, 332, 373, 374)
Isobutyric acid................	$C_4H_8O_2$	14.7	51.2	77.8	98.0	134.5	154.5	− 47	(203, 204, 353, 373, 374)
Ethyl acetate..................	$C_4H_8O_2$	− 43.4	− 13.5	+ 9.1	27.0	59.3	77.1	− 82.4	(113, 455, 491)
Methyl propionate....	$C_4H_8O_2$	− 42.0	− 11.8	+ 11.0	29.0	61.8	79.8	− 87.5	(491)
Propyl formate................	$C_4H_8O_2$	− 43.0	− 12.6	+ 10.8	29.5	62.6	81.3	− 92.9	(297, 491)
Isopropyl formate..............	$C_4H_8O_2$	− 52.0	− 22.7	− 0.2	+ 17.8	50.5	68.3	....	(113, 297, 491)
α-Hydroxyisobutyric acid........	$C_4H_8O_3$	73.5$_s$	110.5	138.0	157.7	193.8	212.0	79	(11)
Ethyl glycolate................	$C_4H_8O_3$	14.3	50.5	78.1	99.8	138.0	158.2	....	(113)
1-Bromobutane.................	C_4H_9Br	− 33.0	− 0.3	+ 24.8	44.7	81.7	101.6	−112.4	(113)
1-Bromo-2-butanol.............	C_4H_9BrO	23.7	55.8	79.5	97.6	128.3	145.0	....	(285)
1-Chlorobutane.....	C_4H_9Cl	− 49.0	− 18.6	+ 5.0	24.0	58.8	77.8	−123.1	(113, 249, 333, 394)
sec-Butyl chloride..............	C_4H_9Cl	− 60.2	− 29.2	− 5.0	+ 14.2	50.0	68.0	−131.3	(113, 439)
Isobutyl chloride...............	C_4H_9Cl	− 53.8	− 24.5	− 1.9	+ 16.0	50.0	68.9	−131.2	(113, 438)
tert-Butyl chloride..............	C_4H_9Cl	s	s	− 19.0	− 1.0	+ 32.6	51.0	− 26.5	(87, 113)
2-(2-Chloroethoxy) ethanol	$C_4H_9ClO_2$	53.0	90.7	118.4	139.5	176.5	196.0	....	(113)
1-Iodo-2-methylpropane.........	C_4H_9I	− 17.0	+ 17.0	42.8	63.5	100.3	120.4	− 90.7	(11)
Ethyl methylcarbamate..........	$C_4H_9NO_2$	26.5	63.2	91.0	112.0	149.8	170.0	....	(375)
Propyl carbamate..............	$C_4H_9NO_2$	52.4	90.0	117.7	138.3	175.8	195.0	....	(11)
Di(nitrosoethyl)amine..........	$C_4H_9N_2O_2$	18.5	57.7	87.6	111.0	153.5	176.9	....	(11)
Butane.	C_4H_{10}	−101.5	− 77.8	− 59.1	− 44.2	− 16.3	− 0.5	−135	(6, 66, 93, 359, 382)
2-Methylpropane.............	C_4H_{10}	−109.2	− 86.4	− 68.4	− 54.1	− 27.1	− 11.7	−145	(6, 16, 93, 187, 359, 382)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Dichlorodiethylsilane	$C_4H_{10}Cl_2Si$	− 9.2	+ 25.4	51.6	71.8	110.0	130.4	......	(114)
Diethyldifluorosilane	$C_4H_{10}F_2Si$	− 56.8	− 28.8	− 7.3	+ 9.8	40.5	58.0	......	(119)
Butyl alcohol	$C_4H_{10}O$	− 1.2	+ 30.2	53.4	70.1	100.8	117.5	− 79.9	(68, 174, 203, 204, 314)
sec-Butyl alcohol	$C_4H_{10}O$	− 12.2	+ 16.9	38.1	54.1	83.9	99.5	−114.7	(68)
Isobutyl alcohol	$C_4H_{10}O$	− 9.0	+ 21.7	44.1	61.5	91.4	108.0	−108	(68, 203, 219, 291, 374)
tert-Butyl alcohol	$C_4H_{10}O$	− 20.4$_s$	+ 5.5$_s$	24.5$_s$	39.8	68.0	82.9	25.3	(68, 310)
Diethyl ether	$C_4H_{10}O$	− 74.3	− 48.1	− 27.7	− 11.5	+ 17.9	34.6	−116.3	(31, 113, 115, 289, 338, 423a)
Methyl propyl ether	$C_4H_{10}O$	− 72.2	− 45.4	− 24.3	− 8.1	+ 22.5	39.1	......	(113)
1,3-Butanediol	$C_4H_{10}O_2$	22.2$_s$	85.3	117.4	141.2	183.8	206.5	77	(189)
2,3-Butanediol	$C_4H_{10}O_2$	44.0	80.3	107.8	127.8	164.0	182.0	22.5	(368)
1,2-Dimethoxyethane	$C_4H_{10}O_2$	− 48.0	− 15.3	+ 10.7	31.8	70.8	93.0	......	(254)
2,2′-Thiodiethanol	$C_4H_{10}O_2S$	42.0	128.0	210.0$_d$	285$_d$	.....	.....	......	(25)
Diethylene glycol	$C_4H_{10}O_3$	91.8	133.8	164.3	187.5	226.5	244.8	......	(71, 141, 355)
1,2,3-Butanetriol	$C_4H_{10}O_3$	102.0	146.0	178.0	202.5	243.5	264.0	......	(113)
Diethyl sulfite	$C_4H_{10}O_3S$	10.0	46.4	74.2	96.3	137.0	159.0	......	(11, 13, 14)
Diethyl sulfate	$C_4H_{10}O_4S$	47.0	87.7	118.0	142.5	185.5	209.5$_d$	− 25.0	(11, 450)
Diethyl sulfide	$C_4H_{10}S$	− 39.6	− 8.0	+ 16.1	35.0	69.7	88.0	− 99.5	(25, 39)
Diethyl selenide	$C_4H_{10}Se$	− 25.7	+ 7.0	31.2	51.8	88.0	108.0	......	(420)
Diethylzinc	$C_4H_{10}Zn$	− 22.4	+ 11.7	38.0	59.1	97.3	118.0	− 28	(161)
Diethylamine	$C_4H_{11}N$	s	− 33.0	− 11.3	+ 6.0	38.0	55.5	− 38.9	(38)
Isobutylamine	$C_4H_{11}N$	− 50.0	− 21.0	+ 1.3	18.8	50.7	68.6	− 85.0	(390)
1,3-Dichlorotetramethyldisiloxane	$C_4H_{12}Cl_2Si_2$	− 7.4	+ 28.3	55.7	76.9	116.3	138.0	− 37	(312)
Tetramethyllead	$C_4H_{12}Pb$	− 29.0$_s$	+ 4.4	30.3	50.8	89.0	110.0	− 27.5	(420)
Tetramethylsilane	$C_4H_{12}Si$	− 83.8	− 58.0	− 37.4	− 20.9	+ 10.0	27.0	−102.1	(15, 114)
Tetramethyltin	$C_4H_{12}Sn$	− 51.3	− 20.6	+ 3.5	22.8	58.5	78.0	......	(62, 420)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Tetramethyldiborane	$C_4H_{14}B_2$	− 59.6	− 27.4	− 3.4	+ 15.3	49.8	68.6	− 72.5	(371)
3-Bromopyridine	C_5H_4BrN	16.8	55.2	84.1	107.8	150.0	173.4	....	(113)
2-Chloropyridine	C_5H_4ClN	13.3	51.7	81.7	104.6	147.7	170.2	....	(113)
2-Furaldehyde	$C_5H_4O_2$	18.5	54.8	82.1	103.4	141.8	161.8	− 36.5	(193, 369, 459)
Citraconic anhydride	$C_5H_4O_3$	47.1	88.9	120.3	145.4	189.8	213.5	....	(11)
Pyridine	C_5H_5N	− 18.9	+ 13.2	38.0	57.8	95.6	115.4	− 42	(11, 181, 199, 203, 204, 443)
Glutaryl chloride	$C_5H_6Cl_2O_2$	56.1	97.8	128.3	151.8	195.3	217.0	....	(11)
Glutaronitrile	$C_5H_6N_2$	91.3	140.0	176.4	205.5	257.3	286.2	....	(11, 234)
Furfuryl alcohol	$C_5H_6O_2$	31.8	68.0	95.7	115.9	151.8	170.0	....	(113, 121)
Glutaric anhydride	$C_5H_6O_3$	100.8	149.5	185.5	212.5	261.0	287.0	....	(11, 234)
Pyrotartaric anhydride	$C_5H_6O_3$	69.7	114.2	147.8	173.8	221.0	247.4	....	(11)
2-Methylthiophene	C_5H_6S	− 27.4	+ 6.0	32.3	53.1	91.8	112.5	− 63.5	(126)
3-Methylthiophene	C_5H_6S	− 24.5	+ 9.1	35.4	55.8	93.8	115.4	− 68.9	(126)
Propyl chloroglyoxylate	$C_5H_7ClO_3$	9.7	43.5	68.8	88.0	123.0	150.0	....	(11)
Tiglonitrile	C_5H_7N	− 25.5	+ 9.2	36.7	58.2	99.7	122.0	....	(113)
Angelonitrile	C_5H_7N	− 8.0	+ 28.0	55.8	77.5	117.7	140.0	....	(113)
α-Ethylacrylonitrile	C_5H_7N	− 29.0	+ 5.0	31.8	53.0	92.2	114.0	....	(113)
Ethyl cyanoacetate	$C_5H_7NO_2$	67.8	106.0	133.8	152.8	187.8	206.0	....	(113)
Isoprene	C_5H_8	− 79.8	− 53.3	− 32.6	− 16.0	+ 15.4	32.6	−146.7	(113, 189)
1,3-Pentadiene	C_5H_8	− 71.8	− 45.0	− 23.4	− 6.7	+ 24.7	42.1	......	(113)
1,4-Pentadiene	C_5H_8	− 83.5	− 57.1	− 37.0	− 20.6	+ 8.3	26.1	......	(244)
Tiglaldehyde	C_5H_8O	− 25.0	+ 10.0	37.0	57.7	95.5	116.4	......	(113)
Levulinaldehyde	$C_5H_8O_2$	28.1	68.0	98.3	121.8	164.0	187.0	....	(158)
Tiglic acid	$C_5H_8O_2$	52.0_s	90.2	119.0	140.5	179.2	198.5	64.5	(11, 113, 220, 257)
α-Valerolactone	$C_5H_8O_2$	37.5	79.8	101.9	136.5	182.3	207.5	....	(11, 377)
α-Ethylacrylic acid	$C_5H_8O_2$	47.0	82.0	108.1	127.5	160.7	179.2	....	(45, 113, 401)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Ethyl acrylate	$C_5H_8O_2$	− 29.5	+ 2.0	26.0	44.5	80.0	99.5	− 71.2	(113)
Methyl methacrylate	$C_5H_8O_2$	− 30.5	+ 1.0	25.5	47.0	82.0	101.0	....	(113)
Levulinic acid	$C_5H_8O_3$	102.0	141.8	169.5	190.2	227.4	245.8d	33.5	(11)
Glutaric acid	$C_5H_8O_4$	155.5	196.0	226.3	247.0	283.5	303.0	97.5	(11, 234)
Dimethyl malonate	$C_5H_8O_4$	35.0	72.0	100.0	121.9	159.8	180.7	− 62	(11)
Ethyl α-chloropropionate	$C_5H_9ClO_2$	+ 6.6	41.9	68.2	89.3	126.2	146.5	....	(11)
Isopropyl chloroacetate	$C_5H_9ClO_2$	+ 3.8	40.2	68.7	90.3	128.0	148.6	....	(297)
Valeronitrile	C_5H_9N	− 6.0	+ 30.0	57.8	78.6	118.7	140.8	....	(159)
α-Hydroxybutyronitrile	C_5H_9NO	41.0	77.8	104.8	125.0	159.8	178.8	....	(113, 169, 170, 442)
1-Pentene	C_5H_{10}	− 80.4	− 54.5	− 34.1	− 17.7	+ 12.8	30.1	....	(6, 113, 359)
2-Methyl-2-butene	C_5H_{10}	− 75.4	− 47.9	− 26.7	− 9.9	+ 21.6	38.5	−133	(244)
2-Methyl-1-butene	C_5H_{10}	− 89.1	− 64.3	− 44.1	− 28.0	+ 2.5	20.2	−135	(290)
Cyclopentane	C_5H_{10}	− 68.0	− 40.4	− 18.6	− 1.3	+ 31.0	49.3	− 93.7	(6, 359, 472)
1,2-Dibromopentane	$C_5H_{10}Br_2$	19.8	58.0	87.4	110.1	151.8	175.0	....	(11)
2-Chloroethyl 2-chloroisopropyl ether	$C_5H_{10}Cl_2O$	24.7	63.0	92.4	115.8	156.5	180.0	....	(113)
2-Chloroethyl 2-chloropropyl ether	$C_5H_{10}Cl_2O$	29.8	70.0	101.5	125.6	169.8	194.1	....	(113)
Di(2-chloroethoxy)methane	$C_5H_{10}Cl_2O_2$	53.0	94.0	125.5	149.6	192.0	215.0	....	(113)
Allyldichloroethylsilane	$C_5H_{10}Cl_2Si$	− 3.0	34.2	62.7	85.2	127.0	150.3	....	(114)
3-Pentanone	$C_5H_{10}O$	− 12.7	+ 17.2	39.4	56.2	86.3	102.7	− 42	(113)
2-Pentanone	$C_5H_{10}O$	− 12.0	+ 17.9	39.8	56.8	86.8	103.3	− 77.8	(113, 491)
3-Methyl-2-butanone	$C_5H_{10}O$	− 19.9	+ 8.3	29.6	45.5	73.8	88.9	− 92	(11, 199, 201)
4-Hydroxy-3-methyl-2-butanone	$C_5H_{10}O_2$	44.6	81.0	108.2	129.0	165.5	185.0	....	(113)
Valeric acid	$C_5H_{10}O_2$	42.2	79.8	107.8	128.3	165.0	184.4	− 34.5	(11, 198, 199, 200, 203, 204)
Isovaleric acid	$C_5H_{10}O_2$	34.5	71.3	98.0	118.9	155.2	175.1	− 37.6	(11, 198, 199, 200, 203)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Ethyl propionate	$C_5H_{10}O_2$	− 28.0	+ 3.4	27.2	45.2	79.8	99.1	− 72.6	(491)
Propyl acetate	$C_5H_{10}O_2$	− 26.7	+ 5.0	28.8	47.8	82.0	101.8	− 92.5	(11, 113, 199, 491)
Isopropyl acetate	$C_5H_{10}O_2$	− 38.3	− 7.2	+ 17.0	35.7	69.8	89.0	....	(152)
Methyl butyrate	$C_5H_{10}O_2$	− 26.8	+ 5.0	29.6	48.0	83.1	102.3	....	(11, 491)
Methyl isobutyrate	$C_5H_{10}O_2$	− 34.1	− 2.9	+ 21.0	39.6	73.6	92.6	− 84.7	(491)
Butyl formate	$C_5H_{10}O_2$	− 26.4	+ 6.1	31.6	51.0	86.2	106.0	....	(297)
Isobutyl formate	$C_5H_{10}O_2$	− 32.7	− 0.8	+ 24.1	43.4	79.0	98.2	− 95.3	(292, 380)
sec-Butyl formate	$C_5H_{10}O_2$	− 34.4	− 3.1	+ 21.3	40.2	75.2	93.6	....	(297)
Diethyl carbonate	$C_5H_{10}O_3$	− 10.1	+ 23.8	49.5	69.7	105.8	125.8	− 43	(11)
1-Bromo-3-methylbutane	$C_5H_{11}Br$	− 20.4	+ 13.6	39.8	60.4	99.4	120.4	....	(199, 201)
1-Iodo-3-methylbutane	$C_5H_{11}I$	− 2.5	+ 34.1	62.3	84.4	125.8	148.2	....	(11)
Piperidine	$C_5H_{11}N$	s	+ 3.9	29.2	49.0	85.7	106.0	− 9	(11, 199, 201)
Isobutyl carbamate	$C_5H_{11}NO_2$	s	96.4	125.3	147.2	186.0	206.5	65	(11)
Isoamyl nitrate	$C_5H_{11}NO_3$	+ 5.2	40.3	67.6	88.6	126.5	147.5	....	(11)
Pentane	C_5H_{12}	− 76.6	− 50.1	− 29.2	− 12.6	+ 18.5	36.1	−129.7	(6, 28, 93, 274, 359, 482, 485)
2-Methylbutane	C_5H_{12}	− 82.9	− 57.0	− 36.5	− 20.2	+ 10.5	27.8	−159.7	(6, 93, 359, 485, 486, 492)
2,2-Dimethylpropane	C_5H_{12}	−102.0	− 76.7$_s$	− 56.1$_s$	− 39.1$_s$	− 7.1	+ 9.5	− 16.6	(6, 17, 113, 253, 359, 465)
Amyl alcohol	$C_5H_{12}O$	+ 13.6	44.9	68.0	85.8	119.8	137.8	....	(68, 148)
Isoamyl alcohol	$C_5H_{12}O$	+ 10.0	40.8	63.4	80.7	113.7	130.6	−117.2	(11, 68, 199, 3)
2-Pentanol	$C_5H_{12}O$	+ 1.5	32.2	54.1	70.7	102.3	119.7	....	(68)
tert-Amyl alcohol	$C_5H_{12}O$	− 12.9$_s$	+ 17.2	38.8	55.3	85.7	101.7	− 11.9	(11, 68)
Ethyl propyl ether	$C_5H_{12}O$	− 64.3	− 35.0	− 12.0	+ 6.8	41.6	61.7	....	(39)
2,3,4-Pentanetriol	$C_5H_{12}O_3$	155.0	204.5	239.6	263.5	307.0	327.2	....	(113)
Ethoxytrimethylsilane	$C_5H_{14}OSi$	− 50.9	− 20.7	+ 3.7	22.1	56.3	75.7	....	(114)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Ethyltrimethylsilane	$C_5H_{14}Si$	− 60.6	− 31.8	− 9.0	+ 9.2	42.8	62.0	....	(466)
Ethyltrimethyltin	$C_5H_{14}Sn$	− 30.0	+ 3.8	30.0	50.0	87.6	108.8	....	(62)
Chloranil	$C_6Cl_4O_2$	70.7$_s$	97.8$_s$	116.1$_s$	129.5$_s$	151.3$_s$	162.6$_s$	290	(92)
Hexachlorobenzene	C_6Cl_6	114.4$_s$	166.4$_s$	206.0$_s$	235.5	283.5	309.4	230	(113)
Pentachlorobenzene	C_6HCl_5	98.6	144.3	178.5	205.5	251.6	276.0	85.5	(113)
Pentachlorophenol	C_6HCl_5O	s	s	211.2	239.6	285.0	309.3$_d$	188.5	(113)
3-Bromo-2,4,6-trichlorophenol	$C_6H_2BrCl_3O$	112.4	163.2	200.5	229.3	278.0	305.8	....	(113)
1,2,3,4-Tetrachlorobenzene	$C_6H_2Cl_4$	68.5	114.7	149.2	175.7	225.5	254.0	46.5	(113)
1,2,3,5-Tetrachlorobenzene	$C_6H_2Cl_4$	58.2	104.1	140.0	168.0	220.0	246.0	54.5	(113)
1,2,4,5-Tetrachlorobenzene	$C_6H_2Cl_4$	s	s	146.0	173.5	220.5	245.0	139	(113)
2,3,4,6-Tetrachlorophenol	$C_6H_2Cl_4O$	100.0	145.3	179.1	205.2	250.4	275.0	69.5	(113)
2-Bromo-4,6-dichlorophenol	$C_6H_3BrCl_2O$	84.0	130.8	165.8	193.2	242.0	268.0	68	(113)
1,2,3-Trichlorobenzene	$C_6H_3Cl_3$	40.0$_s$	85.6	119.8	146.0	193.5	218.5	52.5	(113)
1,2,4-Trichlorobenzene	$C_6H_3Cl_3$	38.4	81.7	114.8	140.0	187.7	213.0	17	(113)
1,3,5-Trichlorobenzene	$C_6H_3Cl_3$	s	78.0	110.8	136.0	183.0	208.4	63.5	(113)
2,4,5-Trichlorophenol	$C_6H_3Cl_3O$	72.0	117.3	151.5	178.0	226.5	251.8	62	(113)
2,4,6-Trichlorophenol	$C_6H_3Cl_3O$	76.5	120.2	152.2	177.8	222.5	246.0	68.5	(113)
1,4-Dibromobenzene	$C_6H_4Br_2$	61.0$_s$	87.7	120.8	146.5	192.5	218.6	87.5	(11, 113, 243)
1,4-Bromochlorobenzene	C_6H_4BrCl	32.0	72.7	103.8	128.0	172.6	196.9	....	(113)
1,2-Dichlorobenzene	$C_6H_4Cl_2$	20.0	59.1	89.4	112.9	155.8	179.0	− 17.6	(113)
1,3-Dichlorobenzene	$C_6H_4Cl_2$	12.1	52.0	82.0	105.0	149.0	173.0	− 24.2	(113)
1,4-Dichlorobenzene	$C_6H_4Cl_2$	s	54.8	84.8	108.4	150.2	173.9	53.0	(113)
2,4-Dichlorophenol	$C_6H_4Cl_2O$	53.0	92.8	123.4	146.0	187.5	210.0	45.0	(113)
2,6-Dichlorophenol	$C_6H_4Cl_2O$	59.5	101.0	131.6	154.6	197.7	220.0	....	(113)
2,4,6-Trichloroaniline	$C_6H_4Cl_3N$	134.0	170.0	195.8	214.6	246.4	262.0	78	(11)
Dichlorophenylarsine	$C_6H_5AsCl_2$	61.8	116.0	151.0	178.9	228.8	256.5	....	(113)
Bromobenzene	C_6H_5Br	+ 2.9	40.0	68.6	90.8	132.3	156.2	− 30.7	(11, 199, 204, 289, 358, 478)
Chlorobenzene	C_6H_5Cl	− 13.0	+ 22.2	49.7	70.7	110.0	132.2	− 45.2	(11, 199, 289, 478)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
2-Chlorophenol	C_6H_5ClO	12.1	51.2	82.0	106.0	149.8	174.5	7.0	(113)
3-Chlorophenol	C_6H_5ClO	44.2	86.1	118.0	143.0	188.7	214.0	32.5	(113)
4-Chlorophenol	C_6H_5ClO	49.8	92.2	125.0	150.0	196.0	220.0	42	(113)
Benzenesulfonylchloride	$C_6H_5ClO_2S$	65.9	112.0	147.7	174.5	224.0	251.5_d	14.5	(11, 235)
Phenyl dichlorophosphate	$C_6H_5Cl_2O_2P$	66.7	110.0	143.4	168.0	213.0	239.5	....	(11, 113)
Trichlorophenylsilane	$C_6H_5Cl_3Si$	33.0	74.2	105.8	130.5	175.7	201.0	....	(114)
Fluorobenzene	C_6H_5F	-43.4_s	−12.4	+11.5	30.4	65.7	84.7	−42.1	(113, 416, 478)
Trifluorophenylsilane	$C_6H_5F_3Si$	−31.0	+0.8	25.4	44.2	78.7	98.3	....	(119)
Iodobenzene	C_6H_5I	24.1	64.0	94.4	118.3	163.9	188.6	−28.5	(115, 289, 358, 478)
Nitrobenzene	$C_6H_5NO_2$	44.4	84.9	115.4	139.9	185.8	210.6	+5.7	(11, 58, 199, 204)
2-Nitrophenol	$C_6H_5NO_3$	49.3	90.4	122.1	146.4	191.0	214.5	45	(11)
1,5-Hexadiene-3-yne	C_6H_6	−45.1	−14.0	+10.0	29.5	64.4	84.0	....	(304)
Benzene	C_6H_6	−36.7	-11.5_s	+7.6	26.1	60.6	80.1	+5.5	(3, 6, 11, 32, 109, 131, 197, 204, 289, 343, 359, 366, 367, 392, 415, 478)
2-Chloroaniline	C_6H_6ClN	46.3	84.8	115.6	139.5	183.7	208.8	....	(204)
3-Chloroaniline	C_6H_6ClN	63.5	102.0	133.6	158.0	203.5	228.5	−10.4	(204)
4-Chloroaniline	C_6H_6ClN	59.3_s	102.1	135.0	159.9	206.6	230.5	70.5	(11)
4-Chlorophenol	C_6H_6ClO	54.3	95.8	126.8	150.6	194.3	217.0	42	(11)
2-Nitroaniline	$C_6H_6N_2O_2$	104.0	150.4	186.0	213.0	260.0	284.5_d	71.5	(35)
3-Nitroaniline	$C_6H_6N_2O_2$	119.3	167.8	204.2	232.1	280.2	305.7_d	114	(35)
4-Nitroaniline	$C_6H_6N_2O_2$	142.4_s	194.4	234.2	261.8	310.2_d	336.0_d	146.5	(35)
Phenol	C_6H_6O	40.1_s	73.8	100.1	121.4	160.0	181.9	40.6	(11, 34, 113, 151, 174, 203, 204)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Pyrocatechol	$C_6H_6O_2$	s	118.3	150.6	176.0	221.5	245.5	105	(11)
Resorcinol	$C_6H_6O_2$	108.4s	152.1	185.3	209.8	253.4	276.5	110.7	(11)
Hydroquinone	$C_6H_6O_2$	132.4s	163.5s	192.0	216.5	262.5	286.2	170.3	(404)
Pyrogallol	$C_6H_6O_3$	s	167.7	204.2	232.0	281.5	309.0d	133	(11)
Benzenethiol	C_6H_6S	18.6	56.0	84.2	106.6	146.7	168.0	....	(11)
Aniline	C_6H_7N	34.8	69.4	96.7	119.9	161.9	184.4	− 6.2	(11, 34, 143, 151, 204, 341)
2-Picoline	C_6H_7N	− 11.1	+ 24.4	51.2	71.4	108.4	128.8	− 70	(11, 199)
Ethylene-bis-(chloroacetate)	$C_6H_8Cl_2O_4$	112.0	158.0	191.0	215.0	259.5	283.5	....	(113)
1,3-Phenylenediamine	$C_6H_8N_2$	99.8	147.0	182.5	209.9	259.0	285.5	62.8	(11)
Phenylhydrazine	$C_6H_8N_2$	71.8	115.8	148.2	173.5	218.2	243.5d	19.5	(11, 113)
Hexamethyldisiloxane	$C_6H\,OSi_2$	− 29.0	+ 2.8	26.7	45.6	80.0	99.2	....	(114)
α-Methylglutaric anhydride	$C_6H\,O_3$	93.8	141.8	177.5	205.0	255.5	282.5	....	(11)
α,α-Dimethylsuccinic anhydride	$C_6H_8O_3$	61.4	102.0	132.3	155.3	197.5	219.5	....	(11)
Dimethyl maleate	$C_6H_8O_4$	45.7	86.4	117.2	140.3	182.2	205.0	....	(11)
Isobutyl dichloroacetate	$C_6H_{10}Cl_2O_2$	28.6	67.5	96.7	119.8	160.0	183.0	....	(11)
Diallyldichlorosilane	$C_6H_{10}Cl_2Si$	+ 9.5	47.4	76.4	99.7	142.0	165.3	....	(114)
Cyclohexanone	$C_6H_{10}O$	+ 1.4	38.7	67.8	90.4	132.5	155.6	− 45.0	(440)
Mesityl oxide	$C_6H_{10}O$	− 8.7	+ 26.0	51.7	72.1	109.8	130.0	− 59	(11, 199)
Isocaprolactone	$C_6H_{10}O_2$	38.3	80.3	112.3	137.2	182.1	207.0	....	(11)
Propionic anhydride	$C_6H_{10}O_3$	20.6	57.7	85.6	107.2	146.0	167.0	− 45	(11, 198, 199)
Ethyl acetoacetate	$C_6H_{10}O_3$	28.5	67.3	96.2	118.5	158.2	180.8	− 45	(11, 199)
Methyl levulinate	$C_6H_{10}O_3$	39.8	79.7	109.5	133.0	175.8	197.7	....	(376)
Adipic acid	$C_6H_{10}O_4$	159.5	205.5	240.5	265.0	312.5	337.5	152	(11, 234)
Diethyl oxalate	$C_6H_{10}O_4$	47.4	83.8	110.6	130.8	166.2	185.7	− 40.6	(11, 199, 201)
Glycol diacetate	$C_6H_{10}O_4$	38.3	77.1	106.1	128.0	168.3	190.5	− 31	(423)
Dimethyl-*l*-malate	$C_6H_{10}O_5$	75.4	118.3	150.1	175.1	219.5	242.6	....	(11)
Dimethyl-*d*-tartrate	$C_6H_{10}O_6$	102.1	148.2	182.4	208.8	255.0	280.0	61.5	(11, 149)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Dimethyl-*dl*-tartrate	$C_6H_{10}O_6$	100.4	147.5	182.4	209.5	257.4	282.0	89	(11, 149)
Diallyl sulfide	$C_6H_{10}S$	− 9.5	+ 26.6	54.2	75.8	116.1	138.6	− 83	(11, 25)
Ethyl α-bromoisobutyrate	$C_6H_{11}BrO_2$	10.6	48.0	77.0	99.8	141.2	163.6	....	(11)
sec-Butyl chloroacetate	$C_6H_{11}ClO_2$	17.0	54.6	83.6	105.5	146.0	167.8	....	(297)
Capronitrile	$C_6H_{11}N$	+ 9.2	47.5	76.9	99.8	141.0	163.7	....	(159)
1-Hexene	C_6H_{12}	− 57.5	− 28.1	− 5.0	+ 13.0	46.8	66.0	− 98.5	(474)
Cyclohexane	C_6H_{12}	− 45.3$_s$	− 15.9$_s$	+ 6.7	25.5	60.8	80.7	+ 6.6	(6, 109, 293, 359, 367, 487)
Methylcyclopentane	C_6H_{12}	− 53.7	− 23.7	− 0.6	+ 17.9	52.3	71.8	−142.4	(6, 359, 471)
Dichlorodiisopropyl ether	$C_6H_{12}Cl_2O$	29.6	68.2	97.3	119.7	159.8	182.7	....	(113)
Bis-2-chloroethyl acetal	$C_6H_{12}Cl_2O_2$	56.2	97.6	127.8	150.7	190.5	212.6	....	(113)
2-Hexanone	$C_6H_{12}O$	+ 7.7	38.8	62.0	79.8	111.0	127.5	− 56.9	(113)
4-Methyl-2-pentanone	$C_6H_{12}O$	− 1.4	+ 30.0	52.8	70.4	102.0	119.0	− 84.7	(113)
Allyl propyl ether	$C_6H_{12}O$	− 39.0	− 7.9	+ 16.4	35.8	71.4	90.5	....	(254)
Allyl isopropyl ether	$C_6H_{12}O$	− 43.7	− 12.9	+ 10.9	29.0	61.7	79.5	....	(254)
Cyclohexanol	$C_6H_{12}O$	21.0$_s$	56.0	83.0	103.7	141.4	161.0	23.9	(113)
Caproic acid	$C_6H_{12}O_2$	71.4	99.5	125.0	144.0	181.0	202.0	− 1.5	(11, 203)
Isocaproic acid	$C_6H_{12}O_2$	66.2	94.0	120.4	141.4	181.0	207.7	− 35	(11, 203, 204)
4-Hydroxy-4-methyl-2-pentanone	$C_6H_{12}O_2$	22.0	58.8	86.7	108.2	147.5	167.9	− 47	(113)
Methyl isovalerate	$C_6H_{12}O_2$	− 19.2	+ 14.0	39.8	59.8	96.7	116.7	....	(380)
Ethyl butyrate	$C_6H_{12}O_2$	− 18.4	+ 15.3	41.5	62.0	100.0	121.0	− 93.3	(380)
Ethyl isobutyrate	$C_6H_{12}O_2$	− 24.3	+ 8.4	33.8	53.5	90.0	110.1	− 88.2	(292, 380)
Propyl propionate	$C_6H_{12}O_2$	− 14.2	+ 19.4	45.0	65.2	102.0	122.4	− 76	(11, 380)
Isobutyl acetate	$C_6H_{12}O_2$	− 21.2	+ 12.8	39.2	59.7	97.5	118.0	− 98.9	(11, 199, 292, 380)
Isoamyl formate	$C_6H_{12}O_2$	− 17.5	+ 17.1	44.0	65.4	102.7	123.3	....	(380)
Paraformaldehyde	$C_6H_{12}O_3$	− 9.4$_s$	+ 24.1$_s$	49.5$_s$	69.0$_s$	104.3$_s$	124.0$_s$	155 ± 5	(11)
sec-Butyl glycolate	$C_6H_{12}O_3$	28.3	66.0	94.2	116.4	155.6	177.5	....	(113)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Hexane	C_6H_{14}	- 53.9	- 25.0	- 2.3	+ 15.8	49.6	68.7	- 95.3	(6, 115, 251, 289, 359, 394, 427, 474)
2-Methylpentane	C_6H_{14}	- 60.9	- 32.1	- 9.7	+ 8.1	41.6	60.3	-154	(6, 21, 359, 471)
3-Methylpentane	C_6H_{14}	- 59.0	- 30.1	- 7.3	+ 10.5	44.2	63.3	-118	(6, 359, 471)
2,2-Dimethylbutane	C_6H_{14}	- 69.3	- 41.5	- 19.5	- 2.0	+ 31.0	49.7	- 99.8	(6, 21, 359, 471)
2,3-Dimethylbutane	C_6H_{14}	- 63.6	- 34.9	- 12.4	+ 5.4	39.0	58.0	-128.2	(6, 359, 471, 488)
1-Hexanol	$C_6H_{14}O$	24.4	58.2	83.7	102.8	138.8	157.0	- 51.6	(68, 185, 380)
2-Hexanol	$C_6H_{14}O$	14.6	45.0	67.9	87.3	121.8	139.9	....	(185)
3-Hexanol	$C_6H_{14}O$	+ 2.5	36.7	62.2	81.8	117.0	135.5	....	(185)
2-Methyl-1-pentanol	$C_6H_{14}O$	15.4	49.6	74.7	94.2	129.8	147.9	....	(184a, 185)
2-Methyl-2-pentanol	$C_6H_{14}O$	- 4.5	+ 27.6	51.3	69.2	102.6	121.1	-103	(185)
2-Methyl-4-pentanol	$C_6H_{14}O$	- 0.3	+ 33.3	58.2	78.0	113.5	131.7	....	(185)
Dipropyl ether	$C_6H_{14}O$	- 43.3	- 11.8	+ 13.2	33.0	69.5	89.5	-122	(113)
Diisopropyl ether	$C_6H_{14}O$	- 57.0	- 27.4	- 4.5	+ 13.7	48.2	67.5	- 60	(133)
Acetal	$C_6H_{14}O_2$	- 23.0	+ 8.0	31.9	50.1	84.0	102.0	....	(11, 199)
1,2-Diethoxyethane	$C_6H_{14}O_2$	- 33.5	+ 1.6	29.7	51.8	94.1	119.5	....	(254)
Di(2-methoxyethyl) ether	$C_6H_{14}O_3$	13.0	50.0	77.5	99.5	138.5	159.8	....	(141)
Diethylene glycol, ethyl ether	$C_6H_{14}O_3$	45.3	85.8	116.7	140.3	180.3	201.9	....	(113)
Dipropyleneglycol	$C_6H_{14}O_3$	73.8	116.2	147.4	169.9	210.5	231.8	....	(71, 113)
Triethyleneglycol	$C_6H_{14}O_4$	114.0	158.1	191.3	214.6	256.6	278.3	....	(71, 141)
Triethylboron	$C_6H_{15}B$	....	-148.0	-131.4	-116.0	- 81.0	- 56.2	....	(413)
Chlorotriethylsilane	$C_6H_{15}ClSi$	- 4.9	+ 32.0	60.2	82.3	123.6	146.3	....	(114)
Triethyl phosphate	$C_6H_{15}O_4P$	39.6	82.1	115.7	141.6	187.0	211.0	....	(76)
Triethylthallium	$C_6H_{15}Tl$	+ 9.3	51.7	85.4	112.1	163.5	192.1d	- 63.0	(357)

ORGANIC COMPOUNDS (Continued
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Diethoxydimethylsilane	$C_6H_{16}O_2Si$	− 19.1	+ 13.3	38.0	57.6	93.2	113.5	....	(114)
Trimethylpropylsilane	$C_6H_{16}Si$	− 46.0	− 13.9	+ 11.3	31.6	69.2	90.0	....	(466)
Trimethylpropyltin	$C_6H_{16}Sn$	− 12.0	+ 21.8	48.5	69.8	109.6	131.7	....	(62)
1,5-Dichlorohexamethyltrisiloxane	$C_6H_{18}Cl_2O_2Si_3$	26.0	65.1	94.8	118.2	160 2	184.0	− 53	(312)
Hexamethylcyclotrisiloxane	$C_6H_{18}O_3Si_3$	s	s	s	78.7	114.7	134.0	64	(188, 312)
3,4-Dichloro-α,α,α-trifluorotoluene	$C_7H_3Cl_2F_3$	11.0	52.2	84 0	109.2	150.5	172.8	− 12.1	(113)
2-Chloro-α,α,α-trifluorotoluene	$C_7H_4ClF_3$	0.0	37.1	65.9	88.3	130.0	152.2	− 6.0	(113)
2-α,α,α-tetrachlorotoluene	$C_7H_4Cl_4$	69.0	117.9	155.0	185.0	233.0	262.1	28.7	(113)
Benzoyl bromide	C_7H_5BrO	47.0	89.8	122.6	147.7	193.7	218.5	0	(11)
Benzoyl chloride	C_7H_5ClO	32.1	73.0	103.8	128.0	172.8	197.2	− 0.5	(11, 203, 204)
α,α,α-Trichlorotoluene	$C_7H_5Cl_3$	45.8	87.6	119.8	144.3	189.2	213.5	− 21.2	(11)
α,α,α-Trifluorotoluene	$C_7H_5F_3$	− 32.0_s	+ 0.4	25.7	45.3	82.0	102.2	− 29.3	(113)
Benzonitrile	C_7H_5N	28.2	69.2	99.6	123.5	166.7	190.6	− 12.9	(113, 204)
Phenyl isocyanide	C_7H_5N	12.0	49.7	78.3	101.0	142.3	165.0_d	....	(11, 235)
Phenyl isocyanate	C_7H_5NO	10.6	48.5	77.7	100.6	142.7	165.6	....	(113)
2-Nitrobenzaldehyde	$C_7H_5NO_3$	85.8	133.4	168.8	196.2	246.8	273.5	40.9	(11)
3-Nitrobenzaldehyde	$C_7H_5NO_3$	96.2	142.8	177.7	204.3	252.1	278.3	58	(11)
Phenyl isothiocyanate	C_7H_5NS	47.2	89.8	122.5	147.7	194.0	218.5	− 21.0	(11, 25, 198, 199)
α,α-dichlorotoluene	$C_7H_6Cl_2$	35.4	78 7	112.1	138.3	187.0	214.0	− 16.1	(11)
Benzaldehyde	C_7H_6O	26.2	62.0	90.1	112.5	154.1	179.0	− 26	(11, 199, 204)
Benzoic acid	$C_7H_6O_2$	96.0_s	132.1	162.6	186.2	227.0	249.2	121.7	(11, 189, 204, 218, 303)
Salicylaldehyde	$C_7H_6O_2$	33.0	73.8	105.2	129.4	173.7	196.5	− 7	(113)
4-Hydroxybenzaldehyde	$C_7H_6O_2$	121.2	169.7	206.0	233.5	282.6	310.0	115.5	(11)
Salicylic acid	$C_7H_6O_3$	113.7_s	146.2_s	172.2	193.4	230.5	256.0	159	(404)
α-Bromotoluene	C_7H_7Br	32.2	73.4	104.8	129.8	175.2	198.5	− 4	(11)
2-Bromotoluene	C_7H_7Br	24.4	62.3	91.0	112.0	157.3	181.8	− 28	(128, 201, 415)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
3-Bromotoluene	C_7H_7Br	14.8	64.0	93.9	117.8	160.0	183.7	− 39.8	(128, 415)
4-Bromotoluene	C_7H_7Br	10.3	61.1	91.8	116.4	160.2	184.5	28.5	(11, 113, 199, 128)
4-Bromoanisole	C_7H_7BrO	48.8	91.9	125.0	150.1	197.5	223.0	12.5	(11)
α-Chlorotoluene	C_7H_7Cl	22.0	60.8	90.7	114.2	155.8	179.4	− 39	(11, 199, 201)
2-Chlorotoluene	C_7H_7Cl	+ 5.4	43.2	72.0	94.7	137.1	159.3	....	(11, 113, 128, 415)
3-Chlorotoluene	C_7H_7Cl	+ 4.8	43.2	73.0	96.3	139.7	162.3	....	(128, 415)
4-Chlorotoluene	C_7H_7Cl	+ 5.5	43.8	73.5	96.6	139.8	162.3	+ 7.3	(11, 113, 128, 199, 415)
2-Fluorotoluene	C_7H_7F	− 24.2	+ 8.9	34.7	55.3	92.8	114.0	− 80	(113)
3-Fluorotoluene	C_7H_7F	− 22.4	+ 11.0	37.0	57.5	95.4	116.0	−110.8	(113)
4-Fluorotoluene	C_7H_7F	− 21.8	+ 11.8	37.8	58.1	96.1	117.0	....	(113)
2-Iodotoluene	C_7H_7I	37.2	79.8	112.4	138.1	185.7	211.0	....	(11)
2-Nitrotoluene	$C_7H_7NO_2$	50.0	93.8	126.3	151.5	197.7	222.3	− 4.1	(11, 36, 204, 302)
3-Nitrotoluene	$C_7H_7NO_2$	50.2	96.0	130.7	156.9	206.8	231.9	15.1	(36, 302)
4-Nitrotoluene	$C_7H_7NO_2$	53.7	100.5	136.0	163.0	212.5	238.3	51.9	(11, 36, 204)
Toluene	C_7H_8	− 26.7	+ 6.4	31.8	51.9	89.5	110.6	− 95.0	(6, 11, 24, 107, 115, 199, 204, 239, 253, 359)
Benzyldichlorosilane	$C_7H_8Cl_2Si$	45.3	83.2	111.8	133.5	173.0	194.3	....	(114)
Dichloromethylphenylsilane	$C_7H_8Cl_2Si$	35.7	77.4	109.5	134.2	180.2	205.5	....	(114)
Dichloro-4-tolysilane	$C_7H_8Cl_2Si$	46.2	84.2	113.2	135.5	175.2	196.3	....	(114)
Anisole	C_7H_8O	+ 5.4	42.2	70.7	93.0	133.8	155.5	− 37.3	(11)
Benzyl alcohol	C_7H_8O	58.0	92.6	119.8	141.7	183.0	204.7	− 15.3	(11, 204)
2-Cresol	C_7H_8O	38.2	76.7	105.8	127.4	168.4	190 8	30.8	(11, 204, 406)
3-Cresol	C_7H_8O	52.0	87.8	116 0	138.0	179.0	202.8	10.9	(11, 204, 406)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
4-Cresol	C_7H_8O	53.0	88.6	117.7	140.0	179.4	201.8	35.5	(11, 204, 406)
3,5-Dimethyl-1,2-pyrone	$C_7H_8O_2$	78.6	122.0	152.7	177.5	221.0	245.0	51.5	(11)
2-Methoxyphenol	$C_7H_8O_2$	52.4	92.0	121.6	144.0	184.1	205.0	28.3	(11)
Ethyl 2-furoate	$C_7H_8O_3$	37.6	77.1	107.5	130.4	172.5	195.0	34	(11)
Benzylamine	C_7H_9N	29.0	67.7	97.3	120.0	161.3	184.5	....	(11)
N-Methylaniline	C_7H_9N	36.0	76.2	106.0	129.8	172.0	195.5	− 57	(11, 204, 300)
2-Toluidine	C_7H_9N	44.0	81.4	110.0	133.0	176.2	199.7	− 16.3	(11, 37, 204)
3-Toluidine	C_7H_9N	41.0	82.0	113.5	136.7	180.6	203.3	− 31.5	(11, 37, 204)
4-Toluidine	C_7H_9N	42.0	81.8	111.5	133.7	176.9	200.4	44.5	(11, 37, 204)
2-Methoxyaniline	C_7H_9NO	61.0	101.7	132.0	155.2	197.3	218.5	5.2	(11)
Toluene-2,4-diamine	$C_7H_{10}N_2$	106.5	151.7	185.7	211.5	256.0	280.0	99	(11)
4-Tolylhydrazine	$C_7H_{10}N_2$	82.0	123.8	154.1	178.0	219.5	242.0d	65.5	(11)
Trimethysuccinic anhydride	$C_7H_{10}O_3$	53.5	97.4	131.0	156.5	205.5	231.0	.....	(11)
Dimethyl citraconate	$C_7H_{10}O_4$	50.8	91.8	122.6	145.8	188.0	210.5	.....	(11)
Dimethyl itaconate	$C_7H_{10}O_4$	69.3	106.6	133.7	153.7	189.8	208.0	38	(11)
trans-Dimethyl mesaconate	$C_7H_{10}O_4$	46.8	87.8	118.0	141.5	183.5	206.0	.....	(11)
2-Cyano-2-butyl acetate	$C_7H_{11}NO_2$	42.0	82.0	111.8	133.8	173.4	195.2	.....	(113, 170)
Butyl acrylate	$C_7H_{12}O_2$	− 0.5	+ 35.5	63.4	85.1	125.2	147.4	− 64.6	(113)
Ethyl levulinate	$C_7H_{12}O_3$	47.3	87.3	117.7	141.3	183.0	206.2	.....	(376)
Pimelic acid	$C_7H_{12}O_4$	163.4	212.0	247.0	272.0	318.5	342.1	103	(11, 234)
Diethyl malonate	$C_7H_{12}O_4$	40.0	81.3	113.3	136.2	176.8	198.9	− 49.8	(11, 180)
Enanthyl chloride	$C_7H_{13}ClO$	34.2	64.6	86.4	102.7	130.7	145.0	......	(11, 229)
Enanthonitrile	$C_7H_{13}N$	21.0	61.6	92.6	116.8	160.0	184.6	....	(159)
Ethylcyclopentane	C_7H_{14}	− 32.2	− 0.1	+ 25.0	45.0	82.3	103.4	−138.6	(6, 359, 471)
Methylcyclohexane	C_7H_{14}	− 35.9	− 3.2	+ 22.0	42.1	79.6	100.9	−126.4	(6, 253, 359, 415, 471)
2-Heptene	C_7H_{14}	− 35.8	− 3.5	+ 21.5	41.3	78.1	98.5	....	(446)
Enanthaldehyde	$C_7H_{14}O$	12.0	43.0	66.3	84.0	125.5	155.0	− 42	(11, 199, 203, 204)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
2-Heptanone	$C_7H_{14}O$	19.3	55.5	81.2	100.0	133.2	150.2	....	(415)
4-Heptanone	$C_7H_{14}O$	23.0	55.0	78.1	96.0	127.3	143.7	− 32.6	(11)
2,4-Dimethyl-3-pentanone	$C_7H_{14}O$	+ 5.2	36.7	59.6	77.0	108.0	123.7	....	(113)
Enanthic acid	$C_7H_{14}O_2$	78.0	113.2	139.5	160.0	199.6	221.5	− 10	(11, 203, 204)
Methyl caproate	$C_7H_{14}O_2$	+ 5.0	42.0	70.0	91.4	129.8	150.0_d	....	(2)
Ethyl isovalerate	$C_7H_{14}O_2$	− 6.1	+ 28.7	55.2	75.9	114.0	134.3	− 99.3	(11, 380)
Propyl butyrate	$C_7H_{14}O_2$	− 1.6	+ 34.0	61.5	82.6	121.7	142.7	− 95.2	(11, 380)
Propyl isobutyrate	$C_7H_{14}O_2$	− 6.2	+ 28.3	54.3	73.9	112.0	133.9	....	(380)
Isopropyl isobutyrate	$C_7H_{14}O_2$	− 16.3	+ 17.0	42.4	62.3	100.0	120.5	....	(489)
Isobutyl propionate	$C_7H_{14}O_2$	− 2.3	+ 32.3	58.5	79.5	116.4	136.8	− 71	(380)
Isoamyl acetate	$C_7H_{14}O_2$	0.0	+ 35.2	62.1	83.2	121.5	142.0	....	(11)
Heptane	C_7H_{16}	− 34.0	− 2.1	+ 22.3	41.8	78.0	98.4	− 90.6	(6, 251, 269, 289, 359, 394, 483)
2-Methylhexane	C_7H_{16}	− 40.4	− 9.1	+ 14.9	34.1	69.8	90.0	−118.2	(6, 359, 471)
3-Methylhexane	C_7H_{16}	− 39.0	− 7.8	+ 16.4	35.6	71.6	91.9	−119.4	(6, 359, 471)
3-Ethylpentane	C_7H_{16}	− 37.8	− 6.8	+ 17.5	36.9	73.0	93.5	−118.6	(6, 359, 471)
2,2-Dimethylpentane	C_7H_{16}	− 49.0	− 18.7	+ 5.0	23.9	59.2	79.2	−123.7	(6, 359, 471)
2,3-Dimethylpentane	C_7H_{16}	− 42.0	− 10.3	+ 13.9	33.3	69.4	89.8	−135	(6, 359, 471)
2,4-Dimethylpentane	C_7H_{16}	− 48.0	− 17.1	+ 6.5	25.4	60.6	80.5	−119.5	(6, 359, 471)
3,3-Dimethylpentane	C_7H_{16}	− 45.9	− 14.4	+ 9.9	29.3	65.5	86.1	−135.0	(6, 359, 471)
2,2,3-Trimethylbutane	C_7H_{16}	s	− 18.8	+ 5.2	24.4	60.4	80.9	− 25.0	(6, 359, 471)
1-Heptanol	$C_7H_{16}O$	42.4	74.7	99.8	119.5	155.6	175.8	34.6	(11, 68)
Triethyl orthoformate	$C_7H_{16}O_3$	+ 5.5	40.5	67.5	88.0	125.7	146.0	....	(11)
Triethoxymethylsilane	$C_7H_{18}O_3Si$	− 1.5	+ 34.6	61.7	82.7	121.8	143.5	....	(114)
Butyltrimethylsilane	$C_7H_{18}Si$	− 23.4	+ 9.9	35.9	56.3	93.8	115.0	....	(466)
Triethylmethylsilane	$C_7H_{18}Si$	− 18.2	+ 16.6	44.0	65.6	105.3	127.0	....	(466)
Phthaloyl chloride	$C_8H_4Cl_2O_2$	86.3_s	134.2	170.0	197.8	248.3	275.8	88.5	(11)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Phthalic anhydride	$C_8H_4O_3$	96.5_s	134.0	172.0	202.3	256.8	284.5	130.8	(97, 189, 284)
α,α-Dichlorophenylacetonitrile	$C_8H_5Cl_2N$	56.0	98.1	130.0	154.5	199.5	223.5	....	(11)
Pentachloroethylbenzene	$C_8H_5Cl_5$	96.2	148.0	186.2	216.0	269.3	299.0	....	(113)
Phenylglyoxylonitrile	C_8H_5NO	44.5	85.5	116.6	141.0	185.0	208.0	33.5	(11)
2,3-Dichlorostyrene	$C_8H_6Cl_2$	61.0	104.6	137.8	163.5	210.0_p	235.0_p	....	(113, 276)
2,4-Dichlorostyrene	$C_8H_6Cl_2$	53.5	97.4	129.2	153.8	200.0_p	225.0_p	....	(113, 276)
2,5-Dichlorostyrene	$C_8H_6Cl_2$	55.5	98.2	131.0	155.8	202.5_p	227.0_p	....	(113, 276)
2,6-Dichlorostyrene	$C_8H_6Cl_2$	47.8	90.0	122.4	147.6	193.5_p	217.0_p	....	(113, 276)
3,4-Dichlorostyrene	$C_8H_6Cl_2$	57.2	100.4	133.7	158.2	205.7_p	230.0_p	....	(113, 276)
3,5-Dichlorostyrene	$C_8H_6Cl_2$	53.5	97.4	129.2	153.8	200.0_p	225.0_p	....	(113, 276)
3,4,5,6-Tetrachloro-1,2-xylene	$C_8H_6Cl_4$	94.4	140.3	174.2	200.5	248.3	273.5	....	(11)
1,2,3,5-Tetrachloro-4-ethylbenzene	$C_8H_6Cl_4$	77.0	126.0	162.1	191.6	243.0	270.0	....	(113)
Phenylglyoxal	$C_8H_6O_2$	s	87.8	115.5	136.2	173.5	193.5	73	(354)
Phthalide	$C_8H_6O_2$	95.5	144.0	181.0	210.0	261.8	290.0	73	(11)
Piperonal	$C_8H_6O_3$	87.0	132.0	165.7	191.7	238.5	263.0	37	(11)
3-Chlorostyrene	C_8H_7Cl	25.3	65.2	96.5	121.2	165.7_p	190.0_p	....	(113)
4-Chlorostyrene	C_8H_7Cl	28.0	67.5	98.0	122.0	166.0_p	191.0_p	− 15.0	(113)
Phenylacetyl chloride	C_8H_7ClO	48.0	89.0	119.8	143.5	186.0	210.0	....	(11)
2-Tolunitrile	C_8H_7N	36.7	77.9	110.0	135.0	180.0	205.2	− 13	(11)
4-Tolunitrile	C_8H_7N	42.5	85.8	109.5	145.2	193.0	217.6	29.5	(11)
Phenylacetonitrile	C_8H_7N	60.0	103.5	136.3	161.8	208.5	233.5	− 23.8	(11)
2-Tolyl isocyanide	C_8H_7N	25.2	64.0	94.0	117.7	159.9	183.5	....	(11, 294)
2-Nitrophenyl acetate	$C_8H_7NO_4$	100.0	142.0	172.8	194.1	233.5	253.0_d	....	(11)
2-Methylbenzothiazole	C_8H_7NS	70.0	111.2	141.2	163.9	204.5	225.5	15.4	(95)
Benzylisothiocyanate	C_8H_7NS	79.5	121.8	153.0	177.7	220.4	243.0	....	(277)
Styrene	C_8H_8	− 7.0	+ 30.8	59.8	82.0_p	122.5_p	145.2_p	− 30.6	(11, 44, 63, 113, 253)
(1,2-Dibromoethyl) benzene	$C_8H_8Br_2$	86.0	129.8	161.8	186.3	230.0	254.0	....	(11)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
1,2-Dichloro-3-ethylbenzene	$C_8H_8Cl_2$	46.0	90.0	123.8	149.8	197.0	222.1	− 40.8	(113)
1,2-Dichloro-4-ethylbenzene	$C_8H_8Cl_2$	47.0	92.3	127.5	153.3	201.7	226.6	− 76.4	(113)
1,4-Dichloro-2-ethylbenzene	$C_8H_8Cl_2$	38.5	83.2	118.0	144.0	191.5	216.3	− 61.2	(113)
Acetophenone	C_8H_8O	37.1	78.0	109.4	133.6	178.0	202.4	20.5	(11, 156, 203, 204)
Phenyl acetate	$C_8H_8O_2$	38.2	78.0	108.1	131.6	173.5	195.9	....	(11)
Phenylacetic acid	$C_8H_8O_2$	97.0	141.3	173.6	198.2	243.0	265.5	76.5	(11)
Anisaldehyde	$C_8H_8O_2$	73.2	117.8	150.5	176.7	223.0	248.0	2.5	(11, 316)
Methyl benzoate	$C_8H_8O_2$	39.0	77.3	107.8	130.8	174.7	199.5	− 12.5	(11, 203, 204)
Methyl salicylate	$C_8H_8O_3$	54.0	95.3	126.2	150.0	197.5	223.2	− 8.3	(11, 334, 341)
Vanillin	$C_8H_8O_3$	107.0	154.0	188.7	214.5	260.0	285.0	81.5	(11)
Dehydroacetic acid	$C_8H_8O_4$	91.7	137.3	171.0	197.5	244.5	269.0	....	(11)
2-Bromo-1,4-xylene	C_8H_9Br	37.5	78.8	110.6	135.7	181.0	206.7	+ 9.5	(113, 166)
1-Bromo-4-ethylbenzene	C_8H_9Br	30.4	74.0	108.5	135.5	182.0	206.0	− 45.0	(11, 113)
(2-Bromoethyl) benzene	C_8H_9Br	48.0	90.5	123.2	148.2	194.0	219.0	....	(113)
1-Chloro-2-ethylbenzene	C_8H_9Cl	17.2	56.1	86.2	110.0	152.2	177.6	− 80.2	(113)
1-Chloro-3-ethylbenzene	C_8H_9Cl	18.6	58.2	89.2	113.6	156.7	181.1	− 53.3	(113)
1-Chloro-4-ethylbenzene	C_8H_9Cl	19.2	60.0	91.8	116.0	159.8	184.3	− 62.6	(113)
1-Chloro-2-ethoxybenzene	C_8H_9ClO	45.8	86.5	117.8	141.8	185.5	208.0	....	(11)
4-Chlorophenethyl alcohol	C_8H_9ClO	84.0	129.0	162.0	188.1	234.5	259.3	....	(113)
Acetanilide	C_8H_9NO	114.0	162.0	199.6	227.2	277.0	303.8	113.5	(11)
Methyl anthranilate	$C_8H_9NO_2$	77.6	124.2	159.7	187.8	238.5	266.5	24	(383)
4-Nitro-1,3-xylene	$C_8H_9NO_2$	65.6	109.8	143.3	168.5	217.5	244.0	+ 2	(302)
Ethylbenzene	C_8H_{10}	− 9.8	+ 25.9	52.8	74.1	113.8	136.2	− 94.9	(6, 11, 265, 359, 415, 471, 474)
2-Xylene	C_8H_{10}	− 3.8	+ 32.1	59.5	81.3	121.7	144.4	− 25.2	(6, 207, 253, 265, 302, 359, 415, 474)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
3-Xylene	C_8H_{10}	− 6.9	+ 28.3	55.3	76.8	116.7	139.1	− 47.9	(6, 11, 207, 253, 265, 302, 359, 415, 474)
4-Xylene	C_8H_{10}	− 8.1	+ 27.3	54.4	75.9	115.9	138.3	+ 13.3	(6, 207, 253, 265, 302, 359, 415, 474)
Dichloroethoxyphenylsilane	$C_8H_{10}Cl_2OSi$	52.4	94.6	126.2	151.4	197.2	222.2	......	(114)
Dichloroethylphenylsilane	$C_8H_{10}Cl_2Si$	48.5	92.4	126.7	153.3	203.5	230.0	......	(114)
2-Ethylphenol	$C_8H_{10}O$	46.2	87.0	117.9	141.8	184.5	207.5	− 45	(406)
3-Ethylphenol	$C_8H_{10}O$	60.0	100.2	130.0	152.0	193.3	214.0	− 4	(406)
4-Ethylphenol	$C_8H_{10}O$	59.3	100.2	131.3	154.2	197.4	219.0	46.5	(406)
2,3-Xylenol	$C_8H_{10}O$	56.0_s	97.6	129.2	152.2	196.0	218.0	75	(406)
2,4-Xylenol	$C_8H_{10}O$	51.8	91.3	121.5	143.0	184.2	211.5	25.5	(406)
2,5-Xylenol	$C_8H_{10}O$	51.8_s	91.3	121.5	143.0	184.2	211.5	74.5	(406)
3,4-Xylenol	$C_8H_{10}O$	66.2	107.7	138.0	161.0	203.6	225.2	62.5	(406)
3,5-Xylenol	$C_8H_{10}O$	62.0_s	102.4	133.3	156.0	197.8	219.5	68	(406)
Phenetole	$C_8H_{10}O$	18.1	56.4	86.6	108.4	149.8	172.0	− 30.2	(11, 199)
α-Methyl benzyl alcohol	$C_8H_{10}O$	49.0	88.0	117.8	140.3	180.7	204.0	......	(113)
Phenethylalcohol	$C_8H_{10}O$	58.2	100.0	130.5	154.0	197.5	219.5	......	(113, 395, 396, 456)
4,6-Dimethylresorcinol	$C_8H_{10}O_2$	49.0	90.7	122.5	147.3	192.0	215.0	......	(11)
2-Phenoxyethanol	$C_8H_{10}O_2$	78.0	121.2	152.2	176.5	221.0	245.3	11.6	(113)
Diethyl dioxosuccinate	$C_8H_{10}O_6$	70.0	112.0	143.8	167.7	210.8	233.5	......	(11)
Chlorodimethylphenylsilane	$C_8H_{11}ClSi$	29.8	70.0	101.2	124.7	168.6	193.5	......	(114)
N-Ethylaniline	$C_8H_{11}N$	38.5	80.6	113.2	137.3	180.8	204.0	− 63.5	(11, 203, 204, 300)
N,N-Dimethylaniline	$C_8H_{11}N$	29.5	70.0	101.6	125.8	169.2	193.1	+ 2.5	(11, 203, 204, 300)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
4-Ethylaniline	$C_8H_{11}N$	52.0	93.8	125.7	149.8	194.2	217.4	– 4	(113)
2,4-Xylidine	$C_8H_{11}N$	52.6	93.0	123.8	146.8	188.3	211.5	....	(11, 199)
2,6-Xylidine	$C_8H_{11}N$	44.0	87.0	120.2	146.0	193.7	217.9	....	(302)
2-Phenetidine	$C_8H_{11}NO$	67.0	108.6	139.9	163.5	207.0	228.0	....	(11)
2-Anilinoethanol	$C_8H_{11}NO$	104.0	149.6	183.7	209.5	254.5	279.6	....	(113)
Dimethyl arsanilate	$C_8H_{12}AsNO_2$	15.0	51.8	79.7	101.0	140.3	160.5	....	(11)
Diethyleneglycol-bis-chloroacetate	$C_8H_{12}Cl_2O_5$	148.3	195.8	229.0	252.0	291.8	313.0	....	(113)
Diethyl maleate	$C_8H_{12}O_4$	57.3	100.0	131.8	156.0	201.7	225.0	....	(11)
Diethyl fumarate	$C_8H_{12}O_4$	53.2	95.3	126.7	151.1	195.8	218.5	+ 0.6	(11)
Dimethylphenylsilane	$C_8H_{12}Si$	+ 5.3	42.6	71.4	94.2	136.4	159.3	....	(114)
Ethyl-α-ethylacetoacetate	$C_8H_{14}O_3$	40.5	80.2	110.3	133.8	175.6	198.0	....	(11)
Propyl levulinate	$C_8H_{14}O_3$	59.7	99.9	130.1	154.0	198.0	221.2	....	(376)
Isopropyl levulinate	$C_8H_{14}O_3$	48.0	88.0	118.1	141.8	185.2	208.2	....	(376)
Dipropyl oxalate	$C_8H_{14}O_4$	53.4	93.9	124.6	148.1	190.3	213.5	....	(11)
Diisopropyl oxalate	$C_8H_{14}O_4$	43.2	81.9	110.5	132.6	171.8	193.5	....	(11)
Diethyl succinate	$C_8H_{14}O_4$	54.6	96.6	127.8	151.1	193.8	216.5	– 20.8	(11, 180)
Diethyl isosuccinate	$C_8H_{14}O_4$	39.8	80.0	111.0	134.8	177.7	201.3	....	(11)
Suberic acid	$C_8H_{14}O_4$	172.8	219.5	254.6	279.0	322.8	345.5	142	(234)
Diethyl malate	$C_8H_{14}O_5$	80.7	125.6	157.8	183.9	229.5	253.4	....	(11)
Diethyl-*dl*-tartrate	$C_8H_{14}O_6$	100.0	147.2	181.7	208.0	254.3	280.0	....	(11)
Diethyl-*d*-tartrate	$C_8H_{14}O_6$	102.0	148.0	182.3	208.5	254.8	280.0	....	(11)
(2-Bromoethyl) cyclohexane	$C_8H_{15}Br$	38.7	80.5	113.0	138.0	186.2	213.0	....	(113)
Caprylonitrile	$C_8H_{15}N$	43.0	80.4	110.6	134.8	179.5	204.5	....	(159)
Ethyl *N,N*-diethyloxamate	$C_8H_{15}NO_3$	76.0	121.7	154.4	180.3	226.5	252.0	....	(11)
2-Methyl-2-heptene	C_8H_{16}	– 16.1	+ 17.8	44.0	64.6	102.2	122.5	....	(11)
1,1-Dimethylcyclohexane	C_8H_{16}	– 24.4	+ 10.3	37.3	57.9	97.2	119.5	– 34	(6, 359, 471)
cis-1,2-Dimethylcyclohexane	C_8H_{16}	– 15.9	+ 18.4	45.3	66.8	107.0	129.7	– 50.0	(6, 359, 471)
trans-1,2-Dimethylcyclohexane	C_8H_{16}	– 21.1	+ 13.0	39.7	61.0	100.9	123.4	– 88.0	(6, 359, 471)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
cis-1,3-Dimethylcyclohexane	C_8H_{16}	−22.7	+11.2	37.5	58.5	97.8	120.1	−76.2	(6, 359, 471)
trans-1,3-Dimethylcyclohexane	C_8H_{16}	−19.4	+14.9	41.4	62.5	102.1	124.4	−92.0	(6, 359, 471)
cis-1,4-Dimethylcyclohexane	C_8H_{16}	−20.0	+14.5	41.1	62.3	101.9	124.3	−87.4	(6, 359, 471)
trans-1,4-Dimethylcyclohexane	C_8H_{16}	−24.3	+10.1	36.5	57.6	97.0	119.3	−36.9	(6, 359, 471)
Ethylcyclohexane	C_8H_{16}	−14.5	+20.6	47.6	69.0	109.1	131.8	−111.3	(6, 359, 471)
Caprylaldehyde	$C_8H_{16}O$	73.4	101.2	120.0	133.9	156.5	168.5	....	(11, 225)
Cyclohexaneethanol	$C_8H_{16}O$	50.4	90.0	119.8	142.7	183.5	205.4	....	(113)
6-Methyl-3-hepten-2-ol	$C_8H_{16}O$	41.6	76.7	102.7	122.6	156.6	175.5	....	(431, 434, 460)
6-Methyl-5-hepten-2-ol	$C_8H_{16}O$	41.9	77.8	104.0	123.8	156.6	174.3	....	(113)
2-Octanone	$C_8H_{16}O$	23.6	60.9	89.8	111.7	151.0	172.9	−16	(11)
2,2,4-Trimethyl-3-pentanone	$C_8H_{16}O$	14.7	46.4	69.8	87.6	118.4	135.0	....	(113)
Caprylic acid	$C_8H_{16}O_2$	92.3	124.0	150.6	172.2	213.9	237.5	16	(11, 203, 204)
Ethyl isocaproate	$C_8H_{16}O_2$	11.0	48.0	76.3	98.4	139.2	160.4	....	(11)
Propyl isovalerate	$C_8H_{16}O_2$	+8.0	45.1	72.8	95.0	135.0	155.9	....	(380)
Isobutyl butyrate	$C_8H_{16}O$	+4.6	42.2	71.7	94.0	135.7	156.9	....	(11, 380)
Isobutyl isobutyrate	$C_8H_{16}O_2$	+4.1	39.9	67.2	88.0	126.3	147.5	−80.7	(11, 203, 380)
Amyl propionate	$C_8H_{16}O_2$	+8.5	46.3	75.5	97.6	138.4	160.2	....	(380)
Tetraethyleneglycol chlorohydrin	$C_8H_{16}ClO_4$	110.1	156.1	190.0	214.7	258.2	281.5	....	(141)
1-Iodoöctane	$C_8H_{17}I$	45.8	90.0	123.8	150.0	199.3	225.5	−45.9	(11, 228)
Ethyl-*l*-leucinate	$C_8H_{17}NO_2$	27.8	72.1	106.0	131.8	167.3	184.0	....	(419)
Octane	C_8H_{18}	−14.0	+19.2	45.1	65.7	104.0	125.6	−56.8	(6, 251, 253, 359, 471, 474, 483a)
2-Methylheptane	C_8H_{18}	−21.0	+12.3	37.9	58.3	96.2	117.6	−109.5	(6, 359, 471)
3-Methylheptane	C_8H_{18}	−19.8	+13.3	38.9	59.4	97.4	118.9	−120.8	(6, 359, 471)
4-Methylheptane	C_8H_{18}	−20.4	+12.4	38.0	58.3	96.3	117.7	−121.1	(6, 359, 471)
2,2-Dimethylhexane	C_8H_{18}	−29.7	+3.1	28.2	48.2	85.6	106.8	....	(6, 359, 471)
2,3-Dimethylhexane	C_8H_{18}	−23.0	+9.9	35.6	56.0	94.1	115.6	....	(6, 359, 471)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
2,4-Dimethylhexane	C_8H_{18}	−26.9	+5.2	30.5	50.6	88.2	109.4	....	(6, 359, 471)
2,5-Dimethylhexane	C_8H_{18}	−26.7	+5.3	30.4	50.5	87.9	109.1	−90.7	(6, 359, 471, 488)
3,3-Dimethylhexane	C_8H_{18}	−25.8	+6.1	31.7	52.5	90.4	112.0	....	(6, 359, 471)
3,4-Dimethylhexane	C_8H_{18}	−22.1	+11.3	37.1	57.7	96.0	117.7	....	(6, 359, 471)
3-Ethylhexane	C_8H_{18}	−20.0	+12.8	38.5	58.9	97.0	118.5	....	(6, 359, 471)
2,2,3-Trimethylpentane	C_8H_{18}	−29.0	+3.9	29.5	49.9	88.2	109.8	−112.3	(6, 359, 471)
2,2,4-Trimethylpentane	C_8H_{18}	−36.5	−4.3	+20.7	40.7	78.0	99.2	−107.3	(6, 132, 253, 359, 471)
2,3,3-Trimethylpentane	C_8H_{18}	−25.8	+6.9	33.0	53.8	92.7	114.8	−101.5	(6, 359, 471)
2,3,4-Trimethylpentane	C_8H_{18}	−26.3	+7.1	32.9	53.4	91.8	113.5	−109.2	(6, 359, 471)
2-Methyl-3-ethylpentane	C_8H_{18}	−24.0	+9.5	35.2	55.7	94.0	115.6	−114.5	(6, 359, 471)
3-Methyl-3-ethylpentane	C_8H_{18}	−23.9	+9.9	36.2	57.1	96.2	118.3	−90	(6, 359, 471)
2,2,3,3-Tetramethylbutane	C_8H_{18}	−17.4	+13.5	36.8	54.8	87.4	106.3	+100.7	(6, 132, 253, 359, 471, 495)
Tetramethylpiperazine	$C_8H_{18}N_2$	23.7	61.7	90.0	113.8	157.8	183.5	....	(113)
1-Octanol	$C_8H_{18}O$	54.0	88.3	115.2	135.2	173.8	195.2	−15.4	(68, 113, 278, 279, 494)
2-Octanol	$C_8H_{18}O$	32.8	70.0	98.0	119.8	157.5	178.5	−38.6	(11, 199)
1,2-Dipropoxy ethane	$C_8H_{18}O_2$	−38.8	+5.0	42.3	74.2	140.0	180.0	....	(254)
Diethylene glycol butyl ether	$C_8H_{18}O_3$	70.0	107.8	135.5	159.8	205.0	231.2	....	(113)
Tetraethylene glycol	$C_8H_{18}O_5$	153.9	197.1	228.0	250.0	228.0	307.8	....	(71, 141)
Dibutyl sulfide	$C_8H_{18}S$	+21.7	66.4	96.0	118.6	159.0	182.0	−79.7	(25)
Dibutyl disulfide	$C_8H_{18}S_2$	+34.6	94.0	145.1	188.0	275.5	330.5	....	(25)
Diisobutylamine	$C_8H_{19}N$	−5.1	+30.6	57.8	79.2	118.0	139.5	−70	(11)
Tetraethoxysilane	$C_8H_{20}O_4Si$	16.0	52.6	81.1	103.6	146.2	168.5	....	(114, 398)
Tetraethyllead	$C_8H_{20}Pb$	38.4	74.8	102.4	123.8	161.8	183.0	−136	(61)
Amyltrimethylsilane	$C_8H_{20}Si$	−9.2	+26.7	54.4	76.2	116.6	139.0	....	(466)
Tetraethylsilane	$C_8H_{20}Si$	−1.0	+36.3	65.3	88.0	130.2	153.0	....	(466)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere Continued

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Tetraethyl bistibine	$C_8H_{20}Sb_2$	97.0	151.2	193.2	225.6	286.2	320.3	....	(309)
1,3-Diethoxytetramethyldisiloxane	$C_8H_{22}O_3Si_2$	14.8	51.2	78.7	100.3	139.8	160.7	....	(114)
1,7-Dichlorooctamethyltetra-siloxane	$C_8H_{24}Cl_2O_3Si_4$	53.3	95.8	127.8	152.7	197.8	222.0	− 62	(312)
Octamethyltrisiloxane	$C_8H_{24}O_2Si_3$	7.4	43.1	70.0	91.1	129.4	150.2	....	(114, 469)
Octamethylcyclotetrasiloxane	$C_8H_{24}O_4Si_4$	21.7	59.0	87.4	110.0	149.6	171.2	17.4	(188, 312, 469)
Coumarin	$C_9H_6O_2$	106.0	153.4	189.0	216.5	264.7	291.0	70	(11)
Quinoline	C_9H_7N	59.7	103.8	136.7	163.2	212.3	237.7	− 15	(11, 199, 477)
Isoquinoline	C_9H_7N	63.5	107.8	141.6	167.6	214.5	240.5	24.6	(11)
Indene	C_9H_8	16.4	58.5	90.7	114.7	157.8	181.6	− 2	(63)
Cinnamylaldehyde	C_9H_8O	76.1	120.0	152.2	177.7	222.4	246.0	− 7.5	(11)
trans-Cinnamic acid	$C_9H_8O_2$	127.5_s	173.0	207.1	232.4	276.7	300.0	133	(11)
Skatole	C_9H_9N	95.0	139.6	171.9	197.4	242.5	266.2	95	(78)
Ethyl 3-nitrobenzoate	$C_9H_9NO_4$	108.1	155.0	192.6	220.3	270.6	298.0	47	(11)
α-Methyl styrene	C_9H_{10}	7.4	47.1	77.8	102.2	143.0	165.4_p	− 23.2	(113)
β-Methyl styrene	C_9H_{10}	17.5	57.0	87.7	111.7	154.7	179.0	− 30.1	(113, 436)
4-Methyl styrene	C_9H_{10}	16.0	55.1	85.0	108.6	151.2	175.0_p	....	(216)
Propenylbenzene	C_9H_{10}	17.5	57.0	87.7	111.7	154.7	179.0	− 30.1	(113)
2,4-Xylaldehyde	$C_9H_{10}O$	59.0_s	99.0	129.7	152.2	194.1	215.5	75	(51, 138, 139)
Cinnamyl alcohol	$C_9H_{10}O$	72.6	117.8	151.0	177.8	224.6	250.0	33	(11)
Propiophenone	$C_9H_{10}O$	50.0	92.2	124.3	149.3	194.2	218.0	21	(11)
2-Vinylanisole	$C_9H_{10}O$	41.9	81.0	110.0	132.3	172.1	194.0_p	....	(215)
3-Vinylanisole	$C_9H_{10}O$	43.4	83.0	112.5	135.3	175.8	197.5_p	....	(215)
4-Vinylanisole	$C_9H_{10}O$	45.2	85.7	116.0	139.7	182.0	204.5_p	....	(215)
Benzyl acetate	$C_9H_{10}O_2$	45.0	87.6	119.6	144.0	189.0	213.5	− 51.5	(179)
Ethyl Benzoate	$C_9H_{10}O_2$	44.0	86.0	118.2	143.2	188.4	213.4	− 34.6	(11)
Hydrocinnamic acid	$C_9H_{10}O_2$	102.2	148.7	183.3	209.0	255.0	279.8	48.5	(11)
Ethyl salicylate	$C_9H_{10}O_3$	61.2	104.2	136.7	161.5	207.0	231.5	1.3	(11, 199)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
N-Methylacetanilide	$C_9H_{11}NO$	s	118.6	152.2	179.8	227.4	253.0	102	(11)
Ethyl carbanilate	$C_9H_{11}NO_2$	107.8	143.7	168.8	187.9	220.0	237.0	52.5	(11)
1,2,3-Trimethylbenzene	C_9H_{12}	16.8	55.9	85.4	108.8	152.0	176.1	− 25.5	(6, 359, 471)
1,2,4-Trimethylbenzene	C_9H_{12}	13.6	50.7	79.8	102.8	145.4	169.2	− 44.1	(6, 359, 471, 474)
1,3,5-Trimethylbenzene	C_9H_{12}	9.6	47.4	76.1	98.9	141.0	164.7	− 44.8	(6, 11, 207, 253, 415, 471, 474)
2-Ethyltoluene	C_9H_{12}	9.4	47.6	76.4	99.0	141.4	165.1	....	(6,113,359,471)
3-Ethyltoluene	C_9H_{12}	7.2	44.7	73.3	95.9	137.8	161.3	− 95.5	(6,113,359,471, 495)
4-Ethyltoluene	C_9H_{12}	7.6	44.9	73.6	96.3	136.4	162.0	....	(6, 216, 359, 471)
Cumene	C_9H_{12}	2.9	38.3	66.1	88.1	129.2	152.4	− 96.0	(6, 253, 359, 471, 474)
Propylbenzene	C_9H_{12}	6.3	43.4	71.6	94.0	135.7	159.2	− 99.5	(6, 359, 471)
2-Ethylanisole	$C_9H_{12}O$	29.7	69.0	98.8	122.3	164.2	187.1	....	(215)
3-Ethylanisole	$C_9H_{12}O$	33.7	73.9	104.8	129.2	172.8	196.5	....	(215)
4-Ethylanisole	$C_9H_{12}O$	33.5	73.9	104.7	128.4	172.3	196.5	....	(215)
3-Phenyl-1-propanol	$C_9H_{12}O$	74.7	116.0	147.4	170.3	212.8	235.0	....	(429)
2-Isopropylphenol	$C_9H_{12}O$	56.6	97.0	127.5	150.3	192.6	214.5	15.5	(113)
3-Isopropylphenol	$C_9H_{12}O$	62.0	104.1	136.2	160.2	205.0	228.0	26	(113)
4-Isopropylphenol	$C_9H_{12}O$	67.0	108.0	139.8	163.3	206.1	228.2	61	(113)
Benzyl ethyl ether	$C_9H_{12}O$	26.0	65.0	95.4	118.9	161.5	185.0	....	(11)
Chloroethoxymethylphenylsilane	$C_9H_{13}ClOSi$	44.8	94.6	117.8	142.6	187.7	212.0	....	(114)
2,4,5-Trimethylaniline	$C_9H_{13}N$	68.4	109.0	139.8	162.0	203.7	234.5	67	(11)
N,*N*-Dimethyl-2-toluidine	$C_9H_{13}N$	28.8	66.2	95.0	118.1	161.5	184.8	− 61	(11, 204)
N,*N*-Dimethyl-4-toluidine	$C_9H_{13}N$	50.1	86.7	116.3	140.3	185.4	209.5	....	(11, 204)
4-Cumidine	$C_9H_{13}N$	60.0	102.2	134.2	158.0	203.2	227.0	....	(113)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Phorone	$C_9H_{14}O$	42.0	81.5	111.3	134.0	175.3	197.2	28	(11)
Isophorone	$C_9H_{14}O$	38.0	81.2	114.5	140.6	188.7	215.2	......	(393)
cis-Diethyl citraconate	$C_9H_{14}O_4$	59.8	103.0	135.7	160.0	206.5	230.3	......	(11)
Diethyl itaconate	$C_9H_{14}O_4$	51.3	95.2	128.2	154.3	203.1	227.9	......	(11)
Diethyl mesaconate	$C_9H_{14}O_4$	62.8	105.3	137.3	161.6	205.8	229.0	......	(11)
Trimethyl citrate	$C_9H_{14}O_7$	106.2	160.4	194.2	219.6	264.2	287.0d	78.5	(11)
Isobutyl levulinate	$C_9H_{16}O_3$	65.0	105.9	136.2	160.2	205.5	229.9	......	(376)
Azelaic acid	$C_9H_{16}O_4$	178.3	225.5	260.0	286.5	332.8	356.5d	106.5	(234)
Diethyl ethylmalonate	$C_9H_{16}O_4$	50.8	91.6	122.4	146.0	188.7	211.5	......	(11)
Diethyl glutarate	$C_9H_{16}O_4$	65.6	109.7	142.8	167.8	212.8	237.0	......	(180)
2-Nonanone	$C_9H_{18}O$	32.1	72.3	103.4	127.4	171.2	195.0	− 19	(183)
Azelaldehyde	$C_9H_{18}O$	33.3	71.6	100.2	123.0	163.4	185.0	......	(458)
Pelargonic acid	$C_9H_{18}O_2$	108.2	137.4	163.7	184.4	227.5	253.5	12.5	(11, 203, 223)
Methyl caprylate	$C_9H_{18}O_2$	34.2	74.9	105.3	128.0	170.0	193.0d	− 40	(2)
Isobutyl isovalerate	$C_9H_{18}O_2$	16.0	53.8	82.7	105.2	146.4	168.7	......	(380)
Isoamyl butyrate	$C_9H_{18}O_2$	21.2	59.9	90.0	113.1	155.3	178.6	......	(380)
Isoamyl isobutyrate	$C_9H_{18}O_2$	14.8	52.8	81.8	104.4	146.0	168.8	......	(380)
Iodononane	$C_9H_{19}I$	70.0	109.0	138.1	159.8	199.3	219.5	......	(225, 228)
Nonane	C_9H_{20}	+ 1.4	38.0	66.0	88.1	128.2	150.8	− 53.7	(11, 223, 484, 495)
1-Nonanol	$C_9H_{20}O$	59.5	99.7	129.0	151.3	192.1	213.5	− 5	(11, 228)
Dipropyleneglycol, isopropyl ether	$C_9H_{20}O_3$	46.0	86.2	117.0	140.3	183.1	205.6	......	(113)
Tripropyleneglycol	$C_9H_{20}O_4$	96.0	140.5	173.7	199.0	244.3	267.2	......	(113)
Hexyltrimethylsilane	$C_9H_{22}Si$	+ 6.7	44.8	74.0	97.2	139.9	163.0	......	(466)
Triethylpropylsilane	$C_9H_{22}Si$	15.2	54.0	83.7	107.4	149.8	173.0	......	(466)
1-Bromonaphthalene	$C_{10}H_7Br$	84.2	133.6	170.2	198.8	252.0	281.1	5.5	(11, 203, 204, 334)
1-Chloronaphthalene	$C_{10}H_7Cl$	80.6	118.6	153.2	180.4	230.8	259.3	− 20	(203, 204)
Dicyclopentadiene	$C_{10}H_8$	s	47.6	77.9	101.7	144.2	166.6d	32.9	(63)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Naphthalene	$C_{10}H_8$	52.6_s	85.8	119.3	145.5	193.2	217.9	80.2	(1, 8, 11, 24, 34, 98, 140, 194, 288, 299, 303, 372, 400, 404, 417)
Dichloro-1-naphthylsilane	$C_{10}H_8Cl_2Si$	106.2	149.2	181.7	205.9	249.7	273.3	....	(114)
1-Naphthol	$C_{10}H_8O$	94.0_s	142.0	177.8	206.0	255.8	282.5	96	(11, 270)
2-Naphthol	$C_{10}H_8O$	$_s$	145.5	181.7	209.8	260.6	288.0	122.5	(11, 270, 400)
1-Naphthylamine	$C_{10}H_9N$	104.3	153.8	191.5	220.0	272.2	300.8	50	(11)
2-Naphthylamine	$C_{10}H_9N$	108.0	157.6	195.7	224.3	277.4	306.1	111.5	(11)
2-Methylquinoline	$C_{10}H_9N$	75.3	119.0	150.8	176.2	211.7	246.5	− 1	(11)
1,3-Divinylbenzene	$C_{10}H_{10}$	32.7	73.8	105.5	130.0	175.2	199.5_p	− 66.9	(113)
4-Phenyl-3-buten-2-one	$C_{10}H_0O$	81.7	127.4	161.3	187.8	235.4	261.0	41.5	(11)
α-Methylcinnamic acid	$C_{10}H_{10}O_2$	125.7	169.8	201.8	224.8	266.8	288.0	....	(11)
Methyl cinnamate	$C_{10}H_{10}O_2$	77.4	123.0	157.9	185.8	235.0	263.0	33.4	(370)
Safrole	$C_{10}H_{10}O_2$	63.8	107.6	140.1	165.1	210.0	233.0	11.2	(383)
1,2-Phenylene diacetate	$C_{10}H_{10}O_4$	98.0	145.7	179.8	206.5	253.3	278.0	....	(11)
Dimethyl phthalate	$C_{10}H_{10}O_4$	100.3	147.6	182.8	210.0	257.8	283.7	....	(142)
2,4-Dimethylstyrene	$C_{10}H_{12}$	34.2	75.8	107.7	132.3	177.5	202.0_p	....	(216)
2,5-Dimethylstyrene	$C_{10}H_{12}$	29.0	69.0	100.2	124.7	168.7	193.0_p	....	(216)
3-Ethylstyrene	$C_{10}H_{12}$	28.3	68.3	99.2	123.2	167.2	191.5_p	....	(113)
4-Ethylstyrene	$C_{10}H_{12}$	26.0	66.3	97.3	121.5	165.0	189.0_p	....	(216)
Tetralin	$C_{10}H_{12}$	38.0	79.0	110.4	135.3	181.8	207.2	− 31.0	(177, 253)
Anethole	$C_{10}H_{12}O$	62.6	106.0	139.3	164.2	210.5	235.3	22.5	(11)
4-Methylpropiophenone	$C_{10}H_{12}O$	59.6	103.8	138.0	164.2	212.7	238.5	....	(214)
Estragole	$C_{10}H_{12}O$	52.6	93.7	124.6	148.5	192.0	215.0	....	(436)
Cuminal	$C_{10}H_{12}O$	58.0	102.0	135.2	160.0	206.7	232.0	....	(11, 199, 203, 204)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
4-Vinylphenetole	$C_{10}H_{12}O$	64.0	105.6	136.3	159.8	202.8	225.0_p	.....	(215)
Eugenol	$C_{10}H_{12}O_2$	78.4	123.0	155.8	182.2	228.3	253.5	.....	(11, 40)
Isoeugenol	$C_{10}H_{12}O_2$	86.3	132.4	167.0	194.0	242.3	267.5	− 10	(383)
Chavibetol	$C_{10}H_{12}O_2$	83.6	127.0	159.8	185.5	229.8	254.0	....	(113)
Propyl benzoate	$C_{10}H_{12}O_2$	54.6	98.0	131.8	157.4	205.2	231.0	− 51.6	(11)
2-Phenoxyethyl acetate	$C_{10}H_{12}O_3$	82.6	128.0	162.3	189.2	235.0	259.7	− 6.7	(113)
2-Chloroethyl α-methylbenzyl ether	$C_{10}H_{13}ClO$	62.3	106.0	139.6	164.8	210.8	235.0	....	(113)
4-*tert*-Butylphenyl dichlorophosphate	$C_{10}H_{13}Cl_2O_2P$	96.0	146.0	184.3	214.3	268.2	299.0	....	(113)
1,2,3,4-Tetramethylbenzene	$C_{10}H_{14}$	42.6	81.8	111.5	135.7	180.0	204.4	− 6.2	(259, 495)
1,2,3,5-Tetramethylbenzene	$C_{10}H_{14}$	40.6	77.8	105.8	128.3	173.7	197.9	− 24.0	(259)
1,2,4,5-Tetramethylbenzene	$C_{10}H_{14}$	45.0_s	74.6_s	104.2	128.1	172.1	195.9	79.5	(253, 259)
4-Ethyl-1,3-xylene	$C_{10}H_{14}$	26.3	66.4	97.2	121.2	164.4	188.4	....	(216, 495)
5-Ethyl-1,3-xylene	$C_{10}H_{14}$	22.1	62.1	92.6	116.5	159.6	183.7	....	(113, 495)
2-Ethyl-1,4-xylene	$C_{10}H_{14}$	25.7	65.6	96.0	120.0	163.1	186.9	....	(216, 495)
1,2-Diethylbenzene	$C_{10}H_{14}$	22.3	62.0	92.5	116.2	159.0	183.5	− 31.4	(140, 495, 501)
1,3-Diethylbenzene	$C_{10}H_{14}$	20.7	59.9	90.4	114.4	156.9	181.1	− 83.9	(113, 253, 495)
1,4-Diethylbenzene	$C_{10}H_{14}$	20.7	60.3	91.1	115.3	159.0	183.8	− 43.2	(113, 216, 253, 495)
Cymene	$C_{10}H_{14}$	17.3	57.0	87.0	110.8	153.5	177.2	− 68.2	(11, 253, 474, 498)
Butylbenzene	$C_{10}H_{14}$	22.7	62.0	92.4	116.2	159.2	183.1	− 88.0	(253, 495)
Isobutylbenzene	$C_{10}H_{14}$	14.1	53.7	83.3	107.0	149.6	172.8	− 51.5	(474, 495)
sec-Butylbenzene	$C_{10}H_{14}$	18.6	57.0	86.2	109.5	150.3	173.5	− 75.5	(253, 495)
tert-Butylbenzene	$C_{10}H_{14}$	13.0	51.7	80.8	103.8	145.8	168.5	− 58	(253)
Carvacrol	$C_{10}H_{14}O$	70.0	113.2	145.2	169.7	213.8	237.0	+ 0.5	(11, 59, 113, 385)
Carbone	$C_{10}H_{14}O$	57.4	100.4	133.0	157.3	203.5	227.5	....	(11, 59, 362)
Cuminyl alcohol	$C_{10}H_{14}O$	74.2	118.0	150.3	176.2	221.7	246.6	....	(11)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
4-Ethylphenetole	$C_{10}H_{14}O$	48.5	89.5	119.8	143.5	185.7	208.0	....	(215)
Thymol	$C_{10}H_{14}O$	64.3	107.4	139.8	164.1	209.2	231.8	51.5	(11, 113, 322)
4-Isobutylphenol	$C_{10}H_{14}O$	72.1	115.5	147.2	171.2	214.7	237.0	....	(11)
4-*sec*-Butylphenol	$C_{10}H_{14}O$	71.4	114.8	147.8	172.4	217.6	242.1	....	(113)
2-*sec*-Butylphenol	$C_{10}H_{14}O$	57.4	100.8	133.4	157.3	203.8	228.0	....	(113)
2-*tert*-Butylphenol	$C_{10}H_{14}O$	56.6	98.1	129.2	153.5	196.3	219.5	....	(113)
4-*tert*-Butylphenol	$C_{10}H_{14}O$	70.0	114.0	146.0	170.2	214.0	238.0	99	(113, 406)
Nicotine	$C_{10}H_{14}N_2$	61.8	107.2	142.1	169.5	219.8	247.3	....	(490)
N-Diethylaniline	$C_{10}N_{15}N$	49.7	91.9	123.6	147.3	192.4	215.5	− 34.4	(11, 199, 204, 300)
N-Phenyliminodiethanol	$C_{10}H_{15}NO_2$	145.0	195.8	233.0	260.6	311.3	337.8	....	(113)
Camphene	$C_{10}H_{16}$	s	47.2_s	75.7	97.9	138.7	160.5	50	(383)
Dipentene	$C_{10}H_{16}$	14.0	53.8	84.3	108.3	150.5	174.6	....	(11, 253, 320)
d-Limonene	$C_{10}H_{16}$	14.0	53.8	84.3	108.3	151 4	175.0	− 96.9	(11, 253)
Myrcene	$C_{10}H_{16}$	14.5	53.2	82.6	106.0	148.3	171.5	....	(327, 387)
α-Phellandrene	$C_{10}H_{16}$	20.0	58.0	87.8	110.6	152.0	175.0	....	(461)
α-Pinene	$C_{10}H_{16}$	− 1.0	+ 37.3	66.8	90.1	132.3	155.0	− 55	(253, 320, 351)
β-Pinene	$C_{10}H_{16}$	+ 4.2	42.3	71.5	94.0	136.1	158.3	....	(320)
Terpenoline	$C_{10}H_{16}$	32.3	70.6	100.0	122.7	163.5	185.0	....	(320, 383)
Diethyl arsanilate	$C_{10}H_{16}AsNO_3$	38.0	74.8	102.6	123.8	161.0	181.0	....	(11)
d-Camphor	$C_{10}H_{16}O$	41.5_s	82.3_s	114.0_s	138.0_s	182.0	209.2	178.5	(1, 105, 303, 336, 404, 444)
l-Dihydrocarvone	$C_{10}H_{16}O$	46.6	90.0	123.7	149.7	197.0	223.0	....	(383)
α-Citral	$C_{10}H_{16}O$	61.7	103.9	135.9	160.0	205.0	228.0_d	....	(383)
d-Fenchone	$C_{10}H_{16}O$	28.0	68.3	99.5	123.6	166.8	191.0	5	(42)
Pulegone	$C_{10}H_{16}O$	58.3	94.0	121.7	143.1	189.8	221.0	....	(383)
α-Thyjone	$C_{10}H_{16}O$	38.3	79.3	110.0	134.0	177.8	201..	....	(265)
Ethoxydimethylphenylsilane	$C_{10}H_{16}OSi$	36.3	76.2	107.2	131.4	175.0	199.5	....	(114)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Campholenic acid	$C_{10}H_{16}O_2$	97.6	139.8	170.0	193.7	234.0	256.0	....	(11)
Diosphenol	$C_{10}H_{16}O_2$	66.7	109.0	141.2	165.6	209.5	232.0	....	(383)
Fencholic acid	$C_{10}H_{16}O_2$	101.7	142.3	171.8	194.0	237.8	264.1	19	(113)
cis-Decalin	$C_{10}H_{18}$	22.5	64.2	97.2	123.2	169.9	194.6	− 43.3	(389)
trans-Decalin	$C_{10}H_{18}$	− 0.8	+ 47.2	85.7	114.6	160.1	186.7	− 30.7	(389)
d-Citronellal	$C_{10}H_{18}O$	44.0	84.8	116.1	140.1	183.8	206.5	....	(432)
Cineol	$C_{10}H_{18}O$	15.0	54.1	84.2	108.2	151.6	176.0	− 1	(11)
Dihydrocarveol	$C_{10}H_{18}O$	63.9	105.0	136.1	159.8	202.8	225.0	....	(362, 441)
dl-Fenchyl alcohol	$C_{10}H_{18}O$	45.8	82.1	110.8	132.3	173.2	201.0	35	(320)
Geraniol	$C_{10}H_{18}O$	69.2	110.0	141.8	165.3	207.8	230.0	....	(383)
d-Linalool	$C_{10}H_{18}O$	40.0	79.8	109.9	133.8	175.6	198.0	....	(383)
Nerol	$C_{10}H_{18}O$	61.7	104.0	136.1	159.8	203.5	226.0	....	(179, 397)
α-Terpineol	$C_{10}H_{18}O$	52.8	94.3	126.0	150.1	194.3	217.5	35	(320)
Citronellic acid	$C_{10}H_{18}O_2$	99.5	141.4	171.9	195.4	236.6	257.0	....	(386, 432, 433, 435)
Amyl levulinate	$C_{10}H_{18}O_3$	81.3	124.0	155.8	180.5	227.4	253.2	....	(376)
Isoamyl levulinate	$C_{10}H_{18}O_3$	75.6	118.8	151.7	177.0	222.7	247.9	....	(376)
Diethyl ethylmethylmalonate	$C_{10}H_{18}O_4$	44.7	85.7	116.7	140.8	184.1	207.5	....	(11)
Diethyl adipate	$C_{10}H_{18}O_4$	74.0	123.0	154.6	179.0	219.1	240.0	− 21	(180)
Diisobutyl oxalate	$C_{10}H_{18}O_4$	63.2	105.3	137.5	161.8	205.8	229.5	....	(11)
Dipropyl succinate	$C_{10}H_{18}O_4$	77.5	122.2	154.8	180.3	226.5	250.8	....	(11)
Sebacic acid	$C_{10}H_{18}O_4$	183.0	232.0	268.2	294.5	332.8	352.3d	134.5	(11, 234)
Dipropyl-*d*-tartrate	$C_{10}H_{18}O_6$	115.6	163.5	199.7	227.0	275.6	303.0	....	(11)
Diisopropyl-*d*-tartrate	$C_{10}H_{18}O_6$	103.7	148.2	181.8	207.3	251.8	275.0	....	(11)
Camphylamine	$C_{10}H_{19}N$	45.3	83.7	112.5	134.6	173.8	195.0	....	(11)
Menthane	$C_{10}H_{20}$	+ 9.7	48.3	78.3	102.1	146.0	169.5	....	(253)
1-Decene	$C_{10}H_{20}$	14.7	53.7	83.3	106.5	149.2	172.0	....	(11, 150)
1,2-Dibromodecane	$C_{10}H_{20}Br_2$	95.7	137.3	167.4	190.2	229.8	250.4	....	(11, 150)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Citronellol	$C_{10}H_{20}O$	66.4	107.0	137.2	159.8	201.0	221.5	....	(432)
Capraldehyde	$C_{10}H_{20}O$	51.9	92.0	122.2	145.3	186.3	208.5	....	(405)
l-Menthol	$C_{10}H_{20}O$	56.0	96.0	126.1	149.4	190.2	212.0	42.5	(11, 31, 325)
Decan-2-one	$C_{10}H_{20}O$	44.2	85.8	117.1	142.0	186.7	211.0	+ 3.5	(11, 183, 224)
Capric acid	$C_{10}H_{20}O_2$	125.0	152.2	179.9	200.0	240.3	268.4	31.5	(11, 203, 223, 224, 225, 231)
Isoamyl isovalerate	$C_{10}H_{20}O_2$	27.0	68.6	100.6	125.1	169.5	194.0	....	(11, 203)
Decane	$C_{10}H_{22}$	16.5	55.7	85.5	108.6	150.6	174.1	− 29.7	(11, 223, 224, 253, 484, 496)
2,7-Dimethyloctane	$C_{10}H_{22}$	+ 6.3	42.3	71.2	93.9	136.0	159.7	− 52.8	(253, 474)
Decyl alcohol	$C_{10}H_{22}O$	69.5	111.3	142.1	165.8	208.8	231.0	+ 7	(11, 225, 228)
Diisoamyl ether	$C_{10}H_{22}O$	18.6	57.0	86.3	109.6	150.3	173.4	....	(11, 247)
2-Butyl-2-ethylbutane-1,3-diol	$C_{10}H_{22}O_2$	94.1	136.8	167.8	191.9	233.5	255.0	....	(11, 150)
Dihydrocitronellol	$C_{10}H_{22}O$	68.0	103.0	127.6	145.9	176.8	193.5	....	(155)
Dipropylene glycol monobutyl ether	$C_{10}H_{22}O_3$	64.7	106.0	136.3	159.8	203.8	227.0	....	(113)
Diisoamyl sulfide	$C_{10}H_{22}S$	43.0	87.6	120.0	145.3	191.0	216.0	....	(25)
Heptyltrimethylsilane	$C_{10}H_{24}Si$	22.3	62.1	92.4	116.5	159.8	184.0	....	(466)
Butyltriethylsilane	$C_{10}H_{24}Si$	27.1	67.5	98.3	123.2	167.5	192.0	....	(466)
1,5-Diethoxyhexamethyltrisiloxane	$C_{16}H_{28}O_4Si_3$	41.8	80.7	110.0	133.2	174.0	196.6	....	(114)
Decamethyltetrasiloxane	$C_{10}H_{30}O_3Si_4$	35.3	74.3	104.0	127.3	169.8	193.5	....	(114, 469)
Decamethylcyclopentasiloxane	$C_{10}H_{30}O_5Si_5$	45.2	86.2	117.7	142.0	186.0	210.0	− 38.0	(188, 312, 469)
1-Naphthoic acid	$C_{11}H_8O_2$	156.0	196.8	225.0	245.8	281.4	300.0	160.5	(11)
2-Naphthoic acid	$C_{11}H_8O_2$	160.8	202.8	231.5	252.7	289.5	308.5	184	(11)
Ethyl-*trans*-cinnamate	$C_{11}H_{12}O_2$	87.6	134.0	169.2	196.0	245.0	271.0	12	(11)
1-Phenyl-1,3-pentanedione	$C_{11}H_{12}O_2$	98.0	144.0	178.0	204.5	251.2	276.5	....	(43)
Ethyl benzoylacetate	$C_{11}H_{12}O_3$	107.6	150.3	181.8	205.0	244.7	265.0d	....	(11)
Myristicine	$C_{11}H_{12}O_3$	95.2	142.0	177.7	205.0	253.5	280.0	....	(384, 428)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
2,4,5-Trimethylstyrene	$C_{11}H_{14}$	48.1	91.6	124.2	149.8	196.1	221.2p	....	(216)
2,4,6-Trimethylstyrene	$C_{11}H_{14}$	37.5	79.7	111.8	136.8	182.3	207.0p	....	(216)
4-Isopropylstyrene	$C_{11}H_{14}$	34.7	76.0	108.0	132.8	178.0	202.5p	....	(216)
Isovalerophenone	$C_{11}H_{14}O$	58.3	101.4	133.8	158.0	204.2	228.0	....	(11)
Pivalophenone	$C_{11}H_{14}O$	57.8	99.0	130.4	154.0	197.7	220.0	....	(295)
2,3,5-Trimethylacetophenone	$C_{11}H_{14}O$	79.0	122.3	154.2	179.7	224.3	247.5	....	(383)
Isobutyl benzoate	$C_{11}H_{14}O_2$	64.0	108.6	141.8	166.4	212.8	237.0	....	(11, 199)
4-Allylveratrole	$C_{11}H_{14}O_2$	85.0	127.0	158.3	183.7	226.2	248.0	....	(40)
3,5-Diethyltoluene	$C_{11}H_{16}$	34.0	75.3	107.0	131.7	176.5	200.7	....	(113, 498)
1,2,4-Trimethyl-5-ethylbenzene	$C_{11}H_{16}$	43.7	84.6	106.0	140.3	184.5	208.1	....	(216)
1,3,5-Trimethyl-2-ethylbenzene	$C_{11}H_{16}$	38.8	80.5	113.2	137.9	183.5	208.0	....	(216)
3-Ethylcumene	$C_{11}H_{16}$	28.3	68.8	99.9	124.3	168.2	193.0	....	(113)
4-Ethylcumene	$C_{11}H_{16}$	31.5	72.0	103.3	127.2	171.8	195.8	....	(216)
sec-Amylbenzene	$C_{11}H_{16}$	29.0	69.2	100.0	124.1	168.0	193.0	....	(11, 503)
4-*tert*-Butyl-2-cresol	$C_{11}H_{16}O$	74.3	118.0	150.8	176.2	221.8	247.0	....	(113)
2-*tert*-Butyl-4-cresol	$C_{11}H_{16}O$	70.0	112.0	143.9	167.0	210.0	232.6	....	(406)
4-*tert*-Amylphenol	$C_{11}H_{16}O$	s	125.5	160.3	189.0	239.5	266.0	93	(11)
Ethylcamphoronic anhydride	$C_{11}H_{16}O_5$	118.2	165.0	199.8	226.6	272.8	298.0	....	(11)
Bornyl formate	$C_{11}H_{18}O_2$	47.0	89.3	121.2	145.8	190.2	214.0	....	(383)
Geranyl formate	$C_{11}H_{18}O_2$	61.8	104.3	136.2	160.7	205.8	230.0	....	(432)
Neryl formate	$C_{11}H_{18}O_2$	57.3	99.7	131.5	155.6	200.0	224.5	....	(178, 397)
Diethoxymethylphenylsilane	$C_{11}H_{18}O_2Si$	56.5	97.2	127.5	151.2	193.8	216.5	....	(114)
Diethyl-γ-oxoazelate	$C_{11}H_{18}O_5$	121.0	165.7	197.7	221.6	264.5	286.0	....	(11)
10-Hendecenoic acid	$C_{11}H_{20}O_2$	114.0	156.3	188.7	213.5	254.0	275.0	24.5	(11, 60)
Menthyl formate	$C_{11}H_{20}O_2$	47.3	90.0	123.0	148.0	194.2	219.0	....	(425)
2-Ethylhexyl acrylate	$C_{11}H_{20}O_2$	50.0	91.8	123.7	147.9	192.2	216.0	....	(113)
Octyl acrylate	$C_{11}H_{20}O_2$	58.5	102.0	135.6	159.1	204.0	227.0	....	(113)
Hexyl levulinate	$C_{11}H_{20}O_3$	90.0	134.7	167.8	193.6	241.0	266.8	....	(376)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Hendecan-2-one	$C_{11}H_{22}O$	68.2	108.9	139.0	161.0	202.3	224.0	15	(11, 223, 224, 328)
Methyl caprate	$C_{11}H_{22}O_2$	63.7	108.0	139.0	161.5	202.9	224.0_d	− 18	(2)
Hendecanoic acid	$C_{11}H_{22}O_2$	101.4	149.0	185.6	212.5	262.8	290.0	29.5	(11, 221, 223)
Hendecane	$C_{11}H_{24}$	32.7	73.9	104.4	128.1	171.9	195.8	− 25.6	(11, 223, 224, 484, 504)
Hendecan-2-ol	$C_{11}H_{24}O$	71.1	112.8	143.7	167.2	209.8	232.0	....	(183, 266)
Trimethyloctylsilane	$C_{11}H_{26}Si$	41.8	82.3	113.0	136.5	179.5	202.0	....	(466)
Amyltriethylsilane	$C_{11}H_{26}Si$	41.8	83.8	116.0	141.2	186.3	211.0	....	(466)
4-Bromobiphenyl	$C_{12}H_9Br$	98.0	150.6	190.8	221.8	277.7	310.0	90.5	(113)
2-Bromo-4-Phenylphenol	$C_{12}H_9BrO$	100.0	152.3	193.8	224.5	280.2	311.0	95	(113)
2-Chlorobiphenyl	$C_{12}H_9Cl$	89.3	134.7	169.9	197.0	243.8	267.5	34	(113)
4-Chlorobiphenyl	$C_{12}H_9Cl$	96.4	146.0	183.8	212.5	264.5	292.9	75.5	(113)
2-Chloro-3-phenylphenol	$C_{12}H_9ClO$	118.0	169.7	207.4	237.0	289.4	317.5	+ 6	(113)
2-Chloro-6-phenylphenol	$C_{12}H_9ClO$	119.8	170.7	208.2	237.1	289.5	317.0	....	(113)
2-Xenyl dichlorophosphate	$C_{12}H_9Cl_2PO$	138.2	187.0	223.8	251.5	301.5	328.5	....	(113)
Carbazole	$C_{12}H_9N$	s	s	s	265.0	323.0	354.8	244.8	(388)
Acenaphthene	$C_{12}H_{10}$	s	131.2	168.2	197.5	250.0	277.5	95	(11, 253, 288)
Biphenyl	$C_{12}H_{10}$	70.6	117.0	152.5	180.7	229.4	254.9	69.5	(11, 34, 80, 103, 143, 194, 379)
Diphenyl chlorophosphate	$C_{12}H_{10}ClPO_3$	121.5	182.0	227.9	265.0	337.2	378.0	....	(113)
Dichlorodiphenylsilane	$C_{12}H_{10}Cl_2Si$	109.6	158.0	195.5	223.8	275.5	304.0	....	(114)
Difluorodiphenylsilane	$C_{12}H_{10}F_2Si$	68.4	115.5	149.8	176.3	225.4	252.5	....	(119)
Azobenzene	$C_{12}H_{10}N_2$	103.5	151.5	187.9	216.0	266.1	293.0	68	(11)
1-Acetonaphthone	$C_{12}H_{10}O$	115.6	161.5	196.8	223.8	270.5	295.5	....	(360)
2-Acetonaphthone	$C_{12}H_{10}O$	120.2	168.5	203.8	229.8	275.8	301.0	55.5	(360)
Diphenyl ether	$C_{12}H_{10}O$	66.1	114.0	150.0	178.8	230.7	258.5	27	(113)
2-Phenylphenol	$C_{12}H_{10}O$	100.0	146.2	180.3	205.9	251.8	275.0	56.5	(113)
4-Phenylphenol	$C_{12}H_{10}O$	s	176.2	213.0	240.9	285.5	308.0	164.5	(113)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Diphenyl sulfide	$C_{12}H_{10}S$	96.1	145.0	182.8	211.8	263.9	292.5	....	(11, 232, 237)
Diphenyl disulfide	$C_{12}H_{10}S_2$	131.6	180.0	214.8	241.3	285.8	310.0	61	(11, 232, 237)
Diphenyl selenide	$C_{12}H_{10}Se$	105.7	154.4	192.2	220.8	273.2	301.5	+ 2.5	(11, 232, 237)
Diphenylamine	$C_{12}H_{11}N$	108.3	157.0	194.3	222.8	274.1	302.0	52.9	(11, 159)
1-Ethylnaphthalene	$C_{12}H_{12}$	70.0	116.8	152.0	180.0	230.8	258.1$_d$	− 27	(113)
1,1-Diphenylhydrazine	$C_{12}H_{12}N_2$	126.0	176.1	213.5	242.5	294.0	322.2	44	(11)
2-Cyclohexyl-4,6-dinitrophenol	$C_{12}H_{14}N_2O_5$	132.8	175.9	206.7	229.0	269.8	291.5	....	(113)
Eugenyl acetate	$C_{12}H_{14}O_3$	101.6	148.0	183.0	209.7	257.4	282.0	29.5	(122)
Apiole	$C_{12}H_{14}O_4$	116.0	160.2	193.7	218.0	262.1	285.0	30	(81, 88)
Diethyl phthalate	$C_{12}H_{14}O_4$	108.8	156.0	192.1	219.5	267.5	294.0	....	(11)
2,5-Diethylstyrene	$C_{12}H_{16}$	49.7	92.6	125.8	151.0	198.0	223.0$_p$	....	(216)
Phenylcyclohexane	$C_{12}H_{16}$	67.5	111.3	144.0	169.3	214.6	240.0	+ 7.5	(113, 253)
Isoamyl benzoate	$C_{12}H_{16}O_2$	72.0	121.6	158.3	186.8	235.8	262.0	....	(11, 199)
1,2,4-Triethylbenzene	$C_{12}H_{18}$	46.0	88.5	121.7	146.8	193.7	218.0	....	(113)
1,4-Diisopropylbenzene	$C_{12}H_{18}$	40.0	81.8	114.0	138.7	184.3	209.0	....	(113, 500)
1,3-Diisopropylbenzene	$C_{12}H_{18}$	34.7	76.0	107.9	132.3	177.6	202.0	−105	(113)
2-*tert*-Butyl-4-ethylphenol	$C_{12}H_{18}O$	76.3	121.0	154.0	179.0	223.8	247.8	....	(406)
4-*tert*-Butyl-2,5-xylenol	$C_{12}H_{18}O$	88.2	135.0	169.8	195.0	241.3	265.3	....	(406)
4-*tert*-Butyl-2,6-xylenol	$C_{12}H_{18}O$	74.0	119.0	152.2	176.0	217.8	239.8	....	(406)
6-*tert*-Butyl-2,4-xylenol	$C_{12}H_{18}O$	70.3	115.0	148.5	172.0	214.2	236.5	....	(406)
6-*tert*-Butyl-3,4-xylenol	$C_{12}H_{18}O$	83.9	127.0	159.7	184.0	226.7	249.5	....	(406)
d-Bornyl acetate	$C_{12}H_{20}O_2$	46.9	90.2	123.7	149.8	197.5	223.0	29	(383)
Geranyl acetate	$C_{12}H_{20}O_2$	73.5	117.9	150.0	175.2	219.8	243.3$_d$	....	(41)
Linalyl acetate	$C_{12}H_{20}O_2$	55.4	96.0	127.7	151.8	196.2	220.0$_d$	....	(383)
Triethoxyphenylsilane	$C_{12}H_{20}O_3Si$	71.0	112.6	143.5	167.5	210.5	233.5	....	(114)
Triethyl citrate	$C_{12}H_{20}O_7$	107.0	144.0	190.4	217.8	267.5	294.0$_d$	....	(11)
Trimethallyl phosphate	$C_{12}H_{21}PO_4$	93.7	149.8	192.0	225.7	288.5	324.0	....	(113)
Citronellyl acetate	$C_{12}H_{22}O_2$	74.7	113.0	140.5	161.0	197.8	217.0	....	(432)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Menthyl acetate	$C_{12}H_{22}O_2$	57.4	100.0	132.1	156.7	202.8	227.0	....	(383)
Dimethyl sebacate	$C_{12}H_{22}O_4$	104.0	156.2	196.0	222.6	269.6	293.5	38	(180)
Diisoamyl oxalate	$C_{12}H_{22}O_4$	85.4	131.4	165.7	192.2	240.0	265.0	....	(11)
Diisobutyl-*d*-tartrate	$C_{12}H_{22}O_6$	117.8	169.0	208.5	239.5	294.0	324.0	73.5	(11)
1-Dodecene	$C_{12}H_{24}$	47.2	87.8	118.6	142.3	185.5	208.0	− 31.5	(11, 226)
Triisobutylene	$C_{12}H_{24}$	18.0	56.5	86.7	110.0	153.0	179.0	....	(406)
Dodecan-2-one	$C_{12}H_{24}O$	77.1	120.4	152.4	177.5	222.5	246.5	....	(11, 223, 224)
Lauraldehyde	$C_{12}H_{24}O$	77.7	123.7	157.8	184.5	231.8	257.0	44.5	(11, 222, 225, 230)
Lauric acid	$C_{12}H_{24}O_2$	121.0	166.0	201.4	227.5	273.8	299.2	48	(11, 157, 221, 223, 224, 225, 226)
Dodecane	$C_{12}H_{26}$	47.8	90.0	121.7	146.2	191.0	216.2	− 9.6	(11,27,223,224, 225,497,502)
Dodecyl alcohol	$C_{12}H_{26}O$	91.0	134.7	167.2	192.0	235.7	259.0	24	(11, 225)
Tripropylene glycol monoisopropyl ether	$C_{12}H_{26}O_4$	82.4	127.3	161.4	187.8	232.8	256.6	....	(113)
Triisobutylamine	$C_{12}H_{27}N$	32.3	69.8	97.8	119.7	157.8	179.0	− 22	(11)
Dodecylamine	$C_{12}H_{27}N$	82.8	127.8	157.4	182.1	225.0	248.0	....	(11, 230)
Triethylhexylsilane	$C_{12}H_{28}Si$	52.4	96.4	130.0	156.0	204.6	230.0	....	(466)
1,7-Diethoxyoctamethyltetrasiloxane	$C_{12}H_{34}O_5Si_4$	67.7	108.6	319.0	162.0	204.0	227.5	....	(114)
Dodecamethylpentasiloxane	$C_{12}H_{36}O_4Si_5$	56.6	98.0	128.8	162.8	196.5	220.5	....	(114, 469)
Dodecamethylcyclohexasiloxane	$C_{12}H_{36}O_6Si_6$	67.3	110.0	141.8	166.3	210.6	236.0	− 3.0	(188, 312, 469)
Acridine	$C_{13}H_9N$	129.4	184.0	224.2	256.0	314.3	346.0	110.5	(11)
Fluorene	$C_{13}H_{10}$	s	146.0	185.2	214.7	268.6	295.0	113	(11, 135, 288)
Benzophenone	$C_{13}H_{10}O$	108.2	157.6	195.7	224.4	276.8	305.4	48.5	(11, 70, 194, 452)
Phenyl benzoate	$C_{13}H_{10}O_2$	106.8	157.8	197.6	227.8	283.5	314.0	70.5	(11)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Salol	$C_{13}H_{10}O_3$	117.8	167.0	205.0	233.8	284.8	313.0	42.5	(11)
Diphenylmethane	$C_{13}H_{12}$	76.0	122.8	157.8	186.3	237.5	264.5	26.5	(97, 99)
Benzhydrol	$C_{13}H_{12}O$	110.0	162.0	200.0	227.5	275.6	301.0	68.5	(11)
Benzyl phenyl ether	$C_{13}H_{12}O$	95.4	144.0	180.1	209.2	259.8	287.0	....	(11)
1-Propionaphthone	$C_{13}H_{12}O$	124.0	171.0	206.9	233.5	280.2	306.0	....	(360)
Chloromethyldiphenylsilane	$C_{13}H_{13}ClSi$	105.0	152.7	189.2	216.0	266.5	295.5	....	(114)
Methyldiphenylamine	$C_{13}H_{13}N$	103.5	149.7	184.0	210.1	257.0	282.0	— 7.6	(11)
2-Isopropylnaphthalene	$C_{13}H_{14}$	76.0	123.4	159.0	187.6	238.5	266.0	....	(113)
Methyldiphenylsilane	$C_{13}H_{14}Si$	88.0	132.8	166.4	193.7	241.5	266.8	....	(114)
Enanthophenone	$C_{13}H_{18}O$	100.0	145.5	178.9	204.2	248.3	271.3	....	(11, 229)
Heptylbenzene	$C_{13}H_{20}$	64.0	110.0	144.0	170.2	217.8	244 0	....	(11, 229, 499)
α-Ionone	$C_{13}H_{20}O$	79.5	123.0	155.6	181.2	225.2	250.0	....	(256)
Bornyl propionate	$C_{13}H_{22}O_2$	64.6	108.0	140.4	165.7	211.2	235.0	....	(383)
2-Tridecanone	$C_{13}H_{26}O$	86.8	131.8	165.7	191.5	238.3	262.5	28.5	(11, 223, 224)
Methyl laurate	$C_{13}H_{26}O_2$	87.8	133.2	166.0	190.8	d	d	5	(2)
Tridecanoic acid	$C_{13}H_{26}O_2$	137.8	181.0	212.4	236.0	276.5	299.0	41	(11, 221)
Tridecane	$C_{13}H_{28}$	59.4	104.0	137.7	162.5	209.4	234.0	— 6.2	(11, 223, 484)
Tripropyleneglycol, monobutyl ether	$C_{13}H_{28}O_4$	101.5	147.0	179.8	204.4	247.0	269.5	....	(113)
Decyltrimethylsilane	$C_{13}H_{30}Si$	67.4	111.0	144.0	169.5	215.5	240.0	....	(466)
Triethylheptylsilane	$C_{13}H_{30}Si$	70.0	114.6	148.0	174.0	221.0	247.0	....	(466)
Anthraquinone	$C_{14}H_8O_2$	190.0_s	234.2_s	264.3_s	285.0_s	346.2	379.9	286	(299, 404)
1,4-Dihydroxyanthraquinone	$C_{14}H_8O_4$	196.7	259.8	307.4	344.5	413.0_d	450.0_d	194	(464)
Anthracene	$C_{14}H_{10}$	145.0_s	187.2_s	217.5_s	250.0	310.2	342.0	217.5	(11, 97, 288, 299, 303, 381)
Phenanthrene	$C_{14}H_{10}$	118.2	173.0	215.8	249.0	308.0	340.2	99.5	(11, 288, 299)
Benzil	$C_{14}H_{10}O_2$	128.4	183.0	224.5	255.8	314.3	347.0	95	(11, 238, 473)
Benzoic anhydride	$C_{14}H_{10}O_3$	143.8	198 0	239.8	270.4	328.8	360.0	42	(11)

ORGANIC COMPOUNDS (Continued)

Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
1,1-Diphenylethylene	$C_{14}H_{12}$	87.4	135.0	170.8	198.6	249.8	277.0	....	(11)
trans-Diphenylethylene	$C_{14}H_{12}$	113.2	161.0	199.0	227.4	287.3	306.5	124	(11)
Desoxybenzoin	$C_{14}H_{12}O$	123.3	173.5	212.0	241.3	293.0	321.0	60	(10, 11)
Benzoin	$C_{14}H_{12}O$	135.6	188.0	227.6	258.0	313.5	343.0	132	(11)
Dibenzyl	$C_{14}H_{14}$	86.8	136.0	173.7	202.8	255.0	284.0	51.5	(11)
2-Isobutyronaphthone	$C_{14}H_{14}O$	133.2	181.0	215.6	242.3	288.2	313.0	....	(360)
Dibenzylamine	$C_{14}H_{15}O$	118.3	165.6	200.2	227.3	274.3	300.0	− 26	(11)
Ethyldiphenylamine	$C_{14}H_{15}N$	98.3	146.0	182.0	209.8	258.8	286.0	....	(11)
1,2-Dichlorotetraethylbenzene	$C_{14}H_{20}Cl_2$	105.6	155.0	192.2	220.7	272.8	302.0	....	(113)
1,4-Dichlorotetraethylbenzene	$C_{14}H_{20}Cl_2$	91.7	143.8	183.2	212.0	265.8	296.5	....	(113)
2-(4-*tert*-Butylphenoxy) ethyl acetate	$C_{14}H_{20}O_3$	118.0	165.8	201.5	228.0	277.6	304.4	....	(113)
1,2,4,5-Tetraethylbenzene	$C_{14}H_{22}$	65.7	111.6	145.8	172.4	221.4	248.0	11.6	(505)
2,4-Di-*tert*-butylphenol	$C_{14}H_{22}O$	84.5	130.0	164.3	190.0	237.0	260.8	....	(406)
Bornyl butyrate	$C_{14}H_{24}O_2$	74.0	118.0	150.7	176.4	222.2	247.0	....	(383)
Bornyl isobutyrate	$C_{14}H_{24}O_2$	70.0	114.0	147.2	172.2	218.2	243.0	....	(277)
Geranyl butyrate	$C_{14}H_{24}O_2$	96.8	139.0	170.1	193.8	235.0	257.4	....	(120)
Geranyl isobutyrate	$C_{14}H_{24}O_2$	90.7	133.0	164.0	187.7	228.5	251.0	....	(120)
Diethyl sebacate	$C_{14}H_{26}O_4$	125.3	172.1	207.5	234.4	280.3	305.5	1.3	(11)
2-Tetradecanone	$C_{14}H_{28}O$	99.3	145.5	179.8	206.0	253.0	278.0	....	(11, 223)
Myristaldehyde	$C_{14}H_{28}O$	99.0	148.3	186.0	214.5	267.9	297.8	23.5	(11, 222, 225, 230)
Myristic acid	$C_{14}H_{28}O_2$	142.0	190.8	223.5	250.5	294.6	318.0	57.5	(11, 157, 221, 223, 225)
1-Chlorotetradecane	$C_{14}H_{29}Cl$	98.5	148.2	187.0	215.5	267.5	296.0	+ 0.9	(113)
Tetradecane	$C_{14}H_{30}$	76.4	120.7	152.7	178.5	226.8	252.5	5.5	(11, 223, 224, 253, 484)
Tetradecylamine	$C_{14}H_{31}N$	102.6	152.0	189.0	215.7	264.6	291.2	....	(11, 230)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Triethyloctylsilane	$C_{14}H_{32}Si$	73.7	120.6	155.7	184.3	235.0	262.0	....	(466)
1,9-Diethoxydecamethylpentasiloxane	$C_{14}H_{40}O_6Si_5$	89.0	131.5	162.2	187.0	230.0	253.3	....	(114)
Tetradecamethylhexasiloxane	$C_{14}H_{42}O_5Si_6$	73.7	117.6	149.8	175.2	220.5	245.5	....	(114, 469)
Tetradecamethylcycloheptasiloxane	$C_{14}H_{42}O_7Si_7$	86.3	131.5	165.3	191.8	239.2	264.0	− 32	(188, 312, 469)
1,3-Diphenyl-2-propanone	$C_{15}H_{14}O$	125.5	177.6	216.6	246.6	301.7	330.5	34.5	(479)
1-Biphenyloxy-2,3-epoxypropane	$C_{15}H_{14}O_2$	135.3	187.2	226.3	255.0	309.8	340.0	....	(113)
1-Isovaleronaphthone	$C_{15}H_{16}O$	136.0	184.0	219.7	246.7	294.0	320.0	....	(360)
4,4-Isopropylidenebisphenol	$C_{15}H_{16}O_2$	193.0	240.8	273.0	297.0	339.0	360.5	....	(113)
Ethoxymethyldiphenylsilane	$C_{15}H_{18}OSi$	109.0	152.7	186.0	211.8	256.8	282.0	....	(114)
Helenin	$C_{15}H_{20}O_2$	157.7	192.1	215.2	232.6	260.6	275.0	76	(11)
Cadinene	$C_{15}H_{24}$	101.3	146.0	179.8	205.6	250.7	275.0	....	(383)
2,6-Di-*tert*-butyl-4-cresol	$C_{15}H_{24}O$	85.8	131.0	164.1	190.0	237.6	262.5	....	(406)
4,6-Di-*tert*-butyl-2-cresol	$C_{15}H_{24}O$	86.2	132.4	167.4	194.0	243.4	269.3	....	(406)
4,6-Di-*tert*-butyl-3-cresol	$C_{15}H_{24}O$	103.7	150.0	185.3	211.0	257.1	282.0	....	(406)
Champacol	$C_{15}H_{26}O$	100.0	148.0	184.0	211.9	261.2	288.0	91	(462)
Triethyl camphoronate	$C_{15}H_{26}O_6$	s	166.0	201.8	228.6	276.0	301.0	135	(11)
Methyl myristate	$C_{15}H_{30}O_2$	115.0	160.8	195.8	222.6	269.8	295.8	18.5	(2)
Pentadecane	$C_{15}H_{32}$	91.6	135.4	167.7	194.0	242.8	270.5	10	(11, 223, 224, 484)
Tetrapropylene glycol monoisopropyl ether	$C_{15}H_{32}O_5$	116.6	163.0	197.7	223.3	268.3	292.7	....	(113)
Dodecyltrimethylsilane	$C_{15}H_{34}Si$	91.2	137.7	172.1	199.5	248.0	273.0	....	(466)
Benzyl cinnamate	$C_{16}H_{14}O_2$	173.8	221.5	255.8	281.5	326.7	350.0	39	(172)
Di(α-methylbenzyl) ether	$C_{16}H_{18}O$	96.7	144.0	179.6	206.8	254.8	281.0	....	(113)
Diethoxydiphenylsilane	$C_{16}H_{20}O_2Si$	111.5	157.6	193.2	220.0	259.7	296.0	....	(114)
Dibutyl phthalate	$C_{16}H_{22}O_4$	148.2	198.2	235.8	263.7	313.5	340.0	....	(142)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Pentaethylchlorobenzene	$C_{16}H_{25}Cl$	90.0	140.7	178.2	208.0	257.2	285.0	....	(113)
Pentaethylbenzene	$C_{16}H_{26}$	86.0	135.8	171.9	200.0	250.2	277.0	....	(113)
2,6-Di-*tert*-butyl-4-ethylphenol	$C_{16}H_{26}O$	89.1	137.0	172.1	198.0	244.0	268.6	....	(406)
4,6-Di-*tert*-butyl-3-ethylphenol	$C_{16}H_{26}O$	111.5	157.4	192.3	218.0	264.6	290.0	....	(406)
Muscone	$C_{16}H_{30}O$	118.0	170.0	210.0	241.5	297.2	328.0	....	(457)
Palmitonitrile	$C_{16}H_{31}N$	134.3	185.8	223.8	251.5	304.5	332.0	31	(11, 233, 236)
1-Hexadecene	$C_{16}H_{32}$	101.6	146.2	178.8	205.3	250.0	274.0	4	(11, 226)
Tetraisobutylene	$C_{16}H_{32}$	63.8	108.5	142.2	167.5	214.6	240.0	....	(406)
2-Hexadecanone	$C_{16}H_{32}O$	109.8	167.3	203.7	230.5	279.8	307.0	....	(11, 223, 224)
Palmitaldehyde	$C_{16}H_{32}O$	121.6	171.8	210.0	239.5	292.3	321.0	34	(11, 222, 225, 230)
Palmitic acid	$C_{16}H_{32}O_2$	153.6	205.8	244.4	271.5	326.0	353.8	64.0	(11, 150, 157, 221, 223, 224, 225)
Hexadecane	$C_{16}H_{34}$	105.3	149.8	181.3	208.5	258.3	287.5	18.5	(11, 223, 224, 228, 484)
Cetyl alcohol	$C_{16}H_{34}O$	122.7	177.8	219.8	251.7	312.7	344.0	49.3	(11, 225)
Cetylamine	$C_{16}H_{36}N$	123.6	176.0	215.7	245.8	300.4	330.0	....	(11, 230, 233)
Decyltriethylsilane	$C_{16}H_{36}Si$	108.5	155.6	191.7	218.3	267.5	293.0	....	(466)
1,1,1-Diethoxydodecamethylhexasiloxane	$C_{16}H_{46}O_7Si_6$	103.6	147.5	180.0	205.5	250.0	273.5	....	(114)
Hexadecamethylheptasiloxane	$C_{16}H_{48}O_6Si_7$	93.2	138.5	171.8	198.0	244.7	270.0	....	(114, 469)
Hexadecamethylcyclooctasiloxane	$C_{16}H_{48}O_8Si_8$	103.5	150.5	186.3	213.8	263.0	290.0	31.5	(188, 469)
Benzanthrone	$C_{17}H_{10}O$	225.0	297.2	350.0	390.0	....	....	174	(464)
4-*tert*-Butylphenyl salicylate	$C_{17}H_{18}O_3$	166.2	225.0	270.7	305.8	370.6	404.0d	....	(113)
Menthyl benzoate	$C_{17}H_{24}O_2$	123.2	170.0	204.3	230.4	277.1	301.0	54.5	(383)
2-Heptadecanone	$C_{17}H_{34}O$	129.6	178.0	214.3	242.0	291.7	319.5	....	(11, 223, 224)
Methyl palmitate	$C_{17}H_{34}O_2$	134.3	184.3	d	....	....	....	30	(2)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
Heptadecane	$C_{17}H_{36}$	115.0	160.0	195.8	223.0	274.5	303.0	22.5	(11, 223, 224, 484)
Tetradecyltrimethylsilane	$C_{17}H_{38}Si$	120.0	166.2	201.5	227.8	275.0	300.0	....	(466)
Tri-2-chlorophenylthiophosphate	$C_{18}H_{12}Cl_3O_3PS$	188.2	231.2	261.7	283.8	322.0	341.3	....	(113)
Triphenyl phosphate	$C_{18}H_{15}O_4P$	193.5	249.8	290.3	322.5	379.2	413.5	49.4	(113)
Hexaethylbenzene	$C_{18}H_{30}$	s	150.3	187.7	216.0	268.5	298.3	130	(113)
2,4,6-Tri-*tert*-butylphenol	$C_{18}H_{30}O$	95.2	142.0	177.4	203.0	250.6	276.3	....	(406)
Oleic Acid	$C_{18}H_{34}O_2$	176.5	223.0	257.2	286.0	334.7	360.0_d	14	(11, 122, 134, 234)
Elaidic acid	$C_{18}H_{34}O_2$	171.3	223.5	260.8	288.0	337.0	362.0	51.5	(11, 230, 234)
Stearaldehyde	$C_{18}H_{36}O$	140.0	192.1	230.8	260.0	313.8	342.5	63.5	(11, 222, 225, 230)
Stearic acid	$C_{18}H_{36}O_2$	173.7	225.0	263.3	291.0	343.0	370.0_d	69.3	(11, 150, 221, 222, 225, 227, 230, 234)
Octadecane	$C_{18}H_{38}$	119.6	169.6	207.4	236.0	288.0	317.0	28	(223, 225, 484)
2-Methylheptadecane	$C_{18}H_{38}$	119.8	168.7	204.8	231.5	279.8	306.5	....	(245)
1-Octadecanol	$C_{18}H_{38}O$	150.3	202.0	240.4	269.4	320.3	349.5	58.5	(11, 225)
Ethylcetylamine	$C_{18}H_{39}N$	133.2	186.0	226.5	256.8	313.0	342.0_d	....	(11, 233)
1,1,3-Diethoxytetradecamethylheptasiloxane	$C_{18}H_{52}O_8Si_7$	119.0	163.5	197.0	223.2	268.3	293.5	....	(114)
Octadecamethyloctasiloxane	$C_{18}H_{54}O_7Si_8$	105.8	152.3	187.5	214.5	263.5	290.0	....	(114, 469)
Triphenylmethane	$C_{19}H_{16}$	169.7	197.0	215.5	228.4	249.8	259.2	93.4	(11, 70, 383)
Diphenyl-2-tolyl thiophosphate	$C_{19}H_{17}O_3PS$	159.7	201.6	230.6	252.5	290.0	310.0	....	(113)
Nonadecane	$C_{19}H_{40}$	133.2	183.5	220.0	248.0	299.8	330.0	32	(11, 223, 224, 484)
Ethoxytriphenylsilane	$C_{20}H_{20}OSi$	167.0	213.5	247.0	273.5	319.5	344.0	....	(114)
Diethylhexadecylamine	$C_{20}H_{43}N$	139.8	194.0	235.0	265.5	324.6	355.0	....	(11, 233)

ORGANIC COMPOUNDS (Continued)
Pressures Less than One Atmosphere (Continued)

Name	Formula	Temperature °C						M.P.	Citation No.
		1 mm	10 mm	40 mm	100 mm	400 mm	760 mm		
1,1,5-Diethoxyhexadecamethyloctasiloxane	$C_{20}H_{58}O_9Si_8$	133.7	179.7	213.8	240.0	286.0	311.5	....	(114)
Eicosamethylnonasiloxane	$C_{20}H_{60}O_8Si_9$	144.0	189.0	220.5	244.3	286.0	307.5	....	(469)
Tritolyl phosphate	$C_{21}H_{21}O_4P$	154.6	198.0	229.7	252.2	292.7	313.0	....	(113)
Heneicosane	$C_{21}H_{44}$	152.6	205.4	243.4	272.0	323.8	350.5	40.4	(11, 223, 224, 484)
Erucic acid	$C_{22}H_{42}O_2$	206.7	254.5	289.1	314.4	358.8	381.5d	33.5	(11, 234)
Brassidic acid	$C_{22}H_{42}O_2$	209.6	256.0	290.0	316.2	359.6	382.5d	61.5	(11, 234)
Docosane	$C_{22}H_{46}$	157.8	213.0	254.5	286.0	343.5	376.0	44.5	(11, 223, 224, 468, 484)
Docosamethyldecasiloxane	$C_{22}H_{66}O_9Si_{10}$	160.3	202.8	233.8	255.0	293.8	314.0	....	(469)
Tricosane	$C_{23}H_{48}$	170.0	223.0	261.3	289.8	339.8	366.5	47.7	(11, 223, 224, 484)
Tetracosane	$C_{24}H_{50}$	183.8	237.6	276.3	305.2	358.0	386.4	51.1	(11, 223, 224, 468, 484)
Tetracosamethylhendecasiloxane	$C_{24}H_{72}O_{10}Si_{11}$	175.2	216.7	246.2	266.3	303.7	322.8	....	(469)
Pentacosane	$C_{25}H_{52}$	194.2	248.2	285.6	314.0	365.4	390.3	53.3	(484)
Hexacosane	$C_{26}H_{54}$	204.0	257.4	295.2	323.2	374.6	399.8	56.6	(11, 468, 484)
Dicarvacryl-2-tolyl phosphate	$C_{27}H_{33}O_4P$	180.2	221.8	251.5	272.5	309.8	330.0	....	(113)
Heptacosane	$C_{27}H_{56}$	211.7	266.8	305.7	333.5	385.0	410.6	59.5	(11, 223, 484)
Octacosane	$C_{28}H_{58}$	226.5	277.4	314.2	341.8	388.9	412.5	61.6	(11, 468, 484)
Nonacosane	$C_{29}H_{60}$	234.2	286.4	323.2	350.0	397.2	421.8	63.8	(484)
Dicarvacryl-mono-(6-chloro-2-xenyl) phosphate	$C_{32}H_{34}ClO_4P$	204.2	249.3	280.5	304.9	342.0	361.0	....	(113)

ORGANIC COMPOUNDS (Continued)

Pressures Greater than One Atmosphere

Name	Formula	Temperature °C							Citation No.
		1 atm.	2 atm.	5 atm.	10 atm.	20 atm.	40 atm.	60 atm.	
Chlorotrifluoromethane	$CClF_3$	− 81.2	− 66.7	− 42.7	− 18.5	+ 12.0	52.8	.....	(113, 430)
Dichlorodifluoromethane	CCl_2F_2	− 29.8	− 12.2	+ 16.1	42.4	74.0	.....	.....	(113, 146)
Carbonyl chloride	CCl_2O	8.3	27.3	57.2	85.0	119.0	159.8	.....	(20, 145, 208, 305, 311)
Trichlorofluoromethane	CCl_3F	23.7	44.1	77.3	108.2	146.7	194.0	.....	(212)
Carbontetrachloride	CCl_4	76.7	102.0	141.7	178.0	222.0	276.0	.....	(115, 175, 289, 343, 352, 394, 481)
Chlorodifluoromethane	$CHClF_2$	− 40.8	− 24.7	+ 0.3	24.0	52.0	85.3	.....	(50, 212)
Dichlorofluoromethane	$CHCl_2F$	8.9	28.4	59.0	87.0	121.2	162.6	.....	(212)
Trichloromethane	$CHCl_3$	61.3	83.9	120.0	152.3	191.8	237.5	.....	(32, 115, 175, 345, 352, 365)
Hydrocyanic acid	CHN	25.8	45.5	75.5	103.5	134.2	170.2	.....	(252)
Methyl bromide	CH_3Br	3.6	23.3	54.8	84.0	121.7	170.2	.....	(117, 323)
Methyl chloride	CH_3Cl	− 24.0	− 6.4	+ 22.0	47.3	77.3	113.8	137.5	(54, 182, 241, 350, 451)
Methyl fluoride	CH_3F	− 78.2	− 64.5	− 42.0	− 21.0	+ 2.6	26.5	43.5	(89, 113, 281)
Methyl iodide	CH_3I	42.4	65.5	101.8	138.0	176.5	228.5	.....	(351, 352, 363)
Methane	CH_4	−161.5	−152.3	−138.3	−124.8	−108.5	− 86.3	.....	(6, 72, 93, 123, 206, 359, 407)
Methanol	CH_4O	64.7	84.0	112.5	138.0	167.8	203.5	224.0	(111, 289, 319, 338, 353)
Methanethiol	CH_4S	6.8	26.1	55.9	83.4	117.5	157.7	185.0	(39)
Methylamine	CH_5N	− 6.3	+ 10.1	36.0	59.5	87.8	121.8	144.6	(19, 38, 130, 186, 324)
Carbon monoxide	CO	−191.3	−183.5	−170.7	−161.0	−149.7	.....	.....	(23, 72, 82, 83, 102, 208, 306, 447)
Carbon dioxide	CO_2	-78.2_s	-69.1_s	− 56.7	− 39.5	− 18.9	+ 5.9	22.4	(4, 5, 53, 124, 167, 168, 196, 208, 242, 275, 307, 308, 343, 407, 448, 454, 463, 493)
Carbon disulfide	CS_2	46.5	69.1	104.8	136.3	175.5	222.8	256.0	(168, 208, 263, 331, 343, 352, 407, 454, 475)

ORGANIC COMPOUNDS (Continued)

Pressures Greater than One Atmosphere (Continued)

Name	Formula	Temperature °C							Citation No.
		1 atm.	2 atm.	5 atm.	10 atm.	20 atm.	40 atm.	60 atm.	
1-Chloro-1,2,2-trifluoroethylene	C_2ClF_3	-27.9	-11.1	+15.5	40.0	71.1	....	.....	(49, 50, 113)
1,2-Dichloro-1,1,2,2-tetrafluoroethane	$C_2Cl_2F_4$	3.5	22.8	54.0	82.3	117.5	....	.....	(212)
1,1,2-Trichloro-1,2,2-trifluoroethane	$C_2Cl_3F_3$	47.6	70.0	105.5	138.0	177.7	....	.....	(212)
Acetylene	C_2H_2	-84.0_s	-71.6	-50.2	-32.7	-10.0	+16.8	34.8	(12, 66, 67, 69, 217, 449)
cis-1,2-Dichloroethylene	$C_2H_2Cl_2$	59.0	82.1	119.3	152.3	194.0	244.5	.....	(113, 175, 176)
trans-1,2-Dichloroethylene	$C_2H_2Cl_2$	47.8	69.8	104.0	135.7	174.0	220.0	.....	(113, 175, 176)
Ethylene	C_2H_4	-103.7	-90.8	-71.1	-52.8	-29.1	-1.5	.....	(6, 66, 93, 57, 116, 244, 359, 407, 448, 453)
1,2-Dibromoethane	$C_2H_4Br_2$	131.5	157.7	200.0	237.0	269.0	295.0	304.5	(11, 31, 113, 349, 351, 438)
1,1-Dichloroethane	$C_2H_4Cl_2$	57.3	80.2	117.3	150.3	192.7	243.0	.....	(113, 352, 402)
1,2-Dichloroethane	$C_2H_4Cl_2$	83.7	108.1	147.8	183.5	226.5	272.0	.....	(113, 133, 315, 352, 402)
Acetic acid	$C_2H_4O_2$	118.1	143.5	180.3	214.0	252.0	297.0	.....	(113, 203, 246, 258, 289, 335, 353, 373, 480)
Methyl formate	$C_2H_4O_2$	32.0	51.9	83.5	112.0	147.2	188.5	.....	(297, 491)
Ethyl bromide	C_2H_5Br	38.4	60.2	95.0	126.8	164.3	206.5	229.5	(113, 347, 391, 438)
Ethyl chloride	C_2H_5Cl	12.3	32.5	64.0	92.6	127.3	167.0	.....	(38, 113, 195, 346, 402)
Ethyl fluoride	C_2H_5F	-32.0	-16.7	+7.7	30.2	57.5	90.0	.....	(50)
Ethane	C_2H_6	-88.6	-75.0	-52.8	-32.0	-6.4	+23.6	.....	(6, 30, 65, 84, 93, 153, 261, 262, 359, 453)
Ethanol	C_2H_6O	78.4	97.5	126.0	151.8	183.0	218.0	242.0	(32, 113, 115, 202, 273, 289, 329, 337, 343, 365, 374, 394)
Dimethyl ether	C_2H_6O	-23.7	-6.4	+20.8	45.5	75.7	112.1	.....	(55, 74, 211, 260, 350)
Ethanethiol	C_2H_6S	35.0	56.6	90.7	121.9	159.5	204.7	.....	(39)
Dimethyl sulfide	C_2H_6S	36.0	57.8	92.3	124.5	163.8	209.0	.....	(39)
Ethylamine	C_2H_7N	16.6	35.7	65.3	91.8	124.0	163.0	.....	(38)

ORGANIC COMPOUNDS (Continued)
Pressures Greater than One Atmosphere (Continued)

Name	Formula	Temperature °C							Citation No.
		1 atm.	2 atm.	5 atm.	10 atm.	20 atm.	40 atm.	60 atm.	
Dimethylamine	C_2H_7N	7.4	25.0	53.9	80.0	111.7	149.8	.....	(38, 390, 467)
Cyanogen	C_2N_2	− 21.0	− 4.4	+ 21.4	44.6	72.6	106.5	.....	(79, 101, 113, 125, 318, 426)
Propadiene	C_3H_4	− 35.0	− 18.4	+ 8.0	33.2	64.5	103.5	.....	(113, 244, 255)
Propyne	C_3H_4	− 23.3	− 7.1	+ 19.5	43.8	74.0	111.5	.....	(113, 165, 262, 286)
Propylene	C_3H_6	− 47.7	− 31.4	− 4.8	+ 19.8	49.5	85.0	.....	(6, 66, 67, 137, 244, 262, 359, 382)
Acetone	C_3H_6O	56.5	78.6	113.0	144.5	181.0	214.5	.....	(29, 115, 129, 343, 364)
Propionic acid	$C_3H_6O_2$	141.1	160.0	186.0	203.5	220.0	233.0	.....	(203, 204, 353, 373)
Methyl acetate	$C_3H_6O_2$	57.8	79.5	113.1	144.2	181.0	225.0	.....	(113, 491)
Ethyl formate	$C_3H_6O_2$	54.3	76.0	110.5	142.2	180.0	225.0	.....	(297, 491)
Propane	C_3H_8	− 42.1	− 25.6	+ 1.4	26.9	58.1	94.8	.....	(6, 30, 66, 93, 137, 153, 262, 359)
1-Propanol	C_3H_8O	97.8	117.0	149.0	177.0	210.8	250.0	.....	(113, 289, 340, 374)
2-Propanol	C_3H_8O	82.5	101.3	130.2	155.7	186.0	220.2	.....	(310)
Ethyl methyl ether	C_3H_8O	7.5	26.5	56.4	84.0	108.0	160.0	.....	(39)
Propylamine	C_3H_9N	48.5	69.8	102.8	133.4	170.0	214.5	.....	(38)
1,3-Butadiene	C_4H_6	− 4.5	+ 15.3	47.0	76.0	114.0	158.0	.....	(52, 162, 189, 445)
Acetic anhydride	$C_4H_6O_3$	139.6	162.0	194.0	221.5	253.0	288.5	.....	(33, 113, 201)
Dimethyl oxalate	$C_4H_6O_4$	163.3	189.6	228.7	....	....	....	.....	(11, 97, 144)
Butyric acid	$C_4H_8O_2$	163.5	188.3	225.0	257.0	295.0	338.0	.....	(204, 332, 373, 374)
Isobutyric acid	$C_4H_8O_2$	154.5	179.8	217.0	250.0	289.0	336.0	.....	(203, 204, 353, 373, 374)
Ethyl acetate	$C_4H_8O_2$	77.1	100.6	136.6	169.7	209.5	....	.....	(113, 455, 491)
Methyl propionate	$C_4H_8O_2$	79.8	103.0	139.8	172.6	212.5	....	.....	(491)
Propyl formate	$C_4H_8O_2$	81.3	104.3	142.0	176.4	217.5	.....	....	(297, 491)
Butane	C_4H_{10}	− 0.5	+ 18.8	50.0	79.5	116.0	....	.....	(6, 66, 93, 359, 382)
2-Methylpropane	C_4H_{10}	− 11.7	+ 7.5	39.0	66.8	99.5	....	.....	(6, 16, 93, 187, 359, 382)
Butyl alcohol	$C_4H_{10}O$	117.5	139.8	172.5	203.0	237.0	277.0	.....	(68, 174, 203, 204, 314)

ORGANIC COMPOUNDS (Continued)
Pressures Greater than One Atmosphere (Continued)

Name	Formula	Temperature °C							Citation No.
		1 atm.	2 atm.	5 atm.	10 atm.	20 atm.	40 atm.	60 atm.	
sec-Butyl alcohol	$C_4H_{10}O$	99.5	118.2	147.5	172.0	204.0	251.0	.....	(68)
Isobutyl alcohol	$C_4H_{10}O$	108.0	127.3	156.2	182.0	212.5	251.0	.....	(68, 203, 219, 374)
tert-Butyl alcohol	$C_4H_{10}O$	82.9	102.0	130.0	154.2	184.5	222.5	.....	(68, 310)
Diethyl ether	$C_4H_{10}O$	34.6	56.0	90.0	122.0	159.0	....	.....	(31, 113, 115, 289, 338, 423a)
Diethyl sulfide	$C_4H_{10}S$	88.0	112.0	153.8	190.2	234.0	....	.....	(25, 39)
Diethylamine	$C_4H_{11}N$	55.5	77.8	113.0	145.3	184.5	....	.....	(38)
Tetramethylsilane	$C_4H_{12}Si$	27.0	48.0	82.0	113.0	152.0	....	.....	(15, 114)
Ethyl propionate	$C_5H_{10}O_2$	99.1	123.8	162.7	197.8	240.0	....	.....	(491)
Propyl acetate	$C_5H_{10}O_2$	101.8	126.8	165.7	200.5	242.8	....	.....	(11, 113, 199, 491)
Isobutyl formate	$C_5H_{10}O_2$	98.2	121.8	157.8	192.4	234.0	....	.....	(292, 380)
Methyl butyrate	$C_5H_{10}O_2$	102.3	127.5	166.7	203.0	244.5	....	.....	(11, 491)
Methyl isobutyrate	$C_5H_{10}O_2$	92.6	116.7	155.2	190.2	232.0	....	.....	(491)
Pentane	C_5H_{12}	36.1	58.0	92.4	124.7	164.3	....	.....	(6, 28, 93, 274, 359, 482, 485)
2-Methylbutane	C_5H_{12}	27.8	48.8	82.8	114.5	154.0	....	.....	(6, 93, 359, 485, 486, 492)
2,2-Dimethylpropane	C_5H_{12}	+ 9.5	29.5	61.1	90.7	127.6	....	.....	(6, 17, 113, 253, 359, 465)
Ethyl propyl ether	$C_5H_{12}O$	61.7	85.3	123.1	156.2	197.2	....	.....	(39)
Bromobenzene	C_6H_5Br	156.2	186.2	232.5	274.5	327.0	387.5	.....	(11, 199, 204, 289, 358, 478)
Chlorobenzene	C_6H_5Cl	132.2	160.2	205.0	245.3	292.8	349.8	.....	(11, 199, 289, 478)
Fluorobenzene	C_6H_5F	84.7	109.9	148.5	184.4	227.6	279.3	.....	(113, 416, 478)
Iodobenzene	C_6H_5I	188.6	220.0	270.0	315.7	371.5	437.2	.....	(115, 289, 358, 478)
Benzene	C_6H_6	80.1	103.8	142.5	178.8	221.5	272.3	.....	(3, 6, 11, 32, 109, 131, 197, 204, 289, 343, 359, 366, 392, 415, 478)
Phenol	C_6H_6O	181.9	208.0	248.2	283.8	328.7	382.1	418.7	(11, 34, 113, 151, 174, 203, 204)

ORGANIC COMPOUNDS (Continued)
Pressures Greater than One Atmosphere (Continued)

Name	Formula	Temperature °C							Citation No.
		1 atm.	2 atm.	5 atm.	10 atm.	20 atm.	40 atm.	60 atm.	
Aniline	C_6H_7N	184.4	212.8	254.8	292.7	342.0	400.0	.....	(11, 34, 143, 151, 204, 341)
Cyclohexane	C_6H_{12}	80.7	106.0	146.4	184.0	228.4	....	.....	(6, 109, 293, 359, 487)
Ethyl isobutyrate	$C_6H_{12}O_2$	110.1	135.5	174.2	210.0	253.0	....	.....	(292, 380)
Hexane	C_6H_{14}	68.7	93.0	131.7	166.6	209.4	....	.....	(6, 115, 251, 289, 359, 394, 427, 474)
2,3-Dimethylbutane	C_6H_{14}	58.0	82.0	120.3	155.7	198.7	....	.....	(6, 359, 471, 488)
Toluene	C_7H_8	110.6	136.5	178.0	215.8	262.5	319.0	.....	(6, 11, 24, 107, 115, 199, 204, 239, 253, 359)
Heptane	C_7H_{16}	98.4	124.8	165.7	202.8	247.5	....	.....	(6, 251, 269, 289, 359, 394, 483)
Ethylbenzene	C_8H_{10}	136.2	163.5	207.5	246.3	294.5	....	.....	(6, 11, 265, 359, 415, 471, 474)
Octane	C_8H_{18}	125.6	152.7	196.2	235.8	181.4	....	.....	(6, 251, 253, 359, 471, 474, 492)
Dodecane	$C_{12}H_{26}$	216.2	249.2	300.0	345.8	....	....	.....	(11, 27, 223, 224, 225)

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VAPOR PRESSURE

Variation with Temperature

The following table gives the value of the constants *a* and *b* in the following equation:

$$\log_{10} p = -\frac{0.05223a}{T} + b$$

where *p* is the pressure in mm of mercury of the saturated vapor at the absolute temperature *T*. ($T = t°C + 273.1$). The values obtained by the use of the equation given above are valid within the temperature ranges indicated for each of the compounds.

Elements and Inorganic Compounds

Compound	Formula	Temp. range °C	*a*	*b*
Aluminum oxide	Al_2O_3	1840 to 2200 liq.	540,000	14.22
Ammonia	NH_3	−127 to −78 sol.	31,211	9.9974
Ammonium bromide	NH_4Br	250 to 400 sol.	90,208	9.9404
Ammonium chloride	NH_4Cl	100 to 400 sol.	83,486	10.0164
Ammonium cyanide	NH_4CN	7 to 17 sol.	41,484	9.978
Ammonium iodide	NH_4I	300 to 400 sol.	95,730	10,2700
Ammonium sulfhydrate	NH_4HS	6 to 40 sol.	46,025	10.7500
Antimony	Sb	1070 to 1325 liq.	189,000	9.051
Argon	A	−208 to −189 sol.	7,814.5	7.5741
		−189 to −183 liq.	6,826.0	6.9605
Arsenic	As	800 to 860 liq.	47,100	6.692
		440 to 815 sol.	133,000	10.800
Arsenous oxide	As_2O_3	100 to 310 sol.	111,350	12.127
		315 to 490 liq.	52,120	6.513
Barium	Ba	930 to 1130 liq.	350,000	15.765
Bismuth	Bi	1210 to 1420 liq.	200,000	8.876
Bismuth trichloride	$BiCl_3$	91 to 213 sol.	13,125	2.681
Cadmium	Cd	150 to 320.9 sol.	109,000	8.564
		500 to 840 liq.	99,900	7.897
Cadmium iodide	CdI_2	385 to 450 liq.	122,200	9.269
Caesium	Cs	200 to 350 liq	73,400	6.949
Caesium chloride	CsCl	986 to 1295 liq	163,200	8.340

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	*a*	*b*
Calcium	Ca	960 to 1110 liq.	370,000	16.240
Carbon	C	3880 to 4430 liq.	540,000*	9.596*
Carbon dioxide	CO_2	−135 to −56.7 sol.	26,179.3	9.9082
Carbon monoxide	CO	−290 to −206 liq.	6,354	6.976
Chlorine	Cl	−154 to −103 sol.	29,293	9.950
Cobalt	Co	2375 liq.	309,000	7.571
Copper	Cu	2100 to 2310 liq.	468,000	12.344
Cuprous chloride	Cu_2Cl_2	878 to 1369 liq.	80,700	5.454
Cyanogen	$(CN)_2$	−72 to −28 sol.	32,437	9.6539
		−32 to −6 liq.	23,750	7.808
Ferrous chloride	$FeCl_2$	700 to 930 sol.	135,200	8.33
Gold	Au	2315 to 2500 liq.	385,000	9.853
Hydriodic acid	HI	−97 to −51 sol.	24,160	8.259
		−50 to −34 liq.	21,580	7.630
Hydrobromic acid	HBr	−114 to −86 sol.	22,420	8.734
		−86 to −66 liq.	17,960	7.427
Hydrochloric acid	HCl	−158 to −110 sol.	19,588	8.4430
Hydrocyanic acid	HCN	−8 to +27 liq.	27,830	7.7446
Hydrofluoric acid	HF	−83 to +48 liq.	25,180	7.370
Hydrogen peroxide	H_2O_2	10 to 90 liq.	48,530	8.853
Hydrogen sulfide	H_2S	−110 to −83 sol.	20,690	7.880
Iron	Fe	2220 to 2450 liq.	309,000	7.482
Krypton	Kr	−189 to −169 sol.	10,065	7.1770
		−169 to −150 liq.	9,377.0	6.92387
Lead	Pb	525 to 1325 liq.	188,500	7.827
Lead bromide	$PbBr_2$	735 to 918 liq.	118,000	8.064
Lead chloride	$PbCl_2$	500 to 950 liq.	141,900	8.961
Lithium bromide	LiBr	1010 to 1265 liq.	152,700	8.068
Lithium chloride	LiCl	1045 to 1325 liq.	155,900	7.939
Lithium fluoride	LiF	1398 to 1666 liq.	218,400	8.753
Lithium iodide	LiI	940 to 1140 liq.	143,600	8.011
Magnesium	Mg	900 to 1070 liq.	260,000	12.993

* Based on boiling point of 3927° C or 4200° absolute.

Compound	Formula	Temp. range °C	*a*	*b*
Manganese	Mn	1510 to 1900 liq.	267,000	9.300
Mercuric bromide	$HgBr_2$	111 to 235 sol.	79,800	10.181
		238 to 331 liq.	61,250	8.284
Mercuric chloride	$HgCl_2$	60 to 130 sol.	85,030	10.888
		130 to 270 sol.	78,850	10.094
		275 to 309 liq.	61,020	8.409
Mercuric iodide	HgI_2	100 to 250 sol.	82,340	10.057
		266 to 360 liq.	62,770	8.115
Mercury	Hg	−80 to −38.87 sol.	73,000	10.383
		400 to 1300 liq	58,700	7.752
Molybdenum	Mo	1800 to 2240 sol.	680,000	10.844
Nitrogen	N_2	−215 to −210 sol.	6,881.3	7.66558
Nitrogen dioxide	NO	−200 to −161 sol.	16,423	10.048
		−163.7 to −148 liq.	13,040	8.440
Nitrogen monoxide	N_2O	−144 to −90 sol.	23,590	9.579
		−90.1 to −88.7 liq.	16,440	7.535
Nitrogen pentoxide	N_2O_5	−30 to +30 sol.	57,180	12.647
Nitrogen tetroxide	N_2O_4	−100 to −40 sol.	55,160	13.400
		−40 to −10 sol.	45,440	11.214
		−8 to +43.2 liq.	33,430	8.814
Nitrogen trioxide	N_2O_3	−25 to 0 liq.	39,400	10.30
Phosphorus (white)	P	20 to 44.1 sol.	63,123	9.6511
Phosphorus (violet)	P	380 to 590 sol.	108,510	11.0842
Platinum	Pt	1425 to 1765 sol.	486,000	7.786
Potassium	K	260 to 760 liq.	84,900	7.183
Potassium bromide	KBr	906 to 1063 liq.	168,100	8.2470
		1095 to 1375 liq.	163,800	7.936
Potassium chloride	KCl	906 to 1105 liq.	174,500	8.3526
		1116 to 1418 liq.	169,700	8.130
Potassium fluoride	KF	1278 to 1500 liq.	207,500	9.000
Potassium hydroxide	KOH	1170 to 1327 liq.	136,000	7.330
Potassium iodide	KI	843 to 1028 liq.	157,600	8.0957
		1063 to 1333 liq.	155,700	7.949

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	*a*	*b*
Rubidium	Rb	250 to 370 liq.	76,000	6.976
Rubidium chloride	RbCl	1142 to 1395 liq.	198,600	9.111
Silicon	Si	1200 to 1320 sol.	170,000	5.950
Silicon dioxide	SiO_2	1860 to 2230 liq.	506,000	13.43
Silver	Ag	1650 to 1950 liq.	250,000	8.762
Silver chloride	AgCl	1255 to 1442 liq.	185,500	8.179
Sodium	Na	180 to 883 liq.	103,300	7.553
Sodium bromide	NaBr	1138 to 1394 liq.	161,600	7.948
Sodium chloride	NaCl	976 to 1155 liq.	180,300	8.3297
		1156 to 1430 liq.	185,800	8.548
Sodium cyanide	NaCN	800 to 1360 liq.	155,520	7.472
Sodium fluoride	NaF	1562 to 1701 liq.	218,200	8.640
Sodium hydroxide	NaOH	1010 to 1402 liq.	132,000	7.030
Sodium iodide	NaI	1063 to 1307 liq.	165,100	8.371
Stannic chloride	$SnCl_4$	−52 to −38 sol.	46,740	9.824
Strontium	Sr	940 to 1140 liq.	360,000	16.056
Sulfur dioxide	SO_2	−95 to −75 sol.	35,827	10.5916
Sulfur trioxide	SO_3	24 to 48 liq.	43,450	10.022
Thallium	Tl	950 to 1200 liq.	120,000	6.140
Thallium chloride	TlCl	665 to 807 liq.	105,200	7.974
Tin	Sn	1950 to 2270 liq.	328,000	9.643
Tungsten	W	2230 to 2770 sol.	897,000	9.920
Zinc	Zn	250 to 419.4 sol.	133,000	9.200
		600 to 985 liq.	118,000	8.108

Organic Compounds

Compound	Formula	Temp. range °C	*a*	*b*
Acetaldehyde	C_2H_4O	−24.3 to +27.5 liq.	27,707	7.8206
Acetic acid	$C_2H_4O_2$	−35 to 10 sol.	41,689	8.502
Acetic anhydride	$C_4H_6O_3$	100 to 140 liq.	45,585	8.688

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	a	b
Acetylene	C_2H_2	−140 to −82 sol.	21,914	8.933
Aniline	C_6H_7N	145 to185 liq.	45,951.6	8.1278
Anthracene	$C_{14}H_{10}$	100 to 600 sol.	70,390	8.706
		100 to 160 liq.	72,000	8.91
		223 to 342 liq.	59,219	7.910
Anthraquinone	$C_{14}H_8O_2$	224 to 286 sol.	110,040	12.305
Benzene	C_6H_6	−58 to −30 sol.	42,904	9.556
		−30 to +5 sol.	44,222	9.846
		0 to 42 liq.	34,172	7.9622
		42 to 100 liq.	32,295	7.6546
Benzoic acid	$C_7H_6O_2$	60 to 110 sol.	63,820	9.033
Benzophenone	$C_{13}H_{10}O$	260 to 308 liq.	58,221	8.137
Benzoyl chloride	C_7H_5ClO	140 to 200 liq.	45,416	7.9245
Benzyl alcohol	C_7H_8O	100 to 135 liq.	59,491	9.5152
		135 to 205 liq.	53,118	8.6977
Butane	C_4H_{10}	−100 to +12 liq.	23,450	7.395
iso-Butane	C_4H_{10}	−115 to −34 liq.	21,273	7.25
n-Butyl alcohol	$C_4H_{10}O$	75 to 117.5 liq	46,774	9.1362
Butyric acid	$C_4H_8O_2$	80 to 165 liq.	51,103	9.010
Bromobenzene	C_6H_5Br	−26 to −15 liq.	42,500	8.075
p-Bromochlorobenzene	C_6H_4BrCl	23 to 63 sol.	69,755	11.629
Camphor	$C_{10}H_{16}O$	0 to 180 sol.	53,559	8.799
Carbon tetrachloride	CCl_4	−70 to −50 sol.	34,608	8.05
		−19 to +20 liq.	33,914	8.004
Chlorobenzene	C_6H_5Cl	−35 to −15 liq.	42,250	8.500
Cyclohexane	C_6H_{12}	−5 to +5 sol.	37,394	8.594
p-Dichlorobenzene	$C_6H_4Cl_2$	30 to 50 sol.	72,218	12.480
Dichloroethane-1,1	$C_2H_4Cl_2$	0 to 30 liq.	31,706	7.909
Dichloroethane-1,2	$C_2H_4Cl_2$	0 to 30 liq.	35,598	8.126
Diphenylamine	$C_{12}H_{11}N$	278 to 284 liq.	57,350	8.088
Ethyl chloride	C_2H_5Cl	−30 to +30 liq.	26,319	7.691
Ethylene	C_2H_4	−160 to −104 liq.	14,396	7.330

VAPOR PRESSURE (Continued)

Compound	Formula	Temp. range °C	*a*	*b*
Ethylene bromide	$C_2H_4Br_2$	10 to 150 liq.	38,082	7.792
Heptane	C_7H_{16}	−63 to −40 liq.	37,358	8.2585
Hexane	C_6H_{14}	−10 to +90 liq.	31,679	7.724
Iodobenzene	C_6H_5I	−30 to +18 liq.	43,000	7.500
Methane	CH_4	−194 to −184 sol.	9,896.2	7.6509
		−174 to −163 liq.	8,516.9	6.8626
Methyl alcohol	CH_4O	−62 to −44 liq.	39,234	8.9547
		−10 to +80 liq.	38,324	8.8017
Methyl chloride	CH_3Cl	−47 to −10 liq.	21,988	7.481
Methyl ether	C_2H_6O	−76 to −20 liq.	23,025	7.720
Methyl fluoride	CH_3F	−102 to −76 liq.	17,053	7.445
Methyl salicylate	$C_8H_8O_3$	175 to 215 liq.	48,670	8.008
Naphthalene	$C_{10}H_8$	0 to 80 sol.	71,401	11.450
		120 to 200 liq.	47,362	7.927
o-Nitroaniline	$C_6H_6N_2O_2$	150 to 260 liq.	63,881	8.8684
m-Nitroaniline	$C_6H_6N_2O_2$	170 to 260 liq.	65,880	8.8188
p-Nitroaniline	$C_6H_6N_2O_2$	190 to 260 liq.	77,345	9.5595
Nitrobenzene	$C_6H_5NO_2$	112 to 209 liq.	48,955	8.192
Nitromethane	CH_3NO_2	47 to 100 liq.	36,914	8.033
Oxalic acid	$C_2H_2O_4$	55 to 105 sol.	90,502.6	12.2229
n-Pentane	C_5H_{12}	−20 to +50 liq.	27,691	7.558
Phenol	C_6H_6O	116 to 180 liq.	49,644	8.587
Phthalic anhydride	$C_8H_4O_3$	160 to 285 liq.	54,920	8.022
Propane	C_3H_8	−136 to −40 liq.	19,037	7.217
Propionic acid	$C_3H_6O_2$	20 to 140 liq.	46,150	8.715
n-Propyl alcohol	C_3H_8O	−45 to −10 liq.	47,274	9.5180
Propyl bromide	C_3H_7Br	0 to 30 liq.	32,430	7.821
Propyl chloride	C_3H_7Cl	0 to 50 liq.	28,894	7.593
Propylene	C_3H_6	−95 to −48 liq.	19,693	7.4463
Quinoline	C_9H_7N	180 to 240 liq.	49,720	7.969
Tetrachloroethane-1, 1, 1, 2	$C_2H_2Cl_4$	105 to 145 liq.	36,508	7.605
Tetrachloroethane-1, 1, 2, 2	$C_2H_2Cl_4$	26 to 145 liq.	39,729	7.846
Toluene	C_7H_8	−92 to +15 liq.	39,198	8.330

LOWERING OF VAPOR PRESSURE BY SALTS IN AQUEOUS SOLUTIONS

The table gives the reduction of the vapor pressure in millimeters due to the presence of the number of grammolecules of salt per liter of water given at the head of the columns, at the temperature 100° C, at which temperature the vapor pressure of pure water is 760 millimeters.

(From Smithsonian Tables.)

Substance	0.5	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0
$Al_2(SO_4)_3$	12.8	36.5							
$AlCl_3$	22.5	61.0	179.0	318.0					
BaS_2O_6	6.6	15.4	34.4						
$Ba(OH)_2$	12.3	22.5	39.0						
$Ba(NO_3)_2$	13.5	27.0							
$Ba(ClO_3)_2$	15.8	33.3	70.5	108.2					
$BaCl_2$	16.4	36.7	77.6						
$BaBr_2$	16.8	38.8	91.4	150.0	204.7				
CaS_2O_8	9.9	23.0	56.0	106.0					
$Ca(NO_3)_2$	16.4	34.8	74.6	139.3	161.7	205.4			
$CaCl_2$	17.0	39.8	95.3	166.6	241.5	319.5			
$CaBr_2$	17.7	44.2	105.8	191.0	283.3	368.5			
$CdSO_4$	4.1	8.9	18.1						
CdI_2	7.6	14.8	33.5	52.7					
$CdBr_2$	8.6	17.8	36.7	55.7	80.0				
$CdCl_2$	9.6	18.8	36.7	57.0	77.3	99.0			
$Cd(NO_3)_2$	15.9	36.1	78.0	122.2					
$Cd(ClO_3)_2$	17.5								
$CoSO_4$	5.5	10.7	22.9	45.5					
$CoCl_2$	15.0	34.8	83.0	136.0	186.4				
$Co(NO_3)_2$	17.3	39.2	89.0	152.0	218.7	282.0	332.0		
$FeSO_4$	5.8	10.7	24.0	42.4					
H_3BO_3	6.0	12.3	25.1	38.0	51.0				
H_3PO_4	6.6	14.0	28.6	45.2	62.0	81.5	103.0	146.9	189.5
H_3AsO_4	7.3	15.0	30.2	46.4	64.9				
H_2SO_4	12.9	26.5	62.8	104.0	148.0	198.4	247.0	343.2	
KH_2PO_4	10.2	19.5	33.3	47.8	60.5	73.1	85.2		
KNO_3	10.3	21.1	40.1	57.6	74.5	88.2	102.1	126.3	148.0
$KClO_3$	10.6	21.6	42.8	62.1	80.0				
$KBrO_3$	10.9	22.4	45.0						
$KHSO_4$	10.9	21.9	43.3	65.3	85.5	107.8	129.2	170.0	
KNO_2	11.1	22.8	44.8	67.0	90.0	110.5	130.7	167.0	198.8
$KClO_4$	11.5	22.3							
KCl	12.2	24.4	48.8	74.1	100.9	128.5	152.2		
$KHCO_3$	11.6	23.6	59.0	77.6	104.2	132.0	160.0	210.0	255.0
KI	12.5	25.3	52.2	82.6	112.2	141.5	171.8	225.5	278.5
$K_2C_2O_4$	13.9	28.3	59.8	94.2	131.0				
K_2WO_4	13.9	33.0	75.0	123.8	175.4	226.4			
K_2CO_3	14.4	31.0	68.3	105.5	152.0	209.0	258.5	350.0	
KOH	15.0	29.5	64.0	99.2	140.0	181.8	223.0	309.5	387.8
K_2CrO_4	16.2	29.5	60.0						
$LiNO_3$	12.2	25.9	55.7	88.9	122.2	155.1	188.0	253.4	309.2
$LiCl$	12.1	25.5	57.1	95.0	132.5	175.5	219.5	311.5	393.5
$LiBr$	12.2	26.2	60.0	97.0	140.0	186.3	241.5	341.5	438.0
Li_2SO_4	13.3	28.1	56.8	89.0					
$LiHSO_4$	12.8	27.0	57.0	93.0	130.0	168.0			
LiI	13.6	28.6	64.7	105.2	154.5	206.0	264.0	357.0	445.0
Li_2SiFl_6	15.4	34.0	70.0	106.0					
$LiOH$	15.9	37.4	78.1						
Li_2CrO_4	16.4	32.6	74.0	120.0	171.0				
$MgSO_4$	6.5	12.0	24.5	47.5					
$MgCl_2$	16.8	39.0	100.5	183.3	277.0	377.0			
$Mg(NO_3)_2$	17.6	42.0	101.0	174.8					

LOWERING OF VAPOR PRESSURE BY SALTS IN AQUEOUS SOLUTIONS (Continued)

Substance	0.5	1.0	2.0	3.0	4.0	5.0	6.0	8.0	10.0
$MgBr_2$	17.9	44.0	115.8	205.3	298.5				
$MgH_2(SO_4)_2$	18.3	46.0	116.0						
$MnSO_4$	6.0	10.5	21.0						
$MnCl_2$	15.0	34.0	76.0	122.3	167.0	209.0			
NaH_2PO_4	10.5	20.0	36.5	51.7	66.8	82.0	96.5	126.7	157.1
$NaHSO_4$	10.9	22.1	47.3	75.0	100.2	126.1	148.5	189.7	231.4
$NaNO_3$	10.6	22.5	46.2	68.1	90.3	111.5	131.7	167.8	198.8
$NaClO_3$	10.5	23.0	48.4	73.5	98.5	123.3	147.5	196.5	223.5
$(NaPO_3)_6$	11.6								
$NaOH$	11.8	22.8	48.2	77.3	107.5	139.1	172.5	243.3	314.0
$NaNO_2$	11.6	24.4	50.0	75.0	98.2	122.5	146.5	189.0	226.2
Na_2HPO_4	12.1	23.5	43.0	60.0	78.7	99.8	122.1		
$NaHCO_3$	12.9	24.1	48.2	77.6	102.2	127.8	152.0	198.0	239.4
Na_2SO_4	12.6	25.0	48.9	74.2					
$NaCl$	12.3	25.2	52.1	80.0	111.0	143.0	176.5		
$NaBrO_3$	12.1	25.0	54.1	81.3	108.8	136.0			
$NaBr$	12.6	25.9	57.0	89.2	124.2	159.5	197.5	268.0	
NaI	12.1	25.6	60.2	99.5	136.7	177.5	221.0	301.5	370.0
$Na_4P_2O_7$	13.2	22.0							
Na_2CO_3	14.3	27.3	53.5	80.2	111.0				
$Na_2C_2O_4$	14.5	30.0	65.8	105.8	146.0				
Na_2WO_4	14.8	33.6	71.6	115.7	162.6				
Na_3PO_4	16.5	30.0	52.5						
$(NaPO_3)_3$	17.1	36.5							
NH_4NO_3	12.8	22.0	42.1	62.7	82.9	103.8	121.0	152.2	180.0
$(NH_4)_2SiFl_6$	11.5	25.0	44.5						
NH_4Cl	12.0	23.7	45.1	69.3	94.2	118.5	138.2	179.0	213.8
NH_4HSO_4	11.5	22.0	46.8	71.0	94.5	118.	139.0	181.2	218.0
$(NH_4)_2SO_4$	11.0	24.0	46.5	69.5	93.0	117.0	141.8		
NH_4Br	11.9	23.9	48.8	74.1	99.4	121.5	145.5	190.2	228.5
NH_4I	12.9	25.1	49.8	78.5	104.5	132.3	156.0	200.0	243.5
$NiSO_4$	5.0	10.2	21.5						
$NiCl_2$	16.1	37.0	86.7	147.0	212.8				
$Ni(NO_3)_2$	16.1	37.3	91.3	156.2	235.0				
$Pb(NO_3)_2$	12.3	23.5	45.0	63.0					
$Sr(SO_3)_2$	7.2	20.3	47.0						
$Sr(NO_3)_2$	15.8	31.0	64.0	97.4	131.4				
$SrCl_2$	16.8	38.8	91.4	156.8	223.3	281.5			
$SrBr_2$	17.8	42.0	101.1	179.0	267.0				
$ZnSO_4$	4.9	10.4	21.5	42.1	66.2				
$ZnCl_2$	9.2	18.7	46.2	75.0	107.0	153.0	195.0		
$Zn(NO_3)_2$	16.6	39.0	93.5	157.5	223.8				

VAPOR PRESSURE OF NITRIC ACID

Temperature °C	Vapor Pressure, mm. of Hg	
	100% HNO_3	90% of HNO_3
0	14.4	5.5
10	26.6	11.
20	47.9	20.
30	81.3	37.3
40	133.	64.4
50	208.	107.
70	467.	242.
80	670.	352.
90	937.	504.
100	1282.	710.

HEAT CONDUCTIVITY

Giving the quantity of heat in calories which is transmitted per **second** through a plate one centimeter thick across an area of one square centimeter when the temperature difference is one degree Centigrade.

METALS

Substance	Temp. ° C.	Conductivity	Observer
Aluminum	–160	0.514	Lees, 1908
	18	0.480	Jaeger & Diesselhorst, 1900
	18	0.504	Lees, 1908
	100	0.492	Jaeger & Diesselhorst, 1900
	100	0.49	Angell, 1911
	200	0.55	"
	300	0.64	"
	400	0.76	"
	600	1.01	"
Antimony	0	0.0442	Lorenz, 1881
	100	0.040	"
	0–30	0.042	Berget, 1890
Bismuth	–186	0.025	Macchia, 1907
	0	0.0177	Lorenz
	18	0.0194	Jaeger & Diesselhorst, 1900
	100	0.0161	Jaeger & Diesselhorst, 1900
Brass (70Cu+30Zn)	–160	0.181	Lees, 1908
(70Cu+30Zn)	17	0.260	" "
yellow	0	0.204	Lorenz
red	0	0.246	"
Bronze, aluminum (90Cu, 10Al)	....	0.18	Van Aubel
Cadmium	–160	0.239	Lees, 1908
	0	0.220	Lorenz
	18	0.222	Jaeger & Diesselhorst, 1900
	100	0.216	Jaeger & Diesselhorst, 1900
Constantan	18	0.054	Jaeger & Diesselhorst, 1900
(60Cu, 40Ni)	100	0.064	Jaeger & Diesselhorst, 1900
Copper, pure	–160	1.097	Lees, 1908
	13	1.00	Angström, 1863
	18	0.918	Jaeger & Diesselhorst, 1900

HEAT CONDUCTIVITY (Continued)

METALS

Substance	Temp. ° C.	Conductivity	Observer
Copper, pure........	100	0.908	Jaeger & Diesselhorst, 1900
	100-197	1.043	Hering, 1910
	100-268	0.969	“
	100-370	0.931	“
	100-541	0.902	“
	100-837	0.858	“
German silver.......	0	0.070	Lorenz, 1881
	100	0.089	“
(52Cu, 26Zn, 22Ni)	....	0.10	Glage, 1905
Gold...............	17	0.705	Barratt, 1914
	18	0.700	Jaeger & Diesselhorst, 1900
	100	0.703	Jaeger & Diesselhorst, 1900
Iridium............	17	0.141	Barratt, 1914
Iron, pure..........	18	0.161	Jaeger & Diesselhorst
	100	0.151	“ “
	100-727	0.202	Hering, 1910
	100-1245	0.191	“
wrought..........	-160	0.152	Lees, 1908
	18	0.144	Jaeger & Diesselhorst
	100	0.143	“ “
cast.............	18	0.109	“ “
	100	0.108	“ “
	54	0.114	Callendar
	102	0.111	“
Steel...............	-160	0.113	Lees, 1908
	18	0.115	“ “
	18	0.108	Jaeger & Diesselhorst
	100	0.107	“ “
Lead...............	-160	0.092	Lees, 1908
	18	0.083	Jaeger & Diesselhorst
	100	0.082	“ “
Magnesium.	0-100	0.376	Lorenz, 1881
Manganin..........	18	0.0519	Jaeger & Diesselhorst
(84Cu, 4Ni, 12Mn)	100	0.06310	“ “
	-160	0.035	Lees, 1908
Mercury...........	0	0.0148	H. F. Weber, 1880
	50	0.0189	“ “
	17	0.0197	R. Weber, 1902
Molybdenum.......	17	0.346	Barratt, 1914
Nickel.............	-160	0.129	Lees, 1908

HEAT CONDUCTIVITY (Continued)

METALS

Substance	Temp. °C.	Conductivity	Observer
Nickel	18	0.142	Jaeger & Diesselhorst, 1900
	100	0.138	Jaeger & Diesselhorst, 1900
	300	0.126	Angell, 1911
	600	0.088	"
	800	0.068	"
	1200	0.058	"
Palladium	18	0.1683	Jaeger & Diesselhorst, 1900
	100	0.182	
Platinum	18	0.1664	Jaeger & Diesselhorst, 1900
	100	0.1733	Jaeger & Diesselhorst, 1900
Platinum-iridium. 10 % Ir	17	0.074	Barratt, 1914
Platinum-rhodium. 10 % Rh	17	0.072	Barratt, 1914
Platinoid	18	0.060	Lees, 1908
Rhodium	17	0.210	Barratt, 1914
Silver, pure	−160	0.998	Lees, 1908
	18	0.974	"
	18	1.006	Jaeger & Diesselhorst, 1900
	100	0.992	Jaeger & Diesselhorst, 1900
Tin	−160	0.192	Lees, 1908
	0	0.1528	Lorenz, 1881
	18	0.155	Jaeger & Diesselhorst, 1900
	100	0.145	Jaeger & Diesselhorst, 1900
	100	0.1423	Lorenz, 1881
Tantalum	17	0.130	Barratt, 1914
Tungsten	17	0.476	"
	18	0.35	Coolidge
Wood's alloy	....	0.0319	H. F. Weber
Zinc	−160	0.278	Lees, 1908
	18	0.2653	Jaeger & Diesselhorst
	100	0.2619	" "

HEAT CONDUCTIVITY (Continued)

VARIOUS SOLIDS

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Asbestos fiber, 500° C. .	0.00019	Randolph, 1912
paper.	0.0006	. . . .
	0.0004	Lees-Chorlton, 1896
Basalt.	0.0052	Hecht, 1903
Brick, common red. . . .	0.0015	Herschel-Lebour & Dunn, 1879
Blotting paper.	0.00015	Lees-Charlton, 1896
Carbon.	0.01	
Carborundum.	0.0005	Lorenz
brick, 150°–1200°. . .	0.032–0.027	Wologdine
Cardboard.	0.0005	. . . .
Cement, Portland.	0.00071	Lees-Chorlton, 1896
Chalk.	0.0020	Herschel-Lebour & Dunn, 1879
Concrete, cinder.	0.00081	. . . .
stone.	0.0022	Norton
Cork.	0.00072	G. Forbes, 1875
	0.00013	Lees, 1892–8
Cotton wool.	0.000043	G. Forbes
felted.	0.000033	"
Diatomic earth.	0.00013	Hutton-Blard
Earth's crust, ave.	0.004	. . . .
Ebonite.	0.00042	Lees
	0.00014	Barratt, 1914
Eiderdown, d = .109. .	0.000046	Peclet, 1878
Felt.	0.000087	. . . .
Fiber, red.	0.0011	Barratt, 1914
Fire brick.	0.00028	Hutton-Blard
	0.0011	Barratt, 1914
Flannel.	0.00023	
Gas carbon, 20°.	0.0085	Barratt, 1914
100°.	0.0095	"
Glass		
crown (window). . . .	0.0025	Lees, 1892–8
flint.	0.002	"
Jena.	0.001–0.002	"
soda, 20°.	0.0017	Barratt, 1914
100°.	0.0018	"
Granite, 100°.	0.0045–0.0050	Poole, 1912
500°.	0.0040	"
Graphite.	0.012	. . . .
Graphite brick, 300° to 700°.	0.24	Wologdine, 1909

HEAT CONDUCTIVITY (Continued)

VARIOUS SOLIDS (Continued)

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Gutta percha	0.00048	Péclet, 1878
Gypsum	0.0031	R. Weber, 1878
Haircloth, felt	0.000042	G. Forbes
Ice	0.005	....
	0.0039	....
	0.0022	Forbes, 1875
Infusorial earth, 100°	0.00034	Skinner
300°	0.00040	"
pressed bricks, 100°	0.00030	"
Lamp black, 100	0.00007	Randolph, 1912
Leather, cowhide	0.00042	Lees-Chorlton, 1896
chamois	0.00015	" "
Lime	0.00029	Hutton-Blard
Linen	0.00021	Lees-Chorlton, 1896
Magnesia, MgO	0.00016–0.00045	Hutton-Blard
brick, 50°–1130°	0.0027–0.0072	Wologdine, 1909
Magnesium carbonate, 100°	0.00023	Skinner
300°	0.00025	"
Marble	0.0071	Lees, 1892–8
Mica, perpendicular to cleavage plane	0.0018	Lees
Paper	0.0003	"
Paraffine	0.0006	"
0°	0.00023	R. Weber, 1878
Plaster of Paris	0.00070	Lees-Chorlton, 1896
Porcelain	0.0025	Lees, 1892–8
165°–1055°	0.0039–0.0047	Wologdine, 1909
Quartz, parallel to axis	0.030	Lees, 1892–8
perpendicular to axis	0.016	"
Rubber, para	0.00045	"
Sand, dry	0.00093	Herschel-Lebour & Dunn, 1879
Sandstone	0.0055	Herschel-Lebour & Dunn, 1879
Sawdust	0.00012	G. Forbes, 1875
Silica, fused, 20°	0.00237	Barratt, 1914
100°	0.00255	"
Silica brick, 100° to 1000° C.	0.002–0.003	Wologdine, 1909
Silk	0.000095	Lees-Chorlton, 1896
Slate	0.004700	Lees, 1892–8

HEAT CONDUCTIVITY (Continued)

VARIOUS SOLIDS (Continued)

Approximate values at ordinary temperatures.

Substance	Conductivity	Observer
Snow, compact	0.00051	Hjeltström
Soil, dry	0.00033	Lees-Chorlton, 1896
Wax, bees'	0.00009	G. Forbes
Wood, fir ‖ to axis	0.00030	....
perpendicular to axis	0.00009	....

THERMAL CONDUCTIVITY OF ORGANIC COMPOUNDS

The values in this table are given as cal/(sec)(cm²)(°C/cm). To convert these values to Btu/(hr)(ft²)(°F/ft) multiply by 242.08.

Substance	k	t, °C	t, °F
Acetaldehyde	0.0004089	21	69.8
Acetic acid	0.0004109	20	68
Acetic anhydride	0.0005286	21	69.8
Acetone	0.0004750	−80	−112
	0.0004543	16	61
	0.0004031	75	167
Allyl alcohol	0.0004295	30	86
Amyl acetate (n)	0.0003085	20	68
(iso)	0.000310	20	68
Amyl alcohol (n)	0.0003874	30–100	86–212
(iso)	0.0003531	30	86
Amyl bromide (n)	0.0002350	18	64.4
Aniline	0.0004237	16.5	61.5
Benzene	0.0003780	22.5	72.5
	0.0003275	50	122
	0.0003630	60	140
	0.0002870	140	284
Bromobenzene	0.0002664	20	68
Butyl acetate (n)	0.000327	20	68
Butyl alcohol (n)	0.0003663	20	68
Carbon tetrachloride	0.0002470	20	68
	0.0002333	50	122
Chlorobenzene	0.0003457	30–100	86–212
Chlorotoluene (p)	0.000310	20	68
Chloroform	0.0002891	16	61
	0.000246	20	68
Cresol (m)	0.0003581	20	68
(p)	0.000345	20.1	68.2
Cumene	0.000298	20	68
Cymene (p)	0.0003217	30	86
Decane	0.0003349	30	86
Diethyl ether	0.0003283	30	86
Dichloroethane, 1–2	0.000302	20	68
Di-isopropyl ether	0.000262	20	68
Ethyl acetate	0.0003560	16	60.8
Ethyl alcohol	0.0003995	20	68
Ethyl benzene	0.0003160	20	68
Ethyl bromide	0.0002862	30	86
Ethyl ether	0.0003283	30	86
Ethyl iodide	0.0002651	30	86
Ethylene glycol	0.0006236	20	68
	0.0006323	15	122
	0.0006443	80	176

HEAT CONDUCTIVITY (Continued)

THERMAL CONDUCTIVITY OF ORGANIC COMPOUNDS (Continued)

Substance	k	t, °C	t, °F
Freon-12 (CCl_2F_2)	0.0002310	0–75	32–167
Freon-21 ($CHCl_2F$)	0.0003180	0–75	32–167
Freon-22 ($CHClF_2$)	0.0002309	40	104
Freon-113 (CCl_2FCCl_2F)	0.0002379	0–80	32–176
Freon-114 ($C_2H_2F_4$)	0.0002127	0–75	32–167
Glycerol	0.000703	20	68
Heptane (n)	0.0003354	30	86
Heptyl alcohol	0.0003882	70–100	86–212
Hexane (n)	0.0003287	30–100	86–212
Hexyl alcohol (n)	0.0003857	30–100	86–212
Iodobenzene	0.0002874	30–100	86–212
Mesitylene	0.0003246	20	68
Methyl alcohol	0.0004832	20	68
Methyl aniline	0.0004419	21.5	70.5
Methyl chloride	0.0004597	−15 (−) +30	5–86
Methyl cyclohexane	0.0003052	30	86
Methylene chloride	0.0002908	0	32
Nitrobenzene	0.0003907	30–100	86–212
Nitromethane	0.0005142	30	86
Nonane (n)	0.0003374	30–100	86–212
Nonyl alcohol (n)	0.0004014	30–100	86–212
Octane (n)	0.0003469	30	86
Octyl alcohol (n)	0.0003973	30–100	86–212
Oleic acid	0.0005514	26.5	79.7
Palmitic acid	0.0004097	72.5	162.5
Pentachloroethane	0.0002994	20	68
Pentane (n)	0.0003221	30	86
Phenetole	0.0003577	−20	−4
Phenyl hydrazine	0.0004121	25	69.8
Propyl acetate (iso)	0.000321	20	68
Propyl alcohol (iso)	0.0003362	20	68
Propylene chloride	0.0002994	20–50	68–122
Propylene glycol (1–2)	0.0004799	20–80	68–176
Stearic acid	0.0003824	72.5	162.5
Tetrachloroethane (sym)	0.000272	20	68
Tetrachloroethylene	0.0003866	20	68
Toluene	0.0003804	−80	−112
	0.0003221	20	68
	0.0002808	80	176
Trichloroethylene	0.0003246	−60	−76
	0.0002775	20	68
Triethylamine	0.0003498	−80	−112
	0.0002891	20	68
	0.0002664	44.4	112
Xylene (o)	0.0003411	−20 (−) +80	(−4)–176
Xylene (m)	0.0003767	25	77

THERMAL CONDUCTIVITY OF INORGANIC GASES

Ammonia	0.0001198	−15 (−) +30	5–86
Argon	0.0002895	−183	−297
	0.0001677	−133	−207
	0.0000553	−105	−157.5
	0.0000409	−75	−102.5
Carbon dioxide	0.0002040	−50	−58
	0.0002412	−40	−40
	0.0002664	−30	−22
	0.0002746	−20	−4
	0.0002495	0	32
	0.0001677	30	86

HEAT CONDUCTIVITY (Continued)

THERMAL CONDUCTIVITY OF INORGANIC GASES (Continued)

Substance	k	t, °C	t, °F
Nitrogen	0.0003400	−196	−321.5
	0.0002961	−189	−308
	0.0002028	−158	−253
	0.0000640	−105	−155
Oxygen	0.0000500	(−207)–(−191)	(−340)–(−312)
	0.0000504	(−178)–(−182)	(−288)–(−295)
Water	0.001348	0	72
	0.001429	20	68
	0.001499	40	104
	0.001557	60	140
	0.001598	100	212
	0.001631	149	300
	0.001553	216	420
	0.001404	271	520
	0.001136	327	620

THERMAL CONDUCTIVITY OF MISCELLANEOUS SUBSTANCES

Chlorinated diphenyl 1242	0.0002936	30–100	86–212
Chlorinated diphenyl 1248	0.0002808	30–100	86–212
Kerosene	0.0003572	30	86
Light heat transfer oil	0.0003159	30–100	86–212
Petroleum ether	0.0003118	30	86
Red oil	0.0003366	30	86
Transformer oil	0.0004242	70–100	86–212

THERMAL CONDUCTIVITY OF MATERIALS

(Bureau of Standards Letter Circular No. 227)

D = Density in pounds per cubic foot.

K = Thermal conductivity in B.T.U. per hour, square foot, and temperature gradient of 1 degree Fahrenheit per inch thickness. The lower the conductivity, the greater the insulating values.

Soft Flexible Materials in Sheet Form

		D	K
Dry Zero	Kapok between burlap or paper..	1.0	0.24
		2.0	0.25
Cabots Quilt	Eel grass between kraft paper....	3.4	0.25
		4.6	0.26
Hair Felt	Felted cattle hair................	11.0	0.26
		13.0	0.26
Balsam Wool	Chemically treated wood fibre....	2.2	0.27
Hairinsul	75% hair 25% jute..............	6.3	0.27
	50% hair 50% jute..............	6.1	0.26
Linofelt	Flax fibres between paper........	4.9	0.28
Thermofelt	Jute and asbestos fibres, felted...	10.0	0.37
	Hair and asbestos fibres. felted...	7.8	0.28

Loose Materials

		D	K
Rock Wool	Fibrous material made from rock,	6.0	0.26
	also made in sheet form, felted and	10.0	0.27
	confined with wire netting.......	14.0	0.28
		18.0	0.29
Glass Wool	Pyrex glass, curled.............	4.0	0.29
		10.0	0.29
Sil-O-Cel	Powdered diatomaceous earth....	10.6	0.31
Regranulated	Fine particles..................	9.4	0.30
Cork	about 3/16 inch particles.........	8.1	0.31
Thermofill	Gypsum in powdered form........	26.	0.52
		34.	0.60
Sawdust	Various........................	12.0	0.41
	redwood........................	10.9	0.42
Shavings	Various, from planer............	8.8	0.41
Charcoal	From maple, beech and birch,		
	coarse.........................	13.2	0.36
	6 mesh.........................	15.2	0.37
	20 mesh........................	19.2	0.39

Semi-flexible Materials in Sheet Form

		D	K
Flaxlinum	Flax fibre......................	13.0	0.31
Fibrofelt	Flax and rye fibre..............	13.6	0.32

THERMAL CONDUCTIVITY OF MATERIALS (Continued)

SEMI-RIGID MATERIALS IN BOARD FORM

Corkboard	No added binder; very low density	5.4	0.25
Corkboard	No added binder; low density....	7.0	0.27
Corkboard	No added binder; medium density	10.6	0.30
Corkboard	No added binder; high density ..	14.0	0.34
Eureka	Corkboard with asphaltic binder .	14.5	0.32
Rock Cork	Rock wool block with binder..... Also called "Tucork"	14.5	0.326
Lith	Board containing rock wool, flax and straw pulp................	14.3	0.40

STIFF FIBROUS MATERIALS IN SHEET FORM

Insulite	Wood pulp....................	16.2	0.34
		16.9	0.34
Celotex	Sugar cane fibre...............	13.2	0.34
		14.8	0.34

*Masonite..............................	K = 0.33
*Inso-board............................	0.33
*Maizewood.............................	0.33 to 0.39
*Cornstalk Pith Board..................	0.24 to 0.30
*Maftex................................	0.34

CELLULAR GYPSUM

Insulex or Pyrocell..................	8	0.35
	12	0.44
	18	0.59
	24	0.77
	30	1.00

WOODS (Across Grain)

Balsa	7.3	0.33
	8.8	0.38
	20	0.58
Cypress..............................	29	0.67
White pine...........................	32	0.78
Mahogany.............................	34	0.90
Virginia pine........................	34	0.98
Oak..................................	38	1.02
Maple................................	44	1.10

MISCELLANEOUS BUILDING MATERIALS

(Data taken from various sources)

	K		K
Cinder concrete....	2 to 3	Limestone....	4 to 9
Building gypsum....	About 3	Concrete...........	6 to 9
Plaster............	2 to 5	Sandstone..........	8 to 16
Building brick......	3 to 6	Marble............	14 to 20
Glass..............	5 to 6	Granite............	13 to 28

* From various commercial laboratories and the work of O. R. Sweeney at Iowa State College.

SATURATED STEAM TABLES

TEMPERATURE OF SATURATED STEAM

The following table gives the temperature of saturated water vapor in degrees Centigrade and degrees Fahrenheit corresponding to gauge pressure in pounds from 0 to 3184. Zero gauge pressure corresponds to an absolute pressure of 14.696 pounds per square inch.

Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C
0	212.0	100.0	**55**	302.5	150.3	**110**	344.1	173.4
1	215.4	101.9	56	303.6	150.9	111	344.7	173.7
2	218.5	103.6	57	304.5	151.4	112	345.4	174.1
3	221.5	105.3	58	305.4	151.9	113	345.9	174.4
4	224.4	106.9	59	306.3	152.4	114	346.5	174.7
5	227.1	108.4	60	307.4	153.0	115	347.2	175.1
6	229.6	109.8	61	308.3	153.5	116	347.7	175.4
7	232.3	111.3	62	309.2	154.0	117	348.3	175.7
8	234.7	112.6	63	309.9	154.4	118	348.8	176.0
9	237.0	113.9	64	310.8	154.9	119	349.5	176.4
10	239.4	115.2	**65**	311.7	155.4	**120**	350.1	176.7
11	241.5	116.4	66	312.6	155.9	121	350.6	177.0
12	243.7	117.6	67	313.5	156.4	122	351.1	177.3
13	245.8	118.8	68	314.2	156.8	123	351.7	177.6
14	247.8	119.9	69	315.1	157.3	124	352.2	177.9
15	249.8	121.0	70	316.0	157.8	125	352.9	178.3
16	251.6	122.0	71	316.8	158.2	126	353.5	178.6
17	253.4	123.0	72	317.7	158.7	127	354.0	178.9
18	255.4	124.1	73	318.4	159.1	128	354.6	179.2
19	257.0	125.0	74	319.3	159.6	129	355.1	179.5
20	258.8	126.0	**75**	320.0	160.0	**130**	355.6	179.8
21	260.4	126.9	76	320.9	160.5	131	356.2	180.1
22	262 0	127.8	77	321.6	160.9	132	356.7	180.4
23	263.7	128.7	78	322.3	161.3	133	357.3	180.7
24	265.3	129.6	79	323.1	161.7	134	357.8	181.0
25	266.7	130.4	80	323.8	162.1	135	358.3	181.3
26	268.3	131.3	81	324.7	162.6	136	358.9	181.6
27	269.8	132.1	82	325.4	163.0	137	359.2	181.8
28	271.2	132.9	83	326.1	163.4	138	359.8	182.1
29	272.7	133.7	84	326.8	163.8	139	360.3	182.4
30	274.1	134.5	**85**	327.6	164.2	**140**	360.9	182.7
31	275.4	135.2	86	328.3	164.6	141	361.4	183.0
32	276.8	136.0	87	329.0	165.0	142	361.9	183.3
33	278.1	136.7	88	329.7	165.4	143	362.3	183.5
34	279.3	137.4	89	330.4	165.8	144	362.8	183.8
35	280.6	138.1	90	331.2	166.2	145	363.4	184.1
36	281.8	138.8	91	331.9	166.6	146	363.9	184.4
37	283.1	139.5	92	332.6	167.0	147	364.5	184.7
38	284.4	140.2	93	333.1	167.3	148	364.8	184.9
39	285.6	140.9	94	333.9	167.7	149	365.4	185.2
40	286.7	141.5	**95**	334.6	168.1	**150**	365.9	185.5
41	288.0	142.2	96	335.1	168.4	151	366.4	185.8
42	289.0	142.8	97	335.8	168.8	152	366.8	186.0
43	290.1	143.4	98	336.6	169.2	153	367.3	186.3
44	291.2	144.0	99	337.3	169.6	154	367.9	186.6
45	292.3	144.6	100	337.8	169.9	155	368.2	186.8
46	293.5	145.3	101	338.5	170.3	156	368.8	187.1
47	294.4	145.8	102	339.1	170.6	157	369.3	187.4
48	295.5	146.4	103	339.8	171.0	158	369.7	187.6
49	296.6	147.0	104	340.5	171.4	159	370.2	187.9
50	297.7	147.6	**105**	341.1	171.7	**160**	370.6	188.1
51	298.6	148.1	106	341.6	172.0	161	371.1	188.4
52	299.7	148.7	107	342.3	172.4	162	371.7	188.7
53	300.7	149.3	108	342.9	172.7	163	372.0	188.9
54	301.6	149.8	109	343.6	173.1	164	372.6	189.2

TEMPERATURE OF SATURATED STEAM (Continued)

Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp °C
165	372.9	189.4	**225**	397.2	202.9	**285**	417.2	214.0
166	373.5	189.7	226	397.6	203.1	286	417.6	214.2
167	373.8	189.9	227	397.9	203.3	287	417.9	214.4
168	374.4	190.2	228	398.3	203.5	288	418.1	214.5
169	374.7	190.4	229	398.7	203.7	289	418.5	214.7
170	375.3	190.7	230	399.0	203.9	290	418.8	214.9
171	375.8	191.0	231	399.4	204.1	291	419.0	215.0
172	376.2	191.2	232	399.7	204.3	292	419.4	215.2
173	376.5	191.4	233	400.1	204.5	293	419.7	215.4
174	376.9	191.6	234	400.3	204.7	294	419.9	215.5
175	377.4	191.9	**235**	400.8	204.9	**295**	420.3	215.7
176	377.8	192.1	236	401.2	205.1	296	420.6	215.9
177	378.3	192.4	237	401.5	205.3	297	420.8	216.0
178	378.7	192.6	238	401.9	205.5	298	421.2	216.2
179	379.2	192.9	239	402.3	205.7	299	421.3	216.3
180	379.6	193.1	240	402.6	205.9	300	421.7	216.5
181	379.9	193.3	241	403.0	206.1	301	422.1	216.7
182	380.5	193.6	242	403.3	206.3	302	422.2	216.8
183	380.8	193.8	243	403.7	206.5	303	422.6	217.0
184	381.4	194.1	244	404.1	206.7	304	423.0	217.2
185	381.7	194.3	**245**	404.4	206.9	**305**	423.1	217.3
186	382.1	194.5	246	404.8	207.1	306	423.5	217.5
187	382.6	194.8	247	405.0	207.2	307	423.9	217.7
188	383.0	195.0	248	405.3	207.4	308	424.0	217.8
189	383.4	195.2	249	405.7	207.6	309	424.4	218.0
190	383.7	195.4	250	406.0	207.8	310	424.6	218.1
191	384.1	195.6	251	406.4	208.0	311	424.9	218.3
192	384.6	195.9	252	406.8	208.2	312	425.3	218.5
193	385.0	196.1	253	407.1	208.4	313	425.5	218.6
194	385.3	196.3	254	407.3	208.5	314	425.8	218.8
195	385.9	196.6	**255**	407.7	208.7	**315**	426.2	219.0
196	386.2	196.8	256	408.0	208.9	316	426.4	219.1
197	386.6	197.0	257	408.4	209.1	317	426.7	219.3
198	387.0	197.2	258	408.7	209.3	318	426.9	219.4
199	387.5	197.5	259	408.9	209.4	319	427.3	219.6
200	387.9	197.7	260	409.3	209.6	320	427.5	219.7
201	388.2	197.9	261	409.6	209.8	321	427.8	219.9
202	388.6	198.1	262	410.0	210.0	322	428.0	220.0
203	388.9	198.3	263	410.4	210.2	323	428.4	220.2
204	389.3	198.5	264	410.7	210.4	324	428.5	220.3
305	389.8	198.8	**265**	410.9	210.5	**325**	428.9	220.5
206	390.2	199.0	266	411.3	210.7	326	429.3	220.7
207	390.6	199.2	267	411.6	210.9	327	429.4	220.8
208	390.9	199.4	268	412.0	211.1	328	429.8	221.0
209	391.3	199.6	269	412.2	211.2	329	430.0	221.1
210	391.6	199.8	270	412.5	211.4	330	430.3	221.3
211	392.2	200.1	271	412.9	211.6	331	430.5	221.4
212	392.5	200.3	272	413.2	211.8	332	430.9	221.6
213	392.9	200.5	273	413.4	211.9	333	431.1	221.7
214	393.3	200.7	274	413.8	212.1	334	431.4	221.9
215	393.6	200.9	**275**	414.1	212.3	**335**	431.6	222.0
216	394.0	201.1	276	414.5	212.5	336	432.0	222.2
217	394.3	201.3	277	414.7	212.6	337	432.1	222.3
218	394.7	201.5	278	415.0	212.8	338	432.5	222.5
219	395.1	201.7	279	415.4	213.0	339	432.7	222.6
220	395.4	201.9	280	415.8	213.2	340	433.0	222.8
221	395.8	202.1	281	415.9	213.3	341	433.2	222.9
222	396.1	202.3	282	416.3	213.5	342	433.6	223.1
223	396.5	202.5	283	416.7	213.7	343	433.9	223.3
224	396.9	202.7	284	417.0	213.9	344	434.1	223.4

TEMPERATURE OF SATURATED STEAM (Continued)

Gauge pressure lbs./in.²	Temp. °F	Temp. °C	Gauge pressure lbs./in.²	Temp. °F	Temp. °C	Gauge pressure lbs./in.²	Temp. °F	Temp. °C
345	434.3	223.5	**585**	486.1	252.3	**960**	541.6	283.1
346	434.7	223.7	590	487.0	252.8	970	542.8	283.8
347	434.8	223.8	595	487.9	253.3	980	544.1	284.5
348	435.2	224.0	600	488.8	253.8	990	545.2	285.1
349	435.4	224.1	605	489.7	254.3	1000	546.4	285.8
350	435.7	224.3	610	490.6	254.8	1010	547.7	286.5
351	435.9	224.4	615	491.5	255.3	1020	548.8	287.1
352	436.3	224.6	620	492.3	255.7	1030	550.0	287.8
353	436.5	224.7	625	493.2	256.2	1040	551.1	288.4
354	436.6	224.8	630	494.1	256.7	1050	552.4	289.1
355	437.0	225.0	**635**	495.0	257.2	**1060**	553.5	289.7
356	437.2	225.1	640	495.7	257.6	1070	554.7	290.4
357	437.5	225.3	645	496.6	258.1	1080	555.8	291.0
358	437.7	225.4	650	497.5	258.6	1090	556.9	291.6
359	438.1	225.6	655	498.2	259.0	1100	558.0	292.2
360	438.3	225.7	660	499.1	259.5	1110	559.0	292.8
365	439.5	226.4	665	499.8	259.9	1120	560.1	293.4
370	440.8	227.1	670	500.7	260.4	1130	561.2	294.0
375	442.0	227.8	675	501.4	260.8	1140	562.5	294.7
380	443.3	228.5	680	502.3	261.3	1150	563.5	295.3
385	444.6	229.2	**685**	503.1	261.7	**1160**	564.6	295.9
390	445.8	229.9	690	504.0	262.2	1170	565.5	296.4
395	447.1	230.6	695	504.7	262.6	1180	566.6	297.0
400	448.2	231.2	700	505.6	263.1	1190	567.7	297.6
405	449.4	231.9	705	506.3	263.5	1200	568.8	298.2
410	450.5	232.5	710	507.0	263.9	1210	569.8	298.8
415	451.8	233.2	715	507.7	264.3	1220	570.7	299.3
420	452.8	233.8	720	508.6	264.8	1230	571.8	299.9
425	453.9	234.4	725	509.4	265.2	1240	572.9	300.5
430	455.2	235.1	730	510.1	265.6	1250	573.8	301.0
435	456.3	235.7	**735**	510.8	266.0	**1260**	574.9	301.6
440	457.3	236.3	740	511.7	266.5	1270	576.0	302.2
445	458.4	236.9	745	512.4	266.9	1280	576.9	302.7
450	459.5	237.5	750	513.1	267.3	1290	578.0	303.3
455	460.6	238.1	755	513.9	267.7	1300	578.8	303.8
460	461.7	238.7	760	514.6	268.1	1310	579.7	304.3
465	462.7	239.3	765	515.3	268.5	1320	580.8	304.9
470	463.8	239.9	770	516.0	268.9	1330	581.7	305.4
475	464.9	240.5	775	516.7	269.3	1340	582.8	306.0
480	466.0	241.1	780	517.5	269.7	1350	583.7	306.5
485	467.1	241.7	**785**	518.2	270.1	**1360**	584.6	307.0
490	468.0	242.2	790	518.9	270.5	1370	585.5	307.5
495	469.0	242.8	795	519.6	270.9	1380	586.6	308.1
500	470.1	243.4	800	520.3	271.3	1390	587.5	308.6
505	471.0	243.9	805	521.1	271.7	1400	588.4	309.1
510	472.1	244.5	810	521.8	272.1	1410	589.3	309.6
515	473.0	245.0	820	523.2	272.9	1420	590.4	310.2
520	474.1	245.6	830	524.7	273.7	1430	591.3	310.7
525	475.0	246.1	840	525.9	274.4	1440	592.2	311.2
530	476.1	246.7	850	527.4	275.2	1450	593.1	311.7
535	477.0	247.2	**860**	528.6	275.9	**1460**	594.0	312.2
540	477.9	247.7	870	530.1	276.7	1470	594.9	312.7
545	478.8	248.2	880	531.3	277.4	1480	595.8	313.2
550	479.8	248.8	890	532.6	278.1	1490	596.7	313.7
555	480.7	249.3	900	534.0	278.9	1500	597.6	314.2
560	481.6	249.8	910	535.3	279.6	1510	598.5	314.7
565	482.5	250.3	920	536.5	280.3	1520	599.2	315.1
570	483.4	250.8	930	537.8	281.0	1530	600.1	315.6
575	484.3	251.3	940	539.1	281.7	1540	601.0	316.1
580	485.2	251.8	950	540.3	282.4	1550	601.9	316.6

TEMPERATURE OF SATURATED STEAM (Continued)

Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C	Gauge pressure lbs./in.^{2}	Temp. °F	Temp. °C
1560	602.6	317.0	**2110**	644.4	340.2	**2660**	678.4	359.1
1570	603.5	317.5	2120	645.1	340.6	2670	678.9	359.4
1580	604.4	318.0	2130	645.8	341.0	2680	679.5	359.7
1590	605.3	318.5	2140	646.3	341.3	2690	680.0	360.0
1600	606.0	318.9	2150	647.1	341.7	2700	680.5	360.3
1610	606.9	319.4	2160	647.8	342.1	2710	681.1	360.6
1620	607.8	319.9	2170	648.5	342.5	2720	681.6	360.9
1630	608.5	320.3	2180	649.0	342.8	2730	682.2	361.2
1640	609.4	320.8	2190	649.8	343.2	2740	682.7	361.5
1650	610.2	321.2	2200	650.3	343.5	2750	683.2	361.8
1660	611.1	321.7	**2210**	651.0	343.9	**2760**	684.0	362.2
1670	612.0	322.2	2220	651.7	344.3	2770	684.5	362.5
1680	612.7	322.6	2230	652.3	344.6	2780	685.0	362.8
1690	613.4	323.0	2240	653.0	345.0	2790	685.6	363.1
1700	614.3	323.5	2250	653.5	345.3	2800	686.1	363.4
1710	615.0	323.9	2260	654.3	345.7	2810	686.5	363.6
1720	615.9	324.4	2270	654.8	346.0	2820	687.0	363.9
1730	616.6	324.8	2280	655.5	346.4	2830	687.6	364.2
1740	617.4	325.2	2290	656.1	346.7	2840	688.1	364.5
1750	618.3	325.7	2300	656.8	347.1	2850	688.6	364.8
1760	619.0	326.1	**2310**	657.3	347.4	**2860**	689.2	365.1
1770	619.9	326.6	2320	658.0	347.8	2870	689.7	365.4
1780	620.6	327.0	2330	658.6	348.1	2880	690.3	365.7
1790	621.3	327.4	2340	659.3	348.5	2890	690.8	366.0
1800	622.0	327.8	2350	659.8	348.8	2900	691.3	366.3
1810	622.8	328.2	2360	660.6	349.2	2910	691.7	366.5
1820	623.7	328.7	2370	661.1	349.5	2920	692.2	366.8
1830	624.4	329.1	2380	661.8	349.9	2930	692.8	367.1
1840	625.1	329.5	2390	662.4	350.2	2940	693.3	367.4
1850	625.8	329.9	2400	663.1	350.6	2950	693.9	367.7
1860	626.5	330.3	**2410**	663.6	350.9	**2960**	694.2	367.9
1870	627.4	330.8	2420	664.2	351.2	2970	694.8	368.2
1880	628.2	331.2	2430	664.9	351.6	2980	695.3	368.5
1890	628.9	331.6	2440	665.4	351.9	2990	695.8	368.8
1900	629.6	332.0	2450	666.0	352.2	3000	696.4	369.1
1910	630.3	332.4	2460	666.7	352.6	3010	696.7	369.3
1920	631.0	332.8	2470	667.2	352.9	3020	697.3	369.6
1930	631.8	333.2	2480	667.9	353.3	3030	697.8	369.9
1940	632.5	333.6	2490	668.5	353.6	3040	698.4	370.2
1950	633.2	334.0	2500	669.0	353.9	3050	698.7	370.4
1960	633.9	334.4	**2510**	669.7	354.3	**3060**	699.3	370.7
1970	634.6	334.8	2520	670.3	354.6	3070	699.8	371.0
1980	635.4	335.2	2530	670.8	354.9	3080	700.3	371.3
1990	636.1	335.6	2540	671.5	355.3	3090	700.7	371.5
2000	636.8	336.0	2550	672.1	355.6	3100	701.2	371.8
2010	637.5	336.4	2560	672.6	355.9	3110	701.8	372.1
2020	638.2	336.8	2570	673.2	356.2	3120	702.1	372.3
2030	639.0	337.2	2580	673.7	356.5	3130	702.7	372.6
2040	639.5	337.5	2590	674.4	356.9	3140	703.2	372.9
2050	640.2	337.9	2600	675.0	357.2	3150	703.6	373.1
2060	640.9	338.3	**2610**	675.5	357.5	**3160**	704.1	373.4
2070	641.7	338.7	2620	676.0	357.8	3170	704.5	373.6
2080	642.4	339.1	2630	676.6	358.1	3180	705.0	373.9
2090	642.9	339.4	2640	677.3	358.5	3184	705.2	*374.0
2100	643.6	339.8	2650	677.8	358.8	....	.....	......

* Critical point.

The heat units used are the large calorie, 15° to 16° C and the B.T.U., 62° to 63° F. The heat of the liquid, q, is the heat required to raise unit mass of water from 0° C (32° F) to the temperature indicated. The heat of vaporization, r, is the heat required to vaporize unit mass of water at the indicated temperature and pressure. Total heat involved, $H = r + q$.

The heat of vaporization overcomes external pressure and changes the state from liquid to vapor at constant temperature and pressure. If u is the

Temperature, degrees Centigrade.	Total pressure, (Gauge pressure plus atmospheric pressure)			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
0	4.579	0.00623	0.0886	0.00	0.0	595.4	1071.7	565.3	1017.5	**32**
1	4.924	0.00670	0.0952	1.01	1.8	594.9	1070.8	564.7	1016.4	**33.8**
2	5.290	0.00719	0.1023	2.02	3.6	594.4	1069.9	564.0	1015.3	**35.6**
3	5.681	0.00772	0.1099	3.03	5.5	593.9	1069.0	563.4	1014.2	**37.4**
4	6.097	0.00829	0.1179	4.03	7.3	593.3	1068.0	562.8	1013.1	**39.2**
5	6.541	0.00889	0.1265	5.04	9.1	592.8	1067.1	562.2	1011.9	**41**
6	7.011	0.00953	0.1356	6.04	10.9	592.3	1066.1	561.5	1010.7	**42.8**
7	7.511	0.01021	0.1453	7.05	12.7	591.8	1065.2	560.9	1009.6	**44.6**
8	8.042	0.01093	0.1555	8.05	14.5	591.2	1064.2	560.2	1008.5	**46.4**
9	8.606	0.01170	0.1664	9.05	16.3	590.7	1063.3	559.6	1007.4	**48.2**
10	9.205	0.01252	0.1780	10.06	18.1	590.2	1062.3	559.0	1006.2	**50**
11	9.840	0.01338	0.1903	11.06	19.9	589.6	1061.3	558.3	1005.0	**51.8**
12	10.513	0.01429	0.2033	12.06	21.7	589.1	1060.4	557.7	1003.9	**53.6**
13	11.226	0.01526	0.2171	13.06	23.5	588.6	1059.4	557.1	1002.7	**55.4**
14	11.980	0.01629	0.2317	14.06	25.3	588.1	1058.5	556.5	1001.6	**57.2**
15	12.779	0.01737	0.2471	15.06	27.1	587.6	1057.6	555.9	1000.5	**59**
16	13.624	0.01852	0.2635	16.06	28.9	587.0	1056.6	555.2	999.4	**60.8**
17	14.517	0.01974	0.2807	17.06	30.7	586.5	1055.7	554.6	998.3	**62.6**
18	15.460	0.02102	0.2990	18.06	32.5	585.9	1054.7	553.9	997.1	**64.4**
19	16.456	0.02237	0.3182	19.06	34.3	585.4	1053.8	553.3	996.0	**66.2**
20	17.51	0.02381	0.3386	20.06	36.1	584.9	1052.8	552.7	994.8	**68**
21	18.62	0.02532	0.3601	21.06	37.9	584.4	1051.9	552.1	993.7	**69.8**
22	19.79	0.02691	0.3827	22.06	39.7	583.9	1051.0	551.5	992.6	**71.6**
23	21.02	0.02858	0.4065	23.06	41.5	583.3	1050.0	550.8	991.4	**73.4**
24	22.32	0.03035	0.4316	24.06	43.3	582.8	1049.1	550.2	990.3	**75.2**
25	23.69	0.03221	0.4581	25.05	45.1	582.3	1048.1	549.5	989.1	**77**
26	25.13	0.03417	0.4860	26.05	46.9	581.8	1047.2	548.9	988.0	**78.8**
27	26.65	0.03623	0.5154	27.05	48.7	581.2	1046.2	548.2	986.9	**80.6**
28	28.25	0.03841	0.5463	28.05	50.5	580.7	1045.2	547.6	985.7	**82.4**
29	29.94	0.04071	0.5790	29.04	52.3	580.2	1044.3	547.0	984.6	**84.2**
30	31.71	0.04311	0.6132	30.04	54.1	579.6	1043.3	546.3	983.4	**86**

ENGLISH UNITS

change in volume the external work is *pu* and the corresponding amount of heat is *Apu* where *A* is the reciprocal of the mechanical equivalent of heat. The part of the heat of vaporization not used in external work is considered used in changing the state from liquid to vapor. The heat required for this work may be represented by $\rho = r - Apu$.

(From Peabody, Steam and Entropy Tables, John Wiley and Sons, Inc., publishers, by permission.)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
0	30.1	54.2	0.0000	2.1804	206.3	3304	0.00485	0.000303	**32**
1	30.2	54.4	0.0037	2.1706	192.7	3087	0.00519	0.000324	**33.8**
2	30.4	54.6	0.0074	2.1609	180.0	2884	0.00556	0.000347	**35.6**
3	30.5	54.8	0.0110	2.1513	168.2	2694	0.00595	0.000371	**37.4**
4	30.5	54.9	0.0146	2.1416	157.2	2518	0.00636	0.000397	**39.2**
5	30.6	55.2	0.0183	2.1320	147.1	2356	0.00680	0.000424	**41**
6	30.8	55.4	0.0219	2.1225	137.7	2206	0.00726	0.000453	**42.8**
7	30.9	55.6	0.0256	2.1130	129.0	2067	0.00775	0.000484	**44.6**
8	31.0	55.7	0.0290	2.1036	120.9	1937	0.00827	0.000516	**46.4**
9	31.1	55.9	0.0326	2.0943	113.4	1816	0.00882	0.000551	**48.2**
10	31.2	56.1	0.0361	2.0850	106.3	1703	0.00941	0.000587	**50**
11	31.3	56.3	0.0397	2.0758	99.8	1599	0.01002	0.000625	**51.8**
12	31.4	56.5	0.0433	2.0667	93.7	1502	0.01067	0.000666	**53.6**
13	31.5	56.7	0.0467	2.0576	88.1	1411	0.01135	0.000709	**55.4**
14	31.6	56.9	0.0502	2.0486	82.9	1327	0.01206	0.000754	**57.2**
15	31.7	57.1	0.0537	2.0396	77.9	1248	0.01283	0.000801	**59**
16	31.8	57.3	0.0571	2.0308	73.3	1174	0.01364	0.000852	**60.8**
17	31.9	57.4	0.0607	2.0220	69.1	1105	0.01447	0.000905	**62.6**
18	32.0	57.6	0.0641	2.0132	65.1	1041	0.01536	0.000961	**64.4**
19	32.1	57.8	0.0675	2.0045	61.3	982	0.01631	0.001018	**66.2**
20	32.2	58.0	0.0709	1.9959	57.8	926	0.01730	0.001080	**68**
21	32.3	58.2	0.0743	1.9873	54.5	873	0.01835	0.001145	**69.8**
22	32.4	58.4	0.0776	1.9788	51.5	824	0.01942	0.001214	**71.6**
23	32.5	58.6	0.0811	1.9703	48.60	778	0.02058	0.001286	**73.4**
24	32.6	58.8	0.0845	1.9620	45.92	735	0.02178	0.001361	**75.2**
25	32.8	59.0	0.0878	1.9536	43.40	695	0.02304	0.001439	**77**
26	32.9	59.2	0.0911	1.9453	41.05	657	0.02436	0.001522	**78.8**
27	33.0	59.3	0.0945	1.9370	38.83	622	0.02575	0.001608	**80.6**
28	33.1	59.5	0.0978	1.9288	36.74	589	0.02722	0.001698	**82.4**
29	33.2	59.7	0.1011	1.9207	34.78	557	0.02875	0.001795	**84.2**
30	33.3	59.9	0.1044	1.9126	32.95	528	0.03035	0.001894	**86**

	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		
Temperature, degrees Centigrade.	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Temperature, degrees Fahrenheit.
t	*p*	*p*	*p*	*q*	*q*	*r*	*r*	*ρ*	*ρ*	*t*
31	33 57	0.04564	0.6492	31.04	55.9	579 1	1042.4	545.7	982.2	**87.8**
32	35.53	0.04830	0.6871	32.04	57.7	578 6	1041.4	545.1	981.0	**89.6**
33	37.59	0.05111	0.7269	33.04	59.5	578.0	1040.4	544.4	979.9	**91.4**
34	39.75	0.05404	0.7687	34.03	61.3	577.4	1039.4	543.7	978.7	**93.2**
35	42.02	0.05713	0.8126	35.03	63.1	576.9	1038.5	543.1	977.6	**95**
36	44.40	0.06037	0.8586	36.03	64.9	576.4	1037.5	542.5	976.4	**96.8**
37	46.90	0.06376	0.9068	37.02	66.6	575.8	1036.5	541.8	975.2	**98.6**
38	49.51	0.06731	0.9574	38.02	68.4	575.3	1035.5	541.2	974.0	**100.4**
39	52.26	0.07105	1.0105	39.02	70.2	574.7	1034.5	540.5	972.8	**102.2**
40	55.13	0.07495	1.0661	40.02	72.0	574.2	1033.5	539.9	971.7	**104**
41	58.14	0.07905	1.1243	41.01	73.8	573.6	1032.5	539.2	970.5	**105.8**
42	61.30	0.08334	1.1854	42.01	75.6	573.1	1031.5	538.6	969.3	**107.6**
43	64.59	0.08782	1.2492	43.01	77.4	572.5	1030.5	537.9	968.2	**109.4**
44	68.05	0.09252	1.3159	44.01	79.2	571.9	1029.4	537.2	966.9	**111.2**
45	71.66	0.09743	1.3858	45.00	81.0	571.3	1028.4	536.5	965.7	**113**
46	75.43	0.10256	1 4587	46.00	82.8	570.8	1027.4	535.8	964.5	**114.8**
47	79.38	0.10792	1.5350	47.00	84.6	570.2	1026.4	535.1	963.3	**116.6**
48	83.50	0.11353	1.6147	48.00	86.4	569.6	1025.3	534.4	962.0	**118.4**
49	87.80	0.11937	1.6979	48.99	88.2	569.0	1024.3	533.7	960 8	**120.2**
50	92.30	0.12549	1.7849	49.99	90.0	568.4	1023.2	533.0	959.6	**122**
51	96.99	0.13187	1.8756	50.99	91.8	567.8	1022.2	532.3	958.4	**123.8**
52	101.88	0.13852	1.9701	51.99	93.6	567.3	1021.2	531.7	957.2	**125.6**
53	106.99	0.14546	2 0689	52.99	95.4	566.8	1020.2	531.1	956.0	**127.4**
54	112.30	0.15268	2.172	53.98	97.2	566.2	1019.1	530.4	954.7	**129.2**
55	117.85	0.16023	2.279	54.98	99.0	565.6	1018.1	529.7	953.5	**131**
56	123.61	0.16806	2.390	55.98	100.8	565.1	1017.1	529.1	952.3	**132.8**
57	129.63	0.17624	2.506	56.98	102.6	564.5	1016.1	528.4	951.1	**134.6**
58	135.89	0.18475	2.627	57.98	104.4	563.9	1015.1	527.7	949.9	**136.4**
59	142.41	0.19362	2.754	58.97	106.2	563.4	1014.1	527.1	948.7	**138.2**
60	149.19	0.20284	2.885	59.97	108.0	562.8	1013.1	526.4	947.5	**140**
61	156.24	0.21242	3.021	60.97	109.8	562.2	1012.0	525.7	946.3	**141.8**
62	163.58	0.2224	3.163	61.97	111.6	561.7	1011.0	525.1	945.1	**143.6**
63	171.20	0.2328	3.310	62.97	113.4	561.1	1009.9	524.4	943.8	**145.4**
64	179.13	0.2435	3.464	63.98	115.2	560.5	1008.9	523.7	942.6	**147.2**
65	187.36	0.2547	3.623	64.98	117.0	559.9	1007.8	523.0	941.3	**149**
66	195.92	0.2664	3.789	65.98	118.8	559.3	1006.8	522.3	940.1	**150.8**
67	204.80	0.2784	3.960	66.98	120.6	558.8	1005.8	521.7	938.9	**152.6**
68	214.02	0.2910	4.139	67.98	122.4	558.2	1004.7	521.0	937.6	**154.4**
69	223.58	0.3040	4.324	68.98	124.2	557.6	1003.6	520.3	936.3	**156.2**
70	233.53	0.3175	4.516	69 98	126.0	556.9	1002 5	519 5	935.0	**158**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	*Apu*	*Apu*	θ	$\frac{r}{T}$	*s*	*s*	$\frac{1}{s}$	$\frac{1}{s}$	*t*
31	33.4	60.2	0.1077	1.9046	31.24	501	0.03201	0.001996	**87.8**
32	33.5	60.4	0.1110	1.8966	29.62	474.7	0.03376	0.002107	**89.6**
33	33.6	60.5	0.1142	1.8886	28.08	449.7	0.03561	0.002224	**91.4**
34	33.7	60.7	0.1175	1.8806	26.62	426.5	0.03757	0.002345	**93.2**
35	33.8	60.9	0.1207	1.8728	25.25	404.7	0.03960	0.002471	**95**
36	33.9	61.1	0.1239	1.8650	23.98	384.2	0.04170	0.002603	**96.8**
37	34.0	61.3	0.1272	1.8572	22.78	364.9	0.04390	0.002740	**98.6**
38	34.1	61.5	0.1304	1.8494	21.65	346.8	0.04619	0.002884	**100.4**
39	34.2	61.7	0.1336	1.8417	20.58	329.7	0.04859	0.003033	**102.2**
40	34.3	61.8	0.1368	1.8341	19.57	313.5	0.0511	0.003190	**104**
41	34.4	62.0	0.1399	1.8265	18.61	298.0	0.0537	0.003356	**105.8**
42	34.5	62.2	0.1431	1.8189	17.69	283.3	0.0565	0.003530	**107.6**
43	34.6	62.3	0.1463	1.8113	16.82	269.5	0.0595	0.003711	**109.4**
44	34.7	62.5	0.1494	1.8038	16.01	256.5	0.0625	0.003899	**111.2**
45	34.8	62.7	0.1526	1.7963	15.25	244.4	0.0656	0.004092	**113**
46	35.0	62.9	0.1557	1.7889	14.54	233.0	0.0688	0.004292	**114.8**
47	35.1	63.1	0.1588	1.7815	13.86	222.1	0.0722	0.004502	**116.6**
48	35.2	63.3	0.1619	1.7742	13.21	211.7	0.0757	0.004724	**118.4**
49	35.3	63.5	0.1650	1.7669	12.60	201.9	0.0794	0.00495	**120.2**
50	35.4	63.6	0.1682	1.7597	12.02	192.6	0.0832	0.00519	**122**
51	35.5	63.8	0.1713	1.7525	11.47	183.8	0.0872	0.00544	**123.8**
52	35.6	64.0	0.1743	1.7454	10.96	175.5	0.0912	0.00570	**125.6**
53	35.7	64.2	0.1774	1.7383	10.47	167.7	0.0955	0.00596	**127.4**
54	35.8	64.4	0.1804	1.7312	10.00	160.3	0.1000	0.00624	**129.2**
55	35.9	64.6	0.1835	1.7242	9.56	153.2	0.1046	0.00653	**131**
56	36.0	64.8	0.1865	1.7173	9.14	146.5	0.1094	0.00683	**132.8**
57	36.1	65.0	0.1895	1.7104	8.74	140.1	0.1144	0.00713	**134.6**
58	36.2	65.2	0.1925	1.7035	8.36	134.0	0.1196	0.00746	**136.4**
59	36.3	65.4	0.1955	1.6967	8.00	128.3	0.1250	0.00779	**138.2**
60	36.4	65.6	0.1986	1.6899	7.66	122.8	0.1305	0.00814	**140**
61	36.5	65.7	0.2016	1.6831	7.34	117.6	0.1362	0.00850	**141.8**
62	36.6	65.9	0.2046	1.6764	7.03	112.7	0.1422	0.00887	**143.6**
63	36.7	66.1	0.2075	1.6696	6.74	108.0	0.1484	0.00926	**145.4**
64	36.8	66.3	0.2105	1.6629	6.46	103.5	0.1548	0.00966	**147.2**
65	36.9	66.5	0.2135	1.6563	6.19	99.2	0.1615	0.01008	**149**
66	37.0	66.7	0.2164	1.6497	5.94	95.1	0.1684	0.01051	**150.8**
67	37.1	66.9	0.2194	1.6431	5.70	91.3	0.1754	0.01095	**152.6**
68	37.2	67.1	0.2223	1.6366	5.47	87.6	0.1828	0.01142	**154.4**
69	37.3	67.3	0.2253	1.6300	5.25	84.1	0.1905	0.01189	**156.2**
70	37.4	67.4	0.2282	1.6235	5.04	80.7	0.1984	0.01239	**158**

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
71	243.8	0.3315	4.715	70.98	127.8	556.4	1001.5	518.8	933.9	**159.8**
72	254.5	0.3460	4.921	71.99	129.6	555.8	1000.4	518.1	932.6	**161.6**
73	265.6	0.3611	5.136	72.99	131.4	555.2	999.4	517.4	931.4	**163.4**
74	277.1	0.3767	5.358	73.99	133.2	554.6	998.3	516.7	930.1	**165.2**
75	289.0	0.3929	5.589	74.99	135.0	554.0	997.3	516.0	928.8	**167**
76	301.3	0.4096	5.826	76.00	136.8	553.4	996.2	515.3	927.6	**168.8**
77	314.0	0.4269	6.072	77.00	138.6	552.9	995.2	514.7	926.4	**170.6**
78	327.2	0.4449	6.327	78.00	140.4	552.3	994.1	514.0	925.2	**172.4**
79	340.9	0.4635	6.592	79.01	142.2	551.7	993.0	513.3	923.9	**174.2**
80	355.1	0.4828	6.867	80.01	144.0	551.1	991.9	512.6	922.6	**176**
81	369.7	0.5026	7.150	81.02	145.8	550.5	990.8	511.9	921.3	**177.8**
82	384.9	0.5233	7.443	82.02	147.6	549.9	989.8	511.2	920.1	**179.6**
83	400.5	0.5445	7.745	83.03	149.4	549.3	988.7	510.5	918.8	**181.4**
84	416.7	0.5665	8.058	84.03	151.2	548.7	987.6	509.8	917.6	**183.2**
85	433.5	0.5894	8.383	85.04	153.1	548.1	986.5	509.1	916.3	**185**
86	450.8	0.6129	8.717	86.04	154.9	547.4	985.4	508.3	915.0	**186.8**
87	468.6	0.6371	9.062	87.05	156.7	546.8	984.3	507.6	913.7	**188.6**
88	487.1	0.6623	9.419	88.06	158.5	546.2	983.2	506.9	912.5	**190.4**
89	506.1	0.6881	9.787	89.06	160.3	545.6	982.1	506.2	911.2	**192.2**
90	525.8	0.7149	10.167	90.07	162.1	544.9	980.9	505.4	909.9	**194**
91	546.1	0.7425	10.560	91.08	163.9	544.3	979.8	504.7	908.5	**195.8**
92	567.1	0.7710	10.966	92.08	165.7	543.7	978.7	504.0	907.2	**197.6**
93	588.7	0.8004	11.384	93.09	167.5	543.1	977.6	503.3	906.0	**199.4**
94	611.0	0.8307	11.815	94.10	169.3	542.5	976.5	502.6	904.7	**201.2**
95	634.0	0.8620	12.260	95.11	171.2	541.9	975.4	501.9	903.4	**203**
96	657.7	0.8942	12.718	96.12	173.0	541.2	974.2	501.1	902.1	**204.8**
97	682.1	0.9274	13.190	97.12	174.8	540.6	973.1	500.4	900.8	**206.6**
98	707.3	0.9616	13.678	98.13	176.6	539.9	971.9	499.6	899.4	**208.4**
99	733.3	0.9970	14.180	99.14	178.5	539.3	970.8	498.9	898.2	**210.2**
100	760.0	1.0333	14.697	100.2	180.3	538.7	969.7	498.2	896.9	**212**
101	787.5	1.0707	15.229	101.2	182.1	538.1	968.5	497.5	895.5	**213.8**
102	815.9	1.1093	15.778	102.2	183.9	537.4	967.3	496.8	894.1	**215.6**
103	845.1	1.1490	16.342	103.2	185.7	536.8	966.2	496.1	892.9	**217.4**
104	875.1	1.1898	16.923	104.2	187.6	536.2	965.1	495.4	891.6	**219.2**
105	906.1	1.2319	17.522	105.2	189.4	535.6	964.0	494.7	890.3	**221**
106	937.9	1.2752	18.137	106.2	191.2	534.9	962.8	493.9	889.0	**222.8**
107	970.6	1.3196	18.769	107.2	193.0	534.2	961.6	493.1	887.6	**224.6**
108	1004.3	1.3653	19.420	108.2	194.8	533.6	960.5	492.4	886.3	**226.4**
109	1038.8	1.4123	20.089	109.3	196.7	532.9	959.3	491.6	885.0	**228.2**
110	1074.5	1.4608	20.777	110.3	198.5	532.3	958.1	490.9	883.6	**230**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	*Apu*	*Apu*	θ	$\frac{r}{T}$	*s*	*s*	$\frac{1}{s}$	$\frac{1}{s}$	*t*
71	37.6	67.6	0.2311	1.6171	4.838	77.5	0.2067	0.01290	**159.8**
72	37.7	67.8	0.2340	1.6107	4.647	74.4	0.2152	0.01344	**161.6**
73	37.8	68.0	0.2369	1.6044	4.466	71.5	0.2239	0.01398	**163.4**
74	37.9	68.2	0.2398	1.5981	4.294	68.8	0.2329	0.01453	**165.2**
75	38.0	68.5	0.2427	1.5918	4.130	66.2	0.2421	0.01510	**167**
76	38.1	68.6	0.2456	1.5856	3.973	63.7	0.2517	0.01570	**168.8**
77	38.2	68.8	0.2484	1.5793	3.822	61.2	0.2616	0.01634	**170.6**
78	38.3	68.9	0.2513	1.5731	3.676	58.8	0.2720	0.01700	**172.4**
79	38.4	69.1	0.2541	1.5670	3.537	56.6	0.2827	0.01767	**174.2**
80	38.5	69.3	0.2570	1.5609	3.404	54.5	0.2938	0.01835	**176**
81	38.6	69.5	0.2598	1.5548	3.277	52.5	0.3052	0.01905	**177.8**
82	38.7	69.7	0.2626	1.5487	3.156	50.6	0.3168	0.01976	**179.6**
83	38.8	69.9	0.2654	1.5426	3.040	48.71	0.3289	0.02053	**181.4**
84	38.9	70.0	0.2682	1.5366	2.929	46.92	0.3414	0.02131	**183.2**
85	39.0	70.2	0.2711	1.5307	2.824	45.23	0.3541	0.02211	**185**
86	39.1	70.4	0.2739	1.5247	2.723	43.62	0.3672	0.02293	**186.8**
87	39.2	70.6	0.2767	1.5187	2.627	42.08	0.3807	0.02376	**188.6**
88	39.3	70.7	0.2795	1.5128	2.534	40.59	0.3946	0.02463	**190.4**
89	39.4	70.9	0.2823	1.5069	2.444	39.15	0.4091	0.02554	**192.2**
90	39.5	71.0	0.2851	1.5010	2.358	37.77	0.4241	0.02648	**194**
91	39.6	71.3	0.2879	1.4952	2.275	36.45	0.4395	0.02743	**195.8**
92	39.7	71.5	0.2906	1.4894	2.197	35.19	0.4552	0.02842	**197.6**
93	39.8	71.6	0.2934	1.4836	2.122	34.00	0.4713	0.02941	**199.4**
94	39.9	71.8	0.2961	1.4779	2.050	32.86	0.4878	0.03043	**201.2**
95	40.0	72.0	0.2989	1.4723	1.980	31.75	0.505	0.03149	**203**
96	40.1	72.1	0.3016	1.4666	1.913	30.67	0.523	0.03260	**204.8**
97	40.2	72.3	0.3043	1.4609	1.849	29.63	0.541	0.03375	**206.6**
98	40.3	72.5	0.3070	1.4552	1.787	28.64	0.560	0.03492	**208.4**
99	40.4	72.6	0.3097	1.4496	1.728	27.69	0.579	0.03611	**210.2**
100	40.5	72.8	0.3125	1.4441	1.671	26.78	0.598	0.03734	**212**
101	40.6	73.0	0.3152	1.4386	1.617	25.90	0.618	0.03861	**213.8**
102	40.6	73.2	0.3179	1.4330	1.564	25.06	0.639	0.03990	**215.6**
103	40.7	73.3	0.3205	1.4275	1.514	24.25	0.661	0.04124	**217.4**
104	40.8	73.5	0.3232	1.4220	1.465	23.47	0.683	0.04261	**219.2**
105	40.9	73.7	0.3259	1.4165	1.419	22.73	0.705	0.04400	**221**
106	41.0	73.8	0.3286	1.4111	1.374	22.01	0.728	0.04543	**222.8**
107	41.1	74.0	0.3312	1.4057	1.331	21.31	0.751	0.04692	**224.6**
108	41.2	74.2	0.3339	1.4003	1.289	20.64	0.776	0.04845	**226.4**
109	41.3	74.3	0.3365	1.3949	1.248	19.99	0.801	0.0500	**228.2**
110	41.4	74.5	0.3392	1.3895	1.209	19.37	0.827	0.0516	**230**

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
111	1111.1	1.5106	21.486	111.3	200.3	531.6	956.9	490.2	882.3	**231.8**
112	1148.7	1.5617	22.214	112.3	202.1	530.9	955.7	489.4	880.9	**233.6**
113	1187.4	1.6144	22.962	113.3	203.9	530.3	954.5	488.7	879.5	**235.4**
114	1227.1	1.6684	23.729	114.3	205.8	529.6	953.3	487.9	878.2	**237.2**
115	1267.9	1.7238	24.518	115.3	207.6	528.9	952.1	487.1	876.8	**239**
116	1309.8	1.7808	25.328	116.4	209.4	528.2	950.8	486.3	875.4	**240.8**
117	1352.8	1.8393	26.160	117.4	211.2	527.5	949.5	485.5	873.9	**242.6**
118	1397.0	1.8993	27.015	118.4	213.0	526.9	948.4	484.8	872.6	**244.4**
119	1442.4	1.9611	27.893	119.4	214.9	526.2	947.2	484.0	871.3	**246.2**
120	1488.9	2.0243	28.792	120.4	216.7	525.6	946.0	483.4	870.0	**248**
121	1536.6	2.0891	29.715	121.4	218.5	524.9	944.8	482.6	868.6	**249.8**
122	1585.7	2.1556	30.664	122.5	220.4	524.2	943.5	481.8	867.1	**251.6**
123	1636.0	2.2241	31.637	123.5	222.2	523.5	942.3	481.0	865.8	**253.4**
124	1687.5	2.2943	32.64	124.5	224.1	522.8	941.0	480.2	864.3	**255.2**
125	1740.5	2.3663	33.66	125.5	225.9	522.1	939.8	479.4	863.0	**257**
126	1794.7	2.4401	34.71	126.5	227.7	521.4	938.6	478.6	861.6	**258.8**
127	1850.3	2.5156	35.78	127.5	229.5	520.7	937.3	477.8	860.2	**260.6**
128	1907.3	2.5931	36.98	128.6	231.4	520.0	936.1	477.0	858.8	**262.4**
129	1965.8	2.6726	38.01	129.6	233.3	519.3	934.8	476.3	857.4	**264.2**
130	2025.6	2.7540	39.17	130.6	235.1	518.6	933.6	475.5	856.0	**266**
131	2086.9	2.8373	40.36	131.6	236.9	517.9	932.3	474.7	854.6	**267.8**
132	2149.8	2.9227	41.57	132.6	238.7	517.3	931.1	474.0	853.2	**269.6**
133	2214.0	3.0101	42.81	133.7	240.6	516.6	929.8	473.3	851.8	**271.4**
134	2280.0	3.0999	44.09	134.7	242.4	515.9	928.5	472.5	850.4	**273.2**
135	2347.5	3.1916	45.39	135.7	244.2	515.1	927.2	471.6	848.9	**275**
136	2416.5	3.2854	46.73	136.7	246.0	514.4	925.9	470.8	847.5	**276.8**
137	2487.3	3.3816	48.10	137.7	247.9	513.7	924.6	470.1	846.1	**278.6**
138	2559.7	3.4801	49.50	138.8	249.7	513.0	923.3	469.3	844.6	**280.4**
139	2633.8	3.581	50.93	139.8	251.6	512.3	922.1	468.5	843.3	**282.2**
140	2709.5	3.684	52.39	140.8	253.4	511.5	920.7	467.6	841.8	**284**
141	2787.1	3.789	53.89	141.8	255.3	510.7	919.3	466.8	840.2	**285.8**
142	2866.4	3.897	55.43	142.8	257.1	510.1	918.1	466.1	838.9	**287.6**
143	2947.7	4.008	57.00	143.9	259.0	509.3	916.7	465.3	837.4	**289.4**
144	3030.5	4.121	58.60	144.9	260.8	508.6	915.4	464.4	835.9	**291.2**
145	3115.3	4.236	60.24	145.9	262.7	507.8	914.1	463.6	834.5	**293**
146	3202.1	4.354	61.92	146.9	264.5	507.1	912.8	462.8	833.1	**294.8**
147	3290.8	4.474	63.64	148.0	266.4	506.4	911.5	462.0	831.6	**296.6**
148	3381.3	4.597	65.39	149.0	268.2	505.6	910.1	461.2	830.1	**298.4**
149	3474.0	4.723	67.18	150.0	270.1	504.9	908.8	460.4	828.7	**300.2**
150	3568.7	4.852	69.01	151.0	271.9	504.1	907.4	459.5	827.2	**302**

SATURATED STEAM (Continued)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
111	41 4	74.6	0.3418	1.3842	1.172	18.77	0.853	0.0533	**231.8**
112	41.5	74.8	0.3445	1.3789	1.136	18.20	0.880	0.0550	**233.6**
113	41.6	75.0	0.3471	1.3736	1.101	17.64	0.908	0.0567	**235.4**
114	41.7	75.1	0.3498	1.3683	1.068	17.10	0.936	0.0585	**237.2**
115	41.8	75.3	0.3524	1.3631	1.036	16.59	0.965	0 0603	**239**
116	41.9	75.4	0.3550	1.3579	1.005	16.09	0.995	0.0622	**240.8**
117	42.0	75.6	0.3576	1.3527	0.9746	15.61	1.026	0.0641	**242.6**
118	42.1	75.8	0.3602	1.3475	0.9460	15.16	1.057	0.0659	**244.4**
119	42.2	75.9	0.3628	1.3423	0.9183	14.72	1.089	0.0679	**246.2**
120	42.2	76.0	0.3654	1.3372	0.8914	14.28	1.122	0.0700	**248**
121	42.3	76.2	0.3680	1.3321	0.8653	13.86	1.156	0.0721	**249.8**
122	42.4	76.4	0.3705	1.3269	0.8401	13.46	1.190	0.0743	**251.6**
123	42.5	76.5	0.3731	1.3218	0.8158	13.07	1.226	0.0765	**253.4**
124	42.6	76.7	0.3756	1.3167	0.7924	12.69	1.262	0.0788	**255.2**
125	42.7	76.8	0.3782	1.3117	0.7698	12.33	1.299	0.0811	**257**
126	42.8	77.0	0.3807	1.3067	0.7479	11.98	1.337	0.0835	**258.8**
127	42.9	77.1	0.3833	1.3017	0.7267	11.64	1.376	0.0859	**260.6**
128	43.0	77.3	0.3858	1.2967	0.7063	11.32	1.416	0.0883	**262.4**
129	43.0	77.4	0.3884	1.2917	0.6867	11.00	1.456	0.0909	**264.2**
130	43.1	77.6	0.3909	1.2868	0.6677	10.70	1.498	0.0935	**266**
131	43.2	77.7	0.3934	1.2818	0.6493	10.40	1.540	0.0961	**267.8**
132	43.3	77.9	0.3959	1.2769	0.6315	10.12	1.583	0.0988	**269.6**
133	43.3	78.0	0.3985	1.2720	0.6142	9.839	1.628	0.1016	**271.4**
134	43.4	78.1	0.4010	1.2672	0.5974	9.569	1.674	0.1045	**273.2**
135	43.5	78.3	0.4035	1.2623	0.5812	9.309	1.721	0.1074	**275**
136	43.6	78.4	0.4060	1.2574	0.5656	9.060	1.768	0.1104	**276.8**
137	43.6	78.5	0.4085	1.2526	0.5506	8.820	1.816	0.1134	**278.6**
138	43.7	78.7	0.4110	1.2479	0.5361	8.587	1.865	0.1165	**280.4**
139	43.8	78.8	0.4135	1.2431	0.5219	8.360	1.916	0.1196	**282.2**
140	43.9	78.9	0.4160	1.2383	0.5081	8.140	1.968	0.1229	**284**
141	43.9	79.1	0.4185	1.2335	0.4948	7.926	2.021	0.1262	**285.8**
142	44.0	79.2	0.4209	1.2288	0.4819	7.719	2.075	0.1296	**287.6**
143	44.0	79.3	0.4234	1.2241	0.4694	7.519	2.130	0.1330	**289.4**
144	44.2	79.5	0.4259	1.2194	0.4574	7.326	2.186	0.1365	**291.2**
145	44.2	79.6	0.4283	1.2147	0.4457	7.139	2.244	0.1401	**293**
146	44.3	79.7	0.4307	1.2100	0.4343	6.957	2.303	0.1437	**294.8**
147	44.4	79.9	0.4332	1.2054	0.4232	6.780	2.363	0.1475	**296.6**
148	44.4	80.0	0.4356	1.2008	0.4125	6.609	2.424	0.1513	**298.4**
149	44.5	80.1	0.4380	1.1962	0.4022	6.443	2.486	0.1552	**300.2**
150	44.6	80.2	0.4405	1.1916	0.3921	6.282	2.550	0.1592	**302**

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
151	3665.3	4.984	70.88	152.1	273.8	503.4	906.1	458.7	825.7	**303.8**
152	3764.1	5.118	72.79	153.1	275.6	502.6	904.7	457.9	824.2	**305.6**
153	3864.9	5.255	74.74	154.1	277.4	501.9	903.3	457.1	822.7	**307.4**
154	3968	5.395	76.73	155.1	279.2	501.1	901.9	456.3	821.2	**309.2**
155	4073	5.538	78.76	156.2	281.1	500.3	900.5	455.4	819.6	**311**
156	4181	5.684	80.84	157.2	283.0	499.6	899.2	454.6	818.2	**312.8**
157	4290	5.833	82.96	158.2	284.8	498.8	897.8	453.8	816.7	**314.6**
158	4402	5.985	85.12	159.3	286.7	498.1	896.5	453.0	815.3	**316.4**
159	4517	6.141	87.33	160.3	288.5	497.3	895.1	452.1	813.7	**318.2**
160	4633	6.300	89.59	161.3	290.4	496.5	893.7	451.2	812.2	**320**
161	4752	6.462	91.89	162.3	292.2	495.7	892.3	450.4	810.7	**321.8**
162	4874	6.628	94.25	163.4	294.1	494.9	890.9	449.5	809.2	**323.6**
163	4998	6.796	96.65	164.4	295.9	494.2	889.5	448.7	807.7	**325.4**
164	5124	6.967	99.09	165.4	297.7	493.4	888.1	447.9	806.2	**327.2**
165	5253	7.142	101.58	166.5	299.6	492.6	886.7	447.0	804.7	**329**
166	5384	7.320	104.11	167.5	301.5	491.9	885.4	446.3	803.3	**330.8**
167	5518	7.502	106.71	168.5	303.3	491.1	883.9	445.4	801.7	**332.6**
168	5655	7.688	109.35	169.5	305.1	490.3	882.5	444.6	800.1	**334.4**
169	5794	7.877	112.04	170.6	307.0	489.5	881.0	443.7	798.5	**336.2**
170	5937	8.071	114.79	171.6	308.9	488.7	879.6	442.8	797.0	**338**
171	6081	8.268	117.59	172.6	310.7	487.9	878.3	441.9	795.6	**339.8**
172	6229	8.469	120.45	173.7	312.6	487.1	876.9	441.1	794.1	**341.6**
173	6379	8.673	123.36	174.7	314.5	486.3	875.4	440.2	792.5	**343.4**
174	6533	8.882	126.33	175.7	316.3	485.5	873.9	439.4	790.9	**345.2**
175	6689	9.094	129.35	176.8	318.2	484.7	872.4	438.5	789.3	**347**
176	6848	9.310	132.43	177.8	320.0	483.9	871.0	437.7	787.8	**348.8**
177	7010	9.531	135.56	178.8	321.8	483.1	869.5	436.8	786.2	**350.6**
178	7175	9.755	138.75	179.9	323.7	482.3	868.1	436.0	784.7	**352.4**
179	7343	9.983	142.00	180.9	325.6	481.4	866.6	435.0	783.1	**354.2**
180	7514	10.216	145.30	181.9	327.5	480.6	865.1	434.2	781.5	**356**
181	7688	10.453	148.67	183.0	329.3	479.8	863.6	433.3	779.9	**357.8**
182	7866	10.695	152.11	184.0	331.2	479.0	862.2	432.5	778.4	**359.6**
183	8046	10.940	155.60	185.0	333.0	478.2	860.7	431.6	776.9	**361.4**
184	8230	11.189	159.15	186.1	334.9	477.4	859.2	430.8	775.3	**363.2**
185	8417	11.444	162.77	187.1	336.8	476.6	857.7	429.9	773.7	**365**
186	8608	11.703	166.46	188.1	338.6	475.7	856.3	429.0	772.2	**366.8**
187	8802	11.967	170.21	189.2	340.5	474.8	854.7	428.0	770.5	**368.6**
188	8999	12.235	174.02	190.2	342.4	474.0	853.2	427.2	768.9	**370.4**
189	9200	12.508	177.90	191.2	344.2	473.2	851.7	426.3	767.4	**372.2**
190	9404	12.786	181.85	192.3	346.1	472.3	850.2	425.4	765.8	**374**

SATURATED STEAM (Continued)

	Heat equivalent of external work.				Specific volume.		Density.		
Temperature, degrees Centigrade. t	Calories per kilogram. Apu	B.T.U. per pound. Apu	Entropy of the liquid. θ	Entropy of vaporization. $\frac{r}{T}$	Cubic meters per kilo. s	Cubic feet per pound. s	Kilos per cubic meter. $\frac{1}{s}$	Pounds per cubic foot. $\frac{1}{s}$	Temperature, degrees Fahrenheit. t
151	44.6	80.4	0.4429	1.1870	0.3824	6.126	2.615	0.1632	**303.8**
152	44.7	80.5	0.4453	1.1824	0.3729	5.974	2.682	0.1674	**305.6**
153	44.8	80.6	0.4477	1.1778	0.3637	5.826	2.750	0.1716	**307.4**
154	44.8	80.7	0.4501	1.1733	0.3548	5.683	2.818	0.1759	**309.2**
155	44.9	80.9	0.4525	1.1688	0.3463	5.546	2.888	0.1803	**311**
156	45.0	81.0	0.4549	1.1644	0.3380	5.413	2.959	0.1847	**312.8**
157	45.0	81.1	0.4573	1.1599	0.3298	5.282	3.032	0.1893	**314.6**
158	45.1	81.2	0.4596	1.1554	0.3218	5.154	3.108	0.1940	**316.4**
159	45.2	81.4	0.4620	1.1509	0.3140	5.029	3.185	0.1988	**318.2**
160	45.3	81.5	0.4644	1.1465	0.3063	4.906	3.265	0.2038	**320**
161	45.3	81.6	0.4668	1.1421	0.2989	4.789	3.345	0.2088	**321.8**
162	45.4	81.7	0.4692	1.1377	0.2920	4.677	3.425	0.2138	**323.6**
163	45.5	81.8	0.4715	1.1333	0.2855	4.571	3.503	0.2188	**325.4**
164	45.5	81.9	0.4739	1.1289	0.2792	4.469	3.582	0.2238	**327.2**
165	45.6	82.0	0.4763	1.1245	0.2729	4.368	3.664	0.2289	**329**
166	45.6	82.1	0.4786	1.1202	0.2666	4.268	3.751	0.2343	**330.8**
167	45.7	82.2	0.4810	1.1159	0.2603	4.168	3.842	0.2399	**332.6**
168	45.7	82.4	0.4833	1.1115	0.2540	4.070	3.937	0.2457	**334.4**
169	45.8	82.5	0.4857	1.1072	0.2480	3.975	4.032	0.2516	**336.2**
170	45.9	82.6	0.4880	1.1029	0.2423	3.883	4.127	0.2575	**338**
171	46.0	82.7	0.4903	1.0987	0.2368	3.794	4.223	0.2636	**339.8**
172	46.0	82.8	0.4926	1.0944	0.2314	3.709	4.322	0.2696	**341.6**
173	46.1	82.9	0.4949	1.0901	0.2262	3.626	4.421	0.2758	**343.4**
174	46.1	83.0	0.4972	1.0859	0.2212	3.545	4.521	0.2821	**345.2**
175	46.2	83.1	0.4995	1.0817	0.2164	3.467	4.621	0.2884	**347**
176	46.2	83.2	0.5018	1.0775	0.2117	3.391	4.724	0.2949	**348.8**
177	46.3	83.3	0.5041	1.0733	0.2072	3.318	4.826	0.3014	**350.6**
178	46.3	83.4	0.5064	1.0691	0.2027	3.247	4.933	0.3080	**352.4**
179	46.4	83.5	0.5087	1.0649	0.1983	3.177	5.04	0.3148	**354.2**
180	46.4	83.6	0.5110	1.0608	0.1941	3.109	5.15	0.3217	**356**
181	46.5	83.7	0.5133	1.0567	0.1899	3.041	5.27	0.3288	**357.8**
182	46.5	83.8	0.5156	1.0525	0.1857	2.974	5.38	0.3362	**359.6**
183	46.6	83.8	0.5178	1.0484	0.1817	2.911	5.50	0.3435	**361.4**
184	46.6	83.9	0.5201	1.0443	0.1778	2.849	5.62	0.3510	**363.2**
185	46.7	84.0	0.5224	1.0403	0.1740	2.787	5.75	0.3588	**365**
186	46.7	84.1	0.5246	1.0362	0.1702	2.727	5.88	0.3667	**366.8**
187	46.8	84.2	0.5269	1.0321	0.1666	2.669	6.00	0.3746	**368.6**
188	46.8	84.3	0.5291	1.0280	0.1632	2.614	6.13	0.3826	**370.4**
189	46.9	84.3	0.5314	1.0240	0.1598	2.560	6.26	0.3906	**372.2**
190	46.9	84.4	0.5336	1.0200	0.1565	2.507	6.39	0.3989	**374**

Temperature, degrees Centigrade.	Total pressure.			Heat of the liquid.		Heat of vaporization.		Heat equivalent of internal work.		Temperature, degrees Fahrenheit.
	Millimeters of mercury.	Kilograms per square centimeter.	Pounds per square inch.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	
t	p	p	p	q	q	r	r	ρ	ρ	t
191	9612	13.068	185.87	193.3	347.9	471.5	848.7	424.5	764.2	**375.8**
192	9823	13.355	189.96	194.4	349.8	470.6	847.1	423.6	762.5	**377.6**
193	10038	13.647	194.11	195.4	351.7	469.8	845.6	422.8	761.0	**379.4**
194	10256	13.944	198.33	196.4	353.5	468.9	844.1	421.9	759.4	**381.2**
195	10479	14.247	202.64	197.5	355.4	468.1	842.5	421.0	757.7	**383**
196	10705	14.554	207.01	198.5	357.3	467.2	841.0	420.1	756.1	**384.8**
197	10934	14.866	211.45	199.5	359.2	466.4	839.5	419.2	754.6	**386.6**
198	11168	15.184	215.96	200.6	361.1	465.6	838.0	418.4	753.0	**388.4**
199	11406	15.507	220.56	201.6	362.9	464.7	836.4	417.4	751.3	**390.2**
200	11647	15.835	225.23	202.7	364.8	463.8	834.8	416.5	749.7	**392**
201	11893	16.169	229.98	203.7	366.7	462.9	833.3	415.6	748.1	**393.8**
202	12142	16.508	234.80	204.7	368.5	462.1	831.8	414.8	746.6	**395.6**
203	12395	16.852	239.71	205.8	370.4	461.2	830.2	413.8	744.9	**397.4**
204	12653	17.202	244.69	206.8	372.3	460.3	828.6	412.9	743.3	**399.2**
205	12915	17.558	249.75	207.9	374.1	459.4	827.0	412.0	741.6	**401**
206	13181	17.921	254.89	208.9	376.0	458.6	825.4	411.1	740.0	**402.8**
207	13452	18.289	260.13	210.0	377.9	457.7	823.8	410.2	738.3	**404.6**
208	13727	18.663	265.45	211.0	379.8	456.8	822.2	409.3	736.7	**406.4**
209	14006	19.042	270.85	212.0	381.6	455.9	820.6	408.4	735.1	**408.2**
210	14290	19.428	276.34	213.1	383.5	455.0	819.1	407.5	733.6	**410**
211	14578	19.820	281.91	214.1	385.4	454.1	817.4	406.6	731.9	**411.8**
212	14871	20.218	287.57	215.2	387.3	453.2	815.8	405.7	730.2	**413.6**
213	15168	20.622	293.31	216.2	389.2	452.4	814.3	404.9	728.7	**415.4**
214	15470	21.033	299.16	217.3	391.1	451.5	812.7	404.0	727.1	**417.2**
215	15778	21.452	305.10	218.3	392.9	450.6	811.0	403.1	725.4	**419**
216	16090	21.876	311.14	219.3	394.8	449.6	809.3	402.1	723.7	**420.8**
217	16406	22.306	317.26	220.4	396.7	448.7	807.7	401.2	722.1	**422.6**
218	16728	22.743	323.48	221.4	398.5	447.8	806.1	400.3	720.5	**424.4**
219	17055	23.188	329.81	222.5	400.4	446.9	804.5	399.4	718.9	**426.2**
220	17387	23.639	336.24	223.5	402.3	446.0	802.9	398.5	717.3	**428**

SATURATED STEAM (Concluded)

Temperature, degrees Centigrade.	Heat equivalent of external work.		Entropy of the liquid.	Entropy of vaporization.	Specific volume.		Density.		Temperature, degrees Fahrenheit.
	Calories per kilogram.	B.T.U. per pound.			Cubic meters per kilo.	Cubic feet per pound.	Kilos per cubic meter.	Pounds per cubic foot.	
t	Apu	Apu	θ	$\frac{r}{T}$	s	s	$\frac{1}{s}$	$\frac{1}{s}$	t
191	47.0	84.5	0.5358	1.0160	0.1533	2.456	6.52	0.4072	**375.8**
192	47.0	84.6	0.5381	1.0120	0.1501	2.405	6.66	0.4158	**377.6**
193	47.0	84.6	0.5403	1.0080	0.1470	2.355	6.80	0.4246	**379.4**
194	47.0	84.7	0.5426	1.0040	0.1440	2.306	6.94	0.4336	**381.2**
195	47.1	84.8	0.5448	1.0000	0.1411	2.259	7.09	0.4426	**383**
196	47.1	84.9	0.5470	0.9961	0.1382	2.214	7.23	0.4516	**384.8**
197	47.2	84.9	0.5492	0.9922	0.1354	2.169	7.38	0.4610	**386.6**
198	47.2	85.0	0.5514	0.9882	0.1327	2.126	7.53	0.4704	**388.4**
199	47.3	85.1	0.5536	0.9843	0.1300	2.083	7.69	0.4801	**390.2**
200	47.3	85.1	0.5558	0.9804	0.1274	2.041	7.84	0.4900	**392**
201	47.3	85.2	0.5580	0.9765	0.1249	2.001	8.00	0.4998	**393.8**
202	47.3	85.2	0.5602	0.9727	0.1225	1.962	8.16	0.510	**395.6**
203	47.4	85.3	0.5624	0.9688	0.1201	1.923	8.33	0.520	**397.4**
204	47.4	85.3	0.5646	0.9650	0.1177	1.885	8.50	0.531	**399.2**
205	47.4	85.4	0.5668	0.9611	0.1153	1.847	8.67	0.541	**401**
206	47.5	85.4	0.5690	0.9572	0.1130	1.810	8.85	0.552	**402.8**
207	47.5	85.5	0.5712	0.9534	0.1108	1.774	9.03	0.564	**404.6**
208	47.5	85.5	0.5733	0.9496	0.1086	1.739	9.21	0.575	**406.4**
209	47.5	85.5	0.5755	0.9458	0.1065	1.705	9.39	0.587	**408.2**
210	47.5	85.5	0.5777	0.9420	0.1044	1.673	9.58	0.598	**410**
211	47.5	85.5	0.5799	0.9382	0.1024	1.640	9.77	0.610	**411.8**
212	47.5	85.6	0.5820	0.9344	0.1004	1.608	9.96	0.622	**413.6**
213	47.5	85.6	0.5842	0.9307	0.0984	1.577	10.16	0.634	**415.4**
214	47.5	85.6	0.5863	0.9269	0.0965	1.546	10.36	0.647	**417.2**
215	47.5	85.6	0.5885	0.9232	0.0947	1.516	10.56	0.660	**419**
216	47.5	85.6	0.5906	0.9195	0.0928	1.486	10.78	0.673	**420.8**
217	47.5	85.6	0.5927	0.9157	0.0910	1.458	10.99	0.686	**422.6**
218	47.5	85.6	0.5948	0.9120	0.0893	1.430	11.20	0.699	**424.4**
219	47.5	85.6	0.5969	0.9084	0.0876	1.403	11.41	0.713	**426.2**
220	47.5	85.6	0.5991	0.9047	0.0860	1.376	11.62	0.727	**428**

Ammonia, NH_3

Temp. °F	Abs. press. sat. vap.		Heat content abv. −40°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. −40°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
−60	5.55	0.390	−21.2	589.6	610.8	−11.8	327.6	339.3	−51.11
−58	5.93	.417	−19.1	590.4	609.5	−10.6	328.0	338.6	−50.00
−56	6.33	.445	−17.0	591.2	608.2	− 9.44	328.4	337.9	−48.89
−54	6.75	.475	−14.8	592.1	606.9	− 8.22	328.9	337.2	−47.78
−52	7.20	.506	−12.7	592.9	605.6	− 7.06	329.4	336.4	−46.67
−50	7.67	0.539	−10.6	593.7	604.3	− 5.89	329.8	335.7	−45.56
−48	8.16	.574	− 8.5	594.4	602.9	− 4.7	330.2	334.9	−44.44
−46	8.68	.610	− 6.4	595.2	601.6	− 3.6	330.7	334.2	−43.33
−44	9.23	.649	− 4.3	596.0	600.3	− 2.4	331.1	333.5	−42.22
−42	9.81	.690	− 2.1	596.8	598.9	− 1.2	331.6	332.7	−41.11
−40	10.41	0.7319	0.0	597.6	597.6	0.0	332.0	332.0	−40.00
−38	11.04	.7762	+ 2.1	598.3	596.2	+ 1.2	332.4	331.2	−38.89
−36	11.71	.8233	4.3	599.1	594.8	2.4	332.8	330.4	−37.78
−34	12.41	.8725	6.4	599.9	593.5	3.6	333.3	329.7	−36.67
−32	13.14	.9238	8.5	600.6	592.1	4.7	333.7	328.9	−35.56
−30	13.90	0.9773	10.7	601.4	590.7	5.94	334.1	328.2	−34.44
−28	14.71	1.034	12.8	602.1	589.3	7.11	334.5	327.4	−33.33
−26	15.55	1.093	14.9	602.8	587.9	8.28	334.9	326.6	−32.22
−24	16.42	1.154	17.1	603.6	586.5	9.50	335.3	325.8	−31.11
−22	17.34	1.219	19.2	604.3	585.1	10.7	335.7	325.1	−30.00
−20	18.30	1.287	21.4	605.0	583.6	11.9	336.1	324.2	−28.89
−18	19.30	1.357	23.5	605.7	582.2	13.1	336.5	323.4	−27.78
−16	20.34	1.430	25.6	606.4	580.8	14.2	336.9	322.7	−26.67
−14	21.43	1.507	27.8	607.1	579.3	15.4	337.3	321.8	−25.56
−12	22.56	1.586	30.0	607.8	577.8	16.7	337.7	321.0	−24.44
−10	23.74	1.669	32.1	608.5	576.4	17.8	338.1	320.2	−23.33
− 8	24.97	1.756	34.3	609.2	574.9	19.1	338.4	319.4	−22.22
− 6	26.26	1.846	36.4	609.8	573.4	20.2	338.8	318.6	−21.11
− 4	27.59	1.940	38.6	610.5	571.9	21.4	339.2	317.7	−20.00
− 2	28.98	2.037	40.7	611.1	570.4	22.6	339.5	316.9	−18.89
0	30.42	2.139	42.9	611.8	568.9	23.8	339.9	316.1	−17.78
2	31.92	2.244	45.1	612.4	567.3	25.1	340.2	315.2	−16.67
4	33.47	2.353	47.2	613.0	565.8	26.2	340.6	314.3	−15.56
6	35.09	2.467	49.4	613.6	564.2	27.4	340.9	313.4	−14.44
8	36.77	2.585	51.6	614.3	562.7	28.7	341.3	312.6	−13.33
10	38.51	2.708	53.8	614.9	561.1	29.9	341.6	311.7	−12.22
12	40.31	2.834	56.0	615.5	559.5	31.1	341.9	310.8	−11.11
14	42.18	2.966	58.2	616.1	557.9	32.3	342.3	309.9	−10.00
16	44.12	3.102	60.3	616.6	556.3	33.5	342.6	309.1	− 8.89
18	46.13	3.243	62.5	617.2	554.7	34.7	342.9	308.2	− 7.78
20	48.21	3.390	64.7	617.8	553.1	35.9	343.2	307.3	− 6.67
22	50.36	3.541	66.9	618.3	551.4	37.2	343.5	306.3	− 5.56
24	52.59	3.697	69.1	618.9	549.8	38.4	343.8	305.4	− 4.44
26	54.90	3.860	71.3	619.4	548.1	39.6	344.1	304.5	− 3.33
28	57.28	4.027	73.5	619.9	546.4	40.8	344.4	303.6	− 2.22

Ammonia, NH_3

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Dens. liq. lb./ft.³	Entropy from −40°F BTU/lb./°F		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³		Liq.	Vap.	
−60	44.73	2.792	0.02235	0.3580	43.91	−0.0517	1.4769	−51.11
−58	42.05	2.625	.02378	.3809		− .0464	1.4713	−50.00
−56	39.56	2.470	.02528	.4049		− .0412	1.4658	−48.89
−54	37.24	2.325	.02685	.4301		− .0360	1.4604	−47.78
−52	35.09	2.191	.02850	.4565		− .0307	1.4551	−46.67
−50	33.08	2.065	0.03023	0.4842	43.49	−0.0256	1.4497	−45.56
−48	31.20	1.948	.03205	.5134		− .0204	1.4445	−44.44
−46	29.45	1.839	.03395	.5438		− .0153	1.4393	−43.33
−44	27.82	1.737	.03595	.5758		− .0102	1.4342	−42.22
−42	26.29	1.641	.03804	.6093		− .0051	1.4292	−41.11
−40	24.86	1.552	0.04022	0.6442	43.08	0.0000	1.4242	−40.00
−38	23.53	1.469	.04251	.6809		.0051	1.4193	−38.89
−36	22.27	1.390	.04489	.7190		.0101	1.4144	−37.78
−34	21.10	1.317	.04739	.7591		.0151	1.4096	−36.67
−32	20.00	1.249	.04999	.8007		.0201	1.4048	−35.56
−30	18.97	1.184	0.05271	0.8443	42.65	0.0250	1.4001	−34.44
−28	18.00	1.124	.05555	.8898		.0300	1.3955	−33.33
−26	17.09	1.067	.05850	.9371		.0350	1.3909	−32.22
−24	16.24	1.014	.06158	.9864		.0399	1.3863	−31.11
−22	15.43	0.9633	.06479	1.038		.0448	1.3818	−30.00
−20	14.68	0.9164	0.06813	1.091	42.22	0.0497	1.3774	−28.89
−18	13.97	.8721	.07161	1.147		.0545	1.3729	−27.78
−16	13.29	.8297	.07522	1.205		.0594	1.3686	−26.67
−14	12.66	.7903	.07898	1.265		.0642	1.3643	−25.56
−12	12.06	.7529	.08289	1.328		.0690	1.3600	−24.44
−10	11.50	0.7179	0.08695	1.393	41.78	0.0738	1.3558	−23.33
− 8	10.97	.6848	.09117	1.460		.0786	1.3516	−22.22
− 6	10.47	.6536	.09555	1.531		.0833	1.3474	−21.11
− 4	9.991	.6237	.1001	1.603		.0880	1.3433	−20.00
− 2	9.541	.5956	.1048	1.679		.0928	1.3393	−18.89
0	9.116	0.5691	0.1097	1.757	41.34	0.0975	1.3352	−17.78
2	8.714	.5440	.1148	1.839		.1022	1.3312	−16.67
4	8.333	.5202	.1200	1.922		.1069	1.3273	−15.56
6	7.971	.4976	.1254	2.009		.1115	1.3234	−14.44
8	7.629	.4763	.1311	2.100		.1162	1.3195	−13.33
10	7.304	0.4560	0.1369	2.193	40.89	0.1208	1.3157	−12.22
12	6.996	.4367	.1429	2.289		.1254	1.3118	−11.11
14	6.703	.4185	.1492	2.390		.1300	1.3081	−10.00
16	6.425	.4011	.1556	2.492		.1346	1.3043	− 8.89
18	6.161	.3846	.1623	2.600		.1392	1.3006	− 7.78
20	5.910	0.3690	0.1692	2.710	40.43	0.1437	1.2969	− 6.67
22	5.671	.3540	.1763	2.824		.1483	1.2933	− 5.56
24	5.443	.3398	.1837	2.943		.1528	1.2897	− 4.44
26	5.227	.3263	.1913	3.064		.1573	1.2861	− 3.33
28	5.021	.3135	.1992	3.191		.1618	1.2825	− 2.22

Ammonia, NH_3 (Continued)

Temp. °F	Abs. press. sat. vap.		Heat content abv. −40°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. −40°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
30	59.74	4.200	75.7	620.5	544.8	42.1	344.7	302.7	− 1.11
32	62.29	4.379	77.9	621.0	543.1	43.3	345.0	301.7	0.00
34	64.91	4.564	80.1	621.5	541.4	44.5	345.3	300.8	+ 1.11
36	67.63	4.755	82.3	622.0	539.7	45.7	345.6	299.8	2.22
38	70.43	4.952	84.6	622.5	537.9	47.0	345.8	298.8	3.33
40	73.32	5.155	86.8	623.0	536.2	48.2	346.1	297.9	4.44
42	76.31	5.365	89.0	623.4	534.4	49.4	346.3	296.9	5.56
44	79.38	5.581	91.2	623.9	532.7	50.7	346.6	295.9	6.67
46	82.55	5.804	93.5	624.4	530.9	51.9	346.9	294.9	7.78
48	85.82	6.034	95.7	624.8	529.1	53.2	347.1	293.9	8.89
50	89.19	6.271	97.9	625.2	527.3	54.4	347.3	292.9	10.00
52	92.66	6.515	100.2	625.7	525.5	55.67	347.6	291.9	11.11
54	96.23	6.766	102.4	626.1	523.7	56.89	347.8	290.9	12.22
56	99.91	7.024	104.7	626.5	521.8	58.17	348.1	289.9	13.33
58	103.7	7.291	106.9	626.9	520.0	59.39	348.3	288.9	14.44
60	107.6	7.565	109.2	627.3	518.1	60.67	348.5	287.8	15.56
62	111.6	7.846	111.5	627.7	516.2	61.94	348.7	286.8	16.67
64	115.7	8.135	113.7	628.0	514.3	63.17	348.9	285.7	17.78
66	120.0	8.437	116.0	628.4	512.4	64.44	349.1	284.7	18.89
68	124.3	8.739	118.3	628.8	510.5	65.72	349.3	283.6	20.00
70	128.8	9.056	120.5	629.1	508.6	66.94	349.5	282.6	21.11
72	133.4	9.379	122.8	629.4	506.6	68.22	349.7	281.4	22.22
74	138.1	9.709	125.1	629.8	504.7	69.50	349.9	280.4	23.33
76	143.0	10.05	127.4	630.1	502.7	70.78	350.1	279.3	24.44
78	147.9	10.40	129.7	630.4	500.7	72.06	350.2	278.2	25.56
80	153.0	10.76	132.0	630.7	498.7	73.33	350.4	277.1	26.67
82	158.3	11.13	134.3	631.0	496.7	74.61	350.6	275.9	27.78
84	163.7	11.51	136.6	631.3	494.7	75.89	350.7	274.8	28.89
86	169.2	11.90	138.9	631.5	492.6	77.17	350.8	273.7	30.00
88	174.8	12.29	141.2	631.8	490.6	78.44	351.0	272.6	31.11
90	180.6	12.70	143.5	632.0	488.5	79.72	351.1	271.4	32.22
92	186.6	13.12	145.8	632.2	486.4	81.00	351 2	270.2	33.33
94	192.7	13.55	148.2	632.5	484.3	82.33	351.4	269.1	34.44
96	198.9	13.98	150.5	632.6	482.1	83.61	351.4	267.8	35.56
98	205.3	14.43	152.9	632.9	480.0	84.94	351.6	266.7	36.67
100	211.9	14.90	155.2	633.0	477.8	86.22	351.7	265.4	37.78
102	218.6	15.37	157.6	633.2	475.6	87.56	351.8	264.2	38.89
104	225.4	15.85	159.9	633.4	473.5	88.83	351.9	263.1	40.00
106	232.5	16.35	162.3	633.5	471 2	90.17	351.9	261.8	41.11
108	239.7	16.85	164.6	633.6	469.0	91.44	352.0	260.6	42.22
110	247.0	17.37	167.0	633.7	466.7	92.78	352.1	259.3	43.33
112	254.5	17.89	169.4	633.8	464.4	94.11	352.1	258.0	44.44
114	262.2	18.43	171.8	633.9	462.1	95.44	352.2	256 7	45.56
116	270.1	18.99	174.2	634.0	459.8	96.78	352.2	255.4	46.67
118	278.2	19.56	176.6	634.0	457.4	98.11	352.2	254.1	47.78
120	286.4	20.14	179.0	634.0	455.0	99.45	352.2	252.8	48.89
122	294.8	20.73	181.4	634.0	452.6	100.8	352.2	251.4	50 00
124	303.4	21.33	183.9	634.0	450.1	102 2	352.2	250.1	51 11

PROPERTIES (Continued)

Ammonia, NH_3 (Continued)

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Dens. liq. lb./ft.³	Entropy from −40°F BTU/lb./°F		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³		Liq.	Vap.	
30	4.825	0.3012	0.2073	3.321	39.96	0.1663	1.2790	− 1.11
32	4.637	.2895	.2156	3.453		.1708	1.2755	0.00
34	4.459	.2784	.2243	3.593		.1753	1.2721	+ 1.11
36	4.289	.2678	.2332	3.735		.1797	1.2686	2.22
38	4.126	.2576	.2423	3.881		.1841	1.2652	3.33
40	3.971	0.2479	0.2518	4.033	39.49	0.1885	1.2618	4.44
42	3.823	.2387	.2616	4.190		.1930	1.2585	5.56
44	3.682	.2299	.2716	4.350		.1974	1.2552	6.67
46	3.547	.2214	.2819	4.515		.2018	1.2519	7.78
48	3.418	.2134	.2926	4.687		.2062	1.2486	8.89
50	3.294	0.2056	0.3036	4.863	39.00	0.2105	1.2453	10.00
52	3.176	.1983	.3149	5.044		.2149	1.2421	11.11
54	3.063	.1912	.3265	5.230		.2192	1.2389	12.22
56	2.954	.1844	.3385	5.422		.2236	1.2357	13.33
58	2.851	.1780	.3508	5.619		.2279	1.2325	14.44
60	2.751	0.1717	0.3635	5.823	38.50	0.2322	1.2294	15.56
62	2.656	.1658	.3765	6.031		.2365	1.2262	16.67
64	2.565	.1601	.3899	6.245		.2408	1.2231	17.78
66	2.477	.1546	.4037	6.466		.2451	1.2201	18.89
68	2.393	.1494	.4179	6.694		.2494	1.2170	20.00
70	2.312	0.1443	0.4325	6.928	38.00	0.2537	1.2140	21.11
72	2.235	.1395	.4474	7.166		.2579	1.2110	22.22
74	2.161	.1349	.4628	7.413		.2622	1.2080	23.33
76	2.089	.1304	.4786	7.666		.2664	1.2050	24.44
78	2.021	.1262	.4949	7.927		.2706	1.2020	25.56
80	1.955	0.1220	0.5115	8.193	37.48	0.2749	1.1991	26.67
82	1.892	.1181	.5287	8.469		.2791	1.1962	27.78
84	1.831	.1143	.5462	8.749		.2833	1.1933	28.89
86	1.772	.1106	.5643	9.039		.2875	1.1904	30.00
88	1.716	.1071	.5828	9.335		.2917	1.1875	31.11
90	1.661	0.1037	0.6019	9.641	36.95	0.2958	1.1846	32.22
92	1.609	.1004	.6214	9.954		.3000	1.1818	33.33
94	1.559	.09733	.6415	10.28		.3041	1.1789	34.44
96	1.510	.09427	.6620	10.60		.3083	1.1761	35.56
98	1.464	.09140	.6832	10.94		.3125	1.1733	36.67
100	1.419	0.08859	0.7048	11.29	36.40	0.3166	1.1705	37.78
102	1.375	.08584	.7270	11.65		.3207	1.1677	38.89
104	1.334	.08328	.7498	12.01		.3248	1.1649	40.00
106	1.293	.08072	.7732	12.39		.3289	1.1621	41.11
108	1.254	.07829	.7972	12.77		.3330	1.1593	42.22
110	1.217	0.07598	0.8219	13.17	35.84	0.3372	1.1566	43.33
112	1.180	.07367	.8471	13.57		.3413	1.1538	44.44
114	1.145	.07148	.8730	13.98		.3453	1.1510	45.56
116	1.112	.06942	.8996	14.41		.3495	1.1483	46.67
118	1.079	.06736	.9269	14.85		.3535	1.1455	47.78
120	1.047	0.06536	0.9549	15.30	35.26	0.3576	1.1427	48.89
122	1.017	.06349	.9837	15.76		.3618	1.1400	50.00
124	0.987	.0616	1.0132	16.229		.3659	1.1372	51.11

Carbon Dioxide, CO_2

Temp. °F	Abs. press. sat. vap.		Heat content abv. 32°F BTU/lb.		Heat of vaporiz. BTU/lb.	Heat content abv 0°C g-cal./g		Heat of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
−20	220.6	15.51	−23.96	102.0	126.0	−13.31	56.67	70.00	−28.89
−18	228.4	16.06	−23.13	102.1	125.2	−12.85	56.72	69.56	−27.78
−16	236.4	16.62	−22.30	102.2	124.5	−12.39	56.78	69.17	−26.67
−14	244.6	17.20	−21.46	102.2	123.7	−11.92	56.78	68.72	−25.56
−12	253.0	17.79	−20.61	102.3	122.9	−11.45	56.83	68.28	−24.44
−10	261.7	18.40	−19.76	102.3	122.0	−10.98	56.83	67.78	−23.33
− 8	270.6	19.03	−18.90	102.3	121.2	−10.50	56.83	67.33	−22.22
− 6	279.7	19.66	−18.04	102.3	120.3	−10.02	56.83	66.83	−21.11
− 4	289.1	20.33	−17.17	102.3	119.5	− 9.539	56.83	66.39	−20.00
− 2	298.7	21.00	−16.29	102.3	118.6	− 9.050	56.83	65.89	−18.89
0	308.6	21.70	−15.41	102.2	117.7	− 8.561	56.78	65.39	−17.78
2	318.7	22.41	−14.51	102.2	116.7	− 8.061	56.78	64.83	−16.67
4	329.1	23.14	−13.61	102.1	115.8	− 7.561	56.72	64.33	−15.56
6	339.8	23.89	−12.71	102.1	114.8	− 7.061	56.72	63.78	−14.44
8	350.7	24.66	−11.79	102.0	113.8	− 6.550	56.67	63.22	−13.33
10	361.8	25.44	−10.87	101.9	112.8	− 6.039	56.61	62.67	−12.22
12	373.3	26.25	− 9.934	101.8	111.7	− 5 519	56.56	62.06	−11.11
14	385.0	27.07	− 8.992	101.7	110.7	− 4.996	56.50	61.50	−10.00
16	397.1	27.92	− 8.038	101.5	109.6	− 4.466	56.39	60.89	− 8.89
18	409.4	28.78	− 7.076	101.4	108.5	− 3.931	56.33	60.28	− 7.78
20	422.0	29.67	− 6.102	101.2	107.3	− 3.390	56.22	59.61	− 6.67
22	434.9	30.58	− 5.117	101.0	106.1	− 2.843	56.11	58.94	− 5.56
24	448.1	31.50	− 4.121	100.8	104.9	− 2.289	56.00	58.28	− 4.44
25	454.8	31.98	− 3.618	100.7	104.3	− 2.010	55.94	57.94	− 3.89
27	468.5	32.94	− 2.601	100.5	103.1	− 1.445	55.83	57.28	− 2.78
29	482.5	33.92	− 1.570	100.2	101.8	− 0.8722	55.67	56.56	− 1.67
31	496.8	34.93	− 0.525	99.98	100.5	− 0.292	55.54	55.83	− 0.56
33	511.4	35.95	+ 0.531	99.69	99.16	+ 0.295	55.38	55.09	+ 0.56
35	526.4	37.01	1.604	99.38	97.77	0.8911	55.21	54.32	1.67
37	541.7	38.09	2.697	99.05	96.35	1.498	55.03	53.53	2.78
39	557.4	39.19	3.806	98.69	94.88	2.114	54.83	52.71	3.89
41	573.4	40.31	4.932	98.31	93.37	2.740	54.62	51.87	5.00
43	589.8	41.47	6.080	97.90	91.82	3.378	54.39	51.01	6.11
45	606.5	42.64	7.251	97.46	90.21	4.028	54.14	50.12	7.22
47	623.6	43.84	8.443	96.99	88.55	4.691	53.88	49.19	8.33
49	641.1	45.07	9.664	96.50	86.83	5.369	53.61	48.24	9.44
51	659.0	46.33	10.91	95.97	85.06	6.061	53.32	47.26	10.56
53	677.3	47.62	12.19	95.40	83.21	6.772	53.00	46.23	11.67
55	695.9	48.93	13.49	94.78	81.29	7.494	52.66	45.16	12.78
57	714.9	50.26	14.84	94.13	79.30	8.244	52.29	44.06	13.89
59	734.3	51.63	16.22	93.44	77.22	9.011	51.91	42.90	15.00
61	754.2	53.03	17.65	92.69	75.04	9.806	51.49	41.69	16.11
63	774.5	54.45	19.13	91.88	72.75	10.63	51.04	40.42	17.22
65	795.1	55.90	20.66	91.01	70.35	11.48	50.56	39.08	18.33
67	816 2	57.38	22.25	90.07	67.81	12.36	50.04	37.67	19.44
69	837.8	58.90	23.92	89.04	65.12	13.29	49.47	36.18	20.56
71	859.8	60.45	25.67	87.92	62.25	14.26	48.84	34.58	21.67
73	882.2	62.02	27.52	86.69	59.17	15.29	48.16	32.87	22.78
75	905.1	63.63	29.50	85.33	55.83	16.39	47.41	31.02	23.89
77	928.4	65.27	31.62	83.80	52.17	17.57	46.56	28.98	25.00
79	952.2	66.95	33.95	82.06	48.11	18.86	45.59	26.73	26.11
81	976.5	68.65	36.54	80.03	43.49	20.30	44.46	24.16	27.22
83	1001.0	70.377	39.53	77.60	38.07	21.96	43.11	21.15	28.33
85	1027.0	72.205	43 18	74.47	31.29	23.99	41.37	17.38	29.44
86	1039.0	73.049	45.45	72.46	27.00	25.25	40.26	15.00	30.00
87	1052.0	73.963	48.32	69.84	21.52	26.84	38.80	11.96	30.56
88	1065.0	74.877	52.78	65.62	12.84	29.32	36.46	7.133	31.11

PROPERTIES (Continued)

Carbon Dioxide, CO_2

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Dens. liq. lb./ft.^{3}	Entropy from 32°F BTU/lb./°F		Temp. °C
	ft.^{3}/lb.	m^3/kg	lb./ft.^{3}	kg/m^3		Liq.	Vap.	
−20	0.4166	0.02601	2.401	38.46	64.34	−0.0514	0.2353	−28.89
−18	.4018	.02508	2.489	39.87	64.15	− .0495	.2342	−27.78
−16	.3876	.02420	2.580	41.33	63.94	− .0476	.2331	−26.67
−14	.3739	.02334	2.674	42.83	63.73	− .0458	.2319	−25.56
−12	.3608	.02252	2.772	44.40	63.49	− .0439	.2307	−24.44
−10	0.3482	0.02174	2.872	46.00	63.25	−0.0420	0.2296	−23.33
− 8	.3360	.02098	2.976	47.67	63.01	− .0401	.2284	−22.22
− 6	.3243	.02025	3.083	49.38	62.76	− .0382	.2273	−21.11
− 4	.3131	.01955	3.194	51.16	62.50	− .0362	.2261	−20.00
− 2	.3022	.01887	3.309	53.00	62.23	− .0343	.2249	−18.89
0	0.2918	0.01822	3.427	54.89	61.95	−0.0324	0.2237	−17.78
2	.2817	.01759	3.550	56.86	61.65	− .0304	.2225	−16.67
4	.2720	.01698	3.676	58.88	61.36	− .0285	.2213	−15.56
6	.2627	.01640	3.807	60.98	61.07	− .0266	.2201	−14.44
8	.2537	.01584	3.942	63.14	60.77	− .0246	.2189	−13.33
10	0.2450	0.01529	4.082	65.39	60.48	−0.0226	0.2176	−12.22
12	.2366	.01477	4.227	67.71	60.18	− .0206	.2164	−11.11
14	.2285	.01426	4.377	70.11	59.88	− .0186	.2151	−10.00
16	.2207	.01378	4.532	72.59	59.58	− .0166	.2139	− 8.89
18	.2131	.01330	4.692	75.16	59.27	− .0146	.2126	− 7.78
20	0.2058	0.01285	4.859	77.83	58.95	−0.0126	0.2113	− 6.67
22	.1987	.01240	5.031	80.59	58.64	− .0105	.2100	− 5.56
24	.1919	.01198	5.211	83.47	58.31	− .0085	.2087	− 4.44
25	.1886	.01177	5.303	84.94	58.14	− .0074	.2080	− 3.89
27	.1821	.01137	5.492	87.97	57.81	− .0053	.2066	− 2.78
29	0.1758	0.01097	5.688	91.11	57.47	−0.0032	0.2053	− 1.67
31	.1697	.01059	5.892	94.38	57.12	− .0011	.2039	− 0.56
33	.1639	.01023	6.103	97.76	56.77	+ .0011	.2025	+ 0.56
35	.1581	.009870	6.323	101.3	56.41	.0033	.2010	1.67
37	.1526	.009527	6.553	105.0	56.03	.0055	.1996	2.78
39	0.1472	0.009189	6.792	108.8	55.65	0.0077	0.1981	3.89
41	.1420	.008865	7.040	112.8	55.25	.0099	.1965	5.00
43	.1370	.008553	7.300	116.9	54.84	.0122	.1950	6.11
45	.1321	.008247	7.571	121.3	54.41	.0146	.1934	7.22
47	.1273	.007947	7.854	125.8	53.97	.0169	.1918	8.33
49	0.1227	0.007660	8.151	130.6	53.51	0.0193	0.1901	9.44
51	.1182	.007379	8.461	135.5	53.04	.0218	.1884	10.56
53	.1138	.007104	8.787	140.8	52.55	.0243	.1867	11.67
55	.1095	.006836	9.132	146.3	52.05	.0268	.1849	12.78
57	.1053	.006574	9.497	152.1	51.53	.0294	.1830	13.89
59	0.1012	0.006318	9.880	158.3	50.99	0.0321	0.1811	15.00
61	.0972	.00607	10.29	164.8	50.42	.0348	.1790	16.11
63	.0933	.00582	10.72	171.7	49.80	.0377	.1770	17.22
65	.0894	.00558	11.18	179.1	49.14	.0406	.1748	18.33
67	.0856	.00534	11.67	186.9	48.44	.0436	.1725	19.44
69	0.0819	0.00511	12.21	195.6	47.69	0.0468	0.1701	20.56
71	.0782	.00488	12.82	205.4	46.87	.0501	.1675	21.67
73	.0745	.00465	13.43	215.1	45.99	.0536	.1647	22.78
75	.0708	.00442	14.13	226.3	45.05	.0573	.1618	23.89
77	.0671	.00419	14.90	238.7	44.06	.0613	.1585	25.00
79	0.0633	0.00395	15.81	253.2	43.04	0.0656	0.1550	26.11
81	.0592	.00370	16.90	270.7	41.95	.0704	.1509	27.22
83	.0548	.00342	18.25	292.3	40.62	.0759	.1461	28.33
85	.0500	.00312	20.00	320.4	38.76	.0826	.1401	29.44
86	.0474	.00296	21.09	337.8	37.41	.0868	.1363	30.00
87	0.0446	0.00278	22.42	359.1	35.34	0.0921	0.1314	30.56
88	.0401	.00250	24.95	399.6	32.79	.1002	.1237	31.11

Sulfur Dioxide, SO_2

Temp. °F	Abs. press. sat. vap.		Heat content abv. −40°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. −40°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
−40	3.136	0.2205	0.00	178.61	178.61	0.00	99.228	99.228	−40 00
−30	4.331	.3045	2.93	179.90	176.97	1.63	99.945	98.317	−34.44
−20	5.883	.4136	5.98	181.07	175.09	3.32	100.59	97.272	−28.89
−10	7.863	.5528	9.16	182.13	172.97	5.09	101.18	96.095	−23.33
0	10.35	.7277	12.44	183.07	170.63	6.911	101.71	94.795	−17.78
2	10.91	0.7670	13.12	183.25	170.13	7.289	101.81	94.517	−16.67
4	11.50	.8085	13.78	183.41	169.63	7.656	101.89	94.239	−15.56
5	11.81	.8303	14.11	183.49	169.38	7.839	101.94	94.100	−15.00
6	12.12	.8521	14.45	183.57	169.12	8.028	101.98	93.956	−14.44
8	12.75	.8964	15.13	183.73	168.60	8.406	102.07	93.667	−13.33
10	13.42	0.9435	15.80	183.87	168.07	8.778	102.15	93.372	−12.22
12	14.12	.9927	16.48	184.01	167.53	9.156	102.23	93.072	−11.11
14	14.84	1.043	17.15	184.14	166.97	9.528	102.30	92.761	−10.00
16	15.59	1.096	17.84	184.28	166.44	9.911	102.38	92.467	− 8.89
18	16.37	1.1509	18.52	184.40	165.88	10.29	102.44	92.156	− 7.78
20	17.18	1.208	19.20	184.52	165.32	10.67	102.51	91.845	− 6.67
22	18.03	1.268	19.90	184.64	164.74	11.06	102.58	91.522	− 5.56
24	18.89	1.328	20.58	184.74	164.16	11.43	102.63	91.200	− 4.44
26	19.80	1.392	21.26	184.84	163.58	11.81	102.69	90.878	− 3.33
28	20.73	1.457	21.96	184.94	162.98	12.20	102.74	90.545	− 2.22
30	21.70	1.526	22.64	185.02	162.38	12.58	102.79	90.211	− 1.11
32	22.71	1.597	23.33	185.10	161.77	12.96	102.83	89.872	0.00
34	23.75	1.670	24.03	185.18	161.15	13.35	102.88	89.528	+ 1.11
36	24.82	1.745	24.72	185.25	160.53	13.73	102.92	89.183	2.22
38	25.95	1.824	25.42	185.31	159.89	14.12	102.95	88.828	3.33
40	27.10	1.905	26.12	185.37	159.25	14.51	102.98	88.472	4.44
42	28.29	1.989	26.81	185.42	158.61	14.89	103.01	88.117	5.56
44	29.52	2.075	27.51	185.46	157.95	15.28	103.03	87.750	6.67
46	30.79	2.165	28.21	185.50	157.29	15.67	103.06	87.383	7.78
48	32.10	2.257	28.92	185.54	156.62	16.07	103.08	87.011	8.89
50	33.45	2.352	29.61	185.56	155.95	16.45	103.09	86.639	10.00
52	34.86	2.451	30.31	185.58	155.27	16.84	103.10	86.261	11.11
54	36.31	2.553	31.00	185.59	154.59	17.22	103.11	85.883	12.22
56	37.80	2.658	31.72	185.61	153.89	17.62	103.12	85.495	13.33
58	39.33	2.765	32.42	185.61	153.19	18.01	103.12	85.106	14.44
60	40.93	2.878	33.10	185.59	152.49	18.39	103.11	84.717	15.56
62	42.58	2.994	33.79	185.57	151.78	18.77	103.09	84.322	16.67
64	44.27	3.112	34.49	185.55	151.06	19.16	103.08	83.922	17.78
66	46.00	3.234	35.19	185.53	150.34	19.55	103.07	83.522	18.89
68	47.78	3.359	35.88	185.50	149.62	19.93	103 06	83.122	20.00
70	49.62	3.489	36.58	185.46	148.88	20.32	103.03	82.711	21.11
72	51.54	3.624	37.28	185.42	148.14	20.71	103.01	82.300	22.22
74	53.48	3.760	37.97	185.37	147.40	21.09	102.98	81.889	23.33
76	55.48	3.901	38.67	185.31	146.64	21.48	102.95	81.467	24.44
78	57.56	4.047	39.36	185.24	145.88	21.87	102.91	81.045	25.56
80	59.68	4.196	40.05	185.17	145.12	22.25	102.87	80.622	26.67
82	61.88	4.351	40.73	185.09	144.36	22.63	102.83	80.200	27.78
84	64.14	4.509	41.43	185.01	143.58	23.02	102.78	79.767	28.89
86	66.45	4.672	42.12	184.92	142.80	23.40	102.73	79.333	30.00
88	68.84	4.840	42.80	184.82	142.02	23.78	102.68	78.900	31.11
90	71.25	5.009	43.50	184.72	141.22	24.17	102.62	78.456	32.22
92	73.70	5.182	44.19	184.61	140.42	24.55	102.56	78.011	33.33
94	76.30	5.364	44.86	184.49	139.62	24.92	102.49	77.567	34.44
96	79.03	5.556	45.54	184.37	138.83	25.30	102.43	77.128	35.56
98	81.77	5.749	46.22	184.25	138.03	25.68	102.36	76.683	36.67
100	84.52	5.942	46.90	184.10	137.20	26.06	102.28	76.222	37.78

PROPERTIES (Continued)

Sulfur Dioxide, SO_2

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Dens. liq. lb./ft.³	Entropy from −40°F BTU/lb./°F		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³		Liq.	Vap.	
−40	22.42	1.400	0.04460	0.7144	95.79	0.00000	0.42562	−40.00
−30	16.56	1.034	.06039	0.9673	94.94	.00674	.41864	−34.44
−20	12.42	0.7754	.08119	1.301	94.10	.01366	.41192	−28.89
−10	9.44	.5893	.1025	1.642	93.27	.02075	.40544	−23.33
0	7.280	.4545	.1374	2.201	92.42	.02795	.39917	−17.78
2	6.923	0.4322	0.1444	2.313	92.25	0.02941	0.39794	−16.67
4	6.584	.4110	.1501	2.404	92.08	.03084	.39670	−15.56
5	6.421	.4009	.1558	2.496	92.00	.03155	.39609	−15.00
6	6.266	.3912	.1596	2.556	91.91	.03228	.39547	−14.44
8	5.967	.3725	.1676	2.685	91.74	.03373	.39426	−13.33
10	5.682	0.3547	0.1760	2.819	91.58	0.03519	0.39306	−12.22
12	5.417	.3382	.1846	2.957	91.41	.03664	.39185	−11.11
14	5.164	.3224	.1936	3.101	91.24	.03808	.39065	−10.00
16	4.926	.3075	.2030	3.252	91.07	.03953	.38946	− 8.89
18	4.701	.2935	.2127	3.407	90.89	.04098	.38827	− 7.78
20	4.487	0.2801	0.2228	3.569	90.71	0.04241	0.38707	− 6.67
22	4.287	.2676	.2332	3.735	90.53	.04385	.38589	− 5.56
24	4.096	.2557	.2441	3.910	90.33	.04528	.38471	− 4.44
26	3.915	.2444	.2559	4.099	90.15	.04671	.38354	− 3.33
28	3.744	.2337	.2671	4.278	89.96	.04814	.38237	− 2.22
30	3.581	0.2236	0.2800	4.485	89.76	0.04956	0.38119	− 1.11
32	3.437	.2146	.2909	4.660	89.58	.05099	.38003	0.00
34	3.283	.2050	.3046	4.879	89.39	.05242	.37887	+ 1.11
36	3.144	.1963	.3181	5.095	89.18	.05384	.37772	2.22
38	3.013	.1881	.3319	5.316	89.00	.05527	.37657	3.33
40	2.887	0.1802	0.3464	5.549	88.81	0.05668	0.37541	4.44
42	2.769	.1729	.3611	5.784	88.62	.05809	.37425	5.56
44	2.656	.1658	.3765	6.031	88.43	.05949	.37311	6.67
46	2.548	.1591	.3925	6.287	88.24	.06090	.37197	7.78
48	2.446	.1527	.4088	6.548	88.05	.06231	.37083	8.89
50	2.348	0.1466	0.4259	6.822	87.87	0.06370	0.36969	10.00
52	2.256	.1408	.4433	7.101	87.67	.06509	.36857	11.11
54	2.167	.1353	.4615	7.392	87.51	.06616	.36743	12.22
56	2.083	.1300	.4801	7.690	87.31	.06785	.36629	13.33
58	2.003	.1250	.4992	7.996	87.13	.06923	.36517	14.44
60	1.923	0.1202	0.5194	8.320	86.95	0.07060	0.36405	15.56
62	1.853	.1157	.5396	8.643	86.77	.07196	.36293	16.67
64	1.783	.1113	.5609	8.984	86.59	.07333	.36181	17.78
66	1.716	.1071	.5827	9.334	86.41	.07469	.36070	18.89
68	1.652	.1031	.6054	9.697	86.22	.07602	.35958	20.00
70	1.590	0.09926	0.6290	10.08	86.02	0.07736	0.35846	21.11
72	1.532	.09564	.6527	10.45	85.82	.07871	.35736	22.22
74	1.476	.09214	.6777	10.86	85.62	.08003	.35624	23.33
76	1.422	.08877	.7030	11.26	85.42	.08135	.35512	24.44
78	1.371	.08559	.7295	11.69	85.23	.08268	.35401	25.56
80	1.321	0.08247	0.7570	12.13	85.03	0.08399	0.35291	26.67
82	1.274	.07953	.7850	12.57	84.84	.08525	.35177	27.78
84	1.229	.07672	.8140	13.04	84.64	.08653	.35065	28.89
86	1.185	.07398	.8440	13.52	84.44	.08783	.34954	30.00
88	1.144	.07142	.8740	14.00	84.25	.08910	.34843	31.11
90	1.104	0.06892	0.9058	14.51	84.05	0.09038	0.34731	32.22
92	1.065	.06649	.9390	15.04	83.86	.09165	.34620	33.33
94	1.028	.06418	.9730	15.59	83.67	.09389	.34508	34.44
96	0.9931	.06200	1.007	16.13	83.47	.09411	.34397	35.56
98	0.9591	.05987	1.043	16.71	83.27	.09532	.34285	36.67
100	0.9262	0.05782	1.080	17.30	83.07	0.09657	0.34173	37.78

Butane, $CH_3(CH_2)_2CH_3$

Temp. °F	Abs. press. sat. vap.		Heat content abv. 32°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
0	7.3	0.51	−17.2	153.3	170.5	− 9.56	85.17	94.72	−17.78
10	9.2	0.65	−11.7	156.8	168.5	− 6.50	87.11	93.61	−12.22
20	11.6	0.816	− 6.7	160.3	167.0	− 3.7	89.06	92.78	− 6.67
30	14.4	1.01	− 1.2	164.3	165.5	− 0.67	91.28	91.94	− 1.11
40	17.7	1.24	+ 4.3	167.8	163.5	+ 2.4	93.22	90.83	+ 4.44
50	21.6	1.52	9.8	171.3	161.5	5.4	95.17	89.72	10.00
60	26.3	1.85	15.8	175.3	159.5	8.78	97.39	88.61	15.56
70	31.6	2.22	21.3	178.8	157.5	11.8	99.33	87.50	21.11
80	37.6	2.64	27.3	182.3	155.0	15.2	101.3	86.11	26.67
90	44.5	3.13	33.8	185.8	152.0	18.8	103.2	84.44	32.22
100	52.2	3.67	39.8	189.3	149.5	22.1	105.2	83.06	37.78
110	60.8	4.27	46.3	193.3	147.0	25.7	107.4	81.67	43.33
120	70.8	4.98	52.8	196.3	143.5	29.3	109.1	79.72	48.89
130	81.4	5.72	59.3	199.8	140.5	32.9	111.0	78.06	54.44
140	92.6	6.51	66.3	203.8	137.5	36.8	113.2	76.39	60.00

Isobutane, $(CH_3)_3CH$

−20	7.50	0.527	−25.5	140.0	165.5	−14.2	77.78	91.94	−28.89
−10	9.28	0.652	−21.0	142.0	163.0	−11.7	78.89	90.56	−23.33
0	11.6	0.816	−16.5	144.0	160.5	− 9.17	80.00	89.17	−17.78
+10	14.6	1.03	−11.5	147.0	158.5	− 6.39	81.67	88.06	−12.22
20	18.2	1.28	− 6.5	149.5	156.0	− 3.6	83.06	86.67	− 6.67
30	22.3	1.57	− 1.0	152.5	153.5	− 0.56	84.72	85.28	− 1.11
40	26.9	1.89	+ 4.5	155.5	151.0	+ 2.5	86.39	83.89	+ 4.44
50	32.5	2.28	10.5	159.0	148.5	5.83	88.33	82.50	10.00
60	38.7	2.72	16.5	162.5	146.0	9.17	90.28	81.11	15.56
70	45.8	3.22	23.0	166.5	143.5	12.8	92.50	79.72	21.11
80	53.9	3.79	30.0	170.5	140.5	16.7	94.72	78.06	26.67
90	63.3	4.45	37.0	174.5	137.5	20.6	96.94	76.39	32.22
100	73.7	5.18	44.5	179.0	134.5	24.7	99.44	74.72	37.78
110	85.1	5.98	52.5	183.5	131.0	29.2	101.9	72.78	43.33
120	98.0	6.89	60.5	188.0	127.5	33.6	104.4	70.83	48.89
130	112.0	7.87	69.5	193.5	124.0	38.6	107.5	68.89	54.44
140	126.8	8.915	78.5	199.0	120.5	43.6	110.6	66.94	60.00

Propane, C_3H_8

−70	7.37	0.518	−55.2	134.3	189.5	−30.7	74.61	105.3	−56.67
−60	9.72	0.683	−50.2	136.8	187.0	−27.9	76.00	103.9	−51.11
−50	12.6	0.886	−44.7	139.8	184.5	−24.8	77.67	102.5	−45.56
−40	16.2	1.14	−39.7	141.8	181.5	−22.1	78.78	100.8	−40.00
−30	20.3	1.43	−34.2	144.8	179.0	−19.0	80.44	99.44	−34.44
−20	25.4	1.79	−29.2	146.8	176.0	−16.2	81.56	97.78	−28.89
−10	31.4	2.21	−23.7	149.8	173.5	−13.2	83.22	96.39	−23.33
0	38.2	2.69	−18.2	152.3	170.5	−10.1	84.61	94.72	−17.78
+10	46.0	3.23	−12.7	155.3	168.0	− 7.06	86.28	93.33	−12.22
20	55.5	3.90	− 7.2	157.8	165.0	− 4.0	87.67	91.67	− 6.67
30	66.3	4.66	− 1.2	160.8	162.0	− 0.67	89.33	90.00	− 1.11
40	78.0	5.48	+ 4.8	163.8	159.0	+ 2.7	91.00	88.33	+ 4.44
50	91.8	6.45	10.8	166.8	156.0	6.00	92.67	86.67	10.00
60	107.1	7.530	16.8	169.8	153.0	9.33	94.33	85.00	15.56
70	124.0	8.718	22.8	172.3	149.5	12.7	95.72	83.06	21.11
80	142.8	10.04	29.3	175.3	146.0	16.3	97.39	81.11	26.67
90	164.0	11.53	35.8	178.3	142.5	19.9	99.06	79.17	32.22
100	187.0	13.15	42.3	180.8	138.5	23.5	100.4	76.94	37.78
110	213.0	14.98	48.8	182.8	134.0	27.1	101.6	74.44	43.33
120	240.0	16.87	55.3	184.3	129.0	30.7	102.4	71.67	48.89

PROPERTIES (Continued)

Butane, $CH_3(CH_2)_2CH_3$

Temp. °F	Spec. vol. sat. vap.		Density of sat. vap.		Density of liq.		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	lb./ft.³	kg/m³	
0	11.1	0.693	0.0901	1.44	38.59	618.1	−17.78
10	8.95	.559	.112	1.79	38.24	612.5	−12.22
20	7.23	.451	.138	2.21	37.89	606.9	− 6.67
30	5.90	.368	.169	2.71	37.54	601.3	− 1.11
40	4.88	.305	.205	3.28	37.19	595.7	+ 4.44
50	4.07	.254	.246	3.94	36.82	589.8	10.00
60	3.40	.212	.294	4.71	36.45	583.9	15 56
70	2.88	.180	.347	5.56	36.06	577.6	21.11
80	2.46	.154	.407	6.52	35.65	571.0	26.67
90	2.10	.131	.476	7.62	35.24	564.5	32.22
100	1.81	.113	.552	8.84	34.84	558.1	37.78
110	1.58	.0986	.633	10.1	34.41	551.2	43.33
120	1.38	.0862	.725	11.6	33.96	544.0	48.89
130	1.21	.0755	.826	13.2	33.49	536.4	54.44
140	1.07	.0668	.934	15.0	32.98	528.3	60.00
Isobutane, $(CH_3)_3CH$							
−20	10.5	0.655	0.0952	1.52	38.35	614.3	−28.89
−10	8.91	.556	.112	1.79	37.95	607.9	−23.33
0	7.17	.448	.139	2.23	37.60	602.3	−17.78
+10	5.75	.359	.174	2.79	37.20	595.9	−12.22
20	4.68	.292	.214	3.43	36.80	589.5	− 6.67
30	3.86	.241	.259	4.15	36.40	583.1	− 1.11
40	3.22	.201	.311	4.98	36.00	576.6	+ 4 44
50	2.71	.169	.369	5.91	35.60	570.2	10.00
60	2.28	.142	.439	7.03	35.20	563.8	15.56
70	1.94	.121	.515	8.25	34.80	557.4	21.11
80	1.66	.104	.602	9.64	34.35	550.2	26.67
90	1.42	.0886	.704	11.3	33.90	543.0	32.22
100	1.23	.0768	.813	13.0	33.45	535.8	37 78
110	1.07	.0668	.935	15.0	33.00	528.6	43.33
120	0.926	.0578	1.08	17.3	32.50	520.6	48.89
130	0.811	.0506	1.23	19.7	32.00	512.6	54.44
140	0.716	.0447	1.32	21.1	31.80	509.4	60.00
Propane, C_3H_8							
−70	12.9	0.805	0.0775	1.24	37.40	599.1	−56.67
−60	9.93	.620	.111	1.78	37.00	592.7	−51.11
−50	7.74	.483	.129	2.07	36.60	586.3	−45.56
−40	6.13	.383	.163	2.61	36.19	579.7	−40.00
−30	4.93	.308	.203	3.25	35.78	573.1	−34 44
−20	4.00	.250	.250	4.00	35.37	566.6	−28.89
−10	3.26	.204	.307	4.92	34.96	560.0	−23.33
0	2.71	.169	.369	5.91	34.54	553.3	−17.78
+10	2.27	.142	.441	7.06	34.12	546.5	−12.22
20	1.90	.119	.526	8.43	33.67	539.3	− 6.67
30	1.60	.0999	.625	10.0	33.20	531.8	− 1.11
40	1.37	.0855	.730	11.7	32.73	524.3	+ 4.44
50	1.18	.0737	.847	13.6	32.24	516.4	10.00
60	1.01	.0631	.990	15.9	31.75	508.6	15.56
70	0.883	.0551	1.13	18.1	31.24	500.4	21.11
80	0.770	.0481	1.30	20.8	30.70	491.8	26.67
90	0.673	.0420	1.49	23.9	30.15	482.9	32.22
100	0.591	.0369	1.69	27.1	29.58	473.8	37.78
110	0.519	.0324	1.96	31.4	28.85	462.1	43.33
120	0.459	.0287	2.18	34.9	28.30	453.3	48.89

Difluorodichloromethane, CCl_2F_2 ("F-12")

Temp. °F	Abs. press. sat. vap.		Heat content abv. −40°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. −40°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.^{2}	kg/cm^2	Liq.	Vap.		Liq.	Vap.		
−40	9.32	0.655	0	73.50	73.50	0	40.83	40.83	−40.00
−30	12.02	0.845	2.03	74.70	72.67	1.13	41.50	40.37	−34.44
−20	15.28	1.074	4.07	75.87	71.80	2.26	42.15	39.89	−28.89
−10	19.20	1.350	6.14	77.05	70.91	3.41	42.81	39.39	−23.33
0	23.87	1.678	8.25	78.21	69.96	4.58	43.45	38.87	−17.78
+10	29.35	2.064	10.39	79.36	68.97	5.772	44.09	38.32	−12.22
20	35.75	2.513	12.55	80.49	67.94	6.972	44.72	37.74	− 6.67
30	43.16	3.034	14.76	81.61	66.85	8.200	45.34	37.14	− 1.11
40	51.68	3.633	17.00	82.71	65.71	9.444	45.95	36.51	+ 4.44
50	61.39	4.316	19.27	83.78	64.51	10.71	46.54	35 84	10.00
60	72.41	5.091	21.57	84.82	63.25	11.98	47.12	35.14	15.56
70	84.82	5.963	23.90	85.82	61.92	13.28	47.68	34.40	21.11
80	98.76	6.944	26.28	86.80	60.52	14.60	48.22	33.62	26.67
90	114.3	8 036	28.70	87.74	59.04	15 94	48.74	32 80	32.22
100	131.6	9.252	31.16	88.62	57.46	17.31	49.23	31.92	37.78
110	150.7	10 60	33.65	89.43	55.78	18.69	49.68	30.99	43.33
120	171.8	12.08	36.16	90.15	53.99	20.09	50 08	29.99	48.89

Carbon Disulfide, CS_2

Temp. °F	Abs. press. sat. vap.		Heat content abv. 32°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.^{2}	kg/cm^2	Liq.	Vap.		Liq.	Vap.		
0	1.10	0.0773	− 8.60	156.90	165.5	− 4.78	87.167	91.94	−17.78
10	1.46	.103	− 5.60	158.90	164.5	− 3.11	88 278	91.39	−12.22
20	1.89	.133	− 3.00	160.20	163.2	− 1.67	89.000	90.67	− 6.67
30	2.36	.166	− 0.50	161.70	162.2	− 0.28	89.833	90.11	− 1.11
40	3.03	.213	+ 2.05	163.25	161.2	+ 1.14	90.695	89.56	+ 4.44
50	3.90	.274	4.24	164.24	160.0	2.36	91.245	88.89	10.00
60	4 95	.348	7 20	166.40	159.2	4.00	92.445	88.44	15.56
70	5.85	.411	9.80	167.90	158.1	5.44	93.278	87.83	21 11
80	7.30	.513	11.70	168.60	156.9	6 500	93.667	87.17	26.67
90	9.15	.643	13.80	169.40	155.6	7.667	94.111	86.44	32.22
100	11.08	.7790	16.15	170.55	154.4	8.972	94 750	85 78	37.78
110	13.50	.9491	18.30	171.50	153.2	10.17	95.278	85.11	43.33
120	16.10	1.132	20.01	172.01	152.0	11.12	95 561	84.44	48.89

Carbon Tetrachloride, CCl_4

20	0.40	0.028	− 2.00	92.45	94.45	− 1.11	51.36	52.47	− 6.67
30	0.60	.042	− 0.25	93.45	93.70	− 0.14	51.92	52.06	− 1.11
40	0 84	.059	+ 1.60	94.80	93.20	+ 0.889	52.67	51.78	+ 4.44
60	1.42	.100	5.95	98 15	92.20	3.31	54.53	51.22	15.56
70	1.85	.130	8.20	99.53	91.40	4.56	55.29	50.78	21.11
80	2.40	.169	9.80	99.87	90.07	5 44	55.48	50 04	26.67
90	3.12	.219	11.60	101.62	90.02	6.444	56.46	50.01	32.22
100	4.00	.281	13.40	102.80	89.40	7.444	57.11	49.67	37.78
110	4.89	.344	15.80	104.50	88.70	8.778	58.06	49.28	43.33
120	5.95	.418	18.06	105.90	87.90	10.03	58.83	48.83	48.89

Ethyl Ether, $(C_2H_5)_2O$

0	1.3	0.091	−18.00	153.00	171.0	−10.00	85.000	95.00	−17.78
10	1.8	.13	−12.0	158 43	170.4	− 6.67	88.017	94 67	−12.22
20	2.5	.18	− 6.50	163.50	170.0	− 3.61	90.833	94 44	− 6 67
30	3.4	.24	− 1.50	167.90	169.4	− 0.833	93.278	94.11	− 1 11
40	4.4	.31	+ 4.00	172.40	168.4	+ 2.22	95.778	93.56	+ 4.44
50	5.5	.39	9.57	177.17	167 6	5.32	98.428	93.11	10.00
70	8.8	.62	20.04	185.44	165.4	11.13	103.02	91.89	21.11
80	10.9	.766	26.40	190.60	164.2	14.67	105 89	91.22	26.67
90	13.4	.942	31.50	194 50	163.0	17.50	108 06	90.56	32.22
100	16.0	1.12	36.50	197 50	161.5	20 28	109 72	89.72	37.78

Difluorodichloromethane, CCl_2F_2 (“F-12”)

Temp. °F	Spec. vol sat. vap.		Density of vap.		Dens. liq. lb./ft.³	Entropy from −40°F BTU/lb./°F		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³		Liq.	Vap.	
−40	3.911	0.2442	0.2557	4.096	94.58	0	0.17517	−40.00
−30	3.088	.1928	.3238	5.187	93.59	0.00471	.17387	−34.44
−20	2.474	.1544	.4042	6.474	92.58	.00940	.17275	−28.89
−10	2.003	.1250	.4993	7.998	91.57	.01403	.17175	−23.33
0	1.637	.1022	.6109	9.785	90.52	.01869	.17091	−17.78
+10	1.351	.08434	.7402	11.86	89.45	.02328	.17015	−12.22
20	1.121	.06998	.8921	14.29	88.37	.02783	.16949	− 6.67
30	0.939	.0586	1.065	17.06	87.24	.03233	.16887	− 1.11
40	.792	.0494	1.263	20.23	86.10	.03680	.16833	+ 4.44
50	.673	.0420	1.485	23.79	84.94	.04126	.16785	10.00
60	.575	.0359	1.740	27.87	83.78	.04568	.16741	15.56
70	.493	.0308	2.028	32.48	82.60	.05009	.16701	21.11
80	.425	.0265	2.353	37.69	81.39	.05446	.16662	26.67
90	.368	.0230	2.721	43.58	80.11	.05882	.16624	32.22
100	.319	.0199	3.135	50.22	78.80	.06316	.16584	37.78
110	.277	.0173	3.610	57.82	77.46	.06749	.16542	43.33
120	.240	.0150	4.167	66.75	76.02	.07180	.16495	48.89

Carbon Disulfide, CS_2

Temp. °F	Spec. vol. sat. vap.		Density sat. vap.		Temp. °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	
0	53.76	3.356	0.0186	0.2979	−17.78
10	43.47	2.714	.0230	.3684	−12.22
20	34.84	2.175	.0287	.4597	− 6.67
30	29.49	1.841	.0339	.5430	− 1.11
40	23.52	1.468	.0425	.6808	+ 4.44
50	20.60	1.286	.0482	.7721	10.00
60	18.00	1.124	.0555	.8890	15.56
70	13.20	0.824	.0758	1.214	21.11
80	10.40	0.649	.0961	1.539	26.67
90	8.30	0.518	.1204	1.929	32.22
100	7.03	0.439	.1369	2.193	37.78
110	5.80	0.362	.1724	2.762	43.33
120	5.10	0.318	.1960	3.140	48.89
Carbon Tetrachloride, CCl_4					
20	69.5	4.34	0.01438	0.2303	− 6.67
30	53.0	3.31	.01886	.3021	− 1.11
40	40.0	2.50	.02500	.4005	+ 4.44
60	24.0	1.50	.04166	.6673	15.56
70	19.5	1.22	.05128	.8214	21.11
80	16.0	0.999	.06345	1.016	26.67
90	13.0	0.812	.07692	1.232	32.22
100	10.0	0.624	.1000	1.602	37.78
110	8.5	0.53	.1176	1.884	43.33
120	7.5	0.47	.1333	2.135	48.89
Ethyl Ether, $(C_2H_5)_2O$					
0	38.0	2.37	0.0263	0.4213	−17.78
10	32.5	2.03	0332	.5318	−12.22
20	27.0	1.69	.0372	.5959	− 6.67
30	21.4	1.34	.0468	.7496	− 1.11
40	17.0	1.06	.0588	.9419	+ 4.44
50	13.2	0.824	.0757	1.213	10.00
70	7.8	0.49	.1280	2.050	21.11
80	6.2	0.39	.1620	2.595	26.67
90	5.1	0.32	.1960	3.140	32.22
100	4.5	0.28	.2220	3 556	37.78

Methyl Chloride, CH_3Cl

Temp. °F	Abs. press. sat. vap.		Heat content abv. 32°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap.		
−20	11.75	0.8261	−19.0	167.36	186.36	−10.6	92.978	103.53	−28.89
−10	15.0	1.055	−15.38	168.83	184.21	−8.544	93.795	102.34	−23.33
−5	16.79	1.180	−13.58	169.54	183.12	−7.544	94.189	101.73	−20.56
0	18.8	1.32	−11.75	170.23	181.98	−6.528	94.572	101.10	−17.78
+5	21.0	1.48	−9.93	170.96	180.84	−5.517	94.978	100.47	−15.00
10	23.3	1.64	−8.06	171.58	179.65	−4.478	95.322	99.806	−12.22
15	25.9	1.82	−6.74	172.24	178.47	−3.744	95.689	99.150	−9.44
20	28.8	2.02	−4.32	172.95	177.27	−2.400	96.083	98.483	−6.67
25	31.8	2.24	−2.48	173.63	176.10	−1.378	96.461	97.833	−3.89
30	35.2	2.47	−0.62	174.28	174.90	−0.344	96.822	97.167	−1.11
35	38.7	2.72	+1.75	174.92	173.77	+0.972	97.178	96.539	+1.67
40	42.6	3.00	3.15	175.57	172.42	1.75	97.539	95.789	4.44
45	46.9	3.30	5.04	176.20	171.16	2.80	97.889	95.089	7.22
50	51.5	3.62	6.88	176.78	169.90	3 82	98.211	94.389	10.00
55	56.4	3.97	8.80	177.45	168.65	4.89	98.583	93.695	12.78
60	61.6	4.33	10.70	178.05	167.35	5.944	98.917	92.972	15.56
65	67.3	4.73	12.62	178.64	166.02	7.011	99.245	92.233	18.33
70	73.3	5.15	14.52	179.17	164.65	8.067	99.539	91.472	21.11
75	79.2	5.57	16.46	179.78	163.28	9.144	99.878	90.711	23.89
80	85.3	6.00	18.36	180.24	161.88	10.20	100.13	89.933	26.67
85	94.1	6.62	20.12	180.74	160.48	11.18	100.41	89.156	29.44
90	102.1	7.178	22.13	181.22	159.09	12.29	100.68	88.383	32.22
95	110.3	7.755	24.07	181.76	157.70	13.37	100.98	87.611	35.00
100	118.8	8.352	26.06	182.36	156.30	14.48	101.31	86.833	37.78

Mercury, Hg

Temp. °F	Abs. press. sat. vap.		Heat content abv. 32°F BTU/lb.		Ht. of vaporiz. BTU/lb.	Heat content abv. 0°C g-cal./g		Ht. of vaporiz. g-cal./g	Temp. °C
	lb./in.²	kg/cm²	Liq.	Vap.		Liq.	Vap		
402	0.4	0.03	13.81	141.96	128.15	7.672	78.867	71.195	205.56
444	0.8	0.06	15.36	142.60	127.24	8.533	79.222	70.689	228.89
458	1.0	0.07	15.89	142.81	126.92	8.828	79.339	70.511	236.67
485	1.5	0.11	16.90	143.23	126.33	9.389	79.572	70.183	251.67
505	2.0	0.14	17.65	143.54	125.89	9.806	79.745	69.939	262.78
558	4.0	0.28	19.62	144.34	124.72	10.90	80.189	69.289	292 22
591	6.0	0.42	20.87	144.86	123.99	11.59	80.478	68.883	310.56
617	8.0	0.56	21.81	145.24	123.43	12.12	80.689	68.572	325.00
637	10.0	0.703	22.58	145.56	122.98	12.54	80.867	68.322	336.11
676	15.0	1.05	24.04	146.16	122.12	13.36	81.200	67.844	357.78
706	20.0	1.41	25.15	146.61	121.46	13.97	81.450	67.478	374.44
730	25.0	1.76	26.05	146.98	120.93	14.47	81.656	67.183	387.78
751	30.0	2.11	26.81	147.29	120.48	14.89	81.828	66.933	399.44
769	35.0	2.46	27.49	147.57	120.08	15.27	81.983	66.711	409.44
785	40.0	2.81	28.08	147.81	119.73	15.60	82.117	66.517	418.33
799	45.0	3.16	28.62	148.04	119.42	15.90	82.245	66.344	426.11
812	50	3.5	29.11	148.24	119.13	16.17	82.356	66.183	433.33
836	60	4.2	29.99	148.60	118.61	16.66	82.556	65.894	446.67
857	70	4.9	30.75	148.90	118.15	17.08	82.722	65.639	458.33
875	80	5.6	31.44	149.19	117.75	17.47	82.883	65.417	468.33
892	90	6.3	32.06	149.44	117.38	17.81	83.022	65.211	477.78
907	100	7.03	32.63	149.68	117.05	18.13	83.156	65.028	486.11
921	110	7.73	33.16	149.90	116.74	18.42	83.278	64.856	493.89
934	120	8.44	33.66	150.10	116.44	18.70	83.389	64.689	501.11
947	130	9.14	34.12	150.29	116.17	18.96	83.495	64.539	508.33
958	140	9.84	34.55	150.47	115.92	19.19	83.595	64.400	514.44
969	150	10.5	34.96	150.63	115.67	19.42	83.683	64.261	520.56
1000	180	12.7	36.09	151.10	115.01	20.05	83.945	63.894	537.78

PROPERTIES (Concluded)

Methyl Chloride, CH_3Cl

Temp. °F	Spec. vol. sat. vap.		Spec. vol. liq.		Density sat. vap.		Density of liq.		Temp. °C
	ft.³/lb.	m³/kg	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	lb./ft.³	kg/m³	
−20	8.09	.505	.015827	.0009880	0.124	1.98	63.185	1012.1	−28.89
−10	6.46	.403	.015985	.0009979	.155	2.48	62.560	1002.1	−23.33
− 5	5.80	.362	.016013	.0009997	.172	2.76	62.450	1000.3	−20.56
0	5.18	.323	.016146	.001008	.193	3.09	61.936	992.09	−17.78
+ 5	4.68	.292	.016228	.001013	.214	3.42	61.623	987.08	−15.00
10	4.18	.261	.016310	.001018	.239	3.83	61.311	982.08	−12.22
15	3.88	.242	.016388	.001023	.258	4.13	61.022	977.45	− 9.44
20	3.41	.213	.016474	.001028	.293	4.70	60.702	972.32	− 6.67
25	3.09	.193	.016552	.001033	.324	5.18	60.415	967.73	− 3.89
30	2.81	.175	.016645	.001039	.356	5.70	60.077	962.31	− 1.11
35	2.50	.156	.016746	.001045	.400	6.41	59.715	956.51	+ 1.67
40	2.31	.144	.016809	.001049	.433	6.93	59.492	952.94	4.44
45	2.10	.131	.016929	.001057	.476	7.63	59.069	946.17	7.22
50	1.93	.120	.017023	.001063	.518	8.30	58.745	940.98	10.00
55	1.75	.109	.017118	.001069	.571	9.16	58.419	935.76	12.78
60	1.61	.101	.017219	.001075	.621	9.95	58.077	930.28	15.56
65	1.47	.0918	.017318	.001081	.680	10.9	57.742	924.91	18.33
70	1.34	.0837	.017421	.001088	.746	12.0	57.403	919.48	21.11
75	1.24	.0774	.017526	.001094	.806	12.9	57.058	913.96	23.89
80	1.14	.0712	.017632	.001101	.877	14.1	56.714	908.44	26.67
85	1.05	.0655	.017740	.001108	.952	15.3	56.369	902.92	29.44
90	0.98	.061	.017850	.001114	1.02	16.3	56.022	897.36	32.22
95	0.91	.057	.017961	.001121	1.10	17.6	55.675	891.80	35.00
100	0.85	.053	.018074	.001128	1.18	18.8	55.327	886.23	37.78

Mercury, Hg

Temp. °F	Spec. vol. sat. vap.		Density of sat. vap.		Entropy above 32°F BTU/lb./°F			Temp °C
	ft.³/lb.	m³/kg	lb./ft.³	kg/m³	Liq.	Vap.	Evap.	
402	114.50	7.1480	0.008733	0.1399	.0209	.1696	.1487	205.56
444	59.72	3.728	.016745	0.26822	.0227	.1635	.1408	228.89
458	48.45	3.025	.02064	0.3306	.0233	.1616	.1383	236.67
485	33.14	2.069	.03017	0.4833	.0244	.1581	.1337	251.67
505	25.32	1.581	.03948	0.6324	.0251	.1556	.1305	262.78
558	13.26	0.8278	.07540	1.208	.0271	.1497	.1226	292.22
591	9.096	.5678	.10993	1.7609	.0283	.1462	.1179	310.56
617	6.9630	.43469	.14361	2.3003	.0292	.1439	.1147	325.00
637	5.6610	.35341	.17664	2.8294	.0299	.1420	.1121	336.11
676	3.8923	.24299	.25691	4.1152	.0312	.1387	.1075	357.78
706	2.983	.1862	.3352	5.369	.0322	.1364	.1042	374.44
730	2.429	.1516	.4117	6.595	.0330	.1346	.1016	387.78
751	2.053	.1282	.4871	7.802	.0336	.1331	.0995	399.44
769	1.7815	.11122	.5613	8.991	.0342	.1319	.0977	409.44
785	1.5762	.098399	.6344	10.16	.0346	.1308	.0962	418.33
799	1.4147	.088317	.7069	11.32	.0351	.1300	.0949	426.11
812	1.284	.08016	.7788	12.47	.0355	.1291	.0936	433.33
836	1.086	.06780	.9204	14.74	.0361	.1276	.0915	446.67
857	0.9436	.05891	1.0597	16.974	.0367	.1265	.0898	458.33
875	.8349	.05212	1.1977	19.185	.0372	.1254	.0882	468.33
892	.7497	.04680	1.3338	21.365	.0377	.1247	.0870	477.78
907	.6811	.04252	1.4682	23.518	.0381	.1237	.0856	486.11
921	.6242	.03897	1.6020	25.661	.0385	.1230	.0845	493.89
934	.5767	.03600	1.7340	27.775	.0389	.1224	.0835	501.11
947	.5360	.03346	1.8656	29.883	.0392	.1218	.0826	508.33
958	.5012	.03129	1.9952	31.959	.0395	.1213	.0818	514.44
969	.4706	.02938	2.125	34.04	.0398	.1207	.0809	520.56
1000	.3990	.02491	2.506	40.14	.0406	.1194	.0788	537.78

MISCELLANEOUS PROPERTIES OF COMMON REFRIGERANTS

Refrigerant	Formula	Flash Point °F.	Ignition Temp. °F.	Explosive Limits % by Volume	
				Lower	Upper
Ammonia	NH_3	....	1204	16	25
Bromotrifluoromethane (Kulene-131)	CF_3Br	nonflammable			
Butane	C_4H_{10}	−76	806	1.8	8.4
Carbon dioxide	CO_2	nonflammable			
Carbon tetrachloride	CCl_4	nonflammable			
Dichlorodifluoromethane (Freon-12)	CCl_2F_2	nonflammable			
Dichlorodifluoromethane, 73.8 % Ethylidene fluoride, 26.2 % (Carrene-7)	CCl_2F_2 CH_3CHF_2	nonflammable			
Dichloromonofluoromethane (Freon-21)	$CHCl_2F$	practically nonflammable			
Dichlorotetrafluoroethane (Freon-114)	$C_2Cl_2F_4$	practically nonflammable			
Ethane	C_2H_6	<20	950	3.0	12.5
Ethylene	C_2H_4	<20	842	3.1	32
Isobutane	$(CH_3)_3CH$	<20	1010	1.8	8.4
Methyl chloride	CH_3Cl	632	1170	10.7	11.4
Monochlorodifluoromethane (Freon-22)	$CHClF_2$	practically nonflammable			
Monochlorotrifluoromethane (Freon-13)	$CClF_3$	nonflammable			
Propane	C_3H_8	<20	871	2.2	9.5
Propylene	C_3H_6	<20	927	2.4	10.3
Sulfur dioxide	SO_2	nonflammable			
Tetrafluoromethane (Freon-14)	CF_4	nonflammable			
Trichloroethylene	C_2HCl_3	nonflammable at normal temperature			
Trichloromonofluoromethane (Freon-11) (Carrene-2)	CCl_3F	nonflammable			
Trichlorotrifluoroethane (Freon-113)	$C_2Cl_3F_3$	practically nonflammable			

MISCELLANEOUS PROPERTIES OF COMMON REFRIGERANTS (Continued)

Vapor Density (Air = 1)	Boiling Point °F	Threshold Limit Value* Parts per Million in Air	Water Soluble	Odor	Refrigerant
0.59	−28	100	yes	yes	Ammonia
5.25	−73.6	....	no	yes	Bromotrifluoromethane (Kulene-131)
2.04	33	....	no	no	Butane
1.53	−108	5000	yes	no	Carbon dioxide
5.32	170	25	no	yes	Carbon tetrachloride
4.17	−21.6	....	no	no	Dichlorodifluoromethane (Freon-12)
3.24	−28.0	....	no	yes	Dichlorodifluoromethane, 73.8 % Ethylidene fluoride, 26.2 % (Carrene-7)
3.55	48	....	no	yes	Dichloromonofluoromethane (Freon-21)
5.89	38	....	no	no	Dichlorotetrafluoroethane (Freon-114)
1.04	−128	....	no	no	Ethane
0.972	−155	....	yes	yes	Ethylene
2.01	14	....	no	no	Isobutane
1.78	−11	100	yes	yes	Methyl chloride
2.9	−41	....	yes	no	Monochlorodifluoromethane (Freon-22)
3.6	−112	....	.....	no	Monochlorotrifluoromethane (Freon-13)
1.56	−45	....	no	no	Propane
1.49	−53	....	yes	yes	Propylene
2.2	14	10	yes	yes	Sulfur dioxide
3.0	−198	....	no	no	Tetrafluoromethane (Freon-14)
4.53	189	200	no	yes	Trichloroethylene
4.7	75.3	....	no	no	Trichloromonofluoromethane (Freon-11) (Carrene-2)
6.4	118	....	no	no	Trichlorotrifluoroethane (Freon-113)

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* Maximum average atmospheric concentration of contaminants to which workers may be exposed for an eight-hour work day without injury to health. (American Conference of Governmental Industrial Hygienists: "Threshold Limit Values for 1954.) Where blanks appear in this column no published information was available on threshold limit values.

HIGH AND LOW TEMPERATURES

Absolute zero, −273.18° C.

M.p. of helium	−272.2° C.
B.p. of helium	−268.9
M.p. of hydrogen	−259.18
B.p. of hydrogen	−252.8
B.p. of liquid air	−192
Industrial furnaces	1700° C.
Bunsen burner	1870
Oxy-hydrogen flame	2800
Tungsten tube furnace (Forsythe)	2800
Carbon arc furnace (Forsythe)	3200

Oxy-acetylene flame	3500° C.
Tungsten arc under pressure (Luckey)	4785
Cored carbon arc (Suits)	5500
Iron welding arc (Suits)	6020
Tungsten arc, max. (Suits)	6440
Exploding wires by high voltage discharge (Anderson)	19700
The Sun (Coblentz)	6000° K.
Stars, max. estimated	30000° K.

SCALE OF FUSIBILITY

Number	Mineral	Approximate fusing point	Notes
1	Stibnite	525° C	Fuses easily in a candle flame.
2	Chalcopyrite	800° C	Fuses slowly in a gas flame.
3	Almandite	1050° C	Only finest splinters rounded in a gas flame.
4	Actinolite	1200° C	Standard-size fragments are rounded easily before the blowpipe.
5	Orthoclase	1300° C	Standard-size fragments are rounded with difficulty before the blowpipe.
6	Bronzite	1400° C	Only finest splinters rounded on points with difficulty before the blowpipe.
7	Quartz	>1400° C	Entirely infusible before the blowpipe.

CONSTANT TEMPERATURE BATHS

The following substances may be utilized between the temperatures indicated (boiling points) by using pressures from 10 to 76 cm. The second temperature given is the boiling point at the latter pressure. Several of the liquids are inflammable and must be used with caution.

Substance	Temperature °C
Ethyl chloride	−31.3 to 12.2
Ethyl ether	−12.1 to 34.5
Carbon disulfide	−4.8 to 46.3
Acetone	7.5 to 56.1
Chloroform	9.7 to 61.2
Methyl alcohol	20.62 to 64.5
Ethyl alcohol	34.4 to 78.5
Benzene	25.8 to 79.8
Water	51.7 to 100.
Toluene	51.8 to 110.5
Chlorobenzene	70.3 to 132.1
Isoamyl acetate	142.5
Bromobenzene	90.7 to 156.2
Aniline	119.4 to 184.4
Naphthalene	144.3 to 217.9
Methyl salicylate	151. to 223.3
Isoamyl benzoate	262.
Diphenylamine	221. to 302.0
Benzophenone	224. to 305.4
Mercury	261.5 to 356.9
Sulfur	330.7 to 444.6
Zinc	758. to 907.

HYGROMETRIC AND BAROMETRIC TABLES

CONVERSION TABLE FOR BAROMETRIC READINGS

U. S. inches to cm.

Inches.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
27.0	68.580	.606	.631	.656	.682	.707	.733	.758	.783	.809
27.1	.834	.860	.885	.910	.936	.961	.987	*.012	*.037	*.063
27.2	69.088	.114	.139	.164	.190	.215	.241	.266	.291	.317
27.3	.342	.368	.393	.418	.444	.469	.495	.520	.545	.571
27.4	.596	.622	.647	.672	.698	.723	.749	.774	.799	.825
27.5	.850	.876	.901	.926	.952	.977	*.002	*.028	*.053	*.079
27.6	70.104	.130	.155	.180	.206	.231	.257	.282	.307	.333
27.7	.358	.384	.409	.434	.460	.485	.511	.536	.561	.587
27.8	.612	.638	.663	.688	.714	.739	.765	.790	.815	.841
27.9	.866	.892	.917	.942	.968	.993	*.018	*.044	*.069	*.095
28.0	71.120	.146	.171	.196	.222	.247	.273	.298	.323	.349
28.1	.374	.400	.425	.450	.476	.501	.527	.552	.577	.603
28.2	.628	.654	.679	.704	.730	.755	.781	.806	.831	.857
28.3	.882	.908	.933	.958	.984	*.009	*.035	*.060	*.085	*.111
28.4	72.136	.162	.187	.212	.238	.263	.289	.314	.339	.365
28.5	.390	.416	.441	.466	.492	.517	.543	.568	.593	.619
28.6	.644	.670	.695	.720	.746	.771	.797	.822	.847	.873
28.7	.898	.924	.949	.974	*.000	*.025	*.051	*.076	*.101	*.127
28.8	73.152	.178	.203	.228	.254	.279	.305	.330	.355	.381
28.9	.406	.432	.457	.482	.508	.533	.559	.584	.609	.635
29.0	.660	.686	.711	.736	.762	.787	.813	.838	.863	.889
29.1	.914	.940	.965	.990	*.016	*.041	*.067	*.092	*.117	*.143
29.2	74.168	.194	.219	.244	.270	.295	.321	.346	.371	.397
29.3	.422	.448	.473	.498	.524	.549	.575	.600	.625	.651
29.4	.676	.702	.727	.752	.778	.803	.829	.854	.879	.905
29.5	.930	.956	.981	*.006	*.032	*.057	*.083	*.108	*.133	*.159
29.6	75.184	.210	.235	.260	.286	.311	.337	.362	.387	.413
29.7	.438	.464	.489	.514	.540	.565	.591	.616	.641	.667
29.8	.692	.718	.743	.768	.794	.819	.845	.870	.895	.921
29.9	.946	.972	.997	*.022	*.048	*.073	*.099	*.124	*.149	*.175
30.0	76.200	.226	.251	.277	.302	.327	.353	.378	.404	.429
30.1	.454	.480	.505	.531	.556	.581	.607	.632	.658	.683
30.2	.708	.734	.759	.785	.810	.835	.861	.886	.912	.937
30.3	.962	.988	*.013	*.039	*.064	*.089	*.115	*.140	*.166	*.191
30.4	77.216	.242	.267	.293	.318	.343	.369	.394	.420	.445
30.5	.470	.496	.521	.547	.572	.597	.623	.648	.674	.699
30.6	.724	.750	.775	.801	.826	.851	.877	.902	.928	.953
30.7	.978	*.004	*.029	*.055	*.080	*.105	*.131	*.156	*.182	*.207
30.8	78.232	.258	.283	.309	.334	.359	.385	.410	.436	.461
30.9	.486	.512	.537	.563	.588	.613	.639	.664	.690	.715

CONVERSION TABLE FOR BAROMETRIC READINGS
(Continued)

U. S. Inches to Millibars

Based on the relation 1 inch of mercury at 32°F represents a pressure of 33.8639 millibars.
Note: Figures in last nine columns to be preceded by 7, 8 or 9 as indicated.

Inches	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
23.0	7 78.87	79.21	79.55	79.89	80.22	80.56	80.90	81.24	81.58	81.92
23.1	7 82.26	82.59	82.93	83.27	83.61	83.95	84.29	84.63	84.97	85.30
23.2	7 85.64	85.98	86.32	86.66	87.00	87.34	87.67	88.01	88.35	88.69
23.3	7 89.03	89.37	89.71	90.04	90.38	90.72	91.06	91.40	91.74	92.08
23.4	7 92.42	92.75	93.09	93.43	93.77	94.11	94.45	94.79	95.12	95.46
23.5	7 95.80	96.14	96.48	96.82	97.16	97.49	97.83	98.17	98.51	98.85
23.6	7 99.19	99.53	99.87	*00.20	*00.54	*00.88	*01.22	*01.56	*01.90	*02.24
23.7	8 02.57	02.91	03.25	03.59	03.93	04.27	04.61	04.94	05.28	05.62
23.8	8 05.96	06.30	06.64	06.98	07.32	07.65	07.99	08.33	08.67	09.01
23.9	8 09.35	09.69	10.02	10.36	10.70	11.04	11.38	11.72	12.06	12.39
24.0	8 12.73	13.07	13.41	13.75	14.09	14.43	14.77	15.10	15.44	15.78
24.1	8 16.12	16.46	16.80	17.14	17.47	17.81	18.15	18.49	18.83	19.17
24.2	8 19.51	19.85	20.18	20.52	20.86	21.20	21.54	21.88	22 22	22.55
24.3	8 22.89	23.23	23.57	23 91	24.25	24.59	24.92	25.26	25.60	25.94
24.4	8 26.28	26.62	26.96	27.30	27.63	27.97	28.31	28.65	28.99	29.33
24.5	8 29.67	30.00	30.34	30.68	31.02	31.36	31.70	32.04	32.37	32.71
24.6	8 33.05	33.39	33.73	34.07	34.41	34.75	35.08	35.42	35.76	36.10
24.7	8 36.44	36.78	37.12	37.45	37.79	38.13	38.47	38.81	39.15	39.49
24.8	8 39.82	40.16	40.50	40.84	41.18	41.52	41.86	42.20	42.53	42.87
24.9	8 43.21	43.55	43.89	44.23	44.57	44.90	45.24	45.58	45.92	46.26
25.0	8 46.60	46.94	47.27	47.61	47.95	48.29	48.63	48.97	49.31	49.65
25.1	8 49.98	50.32	50.66	51.00	51.34	51.68	52.02	52.35	52.69	53.03
25.2	8 53.37	53.71	54.05	54.39	54.72	55.06	55.40	55.74	56.08	56.42
25.3	8 56.76	57.10	57.43	57.77	58.11	58.45	58.79	59.13	59.47	59.80
25.4	8 60.14	60.48	60.82	61.16	61.50	61.84	62.17	62.51	62.85	63.19
25.5	8 63.53	63.87	64.21	64.55	64.88	65.22	65.56	65.90	66.24	66.58
25.6	8 66.92	67.25	67.59	67.93	68.27	68.61	68.95	69.29	69.62	69.96
25.7	8 70.30	70.64	70.98	71.32	71.66	72.00	72.33	72.67	73.01	73.35
25.8	8 73.69	74.03	74.37	74.70	75.04	75.38	75.72	76.06	76.40	76.74
25.9	8 77.08	77.41	77.75	78.09	78.43	78.77	79.11	79.45	79.78	80.12
26.0	8 80.46	80.80	81.14	81.48	81.82	82.15	82.49	82.83	83.17	83.51
26.1	8 83.85	84.19	84.53	84.86	85.20	85.54	85.88	86.22	86.56	86.90
26.2	8 87.23	87.57	87.91	88.25	88.59	88.93	89.27	89.60	89.94	90.28
26.3	8 90.62	90.96	91.30	91 64	91.98	92.31	92.65	92.99	93.33	93.67
26.4	8 94.01	94.35	94.68	95.02	95.36	95.70	96.04	96.38	96.72	97.05
26.5	8 97.39	97.73	98.07	98.41	98.75	99.09	99.43	99.76	*00.10	*00 44
26.6	9 00.78	01.12	01.46	01.80	02.13	02.47	02.81	03.15	03 49	03 83
26.7	9 04.17	04.50	04.84	05.18	05.52	05.86	06.20	06.54	06.88	07.21
26 8	9 07.55	07.89	08.23	08.57	08.91	09.25	09.58	09.92	10.26	10.60
26.9	9 10.94	11.28	11.62	11.95	12.29	12.63	12.97	13.31	13.65	13.99
27.0	9 14.33	14.66	15.00	15.34	15.68	16.02	16.36	16.70	17.03	17.37
27.1	9 17.71	18.05	18.39	18.73	19.07	19.40	19.74	20.08	20.42	20.76
27.2	9 21.10	21.44	21.78	22.11	22.45	22.79	23.13	23.47	23.81	24.15
27.3	9 24.48	24.82	25.16	25 50	25.84	26.18	26.52	26.85	27.19	27 53
27.4	9 27.87	28 21	28.55	28.89	29.23	29.56	29.90	30.24	30.58	30 92

CONVERSION TABLE FOR BAROMETRIC READINGS
(Continued)

U. S. Inches to Millibars (Continued)

Note: Figures in last nine columns to be preceded by 9 or 10 as indicated.

Inches	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
27.5	9 31.26	31.60	31.93	32.27	32.61	32.95	33.29	33.63	33.97	34.31
27.6	9 34.64	34.98	35.32	35.66	36.00	36.34	36.68	37.01	37.35	37.69
27.7	9 38.03	38.37	38.71	39.05	39.38	39.72	40.06	40.40	40.74	41.08
27.8	9 41.42	41.76	42.09	42.43	42.77	43.11	43.45	43.79	44.13	44.46
27.9	9 44.80	45.14	45.48	45.82	46.16	46.50	46.83	47.17	47.51	47.85
28.0	9 48.19	48.53	48.87	49.21	49.54	49.88	50.22	50.56	50.90	51 24
28.1	9 51.58	51.91	52.25	52.59	52.93	53.27	53.61	53.95	54.28	54.62
28.2	9 54.96	55.30	55.64	55.98	56.32	56.66	56.99	57.33	57.67	58.01
28.3	9 58.35	58.69	59.03	59.36	59.70	60.04	60.38	60.72	61.06	61.40
28.4	9 61.73	62.07	62.41	62.75	63.09	63.43	63.77	64.11	64.44	64.78
28.5	9 65.12	65.46	65.80	66.14	66.48	66.81	67.15	67.49	67.83	68.17
28.6	9 68.51	68.85	69.18	69.52	69.86	70.20	70.54	70.88	71.22	71.56
28.7	9 71.89	72.23	72.57	72.91	73.25	73.59	73.93	74.26	74.60	74.94
28.8	9 75.28	75.62	75.96	76.30	76.63	76.97	77.31	77.65	77.99	78.33
28.9	9 78.67	79.01	79.34	79.68	80.02	80.36	80.70	81.04	81.38	81.71
29.0	9 82.05	82.39	82.73	83.07	83.41	83.75	84.08	84.42	84.76	85.10
29.1	9 85.44	85.78	86.12	86.46	86.79	87.13	87.47	87.81	88.15	88.49
29.2	9 88.83	89.16	89.50	89.84	90.18	90.52	90.86	91.20	91.53	91.87
29.3	9 92.21	92.55	92.89	93.23	93.57	93.91	94.24	94.58	94.92	95.26
29.4	9 95.60	95.94	96.28	96.61	96.95	97.29	97.63	97.97	98.31	98.65
29.5	9 98.99	99.32	99.66	*00.00	*00.34	*00.68	*01.02	*01.36	*01.69	*02.03
29.6	10 02.37	02.71	03.05	03.39	03.73	04.06	04.40	04.74	05.08	05.42
29.7	10 05.76	06.10	06.44	06.77	07.11	07.45	07.79	08.13	08.47	08.81
29.8	10 09.14	09.48	09.82	10.16	10.50	10.84	11.18	11.51	11.85	12.19
29.9	10 12.53	12.87	13.21	13.55	13.89	14.22	14.56	14.90	15.24	15.58
30.0	10 15.92	16.26	16.59	16.93	17.27	17.61	17.95	18.29	18.63	18.96
30.1	10 19.30	19.64	19.98	20.32	20.66	21.00	21.34	21.67	22.01	22.35
30.2	10 22 69	23.03	23.37	23.71	24.04	24.38	24.72	25.06	25.40	25.74
30.3	10 26.08	26.41	26.75	27.09	27.43	27.77	28.11	28.45	28.79	29.12
30.4	10 29.46	29.80	30.14	30.48	30.82	31.16	31.49	31.83	32.17	32.51
30.5	10 32.85	33.19	33.53	33.86	34.20	34.54	34.88	35.22	35.56	35.90
30.6	10 36.24	36.57	36.91	37.25	37.59	37.93	38.27	38.61	38.94	39.28
30.7	10 39.62	39.96	40.30	40.64	40.98	41.31	41.65	41.99	42.33	42.67
30.8	10 43.01	43.35	43.69	44.02	44.36	44.70	45.04	45.38	45.72	46.06
30.9	10 46.39	46.73	47.07	47.41	47.75	48.09	48.43	48.76	49.10	49.44
31.0	10 49.78	50.12	50.46	50.80	51.14	51.47	51.81	52.15	52.49	52.83
31.1	10 53.17	53.51	53.84	54.18	54.52	54.86	55.20	55.54	55.88	56.22
31.2	10 56.55	56.89	57.23	57.57	57.91	58.25	58.59	58.92	59.26	59.60
31.3	10 59.94	60.28	60.62	60.96	61.29	61.63	61.97	62.31	62.65	62.99
31.4	10 63.33	63.67	64.00	64.34	64.68	65.02	65.36	65.70	66.04	66.37
31.5	10 66.71	67.05	67.39	67.73	68.07	68.41	68.74	69.08	69.42	69.76
31.6	10 70.10	70.44	70.78	71.12	71.45	71.79	72.13	72.47	72.81	73.15
31.7	10 73.49	73.82	74.16	74.50	74.84	75.18	75.52	75.86	76.19	76.53
31.8	10 76.87	77.21	77.55	77.89	78.23	78.57	78.90	79.24	79.58	79.92
31.9	10 80.26	80.60	80.94	81.27	81.61	81.95	82.29	82.63	82.97	83.31

CONVERSION TABLE FOR BAROMETRIC READINGS
(Continued)

Centimeters to Millibars

Based on the relation 1 centimeter of mercury at 0°C represents a pressure of 13.3322 millibars.

Note: Figures in last nine columns to be preceded by 9.

Centimeters	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
68.0	9 06.59	06.72	06.86	06.99	07.12	07.26	07.39	07.52	07.66	07.79
68.1	9 07.92	08.06	08.19	08.32	08.46	08.59	08.72	08.86	08.99	09.12
68.2	9 09.26	09.39	09.52	09.66	09.79	09.92	10.06	10.19	10.32	10.46
68.3	9 10.59	10.72	10.86	10.99	11.12	11.26	11.39	11.52	11.66	11.79
68.4	9 11.92	12.06	12.19	12.32	12.46	12.59	12.72	12.86	12.99	13.12
68.5	9 13.26	13.39	13.52	13.66	13.79	13.92	14.06	14.19	14.32	14.46
68.6	9 14.59	14.72	14.86	14.99	15.12	15.26	15.39	15.52	15.66	15.79
68.7	9 15.92	16.06	16.19	16.32	16.46	16.59	16.72	16.86	16.99	17.12
68.8	9 17.26	17.39	17.52	17.66	17.79	17.92	18.06	18.19	18.32	18.46
68.9	9 18.59	18.72	18.86	18.99	19.12	19.26	19.39	19.52	19.66	19.79
69.0	9 19.92	20.06	20.19	20.32	20.46	20.59	20.72	20.86	20.99	21.12
69.1	9 21.26	21.39	21.52	21.65	21.79	21.92	22.05	22.19	22.32	22.45
69.2	9 22.59	22.72	22.85	22.99	23.12	23.25	23.39	23.52	23.65	23.79
69.3	9 23.92	24.05	24.19	24.32	24.45	24.59	24.72	24.85	24.99	25.12
69.4	9 25.25	25.39	25.52	25.65	25.79	25.92	26.05	26.19	26.32	26.45
69.5	9 26.59	26.72	26.85	26.99	27.12	27.25	27.39	27.52	27.65	27.79
69.6	9 27.92	28.05	28.19	28.32	28.45	28.59	28.72	28.85	28.99	29.12
69.7	9 29.25	29.39	29.52	29.65	29.79	29.92	30.05	30.19	30.32	30.45
69.8	9 30.59	30.72	30.85	30.99	31.12	31.25	31.39	31.52	31.65	31.79
69.9	9 31.92	32.05	32.19	32.32	32.45	32.59	32.72	32.85	32.99	33.12
70.0	9 33.25	33.39	33.52	33.65	33.79	33.92	34.05	34.19	34.32	34.45
70.1	9 34.59	34.72	34.85	34.99	35.12	35.25	35.39	35.52	35.65	35.79
70.2	9 35.92	36.05	36.19	36.32	36.45	36.59	36.72	36.85	36.99	37.12
70.3	9 37.25	37.39	37.52	37.65	37.79	37.92	38.05	38.19	38.32	38.45
70.4	9 38.59	38.72	38.85	38.99	39.12	39.25	39.39	39.52	39.65	39.79
70.5	9 39.92	40.05	40.19	40.32	40.45	40.59	40.72	40.85	40.99	41.12
70.6	9 41.25	41.39	41.52	41.65	41.79	41.92	42.05	42.19	42.32	42.45
70.7	9 42.59	42.72	42.85	42.99	43.12	43.25	43.39	43.52	43.65	43.79
70.8	9 43.92	44.05	44.19	44.32	44.45	44.59	44.72	44.85	44.99	45.12
70.9	9 45.25	45.39	45.52	45.65	45.79	45.92	46.05	46.19	46.32	46.45
71.0	9 46.59	46.72	46.85	46.99	47.12	47.25	47.39	47.52	47.65	47.79
71.1	9 47.92	48.05	48.19	48.32	48.45	48.59	48.72	48.85	48.99	49.12
71.2	9 49.25	49.39	49.52	49.65	49.79	49.92	50.05	50.19	50.32	50.45
71.3	9 50.59	50.72	50.85	50.99	51.12	51.25	51.39	51.52	51.65	51.79
71.4	9 51.92	52.05	52.19	52.32	52.45	52.59	52.72	52.85	52.99	53.12
71.5	9 53.25	53.39	53.52	53.65	53.79	53.92	54.05	54.19	54.32	54.45
71.6	9 54.59	54.72	54.85	54.99	55.12	55.25	55.39	55.52	55.65	55.79
71.7	9 55.92	56.05	56.19	56.32	56.45	56.59	56.72	56.85	56.99	57.12
71.8	9 57.25	57.39	57.52	57.65	57.79	57.92	58.05	58.19	58.32	58.45
71.9	9 58.59	58.72	58.85	58.99	59.12	59.25	59.39	59.52	59.65	59.79
72.0	9 59.92	60.05	60.19	60.32	60.45	60.59	60.72	60.85	60.98	61.12
72.1	9 61.25	61.38	61.52	61.65	61.78	61.92	62.05	62.18	62.32	62.45
72.2	9 62.58	62.72	62.85	62.98	63.12	63.25	63.38	63.52	63.65	63.78
72.3	9 63.92	64.05	64.18	64.32	64.45	64.58	64.72	64.85	64.98	65.12
72.4	9 65.25	65.38	65.52	65.65	65.78	65.92	66.05	66.18	66.32	66.45
72.5	9 66.58	66.72	66.85	66.98	67.12	67.25	67.38	67.52	67.65	67.78
72.6	9 67.92	68.05	68.18	68.32	68.45	68.58	68.72	68.85	68.98	69.12
72.7	9 69.25	69.38	69.52	69.65	69.78	69.92	70.05	70.18	70.32	70.45
72.8	9 70.58	70.72	70.85	70.98	71.12	71.25	71.38	71.52	71.65	71.78
72.9	9 71.92	72.05	72.18	72.32	72.45	72.58	72.72	72.85	72.98	73.12

CONVERSION TABLE FOR BAROMETRIC READINGS
(Continued)

Centimeters to Millibars (Continued)
Note: Figures in last nine columns to be preceded by 9 or 10.

Centimeters	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
73.0	9 73.25	73.38	73.52	73.65	73.78	73.92	74.05	74.18	74.32	74.45
73.1	9 74.58	74.72	74.85	74.98	75.12	75.25	75.38	75.52	75.65	75.78
73.2	9 75.92	76.05	76.18	76.32	76.45	76.58	76.72	76.85	76.98	77.12
73.3	9 77.25	77.38	77.52	77.65	77.78	77.92	78.05	78.18	78.32	78.45
73.4	9 78.58	78.72	78.85	78.98	79.12	79.25	79.38	79.52	79.65	79.78
73.5	9 79.92	80.05	80.18	80.32	80.45	80.58	80.72	80.85	80.98	81.12
73.6	9 81.25	81.38	81.52	81.65	81.78	81.92	82.05	82.18	82.32	82.45
73.7	9 82.58	82.72	82.85	82.98	83.12	83.25	83.38	83.52	83.65	83.78
73.8	9 83.92	84.05	84.18	84.32	84.45	84.58	84.72	84.85	84.98	85.12
73.9	9 85.25	85.38	85.52	85.65	85.78	85.92	86.05	86.18	86.32	86.45
74.0	9 86.58	86.72	86.85	86.98	87.12	87.25	87.38	87.52	87.65	87.78
74.1	9 87.92	88.05	88.18	88.32	88.45	88.58	88.72	88.85	88.98	89.12
74.2	9 89.25	89.38	89.52	89.65	89.78	89.92	90.05	90.18	90.32	90.45
74.3	9 90.58	90.72	90.85	90.98	91.12	91.25	91.38	91.52	91.65	91.78
74.4	9 91.92	92.05	92.18	92.32	92.45	92.58	92.72	92.85	92.98	93.12
74.5	9 93.25	93.38	93.52	93.65	93.78	93.92	94.05	94.18	94.32	94.45
74.6	9 94.58	94.72	94.85	94.98	95.12	95.25	95.38	95.52	95.65	95.78
74.7	9 95.92	96.05	96.18	96.32	96.45	96.58	96.72	96.85	96.98	97.12
74.8	9 97.25	97.38	97.52	97.65	97.78	97.92	98.05	98.18	98.32	98.45
74.9	9 98.58	98.72	98.85	98.98	99.12	99.25	99.38	99.52	99.65	99.78
75.0	9 99.92	*00.05	*00.18	*00.31	*00.45	*00.58	*00.71	*00.85	*00.98	*01.11
75.1	10 01.25	01.38	01.51	01.65	01.78	01.91	02.05	02.18	02.31	02.45
75.2	10 02.58	02.71	02.85	02.98	03.11	03.25	03.38	03.51	03.65	03.78
75.3	10 03.91	04.05	04.18	04.31	04.45	04.58	04.71	04.85	04.98	05.11
75.4	10 05.25	05.38	05.51	05.65	05.78	05.91	06.05	06.18	06.31	06.45
75.5	10 06.58	06.71	06.85	06.98	07.11	07.25	07.38	07.51	07.65	07.78
75.6	10 07.91	08.05	08.18	08.31	08.45	08.58	08.71	08.85	08.98	09.11
75.7	10 09.25	09.38	09.51	09.65	09.78	09.91	10.05	10.18	10.31	10.45
75.8	10 10.58	10.71	10.85	10.98	11.11	11.25	11.38	11.51	11.65	11.78
75.9	10 11.91	12.05	12.18	12.31	12.45	12.58	12.71	12.85	12.98	13.11
76.0	10 13.25	13.38	13.51	13.65	13.78	13.91	14.05	14.18	14.31	14.45
76.1	10 14.58	14.71	14.85	14.98	15.11	15.25	15.38	15.51	15.65	15.78
76.2	10 15.91	16.05	16.18	16.31	16.45	16.58	16.71	16.85	16.98	17.11
76.3	10 17.25	17.38	17.51	17.65	17.78	17.91	18.05	18.18	18.31	18.45
76.4	10 18.58	18.71	18.85	18.98	19.11	19.25	19.38	19.51	19.65	19.78
76.5	10 19.91	20.05	20.18	20.31	20.45	20.58	20.71	20.85	20.98	21.11
76.6	10 21.25	21.38	21.51	21.65	21.78	21.91	22.05	22.18	22.31	22.45
76.7	10 22.58	22.71	22.85	22.98	23.11	23.25	23.38	23.51	23.65	23.78
76.8	10 23.91	24.05	24.18	24.31	24.45	24.58	24.71	24.85	24.98	25.11
76.9	10 25.25	25.38	25.51	25.65	25.78	25.91	26.05	26.18	26.31	26.45
77.0	10 26.58	26.71	26.85	26.98	27.11	27.25	27.38	27.51	27.65	27.78
77.1	10 27.91	28.05	28.18	28.31	28.45	28.58	28.71	28.85	28.98	29.11
77.2	10 29.25	29.38	29.51	29.65	29.78	29.91	30.05	30.18	30.31	30.45
77.3	10 30.58	30.71	30.85	30.98	31.11	31.25	31.38	31.51	31.65	31.78
77.4	10 31.91	32.05	32.18	32.31	32.45	32.58	32.71	32.85	32.98	33.11
77.5	10 33.25	33.38	33.51	33.65	33.78	33.91	34.05	34.18	34.31	34.45
77.6	10 34.58	34.71	34.85	34.98	35.11	35.25	35.38	35.51	35.65	35.78
77.7	10 35.91	36.05	36.18	36.31	36.45	36.58	36.71	36.85	36.98	37.11
77.8	10 37.25	37.38	37.51	37.65	37.78	37.91	38.05	38.18	38.31	38.45
77.9	10 38.58	38.71	38.85	38.98	39.11	39.24	39.38	39.51	39.64	39.78

TEMPERATURE CORRECTION FOR BAROMETER READINGS

Brass Scale—Metric Units

To reduce readings of a mercurial barometer with a brass scale to 0°C subtract the appropriate quantity as found in the table. These values are based on the coefficient of expansion of mercury $(181792 + 0.175t + 0.035116t^2) \times 10^{-9}$, and of brass 0.0000184 per °C. Corrections are in millimeters.

Temp. °C	Observed height in millimeters								
	620	630	640	650	660	670	680	690	700
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	.10	.10	.10	.11	.11	.11	.11	.11	.11
2	.20	.21	.21	.21	.22	.22	.22	.23	.23
3	.30	.31	.31	.32	.32	.33	.33	.34	.34
4	.40	.41	.42	.42	.43	.44	.44	.45	.46
5	0.51	0.51	0.52	0.53	0.54	0.55	0.56	0.56	0.57
6	.61	.62	.63	.64	.65	.66	.67	.68	.69
7	.71	.72	.73	.74	.75	.77	.78	.79	.80
8	.81	.82	.84	.85	.86	.87	.89	.90	.91
9	.91	.92	.94	.95	.97	.98	1.00	1.01	1.03
10	1.01	1.03	1.04	1.06	1.08	1.09	1.11	1.13	1.14
11	1.11	1.13	1.15	1.17	1.18	1.20	1.22	1.24	1.26
12	1.21	1.23	1.25	1.27	1.29	1.31	1.33	1.35	1.37
13	1.31	1.34	1.36	1.38	1.40	1.42	1.44	1.46	1.48
14	1.41	1.44	1.46	1.48	1.51	1.53	1.55	1.57	1.60
15	1.52	1.54	1.56	1.59	1.61	1.64	1.66	1.69	1.71
16	1.62	1.64	1.67	1.69	1.72	1.75	1.77	1.80	1.82
17	1.72	1.74	1.77	1.80	1.83	1.86	1.88	1.91	1.94
18	1.82	1.85	1.88	1.91	1.93	1.96	1.99	2.02	2.05
19	1.92	1.95	1.98	2.01	2.04	2.07	2.10	2.13	2.17
20	2.02	2.05	2.08	2.12	2.15	2.18	2.21	2.25	2.28
21	2.12	2.15	2.19	2.22	2.26	2.29	2.32	2.36	2.39
22	2.22	2.26	2.29	2.33	2.36	2.40	2.43	2.47	2.51
23	2.32	2.36	2.40	2.43	2.47	2.51	2.54	2.58	2.62
24	2.42	2.46	2.50	2.54	2.58	2.62	2.66	2.69	2.73
25	2.52	2.56	2.60	2.64	2.68	2.72	2.77	2.81	2.85
26	2.62	2.66	2.71	2.75	2.79	2.83	2.88	2.92	2.96
27	2.72	2.77	2.81	2.85	2.90	2.94	2.99	3.03	3.07
28	2.82	2.87	2.91	2.96	3.00	3.05	3.10	3.14	3.19
29	2.92	2.97	3.02	3.06	3.11	3.16	3.21	3.25	3.30
30	3.02	3.07	3.12	3.17	3.22	3.27	3.32	3.36	3.41
31	3.12	3.17	3.22	3.27	3.32	3.37	3.43	3.48	3.53
32	3.22	3.28	3.33	3.38	3.43	3.48	3.54	3.59	3.64
33	3.32	3.38	3.43	3.48	3.54	3.59	3.64	3.70	3.75
34	3.42	3.48	3.53	3.59	3.64	3.70	3.75	3.81	3.87
35	3.52	3.58	3.64	3.69	3.75	3.81	3.86	3.92	3.98

CORRECTION FOR BAROMETER (Continued)

BRASS SCALE—METRIC UNITS

Temp. °C	Observed height in millimeters								
	710	720	730	740	750	760	770	780	79
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	.12	.12	.12	.12	.12	.12	.13	.13	.13
2	.23	.24	.24	.24	.25	.25	.25	.25	.26
3	.35	.35	.36	.36	.37	.37	.38	.38	.39
4	.46	.47	.48	.48	.49	.50	.50	.51	.52
5	0.58	0.59	0.60	0.60	0.61	0.62	0.63	0.64	0.64
6	.70	.71	.71	.72	.73	.74	.75	.76	.77
7	.81	.82	.83	.85	.86	.87	.88	.89	.90
8	.93	.94	.95	.97	.98	.99	1.01	1.02	1.03
9	1.04	1.06	1.07	1.09	1.10	1.12	1.13	1.15	1.16
10	1.16	1.17	1.19	1.21	1.22	1.24	1.26	1.27	1.29
11	1.27	1.29	1.31	1.33	1.35	1.36	1.38	1.40	1.42
12	1.39	1.41	1.43	1.45	1.47	1.49	1.51	1.53	1.55
13	1.50	1.53	1.55	1.57	1.59	1.61	1.63	1.65	1.67
14	1.62	1.64	1.67	1.69	1.71	1.73	1.76	1.78	1.80
15	1.74	1.76	1.78	1.81	1.83	1.86	1.88	1.91	1.93
16	1.85	1.88	1.90	1.93	1.96	1.98	2.01	2.03	2.06
17	1.97	1.99	2.02	2.05	2.08	2.10	2.13	2.16	2.19
18	2.08	2.11	2.14	2.17	2.20	2.23	2.26	2.29	2.32
19	2.20	2.23	2.26	2.29	2.32	2.35	2.38	2.41	2.44
20	2.31	2.34	2.38	2.41	2.44	2.47	2.51	2.54	2.57
21	2.43	2.46	2.50	2.53	2.56	2.60	2.63	2.67	2.70
22	2.54	2.58	2.61	2.65	2.69	2.72	2.76	2.79	2.83
23	2.66	2.69	2.73	2.77	2.81	2.84	2.88	2.92	2.96
24	2.77	2.81	2.85	2.89	2.93	2.97	3.01	3.05	3.08
25	2.89	2.93	2.97	3.01	3.05	3.09	3.13	3.17	3.21
26	3.00	3.04	3.09	3.13	3.17	3.21	3.26	3.30	3.34
27	3.12	3.16	3.20	3.25	3.29	3.34	3.38	3.42	3.47
28	3.23	3.28	3.32	3.37	3.41	3.46	3.51	3.55	3.60
29	3.35	3.39	3.44	3.49	3.54	3.58	3.63	3.68	3.72
30	3.46	3.51	3.56	3.61	3.66	3.71	3.75	3.80	3.85
31	3.58	3.63	3.68	3.73	3.78	3.83	3.88	3.93	3.98
32	3.69	3.74	3.79	3.85	3.90	3.95	4.00	4.05	4.11
33	3.81	3.86	3.91	3.97	4.02	4.07	4.13	4.18	4.23
34	3.92	3.98	4.03	4.09	4.14	4.20	4.25	4.31	4.36
35	4.03	4.09	4.15	4.21	4.26	4.32	4.38	4.43	4.49

CORRECTION FOR BAROMETER (Continued)

Brass Scale—English Units

Standard Temperature of scale 62° F; of mercury, 32° F. Zero correction at 28.5° F; subtract corrections above, add below. Owing to the difference in the standard temperature of English and metric scales, readings taken in inches to be reduced to centimeters should *first* be corrected for temperature.

Temp. ° F	Observed height in inches								
	23.0 in.	23.5 in.	24.0 in.	24.5 in.	25.0 in.	25.5 in.	26.0 in.	26.5 in.	27.0 in.
0	+.060	+.061	+.063	+.064	+.065	+.067	+.068	+.069	+.070
2	.056	.057	.058	.060	.061	.062	.063	.065	.065
4	.052	.053	.054	.055	.056	.057	.058	.060	.061
6	.047	.048	.049	.051	.052	.053	.054	.055	.056
8	.043	.044	.045	.046	.047	.048	.049	.050	.051
10	.039	.040	.041	.042	.042	.043	.044	.045	.046
12	.035	.036	.036	.037	.038	.039	.039	.040	.041
14	.031	.031	.032	.033	.033	.034	.035	.035	.036
16	.026	.027	.028	.028	.029	.029	.030	.031	.031
18	.022	.023	.023	.024	.024	.025	.025	.026	.026
20	.018	.018	.019	.019	.020	.020	.020	.021	.021
22	.014	.014	.014	.015	.015	.015	.016	.016	.016
24	.010	.010	.010	.010	.011	.011	.011	.011	.011
26	.005	.006	.006	.006	.006	.006	.006	.006	.006
28	+.001	+.001	+.001	+.001	+.001	+.001	+.001	+.002	+.002
30	—.003	—.003	—.003	—.003	—.003	—.003	—.003	—.003	—.003
32	.007	.007	.007	.008	.008	.008	.008	.008	008
34	.011	.011	.012	.012	.012	.012	.013	.013	.013
36	.015	.016	.016	.016	.017	.017	.017	.018	.018
38	.020	.020	.020	.021	.021	.022	.022	.023	.023
40	.024	.024	.025	.025	.026	.026	.027	.027	.028
42	.028	.029	.029	.030	.030	.031	.032	.032	.033
44	.032	.033	.033	.034	.035	.036	.036	.037	.038
46	.036	.037	.038	.039	.039	.040	.041	.042	.043
48	.040	.041	.042	.043	.044	.045	.046	.047	.047
50	.045	.046	.046	.048	.048	.050	.050	.052	.052
52	.049	.050	.051	.052	.053	.054	.055	.056	.057
54	.053	.054	.055	.057	.057	.059	.060	.061	.062
56	.057	.058	.060	.061	.062	.063	.064	.066	.067
58	.061	.063	.064	.065	.066	.068	.069	.071	.072
60	.065	.067	.068	.070	.071	.073	.074	.076	.077
62	.069	.071	.073	.074	.076	.077	.079	.080	.082
64	.074	.075	.077	.079	.080	.082	.083	.085	.086
66	.078	.079	.081	.083	.085	.087	.088	.090	.091
68	.082	.084	.085	.088	.089	.091	.093	.095	.096
70	.086	.088	.090	.092	.094	.096	.097	.100	.101
72	.090	.092	.094	.096	.098	.100	.102	.104	.106
74	.094	.096	.098	.101	.103	.105	.107	.109	.111
76	.098	.101	.103	.105	.107	.110	.111	.114	.116
78	.103	.105	.107	.110	.112	.114	.116	.119	.120
80	.107	.109	.111	.114	.116	.119	.121	.123	.125
82	.111	.113	.116	.119	.121	.123	.125	.128	.130
84	.115	.118	.120	.123	.125	.128	.130	.133	.135
86	.119	.122	.124	.127	.130	.133	.135	.138	.140
88	.123	.126	.129	.132	.134	.137	.139	.143	.145
90	.127	.130	.133	.136	.138	.142	.144	.147	.150
92	.132	.134	.137	.141	.143	.146	.149	.152	.154
94	.136	.139	.142	.145	.147	.151	.153	.157	.159
96	.140	.143	.146	.150	.152	.155	.158	.161	.134
98	.144	.147	.150	.154	.156	.160	.163	.166	.169
100	.148	.151	.154	.158	.161	.164	.167	.171	.174

CORRECTION FOR BAROMETER (Continued)

Brass Scale—English Units

Temp. ° F	Observed height in inches								
	27.5 in.	28.0 in.	28.5 in.	29.0 in.	29.5 in.	30.0 in.	30.5 in.	31.0 in.	31.5 in.
0	.072	.073	.075	.076	.077	.078	.080	.081	.082
2	.067	.068	.069	.070	.072	.073	.074	.075	.077
4	.062	.063	.064	.065	.066	.067	.069	.070	.071
6	.057	.058	.059	.060	.061	.062	.063	.064	.065
8	.052	.053	.054	.054	.056	.056	.057	.058	.059
10	.047	.047	.048	.049	.050	.051	.052	.053	.054
12	.042	.042	.043	.044	.045	.045	.046	.047	.048
14	.037	.037	.038	.039	.039	.040	.041	.041	.042
16	.032	.032	.033	.033	.034	.034	.035	.036	.036
18	.027	.027	.028	.028	.029	.029	.030	.030	.031
20	.022	.022	.022	.023	.023	.024	.024	.024	.025
22	.017	.017	.017	.017	.018	.018	.018	.019	.019
24	.012	.012	.012	.012	.012	.013	.013	.013	.013
26	.007	.007	.007	.007	.007	.007	.007	.007	.008
28	+.002	+.002	+.002	+.002	+.002	+.002	+.002	+.002	+.002
30	—.003	—.003	—.004	—.004	—.004	—.004	—.004	—.004	—.004
32	.008	.009	.009	.009	.009	.009	.009	.009	.010
34	.013	.014	.014	.014	.014	.015	.015	.015	.015
36	.018	.019	.019	.019	.020	.020	.020	.021	.021
38	.023	.024	.024	.025	.025	.026	.026	.026	.027
40	.028	.029	.030	.030	.031	.031	.032	.032	.033
42	.033	.034	.035	.035	.036	.036	.037	.038	.038
44	.038	.039	.040	.040	.041	.042	.043	.043	.044
46	.043	.044	.045	.046	.047	.047	.048	.049	.050
48	.048	.049	.050	.051	.052	.053	.054	.054	.055
50	.053	.054	.055	.056	.057	.058	.059	.060	.061
52	.058	.059	.061	.061	.063	.064	.065	.066	.067
54	.063	.064	.066	.067	.068	.069	.070	.071	.073
56	.068	.069	.071	.072	.073	.074	.076	.077	.078
58	.073	.074	.076	.077	.079	.080	.081	.082	.084
60	.078	.080	.081	.082	.084	.085	.087	.088	.090
62	.083	.085	.086	.088	.089	.091	.092	.094	.095
64	.088	.090	.092	.093	.095	.096	.098	.099	.101
66	.093	.095	.097	.098	.100	.101	.103	.105	.107
68	.098	.100	.102	.103	.105	.107	.109	.110	.113
70	.103	.105	.107	.109	.111	.112	.115	.116	.118
72	.108	.110	.112	.114	.116	.118	.120	.122	.124
74	.113	.115	.117	.119	.121	.123	.126	.127	.130
76	.118	.120	.122	.124	.127	.128	.131	.133	.135
78	.123	.125	.128	.129	.132	.134	.137	.138	.141
80	.128	.130	.133	.135	.137	.139	.142	.144	.147
82	.133	.135	.138	.140	.143	.145	.148	.149	.152
84	.138	.140	.143	.145	.148	.150	.153	.155	.158
86	.143	.145	.148	.150	.153	.155	.159	.161	.164
88	.148	.150	.153	.155	.159	.161	.164	.166	.169
90	.153	.155	.158	.161	.164	.166	.170	.172	.175
92	.158	.160	.163	.166	.169	.172	.175	.177	.181
94	.163	.165	.169	.171	.175	.177	.180	.183	.186
96	.168	.170	.174	.176	.180	.182	.186	.188	.192
98	.172	.175	.179	.181	.185	.188	.191	.194	.197
100	.177	.180	.184	.187	.190	.193	.197	.200	.203

TEMPERATURE CORRECTION, GLASS SCALE

METRIC

To reduce readings of a mercurial barometer with a glass scale to 0° C. subtract the appropriate quantity as found in table.

Temp. ° C.	Observed height in centimeters.								
	70 cm.	71 cm.	72 cm.	73 cm.	74 cm.	75 cm.	76 cm.	77 cm.	78 cm.
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	.012	.012	.013	.013	.013	.013	.013	.013	.014
2	.025	.025	.025	.026	.026	.026	.026	.027	.027
3	.036	.036	.037	.037	.038	.038	.039	.039	.040
4	.048	.049	.049	.050	.051	.051	.052	053	.053
5	0.060	0.061	0.062	0.063	0.064	0.064	0.065	0.066	0.067
6	.073	.074	.074	.076	.077	.077	.078	.079	.080
7	.085	.086	.087	.088	.089	.091	.092	.093	.094
8	.096	.098	.099	.100	.101	.103	.104	.105	.107
9	.109	.110	.111	.113	.114	.116	.117	.119	.120
10	0.121	0.122	0.124	0.126	0.127	0.129	0.130	0.132	0.134
11	.133	.135	.137	.138	.140	.142	.144	.146	.147
12	.144	.146	.148	.150	.152	.154	.156	.158	.160
13	.157	.159	.161	.163	.165	.167	.169	.171	.174
14	.169	.171	.174	.176	.178	.180	.183	.185	.187
15	0.181	0.184	0.186	0.189	0.191	0.193	0 196	0.198	0.201
16	.194	.196	.199	.201	.204	.207	.209	.212	.214
17	.205	.208	.210	.213	.216	.219	.221	.224	.227
18	.217	.220	.223	.226	.229	.232	.235	.238	.241
19	.230	.233	.236	.239	.242	.245	.248	.251	.254
20	0.242	0.245	0.248	0.252	0.255	0.258	0.261	0.264	0.268
21	.254	.258	.261	.264	.268	.271	.275	.278	.281
22	.266	.269	.273	.276	.280	.283	.287	.290	.294
23	.278	.282	.285	.289	.293	.296	.300	.304	.308
24	.290	.294	.298	.302	.306	.310	.313	.317	.321
25	0.303	0.307	0.311	0.315	0.319	0.323	0.327	0.331	0.335
26	.315	.319	.323	.327	.332	.336	.340	.344	.348
27	.326	.331	.335	.339	.344	.348	.352	.357	.361
28	.339	.343	.348	.352	.357	.361	.366	.370	.375
29	.351	.356	.360	.365	.370	.374	.379	.384	.388
30	0.363	0.368	0.373	0.378	0.383	0.387	0.392	0.397	0.402

MASS OF WATER VAPOR IN SATURATED AIR

Mass in grams per cubic meter.

(From Smithsonian Tables.)

Temp. ° C.	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
−20	0.892	0.810	0.737	0.673	0.613	0.557	0.505	0.457	0.413	0.373
−10	2.154	1.978	1.811	1.658	1.519	1.395	1.282	1.177	1.079	0.982
− 0	4.835	4.468	4.130	3.813	3.518	3.244	2.988	2.752	2.537	2.340
+ 0	4.835	5.176	5.538	5.922	6.330	6.761	7.219	7.703	8.215	8.757
10	9.330	9.935	10.574	11.249	11.961	12.712	13.505	14.339	15.218	16.144
20	17.118	18.143	19 222	20.355	21.546	22.796	24.109	25.487	26.933	28.450
30	30.039	31.704	33.449	35.275	37.187	39.187	41.279	43.465	45.751	48.138

REDUCTION OF BAROMETER TO SEA LEVEL

The correction to be added to reduce barometric readings to "sea level" values depends principally on three factors: The temperature of the air column (assumed) from the station to sea level, the altitude of the station, and the value of the reading itself. Two tables are provided. Table I is entered with the altitude and assumed temperature and a factor "2000 m" taken out. Table II is entered with the above factor and the approximate barometer reading and the final correction taken out.

The correction is to be added. If B_0 is the corrected or sea level value; B the barometer reading at the station; C the correction,—

$$C = B_0 - B = B\,(10^m - 1)$$

The actual barometer reading at the station should be corrected for temperature of the mercury column by the usual methods before entering the tables or applying the sea level correction.

A complete explanation of the theory of the corrections and a more extended set of tables will be found in the Smithsonian Meteorological Tables.

Latitude Factor

The influence of the latitude on the value of the correction is usually negligible, being overshadowed by uncertainties in the assumed temperature of the air column. For cases where this correction is desirable the table below is provided. The value of the temperature-altitude factor "2000 m" obtained in Table I is corrected for latitude by subtracting for latitudes 0-45° and adding for latitudes from 45-90° the values found. With this corrected value of "2000 m" Table II is entered for the value of the correction.

LATITUDE FACTOR

To be used in connection with Tables I and II, either English or metric units, to obtain latitude corrections to temperature-altitude factor. For latitudes 0-45° subtract the correction. For latitudes 45-90° add the correction.

Temp.—Alt. from Table I	Latitude			
	0°	15°	30°	45°
100	0.3	0.2	0.1	0.0
200	0.5	0.5	0.3	0.0
300	0.8	0.7	0.4	0.0
	90°	75°	60°	45°

REDUCTION OF BAROMETER TO SEA LEVEL (Continued)

METRIC UNITS—TABLE I

Values of the temperature-altitude factor (2000 m.) for entering table II.

Altitude in meters	Assumed temperature of air column °C									
	−16°	−8°	0°	+4°	+8°	+12°	+16°	+20°	+24°	+28°
10	1.2	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0
50	5.8	5.6	5.4	5.3	5.2	5.2	5.1	5.0	4.9	4.9
100	11.5	11.2	10.8	10.7	10.5	10.3	10.2	10.0	9.9	9.7
150	17.3	16.7	16.2	16.0	15.7	15.5	15.3	15.0	14.8	14.6
200	23.0	22.3	21.6	21.3	21.0	20.7	20.3	20.0	19.7	19.5
250	28.8	27.9	27.0	26.6	26.2	25.8	25.4	25.0	24.7	24.3
300	34.5	33.5	32.5	32.0	31.5	31.0	30.5	30.1	29.6	29.2
350	40.3	39.0	37.9	37.3	36.7	36.2	35.6	35.1	34.6	34.0
400	46.0	44.6	43.3	42.6	42.0	41.3	40.7	40.1	39.5	38.9
450	51.8	50.2	48.7	47.9	47.2	46.5	45.8	45.1	44.4	43.8
500	57.5	55.8	54.1	53.3	52.4	51.6	50.9	50.1	49.4	48.6
550	63.3	61.4	59.5	58.6	57.7	56.8	55.9	55.1	54.3	53.5
600	69.0	66.9	64.9	63.9	62.9	62.0	61.0	60.1	59.2	58.3
650	74.8	72.5	70.3	69.2	68.2	67.1	66.1	65.1	64.2	63.2
700	80.6	78.1	75.7	74.6	73.4	72.3	71.2	70.1	69.1	68.1
750	86.3	83.7	81.1	79.9	78.7	77.5	76.3	75.1	74.0	72.9
800	92.1	89.2	86.5	85.2	83.9	82.6	81.4	80.1	79.0	77.8
850	97.8	94.8	92.0	90.5	89.2	87.8	86.4	85.2	83.9	82.7
900	103.6	100.4	97.4	95.9	94.4	93.0	91.5	90.2	88.8	87.5
950	109.3	106.0	102.8	101.2	99.6	98.1	96.6	95.2	93.8	92.4
1000	115.1	111.5	108.2	106.5	104.9	103.3	101.7	100.2	98.7	97.3
1050	120.8	117.1	113.6	111.8	110.1	108.4	106.8	105.2	103.6	102.1
1100	126.6	122.7	119.0	117.2	115.4	113.6	111.9	110.2	108.6	107.0
1150	132.3	128.3	124.4	122.5	120.6	118.8	117.0	115.2	113.5	111.8
1200	138.1	133.8	129.8	127.8	125.9	123.9	122.0	120.2	118.4	116.7
1250	143.8	139.4	135.2	133.1	131.1	129.1	127.1	125.2	123.4	121.6
1300	149.6	145.0	140.6	138.5	136.3	134.3	132.2	130.2	128.3	126.4
1350	155.3	150.6	146.0	143.8	141.6	139.4	137.3	135.2	133.2	131.3
1400	161.1	156.2	151.4	149.1	146.8	144.6	142.4	140.2	138.2	136.2
1450	166.8	161.7	156.8	154.5	152.1	149.7	147.5	145.3	143.1	141.0
1500	172.6	167.3	162.3	159.8	157.3	154.9	152.5	150.3	148.0	145.9
1550	178.3	172.9	167.7	165.1	162.6	160.1	157.6	155.3	153.0	150.7
1600	184.1	178.5	173.1	170.4	167.8	165.2	162.7	160.3	157.9	155.6
1650	189.8	184.0	178.5	175.7	173.0	170.4	167.8	165.3	162.8	160.5
1700	195.6	189.6	183.9	181.1	178.3	175.6	172.9	170.3	167.8	165.3
1750	201.4	195.2	189.3	186.4	183.5	180.7	178.0	175.3	172.7	170.2
1800	207.1	200.8	194.7	191.7	188.8	185.9	183.1	180.3	177.6	175.0
1850	212.9	206.3	200.1	197.0	194.0	191.0	188.1	185.3	182.6	179.9
1900	218.6	211.9	205.5	202.4	199.3	196.2	193.2	190.3	187.5	184.8
1950	224.4	217.5	210.9	207.7	204.5	201.4	198.3	195.3	192.4	189.6
2000	230.1	223.0	216.3	213.0	209.7	206.5	203.4	200.3	197.4	194.5
2050	235.9	228.6	221.7	218.3	215.0	211.7	208.5	205.3	202.3	199.3
2100	241.6	234.2	227.1	223.7	220.2	216.8	213.5	210.4	207.2	204.2
2150	247.4	239.8	232.5	229.0	225.5	222.0	218.6	215.4	212.2	209.1
2200	253.1	245.4	237.9	234.3	230.7	227.2	223.7	220.4	217.1	213.9
2250	258.9	250.9	243.4	239.6	235.9	232.3	228.8	225.4	222.0	218.8
2300	264.6	256.5	248.8	245.0	241.2	237.5	233.9	230.4	227.0	223.6
2350	270.4	262.1	254.2	250.3	246.4	242.7	239.0	235.4	231.9	228.5
2400	276.1	267.7	259.6	255.6	251.7	247.8	244.0	240.4	236.8	233.4
2450	281.9	273.2	265.0	260.9	256.9	253.0	249.1	245.4	241.8	238.2
2500	287.6	278.8	270.4	266.2	262.2	258.1	254.2	250.4	246.7	243.1
2550	293.4	284.4	275.8	271.6	267.4	263.3	259.3	255.4	251.6	247.9
2600	299.1	290.0	281.2	276.9	272.6	268.5	264.4	260.4	256.6	252.8
2650	304.9	295.5	286.6	282.2	277.9	273.6	269.5	265.4	261.5	257.7
2700	310.6	301.1	292.0	287.5	283.1	278.8	274.5	270.4	266.4	262.5
2750	316.4	306.7	297.4	292.9	288.4	283.9	279.6	275.4	271.4	267.4
2800	322.1	312.3	302.8	298.2	293.6	289.1	284.7	280.4	276.3	272.2
2850	327.9	317.8	308.2	303.5	298.8	294.3	289.8	285.4	281.2	277.1
2900	333.6	323.4	313.6	308.8	304.1	299.4	294.9	290.4	286.2	282.0
2950	339.4	329.0	319.0	314.2	309.3	304.6	299.9	295.5	291.1	286.8
3000	345.1	334.5	324.4	319.5	314.6	309.7	305.0	300.5	296.0	291.7

REDUCTION OF BAROMETER TO SEA LEVEL (Continued)

METRIC UNITS—TABLE II

Values of Correction to be Added

Temp.—alt.—factor	Barometer reading					
	780 mm	760 mm	740 mm	720 mm	700 mm	
1	0.9	0.9	0.9	0.8	0.8	
5	4.5	4.4	4.3	4.2	4.0	
10	9.0	8.8	8.6	8.3	8.1	
15	13 6	13.2	12.9	12.5	12.2	
20	18.2	17.7	17.2	16.8	16.3	
25	22.8	22.2	21.6	21.0	20.4	
30	27.4	26.7	26.0	25.3	24.6	
35	.....	31.2	30.4	29.6	28.8	
	760 mm	740 mm	720 mm	700 mm	680 mm	660 mm
40	35 8	34.9	33.9	33.0	32.0	31.1
45	40.4	39 3	38.3	37.2	36.2	35.1
50	45 0	43.8	42.7	41.5	40.3	39.1
55	49 7	48.4	47 1	45.8	44.5	43.1
60	.....	52 9	51.5	50.1	48.6	47.2
65	.....	57.5	55.9	54.4	52.8	51.3
70	.....	62.1	60.4	58.7	57.1	55.4
75	.....	66.7	64.9	63.1	61.3	59.5
	720 mm	700 mm	680 mm	660 mm	640 mm	
80	69 5	67 5	65 6	63.7	61.7	
85	74 0	72 0	69.9	67.9	65.8	
90	78 6	76 4	74.2	72.1	69.9	
95	83 2	80 9	78 6	76.3	74.0	
100	87 9	85 4	83 0	80.5	78.1	
105	.....	89 9	87.4	84.8	82.2	
110	.....	94 5	91.8	89.1	86.4	
115	.....	99.1	96.3	93.4	90.6	
120	.....	103 7	100.7	97.8	94.8	
125	.....	108.3	105.3	102.2	99.1	
	680 mm	660 mm	640 mm	620 mm	600 mm	
125	105 3	102.2	99.1	96.0	92.9	
130	109.8	106 6	103.3	100.1	96 9	
135	114 3	111 0	107.6	104.3	100 9	
140	118 9	115 4	111.9	108.4	104.9	
145	123 5	119.9	116.3	112.6	109.0	
150	128.2	124 4	120.6	116.9	113 1	
155	.....	128 9	125.0	121.1	117 2	
160	.....	133 5	129.4	125.4	121.4	
165	.....	138.1	133.9	129 7	125.5	
170	.....	142.7	138.4	134.0	129.7	

Temp.—alt.—factor	Barometer reading				
	640 mm	620 mm	600 mm	580 mm	560 mm
170	138.4	134.0	129.7	125.4	121.1
175	142.9	138.4	133.9	129.5	125.0
180	147.4	142.8	138.2	133.6	129.0
185	151.9	147.2	142.4	137.7	132.9
190	156.5	151.6	146 7	141.8	136.9
195	161.1	156.1	151.0	146 0	141.0
200	165.7	160.5	155 4	150.2	145.0
205	170.4	165.0	159.7	154.4	149.1
210	.....	169.6	164.1	158.6	153.2
215	.....	174.1	168.5	162.9	157.3
	620 mm	600 mm	580 mm	560 mm	540 mm
215	174.1	168.5	162.9	157.3	151.7
220	178.7	172.9	167.2	161.4	155.7
225	183.3	177.4	171.5	165.6	159.7
230	188.0	181.9	175 8	169.8	163.7
235	192.6	186.4	180.2	174.0	167.8
240	.....	191.0	184.6	178.2	171.9
245	.....	195.5	189.0	182.5	176.0
250	.....	200.1	193.4	186.8	180.1
255	.....	204.7	197.9	191.1	184.3
260	.....	209.4	202 4	195 4	188.4
	580 mm	560 mm	540 mm	520 mm	
260	202 4	195.4	188.4	181.5	
265	206.9	199.8	192.6	185.5	
270	211.5	204.2	196.9	189.6	
275	216.0	208.6	201.1	193.7	
280	220.6	213.0	205.4	197.8	
285	225 2	217.5	209.7	201.9	
290	229 9	222.0	214.0	206.1	
295	.....	226.5	218.4	210.3	
300	.....	231.0	222.8	214.5	
	560 mm	540 mm	520 mm	500 mm	480 mm
305	235.6	227.2	218.8	210.3	201.9
310	240.2	231.6	223 0	214.4	205.9
315	244.8	236.0	227.3	218.6	209.8
320	249.4	240.5	231.6	222.7	213.8
325	254.1	245.0	236 0	226.9	217 8
330	.....	249.6	240.3	231.1	221 8
335	.....	254.1	244.7	235 3	225.9
340	.....	258.7	249 1	239.6	230.0
345	.....	263 3	253 6	243.8	234.1

REDUCTION OF BAROMETER TO SEA LEVEL (Continued)

ENGLISH UNITS—TABLE I

Values of the temperature-altitude factor (2000 m.) for entering table II.

Altitude feet	Assumed temperature of air column °F									
	-20	0	+10	+20	+30	+40	+50	+60	+70	+80
200	7.4	7.1	6.9	6.8	6.6	6.5	6.3	6.2	6.1	6.0
400	14.8	14.1	13.8	13.5	13.2	13.0	12.7	12.4	12.2	11.9
600	22.2	21.2	20.7	20.3	19.9	19.5	19.0	18.6	18.2	17.9
800	29.6	28.3	27.7	27.1	26.5	25.9	25.4	24.8	24.3	23.8
1000	37.0	35.3	34.6	33.8	33.1	32.4	31.7	31.1	30.4	29.8
1200	44.3	42.4	41.5	40.6	39.7	38.9	38.1	37.3	36.5	35.8
1400	51.7	49.5	48.4	47.4	46.4	45.4	44.4	43.5	42.6	41.7
1600	59.1	56.5	55.3	54.1	53.0	51.9	50.8	49.7	48.7	47.7
1800	66.5	63.6	62.2	60.9	59.6	58.4	57.1	55.9	54.7	53.6
2000	73.9	70.6	69.1	67.7	66.2	64.8	63.4	62.1	60.8	59.6
2200	81.3	77.7	76.0	74.4	72.9	71.3	69.8	68.3	66.9	65.5
2400	88.7	84.8	82.9	81.2	79.5	77.8	76.1	74.5	73.0	71.5
2600	96.1	91.8	89.9	87.9	86.1	84.3	82.5	80.7	79.1	77.5
2800	103.5	98.9	96.8	94.7	92.7	90.8	88.8	87.0	85.1	83.4
3000	110.9	106.0	103.7	101.5	99.3	97.2	95.2	93.2	91.2	89.4
3200	118.2	113.0	110.6	108.2	106.0	103.7	101.5	99.4	97.3	95.3
3400	125.6	120.1	117.5	115.0	112.6	110.2	107.9	105.6	103.4	101.3
3600	133.0	127.2	124.4	121.8	119.2	116.7	114.2	111.8	109.5	107.2
3800	140.4	134.2	131.3	128.5	125.8	123.2	120.5	118.0	115.5	113.2
4000	147.8	141.3	138.2	135.3	132.4	129.6	126.9	124.2	121.6	119.2
4200	155.2	148.3	145.1	142.1	139.1	136.1	133.2	130.4	127.7	125.1
4400	162.6	155.4	152.0	148.8	145.7	142.6	139.6	136.6	133.8	131.1
4600	170.0	162.5	159.0	155.6	152.3	149.1	145.9	142.8	139.9	137.0
4800	177.3	169.5	165.9	162.3	158.9	155.6	152.2	149.0	145.9	143.0
5000	184.7	176.6	172.8	169.1	165.6	162.0	158.6	155.2	152.0	148.9
5200	192.1	183.7	179.7	175.9	172.2	168.5	164.9	161.5	158.1	154.9
5400	199.5	190.7	186.6	182.6	178.8	175.0	171.3	167.7	164.2	160.8
5600	206.9	197.8	193.5	189.4	185.4	181.5	177.6	173.9	170.3	166.8
5800	214.3	204.8	200.4	196.2	192.0	188.0	184.0	180.1	176.3	172.8
6000	221.7	211.9	207.3	202.9	198.7	194.4	190.3	186.3	182.4	178.7
6200	229.1	219.0	214.2	209.7	205.3	200.9	196.6	192.5	188.5	184.7
6400	236.4	226.0	221.1	216.4	211.9	207.4	203.0	198.7	194.6	190.6
6600	243.8	233.1	228.0	223.2	218.5	213.9	209.3	204.9	200.7	196.6
6800	251.2	240.1	235.0	230.0	225.1	220.4	215.7	211.1	206.7	202.5
7000	258.6	247.2	241.9	236.7	231.8	226.8	222.0	217.3	212.8	208.5
7200	266.0	254.3	248.8	243.5	238.4	233.3	228.4	223.5	218.9	214.4
7400	273.4	261.3	255.7	250.2	245.0	239.8	234.7	229.7	225.0	220.4
7600	280.8	268.4	262.6	257.0	251.6	246.3	241.0	235.9	231.1	226.4
7800	288.1	275.4	269.5	263.8	258.2	252.8	247.4	242.2	237.1	232.3
8000	295.5	282.5	276.4	270.5	264.8	259.2	253.7	248.4	243.2	238.3
8200	302.9	289.6	283.3	277.3	271.5	265.7	260.1	254.6	249.3	244.2
8400	310.3	296.6	290.2	284.0	278.1	272.2	266.4	260.8	255.4	250.2
8600	317.7	303.7	297.1	290.8	284.7	278.7	272.7	267.0	261.4	256.1
8800	325.1	310.7	304.0	297.6	291.3	285.2	279.1	273.2	267.5	262.1
9000	332.5	317.8	310.9	304.3	297.9	291.6	285.4	279.4	273.6	268.0

REDUCTION OF BAROMETER TO SEA LEVEL (Continued)

ENGLISH UNITS—TABLE II

Value of Correction to be Added.

Temp. alt. factor	Barometer reading					Temp. alt. factor	Barometer reading				
	31	30	29	28	27		26	25	24	23	22
	in.	in.	in.	in.	in.		in.	in.	in.	in.	in.
1	0.04	0.03	0.03	.....	.....	165	5.44	5.23	5.02		
5	0.18	0.17	0.17	.....	.....	170	5.62	5.40	5.19		
10	0.36	0.35	0.34	0.32	.....	175	.....	5.58	5.36		
15	0.54	0.52	0.51	0.49	.....	180	.....	5.76	5.53	5.30	
20	0.72	0.70	0.68	0.65	.....	185	.....	5.93	5.70	5.46	
25	.....	0.88	0.85	0.82	.....	190	.....	6.11	5.87	5.62	
30	.....	1.05	1.02	0.98	.....	195	.....	6.29	6.04	5.79	
35	.....	1.23	1.19	1.15	.....	200	.....	6.47	6.21	5.96	
40	.....	1.41	1.37	1.32	1.27	205	.....	.....	6.39	6.12	
45	.....	1.60	1.54	1.49	1.44	210	.....	.....	6.56	6.29	
50	.....	.....	1.72	1.66	1.60	215	.....	.....	6.74	6.46	
55	.....	.....	1.90	1.83	1.76	220	.....	.....	6.92	6.63	6.34
60	.....	.....	2.07	2.00	1.93	225	.....	.....	7.10	6.80	6.51
65	.....	.....	2.25	2.18	2.10	230	.....	.....	7.28	6.97	6.67
70	.....	.....	2.43	2.35	2.27	235	.....	.....	7.46	7.15	6.84
75	.....	.....	.....	2.53	2.43	240	.....	.....	.....	7.32	7.00
80	.....	.....	.....	2.70	2.60	245	.....	.....	.....	7.49	7.17
	28	27	26	25	24		23	22	21	20	
	in.	in.	in.	in.	in.		in.	in.	in.	in.	
75	2.53	2.43	2.34	.....	.....	250	7.67	7.34			
80	2.70	2.60	2.51	.....	.....	255	7.85	7.51			
85	2.88	2.78	2.67	.....	.....	260	8.03	7.68	7.33		
90	3.06	2.95	2.84	.....	.....	265	8.21	7.85	7.49		
95	3.24	3.12	3.01	.....	.....	270	8.39	8.02	7.66		
100	3.42	3.29	3.17	.....	.....	275	8.57	8.19	7.82		
105	3.60	3.47	3.34	3.21	.....	280	.....	8.37	7.99		
110	.....	3.65	3.51	3.38	.....	285	.....	8.54	8.16		
115	.....	3.82	3.68	3.54	.....	290	.....	8.72	8.32		
120	.....	4.00	3.85	3.70	.....	295	.....	8.90	8.49	8.09	
125	.....	4.18	4.02	3.87	.....	300	.....	9.08	8.66	8.25	
130	.....	4.36	4.20	4.04	.....	305	.....	9.26	8.83	8.41	
135	.....	4.54	4.37	4.20	.....	310	.....	9.44	9.01	8.58	
140	.....	.....	4.55	4.37	4.20	315	.....	9.62	9.18	8.74	
145	.....	.....	4.72	4.54	4.36	320	.....	9.80	9.35	8.91	
150	.....	.....	4.90	4.71	4.52	325	.....	.....	9.53	9.08	
155	.....	.....	5.08	4.88	4.69	330	.....	.....	9.71	9.24	
160	.....	.....	5.26	5.06	4.85						

REDUCTION OF BAROMETER TO GRAVITY AT SEA LEVEL

Metric Units

Correction to be subtracted given in millimeters

(From Smithsonian Physical Tables)

Height above sea level in meters	Observed Height of Barometer in Millimeters						
	500	550	600	650	700	750	800
100	.....	.....	.....	.....	.02	.02	.02
200	.....	.....	.....	.....	.04	.05	.05
300	.....	.....	.....	.....	.07	.07	.07
400	.....	.....	.....	.....	.09	.10	.10
500	.....	.....	.....	.....	.11	.12	.13
600	.....	.....	.....	.12	.13	.14	
700	.....	.....	.....	.14	.15	.16	
800	.....	.....	.....	.16	.18	.19	
900	.....	.....	.....	.18	.20	.22	
1000	.....	.18	.19	.20	.22	.24	
1100	.....	.19	.21	.22	.24		
1200	.....	.21	.23	.24	.26		
1300	.....	.22	.24	.26	.29		
1400	.....	.24	.26	.28	.31		
1500	.24	.26	.28	.30	.33		
1600	.25	.28	.30	.32			
1700	.27	.30	.32	.34			
1800	.28	.31	.34	.36			
1900	.30	.33	.36	.39			
2000	.31	.34	.38	.41			
2100	.33	.36	.40				
2200	.35	.38	.41				
2300	.36	.40	.43				
2400	.38	.42	.45				
2500	.39	.43	.47				

English Units

Height above sea level in feet	Observed Height in Inches						
	18	20	22	24	26	28	30
1000	.....	.....	.....	.....	.003	.003	.003
2000	.....	.....	.....	.004	.005	.005	.006
3000	.....	.....	.007	.007	.008	.008	
4000	.....	.....	.009	.009	.010		
4500	.....	.....	.010	.010	.011		
5000	.....	.010	.011	.011	.012		
5500	.....	.011	.012	.013			
6000	.....	.011	.013	.014			
6500	.011	.012	.014	.015			
7000	.012	.013	.015	.016			
7500	.013	.014	.016	.017			
8000	.014	.015	.017				
8500	.015	.016	.018				
9000	.016	.017	.019				
9500	.016	.018	.020				

REDUCTION OF BAROMETER TO LATITUDE 45°

METRIC SCALE

For latitudes below 45°, subtract the correction; for latitudes greater than 45° it is to be added. Corrections in cm.

(From Smithsonian Meteorological Tables.)

Latitude		OBSERVED HEIGHT OF BAROMETER IN CENTIMETERS					
		68	70	72	74	76	78
25°	65°	0.116	0.120	0.123	0.127	0.130	0.133
26	64	.111	.115	.118	.121	.125	.128
27	63	.106	.110	.113	.116	.119	.122
28	62	.101	.104	.107	.110	.113	.116
29	61	.096	.099	.102	.104	.107	.110
30	60	0.091	0.094	0.096	0.098	0.101	0.104
31	59	.085	.087	.090	.092	.095	.097
32	58	.079	.082	.084	.086	.089	.091
33	57	.074	.076	.078	.080	.082	.084
34	56	.068	.070	.072	.074	.076	.078
35	55	0.062	0.064	0.066	0.067	0.069	0.071
36	54	.056	.058	.059	.061	.063	.064
37	53	.050	.051	.053	.054	.056	.057
38	52	.044	.045	.046	.048	.049	.050
39	51	.038	.039	.040	.041	.042	.043
40	50	0.031	0.032	0.033	0.034	0.035	0.036
41	49	.025	.026	.027	.027	.028	.029
42	48	.019	.019	.020	.021	.021	.022
43	47	.013	.013	.013	.014	.014	.014
44	46	.006	.007	.007	.007	.007	.007

ENGLISH SCALE

Corrections in inches.

Latitude		OBSERVED HEIGHT IN INCHES					
		25	26	27	28	29	30
25°	65°	0.043	0.044	0.046	0.048	0.050	0.051
26	64	.041	.043	.044	.046	.048	.049
27	63	.039	.041	.042	.044	.045	.047
28	62	.037	.039	.040	.042	.043	.045
29	61	.035	.037	.038	.039	.041	.042
30	60	0.033	0.035	0.036	0.037	0.039	0.040
31	59	.031	.032	.034	.035	.036	.037
32	58	.029	.030	.032	.033	.034	.035
33	57	.027	.028	.029	.030	.031	.032
34	56	.025	.026	.027	.028	.029	.030
35	55	0.023	0.024	0.025	0.025	0.026	0.027
36	54	.021	.021	.022	.023	.024	.025
37	53	.018	.019	.020	.021	.021	.022
38	52	.016	.017	.017	.018	.019	.019
39	51	.014	.014	.015	.015	.016	.017
40	50	0.012	0.012	0.012	0.013	0.013	0.014
41	49	.009	.010	.010	.010	.011	.011
42	48	.007	.007	.008	.008	.008	.008
43	47	.005	.005	.005	.005	.005	.006
44	46	.002	.002	.003	.003	.003	.003

RELATIVE HUMIDITY—DEW-POINT

The table gives the relative humidity of the air for temperature *t* and dew-point *d*.

(From Smithsonian Meteorological Tables.)

Depression of dew-point $t-d$° C.	DEW-POINT (*d*).				
	−10	0	+10	+20	+30
0.0	100%	100%	100%	100%	100%
0.2	98	99	99	99	99
0.4	97	97	97	98	98
0.6	95	96	96	96	97
0.8	94	94	95	95	96
1.0	92	93	94	94	94
1.2	91	92	92	93	93
1.4	90	90	91	92	92
1.6	88	89	90	91	91
1.8	87	88	89	90	90
2.0	86	87	88	88	89
2.2	84	85	86	87	88
2.4	83	84	85	86	87
2.6	82	83	84	85	86
2.8	80	82	83	84	85
3.0	79	81	82	83	84
3.2	78	80	81	82	83
3.4	77	79	80	81	82
3.6	76	77	79	80	82
3.8	75	76	78	79	81
4.0	73	75	77	78	80
4.2	72	74	76	77	79
4.4	71	73	75	77	78
4.6	70	72	74	76	77
4.8	69	71	73	75	76
5.0	68	70	72	74	75
5.2	67	69	71	73	75
5.4	66	68	70	72	74
5.6	65	67	69	71	73
5.8	64	66	69	70	72
6.0	63	66	68	70	71
6.2	62	65	67	69	71
6.4	61	64	66	68	70
6.6	60	63	65	67	69
6.8	60	62	64	66	68
7.0	59	61	63	66	68
7.2	58	60	63	65	67
7.4	57	60	62	64	66
7.6	56	59	61	63	65
7.8	55	58	60	63	65

RELATIVE HUMIDITY—DEW-POINT (Continued)

Depression of dew-point $t-d$° C.	Dew-point (d).				
	−10	0	+10	+20	+30
8.0	54	57	60	62	64
8.2	54	56	59	61	63
8.4	53	56	58	60	63
8.6	52	55	57	60	62
8.8	51	54	57	59	61
9.0	51	53	56	58	61
9.2	50	53	55	58	60
9.4	49	52	55	57	59
9.6	48	51	54	56	59
9.8	48	51	53	56	58
10.0	47	50	53	55	57
10.5	45	48	51	54	
11.0	44	47	49	52	
11.5	42	45	48	51	
12.0	41	44	47	49	
12.5	39	42	45	48	
13.0	38	41	44	46	
13.5	37	40	43	45	
14.0	35	38	41	44	
14.5	34	37	40	43	
15.0	33	36	39	42	
15.5	32	35	38	40	
16.0	31	34	37	39	
16.5	30	33	36	38	
17.0	29	32	35	37	
17.5	28	31	34	36	
18.0	27	30	33	35	
18.5	26	29	32	34	
19.0	25	28	31	33	
19.5	24	27	30	33	
20.0	24	26	29	32	
21.0	22	25	27		
22.0	21	23	26		
23.0	19	22	24		
24.0	18	21	23		
25.0	17	19	22		
26.0	16	18	21		
27.0	15	17	20		
28.0	14	16	19		
29.0	13	15	18		
30.0	12	14	17		

RELATIVE HUMIDITY FROM WET AND DRY

This table gives the approximate relative humidity directly from the reading of the air pressure of 74.27 cm Hg. Errors resulting from the use of this table for air temperatures

Condensed from Bulletin of the

t − t′ / t	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6
−10	93	87	80	74	67	61	54	48	41	35	28	22	16	9	..	..	..	..
−9	94	88	81	75	69	63	57	51	45	39	33	27	21	15	9	..	..	..
−8	94	88	83	77	71	65	60	54	48	43	37	32	26	20	15	10	..	..
−7	95	89	84	78	73	67	62	57	52	46	41	36	31	25	20	15	10	5
−6	95	90	85	79	74	69	64	59	54	49	45	40	35	30	25	20	15	11
−5	95	90	86	81	76	71	66	62	57	52	48	43	39	34	29	25	20	16
−4	95	91	86	82	77	73	68	64	59	55	51	46	42	38	33	29	25	21
−3	96	91	87	82	78	74	70	66	62	57	53	49	45	41	37	33	29	25
−2	96	92	88	84	79	75	71	68	64	60	56	52	48	44	40	37	33	29
−1	96	92	88	84	81	77	73	69	66	62	58	54	51	47	43	40	36	33
0	96	93	89	85	81	78	74	71	67	64	60	57	53	50	46	43	40	36
1	97	93	90	86	83	80	76	73	70	66	63	59	56	53	49	46	43	40
2	97	93	90	87	84	81	78	74	71	68	65	62	59	55	52	49	46	43
3	97	94	91	88	84	82	78	76	72	70	67	64	61	58	55	52	49	46
4	97	94	91	88	85	82	79	77	74	71	68	65	62	60	57	54	51	48
5	97	94	91	88	86	83	80	77	75	72	69	67	64	61	58	56	53	51
6	97	94	92	89	86	84	81	78	76	73	70	68	65	63	60	58	55	53
7	97	95	92	89	87	84	82	79	77	74	72	69	67	64	62	59	57	54
8	97	95	92	90	87	85	82	80	77	75	73	70	68	65	63	61	58	56
9	98	95	93	90	88	85	83	81	78	76	74	71	69	67	64	62	60	58
10	98	95	93	90	88	86	83	81	79	77	74	72	70	68	66	63	61	59
11	98	95	93	91	89	86	84	82	80	78	75	73	71	69	67	65	62	60
12	98	96	93	91	89	87	85	82	80	78	76	74	72	70	68	66	64	62
13	98	96	93	91	89	87	85	83	81	79	77	75	73	71	69	67	65	63
14	98	96	94	92	90	88	86	84	82	79	78	76	74	72	70	68	66	64
15	98	96	94	92	90	88	86	84	82	80	78	76	74	73	71	69	67	65
		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7 0	7.5	8.0	8.5	9.0	9.5
16	95	90	85	81	76	71	67	63	58	54	50	46	42	38	34	30	26	23	19
17	95	90	86	81	76	72	68	64	60	55	51	47	43	40	36	32	28	25	21
18	95	91	86	82	77	73	69	65	61	57	53	49	45	41	38	34	30	27	23
19	95	91	87	82	78	74	70	65	62	58	54	50	46	43	39	36	32	29	26
20	96	91	87	83	78	74	70	66	63	59	55	51	48	44	41	37	34	31	28
21	96	91	87	83	79	75	71	67	64	60	56	53	49	46	42	39	36	32	29
22	96	92	87	83	80	76	72	68	64	61	57	54	50	47	44	40	37	34	31
23	96	92	88	84	80	76	72	69	65	62	58	55	52	48	45	42	39	36	33
24	96	92	88	84	80	77	73	69	66	62	59	56	53	49	46	43	40	37	34
25	96	92	88	84	81	77	74	70	67	63	60	57	54	50	47	44	41	39	36
26	96	92	88	85	81	78	74	71	67	64	61	58	54	51	49	46	43	40	37
27	96	92	89	85	82	78	75	71	68	65	62	58	56	52	50	47	44	41	38
28	96	93	89	85	82	78	75	72	69	65	62	59	56	53	51	48	45	42	40
29	96	93	89	86	82	79	76	72	69	66	63	60	57	54	52	49	46	43	41
30	96	93	89	86	83	79	76	73	70	67	64	61	58	55	52	50	47	44	42
31	96	93	90	86	83	80	77	73	70	67	64	61	59	56	53	51	48	45	43
32	96	93	90	86	83	80	77	74	71	68	65	62	60	57	54	51	49	46	44
33	97	93	90	87	83	80	77	74	71	68	66	63	60	57	55	52	50	47	45
34	97	93	90	87	84	81	78	75	72	69	66	63	61	58	56	53	51	48	46
35	97	94	90	87	84	81	78	75	72	69	67	64	61	59	56	54	51	49	47
36	97	94	90	87	84	81	78	75	73	70	67	64	62	59	57	54	52	50	48
37	97	94	91	87	84	82	79	76	73	70	68	65	63	60	58	55	53	51	48
38	97	94	91	88	84	82	79	76	74	71	68	66	63	61	58	56	54	51	49
39	97	94	91	88	85	82	79	77	74	71	69	66	64	61	59	57	54	52	50
40	97	94	91	88	85	82	80	77	74	72	69	67	64	62	59	57	54	53	51

BULB THERMOMETER (CENT. SCALE)

temperature (dry bulb) (t°C) and the wet bulb (t'°C). It is computed for a barometrio above −10°C and between 77.5 and 71 cm Hg will usually be within the errors of observation.

U. S. Weather Bureau No. 1071

$t - t'$ / t	3.8	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0
−10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
−9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
−8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
−7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
−6	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
−5	11	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..
−4	17	12	..	..	..	..	..	..	..	..	..	..	..	..	..	..
−3	21	17	8	..	..	..	..	..	..	..	..	..	..	..	..	..
−2	25	22	12	..	..	..	..	..	..	..	..	..	..	..	..	..
−1	29	26	17	8	..	..	..	..	..	..	..	..	..	..	..	..
0	33	29	21	13	5	..	..	..	..	..	..	..	..	..	..	..
1	36	33	25	17	10	..	..	..	..	..	..	..	..	..	..	..
2	40	37	29	22	14	7	..	..	..	..	..	..	..	..	..	..
3	43	40	33	26	19	12	5	..	..	..	..	..	..	..	..	..
4	46	43	36	29	22	16	9	..	..	..	..	..	..	..	..	..
5	48	45	39	33	26	20	13	7	..	..	..	..	..	..	..	..
6	50	48	41	35	29	24	17	11	5	..	..	..	..	..	..	..
7	52	50	44	38	32	26	21	15	10	..	..	..	..	..	..	..
8	54	51	46	40	35	29	24	19	14	8	..	..	..	..	..	..
9	55	53	48	42	37	32	27	22	17	12	7	..	..	..	..	..
10	57	55	50	44	39	34	29	24	20	15	10	6	..	..	..	..
11	58	56	51	46	41	36	32	27	22	18	13	9	5	..	..	..
12	60	58	53	48	43	39	34	29	25	21	16	12	8	..	..	..
13	61	59	54	50	45	41	36	32	28	23	19	15	11	7	..	..
14	62	60	56	51	47	42	38	34	30	26	22	18	14	10	6	..
15	63	61	57	53	48	44	40	36	32	27	24	20	16	13	9	6
	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	19.0	20.0
16	15	12	8	5	..	..	..	..	..	..	..	..	..	..	..	..
17	18	14	11	8	..	..	..	..	..	..	..	..	..	..	..	..
18	20	17	14	10	7	..	..	..	..	..	..	..	..	..	..	..
19	22	19	16	13	10	7	..	..	..	..	..	..	..	..	..	..
20	24	21	18	15	12	9	6	..	..	..	..	..	..	..	..	..
21	26	23	20	17	14	12	9	6	..	..	..	..	..	..	..	..
22	28	25	22	19	17	14	11	8	6	..	..	..	..	..	..	..
23	30	27	24	21	19	16	13	11	8	6	..	..	..	..	..	..
24	31	29	26	23	20	18	15	13	10	8	5	..	..	..	..	..
25	33	30	28	25	22	20	17	15	12	10	8	..	..	..	..	..
26	34	32	29	26	24	21	19	17	14	12	10	5	..	..	..	..
27	36	33	31	28	26	23	21	18	16	14	12	7	..	..	..	..
28	37	34	32	29	27	25	22	20	18	16	13	9	5	..	..	..
29	38	36	33	31	28	26	24	22	19	17	15	11	7	..	..	..
30	39	37	35	32	30	28	25	23	21	19	17	13	9	5	..	..
31	40	38	36	33	31	29	27	25	22	20	18	14	11	7	..	..
32	41	39	37	35	32	30	28	26	24	22	20	16	12	9	5	..
33	42	40	38	36	33	31	29	27	25	23	21	17	14	10	7	..
34	43	41	39	37	35	32	30	28	26	24	23	19	15	12	8	5
35	44	42	40	38	36	34	32	30	28	26	24	20	17	13	10	7
36	45	43	41	39	37	35	33	31	29	27	25	21	18	15	11	8
37	46	44	42	40	38	36	34	32	30	28	26	23	19	16	13	10
38	47	45	43	41	39	37	35	33	31	29	27	24	20	17	14	11
39	48	46	43	42	39	38	36	34	32	30	28	25	22	18	15	12
40	48	46	44	42	40	38	36	35	33	31	29	26	23	20	16	14

REDUCTION OF PSYCHROMETRIC OBSERVATION

For the reduction of observations with the wet and dry bulb thermometer. Assuming the relative velocity of the air to the thermometer bulbs is at least three meters per second; if t is the temperature of the air as indicated by the dry bulb, t_w, the temperature of the wet bulb, B, the barometric pressure, and E_w, the vapor tension of water corresponding to t_w, then the actual vapor tension is

$$E = E_w - 0.00066B(t - t_w)[1 + 0.00115(t - t_w)].$$

The value of the term

$$0.00066B(t - t_w)[1 + 0.00115(t - t_w)]$$

is given in the following table.

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

$t - t_w$	Barometric Pressure B in Centimeters							
	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0
°C	cm	cm	cm	cm	cm	cm	cm	cm
1	0.047	0.048	0.048	0.049	0.050	0.050	0.051	0.052
2	.093	.094	.096	.097	.098	.100	.101	.103
3	.139	.141	.143	.145	.147	.149	.152	.154
4	.186	.189	.191	.194	.197	.199	.202	.204
5	0.232	0.236	0.239	0.243	0.246	0.249	0.252	0.256
6	.279	.283	.287	.291	.295	.299	.303	.307
7	.326	.331	.336	.340	.345	.350	.354	.359
8	.373	.379	.384	.389	.395	.400	.405	.411
9	.421	.427	.432	.438	.444	.450	.456	.462
10	0.468	0.474	0.481	0.488	0.494	0.501	0.508	0.515
11	.515	.522	.530	.537	.544	.551	.559	.566
12	.562	.570	.578	.586	.594	.602	.611	.619
13	.610	.618	.627	.636	.645	.653	.662	.671
14	.658	.667	.676	.686	.695	.705	.714	.723
15	0.706	0.716	0.726	0.736	0.746	0.756	0.766	0.776
16	.754	.764	.775	.786	.796	.807	.818	.829
17	.802	.813	.824	.836	.847	.859	.870	.882
18	.850	.862	.874	.886	.898	.910	.922	.935
19	.898	.911	.923	.936	.949	.962	.975	.987
20	0.946	0.960	0.973	0.987	1.000	1.014	1.027	1.041

CONSTANT HUMIDITY

The following table shows the % humidity and the aqueous tension at the given temperature within a closed space when an excess of the substance indicated is in contact with a saturated aqueous solution of the given solid phase.

Solid phase	t°C.	% humidity	Aq. tension mm Hg
$H_3PO_4.\frac{1}{2}H_2O$	24	9	1.99
$ZnCl_2.1\frac{1}{2}H_2O$*	20	10	1.74
$KC_2H_3O_2$	168	13	738
$LiCl.H_2O$	20	15	2.60
$KC_2H_3O_2$	20	20	3.47
KF	100	22.9	174
NaBr	100	22.9	174
NaCl, KNO_3 and $NaNO_3$	16.39	30.49	4.23
$CaCl_2.6H_2O$	24.5	31	7.08
$CaCl_2.6H_2O$	20	32.3	5.61
$CaCl_2.6H_2O$	18.5	35	5.54
CrO_3	20	35	6.08
$CaCl_2.6H_2O$	10	38	3.47
$CaCl_2.6H_2O$	5	39.8	2.59
$Zn(NO_3)_2.6H_2O$	20	42	7.29
$K_2CO_3.2H_2O$	24.5	43	9.82
$K_2CO_3.2H_2O$	18.5	44	6.96
KNO_2	20	45	7.81
KCNS	20	47	8.16
NaI	100	50.4	383
$Ca(NO_3)_2.4H_2O$	24.5	51	11.6
$NaHSO_4.H_2O$	20	52	9.03
$Na_2Cr_2O_7.2H_2O$	20	52	9.03
$Mg(NO_3)_2.6H_2O$	24.5	52	11.9
$NaClO_3$	100	54	410
$Ca(NO_3)_2.4H_2O$	18.5	56	8.86
$Mg(NO_3)_2.6H_2O$	18.5	56	8.86
KI	100	56.2	427
$NaBr.2H_2O$	20	58	10.1
$Mg(C_2H_3O_2)_2.4H_2O$	20	65	11.3
$NaNO_2$	20	66	11.5
NH_4Cl and KNO_3	30	68.6	21.6
KBr	100	69.2	526
NH_4Cl and KNO_3	25	71.2	16.7
NH_4Cl and KNO_3	20	72.6	12.6
$NaClO_3$	20	75	13.0
$(NH_4)_2SO_4$	108.	75	754
$NaC_2H_3O_2.3H_2O$	20	76	13.2
$H_2C_2O_4.2H_2O$	20	76	13.2
$Na_2S_2O_3.5H_2O$	20	78	13.5
NH_4Cl	20	79.5	13.8

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* Unstable form.

CONSTANT HUMIDITY (Continued)

Solid phase	t°C.	% humidity	Aq. tension
NH_4Cl	25	79.3	18.6
NH_4Cl	30	77.5	24.4
$(NH_4)_2SO_4$	20	81	14.1
$(NH_4)_2SO_4$	25	81.1	19.1
$(NH_4)_2SO_4$	30	81.1	25.6
KBr	20	84	14.6
Tl_2SO_4	104.7	84.8	768
$KHSO_4$	20	86	14.9
$Na_2CO_3.10H_2O$	24.5	87	20.9
$BaCl_2.2H_2O$	24.5	88	20.1
K_2CrO_4	20	88	15.3
$Pb(NO_3)_2$	103.5	88.4	760
$ZnSO_4.7H_2O$	20	90	15.6
$Na_2CO_3.10H_2O$	18.5	92	14.6
$NaBrO_3$	20	92	16.0
K_2HPO_4	20	92	16.0
$NH_4H_2PO_4$	30	92.9	29.3
$NH_4H_2PO_4$	25	93	21.9
$Na_2SO_4.10H_2O$	20	93	16.1
$NH_4H_2PO_4$	20	93.1	16.2
$ZnSO_4.7H_2O$	5	94.7	6.10
$Na_2SO_3.7H_2O$	20	95	16.5
$Na_2HPO_4.12H_2O$	20	95	16.5
NaF	100	96.6	734
$Pb(NO_3)_2$	20	98	17.0
$CuSO_4.5H_2O$	20	98	17.0
$TlNO_3$	100.3	98.7	759
$TlCl$	100.1	99.7	761

CONSTANT HUMIDITY WITH SULFURIC ACID SOLUTIONS

The relative humidity and pressure of aqueous vapor of air in equilibrium conditions above aqueous solutions of sulfuric acid are given below.

Density of acid solution	Relative humidity	Vapor pressure at 20°C	Density of acid solution	Relative humidity	Vapor pressure at 20°C
1.00	100.0	17.4	1.30	58.3	10.1
1.05	97.5	17.0	1.35	47.2	8.3
1.10	93.9	16.3	1.40	37.1	6.5
1.15	88.8	15.4	1.50	18.8	3.3
1.20	80.5	14.0	1.60	8.5	1.5
1.25	70.4	12.2	1.70	3.2	0.6

For concentration of sulfuric acid solution refer to tables relating density to percent composition.

SOUND

VELOCITY OF SOUND

SOLIDS

Approximate values.
(From Smithsonian Tables.)

Substance	Temp. ° C	Veloc., meters per sec.	Veloc., feet per sec.	Observer
Metals:				
Aluminum	....	5104	16740	Masson
Brass	....	3500	11480	Various
Cadmium	....	2307	7570	Masson
Cobalt	....	4724	15500	Masson
Copper	20	3560	11670	Wertheim
Copper	100	3290	10800	Wertheim
Copper	200	2950	9690	Wertheim
Gold, soft	20	1743	5717	Wertheim
Gold, hard	....	2100	6890	Various
Iron and soft steel	....	5000	16410	Various
Iron	20	5130	16820	Wertheim
Iron	100	5300	17390	Wertheim
Iron	200	4720	15480	Wertheim
Iron cast steel	20	4990	16360	Wertheim
Iron cast steel	200	4790	15710	Wertheim
Lead	20	1227	4026	Wertheim
Magnesium	....	4602	15100	Melde
Nickel	....	4973	16320	Masson
Palladium	....	3150	10340	Various
Platinum	20	2690	8815	Wertheim
Platinum	100	2570	8437	Wertheim
Platinum	200	2460	8079	Wertheim
Silver	20	2610	8553	Wertheim
Silver	100	2640	8658	Wertheim
Tin	....	2500	8200	Various
Zinc	....	3700	12140	Various
Various:				
Brick	....	3652	11980	Chladni
Clay rock	....	3480	11420	Gray and Milne
Cork	....	500	1640	Stefan
Granite	....	6000	19685	
Marble	....	3810	12500	Gray and Milne
Paraffin	15	1304	4280	Warburg
Slate	....	4510	14800	Gray and Milne
Tallow	16	390	1280	Warburg
Glass, from	....	5000	16410	Various
Glass, to	....	6000	19690	Various
Ivory	....	3013	9886	Ciccone & Campanile
Vulcanized rubber	0	54	177	Exner
Wax	17	880	2890	Stefan
Woods:				
Ash, along the fiber	....	4670	15310	Wertheim
Ash, across the rings	....	1390	4570	Wertheim
Ash, along the rings	....	1260	4140	Wertheim
Beech, along the fiber	....	3340	10960	Wertheim
Elm, along the fiber	....	4120	13516	Wertheim
Fir, along the fiber	....	4640	15220	Wertheim
Maple, along the fiber	....	4110	13470	Wertheim
Oak, along the fiber	....	3850	12620	Wertheim
Pine, along the fiber	....	3320	10900	Wertheim
Poplar, along the fiber	....	4280	14050	Wertheim
Sycamore, along fiber	....	4460	14640	Wertheim

VELOCITY OF SOUND (Continued)

LIQUIDS AND GASES

(From Smithsonian Tables.)

Substance	Temp. °C	Veloc., meters per sec.	Veloc., feet per sec.	Observer
Liquids:				
Alcohol, 95 %	12.5	1241.	4072.	Dorsing, 1908
Alcohol	20.5	1213.	3890.	Dorsing, 1908
Ammonia, conc	16.	1663.	5456.	Dorsing, 1908
Benzine	17.	1166.	3826.	Dorsing, 1908
Carbon bisulfide	15.	1161.	3809.	Dorsing, 1908
Chloroform	15.	983.	3225.	Dorsing, 1908
Ether	15.	1032.	3386.	Dorsing, 1908
NaCl, 10 % sol	15.	1470.	4823.	Dorsing, 1908
NaCl, 15 % sol	15.	1530.	5020.	Dorsing, 1908
NaCl, 20 % sol	15.	1650.	5414.	Dorsing, 1908
Turpentine oil	15.	1326.	4351.	Dorsing, 1908
Water, air-free	13.	1441.	4728.	Dorsing, 1908
Water, air-free	19.	1461.	4794.	Dorsing, 1908
Water, air-free	31.	1505.	4938.	Dorsing, 1908
Water, Lake Geneva	9.	1435.	4708.	Colladon-Sturm
Water, Seine River	15.	1437.	4714.	Wertheim
Water, Seine River	30.	1528.	5013.	Wertheim
Water, Seine River	60.	1724.	5657.	Wertheim
Gases:				
Air, dry, CO_2-free	0.	331.78	1088.5	Rowland
Air, dry	0.	331.36	1087.1	Violle, 1900
Air, dry, CO_2-free	0.	331.92	1089.0	Thiesen, 1908
Air 1 atmosphere	0.	331.7	1088.	Mean
Air 25 atmospheres	0.	332.0	1089.	Mean (Witkowski)
Air 50 atmospheres	0.	334.7	1098.	Mean (Witkowski)
Air 100 atmospheres	0.	350.6	1150.	Mean (Witkowski)
Air	20.	344.	1129.	
Air	100.	386.	1266.	Stevens
Air	500.	553.	1814.	Stevens
Air	1000.	700.	2297.	Stevens
Ammonia	0.	415.	1361.	Masson
Carbon monoxide	0.	337.1	1106.	Wullner
Carbon dioxide	0.	258.0	846.	Bückendahl, 1906
Carbon disulfide	0.	189.	606.	Masson
Chlorine	0.	205.3	674.	Strecker
Ethylene	0.	314.	1030.	Dulong
Hydrogen	0.	1269.5	4165.	Dulong
Illuminating gas	0.	490.4	1609.	Zoch
Methane	0.	432.	1417.	Masson
Nitric oxide	0.	325.	1066.	Masson
Nitrous oxide	0.	261.8	859.	Dulong
Oxygen	0.	317.2	1041.	Dulong
Vapors:				
Alcohol	0.	230.6	756.	Masson
Ether	0.	179.2	588.	Masson
Water	0.	401.	1315.	Masson
Water	100.	404.8	1328.	Treitz, 1903
Water	130.	424.4	1392.	Treitz, 1903

MUSICAL SCALES

Equal Tempered Chromatic Scale

$A_4 = 440$

American Standard pitch. Adopted by the American Standards Association in 1936

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C_0	16.35	C_2	65.41	C_4	261.63	C_6	1046.50
$C\#_0$	17.32	$C\#_2$	69.30	$C\#_4$	277.18	$C\#_6$	1108.73
D_0	18.35	D_2	73.42	D_4	293.66	D_6	1174.66
$D\#_0$	19.45	$D\#_2$	77.78	$D\#_4$	311.13	$D\#_6$	1244.51
E_0	20.60	E_2	82.41	E_4	329.63	E_6	1318.51
F_0	21.83	F_2	87.31	F_4	349.23	F_6	1396.91
$F\#_0$	23.12	$F\#_2$	92.50	$F\#_4$	369.99	$F\#_6$	1479.98
G_0	24.50	G_2	98.00	G_4	392.00	G_6	1567.98
$G\#_0$	25.96	$G\#_2$	103.83	$G\#_4$	415.30	$G\#_6$	1661.22
A_0	27.50	A_2	110.00	**A_4**	**440.00**	A_6	1760.00
$A\#_0$	29.14	$A\#_2$	116.54	$A\#_4$	466.16	$A\#_6$	1864.66
B_0	30.87	B_2	123.47	B_4	493.88	B_6	1975.53
C_1	32.70	C_3	130.81	C_5	523.25	C_7	2093.00
$C\#_1$	34.65	$C\#_3$	138.59	$C\#_5$	554.37	$C\#_7$	2217.46
D_1	36.71	D_3	146.83	D_5	587.33	D_7	2349.32
$D\#_1$	38.89	$D\#_3$	155.56	$D\#_5$	622.25	$D\#_7$	2489.02
E_1	41.20	E_3	164.81	E_5	659.26	E_7	2637.02
F_1	43.65	F_3	174.61	F_5	698.46	F_7	2793.83
$F\#_1$	46.25	$F\#_3$	185.00	$F\#_5$	739.99	$F\#_7$	2959.96
G_1	49.00	G_3	196.00	G_5	783.99	G_7	3135.96
$G\#_1$	51.91	$G\#_3$	207.65	$G\#_5$	830.61	$G\#_7$	3322.44
A_1	55.00	A_3	220.00	A_5	880.00	A_7	3520.00
$A\#_1$	58.27	$A\#_3$	233.08	$A\#_5$	932.33	$A\#_7$	3729.31
B_1	61.74	B_3	246.94	B_5	987.77	B_7	3951.07
						C_8	4186.01

Equal Tempered Chromatic Scale

$A_4 = 435$

International Pitch, adopted 1891

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C_0	16.17	C_2	64.66	C_4	258.65	C_6	1034.61
$C\#_0$	17.13	$C\#_2$	68.51	$C\#_4$	274.03	$C\#_6$	1096.13
D_0	18.15	D_2	72.58	D_4	290.33	D_6	1161.31
$D\#_0$	19.22	$D\#_2$	76.90	$D\#_4$	307.59	$D\#_6$	1230.37
E_0	20.37	E_2	81.47	E_4	325.88	E_6	1303.53
F_0	21.58	F_2	86.31	F_4	345.26	F_6	1381.04
$F\#_0$	22.86	$F\#_2$	91.45	$F\#_4$	365.79	$F\#_6$	1463.16
G_0	24.22	G_2	96.89	G_4	387.54	G_6	1550.16
$G\#_0$	25.66	$G\#_2$	102.65	$G\#_4$	410.59	$G\#_6$	1642.34
A_0	27.19	A_2	108.75	**A_4**	**435.00**	A_6	1740.00
$A\#_0$	28.80	$A\#_2$	115.22	$A\#_4$	460.87	$A\#_6$	1843.47
B_0	30.52	B_2	122.07	B_4	488.27	B_6	1953.08
C_1	32.33	C_3	129.33	C_5	517.31	C_7	2069.22
$C\#_1$	34.25	$C\#_3$	137.02	$C\#_5$	548.07	$C\#_7$	2192.26
D_1	36.29	D_3	145.16	D_5	580.66	D_7	2322.62
$D\#_1$	38.45	$D\#_3$	153.80	$D\#_5$	615.18	$D\#_7$	2460.73
E_1	40.74	E_3	162.94	E_5	651.76	E_7	2607.05
F_1	43.16	F_3	172.63	F_5	690.52	F_7	2762.08
$F\#_1$	45.72	$F\#_3$	182.89	$F\#_5$	731.58	$F\#_7$	2926.32
G_1	48.44	G_3	193.77	G_5	775.08	G_7	3100.33
$G\#_1$	51.32	$G\#_3$	205.29	$G\#_5$	821.17	$G\#_7$	3284.68
A_1	54.38	A_3	217.50	A_5	870.00	A_7	3480.00
$A\#_1$	57.61	$A\#_3$	230.43	$A\#_5$	921.73	$A\#_7$	3686.93
B_1	61.03	B_3	244.14	B_5	976.54	B_7	3906.17
						C_8	4138.44

MUSICAL SCALES (Continued)

SCIENTIFIC OR JUST SCALE

$C_4 = 256$

Note	Frequency	Note	Frequency	Note	Frequency	Note	Frequency
C_0	16	C_2	64	**C_4**	**256**	C_6	1024
D_0	18	D_2	72	D_4	288	D_6	1152
E_0	20	E_2	80	E_4	320	E_6	1280
F_0	21.33	F_2	85.33	F_4	341.33	F_6	1365.33
G_0	24	G_2	96	G_4	384	G_6	1536
A_0	26.67	A_2	106.67	A_4	426.67	A_6	1706.67
B_0	30	B_2	120	B_4	480	B_6	1920
C_1	32	C_3	128	C_5	512	C_7	2048
D_1	36	D_3	144	D_5	576	D_7	2304
E_1	40	E_3	160	E_5	640	E_7	2560
F_1	42.67	F_3	170.67	F_5	682.67	F_7	2730.67
G_1	48	G_3	192	G_5	768	G_7	3072
A_1	53.33	A_3	213.33	A_5	853.33	A_7	3413.33
B_1	60	B_3	240	B_5	960	B_7	3840
						C_8	4096

SOUND ABSORPTION

TABLE I.—GENERAL BUILDING MATERIALS

The following table gives the absorption coefficients of various materials. The reverberation time is usually defined as the time required for the reverberant sound to sink to one millionth its initial intensity. This time is given in seconds by the relation, $T_0 = .05\left(\frac{V}{a}\right)$, where V is the volume of the room in cubic feet and a is the absorption. The absorption a is computed by multiplying the area in square feet of each surface by its absorption coefficient and taking the sum of these products plus the absorbing power of objects, such as seats and furnishings.

Data in the following tables have been selected largely from the Official Bulletin of the Acoustical Materials Association.

Material	Coefficients		
	128	512	2048
Floor Coverings:			
Carpet unlined	.09	.20	.27
Carpet felt lined	.11	.37	.27
Carpet, pile, on concrete, 3/8"	.09	.21	.27
Carpet, pile, on 1/8" felt, 3/8"	.11	.37	.27
Carpet, rubber, on concrete, 2/16"	.04	.08	.03
Cocoa matting	.08	.17	.30
Cork flooring slabs, glued down, 3/4"	.08	.08	.21
Cork flooring, like above, waxed and polished, 3/4"	.04	.05	.07
Cork Tile, 1/4"	.04	.06	.7
Linoleum	.02	.03	.04
Linoleum, asphalt, rubber or cork tile on concrete		.03–.08	
Rug, Axminster	.11	.20	.52
Rug, Oriental	.10	.29	.40
Hair felt:			
1" Hair felt on 2" × 1½" battens 3′ c/c	.09	.43	.33
1" Hair felt close against wall	.12	.41	.30
Hangings:			
Fabrics, hung straight:			
Light, 10 ozs. per sq. yd	.04	.11	.30
Medium, 14 ozs. per sq. yd	.06	.13	.40
Heavy, draped, 18 ozs. per sq. yd	.10	.50	82
Hard Plasters, Masonry, Wood:			
Brick wall, painted	.012	.017	.023
Brick wall, unpainted	.024	.03	.049
Clay tile, burned, 1"	.015	.028	.035
Cement		.025	

TABLE I.—GENERAL BUILDING MATERIALS (Continued)

Material	Coefficients		
	128	512	2048
Hard Plasters, Masonry, Wood:			
Concrete or terrazzo	.01	.015	.02
Glass	.035	.027	.02
Interior Stucco, smooth finish, ½″	.03	.04	.04
Marble or glazed tile	.01	.01	.015
Plaster, gypsum or lime, smooth finish on tile or brick	.013	.025	.04
Plaster, gypsum or lime, smooth finish on lath	.02	.03	.04
Plaster, gypsum or lime, rough finish on lath	.039	.06	.054
Wood blocks, pitch pine, laid in mastic, ¾″	.05	.06	.10
Wood flooring	.05	.03	.03
Wood paneling	.08	.06	.06
Combination of Accoustical Materials:			
Fibreglas Semi-rigid Panels and Boards			
Type TW-PF-2.5D 1″ thick, .23 lbs. per sq. ft.	.24	.65	.73
Type TW-PF- 4D 2″ thick, .71 lbs. per sq. ft.	.41	.99	.84
Type TW-PF- 12D 1″ thick, 1.04 lbs. per sq. ft.	.09	.79	.87
Fibreglas Metal Mesh Blankets (style HO)·			
Type TW-G-2D 1″ thick, .42 lbs. per sq. ft.	.24	.57	.70
Type TW-G-4D 2″ thick, .97 lbs. per sq. ft.	.54	.99	.88
Type TW-G-6D 2″ thick, 1.31 lbs. per sq. ft.	.55	.99	.91
Fibreglas Sewn Blankets—Muslin Faced (Styles PM 2 or FM 2)			
Type TW-G-4D 2″ thick, .69 lbs. per sq. ft.	.62	.99	.86
Openings:			
Stage, depending on furnishings		.25–.75	
Deep balcony, upholstered seats		.50–1.00	
Grills, ventilating		.15–.50	
Ventilators, 50% open	.30	.50	.50
Audience, Individual Persons, Chairs, etc.:			
Audience, seated, units per person, depending on character of seats, etc.	1.0–2.0	3.0–4.3	3.5–6.0
Chairs, metal or wood	.15	.17	.20
Pew Cushions	.75–1.1	1.45–1.90	1.4–1.7
Theater and Auditorium Chairs			
Wood veneer seats and back		.25	
Upholstered in leatherette		1.6	
Heavily upholstered in plush or mohair		2.6–3.0	
Wood Pews		.40	

TABLE II.—SPECIAL ACOUSTICAL MATERIALS

The type of material and method of mounting are indicated by symbols as follows:

TYPES OF MATERIALS

1. Cast units composed of small uniform mineral particles held together with Portland cement.
2. Cast units having a surface composed of or resembling small uniform granules. The binder may be gypsum or any other suitable mineral binder.
3. Cast units having a surface composed of or resembling irregular, rough granules. The binder may be gypsum or any other suitable mineral binder.
4. Units having a mechanically perforated surface, which acts as a covering for the sound absorbent material.
5. Units which are mechanically perforated, the perforations extending into the sound absorbent material.
6. Units having a fissured surface.
7. Compressed units composed of long wood fibers held together with a mineral binder. This type shall not have a mechanically perforated surface.
8. Felted fiber or wood pulp units which have a surface that is not mechanically perforated.

TYPES OF MOUNTINGS

1. Cemented to plaster board. Considered equivalent to cementing to plaster or concrete ceiling.
2. Nailed to 1″ × 2″ wood furring 12″ o.c., unless otherwise indicated.
3. Attached to metal supports applied to 1″ × 2″ wood furring.
4. Laid directly on laboratory floor.
5. Nailed to 1″ × 3″ wood furring 24″ o.c. and filled in between furring with 1″ mineral wool, .35 lbs./sq. ft.
6. Laid on 24 ga. sheet iron, nailed to 1″ × 2″ wood furring 24″ c.c.
7. Attached to special metal supports mounted on 2″ × 2″ wood furring.
8. Nailed to 2″ × 2″ wood furring 18″ or 20″ c.c. 2″ mineral wool between furring.

Material, trade name	†Thickness	Types		‡Mfgr. of product	Coefficients			*Noise red. coef.	Surface
		Material	Mounting		128	512	2048		
Absorbatone A	1″	7	2	L-S	.15	.82	.87	.75	Unpainted
Absorbatone A	1″	7	2	L-S	.11	.80	.80	.70	Painted by mfgr.
Absorbatone A	1″	7	5	L-S	.25	.99	.85	.85	Painted by mfgr.
Absorbex Type A	1″	7	1	C.C.	.13	.70	.79	.70	Painted by mfgr.
Absorbex Type A	1″	7	2 (18″ o.c.)	C.C.	.17	.85	.84	.75	Painted by mfgr.
Absorbex Type A	1″	7	8 (18″ o.c.)	C.C.	.41	.96	.85	.85	Painted by mfgr.
Absorbex Type F	1″	7	1	C.C.	.15	.59	.61	.60	Painted by mfgr.
Absorbex Type F	2″	7	1	C.C.	.20	.99	.90	.75	Painted by mfgr.

TABLE II.—SPECIAL ACOUSTICAL MATERIALS (Continued)

Material, trade name	†Thickness	Types		‡Mfgr. of product	Coefficients			*Noise red. coef.	Surface
		Material	Mounting		128	512	2048		
Acousteel-B, pad plus metal facing and supports plus furring	$1\frac{1}{4}''$ $1\frac{5}{8}''$ $2\frac{1}{2}''$	4	3	C.C.	.29	.98	.85	.85	Perforated enameled metal .068″ diameter perforations, 4608 per sq. ft.
Acousteel-B, pad plus metal facing and supports plus furring	$1\frac{1}{4}''$ $1\frac{5}{8}''$ $2\frac{1}{2}''$	4	3	C.C.	.25	.71	.55	.65	50/50 Pattern, $\frac{1}{2}$ perforated enameled metal, backed with pads, same as above; $\frac{1}{2}$ enameled metal unperforated, without pads.
Acoustex 30R	$\frac{5}{8}''$	7	2	N.G.	.09	.45	.77	.55	Painted by mfgr.
Acoustex 30R backed by 1″ rock wool.	$\frac{5}{8}''$	7	2	N.G.	.17	.98	.85	.80	Painted by mfgr.
Acoustex 40R	$\frac{3}{4}''$	7	2	N.G.	.09	.59	.75	.60	Painted by mfgr.
Acoustex 50R	$\frac{7}{8}''$	7	2	N.G.	.09	.67	.78	.65	Painted by mfgr.
Acoustex 60R	1″	7	2	N.G.	.14	.81	.83	.70	Painted by mfgr.
Acousti-Celotex, Type C-1	$\frac{1}{2}''$	5	1	C.C.	.07	.57	.64	.50	Painted by mfgr. Perforated 441 holes per sq. ft. $\frac{3}{16}''$ diameter, $\frac{3}{8}''$ deep.
Acousti-Celotex, Type C-2	$\frac{5}{8}''$	5	1	C.C.	.16	.67	.69	.60	Painted by mfgr. Perforated same as above. $\frac{1}{2}''$ deep.
Acousti-Celotex, Type C-3	$1\frac{3}{16}''$	5	1	C.C.	.15	.82	.63	.65	Same as above $1\frac{1}{8}''$ deep.
Acousti-Celotex, Type C-3	$1\frac{3}{16}''$	5	2	C.C.	.22	.76	.66	.70	Same as above.
Acousti-Celotex, Type C-3	$1\frac{3}{16}''$	5	7	C.C.	.22	.76	.60	.70	Same as above.
Acousti-Celotex, Type C-4	$1\frac{1}{4}''$	5	1	C.C.	.13	.99	.60	.70	Painted by mfgr. Perforated same as above, $1\frac{1}{8}''$ deep.
Acousti-Celotex, Type C-5	$1\frac{3}{16}''$	5	1	C.C.	.12	.78	.83	.70	Painted by mfgr. Perforated 441 holes per sq. ft. $\frac{1}{4}''$ diameter, $1\frac{1}{8}''$ deep.
Acousti-Celotex, Type C-6	$1\frac{1}{4}''$	5	2	C.C.	.30	.94	.69	.80	Painted by mfgr. Perforated same as above, $1\frac{1}{8}''$ deep.

TABLE II.—SPECIAL ACOUSTICAL MATERIALS (Continued)

Material, trade name	†Thickness	Types		‡Mfgr. of product	Coefficients			*Noise red. coef.	Surface
		Material	Mounting		128	512	2048		
Acousti-Celotex, Type C-8	1″	5	2	C.C.	.31	.58	.73	.65	Painted by mfgr. Perforated 441 holes per sq. ft. 3/16″ diameter, 7/8″ deep.
Acousti-Celotex, Type M-1	5/8″	5	1	C.C.	.10	.55	.89	.60	Painted by mfgr. Perforated 676 holes per sq. ft. 5/32″ diameter, 1/2″ deep.
Acousti-Celotex, Type M-2	1″	5	1	C.C.	.12	.82	.80	.70	Painted by mfgr. Perforated same as above, 7/8″ deep.
Acoustimetal, Type P pad plus metal facing and pad supports plus furring	1 1/4″ 1 5/8″ 2 1/2″	4	3	N.G.	.23	.99	.78	.85	Perforated enameled metal .068″ diameter perforations, 4608 per sq. ft.
Acoustone D	9/16″	6	1	USG	.06	.61	.82	.60	Unpainted
Acoustone D	11/16″	6	1	USG	.08	.73	.81	.65	Unpainted
Acoustone D	11/16″	6	1	USG	.13	.79	.76	.65	Painted by mfgr.
Acoustone D	13/16″	6	1	USG	.15	.79	.85	.70	Unpainted
Acoustone D	15/16″	6	1	USG	.20	.84	.85	.75	Unpainted
Acoustone F	9/16″	6	1	USG	.11	.44	.90	.60	Unpainted
Acoustone F	11/16″	6	1	USG	.14	.65	.85	.65	Unpainted
Acoustone F	13/16″	6	1	USG	.14	.81	.85	.70	Unpainted
Acoustone F	15/16″	6	1	USG	.16	.87	.83	.75	Unpainted
Airacoustic	1/2″	8	6	J-M	.22	.48	.86	.60	Unpainted
Airacoustic	1 1/2″	8	6	J-M	.50	.67	.86	.70	Unpainted
Calicel, Standard	3/4″	2	1	C C.	.12	.47	.78	.60	Painted by mfgr.
Calicel, Standard	1″	2	1	C C.	.11	.66	.74	.65	Painted by mfgr.
Calistone, SW	1″	1	4	C.C.	.08	.40	.66	.50	Unpainted
Corkoustic B5	1 1/2″	6	1	A.C.	.06	.73	.56	.55	Painted by mfgr.
Corkoustic B5	1 1/2″	6	2	A.C.	.18	.70	.58	.55	Painted by mfgr.
Corkhoustic B6	1 3/4″	6	1	A.C.	.15	.82	.58	.55	Painted by mfgr.
Corkoustic B6	1 3/4″	6	2	A.C.	.22	.61	.51	.55	Painted by mfgr.
Cushiontone A1	1/2″	5	1	A.C.	.05	.58	.71	.55	Painted by mfgr. Perforated 484 holes per sq. ft. 3/16″ diam. 3/8″ deep

TABLE II.—SPECIAL ACOUSTICAL MATERIALS (Continued)

Material, trade name	†Thickness	Types		‡Mfgr. of product	Coefficients			*Noise red. coef.	Surface
		Material	Mounting		128	512	2048		
Cushiontone A2	⅝″	5	1	A C.	.13	.59	.73	.60	Same as above, ½″ deep
Cushiontone A2	⅝″	5	2	A C.	.11	.53	.70	.60	Same as above.
Cushiontone A3	⅞″	5	1	A C.	.13	.75	.81	.70	Same as above, ¾″ deep.
Econacoustic	½″	8	1	N G.	.05	.54	.76	.60	Painted by mfgr.
Econacoustic	½″	8	2	N G.	.09	.73	.78	.65	Painted by mfgr.
Econacoustic	1″	8	1	N.G.	.25	.78	.79	.70	Painted by mfgr.
Fiberglas Acoustical Tile Type TW-PF 9D	½″	..	2	O-C	.08	.67	.71	.65	Painted by mfgr.
Fiberglas Acoustical Tile Type TW-PF 9D	1″	..	2	O-C.	.22	.97	.68	.75	Painted by mfgr.
Fibracoustic	1″	8	1	J-M.	.17	.79	.79	.75	Painted by mfgr.
Fibracoustic	1″	8	2	J-M	.18	.82	.85	.80	Painted by mfgr.
Fibretex	⅝″	7	2	J-M	.09	.45	.77	.55	Painted by mfgr.
Fibretex	1″	7	2	J-M	.14	.81	.83	.70	Painted by mfgr.
Kencoustic	1½″	6	1	DEK	.05	.61	.56	.50	Painted by mfgr.
Koustex	1″	7	1	DEK	.10	.64	.77	.65	Unpainted
Koustex	1″	7	2	DEK	.15	.75	.80	.70	Painted by mfgr.
Macoustic Plaster, Type 55V Trowel finish	½″	..	..	NG	.32	.53	.68	.55	Finished with steel trowel
Muffletone (Std.)	¾″	2	1	C.C.	.17	.63	.74	.60	Unpainted
Muffletone (Std.)	1″	2	1	C.C.	.18	.72	.79	.70	Painted by mfgr.
Perfatone, pad plus metal facing and pad supports plus furring	1¼″ 1⅝″ 2½″	4	3	USG	.23	.98	.87	.85	Perforated enameled metal, 4608 holes per sq. ft., .073″ diameter
Permacoustic	¾″	6	1	J-M	.19	.74	.75	.65	Unpainted
Permacoustic	1″	6	1	J-M	.23	.71	.70	.65	Painted by mfgr.
Q-T Ductliner	½″	8	6	C.C.	.14	.43	.75	.60	Unpainted
Q-T Ductliner	1″	8	6	C.C.	.29	.78	.88	.75	Unpainted
Reverbolite Acoustical Plaster brush finish	½″	..	..	C.C.	.29	.40	.54	.45	Stippled with rice brush

TABLE II.—SPECIAL ACOUSTICAL MATERIALS (Continued)

Material, trade name	†Thickness	Types		‡Mfgr. of product	Coefficients			*Noise red. coef.	Surface
		Material	Mounting		128	512	2048		
Reverbolite Acoustical Plaster trowel finish	$\frac{1}{2}$"	..	..	C.C.	.26	.47	.65	.50	Finished with steel trowel.
Sabinite Acoustical Plaster	$\frac{1}{2}$"	..	..	USG	.26	.32	.73	.50	Floated with cork float.
Sanacoustic, pad plus metal facing and pad supports plus furring	$1\frac{1}{8}$" $1\frac{9}{16}$" $2\frac{1}{2}$"	4	3	J-M	.25	.99	.91	.85	Perforated enameled metal .068" diam. perforations, 4608 per sq. ft.
Sanacoustic, pad plus metal facing and pad supports plus furring	$1\frac{1}{8}$" $1\frac{9}{16}$" $2\frac{1}{2}$"	4	3	J-M	.22	.63	.52	.65	50/50 pattern, $\frac{1}{2}$ perforated enameled metal backed with pad, .068" diam., 4608 holes/sq. ft.; $\frac{1}{2}$ enameled metal unperforated, unbacked.
Sound Isolation Blanket MK	$\frac{1}{2}$"	..	4	J-M	.05	.48	.86	.55	Muslin covered, unpainted.
Sound Isolation Blanket MK	1"	..	4	J-M	.15	.89	.89	.80	Muslin covered, unpainted.
Sound Isolation Blanket MK	2"	..	4	J-M	.43	.97	.87	.85	Muslin covered, unpainted.
Transite Acoustical Unit, Pad. plus Transite facing	1" $1\frac{1}{8}$"	4	2	J-M	.28	.83	.76	.75	Painted by mfgr. 576 holes per sq. ft., $\frac{5}{32}$" diameter.
Travacoustic	1"	6	1	NG	.14	.80	.85	.75	Unpainted

* The noise reduction coefficient is the average of the coefficients at frequencies from 256 to 2048 cycles inclusive, given to the nearest 5 %. This average coefficient is recommended for use in comparing materials for noise quieting purposes as in offices, hospitals, banks, corridors, etc.

For auditorium treatment, attention should be directed to the coefficients at 512 cycles and other frequencies as explained elsewhere.

† Unless otherwise noted, the thickness given is the thickness of the sound-absorbing element forming the face of the construction. The thickness of other sound-absorbing elements in the construction, if used, is indicated by the type of mounting.

‡ Key to Manufacturer of Product

A.C.—Armstrong Cork Company
C.C.—The Celotex Corporation
DEK—David E. Kennedy, Inc.
J-M—Johns-Manville Sales Corp.
L-S—Luse-Stevenson Co.
N.G.—National Gypsum Co.
O-C—Owens-Corning Fiberglas Corp.
USG—United States Gypsum Company

SPARK-GAP VOLTAGES

Based on results of the American Institute of Electric Engineers
Air at 760 mm, 25° C.

Peak voltage, kilovolts	Diameter of spherical electrodes, cm				Needle points
	2.5	5	10	25	
	Length of spark gap cm				
5	0.13	0.15	0.15	0.16	0.42
10	0.27	0.29	0.30	0.32	0.85
15	0.42	0.44	0.46	0.48	1.30
20	0.58	0.60	0.62	0.64	1.75
25	0.76	0.77	0.78	0.81	2.20
30	0.95	0.94	0.95	0.98	2.69
35	1.17	1.12	1.12	1.15	3.20
40	1.41	1.30	1.29	1.32	3.81
45	1.68	1.50	1.47	1.49	4.49
50	2.00	1.71	1.65	1.66	5.20
60	2.82	2.17	2.02	2.01	6.81
70	4.05	2.68	2.42	2.37	8.81
80	......	3.26	2.84	2.74	11.1
90	......	3.94	3.28	3.11	13.3
100	......	4.77	3.75	3.49	15.5
110	......	5.79	4.25	3.88	17.7
120	......	7.07	4.78	4.28	19.8
130	......	......	5.35	4.69	22.0
140	......	......	5.97	5.10	24.1
150	......	......	6.64	5.52	26.1
160	......	......	7.37	5.95	28.1
170	......	......	8.16	6.39	30.1
180	......	......	9.03	6.84	32.0
190	......	......	10.0	7.30	33.9
200	......	......	11.1	7.76	35.7
210	......	......	12.3	8.24	37.6
220	......	......	13.7	8.73	39.5
230	......	......	15.3	9.24	41.4
240	......	......	......	9.76	43.3
250	......	......	......	10.3	45.2
300	......	......	......	13.3	54.7

CORRECTIONS FOR TEMPERATURE AND PRESSURE

Values found in the above table may be corrected for temperature and pressure by multiplying the values given by the appropriate correction factor found below:

Temp. ° C.	Pressure mm			
	720	740	760	780
0	1.04	1.06	1.09	1.12
10	1.00	1.02	1.05	1.08
20	0.96	0.99	1.02	1.04
30	0.93	0.96	0.98	1.01

DIELECTRIC CONSTANTS

Dielectric Constants of Pure Liquids

The values listed in the following table were obtained from National Bureau of Standards Circular 514.

The dielectric constants are intended to be the limiting values at low frequencies, the so-called static values. Temperature is the only variable considered explicitly. Usually pressure is atmospheric or insignificantly different with respect to its effect on the dielectric constant. Where data are listed above the normal boiling point, the pressure corresponds to the vapor pressure of the liquid unless otherwise noted in the footnote.

Symbols

ϵ = dielectric constant ($\epsilon_{\text{vacuum}=1}$)
t = temperature, Centigrade (°C)
T = temperature, Absolute (°K)
$a = -d\epsilon/dt$
$\alpha = -d \log_{10} \epsilon/dt$
t_1, t_2 = the limits of temperature between which a or α is considered applicable
mp = melting point
bp = boiling point
f = frequency of alternating current in cycles per second

STANDARD LIQUIDS

		$\epsilon_{20°C}$	$\epsilon_{25°C}$	a (or α)*
C_6H_{12}	Cyclohexane	2.023	2.015	0.0016
CCl_4	Carbon tetrachloride	2.238	2.228	.0020
C_6H_6	Benzene	2.284	2.274	.0020
C_6H_5Cl	Chlorobenzene	5.708	5.621	.00133(α)
$C_2H_4Cl_2$	1,2-Dichloroethane	10.65	10.36	.00240(α)
CH_4O	Methanol	33.62	32.63	.00260(α)
$C_6H_5NO_2$	Nitrobenzene	35.74	34.82	.00225(α)
H_2O	Water	80.37	78.54	.00200(α)
H_2	Hydrogen	1.228 at 20.4°K		.0034
O_2	Oxygen	1.507 at 80.0°K		.0024

* The values of a or α given in this table are derived from data in the vicinity of room temperature and are not necessarily identical with the values listed in the following sections of this table. They may be used to calculate values of dielectric constant between 15° and 30°C without introducing significant error.

INORGANIC LIQUIDS

Substance		ϵ	t°C	a (or α) $\times 10^2$	Range t_1, t_2
A	Argon	1.53_8	−191	0.34	−191, −184
$AlBr_3$	Aluminum bromide	3.38	100	0.33	100,240
AsH_3	Arsine	2.50	−100	0.43	−116, −72
BBr_3	Boron bromide	2.58	0	0.28	−70,80
Br_2	Bromine	3.09	20	0.7	0,50
CO_2	Carbon dioxide	1.60[c]	20	....	....
Cl_2	Chlorine	2.10_1	−50	0.31	−65, −33
		1.91	14	0.32	−22,14
		1.7_3	77		
		1.5_4	142		
D_2	Deuterium	1.277	20°K	0.4	18.8,21.2°K
D_2O	Deuterium oxide	78.25	25	(d)	0.4,98

[c] At pressure of 50 atmospheres.

[d] $\epsilon = 78.25[1 - 4.617(10^{-3})(t-25) + 1.22(10^{-5})(t-25)^2 - 2.7(10^{-8})(t-25)^3]$; av. dev. ±0.04%.

Dielectric Constants of Pure Liquids (Continued)

INORGANIC LIQUIDS (Continued)

Substance		ϵ	t°C	a (or α) $\times 10^2$	Range t_1, t_2
F_2	Fluorine	1.54	−202	0.19	−216, −190
$GeCl_4$	Germanium tetrachloride	2.43_0	25	0.240	0,55
HBr	Hydrogen bromide	7.00	−85	0.26(α)	−85, −70
HCl	Hydrogen chloride	6.35	−15	0.288(α)	−85, −15
		12.	−113	....	....
		4.6	28	....	....
HF	Hydrogen fluoride	17_5.	−73	....	....
		13_4.	−42		
		11_1.	−27		
		84.	0		
HI	Hydrogen iodide	3.39	−50	0.8	−51, −37
H_2	Hydrogen	1.228	20.4°K	0.34	14,21°K
H_2O	Water	78.54	25	(e)	0,100
		34.5_9	200	(y)	100,370
H_2O_2	Hydrogen peroxide	84.2	0	(z)	−30,20
H_2S	Hydrogen sulfide	9.26	−85.5	....	....
		9.05	−78.5	....	....
He	Helium	1.055_5	2.06°K	....	....
		1.055_9	2.30[f]		
		1.055_3	2.63		
		1.053_9	3.09		
		1.051_8	3.58		
		1.048	4.19		
I_2	Iodine	$11._1$	118	....	....
		$11._7$	140		
		$13._0$	168		
NH_3	Ammonia	25.	−77.7	....	....
		22.4	−33.4	....	....
		18.9	5	....	....
		17.8	15		
		16.9	25		
		16.3	35		
NOBr	Nitrosyl bromide	$13._4$	15	....	....
NOCl	Nitrosyl chloride	$18._2$	12	....	....
N_2	Nitrogen	1.454	−203	0.29	−210, −195
N_2H_4	Hydrazine	$52._9$	20	0.21(α)	0,25
N_2O	Dinitrogen oxide	1.97	−90	....	....
		1.61	0	0.6	−6,14
N_2O_4	Dinitrogen tetroxide	2.5_6[b]	15	....	....
O_2	Oxygen	1.507	−193	0.24	−218, −183
P	Phosphorus	4.10	34	....	....
		4.06	46		
		3.86	85		
PCl_3	Phosphorus trichloride	3.43	25	0.84	17,60
PCl_5	Phosphorus pentachloride	2.8_5	160	....	....
$POCl_3$	Phosphoryl chloride	$13._3$	22	....	....
$PSCl_3$	Thiophosphoryl chloride	5.8	22	....	....
$PbCl_4$	Lead tetrachloride	2.78	20	....	....
S	Sulfur	3.52	118	(g)	....
		3.48	231		
$SOBr_2$	Thionyl bromide	9.06	20	3.0	at 20

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[b] $f = 3.6 \times 10^8$ cycles/sec.

[e] $\epsilon = 78.54[1 - 4.579(10^{-3})(t - 25) + 1.19(10^{-5})(t - 25)^2 - 2.8(10^{-8})(t - 25)^3]$; av. dev. ±0.03%.

[f] Liquid transition and discontinuity in variation of dielectric constant with temperature at 2.295°K.

[g] Graphical data in the range 118°–350°C show a minimum near 160° and a broad maximum near 200°.

[y] $\epsilon = 5321/T + 233.76 - 0.9297T + 0.001417T^2 - 0.0000008292T^3$.

[z] $\epsilon = 84.2 - 0.62t + 0.0032t^2$.

Dielectric Constants of Pure Liquids (Continued)

INORGANIC LIQUIDS (Continued)

Substance		ϵ	t°C	a (or α) $\times 10^2$	Range t_1,t_2
$SOCl_2$	Thionyl chloride	9.25	20	3.9	at 20
SO_2	Sulfur dioxide	17.6	−20	0.287(α)	−65,−15
		15.0_8	0	....	....
		$14._1$	20	7.7	14,140
		2.1_0	154[h]		
SO_3	Sulfur trioxide	3.11	18	....	....
S_2Cl_2	Sulfur monochloride	4.79	15	0.146(α)	−41,15
SO_2Cl_2	Sulfuryl chloride	$10._0$	22	....	....
$SbCl_5$	Antimony pentachloride	3.22	20	0.46	2,47
Se	Selenium	5.40	250	0.25	237,301
$SiCl_4$	Silicon tetrachloride	2.4_0	16	....	....
$SnCl_4$	Tin tetrachloride	2.87	20	0.30	−30,20
$TiCl_4$	Titanium tetrachloride	2.80	20	0.20	−20,20

ORGANIC LIQUIDS

	C_1				
CCl_4	Carbon tetrachloride	2.238	20	0.200	−10,60
CN_4O_8	Tetranitromethane	2.52_1	25	....	....
CO_2	Carbon dioxide	1.60_4[c]	0	....	....
CS_2	Carbon disulfide	2.641	20	0.268	−90,130
		3.001	−110		
		2.19	180		
$CHBr_3$	Bromoform	4.39	20	0.105(α)	10,70
$CHCl_3$	Chloroform	4.806	20	0.160(α)	0,50
		6.76	−60	....	....
		6.12	−40		
		5.61	−20		
		3.7_1	100	....	....
		3.3_3	140		
		2.9_8	180		
CHN	Hydrocyanic acid	$158._1$	0	([i])	−13,18
		$114._9$	20	0.63(α)	18,26
CH_2Br_2	Dibromomethane	7.77	10	....	....
		6.68	40		
CH_2Cl_2	Dichloromethane	9.08	20	([j])	−80,25
CH_2I_2	Diiodomethane	5.32	25	....	....
CH_2O_2	Formic acid	$58._5$[a]	16	....	....
CH_3Br	Bromomethane	9.82	0	([k])	−80,0
CH_3Cl	Chloromethane	12.6	−20	([l])	−70,−20
CH_3I	Iodomethane	7.00	20	([m])	−70,40
CH_3NO	Formamide	109.	20	72.	18,25
CH_4	Methane	1.70	−173	0.2	−181,−159
CH_4O	Methanol	32.63	25	0.264(α)	5,55
		64.	−113	....	....
		54.	−80		
		40.	−20		

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[a] $f = 4 \times 10^8$ cycles/sec.
[c] At pressure of 50 atmospheres.
[h] Critical temperature.
[i] $\log_{10} \epsilon = 2.199 - 0.0079t + 0.00005t^2$.
[j] $\epsilon = (3320/T) - 2.24$.
[k] $\epsilon = (3320/T) - 2.34$.
[l] $\epsilon = 12.6 - 0.061(t + 20) + 0.0005(t + 20)^2$.
[m] $\epsilon = (2160/T) - 0.39$.

Dielectric Constants of Pure Liquids (Continued)

Organic Liquids (Continued)

	Substance	ϵ	t°C	a (or α) $\times 10^2$	Range t_1,t_2
CH_5N	Methylamine	11.4	−10	0.26(α)	−30,−10
		9.4	25	....	....
	C_2				
C_2HCl_3	Trichloroethylene	3.4_2	ca 16	....	....
C_2HCl_3O	Chloral	4.9_4	20	0.17(α)	15,45
		7.6	−40		
		4.2	62		
$C_2HCl_3O_2$	Trichloroacetic acid	4.6	60	....	....
$C_2H_2Br_2$	*cis*-1,2-Dibromoethylene	7.7_2	0	....	....
		7.0_8	25		
	trans-1,2-Dibromoethylene	2.9_7	0	....	....
		2.8_8	25		
$C_2H_2Br_4$	1,1,2,2-Tetrabromoethane	8.6	3	....	....
		7.0	22		
$C_2H_2Cl_2$	1,1-Dichloroethylene	4.6_7	16	....	....
	cis-1,2-Dichloroethylene	9.20	25	....	....
	trans-1,2-Dichloroethylene	2.14	25	....	....
$C_2H_2Cl_2O_2$	Dichloroacetic acid	8.2	22	....	....
		7.8	61		
C_2H_3ClO	Acetyl chloride	$16._9$	2	....	....
		$15._8$	22		
$C_2H_3ClO_2$	Chloroacetic acid	12.3	60	2.	60,80
C_2H_4O	Ethylene oxide	$13._9$	−1	....	....
	Acetaldehyde	$21._8$[a]	10	....	....
$C_2H_4O_2$	Acetic acid	6.15	20	....	....
		6.29	40		
		6.62	70		
	Methyl formate	8.5	20	5.	0,20
C_2H_5ClO	2-Chloroethanol (Ethylene chlorohydrin)	$25._8$	25	....	....
		$13._2$	132		
C_2H_5NO	Acetamide	59.[a]	83	....	....
$C_2H_5NO_2$	Nitroethane	28.0_6	30	11.4	30,35
C_2H_6O	Ethanol	24.30	25	....	....
		24.3[z]	25	0.270(α)	−5,70
		41.0[z]	−60	0.297(α)	−110,−20
	Methyl ether	5.02	25	2.38	25,100
		2.97	110		
		2.64	120		
		2.37	125		
		2.26	126.1		
		1.90	127.6[p]		
$(C_2H_6OSi)_n$					
$n = 4$	Octamethykcyclotetrasiloxane	2.39	20	....	....
$n = 5$	Decamethylcyclopentasiloxane	2.50	20	....	....
$n = 6$	Dodecamethylcyclohexasiloxane	2.59	20	....	....
$n = 7$	Tetradecamethylcycloheptasiloxane	2.68	20	....	....
$n = 8$	Hexadecamethylcyclooctasiloxane	2.74	20	....	....
$C_2H_6O_2$	Glycol	$37._7$	25	0.224(α)	20,100
C_2H_7N	Dimethylamine	6.32	0	....	....
		5.26	25		

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[a] $f = 4 \times 10^8$ cycles/sec.

[p] Critical temperature = 126.9°C.

[z] Value chosen to conform with the remainder of the tabulated data for this substance.

Dielectric Constants of Pure Liquids (Continued)

ORGANIC LIQUIDS (Continued)

	Substance	ε	t°C	a (or α) × 10^2	Range t_1,t_2
	C_3				
C_3H_6	Propene	1.87_5	20	....	....
		1.79_5	45		
		1.69_0	65		
		1.53_0	85		
		1.44_1	90		
		1.33_1	91.9[h]		
C_3H_6O	2-Propen-1-ol (Allyl alcohol)	$21._6$	15	....	....
	Acetone	20.7_0	25	0.205(α)	−60,40
		17.7	56	....	....
	Propionaldehyde	$18._5$[a]	17	....	....
$C_3H_6O_2$	Propionic acid	3.30	10	....	....
		3.44	40		
	Ethyl formate	7.1_6	25	....	....
	Methyl acetate	6.68	25	2.2	25,40
$C_3H_6O_3$	*dl*-Lactic acid	22.	17	....	....
$C_3H_7NO_2$	Ethyl carbamate (Urethan)	14.2	50	5.2	50,70
C_3H_8	Propane	1.61	0	0.20	−90,15
C_3H_8O	1-Propanol	20.1	25	0.293(α)	20,90
		38.	−80	....	....
		29.	−34		
	2-Propanol	18.3	25	0.310(α)	20,70
$C_3H_8O_2$	1,2-Propanediol	$32._0$	20	0.27(α)	at 20
	1,3-Propanediol	$35._0$	20	0.23(α)	at 20
$C_3H_8O_3$	Glycerol	42.5	25	0.208(α)	0,100
C_3H_9N	Isopropylamine	5.5[b]	20	....	....
	Trimethylamine	2.44	25	0.52	0,25
	C_4				
$C_4H_2O_3$	Maleic anhydride	50.[a]	60	....	....
C_4H_4O	Furan	2.95	25	....	....
C_4H_4S	Thiophene	2.76	16	....	....
C_4H_5N	Pyrrole	7.48	18	....	....
C_4H_5NS	Allyl isothiocyanate	$17._2$[b]	18	....	....
C_4H_6O	Vinyl ether	3.94	20	....	....
$C_4H_6O_3$	Acetic anhydride	$22._4$	1	....	....
		$20._7$	19		
C_4H_8O	2-Butanone	18.5_1	20	0.207(α)	−60,60
	Butyraldehyde	13.4	26	....	....
		10.8	77		
$C_4H_8O_2$	Butyric acid	2.97	20	−0.23	10,70
	Isobutyric acid	2.71	10	....	....
		2.73	40		
	Propyl formate	7.7_2[a]	19	....	....
	Ethyl acetate	6.02	25	1.5	at 25
		5.3_0	77	....	....
	Methyl propionate	5.5[n]	19	....	....
	1,4-Dioxane	2.209	25	0.170	20,50
C_4H_9NO	Morpholine	7.33	25	....	....
$C_4H_{10}O$	1-Butanol	17.8	20	0.300(α)	−40,20
		17.1	25	0.335(α)	25,70
		8.2	118	....	....

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[a] $f = 4 \times 10^8$ cycles/sec.

[b] $f = 3.6 \times 10^8$ cycles/sec.

[h] Critical temperature.

[n] $f = 5 \times 10^8$ cycles/sec.

Dielectric Constants of Pure Liquids (Continued)

Organic Liquids (Continued)

Substance		ϵ	t°C	a (or α) $\times 10^2$	Range t_1, t_2
$C_4H_{10}O$ (Cont.)	2-Methyl-1-propanol	17.7	25	0.377(α)	20,90
		34.	−80	....	....
		26.	−34		
	2-Butanol	15.8	25	....	....
	2-Methyl-2-propanol	10.9	30	....	....
		8.49	50		
		6.89	70		
	Ethyl ether	4.335	20	2.0	at 20
		4.34^z	20	0.217(α)	−40,30
		10.4	−116	....	....
		3.97	40	0.170(α)	40,140
		2.1_2	180		
		1.8_9	190		
		1.5_3	193.3^h		
$C_4H_{10}Zn$	Diethyl zinc	2.5_5	20	....	....
	C_5				
$C_5H_4O_2$	Furfural	$46._9$	1	....	....
		$41._9$	20		
		$34._9$	50		
C_5H_5N	Pyridine	12.3	25	....	....
		9.4	116	....	....
C_5H_8	1,3-Pentadiene[t]	2.32	25	....	....
	2-Methyl-1,3-butadiene (Isoprene)	2.10	25	0.24	−75,25
$C_5H_8O_2$	2,4-Pentanedione (Acetylacetone)	$25._7{}^a$	20	....	....
C_5H_{10}	1-Pentene	2.100	20	....	....
	2-Methyl-1-butene	2.197	20	....	....
	Cyclopentane	1.965	20	....	....
	Ethylcyclopropane	1.933	20	....	....
$C_5H_{10}O$	2-Pentanone	15.4_5	20	0.195(α)	−40,80
		22.0	−60		
	3-Pentanone	17.0_0	20	0.225(α)	0,80
		19.4	−20		
		19.8	−40		
$C_5H_{10}O_2$	Valeric acid	2.6_8	20	....	....
	Isovaleric acid	2.6_4	20	....	....
	Methyl butyrate	5.6^n	20	....	....
$C_5H_{11}N$	Piperidine	5.8^b	22	....	....
C_5H_{12}	*n*-Pentane	1.844	20	0.160	−50,30
		2.011	−90		
		1.984	−70		
	2-Methylbutane	1.843	20	....	....
$C_5H_{12}O$	1-Pentanol	13.9	25	0.23(α)	15,35
	3-Methyl-1-butanol	14.7	25	....	....
		5.8_2	132		
	2-Methyl-2-butanol	5.82	25	....	....
	C_6				
$C_6H_4Cl_2$	*o*-Dichlorobenzene	9.93	25	0.194(α)	0,50
	m-Dichlorobenzene	5.04	25	0.120(α)	0,50
	p-Dichlorobenzene	2.41	50	0.18	50,80
C_6H_5Br	Bromobenzene	5.40	25	0.115(α)	0,70

[a] $f = 4 \times 10^8$ cycles/sec.

[b] $f = 3.6 \times 10^8$ cycles/sec.

[h] Critical temperature.

[n] $f = 5 \times 10^8$ cycles/sec.

[t] Mixture of *cis-trans* isomers.

[z] Value chosen to conform with the remainder of the tabulated data for this substance.

Dielectric Constants of Pure Liquids (Continued)

ORGANIC LIQUIDS (Continued)

Substance		ε	t°C	a (or α) × 10²	Range t_1,t_2
C_6H_5Cl	Chlorobenzene	5.708	20	....	....
		5.621	25		
		5.71	20	0.130(α)	0,80
		7.28	−50		
		6.30	−20		
		4.21	130		
C_6H_5ClO	*o*-Chlorophenol	6.31	25	2.7	25,58
	p-Chlorophenol	9.47	55	3.7	55,65
C_6H_5I	Iodobenzene	4.63	20	....	....
$C_6H_5NO_2$	Nitrobenzene	34.82	25	0.225(α)	10,80
		20.8	130	0.164(α)	130,211
		24.9	90		
		22.7	110		
$C_6H_5NO_3$	*o*-Nitrophenol	$17._3$	50	6.4	50,60
C_6H_6	Benzene	2.284	20	0.200	10,60
		2.073	129	....	....
		1.966	182		
C_6H_6BrN	*m*-Bromoaniline	$13._0$[n]	19	....	....
C_6H_6ClN	*m*-Chloroaniline	$13._4$[n]	19	....	....
$C_6H_6N_2O_2$	*o*-Nitroaniline	$34._6$	90	3.	90,110
	p-Nitroaniline	$56._3$	160	6.	160,180
C_6H_6O	Phenol	9.78	60	0.32(α)	40,70
C_6H_7N	Aniline	6.89	20	0.148(α)	0,50
		5.93	70	....	....
		4.54	184.6	....	....
	2-Methylpyridine (α-Picoline)	9.8[b]	20	....	....
$C_6H_8N_2$	Phenylhydrazine	7.2	23	....	....
C_6H_{10}	Cyclohexene	2.220	25	....	....
		2.6_0	−105	....	....
$C_6H_{10}O$	Cyclohexanone	18.3	20	....	....
		$19._9$	−40	....	....
$C_6H_{10}O_3$	Ethyl acetoacetate	$15._7$[a]	22	....	....
C_6H_{12}	Cyclohexane	2.023	20	0.160	10,60
	Methylcyclopentane	1.985	20	....	....
	Ethylcyclobutane	1.965	20	....	....
$C_6H_{12}O$	Cyclohexanol	15.0	25	0.437(α)	20,66
		7.2_4	100		
		4.8_8	150		
$C_6H_{12}O_2$	Butyl acetate	5.01	20	1.4	20,40
		6.8_5	−73		
	Ethyl butyrate	5.10	18	1.0	at 20
$C_6H_{12}O_3$	Paraldehyde	13.9	25	....	....
		6.29	128		
C_6H_{14}	*n*-Hexane	1.890	20	0.155	−10,50
		2.044	−90		
		1.990	−50		
$C_6H_{14}O$	1-Hexanol	13.3	25	0.35(α)	15,35
		8.5_5	75		
	Propyl ether	3.3_9	26	....	....
	Isopropyl ether	3.88	25	1.8	0,25
$C_6H_{15}Al$	Triethyl aluminum	2.9	20	....	....
$C_6H_{15}N$	Dipropylamine	2.9[b]	21	....	....
	Triethylamine	2.42	25	....	....
$C_6H_{18}OSi_2$	$(CH_3)_3Si[OSi(CH_3)_2]_nCH_3$				
$n = 1$	Hexamethyldisiloxane	2.17	20	....	....
$n = 2$	Octamethyltrisiloxane	2.30	20	....	....

[a] $f = 4 \times 10^8$ cycles/sec.

[b] $f = 3.6 \times 10^8$ cycles/sec.

[n] $f = 5 \times 10^8$ cycles/sec.

Dielectric Constants of Pure Liquids (Continued)

Organic Liquids (Continued)

	Substance	ε	t°C	a (or α) × 10²	Range t_1,t_2
$C_6H_{18}OSi_2$ (Cont.)					
$n = 3$	Decamethyltetrasiloxane	2.39	20	....	....
$n = 4$	Dodecamethylpentasiloxane	2.46	20	....	....
$n = 5$	Tetradecamethylhexasiloxane	2.50	20	....	....
$n = 66$[w]		2.72	20	....	....
	C_7				
C_7H_5ClO	Benzoyl chloride	29.	0	....	....
		23.	20		
C_7H_5NO	Phenyl isocyanate	8.8[b]	20	....	....
C_7H_5NS	Phenyl isothiocyanate	$10._4$[a]	20	....	....
C_7H_6O	Benzaldehyde	$19._7$	0	....	....
		$17._8$	20		
$C_7H_6O_2$	Salicylaldehyde	$17._1$	30	7.	30,40
C_7H_7Br	*o*-Bromotoluene	4.28	58	....	....
	m-Bromotoluene	5.36	58	....	....
	p-Bromotoluene	5.49	58	....	....
C_7H_7Cl	*o*-Chlorotoluene	4.45	20	....	....
		4.16	58	....	....
	m-Chlorotoluene	5.55	20	....	....
		5.04	58	....	....
	p-Chlorotoluene	6.08	20	....	....
		5.55	58	....	....
	α-Chlorotoluene	7.0	13	....	....
$C_7H_7NO_2$	*o*-Nitrotoluene	27.4	20	15.	at 20
		$21._6$	58	....	....
		11.8	222	....	....
	m-Nitrotoluene	$23._8$	20	....	....
		$21._9$	58	....	....
	p-Nitrotoluene	$22._2$	58	....	....
C_7H_8	Toluene	2.438	0	0.0455(α)	−90,0
		2.379	25	0.243	0,90
		2.15_7	127		
		2.04_2	181		
C_7H_8O	Benzyl alcohol	13.1	20	....	....
		9.47	70	....	....
		6.6	132	....	....
	o-Cresol	11.5	25	11.	25,30
	m-Cresol	11.8	25	0.41(α)	15,50
	p-Cresol	9.9_1	58	....	....
C_7H_9N	*o*-Toluidine	6.34	18	....	....
		5.71	58	....	....
		4.00	200	....	....
	m-Toluidine	5.95	18	....	....
		5.45	58	....	....
	p-Toluidine	4.98	54	....	....
	N-Methylaniline	5.97	22	....	....
	1-Heptene	2.05	20	....	....
	C_8				
C_8H_8	Styrene (Phenylethylene)	2.43	25	....	....
		2.32	75		
	Acetophenone	17.39	25	4.	at 25
		8.64	202	....	....
$C_8H_8O_2$	Phenyl acetate	5.23	20	0.7	at 20
	Methyl benzoate	6.59	20	0.14(α)	20,50

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[a] $f = 4 \times 10^8$ cycles/sec.

[b] $f = 3.6 \times 10^8$ cycles/sec.

[w] Silicone oil of average molecular weight corresponding to this formula.

Dielectric Constants of Pure Liquids (Continued)

ORGANIC LIQUIDS (Continued)

	Substance	ε	t°C	a (or α) × 10^2	Range t_1,t_2
$C_8H_8O_3$	Methyl salicylate	9.41	30	3.1	30,40
C_8H_{10}	Ethylbenzene	2.412	20	....	....
	o-Xylene	2.568	20	0.266	−20,130
	m-Xylene	2.374	20	0.195	−40,180
	p-Xylene	2.270	20	0.160	20,130
C_8H_{18}	*n*-Octane	1.948	20	0.130	−50,50
		1.879	70		
		1.817	110		
	2,2,3-Trimethylpentane	1.96	20	....	....
	2,2,4-Trimethylpentane	1.940	20	0.142	−100,100
$C_8H_{18}O$	1-Octanol	10.3_4	20	0.410(α)	20,60
$C_8H_{20}O_4Si$	Tetraethyl silicate	4.1^b	ca 20	....	....
	C_9				
C_9H_7N	Quinoline	9.00	25	....	....
		5.05	238		
	Isoquinoline	10.7	25	....	....
C_9H_8O	Cinnamaldehyde	16.9	24	....	....
$C_9H_{10}O_2$	Benzyl acetate	5.1^n	21	....	....
	Ethyl benzoate	6.02	20	2.1	20,40
$C_9H_{10}O_3$	Ethyl salicylate	7.99	30	2.	30,40
C_9H_{12}	Isopropylbenzene (Cumene)	2.38_0	20	....	....
	1,3,5-Trimethylbenzene (Mesitylene)	2.27_9	20	....	....
C_9H_{20}	*n*-Nonane	1.972	20	0.135	−10,90
		2.059	−50		
		1.847	110		
		1.787	150		
	C_{10}				
$C_{10}H_8$	Naphthalene	2.54	85	....	....
$C_{10}H_{10}O_4$	Dimethyl phthalate	8.5	24	....	....
$C_{10}H_{16}$	*d*-Camphene	2.33	ca 40	....	....
	d-Pinene	2.64	25	....	....
	l-Pinene	2.76	20	....	....
	Terpinene	2.7^b	21	....	....
	d-Limonene	2.3_6	20	....	....
	dl-Limonene (Dipentene)	2.3_0	20	....	....
$C_{10}H_{22}$	*n*-Decane	1.991	20	0.130	10,110
		2.050	−30		
		1.844	130		
		1.783	170		
$C_{10}H_{22}O$	1-Decanol	8.1	20	....	....
$C_{11}H_{24}$	*n*-Undecane	2.005	20	0.125	10,130
		2.039	−10		
		1.838	150		
		1.781	190		
	C_{12}				
$C_{12}H_{10}$	Diphenyl	2.53	75	0.18	75,155
$C_{12}H_{10}O$	Phenyl ether	3.65	30	0.7	30,50
$C_{12}H_{11}N$	Diphenylamine	3.3	52	....	....
$C_{12}H_{26}$	*n*-Dodecane	2.014	20	0.120	10,150
		2.047	−10		
		1.776	210		
	C_{13}				
$C_{13}H_{10}O$	Benzophenone	11.4	50	....	....
	C_{14}				
$C_{14}H_{15}N$	Dibenzylamine	3.6^b	20	....	....

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[b] $f = 3.6 \times 10^8$ cycles/sec.
[n] $f = 5 \times 10^8$ cycles/sec.

Organic Liquids (Continued)

Substance		ϵ	t°C	a (or α) × 10^2	Range t_1,t_2
	C_{16}				
$C_{16}H_{32}O_2$	Palmitic acid	2.30	71	....	....
	C_{18}				
$C_{18}H_{32}O_2$	Linoleic acid	2.61	0	....	....
		2.71	20		
		2.70	70		
		2.60	120		
$C_{18}H_{34}O_2$	Oleic acid	2.46	20	....	....
		2.45	60		
		2.41	100		
$C_{18}H_{36}O_2$	Stearic acid	2.29	70	....	....
		2.26	100	....	....
	Ethyl palmitate	3.20	20	0.4	20,40
		2.71	104	....	....
		2.46	182		
	C_{19}				
$C_{19}H_{16}$	Triphenylmethane	2.45	100	0.14	94,175
$C_{19}H_{38}O_4$	Monopalmitin	5.34	67	....	....
		5.09	80		
	C_{20}				
$C_{20}H_{38}O_2$	Ethyl Oleate	3.17	28	0.48	28,122
$C_{20}H_{40}O_2$	Ethyl Stearate	2.98	40	0.6	32,50
		2.69	100		
		2.48	167		
	C_{21}				
$C_{21}H_{21}O_4P$	Tricresyl phosphate	6.9	40	....	....
	C_{22}				
$C_{22}H_{42}O_2$	Butyl oleate	4.0	25	....	....
$C_{22}H_{44}O_2$	Butyl stearate	3.11_1	30	0.53	30,35

DIELECTRIC CONSTANTS

Dielectric Constants of Solids

Compiled by Earle C. Gregg, Jr.

SOLIDS* (17 to 22°C)

Material	Frequency	Dielectric constant	Material	Frequency	Dielectric constant
Acetamide	4×10^{88}	4.0	Mercuric chloride	10^6	3.2
Acetanilide	....	2.9	Mercurous chloride	10^6	9.4
Acetic acid (2°C)	4×10^8	4.1	Naphthalene	4×10^8	2.52
Aluminum oleate	4×10^8	2.40	Phenanthrene	4×10^8	2.80
Ammonium bromide	10^6	7.1	Phenol (10°C)	4×10^8	4.3
Ammonium chloride	10^6	7.0	Phosphorus, red	10^8	4.1
Antimony trichloride	10^8	5.34	Phosphorus, yellow	10^8	3.6
Apatite ⊥ optic axis	3×10^8	9.50			
“ ∥ optic axis	3×10^8	7.41	Potassium aluminum sulfate	10^6	3.8
Asphalt	$<3 \times 10^6$	2.68			
Barium chloride (anhyd.)	6×10^7	11.4	Potassium carbonate (15°C)	10^8	5.6
“ “ ($2H_2O$)	6×10^7	9.4	Potassium chlorate	6×10^7	5.1
Barium nitrate	6×10^7	5.9	Potassium chloride	10^4	5.03
Barium sulfate (15°C)	10^8	11 4	Potassium chromate	6×10^7	7.3
Beryl ⊥ optic axis	10^4	7.02	Potassium iodide	6×10^7	5.6
“ ∥ optic axis	10^4	6.08	Potassium nitrate	6×10^7	5.0
Calcite ⊥ optic axis	10^4	8.5	Potassium sulfate	6×10^7	5.9
“ ∥ optic axis	10^4	8 0	Quartz ⊥ optic axis	3×10^7	4.34
Calcium carbonate	10^6	6.14	“ ∥ optic axis	3×10^7	4.27
Calcium fluoride	10^4	7.36	Resorcinol	4×10^8	3.2
Calcium sulfate ($2H_2O$)	10^4	5.66	Ruby ⊥ optic axis	10^4	13.27
Cassiterite ⊥ optic axis	10^{12}	23.4	“ ∥ optic axis	10^4	11.28
Cassiterite ∥ optic axis	10^{12}	24.	Rutile ⊥ optic axis	10^8	86
d-Cocaine	5×10^8	3.10	“ ∥ optic axis	10^8	170
Cupric oleate	4×10^8	2.80	Selenium	10^8	6.6
Cupric oxide (15°C)	10^8	18.1	Silver bromide	10^6	12.2
Cupric sulfate (anhyd.)	6×10^7	10.3	Silver chloride	10^6	11.2
Cupric sulfate ($5H_2O$)	6×10^7	7.8	Silver cyanide	10^6	5.6
Diamond	10^4	16.5	Smithsonite ⊥ optic axis	10^{12}	9.3
“	10^8	5.5	“ ∥ optic axis	10^{10}	9.4
Diphenylmethane	4×10^8	2.7	Sodium carbonate (anhyd.)	6×10^7	8.4
Dolomite ⊥ optic axis	10^8	8.0	Sodium carbonate ($10H_2O$)	6×10^7	5.3
“ ∥	10^8	6.8	Sodium chloride	10^4	6.12
Ferrous oxide (15°C)	10^8	14.2	Sodium nitrate	....	5.2
Iodine	10^8	4	Sodium oleate	4×10^8	2.75
Lead acetate	10^6	2.6	Sodium perchlorate	6×10^7	5.4
Lead carbonate (15°C)	10^8	18.6	Sucrose (mean)	3×10^8	3.32
Lead chloride	10^6	4.2	Sulfur (mean)	....	4.0
Lead monoxide (15°C)	10^8	25.9	Thallium chloride	10^6	46.9
Lead nitrate	6×10^7	37.7	*p*-Toluidine	4×10^8	3.0
Lead oleate	4×10^8	3.27	Tourmaline ⊥ optic axis	10^4	7.10
Lead sulfate	10^6	14.3	“ ∥ optic axis	10^4	6.3
Lead sulfide (15°)	16^6	17.9	Urea	4×10^8	3.5
Malachite (mean)	10^{12}	7.2	Zircon ⊥, ∥	10^8	12

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* For plastics and other insulating materials, refer to table on Properties of Dielectrics.

Table of Dielectric Constants of Reference Gases at 20°C and 1 Atmosphere

The listed values $(\epsilon - 1)$ refer to the gas at a temperature of 20°C and pressure of 1 atmosphere. The values can be adjusted to slightly different conditions without introducing more than 0.1% error by use of the following equation:

$$\frac{(\epsilon - 1)_{t,p}}{(\epsilon - 1)_{20°,1\,\mathrm{atm}}} = \frac{p}{760[1 + 0.003411(t - 20)]}$$

where p = pressure in mm Hg
t = degrees C

t should be between 10 and 30°C and p between 700 and 800 mm Hg. From National Bureau of Standards Circular 537.

Substance	$(\epsilon - 1) \cdot 10^6$	Reference
Helium	Radio frequency	
	67.8	Watson
	63.7	Hector
	64.5	Jelatis
	Microwave	
	65.6	Birnbaum
	65.2	Essen
	Optical	
	64.6	Koch
	64.5	Cuthbertson
Hydrogen	Radio frequency	
	254.$_0$	Watson
	Microwave	
	253.4	Essen
	Optical	
	254.1	Cuthbertson
	253.6	Koch
	253.7	Kirn
	254.3	Tausz
Oxygen	Radio frequency	
	494.$_3$	Watson
	496.2	Jelatis
	Microwave[a]	
	494.9	Birnbaum
	495.0	Essen
	494.9	Essen
	Optical	
	494.5	Cuthbertson
	493.5	Lowery
	494.7	Tausz
	494.4	Ladenberg
Argon	Radio frequency	
	513.$_0$	Watson
	516.4	Jelatis
	Microwave	
	517.7	Essen
	Optical	
	516.8	Cuthbertson
	517.8	Quarder
	517.0	Tausz
	516.7	Damköhler
Air (dry, CO_2 free)	Radio frequency	
	537.$_0$	Watson
	Microwave[a]	
	536.5	Birnbaum
	536.6	Essen
	536.6	Essen
	Optical	
	536.9	Koch
	535.8	Meggers
	536.0	Traub
	536.7	Quarder
	536.4	Lowery
	536.5	Tausz
	536.1	Koster
	536.3	Perard
	535.8	Barrell
Nitrogen	Radio frequency	
	547.$_2$	Watson
	Microwave	
	547.3	Birnbaum
	548.0	Essen
	548.0	Essen
	Optical	
	548.9	Cuthbertson
	548.7	Koch
	547.2	Tausz
Carbon dioxide	Radio frequency	
	921.$_5$	Watson
	Microwave	
	922.4	Birnbaum
	920.$_6$	Essen

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[a] These values were derived from measurements of the refractive index after making allowance for the magnetic permeability of oxygen.

DIELECTRIC CONSTANTS

Dielectric Constants of Gases at 760 MM Pressure

Compiled by Earle C. Gregg, Jr.

GASES AT 760 MM PRESSURE

Material	Temperature °C	Frequency cycles/sec.	Dielectric Constant
Acetaldehyde	20	$<3 \times 10^6$	1.0213
Acetone	100	$<3 \times 10^6$	1.0159
Acetyl chloride	20	$<3 \times 10^6$	1.0217
Acetylene	0	$<3 \times 10^6$	1.00134
Air	0	$<3 \times 10^6$	1.000590
Ammonia	0	$<10^6$	1.0072
β-Amylene	100	$<3 \times 10^6$	1.0028
Argon	0	$<10^6$	1.000545
Benzene	100	$<3 \times 10^6$	1.0028
Bromine	180	$<3 \times 10^6$	1.0128
Butylene	0	$<3 \times 10^6$	1.00319
Carbon dioxide	0	$<10^6$	1.000985
Carbon disulfide	0	$<3 \times 10^6$	1.0029
Carbon monoxide	0	$<3 \times 10^6$	1.00070
Carbon tetrachloride	110	$<3 \times 10^6$	1.0030
Chloroform	120	$<3 \times 10^6$	1.0042
Dichlorodifluoromethane	23	10^{10}	1.00029
Dichlorofluoromethane	23	10^{10}	1.00049
Dimethylamine	23	2.5×10^{10}	1.00040
Ethane	0	$<3 \times 10^6$	1.00150
Ethyl alcohol	100	$<3 \times 10^6$	1.0061
Ethylamine	23	10^{10}	1.00053
Ethyl bromide	20	$<3 \times 10^6$	1.0139
Ethyl chloride	20	$<3 \times 10^6$	1.0132
Ethyl ether	100	$<3 \times 10^6$	1.0049
Ethyl formate	100	$<3 \times 10^6$	1.0083
Ethyl iodide	20	$<3 \times 10^6$	1.0140
" "	100	$<3 \times 10^6$	1.0089
Ethylene	0	$<3 \times 10^6$	1.00144
Helium	0	$<3 \times 10^6$	1.0000684
n-Heptane	100	$<3 \times 10^6$	1.0035
Hydrogen	0	2×10^6	1.000264
Hydrogen bromide	0	$<3 \times 10^6$	1.00313
Hydrogen chloride	0	$<3 \times 10^6$	1.0046
Hydrogen iodide	0	$<3 \times 10^6$	1.00234
Hydrogen sulfide	23	10^{10}	1.00030
Mercury	400	3×10^8	1.00074
Methane	0	$<3 \times 10^6$	1.000944
Methyl alcohol	100	$<3 \times 10^6$	1.0057
Methyl bromide	23	10^{10}	1.00095
Methyl chloride	23	10^{10}	1.00094
Methyl iodide	100	$<3 \times 10^6$	1.0063
Methylamine	100	$<3 \times 10^6$	1.0038
Methylene chloride	100	$<3 \times 10^6$	1.0065
Neon	0	$<3 \times 10^6$	1.000127
Nitrogen	0	$<3 \times 10^6$	1.000580
Nitromethane	100	$<3 \times 10^6$	1.0247
Nitrous oxide (N_2O)	0	2×10^6	1.00113
Oxygen	0	$<3 \times 10^6$	1.000523
n-Pentane	100	$<3 \times 10^6$	1.0025
n-Propyl chloride	20	$<3 \times 10^6$	1.0143
iso-Propyl chloride	20	$<3 \times 10^6$	1.0152
Sulfur dioxide	23	10^{10}	1.00075
Toluene	126	$<3 \times 10^6$	1.0043
Vinyl bromide	20	$<3 \times 10^6$	1.0081
Water (steam)	110	$<3 \times 10^6$	1.0126
"	140	$<3 \times 10^6$	1.00785

Dielectric Constant of Water

t°C	ϵ	t°C	ϵ
0	88.00	40	73.28
5	86.04	45	71.59
10	84.11	50	69.94
15	82.22	60	66.74
20	80.36	70	63.68
25	78.54	80	60.76
30	76.75	90	57.98
35	75.00	100	55.33

PROPERTIES OF DIELECTRICS

Compiled by Earle C. Gregg, Jr.

In most cases properties have been determined by A S T M (American Society for Testing Materials) test methods at room temperature under standard conditions. Values will in general change considerably with temperature.

PLASTICS

Material	Dielectric Constant 10^6 Cycles	Dielectric Strength volts/mil	Volume Resistivity Ohms-cm 23°C	Power Factor 10^6 Cycles
Allyl resin, cast	3.6–4.5	380	$>4 \times 10^{14}$	0.028–0.06
Aniline formaldehyde resin, no filler	3.5–3.6	600–650	10^{16}–10^{17}	0.006–0.008
Casein	6.1–6.8	400–700	...	0.052
Cellulose acetate, molding	3.2–7.0	250–365	10^{10}–10^{13}	0.01–1.0
sheet	4.0–5.5	250–300	10^{11}–10^{13}	0.04–0.06
Cellulose acetate butyrate	3.2–6.2	250–400	10^{10}–10^{12}	0.01–0.04
Cellulose nitrate (proxylin)	6.4	300–600	$(10\text{–}15) \times 10^{10}$	0.06–0.09
Cold molded compound, inorganic, refractory	...	45	...	...
Cold molded compound, organic nonrefractory	6.0	85–115	1.3×10^{12}	0.07
Ethyl cellulose	2.8–3.9	350–500	10^{12}–10^{14}	0.01–0.06
Epoxy cast resin	3.62	400	10^{16}–10^{17}	0.019
Glycerol phthalate, cast, alkyd	3.7–4.0	300–350	$>10^{14}$	0.025–0.035
Melamine formaldehyde resins, molding				
Alpha cellulose filler	7.2–8.2	300–400	$10^{12} \times 10^{14}$	0.027–0.045
Asbestos filler	6.1–6.7	350–400	2.4×10^{11}	0.041–0.050
Cellulose filler	4.7–7.0	350–400	...	0.032–0.060
Flock filler	...	300–330	...	...
Macerated fabric filler	6.5–6.9	250–350	10^{9}–10^{10}	0.036
Methyl methacrylate, cast	2.7–3.2	450–500	$>10^{15}$	0.02–0.03
molding	2.7–3.2	450–500	$>10^{14}$	0.02–0.03
Mica, glass bonded, compression	7.4–7.85	...	10^{14}–10^{15}	0.0015–0.002
injection	6.9–9.2	...	10^{14}–10^{17}	0.0015–0.012
Nylon (F.M. 3001)	3.5	470	4×10^{14}	0.03
Phenol formaldehyde resins, molding				
Asbestos filler	5.0–7.0	100–350	10^{10}–10^{12}	0.10–0.50
Glass fiber	6.6	140–370	7×10^{12}	0.02
Mica filler	4.2–5.2	300–460	10^{12}–10^{14}	0.005–0.04
No filler	4.5–5.0	300–400	10^{11}–10^{12}	0.015–0.03
Sisal felt	3–5	250–400	10^{11}–10^{12}	0.3–0.5
Wood flour filler	4.–7.	200–425	10^{9}–10^{13}	0.03–0.07
Phenol formaldehyde resins, cast				
Mineral filler	9–15	100–250	10^{9}–10^{12}	0.07–0.2
No filler	4.0–5.5	350–400	10^{12}–10^{13}	0.04–0.05
Polyacrylic ester (filled and vulcanized)	...	400–700	2×10^{11} at 70°C	...
Polyester, cast resin, rigid	2.8–4.1	380–500	10^{14}	0.006–0.026
flexible	4.1–5.2	250–500	...	0.023–0.052
Polyester molding materials, (glass fiber filler)	4.0–4.5	150–400	10^{12}–10^{14}	0.015–0.020
Polyethylene	2.3	460	1.6×10^{13}	<0.0005
Polymonochlorodifluoroethylene	2.5	400	1.2×10^{18}	0.010
Polystyrene molding	2.4–2.65	500–700	10^{17}–10^{19}	0.0001–0.0004
Polytetrafluoroethylene	2.0	480	$>10^{15}$	<0.0002–0.0005
Rubber, hard	2.8	470	2×10^{15}	0.06
chlorinated	3 approx.	...	1.5×10^{13}	0.006
modified, isomerized	2.4–2.7	620	5×10^{16}	0.0008–0.002
Shellac	...	200–600	1.8×10^{9}	...
Silicone molding compound (glass fiber filled)	3.7	185	$10^{11} \times 10^{13}$	0.0017
Styrene, modified, molding (shock resistant type)	2.4–3.8	300–600	10^{12}–10^{17}	0.0004–0.02
Urea formaldehyde resin, alpha cellulose filler	6.4–6.9	300–400	10^{12}–10^{13}	0.028–0.032

PROPERTIES OF DIELECTRICS (Continued)

PLASTICS

Material	Dielectric Constant 10^6 Cycles	Dielectric Strength volts/mil	Volume Resistivity Ohms-cm 23°C	Power Factor 10^6 Cycles
Vinyl butyral, flexible, unfilled	3.92	350	5×10^{10}	0.061
rigid	3.33	400	$>10^{14}$	0.0065
Vinyl chloride rigid	2.8–3.0	700–1300	$>10^{16}$	0.006–0.014
flexible filled	3.5–4.5	600–800	5×10^{14}	0.09–0.10
flexible unfilled	3.5–4.5	800–1000	5×10^{12}	0.09–0.10
Vinyl chloride, acetate rigid	3.0–3.1	425	10^{16}	0.018–0.019
flexible, unfilled	3.3–4.3	300–400	10^{11}–10^{13}	0.04–0.14
flexible, filled	3.3–4.3	250–350	10^{11}–10^{13}	0.04–0.14
Vinyl formal molding compound	3.0	490	....	0.023
Vinylidene chloride	3.0–4.0	350	10^{14}–10^{16}	0.05–0.08

CERAMICS

Alumina	4.5–8.4	40–160	10^{11}–10^{14}	0.0002–0.01
Corderite	4.5–5.4	40–250	10^{12}–10^{14}	0.004–0.012
Forsterite	6.2	240	10^{14}	0.0004
Porcelain (Dry Process)	6.0–8.0	40–240	10^{12}–10^{14}	0.003–0.02
Porcelain (Wet Process)	6.0–7.0	90–400	10^{12}–10^{14}	0.006–0.01
Porcelain, Zircon	7.1–10.5	250–400	10^{13}–10^{15}	0.0002–0.008
Steatite	5.5–7.5	200–400	10^{13}–10^{15}	0.0002–0.004
Titanates (Ba, Sr, Ca, Mg, and Pb)	15–12,000	50–300	10^{8}–10^{15}	0.0001–0.02
Titanium Dioxide	14–110	100–210	10^{13}–10^{18}	0.0002–0.005

WAXES

Acrawax C	2.4	....	....	0.005
Beeswax, white	2.75–3.0	....	5×10^{14}	0.025
Beeswax, yellow	2.9	....	8×10^{14}	0.029
Candelilla	2.25–2.50			
Carnauba	2.75–3.0			
Cerese, brown G	2.27	....	....	0.0025
Ceresine	2.25–2.50	....	$>5 \times 10^{18}$	0.0011
Halowax 1001	−4.10	....	2×10^{13}	0.014
Halowax 1013	−4.75	....	....	0.036
Halowax 1014	−4.40	....	....	0.035
Halowax 11–314	2.94	....	....	0.00094
Microcrystalline waxes	2.2–2.5			
Opalwax	3.1	....	....	0.34
Ozokerite wax	2.3	100–150	5×10^{14}	0.0018
Paraffin	2.0–2.5	250	10^{15}–10^{19}	0.003 (900 cps)
Parawax	2.25	....	10^{16}	0.00045
135 A.M.P. wax	2.25	....	....	0.00023

PROPERTIES OF DIELECTRICS (Continued)

Glasses

Type	Dielectric Constant at 100 mc 20°C	Volume Resistivity 350°C megohm-cm	Power Factor 100 mc 20°C
Corning 0010	6.32	10	0.015
Corning 0080	6.75	0.13	0.058
Corning 0120	6.65	100	0.012
Pyrex 1710	6.00	2,500	0.025
Pyrex 3320	4.71	....	0.019
Pyrex 7040	4.65	80	0.013
Pyrex 7050	4.77	16	0.017
Pyrex 7052	5.07	25	0.019
Pyrex 7060	4.70	13	0.018
Pyrex 7070	4.00	1,300	0.0048
Vycor 7230	3.83	....	0.0061
Pyrex 7720	4.50	16	0.014
Pyrex 7740	5.00	4	0.040
Pyrex 7750	4.28	50	0.011
Pyrex 7760	4.50	50	0.0081
Vycor 7900	3.9	130	0.0023
Vycor 7910	3.8	1,600	0.00091
Vycor 7911	3.8	4,000	0.00072
Corning 8870	9.5	5,000	0.0085
G. E. Clear (Silica Glass)	3.81	4,000–30,000	0.00038
Quartz (Fused)	3.75–4.1 (1 mc)	....	0.0002 (1 mc)

RESISTIVITY OF DIELECTRICS

Giving the volume resistivity ρ, the variation of the volume resistivity with temperature, given as the ratio of the value at 20° C. to that at 30° C., and the surface resistivity for various dielectrics. The surface resistivity is the resistance between the opposite edges of a centimeter square. A large part of the data are from Curtis, Bulletin of the Bureau of Standards 1915. Temperatures, unless otherwise stated, are 22° C. The numbers in parentheses refer to the source of information.

Material	Volume resistivity			Surface resistivity, ohm-cm	
	Temp. °C.*	ρ ohm-cm	ρ^{20}/ρ^{30}	Humidity 50 %	Humidity 90 %
Amberite	22	5×10^{16}		2×10^{15}	3×10^{12}
Amber		5×10^{16}		6×10^{14}	1×10^{11}
Bakelite†					
No. 1		2×10^{11}		3×10^{11}	2×10^{8}
140		2×10^{7}	2.4	3×10^{9}	2×10^{5}
150		4×10^{12}	3.6	3×10^{12}	4×10^{9}
190		1×10^{11}	3.6	1×10^{11}	5×10^{8}
L 558		2×10^{16}	2.6	8×10^{15}	8×10^{14}
G5074		4×10^{10}		3×10^{11}	5×10^{5}
5199RGRB		5×10^{12}		6×10^{12}	1×10^{10}
5200		4×10^{11}	5.3	1×10^{12}	5×10^{9}
Bakelite micarta		5×10^{10}	2.4	2×10^{10}	1×10^{8}
Beeswax					
yellow, unrefined		20×10^{14}	16.0	$^{**}6 \times 10^{14}$	$^{**}5 \times 10^{14}$
	20	8×10^{14} (1)			
white		6×10^{14}			
	22	5×10^{14} (1)			
Celluloid		2×10^{10}	1.8	5×10^{10}	2×10^{9}
	16	4×10^{10} (2)			
Ceresin		$>5 \times 10^{18}$		$>^{**}1 \times 10^{17}$	$>^{**}1 \times 10^{17}$
Condensite					
black		4×10^{10}	2.9	6×10^{10}	8×10^{8}
yellow		4×10^{10}	2.9	3×10^{11}	6×10^{9}
Dielectrite		5×10^{12}	3.0	5×10^{11}	4×10^{7}
Duranoid		3×10^{15}		6×10^{12}	3×10^{8}
Electrose, No. 8		2×10^{16}		1×10^{15}	2×10^{12}
black		1×10^{14}	2.0	1×10^{12}	6×10^{9}
yellow		5×10^{15}	2.3	3×10^{14}	5×10^{8}
Fibre, hard		2×10^{10}	3.2	5×10^{9}	3×10^{7}
red		5×10^{9}	2.6	2×10^{10}	2×10^{8}
	20	1×10^{8} (3)			
Galalith,					
black		2×10^{10}		8×10^{10}	3×10^{9}
white		1×10^{10}		4×10^{10}	6×10^{8}
Glass, German		5×10^{13}	2.5	4×10^{11}	6×10^{8}
	18	5×10^{11} (4)			
Kavalier		8×10^{15}	4.5	4×10^{12}	1×10^{9}
	17	1×10^{16} (5)			
opal		1×10^{12}	2.8		
plate, commercial		2×10^{13}	3.2	5×10^{10}	2×10^{8}
ordinary	20	9×10^{13}			
Bohemian	20	6×10^{12}			
Glyptal		1×10^{16}	3.0		
Gummon		3×10^{12}	1.4	2×10^{12}	3×10^{8}
Halowax 1001		2×10^{13}	2.5	$^{*}6 \times 10^{15}$	$^{*}5 \times 10^{14}$
1014	30	1×10^{14}			

* Temperature is 22°C. except where otherwise stated.
† For composition of bakelite samples see table following.
** Leakage resistivity.

RESISTIVITY OF DIELECTRICS (Continued)

Material	Volume resistivity			Surface resistivity, ohm-cm	
	Temp. °C.	ρ ohm-cm	ρ^{20}/ρ^{30}	Humidity 50%	Humidity 90%
Hard Rubber		1×10^{18} 2×10^{15} (6) 3×10^{16} (?)		3×10^{15}	2×10^{9}
Hemit		1×10^{10}	1.2	1×10^{10}	3×10^{8}
Insulate		8×10^{15}	1.0	3×10^{14}	3×10^{11}
Ivory		2×10^{8}	1.5	5×10^{9}	1×10^{9}
Khotinsky Cement		2×10^{15}	11.0	$^{*}7\times10^{14}$	$^{*}5\times10^{11}$
Lavite		2×10^{10}		1×10^{11}	1×10^{8}
Marble					
Italian		1×10^{11} 1×10^{10} (?)		3×10^{9}	2×10^{7}
Pink Tennessee		5×10^{9}		5×10^{9}	3×10^{7}
Blue Vermont		1×10^{9}		8×10^{9}	1×10^{7}
Mica	20	9×10^{15} (6)			
black African		4×10^{13}		3×10^{12}	3×10^{9}
brown African		2×10^{15}	1.2	3×10^{11}	1×10^{9}
colorless		2×10^{17}	2.0	2×10^{13}	8×10^{9}
India ruby		5×10^{13}	2.7	1×10^{10}	9×10^{7}
stained		2×10^{13} (7)			
Indian ruby		5×10^{16}	1.0		
slightly stained		4×10^{13} (7)			
Moulded mica		1×10^{15}	1.2	5×10^{13}	3×10^{9}
Paraffin (special)		$>5\times10^{18}$		$^{*}9\times10^{15}$	$^{*}6\times10^{15}$
parowax		1×10^{16} 3×10^{18} (8)	2.0		
	17	5×10^{16} (5)			
Porcelain, unglazed		3×10^{14}	1.6	6×10^{11}	5×10^{8}
glazed				2×10^{13}	5×10^{6}
Quartz crystal					
∥ to axis	17 20	2×10^{14} (5) 1×10^{14} (6)			
⊥ to axis	17 20	2×10^{16} (5) 3×10^{16} (6)			
fused		$>5\times10^{18}$		3×10^{12}	2×10^{6}
cleaned with chromic acid				3×10^{14}	2×10^{13}
Redmonite		2×10^{14}	2.0	5×10^{13}	3×10^{10}
Rosin		5×10^{16}	3.6	5×10^{14}	2×10^{14}
	17	7×10^{15} (5)			
Sealing wax		8×10^{15}	0.9	2×10^{15}	9×10^{13}
	19	1×10^{15} (1)			
Shellac		1×10^{16} 9×10^{15} (?)	1.5	5×10^{13}	6×10^{9}
Slate		1×10^{8} 2×10^{8} (?)		9×10^{6}	1×10^{6}
Stabalite		3×10^{13}	1.6	2×10^{13}	4×10^{7}
Sulfur		1×10^{17}	4.9	7×10^{15}	1×10^{14}
	17	8×10^{15} (5)			
Tegit		2×10^{12}	1.4		
Tetrachlornaphthalene		5×10^{13}	2.9	$^{*}1\times10^{14}$	$^{*}1\times10^{14}$
Wood, paraffined					
mahogany		4×10^{13}		3×10^{12}	5×10^{9}
maple		3×10^{10}	3.6	8×10^{11}	2×10^{9}
poplar		5×10^{11}	3.6	1×10^{13}	1×10^{9}

* Leakage resistivity.

RESISTIVITY OF DIELECTRICS (Continued)

DESCRIPTION OF MATERIALS

Amberite is made by compressing scrap amber.

Bakelite. A phenol condensation product, with various fillers. The various samples were made as follows:

Number	Percent pure Bakelite	Filler	Phenolic Body	Condensing Agent
1		Paper	Cresols	Ammonia
140	50	Vegetable	Phenol	Caustic soda
150	50	Fiber	"	Ammonia
190	50	"	Cresols	"
5199	50	"	Phenol	"
5200	50	Fiber & clay	"	"
5074	35	Talc	"	Caustic soda
588	100	None	"	
1 Regular	100	None	Cresols	Ammonia

Ceresin is a waxy material refined from the mineral ozokerite, m.p. below 100° C. sp. gr. 0.91–0.97. Condensite is a phenol condensation product.

Hard fiber, soft cotton paper, treated with zinc chloride, dried and pressed.

Galalith is made from the casein of milk.

Kavalier glass is hard combustion tubing having a large potassium and calcium content.

Glyptal is an artificial resin resembling amber.

Gummon, hemit, and tegit are coal tar products.

Halowax, chlorinated naphthalenes.

Moulded mica is ground mica and asbestos with shellac.

Stabalite is a rubber compound.

REFERENCES

1. Dietrich, 1909
2. Addenbrooke, 1911
3. Rayner, 1905
4. Campbell, 1913
5. Thornton, 1910
6. Curie, 1889
7. Wilson-Mitchell, 1905
8. Braum, 1887

LIQUIDS

Resistance in ohms per centimeter cube.

Substance.	Temp. ° C.	Resistance, ohms.
Alcohol, ethyl	15	$.3 \times 10^6$
methyl		$.14 \times 10^6$
Oils, olive		5×10^{12}
paraffin		1×10^{16}
Petroleum		2×10^{16}
Water distilled	18	0.5×10^6

FUSED SALTS

(Poincaré.)

Substance.	Temp. ° C.	Resistance, ohms.
Calcium chloride	750	.862
Potassium bromide	750	.714
chlorate fused	355	2.20
Silver nitrate	350	.820
Sodium chloride fused	750	.294

DIPOLE MOMENTS

Electric Dipole Moments of Gases

Symbols used in this table are as follows:

μ = the dipole moment
A = the sum of the optical and infrared contributions to the molar polarization
R = the molar refraction. The values of R refer to the sodium D line unless accompanied by a subscript giving the wavelength in millimicrons. Bracketed terms were calculated from published data
A more complete listing of compounds may be found in N. B. S. Circular 537.

INORGANIC GASES

Substance		$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
$AsCl_3$	Arsenic trichloride	1.59 ± .01	37.6 ± .2	(28.5)	380–470
AsF_3	Arsenic trifluoride	2.815 ± .025	M Stark		....
AsH_3	Arsine	0.16	14.5		226–373
AsH_2D	Arsine-*d*	0.22 ± .02	M Stark		....
BF_3	Boron fluoride	0	8.90	6.09_∞	193; 298
		0	8.36		293–472
B_2H_6	Diborane	0	14.46	12.91_∞	193; 298
$B_3H_6N_3$	Triazatriborine	ca 0	ca 23.8	20.2_∞	298
B_5H_9	Pentaborane	2.13 ± .04	M Stark		....
$BrCl$	Bromine chloride	0.57 ± .02	M Stark		....
BrF	Bromine fluoride	1.29	M Stark		....
Br_2	Bromine	0	17.7	(16.3_∞)	293–412
ClF	Chlorine fluoride	0.88	M Stark		....
ClF_3	Chlorine trifluoride	0.554 ± .002	15.94 ± .11		273–356
$CsCl$	Cesium chloride	10.5 ± .25	R Stark		....
CsF	Cesium fluoride	7.42 ± .47	R Stark		....
CsI	Cesium iodide	10.2	Mol. beam		873
$GeCl_4$	Germanium tetrachloride	0	38.0	31.5	369–501
GeH_3Cl	Chlorogermane	2.03	....	16.9	275–297
		2.13	M Stark		....
HBr	Hydrogen bromide	0.80 ± .01	9.1 ± .2	(8.87_∞)[d]	218–599
HCl	Hydrogen chloride	1.050 ± .004	7.63 ± .21	(6.51_∞)[d]	201–589
		1.077 ± .019	6.63 ± .39		286–373
		1.081 ± .004	6.98 ± .14		291–517
DCl	Deuterium chloride	1.085 ± .001	7.16 ± .04	(6.50_∞)[d]	291–517
HF	Hydrogen fluoride	1.91	....	2.0	305–374
		1.91	....		296–333
HI	Hydrogen iodide	0.42	13.5	(13.2_∞)	245–346
HN_3	Hydrazoic acid	0.847[f] ± .005	M Stark		....
H_2O	Water	1.85	3.9	3.67_∞	423–483
		1.844 ± .030	4.3 ± 1.8		383–484
		1.844 ± .007	4.0 ± .6		394–462
		1.850 ± .027	3.4 ± 1.7		384–522
		1.853 ± .011	3.8 ± .7		298–376
DHO	Deuterium hydrogen oxide	1.84 ± .01	M Stark		....
D_2O	Deuterium oxide	1.861 ± .016	3.6 ± 1.2	(3.63_∞)	364–473
		1.87 ± .02	M Stark		....
H_2S	Hydrogen sulfide	0.92 ± .01	9.96 ± .64	(9.25_∞)	197–542
HDS	Hydrogen sulfide-*d*	1.02	M Stark		....
Hg	Mercury	0	12.7	(12.7_∞)	674–743
$HgBr_2$	Mercuric bromide	0	36.5	29.3_∞	614–695
$HgCl_2$	Mercuric chloride	0	29.2	22.9_∞	599–701
HgI_2	Mercuric iodide	0	48.3	41.6_∞	568–701
ICl	Iodine chloride	0.54 ± .01	30.9 ± .3		334–435
KBr	Potassium bromide	9.1	Mol. beam		920
KCl	Potassium chloride	6.3	Mol. beam		1023
		8.0	Mol. beam		949
KF	Potassium fluoride	7.33 ± .24	R Stark		....
KI	Potassium iodide	6.8	Mol. beam		950
		9.2	Mol. beam		898

[d] T. Larson, Z. Physik 111, 391 (1938).
[f] For the dipole component along the NNN axis.

Electric Dipole Moments of Gases (Continued)

INORGANIC GASES (Continued)

	Substance	$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
Kr	Krypton	0	6.26	6.27_{∞}	298
NF_3	Nitrogen fluoride	0.22	9.02	7.03_{∞}	193–368
		0.25	9.12		193–368
NH_3	Ammonia	1.469 ± .006	5.3 ± .4	(5.54_{∞})	274–457
		1.477 ± .006	5.3 ± .4		274–423
		1.46	5.9		294–419
		1.438 ± .011	6.5 ± .7		279–403
		1.468 ± .009	M Stark		....
ND_3	Deuteroammonia	1.509 ± .005	4.3 ± .3		274–425
NO	Nitrogen oxide	0.07 ± .02	4.74 ± .07		235–477
		0.16	4.31	4.30_{∞}	193; 298
NOF	Nitrosyl fluoride	1.81	M Stark		....
NO_2	Nitrogen dioxide	0.39	....	7.63	297–397
	Dimer (N_2O_4)	0.55	....	16.75	297–397
	Monomer	0.58	....	7.62	298
		0.41			343
		0.30			398
	Dimer (N_2O_4)	0	16.87	16.73	298–398
	Monomer	0.32	....	7.62_{644}	298–372
	Dimer (N_2O_4)	0.42	....	16.76_{644}	298–372
NO_2F	Nitryl fluoride	0.47	M Stark		....
N_2O	Dinitrogen oxide	0.14 ± .01	7.85 ± .05		293–454
		0.17	7.76	7.36_{∞}	193–298
		0.16	M Stark		....
		0.166 ± .002	M Stark		....
NaI	Sodium iodide	4.9	Mol. beam		950
Ne	Neon	0	1.001	(0.997_{∞})	82; 298
		0	1.000		298
O_3	Ozone	0.52	8.1	(7.2_{∞})	194–360
		0.65 ± .05	R Stark		....
OsO_4	Osmium tetroxide	0	20.6	16.6	429–561
PCl_3	Phosphorus trichloride	0.78 ± .01	32.2 ± .2	(26.0)	306–463
PF_3	Phosphorus trifluoride	1.025 ± .005	M Stark		....
PF_5	Phosphorus pentafluoride	0	15.4	9.6	283–388
PH_3	Phosphine	0.55	12.21	(10.8)	226–373
PH_2D	Phosphine-*d*	0.55 ± .01	M Stark		....
POF_3	Phosphorus oxyfluoride	1.735 ± .035	M Stark		....
		1.69 ± .05	M Stark		....
		1.77 ± .02	M Stark		....
PSF_3	Phosphorus thiofluoride	0.633 ± .02	M Stark		....
SF_6	Sulfur hexafluoride	0	16.5	11.31_{∞}	193; 298
		0	16.8		301
		0	15.7		292
S_2F_{10}	Disulfur decafluoride	0	33.4		298
$SOCl_2$	Thionyl chloride	1.452 ± .004	25.2 ± .3	21.0_{∞}	288–407
SO_2	Sulfur dioxide	1.633 ± .006	10.6 ± .4		266–444
		1.590 ± .025	13.7 ± 1.8		292–353
		1.631 ± .011	10.8 ± .8	9.54_{∞}	289–457
		1.59 ± .01	M Stark		....
SO_2Cl_2	Sulfuryl chloride	1.81	26.4	20.7_{∞}	293–416
SO_2F_2	Sulfuryl fluoride	0.228 ± .004	M Stark		....
SO_3	Sulfur trioxide	0	12.20	10.55_{∞}	353–433
SbH_2D	Stibine-*d*	0.116 ± .003	M Stark		....
SeF_6	Selenium hexafluoride	0	18.5	13.4	293
SiF_4	Silicon tetrafluoride	0	13.75	8.38_{∞}	193; 298
$SiHCl_3$	Trichlorosilane	0.858 ± .001	27.0 ± .1		285–414
$SiHF_3$	Trifluorosilane	1.26 ± .02	M Stark		....
SiH_2Cl_2	Dichlorosilane	1.167 ± .005	22.5 ± .2		291–397
SiH_3Br	Bromosilane	1.31 ± .03	M Stark		....
SiH_3Cl	Chlorosilane	1.292 ± .006	17.7 ± .3		288–402
		1.31	M Stark		....

DIPOLE MOMENTS

Electric Dipole Moments of Gases (Continued)

INORGANIC GASES (Continued)

	Substance	$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
SiH_3F	Fluorosilane	1.268 ± .013	M Stark		....
SiH_4	Silane	0	13.71	11.95_∞	240; 298
Si_2H_6	Disilane	0	28.10	23.72_∞	298
$SnBr_4$	Stannic bromide	0	55.6	47.7_∞	418–519
$SnCl_4$	Stannic chloride	0	45.5	34.6_∞	363–473
SnI_4	Stannic iodide	0	81.4	70.1_∞	526
TlCl	Thallium chloride	4.44	R Stark		....
TeF_6	Tellurium hexafluoride	0	22.7	15.0	292
$TiCl_4$	Titanium tetrachloride	0	41.3	37.8	373; 481
UF_6	Uranium hexafluoride	0	30.7		293
		0	31.5		313–356
Xe	Xenon	0	10.09	10.14_∞	298

ORGANIC SUBSTANCES

	Substance	$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
	C_1				
CBr_2F_2	Dibromodifluoromethane	1.02	....	(22.1)	302
CClN	Cyanogen chloride	2.802 ± .020	M Stark		....
CCl_2F_2	Dichlorodifluoromethane	0.505 ± .002	20.23 ± .03		305–470
		0.55	19.7		300–410
CCl_2O	Phosgene	1.19 ± .01	18.4 ± .4	(16.6_∞)	303–425
CCl_2S	Thiophosgene	0.29	25.7		303–414
CCl_3F	Trichlorofluoromethane	0.45 ± .03	23.9 ± .6		299–376
CCl_3NO_2	Trichloronitromethane	1.89	....	(27.3)	344
CCl_4	Carbon tetrachloride	0	28.14	(25.83_∞)	296; 368
CF_4	Carbon tetrafluoride	0	9.73	7.12_∞	193–368
		0	10.1		298; 368
		0	10.7		298
CN_4O_8	Tetranitromethane	0	36.6	36.0_{546}	355
CO	Carbon monoxide	0.097 ± .004	5.01 ± .03		90–391
		0.10	4.98	4.89_∞	83; 298
		0.117 ± .005	4.65 ± .02		273–373
CO_2	Carbon dioxide	0	7.35	6.54_∞	298
COS	Carbonyl sulfide	0.67 ± .01	14.4 ± .2	(12.8_∞)	202–365
		0.72	M Stark		....
		0.72	....		265; 333
	$C^{12}O^{16}S^{32}$	0.732 ± .007	M Stark		....
	$C^{13}O^{16}S^{32}$	0.722 ± .007	M Stark		....
CS_2	Carbon disulfide	0	22.36	(20.37_∞)	325–489
$CHBrF_2$	Bromodifluoromethane	1.50	....	(14.4)	300
$CHClF_2$	Chlorodifluoromethane	1.409 ± .003	14.9 ± .1		304–479
		1.48	....	(11.5)	298
$CHCl_2F$	Dichlorofluoromethane	1.293 ± .006	17.2 ± .3		305–424
		1.41	....	(16.5)	303
$CHCl_3$	Chloroform	1.02	24.8	(21.0_∞)	298; 368
		1.013 ± .001	25.28 ± .05	21.4	301–427
CHF_3	Fluoroform	1.60	8.8	6.98_∞	193–368
		1.645 ± .009	M Stark		....
CHN	Hydrogen cyanide	2.91 ± .05	11.8 ± 5.3		292–424
		2.95 ± .01	6.2 ± 1.2		301–470
		3.00	....	(6.3)	298; 368
CHNO	Isocyanic acid	1.592[p] ± .015	M Stark		....
CDNO	Isocyanic acid-*d*	1.619[p] ± .015	M Stark		....
CHNS	Isothiocyanic acid	1.72[q]	M Stark		....
CH_2Br_2	Dibromomethane	1.43 ± .03	23.5 ± 1.3	(20.7_∞)	338–427
CH_2ClNO_2	Chloronitromethane	2.91	....	17.4	412–484
CH_2Cl_2	Dichloromethane	1.54	18.7	$(16.0)_\infty$	297; 368
		1.57 ± .01	20.0 ± .7	16.6	301–427

[p] For the dipole component along the NCO axis.

[q] For the dipole component along the SCN axis.

Electric Dipole Moments of Gases (Continued)

Organic Substances (Continued)

	Substance	$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
	C_1 (Cont.)				
CH_2F_2	Difluoromethane	1.93	M Stark		....
CH_2O	Formaldehyde	2.27	....	7.0	420–520
		2.17 ± .02	M Stark		....
		2.34 ± .02	M Stark		....
CH_2O_2	Formic acid	1.52	....	8.5	345–423
		ca 1.4	....		310–347
	Dimer ($C_2H_4O_4$)	0	32		310–347
CH_3Br	Bromomethane	1.80 ± .02	15.2 ± 1.1		306–406
		1.81	....	(14.6)	297; 368
CH_3Cl	Chloromethane	1.87 ± .01	13.5 ± .5	(11.2_∞)	290–456
		1.87 ± .01	14.1 ± .5		298–418
CH_3F	Fluoromethane	1.81 ± .01	9.6 ± .6	(6.7)	224–498
CH_3I	Iodomethane	1.60 ± .01	20.1 ± .5		305–494
		1.62	....	(19.3)	301; 368
CH_3NO	Formamide	3.25	....	10.6	425–449
CH_3NO_2	Nitromethane	3.44 ± .01	18.6 ± .7		339–494
		3.57	....	12.5	373–470
CH_4	Methane	0	6.53	6.45_∞	193; 298
CH_4O	Methanol	1.70 ± .01	7.8 ± .6	(8.2)	345–502
		1.70 ± .01	9.7 ± .4		308–482
		1.70	8.1		302; 368
		1.706 ± .004	7.6 ± .2		298–479
CH_5N	Methyl amine	1.24 ± .03	13.4 ± 1.0	10.3	338–458
		1.26	13.7		298; 368
		1.35 ± .04	9.7 ± 1.6		288–417
CH_6Si	Methyl silane	0.73	M Stark		....
CH_6Sn	Methyl stannane	0.68 ± .03	M Stark		....
	C_2				
C_2ClF_5	Chloropentafluoroethane	0.80	....	(15.8)	300
$C_2Cl_2F_4$	1,2-Dichlorotetrafluoroethane	0.80	....	(21.5)	299
C_2H_6	Hexafluoroethane	0	17.2	(10.8)	296
C_2N_2	Cyanogen	0	20.1	11.9_∞	239; 298
C_2HBr	Bromoacetylene	0.0[a]	18.64	(17.2)	289–354
C_2HCl	Chloroacetylene	0.446 ± .005	15.3 ± .1	(14.3)	287–363
C_2HCl_5	Pentachloroethane	0.95 ± .03	35.4 ± .8	(35.6)	400–517
C_2H_2	Acetylene	0	9.97		196–461
		0	9.84	8.58_∞	193; 298
$C_2H_2Cl_2$	*cis*-Dichloroethylene	1.90 ± .02	19.9 ± 1.6	(20.3)	301–427
$C_2H_2Cl_2F_2$	1,1-Dichloro-2,2-difluoroethane	1.34	....	21.2	334
$C_2H_2Cl_2O$	Chloroacetyl chloride	2.23 ± .06	22.5 ± 3.7	21.8	358–529
$C_2H_2Cl_3F$	1,2,2-Trichloro-1-fluoroethane	1.38	....	25.7	379
$C_2H_2Cl_4$	1,1,2,2-Tetrachloroethane	1.36	....	(30.6)	401–436
		1.32 ± .03	32.4 ± 1.2		378–501
$C_2H_2F_2$	1,1-Difluoroethylene	1.37 ± .02	M Stark		....
C_2H_2O	Ketene	1.45	....	11.0	398–446
		1.414 ± .010	M Stark		....
C_2HDO	Ketene-*d*	1.423 ± .015	M Stark		....
C_2D_2O	Ketene-d_2	1.442 ± .013	M Stark		....
C_2H_3Br	Bromoethylene	1.415 ± .001	19.14 ± .06	18.5	295–413
C_2H_3Cl	Chloroethylene	1.449 ± .003	16.18 ± .12	15.6	287–413
$C_2H_3ClF_2$	1-Chloro-1,1-difluoroethane	2.21	....	(16.1)	300
		2.14	20.3		357–507
C_2H_3ClO	Acetyl chloride	2.72 ± .04	16.7 ± 3.7	16.8	320–483
$C_2H_3ClO_2$	Methyl chloroformate	2.41	....	(17.9)	308
$C_2H_3Cl_3$	1,1,1-Trichloroethane	1.79 ± .02	27.0 ± 1.0		301–395
		1.77	....	26.1	336–399
	1,1,2-Trichloroethane	1.22 ± .02	33.3 ± .6		340–517

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[a] Although the structure is not symmetrical, the dipole moment appears to be virtually zero.

DIPOLE MOMENTS

Electric Dipole Moments of Gases (Continued)

Organic Substances (Continued)

	Substance	$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
	C_2 (Cont.)				
$C_2H_3F_3$	1,1,1-Trifluoroethane	2.35	....	(11.1)	298
		2.321 ± .034	M Stark		....
C_2H_3I	Iodoethylene	1.30	....	23.5	290–413
C_2H_3N	Acetonitrile	3.84	....	(11.1)	298; 368
		3.96 ± .03	11.1 ± 3.1		354–463
C_2H_4	Ethylene	0	10.79		237–461
		0	10.74	10.34_{∞}	193; 298
C_2H_4BrCl	1-Bromo-2-chloroethane	1.16	....	24.0	339
		1.21	....		368
		1.35	....		436
$C_2H_4Br_2$	1,2-Dibromoethane	1.02	....	27.0	339
C_2H_4ClF	1-Chloro-2-fluoroethane	1.84	....	(16.4)	309
$C_2H_4ClNO_2$	1-Chloro-1-nitroethane	3.27 ± .05	27.5 ± 4.5	21.9	415–468
$C_2H_4Cl_2$	1,1-Dichloroethane	2.06 ± .02	21.8 ± 1.4	21.2	301–427
$C_2H_4Cl_2$	1,2-Dichloroethane	1.19	....	(21.0)	305
C_2H_4O	Ethylene oxide	1.90	11.4	(10.9)	290–449
		1.91	....		297; 368
		1.88 ± .01	M Stark		....
	Acetaldehyde	2.72	....	11.6	300–455
		2.72	....		420; 469
$C_2H_4O_2$	Acetic acid	1.74	....	12.9	450–494
C_2H_4S	Ethylene sulfide	1.84 ± .02	M Stark		....
C_2H_5Br	Bromoethane	2.03 ± .01	21.2 ± .4	(18.3_{∞})	303–441
		2.02 ± .04	20.3 ± 2.5	19.1	292–443
C_2H_5Cl	Chloroethane	2.06	17.8		292–455
		2.03 ± .03	20.9 ± 2.7		298–418
		2.07	....	(16.3)	296; 368
		1.98	....		292; 359
C_2H_5ClO	2-Chloroethanol	1.78	....	17.8	339–435
	Chloromethoxymethane	2.03	....	(18.0)	347–507
C_2H_5F	Fluoroethane	1.92 ± .01	12.5 ± .7	(11.3)	236–535
C_2H_5I	Iodoethane	1.92 ± .03	25.3 ± 1.9		348–463
		1.90	....	24.3	293; 337
$C_2H_5NO_2$	Nitroethane	3.54 ± .02	24.3 ± 2.3	17.0	365–461
		3.70 ± .04	15.9 ± 4.2		398–484
	Ethyl nitrite	2.38	....	(17.9)	290
C_2H_6	Ethane	0	11.21		200–470
		0	11.15	11.07_{∞}	193; 298
C_2H_6O	Methyl ether	1.30	15.1		292–453
		1.30 ± .02	15.4 ± .8		298–418
		1.29	15.0		297; 369
		1.31 ± .04	13.4 ± 2.0	13.3	290–428
	Ethanol	1.69	....	(12.8)	351–499
		1.70 ± .01	13.0 ± .4		298–450
		1.68 ± .02	14.3 ± 1.3		308–483
$C_2H_6O_2$	Ethylene glycol	2.28	....	14.4	417–506
$C_2H_6O_2S$	Dimethyl sulfone	4.49	....	18.3_{546}	424–526
C_2H_6S	Ethanethiol	1.58 ± .00	18.7 ± .1	(19.2)	308–478
C_2H_7N	Ethyl amine	1.22 ± .02	17.9 ± .8	14.7	303–447
	Dimethyl amine	1.03	15.8		288–427
$C_2H_8N_2$	Ethylene diamine	1.99	....	(18.2)	355; 429
	C_3				
C_3HN	Cyanoacetylene	3.6 ± .2	M Stark		....
C_3H_3N	Acrylonitrile	3.83 ± .01	20.3 ± 1.5	15.6	387–509
C_3H_4	Propyne	0.72	15.6	14.0_{∞}	298; 368
		0.78	....	14.0	298; 348
		0.75 ± .01	M Stark		....
	1,2-Propanediene	0	16.6	15.1_{∞}	298; 368

DIPOLE MOMENTS

Electric Dipole Moments of Gases (Continued)

ORGANIC SUBSTANCES (Continued)

	Substance	$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
	C_3 (Cont.)				
C_3H_4O	Propenal (Acrolein)	3.04	....	16.1	377–478
C_3H_5Cl	*cis*-1-Chloro-1-propene	1.71	....	20.4	345–476
	trans-1-Chloro-1-propene	1.97	....	20.4	345–476
	2-Chloro-1-propene	1.66 ± .02	21.8 ± 1.1	20.4	339–469
	3-Chloro-1-propene (Allyl chloride)	1.90 ± .01	20.1 ± .8		308–480
		1.98	....	20.4	377–480
C_3H_5ClO	Chloroacetone	2.21	....	21.2	336
$C_3H_5ClO_2$	Ethyl chloroformate	2.59	....	(22.6)	308
C_3H_5N	Propionitrile	4.05 ± .04	16.9 ± 4.7		351–469
		4.00	....	15.8	395–477
C_3H_6	Cyclopropane	0	14.28	(13.9)	297; 368
	Propene	0.35 ± .01	15.7 ± .1		246–476
		0.34	15.9	15.2_{∞}	193–298
$C_3H_6Cl_2$	1,2-Dichloropropane	1.46	....	25.6	345
		1.53	....		394
		1.63	....		466
		1.68	....		506
	1,3-Dichloropropane	2.08 ± .02	27.4 ± .9	(25.8)	374–485
	2,2-Dichloropropane	2.27	....	25.8	300–372
C_3H_6O	Allyl alcohol	1.60 ± .04	19.3 ± 1.9	(17.0)	329–479
	Propionaldehyde	2.72 ± .03	16.4 ± 2.2	16.0	354–509
	Acetone	2.89	....		292–456
		2.88	....	16.2	301–455
		2.87	....		298; 368
$C_3H_6O_2$	Propionic acid	1.75	....	17.4	430–486
	Ethyl formate	1.93 ± .03	20.2 ± 2.0	17.8	292–435
	Methyl acetate	1.72	....	17.6	327–517
		1.72 ± .02	17.5 ± .9		308–482
$C_3H_6O_3$	Dimethyl carbonate	0.90	....	(19.4)	328
	Trioxane	2.08 ± .01	M Stark		....
C_3H_7Br	1-Bromopropane	2.18	....	23.7	348–441
	2-Bromopropane	2.21	....	24.1	287–380
C_3H_7Cl	1-Chloropropane	2.05 ± .01	25.3 ± .6	20.8	338–458
	2-Chloropropane	2.17	....	(21.1)	288–383
C_3H_7I	1-Iodopropane	2.04	....	28.9	337; 374
$C_3H_7NO_2$	1-Nitropropane	3.60	....	21.4	343–466
		3.72	....		382–457
	2-Nitropropane	3.73	....	21.6	392–455
C_3H_8	Propane	0	16.07		227–486
		0	16.05	15.73_{∞}	240; 298
C_3H_8O	Methoxyethane	1.23 ± .02	20.0 ± .7	17.7	303–369
	1-Propanol	1.69 ± .03	16.6 ± 1.6	(17.4)	376–505
		1.67 ± .05	17.4 ± 2.6		308–481
	2-Propanol	1.60 ± .03	20.7 ± 1.6	(17.5)	307–482
		1.69 ± .02	17.7 ± 1.1		289–468
$C_3H_8O_2$	Dimethoxymethane (Methyal)	0.77	....	(19.3)	307
		0.87	....		352
		1.00	....		407
		1.17	....		482
C_3H_9N	*n*-Propylamine	1.17 ± .02	23.2 ± .6	19.4	334–432
C_3H_9N	Trimethylamine	0.67	20.2	19.4	289–418
	C_4				
$C_4H_4N_2$	Succinonitrile	3.47	....	(20.4)	443
C_4H_4O	Furan	0.661 ± .006	M Stark		....
C_4H_4S	Thiophene	0.56 ± .06	24.4 ± 1.1	(24.3)	329–474
C_4H_5N	Methacrylonitrile	3.69	....	20.2	395–473
C_4H_6	1-Butyne	0.80	....	18.7	298–398
	1,3-Butadiene	0	21.8	21.6	299–462

Electric Dipole Moments of Gases (Continued)

ORGANIC SUBSTANCES (Continued)

	Substance	$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
	C_4 (Cont.)				
C_4H_6O	Crotonaldehyde	3.67	....	21.5	412–519
	Methacrylaldehyde (Methacrolein)	2.68	....	21.0	366–466
$C_4H_6O_2$	Biacetyl	1.30	....	20.6	329
$C_4H_6O_3$	Acetic anhydride	ca 2.8	....	(22.4)	320–540
C_4H_7N	Butyronitrile	4.07	....	21.2	339–443
C_4H_8	1-Butene	0.38 ± .01	20.1 ± .2		274–466
		0.30	21.5	19.74_{∞}	298; 368
	trans-2-Butene	0	21.42	19.85_{∞}	298; 368
	2-Methylpropene	0.49	20.9	19.85_{∞}	298; 368
$C_4H_8Cl_2$	1,4-Dichlorobutane	2.22	....	30.3	433–507
C_4H_8O	Butyraldehyde	2.72	....	20.6	354–412
$C_4H_8O_2$	Ethyl acetate	1.78 ± .00	24.4 ± .2	22.3	302–467
	1,4-Dioxane	0	24.5	(21.6)	337–487
C_4H_9Br	1-Bromobutane	2.08 ± .05	35.0 ± 3.3	28.3	352–474
	2-Bromobutane	2.23	....	28.4	343
C_4H_9Cl	1-Chlorobutane	2.05 ± .01	28.6 ± .6		315–480
	1-Chloro-2-methylpropane	2.00 ± .07	28.0 ± 4.9	25.4	345–407
	2-Chloro-2-methylpropane	2.13	....	25.9	314–354
	2-Chlorobutane	2.04 ± .05	31.2 ± 3.3	25.7	336–392
C_4H_9I	1-Iodobutane	2.12	....	33.5	349; 415
$C_4H_9NO_2$	1-Nitrobutane	3.59	....	26.2	373–470
	2-Methyl-2-nitropropane	3.71	....	26.1	379–449
C_4H_{10}	*n*-Butane	0	20.68	20.20_{∞}	298; 368
	2-Methylpropane	0	20.87	20.18_{∞}	298; 368
$C_4H_{10}O$	Ethyl ether	1.15 ± .00	25.8 ± .2	(22.1_{∞})	289–455
	1-Butanol	1.67 ± .02	21.9 ± .7	(22.1)	385–490
	2-Methylpropanol	1.64 ± .01	22.5 ± .6	(22.2)	328–481
$C_4H_{10}S$	Ethyl sulfide	1.54 ± .05	27.2 ± 2.6	(28.5)	308–474
$C_4H_{11}N$	Diethylamine	0.92 ± .03	25.7 ± 1.0	24.3	334–413
	C_5				
C_5H_5N	4-Cyano-1,3-butadiene	3.90	....	26.4	427–464
C_5H_6	1,3-Cyclopentadiene	0.53	....	21.8	344–452
C_5H_8	1-Pentyne	0.86	....	23.0	298–398
	trans-1,3-Pentadiene	0.68	....	25.3	389–469
	2-Methyl-1,3-butadiene (Isoprene)	0.38	....	25.2	358–477
$C_5H_8O_2$	Acetyl acetone	3.05	....	26.4	322–477
C_5H_9N	Valeronitrile	4.12 ± .03	26.2 ± 3.5	25.2	423–522
$C_5H_{10}O_3$	Diethyl carbonate	1.10 ± .03	28.6 ± .9	28.6	352–477
$C_5H_{11}Br$	1-Bromopentane	2.20	....	(33.1)	392; 484
$C_5H_{11}Cl$	1-Chloropentane	2.16	....	30.3	351; 381
C_5H_{12}	Pentane	0	25.2	(24.3_{∞})	307–384
	C_6				
$C_6H_4ClNO_2$	*o*-Chloronitrobenzene	4.64	....	36.9	477
	m-Chloronitrobenzene	3.73	....	36.9	483
	p-Chloronitrobenzene	2.83	....	36.9	483
$C_6H_4Cl_2$	*o*-Dichlorobenzene	2.52 ± .03	35.2 ± 1.8		445–523
		2.48	....	35.9	354–424
	m-Dichlorobenzene	1.72	....	36.0	413; 458
	p-Dichlorobenzene	0	38.1	36.0	434
$C_6H_4FNO_2$	*p*-Fluoronitrobenzene	2.87	....	32.4	488–524
$C_6H_4F_2$	*m*-Difluorobenzene	1.62	....	25.9	353–423
$C_6H_4N_2O_4$	*p*-Dinitrobenzene	0	46.5	38.3	473–528
$C_6H_4O_2$	*p*-Benzoquinone	0	36.6	28.3_{546}	393–520
C_6H_5Br	Bromobenzene	1.70 ± .01	37.2 ± .6		374–483
C_6H_5Cl	Chlorobenzene	1.70 ± .04	34.7 ± 2.1		360–495
C_6H_5ClO	*o*-Chlorophenol	1.24	....	(32.7)	421
	p-Chlorophenol	2.11	....	(32.7)	430–550
C_6H_5F	Fluorobenzene	1.58 ± .02	26.0 ± .9		344-507
C_6H_5I	Iodobenzene	1.70	....	39.2	433–487

Electric Dipole Moments of Gases (Continued)

ORGANIC SUBSTANCES (Continued)

	Substance	$\mu \times 10^{18}$ esu	A	R	Temperature (°K)
	C_6 (Cont.)				
$C_6H_5NO_2$	Nitrobenzene	4.27	....	(32.7)	402–523
C_6H_6	Benzene	0	26.9	(26.2)	326–480
C_6H_6O	Phenol	1.45	....	28.0	450
C_6H_7N	Aniline	1.53	....	30.6	459
$C_6H_8N_2$	*o*-Phenylenediamine	1.53	....	(34.9)	506–596
	m-Phenylenediamine	1.81	....	(34.9)	504; 556
	p-Phenylenediamine	1.53	....	(34.9)	505; 564
C_6H_{10}	1-Hexyne	0.89	....	27.6	298–398
	2-Ethyl-1,3-butadiene	0.45	....	29.8	384–479
	3-Methyl-1,3-pentadiene	0.63	....	29.8	399–487
	2-Methyl-1,3-pentadiene	0.65	....	30.4	399–497
	2,3-Dimethyl-1,3-butadiene	0.52	....	29.8	371–484
	Cyclohexene	0.55	....	(27.0)	308–480
$C_6H_{10}O_3$	Ethyl acetoacetate	2.98	....	32.6	394–431
$C_6H_{12}O_2$	Amyl formate	1.90 ± .03	35.8 ± 1.9	31.8	376–516
$C_6H_{12}O_3$	Paraldehyde	1.43 ± .04	45.2 ± 1.5	33.1	386–473
C_6H_{14}	*n*-Hexane	0	30.0		337–484
		0	29.9	29.9	352; 384
$C_6H_{14}O$	Propyl ether	1.30	....	31.7	368–448
		1.21	32.3		331–473
$C_6H_{14}O_2$	1,1-Diethoxyethane (Acetal)	1.11	....	(33.2)	328
$C_6H_{15}N$	Triethylamine	0.66 ± .04	33.0 ± .8	33.1	373–453
	C_7				
$C_7N_7NO_3$	*o*-Nitroanisole	4.83	....	39.6	477
	m-Nitroanisole	4.55	....	39.6	476
	p-Nitroanisole	5.26	....	39.6	478
C_7H_8	Toluene	0.36 ± .03	32.2 ± .4	(31.1)	357–482
C_7H_8O	Anisole	1.38	....	(33.0)	403
C_7H_9NO	*o*-Ansidine	1.61	....	(35.9)	464–571
C_7H_{12}	1-Heptyne	0.87	....	32.3	348; 398
C_7H_{14}	Methylcyclohexane	0	33.0	(32.5)	370; 456
$C_7H_{14}O$	Cyclohexyl methyl ether	1.35	....	33.9	406–473
$C_7H_{14}O_2$	Amyl acetate	1.75 ± .04	37.5 ± 2.1	36.2	376–517
$C_7H_{15}Br$	1-Bromoheptane	2.16	....	42.3	373–434
C_7H_{16}	*n*-Heptane	0	34.9	(34.6)	348–501
		0	34.2		384
	C_8				
C_8H_8	Styrene	ca 0	ca 37.6	36.4	442; 462
C_8H_8O	Acetophenone	3.02 ± .02	37.9 ± 1.7	36.3	410–493
$C_8H_8O_2$	2,5-Dimethyl-1,4-benzoquinone	0	47.4	38.4_{546}	415–519
C_8H_{10}	Ethylbenzene	0.59 ± .01	35.8 ± .1	(35.7)	349–455
	o-Xylene	0.62	37.7	35.8	413–512
	p-Xylene	0	37.7	36.0	447
$C_8H_{10}O$	Phenetole	1.45	....	37.6	415; 473
$C_8H_{11}N$	*N*-Dimethylaniline	1.68	....	40.8	455
$C_8H_{12}O_2$	Ethyl sorbate	2.07	....	43.3	507
$C_8H_{14}O_4$	Diethyl succinate	2.35	....	42.3	430
C_8H_{16}	Ethylcyclohexane	0	40.0	(37.1)	370; 456
C_8H_{18}	*n*-Octane	0	40.2	(39.2)	433
$C_8H_{18}O$	*n*-Butyl ether	1.17	43.4	40.8	385–455
	C_9				
$C_9H_{10}O_2$	Ethyl benzoate	2.00	....	42.6	405–505
C_9H_{12}	Isopropylbenzene	0.79	....	(40.4)	411; 455
C_9H_{18}	Isopropylcyclohexane	0	43.3	(41.6)	391; 456
	C_{10}				
$C_{10}H_{14}$	*t*-Butylbenzene	0.83	....	45.0	456; 477
$C_{10}H_{20}$	*t*-Butylcyclohexane	0	49.9	(46.2)	411; 456
	C_{12}				
$C_{12}H_{10}O$	Diphenyl ether	1.23	....	52.8	444; 483
	C_{14}				
$C_{14}H_{14}O$	Di-p-tolyl ether	1.54	....	62.7	502

DIPOLE MOMENTS

Dipole Moments for Some Inorganic Compounds

Compound	Dipole Moment × 10^{-18} e. s. u.
HF	1.92 ± 0.02
HCl	1.084 ± 0.003 – 0.007
HBr	0.78
HI	0.38
DCl	1.084 ± 0.003 – 0.007
H_2O	1.87
H_2O_2	2.13 ± 0.05
H_2S	1.10
SO_2	1.60
SO_3	0.00
NH_3	1.3
N_2H_4	1.84
NO	0.16
NO_2	0.29
N_2O_4	0.37
NOCl	1.83
NOBr	1.87
PCl_3	0.90 – 1.16
PCl_5	0.0
CO	0.10
CO_2	0.0

Dipole Moments of Amino Acid Esters

Substance	$\mu \cdot 10^{18}$ e. s. u.
Glycine ethyl ester	2.11
α-Alanine ethyl ester	2.09
α-Aminobutyric acid ethyl ester	2.13
α-Aminovaleric acid ethyl ester	2.13
Valine ethyl ester	2.11
α-Aminocaproic acid ethyl ester	2.13
β-Alanine ethyl ester	2.14
β-Aminobutyric acid ethyl ester	2.11

Accurate to ±0.01 · 10^{-18} e. s. u.
J. Wyman, Chem Rev., 1936, **19**, 213.

DIPOLE MOMENTS

Dipole Moments of Amides

Substance	$\mu \cdot 10^{18}$ e. s. u.
Urea	4.56
Thiourea	4.89
Symm.-dimethylurea	4.8
Tetraethylurea	3.3
Propylurea	4.1
Acetamide	3.6
Sulfamide	3.9
Benzamide	3.6
Valeramide	3.7
Caproamide	3.9

[a] For comprehensive list of dipole moments see Trans. Faraday Soc., 1934, **30,** General Discussion.

Dipole Moments of Some Hormones and Related Compounds in Dioxan

Substance[a]	$\mu \cdot 10^{18}$ e. s. u.
Cholestane-$3(\beta):7(\alpha)$-diol	2.31
Cholestane-$3(\beta):7(\beta)$-diol	2.55
Cholestane	2.98
Δ^5-Cholestane-$3(\beta)$ol-7 one	3.79
Androsterone	3.70
β-Androsterone	2.95
Δ^5-Androstene-$3(\beta):17(\alpha)$-diol	2.89
Δ^5-Androstene-$3(\beta):17(\beta)$-diol	2.69
Δ^5-Androstene-$3(\beta)$ol-17 one	2.46
Testosterone	4.32
cis-Testosterone	5.17
Δ^4-Androstene-3:17 dione	3.32
Isophorone	3.96

[a] Ethylenic $>C{=}C<$ in a six membered ring and conjugated with $>C{=}O$ increases the dipole moment approximately by 1 Debye. Non-conjugated $>C{=}C<$ in sterols decreases the dipole moment by approximately 0.49. Biological activity is not correlated with dipole moment. W. D. Kumler and G. M. Fohlen, J. Am. Chem. Soc., 1945, **67,** 437.

ELECTROMOTIVE FORCE AND COMPOSITION OF VOLTAIC CELLS

STANDARD CELLS

(From Smithsonian Tables.)

Name of cell.	Negative pole.	Solution.	Positive pole.	Depolarizer.	E.M.F. in volts.
Weston normal..	Cadmium amalgam...	Saturated solution of $CdSO_4$.....	Mercury. .	Paste of Hg_2SO_4 and $CdSO_4$	1.0183 at 20° C.
Clark standard. .	Zinc amalgam.......	Saturated solution of $ZnSO_4$.....	Mercury. .	Paste of Hg_2SO_4 and $ZnSO_4$.	1.4328 at 15° C.

Temperature equations:

Clark cell: $E_t = 1.4328[1 - 0.00119(t - 15) - 0.000007(t - 15)^2]$ volt

Weston cell: $E_t = 1.0183[1 - 0.0000406(t - 20) - 0.00000095(t - 20)^2 + 0.00000001(t - 20)^3]$ volt

DOUBLE FLUID CELLS

Name of cell.	Negative pole.	Solution.	Positive pole.	Solution.	E.M.F. in volts.
Bunsen.........	Amal. zinc..........	1 part H_2SO_4 to 12 parts H_2O....	Carbon...	Fuming nitric acid.........	1.94
Bunsen.........	Amal. zinc..........	1 part H_2SO_4 to 12 parts H_2O....	Carbon...	HNO_3, density, 1.38.........	1.86
Bichromate.....	Amal. zinc..........	12 parts $K_2Cr_2O_7$ to 25 parts H_2SO_4 and 100 parts H_2O.	Carbon...	1 part H_2SO_4 to 12 parts H_2O	2.00
Bichromate.. ..	Amal. zinc..........	1 part H_2SO_4 to 12 parts H_2O....	Carbon...	12 parts $K_2Cr_2O_7$ to 100 parts H_2O...............	2.03
Daniell.........	Amal. zinc..........	1 part H_2SO_4 to 4 parts H_2O.....	Copper...	Saturated solution of $CuSO_4+5H_2O$...........	1.06
Daniell.........	Amal. zinc..	5% solution of $ZnSO_4+6H_2O$....	Copper...	Saturated solution of $CuSO_4+5H_2O$...........	1.08
Daniell	Amal. zinc..........	1 part NaCl to 4 parts H_2O.....	Copper...	Saturated solution of $CuSO_4+5H_2O$...........	1.05
Grove...	Amal. zinc........ .	1 part H_2SO_4 to 12 parts H_2O....	Platinum .	Fuming nitric acid.........	1.93
Grove..........	Amal. zinc..........	Solution of $ZnSO_4$..............	Platinum .	HNO_3 density 1.33........	1.66

ELECTROMOTIVE FORCE AND COMPOSITION OF VOLTAIC CELLS (Continued)

Double Fluid Cells (Continued)

Name of cell.	Negative pole.	Solution.	Positive pole.	Solution.	E.M.F. in volts.
Grove	Amal. zinc	H_2SO_4 solution, density 1.136	Platinum	HNO_3 density 1.33	1.79
Grove	Amal. zinc	H_2SO_4 solution, density 1.14	Platinum	HNO_3 density 1.19	1.66
Grove	Amal. zinc	NaCl solution	Platinum	HNO_3 density, 1.33	1.88

Single Fluid Cells

Name of cell.	Negative pole.	Solution.	Positive pole.	E.M.F.
Dry cell	Zinc	Ammonium Chloride	Carbon with MnO_2	1.53
Leclanché	Amal. zinc	Solution of sal-ammoniac	Carbon, depolarizer: manganese peroxide with powd. carbon	1.46
Edison-Lalande	Amal. zinc	Solution of caustic potash	Copper, depolarizer, CuO	0.70
Chloride of silver	Zinc	23% sol. of sal-ammoniac	Silver, depolarizer: silver chloride	1.02

Storage Cells

Name of cell.	Negative pole.	Solution.	Positive pole.	E.M.F.
Lead accumulator	Lead	H_2SO_4 solution of density 1.1	PbO_2	2.2
Regnier (1)	Copper	$CuSO_4+H_2SO_4$	PbO_2	1.68 to 0.85, average, 1.3
Regnier (2)	Amal. zinc	$ZnSO_4$ solution	PbO_2 in H_2SO_4	2.36
Main	Amal. zinc	H_2SO_4, density about 1.1	PbO_2	2.50
Edison	Iron	KOH, 20% solution	A nickel oxide	1.1, mean of full discharge

CONTACT POTENTIALS

Potential of metal at left minus potential of metal at top in volts. The values are given for room temperature and for pressures, indicated by the superscript. Figures indicate pressure in mm of Hg, $^{\text{vac.}}$, vacuum, $^{\text{atm.}}$, atmospheric pressure. The figures are for fresh surfaces.

	Brass	Platinum	Other metals
Aluminum	$+1.04^{\text{vac.}}$ $+0.19^{\text{atm.}}$	+1.20	Fe, +0.87 Z , +0.29
Antimony	$+0.15^{\text{atm.}}$		
Bismuth	$+0.07^{\text{atm.}}$	+0.35	
Cadmium			Hg, $-0.22^{.05}$
$C^* + NH_3$			Cu, + 079
$C + H_2$			Cu, +.096
$C + N_2$			Cu, +.129
$C + CO_2$			Cu, + 130
$C + NO$			Cu, +.136
$C + O_2$			Cu, +.142
$C + O_3$			Cu, +.155
Copper	$+0.10^{\text{vac.}}$ $-0.04^{\text{atm.}}$	+0.13	
CuO			Li, −1.52
CuO			Na, −2.52
Gold	$-0.23^{\text{atm.}}$		
Iron	$+0.24^{\text{vac.}}$		Zn, $-0.06^{\text{vac.}}$
Lead	$+0.41^{\text{atm.}}$		
Magnesium	$+1.47^{\text{vac.}}$	+1.05	
Mercury			Sb, -0.26^{05}
Nickel	$+0.16^{\text{atm.}}$		Zn, $+0.17^{.05}$
Platinum	$-0.32^{\text{atm.}}$		
Potassium		+2.8	
Silver	$+0.05^{\text{vac.}}$ $-0.35^{\text{atm.}}$		
Sodium		+2.40	
Tin		+0.62	
Zinc		+0.90	

* Coconut charcoal saturated with the gas named.

DIFFERENCE OF POTENTIAL BETWEEN METALS IN SOLUTIONS OF SALTS

The table gives the difference in potential in hundredths of a volt between zinc in a normal solution of sulfuric acid and the metal named at the head of the columns in the solution named at the side. The signs given refer to the external difference of potential.

(Magnanini.)

Strength of the solution in gramme molecules per liter.	Difference of potential in centivolts.					
	Zinc.	Cadmium.	Lead.	Tin.	Copper.	Silver.
0.5 Sulfuric acid	0.0	36.6	51.3	51.3	100.7	121.3
1.0 Sodium hydroxide	−32.1	19.5	31.8	0.2	80.2	95.8
1.0 Potassium hydroxide	−42.5	15.5	32.0	−1.2	77.0	104.0
0.5 Sodium sulfate	1.4	35.6	50.8	51.4	101.3	120.9
1.0 Potassium nitrate	11.8	31.9	42.6	31.1	81.2	105.7
1.0 Sodium nitrate	11.5	32.3	51.0	40.9	95.7	114.8
0.5 Potassium bichromate	72.8	61.1	78.4	68.1	123.6	132.4
0.5 Potassium sulfate	1.8	34.7	51.0	40.9	95.7	114.8
0.2 Potassium chlorate	15.−10.	39.9	53.8	57.7	105.3	120.9
1.0 Ammonium chloride	2.9	32.4	51.3	50.9	81.2	101.7
1.0 Sodium chloride		31.9	51.2	50.3	80.9	101.3
1.0 Potassium chloride		32.1	51.6	52.6	81.6	107.6

ELECTROCHEMICAL EQUIVALENTS OF THE ELEMENTS

By G. A. Roush

Element	Valence	Mg per coulomb	Coulombs per mg	Grams per amp.-hr.	Amp.-hr. per gram	Lb./1000 amp.-hr.	Amp.-hr. per lb.
A	n	0.41393	2.41588	1.49014	0.67108	3.28519	304.396
Ab	7	0.32717	3.05656	1.17779	0.84904	2.59656	385.120
Ac	3	0.78411	1.27533	2.82280	0.35426	6.22320	160.689
Ag	1	1.11793[1]	0.89451	4.02454	0.24848	8.87259	112.707
Al	3	0.09316	10.73415	0.33538	2.98171	0.73938	1352.480
As	5	0.15254	6.44106	0.55891	1.78918	1.23219	811.560
	3	0.25876	3.86464	0.93152	1.07351	2.05366	486.936
Au	3	0.68117	1.46805	2.45223	0.40779	5.40624	184.972
	1	2.04352	0.48935	7.35668	0.13593	16.21871	61.657
B	3	0.03737	26.75602	0.13455	7.43223	0.29662	3371.201
Ba	2	0.71171	1.40507	2.56216	0.39030	5.64858	177.035
Be	2	0.04674	21.39688	0.16825	5.94358	0.37092	2695.963
Bi	5	0.43316	2.30861	1.55938	0.64128	3.43784	290.880
	3	0.72193	1.38517	2.59896	0.38477	5.72973	174.528
Br	1	0.82815	1.20752	2.98132	0.33542	6.57269	152.145
C	4	0.03111	32.13989	0.11201	8.92775	0.24694	4049.558
	2	0.06223	16.06994	0.22402	4.46387	0.49388	2024.779
Ca	2	0.20767	4.81537	0.74761	1.33760	1.64819	606.726
Cb	5	0.19256	5.19320	0.69321	1.44255	1.52828	654.332
Cd	2	0.58244	1.71693	2.09677	0.47692	4.62258	216.329
Ce	3	0.48404	2.06594	1.74255	0.57387	3.84166	260.304
Cl	1	0.36743	2.72161	1.32275	0.75600	2.91616	342.917
Co	2	0.30539	3.27452	1.09931	0.90966	2.42356	412.617
Cr	6	0.08983	11.13247	0.32338	3.09235	0.71293	1402.668
	3	0.17965	5.56624	0.64676	1.54618	1.42585	701.334
Cs	1	1.37731	0.72606	4.95830	0.20168	10.93118	91.481
Cu	2	0.32938	3.03602	1.18576	0.84334	2.61416	382.532
	1	0.65876	1.51801	2.37152	0.42167	5.22831	191.266
D[2]	1	0.020878	47.89771	0.075160	13.30492	0.16570	6035.011
Dy	3	0.56069	1.78351	2.01849	0.49542	4.44901	224.886
Er	3	0.57907	1.72691	2.08464	0.47970	4.59585	217.588
Eu	3	0.52504	1.90461	1.89016	0.52906	4.16708	241.911
F	1	0.19689	5.07895	0.70881	1.41082	1.56265	639.937
Fe	3	0.19291	5.18353	0.69451	1.43987	1.53113	653.114
	2	0.28938	3.45568	1.04176	0.95991	2.29669	435.409
Ga	3	0.24083	4.15232	0.86698	1.15342	1.91137	523.184
Gd	3	0.54179	1.84572	1.95046	0.51270	4.30002	232.737
Ge	4	0.18808	5.31680	0.67710	1.47689	1.49275	669.906
H	1	0.010446	95.73321	0.037605	26.59256	0.082904	12062.183
He	n	0.04147	24.11294	0.14930	6.69804	0.32914	3038.180
Hf	4	0.46269	2.16125	1.66570	0.60035	3.67223	272.313
Hg	2	1.03943	0.96207	3.74195	0.26724	8.24958	121.218
	1	2.07886	0.48103	7.48390	0.13362	16.49917	60.609
Ho	3	0.56974	1.75518	2 05107	0.48755	4.5218	221.149
I	1	1.31523	0.76032	4.73484	0.21120	10.43853	95.799
Il	3	0.50432	1.98288	2.72332	0.55080	3.90256	272.539
In	3	0.39641	2 52266	1.42707	0.70074	3.14614	317.849
Ir	4	0.50026	1.99896	1.80095	0.55546	3.97038	251.865
K	1	0.40514	2.46828	1.45850	0.68563	2.21545	310.998
Kr	n	0.86736	1.15293	3.12249	0.32026	6.88390	145.266

ELECTROCHEMICAL EQUIVALENTS OF THE ELEMENTS (Continued)

Element	Valence	Mg per coulomb	Coulombs per mg	Grams per amp.-hr.	Amp.-hr. per gram	Lb./1000 amp.-hr.	Amp.-hr. per lb.
La	3	0.47986	2.08393	1.72750	0.57887	3.80849	262.571
Li	1	0.07192	13.90490	0.25890	3.86247	0.57078	1751.988
Lu	3	0.60446	1.65438	2.17604	0.45955	4.79734	208.448
Ma	7	0.14478	6.90695	0.52121	1.91860	1.14908	870.262
Mg	2	0.12601	7.93586	0.45364	2.20440	1.00010	999.901
Mn	4	0.14230	7.02727	0.51229	1.95202	1.12941	885.421
	2	0.28461	3.51363	1.02458	0.97601	2.25881	442.711
Mo	6	0.16580	6.03125	0.59689	1.67535	1.31592	759.925
N	5	0.029032	34.44446	0.10452	9.56795	0.23042	4389.95
	3	0.048387	20.66676	0.17419	5.74077	0.38403	2603.97
Na	1	0.23831	4.19620	0.85792	1.16561	1.89139	528.712
Nd	3	0.49834	2.00665	1.79403	0.55740	3.95516	252.834
Ne	*n*	0.20915	4.78125	0.75294	1.32813	1.65995	602.428
Ni	2	0.30409	3.28846	1.09474	0.91346	2.41348	414.340
O	2	0.082902	12.06250	0.29845	3.35069	0.65796	1519.850
Os	4	0.49611	2.01567	1.78601	0.55991	3.93748	253.970
P	5	0.06421	15.57456	0.23115	4.32627	0.50959	1962.362
Pa	5	0.59845	2.08874	1.72352	0.58021	3.79972	263.177
Pb	4	0.53681	1.86284	1.93253	0.51746	4.26050	234.715
	2	1.07363	0.93142	3.86506	0.25873	8.52099	117.357
Pd	4	0.27642	3.61762	0.99513	1.00489	2.19388	455.812
Po	6	0.36269	2.75714	1.30570	0.76587	2.87857	347.394
Pr	3	0.48677	2.05436	1.75237	0.57065	3.86332	258.845
Pt	4	0.50578	1.97716	1.82080	0.54921	4.01417	249.117
Ra	2	1.17124	0.85379	4.21648	0.23716	9.29574	107.576
Rb	1	0.88580	1.12892	3.18889	0.31359	7.03030	142.241
Re	7	0.27581	3.62568	0.99292	1.00713	2.18901	456.828
Rh	4	0.26661	3.75085	0.95978	1.04190	2.11596	472.599
Rn	*n*	2.30052	0.43468	8.28187	0.12075	18.25839	54.769
Ru	4	0.26347	3.79548	0.94850	1.05430	2.09108	478.222
S	6	0.05537	18.05989	0.19934	5.01664	0.43946	2275.508
	4	0.08306	12.03993	0.29901	3.34442	0.65919	1517.005
	2	0.16611	6.01996	0.59801	1.67221	1.31839	758.503
Sb	5	0.25235	3.96272	0.90847	1.10075	2.00283	499.294
	3	0.42059	2.37763	1.51411	0.66045	3.33805	299.576
Sc	3	0.15579	6.41907	0.56083	1.78307	1.23642	808.789
Se	6	0.13637	7.33283	0.49094	2.03690	1.08234	923.921
Si	4	0.07269	13.75624	0.26170	3.82118	0.57695	1733.257
Sm	3	0.51962	1.92448	1.87063	0.53458	4.12404	242.481
Sn	4	0.30751	3.25190	1.10705	0.90330	2.44062	409.732
Sn	2	0.61503	1.62595	2.21409	0.45165	4.88124	204.866
Sr	2	0.45404	2.20244	1.63455	0.61179	3.60356	277.503
Ta	5	0.37488	2.66751	1.34957	0.74098	2.97529	336.101
Tb	3	0.54991	1.181847	1.97969	0.50513	4.36447	229.113
Te	6	0.22040	4.53726	0.79343	1.26037	1.74921	571.686
Th	4	0.60135	1.66293	2.16485	0.46193	4.77268	209.526
Ti	4	0.12409	8.05846	0.44674	2.23846	0.98488	1015.348
Tl	3	0.70601	1.41641	2.54164	0.39345	5.59002	178.571
Tm	3	0.58515	1.70897	2.10653	0.47471	4.64410	215.327
U	6	0.41117	2.43206	1.48023	0.67557	3.26168	306.591

ELECTROCHEMICAL EQUIVALENTS OF THE ELEMENTS (Continued)

Element	Valence	Mg per coulomb	Coulombs per mg	Grams per amp.-hr.	Amp.-hr. per gram	Lb./1000 amp.-hr.	Amp.-hr. per lb.
V	5	0.1056*0*	9.470*07*	0.3801*5*	2.630*57*	0.8380*8*	1193.*209*
Vi	1	2.32*124*	0.430*80*	8.35*648*	0.119*67*	18.4*2288*	54.*280*
W	6	0.3177*9*	3.146*74*	1.144*04*	0.8740*9*	2.522*18*	396.4*83*
Xe	*n*	1.360*62*	0.7349*6*	4.898*24*	0.2041*6*	10.79*877*	92.60*3*
Y	3	0.3071*5*	3.255*74*	1.105*74*	0.9043*7*	2.437*74*	410.*216*
Yb	3	0.59772	1.6730*2*	2.1517*9*	0.46473	4.7438*9*	210.797
Zn	2	0.3387*6*	2.951*97*	1.219*52*	0.8199*9*	2.688*59*	371.9*42*
Zr	4	0.2363*2*	4.231*53*	0.8507*6*	1.175*42*	1.875*60*	533.1*64*

The above compilation is abridged from a complete table published in Volume 73 of the Transactions of the Electrochemical Society, but has been corrected to correspond to the 1942 atomic weights as published by the American Chemical Society and the best values obtainable for the few elements not listed in the official table; in most cases the only valence covered is that which determines the placing of the element in the periodic table, though in a few cases the most important valence from an electrochemical standpoint is given precedence, and for a few of the more important elements two or more valences are given; values for elements in the O group of the periodic system are calculated on the basis of unit valence, listed as *n*, to distinguish them from elements with a true unit valence. For uses where a more complete table is required, the reader is referred to the original publication

Digits printed in italics may, if desired, be dropped from the values, rounding them off to the nearest preceding digit; such digits have been carried as a matter of convenience and uniformity in calculating and tabulating, but are in excess of the number of significant figures in the primary data, and hence do not add to the true accuracy of the results.

[1] This value varies from the basic figure of 1.1180 mg because of the rounding off of the value of the Faraday to 96,500 coulombs; other values also differ in the same proportion.

[2] This is the second isotope of hydrogen, and is the only isotope included in the table, as no others have as yet been isolated to a sufficient degree to have their atomic weights determined.

INTERNAL RESISTANCE OF VARIOUS VOLTAIC CELLS

The internal resistance is subject to large variations; the values given can be considered only approximate.

Cell	Resistance, ohms	Cell	Resistance, ohms
Edison-Lalande...	0.03	Grove............	0.1–0.2
Daniell...........	0.85	Bunsen...........	0.1–0.2
Gravity..........	1–5	Bichromate.......	0.08–0.40
Silver chloride....	4.	Storage..........	0.004–0.02
Dry cell..........	0.05–0.10	Clark standard....	20–50
Leclanché........	0.4–0.2	Weston standard...	20–50

IONIZATION POTENTIALS

The Elements

The following table gives the ionization potentials in volts for the elements in the atomic state. The degree of ionization is indicated by the numerals I, II, etc. Doubtful values are indicated by parentheses.

El.	At. No.	Ionization potential, volts					
		I	II	III	IV	V	VI
A	18	15.68	27.76	40.75	(61)	(78)	....
Ac	89	....	....	....	....	....	....
Ag	47	7.542	21.4	35.9	....	....	....
Al	13	5.96	18.74	28.31	119.37	153.4	....
As	33	10.5	20.1	28.0	49.9	62.5	....
Au	79	9.18	19.95	....	....	....	....
B	5	8.257	25.00	37.75	258.1	338.5	....
Ba	56	5.19	9.95	....	....	....	....
Be	4	9.28	18.12	153.1	216.6	....	....
Bi	83	8.0	16.6	25.42	45.1	55.7	....
Br	35	11.80	19.1	25.7	(50)	....	....
C	6	11.217	24.27	47.65	64.22	390.1	....
Ca	20	6.09	11.82	50.96	69.7	....	....
Cb	41	....	....	24.2	....	49.3	....
Cd	48	8.96	16.84	38.0	....	....	....
Ce	58	6.54	14.8	....	(36.5)	....	....
Cl	17	12.952	23.67	39.69	53.16	67.4	....
Co	27	7.81	17.3	....	....	....	....
Cr	24	6.74	16.6	....	....	(73)	....
Cs	55	3.87	23.4	(35)	(51)	(58)	....
Cu	29	7.68	20.34	29.5	....	....	....
Dy	66	6.8	....	....	....	....	....
Er	68	....	....	....	....	....	....
Eu	63	5.64	11.4	....	....	....	....
F	9	17.34	34.81	62.35	86.72	113.67	156.37*
Fe	26	7.83	16.16	....	....	....	....
Ga	31	5.97	20.43	30.6	63.8	....	....
Gd	64	6.7	....	....	....	....	....
Ge	32	8.09	15.86	34.07	45.5	93.0	....
H	1	13.527	....	....	....	....	....
He	2	24.46	54.14	....	....	....	....
Hf	72	....	(14.8)	....	....	....	....
Hg	80	10.39	18.65	34.3	(72)	(82)	....
Ho	67	....	....	....	....	....	....
I	53	10.6	19.4	....	....	....	....
Il	61	....	....	....	....	....	....
In	49	5.76	18.79	27.9	57.8	....	....
Ir	77	....	....	....	....	....	....
K	19	4.318	31.66	46.5	....	....	....
Kr	36	13.93	26.4	36.8	(68)	....	....
La	57	5.6	11.4	(20.4)	....	....	....
Li	3	5.363	75.26	121.8	....	....	....
Lu	71	....	....	....	....	....	....
Ma	43	....	....	....	....	....	....
Mg	12	7.61	14.96	79.72	108.9	....	....
Mn	25	7.41	15.70	....	....	(76)	....
Mo	42	7.35	....	....	....	60.8	....
N	7	14.48	29.47	47.40	77.0	97.4	....
Na	11	5.12	47.06	70.72	....	....	....
Nd	60	6.3	....	....	....	....	....
Ne	10	21.47	40.9	63.2	....	....	....

* Seventh ionization potential of fluorine, 184.26 volts.

IONIZATION POTENTIALS (Continued)

THE ELEMENTS (Continued)

El.	At. No.	Ionization potential, volts					
		I	II	III	IV	V	VI
Ni	28	7.61	18.2	......	......	......	......
O	8	13.550	34.93	54.87	76.99	113.	137.5
Os	76	(8.7)	......	......	......	......	......
P	15	10.9	19.56	30.012	51.106	64.698	......
Pa	91	......	......	......	......	......	......
Pb	82	7.38	14.96	(31.9)	42.11	69.4	......
Pd	46	8.3	19.8	......	......	......	......
Po	84	......	......	......	......	......	......
Pr	59	5.8	......	......	......	......	......
Pt	78	8.88	......	......	......	......	......
Ra	88	5.252	10.099	......	......	......	......
Rb	37	4.159	27.36	(47)	(80)	......	......
Re	75	......	......	......	......	......	......
Rh	45	7.7	......	......	......	......	......
Rn	86	10.698	......	......	......	......	......
Ru	44	7.7	......	......	......	......	......
S	16	10.30	23.3	34.9	47.08	63.	87.65
Sb	51	8.5	(18)	24.7	44.0	55.5	......
Sc	21	6.7	12.8	24.61	(73.9)	(97.0)	......
Se	34	9.70	21.3	33.9	42.72	72.8	......
Si	14	8.12	16.27	33.35	44.93	165.6	......
Sm	62	6.6	11.4	......	......	......	......
Sn	50	7.30	14.5	30.5	39.4	80.7	......
Sr	38	5.667	10.98	......	......	......	......
Ta	73	......	......	......	......	......	......
Tb	65	6.7	......	......	......	......	......
Te	52	8.96	......	30.5	37.7	60.0	(72)
Th	90	......	......	29.4	......	......	......
Ti	22	6.81	13.6	27.6	42.98	(99.6)	......
Tl	81	6.07	20.32	29.7	50.5	......	......
Tm	69	......	......	......	......	......	......
U	92	......	......	......	......	......	......
V	23	6.71	14.1	(26.4)	(48)	(65)	......
W	74	8.1	......	......	......	......	......
Xe	54	12.08	(21.1)	32.0	(46)	(76)	......
Y	39	6.5	12.3	20.4	......	......	......
Yb	70	7.1	......	......	......	......	......
Zn	30	9.36	17.89	40.0	......	......	......
Zr	40	6.92	13.97	24.00	33.8	......	......

COMPOUNDS

The first ionization potential of the molecules indicated is given in volts.

Compound	Ionization potential I volts	Compound	Ionization potential I volts
Br_2	12.8	CH_3Cl, methyl chloride	10.7
BrCl	12.9 (calc.)	CH_3I, methyl iodide	9.1
C_2	12	CH_4, methane	14.5
CH_2O, formaldehyde	11.3	CN	14
CH_3Br, methyl bromide	10.0	CO	14.1

IONIZATION POTENTIALS (Continued)

COMPOUNDS (Continued)

Compound	Ionization potential I volts	Compound	Ionization potential I volts
CO_2	14.4	HI	12.8
CS	10.6	H_2O	12.56
CS_2	10.4	H_2S	10.42
C_2H_2, acetylene	11.6	I_2	9.7
C_2H_4, ethylene	12.2	IBr	11.6 (calc.)
C_2H_6, ethane	12.8	ICl	11.9 (calc.)
C_6H_6, benzene	9.6	N_2	15.51
C_7H_8, toluene	8.5	NH_3	11.2
Cl_2	13.2	NO	9.5
F_2	17.8 (calc.)	NO_2	11.0
H_2	15.6	N_2O	12.9
HBr	13.2	O_2	12.5
HCN	14.8	S_2	10.7
HCl	13.8	SO_2	13.1
HF	17.7 (calc.)		

NUCLEAR SPINS AND MOMENTS

Arnold L. Blum, Varian Associates

The following symbols are used in this table:

A = Mass number (number of protons and neutrons)
Z = Atomic number (number of protons)
I = Nuclear spin in units of $h/2\pi$
μ = Magnetic moment without diamagnetic correction
Q = Electric quadrupole moment in units of 10^{-24} cm^2
* = radioactive isotope

The experimental method employed for the most precise measurements of μ is indicated by the following code:

B = Electron paramagnetic resonance
C = Atomic and molecular beams
D = Microwave spectroscopy
E = Optical hyperfine structure
F = Nuclear alignment at low temperatures
G = Nuclear magnetic resonance

The number of significant figures of any quantity in the table is intended to indicate that measurements have been made to at least that order of accuracy. It should be noted, however, that differences in chemical environment can shift the measured Larmor frequency of any nuclide by amounts many times greater than the uncertainty in a nuclear magnetic resonance measurement.

Nuclide		Spin I	Magnetic moment μ	Larmor frequency megacycles at 10^4 gauss	Method of μ measurement	Quadrupole moment Q
Z	A					
0	n 1 *	$\frac{1}{2}$	-1.91315	29.1681	C	....
1	H 1	$\frac{1}{2}$	2.79268	42.5776	G	....
1	H 2	1	0.85738	6.5359	A	2.77×10^{-3}
1	H 3 *	$\frac{1}{2}$	2.9787	45.414	A	....
2	He 3	$\frac{1}{2}$	-2.1274	32.435	A	....
3	Li 6	1	0.82191	6.265	A	4.6×10^{-4}
3	Li 7	$\frac{3}{2}$	3.2560	16.547	A	-4.2×10^{-2}
4	Be 9	$\frac{3}{2}$	-1.1774	5.983	A	2×10^{-2}
5	B 10	3	1.8006	4.575	A	0.111
5	B 11	$\frac{3}{2}$	2.6880	13.660	A	3.55×10^{-2}
6	C 13	$\frac{1}{2}$	0.70216	10.705	A	....
7	N 14	1	0.40357	3.076	A	7.1×10^{-2}
7	N 15	$\frac{1}{2}$	-0.28304	4.315	A	....
8	O 17	$\frac{5}{2}$	-1.8930	5.772	A	-4×10^{-3}
9	F 19	$\frac{1}{2}$	2.6272	40.055	A	....
10	Ne 21	$\frac{3}{2}$	....	....	...	....
11	Na 22 *	3	1.745	4.434	C	....
11	Na 23	$\frac{3}{2}$	2.2161	11.262	A	0.1
11	Na 24 *	4	1.69	3.22	C	....
12	Mg 25	$\frac{5}{2}$	-0.85470	2.606	A	....
13	Al 27	$\frac{5}{2}$	3.6385	11.094	A	0.149
14	Si 29	$\frac{1}{2}$	-0.55477	8.458	A	....
15	P 31	$\frac{1}{2}$	1.1305	17.236	A	....
16	S 33	$\frac{3}{2}$	0.64274	3.266	A	-6.4×10^{-2}
16	S 35 *	$\frac{3}{2}$	1.00	5.08	D	4.5×10^{-2}
17	Cl 35	$\frac{3}{2}$	0.82088	4.172	A	-7.97×10^{-2}
17	Cl 36 *	2	1.2839	4.893	A	-1.68×10^{-2}
17	Cl 37	$\frac{3}{2}$	0.68328	3.472	A	-6.21×10^{-2}
19	K 39	$\frac{3}{2}$	0.39094	1.987	A	0.14
19	K 40 *	4	-1.296	2.470	C	....
19	K 41	$\frac{3}{2}$	0.21453	1.090	A	....
19	K 42 *	2	-1.14	4.34	C	....
20	Ca 43	$\frac{7}{2}$	-1.3153	2.865	A	....
21	Sc 45	$\frac{7}{2}$	4.7491	10.344	A	....
22	Ti 47	$\frac{5}{2}$	-0.78711	2.400	A	....
22	Ti 49	$\frac{7}{2}$	-1.1023	2.401	A	....
23	V 49 *	$\frac{7}{2}$	4.68	10.2	B	....
23	V 50	6	3.3413	4.245	A	....
23	V 51	$\frac{7}{2}$	5.1392	11.193	A	0.3
24	Cr 53	$\frac{3}{2}$	-0.47354	2.406	A	....
25	Mn 53 *	$\frac{7}{2}$	5.050	11.00	B	....
25	Mn 55	$\frac{5}{2}$	3.4610	10.553	A	0.5

NUCLEAR SPINS AND MOMENTS (Continued)

Nuclide			Spin I	Magnetic moment μ	Larmor frequency megacycles at 10^4 gauss	Method of μ measurement	Quadrupole moment Q
Z	A						
26	Fe 57		...	≤ 0.05	...	B	...
27	Co 56	*	4	3.855	7.347	B	...
27	Co 57	*	$\frac{7}{2}$	4.65	10.1	B	...
27	Co 58	*	2	4.052	15.44	B	...
27	Co 59		$\frac{7}{2}$	4.6388	10.103	A	0.5
27	Co 60	*	5	3.800	5.793	B	...
28	Ni 61		...	<0.25	...	E	...
29	Cu 63		$\frac{3}{2}$	2.2206	11.285	A	−0.15
29	Cu 64	*	1	0.40	3.0	C	...
29	Cu 65		$\frac{3}{2}$	2.3789	12.090	A	−0.14
30	Zn 67		$\frac{5}{2}$	0.8735	2.664	A	0.18
31	Ga 69		$\frac{3}{2}$	2.0107	10.219	A	0.2318
31	Ga 71		$\frac{3}{2}$	2.5549	12.984	A	0.1461
32	Ge 73		$\frac{9}{2}$	−0.8768	1.485	A	−0.2
33	As 75		$\frac{3}{2}$	1.4348	7.292	A	0.3
34	Se 75	*	$\frac{5}{2}$	...	...	..	1.1
34	Se 77		$\frac{1}{2}$	0.5333	8.131	A	...
34	Se 79	*	$\frac{7}{2}$	−1.015	2.211	D	0.9
35	Br 79		$\frac{3}{2}$	2.0990	10.667	A	0.33
35	Br 81		$\frac{3}{2}$	2.2626	11.499	A	0.28
36	Kr 83		$\frac{9}{2}$	−0.968	1.64	C	0.15
36	Kr 85	*	$\frac{9}{2}$	1.00	1.70	E	2.5
37	Rb 81	*	$\frac{3}{2}$	2.00	10.2	C	...
37	Rb 82	*	5	...	...	..	...
37	Rb 83	*	$\frac{5}{2}$	...	...	..	...
37	Rb 84	*	2	...	...	..	...
37	Rb 85		$\frac{5}{2}$	1.3482	4.111	A	0.31
37	Rb 86	*	2	(−)1.7	6.5	C	...
37	Rb 87		$\frac{3}{2}$	2.7414	13.932	A	0.15
38	Sr 87		$\frac{9}{2}$	−1.0893	1.845	A	...
39	Y 89		$\frac{1}{2}$	−0.1368	2.086	A	...
40	Zr 91		$\frac{5}{2}$	−1.298	3.958	A	...
41	Nb 93		$\frac{9}{2}$	6.1435	10.407	A	−0.2
42	Mo 95		$\frac{5}{2}$	−0.9099	2.774	A	...
42	Mo 97		$\frac{5}{2}$	−0.9290	2.833	A	...
43	Tc 99	*	$\frac{9}{2}$	5.6572	9.583	A	0.3
44	Ru 99		$\frac{5}{2}$	−0.63	1.9	E	...
44	Ru 101		$\frac{5}{2}$	−0.69	2.1	E	...
45	Rh 103		$\frac{1}{2}$	−0.0879	1.340	A	...
46	Pd 105		$\frac{5}{2}$	−0.57	1.74	E	...
47	Ag 105	*	$\frac{1}{2}$	...	...	..	...
47	Ag 107		$\frac{1}{2}$	−0.1130	1.723	A	...
47	Ag 109		$\frac{1}{2}$	−0.1299	1.981	A	...
47	Ag 111	*	$\frac{1}{2}$	−0.145	2.21	C	...
48	Cd 111		$\frac{1}{2}$	−0.5922	9.028	A	...
48	Cd 113		$\frac{1}{2}$	−0.6195	9.444	A	...
49	In 113		$\frac{9}{2}$	5.4956	9.310	A	1.144
49	In 115	*	$\frac{9}{2}$	5.5072	9.329	A	1.161
50	Sn 115		$\frac{1}{2}$	−0.9132	13.92	A	...
50	Sn 117		$\frac{1}{2}$	−0.9949	15.17	A	...
50	Sn 119		$\frac{1}{2}$	−1.0408	15.87	A	...
51	Sb 121		$\frac{5}{2}$	3.3417	10.19	A	−0.53
51	Sb 123		$\frac{7}{2}$	2.5334	5.518	A	−0.68
52	Te 123		$\frac{1}{2}$	−0.7319	11.16	A	...
52	Te 125		$\frac{1}{2}$	−0.8824	13.45	A	...
53	I 125	*	$\frac{5}{2}$	...	...	..	0.8
53	I 127		$\frac{5}{2}$	2.7940	8.519	A	−0.69
53	I 129	*	$\frac{7}{2}$	2.6030	5.669	A	−0.43
53	I 131	*	$\frac{7}{2}$	...	...	..	−0.412
54	Xe 129		$\frac{1}{2}$	−0.7725	11.78	A	...
54	Xe 131		$\frac{3}{2}$	0.6868	3.490	A	−0.12
55	Cs 127	*	$\frac{1}{2}$	1.41	21.5	C	...
55	Cs 129	*	$\frac{1}{2}$	1.47	22.4	C	...
55	Cs 130	*	1	...	...	..	...
55	Cs 131	*	$\frac{5}{2}$	3.48	10.6	C	...
55	Cs 132	*	2	...	...	..	...

NUCLEAR SPINS AND MOMENTS (Continued)

Nuclide			Spin I	Magnetic moment μ	Larmor frequency megacycles at 10^4 gauss	Method of μ measurement	Quadrupole moment Q
Z		A					
55	Cs	133	$\frac{7}{2}$	2.5642	5.585	A	-3×10^{-3}
55	Cs	134 *	4	2.96	5.64	C	....
55	Cs	135 *	$\frac{7}{2}$	2.727	5.94	C	....
55	Cs	137 *	$\frac{7}{2}$	2.84	6.18	C	....
56	Ba	135	$\frac{3}{2}$	0.8323	4.230	A	....
56	Ba	137	$\frac{3}{2}$	0.9311	4.732	A	....
57	La	138 *	5	3.684	5.617	A	2.7
57	La	139	$\frac{7}{2}$	2.7614	6.014	A	0.6
58	Ce	141 *	$\frac{7}{2}$	0.16	0.35	F	....
59	Pr	141	$\frac{5}{2}$	3.92	11.95	B	-5.4×10^{-2}
60	Nd	143	$\frac{7}{2}$	-1.03	2.24	B	<1.2
60	Nd	145	$\frac{7}{2}$	0.64	1.4	B	<1.2
60	Nd	147 *	$\frac{9}{2}$	0.22	0.37	F	....
62	Sm	147	$\frac{7}{2}$	-0.83	1.8	B	0.72
62	Sm	149	$\frac{7}{2}$	-0.68	1.5	B	0.72
63	Eu	151	$\frac{5}{2}$	3.4	10.	E	~ 1.2
63	Eu	153	$\frac{5}{2}$	1.5	4.6	E	~ 2.5
63	Eu	154 *	3	2.0	5.1	B	....
64	Gd	155	$\frac{3}{2}$	-0.24	1.2	B	1.1
64	Gd	157	$\frac{3}{2}$	-0.32	1.6	B	1.0
65	Tb	159	$\frac{3}{2}$	1.52	7.72	B	....
66	Dy	161	$\frac{5}{2}$	0.38	1.2	B	....
66	Dy	163	$\frac{5}{2}$	0.53	1.6	B	....
67	Ho	165	$\frac{7}{2}$	3.29	7.17	B	2
68	Er	167	$\frac{7}{2}$	0.48	1.04	B	~ 10
69	Tm	169	$\frac{1}{2}$	-0.20	3.05	E	....
70	Yb	171	$\frac{1}{2}$	0.43	6.6	B	....
70	Yb	173	$\frac{5}{2}$	-0.60	1.8	B	3.9
71	Lu	175	$\frac{7}{2}$	2.6	5.7	E	5.8
71	Lu	176 *	$\geqslant 7$	4.2	....	E	6–8
72	Hf	177	$\frac{7}{2}$	0.61	1.3	E	3
72	Hf	179	$\frac{9}{2}$	-0.47	0.80	E	3
73	Ta	181	$\frac{7}{2}$	2.1	4.6	E	6.0
74	W	183	$\frac{1}{2}$	0.115	1.75	A	....
75	Re	185	$\frac{5}{2}$	3.1437	9.586	A	2.8
75	Re	187	$\frac{5}{2}$	3.1760	9.684	A	2.6
76	Os	187	$\frac{1}{2}$	~ 0.12	~ 1.8	E	....
76	Os	189	$\frac{3}{2}$	0.6506	3.307	A	2.0
77	Ir	191	$\frac{3}{2}$	0.16	0.813	E	~ 1.2
77	Ir	193	$\frac{3}{2}$	0.17	0.86	E	~ 1.0
78	Pt	195	$\frac{1}{2}$	0.6004	9.153	A	....
79	Au	197	$\frac{3}{2}$	0.136	0.691	E	0.56
79	Au	198 *	2	0.50	1.9	C	....
79	Au	199 *	$\frac{3}{2}$	0.24	1.2	C	....
80	Hg	197 *	$\frac{1}{2}$	0.52	7.9	E	....
80	Hg	199	$\frac{1}{2}$	0.499	7.61	A	....
80	Hg	201	$\frac{3}{2}$	-0.607	3.08	E	0.5
81	Tl	199 *	$\frac{1}{2}$	....	....	..	....
81	Tl	203	$\frac{1}{2}$	1.5960	24.33	A	....
81	Tl	204 *	2	....	....	..	....
81	Tl	205	$\frac{1}{2}$	1.6114	24.57	A	....
82	Pb	207	$\frac{1}{2}$	0.5837	8.899	A	....
83	Bi	209	$\frac{9}{2}$	4.0389	6.842	A	-0.4
84	Po	209 *	$\frac{1}{2}$	....	....	..	....
89	Ac	227 *	$\frac{3}{2}$	1.1	5.6	E	-1.7
91	Pa	231 *	$\frac{3}{2}$	....	....	..	....
92	U	233 *	$\frac{5}{2}$	~ 0.51	1.5	B	0.34
92	U	235 *	$\frac{7}{2}$	~ 0.51	1.1	B	4.0
93	Np	237 *	$\frac{5}{2}$	6 ± 2.5	~ 20	B	....
93	Np	239 *	$\frac{1}{2}$	....	....	..	....
94	Pu	239 *	$\frac{1}{2}$	0.4	6.1	B	....
94	Pu	241 *	$\frac{5}{2}$	1.4	4.3	B	....
95	Am	241 *	$\frac{5}{2}$	1.4	4.3	E	4.9
95	Am	243 *	$\frac{5}{2}$	1.4	4.3	E	4.9
96	Cm	244 *	$\frac{7}{2}$	....	....	..	....

RELATIVE SENSITIVITIES

This table gives sensitivities relative to the proton for nuclear magnetic resonance experiments, as computed from the following formulas:

$$(\text{Sens. at const. field}) = 7.652 \times 10^{-3}\mu^3(I + 1)/I^2,$$
$$(\text{Sens. at const. frequency}) = 0.2387\mu(I + 1).$$

They represent induced signal voltages relative to a *constant* noise input in an idealized experiment where the only quantities varied are the spins and magnetic moments of the nuclei.

The actual signal-to-noise ratio in any nuclear magnetic resonance experiment is affected by a large number of factors, including sample geometry, relaxation times, line splittings, variations in receiver sensitivity with frequency, and isotopic abundance. Whereas the above parameters vary with the experiment and the apparatus, the listed sensitivities represent the best that can be expected under absolutely optimum conditions.

Nuclide		Relative sensitivity	
		At constant field	At constant frequency
n	1	0.32	0.68
H	1	**1.00**	**1.00**
H	2	9.6×10^{-3}	0.41
H	3	1.21	1.07
He	3	0.44	0.76
Li	6	8.5×10^{-3}	0.39
Li	7	0.29	1.94
Be	9	1.4×10^{-2}	0.70
B	10	2.0×10^{-2}	1.72
B	11	0.16	1.60
C	13	1.6×10^{-2}	0.25
N	14	1.0×10^{-3}	0.19
N	15	1.0×10^{-3}	0.10
O	17	2.9×10^{-2}	1.58
F	19	0.83	0.94
Ne	21	....	....
Na	22	1.8×10^{-2}	1.67
Na	23	9.3×10^{-2}	1.32
Na	24	1.2×10^{-2}	2.02
Mg	25	2.7×10^{-3}	0.71
Al	27	0.21	3.04
Si	29	7.8×10^{-2}	0.20
P	31	6.6×10^{-2}	0.40
S	33	2.3×10^{-3}	0.38
S	35	8.5×10^{-3}	0.60
Cl	35	4.7×10^{-3}	0.49
Cl	36	1.2×10^{-2}	0.92
Cl	37	2.7×10^{-3}	0.41
K	39	5.1×10^{-4}	0.23
K	40	5.2×10^{-3}	1.55
K	41	8.4×10^{-5}	0.13
K	42	8.5×10^{-3}	0.82
Ca	43	6.4×10^{-3}	1.41
Sc	45	0.30	5.10
Ti	47	2.1×10^{-3}	0.66
Ti	49	3.8×10^{-3}	1.18
V	49	0.25	4.80
V	50	5.5×10^{-2}	5.58
V	51	0.38	5.53
Cr	53	9.0×10^{-5}	0.28
Mn	53	0.28	5.42
Mn	55	0.18	2.89
Fe	57	....	....
Co	56	0.14	4.60
Co	57	0.28	4.99
Co	58	0.38	2.90
Co	59	0.28	4.83
Co	60	0.10	5.44
Ni	61	....	....
Cu	63	9.3×10^{-2}	1.32
Cu	64	9.8×10^{-4}	0.19
Cu	65	0.11	1.42
Zn	67	2.9×10^{-3}	0.73
Ga	69	6.9×10^{-2}	1.20
Ga	71	0.14	1.52
Ge	73	1.4×10^{-3}	1.15
As	75	2.5×10^{-2}	0.86
Se	75	....	....
Se	77	7.0×10^{-3}	0.19
Se	79	2.9×10^{-3}	1.09
Br	79	7.9×10^{-2}	1.25
Br	81	9.8×10^{-2}	1.35
Kr	83	1.9×10^{-3}	1.27
Kr	85	2.1×10^{-3}	1.31
Rb	81	6.8×10^{-3}	0.07
Rb	82	....	....
Rb	83	....	....
Rb	84	....	....
Rb	85	1.0×10^{-2}	1.13
Rb	86	2.8×10^{-2}	1.2
Rb	87	0.18	1.64
Sr	87	2.7×10^{-3}	1.43
Y	89	1.2×10^{-4}	0.05
Zr	91	9.4×10^{-3}	1.08
Nb	93	0.48	8.07
Mo	95	3.2×10^{-3}	0.76
Mo	97	3.4×10^{-3}	0.78
Tc	99	0.38	7.43
Ru	99	1.1×10^{-3}	0.53
Ru	101	1.4×10^{-3}	0.58
Rh	103	3.1×10^{-5}	0.03
Pd	105	7.8×10^{-4}	0.48
Ag	105	....	....
Ag	107	6.6×10^{-5}	0.04
Ag	109	1.0×10^{-4}	0.05
Ag	111	1.4×10^{-4}	0.05
Cd	111	9.5×10^{-3}	0.21
Cd	113	1.1×10^{-2}	0.22
In	113	0.34	7.22
In	115	0.35	7.23

RELATIVE SENSITIVITIES (Continued)

Nuclide	Relative sensitivity	
	At constant field	At constant frequency
Sn 115	3.5×10^{-2}	0.33
Sn 117	4.5×10^{-2}	0.36
Sn 119	5.2×10^{-2}	0.37
Sb 121	0.16	2.79
Sb 123	4.6×10^{-2}	2.72
Te 123	1.8×10^{-2}	0.26
Te 125	3.2×10^{-2}	0.32
I 125	....	....
I 127	9.4×10^{-2}	2.33
I 129	5.0×10^{-2}	2.80
I 131	....	....
Xe 129	2.1×10^{-2}	0.28
Xe 131	2.8×10^{-3}	0.41
Cs 127	0.13	0.51
Cs 129	0.15	0.53
Cs 130	....	....
Cs 131	0.18	2.91
Cs 132	....	....
Cs 133	4.7×10^{-2}	2.75
Cs 134	6.2×10^{-2}	3.53
Cs 135	5.7×10^{-2}	2.93
Cs 137	6.4×10^{-2}	3.05
Ba 135	4.9×10^{-3}	0.50
Ba 137	6.9×10^{-3}	0.55
La 138	9.2×10^{-2}	2.64
La 139	5.9×10^{-2}	2.97
Ce 141	1.1×10^{-5}	0.17
Pr 141	0.26	3.27
Nd 143	3.1×10^{-3}	1.11
Nd 145	7.4×10^{-4}	0.69
Nd 147	2.2×10^{-5}	0.29
Sm 147	1.6×10^{-3}	0.89
Sm 149	8.8×10^{-4}	0.73
Eu 151	0.17	2.84
Eu 153	1.4×10^{-2}	1.25
Eu 154	2.7×10^{-2}	1.91
Gd 155	1.2×10^{-4}	0.14
Gd 157	2.8×10^{-4}	0.19
Tb 159	3.0×10^{-2}	0.91
Dy 161	2.3×10^{-4}	0.32
Dy 163	6.4×10^{-4}	0.44
Ho 165	0.10	3.53
Er 167	3.1×10^{-4}	0.52
Tm 169	3.7×10^{-4}	0.07
Yb 171	3.6×10^{-3}	0.15
Yb 173	9.3×10^{-4}	0.50
Lu 175	4.9×10^{-2}	2.79
Lu 176	....	....
Hf 177	6.4×10^{-4}	0.65
Hf 179	2.2×10^{-3}	0.62
Ta 181	2.6×10^{-2}	2.26
W 183	7.0×10^{-5}	0.04
Re 185	0.13	2.63
Re 187	0.14	2.65
Os 187	7.9×10^{-5}	0.04
Os 189	2.3×10^{-3}	0.39
Ir 191	3.5×10^{-5}	0.09
Ir 193	4.2×10^{-5}	0.10
Pt 195	9.9×10^{-3}	0.22
Au 197	2.1×10^{-5}	0.08
Au 198	7.2×10^{-4}	0.36
Au 199	1.2×10^{-4}	0.14
Hg 197	6.5×10^{-3}	0.19
Hg 199	5.7×10^{-3}	0.18
Hg 201	1.9×10^{-3}	0.36
Tl 199	....	....
Tl 203	0.19	0.57
Tl 204	....	....
Tl 205	0.19	0.58
Pb 207	9.1×10^{-3}	0.21
Bi 209	0.14	5.30
Po 209	....	....
Ac 227	1.1×10^{-2}	0.66
Pa 231	....	....
U 233	5.7×10^{-4}	0.43
U 235	3.7×10^{-4}	0.55
Np 237	0.93	5.01
Np 239	....	....
Pu 239	2.9×10^{-3}	0.14
Pu 241	1.2×10^{-2}	1.17
Am 241	1.2×10^{-2}	1.17
Am 243	1.2×10^{-2}	1.17
Cm 244	....	....

ELECTRON WORK FUNCTIONS OF THE ELEMENTS

From data published up to 1954

Compiled by Herbert B. Michaelson

Preferred values for well-outgassed polycrystalline materials are indicated by an asterisk (*). Because of the anisotropy and allotropy of work function, however, the designation "preferred value" has a rather limited meaning.

Values are expressed in electron-volts.

Each value is followed by a reference to the literature.

Element	Thermionic Work Function	Photoelectric Work Function	Work Function by Contact Potential Method
Ag	3.09 (1)	3.67 (4)	4.21 (116)
	3.56 (2)	4.1 to 4.75 (5)	4.33 (8)
	4.08 (3)	4.50 to 4.52 (117)	4.35 (115)
	4.31 (114)	4.56 (600°)* (6)	4.44 (9)
		4.73 (20°)* (6)	4.47 (10)
		4.75 (111) face (7)	
		4.81 (100) face (7)	
Al	...	2.98 (4)	3.38 (9)
		3.43 (11)	4.25 (115)
		4.08* (12)	
		4.20 (113)	
		4.36 (13)	
As	...	4.72 (118)	
		5.11 (14)	
Au	4.0 to 4.58 (2)	4.73 (740°C)* (15)	4.46 (9)
	4.25 (114)	4.82 (20°C)* (15)	
	4.32 (3)	4.86 to 4.92 (5)	
B	...	4.4 to 4.6 (16)	
Ba	2.11 (17)	2.48* (19)	1.73 (9)
		2.49 (20)	2.39 (18)
		2.52 (21)	
Be	...	3.17 (14)	3.10 (9)
		3.30 (22)	
		3.92* (23)	
Bi	...	4.14 (11)	4.17 (9)
		4.22 to 4.25* (24)	
		4.31 (25)	
		4.34 (118)	
		4.44 (22)	
		4.46 (47)	

ELECTRON WORK FUNCTIONS OF THE ELEMENTS
(Continued)

Element	Thermionic Work Function		Photoelectric Work Function		Work Function by Contact Potential Method	
C	4.00	(26)	4.81	(29)		
	4.34	(27)				
	4.35	(119)				
	4.39	(28)				
	4.60*	(120)				
	4.83	(121)				
	4.84	(122)				
Ca	2.24	(30)	2.42	(14)	3.33	(9)
			2.706*	(21)		
			2.76	(31)		
			3.20	(32)		
			3.21	(33)		
Cb	3.96	(34)				
	4.01*	(35)				
Cd	...		3.68	(14)	4.00	(9)
			3.73	(4)	4.49	(123)
			3.94	(11)		
			4.07*	(36)		
			4.099	(113)		
Ce	2.6	(37)	2.84	(32)		
Co	4.40*	(38)	3.90	(31)	4.21	(9)
	4.41	(124)	4.12 to 4.25	(39)		
Cr	4.58	(124)	4.37	(25)	4.38	(9)
	4.60*	(40)				
	4.7	(41)				
Cs	1.81*	(42)	1.9	(43)		
			1.96	(44)		
Cu	3.85	(1)	4.07	(4)	4.46*	(9, 126)
	4.26	(2)	4.18	(31)	4.61	(115)
	4.38	(3)	4.70	(125)	4.86	(123)
	4.50	(114)	4.86 (111) face	(46)		
	4.55 (a)	(45)	5.61 (100) face	(46)		
Fe	4.04	(48)	3.91	(31)	4.40	(9)
	γ4.21	(38)	3.92	(53)		
			β4.62	(128)		
	γ4.31	(124)	γ4.68	(128)		
	4.47	(49)	α4.70	(128)		
	β4.48	(38)	4.72	(50)		
	4.76	(127)	4.77	(51)		

(a) By field current method.

ELECTRON WORK FUNCTIONS OF THE ELEMENTS (Continued)

Element	Thermionic Work Function		Photoelectric Work Function		Work Function by Contact Potential Method	
Ga	4.12	(14)	...		3.80	(9)
Ge	...		4.29	(31)	4.50	(9)
			4.5	(52)		
			4.73	(14)		
			4.80	(16)		
Hf	3.53	(54)				
Hg	...		4.50	(55)	4.50	(9)
			4.52	(56)		
			4.53*	(57, 58)		
I	...		2.8 (rhombic)	(129)		
			5.4 (monoclinic)	(129)		
			6.8 (amorphous)	(129)		
Ir	5.3	(130)	...		4.57	(9)
K	...		2.0	(59)	1.60	(9)
			2.12	(22)		
			2.24*	(44, 43)		
			2.26	(60)		
La	3.3	(37)				
Li	...		2.28	(43)	1.40	(9)
			2.42	(14)	2.49*	(61)
Mg	...		2.74	(14)	3.58	(9)
			< 3.0	(62)	3.78	(66)
			3.59	(63)		
			3.62	(64)		
			3.68*	(23)		
			3.79	(65)		
Mn	3.83	(124)	3.76	(14)	4.14	(9)

ELECTRON WORK FUNCTIONS OF THE ELEMENTS (Continued)

Element	Thermionic Work Function	Photoelectric Work Function	Work Function by Contact Potential Method
Mo	4.15 (67)	4.15 (67)	4.08 (75)
	4.17 (68)	4.34 (25)	4.48 (9)
	4.19 (69)		
	4.20* (70)		
	4.23 (121)		
	4.32 (71)		
	4.33 (72)		
	4.38 (73)		
	4.44 (74)		
Na	...	2.06 (14)	1.60 (9)
		2.25 (76)	2.26 (77)
		2.28* (19)	
		2.29 (23)	
		2.47 (43)	
Nd	3.3 (37)		
Ni	4.50 (124)	3.67 (4)	4.32 (9)
	4.61 (38)	4.06 (31)	4.96 (300°K) (79)
	4.63 (48)	4.87 (25)	
	5.03* (78)	5.01* (51)	
	5.1 (a) (45)	5.05 (623°K) (131)	
	5.24 (1150°K) (131)	5.20 (1108°K) (131)	
Os	...	...	4.55 (9)
Pb	...	3.97 (4)	3.94 (9)
		4.14 (11)	
Pd	4.99* (80)	4.97* (80)	4.49 (9)
Pr	2.7 (37)		
Pt	4.72 (132)	4.09 (4)	4.52 (9)
	5.08 (26)	6.35 (84)	5.36* (85)
	5.29 (81)		
	5.32* (82)		
	6.27 (83)		
Rb	...	2.09* (44)	
		2.16 (43)	

(a) By field current method.

ELECTRON WORK FUNCTIONS OF THE ELEMENTS
(Continued)

Element	Thermionic Work Function		Photoelectric Work Function		Work Function by Contact Potential Method	
Re	4.74	(133)				
	5.1*	(86)	~5.0	(87)		
Rh	4.58	(88)	4.57	(88)	4.52	(9)
	4.80*	(89)				
	4.9	(130)				
Ru	...		...		4.52	(9)
Sb	...		4.01	(90)	4.14	(9)
			4.60	(118)		
Se	...		4.62	(11)	4.42	(9)
			5.11	(14)		
Si	3.59	(28)			4.2	(91)
	4.02	(134)	4.37 to 4.67	(117)		
Sm	3.2	(37)				
Sn	...		3.62	(4)	4.09	(9)
			3.87	(11)	4.64	(123)
			(liq.) 4.21	(92)		
			γ4.38*	(92)		
			β4.50*	(92)		
Sr	...		2.06	(93)		
			2.24	(14)		
			2.74*	(64)		
Ta	4.03	(135)	4.05	(63)		
	4.07	(74)	4.12	(32)	3.96	(9)
	4.10	(94)	4.16	(96)	4.25	(97)
	4.19*	(95)				
Te	...		4.04	(117)	4.70	(9)
			4.76	(16)		
Th	3.35*	(73)	3.38	(32)	3.46	(9)
			3.47	(98)		
			3.57	(11)		

ELECTRON WORK FUNCTIONS OF THE ELEMENTS
(Continued)

Element	Thermionic Work Function	Photoelectric Work Function	Work Function by Contact Potential Method
Ti	3.95 (124)	3.95 (14) 4.17 (98) 4.45 (136)	4.14 (9)
Tl	...	3.68 (107)	3.84 (9)
U	3.27 (99)	3.63 (32)	4.32 (9)
V	4.12 (124)	3.77 (14)	4.44 (9)
W	4.25 (100) 4.29 (116) face (142) 4.38 (111) face (142) 4.39 (111) face (140) 4.39 (116) face (140) 4.45 (doped) (138) 4.46 (101) 4.52* (001) face (26, 102, 142) 4.53 (103, 138) 4.56 (001) face (140) 4.58 (110) face (71, 73, 142) 4.59 (001) face (139) 4.65 (112) face (142) 4.68 (110) face (140) 4.69 (112) face (140) 5.01 (137)	4.35 (310) face (104) 4.49 (143) 4.50 (211) face (104) 4.54 (105) 4.60 (32)	4.38 (9)
Zn	...	3.08 (4) 3.28 (106) 3.32 and 3.57 (108) 3.60 (11) 3.89 (31) 4.24 (109) 4.26 (0001) face (110) 4.307 (113)	3.40 (111) 3.66 (9) 4.28 (112) 4.65 (123)
Zr	4.12 (54) 4.21* (141)	3.73 (32) 4.33 (136)	3.60 (9)

ELECTRON WORK FUNCTIONS OF THE ELEMENTS
(Continued)

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ELECTRON WORK FUNCTIONS OF THE ELEMENTS
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ELECTRON PHYSICS TABLES

ELECTRON PHYSICS TABLES

Values in these tables were obtained from National Bureau of Standards Circular 571 which were prepared by L. Marton, C. Marton, and W. G. Hall.

The present tables of electron physics are suited to requirements in physics and in engineering.

V is the potential difference, in absolute volts, that is required to impart to an electron initially at rest a kinetic energy E expressed in electron volts. If E is expressed in centimeter-gram-second units of energy (ergs) then $V = (E \times 10^{-8})/e$, where e is the electronic charge in electromagnetic units.

It is often found convenient to determine the value of the momentum which is relativistically correct in terms of a formula which is of a non-relativistic form. Thus, if we write

$$p = (2em_0V^*)^{\frac{1}{2}}$$

where m_0 is the rest mass of the electron, e is the charge of the electron in emu; then V^* may be considered as the "effective relativistic potential difference" which is given by

$$V^* = V + \frac{e}{2m_0c^2} V^2$$

where c is the velocity of light.

The third column lists the quantity $H\rho$, the product of the magnetic field and the radius of curvature of the path of the electron in the plane perpendicular to the field. In these tables H is expressed in oersteds and ρ in centimeters.[1] $H\rho$ is given by

$$eH\rho = p$$

so that

$$H\rho = \sqrt{\frac{2m_0}{e}}\sqrt{V^*}$$

The next tabulated quantity is λ, the deBroglie wavelength of the electron in the absence of a magnetic field. It is given by

$$\lambda = \frac{h}{p} = h(2m_0eV^*)^{-\frac{1}{2}}$$

where h is Planck's constant.

The next column contains p^*, the momentum of the electron in units of m_0c. The following relation was used in computing these tables:

$$p^* = \frac{p}{m_0c} = \left(\frac{2e}{m_0c^2} V^*\right)^{\frac{1}{2}}$$

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[1] Workers in this field who are accustomed to considering electrodynamics as developed from four fundamental quantities, as in the MKSA system of units, may prefer the symbol B (in gausses) because they are used to write the transverse force on an electron as $F = \text{ev} \times B$. However, in the 3-dimensional cgsem system of units H and B are indistinguishable in vacuum and the combined symbols "$H\rho$" are deeply rooted in literature.

In one column are tabulated values for E^*, the kinetic energy of the electron in units of its rest energy. This is expressed by

$$E^* = \frac{E}{m_0c^2}$$

so that

$$E^* = (p^*)^2 + 1^{\frac{1}{2}} - 1 = \frac{eV}{m_0c^2}$$

The total energy in these units W^* is tabulated in another column. This quantity bears a simple relationship to E^*,

$$W^* = E^* + 1$$

The last column contains $\beta = v/c$, the ratio of electron velocity to light velocity. In taking account of the above listed equations the following relationships are valid:

$$\beta = \frac{p^*}{W^*} = \frac{p^*}{E^* + 1} = \frac{p^*}{\sqrt{p^{*2} + 1}} = \sqrt{\frac{2eV^*}{2eV^* + m_0c^2}}.$$

The following table summarizes the notations and equations used in these tables:

Potential difference ("volt-energy")	$V = 10^{-8} \frac{m_0}{e} c^2E^*$
"Relativistic potential difference"	$V^* = V + \frac{e_{\text{emu}}}{2m_0c^2} V^2$
Magnetic field	H
Radius of curvature	ρ
Wavelength of the electron	$\lambda = \frac{h}{p}$
Momentum in units of m_0c	$p^* = \frac{p}{m_0c} = \beta W^*$
Kinetic energy in units of rest energy	$E^* = E/m_0c^2 = W^* - 1$
Total energy in units of rest energy	$W^* = E^* + 1$
Ratio of light-to-electron velocities	$\beta = v/c$
Charge of the electron	e
Rest mass of the electron	m_0
Velocity of the electron	v
Momentum of the electron	$p = eH\rho$
Kinetic energy	$E = m_0c^2E^* = \frac{vV}{10^{-8}}$
Total energy	$W = m_0c^2W^*$

V		V^*		$H\rho$		λ	
1.0000000	0	1.0000010	0	3.3720802	0	1.2263646	− 7
1.1000000	0	1.1000012	0	3.5366677	0	1.1692927	− 7
1.2000000	0	1.2000014	0	3.6939292	0	1.1195125	− 7
1.3000000	0	1.3000017	0	3.8447636	0	1.0755928	− 7
1.4000000	0	1.4000019	0	3.9898999	0	1.0364671	− 7
1.5000000	0	1.5000022	0	4.1299390	0	1.0013223	− 7
1.6000000	0	1.6000025	0	4.2653828	0	9.6952606	− 8
1.7000000	0	1.7000028	0	4.3966562	0	9.4057839	− 8
1.8000000	0	1.8000032	0	4.5241221	0	9.1407785	− 8
1.9000000	0	1.9000035	0	4.6480939	0	8.8969800	− 8
2.0000000	0	2.0000039	0	4.7688439	0	8.6717030	− 8
2.1000000	0	2.1000043	0	4.8866111	0	8.4627152	− 8
2.2000000	0	2.2000047	0	5.0016062	0	8.2681436	− 8
2.3000000	0	2.3000052	0	5.1140161	0	8.0864036	− 8
2.4000000	0	2.4000056	0	5.2240078	0	7.9161441	− 8
2.5000000	0	2.5000061	0	5.3317309	0	7.7562051	− 8
2.6000000	0	2.6000066	0	5.4373202	0	7.6055845	− 8
2.7000000	0	2.7000071	0	5.5408978	0	7.4634111	− 8
2.8000000	0	2.8000077	0	5.6425744	0	7.3289239	− 8
2.9000000	0	2.9000082	0	5.7424510	0	7.2014542	− 8
3.0000000	0	3.0000088	0	5.8406200	0	7.0804124	− 8
3.2000000	0	3.2000100	0	6.0321670	0	6.8555792	− 8
3.4000000	0	3.4000113	0	6.2178160	0	6.6508881	− 8
3.6000000	0	3.6000127	0	6.3980805	0	6.4635008	− 8
3.8000000	0	3.8000141	0	6.5734035	0	6.2911091	− 8
4.0000000	0	4.0000157	0	6.7441703	0	6.1318140	− 8
4.2000000	0	4.2000173	0	6.9107188	0	5.9840372	− 8
4.4000000	0	4.4000189	0	7.0733469	0	5.8464541	− 8
4.6000000	0	4.6000207	0	7.2323191	0	5.7179444	− 8
4.8000000	0	4.8000225	0	7.3878713	0	5.5975526	− 8
5.0000000	0	5.0000245	0	7.5402154	0	5.4844585	− 8
5.5000000	0	5.5000296	0	7.9082465	0	5.2292247	− 8
6.0000000	0	6.0000352	0	8.2598961	0	5.0066003	− 8
6.5000000	0	6.5000413	0	8.5971746	0	4.8101848	− 8
7.0000000	0	7.0000479	0	8.9217118	0	4.6352089	− 8
7.5000000	0	7.5000550	0	9.2348514	0	4.4780361	− 8
8.0000000	0	8.0000626	0	9.5377158	0	4.3358388	− 8
8.5000000	0	8.5000707	0	9.8312548	0	4.2063805	− 8
9.0000000	0	9.0000793	0	1.0116280	1	4.0878660	− 8
9.5000000	0	9.5000883	0	1.0393492	1	3.9788356	− 8

p^*	E^*	W^*	β
1.9783867 − 3	1.9570050 − 6	1.0000020 0	1.9783828 − 3
2.0749496 − 3	2.1527055 − 6	1.0000022 0	2.0749451 − 3
2.1672142 − 3	2.3484060 − 6	1.0000023 0	2.1672091 − 3
2.2557082 − 3	2.5441065 − 6	1.0000025 0	2.2557025 − 3
2.3408591 − 3	2.7398070 − 6	1.0000027 0	2.3408527 − 3
2.4230195 − 3	2.9355075 − 6	1.0000029 0	2.4230124 − 3
2.5024839 − 3	3.1312080 − 6	1.0000031 0	2.5024761 − 3
2.5795015 − 3	3.3269085 − 6	1.0000033 0	2.5794929 − 3
2.6542853 − 3	3.5226090 − 6	1.0000035 0	2.6542760 − 3
2.7270190 − 3	3.7183095 − 6	1.0000037 0	2.7270089 − 3
2.7978626 − 3	3.9140100 − 6	1.0000039 0	2.7978517 − 3
2.8669562 − 3	4.1097105 − 6	1.0000041 0	2.8669444 − 3
2.9344234 − 3	4.3054110 − 6	1.0000043 0	2.9344108 − 3
3.0003739 − 3	4.5011115 − 6	1.0000045 0	3.0003604 − 3
3.0649056 − 3	4.6968120 − 6	1.0000047 0	3.0648912 − 3
3.1281063 − 3	4.8925125 − 6	1.0000049 0	3.1280910 − 3
3.1900552 − 3	5.0882130 − 6	1.0000051 0	3.1900389 − 3
3.2508237 − 3	5.2839135 − 6	1.0000053 0	3.2508066 − 3
3.3104770 − 3	5.4796140 − 6	1.0000055 0	3.3104589 − 3
3.3690742 − 3	5.6753145 − 6	1.0000057 0	3.3690551 − 3
3.4266696 − 3	5.8710150 − 6	1.0000059 0	3.4266495 − 3
3.5390495 − 3	6.2624160 − 6	1.0000063 0	3.5390273 − 3
3.6479691 − 3	6.6538171 − 6	1.0000067 0	3.6479448 − 3
3.7537296 − 3	7.0452181 − 6	1.0000070 0	3.7537031 − 3
3.8565909 − 3	7.4366191 − 6	1.0000074 0	3.8565622 − 3
3.9567792 − 3	7.8280201 − 6	1.0000078 0	3.9567482 − 3
4.0544925 − 3	8.2194211 − 6	1.0000082 0	4.0544592 − 3
4.1499058 − 3	8.6108221 − 6	1.0000086 0	4.1498701 − 3
4.2431742 − 3	9.0022231 − 6	1.0000090 0	4.2431360 − 3
4.3344361 − 3	9.3936241 − 6	1.0000094 0	4.3343954 − 3
4.4238158 − 3	9.7850251 − 6	1.0000098 0	4.4237725 − 3
4.6397382 − 3	1.0763528 − 5	1.0000108 0	4.6396883 − 3
4.8460497 − 3	1.1742030 − 5	1.0000117 0	4.8459928 − 3
5.0439297 − 3	1.2720533 − 5	1.0000127 0	5.0438656 − 3
5.2343345 − 3	1.3699035 − 5	1.0000137 0	5.2342628 − 3
5.4180523 − 3	1.4677538 − 5	1.0000147 0	5.4179728 − 3
5.5957417 − 3	1.5656040 − 5	1.0000157 0	5.5956541 − 3
5.7679599 − 3	1.6634543 − 5	1.0000166 0	5.7678640 − 3
5.9351833 − 3	1.7613045 − 5	1.0000176 0	5.9350787 − 3
6.0978226 − 3	1.8591548 − 5	1.0000186 0	6.0977093 − 3

V		V^*		$H\rho$		λ	
1.0000000	1	1.0000098	1	1.0663501	1	3.8780883	− 8
1.1000000	1	1.1000118	1	1.1183980	1	3.6976103	− 8
1.2000000	1	1.2000141	1	1.1681291	1	3.5401906	− 8
1.3000000	1	1.3000165	1	1.2158280	1	3.4013035	− 8
1.4000000	1	1.4000192	1	1.2617249	1	3.2775764	− 8
1.5000000	1	1.5000220	1	1.3060100	1	3.1664381	− 8
1.6000000	1	1.6000250	1	1.3488420	1	3.0658890	− 8
1.7000000	1	1.7000283	1	1.3903552	1	2.9743478	− 8
1.8000000	1	1.8000317	1	1.4306644	1	2.8905451	− 8
1.9000000	1	1.9000353	1	1.4698686	1	2.8134486	− 8
2.0000000	1	2.0000391	1	1.5080541	1	2.7422091	− 8
2.1000000	1	2.1000432	1	1.5452964	1	2.6761208	− 8
2.2000000	1	2.2000474	1	1.5816621	1	2.6145913	− 8
2.3000000	1	2.3000518	1	1.6172103	1	2.5571194	− 8
2.4000000	1	2.4000564	1	1.6519938	1	2.5032781	− 8
2.5000000	1	2.5000612	1	1.6860599	1	2.4527004	− 8
2.6000000	1	2.6000661	1	1.7194513	1	2.4050694	− 8
2.7000000	1	2.7000713	1	1.7522066	1	2.3601098	− 8
2.8000000	1	2.8000767	1	1.7843607	1	2.3175806	− 8
2.9000000	1	2.9000823	1	1.8159456	1	2.2772707	− 8
3.0000000	1	3.0000881	1	1.8469906	1	2.2389934	− 8
3.2000000	1	3.2001002	1	1.9075656	1	2.1678939	− 8
3.4000000	1	3.4001131	1	1.9662755	1	2.1031640	− 8
3.6000000	1	3.6001268	1	2.0232828	1	2.0439060	− 8
3.8000000	1	3.8001413	1	2.0787275	1	1.9893901	− 8
4.0000000	1	4.0001566	1	2.1327315	1	1.9390157	− 8
4.2000000	1	4.2001726	1	2.1854016	1	1.8922837	− 8
4.4000000	1	4.4001894	1	2.2368320	1	1.8487753	− 8
4.6000000	1	4.6002071	1	2.2871064	1	1.8081362	− 8
4.8000000	1	4.8002254	1	2.3362994	1	1.7700641	− 8
5.0000000	1	5.0002446	1	2.3844780	1	1.7342999	− 8
5.5000000	1	5.5002960	1	2.5008677	1	1.6535860	− 8
6.0000000	1	6.0003523	1	2.6120775	1	1.5831842	− 8
6.5000000	1	6.5004134	1	2.7187431	1	1.5210705	− 8
7.0000000	1	7.0004795	1	2.8213800	1	1.4657366	− 8
7.5000000	1	7.5005504	1	2.9204129	1	1.4160326	− 8
8.0000000	1	8.0006262	1	3.0161968	1	1.3710643	− 8
8.5000000	1	8.5007070	1	3.1090321	1	1.3301245	− 8
9.0000000	1	9.0007926	1	3.1991755	1	1.2926455	− 8
9.5000000	1	9.5008831	1	3.2868484	1	1.2581657	− 8

TABLES (Continued)

p*	E*	W*	β
6.2562356 − 3	1.9570050 − 5	1.0000196 0	6.2561131 − 3
6.5615984 − 3	2.1527055 − 5	1.0000215 0	6.5614572 − 3
6.8533694 − 3	2.3484060 − 5	1.0000235 0	6.8532084 − 3
7.1332165 − 3	2.5441065 − 5	1.0000254 0	7.1330350 − 3
7.4024922 − 3	2.7398070 − 5	1.0000274 0	7.4022894 − 3
7.6623111 − 3	2.9355075 − 5	1.0000294 0	7.6620862 − 3
7.9136048 − 3	3.1312080 − 5	1.0000313 0	7.9133570 − 3
8.1571611 − 3	3.3269085 − 5	1.0000333 0	8.1568897 − 3
8.3936536 − 3	3.5226090 − 5	1.0000352 0	8.3933580 − 3
8.6236636 − 3	3.7183095 − 5	1.0000372 0	8.6233429 − 3
8.8476965 − 3	3.9140100 − 5	1.0000391 0	8.8473502 − 3
9.0661954 − 3	4.1097105 − 5	1.0000411 0	9.0658229 − 3
9.2795514 − 3	4.3054110 − 5	1.0000431 0	9.2791519 − 3
9.4881113 − 3	4.5011115 − 5	1.0000450 0	9.4876843 − 3
9.6921848 − 3	4.6968120 − 5	1.0000470 0	9.6917296 − 3
9.8920496 − 3	4.8925125 − 5	1.0000489 0	9.8915656 − 3
1.0087956 − 2	5.0882130 − 5	1.0000509 0	1.0087442 − 2
1.0280130 − 2	5.2839135 − 5	1.0000528 0	1.0279586 − 2
1.0468777 − 2	5.4796140 − 5	1.0000548 0	1.0468203 − 2
1.0654084 − 2	5.6753145 − 5	1.0000568 0	1.0653480 − 2
1.0836224 − 2	5.8710150 − 5	1.0000587 0	1.0835588 − 2
1.1191615 − 2	6.2624160 − 5	1.0000626 0	1.1190914 − 2
1.1536064 − 2	6.6538171 − 5	1.0000665 0	1.1535296 − 2
1.1870523 − 2	7.0452181 − 5	1.0000705 0	1.1869687 − 2
1.2195815 − 2	7.4366191 − 5	1.0000744 0	1.2194908 − 2
1.2512655 − 2	7.8280201 − 5	1.0000783 0	1.2511675 − 2
1.2821668 − 2	8.2194211 − 5	1.0000822 0	1.2820614 − 2
1.3123409 − 2	8.6108221 − 5	1.0000861 0	1.3122279 − 2
1.3418367 − 2	9.0022231 − 5	1.0000900 0	1.3417159 − 2
1.3706980 − 2	9.3936241 − 5	1.0000939 0	1.3705693 − 2
1.3989642 − 2	9.7850251 − 5	1.0000979 0	1.3988273 − 2
1.4672496 − 2	1.0763528 − 4	1.0001076 0	1.4670917 − 2
1.5324960 − 2	1.1742030 − 4	1.0001174 0	1.5323160 − 2
1.5950763 − 2	1.2720533 − 4	1.0001272 0	1.5948734 − 2
1.6552929 − 2	1.3699035 − 4	1.0001370 0	1.6550662 − 2
1.7133952 − 2	1.4677538 − 4	1.0001468 0	1.7131437 − 2
1.7695912 − 2	1.5656040 − 4	1.0001566 0	1.7693142 − 2
1.8240574 − 2	1.6634543 − 4	1.0001663 0	1.8237540 − 2
1.8769441 − 2	1.7613045 − 4	1.0001761 0	1.8766136 − 2
1.9283815 − 2	1.8591548 − 4	1.0001859 0	1.9280230 − 2

V		*V**		*H*ρ		λ	
1.0000000	2	1.0000979	2	3.3722435	1	1.2263052	− 8
1.1000000	2	1.1001184	2	3.5368562	1	1.1692304	− 8
1.2000000	2	1.2001409	2	3.6941439	1	1.1194474	− 8
1.3000000	2	1.3001654	2	3.8450056	1	1.0755250	− 8
1.4000000	2	1.4001918	2	3.9901704	1	1.0363968	− 8
1.5000000	2	1.5002202	2	4.1302390	1	1.0012495	− 8
1.6000000	2	1.6002505	2	4.2657134	1	9.6945094	− 9
1.7000000	2	1.7002828	2	4.3970182	1	9.4050096	− 9
1.8000000	2	1.8003170	2	4.5245165	1	9.1399817	− 9
1.9000000	2	1.9003532	2	4.6485216	1	8.8961614	− 9
2.0000000	2	2.0003914	2	4.7693059	1	8.6708631	− 9
2.1000000	2	2.1004315	2	4.8871081	1	8.4618546	− 9
2.2000000	2	2.2004736	2	5.0021391	1	8.2672627	− 9
2.3000000	2	2.3005176	2	5.1145858	1	8.0855029	− 9
2.4000000	2	2.4005636	2	5.2246150	1	7.9152240	− 9
2.5000000	2	2.5006116	2	5.3323765	1	7.7552661	− 9
2.6000000	2	2.6006615	2	5.4380049	1	7.6046268	− 9
2.7000000	2	2.7007133	2	5.5416224	1	7.4624353	− 9
2.8000000	2	2.8007671	2	5.6433396	1	7.3279301	− 9
2.9000000	2	2.9008229	2	5.7432576	1	7.2004429	− 9
3.0000000	2	3.0008807	2	5.8414686	1	7.0793838	− 9
3.2000000	2	3.2010020	2	6.0331018	1	6.8545168	− 9
3.4000000	2	3.4011311	2	6.2188399	1	6.6497931	− 9
3.6000000	2	3.6012681	2	6.3991960	1	6.4623740	− 9
3.8000000	2	3.8014130	2	6.5746132	1	6.2899515	− 9
4.0000000	2	4.0015656	2	6.7454768	1	6.1306264	− 9
4.2000000	2	4.2017261	2	6.9121245	1	5.9828202	− 9
4.4000000	2	4.4018944	2	7.0748542	1	5.8452086	− 9
4.6000000	2	4.6020705	2	7.2339303	1	5.7166708	− 9
4.8000000	2	4.8022545	2	7.3895888	1	5.5962516	− 9
5.0000000	2	5.0024463	2	7.5420412	1	5.4831308	− 9
5.5000000	2	5.5029600	2	7.9103530	1	5.2278322	− 9
6.0000000	2	6.0035226	2	8.2622962	1	5.0051459	− 9
6.5000000	2	6.5041342	2	8.5998808	1	4.8086711	− 9
7.0000000	2	7.0047947	2	8.9247362	1	4.6336381	− 9
7.5000000	2	7.5055041	2	9.2382055	1	4.4764103	− 9
8.0000000	2	8.0062624	2	9.5414108	1	4.3341597	− 9
9.0000000	2	9.0079259	2	1.0120689	2	4.0860852	− 9
9.5000000	2	9.5088310	2	1.0398274	2	3.9770061	− 9
1.0000000	3	1.0009785	3	1.0668665	2	3.8762113	− 9

p^*	E^*	W^*	β
1.9784825 − 2	1.9570050 − 4	1.0001957 0	1.9780954 − 2
2.0750601 − 2	2.1527055 − 4	1.0002153 0	2.0746135 − 2
2.1673402 − 2	2.3484060 − 4	1.0002348 0	2.1668313 − 2
2.2558502 − 2	2.5441065 − 4	1.0002544 0	2.2552765 − 2
2.3410179 − 2	2.7398070 − 4	1.0002740 0	2.3403767 − 2
2.4231956 − 2	2.9355075 − 4	1.0002936 0	2.4224844 − 2
2.5026779 − 2	3.1312080 − 4	1.0003131 0	2.5018945 − 2
2.5797139 − 2	3.3269085 − 4	1.0003327 0	2.5788560 − 2
2.6545167 − 2	3.5226090 − 4	1.0003523 0	2.6535820 − 2
2.7272700 − 2	3.7183095 − 4	1.0003718 0	2.7262563 − 2
2.7981337 − 2	3.9140100 − 4	1.0003914 0	2.7970389 − 2
2.8672478 − 2	4.1097105 − 4	1.0004110 0	2.8660699 − 2
2.9347361 − 2	4.3054110 − 4	1.0004305 0	2.9334731 − 2
3.0007081 − 2	4.5011115 − 4	1.0004501 0	2.9993580 − 2
3.0652618 − 2	4.6968120 − 4	1.0004697 0	3.0638228 − 2
3.1284851 − 2	4.8925125 − 4	1.0004893 0	3.1269552 − 2
3.1904569 − 2	5.0882130 − 4	1.0005088 0	3.1888343 − 2
3.2512488 − 2	5.2839135 − 4	1.0005284 0	3.2495318 − 2
3.3109260 − 2	5.4796140 − 4	1.0005480 0	3.3091127 − 2
3.3695474 − 2	5.6753145 − 4	1.0005675 0	3.3676362 − 2
3.4271675 − 2	5.8710150 − 4	1.0005871 0	3.4251566 − 2
3.5395980 − 2	6.2624160 − 4	1.0006262 0	3.5373827 − 2
3.6485698 − 2	6.6538171 − 4	1.0006654 0	3.6461437 − 2
3.7543841 − 2	7.0452181 − 4	1.0007045 0	3.7517409 − 2
3.8573007 − 2	7.4366191 − 4	1.0007437 0	3.8544343 − 2
3.9575457 − 2	7.8280201 − 4	1.0007828 0	3.9544501 − 2
4.0553173 − 2	8.2194211 − 4	1.0008219 0	4.0519868 − 2
4.1507901 − 2	8.6108221 − 4	1.0008611 0	4.1472190 − 2
4.2441195 − 2	9.0022231 − 4	1.0009002 0	4.2403023 − 2
4.3354437 − 2	9.3936241 − 4	1.0009394 0	4.3313750 − 2
4.4248870 − 2	9.7850251 − 4	1.0009785 0	4.4205615 − 2
4.6409741 − 2	1.0763528 − 3	1.0010764 0	4.6359841 − 2
4.8474579 − 2	1.1742030 − 3	1.0011742 0	4.8417726 − 2
5.0455175 − 2	1.2720533 − 3	1.0012721 0	5.0391074 − 2
5.2361089 − 2	1.3699035 − 3	1.0013699 0	5.2289458 − 2
5.4200201 − 2	1.4677538 − 3	1.0014678 0	5.4120765 − 2
5.5979096 − 2	1.5656040 − 3	1.0015656 0	5.5891591 − 2
5.9377700 − 2	1.7613045 − 3	1.0017613 0	5.9273301 − 2
6.1006278 − 2	1.8591548 − 3	1.0018592 0	6.0893069 − 2
6.2592651 − 2	1.9570050 − 3	1.0019570 0	6.2470396 − 2

V		V^*		$H\rho$		λ	
1.1000000	3	1.1011840	3	1.1189937	2	3.6956418	− 9
1.2000000	3	1.2014090	3	1.1688079	2	3.5381348	− 9
1.3000000	3	1.3016537	3	1.2165933	2	3.3991638	− 9
1.4000000	3	1.4019179	3	1.2625802	2	3.2753562	− 9
1.5000000	3	1.5022016	3	1.3069585	2	3.1641401	− 9
1.6000000	3	1.6025050	3	1.3498869	2	3.0635158	− 9
1.7000000	3	1.7028279	3	1.3914995	2	2.9719017	− 9
1.8000000	3	1.8031703	3	1.4319111	2	2.8880283	− 9
1.9000000	3	1.9035324	3	1.4712207	2	2.8108630	− 9
2.0000000	3	2.0039140	3	1.5095143	2	2.7395566	− 9
2.1000000	3	2.1043152	3	1.5468674	2	2.6734030	− 9
2.2000000	3	2.2047360	3	1.5833465	2	2.6118097	− 9
2.3000000	3	2.3051763	3	1.6190108	2	2.5542756	− 9
2.4000000	3	2.4056362	3	1.6539130	2	2.5003733	− 9
2.5000000	3	2.5061156	3	1.6881003	2	2.4497359	− 9
2.6000000	3	2.6066147	3	1.7216153	2	2.4020465	− 9
2.7000000	3	2.7071333	3	1.7544965	2	2.3570294	− 9
2.8000000	3	2.8076715	3	1.7867790	2	2.3144440	− 9
2.9000000	3	2.9082292	3	1.8184945	2	2.2740788	− 9
3.0000000	3	3.0088065	3	1.8496724	2	2.2357472	− 9
3.2000000	3	3.2100199	3	1.9105198	2	2.1645417	− 9
3.4000000	3	3.4113115	3	1.9695108	2	2.0997091	− 9
3.6000000	3	3.6126814	3	2.0268076	2	2.0403515	− 9
3.8000000	3	3.8141296	3	2.0825499	2	1.9857387	− 9
4.0000000	3	4.0156560	3	2.1368594	2	1.9352700	− 9
4.2000000	3	4.2172608	3	2.1898427	2	1.8884461	− 9
4.4000000	3	4.4189438	3	2.2415938	2	1.8448480	− 9
4.6000000	3	4.6207051	3	2.2921963	2	1.8041211	− 9
4.8000000	3	4.8225447	3	2.3417246	2	1.7659634	− 9
5.0000000	3	5.0244626	3	2.3902454	2	1.7301152	− 9
5.5000000	3	5.5295997	3	2.5075207	2	1.6491987	− 9
6.0000000	3	6.0352261	3	2.6196572	2	1.5786035	− 9
6.5000000	3	6.5413417	3	2.7272886	2	1.5163044	− 9
7.0000000	3	7.0479466	3	2.8309291	2	1.4607925	− 9
7.5000000	3	7.5550408	3	2.9310018	2	1.4109168	− 9
8.0000000	3	8.0626242	3	3.0278607	2	1.3657827	− 9
8.5000000	3	8.5706968	3	3.1218049	2	1.3246824	− 9
9.0000000	3	9.0792587	3	3.2130899	2	1.2870476	− 9
9.5000000	3	9.5883099	3	3.3019365	2	1.2524165	− 9
1.0000000	4	1.0097850	4	3.3885363	2	1.2204089	− 9

p^*	E^*	W^*	β
6.5650934 − 2	2.1527055 − 3	1.0021527 0	6.5509911 − 2
6.8573516 − 2	2.3484060 − 3	1.0023484 0	6.8412854 − 2
7.1377066 − 2	2.5441065 − 3	1.0025441 0	7.1195936 − 2
7.4075101 − 2	2.7398070 − 3	1.0027398 0	7.3872704 − 2
7.6678760 − 2	2.9355075 − 3	1.0029355 0	7.6454328 − 2
7.9197352 − 2	3.1312080 − 3	1.0031312 0	7.8950142 − 2
8.1638749 − 2	3.3269085 − 3	1.0033269 0	8.1368045 − 2
8.4009683 − 2	3.5226090 − 3	1.0035226 0	8.3714788 − 2
8.6315960 − 2	3.7183095 − 3	1.0037183 0	8.5996199 − 2
8.8562631 − 2	3.9140100 − 3	1.0039140 0	8.8217347 − 2
9.0754123 − 2	4.1097105 − 3	1.0041097 0	9.0382676 − 2
9.2894341 − 2	4.3054110 − 3	1.0043054 0	9.2496107 − 2
9.4986752 − 2	4.5011115 − 3	1.0045011 0	9.4561122 − 2
9.7034448 − 2	4.6968120 − 3	1.0046968 0	9.6580826 − 2
9.9040203 − 2	4.8925125 − 3	1.0048925 0	9.8558006 − 2
1.0100651 − 1	5.0882130 − 3	1.0050882 0	1.0049517 − 1
1.0293564 − 1	5.2839135 − 3	1.0052839 0	1.0239460 − 1
1.0482964 − 1	5.4796140 − 3	1.0054796 0	1.0425835 − 1
1.0669039 − 1	5.6753145 − 3	1.0056753 0	1.0608830 − 1
1.0851958 − 1	5.8710150 − 3	1.0058710 0	1.0788618 − 1
1.1208947 − 1	6.2624160 − 3	1.0062624 0	1.1139189 − 1
1.1555045 − 1	6.6538171 − 3	1.0066538 0	1.1478668 − 1
1.1891203 − 1	7.0452181 − 3	1.0070452 0	1.1808013 − 1
1.2218241 − 1	7.4366191 − 3	1.0074366 0	1.2128049 − 1
1.2536873 − 1	7.8280201 − 3	1.0078280 0	1.2439496 − 1
1.2847724 − 1	8.2194211 − 3	1.0082194 0	1.2742984 − 1
1.3151346 − 1	8.6108221 − 3	1.0086108 0	1.3039069 − 1
1.3448229 − 1	9.0022231 − 3	1.0090022 0	1.3328245 − 1
1.3738809 − 1	9.3936241 − 3	1.0093936 0	1.3610953 − 1
1.4023479 − 1	9.7850251 − 3	1.0097850 0	1.3887589 − 1
1.4711529 − 1	1.0763528 − 2	1.0107635 0	1.4554867 − 1
1.5369429 − 1	1.1742030 − 2	1.0117420 0	1.5191055 − 1
1.6000899 − 1	1.2720533 − 2	1.0127205 0	1.5799916 − 1
1.6608954 − 1	1.3699035 − 2	1.0136990 0	1.6384502 − 1
1.7196077 − 1	1.4677538 − 2	1.0146775 0	1.6947332 − 1
1.7764344 − 1	1.5656040 − 2	1.0156560 0	1.7490512 − 1
1.8315511 − 1	1.6634543 − 2	1.0166345 0	1.8015826 − 1
1.8851077 − 1	1.7613045 − 2	1.0176130 0	1.8524799 − 1
1.9372336 − 1	1.8591548 − 2	1.0185915 0	1.9018748 − 1
1.9880414 − 1	1.9570050 − 2	1.0195701 0	1.9498821 − 1

V		V^*		$H\rho$		λ	
1.1000000	4	1.1118399	4	3.5556484	2	1.1630508	− 9
1.2000000	4	1.2140904	4	3.7155508	2	1.1129978	− 9
1.3000000	4	1.3165367	4	3.8691375	2	1.0688170	− 9
1.4000000	4	1.4191786	4	4.0171331	2	1.0294406	− 9
1.5000000	4	1.5220163	4	4.1601342	2	9.9405444	− 10
1.6000000	4	1.6250497	4	4.2986393	2	9.6202532	− 10
1.7000000	4	1.7282787	4	4.4330699	2	9.3285239	− 10
1.8000000	4	1.8317035	4	4.5637860	2	9.0613360	− 10
1.9000000	4	1.9353239	4	4.6910981	2	8.8154195	− 10
2.0000000	4	2.0391401	4	4.8152764	2	8.5880841	− 10
2.1000000	4	2.1431520	4	4.9365571	2	8.3770930	− 10
2.2000000	4	2.2473595	4	5.0551490	2	8.1805696	− 10
2.3000000	4	2.3517628	4	5.1712370	2	7.9969257	− 10
2.4000000	4	2.4563617	4	5.2849861	2	7.8248074	− 10
2.5000000	4	2.5611564	4	5.3965442	2	7.6630519	− 10
2.6000000	4	2.6661468	4	5.5060444	2	7.5106547	− 10
2.7000000	4	2.7713328	4	5.6136073	2	7.3667423	− 10
2.8000000	4	2.8767146	4	5.7193421	2	7.2305516	− 10
2.9000000	4	2.9822921	4	5.8233484	2	7.1014124	− 10
3.0000000	4	3.0880652	4	5.9257171	2	6.9787331	− 10
3.2000000	4	3.3001987	4	6.1258693	2	6.7507151	− 10
3.4000000	4	3.5131149	4	6.3203898	2	6.5429506	− 10
3.6000000	4	3.7268139	4	6.5097834	2	6.3525920	− 10
3.8000000	4	3.9412958	4	6.6944854	2	6.1773230	− 10
4.0000000	4	4.1565604	4	6.8748738	2	6.0152374	− 10
4.2000000	4	4.3726078	4	7.0512798	2	5.8647507	− 10
4.4000000	4	4.5894381	4	7.2239951	2	5.7245330	− 10
4.6000000	4	4.8070511	4	7.3932783	2	5.5934589	− 10
4.8000000	4	5.0254470	4	7.5593601	2	5.4705687	− 10
5.0000000	4	5.2446256	4	7.7224469	2	5.3550382	− 10
5.5000000	4	5.7959970	4	8.1182377	2	5.0939625	− 10
6.0000000	4	6.3522609	4	8.4988830	2	4.8658157	− 10
6.5000000	4	6.9134173	4	8.8663337	2	4.6641599	− 10
7.0000000	4	7.4794662	4	9.2221671	2	4.4841953	− 10
7.5000000	4	8.0504077	4	9.5676796	2	4.3222600	− 10
8.0000000	4	8.6262416	4	9.9039513	2	4.1755050	− 10
8.5000000	4	9.2069681	4	1.0231893	3	4.0416761	− 10
9.0000000	4	9.7925870	4	1.0552282	3	3.9189624	− 10
9.5000000	4	1.0383099	5	1.0865787	3	3.8058909	− 10
1.0000000	5	1.0978503	5	1.1172986	3	3.7012487	− 10

p^*	E^*	W^*	β
2.0860854 − 1	2.1527055 − 2	1.0215271 0	2.0421245 − 1
2.1798996 − 1	2.3484060 − 2	1.0234841 0	2.1298813 − 1
2.2700083 − 1	2.5441065 − 2	1.0254411 0	2.2136897 − 1
2.3568368 − 1	2.7398070 − 2	1.0273981 0	2.2939860 − 1
2.4407349 − 1	2.9355075 − 2	1.0293551 0	2.3711302 − 1
2.5219954 − 1	3.1312080 − 2	1.0313121 0	2.4454241 − 1
2.6008653 − 1	3.3269085 − 2	1.0332691 0	2.5171229 − 1
2.6775559 − 1	3.5226090 − 2	1.0352261 0	2.5864456 − 1
2.7522495 − 1	3.7183095 − 2	1.0371831 0	2.6535811 − 1
2.8251044 − 1	3.9140100 − 2	1.0391401 0	2.7186944 − 1
2.8962594 − 1	4.1097105 − 2	1.0410971 0	2.7819301 − 1
2.9658368 − 1	4.3054110 − 2	1.0430541 0	2.8434160 − 1
3.0339451 − 1	4.5011115 − 2	1.0450111 0	2.9032659 − 1
3.1006813 − 1	4.6968120 − 2	1.0469681 0	2.9615814 − 1
3.1661320 − 1	4.8925125 − 2	1.0489251 0	3.0184538 − 1
3.2303754 − 1	5.0882130 − 2	1.0508821 0	3.0739655 − 1
3.2934821 − 1	5.2839135 − 2	1.0528391 0	3.1281912 − 1
3.3555163 − 1	5.4796140 − 2	1.0547961 0	3.1811989 − 1
3.4165364 − 1	5.6753145 − 2	1.0567531 0	3.2330506 − 1
3.4765958 − 1	5.8710150 − 2	1.0587102 0	3.2838032 − 1
3.5940243 − 1	6.2624160 − 2	1.0626242 0	3.3822159 − 1
3.7081487 − 1	6.6538171 − 2	1.0665382 0	3.4768083 − 1
3.8192653 − 1	7.0452181 − 2	1.0704522 0	3.5678990 − 1
3.9276292 − 1	7.4366191 − 2	1.0743662 0	3.6557640 − 1
4.0334624 − 1	7.8280201 − 2	1.0782802 0	3.7406441 − 1
4.1369591 − 1	8.2194211 − 2	1.0821942 0	3.8227511 − 1
4.2382905 − 1	8.6108221 − 2	1.0861082 0	3.9022728 − 1
4.3376084 − 1	9.0022231 − 2	1.0900222 0	3.9793761 − 1
4.4350479 − 1	9.3936241 − 2	1.0939362 0	4.0542106 − 1
4.5307303 − 1	9.7850251 − 2	1.0978503 0	4.1269110 − 1
4.7629393 − 1	1.0763528 − 1	1.1076353 0	4.3000971 − 1
4.9862624 − 1	1.1742030 − 1	1.1174203 0	4.4622980 − 1
5.2018444 − 1	1.2720533 − 1	1.1272053 0	4.6148153 − 1
5.4106105 − 1	1.3699035 − 1	1.1369904 0	4.7587128 − 1
5.6133213 − 1	1.4677538 − 1	1.1467754 0	4.8948743 − 1
5.8106107 − 1	1.5656040 − 1	1.1565604 0	5.0240443 − 1
6.0030130 − 1	1.6634543 − 1	1.1663454 0	5.1468569 − 1
6.1909841 − 1	1.7613045 − 1	1.1761304 0	5.2638583 − 1
6.3749158 − 1	1.8591548 − 1	1.1859155 0	5.3755229 − 1
6.5551483 − 1	1.9570050 − 1	1.1957005 0	5.4822616 − 1

V		V^*		$H\rho$		λ
1.1000000	5	1.2183988	5	1.1770432	3	3.5133797 − 10
1.2000000	5	1.3409044	5	1.2347999	3	3.3490445 − 10
1.3000000	5	1.4653669	5	1.2908354	3	3.2036615 − 10
1.4000000	5	1.5917865	5	1.3453649	3	3.0738128 − 10
1.5000000	5	1.7201631	5	1.3985645	3	2.9568889 − 10
1.6000000	5	1.8504966	5	1.4505805	3	2.8508585 − 10
1.7000000	5	1.9827872	5	1.5015360	3	2.7541131 − 10
1.8000000	5	2.1170348	5	1.5515354	3	2.6653597 − 10
1.9000000	5	2.2532394	5	1.6006683	3	2.5835457 − 10
2.0000000	5	2.3914010	5	1.6490123	3	2.5078041 − 10
2.1000000	5	2.5315196	5	1.6966347	3	2.4374133 − 10
2.2000000	5	2.6735952	5	1.7435946	3	2.3717668 − 10
2.3000000	5	2.8176278	5	1.7899442	3	2.3103512 − 10
2.4000000	5	2.9636174	5	1.8357298	3	2.2527280 − 10
2.5000000	5	3.1115641	5	1.8809925	3	2.1985201 − 10
2.6000000	5	3.2614677	5	1.9257692	3	2.1474016 − 10
2.7000000	5	3.4133283	5	1.9700930	3	2.0990887 − 10
2.8000000	5	3.5671460	5	2.0139938	3	2.0533330 − 10
2.9000000	5	3.7229206	5	2.0574987	3	2.0099161 − 10
3.0000000	5	3.8806523	5	2.1006323	3	1.9686452 − 10
3.2000000	5	4.2019866	5	2.1858734	3	1.8918752 − 10
3.4000000	5	4.5311489	5	2.2698745	3	1.8218627 − 10
3.6000000	5	4.8681392	5	2.3527684	3	1.7576740 − 10
3.8000000	5	5.2129576	5	2.4346682	3	1.6985476 − 10
4.0000000	5	5.5656040	5	2.5156710	3	1.6438556 − 10
4.2000000	5	5.9260784	5	2.5958607	3	1.5930746 − 10
4.4000000	5	6.2943809	5	2.6753105	3	1.5457644 − 10
4.6000000	5	6.6705113	5	2.7540844	3	1.5015516 − 10
4.8000000	5	7.0544698	5	2.8322388	3	1.4601169 − 10
5.0000000	5	7.4462563	5	2.9098237	3	1.4211857 − 10
5.5000000	5	8.4599701	5	3.1015737	3	1.3333231 − 10
6.0000000	5	9.5226090	5	3.2906043	3	1.2567296 − 10
6.5000000	5	1.0634173	6	3.4773591	3	1.1892358 − 10
7.0000000	5	1.1794662	6	3.6621864	3	1.1292161 − 10
7.5000000	5	1.3004077	6	3.8453639	3	1.0754248 − 10
8.0000000	5	1.4262416	6	4.0271169	3	1.0268885 − 10
8.5000000	5	1.5569681	6	4.2076299	3	9.8283354 − 11
9.0000000	5	1.6925870	6	4.3870561	3	9.4263664 − 11
9.5000000	5	1.8330985	6	4.5655236	3	9.0578874 − 11
1.0000000	6	1.9785025	6	4.7431405	3	8.7186956 − 11

p^*		E^*		W^*		β	
6.9056681	− 1	2.1527055	− 1	1.2152706	0	5.6824121	− 1
7.2445242	− 1	2.3484060	− 1	1.2348406	0	5.8667687	− 1
7.5732825	− 1	2.5441065	− 1	1.2544107	0	6.0373232	− 1
7.8932049	− 1	2.7398070	− 1	1.2739807	0	6.1957021	− 1
8.2053248	− 1	2.9355075	− 1	1.2935508	0	6.3432569	− 1
8.5105008	− 1	3.1312080	− 1	1.3131208	0	6.4811256	− 1
8.8094546	− 1	3.3269085	− 1	1.3326909	0	6.6102762	− 1
9.1027993	− 1	3.5226090	− 1	1.3522609	0	6.7315407	− 1
9.3910604	− 1	3.7183095	− 1	1.3718310	0	6.8456397	− 1
9.6746925	− 1	3.9140100	− 1	1.3914010	0	6.9532022	− 1
9.9540912	− 1	4.1097105	− 1	1.4109711	0	7.0547806	− 1
1.0229603	0	4.3054110	− 1	1.4305411	0	7.1508629	− 1
1.0501535	0	4.5011115	− 1	1.4501112	0	7.2418827	− 1
1.0770157	0	4.6968120	− 1	1.4696812	0	7.3282267	− 1
1.1035712	0	4.8925125	− 1	1.4892513	0	7.4102416	− 1
1.1298415	0	5.0882130	− 1	1.5088213	0	7.4882391	− 1
1.1558461	0	5.2839135	− 1	1.5283914	0	7.5625007	− 1
1.1816025	0	5.4796140	− 1	1.5479614	0	7.6332815	− 1
1.2071267	0	5.6753145	− 1	1.5675315	0	7.7008132	− 1
1.2324330	0	5.8710150	− 1	1.5871015	0	7.7653070	− 1
1.2824437	0	6.2624160	− 1	1.6262416	0	7.8859357	− 1
1.3317268	0	6.6538171	− 1	1.6653817	0	7.9965258	− 1
1.3803603	0	7.0452181	− 1	1.7045218	0	8.0982262	− 1
1.4284106	0	7.4366191	− 1	1.7436619	0	8.1920159	− 1
1.4759346	0	7.8280201	− 1	1.7828020	0	8.2787354	− 1
1.5229816	0	8.2194211	− 1	1.8219421	0	8.3591110	− 1
1.5695945	0	8.6108221	− 1	1.8610822	0	8.4337732	− 1
1.6158109	0	9.0022231	− 1	1.9002223	0	8.5032729	− 1
1.6616638	0	9.3936241	− 1	1.9393624	0	8.5680932	− 1
1.7071825	0	9.7850251	− 1	1.9785025	0	8.6286599	− 1
1.8196815	0	1.0763528	0	2.0763528	0	8.7638360	− 1
1.9305851	0	1.1742030	0	2.1742030	0	8.8795069	− 1
2.0401534	0	1.2720533	0	2.2720533	0	8.9793381	− 1
2.1485909	0	1.3699035	0	2.3699035	0	9.0661533	− 1
2.2560604	0	1.4677538	0	2.4677538	0	9.1421618	− 1
2.3626942	0	1.5656040	0	2.5656040	0	9.2091149	− 1
2.4686005	0	1.6634543	0	2.6634543	0	9.2684172	− 1
2.5738692	0	1.7613045	0	2.7613045	0	9.3212073	− 1
2.6785754	0	1.8591548	0	2.8591548	0	9.3684168	− 1
2.7827825	0	1.9570050	0	2.9570050	0	9.4108144	− 1

V		V^*		$H\rho$		λ
1.1000000	6	2.2839880	6	5.0961781	3	8.1147082 − 11
1.2000000	6	2.6090436	6	5.4467614	3	7.5924012 − 11
1.3000000	6	2.9536692	6	5.7953359	3	7.1357379 − 11
1.4000000	6	3.3178649	6	6.1422436	3	6.7327187 − 11
1.5000000	6	3.7016306	6	6.4877518	3	6.3741647 − 11
1.6000000	6	4.1049664	6	6.8320729	3	6.0529211 − 11
1.7000000	6	4.5278722	6	7.1753777	3	5.7633201 − 11
1.8000000	6	4.9703481	6	7.5178056	3	5.5008071 − 11
1.9000000	6	5.4323941	6	7.8594710	3	5.2616770 − 11
2.0000000	6	5.9140100	6	8.2004694	3	5.0428818 − 11
2.1000000	6	6.4151961	6	8.5408806	3	4.8418893 − 11
2.2000000	6	6.9359521	6	8.8807722	3	4.6565769 − 11
2.3000000	6	7.4762783	6	9.2202015	3	4.4851512 − 11
2.4000000	6	8.0361744	6	9.5592179	3	4.3260859 − 11
2.5000000	6	8.6156407	6	9.8978638	3	4.1780731 − 11
2.6000000	6	9.2146769	6	1.0236176	4	4.0399851 − 11
2.7000000	6	9.8332833	6	1.0574186	4	3.9108445 − 11
2.8000000	6	1.0471460	7	1.0911923	4	3.7897993 − 11
2.9000000	6	1.1129206	7	1.1249411	4	3.6761035 − 11
3.0000000	6	1.1806523	7	1.1586671	4	3.5691008 − 11
3.2000000	6	1.3219866	7	1.2260585	4	3.3729220 − 11
3.4000000	6	1.4711489	7	1.2933796	4	3.1973598 − 11
3.6000000	6	1.6281392	7	1.3606407	4	3.0393033 − 11
3.8000000	6	1.7929576	7	1.4278504	4	2.8962417 − 11
4.0000000	6	1.9656040	7	1.4950155	4	2.7661250 − 11
4.2000000	6	2.1460784	7	1.5621419	4	2.6472626 − 11
4.4000000	6	2.3343809	7	1.6292343	4	2.5382475 − 11
4.6000000	6	2.5305113	7	1.6962967	4	2.4378988 − 11
4.8000000	6	2.7344698	7	1.7633326	4	2.3452182 − 11
5.0000000	6	2.9462563	7	1.8303449	4	2.2593554 − 11
5.5000000	6	3.5099701	7	1.9977880	4	2.0699894 − 11
6.0000000	6	4.1226090	7	2.1651289	4	1.9100017 − 11
6.5000000	6	4.7841731	7	2.3323898	4	1.7730312 − 11
7.0000000	6	5.4946623	7	2.4995866	4	1.6544335 − 11
7.5000000	6	6.2540766	7	2.6667315	4	1.5507373 − 11
8.0000000	6	7.0624161	7	2.8338335	4	1.4592953 − 11
8.5000000	6	7.9196806	7	3.0009000	4	1.3780532 − 11
9.0000000	6	8.8258703	7	3.1679364	4	1.3053923 − 11
9.5000000	6	9.7809851	7	3.3349474	4	1.2400195 − 11
1.0000000	7	1.0785025	8	3.5019365	4	1.1808894 − 11

p^*		E^*		W^*		β
2.9899084	0	2.1527055	0	3.1527055	0	9.4836272 − 1
3.1955943	0	2.3484060	0	3.3484060	0	9.5436284 − 1
3.4001016	0	2.5441065	0	3.5441065	0	9.5936778 − 1
3.6036310	0	2.7398070	0	3.7398070	0	9.6358743 − 1
3.8063394	0	2.9355075	0	3.9355075	0	9.6717878 − 1
4.0083512	0	3.1312080	0	4.1312080	0	9.7026130 − 1
4.2097669	0	3.3269085	0	4.3269085	0	9.7292718 − 1
4.4106680	0	3.5226090	0	4.5226090	0	9.7524858 − 1
4.6111219	0	3.7183095	0	4.7183095	0	9.7728261 − 1
4.8111843	0	3.9140100	0	4.9140100	0	9.7907499 − 1
5.0109023	0	4.1097105	0	5.1097105	0	9.8066265 − 1
5.2103154	0	4.3054110	0	5.3054110	0	9.8207572 − 1
5.4094573	0	4.5011115	0	5.5011115	0	9.8333896 − 1
5.6083569	0	4.6968120	0	5.6968120	0	9.8447287 − 1
5.8070392	0	4.8925125	0	5.8925125	0	9.8549458 − 1
6.0055256	0	5.0882130	0	6 0882130	0	9.8641844 − 1
6.2038351	0	5.2839135	0	6.2839135	0	9.8725659 − 1
6.4019839	0	5.4796140	0	6.4796140	0	9.8801933 − 1
6.5999867	0	5.6753145	0	6.6753145	0	9.8871546 − 1
6.7978561	0	5.8710150	0	6.8710150	0	9.8935253 − 1
7.1932390	0	6.2624160	0	7.2624160	0	9.9047465 − 1
7.5882090	0	6.6538171	0	7.6538171	0	9.9142806 − 1
7.9828274	0	7.0452181	0	8.0452181	0	9.9224500 − 1
8.3771440	0	7.4366191	0	8.4366191	0	9.9295036 − 1
8.7711994	0	7.8280201	0	8.8280201	0	9.9356360 − 1
9.1650273	0	8.2194211	0	9.2194211	0	9.9410008 − 1
9.5586558	0	8.6108221	0	9.6108221	0	9.9457213 − 1
9.9521086	0	9.0022231	0	1.0002223	1	9.9498967 − 1
1.0345406	1	9.3936241	0	1.0393624	1	9.9536078 − 1
1.0738564	1	9.7850251	0	1.0785025	1	9.9569211 − 1
1.1720946	1	1.0763528	1	1.1763528	1	9.9638022 − 1
1.2702729	1	1.1742030	1	1.2742030	1	9.9691565 − 1
1.3684042	1	1.2720533	1	1.3720533	1	9.9734046 − 1
1.4664980	1	1.3699035	1	1.4699035	1	9.9768316 − 1
1.5645612	1	1.4677538	1	1.5677538	1	9.9796363 − 1
1.6625994	1	1.5656040	1	1.6656040	1	9.9819608 − 1
1.7606166	1	1.6634543	1	1.7634543	1	9.9839087 − 1
1.8586163	1	1.7613045	1	1.8613045	1	9.9855573 − 1
1.9566010	1	1.8591548	1	1.9591548	1	9.9869649 − 1
2.0545729	1	1.9570050	1	2.0570050	1	9.9881762 − 1

V		V^*		$H\rho$		λ
1.1000000	7	1.2939880	8	3.8358606	4	1.0780892 − 11
1.2000000	7	1.5290436	8	4.1697270	4	9.9176753 − 12
1.3000000	7	1.7836692	8	4.5035485	4	9.1825364 − 12
1.4000000	7	2.0578649	8	4.8373345	4	8.5489227 − 12
1.5000000	7	2.3516306	8	5.1710917	4	7.9971504 − 12
1.6000000	7	2.6649664	8	5.5048255	4	7.5123178 − 12
1.7000000	7	2.9978722	8	5.8385398	4	7.0829350 − 12
1.8000000	7	3.3503481	8	6.1722378	4	6.7000008 − 12
1.9000000	7	3.7223941	8	6.5059221	4	6.3563624 − 12
2.0000000	7	4.1140100	8	6.8395946	4	6.0462646 − 12
2.1000000	7	4.5251961	8	7.1732569	4	5.7650240 − 12
2.2000000	7	4.9559521	8	7.5069105	4	5.5087907 − 12
2.3000000	7	5.4062783	8	7.8405564	4	5.2743704 − 12
2.4000000	7	5.8761744	8	8.1741956	4	5.0590909 − 12
2.5000000	7	6.3656407	8	8.5078289	4	4.8606994 − 12
2.6000000	7	6.8746770	8	8.8414569	4	4.6772833 − 12
2.7000000	7	7.4032833	8	9.1750802	4	4.5072084 − 12
2.8000000	7	7.9514597	8	9.5086993	4	4.3490699 − 12
2.9000000	7	8.5192061	8	9.8423147	4	4.2016537 − 12
3.0000000	7	9.1065226	8	1.0175927	5	4.0639049 − 12
3.2000000	7	1.0339866	9	1.0843142	5	3.8138391 − 12
3.4000000	7	1.1651489	9	1.1510347	5	3.5927674 − 12
3.6000000	7	1.3041392	9	1.2177543	5	3.3959230 − 12
3.8000000	7	1.4509576	9	1.2844732	5	3.2195299 − 12
4.0000000	7	1.6056040	9	1.3511915	5	3.0605579 − 12
4.2000000	7	1.7680784	9	1.4179093	5	2.9165475 − 12
4.4000000	7	1.9383809	9	1.4846266	5	2.7854814 − 12
4.6000000	7	2.1165113	9	1.5513435	5	2.6656893 − 12
4.8000000	7	2.3024698	9	1.6180601	5	2.5557764 − 12
5.0000000	7	2.4962563	9	1.6847764	5	2.4545689 − 12
5.5000000	7	3.0149701	9	1.8515660	5	2.2334607 − 12
6.0000000	7	3.5826090	9	2.0183542	5	2.0488969 − 12
6.5000000	7	4.1991731	9	2.1851415	5	1.8925089 − 12
7.0000000	7	4.8646623	9	2.3519281	5	1.7583020 − 12
7.5000000	7	5.5790766	9	2.5187139	5	1.6418696 − 12
8.0000000	7	6.3424161	9	2.6854993	5	1.5398998 − 12
8.5000000	7	7.1546806	9	2.8522843	5	1.4498554 − 12
9.0000000	7	8.0158703	9	3.0190689	5	1.3697600 − 12
1.0000000	8	9.8850251	9	3.3526373	5	1.2334766 − 12
1.1000000	8	1.1949880	10	3.6862048	5	1.1218584 − 12

p^*		E^*		W^*		β
2.2504849	1	2.1527055	1	2.2527055	1	9.9901423 − 1
2.4463630	1	2.3484060	1	2.4484060	1	9.9916558 − 1
2.6422148	1	2.5441065	1	2.6441065	1	9.9928457 − 1
2.8380458	1	2.7398070	1	2.8398070	1	9.9937981 − 1
3.0338599	1	2.9355075	1	3.0355075	1	9.9945722 − 1
3.2296602	1	3.1312080	1	3.2312080	1	9.9952099 − 1
3.4254492	1	3.3269085	1	3.4269085	1	9.9957415 − 1
3.6212285	1	3.5226090	1	3.6226090	1	9.9961893 − 1
3.8169998	1	3.7183095	1	3.8183095	1	9.9965699 − 1
4.0127642	1	3.9140100	1	4.0140100	1	9.9968963 − 1
4.2085226	1	4.1097105	1	4.2097105	1	9.9971782 − 1
4.4042759	1	4.3054110	1	4.4054110	1	9.9974234 − 1
4.6000247	1	4.5011115	1	4.6011115	1	9.9976379 − 1
4.7957696	1	4.6968120	1	4.7968120	1	9.9978267 − 1
4.9915109	1	4.8925125	1	4.9925125	1	9.9979938 − 1
5.1872492	1	5.0882130	1	5.1882130	1	9.9981423 − 1
5.3829848	1	5.2839135	1	5.3839135	1	9.9982749 − 1
5.5787179	1	5.4796140	1	5.5796140	1	9.9983938 − 1
5.7744487	1	5.6753145	1	5.7753145	1	9.9985008 − 1
5.9701776	1	5.8710150	1	5.9710150	1	9.9985975 − 1
6.3616301	1	6.2624160	1	6.3624160	1	9.9987648 − 1
6.7530767	1	6.6538171	1	6.7538171	1	9.9989038 − 1
7.1445183	1	7.0452181	1	7.1452181	1	9.9990206 − 1
7.5359556	1	7.4366191	1	7.5366191	1	9.9991197 − 1
7.9273894	1	7.8280201	1	7.9280201	1	9.9992045 − 1
8.3188200	1	8.2194211	1	8.3194211	1	9.9992776 − 1
8.7102480	1	8.6108221	1	8.7108221	1	9.9993410 − 1
9.1016737	1	9.0022231	1	9.1022231	1	9.9993965 − 1
9.4930974	1	9.3936241	1	9.4936241	1	9.9994452 − 1
9.8845192	1	9.7850251	1	9.8850251	1	9.9994883 − 1
1.0863067	2	1.0763528	2	1.0863528	2	9.9995763 − 1
1.1841608	2	1.1742030	2	1.1842030	2	9.9996434 − 1
1.2820143	2	1.2720533	2	1.2820533	2	9.9996958 − 1
1.3798673	2	1.3699035	2	1.3799035	2	9.9997374 − 1
1.4777199	2	1.4677538	2	1.4777538	2	9.9997710 − 1
1.5755723	2	1.5656040	2	1.5756040	2	9.9997986 − 1
1.6734244	2	1.6634543	2	1.6734543	2	9.9998215 − 1
1.7712763	2	1.7613045	2	1.7713045	2	9.9998406 − 1
1.9669796	2	1.9570050	2	1.9670050	2	9.9998708 − 1
2.1626824	2	2.1527055	2	2.1627055	2	9.9998931 − 1

V		V^*		$H\rho$		λ
1.2000000	8	1.4210436	10	4.0197717	5	1.0287648 − 12
1.3000000	8	1.6666692	10	4.3533381	5	9.4993767 − 13
1.4000000	8	1.9318649	10	4.6869041	5	8.8233081 − 13
1.5000000	8	2.2166306	10	5.0204697	5	8.2370775 − 13
1.6000000	8	2.5209664	10	5.3540351	5	7.7238937 − 13
1.7000000	8	2.8448723	10	5.6876003	5	7.2709044 − 13
1.8000000	8	3.1883481	10	6.0211653	5	6.8681054 − 13
1.9000000	8	3.5513941	10	6.3547302	5	6.5075931 − 13
2.0000000	8	3.9340100	10	6.6882949	5	6.1830405 − 13
2.1000000	8	4.3361961	10	7.0218596	5	5.8893229 − 13
2.2000000	8	4.7579521	10	7.3554241	5	5.6222452 − 13
2.3000000	8	5.1992783	10	7.6889886	5	5.3783404 − 13
2.4000000	8	5.6601745	10	8.0225530	5	5.1547180 − 13
2.5000000	8	6.1406407	10	8.3561173	5	4.9489490 − 13
2.6000000	8	6.6406770	10	8.6896816	5	4.7589774 − 13
2.7000000	8	7.1602833	10	9.0232458	5	4.5830513 − 13
2.8000000	8	7.6994597	10	9.3568100	5	4.4196685 − 13
2.9000000	8	8.2582061	10	9.6903741	5	4.2675337 − 13
3.0000000	8	8.8365226	10	1.0023938	6	4.1255241 − 13
3.2000000	8	1.0051866	11	1.0691066	6	3.8680892 − 13
3.4000000	8	1.1345489	11	1.1358194	6	3.6408955 − 13
3.6000000	8	1.2717393	11	1.2025322	6	3.4389098 − 13
3.8000000	8	1.4167576	11	1.2692450	6	3.2581572 − 13
4.0000000	8	1.5696040	11	1.3359578	6	3.0954570 − 13
4.2000000	8	1.7302784	11	1.4026706	6	2.9482331 − 13
4.4000000	8	1.8987809	11	1.4693833	6	2.8143778 − 13
4.6000000	8	2.0751113	11	1.5360961	6	2.6921492 − 13
4.8000000	8	2.2592698	11	1.6028089	6	2.5800955 − 13
5.0000000	8	2.4512563	11	1.6695216	6	2.4769969 − 13
5.5000000	8	2.9654701	11	1.8363035	6	2.2520242 − 13
6.0000000	8	3.5286090	11	2.0030854	6	2.0645150 − 13
6.5000000	8	4.1406731	11	2.1698672	6	1.9058308 − 13
7.0000000	8	4.8016623	11	2.3366491	6	1.7697993 − 13
7.5000000	8	5.5115766	11	2.5034309	6	1.6518929 − 13
8.0000000	8	6.2704161	11	2.6702127	6	1.5487155 − 13
8.5000000	8	7.0781806	11	2.8369946	6	1.4576693 − 13
9.0000000	8	7.9348703	11	3.0037764	6	1.3767336 − 13
9.5000000	8	8.8404851	11	3.1705582	6	1.3043128 − 13
1.0000000	9	9.7950251	11	3.3373401	6	1.2391305 − 13
1.2000000	9	1.4102436	12	4.0044673	6	1.0326966 − 13

p^*		E^*		W^*		β	
2.3583848	2	2.3484060	2	2.3584060	2	9.9999101	− 1
2.5540869	2	2.5441065	2	2.5541065	2	9.9999234	− 1
2.7497888	2	2.7398070	2	2.7498070	2	9.9999339	− 1
2.9454905	2	2.9355075	2	2.9455075	2	9.9999424	− 1
3.1411921	2	3.1312080	2	3.1412080	2	9.9999493	− 1
3.3368935	2	3.3269085	2	3.3369085	2	9.9999551	− 1
3.5325949	2	3.5226090	2	3.5326090	2	9.9999599	− 1
3.7282961	2	3.7183095	2	3.7283095	2	9.9999640	− 1
3.9239973	2	3.9140100	2	3.9240100	2	9.9999675	− 1
4.1196984	2	4.1097105	2	4.1197105	2	9.9999705	− 1
4.3153994	2	4.3054110	2	4.3154110	2	8.9999731	− 1
4.5111005	2	4.5011115	2	4.5111115	2	9.9999754	− 1
4.7068014	2	4.6968120	2	4.7068120	2	9.9999774	− 1
4.9025023	2	4.8925125	2	4.9025125	2	9.9999792	− 1
5.0982032	2	5.0882130	2	5.0982130	2	9.9999808	− 1
5.2939041	2	5.2839135	2	5.2939135	2	9.9999822	− 1
5.4896049	2	5.4796140	2	5.4896140	2	9.9999834	− 1
5.6853058	2	5.6753146	2	5.6853146	2	9.9999845	− 1
5.8810065	2	5.8710151	2	5.8810151	2	9.9999855	− 1
6.2724081	2	6.2624161	2	6.2724161	2	9.9999873	− 1
6.6638096	2	6.6538171	2	6.6638171	2	9.9999887	− 1
7.0552110	2	7.0452181	2	7.0552181	2	9.9999900	− 1
7.4466123	2	7.4366191	2	7.4466191	2	9.9999910	− 1
7.8380137	2	7.8280201	2	7.8380201	2	9.9999919	− 1
8.2294150	2	8.2194211	2	8.2294211	2	9.9999926	− 1
8.6208163	2	8.6108221	2	8.6208221	2	9.9999933	− 1
9.0122175	2	9.0022231	2	9.0122231	2	9.9999938	− 1
9.4036188	2	9.3936241	2	9.4036241	2	9.9999943	− 1
9.7950200	2	9.7850251	2	9.7950251	2	9.9999948	− 1
1.0773523	3	1.0763528	3	1.0773528	3	9.9999957	− 1
1.1752026	3	1.1742030	3	1.1752030	3	9.9999964	− 1
1.2730529	3	1.2720533	3	1.2730533	3	9.9999969	− 1
1.3709031	3	1.3699035	3	1.3709035	3	9.9999973	− 1
1.4687534	3	1.4677538	3	1.4687538	3	9.9999977	− 1
1.5666037	3	1.5656040	3	1.5666040	3	9.9999980	− 1
1.6644540	3	1.6634543	3	1.6644543	3	9.9999982	− 1
1.7623042	3	1.7613045	3	1.7623045	3	9.9999984	− 1
1.8601545	3	1.8591548	3	1.8601548	3	9.9999986	− 1
1.9580048	3	1.9570050	3	1.9580050	3	9.9999987	− 1
2.3494058	3	2.3484060	3	2.3494060	3	9.9999991	− 1

V		V^*		$H\rho$		λ
1.4000000	9	1.9192649	12	4.6715946	6	8.8522232 − 14
1.6000000	9	2.5065664	12	5.3387218	6	7.7460485 − 14
1.8000000	9	3.1721481	12	6.0058491	6	6.8856206 − 14
2.0000000	9	3.9160100	12	6.6729763	6	6.1972344 − 14
2.2000000	9	4.7381521	12	7.3401035	6	5.6339802 − 14
2.4000000	9	5.6385745	12	8.0072308	6	5.1645818 − 14
2.6000000	9	6.6172770	12	8.6743580	6	4.7673843 − 14
2.8000000	9	7.6742597	12	9.3414852	6	4.4269190 − 14
3.0000000	9	8.8095226	12	1.0008612	7	4.1318413 − 14
3.2000000	9	1.0023066	13	1.0675740	7	3.8736425 − 14
3.4000000	9	1.1314889	13	1.1342867	7	3.6458154 − 14
3.6000000	9	1.2684993	13	1.2009994	7	3.4432988 − 14
3.8000000	9	1.4133376	13	1.2677121	7	3.2620969 − 14
4.0000000	9	1.5660040	13	1.3344248	7	3.0990129 − 14
4.2000000	9	1.7264984	13	1.4011376	7	2.9514588 − 14
4.4000000	9	1.8948209	13	1.4678503	7	2.8173172 − 14
4.6000000	9	2.0709713	13	1.5345630	7	2.6948387 − 14
4.8000000	9	2.2549498	13	1.6012757	7	2.5825657 − 14
5.0000000	9	2.4467563	13	1.6679885	7	2.4792737 − 14
5.5000000	9	2.9605201	13	1.8347703	7	2.2539061 − 14
6.0000000	9	3.5232090	13	2.0015521	7	2.0660966 − 14
6.5000000	9	4.1348231	13	2.1683339	7	1.9071785 − 14
7.0000000	9	4.7953623	13	2.3351157	7	1.7709615 − 14
7.5000000	9	5.5048266	13	2.5018975	7	1.6529054 − 14
8.0000000	9	6.2632161	13	2.6686793	7	1.5496054 − 14
8.5000000	9	7.0705306	13	2.8354611	7	1.4584576 − 14
9.0000000	9	7.9267703	13	3.0022429	7	1.3774368 − 14
9.5000000	9	8.8319351	13	3.1690247	7	1.3049440 − 14
1.0000000	10	9.7860251	13	3.3358065	7	1.2397002 − 14

*p**		*E**		*W**		*β*	
2.7408068	3	2.7398070	3	2.7408070	3	9.9999993	− 1
3.1322079	3	3.1312080	3	3.1322080	3	9.9999995	− 1
3.5236089	3	3.5226090	3	3.5236090	3	9.9999996	− 1
3.9150099	3	3.9140100	3	3.9150100	3	9.9999997	− 1
4.3064109	3	4.3054110	3	4.3064110	3	9.9999997	− 1
4.6978119	3	4.6968120	3	4.6978120	3	9.9999998	− 1
5.0892129	3	5.0882130	3	5.0892130	3	9.9999998	− 1
5.4806140	3	5.4796140	3	5.4806140	3	9.9999998	− 1
5.8720150	3	5.8710151	3	5.8720151	3	9.9999999	− 1
6.2634160	3	6.2624161	3	6.2634161	3	9.9999999	− 1
6.6548170	3	6.6538171	3	6.6548171	3	9.9999999	− 1
7.0462180	3	7.0452181	3	7.0462181	3	9.9999999	− 1
7.4376190	3	7.4366191	3	7.4376191	3	9.9999999	− 1
7.8290200	3	7.8280201	3	7.8290201	3	9.9999999	− 1
8.2204210	3	8.2194211	3	8.2204211	3	9.9999999	− 1
8.6118220	3	8.6108221	3	8.6118221	3	9.9999999	− 1
9.0032230	3	9.0022231	3	9.0032231	3	9.9999999	− 1
9.3946240	3	9.3936241	3	9.3946241	3	9.9999999	− 1
9.7860250	3	9.7850251	3	9.7860251	3	9.9999999	− 1
1.0764528	4	1.0763528	4	1.0764528	4	1.0000000	0
1.1743030	4	1.1742030	4	1.1743030	4	1.0000000	0
1.2721533	4	1.2720533	4	1.2721533	4	1.0000000	0
1.3700035	4	1.3699035	4	1.3700035	4	1.0000000	0
1.4678538	4	1.4677538	4	1.4678538	4	1.0000000	0
1.5657040	4	1.5656040	4	1.5657040	4	1.0000000	0
1.6635543	4	1.6634543	4	1.6635543	4	1.0000000	0
1.7614045	4	1.7613045	4	1.7614045	4	1.0000000	0
1.8592548	4	1.8591548	4	1.8592548	4	1.0000000	0
1.9571050	4	1.9570050	4	1.9571050	4	1.0000000	0

PROPERTIES OF METALS AS CONDUCTORS

Metal.	Resistivity microhm-centimeters 20° C.	Temp. coefficient 20° C.	Specific gravity.	Tensile strength, lbs./in.	Melting point ° C.
*Advance. See *constantan*					
Aluminum	2.824	0.0039	2.70	30,000	659
Antimony	41.7	.0036	6.6	....	630
Arsenic	33.3	.0042	5.73	....	....
Bismuth	120	.004	9.8	....	271
Brass	7	.002	8.6	70,000	900
Cadmium	7.6	.0038	8.6	....	321
*Calido. See *nichrome*					
Climax	87	.0007	8.1	150,000	1250
Cobalt	9.8	.0033	8.71	....	1480
Constantan	49	.00001	8.9	120,000	1190
Copper: annealed	1.7241	.00393	8.89	30,000	1083
hard-drawn	1.771	.00382	8.89	60,000	....
Eureka. See *constantan*					
Excello	92	.00016	8.9	95,000	1500
Gas Carbon	5000	−.0005	....	....	3500
German silver, 18% Ni	33	.0004	8.4	150,000	1100
Gold	2.44	.0034	19.3	20,000	1063
Ideal. See *constantan*					
Iron, 99.98% pure	10	.005	7.8	....	1530
Lead	22	.0039	11.4	3,000	327
Magnesium	4.6	.004	1.74	33,000	651
Manganin	44	.00001	8.4	150,000	910
Mercury	95.783	.00089	13.546	0	−38.9
Molybdenum, drawn	5.7	.004	9.0	....	2500
Monel metal	42	.0020	8.9	160,000	1300
*Nichrome	100	.0004	8.2	150,000	1500
Nickel	7.8	.006	8.9	120,000	1452
Palladium	11	.0033	12.2	39,000	1550
Phosphor bronze	7.8	.0018	8.9	25,000	750
Platinum	10	.003	21.4	50,000	1755
Silver	1.59	.0038	10.5	42,000	960
Steel, E. B. B.	10.4	.005	7.7	53,000	1510
Steel, B. B.	11.9	.004	7.7	58,000	1510
Steel, Siemens-Martin	18	.003	7.7	100,000	1510
Steel, manganese	70	.001	7.5	230,000	1260
Tantalum	15.5	.0031	16.6	....	2850
*Therlo	47	.00001	8.2	....	....
Tin	11.5	.0042	7.3	4,000	232
Tungsten, drawn	5.6	.0045	19	500,000	3400
Zinc	5.8	.0037	7.1	10,000	419

* Trade mark.

RESISTIVITY

Giving the resistivity ρ for metals, including alloys and carbon. Temperature coefficients of resistance are given in a succeeding table.

Material	Temp. °C.	Resistivity ohm-cm	Authority
*Advance,	0	47.—49.	
Aluminum,			
commercial	20	2.828×10^{-6}	Bureau of Standards
Al 99.57, Si 0.29, Fe 0.14			
pure	−189	.64	Niccolai, 1907
	−100	1.53	"
	0	2.63	"
	+100	3.86	"
	400	8.0	"
Aluminum bronze	0	12.—13.	Various
Cu 97, Al 3	0	8.26	Pecheux, 1909
Cu 90, Al 10	0	12.6	"
Cu 6, Al 94	0	3.1	"
Antimony	20	41.7	Bureau of Standards
	−190	10.5	Eucken, Gelhoff
liquid	+860	120.	de la Rive
Argentan			
Cu 56, Ni 26	15	42.	Matthiessen
Arsenic	0	35.	"
Bismuth	18	119.0	Jäger, Diesselhorst
	100	160.2	" "
	−200	34.8	Various
	−100	75.6	"
	+100	156.5	Northrup, 1914
	200	214.5	"
liquid	300	128.9	"
"	500	139.9	"
"	700	150.8	"
Brass			
various	0	6.4—8.4	Various
hard drawn Cu 70.2, Zn 29.8	0	8.2	Siemens
annealed	0	7.0	"
Bronze			
Cu 88, Sn 12	20	18	
Cu 89, Sn 6, Zn 4	15	13.5	
Cadmium, drawn	18	7.54	Jäger, Diesselhorst
	100	9.82	" "
	−252.9	0.17	Euchen, Gehlhoff, 1912
	−200	1.66	" "
	−100	4.80	" "
	+300	16.50	Northrup, 1913
liquid	400	33.70	"
	500	35.12	"
	700	35.78	"
Calcium, Ca 99.57 %	20	4.6	Swisher, 1917
*Calido,	0	110	
Carboloy	20	19.6	
Carbon	0	3500	
	500	2700	
	1000	2100	
	2000	1100	
	2500	900	
Cesium	0	19	Various
	−187	5.25	Guntz, Broniewski
	27	22.2	Hackspill
liquid	30	36.6	"

* Trade mark.

Material	Temp. °C.	Resistivity ohm-cm	Authority
Chromium	28	13.0×10^{-6}	Brenner *et al* 1948
Climax,	20	87	Bureau of Standards
Cobalt, Co 99.8%	20	9.7	Reichardt, 1901
Constantan, Cu 60, Ni 40	20	49	Bureau of Standards
	−200	42.4	Niccolai
	−150	43.0	"
	−100	43.5	"
	−50	43.9	"
	0	44.1	"
	+100	44.6	"
	400	44.8	"
Copper, commercial			
annealed	20	1.7241*	Bureau of Standards
hard drawn	20	1.77	"
pure, annealed	20	1.692	Wolff, Dellinger 1910
	−258.6	.014	Niccolai
	−206.6	.163	"
	−150	.567	"
	−100	904	"
	+100	2.28	Northrup, 1914
	200	2.96	"
	500	5.08	"
	1000	9.42	"
liquid	1500	24.62	"
Copper-manganese			
Mn 0.98	0	4.83	Münker, 1912
Mn 1.49	0	6.66	" "
Mn 4.2	20	17.9	Sebast & Gray, 1916
Mn 7.4	20	19.7	" " " "
Mn 15	20	50	Klein, 1924
Copper-manganese-iron			
Cu 91, Mn 7.1, Fe 1.9	0	20	Blood
Cu 70.6, Mn 23.2, Fe 6.2	0	77	"
Copper-manganese-nickel			
Cu 73, Mn 24, Ni 3	0	48	Feussner, Lindeck
Eureka	0	47	Drysdale, 1907
Excello	20	92	Bureau of Standards
Gallium	0	53	Guntz, Broniewski
German silver, Ni 18%	20	33	Bureau of Standards
Cu 60.16, Zn 25.37, Ni 14.03, Fe 0.3, Co and Mn trace	−200	27.9	Dewar, Fleming
	−100	29.3	
	+100	33.1	
Gold, pure, drawn	20	2.44	Jäger, Diesselhorst
	−252.8	.018	Niccolai
	−200	.601	"
99.9 pure	−183	.68	Dewar, Fleming
	−150	.997	Niccolai, 1907
	−100	1.400	"
	+100	2.97	Northrup, 1914

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* Int. Ann. Cu. Std.

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Gold, 99.9 pure	200	3.83×10^{-6}	Northrop, 1914
	500	6.62	"
	1000	12.52	"
	1500	3.70	"
Gold-copper-silver			
Au 58.3, Cu 26.5, Ag 15.2	0	13.2	Matthiessen
Au 66.5, Cu 15.4, Ag 18.1	0	14.6	"
Au 7.4, Cu 78.3, Ag 14.3	0	3.6	"
Gold-silver			
Au 90, Ag 10	0	6.3	
Au 67, Ag 33	0	10.8	
Graphite	0	800	
	500	830	
	1000	870	
	2000	1000	
	2500	1100	
Ia — Ia			
Cu 60, Ni 40	0	50	Drysdale, 1907
Ideal, (*See constantan*)			
Illium		91.61	Knipp, Hall 1922
Indium	0	8.37	Erhardt, 1881
Invar (*See steel*)			
Iridium	−186	1.92	Broniewski, Hackspill
	0	6.10	" "
	100	8.30	" "
Iron 99.98% pure	20	10	Bureau of Standards
	−252.7	0.011	Niccolai
	−205.3	.652	Dewar, Fleming
	−200.	2.27	Niccolai
	−192.5	.844	"
	−100	5.92	"
	+100	16.61	"
	200	24.50	"
	400	43.29	"
(*See also under steel*)			
Lead	20	22.	Bureau of Standards
	−252.9	.59	Schimank, Nernst
	−203	4.42	" "
	−192.8	5.22	" "
	−103	11.8	
	+100	27.8	Northrup
	200	38	"
	219	50	"
liquid	333	95.0	"
"	400	98.3	"
"	600	107.2	"
"	800	116.2	"
cold pressed	−183	6.02	Dewar, Fleming
" "	−78	14.1	
" "	0	20.4	
" "	90.4	28.0	
" "	196.1	36.9	
Lithium	−187	1.34	Guntz, Broniewski
	0	8.55	" "
	99.3	12.7	" "

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Lithium liquid	230	45.2×10^{-6}	Bernini, 1905
Magnesium	20	4.6	Bureau of Standards
Zn free	−183	1.00	Dewar, Fleming
" "	−78	2.97	" "
" "	0	4.35	" "
" "	98.5	5.99	" "
pure	400	11.9	Niccolai, 1907
Manganese		5.0	Shukow
Manganese-copper			
Mn 30, Cu 70	0	100	Feussner, Lindeck
Manganin, Cu 84,	20	44	Bureau of Standards
Mn 12, Ni 4	22.5	45	Kimura, Sakamaki
	−200	37.8	Niccolai
	−100	38.5	"
	−50	38.7	"
	0	38.8	"
	100	38.9	"
	400	38.3	"
Mercury	20	95.783	Bureau of Standards
solid	−183.5	6.97	Dewar, Fleming
"	−102.9	15.04	" "
"	−50.3	12.3	" "
"	−39.2	25.5	" "
liquid	−36.1	80.6	" "
"	0	94.07	" "
"	50	98.50	Grimaldi
"	100	103.25	Vincentini, Omodei
"	200	114.27	" "
"	350	135.5	" "
"	100	103.1	Northrup
"	200	114.0	"
"	300	127.0	"
Molybdenum, drawn	20	5.7	Bureau of Standards
"	750	21.0	
Monel metal	20	42	Bureau of Standards
*Nichrome	20	100	Bureau of Standards
Nickel (99.99 %)	0	6.141	NBS Circular 495 (1950)
	20	6.844	"
	100	10.327	"
Nickel-copper-zinc Ni 12.84, Cu 30.59 Zn 6.57 by vol.	0	20.3	Matthiessen
Nickelin Ni 18.46, Cu 61.63 Zn 19.67, Fe 0.24 Co 0.19, Mn 0.18	0	33	Feussner, Lindeck
Osmium	20	60.2	Niccolai
Palladium	20	11	Bureau of Standards
	−183	2.78	Dewar, Fleming
	−78	7.17	" "
	0	10.21	" "
	98.5	13.79	" "
Patent nickel Ni 25.1, Cu 74.41 Fe 0.42, Zn 0.23 Mn 0.13, Co trace	0	34	Feussner, Lindeck
Phosphor bronze			
Sn 5.08, P 0.01		10.5	
Sn 2	0	5–6	

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* Trade mark.

Material	Temp. °C.	Resistivity ohm-cm	Authority
Platinoid, Cu 62, Ni 15, Zn 22	−160	32.5×10^{-6}	Lees, 1908
	18	34.4	"
Platinum	20	10	Bureau of Standards
	−203.1	2.44	Dewar, Fleming
	−97.5	6.87	" "
	0	10.96	" "
	+100	14.85	" "
	400	26	Niccolai
	−265	.10	Nernst
	−253	.15	"
	−233	.54	"
	−153	4.18	"
	−73	7.82	"
	0	11.05	"
	+100	14.1	Pirrani
	200	17.9	"
	400	25.4	"
	800	40.3	"
	1000	47.0	"
	1200	52.7	"
	1400	58.0	"
	1600	63.0	"
Platinum-iridium			
P 90, Ir 10	0	24	Barnes, 1888
P 80, Ir 20	0	31	"
Platinum-rhodium Pt 90, Rh 10	−200	14.49	Dewar, Fleming
	−100	18.05	" "
	0	21.14	" "
	+100	24.20	" "
Platinum-silver Pt 67, Ag 33	0	24.2	
Platinite, nickel steel Ni 46–48 %	0	45	
Potassium	−200	1.72	Guntz, Broniewski
	−100	3.72	" "
	−75	4.0	Hackspill
	0	6.1	"
	+55	8.4	"
liquid	100	15.31	Northrup
Rheotan Cu 53.28, Ni 25.31 Zn 16.80, Fe 4.46 Mn 0.37	0	53	Feussner, Lindeck
Rhodium	−186	0.7	Broniewski, Hackspill
	−78.3	3.09	" "
	0	4.69	" "
	+100	6.60	" "
Rose metal Bi 49, Pb 28, Sn 23	0	64	
Rubidium	−190	2.5	Hackspill
	0	11.6	
	+35	13.4	
liquid	40	19.6	
Silicium (silicon)	20	58.	
Silicium bronze	0	2.4	
Silver 99.98 %	18	1.629	Jäger, Diesselhorst
electrolytic	−183	0.390	Dewar, Fleming
"	−78	1.021	" "

RESISTIVITY (Continued)

Material	Temp. °C.	Resistivity ohm-cm	Authority
Silver, 99.98 %	0	1.468×10^{-6}	Dewar, Fleming
electrolytic	+98.15	2.062	" "
"	192.1	2.608	" "
	−258.6	.009	Niccolai
	−200	.357	"
	−100	.916	"
	0	1.506	"
	+100	2.15	Northrup
	200	2.80	"
	400	3.46	"
	750	6.65	"
liquid	1000	11.3	"
"	1500	15.3	"
Sodium	−180	1.0	Hackspill
	−75	2.8	"
	0	4.3	"
	55	5.4	"
liquid	116	10.2	"
"	−200	0.605	Various
	140	10.34	Northrup
Sodium-amalgam	0	95	
Hg 98, Na 2			
Steel			
aluminum	20	64	Portevin, 1909
Al 5, C 0.2			
Al 15, C 09	20	88	"
chromium	20	60	"
Cr 13, C oz			
Cr 40, C 08	20	71	
invar			
35 % Ni	20	81	Bureau of Standards
manganese	20	70	" "
nickel			
Ni 10, C 0.1	20	29	
Ni 25, C 0.1	20	39	
Ni 80, C 0.1	20	82	Portevin, 1909
piano wire	0	11.8	Stronhal, Barnes
Siemens-martin	20	18	Bureau of Standards
silicon, Si 25 %	20	45	
Si 4 %	20	62	
tempered glass			
hard		45.7	Stronhal, Barnes
tempered yellow		27	" "
" blue		20.5	" "
" soft		15.9	" "
titanium			
Ti 2.5, C 0.15,	20	16	Portevin, 1909
tungsten			
W 5, C 0.2	20	20	"
W 20, C 0.2	20	24	"
vanadium			
V 5, C 1.1	20	121	"
Strontium	20	24.8	Matthiessen
Tantalum	27	13.85	Malter, 1939
"	727	44.1	" "
Tellurium	19.6	200,000	Matthiessen
Thallium, pure	−183	4.08	Dewar, Fleming
	−78	11.8	" "
	0	17.60	" "
	+98.5	24.7	" "

RESISTIVITY (Concluded)

Material	Temp. °C.	Resistivity ohm-cm	Authority
*Therlo	20	47×10^{-6}	Bolton, 1909
Thorium	15	40.1	Rentschler, Marden, 1928
	20	18	Bureau of Standards
Tin	20	11.5	Bureau of Standards
	−184	3.40	Dewar, Fleming
	−78	8.8	" "
	0	13.0	" "
	+91.45	18.2	" "
	200	20.30	Northrup
	225	22.00	"
liquid	235	47.60	"
	750	61.22	"
Tin-bismuth			
Sn 90.5, Bi 9.5,	12	16	
Sn 2., Bi 98	0	244	
Tin-lead			
Sn 90, Pb 10	15	13.5	
Sn 33.3, Pb 66.7	15	16	Laport, 1897
Titanium		3.2	Shukow
Tungsten	20	5.51	Langmuir, 1916
	727	25.3	"
	1227	41.4	"
	1727	59.4	"
	2727	98.9	"
	3237	118	
Wood's metal			
Bi 56, Pb 14, Sn 14	0	52	
Zinc	−183	1.62	Dewar, Fleming
	−78	3.34	" "
	0	5.75	" "
	+92.5	8.00	
	191.5	10.37	
liquid	440	37.2	de la Rive
	100	7.95	Northrup
	300	13.25	"
	415	17.00	"
liquid	427	37.30	"
"	500	36.60	"
"	600	35.90	"
"	700	35.60	"
"	800	35.60	"
"	850	35.74	"

Material	Temp. °C.	Resistivity ohm-cm	Temperature coefficient
Alloy 193	0	$87\text{–}96 \times 10^{-6}$	0.000014–.0008
Alumel	0	33.3	0.0012
Chromel	0	70–110	0.00011–.000054
Copel	0	49.5	0.00000
Dowmetal	0	13–17	....
Duralumin	0	3.35	....
*Nichrome II	0	109–111	0.00015
* " III	0	90–97	0.00005–.00019
* " IV	0	98–103	0.00018

* Trade mark.

TEMPERATURE COEFFICIENT OF RESISTIVITY

Giving the temperature coefficient of resistivity for degrees centigrade for various metals including alloys.

Material	T °C.	α	Authority
*Advance (*See constantan*)			
Aluminum	18	0.0039	Jäger, Diesselhorst, 1900
	25	.0034	Somerville, 1910
	100	.0040	"
	500	.0050	"
annealed, highest purity	0–100	.00445	Holborn, 1921
Aluminum-bronze			
Cu 97, Al 3		.00102	
Cu 90, Al 10		.00320	
Cu 6, Al 94		.00380	
Antimony	20	.0036	
Arsenic		.0042	
Bismuth	20	.004	Bureau of Standards
	0–100	.00446	Holborn, 1921
Brass	20	.002	Bureau of Standards
Cu 66, Zn 34	15	.0020	
Cu 60, Zn 40	15	.0010	
Bronze			
Cu 88, Sn 12	20	.0005	
Cadmium	20	.0038	Bureau of Standards
drawn			
annealed, pure	0–100	.00424	Holborn, 1921
	0	.0042	
Carbon		−.0005	
Climax	20	+.0007	Bureau of Standards
Cobalt	0	.0033	
	0–100	.00658	Holborn, 1921
Constantan	12	.000008	Somerville, 1911
	25	.000002	"
	100	.000033	"
	200	.000020	"
	500	.000027	"
Copper, annealed	20	.00393	Bureau of Standards
hard drawn	20	.00382	" "
	100	.0038	Somerville, 1911
	400	.0042	"
	1000	.0062	"
electrolytic	0	.0041	
pure, annealed	0–100	.00433	Holborn, 1921
Copper-manganese			
Cu 96.5, Mn 3.5		.00022	Feussner, Lindeck
Cu 95, Mn 8		.000026	" "
Cu 70, Mn 30		.00004	" "
Copper-manganese-iron			
Cu 91, Mn 7.1, Fe 1.9	0	.000120	Blood
Cu 70.6, Mn 23.2, Fe 6.2	0	.000022	"
Copper-manganese-nickel			
Cu 73, Mn 24, Ni 3	0	−.00003	Feussner, Lindeck
Eureka	0	+.00005	Drysdale, 1907
Excello	20	.00016	Bureau of Standards
German-silver			
Ni 18%	20	.0004	Bureau of Standards
Cu 60, Zn 25, Ni 15	0	.00036	Feussner, Lindeck
Gold	20	.0034	Bureau of Standards
	100	.0025	Somerville, 1910
	500	.0035	"
	1000	.0049	"
	0–100	.00400	Holborn, 1921

* Trade mark.

TEMPERATURE COEFFICIENT OF RESISTIVITY
(Continued)

Material	T °C.	α	Authority
Gold-copper-silver			
Au 58.3, Cu 26.5, Ag 15.2	0	.000574	Matthiessen
Au 66.5, Cu 15.4, Ag 18.1	0	.000529	"
Au 7.4, Cu 78.3, Ag 14.3	0	.001830	"
Gold-silver			
Au 90, Ag 10	0	.0012	
Au 67, Ag 33	0	.00065	
Ia Ia			
Cu 60, Ni 40	0	−.00003	Drysdale, 1907
Illium		+.000479	Knipp-Hall, 1922
Indium	0	.0047	
Iridium	0–100	.00411	Holborn, 1921
Iron	20	.0050	Bureau of Standards
	0	.0062	Dewar, Fleming
	25	.0052	Somerville, 1910
	100	.0068	"
	500	.0147	"
	1000	.0050	"
	0–100	.00657	Holborn, 1912
Lead	18	.0043	Jäger, Diesselhorst
pure	0–100	.00422	Holborn, 1921
Lithium	0	.0047	
	230	.0027	
Magnesium	20	.004	Bureau of Standards
	0	.0038	Vincentini, Omodei
	25	.0050	Somerville, 1910
	100	.0045	"
	500	.0036	"
	600	.0100	"
Manganese-copper	0	.000040	Feussner-Lindeck
Mn 30, Cu 70			
Manganin			
Cu 84, Mn 12, Ni 4	12	.000006	Somerville, 1910
	25	.000000	"
	100	−.000042	"
	250	−.000052	"
	475	.000000	"
	500	+.00011	"
Mercury	20	.00089	Bureau of Standards
	0	.00088	Glazebrook
Molybdenum	25	.0033	Somerville
	100	.0034	"
	1000	.0048	"
	0–100	.00435	Holborn, 1921
Monel-metal	20	.0020	Bureau of Standards
*Nichrome	20	.0004	Bureau of Standards
Nickel	20	.006	Bureau of Standards
	0	.006	Vincentini
	25	.0043	Somerville
	100	.0043	"
	500	.0030	"
	1000	.0037	"
pure, annealed	0–100	.00675	Holborn, 1912
Palladium	20	.0033	Bureau of Standards
pure	0–100	.00377	Holborn
"	0	.0035	Dewar, Fleming
Phosphor-bronze	0	.0040 — .0030	

* Trade mark.

TEMPERATURE COEFFICIENT OF RESISTIVITY
(Concluded)

Material	T °C.	α	Authority
Platinite, nickel steel, Ni 46–48%	0	.003	
Platinum	20	.003	Bureau of Standards
	0	.0037	Dewar, Fleming
	0–100	.00392	Holborn, 1921
Platinum-iridium			
Pt 90, Ir 18	0	.0012	Barnes, 1888
Pt 80, Ir 20	0	.0008	"
Platinum-rhodium			
Pt 90, Rh 10	0	.0013	Le Chatelier, 1900
Platinum-silver			
Pt 33, Ag 67	0	.00024	
Potassium	0	.0055	
liquid	100	.0042	
Rheotan	0	.0004	
Rhodium	0–100	.00443	Holborn
Rose metal	0	.0020	
Rubidium	0	.0060	
Silicium bronze	0	.0038–.0023	
Silver	20	.0038	Bureau of Standards
	25	.0030	Somerville, 1910
	100	.0036	"
	500	.0044	"
pure, annealed	0–100	.00410	Holborn, 1921
Sodium	0	.0044	
liquid	120	.0033	
Steel			
invar Ni 36, C 0.2	0	.0020	
piano wire	0	.0032	Strouhal, Barnes
Siemens-Martin	20	.003	Bureau of Standards
Silicon			
Si 4%	20	.0008	
tempered glass hard	0	.0016	Strouhal, Barnes
tempered blue	0	.0033	" "
Tantalum	20	.0031	Bureau of Standards
	0–100	.00347	Holborn, 1921
Thallium	0	.0040	
liquid	295	.00035	
*Therlo	20	.00001	Bureau of Standards
Thorium	20–1800	.0021	Rentschler, Marden, 1925
Tin	20	.0042	Bureau of Standards
Tungsten	18	.0045	Jäger, Diesselhorst
	500	.0057	Somerville
	1000	.0089	"
pure, annealed	0–100	.00465	Holborn, 1921
Wood's metal	0	.0020	
Zinc	20	.0037	Bureau of Standards
	0	.0040	
	0–100	.00415	Holborn, 1921

* Trade mark.

SUPERCONDUCTING TRANSITION TEMPERATURES, MAGNETIC THRESHOLD FIELDS AT ABSOLUTE ZERO, ELECTRONIC CONSTANTS AND DEBYE TEMPERATURES FOR SUPERCONDUCTING ELEMENTS

Compiled by G. Preston Burns

Name of element	Atomic number	Crystal system	T_0 (°K.)	H_0 (Oersted)	(10^{-4} cal./mole deg.^{2})	(°K.)
Aluminum..	13	Cub.	1.175	106	3.27– 3.48	375
Titanium...	22	Hex.	0.39	100	8.0 – 8.5	430
Vanadium..	23	Cub.	4.89	1340	21.1 –22.1	338
Zinc.......	30	Hex.	0.93	42–52.5	1.25– 1.50	235
Gallium....	31	Orth.	1.103	47–50.3	1.2	240
Zirconium..	40	Hex.	0.55	46.6	6.92– 7.25	265
Niobium...	41	Cub.	8.7–8.9	1960	17.5 –20.4	252
Technetium.	43	Hex.	11.2	....	....	...
Ruthenium.	44	Hex.	0.47	46	8.0	...
Rhodium...	45	Cub.	0.9	....	10.0 –11.7	350
Cadmium ..	48	Hex.	0.56–0.65	27–28.8	1.5 – 1.7	165
Indium.....	49	Tetr.	3.342–3.374	269–275	4.0 – 4.33	109
Tin........	50	Tetr.	3.74	304–310	4.18– 4.46	195
Lanthanum.	57	Hex.	4.8–5.8	....	16–21	132
Hafnium ...	72	Hex.	0.37	....	6.3 – 6.8	213
Tantalum ..	73	Cub.	4.38	860	13.0 –14.0	230
Rhenium...	75	Hex.	1.70	188	5.85	210
Osmium....	76	Hex.	0.71	65	5.62	...
Mercury....	80	Rhom.	4.160	400–419	5.3	69
Thallium...	81	Hex.	2.392	171	3.5	100
Lead.......	82	Cub.	7.22	800	7.48– 8.0	96.3
Thorium...	90	Cub.	1.388–1.40	131	11.2 –13.3	168
Uranium...	92	Orth.	1.1	....	26	200

SUPERCONDUCTIVITY OF SOME ALLOYS AND COMPOUNDS

NbC	10.1°K	Bi_6Tl_3	6.5°K	Mo_2C	2.4°K
TaC	9.2	Sb_2Tl_7	5.5	W_2C	2.05
Pb-As-Bi	9.0	TaSi	4.2	Au_2Bi	1.84
Pb-Bi-Sb	8.9	PbS	4.1	CuS	1.6
Pb-Sn-Bi	8.5	Hg_5Tl_7	3.8	TiN	1.4
Pb-As alloy	8.4	ZrB	2.82	VN	1.3
MoC	7.7	WC	2.8	TiC	1.1
N_2Pb_5	7.2				

ELECTRICAL RESISTIVITY OF ROCKS AND SOILS

Igneous rocks	Resistivity ohm-cm	Sedimentary rocks	Resistivity ohm-cm
Granite	10^7–10^9	Limestone	10^4
Lava flow (basic)	10^6–10^7	Limestone, Cambrian	10^4–10^5
Lava, fresh	3×10^5–10^6	Sandstone, eastern	3×10^3–10^4
Quartz vein, massive	$>10^6$	Sandstone	10^5
		Limestone	10^5

Metamorphic rocks	Resistivity ohm-cm	Unconsolidated materials	Resistivity ohm-cm
Marble, white	10^{10}	Clay, blue	2×10^4
Marble	4×10^8	Clayey earth	10^4–4×10^4
Marble, yellow	10^{10}	Clay, fire	2×10^5
Schist, mica	10^7	Gravel	10^5
Shale, Nonesuch	10^4	Sand, dry	10^5–10^6
Shale, bed	10^5	Sand, moist	10^5–10^6

RATIO TABLES FOR BRIDGE CALCULATIONS

The Leeds & Northrup Co.

$$\frac{A}{1000 - A}$$

The first table gives values of the ratio, $A/(1000 - A)$, the value of A being measured from the zero at one end of the scale. If the balance point is at 500, $A = 500$ and the ratio is unity.

	Units									
A	0	1	2	3	4	5	6	7	8	9
0	.0 0000	1001	2004	3010	4016	5025	6036	7049	8064	9082
10	.0 1010	1112	1214	1317	1420	1523	1626	1730	1833	1937
20	.0 2041	2145	2250	2354	2459	2564	2670	2775	2881	2987
30	.0 3093	3199	3306	3413	3520	3627	3735	3843	3950	4058
40	.0 4167	4275	4384	4493	4602	4712	4820	4931	5042	5152
50	.0 5263	5374	5485	5596	5708	5820	5932	6044	6156	6269
60	.0 6383	6496	6610	6724	6838	6952	7066	7180	7296	7412
70	.0 7527	7643	7759	7875	7992	8109	8225	8342	8460	8578
80	.0 8696	8814	8933	9051	9170	9290	9408	9528	9649	9770
90	.0989	.1001	.1013	.1025	.1037	.1050	.1062	.1074	.1086	.1099
100	.1111	.1123	.1136	.1148	.1160	.1173	.1186	.1198	.1211	.1223
110	.1236	.1248	.1261	.1274	.1287	.1300	.1312	.1325	.1338	.1351
120	.1364	.1377	.1390	.1403	.1416	.1429	.1442	.1455	.1468	.1481
130	.1494	.1507	.1521	.1534	.1547	.1561	.1574	.1587	.1601	.1615
140	.1628	.1641	.1655	.1669	.1682	.1695	.1710	.1723	.1737	.1751
150	.1765	.1778	.1792	.1806	.1821	.1834	.1848	.1862	.1876	.1890
160	.1905	.1919	.1933	.1947	.1962	.1976	.1990	.2005	.2019	.2034
170	.2048	.2063	.2077	.2092	.2106	.2121	.2136	.2151	.2165	.2180
180	.2195	2210	.2225	.2240	.2255	.2270	.2285	.2300	.2315	.2331
190	.2346	.2361	.2376	.2392	.2407	.2423	.2438	.2454	.2469	.2485
200	.2500	.2516	.2532	.2547	.2563	.2579	.2595	.2610	.2625	.2642
210	.2658	.2674	.2690	.2706	.2722	.2739	.2755	.2772	2788	.2804
220	.2820	.2837	.2853	.2870	.2887	.2903	.2920	.2937	.2954	.2971
230	.2987	.3004	.3020	.3038	.3055	.3072	.3089	.3106	3123	.3140
240	.3157	.3175	.3192	.3210	.3228	.3245	.3262	.3280	.3298	.3316
250	.3333	.3351	.3369	.3387	.3405	.3423	.3440	.3459	.3477	3495
260	.3513	.3532	.3550	.3568	.3587	.3606	.3624	.3643	3662	.3681
270	.3699	.3717	.3736	.3755	.3774	.3793	.3812	.3831	3850	.3869
280	.3889	.3908	.3928	.3947	.3966	.3986	.4005	.4024	4044	4064
290	.4084	.4104	.4124	.4144	.4164	.4185	4205	.4225	4245	.4265
300	.4285	.4306	.4326	.4347	.4368	.4389	.4409	.4430	4450	.4471
310	.4493	.4514	.4535	.4556	.4577	.4598	.4619	.4640	.4661	.4683
320	.4705	.4727	.4749	.4771	.4793	.4814	.4836	.4858	.4881	.4903
330	.4925	.4947	.4969	.4992	.5015	.5038	.5060	.5083	.5106	.5129
340	.5152	.5174	.5197	.5220	.5244	.5267	.5290	.5313	.5336	.5360
350	.5384	.5407	.5431	.5455	.5480	.5504	.5528	.5553	.5576	.5600
360	.5625	.5650	.5674	.5698	.5723	.5748	.5773	5798	.5823	.5848
370	.5873	.5899	.5924	.5949	.5974	.6000	.6025	.6051	.6077	.6103
380	.6129	.6155	.6181	.6207	.6233	.6260	.6286	.6313	.6340	.6367
390	.6394	.6420	.6447	.6474	.6502	.6529	.6557	6584	.6611	.6638
400	.6666	.6694	.6722	.6750	.6778	.6806	.6834	.6862	.6891	.6920
410	.6949	.6978	.7007	.7036	.7065	.7094	.7123	.7152	.7181	.7211
420	.7241	.7271	.7301	.7331	.7361	.7391	.7421	.7451	.7482	.7512
430	.7543	.7574	.7605	.7636	.7667	.7698	.7729	.7760	.7792	.7824
440	.7857	7889	.7921	.7953	.7986	.8018	.8050	.8084	.8117	.8150
450	.8182	.8215	.8248	8282	.8316	.8349	.8382	.8416	.8450	.8484
460	.8518	.8552	.8586	.8620	.8655	.8691	.8727	.8762	.8798	.8834
470	.8868	.8904	.8939	.8975	.9011	.9048	.9084	.9120	.9157	.9194
480	.9231	.9267	.9304	.9341	.9379	.9417	.9454	.9493	.9531	.9570
490	.9609	.9649	.9687	.9725	.9764	.9803	.9842	.9881	.9920	.9960

RATIO TABLES FOR BRIDGE CALCULATIONS
(Continued)

UNITS

A	0	1	2	3	4	5	6	7	8	9
500	1.000	1.004	1.008	1.012	1.016	1.020	1.024	1.028	1.032	1.036
510	1.041	1.045	1.049	1.053	1.058	1.062	1.066	1.071	1.075	1.079
520	1.083	1.088	1.092	1.097	1.101	1.105	1.110	1.114	1.119	1.123
530	1.128	1.132	1.137	1.141	1.146	1.151	1.155	1.160	1.165	1.169
540	1.174	1.179	1.183	1.188	1.193	1.198	1.203	1.208	1.212	1.217
550	1.222	1.227	1.232	1.237	1.242	1.247	1.252	1.257	1.262	1.267
560	1.273	1.278	1.283	1.288	1.294	1.299	1.304	1.309	1.314	1.320
570	1.326	1.331	1.336	1.342	1.347	1.353	1.359	1.364	1.370	1.375
580	1.381	1.386	1.392	1.398	1.404	1.410	1.415	1.421	1.427	1.433
590	1.439	1.445	1.451	1.457	1.463	1.469	1.475	1.481	1.487	1.494
600	1.500	1.506	1.513	1.519	1.525	1.531	1.538	1.544	1.551	1.557
610	1.564	1.571	1.577	1.584	1.591	1.597	1.604	1.611	1.618	1.625
620	1.632	1.639	1.645	1.652	1.659	1.667	1.674	1.681	1.688	1.695
630	1.703	1.710	1.717	1.724	1.732	1.740	1.747	1.755	1.763	1.770
640	1.778	1.786	1.793	1.801	1.809	1.817	1.825	1.833	1.841	1.849
650	1.857	1.865	1.873	1.882	1.890	1.899	1.907	1.916	1.924	1.933
660	1.941	1.950	1.958	1.967	1.976	1.985	1.994	2.003	2.012	2.021
670	2.030	2.039	2.048	2.058	2.068	2.078	2.087	2.096	2.106	2.115
680	2.125	2.135	2.145	2.155	2.165	2.175	2.185	2.195	2.205	2.215
690	2.225	2.236	2.247	2.257	2.268	2.278	2.289	2.300	2.311	2.322
700	2.333	2.344	2.355	2.367	2.378	2.389	2.401	2.413	2.425	2.436
710	2.448	2.460	2.472	2.485	2.497	2.509	2.521	2.534	2.546	2.559
720	2.571	2.584	2.597	2.610	2.623	2.636	2.650	2.663	2.676	2.690
730	2.703	2.716	2.731	2.745	2.759	2.774	2.788	2.802	2.817	2.831
740	2.846	2.861	2.876	2.891	2.907	2.922	2.937	2.953	2.968	2.984
750	3.000	3.016	3.032	3.049	3.065	3.081	3.098	3.115	3.132	3.150
760	3.168	3.185	3.202	3.220	3.237	3.255	3.273	3.291	3.310	3.329
770	3.348	3.367	3.386	3.405	3.425	3.445	3.464	3.484	3.505	3.525
780	3.546	3.566	3.587	3.608	3.630	3.652	3.674	3.695	3.717	3.740
790	3.762	3.785	3.808	3.831	3.854	3.878	3.902	3.926	3.950	3.975
800	4.000	4.025	4.050	4.075	4.102	4.127	4.154	4.181	4.209	4.236
810	4.263	4.290	4.319	4.348	4.376	4.405	4.435	4.464	4.494	4.525
820	4.556	4.587	4.618	4.650	4.682	4.715	4.748	4.781	4.814	4.848
830	4.882	4.917	4.953	4.988	5.025	5.061	5.097	5.135	5.173	5.211
840	5.250	5.290	5.330	5.370	5.411	5.451	5.493	5.536	5.580	5.623
850	5.666	5.711	5.757	5.803	5.850	5.898	5.945	5.994	6.043	6.093
860	6.143	6.194	6.247	6.300	6.353	6.407	6.463	6.519	6.576	6.634
870	6.693	6.752	6.812	6.873	6.937	7.000	7.064	7.129	7.196	7.264
880	7.334	7.403	7.474	7.546	7.620	7.696	7.772	7.849	7.928	8.009
890	8.091	8.175	8.259	8.346	8.434	8.524	8.616	8.709	8.804	8.901
900	9.000	9.101	9.204	9.309	9.416	9.526	9.638	9.753	9.870	9.989
910	10.11	10.23	10.36	10.49	10.63	10.76	10.90	11.05	11.19	11.34
920	11.50	11.66	11.82	11.99	12.16	12.33	12.51	12.70	12.89	13.08
930	13.28	13.49	13.71	13.93	14.15	14.38	14.62	14.87	15.13	15.40
940	15.66	15.95	16.24	16.54	16.86	17.18	17.52	17.87	18.23	18.61
950	19.00	19.41	19.83	20.28	20.75	21.22	21.73	22.26	22.81	23.38
960	24.00	24.64	25.32	26.03	26.77	27.57	28.41	29.30	30.25	31.26
970	32.33	33.49	34.70	36.04	37.46	39.00	40.67	42.48	44.44	46.62
980	49.00	51.63	54.55	57.83	61.50	65.67	70.43	75.93	82.33	89.91
990	99.00	110.1	124.0	141.9	165.7	199.0	249.0	332.3	499.0	999.0

RATIO TABLES FOR BRIDGE CALCULATIONS
(Continued)

$$\frac{4500 + A}{5500 - A}$$

The second table gives values of the ratio $(4500 + A)/(5500 - A)$, the value of A being measured from the 4500 division on a total scale of 10,000. If the balance point is at 5000, $A = 500$ and the ratio is unity.

Units

A	0	1	2	3	4	5	6	7	8	9
0	.8182	.8185	.8188	.8192	.8195	.8198	.8202	.8205	.8208	.8212
10	.8215	.8218	.8221	.8225	.8228	.8232	.8235	.8238	.8241	.8245
20	.8248	.8251	.8254	.8258	.8262	.8265	.8268	.8272	.8275	.8278
30	.8281	.8285	.8288	.8292	.8295	.8298	.8302	.8305	.8308	.8312
40	.8315	.8318	.8322	.8325	.8328	.8332	.8335	.8338	.8341	.8345
50	.8349	.8353	.8356	.8360	.8363	.8366	.8370	.8373	.8376	.8379
60	.8382	.8385	.8389	.8392	.8396	.8399	.8403	.8406	.8409	.8413
70	.8416	.8419	.8423	.8426	.8424	.8433	.8436	.8440	.8443	.8447
80	.8450	.8453	.8457	.8460	.8464	.8467	.8470	.8474	.8477	.8481
90	.8484	.8487	.8491	.8495	.8498	.8501	.8505	.8509	.8513	.8517
100	.8519	.8522	.8525	.8529	.8532	.8536	.8539	.8543	.8546	.8549
110	.8553	.8556	.8560	.8563	.8567	.8570	.8574	.8577	.8581	.8584
120	.8587	.8591	.8594	.8598	.8601	.8605	.8608	.8612	.8615	.8619
130	.8622	.8626	.8629	.8633	.8636	.8640	.8643	.8646	.8650	.8653
140	.8657	.8660	.8664	.8667	.8671	.8674	.8678	.8681	.8685	.8688
150	.8692	.8695	.8699	.8702	.8706	.8709	.8713	.8716	.8720	.8723
160	.8727	.8730	.8734	.8737	.8741	.8744	.8748	.8751	.8755	.8758
170	.8762	.8765	.8769	.8772	.8776	.8779	.8783	.8786	.8790	.8793
180	.8797	.8800	.8804	.8808	.8811	.8815	.8818	.8822	.8825	.8829
190	.8832	.8836	.8839	.8843	.8847	.8850	.8854	.8857	.8861	.8864
200	.8868	.8871	.8875	.8879	.8882	.8885	.8889	.8893	.8896	.8900
210	.8903	.8907	.8910	.8914	.8917	.8921	.8925	.8929	.8932	.8936
220	.8939	.8942	.8946	.8950	.8953	.8957	.8960	.8964	.8968	.8972
230	.8975	.8979	.8982	.8986	.8990	.8993	.8997	.9001	.9004	.9008
240	.9011	.9015	.9018	.9022	.9025	.9029	.9032	.9037	.9040	.9044
250	.9048	.9051	.9055	.9059	.9063	.9066	.9070	.9073	.9077	.9080
260	.9084	.9088	.9091	.9095	.9098	.9101	.9105	.9108	.9112	.9116
270	.9120	.9123	.9127	.9131	.9135	.9139	.9142	.9146	.9150	.9153
280	.9157	.9161	.9165	.9168	.9172	.9175	.9179	.9183	.9186	.9190
290	.9194	.9198	.9202	.9205	.9209	.9212	.9215	.9220	.9223	.9227
300	.9231	.9234	.9238	.9242	.9245	.9249	.9253	.9257	.9260	.9264
310	.9268	.9272	.9276	.9279	.9282	.9286	.9290	.9294	.9298	.9301
320	.9305	.9309	.9312	.9316	.9320	.9324	.9327	.9331	.9335	.9339
330	.9342	.9346	.9350	.9354	.9357	.9361	.9365	.9369	.9372	.9376
340	.9380	.9384	.9388	.9391	.9395	.9399	.9403	.9406	.9410	.9414
350	.9417	.9421	.9425	.9429	.9432	.9436	.9440	.9444	.9448	.9451
360	.9455	.9459	.9463	.9467	.9470	.9474	.9478	.9482	.9486	.9489
370	.9493	.9497	.9500	.9504	.9508	.9512	.9516	.9520	.9523	.9527
380	.9531	.9535	.9539	.9543	.9547	.9550	.9554	.9558	.9562	.9566
390	.9570	.9573	.9577	.9581	.9585	.9589	.9592	.9596	.9600	.9604
400	.9608	.9611	.9615	.9619	.9623	.9627	.9631	.9635	.9639	.9643
410	.9646	.9650	.9654	.9658	.9661	.9665	.9669	.9673	.9677	.9681
420	.9685	.9689	.9693	.9697	.9700	.9704	.9708	.9712	.9716	.9720
430	.9724	.9728	.9732	.9736	.9740	.9744	.9748	.9751	.9755	.9759
440	.9763	.9767	.9771	.9774	.9778	.9782	.9786	.9790	.9795	.9798
450	.9802	.9806	.9810	.9814	.9818	.9822	.9826	.9830	.9834	.9837
460	.9841	.9846	.9849	.9853	.9857	.9861	.9865	.9869	.9873	.9877
470	.9881	.9885	.9889	.9893	.9897	.9900	.9904	.9908	.9912	.9916
480	.9920	.9924	.9928	.9932	.9936	.9940	.9944	.9948	.9952	.9956
490	.9960	.9964	.9968	.9972	.9976	.9980	.9984	.9988	.9992	.9996

RATIO TABLES FOR BRIDGE CALCULATIONS
(Continued)

	Units									
A	0	1	2	3	4	5	6	7	8	9
500	1.0000	1.0004	1.0008	1.0012	1.0016	1.0020	1.0024	1.0028	1.0032	1.0036
510	1.0040	1.0044	1.0048	1.0052	1.0056	1.0061	1.0065	1.0069	1.0073	1.0077
520	1.0081	1.0085	1.0089	1.0093	1.0097	1.0101	1.0105	1.0109	1.0113	1.0117
530	1.0121	1.0125	1.0129	1.0133	1.0137	1.0142	1.0146	1.0150	1.0154	1.0158
540	1.0162	1.0166	1.0170	1.0174	1.0178	1.0183	1.0187	1.0192	1.0196	1.0200
550	1.0203	1.0207	1.0211	1.0215	1.0219	1.0224	1.0228	1.0232	1.0236	1.0240
560	1.0244	1.0248	1.0252	1.0256	1.0260	1.0264	1.0269	1.0273	1.0277	1.0281
570	1.0285	1.0289	1.0293	1.0297	1.0301	1.0305	1.0309	1.0313	1.0317	1.0321
580	1.0325	1.0329	1.0333	1.0337	1.0341	1.0345	1.0350	1.0354	1.0358	1.0362
590	1.0366	1.0370	1.0375	1.0379	1.0383	1.0388	1.0392	1.0396	1.0400	1.0405
600	1.0409	1.0413	1.0417	1.0421	1.0425	1.0429	1.0434	1.0438	1.0442	1.0446
610	1.0450	1.0454	1.0458	1.0463	1.0467	1.0471	1.0475	1.0479	1.0484	1.0488
620	1.0492	1.0496	1.0500	1.0505	1.0509	1.0513	1.0517	1.0521	1.0526	1.0530
630	1.0534	1.0538	1.0542	1.0547	1.0551	1.0555	1.0559	1.0563	1.0568	1.0572
640	1.0576	1.0580	1.0585	1.0589	1.0593	1.0598	1.0602	1.0606	1.0610	1.0615
650	1.0619	1.0623	1.0628	1.0632	1.0636	1.0641	1.0645	1.0649	1.0653	1.0658
660	1.0662	1.0666	1.0670	1.0675	1.0679	1.0683	1.0687	1.0691	1.0696	1.0700
670	1.0704	1.0708	1.0713	1.0717	1.0721	1.0726	1.0730	1.0734	1.0738	1.0743
680	1.0747	1.0751	1.0755	1.0760	1.0764	1.0768	1.0772	1.0776	1.0781	1.0785
690	1.0789	1.0794	1.0798	1.0803	1.0807	1.0811	1.0816	1.0821	1.0825	1.0830
700	1.0834	1.0838	1.0843	1.0847	1.0851	1.0856	1.0860	1.0864	1.0868	1.0873
710	1.0877	1.0881	1.0886	1.0890	1.0895	1.0899	1.0903	1.0908	1.0912	1.0917
720	1.0921	1.0925	1.0930	1.0934	1.0939	1.0943	1.0947	1.0952	1.0956	1.0961
730	1.0965	1.0969	1.0974	1.0978	1.0982	1.0987	1.0991	1.0995	1.0999	1.1004
740	1.1008	1.1013	1.1017	1.1022	1.1026	1.1031	1.1035	1.1040	1.1044	1.1049
750	1.1053	1.1057	1.1062	1.1066	1.1071	1.1075	1.1079	1.1084	1.1088	1.1093
760	1.1097	1.1102	1.1106	1.1111	1.1115	1.1120	1.1124	1.1129	1.1133	1.1138
770	1.1142	1.1147	1.1151	1.1156	1.1160	1.1165	1.1169	1.1174	1.1178	1.1183
780	1.1187	1.1192	1.1196	1.1201	1.1205	1.1210	1.1214	1.1219	1.1223	1.1228
790	1.1232	1.1236	1.1241	1.1245	1.1250	1.1254	1.1258	1.1263	1.1267	1.1272
800	1.1276	1.1281	1.1285	1.1290	1.1294	1.1299	1.1304	1.1308	1.1313	1.1317
810	1.1322	1.1327	1.1331	1.1336	1.1340	1.1345	1.1349	1.1354	1.1358	1.1363
820	1.1367	1.1372	1.1376	1.1381	1.1385	1.1390	1.1395	1.1400	1.1404	1.1408
830	1.1413	1.1418	1.1422	1.1427	1.1431	1.1436	1.1441	1.1445	1.1450	1.1454
840	1.1459	1.1464	1.1468	1.1473	1.1477	1.1482	1.1487	1.1491	1.1496	1.1500
850	1.1505	1.1510	1.1514	1.1519	1.1523	1.1528	1.1533	1.1537	1.1542	1.1546
860	1.1551	1.1556	1.1560	1.1565	1.1570	1.1575	1.1579	1.1584	1.1589	1.1593
870	1.1598	1.1603	1.1608	1.1612	1.1617	1.1622	1.1627	1.1632	1.1636	1.1641
880	1.1646	1.1651	1.1655	1.1660	1.1664	1.1669	1.1674	1.1678	1.1683	1.1687
890	1.1692	1.1697	1.1701	1.1706	1.1710	1.1715	1.1720	1.1724	1.1729	1.1733
900	1.1738	1.1743	1.1748	1.1752	1.1757	1.1762	1.1767	1.1772	1.1776	1.1781
910	1.1786	1.1791	1.1796	1.1800	1.1805	1.1810	1.1815	1.1820	1.1824	1.1829
920	1.1834	1.1839	1.1844	1.1848	1.1853	1.1858	1.1863	1.1868	1.1872	1.1877
930	1.1882	1.1887	1.1892	1.1896	1.1901	1.1906	1.1911	1.1916	1.1920	1.1925
940	1.1930	1.1935	1.1939	1.1944	1.1949	1.1954	1.1958	1.1963	1.1968	1.1972
950	1.1977	1.1982	1.1987	1.1992	1.1997	1.2002	1.2006	1.2011	1.2016	1.2021
960	1.2026	1.2031	1.2036	1.2041	1.2046	1.2051	1.2055	1.2060	1.2065	1.2070
970	1.2075	1.2080	1.2085	1.2090	1.2095	1.2100	1.2104	1.2109	1.2114	1.2119
980	1.2124	1.2129	1.2134	1.2139	1.2144	1.2149	1.2153	1.2158	1.2163	1.2168
990	1.2173	1.2178	1.2183	1.2188	1.2193	1.2198	1.2202	1.2207	1.2212	1.2217

RESISTANCE OF ELECTROLYTES

Resistance of aqueous solutions of various salts and acids in ohms per centimeter cube for a temperature of 18° C.

(From observations by Kohlrausch.)

Salt.	Number of grams of salt in 100 grams solution.							
	5	10	15	20	25	30	40	50
Acetic acid	...	654.	616.	622.5	658.	714.	925.	1351.
Ammonium chloride	10.89	5.63	3.86	2.97	2.48			
Copper nitrate	27.4	15.7	11.7	9.82	9.17			
sulfate	52.9	31.2	23.7					
Hydrochloric acid	2.54	1.59	1.34	1.31	1.38	1.51	1.94	
Potassium iodide	29.5	14.7	.....	6.88	....	4.34	3.16	2.55
Silver nitrate	39.0	21.0	14.64	11.46	9.45	8.07	6.39	5.39
Sodium carbonate	22.2	14.2	12.0					
chloride	14.94	8.33	6.10	5.11	4.69			
hydroxide	5.08	3.20	2.89	3.06	3.68	4.95	8.61	
Sulfuric acid	4.79	2.55	1.84	1.53	1.39	1.35	1.47	1.85
Zinc chloride	20.70	13.75	....	10.96	....	10.80	11.83	15.87
sulfate	52.3	31.2	24.1	21.4	20.8	22.5		
(Concentration)	6.2	12.4	18.6	24.8	31.	37.2	43.4	
Nitric acid	3.2	1.84	1.45	1.30	1.28	1.32	1.43	
(Concentration)	8.4	12.6	16.8	21.	25.2	29.4	33.6	
Potassium hydroxide	3.67	2.66	2.19	1.96	1.85	1.84	1.91	

CONDUCTIVITY OF STANDARD SOLUTIONS

Giving the conductivity in reciprocal ohms (mho) per cm. for NaCl, KCl, H_2SO_4 and $MgSO_4$ for various temperatures. Solutions are as follows: —

H_2SO_4, — maximum conductivity (18° C.); dissolve 378 g. of 97% acid in pure water and dilute to 1 liter. Density at 18° C., 1.223.

$MgSO_4$, — maximum conductivity (18° C.); dissolve in 1 liter of distilled water 552 g. of $MgSO_4 7H_2O$. Density at 18° C., 1.190.

NaCl, — solution saturated at all temperatures given. An excess of NaCl in distilled water, about 450 g. per liter. D = 1.2014 (18° C.).

KCl, — normal solution, 74.59 grams per liter of solution at 18° C. Dissolve 74.555 grams (weighed in air) of KCl and dilute to 1 liter. Density, 1.04492.

Solution.	0° C.	5°	10°	15°
H_2SO_4	0.5184	0.5792	0.6408	0.7028
$MgSO_4$	0.02877	0.03402	0.03963	0.04555
NaCl	0.1345	0.1555	0.1779	0.2014
KCl, normal	0.06541	0.07414	0.08319	0.09252
KCl, 1/10 normal	0.00715	0.00822	0.00933	0.01048
KCl, 1/100 normal	0.000776	0.000896	0.001020	0.001147

	16°	17°	18°	19°	20°
H_2SO_4	0.7151	0.7275	0.7398	0.7522	0.7645
$MgSO_4$	0.04676	0.04799	0.04922	0.05046	0.05171
NaCl	0.2062	0.2111	0.2160	0.2209	0.2259
KCl, n.	0.09441	0.09631	0.09822	0.10014	0.10207
KCl, 1/10 n.	0.01072	0.01095	0.01119	0.01143	0.01167
KCl, 1/100 n.	0.001173	0.001199	0.001225	0.001251	0.001278

	21°	22°	23°	24°	25°
H_2SO_4	0.7768	0.7890	0.8013	0.8135	0.8257
$MgSO_4$	0.05297	0.05424	0.05551	0.05679	0.05808
NaCl	0.2309	0.2360	0.2411	0.2462	0.2513
KCl, n.	0.10400	0.10594	0.10789	0.10984	0.11180
KCl, 1/10, n.	0.01191	0.01215	0.01239	0.01264	0.01288
KCl, 1/100 n.	0.001305	0.001332	0.001359	0.001386	0.001413

	26°	27°	28°	29°	30°
H_2SO_4	0.8378	0.8499	0.8620	0.8740	0.8860
$MgSO_4$	0.05937	0.06067	0.06197	0.06328	0.06459
NaCl	0.2565	0.2616	0.2669	0.2721	0.2774
KCl, n.	0.11377	0.11574	....	....	....
KCl, 1/10 n.	0.01313	0.01337	0.01362	0 01387	0.01412
KCl, 1/50 n.	0.002819	0.002873	0.002927	0.002981	0.003036

EQUIVALENT CONDUCTANCE OF AQUEOUS SOLUTIONS

The equivalent conductance is given in reciprocal ohms. Concentration is given in milli-equivalents of solute per liter of solution. Corrected for conductance of water except in case of the strong acids.

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Acetic acid	0.	347.	773.
	10.	14.50	25.1
	30.	8.50	14.7
	80.	5.22	9.05
	100.	4.67	8.10
*Ammonium acetate	0.	99.8	338.
	10.	91.7	300.
	25.	88.2	286.
*Ammonium chloride	0.	131.1	415.
	2.	126.5	399.
	10.	122.5	382.
	30.	118.1	......
Ammonium hydroxide	0.	238.	647.
	10.	9.66	23.2
	30.	5.66	13.6
	100.	3.10	7.47
Barium ferrocyanide	0.	91.	521.
	2.	46.9	202.3
	12.5	30.4	129.8
Barium hydroxide	0.	222.	645.
	2.	215.	591.
	10.	207.	548.
	50.	191.1	478.
	100.	180.1	443.
Barium nitrate	0.	116.9	385.
	2.	109.7	352.
	10.	101.	322.
	40.	88.7	280.
	80.	81.6	258.
	100.	79.1	249.
Calcium ferrocyanide	0.	88.	512.
	100.	21.9	84.3
	200.	20.6	77.5
	400.	202.	76.2
Calcium nitrate	0.	70.4	369.
	2.	66.5	346.5
	50.	55.6	276.8
	100.	51.9	255.5
	200.	48.3	234.4

* Values have been corrected for hydrolysis.

EQUIVALENT CONDUCTANCE OF AQUEOUS SOLUTIONS (Continued)

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Hydrochloric acid	0.	379.	850.
	2.	373.6	826.
	10.	368.1	807.
	80.	353.	762.
	100.	350.6	754.
Lanthanum nitrate	0.	75.4	413.
	2.	68.9	363.5
	12.5	61.4	311.2
	50.	54.	261.4
	100.	49.9	236.7
	200.	46.	210.8
Magnesium sulfate	0.	114.1	426.
	2.	94.3	302.
	10.	76.1	234.
	20.	67.5	190.
	40.	59.3	160.
	80.	52.	136.
	100.	49.8	130.
	200.	43.1	110.
Nitric acid	0.	377.	826.
	2.	371.2	806.
	10.	365.	786.
	50.	353.7	750.
	100.	346.4	728.
Phosphoric acid	0.	338.3	730.
	2.	283.1	498.
	10.	203.	308.
	50.	122.7	168.
	100.	95.7	128.
Potassium chloride	0.	130.1	414.
	2.	126.3	393.
	10.	122.4	377.
	80.	113.5	342.
	100.	112.	336.
Potassium citrate	0.	76.4	420.
	2.	71.	381.2
	5.	67.6	357.2
	50.	54.4	273.
	100.	50.2	247.5
	300.	43.5	209.5
Potassium nitrate	0.	80.8	384.
	2.	78.6	370.3
	12.5	75.3	351.5

EQUIVALENT CONDUCTANCE OF AQUEOUS SOLUTIONS (Continued)

Substance.	Concentration milli-equivalents per liter.	18° C.	100° C.
Potassium nitrate	50.	70.7	326.1
	100.	67.2	308.5
Potassium ferrocyanide	0.	98.4	527.
	2.	84.8	427.6
	50.	58.2	272.4
	100.	53.	245.
	206.	48.8	222.3
	400.	45.4	203.1
Potassium oxalate	0.	79.4	419.
	2.	74.9	389.3
	50.	63.	312.2
	100.	59.3	288.9
	200.	55.8	265.1
Potassium sulfate	0.	132.8	455.
	2.	124.8	402.
	10.	115.7	365.
	40.	104.2	320.
	80.	97.2	294.
	100.	95.	286.
Silver nitrate	0.	115.8	367.
	2.	112.2	353.
	10.	108.	337.
	20.	105.1	326.
	40.	101.3	312.
	80.	96.5	294.
	100.	94.6	289.
Sodium acetate	0.	78.1	285.
	2.	74.5	268.
	10.	71.2	253.
	80.	63.4	221.
Sodium chloride	0.	109.	362.
	2.	105.6	349.
	10.	102.	336.
	80.	93.5	301.
	100.	92.0	296.
Sodium hydroxide	0.	216.5	594.
	2.	212.1	582.
	20.	205.8	559.
	50.	200.6	540.
Sulfuric acid	0.	383.	891.
	2.	353.9	571.
	10.	309.	446.
	50.	253.5	384.
	100.	233.3	369.

THE EQUIVALENT CONDUCTANCE OF THE SEPARATE IONS

(From Smithsonian Physical Tables)

Ion.	0°	18°	25°	50°	75°	100°	128°	156°
K	40.4	64.6	74.5	115	159	206	263	317
Na	26.	43.5	50.9	82	116	155	203	249
NH_4	40.2	64.5	74.5	115	159	207	264	319
Ag	32.9	54.3	63.5	101	143	188	245	299
$\frac{1}{2}$Ba	33.	55.	65.	104	149	200	262	322
$\frac{1}{2}$Ca	30.	51.	60.	98	142	191	252	312
$\frac{1}{3}$La	35.	61.	72.	119	173	235	312	388
Cl	41.1	65.5	75.5	116	160	207	264	318
NO_3	40.4	61.7	70.6	104	140	178	222	263
$C_2H_3O_2$	20.3	34.6	40.8	67	96	130	171	211
$\frac{1}{2}SO_4$	41.	68.	79.	125	177	234	303	370
$\frac{1}{2}C_2O_4$	39.	63.	73.	115	163	213	275	336
$\frac{1}{3}C_6H_5O_7$	36.	60.	70.	113	161	214		
$\frac{1}{4}Fe(CN)_6$	58.	95.	111.	173	244	321		
H	240.	314.	350.	465	565	644	722	777
OH	105.	172.	192.	284	360	439	525	592

ACTIVITY COEFFICIENTS OF ACIDS, BASES AND SALTS

The following coefficients are valid only at 25°C. The concentrations are expressed as molalities.

Name	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
$AgNO_3$	0.734	0.657	0.606	0.567	0.536	0.509	0.485	0.464	0.446	0.429
$AlCl_3$	(0.337)	0.305	0.302	0.313	0.331	0.356	0.388	0.429	0.479	0.539
$Al_2(SO_4)_3$	(0.0350)	0.0225	0.0176	0.0153	0.0143	0.0140	0.0142	0.0149	0.0159	0.0175
$CdSO_4$	(0.150)	0.102	0.082	0.069	0.061	0.055	0.050	0.046	0.043	0.041
$CrCl_3$	(0.331)	0.298	0.294	0.300	0.314	0.335	0.362	0.397	0.436	0.481
$Cr(NO_3)_3$	(0.319)	0.285	0.279	0.281	0.291	0.304	0.322	0.344	0.371	0.401
$Cr_2(SO_4)_3$	(0.0458)	0.0300	0.0238	0.0207	0.0190	0.0182	0.0181	0.0185	0.0194	0.0208
CsBr	0.754	0.694	0.654	0.626	0.603	0.586	0.571	0.558	0.547	0.538
CsCl	0.756	0.694	0.656	0.628	0.606	0.589	0.575	0.563	0.553	0.544
CsI	0.754	0.692	0.651	0.621	0.599	0.581	0.567	0.554	0.543	0.533
$CsNO_3$	0.733	0.655	0.602	0.561	0.528	0.501	0.478	0.458	0.439	0.422
CsOAc	0.799	0.771	0.761	0.759	0.762	0.768	0.776	0.783	0.792	0.802
$CuSO_4$	(0.150)	0.104	0.083	0.071	0.062	0.056	0.052	0.048	0.045	0.043
HBr	0.805	0.782	0.777	0.781	0.789	0.801	0.815	0.832	0.850	0.871
HCl	0.796	0.767	0.756	0.755	0.757	0.763	0.772	0.783	0.795	0.809
$HClO_4$	0.803	0.778	0.768	0.766	0.769	0.776	0.785	0.795	0.808	0.823
HI	0.818	0.807	0.811	0.823	0.839	0.860	0.883	0.908	0.935	0.963
HNO_3	0.791	0.754	0.735	0.725	0.720	0.717	0.717	0.718	0.721	0.724
KBr	0.772	0.722	0.693	0.673	0.657	0.646	0.636	0.629	0.622	0.617
KCl	0.770	0.718	0.688	0.666	0.649	0.637	0.626	0.618	0.610	0.604
KCNS	0.769	0.716	0.685	0.663	0.646	0.633	0.623	0.614	0.606	0.599
KF	0.775	0.727	0.700	0.682	0.670	0.661	0.654	0.650	0.646	0.645
KI	0.778	0.733	0.707	0.689	0.676	0.667	0.660	0.654	0.649	0.645
KNO_3	0.739	0.663	0.614	0.576	0.545	0.519	0.496	0.476	0.459	0.443
KOAc	0.796	0.766	0.754	0.750	0.751	0.754	0.759	0.766	0.774	0.783
KOH	0.798	0.760	0.742	0.734	0.732	0.733	0.736	0.742	0.749	0.756
LiBr	0.796	0.766	0.756	0.752	0.753	0.758	0.767	0.777	0.789	0.803
LiCl	0.790	0.757	0.744	0.740	0.739	0.743	0.748	0.755	0.764	0.774
$LiClO_4$	0.812	0.794	0.792	0.798	0.808	0.820	0.834	0.852	0.869	0.887
LiI	0.815	0.802	0.804	0.813	0.824	0.838	0.852	0.870	0.888	0.910
$LiNO_3$	0.788	0.752	0.736	0.728	0.726	0.727	0.729	0.733	0.737	0.743
LiOAc	0.784	0.742	0.721	0.709	0.700	0.691	0.689	0.688	0.688	0.689
$MgSO_4$	(0.150)	0.108	0.088	0.076	0.068	0.062	0.057	0.054	0.051	0.049
$MnSO_4$	(0.150)	0.106	0.085	0.073	0.064	0.058	0.053	0.049	0.046	0.044
NaBr	0.782	0.741	0.719	0.704	0.697	0.692	0.689	0.687	0.687	0.687
NaCl	0.778	0.735	0.710	0.693	0.681	0.673	0.667	0.662	0.659	0.657
$NaClO_4$	0.775	0.729	0.701	0.683	0.668	0.656	0.648	0.641	0.635	0.629
NaCNS	0.787	0.750	0.731	0.720	0.715	0.712	0.710	0.710	0.711	0.712
NaF	0.765	0.710	0.676	0.651	0.632	0.616	0.603	0.592	0.582	0.573
NaH_2PO_4	0.744	0.675	0.629	0.593	0.563	0.539	0.517	0.499	0.483	0.468
NaI	0.787	0.751	0.735	0.727	0.723	0.723	0.724	0.727	0.731	0.736
$NaNO_3$	0.762	0.703	0.666	0.638	0.617	0.599	0.583	0.570	0.558	0.548
NaOAc	0.791	0.757	0.744	0.737	0.735	0.736	0.740	0.745	0.752	0.757
NaOH	0.766	0.727	0.708	0.697	0.690	0.685	0.681	0.679	0.678	0.678
$NiSO_4$	(0.150)	0.105	0.084	0.071	0.063	0.056	0.052	0.047	0.044	0.042
RbBr	0.763	0.706	0.673	0.650	0.632	0.617	0.605	0.595	0.586	0.578
RbCl	0.764	0.709	0.675	0.652	0.634	0.620	0.608	0.599	0.590	0.583
RbI	0.762	0.705	0.671	0.647	0.629	0.614	0.602	0.591	0.583	0.575
$RbNO_3$	0.734	0.658	0.606	0.565	0.534	0.508	0.485	0.465	0.446	0.430
RbOAc	0.796	0.767	0.756	0.753	0.755	0.759	0.766	0.773	0.782	0.792
$TlNO_3$	0.702	0.606	0.545	0.500	.....	.....	.....	.....	.....	.....
$ZnSO_4$	(0.150)	0.104	0.083	0.071	0.063	0.057	0.052	0.048	0.046	0.043

STANDARD CALIBRATION TABLES FOR THERMOCOUPLES

The following tables which represent the Temperature-E. M. F. functions of various thermocouples should be used with appropriate correction curves if precise results are desired. These curves must be determined for each individual couple by plotting ΔE, the difference between the observed and the standard E. M. F., against the standard E. M. F. at three or more fixed temperature points. The value ΔE as shown by such a correction curve is then subtracted algebraically from the observed E. M. F. to give the true E. M. F. reading.

In the following tables the fixed or "cold junction" is at 0° C.; when the cold junction is not maintained at 0° C. the readings of the E. M. F. must be corrected as follows: $Et = E_{(t-tc)} + Etc$ where $E_{(t-tc)}$ is the observed reading, Etc is the E. M. F. for the temperature corresponding to the cold junction temperature as read from the standard table and Et is the E. M. F. produced by the hot junction corrected to the value which would be obtained with the cold junction at 0° C. The temperature corresponding to Et is then obtained by reference to the standard table.

Since the E. M. F.-temperature function is not linear the cold junction should be maintained at a temperature very close to that at which the thermocouple was calibrated. Otherwise considerable error will result despite the above correction.

PLATINUM VERSUS PLATINUM-10-PERCENT RHODIUM THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948). Reference Junctions at 0° C.)

°C	0	10	20	30	40	50	60	70	80	90
	Millivolts									
0	0	0.06	0.11	0.17	0.24	0.30	0.36	0.43	0.50	0.57
100	0.64	0.72	0.79	0.87	0.95	1.03	1.11	1.19	1.27	1.35
200	1.44	1.52	1.61	1.69	1.78	1.87	1.96	2.05	2.14	2.23
300	2.32	2.41	2.50	2.59	2.69	2.78	2.87	2.97	3.06	3.16
400	3.25	3.35	3.44	3.54	3.64	3.73	3.83	3.93	4.02	4.12
500	4.22	4.32	4.42	4.52	4.62	4.72	4.82	4.92	5.02	5.12
600	5.22	5.33	5.43	5.53	5.64	5.74	5.84	5.95	6.05	6.16
700	6.26	6.37	6.47	6.58	6.68	6.79	6.90	7.01	7.11	7.22
800	7.33	7.44	7.55	7.66	7.77	7.88	7.99	8.10	8.21	8.32
900	8.43	8.55	8.66	8.77	8.88	9.00	9.11	9.23	9.34	9.46
1000	9.57	9.69	9.80	9.92	10.04	10.15	10.27	10.39	10.51	10.62
1100	10.74	10.86	10.98	11.10	11.22	11.34	11.46	11.58	11.70	11.82
1200	11.94	12.06	12.18	12.30	12.42	12.54	12.66	12.78	12.90	13.02
1300	13.14	13.26	13.38	13.50	13.62	13.74	13.86	13.98	14.10	14.22
1400	14.34	14.46	14.58	14.70	14.82	14.94	15.05	15.17	15.29	15.41
1500	15.53	15.65	15.77	15.89	16.01	16.12	16.24	16.36	16.48	16.60
1600	16.72	16.83	16.95	17.07	17.19	17.31	17.42	17.54	17.66	17.77
1700	17.89	18.01	18.12	18.24	18.36	18.47	18.59	...	...	...

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

PLATINUM VERSUS PLATINUM-10-PERCENT RHODIUM THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	10	20	30	40	50	60	70	80	90
	Millivolts									
0	...	...	...	...	0.02	0.06	0.09	0.12	0.15	0.19
100	0.22	0.26	0.29	0.33	0.36	0.40	0.44	0.48	0.52	0.56
200	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.89	0.93	0.97
300	1.02	1.06	1.11	1.15	1.20	1.24	1.29	1.33	1.38	1.43
400	1.47	1.52	1.57	1.62	1.66	1.71	1.76	1.81	1.86	1.91
500	1.96	2.01	2.06	2.11	2.16	2.21	2.26	2.31	2.36	2.41
600	2.46	2.51	2.56	2.61	2.66	2.72	2.77	2.82	2.87	2.92
700	2.98	3.03	3.08	3.14	3.19	3.24	3.29	3.35	3.40	3.45
800	3.51	3.56	3.61	3.67	3.72	3.78	3.83	3.88	3.94	3.99
900	4.05	4.10	4.16	4.21	4.26	4.32	4.37	4.43	4.49	4.54
1000	4.60	4.65	4.71	4.76	4.82	4.87	4.93	4.99	5.04	5.10
1100	5.16	5.21	5.27	5.33	5.38	5.44	5.50	5.56	5.61	5.67
1200	5.73	5.78	5.84	5.90	5.96	6.02	6.07	6.13	6.19	6.25
1300	6.31	6.37	6.42	6.48	6.54	6.60	6.66	6.72	6.78	6.84
1400	6.90	6.96	7.02	7.08	7.14	7.20	7.26	7.32	7.38	7.44
1500	7.50	7.56	7.62	7.68	7.74	7.80	7.86	7.93	7.99	8.05
1600	8.11	8.17	8.23	8.30	8.36	8.42	8.48	8.55	8.61	8.67
1700	8.73	8.80	8.86	8.92	8.98	9.05	9.11	9.17	9.24	9.30
1800	9.37	9.43	9.49	9.56	9.62	9.69	9.75	9.82	9.88	9.94
1900	10.01	10.07	10.14	10.20	10.27	10.33	10.40	10.47	10.53	10.60
2000	10.66	10.73	10.79	10.86	10.93	10.99	11.06	11.12	11.19	11.26
2100	11.32	11.39	11.46	11.52	11.59	11.66	11.72	11.79	11.86	11.92
2200	11.99	12.06	12.12	12.19	12.26	12.32	12.39	12.46	12.52	12.59
2300	12.66	12.72	12.79	12.86	12.92	12.99	13.06	13.12	13.19	13.26
2400	13.33	13.39	13.46	13.53	13.59	13.66	13.73	13.79	13.86	13.92
2500	13.99	14.06	14.12	14.19	14.26	14.32	14.39	14.46	14.52	14.59
2600	14.66	14.72	14.79	14.86	14.92	14.99	15.05	15.12	15.19	15.25
2700	15.32	15.39	15.45	15.52	15.58	15.65	15.72	15.78	15.85	15.91
2800	15.98	16.05	16.11	16.18	16.24	16.31	16.37	16.44	16.51	16.57
2900	16.64	16.70	16.77	16.83	16.90	16.97	17.03	17.10	17.16	17.23
3000	17.29	17.36	17.42	17.49	17.55	17.62	17.68	17.75	17.81	17.88
3100	17.94	18.01	18.07	18.14	18.20	18.27	18.33	18.40	18.46	18.53
3200	18.59	18.66	...	...	...	...	...	...	...	...

* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

PLATINUM VERSUS PLATINUM-13-PERCENT RHODIUM THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948). Reference Junctions at 0° C.)

°C	0	10	20	30	40	50	60	70	80	90
	Millivolts									
0	0.00	0.06	0.11	0.17	0.23	0.30	0.36	0.43	0.50	0.57
100	0.65	0.72	0.80	0.88	0.96	1.04	1.12	1.21	1.29	1.38
200	1.47	1.55	1.64	1.73	1.83	1.92	2.01	2.11	2.20	2.30
300	2.40	2.49	2.59	2.69	2.79	2.89	2.99	3.09	3.19	3.30
400	3.40	3.50	3.61	3.71	3.82	3.92	4.03	4.13	4.24	4.35
500	4.46	4.56	4.67	4.78	4.89	5.00	5.12	5.23	5.34	5.45
600	5.56	5.68	5.79	5.91	6.02	6.14	6.25	6.37	6.49	6.60
700	6.72	6.84	6.96	7.08	7.20	7.32	7.44	7.56	7.68	7.80
800	7.92	8.05	8.17	8.29	8.42	8.54	8.67	8.80	8.92	9.05
900	9.18	9.30	9.43	9.56	9.69	9.82	9.95	10.08	10.21	10.34
1000	10.47	10.60	10.74	10.87	11.00	11.14	11.27	11.41	11.54	11.68
1100	11.82	11.95	12.09	12.23	12.37	12.50	12.64	12.78	12.92	13.06
1200	13.19	13.33	13.47	13.61	13.75	13.89	14.03	14.17	14.30	14.44
1300	14.58	14.72	14.86	15.00	15.14	15.28	15.42	15.55	15.69	15.83
1400	15.97	16.11	16.25	16.39	16.52	16.66	16.80	16.94	17.08	17.22
1500	17.36	17.49	17.63	17.77	17.91	18.04	18.18	18.32	18.45	18.59
1600	18.73	18.86	19.00	19.14	19.27	19.41	19.55	19.68	19.82	19.95
1700	20.09	...	...	...	...	...	...	...	...	...

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

PLATINUM VERSUS PLATINUM-13-PERCENT RHODIUM THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	10	20	30	40	50	60	70	80	90
	Millivolts									
0	...	...	...	...	0.02	0.06	0.09	0.12	0.15	0.19
100	0.22	0.26	0.29	0.33	0.36	0.40	0.44	0.48	0.52	0.56
200	0.60	0.64	0.68	0.72	0.76	0.81	0.85	0.89	0.94	0.98
300	1.03	1.08	1.12	1.17	1.21	1.26	1.31	1.36	1.41	1.46
400	1.50	1.55	1.60	1.65	1.70	1.75	1.81	1.86	1.91	1.96
500	2.01	2.07	2.12	2.17	2.22	2.28	2.33	2.38	2.44	2.49
600	2.55	2.60	2.66	2.71	2.77	2.82	2.88	2.94	2.99	3.05
700	3.10	3.16	3.22	3.27	3.33	3.39	3.45	3.50	3.56	3.62
800	3.68	3.74	3.79	3.85	3.91	3.97	4.03	4.09	4.15	4.21
900	4.26	4.32	4.38	4.44	4.50	4.56	4.62	4.69	4.75	4.81
1000	4.87	4.93	4.99	5.05	5.12	5.18	5.24	5.30	5.36	5.43
1100	5.49	5.55	5.61	5.68	5.74	5.81	5.87	5.93	6.00	6.06
1200	6.13	6.19	6.25	6.32	6.38	6.45	6.51	6.58	6.64	6.71
1300	6.77	6.84	6.90	6.97	7.04	7.10	7.17	7.24	7.30	7.37
1400	7.44	7.50	7.57	7.64	7.71	7.77	7.84	7.91	7.98	8.05
1500	8.12	8.18	8.25	8.32	8.39	8.46	8.53	8.60	8.67	8.74
1600	8.81	8.88	8.95	9.02	9.09	9.16	9.23	9.30	9.37	9.45
1700	9.52	9.59	9.66	9.73	9.80	9.87	9.95	10.02	10.09	10.16
1800	10.24	10.31	10.38	10.46	10.53	10.60	10.68	10.75	10.82	10.90
1900	10.97	11.05	11.12	11.20	11.27	11.35	11.42	11.50	11.58	11.65
2000	11.73	11.80	11.88	11.95	12.03	12.11	12.18	12.26	12.34	12.41
2100	12.49	12.56	12.64	12.72	12.80	12.87	12.95	13.03	13.10	13.18
2200	13.26	13.33	13.41	13.49	13.56	13.64	13.72	13.80	13.87	13.95
2300	14.03	14.10	14.18	14.26	14.34	14.41	14.49	14.57	14.64	14.72
2400	14.80	14.88	14.95	15.03	15.11	15.18	15.26	15.34	15.42	15.49
2500	15.57	15.65	15.72	15.80	15.88	15.95	16.03	16.11	16.19	16.26
2600	16.34	16.42	16.49	16.57	16.65	16.73	16.80	16.88	16.96	17.03
2700	17.11	17.19	17.26	17.34	17.42	17.49	17.57	17.65	17.72	17.80
2800	17.88	17.95	18.03	18.10	18.18	18.26	18.33	18.41	18.48	18.56
2900	18.64	18.71	18.79	18.86	18.94	19.02	19.09	19.17	19.24	19.32
3000	19.39	19.47	19.55	19.62	19.70	19.77	19.85	19.92	20.00	20.08
3100	20.15	...	...	...	...	...	...	...	...	...

* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948). Reference Junctions at 0° C.)

°C	0	1	2	3	4	5	6	7	8	9
					Millivolts					
−190	−5.60	−5.62	−5.63	−5.65	−5.67	−5.68	−5.70	−5.71	−5.73	−5.74
−180	−5.43	−5.45	−5.46	−5.48	−5.50	−5.52	−5.53	−5.55	−5.57	−5.58
−170	−5.24	−5.26	−5.28	−5.30	−5.32	−5.34	−5.35	−5.37	−5.39	−5.41
−160	−5.03	−5.05	−5.08	−5.10	−5.12	−5.14	−5.16	−5.18	−5.20	−5.22
−150	−4.81	−4.84	−4.86	−4.88	−4.90	−4.92	−4.95	−4.97	−4.99	−5.01
−140	−4.58	−4.60	−4.62	−4.65	−4.67	−4.70	−4.72	−4.74	−4.77	−4.79
−130	−4.32	−4.35	−4.37	−4.40	−4.42	−4.45	−4.48	−4.50	−4.52	−4.55
−120	−4.06	−4.08	−4.11	−4.14	−4.16	−4.19	−4.22	−4.24	−4.27	−4.30
−110	−3.78	−3.81	−3.84	−3.86	−3.89	−3.92	−3.95	−3.98	−4.00	−4.03
−100	−3.49	−3.52	−3.55	−3.58	−3.61	−3.64	−3.66	−3.69	−3.72	−3.75
−90	−3.19	−3.22	−3.25	−3.28	−3.31	−3.34	−3.37	−3.40	−3.43	−3.46
−80	−2.87	−2.90	−2.93	−2.96	−3.00	−3.03	−3.06	−3.09	−3.12	−3.16
−70	−2.54	−2.57	−2.61	−2.64	−2.67	−2.71	−2.74	−2.77	−2.80	−2.84
−60	−2.20	−2.24	−2.27	−2.30	−2.34	−2.37	−2.41	−2.44	−2.47	−2.51
−50	−1.86	−1.89	−1.93	−1.96	−2.00	−2.03	−2.07	−2.10	−2.13	−2.17
−40	−1.50	−1.54	−1.57	−1.61	−1.64	−1.68	−1.72	−1.75	−1.79	−1.82
−30	−1.14	−1.17	−1.21	−1.25	−1.28	−1.32	−1.36	−1.39	−1.43	−1.47
−20	−0.77	−0.80	−0.84	−0.88	−0.92	−0.95	−0.99	−1.03	−1.06	−1.10
−10	−0.39	−0.42	−0.46	−0.50	−0.54	−0.58	−0.62	−0.66	−0.69	−0.73
(−)0	−0.00	−0.04	−0.08	−0.12	−0.16	−0.19	−0.23	−0.27	−0.31	−0.35
(+)0	0.00	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36
10	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76
20	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16
30	1.20	1.24	1.28	1.32	1.36	1.40	1.44	1.49	1.53	1.57
40	1.61	1.65	1.69	1.73	1.77	1.81	1.85	1.90	1.94	1.98
50	2.02	2.06	2.10	2.14	2.18	2.23	2.27	2.31	2.35	2.39
60	2.43	2.47	2.51	2.56	2.60	2.64	2.68	2.72	2.76	2.80
70	2.85	2.89	2.93	2.97	3.01	3.05	3.10	3.14	3.18	3.22
80	3.26	3.30	3.35	3.39	3.43	3.47	3.51	3.56	3.60	3.64
90	3.68	3.72	3.76	3.81	3.85	3.89	3.93	3.97	4.01	4.06
100	4.10	4.14	4.18	4.22	4.26	4.31	4.35	4.39	4.43	4.47
110	4.51	4.55	4.60	4.64	4.68	4.72	4.76	4.80	4.84	4.88
120	4.92	4.96	5.01	5.05	5.09	5.13	5.17	5.21	5.25	5.29
130	5.33	5.37	5.41	5.45	5.49	5.53	5.57	5.61	5.65	5.69
140	5.73	5.77	5.81	5.85	5.89	5.93	5.97	6.01	6.05	6.09
150	6.13	6.17	6.21	6.25	6.29	6.33	6.37	6.41	6.45	6.49
160	6.53	6.57	6.61	6.65	6.69	6.73	6.77	6.81	6.85	6.89
170	6.93	6.97	7.01	7.05	7.09	7.13	7.17	7.21	7.25	7.29
180	7.33	7.37	7.41	7.45	7.49	7.53	7.57	7.61	7.65	7.69
190	7.73	7.77	7.81	7.85	7.89	7.93	7.97	8.01	8.05	8.09
200	8.13	8.17	8.21	8.25	8.29	8.33	8.37	8.41	8.46	8.50
210	8.54	8.58	8.62	8.66	8.70	8.74	8.78	8.82	8.86	8.90
220	8.94	8.98	9.02	9.06	9.10	9.14	9.18	9.22	9.26	9.30
230	9.34	9.38	9.42	9.46	9.50	9.54	9.59	9.63	9.67	9.71
240	9.75	9.79	9.83	9.87	9.91	9.95	9.99	10.03	10.07	10.11
250	10.16	10.20	10.24	10.28	10.32	10.36	10.40	10.44	10.48	10.52
260	10.57	10.61	10.65	10.69	10.73	10.77	10.81	10.85	10 89	10.93
270	10.98	11.02	11.06	11.10	11.14	11.18	11.22	11.26	11.30	11.34
280	11.39	11.43	11.47	11.51	11.55	11.59	11.63	11.67	11.72	11.76
290	11.80	11.84	11.88	11.92	11.96	12.01	12.05	12.09	12.13	12.17
300	12.21	12.25	12.29	12.34	12.38	12.42	12.46	12.50	12.54	12.58

CALIBRATION TABLES
FOR THERMOCOUPLES (Continued)
CHROMEL-ALUMEL THERMOCOUPLES

Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948).
Reference Junctions at 0° C.)

°C	0	1	2	3	4	5	6	7	8	9
	Millivolts									
300	12.21	12.25	12.29	12.34	12.38	12.42	12.46	12.50	12.54	12.58
310	12.63	12.67	12.71	12.75	12.79	12.83	12.88	12.92	12.96	13.00
320	13.04	13.08	13.12	13.17	13.21	13.25	13.29	13.33	13.37	13.42
330	13.46	13.50	13.54	13.58	13.62	13.67	13.71	13.75	13.79	13.83
340	13.88	13.92	13.96	14.00	14.04	14.09	14.13	14.17	14.21	14.25
350	14.29	14.34	14.38	14.42	14.46	14.50	14.55	14.59	14.63	14.67
360	14.71	14.76	14.80	14.84	14.88	14.92	14.97	15.01	15.05	15.09
370	15.13	15.18	15.22	15.26	15.30	15.34	15.39	15.43	15.47	15.51
380	15.55	15.60	15.64	15.68	15.72	15.76	15.81	15.85	15.89	15.93
390	15.98	16.02	16.06	16.10	16.14	16.19	16.23	16.27	16.31	16.36
400	16.40	16.44	16.48	16.52	16.57	16.61	16.65	16.69	16.74	16.78
410	16.82	16.86	16.91	16.95	16.99	17.03	17.07	17.12	17.16	17.20
420	17.24	17.29	17.33	17.37	17.41	17.46	17.50	17.54	17.58	17.62
430	17.67	17.71	17.75	17.79	17.84	17.88	17.92	17.96	18.01	18.05
440	18.09	18.13	18.17	18.22	18.26	18.30	18.34	18.39	18.43	18.47
450	18.51	18.56	18.60	18.64	18.68	18.73	18.77	18.81	18.85	18.90
460	18.94	18.98	19.02	19.07	19.11	19.15	19.19	19.24	19.28	19.32
470	19.36	19.41	19.45	19.49	19.54	19.58	19.62	19.66	19.71	19.75
480	19.79	19.84	19.88	19.92	19.96	20.01	20.05	20.09	20.13	20.18
490	20.22	20.26	20.31	20.35	20.39	20.43	20.48	20.52	20.56	20.60
500	20.65	20.69	20.73	20.77	20.82	20.86	20.90	20.94	20.99	21.03
510	21.07	21.11	21.16	21.20	21.24	21.28	21.32	21.37	21.41	21.45
520	21.50	21.54	21.58	21.63	21.67	21.71	21.75	21.80	21.84	21.88
530	21.92	21.97	22.01	22.05	22.09	22.14	22.18	22.22	22.26	22.31
540	22.35	22.39	22.43	22.48	22.52	22.56	22.61	22.65	22.69	22.73
550	22.78	22.82	22.86	22.90	22.95	22.99	23.03	23.07	23.12	23.16
560	23.20	23.25	23.29	23.33	23.38	23.42	23.46	23.50	23.54	23.59
570	23.63	23.67	23.72	23.76	23.80	23.84	23.89	23.93	23.97	24.01
580	24.06	24.10	24.14	24.18	24.23	24.27	24.31	24.36	24.40	24.44
590	24.49	24.53	24.57	24.61	24.65	24.70	24.74	24.78	24.83	24.87
600	24.91	24.95	25.00	25.04	25.08	25.12	25.17	25.21	25.25	25.29
610	25.34	25.38	25.42	25.47	25.51	25.55	25.59	25.64	25.68	25.72
620	25.76	25.81	25.85	25.89	25.93	25.98	26.02	26.06	26.10	26.15
630	26.19	26.23	26.27	26.32	26.36	26.40	26.44	26.48	26.53	26.57
640	26.61	26.65	26.70	26.74	26.78	26.82	26.86	26.91	26.95	26.99
650	27.03	27.07	27.12	27.16	27.20	27.24	27.28	27.33	27.37	27.41
660	27.45	27.49	27.54	27.58	27.62	27.66	27.71	27.75	27.79	27.83
670	27.87	27.92	27.96	28.00	28.04	28.08	28.13	28.17	28.21	28.25
680	28.29	28.34	28.38	28.42	28.46	28.50	28.55	28.59	28.63	29.67
690	28.72	28.76	28.80	28.84	28.88	28.93	28.97	29.01	29.05	29.10
700	29.14	29.18	29.22	29.26	29.30	29.35	29.39	29.43	29.47	29.52
710	29.56	29.60	29.64	29.68	29.72	29.77	29.81	29.85	29.89	29.93
720	29.97	30.02	30.06	30.10	30.14	30.18	30.23	30.27	30.31	30.35
730	30.39	30.44	30.48	30.52	30.56	30.60	30.65	30.69	30.73	30.77
740	30.81	30.85	30.90	30.94	30.98	31.02	31.06	31.10	31.15	31.19
750	31.23	31.27	31.31	31.35	31.40	31.44	31.48	31.52	31.56	31.60
760	31.65	31.69	31.73	31.77	31.81	31.85	31.90	31.94	31.98	32.02
770	32.06	32.10	32.15	32.19	32.23	32.27	32.31	32.35	32.39	32.43
780	32.48	32.52	32.56	32.60	32.64	32.68	32.72	32.76	32.81	32.85
790	32.89	32.93	32.97	33.01	33.05	33.09	33.13	33.18	33.22	33.26
800	33.30	33.34	33.38	33.42	33.46	33.50	33.54	33.59	33.63	33.67

CALIBRATION TABLES
FOR THERMOCOUPLES (Continued)
CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948). Reference Junctions at 0° C.)

°C	0	1	2	3	4	5	6	7	8	9
	Millivolts									
800	33.30	33.34	33.38	33.42	33.46	33.50	33.54	33.59	33.63	33.67
810	33.71	33.75	33.79	33.83	33.87	33.91	33.95	33.99	34.04	34.08
820	34.12	34.16	34.20	34.24	34.28	34.32	34.36	34.40	34.44	34.48
830	34.53	34.57	34.61	34.65	34.69	34.73	34.77	34.81	34.85	34.89
840	34.93	34.97	35.02	35.06	35.10	35.14	35.18	35.22	35.26	35.30
850	35.34	35.38	35.42	35.46	35.50	35.54	35.58	35.63	35.67	35.71
860	35.75	35.79	35.83	35.87	35.91	35.95	35.99	36.03	36.07	36.11
870	36.15	36.19	36.23	36.27	36.31	36.35	36.39	36.43	36.47	36.51
880	36.55	36.59	36.63	36.67	36.72	36.76	36.80	36.84	36.88	36.92
890	36.96	37.00	37.04	37.08	37.12	37.16	37.20	37.24	37.28	37.32
900	37.36	37.40	37.44	37.48	37.52	37.56	37.60	37.64	37.68	37.72
910	37.76	37.80	37.84	37.88	37.92	37.96	38.00	38.04	38.08	38.12
920	38.16	38.20	38.24	38.28	38.32	38.36	38.40	38.44	38.48	38.52
930	38.56	38.60	38.64	38.68	38.72	38.76	38.80	38.84	38.88	38.92
940	38.95	38.99	39.03	39.07	39.11	39.15	39.19	39.23	39.27	39.31
950	39.35	39.39	39.43	39.47	39.51	39.55	39.59	39.63	39.67	39.71
960	39.75	39.79	39.83	39.86	39.90	39.94	39.98	40.02	40.06	40.10
970	40.14	40.18	40.22	40.26	40.30	40.34	40.38	40.41	40.45	40.49
980	40.53	40.57	40.61	40.65	40.69	40.73	40.77	40.81	40.85	40.89
990	40.92	40.96	41.00	41.04	41.08	41.12	41.16	41.20	41.24	41.28
1000	41.31	41.35	41.39	41.43	41.47	41.51	41.55	41.59	41.63	41.67
1010	41.70	41.74	41.78	41.82	41.86	41.90	41.94	41.98	42.02	42.05
1020	42.09	42.13	42.17	42.21	42.25	42.29	42.33	42.36	42.40	42.44
1030	42.48	42.52	42.56	42.60	42.63	42.67	42.71	42.75	42.79	42.83
1040	42.87	42.90	42.94	42.98	43.02	43.06	43.10	43.14	43.17	43.21
1050	43.25	43.29	43.33	43.37	43.41	43.44	43.48	43.52	43.56	43.60
1060	43.63	43.67	43.71	43.75	43.79	43.83	43.87	43.90	43.94	43.98
1070	44.02	44.06	44.10	44.13	44.17	44.21	44.25	44.29	44.33	44.36
1080	44.40	44.44	44.48	44.52	44.55	44.59	44.63	44.67	44.71	44.74
1090	44.78	44.82	44.86	44.90	44.93	44.97	45.01	45.05	45.09	45.12
1100	45.16	45.20	45.24	45.27	45.31	45.35	45.39	45.43	45.46	45.50
1110	45.54	45.58	45.62	45.65	45.69	45.73	45.77	45.80	45.84	45.88
1120	45.92	45.96	45.99	46.03	46.07	46.11	46.14	46.18	46.22	46.26
1130	46.29	46.33	46.37	46.41	46.44	46.48	46.52	46.56	46.59	46.63
1140	46.67	46.70	46.74	46.78	46.82	46.85	46.89	46.93	46.97	47.00
1150	47.04	47.08	47.12	47.15	47.19	47.23	47.26	47.30	47.34	47.38
1160	47.41	47.45	47.49	47.52	47.56	47.60	47.63	47.67	47.71	47.75
1170	47.78	47.82	47.86	47.89	47.93	47.97	48.00	48.04	48.08	48.12
1180	48.15	48.19	48.23	48.26	48.30	48.34	48.37	48.41	48.45	48.48
1190	48.52	48.56	48.59	48.63	48.67	48.70	48.74	48.78	48.81	48.85
1200	48.89	48.92	48.96	49.00	49.03	49.07	49.11	49.14	49.18	49.22
1210	49.25	49.29	49.32	49.36	49.40	49.43	49.47	49.51	49.54	49.58
1220	49.62	49.65	49.69	49.72	49.76	49.80	49.83	49.87	49.90	49.94
1230	49.98	50.01	50.05	50.08	50.12	50.16	50.19	50.23	50.26	50.30
1240	50 34	50.37	50.41	50.44	50.48	50.52	50.55	50.59	50.62	50.66
1250	50.69	50.73	50.77	50.80	50.84	50.87	50.91	50.94	50.98	51.02
1260	51.05	51.09	51.12	51.16	51.19	51.23	51.27	51.30	51.34	51.37
1270	51.41	51.44	51.48	51.51	51.55	51.58	51.62	51.66	51.69	51.73
1280	51.76	51.80	51.83	51.87	51.90	51.94	51.97	52.01	52.04	52.08
1290	52.11	52.15	52.18	52.22	52.25	52.29	52.32	52.36	52.39	52.43
1300	52.46	52.50	52.53	52.57	52.60	52.64	52.67	52.71	52.74	52.78

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948). Reference Junctions at 0° C.)

°C	0	1	2	3	4	5	6	7	8	9
	Millivolts									
1300	52.46	52.50	52.53	52.57	52.60	52.64	52.67	52.71	52.74	52.78
1310	52.81	52.85	52.88	52.92	52.95	52.99	53.02	53.06	53.09	53.13
1320	53.16	53.20	53.23	53.27	53.30	53.34	53.37	53.41	53.44	53.47
1330	53.51	53.54	53.58	53.61	53.65	53.68	53.72	53.75	53.79	53.82
1340	53.85	53.89	53.92	53.96	53.99	54.03	54.06	54.10	54.13	54.16
1350	54.20	54.23	54.27	54.30	54.34	54.37	54.40	54.44	54.47	54.51
1360	54.54	54.57	54.61	54.64	54.68	54.71	54.74	54.78	54.81	54.85
1370	54.88	54.91	....	....	....	....	....	....	....	....

CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
	Millivolts									
−300	−5.51	−5.52	−5.53	−5.54	−5.54	−5.55	−5.56	−5.57	−5.58	−5.59
−290	−5.41	−5.42	−5.43	−5.44	−5.45	−5.46	−5.47	−5.48	−5.49	−5.50
−280	−5.30	−5.31	−5.32	−5.34	−5.35	−5.36	−5.37	−5.38	−5.39	−5.40
−270	−5.20	−5.21	−5.22	−5.23	−5.24	−5.25	−5.26	−5.27	−5.28	−5.29
−260	−5.08	−5.09	−5.10	−5.12	−5.13	−5.14	−5.15	−5.16	−5.17	−5.18
−250	−4.96	−4.97	−4.99	−5.00	−5.01	−5.02	−5.03	−5.04	−5.06	−5.07
−240	−4.84	−4.85	−4.86	−4.88	−4.89	−4.90	−4.91	−4.92	−4.94	−4.95
−230	−4.71	−4.72	−4.74	−4.75	−4.76	−4.77	−4.79	−4.80	−4.81	−4.82
−220	−4.58	−4.59	−4.60	−4.62	−4.63	−4.64	−4.66	−4.67	−4.68	−4.70
−210	−4.44	−4.45	−4.46	−4.48	−4.49	−4.51	−4.52	−4.53	−4.55	−4.56
−200	−4.29	−4.31	−4.32	−4.34	−4.35	−4.36	−4.38	−4.39	−4.41	−4.42
−190	−4.15	−4.16	−4.18	−4.19	−4.21	−4.22	−4.24	−4.25	−4.26	−4.28
−180	−4.00	−4.01	−4.03	−4.04	−4 06	−4.07	−4.09	−4.10	−4.12	−4.13
−170	−3.84	−3.86	−3.88	−3.89	−3.91	−3.92	−3.94	−3.95	−3.97	−3.98
−160	−3.69	−3.70	−3.72	−3.73	−3.75	−3.76	−3.78	−3.80	−3.81	−3.83
−150	−3.52	−3.54	−3.56	−3.57	−3.59	−3.60	−3.62	−3.64	−3.65	−3.67
−140	−3.36	−3.38	−3.39	−3.41	−3.42	−3.44	−3.46	−3.47	−3.49	−3.51
−130	−3.19	−3.20	−3.22	−3.24	−3.25	−3.27	−3.29	−3.31	−3.32	−3.34
−120	−3.01	−3.03	−3.05	−3.06	−3.08	−3.10	−3.12	−3.13	−3.15	−3.17
−110	−2.83	−2.85	−2.87	−2.89	−2.90	−2.92	−2.94	−2.96	−2.98	−2.99
−100	−2.65	−2.67	−2.69	−2.71	−2.72	−2.74	−2.76	−2.78	−2.80	−2.82
−90	−2.47	−2.49	−2.50	−2.52	−2.54	−2.56	−2.58	−2.60	−2.62	−2.63
−80	−2.28	−2.30	−2.32	−2.34	−2.36	−2.37	−2.39	−2.41	−2.43	−2.45
−70	−2.09	−2.11	−2.13	−2.15	−2.17	−2.18	−2.20	−2.22	−2.24	−2.26
−60	−1.90	−1.92	−1.94	−1.96	−1.97	−1.99	−2.01	−2.03	−2.05	−2.07
−50	−1.70	−1.72	−1.74	−1.76	−1.78	−1.80	−1.82	−1.84	−1.86	−1.88
−40	−1.50	−1.52	−1.54	−1.56	−1.58	−1.60	−1.62	−1.64	−1.66	−1.68
−30	−1.30	−1.32	−1.34	−1.36	−1.38	−1.40	−1.42	−1.44	−1.46	−1.48
−20	−1.10	−1.12	−1.14	−1.16	−1.18	−1.20	−1.22	−1.24	−1.26	−1.28
−10	−0.89	−0.91	−0.93	−0.95	−0.97	−0.99	−1.01	−1.03	−1.06	−1.08
(−)0	−0.68	−0.70	−0.72	−0.75	−0.77	−0.79	−0.81	−0.83	−0.85	−0.87
(+)0	−0.68	−0.66	−0.64	−0.62	−0.60	−0.58	−0.56	−0.54	−0.52	−0.49
10	−0.47	−0.45	−0.43	−0.41	−0.39	−0.37	−0.34	−0.32	−0.30	−0.28
20	−0.26	−0.24	−0.22	−0.19	−0.17	−0.15	−0.13	−0.11	−0.09	−0.07
30	−0.04	−0.02	0.00	0.02	0.04	0.07	0.09	0.11	0.13	0.15
40	0.18	0.20	0.22	0.24	0.26	0.29	0.31	0.33	0.35	0.37
50	0.40	0.42	0.44	0.46	0.48	0.51	0.53	0.55	0.57	0.60
60	0.62	0.64	0.66	0.68	0.71	0.73	0.75	0.77	0.80	0.82
70	0.84	0.86	0.88	0.91	0.93	0.95	0.97	1.00	1.02	1.04
80	1.06	1.09	1.11	1.13	1.15	1.18	1.20	1.22	1.24	1.27
90	1.29	1.31	1.33	1.36	1.38	1.40	1.43	1.45	1.47	1.49
100	1.52	1.54	1.56	1.58	1.61	1.63	1.65	1.68	1.70	1.72

* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
					Millivolts					
100	1.52	1.54	1.56	1.58	1.61	1.63	1.65	1.68	1.70	1.72
110	1.74	1.77	1.79	1.81	1.84	1.86	1.88	1.90	1.93	1.95
120	1.97	2.00	2.02	2.04	2.06	2.09	2.11	2.13	2.16	2.18
130	2.20	2.23	2.25	2.27	2.29	2.32	2.34	2.36	2.39	2.41
140	2.43	2.46	2.48	2.50	2.52	2.55	2.57	2.59	2.62	2.64
150	2.66	2.69	2.71	2.73	2.75	2.78	2.80	2.82	2.85	2.87
160	2.89	2.92	2.94	2.96	2.98	3.01	3.03	3.05	3.08	3.10
170	3.12	3.15	3.17	3.19	3.22	3.24	3.26	3.29	3.31	3.33
180	3.36	3.38	3.40	3.43	3.45	3.47	3.49	3.52	3.54	3.56
190	3.59	3.61	3.63	3.66	3.68	3.70	3.73	3.75	3.77	3.80
200	3.82	3.84	3.87	3.89	3.91	3.94	3.96	3.98	4.01	4.03
210	4.05	4.08	4.10	4.12	4.15	4.17	4.19	4.21	4.24	4.26
220	4.28	4.31	4.33	4.35	4.38	4.40	4.42	4.44	4.47	4.49
230	4.51	4.54	4.56	4.58	4.61	4.63	4.65	4.67	4.70	4.72
240	4.74	4.77	4.79	4.81	4.83	4.86	4.88	4.90	4.92	4.95
250	4.97	4.99	5.02	5.04	5.06	5.08	5.11	5.13	5.15	5.17
260	5.20	5.22	5.24	5.26	5.29	5.31	5.33	5.35	5.38	5.40
270	5.42	5.44	5.47	5.49	5.51	5.53	5.56	5.58	5.60	5.62
280	5.65	5.67	5.69	5.71	5.73	5.76	5.78	5.80	5.82	5.85
290	5.87	5.89	5.91	5.93	5.96	5.98	6.00	6.02	6.05	6.07
300	6.09	6.11	6.13	6.16	6.18	6.20	6.22	6.25	6.27	6.29
310	6.31	6.33	6.36	6.38	6.40	6.42	6.45	6.47	6.49	6.51
320	6.53	6.56	6.58	6.60	6.62	6.65	6.67	6.69	6.71	6.73
330	6.76	6.78	6.80	6.82	6.84	6.87	6.89	6.91	6.93	6.96
340	6.98	7.00	7.02	7.04	7.07	7.09	7.11	7.13	7.15	7.18
350	7.20	7.22	7.24	7.26	7.29	7.31	7.33	7.35	7.38	7.40
360	7.42	7.44	7.46	7.49	7.51	7.53	7.55	7.58	7.60	7.62
370	7.64	7.66	7.69	7.71	7.73	7.75	7.78	7.80	7.82	7.84
380	7.87	7.89	7.91	7.93	7.95	7.98	8.00	8.02	8.04	8.07
390	8.09	8.11	8.13	8.16	8.18	8.20	8.22	8.24	8.27	8.29
400	8.31	8.33	8.36	8.38	8.40	8.42	8.45	8.47	8.49	8.51
410	8.54	8.56	8.58	8.60	8.62	8.65	8.67	8.69	8.71	8.74
420	8.76	8.78	8.80	8.82	8.85	8.87	8.89	8.91	8.94	8.96
430	8.98	9.00	9.03	9.05	9.07	9.09	9.12	9.14	9.16	9.18
440	9.21	9.23	9.25	9.27	9.30	9.32	9.34	9.36	9.39	9.41
450	9.43	9.45	9.48	9.50	9.52	9.54	9.57	9.59	9.61	9.63
460	9.66	9.68	9.70	9.73	9.75	9.77	9.79	9.82	9.84	9.86
470	9.88	9.91	9.93	9.95	9.97	10.00	10.02	10.04	10.06	10.09
480	10.11	10.13	10.16	10.18	10.20	10.22	10.25	10.27	10.29	10.31
490	10.34	10.36	10.38	10.40	10.43	10.45	10.47	10.50	10.52	10.54
500	10.57	10.59	10.61	10.63	10.66	10.68	10.70	10.72	10.75	10.77
510	10.79	10.82	10.84	10.86	10.88	10.91	10.93	10.95	10.98	11.00
520	11.02	11.04	11.07	11.09	11.11	11.13	11.16	11.18	11.20	11.23
530	11.25	11.27	11.29	11.32	11.34	11.36	11.39	11.41	11.43	11.45
540	11.48	11.50	11.52	11.55	11.57	11.59	11.61	11.64	11.66	11.68
550	11.71	11.73	11.75	11.78	11.80	11.82	11.84	11.87	11.89	11.91
560	11.94	11.96	11.98	12.01	12.03	12.05	12.07	12.10	12.12	12.14
570	12.17	12.19	12.21	12.24	12.26	12.28	12.30	12.33	12.35	12.37
580	12.40	12.42	12.44	12.47	12.49	12.51	12.53	12.56	12.58	12.60
590	12.63	12.65	12.67	12.70	12.72	12.74	12.76	12.79	12.81	12.83
600	12.86	12.88	12.90	12.93	12.95	12.97	13.00	13.02	13.04	13.06

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* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
	Millivolts									
600	12.86	12.88	12.90	12.93	12.95	12.97	13.00	13.02	13.04	13.06
610	13.09	13.11	13.13	13.16	13.18	13.20	13.23	13.25	13.27	13.30
620	13.32	13.34	13.36	13.39	13.41	13.44	13.46	13.48	13.50	13.53
630	13.55	13.57	13.60	13.62	13.64	13.67	13.69	13.71	13.74	13.76
640	13.78	13.81	13.83	13.85	13.88	13.90	13.92	13.95	13.97	13.99
650	14.02	14.04	14.06	14.09	14.11	14.13	14.15	14.18	14.20	14.22
660	14.25	14.27	14.29	14.32	14.34	14.36	14.39	14.41	14.43	14.46
670	14.48	14.50	14.53	14.55	14.57	14.60	14.62	14.64	14.67	14.69
680	14.71	14.74	14.76	14.78	14.81	14.83	14.85	14.88	14.90	14.92
690	14.95	14.97	14.99	15.02	15.04	15.06	15.09	15.11	15.13	15.16
700	15.18	15.20	15.23	15.25	15.27	15.30	15.32	15.34	15.37	15.39
710	15.41	15.44	15.46	15.48	15.51	15.53	15.55	15.58	15.60	15.62
720	15.65	15.67	15.69	15.72	15.74	15.76	15.79	15.81	15.83	15.86
730	15.88	15.90	15.93	15.95	15.98	16.00	16.02	16.05	16.07	16.09
740	16.12	16.14	16.16	16.19	16.21	16.23	16.26	16.28	16.30	16.33
750	16.35	16.37	16.40	16.42	16.45	16.47	16.49	16.52	16.54	16.56
760	16.59	16.61	16.63	16.66	16.68	16.70	16.73	16.75	16.77	16.80
770	16.82	16.84	16.87	16.89	16.92	16.94	16.96	16.99	17.01	17.03
780	17.06	17.08	17.10	17.13	17.15	17.17	17.20	17.22	17.24	17.27
790	17.29	17.31	17.34	17.36	17.39	17.41	17.43	17.46	17.48	17.50
800	17.53	17.55	17.57	17.60	17.62	17.64	17.67	17.69	17.71	17.74
810	17.76	17.78	17.81	17.83	17.86	17.88	17.90	17.93	17.95	17.97
820	18.00	18.02	18.04	18.07	18.09	18.11	18.14	18.16	18.18	18.21
830	18.23	18.25	18.28	18.30	18.33	18.35	18.37	18.40	18.42	18.44
840	18.47	18.49	18.51	18.54	18.56	18.58	18.61	18.63	18.65	18.68
850	18.70	18.73	18.75	18.77	18.80	18.82	18.84	18.87	18.89	18.91
860	18.94	18.96	18.99	19.01	19.03	19.06	19.08	19.10	19.13	19.15
870	19.18	19.20	19.22	19.25	19.27	19.29	19.32	19.34	19.36	19.39
880	19.41	19.44	19.46	19.48	19.51	19.53	19.55	19.58	19.60	19.63
890	19.65	19.67	19.70	19.72	19.75	19.77	19.79	19.82	19.84	19.86
900	19.89	19.91	19.94	19.96	19.98	20.01	20.03	20.05	20.08	20.10
910	20.13	20.15	20.17	20.20	20.22	20.24	20.27	20.29	20.32	20.34
920	20.36	20.39	20.41	20.43	20.46	20.48	20.50	20.53	20.55	20.58
930	20.60	20.62	20.65	20.67	20.69	20.72	20.74	20.76	20.79	20.81
940	20.84	20.86	20.88	20.91	20.93	20.95	20.98	21.00	21.03	21.05
950	21.07	21.10	21.12	21.14	21.17	21.19	21.21	21.24	21.26	21.28
960	21.31	21.33	21.36	21.38	21.40	21.43	21.45	21.47	21.50	21.52
970	21.54	21.57	21.59	21.62	21.64	21.66	21.69	21.71	21.73	21.76
980	21.78	21.81	21.83	21.85	21.88	21.90	21.92	21.95	21.97	21.99
990	22.02	22.04	22.07	22.09	22.11	22.14	22.16	22.18	22.21	22.23
1000	22.26	22.28	22.30	22.33	22.35	22.37	22.40	22.42	22.44	22.47
1010	22.49	22.52	22.54	22.56	22.59	22.61	22.63	22.66	22.68	22.71
1020	22.73	22.75	22.78	22.80	22.82	22.85	22.87	22.90	22.92	22.94
1030	22.97	22.99	23.01	23.04	23.06	23.08	23.11	23.13	23.16	23.18
1040	23.20	23.23	23.25	23.27	23.30	23.32	23.35	23.37	23.39	23.42
1050	23.44	23.46	23.49	23.51	23.54	23.56	23.58	23.61	23.63	23.65
1060	23.68	23.70	23.72	23.75	23.77	23.80	23.82	23.84	23.87	23.89
1070	23.91	23.94	23.96	23.99	24.01	24.03	24.06	24.08	24.10	24.13
1080	24.15	24.18	24.20	24.22	24.25	24.27	24.29	24.32	24.34	24.36
1090	24.39	24.41	24.44	24.46	24.49	24.51	24.53	24.55	24.58	24.60
1100	24.63	24.65	24.67	24.70	24.72	24.74	24.77	24.79	24.82	24.84

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* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
	Millivolts									
1100	24.63	24.65	24.67	24.70	24.72	24.74	24.77	24.79	24.82	24.84
1110	24.86	24.89	24.91	24.93	24.96	24.98	25.01	25.03	25.05	25.08
1120	25.10	25.12	25.15	25.17	25.20	25.22	25.24	25.27	25.29	25.31
1130	25.34	25.36	25.38	25.41	25.43	25.46	25.48	25.50	25.53	25.55
1140	25.57	25.60	25.62	25.65	25.67	25.69	25.72	25.74	25.76	25.79
1150	25.81	25.83	25.86	25.88	25.91	25.93	25.95	25.98	26.00	26.02
1160	26.05	26.07	26.09	26.12	26.14	26.16	26.19	26.21	26.24	26.26
1170	26.28	26.31	26.33	26.35	26.38	26.40	26.42	26.45	26.47	26.49
1180	26.52	26.54	26.56	26.59	26.61	26.63	26.66	26.68	26.70	26.73
1190	26.75	26.77	26.80	26.82	26.85	26.87	26.89	26.91	26.94	26.96
1200	26.98	27.01	27.03	27.06	27.08	27.10	27.12	27.15	27.17	27.20
1210	27.22	27.24	27.27	27.29	27.31	27.34	27.36	27.38	27.40	27.43
1220	27.45	27.48	27.50	27.52	27.55	27.57	27.59	27.62	27.64	27.66
1230	27.69	27.71	27.73	27.76	27.78	27.80	27.83	27.85	27.87	27.90
1240	27.92	27.94	27.97	27.99	28.01	28.04	28.06	28.08	28.11	28.13
1250	28.15	28.18	28.20	28.22	28.25	28.27	28.29	28.32	28.34	28.37
1260	28.39	28.41	28.44	28.46	28.48	28.50	28.53	28.55	28.58	28.60
1270	28.62	28.65	28.67	28.69	28.72	28.74	28.76	28.79	28.81	28.83
1280	28.86	28.88	28.90	28.93	28.95	28.97	29.00	29.02	29.04	29.07
1290	29.09	29.11	29.14	29.16	29.18	29.21	29.23	29.25	29.28	29.30
1300	29.32	29.35	29.37	29.39	29.42	29.44	29.46	29.49	29.51	29.53
1310	29.56	29.58	29.60	29.63	29.65	29.67	29.70	29.72	29.74	29.77
1320	29.79	29.81	29.84	29.86	29.88	29.91	29.93	29.95	29.97	30.00
1330	30.02	30.05	30.07	30.09	30.11	30.14	30.16	30.18	30.21	30.23
1340	30.25	30.28	30.30	30.32	30.35	30.37	30.39	30.42	30.44	30.46
1350	30.49	30.51	30.53	30.56	30.58	30.60	30.63	30.65	30.67	30.70
1360	30.72	30.74	30.77	30.79	30.81	30.83	30.86	30.88	30.90	30.93
1370	30.95	30.97	31.00	31.02	31.04	31.07	31.09	31.11	31.14	31.16
1380	31.18	31.21	31.23	31.25	31.28	31.30	31.32	31.34	31.37	31.39
1390	31.42	31.44	31.46	31.48	31.51	31.53	31.55	31.58	31.60	31.62
1400	31.65	31.67	31.69	31.72	31.74	31.76	31.78	31.81	31.83	31.85
1410	31.88	31.90	31.92	31.95	31.97	31.99	32.02	32.04	32.06	32.08
1420	32.11	32.13	32.15	32.18	32.20	32.22	32.25	32.27	32.29	32.31
1430	32.34	32.36	32.38	32.41	32.43	32.45	32.48	32.50	32.52	32.54
1440	32.57	32.59	32.61	32.64	32.66	32.68	32.70	32.73	32.75	32.77
1450	32.80	32.82	32.84	32.86	32.89	32.91	32.93	32.96	32.98	33.00
1460	33.02	33.05	33.07	33.09	33.12	33.14	33.16	33.18	33.21	33.23
1470	33.25	33.28	33.30	33.32	33.34	33.37	33.39	33.41	33.43	33.46
1480	33.48	33.50	33.53	33.55	33.57	33.59	33.62	33.64	33.66	33.69
1490	33.71	33.73	33.75	33.78	33.80	33.82	33.84	33.87	33.89	33.91
1500	33.93	33.96	33.98	34.00	34.03	34.05	34.07	34.09	34.12	34.14
1510	34.16	34.18	34.21	34.23	34.25	34.28	34.30	34.32	34.34	34.37
1520	34.39	34.41	34.43	34.46	34.48	34.50	34.53	34.55	34.57	34.59
1530	34.62	34.64	34.66	34.68	34.71	34.73	34.75	34.77	34.80	34.82
1540	34.84	34.87	34.89	34.91	34.93	34.96	34.98	35.00	35.02	35.05
1550	35.07	35.09	35.11	35.14	35.16	35.18	35.21	35.23	35.25	35.27
1560	35.29	35.32	35.34	35.36	35.39	35.41	35.43	35.45	35.48	35.50
1570	35.52	35.54	35.57	35.59	35.61	35.63	35.66	35.68	35.70	35.72
1580	35.75	35.77	35.79	35.81	35.84	35.86	35.88	35.90	35.93	35.95
1590	35.97	35.99	36.02	36.04	36.06	36.08	36.11	36.13	36.15	36.17
1600	36.19	36.22	36.24	36.26	36.29	36.31	36.33	36.35	36.37	36.40

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* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
	Millivolts									
1600	36.19	36.22	36.24	36.26	36.29	36.31	36.33	36.35	36.37	36.40
1610	36.42	36.44	36.46	36.49	36.51	36.53	36.55	36.58	36.60	36.62
1620	36.64	36.67	36.69	36.71	36.73	36.76	36.78	36.80	36.82	36.84
1630	36.87	36.89	36.91	36.93	36.96	36.98	37.00	37.02	37.05	37.07
1640	37.09	37.11	37.14	37.16	37.18	37.20	37.23	37.25	37.27	37.29
1650	37.31	37.34	37.36	37.38	37.40	37.43	37.45	37.47	37.49	37.52
1660	37.54	37.56	37.58	37.60	37.63	37.65	37.67	37.69	37.72	37.74
1670	37.76	37.78	37.81	37.83	37.85	37.87	37.89	37.92	37.94	37.96
1680	37.98	38.01	38.03	38.05	38.07	38.09	38.12	38.14	38.16	38.18
1690	38.20	38.23	38.25	38.27	38.29	38.32	38.34	38.36	38.38	38.40
1700	38.43	38.45	38.47	38.49	38.51	38.54	38.56	38.58	38.60	38.62
1710	38.65	38.67	38.69	38.71	38.73	38.76	38.78	38.80	38.82	38.84
1720	38.87	38.89	38.91	38.93	38.95	38.98	39.00	39.02	39.04	39.06
1730	39.09	39.11	39.13	39.15	39.17	39.20	39.22	39.24	39.26	39.28
1740	39.31	39.33	39.35	39.37	39.39	39.42	39.44	39.46	39.48	39.50
1750	39.53	39.55	39.57	39.59	39.61	39.64	39.66	39.68	39.70	39.72
1760	39.75	39.77	39.79	39.81	39.83	39.86	39.88	39.90	39.92	39.94
1770	39.96	39.99	40.01	40.03	40.05	40.07	40.10	40.12	40.14	40.16
1780	40.18	40.20	40.23	40.25	40.27	40.29	40.31	40.34	40.36	40.38
1790	40.40	40.42	40.44	40.47	40.49	40.51	40.53	40.55	40.58	40.60
1800	40.62	40.64	40.66	40.68	40.71	40.73	40.75	40.77	40.79	40.82
1810	40.84	40.86	40.88	40.90	40.92	40.95	40.97	40.99	41.01	41.03
1820	41.05	41.08	41.10	41.12	41.14	41.16	41.18	41.21	41.23	41.25
1830	41.27	41.29	41.31	41.34	41.36	41.38	41.40	41.42	41.45	41.47
1840	41.49	41.51	41.53	41.55	41.57	41.60	41.62	41.64	41.66	41.68
1850	41.70	41.73	41.75	41.77	41.79	41.81	41.83	41.85	41.88	41.90
1860	41.92	41.94	41.96	41.99	42.01	42.03	42.05	42.07	42.09	42.11
1870	42.14	42.16	42.18	42.20	42.22	42.24	42.26	42.29	42.31	42.33
1880	42.35	42.37	42.39	42.42	42.44	42.46	42.48	42.50	42.52	42.55
1890	42.57	42.59	42.61	42.63	42.65	42.67	42.69	42.72	42.74	42.76
1900	42.78	42.80	42.82	42.84	42.87	42.89	42.91	42.93	42.95	42.97
1910	42.99	43.01	43.04	43.06	43.08	43.10	43.12	43.14	43.17	43.19
1920	43.21	43.23	43.25	43.27	43.29	43.31	43.34	43.36	43.38	43.40
1930	43.42	43.44	43.47	43.49	43.51	43.53	43.55	43.57	43.59	43.61
1940	43.63	43.66	43.68	43.70	43.72	43.74	43.76	43.78	43.81	43.83
1950	43.85	43.87	43.89	43.91	43.93	43.95	43.98	44.00	44.02	44.04
1960	44.06	44.08	44.10	44.13	44.15	44.17	44.19	44.21	44.23	44.25
1970	44.27	44.30	44.32	44.34	44.36	44.38	44.40	44.42	44.44	44.47
1980	44.49	44.51	44.53	44.55	44.57	44.59	44.61	44.63	44.66	44.68
1990	44.70	44.72	44.74	44.76	44.78	44.80	44.82	44.85	44.87	44.89
2000	44.91	44.93	44.95	44.97	44.99	45.01	45.03	45.06	45.08	45.10
2010	45.12	45.14	45.16	45.18	45.20	45.22	45.24	45.27	45.29	45.31
2020	45.33	45.35	45.37	45.39	45.41	45.43	45.45	45.48	45.50	45.52
2030	45.54	45.56	45.58	45.60	45.62	45.64	45.66	45.69	45.71	45.73
2040	45.75	45.77	45.79	45.81	45.83	45.85	45.87	45.90	45.92	45.94
2050	45.96	45.98	46.00	46.02	46.04	46.06	46.08	46.11	46.13	46.15
2060	46.17	46.19	46.21	46.23	46.25	46.27	46.29	46.31	46.33	46.36
2070	46.38	46.40	46.42	46.44	46.46	46.48	46.50	46.52	46.54	46.56
2080	46.58	46.60	46.63	46.65	46.67	46.69	46.71	46.73	46.75	46.77
2090	46.79	46.81	46.83	46.85	46.87	46.90	46.92	46.94	46.96	46.98
2100	47.00	47.02	47.04	47.06	47.08	47.10	47.12	47.14	47.17	47.19

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* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

CHROMEL-ALUMEL THERMOCOUPLES

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
	Millivolts									
2100	47.00	47.02	47.04	47.06	47.08	47.10	47.12	47.14	47.17	47.19
2110	47.21	47.23	47.25	47.27	47.29	47.31	47.33	47.35	47.37	47.39
2120	47.41	47.43	47.45	47.47	47.49	47.52	47.54	47.56	47.58	47.60
2130	47.62	47.64	47.66	47.68	47.70	47.72	47.74	47.76	47.78	47.80
2140	47.82	47.84	47.86	47.89	47.91	47.93	47.95	47.97	47.99	48.01
2150	48.03	48.05	48.07	48.09	48.11	48.13	48.15	48.17	48.19	48.21
2160	48.23	48.25	48.27	48.29	48.32	48.34	48.36	48.38	48.40	48.42
2170	48.44	48.46	48.48	48.50	48.52	48.54	48.56	48.58	48.60	48.62
2180	48.64	48.66	48.68	48.70	48.72	48.74	48.76	48.79	48.81	48.83
2190	48.85	48.87	48.89	48.91	48.93	48.95	48.97	48.99	49.01	49.03
2200	49.05	49.07	49.09	49.11	49.13	49.15	49.17	49.19	49.21	49.23
2210	49.25	49.27	49.29	49.31	49.33	49.35	49.37	49.39	49.41	49.43
2220	49.45	49.47	49.49	49.51	49.53	49.55	49.57	49.59	49.61	49.63
2230	49.65	49.67	49.69	49.71	49.73	49.76	49.78	49.80	49.82	49.84
2240	49.86	49.88	49.90	49.92	49.94	49.96	49.98	50.00	50.02	50.04
2250	50.06	50.08	50.10	50.12	50.14	50.16	50.18	50.20	50.22	50.24
2260	50.26	50.28	50.30	50.32	50.34	50.36	50.38	50.40	50.42	50.44
2270	50.46	50.48	50.50	50.52	50.54	50.56	50.57	50.59	50.61	50.63
2280	50.65	50.67	50.69	50.71	50.73	50.75	50.77	50.79	50.81	50.83
2290	50.85	50.87	50.89	50.91	50.93	50.95	50.97	50.99	51.01	51.03
2300	51.05	51.07	51.09	51.11	51.13	51.15	51.17	51.19	51.21	51.23
2310	51.25	51.27	51.29	51.31	51.33	51.35	51.37	51.39	51.41	51.43
2320	51.45	51.47	51.48	51.50	51.52	51.54	51.56	51.58	51.60	51.62
2330	51.64	51.66	51.68	51.70	51.72	51.74	51.76	51.78	51.80	51.82
2340	51.84	51.86	51.88	51.90	51.92	51.94	51.96	51.98	52.00	52.01
2350	52.03	52.05	52.07	52.09	52.11	52.13	52.15	52.17	52.19	52.21
2360	52.23	52.25	52.27	52.29	52.31	52.33	52.35	52.37	52.39	52.41
2370	52.42	52.44	52.46	52.48	52.50	52.52	52.54	52.56	52.58	52.60
2380	52.62	52.64	52.66	52.68	52.70	52.72	52.74	52.76	52.77	52.79
2390	52.81	52.83	52.85	52.87	52.89	52.91	52.93	52.95	52.97	52.99
2400	53.01	53.03	53.05	53.07	53.08	53.10	53.12	53.14	53.16	53.18
2410	53.20	53.22	53.24	53.26	53.28	53.30	53.32	53.34	53.35	53.37
2420	53.39	53.41	53.43	53.45	53.47	53.49	53.51	53.53	53.55	53.57
2430	53.59	53.60	53.62	53.64	53.66	53.68	53.70	53.72	53.74	53.76
2440	53.78	53.80	53.82	53.83	53.85	53.87	53.89	53.91	53.93	53.95
2450	53.97	53.99	54.01	54.03	54.04	54.06	54.08	54.10	54.12	54.14
2460	54.16	54.18	54.20	54.22	54.24	54.25	54.27	54.29	54.31	54.33
2470	54.35	54.37	54.39	54.41	54.43	54.44	54.46	54.48	54.50	54.52
2480	54.54	54.56	54.58	54.60	54.62	54.63	54.65	54.67	54.69	54.71
2490	54.73	54.75	54.77	54.79	54.81	54.82	54.84	54.86	54.88	54.90
2500	54.92	....	....	....	....	....	....	....	....	....

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* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

IRON-CONSTANTAN THERMOCOUPLES (MODIFIED 1913)

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948). Reference Junctions at 0° C.)

°C	0	1	2	3	4	5	6	7	8	9
					Millivolts					
−190	−7.66	−7.69	−7.71	−7.73	−7.76	−7.78	....	....	....	....
−180	−7.40	−7.43	−7.46	−7.49	−7.51	−7.54	−7.56	−7.59	−7.61	−7.64
−170	−7.12	−7.15	−7.18	−7.21	−7.24	−7.27	−7.30	−7.32	−7.35	−7.38
−160	−6.82	−6.85	−6.88	−6.91	−6.94	−6.97	−7.00	−7.03	−7.06	−7.09
−150	−6.50	−6.53	−6.56	−6.60	−6.63	−6.66	−6.69	−6.72	−6.76	−6.79
−140	−6.16	−6.19	−6.22	−6.26	−6.29	−6.33	−6.36	−6.40	−6.43	−6.46
−130	−5.80	−5.84	−5.87	−5.91	−5.94	−5.98	−6.01	−6.05	−6.08	−6.12
−120	−5.42	−5.46	−5.50	−5.54	−5.58	−5.61	−5.65	−5.69	−5.72	−5.76
−110	−5.03	−5.07	−5.11	−5.15	−5.19	−5.23	−5.27	−5.31	−5.35	−5.38
−100	−4.63	−4.67	−4.71	−4.75	−4.79	−4.83	−4.87	−4.91	−4.95	−4.99
−90	−4.21	−4.25	−4.30	−4.34	−4.38	−4.42	−4.46	−4.50	−4.55	−4.59
−80	−3.78	−3.82	−3.87	−3.91	−3.96	−4.00	−4.04	−4.08	−4.13	−4.17
−70	−3.34	−3.38	−3.43	−3.47	−3.52	−3.56	−3.60	−3.65	−3.69	−3.74
−60	−2.89	−2.94	−2.98	−3.03	−3.07	−3.12	−3.16	−3.21	−3.25	−3.30
−50	−2.43	−2.48	−2.52	−2.57	−2.62	−2.66	−2.71	−2.75	−2.80	−2.84
−40	−1.96	−2.01	−2.06	−2.10	−2.15	−2.20	−2.24	−2.29	−2.34	−2.38
−30	−1.48	−1.53	−1.58	−1.63	−1.67	−1.72	−1.77	−1.82	−1.87	−1.91
−20	−1.00	−1.04	−1.09	−1.14	−1.19	−1.24	−1.29	−1.34	−1.39	−1.43
−10	−0.50	−0.55	−0.60	−0.65	−0.70	−0.75	−0.80	−0.85	−0.90	−0.95
(−)0	0.00	−0.05	−0.10	−0.15	−0.20	−0.25	−0.30	−0.35	−0.40	−0.45
(+)0	0.00	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45
10	0.50	0.56	0.61	0.66	0.71	0.76	0.81	0.86	0.91	0.97
20	1.02	1.07	1.12	1.17	1.22	1.28	1.33	1.38	1.43	1.48
30	1.54	1.59	1.64	1.69	1.74	1.80	1.85	1.90	1.95	2.00
40	2.06	2.11	2.16	2.22	2.27	2.32	2.37	2.42	2.48	2.53
50	2.58	2.64	2.69	2.74	2.80	2.85	2.90	2.96	3.01	3.06
60	3.11	3.17	3.22	3.27	3.33	3.38	3.43	3.49	3.54	3.60
70	3.65	3.70	3.76	3.81	3.86	3.92	3.97	4.02	4.08	4.13
80	4.19	4.24	4.29	4.35	4.40	4.46	4.51	4.56	4.62	4.67
90	4.73	4.78	4.83	4.89	4.94	5.00	5.05	5.10	5.16	5.21
100	5.27	5.32	5.38	5.43	5.48	5.54	5.59	5.65	5.70	5.76
110	5.81	5.86	5.92	5.97	6.03	6.08	6.14	6.19	6.25	6.30
120	6.36	6.41	6.47	6.52	6.58	6.63	6.68	6.74	6.79	6.85
130	6.90	6.96	7.01	7.07	7.12	7.18	7.23	7.29	7.34	7.40
140	7.45	7.51	7.56	7.62	7.67	7.73	7.78	7.84	7.89	7.95
150	8.00	8.06	8.12	8.17	8.23	8.28	8.34	8.39	8.45	8.50
160	8.56	8.61	8.67	8.72	8.78	8.84	8.89	8.95	9.00	9.06
170	9.11	9.17	9.22	9.28	9.33	9.39	9.44	9.50	9.56	9.61
180	9.67	9.72	9.78	9.83	9.89	9.95	10.00	10.06	10.11	10.17
190	10.22	10.28	10.34	10.39	10.45	10.50	10.56	10.61	10.67	10.72
200	10.78	10.84	10.89	10.95	11.00	11.06	11.12	11.17	11.23	11.28
210	11.34	11.39	11.45	11.50	11.56	11.62	11.67	11.73	11.78	11.84
220	11.89	11.95	12.00	12.06	12.12	12.17	12.23	12.28	12.34	12.39
230	12.45	12.50	12.56	12.62	12.67	12.73	12.78	12.84	12.89	12.95
240	13.01	13.06	13.12	13.17	13.23	13.28	13.34	13.40	13.45	13.51
250	13.56	13.62	13.67	13.73	13.78	13.84	13.89	13.95	14.00	14.06
260	14.12	14.17	14.23	14.28	14.34	14.39	14.45	14.50	14.56	14.61
270	14.67	14.72	14.78	14.83	14.89	14.94	15.00	15.06	15.11	15.17
280	15.22	15.28	15.33	15.39	15.44	15.50	15.55	15.61	15.66	15.72
290	15.77	15.83	15.88	15.94	16.00	16.05	16.11	16.16	16.22	16.27
300	16.33	16.38	16.44	16.49	16.55	16.60	16.66	16.71	16.77	16.82

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

IRON-CONSTANTAN THERMOCOUPLES (MODIFIED 1913)

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees C (Int. 1948). Reference Junctions at 0° C.)

°C	0	1	2	3	4	5	6	7	8	9
	Millivolts									
300	16.33	16.38	16.44	16.49	16.55	16.60	16.66	16.71	16.77	16.82
310	16.88	16.93	16.99	17.04	17.10	17.15	17.21	17.26	17.32	17.37
320	17.43	17.48	17.54	17.60	17.65	17.71	17.76	17.82	17.87	17.93
330	17.98	18.04	18.09	18.15	18.20	18.26	18.32	18.37	18.43	18.48
340	18.54	18.59	18.65	18.70	18.76	18.81	18.87	18.92	18.98	19.03
350	19.09	19.14	19.20	19.26	19.31	19.37	19.42	19.48	19.53	19.59
360	19.64	19.70	19.75	19.81	19.86	19.92	19.97	20.03	20.08	20.14
370	20.20	20.25	20.31	20.36	20.42	20.47	20.53	20.58	20.64	20.69
380	20.75	20.80	20.86	20.91	20.97	21.02	21.08	21.13	21.19	21.24
390	21.30	21.35	21.41	21.46	21.52	21.57	21.63	21.68	21.74	21.79
400	21.85	21.90	21.96	22.02	22.07	22.13	22.18	22.24	22.29	22.35
410	22.40	22.46	22.51	22.57	22.62	22.68	22.73	22.79	22.84	22.90
420	22.95	23.01	23.06	23.12	23.17	23.23	23.28	23.34	23.39	23.45
430	23.50	23.56	23.61	23.67	23.72	23.78	23.83	23.89	23.94	24.00
440	24.06	24.11	24.17	24.22	24.28	24.33	24.39	24.44	24.50	24.55
450	24.61	24.66	24.72	24.77	24.83	24.88	24.94	25.00	25.05	25.11
460	25.16	25.22	25.27	25.33	25.38	25.44	25.49	25.55	25.60	25.66
470	25.72	25.77	25.83	25.88	25.94	25.99	26.05	26.10	26.16	26.22
480	26.27	26.33	26.38	26.44	26.49	26.55	26.61	26.66	26.72	26.77
490	26.83	26.89	26.94	27.00	27.05	27.11	27.17	27.22	27.28	27.33
500	27.39	27.45	27.50	27.56	27.61	27.67	27.73	27.78	27.84	27.90
510	27.95	28.01	28.07	28.12	28.18	28.23	28.29	28.35	28.40	28.46
520	28.52	28.57	28.63	28.69	28.74	28.80	28.86	28.91	28.97	29.02
530	29.08	29.14	29.20	29.25	29.31	29.37	29.42	29.48	29.54	29.59
540	29.65	29.71	29.76	29.82	29.88	29.94	29.99	30.05	30.11	30.16
550	30.22	30.28	30.34	30.39	30.45	30.51	30.57	30.62	30.68	30.74
560	30.80	30.85	30.91	30.97	31.02	31.08	31.14	31.20	31.26	31.31
570	31.37	31.43	31.49	31.54	31.60	31.66	31.72	31.78	31.83	31.89
580	31.95	32.01	32.06	32.12	32.18	32.24	32.30	32.36	32.41	32.47
590	32.53	32.59	32.65	32.71	32.76	32.82	32.88	32.94	32 41	32.47
600	33.11	33.17	33.23	33.29	33.35	33.41	33.46	33.52	33.58	33.64
610	33.70	33.76	33.82	33.88	33.94	33.99	34.05	34.11	34.17	34.23
620	34.29	34.35	34.41	34.47	34.53	34.58	34.64	34.70	34.76	34.82
630	34.88	34.94	35.00	35.06	35.12	35.18	35.24	35.30	35.36	35.42
640	35.48	35.54	35.60	36.66	35.72	35.78	35.84	35.90	35.96	36.02
650	36.08	36.14	36.20	36.26	36.32	36.38	36.44	36.50	36.56	36.62
660	36.69	36.75	36.81	36.87	36.93	36.99	37.05	37.11	37.18	37.24
670	37.30	37.36	37.42	37.48	37.54	37.60	37.66	37.73	37.79	37.85
680	37.91	37.97	38.04	38.10	38.16	38.22	38.28	38.34	38.41	38.47
690	38.53	38.59	38.66	38.72	38.78	38.84	38.90	38.97	39.03	39.09
700	39.15	39.22	39.28	39.34	39.40	39.47	39.53	39.59	39.65	39.72
710	39.78	39.84	39.91	39.97	40.03	40.10	40.16	40.22	40.28	40.35
720	40.41	40.48	40.54	40.60	40.66	40.73	40.79	40.86	40.92	40.98
730	41.05	41.11	41.17	41.24	41.30	41.36	41.43	41.49	41.56	41.62
740	41.68	41.75	41.81	41.87	41.94	42.00	42.07	42.13	42.19	42.26
750	42.32	42.38	42.45	42.51	42.58	42.64	42.70	42.77	42.83	42.90
760	42.96	....	....	....	....	....	....	....	....	....

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

IRON-CONSTANTAN THERMOCOUPLES (MODIFIED 1913)

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
	Millivolts									
−310	−7.66	−7.68	−7.69	−7.70	−7.71	−7.73	−7.74	−7.75	−7.76	−7.78
−300	−7.52	−7.54	−7.55	−7.57	−7.58	−7.59	−7.61	−7.62	−7.64	−7.65
−290	−7.38	−7.39	−7.40	−7.42	−7.44	−7.45	−7.46	−7.48	−7.49	−7.51
−280	−7.22	−7.24	−7.25	−7.27	−7.28	−7.30	−7.31	−7.33	−7.34	−7.36
−270	−7.06	−7.07	−7.09	−7.11	−7.12	−7.14	−7.15	−7.17	−7.19	−7.20
−260	−6.89	−6.90	−6.92	−6.94	−6.96	−6.97	−6.99	−7.01	−7.02	−7.04
−250	−6.71	−6.73	−6.75	−6.77	−6.78	−6.80	−6.82	−6.84	−6.85	−6.87
−240	−6.53	−6.55	−6.57	−6.59	−6.61	−6.62	−6.64	−6.66	−6.68	−6.70
−230	−6.35	−6.37	−6.38	−6.40	−6.42	−6.44	−6.46	−6.48	−6.50	−6.52
−220	−6.16	−6.18	−6.19	−6.21	−6.23	−6.25	−6.27	−6.29	−6.31	−6.33
−210	−5.96	−5.98	−6.00	−6.02	−6.04	−6.06	−6.08	−6.10	−6.12	−6.14
−200	−5.76	−5.78	−5.80	−5.82	−5.84	−5.86	−5.88	−5.90	−5.92	−5.94
−190	−5.55	−5.57	−5.59	−5.61	−5.63	−5.65	−5.67	−5.70	−5.72	−5.74
−180	−5.34	−5.36	−5.38	−5.40	−5.42	−5.44	−5.46	−5.49	−5.51	−5.53
−170	−5.12	−5.14	−5.16	−5.19	−5.21	−5.23	−5.25	−5.27	−5.30	−5.32
−160	−4.90	−4.92	−4.94	−4.97	−4.99	−5.01	−5.03	−5.06	−5.08	−5.10
−150	−4.68	−4.70	−4.72	−4.74	−4.76	−4.79	−4.81	−4.83	−4.86	−4.88
−140	−4.44	−4.47	−4.49	−4.51	−4.54	−4.56	−4.58	−4.61	−4.63	−4.65
−130	−4.21	−4.23	−4.26	−4.28	−4.30	−4.33	−4.35	−4.38	−4.40	−4.42
−120	−3.97	−4.00	−4.02	−4.04	−4.07	−4.09	−4.12	−4.14	−4.16	−4.19
−110	−3.73	−3.76	−3.78	−3.81	−3.83	−3.85	−3.88	−3.90	−3.93	−3.95
−100	−3.49	−3.51	−3.54	−3.56	−3.59	−3.61	−3.64	−3.66	−3.68	−3.71
−90	−3.24	−3.27	−3.29	−3.32	−3.34	−3.36	−3.39	−3.41	−3.44	−3.46
−80	−2.99	−3.02	−3.04	−3.07	−3.09	−3.12	−3.14	−3.17	−3.19	−3.22
−70	−2.74	−2.76	−2.79	−2.81	−2.84	−2.86	−2.89	−2.92	−2.94	−2.97
−60	−2.48	−2.51	−2.53	−2.56	−2.58	−2.61	−2.64	−2.66	−2.69	−2.71
−50	−2.22	−2.25	−2.27	−2.30	−2.33	−2.35	−2.38	−2.40	−2.43	−2.46
−40	−1.96	−1.99	−2.01	−2.04	−2.06	−2.09	−2.12	−2.14	−2.17	−2.20
−30	−1.70	−1.72	−1.75	−1.78	−1.80	−1.83	−1.86	−1.88	−1.91	−1.94
−20	−1.43	−1.46	−1.48	−1.51	−1.54	−1.56	−1.59	−1.62	−1.64	−1.67
−10	−1.16	−1.19	−1.21	−1.24	−1.27	−1.29	−1.32	−1.35	−1.38	−1.40
(−)0	−0.89	−0.91	−0.94	−0.97	−1.00	−1.02	−1.05	−1.08	−1.10	−1.13
+(0)	−0.89	−0.86	−0.83	−0.80	−0.78	−0.75	−0.72	−0.70	−0.67	−0.64
10	−0.61	−0.58	−0.56	−0.53	−0.50	−0.48	−0.45	−0.42	−0.39	−0.36
20	−0.34	−0.31	−0.28	−0.25	−0.22	−0.20	−0.17	−0.14	−0.11	−0.09
30	−0.06	−0.03	0.00	0.03	0.05	0.08	0.11	0.14	0.17	0.19
40	0.22	0.25	0.28	0.31	0.34	0.36	0.39	0.42	0.45	0.48
50	0.50	0.53	0.56	0.59	0.62	0.65	0.67	0.70	0.73	0.76
60	0.79	0.82	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.04
70	1.07	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.30	1.33
80	1.36	1.39	1.42	1.45	1.48	1.51	1.54	1.56	1.59	1.62
90	1.65	1.68	1.71	1.74	1.77	1.80	1.83	1.85	1.88	1.91
100	1.94	1.97	2.00	2.03	2.06	2.09	2.12	2.14	2.17	2.20
110	2.23	2.26	2.29	2.32	2.35	2.38	2.41	2.44	2.47	2.50
120	2.52	2.55	2.58	2.61	2.64	2.67	2.70	2.73	2.76	2.79
130	2.82	2.85	2.88	2.91	2.94	2.97	3.00	3.03	3.06	3.08
140	3.11	3.14	3.17	3.20	3.23	3.26	3.29	3.32	3.35	3.38
150	3.41	3.44	3.47	3.50	3.53	3.56	3.59	3.62	3.65	3.68
160	3.71	3.74	3.77	3.80	3.83	3.86	3.89	3.92	3.95	3.98
170	4.01	4.04	4.07	4.10	4.13	4.16	4.19	4.22	4.25	4.28
180	4.31	4.34	4.37	4.40	4.43	4.46	4.49	4.52	4.55	4.58
190	4.61	4.64	4.67	4.70	4.73	4.76	4.79	4.82	4.85	4.88
200	4.91	4.94	4.97	5.00	5.03	5.06	5.09	5.12	5.15	5.18

* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES
FOR THERMOCOUPLES (Continued)
IRON-CONSTANTAN THERMOCOUPLES
(MODIFIED 1913)

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F)

°F	0	1	2	3	4	5	6	7	8	9
					Millivolts					
200	4.91	4.94	4.97	5.00	5.03	5.06	5.09	5.12	5.15	5.18
210	5.21	5.24	5.27	5.30	5.33	5.36	5.39	5.42	5.45	5.48
220	5.51	5.54	5.57	5.60	5.63	5.66	5.69	5.72	5.75	5.78
230	5.81	5.84	5.87	5.90	5.93	5.96	5.99	6.02	6.05	6.08
240	6.11	6.14	6.17	6.20	6.24	6.27	6.30	6.33	6.36	6.39
250	6.42	6.45	6.48	6.51	6.54	6.57	6.60	6.63	6.66	6.69
260	6.72	6.75	6.78	6.81	6.84	6.87	6.90	6.93	6.96	7.00
270	7.03	7.06	7.09	7.12	7.15	7.18	7.21	7.24	7.27	7.30
280	7.33	7.36	7.39	7.42	7.45	7.48	7.51	7.54	7.58	7.61
290	7.64	7.67	7.70	7.73	7.76	7.79	7.82	7.85	7.88	7.91
300	7.94	7.97	8.00	8.04	8.07	8.10	8.13	8.16	8.19	8.22
310	8.25	8.28	8.31	8.34	8.37	8.40	8.44	8.47	8.50	8.53
320	8.56	8.59	8.62	8.65	8.68	8.71	8.74	8.77	8.80	8.84
330	8.87	8.90	8.93	8.96	8.99	9.02	9.05	9.08	9.11	9.14
340	9.17	9.20	9.24	9.27	9.30	9.33	9.36	9.39	9.42	9.45
350	9.48	9.51	9.54	9.58	9.61	9.64	9.67	9.70	9.73	9.76
360	9.79	9.82	9.85	9.88	9.92	9.95	9.98	10.01	10.04	10.07
370	10.10	10.13	10.16	10.19	10.22	10.25	10.28	10.32	10.35	10.38
380	10.41	10.44	10.47	10.50	10.53	10.56	10.60	10.63	10.66	10.69
390	10.72	10.75	10.78	10.81	10.84	10.87	10.90	10.94	10.97	11.00
400	11.03	11.06	11.09	11.12	11.15	11.18	11.21	11.24	11.28	11.31
410	11.34	11.37	11.40	11.43	11.46	11.49	11.52	11.55	11.58	11.62
420	11.65	11.68	11.71	11.74	11.77	11.80	11.83	11.86	11.89	11.92
430	11.96	11.99	12.02	12.05	12.08	12.11	12.14	12.17	12.20	12.23
440	12.26	12.30	12.33	12.36	12.39	12.42	12.45	12.48	12.51	12.54
450	12.57	12.60	12.64	12.67	12.70	12.73	12.76	12.79	12.82	12.85
460	12.88	12.91	12.94	12.98	13.01	13.04	13.07	13.10	13.13	13.16
470	13.19	13.22	13.25	13.28	13.31	13.34	13.38	13.41	13.44	13.47
480	13.50	13.53	13.56	13.59	13.62	13.65	13.68	13.72	13.75	13.78
490	13.81	13.84	13.87	13.90	13.93	13.96	13.99	14.02	14.05	14.08
500	14.12	14.15	14.18	14.21	14.24	14.27	14.30	14.33	14.36	14.39
510	14.42	14.45	14.48	14.52	14.55	14.58	14.61	14.64	14.67	14.70
520	14.73	14.76	14.79	14.82	14.85	14.88	14.91	14.94	14.98	15.01
530	15.04	15.07	15.10	15.13	15.16	15.19	15.22	15.25	15.28	15.31
540	15.34	15.37	15.40	15.44	15.47	15.50	15.53	15.56	15.59	15.62
550	15.65	15.68	15.71	15.74	15.77	15.80	15.84	15.87	15.90	15.93
560	15.96	15.99	16.02	16.05	16.08	16.11	16.14	16.17	16.20	16.23
570	16.26	16.30	16.33	16.36	16.39	16.42	16.45	16.48	16.51	16.54
580	16.57	16.60	16.63	16.66	16.69	16.72	16.75	16.78	16.82	16.85
590	16.88	16.91	16.94	16.97	17.00	17.03	17.06	17.09	17.12	17.15
600	17.18	17.21	17.24	17.28	17.31	17.34	17.37	17.40	17.43	17.46
610	17.49	17.52	17.55	17.58	17.61	17.64	17.68	17.71	17.74	17.77
620	17.80	17.83	17.86	17.89	17.92	17.95	17.98	18.01	18.04	18.08
630	18.11	18.14	18.17	18.20	18.23	18.26	18.29	18.32	18.35	18.38
640	18.41	18.44	18.47	18.50	18.54	18.57	18.60	18.63	18.66	18.69
650	18.72	18.75	18.78	18.81	18.84	18.87	18.90	18.94	18.97	19.00
660	19.03	19.06	19.09	19.12	19.15	19.18	19.21	19.24	19.27	19.30
670	19.34	19.37	19.40	19.43	19.46	19.49	19.52	19.55	19.58	19.61
680	19.64	19.67	19.70	19.74	19.77	19.80	19.83	19.86	19.89	19.92
690	19.95	19.98	20.01	20.04	20.07	20.10	20.13	20.16	20.20	20.23
700	20.26	20.29	20.32	20.35	20.38	20.41	20.44	20.47	20.50	20.53

* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

IRON-CONSTANTAN THERMOCOUPLES (MODIFIED 1913)

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
	Millivolts									
700	20.26	20.29	20.32	20.35	20.38	20.41	20.44	20.47	20.50	20.53
710	20.56	20.59	20.62	20.66	20.69	20.72	20.75	20.78	20.81	20.84
720	20.87	20.90	20.93	20.96	20.99	21.02	21.05	21.08	21.11	21.14
730	21.18	21.21	21.24	21.27	21.30	21.33	21.36	21.39	21.42	21.45
740	21.48	21.51	21.54	21.57	21.60	21.64	21.67	21.70	21.73	21.76
750	21.79	21.82	21.85	21.88	21.91	21.94	21.97	22.00	22.03	22.06
760	22.10	22.13	22.16	22.19	22.22	22.25	22.28	22.31	22.34	22.37
770	22.40	22.43	22.46	22.49	22.52	22.55	22.58	22.62	22.65	22.68
780	22.71	22.74	22.77	22.80	22.83	22.86	22.89	22.92	22.95	22.98
790	23.01	23.04	23.08	23.11	23.14	23.17	23.20	23.23	23.26	23.29
800	23.32	23.35	23.38	23.41	23.44	23.47	23.50	23.53	23.56	23.60
810	23.63	23.66	23.69	23.72	23.75	23.78	23.81	23.84	23.87	23.90
820	23.93	23.96	23.99	24.02	24.06	24.09	24.12	24.15	24.18	24.21
830	24.24	24.27	24.30	24.33	24.36	24.39	24.42	24.45	24.48	24.52
840	24.55	24.58	24.61	24.64	24.67	24.70	24.73	24.76	24.79	24.82
850	24.85	24.88	24.91	24.94	24.98	25.01	25.04	25.07	25.10	25.13
860	25.16	25.19	25.22	25.25	25.28	25.32	25.35	25.38	25.41	25.44
870	25.47	25.50	25.53	25.56	25.59	25.62	25.65	25.68	25.72	25.75
880	25.78	25.81	25.84	25.87	25.90	25.93	25.96	25.99	26.02	26.06
890	26.09	26.12	26.15	26.18	26.21	26.24	26.27	26.30	26.33	26.36
900	26.40	26.43	26.46	26.49	26.52	26.55	26.58	26.61	26.64	26.67
910	26.70	26.74	26.77	26.80	26.83	26.86	26.89	26.92	26.95	26.98
920	27.02	27.05	27.08	27.11	27.14	27.17	27.20	27.23	27.26	27.30
930	27.33	27.36	27.39	27.42	27.45	27.48	27.51	27.54	27.58	27.61
940	27.64	27.67	27.70	27.73	27.76	27.80	27.83	27.86	27.89	27.92
950	27.95	27.98	28.02	28.05	28.08	28.11	28.14	28.17	28.20	28.23
960	28.26	28.30	28.33	28.36	28.39	28.42	28.45	28.48	28.52	28.55
970	28.58	28.61	28.64	28.67	28.70	28.74	28.77	28.80	28.83	28.86
980	28.89	28.92	28.96	28.99	29.02	29.05	29.08	29.11	29.14	29.18
990	29.21	29.24	29.27	29.30	29.33	29.37	29.40	29.43	29.46	29.49
1000	29.52	29.56	29.59	29.62	29.65	29.68	29.71	29.75	29.78	29.81
1010	29.84	29.87	29.90	29.94	29.97	30.00	30.03	30.06	30.10	30.13
1020	30.16	30.19	30.22	30.25	30.28	30.32	30.35	30.38	30.41	30.44
1030	30.48	30.51	30.54	30.57	30.60	30.64	30.67	30.70	30.73	30.76
1040	30.80	30.83	30.86	30.89	30.92	30.96	30.99	31.02	31.05	31.08
1050	31.12	31.15	31.18	31.21	31.24	31.28	31.31	31.34	31.37	31.40
1060	31.44	31.47	31.50	31.53	31.56	31.60	31.63	31.66	31.69	31.72
1070	31.76	31.79	31.82	31.85	31.88	31.92	31.95	31.98	32.01	32.05
1080	32.08	32.11	32.14	32.18	32.21	32.24	32.27	32.30	32.34	32.37
1090	32.40	32.43	32.47	32.50	32.53	32.56	32.60	32.63	32.66	32.69
1100	32.72	32.76	32.79	32.82	32.86	32.89	32.92	32.95	32.98	33.02
1110	33.05	33.08	33.11	33.15	33.18	33.21	33.24	33.28	33.31	33.34
1120	33.37	33.41	33.44	33.47	33.50	33.54	33.57	33.60	33.64	33.67
1130	33.70	33.73	33.76	33.80	33.83	33.86	33.90	33.93	33.96	33.99
1140	34.03	34.06	34.09	34.12	34.16	34.19	34.22	34.26	34.29	34.32
1150	34.36	34.39	34.42	34.45	34.49	34.52	34.55	34.58	34.62	34.65
1160	34.68	34.72	34.75	34.78	34.82	34.85	34.88	34.92	34.95	34.98
1170	35.01	35.05	35.08	35.11	35.15	35.18	35.21	35.25	35.28	35.31
1180	35.35	35.38	35.41	35.45	35.48	35.51	35.54	35.58	35.61	35.64
1190	35.68	35.71	35.74	35.78	35.81	35.84	35.88	35.91	35.94	35.98
1200	36.01	36.05	36.08	36.11	36.15	36.18	36.21	36.25	36.28	36.31

* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)
IRON-CONSTANTAN THERMOCOUPLES (MODIFED 1913)

(Electromotive Force in Absolute Millivolts. Temperatures in Degrees F.* Reference Junctions at 32° F.)

°F	0	1	2	3	4	5	6	7	8	9
	Millivolts									
1200	36.01	36.05	36.08	36.11	36.15	36.18	36.21	36.25	36.28	36.31
1210	36.35	36.38	36.42	36.45	36.48	36.52	36.55	36.58	36.62	36.65
1220	36.69	36.72	36.75	36.79	36.82	36.86	36.89	36.92	36.96	36.99
1230	37.02	37.06	37.09	37.13	37.16	37.20	37.23	37.26	37.30	37.33
1240	37.36	37.40	37.43	37.47	37.50	37.54	37.57	37.60	37.64	37.67
1250	37.71	37.74	37.78	37.81	37.84	37.88	37.91	37.95	37.98	38.02
1260	38.05	38.08	38.12	38.15	38.19	38.22	38.26	38.29	38.32	38.36
1270	38.39	38.43	38.46	38.50	38.53	38.57	38.60	38.64	38.67	38.70
1280	38.74	38.77	38.81	38.84	38.88	38.91	38.95	38.98	39.02	39.05
1290	39.08	39.12	39.15	39.19	39.22	39.26	39.29	39.33	39.36	39.40
1300	39.43	39.47	39.50	39.54	39.57	39.61	39.64	39.68	39.71	39.75
1310	39.78	39.82	39.85	39.89	39.92	39.96	39.99	40.03	40.06	40.10
1320	40.13	40.17	40.20	40.24	40.27	40.31	40.34	40.38	40.41	40.45
1330	40.48	40.52	40.55	40.59	40.62	40.66	40.69	40.73	40.76	40.80
1340	40.83	40.87	40.90	40.94	40.98	41.01	41.05	41.08	41.12	41.15
1350	41.19	41.22	41.26	41.29	41.33	41.36	41.40	41.43	41.47	41.50
1360	41.54	41.58	41.61	41.65	41.68	41.72	41.75	41.79	41.82	41.86
1370	41.90	41.93	41.97	42.00	42.04	42.07	42.11	42.14	42.18	42.22
1380	42.25	42.29	42.32	42.36	42.39	42.43	42.46	42.50	42.53	42.57
1390	42.61	42.64	42.68	42.71	42.75	42.78	42.82	42.85	42.89	42.92
1400	42.96	....	....	....	....	....	....	....	....	....

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* Based on the International Temperature Scale of 1948.

CALIBRATION TABLES FOR THERMOCOUPLES (Continued)

TEMPERATURE-E. M. F. VALUES FOR COPPER-CONSTANTAN

E. M. F. values are in millivolts; reference junctions at 0°C.; temperatures are in degrees Centigrade

Roeser and Wensel, National Bureau of Standards

°C	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
−200°	−5.54									
−100°	−3.35	−3.62	−3.89	−4.14	−4.38	−4.60	−4.82	−5.02	−5.20	−5.38
0°	0	−0.38	−0.75	−1.11	−1.47	−1.81	−2.14	−2.46	−2.77	−3.06
0°	0	0.39	0.79	1.19	1.61	2.03	2.47	2.91	3.36	3.81
100°	4.28	4.75	5.23	5.71	6.20	6.70	7.21	7.72	8.23	8.76
200°	9.29	9.82	10.36	10.91	11.46	12.01	12.57	13.14	13.71	14.28
300°	14.86	15.44	16.03	16.62	17.22	17.82	18.42	19.03	19.64	20.25
400°	20.87									

TEMPERATURE-E. M. F. VALUES FOR COPPER-CONSTANTAN

E. M. F. values are in millivolts; reference junctions at 32°F.; temperatures are in degrees Fahrenheit

Roeser and Wensel, National Bureau of Standards

°F	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
−300°	−5.28									
−200°	−4.11	−4.25	−4.38	−4.50	−4.63	−4.75	−4.86	−4.97	−5.08	−5.18
−100°	−2.56	−2.73	−2.90	−3.06	−3.22	−3.38	−3.53	−3.68	−3.83	−3.97
0°	−0.67	−0.87	−1.07	−1.27	−1.47	−1.66	−1.84	−2.03	−2.21	−2.39
0°	−0.67	−0.46	−0.26	−0.04	+0.17	0.39	0.61	0.83	1.06	1.29
100°	1.52	1.75	1.99	2.23	2.47	2.71	2.96	3.21	3.46	3.71
200°	3.97	4.22	4.48	4.75	5.01	5.28	5.55	5.82	6.09	6.37
300°	6.64	6.92	7.21	7.49	7.77	8.06	8.35	8.64	8.93	9.23
400°	9.52	9.82	10.12	10.42	10.72	11.03	11.33	11.64	11.95	12.26
500°	12.57	12.89	13.20	13.52	13.83	14.15	14.47	14.79	15.12	15.44
600°	15.77	16.10	16.42	16.75	17.08	17.42	17.75	18.08	18.42	18.75
700°	19.09	19.43	19.77	20.11	20.45	20.80				

REFERENCE TABLE FOR Pt TO Pt—10 PER CENT Rh THERMOCOUPLE

Emfs are expressed in microvolts and temperatures in °C. Cold junctions at 0°C.
ROESER AND WENSEL, NATIONAL BUREAU OF STANDARDS

E(μv)	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	E(μv)
0	0	146.9	265.0	373.7	477.7	578.1	675.3	769.5	861.0	0
	17.7	12.5	11.2	10.5	10.2	9.9	9.5	9.3	9.0	
100	17.7	159.4	276.2	384.2	487.9	588.0	684.8	778.8	870.0	100
	16.7	12.3	11.1	10.5	10.2	9.8	9.5	9.2	9.0	
200	34.4	171.7	287.3	394.7	498.1	597.8	694.3	788.0	879.0	200
	15.8	12.1	11.0	10.5	10.1	9.8	9.5	9.2	9.0	
300	50.2	183.8	298.3	405.2	508.2	607.6	703.8	797.2	888.0	300
	15.2	12.0	11.0	10.5	10.1	9.8	9.5	9.2	9.0	
400	65.4	195.8	309.3	415.7	518.3	617.4	713.3	806.4	897.0	400
	14.6	11.8	10.9	10.4	10.1	9.7	9.4	9.2	8.9	
500	80.0	207.6	320.2	426.1	528.4	627.1	722.7	815.6	905.9	500
	14.1	11.7	10.8	10.4	10.0	9.7	9.4	9.1	8.9	
600	94.1	219.3	331.0	436.5	538.4	636.8	732.1	824.7	914.8	600
	13.7	11.6	10.7	10.3	10.0	9.7	9.4	9.1	8.9	
700	107.8	230.9	341.7	446.8	548.4	646.5	741.5	833.8	923.7	700
	13.3	11.5	10.7	10.3	9.9	9.6	9.4	9.1	8.9	
800	121.1	242.4	352.4	457.1	558.3	656.1	750.9	842.9	932.6	800
	13.0	11.3	10.7	10.3	9.9	9.6	9.3	9.1	8.8	
900	134.1	253.7	363.1	467.4	568.2	665.7	760.2	852.0	941.4	900
	12.8	11.3	10.6	10.3	9.9	9.6	9.3	9.0	8.8	
1,000	146.9	265.0	373.7	477.7	578.1	675.3	769.5	861.0	950.2	1,000

REFERENCE TABLE FOR Pt TO Pt—10 PER CENT Rh THERMOCOUPLE (Continued)

Emfs are expressed in microvolts and temperatures in °C. Cold junctions at 0°C.

E(μv)	9,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	E(μv)
0	950.2	1,037.2	1,122.3	1,206.4	1,290.0	1,373.8	1,458.0	1,542.6	1,627.8	0
	8.8	8.6	8.5	8.3	8.3	8.4	8.4	8.5	8.6	
100	959.0	1,045.8	1,130.8	1,214.7	1,298.3	1,382.2	1,466.4	1,551.1	1,636.4	100
	8.8	8.6	8.4	8.4	8.4	8.4	8.4	8.5	8.5	
200	967.8	1,054.4	1,139.2	1,223.1	1,306.7	1,390.6	1,474.8	1,559.6	1,644.9	200
	8.7	8.5	8.4	8.3	8.4	8.4	8.5	8.5	8.6	
300	976.5	1,062.9	1,147.6	1,231.4	1,315.1	1,399.0	1,483.3	1,568.1	1,653.5	300
	8.8	8.6	8.4	8.4	8.4	8.4	8.5	8.5	8.6	
400	985.3	1,071.5	1,156.0	1,239.8	1,323.5	1,407.4	1,491.8	1,576.6	1,662.1	400
	8.7	8.5	8.4	8.4	8.3	8.4	8.4	8.5	8.6	
500	994.0	1,080.0	1,164.4	1,248.2	1,331.8	1,415.8	1,500.2	1,585.1	1,670.7	500
	8.7	8.5	8.4	8.3	8.4	8.4	8.5	8.6	8.6	
600	1,002.7	1,088.5	1,172.8	1,256.5	1,340.2	1,424.2	1,508.7	1,593.7	1,679.3	600
	8.6	8.5	8.4	8.4	8.4	8.5	8.5	8.5	8.6	
700	1,011.3	1,097.0	1,181.2	1,264.9	1,348.6	1,432.7	1,517.2	1,602.2	1,687.9	700
	8.7	8.4	8.4	8.3	8.4	8.4	8.4	8.5	8.6	
800	1,020.0	1,105.4	1,189.6	1,273.2	1,357.0	1,441.1	1,525.6	1,610.7	1,696.5	800
	8.6	8.5	8.4	8.4	8.4	8.4	8.5	8.6	8.6	
900	1,028.6	1,113.9	1,198.0	1,281.6	1,365.4	1,449.5	1,534.1	1,619.3	1,705.1	900
	8.6	8.4	8.4	8.4	8.4	8.5	8.5	8.5	8.6	
1,000	1,037.2	1,122.3	1,206.4	1,290.0	1,373.8	1,458.0	1,542.6	1,627.8	1,713.7	1,000

REFERENCE TABLE FOR Pt TO Pt—10 PER CENT Rh THERMOCOUPLE

Emfs are expressed in microvolts and temperatures in °F. Cold junctions at 32°F.
Roeser and Wensel, National Bureau of Standards

E(μv)	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	E(μv)
0	32.0	296.4	509.0	704.7	891.9	1,072.6	1,247.5	1,417.1	1,581.8	0
	31.9	22.5	20.1	19.0	18.4	17.7	17.1	16.7	16.2	
100	63.9	318.9	529.1	723.7	910.3	1,090.3	1,264.6	1,433.8	1,598.0	100
	30.0	22.1	20.0	18.9	18.3	17.7	17.1	16.6	16.2	
200	93.9	341.0	549.1	742.6	928.6	1,108.0	1,281.7	1,450.4	1,614.2	200
	28.5	21.8	19.9	18.8	18.2	17.7	17.1	16.6	16.2	
300	122.4	362.8	569.0	761.4	946.8	1,125.7	1,298.8	1,467.0	1,630.4	300
	27.3	21.6	19.8	18.8	18.1	17.6	17.1	16.5	16.1	
400	149.7	384.4	588.8	780.2	964.9	1,143.3	1,315.9	1,483.5	1,646.5	400
	26.3	21.3	19.6	18.8	18.1	17.5	17.0	16.5	16.1	
500	176.0	405.7	608.4	799.0	983.0	1,160.8	1,332.9	1,500.0	1,662.6	500
	25.4	21.0	19.4	18.7	18.1	17.5	16.9	16.5	16.0	
600	201.4	426.7	627.8	817.7	1,001.1	1,178.3	1,349.8	1,516.5	1,678.6	600
	24.6	20.9	19.3	18.6	18.0	17.4	16.9	16.4	16.0	
700	226.0	447.6	647.1	836.3	1,019.1	1,195.7	1,366.7	1,532.9	1,694.6	700
	24.0	20.7	19.3	18.5	17.9	17.3	16.9	16.3	16.0	
800	250.0	468.3	666.4	854.8	1,037.0	1,213.0	1,383.6	1,549.2	1,710.6	800
	23.4	20.4	19.2	18.6	17.8	17.3	16.8	16.3	15.9	
900	273.4	488.7	685.6	873.4	1,054.8	1,230.3	1,400.4	1,565.5	1,726.5	900
	23.0	20.3	19.1	18.5	17.8	17.2	16.7	16.3	15.9	
1,000	296.4	509.0	704.7	891.9	1,072.6	1,247.5	1,417.1	1,581.8	1,742.4	1,000

REFERENCE TABLE FOR Pt TO Pt—10 PER CENT Rh THERMOCOUPLE (Continued)

Emfs are expressed in microvolts and temperatures in °F. Cold junctions at 32°F.

E(μv)	9,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	E(μv)
0	1,742.4	1,899.0	2,052.1	2,203.5	2,354.0	2,504.8	2,656.4	2,808.7	2,962.0	0
	15.8	15.5	15.2	15.0	15.0	15.2	15.1	15.3	15.4	
100	1,758.2	1,914.5	2,067.3	2,218.5	2,369.0	2,520.0	2,671.5	2,824.0	2,977.4	100
	15.8	15.4	15.2	15.0	15.1	15.1	15.2	15.3	15.4	
200	1,774.0	1,929.9	2,082.5	2,233.5	2,384.1	2,535.1	2,686.7	2,839.3	2,992.8	200
	15.7	15.4	15.2	15.0	15.1	15.1	15.2	15.3	15.5	
300	1,789.7	1,945.3	2,097.7	2,248.5	2,399.2	2,550.2	2,701.9	2,854.6	3,008.3	300
	15.8	15.4	15.1	15.1	15.1	15.1	15.3	15.3	15.5	
400	1,805.5	1,960.7	2,112.8	2,263.6	2,414.3	2,565.3	2,717.2	2,869.9	3,023.8	400
	15.7	15.3	15.1	15.1	15.0	15.1	15.2	15.3	15.5	
500	1,821.2	1,976.0	2,127.9	2,278.7	2,429.3	2,580.4	2,732.4	2,885.2	3,039.3	500
	15.6	15.3	15.1	15.0	15.1	15.2	15.3	15.4	15.4	
600	1,836.8	1,991.3	2,143.0	2,293.7	2,444.4	2,595.6	2,747.7	2,900.6	3,054.7	600
	15.6	15.2	15.2	15.1	15.1	15.2	15.3	15.4	15.5	
700	1,852.4	2,006.5	2,158.2	2,308.8	2,459.5	2,610.8	2,763.0	2,916.0	3,070.2	700
	15.6	15.2	15.1	15.0	15.1	15.2	15.2	15.3	15.5	
800	1,868.0	2,021.7	2,173.3	2,323.8	2,474.6	2,626.0	2,778.2	2,931.3	3,085.7	800
	15.5	15.2	15.1	15.1	15.1	15.2	15.2	15.4	15.5	
900	1,883.5	2,036.9	2,188.4	2,338.9	2,489.7	2,641.2	2,793.4	2,946.7	3,101.2	900
	15.5	15.2	15.1	15.1	15.1	15.2	15.3	15.3	15.5	
1,000	1,899.0	2,052.1	2,203.5	2,354.0	2,504.8	2,656.4	2,808.7	2,962.0	3,116.7	1,000

REFERENCE TABLE FOR Pt TO Pt—13 PER CENT Rh THERMOCOUPLE

Emfs are expressed in microvolts and temperatures in °C. Cold junctions at 0°C.
Roeser and Wensel, National Bureau of Standards

E(μv)	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	E(μv)
0	0	145.3	258.8	361.0	457.4	549.8	638.3	723.5	806.0	886.1	0
	17.9	12.2	10.6	9.9	9.5	9.0	8.7	8.4	8.1	7.9	
100	17.9	157.5	269.4	370.9	466.9	558.8	647.0	731.9	814.1	894.0	100
	16.7	12.0	10.5	9.8	9.4	9.0	8.6	8.4	8.1	7.8	
200	34.6	169.5	279.9	380.7	476.3	567.8	655.6	740.3	822.2	901.8	200
	15.8	11.7	10.4	9.8	9.4	9.0	8.6	8.3	8.1	7.9	
300	50.4	181.2	290.3	390.5	485.7	576.8	644.2	748.6	830.3	909.7	300
	15.1	11.5	10.3	9.7	9.3	8.9	8.6	8.3	8.0	7.8	
400	65.5	192.7	300.6	400.2	495.0	585.7	672.8	756.9	838.3	917.5	400
	14.5	11.4	10.2	9.7	9.3	8.9	8.5	8.2	8.0	7.8	
500	80.0	204.1	310.8	409.9	504.3	594.6	681.3	765.1	846.3	925.3	500
	13.9	11.2	10.2	9.6	9.2	8.8	8.5	8.2	8.0	7.8	
600	93.9	215.3	321.0	419.5	513.5	603.4	689.8	773.3	854.3	933.1	600
	13.4	11.1	10.1	9.5	9.1	8.8	8.5	8.2	8.0	7.8	
700	107.3	226.4	331.1	429.0	522.6	612.2	698.3	781.5	862.3	940.9	700
	13.0	10.9	10.0	9.5	9.1	8.7	8.4	8.2	8.0	7.8	
800	120.3	237.3	341.1	438.5	531.7	620.9	706.7	789.7	870.3	948.7	800
	12.6	10.8	10.0	9.5	9.1	8.7	8.4	8.1	7.9	7.7	
900	132.9	248.1	351.1	448.0	540.8	629.6	715.1	797.8	878.2	956.4	900
	12.4	10.7	9.9	9.4	9.0	8.7	8.4	8.2	7.9	7.7	
1,000	145.3	258.8	361.0	457.4	549.8	638.3	723.5	806.0	886.1	964.1	1,000

REFERENCE TABLE FOR Pt TO Pt—13 PER CENT Rh THERMOCOUPLE (Continued)

Emfs are expressed in microvolts and temperatures in °C. Cold junctions at 0°C.

E(μv)	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	E(μv)
0	964.1	1,040.0	1,113.9	1,186.9	1,259.3	1,331.8	1,404.3	1,476.9	1,550.0	1,623.6	0
	7.6	7.4	7.3	7.2	7.3	7.2	7.3	7.3	7.4	7.4	
100	971.7	1,047.4	1,121.2	1,194.1	1,266.6	1,339.0	1,411.6	1,484.2	1,557.4	1,631.0	100
	7.7	7.5	7.4	7.3	7.2	7.2	7.3	7.3	7.4	7.4	
200	979.4	1,054.9	1,128.6	1,201.4	1,273.8	1,346.2	1,418.9	1,491.5	1,564.8	1,638.4	200
	7.6	7.4	7.3	7.3	7.3	7.3	7.2	7.3	7.3	7.4	
300	987.0	1,062.3	1,135.9	1,208.7	1,281.1	1,353.5	1,426.1	1,498.8	1,572.1	1,645.8	300
	7.7	7.4	7.3	7.2	7.2	7.3	7.2	7.3	7.4	7.4	
400	994.7	1,069.7	1,143.2	1,215.9	1,288.3	1,360.8	1,433.3	1,506.1	1,579.5	1,653.2	400
	7.6	7.4	7.3	7.3	7.2	7.2	7.2	7.3	7.3	7.4	
500	1,002.3	1,077.1	1,150.5	1,223.2	1,295.5	1,368.0	1,440.5	1,513.4	1,586.8	1,660.6	500
	7.6	7.3	7.3	7.2	7.2	7.3	7.3	7.3	7.4	7.4	
600	1,009.9	1,084.4	1,157.8	1,230.4	1,302.7	1,375.3	1,447.8	1,520.7	1,594.2	1,668.0	600
	7.6	7.4	7.3	7.2	7.2	7.3	7.2	7.3	7.3	7.4	
700	1,017.5	1,091.8	1,165.1	1,237.6	1,309.9	1,382.6	1,455.0	1,528.0	1,601.5	1,675.4	700
	7.5	7.4	7.2	7.2	7.3	7.2	7.3	7.3	7.4	7.4	
800	1,025.0	1,099.2	1,172.3	1,244.8	1,317.2	1,389.8	1,462.3	1,535.3	1,608.9	1,682.8	800
	7.5	7.3	7.3	7.3	7.3	7.3	7.3	7.4	7.3	7.4	
900	1,032.5	1,106.5	1,179.6	1,252.1	1,324.5	1,397.1	1,469.6	1,542.7	1,616.2	1,690.2	900
	7.5	7.4	7.3	7.2	7.3	7.2	7.3	7.3	7.4	7.4	
1,000	1,040.0	1,113.9	1,186.9	1,259.3	1,331.8	1,404.3	1,476.9	1,550.0	1,623.6	1,697.6	1,000

REFERENCE TABLE FOR Pt TO Pt—13 PER CENT Rh THERMOCOUPLE

Emfs are expressed in microvolts and temperatures in °F. Cold junctions at 32°F.
Roeser and Wensel, National Bureau of Standards

E(μv)	0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	E(μv)
0	32.0	293.5	497.8	681.8	855.3	1,021.6	1,180.9	1,334.3	1,482.8	1,627.0	0
	32.2	22.0	19.1	17.8	17.0	16.2	15.6	15.1	14.6	14.2	
100	64.2	315.5	516.9	699.6	872.3	1,037.8	1,196.5	1,349.4	1,497.4	1,641.2	100
	30.1	21.6	18.9	17.7	17.0	16.2	15.6	15.1	14.6	14.1	
200	94.3	337.1	535.8	717.3	889.3	1,054.0	1,212.1	1,364.5	1,512.0	1,655.3	200
	28.4	21.1	18.7	17.6	16.9	16.2	15.5	15.0	14.5	14.1	
300	122.7	358.2	554.5	734.9	906.2	1,070.2	1,227.6	1,379.5	1,526.5	1,669.4	300
	27.2	20.7	18.6	17.5	16.8	16.1	15.4	14.9	14.4	14.1	
400	149.9	378.9	573.1	752.4	923.0	1,086.3	1,243.0	1,394.4	1,540.9	1,683.5	400
	26.1	20.4	18.4	17.4	16.7	16.0	15.3	14.8	14.4	14.0	
500	176.0	399.3	591.5	769.8	939.7	1,102.3	1,258.3	1,409.2	1,555.3	1,697.5	500
	25.0	20.2	18.3	17.3	16.6	15.9	15.3	14.8	14.4	14.1	
600	201.0	419.5	609.8	787.1	956.3	1,118.2	1,273.6	1,424.0	1,569.7	1,711.6	600
	24.1	20.0	18.2	17.2	16.4	15.8	15.3	14.8	14.4	14.0	
700	225.1	439.5	628.0	804.3	972.7	1,134.0	1,288.9	1,438.8	1,584.1	1,725.6	700
	23.4	19.7	18.0	17.1	16.4	15.7	15.2	14.7	14.4	14.0	
800	248.5	459.2	646.0	821.4	989.1	1,149.7	1,304.1	1,453.5	1,598.5	1,739.6	800
	22.7	19.4	18.0	17.0	16.3	15.6	15.1	14.6	14.3	13.9	
900	271.2	478.6	664.0	838.4	1,005.4	1,165.3	1,319.2	1,468.1	1,612.8	1,753.5	900
	22.3	19.2	17.8	16.9	16.2	15.6	15.1	14.7	14.2	13.9	
1,000	293.5	497.8	681.8	855.3	1,021.6	1,180.9	1,334.3	1,482.8	1,627.0	1,767.4	1,000

REFERENCE TABLE FOR Pt TO Pt—13 PER CENT Rh THERMOCOUPLE (Continued)

Emfs are expressed in microvolts and temperatures in °F. Cold junctions at 32°F.

E(μv)	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	E(μv)
0	1,767.4	1,904.0	2,037.0	2,168.4	2,298.7	2,429.2	2,559.7	2,690.4	2,822.0	2,954.5	0
	13.8	13.4	13.2	13.0	13.1	13.0	13.1	13.2	13.3	13.3	
100	1,781.2	1,917.4	2,050.2	2,181.4	2,311.8	2,442.2	2,572.8	2,703.6	2,835.3	2,967.8	100
	13.7	13.4	13.2	13.1	13.0	13.0	13.1	13.1	13.3	13.3	
200	1,794.9	1,930.8	2,063.4	2,194.5	2,324.8	2,455.2	2,585.9	2,716.7	2,848.6	2,981.1	200
	13.7	13.3	13.2	13.1	13.1	13.1	13.0	13.1	13.2	13.3	
300	1,808.6	1,944.1	2,076.6	2,207.6	2,337.9	2,468.3	2,598.9	2,729.8	2,861.8	2,994.4	300
	13.8	13.3	13.2	13.0	13.0	13.1	13.0	13.2	13.3	13.4	
400	1,822.4	1,957.4	2,089.8	2,220.6	2,350.9	2,481.4	2,611.9	2,743.0	2,875.1	3,007.8	400
	13.7	13.3	13.1	13.1	13.0	13.0	13.0	13.1	13.2	13.3	
500	1,836.1	1,970.7	2,102.9	2,233.7	2,363.9	2,494.4	2,624.9	2,756.1	2,888.3	3,021.1	500
	13.7	13 3	13.1	13.0	13.0	13.1	13.1	13.2	13.3	13.3	
600	1,849.8	1,984.0	2,116.0	2,246.7	2,376.9	2,507.5	2,638.0	2,769.3	2,901.6	3,034.4	600
	13.6	13.3	13.1	13.0	13.0	13.1	13.0	13.1	13.2	13.3	
700	1,863.4	1,997.3	2,129.1	2,259.7	2,389.9	2,520.6	2,651.0	2,782.4	2,914.8	3,047.7	700
	13.6	13.3	13.1	13.0	13.1	13.0	13.1	13.2	13.2	13.3	
800	1,877.0	2,010.6	2,142.2	2,272.7	2,403.0	2,533.6	2,664.1	2,795.6	2,928.0	3,061.0	800
	13.5	13.2	13.1	13.0	13.1	13.1	13.1	13.2	13.2	13.4	
900	1,890.5	2,023.8	2,155.3	2,285.7	2,416.1	2,546.7	2,677.2	2,808.8	2,941.2	3,074.4	900
	13.5	13.2	13.1	13.0	13.1	13.0	13.2	13.2	13.3	13.3	
1,000	1,904.0	2,037.0	2,168.4	2,298.7	2,429.2	2,559.7	2,690.4	2,822.0	2,954.5	3,087.7	1,000

THERMOELECTRIC POWER

The following table gives values of the constants A and B in the equation for the thermoelectric power

$$Q = A + Bt$$

where A is the thermoelectric power at 0°C, B the temperature coefficient and t the temperature at 0°C.

Q will be found in microvolts per °C for any metal when the appropriate constants and the temperature in °C are substituted in the equation.

The values are given with respect to lead except where otherwise indicated. Values are regarded as positive if the current flows from the metal listed to the reference metal at the cold junction.

Metal	Microvolts per °C		Temp. range °C
	A	B	
		$\times 10^{-2}$	
Aluminum, 99 % pure	− 0.4717	+ 0.2718	−200–+100
commercial	− 0.38	− 0.01	0–100
	− 0.53	+ 0.21	
Antimony, used in cast form, solid rods soldered end to end	+ 35.58	+14.50	0–100
Bismuth, commercial	− 43.688	−46.47	−200–+100
electrolytic	− 74.42	+ 3.2	0–100
Brass, 85.8 Cu, 14.22 Zn	+ 0.710	+ 0.56	− 78–+100
66.3 Cu, 33.72 Zn	+ 0.699	+ 0.69	− 78–+100
Cadmium	+ 3.059	+ 2.856	−200–+100
cold drawn	+ 2.85	+ 3.89	0–100
Calcium, 99.57 % pure	− 8.20	− 2.9	0–400
Carbon, filament	+ 11.056	+ 3.578	−200–+100
Cerium, 97.7 % Ce, 1.2 % Fe, remainder cerium oxide and cerium carbide	+ 4.39	− 1.26	0–200
Cesium	+ 0.66	− 0.10	−183–0
	+ 7.735	− 3.34	28–100
Cobalt	− 10.7	− 5.70	0–1200
Constantan, 60 Cu, 40 Ni	− 38.105	− 8.88	0–400
Copper, electrolytic	+ 2.705	+ 0.7866	−270–+200
pure, hard drawn	+ 2.76	+ 1.22	0–100
German silver, commercial	− 10.861	− 3.29	−200–+100
Germanium	+302.5	+72.5	−200–+125
Gold	+ 2.90	+ 0.68	−260–0
	+ 2.90	+ 0.934	0–200
Indium	+ 2.40	+ 0.190	0–100
Iridium, Heraeus made	+ 2.44	− 0.28	− 80–+100
Iron	− 51.34	−20.4	−260–−200
transformer iron	+ 16.65	− 2.966	−230–+100
Lithium	+ 14.37	+ 8.76	−200–+ 50
Magnesium	− 0.2010	+ 0.2572	−200–+100
Heraeus made	− 0.120	+ 0.193	0–200
Manganin, 84 Cu, 12 Mn, 4 Ni	+ 1.366	+ 0.083	0–100
Mercury	− 8.8103	− 3.333	0–200
Molybdenum	+ 5.892	+ 4.334	0–100
*Nichrome, 58.5 Ni, 22.5 Fe 16 Cr, 3 Mn (Against Pt)	+ 25.0	....	0–420
Nickel	− 19.067	− 3.022	0–200
	− 17.633	− 5.016	−260–0
Nickel-chromium, 84 Ni, 16 Cr (Against Pt)	+ 30.22	....	600–1200
90 Ni, 10 Cr (Against Pt)	+ 30.3	0.0	0–1200
Palladium	− 7.409	− 3.922	−200–+100
Platinoid	− 10.620	− 2.77	−200–+100
Platinum	− 3.038	− 3.248	−200–+300
	− 6.677	+ 0.1528	−260–0

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* Trade mark.

THERMOELECTRIC POWER—(Continued)

Metal	Microvolts per °C		Temp. range °C
	A	B	
Platinum		$\times 10^{-2}$	
Baker's platinum	− 1.788	− 3.460	0–100
Platinum-iridium, 85 Pt, 15 Ir	+ 14.083	+ 1.06	0–1200
90 Pt, 10 Ir	+ 13.208	+ 0.75	0–1200
Platinum-rhodium, 90 Pt, 10 Rh (Against Pt)	+ 7.013	+ 0.64	0–1600
85 Pt, 15 Rh (Against Pt)	+ 6.69	+ 1.07	0–1600
Potassium	− 11.33	− 3.76	−183–0
Rubidium	− 8.26	− 3.02	−183–0
	− 0.28	− 6.00	38–100
Silicon	−408.2	−46.96	−200–+350
Silver, annealed	+ 2.50	+ 1.15	0–100
electrolytic	+ 2.947	+ 0.6782	−200–+100
Sodium	− 4.16	− 1.44	−183–0
Steel (piano wire)	+ 10.763	− 1.56	−200–+100
Thallium	+ 1.659	− 0.268	0–100
Tin	+ 0.0684	+ 0.0038	−200–+100
	+ 0.230	− 0.134	0–100
Tungsten	+ 1.594	+ 3.41	0–100
Zinc	+ 3.096	+ 3.191	−260–0
	+ 3.047	− 0.99	0–100

VALUES FOR THE LANGEVIN FUNCTION $\mathcal{L}(u)$

Compiled by Allen L. King

Because of random thermal rotations a dipole or dipole-like element ordinarily has an average dipole moment of zero. If it is placed in an orienting field F however it tends to align itself with the field so that the average component of the dipole moment parallel to the field equals $\bar{p}$. Classically, if the system is in thermal equilibrium,

$$\bar{p} = p_0(\coth u - 1/u) = p_0\mathcal{L}(u)$$

Here p_0 is the moment of the dipole itself and $\mathcal{L}(u)$ is the Langevin function of the argument u which equals Fp_0/kT.

$$\text{For } u \ll 1 \quad \mathcal{L}(u) = \frac{u}{3}$$

The Langevin function applies to permanent electric and magnetic dipoles.

(u)	0	1	2	3	4	5	6	7	8	9	10	Diff.
0.0	0000	0033	0066	0100	0133	0166	0200	0233	0266	0300	0333	33
0.1	0333	0366	0400	0433	0466	0499	0532	0565	0598	0631	0665	33
0.2	0665	0698	0731	0764	0797	0830	0862	0896	0929	0961	0994	33
0.3	0994	1027	1059	1092	1124	1157	1190	1222	1254	1287	1319	32
0.4	1319	1352	1384	1416	1448	1480	1512	1544	1576	1608	1640	32
0.5	1640	1671	1703	1734	1765	1797	1829	1860	1892	1923	1953	31
0.6	1953	1985	2016	2046	2077	2108	2138	2169	2200	2230	2260	31
0.7	2260	2290	2321	2351	2381	2411	2441	2471	2500	2530	2559	30
0.8	2559	2589	2618	2647	2676	2705	2734	2763	2792	2821	2850	29
0.9	2850	2878	2906	2934	2963	2991	3019	3047	3075	3103	3130	28
1.0	3130	3158	3185	3212	3240	3267	3294	3321	3348	3375	3401	27
1.1	3401	3428	3454	3480	3507	3533	3559	3585	3611	3637	3662	26
1.2	3662	3688	3713	3738	3763	3788	3813	3838	3863	3888	3913	25
1.3	3913	3937	3961	3985	4009	4033	4057	4081	4105	4129	4152	24
1.4	4152	4176	4199	4222	4245	4268	4291	4313	4336	4359	4381	23

VALUES FOR THE LANGEVIN FUNCTION $\mathcal{L}(u)$
(Continued)

1.5	4381	4403	4426	4448	4469	4491	4514	4536	4557	4579	4600	22
1.6	4600	4621	4642	4663	4684	4705	4726	4747	4768	4788	4808	21
1.7	4808	4828	4849	4869	4889	4909	4928	4948	4967	4987	5006	20
1.8	5006	5025	5044	5064	5083	5102	5121	5139	5158	5176	5195	19
1.9	5195	5213	5231	5249	5267	5285	5303	5321	5338	5356	5373	18
2.0	5373	5391	5408	5425	5442	5459	5476	5493	5509	5526	5542	17
2.1	5542	5559	5575	5591	5608	5624	5640	5656	5672	5688	5704	16
2.2	5704	5719	5734	5750	5765	5780	5795	5810	5825	5840	5855	15
2.3	5855	5870	5885	5899	5913	5928	5943	5957	5971	5985	6000	14
2.4	6000	6014	6027	6041	6055	6068	6082	6095	6109	6122	6136	13.5
2.5	6136	6149	6162	6175	6188	6201	6214	6227	6239	6252	6265	13
2.6	6265	6278	6290	6302	6314	6326	6339	6351	6363	6375	6387	12
2.7	6387	6399	6411	6422	6434	6446	6457	6469	6480	6492	6503	11.5
2.8	6503	6514	6525	6536	6548	6559	6570	6581	6591	6602	6613	11
2.9	6613	6624	6634	6644	6655	6665	6676	6686	6696	6707	6717	10
3.0	6717	6727	6737	6747	6757	6767	6777	6787	6796	6806	6815	10
3.1	6815	6825	6834	6844	6853	6862	6871	6880	6890	6899	6908	9
3.2	6908	6917	6926	6935	6944	6953	6962	6971	6979	6988	6997	9
3.3	6997	7006	7014	7023	7031	7040	7048	7056	7064	7073	7081	8.5
3.4	7081	7089	7197	7105	7113	7121	7129	7137	7145	7153	7161	8
3.5	7161	7169	7176	7184	7192	7200	7207	7215	7223	7230	7237	8
3.6	7237	7245	7252	7259	7267	7274	7281	7288	7295	7302	7309	7
3.7	7309	7317	7324	7330	7337	7344	7351	7358	7364	7371	7378	7
3.8	7378	7385	7392	7398	7405	7412	7418	7425	7431	7437	7444	6.5
3.9	7444	7450	7457	7463	7470	7476	7482	7488	7494	7501	7507	6

Note: Higher values of the Langevin function are nearly equal to (u − 1)/u.

MAGNETIC PROPERTIES OF TRANSFORMER STEELS

Ordinary Transformer Steel

B (Gauss)	H (Oersted)	Permeability = B/H
2,000	0.60	3,340
4,000	0.87	4,600
6,000	1.10	5,450
8,000	1.48	5,400
10,000	2.28	4,380
12,000	3.85	3,120
14,000	10.9	1,280
16,000	43.0	372
18,000	149	121

High Silicon Transformer Steel

B	H	Permeability
2,000	0.50	4,000
4,000	0.70	5,720
6,000	0.90	6,670
8,000	1.28	6,250
10,000	1.99	5,020
12,000	3.60	3,340
14,000	9.80	1,430
16,000	47.4	338
18,000	165	109

SATURATION CONSTANTS FOR MAGNETIC SUBSTANCES

Substance	Field intensity (For saturation)	Induced magnetization (For saturation)	Substance	Field intensity (For saturation)	Induced magnetization (For saturation)
Cobalt	9000	1300	Nickel, hard	8000	400
Iron, wrought	2000	1700	annealed	7000	515
cast	4000	1200	Vicker's steel	15000	1600
Manganese steel	7000	200			

MAGNETIC MATERIALS
High-permeability Materials

Material	Form	Approximate percent composition					Typical heat treatment °C	Permeability at $B = 20$ gausses	Maximum permeability	Saturation flux density B gausses	Hysteresis‡ loss, W_h ergs/cm³	Coercive‡ force H_c oersteds	Resistivity microhm-cm	Density, g/cm³
		Fe	Ni	Co	Mo	Other								
Cold rolled steel...	Sheet	98.5	—	—	—	—	950 Anneal	180	2,000	21,000	—	1.8	10	7.88
Iron..............	Sheet	99.91	—	—	—	—	950 Anneal	200	5,000	21,500	5,000	1.0	10	7.88
Purified iron......	Sheet	99.95	—	—	—	—	1480 H_2 + 880	5,000	180,000	21,500	300	.05	10	7.88
4% Silicon-iron...	Sheet	96	—	—	—	4 Si	800 Anneal	500	7,000	19,700	3,500	.5	60	7.65
Grain oriented*.	Sheet	97	—	—	—	3 Si	800 Anneal	1,500	30,000	20,000	—	.15	47	7.67
45 Permalloy......	Sheet	54.7	45	—	—	.3 Mn	1050 Anneal	2,500	25,000	16,000	1,200	.3	45	8.17
45 Permalloy†.....	Sheet	54.7	45	—	—	.3 Mn	1200 H_2 Anneal	4,000	50,000	16,000	—	.07	45	8.17
Hipernik..........	Sheet	50	50	—	—	—	1200 H_2 Anneal	4,500	70,000	16,000	220	.05	50	8.25
Monimax.........	Sheet	—	—	—	—	—	1125 H_2 Anneal	2,000	35,000	15,000	—	.1	80	8.27
Sinimax..........	Sheet	—	—	—	—	—	1125 H_2 Anneal	3,000	35,000	11,000	—	—	90	—
78 Permalloy......	Sheet	21.2	78.5	—	—	.3 Mn	1050 + 600 Q§	8,000	100,000	10,700	200	.05	16	8.60
4-79 Permalloy...	Sheet	16.7	79	—	4	.3 Mn	1100 + Q	20,000	100,000	8,700	200	.05	55	8.72
Mu metal.........	Sheet	18	75	—	—	2 Cr, 5 Cu	1175 H_2	20,000	100,000	6,500	—	.05	62	8.58
Supermalloy......	Sheet	15.7	79	—	5	.3 Mn	1300 H_2 + Q	100,000	800,000	8,000	—	.002	60	8.77
Permendur........	Sheet	49.7	—	50	—	.3 Mn	800 Anneal	800	5,000	24,500	12,000	2.0	7	8.3
2V Permendur....	Sheet	49	—	49	—	2 V	800 Anneal	800	4,500	24,000	6,000	2.0	26	8.2
Hiperco..........	Sheet	64	—	34	—	Cr	850 Anneal	650	10,000	24,200	—	1.0	25	8.0
2-81 Permalloy...	Insulated powder	17	81	—	2	—	650 Anneal	125	130	8,000	—	<1.0	10^6	7.8
Carbonyl iron.....	Insulated powder	99.9	—	—	—	—	—	55	132	—	—	—	—	7.86
Ferroxcube III....	Sintered powder	$MnFe_2O_4 + ZnFe_2O_4$					—	1,000	1,500	2,500	—	.1	10^8	5.0

* Properties in direction of rolling.

† Similar properties for Nicaloi, 4750 alloy, Carpenter 49, Armco 48.

‡ At saturation.

§ Q, quench or controlled cooling.

MAGNETIC MATERIALS (Continued)
Permanent Magnet Alloys

Material	Percent composition (remainder Fe)	Heat treatment* (temperature, °C)	Magnetizing force $H_{max.}$ oersteds	Coercive force H_c oersteds	Residual induction B_r gausses	Energy product $BH_{max.}$ $\times 10^{-6}$	Method of fabrication†	Mechanical properties‡	Weight lb/in.^{3}
Carbon steel	1 Mn, 0.9 C	Q 800	300	50	10,000	.20	HR, M, P	H, S	.280
Tungsten steel	5 W, 0.3 Mn, 0.7 C	Q 850	300	70	10,300	.32	HR, M, P	H, S	.292
Chromium steel	3.5 Cr, 0.9 C, 0.3 Mn	Q 830	300	65	9,700	.30	HR, M, P	H, S	.280
17% Cobalt steel	17 Co, 0.75 C, 2.5 Cr, 8 W	—	1,000	150	9,500	.65	HR, M, P	H, S	—
36% Cobalt steel	36 Co, 0.7 C, 4 Cr, 5 W	Q 950	1,000	240	9,500	.97	HR, M, P	H, S	.296
Remalloy or Comol	17 Mo, 12 Co	Q 1200, B 700	1,000	250	10,500	1.1	HR, M, P	H	.295
Alnico I	12 Al, 20 Ni, 5 Co	A 1200, B 700	2,000	440	7,200	1.4	C, G	H, B	.249
Alnico II	10 Al, 17 Ni, 2.5 Co, 6 Cu	A 1200, B 600	2,000	550	7,200	1.6	C, G	H, B	.256
Alnico II (sintered)	10 Al, 17 Ni, 2.5 Co, 6 Cu	A 1300	2,000	520	6,900	1.4	Sn, G	H	.219
Alnico IV	12 Al, 28 Ni, 5 Co	Q 1200, B 650	3,000	700	5,500	1.3	Sn, C, G	H	.253
Alnico V	8 Al, 14 Ni, 24 Co, 3 Cu	AF 1300, B 600	2,000	550	12,500	4.5	C, G	H, B	.264
Alnico VI	8 Al, 15 Ni, 24 Co, 3 Cu, 1 Ti	—	3,000	750	10,000	3.5	C, G	H, B	.268
Alnico XII	6 Al, 18 Ni, 35 Co, 8 Ti	—	3,000	950	5,800	1.5	C, G	H, B	.26
Vicalloy I	52 Co, 10 V	B 600	1,000	300	8,800	1.0	C, CR, M, P	D	.295
Vicalloy II (wire)	52 Co, 14 V	CW + B 600	2,000	510	10,000	3.5	C, CR, M, P	D	.292
Cunife (wire)	60 Cu, 20 Ni	CW + B 600	2,400	550	5,400	1.5	C, CR, M, P	D, M	.311
Cunico	50 Cu, 21 Ni, 29 Co	—	3,200	660	3,400	.80	C, CR, M, P	D, M	.300
Vectolite	30 Fe_2O_3, 44 Fe_3O_4, 26 C_2O_3	—	3,000	1,000	1,600	.60	Sn, G	W	.113
Silmanal	86.8 Ag, 8.8 Mn, 4.4 Al	—	20,000	6,000[a]	550	.075	C, CR, M, P	D, M	.325
Platinum-cobalt	77 Pt, 23 Co	Q 1200, B 650	15,000	3,600	5,900	6.5	C, CR, M	D	—
Hyflux	Fine powder	—	2,000	390	6,600	.97	—	—	.176

[a] Value given is intrinsic H_c.

* Q—Quenched in oil or water. A—Air cooled. B—Baked. F—Cooled in magnetic field. CW—Cold worked.

† HR—Hot rolled or forged. CR—Cold rolled or drawn. M—Machined. G—Must be ground. P—Punched. C—Cast. Sn—Sintered.

‡ H—Hard. B—Brittle. S—Strong. D—Ductile. M—Malleable. W—Weak.

MAGNETIC SUSCEPTIBILITY

The following tables give the specific susceptibility χ for various substances. The relation to volume susceptibility κ is shown by the equation $\chi = \kappa/d$, where d is the density of the substance. Unit of χ, 1×10^{-6} cgs electromagnetic units. Room temperature is to be understood where no other is stated. The values are positive for paramagnetic bodies, negative for diamagnetic.

ELEMENTS AND INORGANIC COMPOUNDS

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Aluminum	Al	−170 sol.	0.60	31
		18	0.65	16
		230	0.64	16
		500	0.57	16
		1000 liq.	0.57	16
Aluminum bromide	$AlBr_3$	19	−0.32	27
Aluminum chloride	$AlCl_3$	19	−0.60	27
Aluminum oxide	Al_2O_3	....	−0.098	45
Aluminum sulfate	$Al_2(SO_4)_3$	18	−0.48	27
Alum, ammonium, iron	$Fe_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$	−258.4	598.	29
		−196	114.7	29
		17	30.4	29
Ammonia	NH_3	16 gas	−1.1	33
Ammonium chloroplatinate	$(NH_4)_2PtCl_6$	....	−0.42	11
Ammonium metavanadate	NH_4VO_3	15	−0.12	27
Antimony	Sb	18 sol.	−0.87	1
		800 liq.	−0.49	16
Antimony bromide	$SbBr_3$	....	−0.275	33
Antimony pentachloride	$SbCl_5$	....	−0.371	31
Antimony trichloride	$SbCl_3$	....	−0.364	33
Antimony trioxide	Sb_2O_3	14	−0.19	27
Argon	A	20 gas	−0.45	15
Arsenic	As	18	−0.31	1
Arsenous oxide	As_2O_3	18	−0.27	27
Arsenous sulfide	As_2S_3	18	−0.03	27
Barium	Ba	18	0.9	31
Barium bromide	$BaBr_2$	....	−0.39	27
	$BaBr_2 \cdot 2H_2O$	....	−0.371	8
Barium carbonate	$BaCO_3$	....	−0.298	33
Barium chloride	$BaCl_2$	....	−0.41	27
	$BaCl_2 \cdot 2H_2O$	....	−0.368	8
Barium hydroxide	$Ba(OH)_2$	18	−0.32	27
	$Ba(OH)_2 \cdot 8H_2O$	....	−0.497	33
Barium iodide	BaI_2	22	−0.39	24
	$BaI_2 \cdot 2H_2O$	19	−0.38	27
Barium nitrate	$Ba(NO_3)_2$	....	−0.254	33
Barium oxide	BaO	20	−0.13	27
Barium sulfate	$BaSO_4$	....	−0.306	33
Barium sulfide	BaS	18	−0.32	27
Beryllium	Be	20	−1.0	31
Beryllium chloride	$BeCl_2$	17	−0.60	27
Beryllium hydroxide	$Be(OH)_2$	....	−0.537	33
Beryllium oxide	BeO	16	0.0	27
Beryllium sulfate	$BeSO_4$	18	−0.46	27
	$BeSO_4 \cdot 4H_2O$	17	−0.51	27
Bismuth	Bi	−259	−1.55	30
		−100	−1.52	31
		18	−1.35	1
		150	−1.19	16
		260	−1.02	16
Bismuth bromide	$BiBr_3$	....	−0.328	12

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Bismuth iodide	BiI_3	20	−0.49	27
Bismuth nitrate	$Bi(NO_3)_3 \cdot 5H_2O$	....	−0.365	12
Bismuth sulfide	Bi_2S_3	....	−0.385	12
Bismuth trichloride	$BiCl_3$	....	−0.322	12
Bismuth trioxide	Bi_2O_3	....	−0.170	8
Boron	B	18	−0.69	1
Boric acid	H_3BO_3	....	−0.52	26
Boron oxide	B_2O_3	14	−0.55	27
Bromine	Br	−170 sol.	−0.40	31
		− 8	−0.40	31
		18 liq.	−0.39	1
Cadmium	Cd	18	−0.18	1
		400	−0.16	16
Cadmium bromide	$CdBr_2$	18	−0.38	27
Cadmium chloride	$CdCl_2$	18	−0.32	27
Cadmium iodide	CdI_2	18	−0.32	27
Cadmium oxide	CdO	15	−0.30	27
Calcium	Ca	18	1.10	31
Calcium carbonate	$CaCO_3$	....	−0.382	33
Calcium chloride	$CaCl_2$	17	−0.49	27
	$CaCl_2 \cdot 6H_2O$	17	−0.54	27
Calcium hydroxide	$Ca(OH)_2$	16	−0.39	27
Calcium oxide	CaO	16	−0.27	27
Calcium sulfate	$CaSO_4$	....	−0.364	33
	$CaSO_4 \cdot H_2O$	....	−0.384	33
Carbon (diamond)	C	−170	−0.49	31
		20	−0.49	16
		200	−0.50	16
		400	−0.51	16
		900	−0.54	16
		1200	−0.56	16
Carbon (gas carbon)	C	20	−2.0	16
		100	−2.0	16
		500	−1.8	16
		850	−1.6	16
		1150	−1.5	16
Carbon (graphite)	C	−170	−6.0	31
		20	−3.5	31
		300	−2.7	31
		600	−2.0	31
		900	−1.4	31
		1000	−1.3	31
Carbon dioxide	CO_2	20 gas	−0.423	35
Carbon disulfide	CS_2	....	−0.54	26
Cerium	Ce	−170	38.	31
		−150	35.	31
		−100	26.	31
		18	15.	31
		100	12.	31
		200	11.	31
Ceric oxide	CeO_2	....	0.39	26
Cerous bromide	$CeBr_3$	18	6.0	5
Cerous chloride	$CeCl_3$	19	6.1	27
Cerous sulfate	$Ce_2(SO_4)_3$	....	7.8	39
Cesium	Cs	18	−0.10	31
Cesium carbonate	Cs_2CO_3	....	−0.320	33
Cesium chloride	CsCl	....	−0.363	33
Cesium nitrate	$CsNO_3$	....	−0.412	33
Cesium sulfate	Cs_2SO_4	....	−0.322	33
Chlorine	Cl	−60 liq.	−0.57	33
Chromium	Cr	18	3.6	1
		500	3.8	16
		1100	4.2	16

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Chromic chloride	$CrCl_3$	19	44.3	17
Chromic oxide	Cr_2O_3	18	25.5	18
Chromic sulfate	$Cr_2(SO_4)_3$	21	29.5	19
Chromium trioxide	CrO_3	17	0.51	18
Chromous chloride	$CrCl_2$	....	84.	38
Chromous hydroxide	$Cr(OH)_2$	....	48.5	34
Chromous sulfate	$CrSO_4$	....	66.	2
Chromous sulfide	CrS	20	28.4	41
Cobaltic oxide	Co_2O_3	....	34.3	45
Cobalto cobaltic oxide	Co_3O_4	....	39 to 43.6	45
Cobaltous bromide	$CoBr_2$	....	46.8	9
Cobaltous chloride	$CoCl_2$	25	90.5	19
Cobaltous iodide	CoI_2	18	32.	25
Cobaltous nitrate	$Co(NO_3)_2 \cdot 6H_2O$	....	33.1	8
Cobaltous oxide	CoO	....	74.5	45
Cobaltous sulfate	$CoSO_4$	22	59.6	19
	$CoSO_4 \cdot H_2O$	....	53.6	11
	$CoSO_4 \cdot 7H_2O$	19.9	37.0	21
Columbium	Cb	18	1.5	1
Copper	Cu	18	−0.086	1
		500	−0.075	16
		1050	−0.070	16
Cupric bromide	$CuBr_2$	31	3.10	19
Cupric chloride	$CuCl_2$	19	9.10	19
	$CuCl_2 \cdot 2H_2O$	17	8.35	11
Cupric nitrate	$Cu(NO_3)_2 \cdot 6H_2O$	....	5.50	8
Cupric oxide	CuO	....	3.8	45
Cupric sulfate	$CuSO_4$	....	8.6	11
	$CuSO_4 \cdot 5H_2O$	....	5.9	11
Cupric sulfide	CuS	17	−0.20	27
Cuprous oxide	Cu_2O	....	1.2	45
Cuprous sulfide	Cu_2S	18	−0.18	27
Dysprosium oxide	Dy_2O_3	16	229.	29
Erbium	Er	18	22.	18
Erbium chloride	$ErCl_3$	18	114.	5
Erbium oxide	Er_2O_3	20	189.1	43
Erbium sulfate	$Er_2(SO_4)_3$	....	118.	40
Ferric bromide	$FeBr_3$	18	48.	25
Ferric chloride	$FeCl_3$	20	86.2	19
Ferric hydroxide	$Fe(OH)_3$	....	157.	27
Ferric nitrate	$Fe(NO_3)_3 \cdot 6H_2O$	....	31.3	8
Ferric oxide	Fe_2O_3	18	20.6	18
Ferric sulfate	$Fe_2(SO_4)_3$	23	57.3	19
Ferrous ammonium sulfate	$FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	−258.6	547.	21
		17.2	32.6	21
Ferrous chloride	$FeCl_2$	17	101.2	19
	$FeCl_2 \cdot 4H_2O$	19	60.1	19
Ferrous iodide	FeI_2	18	40.	25
Ferrous sulfate	$FeSO_4$	19	74.2	19
	$FeSO_4 \cdot 7H_2O$	16.5	41.5	21
Gadolinium chloride	$GdCl_3$	18	91.	5
Gadolinium oxide	Gd_2O_3	20	130.1	43
Gadolinium sulfate	$Gd_2(SO_4)_3$	....	92.6	11
Gallium	Ga	−170 sol.	−0.26	31
		18	−0.24	31
		30	−0.23	31
		100 liq.	−0.04	31
Germanium	Ge	−170 sol.	−0.30	31
		18	−0.12	31
		900 liq.	−0.30	31

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Gold	Au	18	−0.15	1
Gold chloride	$AuCl_3$	21	0.43	27
Hafnium oxide	HfO_2	....	−0.110	27
Helium	He	20 gas	−0.47	15
Holmium chloride	$HoCl_3$	....	172.	46
Holmium nitrate	$Ho(NO_3)_3$	....	123.6	46
Holmium oxide	Ho_2O_3	....	243.	46
Hydrochloric acid	HCl	22	−0.661	8
Hydrogen	H	20 gas	−1.97	1
Indium	In	20	−0.11	16
Indium trichloride	$InCl_3$	18	−0.39	27
Iodine	I	−100 sol.	−0.32	31
		−60	−0.33	31
		0	−0.35	31
		18	−0.36	1
		50	−0.37	16
		113 liq.	−0.39	16
		160	−0.33	16
Iridium	Ir	18	0.14	1
		200	0.17	16
		450	0.20	16
		850	0.26	16
		1150	0.31	16
Iron carbonyl	$Fe(CO)_5$	19	−0.40	32
Lanthanum	La	18	1.04	31
Lanthanum chloride	$LaCl_3$	15	5.6	27
Lanthanum sesquioxide	La_2O_3	24	−0.40	43
Lanthanum sulfate	$La_2(SO_4)_3$	....	−0.30	39
Lead	Pb	−170 sol.	−0.14	31
		18	−0.12	1
		330 liq.	−0.08	16
Lead bromide	$PbBr_2$	20	−0.28	27
Lead chloride	$PbCl_2$	15	−0.32	27
Lead iodide	PbI_2	19	−0.33	27
Lead monoxide	PbO	18	−0.13	27
Lead nitrate	$Pb(NO_3)_2$	....	−0.248	37
Lead oxide (red)	Pb_3O_4	18	−0.24	27
Lithium	Li	16	0.50	31
Lithium carbonate	Li_2CO_3	....	−0.413	33
Lithium chloride	LiCl	....	−0.573	33
Lithium nitrate	$LiNO_3$	19	−0.48	27
Lithium oxide	Li_2O	20	−0.57	27
Lithium sulfate	Li_2SO_4	15	−0.38	27
Magnesium	Mg	18 sol	0.55	16
		700 liq.	0.55	16
Magnesium bromide	$MgBr_2$	20	−0.57	27
Magnesium carbonate	$MgCO_3$	....	−0.51	27
	$MgCO_3{\cdot}3H_2O$	....	−0.525	33
Magnesium chloride	$MgCl_2$	18	−0.58	27
	$MgCl_2{\cdot}6H_2O$	18	−0.57	27
Magnesium oxide	MgO	17	−0.25	27
Magnesium sulfate	$MgSO_4$	....	−0.45	36
	$MgSO_4{\cdot}7H_2O$	....	−0.551	33
Manganese	Mn	18	9.9	1
Manganese bromide	$MnBr_2$	18	68.	25
Manganese chloride	$MnCl_2$	24	107.0	19
Manganese dioxide	MnO_2	21	38.4	18
Manganese hydroxide (ous)	$Mn(OH)_2$	....	49.	34
Manganese iodide	MnI_2	18	47.	25
Manganese nitrate	$Mn(NO_3)_2{\cdot}6H_2O$	....	45.5	8
Manganese oxide (ous)	MnO	21	75.9	18

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Manganese oxide (ic)	Mn_2O_3	21	69.0	18
Manganese oxide (ous-ic)	Mn_3O_4	20	55.8	18
Manganese phosphate	$MnPO_4$	....	69.	38
Manganese sulfate (ous)	$MnSO_4$	24	88.5	18
Manganese sulfide (ous)	MnS	10	44.32	41
Mercury	Hg	−80 sol.	−0.15	31
		18 liq.	−0.19	1
		310	−0.193	16
Mercuric bromide	$HgBr_2$	15	−0.30	27
Mercuric chloride	$HgCl_2$	17	−0.19	27
Mercuric iodide	HgI_2	17	−0.33	27
Mercuric oxide	HgO	16	−0.24	27
Mercuric sulfide	HgS	16	−0.23	27
Mercurous chloride	$HgCl$	19	−0.23	27
Molybdenum	Mo	18	0.04	16
Molybdenum dioxide	MoO_2	20	0.33	41
Molybdenum trioxide	MoO_3	20	0.88	41
Molybdenum sesquioxide	Mo_2O_3	16	−0.35	27
Neodymium	Nd	18	36.	31
Neodymium oxide	Nd_2O_3	....	30.3	39
Neodymium sulfate	$Nd_2(SO_4)_3$	....	18.3	39
Neon	Ne	20 gas	−0.33	15
Nickel bromide	$NiBr_2$	18	19.	25
Nickel carbonyl	$Ni(CO)_4$	19	−0.481	32
Nickel chloride	$NiCl_2$	24	44.7	19
Nickel hydroxide (ous)	$Ni(OH)_2$	....	48.3	45
Nickel monoxide	NiO	....	53.7	45
Nickel nitrate	$Ni(NO_3)_2{\cdot}6H_2O$	....	13.6	8
Nickel sulfate	$NiSO_4$	15.9	26.7	21
	$NiSO_4{\cdot}6H_2O$	....	15.6	11
	$NiSO_4{\cdot}7H_2O$	19.1	16.0	21
Nitric acid	HNO_3	22	−0.467	8
Nitrogen	N	20 gas	−0.342	1
Nitrogen dioxide	NO	22 gas	48.66	35
Nitrogen monoxide	N_2O	12 liq.	−0.429	35
Nitrogen pentoxide	N_2O_5	16 sol.	−0.332	35
Nitrogen peroxide	N_2O_4	−16 sol.	−0.276	35
	NO_2	135 gas	3.26	35
Nitrogen trioxide	N_2O_3	18 liq.	−0.206	35
Osmium	Os	18	0.05	1
Oxygen (1st modification)	O	−259 sol.	54.	30
		−240	60.	30
(2nd modification)	....	−240	118.	30
		−219	113.	30.
(liquid)	....	−219 liq.	310.	30
		−203	273.	30
		−196	260.	30
		20 gas	106.2	1
Palladium	Pd	−258	10.9	29
		−196	8.1	29
		−103	6.9	29
		0	5.4	31
		18	5.4	1
		200	4.6	16
		750	2.6	16
		1230	1.7	16
Phosphorus (white)	P	20 sol.	−0.90	1
Phosphorus (red)	P	20	−0.67	3
		45 liq.	−0.90	16
Phosphorus pentoxide	P_2O_5	18	−0.46	27
Platinum	Pt	−170	1.31	31

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Platinum (continued)	Pt	−100	1.20	31
		18	1.10	1
		250	0.66	16
		700	0.45	16
		1220	0.30	16
Platinum tetrachloride	$PtCl_4$	22	0.0	24
Potassium	K	18	0.52	1
Potassium acid fluoride	KHF_2	....	−0.428	8
Potassium bromide	KBr	....	−0.377	8
Potassium carbonate	K_2CO_3	....	−0.488	8
Potassium chlorate	$KClO_3$	....	−0.30	26
Potassium chloride	KCl	....	−0.516	33
Potassium chloroplatinate	K_2PtCl_6	....	−0.393	11
Potassium chloroplatinite	K_2PtCl_4	....	−0.356	11
Potassium cyanate	KCNO	....	−0.465	33
Potassium dichromate	$K_2Cr_2O_7$	....	0.129	8
Potassium ferricyanide	$K_3Fe(CN)_6$	21	7.08	19
Potassium ferrocyanide	$K_4Fe(CN)_6{\cdot}3H_2O$	....	−0.420	32
Potassium hydroxide	KOH	22	−0.33	24
Potassium iodide	KI	....	−0.422	8
Potassium nitrate	KNO_3	....	−0.326	33
Potassium permanganate	$KMnO_4$	21	0.175	19
Potassium sulfate	K_2SO_4	....	−0.403	33
Potassium tetrathionate	$K_2S_4O_6$	....	−0.412	33
Praseodymium	Pr	−170 sol.	90.	31
		−100	53	31
		20	25.	31
		200	14.	31
		600	8.	31
		900 liq.	7.	31
Praseodymium chloride	$PrCl_3$	19	17.	27
Praseodymium sulfate	$Pr_2(SO_4)_3$	....	13.7	28
Praseodymium trioxide	Pr_2O_3	....	15.6	28
Quartz (*see Silicon dioxide*)	SiO_2	....	....	.....
Rhodium	Rh	−180	0.90	31
		− 40	1.05	31
		18	1.11	1
		280	1.31	16
		730	1.52	16
		1140	1.86	16
Rubidium	Rb	18	0.09	1
Rubidium carbonate	Rb_2CO_3	....	−0.321	33
Rubidium chloride	RbCl	....	−0.327	33
Rubidium nitrate	$RbNO_3$	....	−0.281	33
Rubidium sulfate	Rb_2SO_4	....	−0.331	33
Ruthenium	Ru	−170	0.55	31
		18	0.50	1
		750	0.65	16
		1100	0.75	16
Samarium oxide	Sa_2O_3	22	6.02	43
Scandium nitrate	$Sc(NO_3)_3$	21	0.0	27
Scandium oxide	Sc_2O_3	....	−0.018	26
Scandium sulfate	$Sc_2(SO_4)_3$	....	−0.33	39
Selenium	Se	18	−0.32	1
Selenious acid	H_2SeO_3	18	−0.36	27
Silicon	Si	18	−0.13	1
Silicochloroform	$SiHCl_3$	....	−0.515	33
Silicon dioxide	SiO_2	....	−0.493	33
Silicon tetrabromide	$SiBr_4$	....	−0.360	33
Silicon tetrachloride	$SiCl_4$	....	−0.537	33
Silver	Ag	−170 sol.	−0.16	31

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Silver (continued)	Ag	−80	−0.18	31
		−40	−0.19	31
		18	−0.20	31
		270	−0.23	16
		945	−0.26	16
		1000 liq.	−0.28	16
Silver bromide	$AgBr$	19	−0.33	27
Silver chloride	$AgCl$	17	−0.35	27
Silver iodide	AgI	19	−0.37	27
Sodium	Na	18	0.51	1
Sodium acetate	$NaC_2H_3O_2{\cdot}3H_2O$	....	−0.50	26
Sodium acid carbonate	$NaHCO_3$	....	−0.21	26
Sodium bromide	$NaBr$	18	−0.47	27
Sodium carbonate	Na_2CO_3	17	−0.24	27
	$Na_2CO_3{\cdot}10H_2O$	17	−0.58	27
Sodium chloride	$NaCl$	18	−0.499	19
Sodium fluoride	NaF	21	−0.51	27
Sodium hydroxide	$NaOH$	17	−0.59	27
Sodium iodide	$NaI{\cdot}2H_2O$	....	−0.402	8
Sodium nitrate	$NaNO_3$	....	−0.28	26
di-Sodium phosphate	Na_2HPO_4	....	−0.399	33
di-Sodium phosphite	Na_2HPO_3	....	−0.451	33
Sodium sulfate	$Na_2SO_4{\cdot}10H_2O$	....	−0.86	26
Sodium sulfite	$Na_2SO_3{\cdot}7H_2O$	....	−0.462	33
Sodium tetraborate	$Na_2B_4O_7{\cdot}10H_2O$	....	−0.59	26
Sodium thiosulfate (hypo)	$Na_2S_2O_3$	....	−0.391	33
Stannic bromide	$SnBr_4$	....	−0.354	33
Stannic chloride	$SnCl_4$	....	−0.442	33
Stannic hydroxide	$Sn(OH)_4$	....	−0.321	33
Stannic oxide	SnO_2	15	−0.050	27
Stannous chloride	$SnCl_2$	18	−0.37	27
Stannous oxide	SnO	17	−0.11	27
Stannous sulfate	$SnSO_4$	18	−0.29	27
Strontium	Sr	18	−0.2	31
Strontium bromide	$SrBr_2$	19	−0.39	27
Strontium carbonate	$SrCO_3$	....	−0.316	33
Strontium chloride	$SrCl_2$	20	−0.56	27
Strontium iodide	SrI_2	19	−0.44	27
Strontium oxide	SrO	20	−0.060	27
Strontium sulfate	$SrSO_4$	....	−0.315	33
Sulfur (rhombic)	S	−170 sol.	−0.49	16, 31
		18	−0.49	1
		112	−0.49	16, 31
		113 liq.	−0.49	16, 31
		220	−0.49	16, 31
Sulfur dioxide	SO_2	liq.	−0.285	33
Sulfur trioxide	SO_3	16	−0.289	33
Sulfuric acid	H_2SO_4	22	−0.441	8
Tantalum	Ta	−170	0.83	31
		18	0.87	1
		420	0.88	16
		820	0.77	16
Tellurium	Te	−160 sol.	−0.46	31
		−60	−0.36	31
		0	−0.32	31
		18	−0.31	1
		130	−0.32	16
		436	−0.31	16
		470 liq.	−0.071	16
Tellurium dioxide	TeO_2	18	−0.14	27
Thallium	Tl	18	−0.24	1

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Temp. °C	Susceptibility 10^{-6} cgs	Observer
Thallium monochloride....	$TlCl$	20	−0.19	27
Thallium sulfate (ous).....	Tl_2SO_4	20	−0.25	27
Thallium trichloride.......	$TlCl_3$	20	−0.23	27
Thorium.................	Th	−170	0.05	31
		18	0.13	1
		150	0.23	16
		390	0.29	16
Thorium nitrate..........	$Th(NO_3)_4$	....	−0.14	27
Tin.....................	Sn	18 sol.	0.025	1
(gray)................	....	18	−0.35	16
		400 liq.	−0.036	16
Tin tetraethyl...........	$Sn(C_2H_5)_4$	....	−0.138	33
Tin tetramethyl..........	$Sn(CH_3)_4$	....	−0.218	33
Titanium................	Ti	−170	1.6	31
		20	1.25	31
Titanium dioxide.........	TiO_2	....	0.066	40
Titanium sulfide.........	TiS_2	....	0.56	40
Tungsten................	W	18	0.28	1
Tungsten trioxide........	WO_3	15	0.81	41
Tungstic acid............	H_2WO_4	18	−1.1	27
Uranium.................	U	18	2.6	31
Uranium dioxide..........	UO_2	17	7.5	41
Uranium oxide (ous-ic)....	U_3O_8	15	0.95	41
Uranium tetrachloride.....	UCl_4	19	−0.40	27
Uranium trioxide..........	UO_3	16	1.08	41
Uranyl nitrate............	$UO_2(NO_3)_2$	15	−0.44	27
Vanadium................	V	18	1.4	1
Vanadium oxide...........	VO_2	13	3.73	41
Vanadium pentoxide.......	V_2O_5	15	0.85	41
Vanadium trioxide........	V_2O_3	15	13.9	41
Water...................	H_2O	−120 to 0 sol.	−0.699	19
Ytterbium...............	Yb	−160	16.8	31
		20	5.3	31
Ytterbium chloride........	$YbCl_3$	....	25.	5
Ytterbium oxide..........	Yb_2O_3	....	38.	27
Yttrium chloride..........	YCl_3	17	20.	27
Yttrium oxide............	Y_2O_3	22	0.53	43
Yttrium sulfate...........	$Y_2(SO_4)_3$	....	−0.24	39
Zinc....................	Zn	18 sol.	−0.157	1
		450 liq.	−0.09	16
Zinc bromide.............	$ZnBr_2$	19	−0.40	27
Zinc chloride.............	$ZnCl_2$	22	−0.47	24
Zinc hydroxide............	$Zn(OH)_2$	....	−0.487	45
Zinc oxide...............	ZnO	....	−0.362	8
Zinc sulfate..............	$ZnSO_4 \cdot 7H_2O$	....	−0.48	26
Zirconium...............	Zr	18	−0.45	1
Zirconium dioxide.........	ZrO_2	15	−0.112	27

ORGANIC COMPOUNDS

Room temperature is to be understood where no other is stated.

Substance	Formula	Susceptibility 10^{-6} cgs	Observer
Acetaldehyde........................	C_2H_4O	−0.502	33
Acetamide...........................	C_2H_5NO	−0.577	
Acetic acid..........................	$C_2H_4O_2$	−0.526	
Acetic anhydride.....................	$C_4H_6O_3$	−0.517	

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Susceptibility 10^{-6} cgs	Observer
Acetone	C_3H_6O	−0.581	
Acridine	$C_{13}H_9N$	−0.688	
n-Amyl alcohol	$C_5H_{12}O$	−0.766	26
iso-Amyl alcohol	$C_5H_{12}O$	−0.799	33
tert.-Amyl alcohol	$C_5H_{12}O$	−0.804	
iso-Amyl ether	$C_{10}H_{22}O$	−0.813	
Amyl nitrate	$C_5H_{11}NO_3$	−0.574	
Aniline	C_6H_7N	−0.692 (10°)	32
Anisole	C_7H_8O	−0.672	33
Anthracene	$C_{14}H_{10}$	−0.726	
Anthraquinone	$C_{14}H_8O_2$	−0.575	
Benzaldehyde	C_7H_6O	−0.573	
Benzene	C_6H_6	−0.712 (16.8°)	19, 20
Benzoic acid	$C_7H_6O_2$	−0.556	13, 14
Benzophenone	$C_{13}H_{10}O$	−0.594	33
Benzoyl chloride	C_7H_5ClO	−0.539 (20°)	
Benzyl alcohol	C_7H_8O	−0.705	
Bromobenzene	C_6H_5Br	−0.540 (−20°)	32
Bromoform	$CHBr_3$	−0.316	33
n-Butyl alcohol	$C_4H_{10}O$	−0.743	26
iso-Butyl alcohol	$C_4H_{10}O$	−0.798	33
iso-Butylamine	$C_4H_{11}N$	−0.843	
n-Butyric acid	$C_4H_8O_2$	−0.632	
iso-Butyric acid	$C_4H_8O_2$	−0.646	
Cacodylic acid	$C_2H_7AsO_2$	−0.579	
Camphor	$C_{10}H_{16}O$	−0.68	10
Camphoric acid	$C_{10}H_{16}O_4$	−0.746	13, 14
Carbon tetrabromide	CBr_4	−0.293	33
Carbon tetrachloride	CCl_4	−0.429	
Carbon tetraiodide	CI_4	−0.261	
Chloral	C_2HCl_3O	−0.459	
Chloroacetone	C_3H_5ClO	−0.550	
Chlorobenzene	C_6H_5Cl	−0.664 (−30°)	32
Chloroform	$CHCl_3$	−0.488	33
Chrysene	$C_{18}H_{12}$	−0.648	
Cinnamic aldehyde	C_9H_8O	−0.566	
Cyanogen	C_2N_2	−0.415	
Cyanuric acid	$C_3H_3N_3O_3$	−0.490	
Cyclohexane	C_6H_{12}	−0.810	
Cyclohexene	C_6H_{10}	−0.711	
Cymene	$C_{10}H_{14}$	−0.769	
Decane	$C_{10}H_{22}$	−0.876	
Diethylamine	$C_4H_{11}N$	−0.835	
m-Dinitrobenzene	$C_6H_4N_2O_4$	−0.398	
Diphenyl	$C_{12}H_{10}$	−0.677	
Diphenylamine	$C_{12}H_{11}N$	−0.634	
Ethyl acetate	$C_4H_8O_2$	−0.607 (−6°)	19, 20
Ethyl acetoacetate (fresh)	$C_6H_{10}O_3$	−0.576	33
Ethyl alcohol	C_2H_6O	−0.744	
Ethyl benzoate	$C_9H_{10}O_2$	−0.628	
Ethyl bromide	C_2H_5Br	−0.489	
Ethyl cinnamate	$C_{11}H_{12}O_2$	−0.610	
Ethyl ether	$C_4H_{10}O$	−0.766	26
Ethyl formate	$C_3H_6O_2$	−0.581	33
Ethyl iodide	C_2H_5I	−0.679	26
Ethylene	C_2H_4	−1.6	6, 7
Ethylene bromide	$C_2H_4Br_2$	−0.422	33
Ethylene chloride	$C_2H_4Cl_2$	−0.602	
Ethylene iodide	$C_2H_4I_2$	−0.381	
Ethylidene chloride	$C_2H_4Cl_2$	−0.580	
Eucalyptol	$C_{10}H_{18}O$	−0.754	
Eugenol and iso-eugenol	$C_{10}H_{12}O_2$	−0.622	
Fluorobenzene	C_6H_5F	−0.608	

MAGNETIC SUSCEPTIBILITY (Continued)

Substance	Formula	Susceptibility 10^{-6} cgs	Observer
Formaldehyde	CH_2O	−0.62	26
Formamide	CH_3NO	−0.486	33
Formic acid	CH_2O_2	−0.432	
Fumaric acid	$C_4H_4O_4$	−0.426	13, 14
Furfural	$C_5H_4O_2$	−0.492	33
Glycerol	$C_3H_8O_3$	−0.538	26
Glycol	$C_2H_6O_2$	−0.624	33
Hexachlorobenzene	C_6Cl_6	−0.518	
Hexane	C_6H_{14}	−0.888	
Iodobenzene	C_6H_5I	−0.471	
Maleic acid	$C_4H_4O_4$	−0.427	13, 14
Methane	CH_4	−2.5	6, 7
Methyl acetate	$C_3H_6O_2$	−0.590	33
Methyl alcohol	CH_4O	−0.65 (−3°)	19, 20
Methylamine	CH_5N	−0.870	33
Methyl benzoate	$C_8H_8O_2$	−0.602	
Methyl bromide	CH_3Br	−0.603	
Methyl chloride	CH_3Cl	−0.633	
Methyl ether	C_2H_6O	−0.716	22
Methyl formate	$C_2H_4O_2$	−0.518	33
Methyl iodide	CH_3I	−0.403	
Methyl propionate	$C_4H_8O_2$	−0.628	
Methyl salicylate	$C_8H_8O_3$	−0.580	
Methylene bromide	CH_2Br_2	−0.379	33
Methylene chloride	CH_2Cl_2	−0.549	
Methylene iodide	CH_2I_2	−0.349	
Naphthalene	$C_{10}H_8$	−0.717	
Naphthol	$C_{10}H_8O$	−0.673	
Nitrobenzene	$C_6H_5NO_2$	−0.499 (20°)	32
Nitroethane	$C_2H_5NO_2$	−0.472	33
Nitrosobenzene	C_6H_5NO	−0.514	
Octane	C_8H_{18}	−0.872	
Oleic acid	$C_{18}H_{34}O_2$	−0.742	
Paraldehyde	$C_6H_{12}O_3$	−0.652	
Phenetole	$C_8H_{10}O$	−0.692	
Phenol	C_6H_6O	−0.648	
Phenyl cyanide	C_7H_5N	−0.651	
Phthalic acid	$C_8H_6O_4$	−0.446	13, 14
Piperidine	$C_5H_{11}N$	−0.755	33
Propionic acid	$C_3H_6O_2$	−0.587	
Propyl alcohol	C_3H_8O	−0.766	
Pyridine	C_5H_5N	−0.623	
Quinoline	C_9H_7N	−0.662	
Quinone	$C_6H_4O_2$	−0.382	
Resorcinol	$C_6H_6O_2$	−0.617	
Stilbene	$C_{14}H_{12}$	−0.666	
Succinic acid	$C_4H_6O_4$	−0.461	13, 14
Terpineol	$C_{10}H_{18}O$	−0.725	33
Tetrabromethylene	C_2Br_4	−0.334	
Tetrachloroethylene	C_2Cl_4	−0.508	
Toluene	C_7H_8	−0.729	
o-Toluidine	C_7H_9N	−0.701	33
Trichlorobenzene	$C_6H_3Cl_3$	−0.587	
Trichloronitromethane	CCl_3NO_2	−0.458	
Triethylphosphine	$C_6H_{15}P$	−0.762	
Trinitrobenzene-1, 3, 5	$C_6H_3N_3O_6$	−0.352	
Urea	CH_4N_2O	−0.560	
o-Xylene	C_8H_{10}	−0.662 (−10°)	32
m-Xylene	C_8H_{10}	−0.743	33

MAGNETIC SUSCEPTIBILITY (Continued)

MISCELLANEOUS

Substance	Susceptibility	Observer
Air, 20°C, 1 atm.	24.16 gas	1
Celluloid	−0.13	23, 24
Ebonite	0.6	44
Glass (crown)	−0.90	23, 24
Glass (heavy flint)	−1.2	23, 24
Linseed oil	−0.74	10
Marble ($CaCO_3$)	−0.8	44
Paraffin	−0.6	44
Petroleum	−0.83	26
Shellac	−0.30	26
Wax (white)	−0.6	44
Wood	−0.3 to 0.7	44

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18 Honda and Soné, 1913
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MAGNETIC INCLINATION OR DIP AND HORIZONTAL INTENSITY

The mean or limiting values are given for the territory covered by the State named. The horizontal intensity is given in gausses. The table is compiled from the results of the U. S. Coast and Geodetic Survey for 1911 and 1912.

State.	Dip, degrees.		Horizontal intensity.	
Alabama	62.	to 66.	.23	to .26
Alaska	67.	74.	.16	.21
Arizona	59.		.27	
Arkansas	63.	65.	.24	.25
California	58.	62.	.25	.27
Colorado	67.	68.	.22	.23
Connecticut	72.	73.	17	.18
Delaware	70.	71.5	19	.20
Florida	57.	58.	27	.29
Georgia	62.	66.	.23	.26
Hawaii	39.		.29	
Idaho	69.		.21	
Indiana	69.	72.	.18	.21
Iowa	71.	73.	.18	.20
Kansas	67.	69.	.21	.23
Kentucky	68.	70.	.20	.22
Maine	74.	76.	.14	.16
Maryland	70		.20	
Massachusetts	73.		.17	
Michigan	73.	76.	.15	.18
Mississippi	61.	66.	.24	.26
Missouri	67.	71.	.20	.22
Montana	70.	72.	.18	.20
Nebraska	70.	71.	.20	
New Hampshire	73.	74.	.16	.17
New Jersey	71.		.19	
New Mexico	63.	65.	.24	.25
New York	74.		.16	.17
North Carolina	66.	68.	.21	.23
North Dakota	74.	77.	.15	.16
Ohio	71.	73.	.18	.20
Oklahoma	63.	67.	.23	.25
Oregon	68.	69.	.21	
Pennsylvania	71.	72.	.18	.19
Philippines	0.	23.	.37	.39
Porto Rico	49.	50.	.29	.30
South Carolina	66.	67.	.23	
South Dakota	71.	74.	.17	.19
Tennessee	66.	68.	.22	.23
Texas	57.	63.	.25	.29
Utah	66.	67.	.22	.23
Vermont	73.	75.	.16	.17
Virginia	68.	70.	.20	.21
Washington	71.		.19	
West Virginia	70.5		.20	
Wisconsin	74.	76.	.15	.17
Wyoming	68.	72.	.19	.22

MAGNETIC DECLINATION

(Selected from tables of the U. S. Coast and Geodetic Survey)

State.	Station.	Magnetic declination in degrees and tenths					
		1870 °	1880 °	1890 °	1900 °	1910 °	1920 °
Ala.	Ashland	4.7 E	4.1 E	3.4 E	3.0 E	2.9 E	3.0 E
	Tuscaloosa	6.1 E	5.5 E	4.8 E	4.4 E	4.4 E	4.6 E
Alas.	Sitka	29.0 E	29.3 E	29.5 E	29.7 E	30.2 E	30.4 E
	Kodiak	25.7 E	25.2 E	24.8 E	24.5 E	24.2 E	24.2 E
	Unalaska	20.1 E	19.6 E	19.0 E	18.3 E	17.5 E	17.2 E
	St. Michael	......	24.7 E	23.1 E	22.1 E	21.5 E	21.0 E
Ariz.	Holbrook	13.8 E	13.6 E	13.4 E	13.5 E	14.1 E	14.5 E
	Prescott	13.7 E	13.7 E	13.6 E	13.7 E	14.4 E	14.9 E
Ark.	Augusta	7.1 E	6.5 E	5.9 E	5.5 E	5.6 E	5.8 E
	Danville	8.6 E	8.1 E	7.6 E	7.2 E	7.4 E	7.7 E
Calif.	Bagdad	14.3 E	14.4 E	14.4 E	14.6 E	15.3 E	15.7 E
	Mojave	14.6 E	14.9 E	14.9 E	15.1 E	15.8 E	16.3 E
	Modesto	16.1 E	16.1 E	16.2 E	16.6 E	17.3 E	17.7 E
	Redding	18.1 E	18.2 E	18.3 E	18.7 E	19.4 E	19.7 E
Colo.	Pueblo	13.7 E	13.5 E	13.0 E	12.8 E	13.3 E	13.7 E
	Ouray	15.2 E	15.0 E	14.6 E	14.6 E	15.1 E	15.5 E
Conn.	Hartford	8.7 W	9.4 W	9.8 W	10.4 W	11.2 W	12.1 W
Del.	Dover	4.7 W	5.3 W	5.9 W	6.5 W	7.2 W	8.0 W
D. C.	Washington	2.4 W	3.0 W	3.6 W	4.2 W	4.9 W	5.6 W
Fla.	Miami	3.3 E	2.7 E	2.2 E	1.7 E	1.5 E	1.5 E
	Bartow	3.2 E	2.6 E	2.1 E	1.6 E	1.4 E	1.3 E
	Jacksonville	3.0 E	2.4 E	1.8 E	1.3 E	1.1 E	0.9 E
	Tallahassee	4.2 E	3.6 E	3.0 E	2.5 E	2.4 E	2.4 E
Ga.	Millen	2.7 E	2.1 E	1.5 E	0.9 E	0.7 E	0.5 E
	Americus	4.1 E	3.5 E	2.9 E	2.4 E	2.2 E	2.2 E
Haw.	Honolulu	9.5 E	9.8 E	10.1 E	10.4 E	10.7 E	11.1 E
Idaho.	Pocatello	18.0 E	17.9 E	17.8 E	17.9 E	18.5 E	18.8 E
	Boise	18.8 E	18.8 E	18.6 E	18.8 E	19.5 E	19.8 E
	Pierce	21.2 E	21.1 E	21.2 E	21.4 E	22.0 E	22.2 E
Ill.	Kankakee	5.3 E	4.8 E	4.1 E	3.5 E	3.3 E	3.1 E
	Rushville	7.0 E	6.4 E	5.7 E	5.2 E	5.1 E	5.1 E
Ind.	Indianapolis	3.3 E	2.7 E	2.1 E	1.5 E	1.1 E	0.9 E
Iowa.	Walker	8.2 E	7.5 E	6.8 E	6.2 E	6.2 E	6.2 E
	Sac City	10.2 E	9.6 E	8.8 E	8.4 E	8.6 E	8.6 E
Kans.	Emporia	11.2 E	10.8 E	10.2 E	9.9 E	10.1 E	10.3 E
	Ness City	12.2 E	11.9 E	11.3 E	11.2 E	11.4 E	11.7 E
Ky.	Manchester	1.6 E	1.0 E	0.3 E	0.3 W	0.6 W	0.8 W
	Louisville	3.2 E	2.5 E	1.9 E	1.5 E	1.3 E	1.2 E
	Princeton	5.5 E	4.8 E	4.2 E	3.9 E	3.7 E	3.8 E
La.	Winfield	8.2 E	7.6 E	7.1 E	6.8 E	7.0 E	7.4 E
Me.	Eastport	18.5 W	18.8 W	19.0 W	19.3 W	20.0 W	21.0 W
	Bangor	15.9 W	16.4 W	16.7 W	17.1 W	17.8 W	18.8 W
	Portland	13.1 W	13.6 W	14.1 W	14.5 W	15.3 W	16.3 W
Md.	Baltimore	3.8 W	4.4 W	5.0 W	5.6 W	6.3 W	7.0 W
Mass.	Boston	11.0 W	11.5 W	12.0 W	12.6 W	13.4 W	14.4 W
	Pittsfield	9.3 W	10.0 W	10.4 W	11.0 W	11.8 W	12.7 W
Mich.	Marquette	4.7 E	3.8 E	3.0 E	2.4 E	2.1 E	1.7 E
	Lapeer	0.3 E	0.5 W	1.2 W	1.8 W	2.3 W	2.8 W
	Grand Haven	3.1 E	2.4 E	1.6 E	1.1 E	0.7 E	0.3 E
Minn.	St. Paul	10.9 E	10.3 E	9.5 E	8.9 E	8.8 E	8.7 E
	Marshall	11.0 E	10.5 E	9.8 E	9.3 E	9.4 E	9.4 E
	Hibbing	9.7 E	9.0 E	8.2 E	7.6 E	7.7 E	7.5 E
	Bagley	12.3 E	11.7 E	11.0 E	10.4 E	10.6 E	10.5 E
Miss.	Meridian	6.5 E	5.9 E	5.2 E	4.8 E	4.9 E	5.1 E
	Vicksburg	7.6 E	7.1 E	6.4 E	6.0 E	6.1 E	6.4 E
Mo.	Hermann	8.3 E	7.7 E	7.0 E	6.5 E	6.5 E	6.6 E

MAGNETIC DECLINATION (Continued)

(Selected from tables of the U. S. Coast and Geodetic Survey)

State.	Station.	Magnetic declination in degrees and tenths.					
		1870 °	1880 °	1890 °	1900 °	1910 °	1920 °
Mo.	Sedalia	9.3 E	8.7 E	8.0 E	7.6 E	7.8 E	8.0 E
Mont.	Miles City	17.7 E	17.4 E	16.9 E	16.9 E	17.3 E	17.6 E
	Lewistown	20.1 E	19.9 E	19.6 E	19.6 E	20.1 E	20.4 E
	Ovando	21.2 E	21.1 E	20.9 E	21.1 E	21.6 E	22.0 E
Nebr.	Albion	12.5 E	12.0 E	11.4 E	11.0 E	11.2 E	11.5 E
	Valentine	13.9 E	13.4 E	12.8 E	12.6 E	12.8 E	13.1 E
	Alliance	15.3 E	14.8 E	14.3 E	14.2 E	14.5 E	14.8 E
Nev.	Elko	17.7 E	17.7 E	17.6 E	17.8 E	18.4 E	18.9 E
	Hawthorne	16.8 E	17.0 E	17.0 E	17.3 E	18.0 E	18.4 E
N. H.	Hanover	11.1 W	11.6 W	12.0 W	12.6 W	13.2 W	14.2 W
N. J.	Trenton	6.0 W	6.7 W	7.2 W	7.8 W	8.6 W	9.4 W
N. Mex.	Santa Rosa	12.7 E	12.4 E	12.0 E	11.9 E	12.5 E	12.9 E
	Laguna	13.6 E	13.4 E	13.0 E	13.0 E	13.6 E	14.1 E
N. Y.	Albany	9.2 W	10.0 W	10.3 W	10.9 W	11.6 W	12.5 W
	Elmira	5.4 W	6.3 W	7.0 W	7.5 W	8.2 W	9.0 W
	Buffalo	3.8 W	4.7 W	5.4 W	5.9 W	6.5 W	7.2 W
N. C.	Newbern	1.0 W	1.7 W	2.3 W	2.9 W	3.4 W	4.0 W
	Greensboro	1.0 E	0.3 E	0.3 W	0.8 W	1.3 W	1.8 W
	Asheville	2.0 E	1.3 E	0.7 E	0.2 E	0.2 W	0.5 W
N. D.	Jamestown	13.7 E	13.2 E	12.5 E	12.2 E	12.4 E	12.5 E
	Bismarck	16.1 E	15.6 E	15.0 E	14.7 E	15.0 E	15.2 E
	Dickinson	17.5 E	17.1 E	16.5 E	16.3 E	16.7 E	16.9 E
Ohio	Canton	0.0	0.7 W	1.3 W	1.9 W	2.5 W	3.1 W
	Urbana	2.4 E	1.8 E	1.1 E	0.5 E	0.1 E	0.3 W
Okla.	Okmulgee	9.8 E	9.5 E	9.1 E	8.7 E	8.9 E	9.2 E
	Enid	11.0 E	10.6 E	10.2 E	9.8 E	10.1 E	10.5 E
Ore.	Sumpter	20.0 E	20.2 E	20.2 E	20.4 E	21.1 E	21.4 E
	Detroit	20.1 E	20.3 E	20.5 E	20.8 E	21.6 E	21.9 E
Pa.	Wilkes-Barre	5.3 W	6.0 W	6.6 W	7.2 W	8.0 W	8.8 W
	LockHaven	4.3 W	5.0 W	5.6 W	6.3 W	7.0 W	7.7 W
	Indiana	2.0 W	2.6 W	3.3 W	3.9 W	4.6 W	5.2 W
P. R.	San Juan	......	......	......	1.0 W	2.0 W	3.4 W
R. I.	Newport	10.3 W	10.8 W	11.3 W	11.9 W	12.7 W	13.7 W
S. C.	Marion	0.9 E	0.3 E	0.4 W	1.0 W	1.4 W	1.8 W
	Aiken	2.5 E	1.9 E	1.3 E	0.7 E	0.4 E	0.1 E
S. D.	Huron	12.7 E	12.3 E	11.7 E	11.2 E	11.5 E	11.7 E
	Murdo	14.7 E	14.3 E	13.7 E	13.4 E	13.7 E	13.9 E
	Rapid City	16.3 E	15.8 E	15.3 E	15.1 E	15.4 E	15.7 E
Tenn.	Knoxville	1.8 E	1.1 E	0.5 E	0.0	0.3 W	0.5 W
	Shelbyville	4.9 E	4.3 E	3.7 E	3.2 E	3.0 E	2.9 E
	Huntingdon	6.1 E	5.5 E	4.9 E	4.4 E	4.3 E	4.4 E
Tex.	Houston	8.9 E	8.4 E	7.9 E	7.7 E	8.1 E	8.6 E
	San Antonio	9.5 E	9.2 E	8.7 E	8.7 E	9.2 E	9.7 E
	Pecos	11.0 E	10.8 E	10.4 E	10.3 E	10.8 E	11.3 E
	Wytheville	0.8 E	0.1 E	0.5 W	1.1 W	1.5 W	1.9 W
Utah	Manti	16.8 E	16.7 E	16.4 E	16.5 E	17.1 E	17.5 E
Vt.	Rutland	10.5 W	11.2 W	11.6 W	12.1 W	12.8 W	13.8 W
Va.	Richmond	1.8 W	2.5 W	3.1 W	3.7 W	4.2 W	4.9 W
	Lynchburg	0.7 W	1.4 W	2.0 W	2.6 W	3.1 W	3.7 W
	Stanley	7.8 E	7.1 E	6.3 E	5.8 E	5.6 E	5.4 E
Wash.	Wilson Creek	21.8 E	21.9 E	22.1 E	22.4 E	23.0 E	23.3 E
	Seattle	22.0 E	22.2 E	22.4 E	22.8 E	23.5 E	23.8 E
W. Va.	Sutton	0.4 W	1.1 W	1.8 W	2.4 W	2.9 W	3.4 W
Wis.	Shawano	5.9 E	5.0 E	4.3 E	3.7 E	3.4 E	3.1 E
	Floydada	11.2 E	10.9 E	10.4 E	10.3 E	10.7 E	11.1 E
Wyo.	Douglas	16.0 E	15.8 E	15.3 E	15.2 E	15.7 E	16.0 E
	Green River	17.0 E	16.8 E	16.5 E	16.6 E	17.2 E	17.5 E

ATOMIC ABSORPTION COEFFICIENTS

$$\frac{\mu}{\nu} = \frac{\mu}{\rho} \times \frac{W}{N}$$

The values are multiplied by 10^{23}

A.U.	H 1	Li 3	C 6	N 7	O 8	Al 13	Fe 26	Cu 29	Mo 42	Ag 47	Pb 82	H_2O (H)
.025	..	....	.....	....	.....	.317	.625	.....	......	......	2.60	.....
.100	..	....	.285	....	.....	.724	....	3.3	......	......	......	.....
.125	.04	....	.305	....	.385	.792	3.67	4.8	21.3	......	103.	.478
.150	.05	....	.323	.376	.430	.889	5.38	8.3	31.0	......	53.6	.534
.175	.06	....	.329	.395	.459	1.04	7.55	11.8	44.7	66.5	86.1	.578
.20	.05	....	.343	.409	.482	1.19	9.75	16.4	63.5	107.	157.	.591
.25	.05	....	.370	.446	.546	1.62	17.3	29.0	117.	203.	290.	.650
.30	.04	.197	.400	.518	.641	2.34	28.4	47.2	201.	323.	485.	.730
.35	.04	.215	.433	.580	.763	3.31	43.9	72.9	302.	483.	772.	.840
.40	.05	.238	.475	....	.886	4.56	64.5	106.	422.	686.	1150.	.992
.50	.08	.280	.602	....	1.29	8.44	127.	197.	769.	204.	2070.	1.458
.60	.09	.350	.780	....	1.92	14.0	208.	332.	1277.	348.	......	2.11
.70	.10	.462	1.052	....	2.85	22.1	325.	512.	297.	......	......	3.04
.80	.17	....	1.40	....	4.03	32.4	466.	.....	430.	......	......	4.38
1.00	..	....	2.51	....	.....	61.6	830.	.....	838.	2000.	......	8.01

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS

Radiation traversing a layer of substance is reduced in intensity by a constant fraction μ per centimeter. After penetrating to a depth x the intensity is $I = I_0 e^{-\mu x}$ where I_0 is the intensity at the surface. μ/ρ is the mass absorption coefficient where ρ is the density of the material.

Values of μ/ρ for $\lambda = .005$ Å to $\lambda = 44.6$ Å. Where two values of μ/ρ for one value of λ occur they represent the maximum and minimum values at an absorption discontinuity.

Compiled by S. J. M. Allen

$\lambda = 44.6 - 2.74$ Å

λ, Å	He	C	N	O	Ne	Al	S	Cl	A
44.6	3600	2170	3850	5765	13100	....	....	....	45700
11.88	....	......	......	......	6850	850	....	....	.....
9.87	....	1063	1796	2540	4310	500	1320	1570	1860
8.32	....	656	1109	1585	2750	330	794	962	1160
7.94	....	......	......	......	.....	280 3700	....	....	.....
6.97	....	390	645	976	1727	2800	500	610	748
5.39	....	185	312	476	865	1450	249	310	360
5.17	....	160	273	413	763	1350	221	277	324
5.01	....	......	......	......	.....	....	210 2260	....	.....
4.38	....	......	......	......	.....	....	....	178 1830	.....
4.36	....	97.8	166	258	478	815	1570	1800	202
4.15	....	84.6	144	222	416	720	1350	1476	174
3.93	....	71.0	121	189	356	635	1175	1256	153
3.87	....	......	......	......	.....	....	....	....	148 1460
3.69	....	......	......	......	.....	....	....	....	.....
3.59	....	55.2	96	150	279	500	928	966	1215
3.51	....	.....	......	......	.....	....	....	....	.....
3.38	....	46.0	79.5	117	231	425	795	880	1025
3.35	....	43.0	......	......	.....	417	780	870	1015
3.24	....	......	......	......	.....	....	....	....	.....
3.03	....	35.0	......	84.0	175	323	595	670	760
2.74	....	25.0	......	60.0	135	250	454	520	600

λ, Å	Fe	Ni	Cu	Zn	Kr	Ag	Sn	Xe	Pt	Au
44.6	...	....	....	...	31800	....	...	6740	....	12500
11.88	...	6900	7550	...	......	....	...	....	....	.....
9 87	...	4540	5030	...	......	2700	...	....	2440	.....
8.32	...	3140	3450	...	......	1800	...	....	1560	.....
7.94	...	....	....	...	......	....	...	....	....	.....
6.97	...	2000	2130	...	......	1300	...	....	1190	.....
5.39	...	1250	1290	...	......	845	...	....	1645	.....
5.17	...	1150	1190	...	......	790	...	....	....	.....
5 01	...	....	....	...	......	....	...	....	....	.....
4 38	...	....	....	...	......	....	...	....	....	.....
4.36	610	715	760	910	......	535	640	....	....	.....
4.15	540	630	690	820	......	461	550	....	1290	...
3.93	470	555	610	715	......	408	490	....	....	.
3.87	...	....	....	...	......	....	...	....	....	..
3.69	...	....	....	...	......	354 1410	...	....	....	...
3.59	375	450	495	575	......	1360	...	....	1370	.....
3.51	...	....	....	...	......	1300 1510	...	....	....	....
3 38	320	380	....	495	......	...	...	....	....	....
3.35	312	375	404	480	......	1310	...	....	1120	.....
3.24	...	....	...	...	......	1230 1440	...	....	....	.....
3.03	245	290	315	375	......	1290	...	....	939	.....
2.74	185	239	262	283	......	925	...	....	756	.....

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = 2.50 – .900 Å

λ, Å	H	Li	Be	B	C	N	O	Ne	Na
2.50	.52	4.0	6.1	9.1	17.8	.....	44.5	100	128
2.29	...	....	....	....	15.0	.....	36.4	75.5	.....
1.93	.50	2.10	3.05	4.7	8.75	14.0	21.7	49.0	61.3
1.74	...	....	....	....	.....	.....	.....	.....	.....
1.656	...	....	....	....	.....	.....	.....	.....	.....
1.539	.48	1.10	1.60	2.45	4.52	7.45	11.1	24.0	32.1
1.484	...	....	....	....	.....	.....	.....	.....	.....
1.432	...	....	....	....	.....	.....	.....	.....	.....
1.389	.47	.86	1.25	1.87	3.35	5.50	8.1	17.0	23.4
1.377	...	....	....	....	.....	.....	.....	.....	.....
1.293	...	....	....	....	.....	.....	.....	.....	.....
1.280	...	....	....	....	.....	.....	.....	.....	.....
1.235	.46	.67	.95	1.35	2.42	3.95	5.7	12.4	17.1
1.104	...	....	....	....	.....	.....	.....	.....	.....
1.071	...	....	....	....	.....	.....	.....	.....	.....
1.038	...	....	....	....	.....	.....	.....	.....	.....
1.000	.45	.43	.55	.76	1.36	2.10	3.13	6.5	8.8
.980	...	....	....	....	.....	.....	.....	.....	....
.949	...	....	....	....	1.20	.....	.....	.....	.....
.932	...	....	....	....	.....	.....	.....	.....	.....
.900	...	....	....	....	1.05	.....	.....	.....	.....

λ, Å	Mg	Al	S	Cl	A	Ca	Fe	Ni	Cu
2.50	161	193	355	400	475	620	147	180	197
2.29	.....	150	285	315	355	480	115	137	153
1.93	77.2	93.5	173	198	235	306	71.2	89.5	96.2
1.74	.....	83.0	.....	.....	.....	...	54	.....	.....
							465		
1.656	.....	60.7	110	126	143	195	410	59.2	63.5
1.539	40.8	49.0	91	103	114	163	325	48.0	50.9
1.484	.....	......	.....	.....	.....	...	.....	40.5	.....
								338	
1.432	.....	40.0	75	85	93	130	285	325	42
1.389	31.5	36.8	68.5	76.7	85.7	125	252	275	38.5
1.377	.....	......	.....	.....	.....	...	.....	.....	37.0
									307
1.293	.....	29.8	55.3	60	72	102	212	233	260
1.280	.....	28.8	.....	.....	.....	...	.....	225	252
1.235	21.4	26.3	49.5	55.5	62.5	90	181	208	230
1.104	.....	18.6	38.0	44	50	67	135	155	175
1.071	.....	......	.....	.....	.....	...	.....	.....	.....
1.038	.....	......	.....	.....	.....	...	.....	.....	.....
1.000	11.8	14.12	26.7	29.7	34.5	49	100	121	130
.980	.....	......	.....	.....	.....	...	.....	.....	.....
.949	.....	12.0	22.0	24.5	.....	42	86	99	114
.932	.....	......	.....	.....	.....	...	.....	.....	.....
.900	.....	10.4	.....	.....	.....	...	74.5	86.5	98.5

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = 2.50 – .900 Å

' λ, Å	Zn	Br	Mo	Ag	Sn	I	W	Pt	Au	Pb
2.50	228	...	..	710	850	...	...	596	.....	...
2 29	180	...	..	550	670	...	...	480	.....	...
1 93	110	...	..	405	470	...	300	358	385	428
1.74	.....	...	..	.....	.....	...	...	.....	.....	...
1.656	72.5	...	..	285	.....	...	...	228	.....	...
1.539	58.6	89	..	217	247	290	176	202	213	230
1.484	.....	...	..	.....	.....	...	...	.....	.....	...
1.432	49.3	...	..	192	220	...	130	172	179	202
1.389	45.2	...	..	174	209	...	...	155	166	185
1.377	.....	...	..	.....	.....	...	...	.....	.....	...
1.293	39	...	..	146	176	...	...	132	138	154
1.280	36	...	..	127	146	...	...	.....	.....	...
	287									
1.235	250	...	..	125	140	...	95	115	122	137
1.104	208	...	..	96.5	115	...	...	99	107	120
1.071	.....	...	..	.....	.....	...	...	77 5	.....	...
								198		
1.038	.....	...	..	.....	.....	...	...	.....	76.5	...
									194	
1.000	145	...	52	73.0	86.0	...	...	165	174	75
.980	.....	...	..	.....	.....	...	...	155	168	73
.949	129	...	..	63.0	75.5	...	...	146	156	68
										168
.932	.....	...	..	.....	.....	...	...	136	148	159
								184		
.900	112	150	...	54.2	65.0	...	...	168	134	145
									182	

λ = .892 – .184 Å

λ, Å	H	Li	Be	B	C	N	O	Ne	Na	Mg	Al
.892	....	....	....	....	....	.....	.....	.....	.....	.....	.....
.880	.440	.350	.425	.580	.990	1.50	2.20	4.55	6.10	8.34	9.75
.862	....	....	....	....	....	.....	.....	.....	.....	.....	.....
.850	....	....	....	....	.907	.....	.....	.....	.....	.....	8.85
.814	....	....	....	....	.814	....	....	.....	.....	.....	7.85
.780	....	....	....	....	.750	.....	.....	.....	.....	.....	6.86
.710	.435	.260	.315	.365	.598	.870	1.22	2.50	3.30	4.30	5.22
.680	....	....	....	....	.550	.....	.....	.....	.....	.....	4.52
.631	.435	.225	.255	.305	.467	.610	.900	1 80	2.30	3.0	3.73
.618	....	....	....	....	....	.....	.....	.....	.....	.....	.....
.560	....	....	....	....	.370	.....	.....	.....	.....	.....	2.60
.497	.435	.198	.210	.220	.315	.400	.520	.930	1.18	1.52	1.90
.485	....	....	....	....	.308	.....	.....	.....	.....	.....	1.77
.476	.430	....	....	.215	.304	.....	.485	.....	.....	.....	1.74
.424	....	....	....	....	....	.....	.....	.....	.....	.....	1.23
.417	.390	.180	.185	.198	.256	.310	.372	.580	.750	.940	1.170
.380	....	....	....	....	.230	.....	.....	.....	.....	.....	.950
.331	....	....	....	....	....	.....	.....	.....	.....	.....	.....
.260	.385	.156	.166	.175	.185	.200	.210	.270	.305	.343	.402
.220	....	....	....	....	.178	.....	.....	.....	.....	.....	.300
.200	.375	.151	.160	.165	.175	.180	.183	.210	.225	.250	.270
.184	....	....	....	....	.166	.....	.....	.....	.....	.....	.246

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = .892 – .184 A

λ, Å	S	Cl	A	Ca	Fe	Ni	Cu	Zn	Br	Sr	Mo
.892	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.880	18.2	20.7	24.0	34.8	69.5	82	91.2	103	.....	.....	36.0
.862	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.850	.....	.....	.....	.....	63.5	74	84.5	96.5	.....	.....	.....
.814	.....	.....	.....	.....	57	66	75.7	86	.....	.....	28
.780	.....	.....	.....	.....	50.5	59.5	67.5	77	.....	.....	.....
.710	9.90	11.6	13.0	18.6	38.5	48.1	51.0	59.0	80	106.	19.9
.680	.....	.....	.....	.....	32.7	41	45.3	52.7	.....	.....	.....
.631	6.90	8.40	9.80	13.3	27.0	34	36.2	41.0	56.8	72.5	15.0
.618	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.5
											88.0
.560	.....	.....	.....	.....	18.2	24	25.5	30.7	.....	.....	.....
.497	3.50	4.20	5.0	6.60	13.9	17.9	18.4	21.0	32.0	40.5	50.2
.485	.....	.....	.....	.....	12.4	15.4	16.9	19.5	.....	.....	.....
.476	.....	.....	.....	.....	.....	.....	16.6	.....	.....	.....	42
.424	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.417	2.10	2.47	2.95	3.97	8.45	10.5	11.45	12.3	19.0	24.0	30.0
.380	.....	.....	.....	.....	6.32	7.70	8.42	9.95	.....	.....	22
.331	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.260	.650	.750	.850	1.10	2.28	2.89	3.16	3.58	5.30	6.50	8.20
.220	.....	.....	.....	.....	1.42	1.80	2.00	2.32	.....	.....	.....
.200	.400	.445	.500	.630	1.10	1.45	1.55	1.78	2.4	3.32	4.30
.184	.....	.....	.....	.....	.....	1.24	.....	.....	.....	.....	.....

λ, Å	Ag	Sn	I	Ba	Ta	W	Pt	Au	Pb	Bi	U
.892	.....	.....	.....	.....	.....	.....	165	178	142	....	....
							201				
.880	50	60	.....	.....	.....	.....	195	170	135	....	....
.862	.....	.....	.....	.....	.....	.....	185	163	130	....	....
								193			
.850	46	56	.....	.....	.....	.....	179	186	124	....	....
.814	41	49.5	.....	.....	.....	.....	160	167	111	....	....
									150		
.780	36	44.5	.....	.....	.....	.....	144	150	136	....	....
									166		
.710	27.5	34.0	38.5	42.0	100	104	115	120	136	....	..
.680	23.5	28.4	.....	.....	.....	.....	102	108	120	....	..
.631	19.6	23.0	26.4	31.1	72	75	84.5	87	98	....	..
.618	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	..
.560	13.3	16.2	.....	.....	.....	.....	62	66	75	....	..
.497	10.5	11.8	15.6	17.8	36	38	47	48.5	52.8	....	..
.485	9.8	11.1	.....	.....	.....	.....	.....	.....	.....	....	..
	62.5										
.476	60	.....	.....	.....	.....	.....	42	.....	47.5	....	..
.424	43.5	8.0	.....	.....	.....	.....	.....	.....	.....	....	..
		46.6									
.417	41	45	9.2	10.5	21.5	22.5	27.4	28.4	32.0	....	.
.380	31.2	34	....	...	.....	17.3	21.1	22	26.4	27.8	..
.331	21.7	24.5	....	5.4	.....	.....	.....	.....	18.1	19.5	..
				28.0							
260	11.4	12.8	14.2	16.1	6.7	6.85	8.0	8.3	10.0	11.0	...
.220	7.05	7.80	....	....	.....	4.25	5.25	5.50	5.92	6.4	....
.200	5.48	6.20	7.0	8.0	3.4	3.50	4.25	4.40	4.90	5.1	5.40
.184	4.45	.....	....	....	2.8	.....	3.45	3.60	4.05	4.2	....
					11.8						

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = .178 — .005 A

λ, Å	H	Li	Be	B	C	N	O	Ne	Na	Mg	Al
.178	....	....	....	....	.164	....	....	....	....	....	.235
.175	.360	.144	.150	.155	.163	.166	.169	.185	.195	.205	.228
.158	....	....	....	....	.160	....	....	....	....	....	.208
.155	....	....	....	....	.....	....	....	....	....	....	.....
.146	.340	....	....	....	.155	....	.162	....	.170	.176	.195
.142	.330	....	....	....	.153	....	....	....	....	....	.191
130	.320	.132	....	.149	.152	....	.157	....	.160	.168	.186
.120	....	....	....	....	.150	....	.154	....	....	.163	.172
.113	.310	....	....	....	.147	....	.153	....	.155	.160	.166
.107	....	....	....	....	.....	....	....	....	....	....	.....
.098	.280	.125	....	.138	.142	....	.144	....	.150	.152	.156
.080	.255	....	....	....	.137	....	....	....	....	....	.146
.072	.250	.118	....	.132	.136	....	.137	....	.139	.140	.143
.064	.245	.110	....	.126	.130	....	.130	....	.130	.130	.130
.050	....	....	....	....	.....	.120	....	....	....	....	.115
.040	.205	....	....	....	.110	....	....	....	....	....	.106
.030	.180	....	....	....	.095	....	....	....	....	....	.093
.024	.165	....	....	....	.080	....	....	....	....	....	.079
.010	.117	....	....	....	.059	....	....	....	....	....	.058
.005	.078	....	....	....	.0385	....	....	....	....	....	.0380

λ, Å	S	Cl	A	Ca	Fe	Ni	Cu	Zn	Br	Sr	Mo
.178	....	....	....	....	....	.....	1.15	.....	....	....	.....
.175	.335	.341	.400	.460	.800	1.05	1.12	1.26	1.90	2.24	2.95
.158	....	....	....	....	.640	.815	.862	.990	....	....	.....
.155	....	....	....	....	....	.....	......	.....	....	....	.....
.146	.249	.280	....	.345	.520	.....	.680	.....	....	....	.....
.142	....	....	....	....	.515	.630	.670	.780	....	....	1.55
.130	.220	.230	....	.290	.424	.....	.551	.....	....	....	.....
.120	.200	....	....	....	.368	.430	.455	.537	....	....	.....
.113	.189	.195	....	.230	.337	.....	.422	.....	....	....	.....
.107	....	....	....	....	....	.....	......	.....	....	....	.....
.098	.166	.176	....	.200	.265	.....	.325	.....	....	....	.790
.080	....	.164	....	....	.235	.264	.268	.308	....	....	.....
.072	.150	.158	....	.180	.202	.....	.232	.....	....	....	.....
.064	.139	.142	....	.155	.178	.....	.198	.....	....	....	.413
.050	....	....	....	....	.140	.....	.155	.....	....	....	.....
.040	....	....	....	....	.118	.....	.126	.....	....	....	.....
.030	....	....	....	....	.095	.....	.100	.....	....	....	.....
024	....	....	....	....	.080	.....	.081	.....	....	....	.....
.010	....	....	....	....	.058	.....	.057	.....	....	....	.....
.005	....	....	....	....	....	.....	.0380	.....	....	....	.....

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

λ = .178 – .005 A

λ, Å	Ag	Sn	I	Ba	Ta	W	Pt	Au	Pb	U
.178	.....	......	....	....	.....	2.7 11.3	3.16	3.30	3.55	.....
.175	3.96	4.50	5.10	5.70	10.0	10.5	2.97	3.13	3.48	3.95
.158	3.00	3.40	....	....	.....	8.6	2.45 9.40	2.43	2.60	.....
.155	.....	......	....	....	.....	.....	....	2.30 8.80	......	.....
.146	2.48	2.66	....	....	6.75	.....	7.60	7.85	2.35	2.70
.142	2.31	2.64	....	....	.....	6.75	7.20	7.33	2.10 7.75	.....
.130	1.97	2.12	....	....	5.10	.....	6.30	6.40	6.55	2.20
.120	1.61	1.77	....	2.20	.....	4.60	4.92	4.98	5.20	1.90
.113	1.47	1.60	....	....	3.80	.....	4.40	4.50	4.75	.....
.107	.....	......	....	....	.....	.....	....	....	......	1.62 4.65
.098	1.05	1.17	....	....	2.80	.....	3.15	3.21	3.50	3.90
.080	.73	.79	....	....	.....	2.30	2.40	2.42	2.50	2.70
.072	.584	.614	....	....	1.75	.....	2.00	2.05	2.10	2.25
.064	.465	.490	....	....	1.35	.....	1.52	1.55	1.64	1.80
.050	.....	.320	....	....	.....	.....	.86	.88	1.00	.....
.040	.....	.21	....	....	.....	.....	....	....	.62	.....
.030	.....	.13	....	....	.....	.....	....	....	.38	.....
.024	.....	.10	....	....	.....	.....	....	....	.21	.....
.010	.....	.060	....	....	.....	.....	....	....	.071	.082
.005	.....	.0385	....	....	.....	.....	....	....	.0425	.044

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Equation on next page)

Values of μ/ρ for E = 2.00 Mev to E = 20.0 Mev.

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	Atomic number	E 2.00	2.25	2.50	2.75	3.00	3.50	4.00	4.50	5.00	5.50
H	1	.0876	.0819	.0770	.0727	.0691	.0629	.0578	.0537	.0502	.0471
Li	3	.0382	.0358	.0338	.0319	.0304	.0277	.0256	.0238	.0225	.0212
Be	4	.0393	.0368	.0347	.0328	.0312	.0286	.0265	.0247	.0233	.0221
B	5	.0409	.0385	.0363	.0344	.0327	.0300	.0278	.0260	.0246	.0233
C	6	.0443	.0417	.0393	.0373	.0355	.0327	.0304	.0284	.0269	.0256
N	7	.0445	.0417	.0394	.0374	.0356	.0329	.0306	.0288	.0272	.0260
O	8	.0445	.0418	.0395	.0376	.0359	.0331	.0309	.0291	.0275	.0264
F	9	.0422	.0396	.0376	.0357	.0341	.0315	.0295	.0279	.0264	.0254
Na	11	.0427	.0402	.0381	.0363	.0348	.0322	.0302	.0286	.0274	.0263
Mg	12	.0441	.0416	.0394	.0376	.0360	.0335	.0314	.0298	.0285	.0275
Al	13	.0431	.0407	.0386	.0368	.0353	.0329	.0310	.0294	.0282	.0272
Si	14	.0447	.0422	.0400	.0383	.0367	.0342	.0322	.0307	.0295	.0285
P	15	.0435	.0410	.0390	.0372	.0358	.0334	.0316	.0301	.0290	.0281
S	16	.0448	.0423	.0402	.0385	.0370	.0346	.0327	.0313	.0302	.0293
Cl	17	.0431	.0407	.0387	.0371	.0356	.0335	.0317	.0304	.0293	.0284
K	19	.0438	.0414	.0395	.0378	.0365	.0343	.0326	.0313	.0303	.0295
Ca	20	.0451	.0426	.0406	.0390	.0376	.0354	.0337	.0324	.0315	.0308
Sc	21	.0420	.0399	.0380	.0365	.0352	.0332	.0317	.0305	.0297	.0290
Ti	22	.0416	.0394	.0375	.0361	.0348	.0330	.0315	.0304	.0296	.0290
V	23	.0410	.0389	.0371	.0356	.0344	.0326	.0312	.0302	.0294	.0288
Cr	24	.0419	.0398	.0380	.0366	.0354	.0335	.0322	.0311	.0303	.0298
Mn	25	.0414	.0393	.0376	.0363	.0350	.0334	.0319	.0310	.0302	.0297
Fe	26	.0424	.0403	.0385	.0371	.0360	.0342	.0329	.0319	.0312	.0308
Co	27	.0418	.0397	.0381	.0367	.0356	.0339	.0326	.0316	.0311	.0306
Ni	28	.0437	.0414	.0397	.0384	.0372	.0355	.0343	.0333	.0326	.0322
Cu	29	.0418	.0397	.0381	.0368	.0357	.0341	.0330	.0321	.0316	.0311
Zn	30	.0421	.0401	.0384	.0371	.0360	.0345	.0334	.0326	.0321	.0318
Ge	32	.0406	.0386	.0372	.0358	.0348	.0336	.0325	.0318	.0314	.0311
As	33	.0406	.0387	.0372	.0361	.0350	.0336	.0328	.0321	.0317	.0315
Se	34	.0398	.0379	.0365	.0354	.0344	.0331	.0322	.0315	.0313	.0311
Br	35	.0405	.0387	.0372	.0361	.0352	.0340	.0329	.0323	.0321	.0319
Rb	37	.0403	.0384	.0370	.0359	.0350	.0339	.0331	.0325	.0323	.0323
Sr	38	.0403	.0386	.0372	.0361	.0352	.0341	.0334	.0328	.0327	.0326
Zr	40	.0410	.0392	.0378	.0368	.0360	.0349	.0341	.0338	.0337	.0336
Cb	41	.0414	.0397	.0383	.0372	.0363	.0354	.0346	.0342	.0341	.0343
Mo	42	.0411	.0394	.0381	.0370	.0362	.0353	.0346	.0342	.0341	.0343
Pd	46	.0409	.0392	.0380	.0370	.0364	.0353	.0348	.0346	.0346	.0347
Ag	47	.0414	.0398	.0385	.0376	.0368	.0359	.0355	.0352	.0352	.0355
Cd	48	.0407	.0391	.0379	.0369	.0363	.0355	.0350	.0348	.0348	.0351
Sn	50	.0404	.0389	.0376	.0367	.0361	.0353	.0350	.0348	.0350	.0352
Sb	51	.0403	.0387	.0376	.0367	.0360	.0354	.0350	.0348	.0351	.0353
Te	52	.0394	.0379	.0366	.0359	.0352	.0347	.0343	.0342	.0343	.0347
I	53	.0405	.0389	.0377	.0369	.0362	.0357	.0354	.0354	.0355	.0358
Cs	55	.0404	.0388	.0377	.0369	.0363	.0358	.0355	.0355	.0357	.0362
Ba	56	.0399	.0384	.0374	.0366	.0360	.0355	.0353	.0353	.0355	.0360
La	57	.0404	.0388	.0378	.0369	.0363	.0358	.0357	.0358	.0361	.0365
Hf	72	.0424	.0409	.0399	.0393	.0387	.0387	.0388	.0392	.0398	.0407
Ta	73	.0427	.0411	.0401	.0395	.0391	.0390	.0391	.0396	.0402	.0411
W	74	.0428	.0412	.0402	.0395	.0392	.0391	.0394	.0396	.0405	.0412
Os	76	.0429	.0414	.0403	.0397	.0393	.0394	.0395	.0401	.0407	.0416
Pt	78	.0434	.0419	.0409	.0402	.0399	.0399	.0401	.0406	.0413	.0424
Au	79	.0438	.0422	.0412	.0406	.0402	.0402	.0405	.0409	.0418	.0427
Hg	80	.0439	.0424	.0413	.0407	.0402	.0403	.0406	.0411	.0420	.0430
Pb	82	.0441	.0425	.0414	.0408	.0404	.0405	.0409	.0415	.0422	.0432
Bi	83	.0445	.0428	.0418	.0412	.0409	.0409	.0413	.0419	.0427	.0438
U	92	.0459	.0442	.0431	.0425	.0422	.0424	.0428	.0435	.0446	.0457

MASS ABSORPTION COEFFICIENTS FOR X AND γ RAYS (Continued)

$$\mu = \gamma + \sigma + \chi$$

where γ is the photoelectric absorption coefficient; σ is the Compton scattering coefficient calculated; and χ is the pair-formation coefficient.

	Atomic number	E 6.00	7.00	8.00	9.00	10.00	12.0	14.0	16.0	18.0	20.0
H	1	.0445	.0402	.0369	.0341	.0318	.0281	.0253	.0232	.0215	.0201
Li	3	.0202	.0183	.0170	.0158	.0150	.0135	.0124	.0117	.0109	.0105
Be	4	.0210	.0193	.0179	.0168	.0159	.0145	.0135	.0127	.0121	.0116
B	5	.0223	.0205	.0192	.0180	.0172	.0158	.0148	.0141	.0134	.0130
C	6	.0244	.0227	.0212	.0202	.0192	.0178	.0169	.0161	.0155	.0150
N	7	.0248	.0231	.0218	.0208	.0199	.0185	.0177	.0169	.0165	.0160
O	8	.0253	.0236	.0223	.0213	.0206	.0193	.0185	.0178	.0174	.0170
F	9	.0244	.0229	.0217	.0208	.0201	.0190	.0182	.0178	.0174	.0171
Na	11	.0254	.0240	.0230	.0221	.0215	.0205	.0199	.0196	.0193	.0191
Mg	12	.0266	.0252	.0242	.0234	.0228	.0219	.0214	.0211	.0208	.0207
Al	13	.0264	.0251	.0241	.0234	.0229	.0221	.0217	.0214	.0212	.0212
Si	14	.0277	.0265	.0255	.0248	.0243	.0237	.0232	.0231	.0230	.0230
P	15	.0272	.0261	.0253	.0247	.0243	.0237	.0234	.0233	.0232	.0232
S	16	.0285	.0274	.0266	.0260	.0256	.0251	.0248	.0248	.0249	.0249
Cl	17	.0277	.0268	.0261	.0256	.0252	.0249	.0247	.0247	.0248	.0249
K	19	.0289	.0281	.0274	.0271	.0268	.0266	.0266	.0267	.0269	.0272
Ca	20	.0301	.0293	.0287	.0283	.0282	.0281	.0281	.0283	.0286	.0289
Sc	21	.0285	.0278	.0273	.0270	.0269	.0269	.0269	.0273	.0275	.0279
Ti	22	.0285	.0278	.0275	.0272	.0271	.0272	.0274	.0276	.0280	.0284
V	23	.0283	.0278	.0275	.0273	.0273	.0274	.0276	.0280	.0284	.0288
Cr	24	.0293	.0289	.0285	.0284	.0285	.0287	.0289	.0295	.0299	.0304
Mn	25	.0294	.0288	.0286	.0286	.0287	.0289	.0293	0298	.0303	.0309
Fe	26	.0303	.0300	.0298	.0298	.0299	.0303	.0307	.0314	.0319	.0325
Co	27	.0303	.0300	.0298	.0299	.0300	.0305	.0310	.0316	.0322	.0328
Ni	28	.0319	.0316	.0316	.0317	.0319	.0324	.0330	.0338	.0344	.0352
Cu	29	.0309	.0307	.0307	.0308	.0310	.0316	.0323	.0331	.0338	.0345
Zn	30	.0314	.0313	.0314	.0315	.0318	.0325	.0333	.0341	.0349	.0357
Ge	32	.0310	.0309	.0311	.0313	.0317	.0325	.0334	.0343	.0351	.0360
As	33	.0313	.0315	.0315	.0319	.0322	.0332	.0341	.0350	.0360	.0368
Se	34	.0310	.0312	.0313	.0317	.0321	.0331	.0340	.0350	.0360	.0368
Br	35	.0319	.0321	.0324	.0328	.0333	.0343	.0353	.0364	.0373	.0384
Rb	37	.0322	.0326	.0329	.0335	.0340	.0351	.0363	.0375	.0385	.0397
Sr	38	.0326	.0330	.0334	.0341	.0346	.0358	.0371	.0383	.0395	.0406
Zr	40	.0337	.0342	.0348	.0354	.0362	.0376	.0389	.0403	.0416	.0428
Cb	41	.0343	.0348	.0355	.0362	.0370	.0384	.0399	.0414	.0426	.0439
Mo	42	.0345	.0350	.0357	.0364	.0372	.0387	.0403	.0418	.0431	.0445
Pd	46	.0349	.0357	.0363	.0370	.0378	.0393	.0405	.0418	.0429	.0439
Ag	47	.0356	.0364	.0372	.0380	.0387	.0402	.0416	.0429	.0440	.0450
Cd	48	.0353	.0360	.0369	.0378	.0384	.0400	.0414	.0427	.0438	.0449
Sn	50	.0356	.0363	.0372	.0382	.0390	.0406	.0420	.0434	.0446	.0457
Sb	51	.0357	.0366	.0374	.0384	.0393	.0408	.0424	.0438	.0450	.0460
Te	52	.0350	.0360	.0368	.0378	.0387	.0403	.0417	.0432	.0443	.0454
I	53	.0362	.0373	.0383	.0391	.0401	.0418	.0434	.0448	.0461	.0472
Cs	55	.0366	.0376	.0387	.0398	.0408	.0426	.0442	.0458	.0470	.0481
Ba	56	.0364	.0375	.0385	.0397	.0406	.0424	.0441	.0456	.0470	.0481
La	57	.0369	.0382	.0392	.0404	.0415	.0432	.0449	.0466	.0478	.0491
Hf	72	.0415	.0433	.0448	.0464	.0479	.0501	.0523	.0543	.0559	.0573
Ta	73	.0419	.0437	.0454	.0470	.0484	.0506	.0529	.0549	.0566	.0580
W	74	.0420	.0439	.0456	.0472	.0488	.0510	.0533	.0553	.0569	.0584
Os	76	.0425	.0443	.0461	.0478	.0494	.0516	.0540	.0560	.0577	.0592
Pt	78	.0432	.0451	.0470	.0487	.0504	.0526	.0550	.0571	.0589	.0603
Au	79	.0437	.0457	.0475	.0493	.0509	.0533	.0557	.0578	.0595	.0610
Hg	80	.0439	.0459	.0478	.0495	.0511	.0535	.0559	.0581	.0598	.0613
Pb	82	.0442	.0463	.0482	.0500	.0518	.0540	.0566	.0588	.0604	.0619
Bi	83	.0447	.0469	.0488	.0508	.0523	.0547	.0572	.0595	.0611	.0626
U	92	.0468	.0491	.0513	.0533	.0552	.0574	.0600	.0624	.0642	.0657

K AND L X-RAY ABSORPTION EDGES

The wavelengths in Angstroms for the K absorption edge of elements having atomic numbers 3 to 11 and 83 to 100 were calculated from critical X-ray absorption energies listed in the Review of Scientific Instruments, **23,** 523–528. (1952.)

All wavelengths for the L absorption edges were calculated from absorption energies given in the above reference.

Values for the M, N, and O absorption edges are also listed in the above reference. The wavelengths in Angstroms for the K absorption edge of the elements having atomic numbers 12 to 82 are reproduced by permission from Structure of Metals, Barrett, 2nd edition, McGraw-Hill Book Company, Inc. (1952.)

ABSORPTION EDGES—ANGSTROMS

Atomic Number	Element	K	LI	LII	LIII
3	Li	226.62			
4	Be	110.68			
5	B	66.289			
6	C	43.648			
7	N	30.990			
8	O	23.301			
9	F	17.913			
10	Ne	14.183			
11	Na	11.478			
12	Mg	9.5117	197.39	247.92	
13	Al	7.9511	142.48	172.16	
14	Si	6.7446	105.05	126.48	
15	P	5.7866	81.02	96.843	
16	S	5.0182	64.228	76.049	76.519
17	Cl	4.3969	52.084	61.366	61.672
18	A	3.87068	43.192	50.390	50.803
19	K	3.43645	36.352	42.020	42.452
20	Ca	3.07016	31.068	35.417	35.827
21	Sc	2.7572	26.831	30.161	30.457
22	Ti	2.497_{30}	23.389	26.831	27.184
23	Va	2.269_{02}	20.523	23.702	24.0699
24	Cr	2.070_{12}	18.256	21.226	21.5958
25	Mn	1.896_{36}	16.268	18.896	19.2484
26	Fe	1.743_{34}	14.601	17.169	17.4838
27	Co	1.608_{11}	13.343	15.534	15.8314
28	Ni	1.488_{02}	12.267	14.135	14.4476
29	Cu	1.380_{43}	11.269	12.994	13.2578
30	Zn	1.283_{3}	10.330	11.8395	12.1055
31	Ga	1.195_{67}	9.535	10.6130	10.8546
32	Ge	1.116_{52}	8.729	9.9646	10.2277
33	As	1.044_{97}	8.107	9.1281	9.3767
34	Se	0.979_{78}	7.467	8.4212	8.6624
35	Br	0.91994	6.925	7.7523	7.9871
36	Kr	0.86546	6.456	7.1653	7.4227
37	Rb	0.81549	6.006	6.6538	6.8752
38	Sr	0.76969	5.604	6.1856	6.3996
39	Y	0.72762	5.19312	5.70981	5.91412
40	Zr	0.68877	4.89380	5.37088	5.57374
41	Nb	0.65291	4.59111	5.02472	5.22596
42	Mo	0.61977	4.32066	4.71330	4.90930
43	Tc	0.58888	4.06426	4.42714	4.62537
44	Ru	0.560_{47}	3.84133	4.17654	4.36632
45	Rh	0.533_{78}	3.64159	3.94902	4.13889
46	Pd	0.509_{15}	3.42999	3.71360	3.89688
47	Ag	0.4858_{2}	3.23824	3.49478	3.67288
48	Cd	0.46408	3.08434	3.32243	3.50070
49	In	0.44397	2.93327	3.15500	3.32154
50	Sn	0.42468	2.78875	2.99492	3.16952

K AND L X-RAY ABSORPTION EDGES (Continued)

Atomic Number	Element	K	LI	LII	LIII
51	Sb	0.40663	2.63296	2.82304	2.99637
52	Te	0.38972	2.50272	2.68253	2.85162
53	I	0.37379	2.38982	2.55324	2.71901
54	Xe	0.35849	2.27449	2.43058	2.59330
55	Cs	0.34473	2.17245	2.31268	2.47227
56	Ba	0.33137	2.08336	2.20216	2.36114
57	La	0.31842	1.97892	2.10030	2.25792
58	Ce	0.30647	1.89078	2.00940	2.16410
59	Pr	0.29517	1.81307	1.92305	2.07707
60	Nd	0.28451	1.73759	1.84244	1.99452
61	Pm	0.27425	1.66837	1.76581	1.91888
62	Sm	0.26462	1.60113	1.69436	1.84464
63	Eu	0.25552	1.53815	1.62591	1.77491
64	Gd	0.24680	1.47870	1.56081	1.70955
65	Tb	0.23840	1.42270	1.50108	1.64840
66	Dy	0.23046	1.36926	1.44357	1.59025
67	Ho	0.22290	1.31942	1.38999	1.53529
68	Er	0.21565	1.27086	1.33721	1.48242
69	Tm	0.2089	1.22708	1.28856	1.43140
70	Yb	0.20223	1.18136	1.24146	1.38518
71	Lu	0.19584	1.14007	1.19745	1.34039
72	Hf	0.18981	1.09864	1.15311	1.29570
73	Ta	0.18393	1.06084	1.11264	1.25427
74	W	0.17837	1.02497	1.07436	1.21529
75	Re	0.17311	0.99009	1.03645	1.17720
76	Os	0.16780	0.95574	1.00129	1.14143
77	Ir	0.16286	0.92425	0.96700	1.10599
78	Pt	0.15817	0.89405	0.93484	1.07306
79	Au	0.15344	0.86378	0.90277	1.04028
80	Hg	0.14923	0.83531	0.87790	1.00944
81	Tl	0.14470	0.80787	0.84355	0.97968
82	Pb	0.14077	0.78153	0.81552	0.95112
83	Bi	0.13691	0.75649	0.78910	0.92459
84	Po	0.13306	0.73219	0.76377	0.89761
85	At	0.12949	0.70915	0.73873	0.87234
86	Rn	0.12591	0.68675	0.71529	0.84845
87	Fr	0.12261	0.66537	0.69290	0.82529
88	Ra	0.11931	0.64461	0.67114	0.80284
89	Ac	0.11618	0.62479	0.65002	0.78158
90	Th	0.11290	0.60610	0.63010	0.76151
91	Pa	0.11028	0.58748	0.61064	0.74138
92	U	0.10775	0.56974	0.59186	0.72225
93	Np	0.10487	0.55314	0.57415	0.70391
94	Pu	0.10228	0.53662	0.55712	0.68637
95	Am	0.09972	0.52084	0.54036	0.66933
96	Cm	0.09674	0.50595	0.52458	0.65276
97	Bk	0.09506	0.49131	0.50928	0.63667
98	Cf	0.09278	0.47713	0.49445	0.62135
99		0.09068	0.46357	0.48009	0.60645
100		0.08861	0.45059	0.46654	0.59225

CRITICAL X-RAY ABSORPTION ENERGIES IN KEV

Compiled by J. M. Cork

For values of energies not listed see The Review of Scientific Instruments, Volume 23, No. 10, page 523, 1952)

Z	Element	K	L_1	L_2	L_3	M_1	N_1	O_1
3	Lithium	(0.0547)						
4	Beryllium	*(0.112)						
5	Boron	*(0.187)						
6	Carbon	(0.284)						
7	Nitrogen	(0.400)						
8	Oxygen	(0.532)						
9	Fluorine	*(0.692)						
10	Neon	*(0.874)						
11	Sodium	*(1.08)						
12	Magnesium	1.30	(0.0628)	0.0502				
13	Aluminum	1.559	(0.0870)	0.0720				
14	Silicon	1.838	*(0.118)	0.0977				
15	Phosphorus	2.142	*(0.153)	0.128				
16	Sulfur	2.469	*(0.193)	0.163	0.162			
17	Chlorine	2.822	*(0.238)	0.202	0.201	(0.0297)		
18	Argon	3.200	*(0.287)	*0.246	*0.244	*(0.0350)		
19	Potassium	3.606	*(0.341)	0.295	0.292	*(0.0408)		
20	Calcium	4.038	*(0.399)	0.350	0.346	*(0.0471)		
21	Scandium	4.496	*(0.462)	0.411	0.407	*(0 0538)		
22	Titanium	4.966	*(0.530)	0.462	0.456	*(0.0605)		
23	Vanadium	5.467	*(0.604)	0.523	0.515	*(0.0681)		
24	Chromium	5.988	*(0.679)	0.584	0.574	*(0.0762)		
25	Manganese	6.542	*(0.762)	0.656	0.644	*(0.0847)		
26	Iron	7.113	(0.849)	0.722	0.709	0.0937		
27	Cobalt	7.713	*0.929	0.798	0.783	0.103		
28	Nickel	8.337	1.02	0.877	0.858	0.111		
29	Copper	8.982	1.10	0.954	0.935	0.121		
30	Zinc	9.662	1.20	1.05	1.02	0.137		
31	Gallium	10.39	*1.30	1.17	1.14	0.182		
32	Germanium	11.10	*1.42	1.24	1.21	0.175		
33	Arsenic	11.87	1.529	1.358	1.32	0.202		
34	Selenium	12.65	*1.66	1.472	1.431	0.227		
35	Bromine	13.48	*1.79	1.599	1.552	0.259		
36	Krypton	*14.32	*1.92	*1.729	*1.674	*0.289		
37	Rubidium	15.197	2.064	1.863	1.803	*0.323		
38	Strontium	16.101	2.212	2.004	1.937	0.356	0.0339	
39	Yttrium	17.053	2.387	2.171	2.096	0.411	0.0638	
40	Zirconium	17.998	2.533	2.308	2.224	0.432	0.0516	
41	Niobium	18.986	2.700	2.467	2.372	0.471	0.0584	
42	Molybdenum	20.003	2.869	2.630	2.525	0.509	0.0692	
43	Technetium	*21.050	*3.045	*2.796	*2 680	*0.546	*0.0718	
44	Ruthenium	22.117	3.227	2.968	2.839	0.584	0.0747	
45	Rhodium	23.210	3.404	3.139	2.995	0.619	0.0733	
46	Palladium	24.356	3.614	3.338	3.181	0.677	0.0937	
47	Silver	25.535	3.828	3.547	3.375	0.743	0.118	
48	Cadmium	26.712	4.019	3.731	3.541	0.775	0.111	
49	Indium	27.929	4.226	3.929	3.732	0.823	0.118	
50	Tin	29.182	4 445	4.139	3.911	0.868	0.119	
51	Antimony	30.497	4.708	4.391	4.137	0.950	0.159	
52	Tellurium	31.817	4.953	4.621	4.347	1.01	0.175	
53	Iodine	33.164	5.187	4.855	4.559	1.07	0.187	
54	Xenon	*34.551	*5.448	*5.103	*4.783	*1.14	*0.208	
55	Cesium	35.974	5.706	5.360	5.014	1.22	0.231	0.0258
56	Barium	37 432	5.995	5.629	5.250	1.30	0.255	0.0475
57	Lanthanum	38.923	6.264	5.902	5 490	1.371	0.280	0.0407
58	Cerium	40.43	6.556	6 169	5.728	1.439	0.295	0.0434
59	Praseodymium	41.99	6.837	6.446	5.968	1.514	0.310	0.0421
60	Neodymium	43.57	7.134	6.728	6.215	1.583	0.323	0.0421
61	Promethium	*45.19	*7.431	*7.022	*6.462	*1.654	*0.336	*0.0414
62	Samarium	46.85	7.742	7.316	6.720	1.727	0.349	0.0407

CRITICAL X-RAY ABSORPTION ENERGIES IN KEV
(Continued)

Z	Element	K	L_1	L_2	L_3	M_1	N_1	O_1
63	Europium	48.51	8.059	7.624	6.984	1.808	0.370	0.0394
64	Gadolinium	50.23	8.383	7.942	7.251	1.888	0.388	0.0570
65	Terbium	52.00	8.713	8.258	7.520	1.970	0.399	0.0475
66	Dysprosium	53.77	9.053	8.587	7.795	2.036	0.422	0.0421
67	Holmium	55.61	9.395	8.918	8.074	2.130	0.433	*0.0480
68	Erbium	57.47	9.754	9.270	8.362	2.221	0.451	0.0543
69	Thulium	*59.38	*10.12	*9.622	*8.655	*2.310	*0.471	*0.0640
70	Ytterbium	61.31	10.49	9.985	8.949	2.402	0.491	0.0747
71	Lutetium	63.32	10.87	10.35	9.248	2.493	0.502	0.0584
72	Hafnium	65.37	11.28	10.75	9.567	2.608	0.544	0.0760
73	Tantalum	67.46	11.68	11.14	9.883	2.713	0.572	0.0747
74	Tungsten (Wolfram)	69.51	12.09	11.54	10.20	2.814	0.588	0.0733
75	Rhenium	*71.67	*12.52	*11.96	*10.53	*2.931	*0.619	*0.0784
76	Osmium	*73.87	*12.97	*12.38	*10.86	*3.045	*0.650	*0.0841
77	Iridium	76.11	13.41	12.82	11.21	3.166	0.683	0.0896
78	Platinum	78.35	13.865	13.26	11.55	3.285	0.710	0.0869
79	Gold	80.67	14.351	13.731	11.92	3.424	0.758	0.106
80	Mercury	*83.08	*14.838	*14.205	*12.278	*3.561	0.799	*0.116
81	Thallium	85.52	15.344	14.695	12.65	3.701	0.842	0.126
82	Lead	87.95	15.861	15.200	13.03	3.852	0.893	0.148
83	Bismuth	90.54	16.386	15.709	13.42	4.000	0.938	0.157
84	Polonium	*93.16	*16.925	*16.233	*13.81	*4.153	*0.986	*0.171
85	Astatine	*95.73	*17.481	*16.777	*14.21	4.314	*1.036	*0.185
86	Radon	*98.45	*18.054	*17.331	*14.61	*4.477	*1.090	*0.200
87	Francium	*101.1	*18.628	*17.893	*15.02	*4.644	*1.143	*0.215
88	Radium	*103.9	*19.228	*18.473	*15.44	*4.814	*1.199	*0.232
89	Actinium	*106.7	*19.829	*19.071	*15.86	*4.991	*1.254	*0.249
90	Thorium	109.8	20.452	19.673	16.278	5.163	1.306	0.266
91	Protactinium	*112.4	*21.096	*20.295	*16.720	*5.355	*1.374	*0.294
92	Uranium	115.0	21.757	20.944	17.163	5.546	1.439	0.322
93	Neptunium	†118.2	†22.411	†21.585	†17.606	†5.736	†1.498	
94	Plutonium	†121.2	†23.117	†22.250	†18.062	†5.934	†1.562	
95	Americium	†124.3	†23.795	†22.935	†18.524	†6.136	†1.631	
96	Curium	†127.2	†24.502	†23.629	†18.992	†6.340	†1.698	
97	Berkelium	†131.3	†25.231	†24.344	†19.466	†6.554	†1.769	
98	Californium	†133.6	†26.010	†25.070	†19.954	†6.770	†1.839	

* Computed by interpolation.
† Computed by extrapolation.

X-RAY SPECTRA

Compiled by J. M. Cork

EMISSION WAVE-LENGTHS IN THE K AND L SERIES, $\lambda \times 10^8$ cm.

For calcite d = 3.02904×10^{-8} cm.

At. No.	Element	K Series				L Series								
		α_2	α_1	β_1	β_2	l	α_2	α_1	η	β_1	β_4	β_3	β_2	γ_1
11	Sodium	11.885		11.594										
12	Magnesium	9.869		9.539										
13	Aluminum	8.320		7.965										
14	Silicon	7.111		6.7545										
15	Phosphorus	6.142		5.7921										
16	Sulphur	5.3637	5.3613	5.0211										
17	Chlorine	4.7212	4.7182	4.3942										
18	Argon	......	......	....										
19	Potassium	3.7371	3.7337	3.4468										
20	Calcium	3.3549	3.3517	3.0834										
21	Scandium	3.0284	3.0250	2.7739										
22	Titanium	2.7468	2.7432	2.5090										
23	Vanadium	2.5021	2.4984	2.2797	....	......	24.3		......					
24	Chromium	2.2889	2.2850	2.0806	....	......	21.52		......	21.19				
25	Manganese	2.1015	2.0975	1.9062	....	......	19.39		......	19.04				
26	Iron	1.9360	1.9321	1.7530	....	20.12	17.58		19.65	17.22	15.61			
27	Cobalt	1.7892	1.7853	1.6174	....	18.20	15.94		17.77	15.62	.....			
28	Nickel	1.6584	1.6545	1.4970	1.4856	16.55	14.53		16.17	14.24	13.14			
29	Copper	1.5412	1.5374	1.3894	1.3782	15.19	13.306		14.83	13.03	12.10			
30	Zinc	1.4360	1.4322	1.2926	1.2811	13.95	12.23		13.61	11.95	11.16			
31	Gallium	1.3409	1.3372	1.2052	1.1938	12.89	11.27		12.56	11.01	.....			
32	Germanium	1.2552	1.2513	1.1267	1.1146	11.922	10.415		11.587	10.153				

X-RAY SPECTRA (Continued)

EMISSION WAVE-LENGTHS IN THE K AND L SERIES, λ × 10^8 cm.

At. No.	Element	K Series				L Series								
		α_2	α_1	β_1	β_2	1	α_2	α_1	η	β_1	β_4	β_3	β_2	γ_1
33	Arsenic	1.1774	1.1734	1.0551	1.0428	11.048	9.652		10.711	......				
34	Selenium	1.1065	1.1025	.99013	.97791	10.272	8.972		9.939	8.718				
35	Bromine	1.0417	1.0376	.93087	.91853	9.564	8.358		9.235	8.109				
37	Rubidium	.9278	.9236	.82696	.81476	....	....		....	......	6.801	6.769		
38	Strontium	.8776	8734	.78130	.76921	7.822	6.849		7.506	6.610	6.392	6.358		
39	Yttrium	.8313	.8271	.73919	.72713	....	6.436		7.031	6.204	6.008	5.974	......	......
40	Zirconium	.7885	.7843	.70028	.68850	6.899	6.057		6.594	5.824	5.652	5.619	5.574	5.374
41	Niobium	.7489	.7446	.66438	.65280	6.510	5.718	5.712	6.196	5.480	5.330	5.297	5.226	5.024
42	Molybdenum	.71210	.70783	.63098	.61970	....	5.401	5.395	5.836	5.166	5.041	5.005	4.910	......
43	Technetium	.6735	.6778	.6014	.5899	....	......	......	....	......	......	......	......	......
44	Ruthenium	.64606	.64174	.57131	.56051	5.486	4.843	4.836	....	4.611	4.513	4.476	4.362	4.173
45	Rhodium	.61637	.61202	.54449	.53396	5.2070	4.5956	4.5878	4.9112	4.3640	4.2802	4.2447	4.1221	3.9357
46	Palladium	.58860	.58422	.51961	.50928	4.9396	4.3666	4.3585	4.6502	4.1373	4.0623	4.0257	3 9007	3.7164
47	Silver	.56265	55824	.49622	.48607	4.6976	4.1538	4.1456	4.4101	3.9266	3.8611	3.8245	3.6938	3.5149
48	Cadmium	.53831	.53388	.47412	.46437	4.4713	3.9564	3.9478	4.1875	3.7301	3.6743	3.6364	3 5064	3.3280
49	Indium	.51547	.51104	.45360	.44407	4.2593	3.7724	3.7637	3.9761	3.5478	3.4990	3.4619	3.3312	3.1513
50	Tin	.49404	.48961	.43434	.42504	4.0633	3.6011	3.5922	3.7818	3.3779	3.3363	3.2989	3.1679	2.9949
51	Antimony	.47383	.46937	.41622	.40713	3.8803	3.4408	3.4318	3.5996	3.2184	3.1843	3.1451	3.0166	2.8451
52	Tellurium	.45483	.45035	.39917	.39029	3.7101	3.2910	3.2820	....	3.0700	3.0400	3.0013	2.8761	2.7065
53	Iodine	.43692	.43242	.38311	.37466	3.5497	3.1509	3.1417	....	2.9309	2.9059	2.8682	2.7461	2.5775
54	Xenon	....	....	....	....	....	......	......	....	......	......	......	......	......
55	Cesium	.40400	.39946	.35363	.34538	3.2596	2.8956	2.8861	2.9833	2.6778	2.6605	2.6299	2.5064	2.3425
56	Barium	.38886	.38431	.34010	.33207	3.1287	2.7790	2.7696	2.8571	2.5622	2.5498	2.5110	2.3993	2.2366
57	Lanthanum	.37452	.36996	.32730	.31944	3.0000	2.6688	2.6597	2.7340	2.4533	2.4438	2.4053	2.2980	2.1372
58	Cerium	.36094	.35636	.31515	.30752	2.8857	2.5651	2.5560	2.6147	2.3510	2.3442	2.3059	2.2041	2.0443
59	Praseodymium	.34803	.34343	.30363	.29617	2.7781	2.4676	2.4577	2.5070	2.2539	2.2501	2.2124	2.1148	1.9568

X-RAY SPECTRA (Continued)

EMISSION WAVE-LENGTHS IN THE K AND L SERIES, $\lambda \times 10^{-8}$ cm.

At. No.	Element	K Series				L Series								
		α_2	α_1	β_1	β_2	1	α_2	α_1	η	β_1	β_4	β_3	β_2	γ_1
60	Neodymium	.33577	.33115	.29268	.28573	2.6703	2.3756	2.3653	2.4042	2.1622	2.1622	2.1222	2.0314	1.8738
61	Promethium	.32368	.31902	.28200	.27503	......	2.2879	2.2775	......	2.754	......	2.0379	1.9518	1.7953
62	Samarium	.31311	.30844	.27250	.26575	2.4770	2.2057	2.1950	2.2140	1.9936	1.9964	1.9580	1.8781	1.7231
63	Europium	.30267	.29795	.26307	.25645	2.3903	2.1273	2.1163	......	1.9163	1.9221	1.8827	1.8082	1.6543
64	Gadolinium	.29251	.28778	.25394	.24762	2.3071	2.0526	2.0419	......	1.8425	1.8493	1.8109	1.7419	1.5886
65	Terbium	.28294	.27820	.24551	.23912	2.2290	1.9823	1.9715	......	1.7727	1.7814	1.7425	1.6790	1.5266
66	Dysprosium	.27369	.26895	.23710	.23128	2.1540	1.9159	1.9048	1.8922	1.7070	1.7175	1.6786	1.6203	1.4696
67	Holmium	.26499	.26030	......	......	2.0821	1.8521	1.8410	1.8220	1.6435	1.6553	1.6160	1.5637	1.4142
68	Erbium	.25669	.25198	.22215	.21671	2.0151	1.7914	1.7804	1.7548	1.5834	1.5964	1.5579	1.5106	1.3623
69	Thulium	.24861	.24387	.21487	......	1.9511	1.7339	1.7228	1.6923	1.5268	1.5412	1.5023	1.4602	1.3127
70	Ytterbium	.24099	.23625	.20834	.20322	1.8900	1.6789	1.6678	1.6310	1.4725	1.4882	1.4494	1.4128	1.2648
71	Lutetium	.23358	.22882	.20171	.19649	1.8318	1.6264	1.6155	1.5738	1.4207	1.4372	1.3982	1.3672	1.2203
72	Hafnium	.22653	.22173	.19515	.19042	1.7774	1.5770	1.5661	1.5197	1.3711	1.3893	1.3497	1.3235	1.1765
73	Tantalum	.21984	.21505	.18969	.18462	1.7249	1.5298	1.5188	1.4679	1.3242	1.3431	1.3041	1.2819	1.1356
74	Tungsten (Wolfram)	.21338	.20857	.18399	.17905	1.6750	1.4844	1.4734	1.4181	1.2792	1.2988	1.2599	1.2420	1.0963
75	Rhenium	.20718	.20236	.17851	.17370	......	......	......	......	......	......	......	......	......
76	Osmium	.20122	.19639	.17326	.16856	......	1.3987	1.3886	......	1.1949	......	......	1.1688	1.0229
77	Iridium	.19550	.19065	.16819	.16361	......	1.3598	1.3485	1.2817	1.1554	1.1771	1.1385	1.1329	.98876
78	Platinum	.18999	.18513	.16333	.15886	1.4964	1.3215	1.3103	1.2403	1.1176	1.1398	1.1016	1.0997	.95599
79	Gold	.18469	.17982	.15865	.15429	1.4569	1.2850	1.2737	1.2003	1.0813	1.1042	1.0655	1.0680	.9246
80	Mercury	......	......	......	......	1.4184	1.2495	1.2386	1.1616	1.0465	1.0692	1.0305	1.0377	.8946
81	Thallium	.17467	.16979	.13983	.14540	1.3819	1.2163	1.2049	1.1254	1.0130	1.0370	.9985	1.0082	.8657
82	Lead	.16994	.16503	.14567	.14162	1.3474	1.1841	1.1726	1.0900	.9808	1.0056	.9672	.9808	.8380
83	Bismuth	.16537	.16045	.14165	.13769	1.3137	1.1530	1.1415	1.0565	.9500	.9750	.9367	.9532	.8114
90	Thorium	.13754	.13254	.11715	.11381	1.1128	.9658	.9540	.8528	.7636	.7919	.7532	.7919	.6517
92	Uranium	.13070	.12569	.11116	.1084	1.0649	.9206	.9087	.8035	.7185	.7464	.7088	.7531	.6136

Wave-lengths in Ångstrom units as determined by Crystal.

X-RAY SPECTRA (Continued)

EMISSION WAVE-LENGTHS IN THE M SERIES, $\lambda \times 10^8$ cm.

Atomic Number	Element	α_2	α_1	β	γ
58	Cerium	......	14.030	13.755	11.511
59	Praseodymium	......	......	......	10.975
60	Neodymium	......	12.650	12.375	10.483
62	Samarium	11.475	11.406	11.238	9.580
63	Europium	11.003	10.932	10.723	9.192
64	Gadolinium	10.428	10.394	10.233	8.826
65	Terbium	9.946	9.917	9.772	8.468
66	Dysprosium	9.555	9.524	9.345	8.127
67	Holmium	9.165	9.143	8.947	7.849
68	Erbium	8.794	8.783	8.576	7.530
70	Ytterbium	8.138	8.122	7.893	7.009
71	Lutetium	......	7.824	7.585	6.748
72	Hafnium	......	7.524	7.289	6.530
73	Tantalum	......	7.237	7.008	6.299
74	Tungsten (Wolfram)	......	6.969	6.743	6.076
75	Rhenium	......	6.715	6.491	5.875
76	Osmium	......	6.477	6.254	5.670
77	Iridium	6.262	6.249	6.025	5.490
78	Platinum	6.045	6.034	5.816	5.309
79	Gold	5.842	5.828	5.612	5.135
81	Thallium	5.461	5.450	5.239	4.815
82	Lead	5.288	5.274	5.065	4.665
83	Bismuth	5.119	5.108	4.899	4.522
90	Thorium	4.143	4.130	3.934	3.672
92	Uranium	3.916	3.902	3.708	3.473

GRATING PLACE IN CRYSTALS
$d \times 10^8$

Calcite	3.02904	(1st order)	Siegbahn
	3.02935	(2nd order)	“
Calcium fluoride	5.455	(Cu radiation)	Gerlach
	5.478	(Ni radiation)	“
Mica	9.845	(1st order)	Davis and Terrill
	9.958	(7th order)	
Potassium ferrocyanide	8.408		Siegbahn
Quartz (0001)	1.797		Ingelstam
Rocksalt (plane parallel to face)	2.81400		Siegbahn
Silicon	5.415	(Cu radiation)	Gerlach
	5.410	(Ni radiation)	“
Topaz (100)	2.316		Ingelstam
Zinc blende	5.90	(Cu radiation)	Gerlach

X-RAY CRYSTALLOGRAPHIC DATA*

Compiled with the collaboration of John G. Albright

The following table presents crystallographic data for about 1300 compounds. For convenience they have been separated into; elements. inorganic compounds. minerals. metal-organic compounds and organic compounds. Alloys will be found among the inorganic compounds under one or the other of the metal constituents.

The crystal system is given using abbreviations indicated below. The type of structure is indicated by reference to certain characteristic compounds. The space group is indicated by the symbols of the Shoenflies system. The dimensions of the unit cell *a*, *b*. and *c* in angstrom units are given in order followed in some cases by axial angles. The last column indicates the number of molecules per unit cell.

For an explanation of the space group symbols, structure types or other details of crystallographic data see Wyckoff: The Structure of Crystals and also Davey: Study of Crystal Structure and its Applications (p. 672).

Abbreviations: b.c., body centered; c.p., close packed; cub., cubic; dia., diamond; f.c., face centered; hex., hexagonal; monocl.. monoclinic; rhbdr.. rhombohedral; rhomb., rhombic: tetr., tetragonal; tricl., triclinic.

The Elements

Substance	System, struct. type	Space group	Lattice constants	Atoms
			a, *b*, *c*, Ax. ang	
A (−235°C)	cub., f.c.. Cu	O_h^5	5.43	4
Ag	cub., f.c., Cu	O_h^5	4.0776	4
Al	cub., f.c.. Cu	O_h^5	4.04145	4
As	hex., rhbdr.	D_{3d}^5	4.151, $\omega = 53° 49'$	2
As	rhbdr., f.c.	....	5.599, $\omega = 84° 18'$	8
Au	cub., f.c., Cu	O_h^5	4.0702	4
Ba	cub., b.c., W	O_h^9	5.015	2
Be	hex., c.p.. Mg	D_{6h}^4	2.283, ... 3 607 2.2679, ... 3.5942 (Neuburger 1933)	2
Bi	hex., rhbdr., As	D_{6h}^5	4.749, $\omega = 57° 16'$	2
Bi	rhbdr.. f.c.	....	6.578, $\omega = 87° 34'$	8
Br (−150°C)	rhomb., I	V_h^{18}	4.48, 6.67. 8.72	8
C (diamond. 18°C)	cub., f.c.	O_h^7	3.5597	8
C (graphite)	hex.	D_{6h}^4	2.455, ... 6.69	4
Ca	cub., f.c., Cu	O_h^5	5.56	4
Cb (Nb)	cub., b.c.. W	O_h^9	3.03	2
Cd	hex., c.p.. Mg	D_{6h}^4	2.973, ..., 5.606	2
Ce (α)	hex., c.p.. Mg	D_{6h}^4	3.65, ... 5.91	2
Ce (β)	cub., f.c., Cu	O_h^5	5.12	4
Cl (−185°C)	tetr.	D_{4h}^{16}	8.56, ... 6.12	8
Co (α)	hex., c.p.. Mg	D_{6h}^4	2.514, ..., 4.105	2
Co (β)	cub., f.c., Cu	O_h^5	3.554	4
Cr (α)	cub., b.c., W	O_h^9	2.878	2
Cr (β)	hex., c.p.. Mg	D_{6h}^4	2.717. ..... 4.418	2

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* See also Supplementary Table following.

Substance	System, struct. type	Space group	Lattice constants	Atoms
			a, b, c, Ax. ang.	
Cr (γ)	cub., b.c.,	T_d^3	8.717	58
Cs (−173°C)	cub., b.c., W	O_h^9	6.05	2
Cu	cub., f.c.	O_h^5	3.608	4
Er	hex., c.p., Mg	D_{6h}^4	3.74, ..., 6.09	2
Fe (α)	cub., b.c., W	O_h^9	2.86106	2
Fe (β) (800°C)	cub., b.c.	....	2.90	2
Fe (γ) (1100°C)	cub., f.c.	O_h^5	3.63	4
Fe (δ) (1425°C)	cub., b.c.	....	2.93	2
Ga	rhomb.	V_h^{18}	4.5167, 4.5107, 7.6448	
Ga	tetr. (simple)	D_{4h}^{16}	4.51, ... 7.51	8
Ge	cub., f.c., Dia.	O_h^7	5.647	8
H_2 (−271°C)	hex.	....	3.75, ..., 6.11	4
Hg (−46°C)	rhbdr.	D_{3d}^5	2.997, $\omega = 70^\circ 32'$	1
Hg (−46°C)	rhbdr., f.c.	....	4.578, $\omega = 98^\circ 13'$	4
Hf	hex., c.p., Mg	D_{6h}^4	3.200, ..., 5.077	2
I_2	rhomb., $4I_2$ groups	V_h^{18}	4.795, 7.255, 9.780	8
In	tetr., f.c.	D_{4h}^{17}	4.583, ..., 4.936	4
Ir	cub., f.c., Cu	O_h^5	3.823	4
K	cub., b.c., W	O_h^9	5.333	2
Kr (−252.5°C)	cub., f.c., Cu	O_h^5	5.59	4
La	hex., c.p., Mg	D_{6h}^4	3.72, ..., 6.06	2
La (β)	cub., f.c.	....	5.296	
Li (−173°C)	cub., b.c., W	O_h^9	3.46	2
Mg	hex., c.p.	D_{6h}^4	3.203, ..., 5.196	2
Mn (α)	cub., b.c.	T_d^3	8.894	58
Mn (β)	cub.	O^6 or O^7	6.300	20
Mn (γ)	tetr., f.c., In	D_{4h}^{17}	3.774, ..., 3.526	4
Mo	cub., b.c., W	O_h^9	3.1401	2
N_2 (α) (−252°C)	cub.	T^4	5.66 ($4N_2$)	8
Na (−173°C)	cub., b.c., W	O_h^9	4.24	2
Ne (−268°C)	cub., f.c., Cu	O_h^5	4.52	4
Ni (α)	hex., c.p., Mg	D_{6h}^4	2.66, ..., 4.29	2
Ni (β)	cub., f.c., Cu	O_h^5	3.517	4
O_2 (−252°C)	rhomb., b.c.	....	5.50, 3.82, 3.44	4
O_2 (β)	rhbdr.	....	6.19, $\alpha = 99.1^\circ$	6
O_2 (γ) (−223°C)	cub.	T_h^6	6.83	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants *a*, *b*, *c*, Ax. ang.	Atoms
Os	hex., c.p., Mg	D_{6h}^4	2.724, ..., 4.314	2
P (metallic)	hex., rhbdr., As	D_{3d}^5	5.14, $\omega = 34° 7'$	2
P (metallic)	rhbdr., f.c.	. . . .	5.96, $\omega = 60° 47'$	8
P (red and black)*	rhomb., f.c.	V_h^{18}	3.31, 4.38, 10.50	8
P (white, −35°C)	cub.	. . . .	7.17 ($4P_4$)	16
Pb	cub., f.c., Cu	O_h^5	4.941	4
Pd	cub., f.c., Cu	O_h^5	3.879	4
Po	monocl.	C_2^3	7.42, 4.29, 14.10, $\beta =$ 92° (?)	
Pt	cub., f.c., Cu	O_h^5	3.9142	4
Rb (−173°C)	cub., b.c., W	O_h^9	5.62	2
Re	hex., c.p., Mg	D_{6h}^4	2.765, ..., 4.470	2
Rh	cub., f.c., Cu	O_h^5	3.7944	4
Ru	hex., c.p., Mg	D_{6h}^4	2.695, ..., 4.273	2
S	rhomb., f.c.	V_h^{24}	10.48, 12.92, 24.55	128
Sb	hex., rhbdr., As	D_{3d}^5	4.501, $\omega = 57° 5'$	2
Sb	rhbdr., f.c.	. . . .	6.226, $\omega = 87° 24'$	8
Se	hex.	D_3^4 or D_3^6	4.337, ..., 4.944	3
Se (α)	monocl.	C_{2h}^2	8.992, 8.973, 11.52, $\beta = 91° 34'$ ($4Se_8$)	32
Se (β)	monocl.	C_{2h}^5	12.74, 8.04, 9.25, $\beta =$ 93° 4′	32
Si	cub., f.c., Dia.	O_h^7	5.4173	8
Sn (α, gray)	cub., f.c., Dia.	O_h^7	6.46	8
Sn (β, white)	tetr., double b.c.	D_{4h}^{19}	5.818, ..., 3.174	4
Sr	cub., f.c., Cu	O_h^5	6.075	4
Ta	cub., b.c., W	O_h^9	3.281	2
Te	hex., Se	D_3^4 or D_3^6	4.495, ..., 5.912	3
Th	cub., f.c., Cu	O_h^5	5.074	4
Ti	hex., c.p., Mg	D_{6h}^4	2.951, ..., 4.692	2
Ti (β) (above 900°C)	cub., b.c.	. . . .	3.32	2
Tl (α)	hex., c.p., Mg	D_{6h}^4	3.450, ..., 5.520	2
Tl (β) (above 230°C)	cub., f.c., Cu	O_h^5	4.841	4
U	cub., b.c., W	O_h^9	3.43	2
U	monocl.(Wilson,1933)	C_{2h}^3	2.829, 4.887, 3.308	2
V	cub., b.c., W	O_h^9	3.011	2

* Crystalline and "amorphous" black and red phosphorus all give similar x-ray patterns.

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Atoms
			a, b, c, Ax. ang.	
W (α)	cub., b.c.	O_h^9	3.1583	2
W (β)	cub.	O^2 or O_h^3	5.04	8
Xe (−173°C)	cub., f.c., Cu	O_h^5	6.18	4
Zn	hex., c.p., Mg	D_{6h}^4	2.6585, ..., 4.9342	2
Zr	hex., c.p., Mg	D_{6h}^4	3.223, ..., 5.123	2

INORGANIC COMPOUNDS

				Mol.
AgBr	cub., NaCl	O_h^5	5.755	4
$AgBrO_3$	tetr., $AgClO_3$	V_d^{11} or D_{4h}^{17}	8.59, ..., 8.01	8
AgCN	hex.	C_{3v}^5	4.60, α = 81° 14′	
AgCa	cub., f.c.	. . . .	9.07	
AgCd (β-phase)	cub., CsCl	O_h^1	3.33	1
AgCl	cub., NaCl	O_h^5	5.545	4
$AgClO_3$	tetr.	V_d^{11} or D_{4h}^{17}	8.47, ..., 7.90	8
$AgClO_4$ (200°C)	cub., $KClO_4$	T_d^2	6.92	4
$Ag[Co(NH_3)_2(NO_2)_4]$	tetr.	D_{4h}^4	6.97, ..., 10.43	2
AgF	cub., NaCl	O_h^5	4.92	4
AgI	cub., ZnS	T_d^2	6.47	4
AgI	hex, ZnO	C_{6v}^4	4.58, ..., 7.49	2
Agl (α) (145.8–550°C)	cub.	. . . .	5.034	2
$AgIO_4$	tetr.	C_{4h}^6	5.368, ..., 12.013	4
$AgK(CN)_2$	hex.	D_{3d}^2	7.384, ..., 17.55	
AgMg	cub., CsCl	O_h^1	3.28	
$AgMnO_4$	monocl.	C_{2h}^5	5.66, 8.27, 7.12, β = 92° 29′	4
$AgNO_2$	rhomb.	C_v^{20} or D_{2h}^{13}	3.505, 6.14, 5.16	2
$AgNO_3$	rhomb.	$V^1 - V^4$	6.97, 7.34, 10.14	8
$[AgNO_3.CO(NH_2)_2]n$	monocl	$C_{2h}^2(C_2^2?)$	10.23, 16.84, 6.25	8
AgN_3	rhomb.(pseudotetr.)	V_h^{26}	5.89, 5.58, 5.96	4
$AgRhO_4$	tetr.	C_{4h}^6	5.349, ..., 11.916	4
Ag (Sb. Bi)S_2	tricl.	. . . .	5.67, 5.69, 5.62	2
AgZn	cub., CsCl	O_h^1	3.156	1
Ag_2F	hex., CdI_2	D_{3d}^3	3.0, ..., 5.74	1
Ag_2HgI_4	tetr.	V_d^1	6.340	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol
			a, *b*, *c*, Ax. ang.	
Ag_2HgI_4 (α, >50°C)	cub.	T_d^2	6.383	1
Ag_2MoO_4	cub., $MgAl_2O_4$	O_h^7	9.26	8
Ag_2O	cub., Cu_2O	O_h^4	4.72	2
Ag_2S (α)	cub., b.c.	....	4.88	2
$Ag_2SO_4.4NH_3$	tetr.	V_4^d	8.44, ..., 6.35	2
Ag_2Se (α)	cub., b.c.	....	4.983	2
Ag_2Te (α)	cub., f.c.	....	6.572	4
Ag_3Al	cub., β-Mn	....	6.920	5
Ag_3AsO_4	cub., Ag_3PO_4	T_d^4	6.12	2
Ag_3Hg_4	cub.	O_h^9	10.09	4
Ag_3PO_4	cub.	O_h^3	5.99	2
Ag_3SbS_3	hex. (rhbdr.)	....	7.07, α = 104° 1′	2
Ag_5Cd_8	cub., Cu_5Zn_8	T_d^3	9.96	4
Ag_5Zn_8	cub., Cu_5Zn_8	T_d^3	9.33	4
AlAs	cub., ZnS	T_d^2	5.62	
AlB_2	hex.	....	3.00, ..., 3.245	1
AlB_{12}	tetr.	....	12.55, ..., 10.18	16
$AlCl_3$	monocl.	C_2^3	5.91, 10.24, 6.16, β = 71° 21′	4
$AlCl_3$	pseudo-hex.	D_3^3 or D_3^5	5.91, ..., 17.52	6
$AlCl_3.6H_2O$	hex. (rhbdr.)	D_{3d}^6	7.85	2
AlCu	hex.	....	3.89, α = 94° 36′	4
$AlCu_2Mn$	cub., $AlCu_3$	....	5.950	4
$AlCu_3$	cub., f.c.	....	3.47	4
AlF_3	hex.	D_3^7	4.914, ..., 12.46	6
AlF_3	rhbdr.	....	5.029, α = 58° 31′	2
$AlH(SiW_{12}O_{40}).28H_2O$	rhbdr.	D_{3d}^5	16.45, α = 56° 18′	2
AlN	hex., ZnO	C_{6v}^4	3.104, ..., 4.965	2
$Al(OH)_3$	monocl.	C_{2h}^5	8.6236, 5.06021, 9.699, β = 85° 26′	8
AlP	cub., ZnS	T_d^2	5.42	
$Al(PO_3)_3$	cub.	T_d^6	13.63	16
AlSb	cub., ZnS	T_d^2	6.13	4
$(Al, Sc)_2O_3$	cub.	O_i^{10}	9.22	16
Al_2Cu	tetr., b.c.	D_{4h}^{18}	6.04, ..., 4.86	4
Al_2O_3 (α, corundum)	hex. (rhbdr.), Fe_2O_3	D_{3d}^6	5.12, α = 55° 17′	2
Al_2O_3 (β)	hex.	....	5.56, ..., 22.55	
Al_2O_3 (γ)	cub., $MgAl_2O_4$	O_h^7	7.895	$10\frac{2}{3}$
$Al_2O_3.H_2O$	rhomb.	....	4.38, 9.35, 2.82	
Al_2SiO_5 (cyanite)	tricl.	O_i^1	7.09, 7.72, 5.56, β = 101° 2′	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
Al_3Mg_4	cub.	....	4.80	1
Al_4C_3	rhbdr.	D^5_{3d}	8.53, $\alpha = 22° 28'$	1
Al_4Cu_9	cub., Cu_5Zn_8	T^3_d	8.70	4
Al_5C_3N	hex.	C^4_{6v}	3.280, ..., 21.55	2
AsI_3	hex.	C^1_3	7.187, ..., 21.39	6
AsI_3	rhbdr.	C^2_{3i}	8.25, $\alpha = 51° 20'$	2
As_2O_3	cub.	O^7_i	11.06	16
AuCu	tetr.	....	3.98, ..., 3.72	
$AuCu_3$	cub.	....	3.75	1
$AuSb_2$	cub., FeS_2	T^6_h	6.636	4
AuSn	hex., NiAs	C^4_{6v} or D^4_{6h}	4.307, ..., 5.494	2
AuZn	cub., CsCl	O^1_h	3.19	1
$AuZn_3$ (α)	cub.	....	7.88	8
Au_2Bi	cub.	O^7_h	7.942	8
Au_2Pb	cub.	....	7.91	8
Au_5Zn_8	cub., Cu_5Zn_8	T^3_d	9.27	4
$BAsO_4$	tetr.	S^2_4	4.458, ..., 6.796	2
BN	hex., graphite	D^4_{6h}, C_{3h}*	2.51, ..., 6.69	4, 2*
BPO_4	tetr.	S^2_4	4.332, ..., 6.64	2
B_2H_6	hex.	D^4_{6h}	4.54, ..., 8.69	2
$B_{10}H_{14}$	rhomb.	V^{21}_h	14.46, 20.85, 5.69	
BaC_2	tetr., f.c., CaC_2	D^{17}_{4h}	4.39, ..., 7.04	2
$BaCO_3$	rhomb., KNO_3	V^{16}_h	5.29, 8.88, 6.41	4
$Ba(ClO_4)_2.3H_2O$	hex.	....	7.28, ..., 9.64	2
BaF_2	cub., CaF_2	O^5_h	6.184	4
$BaMoO_4$	tetr., $CaWO_4$	C^6_{4h}	5.56, ..., 12.76	4
$Ba(NO_3)_2$	cub.	T^6_h	8.11	4
$Ba(N_3)_2$	monocl.	C^1_{2h} or C^2_{2h}	6.22, 29.29, 7.02, $\beta =$ 105° 14′	10
$BaNi(CN)_4.4H_2O$	monocl.	....	11.89, 14.08, 6.54, $\beta =$ 103° 42′	4
BaO	cub., NaCl	O^5_h	5.50	4
BaO_2	tetr.	O^{17}_{4h}	5.34, ..., 6.77	
BaS	cub., NaCl	O^5_h	6.35	4
$BaSO_4$	rhomb.	V^{16}_h	8.85, 5.44, 7.13	4
BaS_3	rhomb.	....	8.32, 9.64, 4.82	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
$Ba(SbO_3)_2.8H_2O$	monocl., b.c. (pseudo-rhomb.)	...	9.961, 12.506, 10.129, β = 87° 17′	
BaSe	cub., NaCl	O_h^5	6.62	4
BaTe	cub., NaCl	O_h^5	6.986	4
$BaTiO_3$	cub., $CaTiO_3$	...	3.97	
$BaWO_4$	tetr., $CaWO_4$	C_{4h}^6	5.60, ..., 12.69	4
BeO	hex., ZnO	C_{6v}^4	2.70, ..., 4.39	2
BeS	cub., ZnS	T_d^2	4.85	
$BeSO_4.4H_2O$	tetr.	D_{2d}^{10} or D_{4h}^{18}	8.03, ..., 10.75	
BeSe	cub., ZnS	T_d^2	5.07	
$BeSiO_3.AlO_2H$	monocl.	C_{2h}^2	4.63, 14.30, 4.71, β = 100° 16′	4
BeTe	cub., ZnS	T_d^2	5.54	
Be_2C	cub., CaF_2	O_h^5	4.33	
Be_2SiO_4 (phenacite)	rhbdr.	C_{3i}^2	7.68	6
$Be_2SiW_{12}O_{40}.31H_2O$	cub.	O_h^7	23.3	8
BiF_3	cub.	...	5.85	4
BiI_3	hex., AsI_3	C_3^1	7.498, ..., 20.67	6
CBr_4 (above 47°)	cub.	T_h^6	11.34	8
CBr_4	monocl.	C_{2h}^3 or C_{2h}^6	12.10, 3.41, 10.20, β = 125° 3′	8
CI_4	cub.	T_h^6	11.62	8
CO (temp. liq. H_2)	cub., $\alpha - N_2$	T^4	5.63	4
COS (temp. liq. air)	hex. (trig.)	C_3^4 or C_{3v}^5	4.08	1
CO_2 (−190° C)	cub.	T_h^6	5.575	4
CS_2 (−185° C)	tetr.	...	8.12, ..., 3.77	
CaB_2O_4	rhomb.	V_h^{14}	6.19, 11.60, 4.28	4
CaB_6	cub.	...	4.145	1
$CaCN_2$	hex., $CsCl_2I$	D_{3d}^5	5.11, α = 43° 50′	1
$CaCO_3$ (aragonite)	rhomb., KNO_3	V_h^{16}	4.94, 7.94, 5.72	4
$CaCO_3$ (calcite)	rhbdr., $NaNO_3$	D_{3d}^6	6.361, α = 46° 6′	2
$CaCO_3$ (vaterite)	hex.	...	4.120, ..., 8.556	2
CaC_2	tetr.	D_{4h}^{17}	3.87, ..., 6.37	2
$CaC_2O_4.3H_2O$	...	...	12.375, ..., 7.377	8
$CaCl_2$	rhomb.	V_h^{12}	6.24, 6.43, 4.20	2
$CaCrO_4$	tetr.	D_{4h}^{19}	7.25, ..., 6.34	
$CaCrO_4.H_2O$	rhomb.	V_h^{15}	7.99, 12.77, 8.11	8
$CaCrO_4.2H_2O$	rhomb.	V_h^{11}	16.02, 11.39, 5.60	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
CaF_2 (fluorite)	cub.	O_h^5	5.451	4
CaI_2	hex.	....	4.48, ..., 6.96	
$CaIn_2O_4$	tetr., Mn_3O_4	D_{4h}^{19}	6.201, ..., 9.822	4
Ca (Mg, Fe) $(CO_3)_2$	hex.	C_{3h}^2	6.02, $\alpha = 47° 7'$	1
$CaMoO_4$	tetr., $CaWO_4$	C_{4h}^6	5.23, ..., 11.44	4
$Ca(NO_3)_2$	cub., $Ba(NO_3)_2$	T_h^6	7.60	4
CaO	cub., NaCl	O_h^5	4.797	4
$3CaO.Al_2O_3$	cub., b.c.	O_h^1	7.624	3
$5CaO.3Al_2O_3$	cub.	T_d^6	11.95	
$Ca(OH)_2$	hex., CdI_2	D_{3d}^3	3.582, ..., 4.902	1
$CaPb_3$	cub.	....	4.891	
CaS	cub., NaCl	O_h^5	5.68	4
$CaSO_4$ (anhydrite)	rhomb.	V_h^{17}	6.22, 6.96, 6.97	4
$CaSO_4.2H_2O$	monocl.	C_{2h}^3	10.47, 15.15, 6.51, $\beta =$ 151° 33′	4
$CaSO_4.4CO(NH_2)_2$	tricl.	....	14.74, 14.95, 6.47, $\alpha =$ 91° 26′, $\gamma =$ 86° 50′	4
CaSe	cub., NaCl	O_h^5	5.91	4
$CaSiO_3BO_2H$	monocl.	C_{2h}^5	9.64, 7.62, 4.82, $\beta =$ 90° 9′	4
$CaSi_2$	hex. (rhbdr.)	D_{3d}^5	10.4, $\alpha = 21° 30'$	2
$CaSnO_3$	cub. (?), $CaTiO_3$	....	3.92	
$CaSn_3$	cub.	....	4.732	
CaTe	cub., NaCl	O_h^5	6.345	4
$CaTl_3$	cub.	....	4.794	
$CaWO_4$ (scheelite)	tetr.	C_{4h}^6	5.24, ... 11.38	4
$CaZrO_3$	cub. (?), $CaTiO_3$	....	3.99	
$Ca_3Al_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.840	8
$Ca_3Cr_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.950	8
$Ca_3Fe_2Si_3O_{12}$	cub., b.c.	O_h^{10}	12.026	8
CbC	cub., NaCl	O_h^5	4.40	4
CbN	cub., NaCl	O_h^5	4.41	4
CbO_2	tetr., SnO_2	D_{4h}^{14}	4.77, ..., 2.96	2
$CdBr_2$	hex., $CdCl_2$	D_{3d}^5	6.63, $\alpha = 34° 42'$	1
$CdCO_3$	hex., $NaNO_3$	D_{3d}^6	6.112, $\alpha = 47° 24'$	2
$CdCl_2$	hex. (rhbdr.)	D_{3d}^5	6.35, $\alpha = 36° 40'$	1
$CdCr_2O_4$	cub., $MgAl_2O_4$	....	8.59	

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
CdF_2	cub., CaF_2	O_h^5	5.40	4
$CdFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.73	8
CdI_2	hex.	D_{3d}^3	4.24, ..., 6.84	4
$CdIn_2O_4$	tetr., Mn_3O_4	D_{4h}^{19}	6.117, ..., 9.875	4
$Cd(NH_3)_4(ReO_4)_2$	cub.	T_d^2	10.53	4
CdO	cub., NaCl	O_h^5	4.689	4
$CdO.Fe_2O_3$	cub.	....	8.67	8
$Cd(OH)_2$	hex., CdI_2	D_{3d}^3	3.47, ..., 4.64	1
$Cd(OH)Cl$	hex.	C_{6v}^4	3.66, ..., 10.27	2
CdS (α)	hex., ZnO	C_{6v}^4	4.14, ..., 6.72	2
CdS (β)	cub., ZnS	T_d^2	5.82	4
$3CdSO_4.8H_2O$	monocl.	C_{2h}^6	9.44, 11.87, 16.49, $\beta =$ 117° 16′	4
CdSb	rhomb.	V_h, V or C_{2v}	8.492, 8.320, 6.390	8
CdSe	hex., ZnO	C_{6v}^4	4.30, ..., 7.02	2
CdTe	cub., ZnS	T_d^2	6.41	
$CdTiO_3$	cub. (?)	....	3.75	
Cd_3As_2	cub., Zn_3As_2	....	6.29	2
Cd_3P_2	cub., Zn_3As_2	....	6.06	2
CeC_2	tetr., CaC_2	D_{4h}^{17}	3.87, ..., 6.48	2
CeF_3	hex.	D_6^6	7.114, ..., 7.273	6
CeN	cub., f.c.	....	5.01	
CeO_2	cub., CaF_2	O_h^5	5.41	4
CeP	cub., f.c..	....	5.89	
$CePb_3$	cub.	....	4.864	
$CeSn_3$	cub.	....	4.711	
Ce_2O_3	hex., La_2O_3	D_{3d}^3	3.880, ..., 6.057	1
$Ce_2(WO_4)_3$	tetr.	....	5.336, ..., 11.620	
$CoAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.059	8
CoAs	rhomb.	....	5.96, 5.15, 3.51	
CoAsS	cub.	T^4	5.60	4
$CoBr_2$	hex., CdI_2	D_{3d}^3	3.685, ..., 6.120	1
$CoCO_3$	hex. (rhbdr.), $NaNO_3$	D_{3d}^6	5.67, α = 48° 14′	2
$CoCl_2$	rhbdr.	C_{3v}^5 (?)	(5.91, α = 103° 22′) 6.16, α = 33° 26′	(4) 1
$CoCr_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.319	8
CoF_2	tetr., SnO_2	D_{4h}^{14}	4.69, ..., 3.19	2
$CoFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.35	8
CoI_2	hex., CdI_2	D_{3d}^3	3.96, ..., 6.65	1

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
$[Co.4NH_3.2H_2O]Co(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.02, $\alpha = 95° 51'$	1
$[Co.5NH_3.H_2O]ClO_3.SO_4$	cub., $(NH_4)_2PtCl_6$	....	10.73	
$[Co.5NH_3.H_2O](ClO_4)_3$	cub., $(NH_4)_3FeF_6$		11.32	
$[Co.5NH_3.H_2O]ClO_4.SO_4$	cub., $(NH_4)_2 PtCl_6$	....	10.89	
$[Co.5NH_3.H_2O]Co(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.18, $\alpha = 96° 49'$	1
$[Co.5NH_3.H_2O]Fe(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.18, $\alpha = 96° 53'$	1
$[Co.5NH_3.H_2O]I_3$	cub., $(NH_4)_3FeF_6$	....	10.81	
$[Co.5NH_3.H_2O]SO_4Br$	cub., $(NH_4)_2PtCl_6$	....	10.45	
$[Co.5NH_3.H_2O]SO_4I$	cub., $(NH_4)_2PtCl_6$	....	10.62	
$[Co.5NH_3.H_2O]SeO_4Br$	cub., $(NH_4)_2PtCl_6$	....	10.63	
$[Co.6NH_3]ClO_3.SO_4$	cub., $(NH_4)_2PtCl_6$	....	10.80	
$[Co.6NH_3](ClO_4)_3$	cub., $(NH_4)_3FeF_6$	....	11.39	
$[Co.6NH_3]ClO_4.SO_4$	cub., $(NH_4)_2PtCl_6$	....	10.95	
$[Co.6NH_3]Co(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.24, $\alpha = 97° 28'$	1
$[Co.6NH_3]Cr(CN)_6$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	7.40, $\alpha = 97° 48'$	1
$[Co.6NH_3]I_3$	cub., $(NH_4)_3FeF_6$	....	10.88	
$[Co.6NH_3]SO_4Br$	cub., $(NH_4)_2PtCl_6$	....	10.51	
$[Co.6NH_3]SO_4I$	cub., $(NH_4)_2PtCl_6$	....	10.71	
$[Co.6NH_3]SeO_4I$	cub., $(NH_4)_2PtCl_6$	....	10.79	
CoO	cub., $NaCl$	O_h^5	4.24	4
$Co(OH)_2$	hex., CdI_2	D_{3d}^3	3.19, ..., 4.66	1
CoP	rhomb.	....	5.588, 5.066, 3.274	
CoS	hex., $NiAs$	C_{6v}^4 or D_{6h}^4	3.37, ..., 5.14	2
$CoSO_3.6H_2O$	hemi. trig.	C_3^4	8.822, ..., 9.040, $\alpha = 96° 22'$	
$CoSO_4$	rhomb.	....	4.65, 6.66, 8.46	
$CoSO_4.7H_2O$	monocl., $FeSO_3.7H_2O$	C_{2h}^6	15.45, 13.08, 20.04, $\beta = 104° 40'$	16
CoS_2	cub., FeS_2	T_h^6	5.64	4
$CoSb$	hex., $NiAs$	C_{6v}^4	3.866, ..., 5.188	2
$CoSe$	hex., $NiAs$	C_{6v}^4 or D_{6h}^4	3.614, ..., 5.278	2
$CoSi$	cub.	T^4	4.438	
$CoSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.26, $\alpha = 96° 1'$	1
$CoTe$	hex., $NiAs$	C_{6v}^4 or D_{6h}^4	3.886, ..., 5.360	2
Co_2Al_5	hex.	D_{6h}^4	7.656, ..., 7.593	4
$Co_2O_3.2Fe_2O_3$	cub.	....	8.35	
Co_2Si	rhomb.	V_h^{16}	7.095, 4.908, 3.730	4
Co_2SnO_4	cub., $MgAl_2O_4$	O_h^7	8.60	8
Co_3O_4	cub., $MgAl_2O_4$	O_h^7	8.110	8
Co_3S_4	cub., $Mg Al_2O_4$	O_h^7	9.36	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
$Cr(CO)_6$	rhomb.	C_{2v}^9	11.72, 6.27, 10.89	4
$CrCl_3$	hex. (rhbdr.)	D_3^3 or D_3^5	6.02, ... , 17.3	6
$CrCl_3.6H_2O$	hex. (rhbdr.)	D_{3d}^6	7.98	2
$CrH(SiW_{12}O_{40}).24H_2O$	....	....	15.98, $\alpha = 58° 32'$	
$CrH(SiW_{12}O_{40}).28H_2O$	hex. (rhbdr.)	D_{3d}^5	16.47, $\alpha = 56° 14'$	2
CrN	cub., NaCl	O_h^5	4.140	4
$[Cr.5NH_3.H_2O](ClO_4)_3$	cub., $(NH_4)_3FeF_6$	....	11.47	
$[Cr.5NH_3.H_2O]SO_4Br$	cub., $(NH_4)_2PtCl_6$	....	10.535	
$[Cr.6NH_3](ClO_4)_3$	cub., $(NH_4)_3FeF_6$	....	11.545	
CrS	hex., NiAs	C_{6v}^4 or D_{6h}^4	3.44, ... , 5.67	2
CrSb	hex., NiAs	C_{6v}^4 or D_{6h}^4	4.107, ... , 5.468	2
CrSe	hex., NiAs	C_{6v}^4 or D_{6h}^4	3.59, ... , 5.80	2
CrSi	cub.	T^4	4.620	4
$CrSi_2$	hex.	D_6^4	4.422, ... , 6.351	3
CrTe	hex., NiAs	C_{6v}^4 or D_{6h}^4	3.981. . . . . , 6.211	2
Cr_2O_3	hex., Fe_2O_3	D_{3d}^6	5.35, $\alpha = 54° 58'$	2
Cr_3C_2	rhomb.	....	2.82, 5.52, 11.46	4
Cr_3Si	cub.	....	4.555	2
Cr_4C	cub.	....	10.64	24
Cr_5Al_8	rhbdr. (pseudo-cub.)	....	7.7894, $\alpha = 109° 7.6'$	2
Cr_7C_3	hex.	....	13.98	80
$CsAl(SO_4)_2.12H_2O$	cub.	T_h^6	12.31	4
CsBr	cub., CsCl	O_h^1	4.287	1
$CsBr_2I$	rhomb.	V_h^{16}	6.57, 9.18, 10.66	4
$CsCdBr_3$	cub. (?), $CaTiO_3$	....	5.33	
$CsCdCl_3$	cub. (?), $CaTiO_3$	....	5.20	
CsCl	cub.	O_h^1	4.110	1
CsCl(>445°C)	cub., NaCl	O_h^5	7.02	
$CsClO_4$	rhomb., $BaSO_4$	V_h^{16}	9.82, 6.00, 7.79	4
$CsClO_4$ (250°C)	cub., $KClO_4$	....	7.96	1
$CsCl_2I$	hex.	D_{3d}^5	5.46, $\alpha = 70° 42'$	1
CsF	cub., NaCl	O_h^5	6.01	4
$CsHgBr_3$	cub. (?), $CaTiO_3$	....	5.77	
$CsHgCl_3$	cub. (?), $CaTiO_3$	....	5.44	
CsI	cub., CsCl	O_h^1	4.562	1
$CsIBr_2$	rhomb.	V_h^{16}	6.57, 9.18, 10.66	4
$CsICl_2$	rhbdr.	D_{3d}^5	....	1
$CsIO_3$	cub. (?), $CaTiO_3$	....	4.66	
CsI_3	rhomb.	V_h^{16}	6.82, 9.94, 11.01	4

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
CsSH	cub., CsCl	O_h^1	4.29	
$Cs_2AgAuCl_6$	cub.	....	5.33	
$Cs_2AuAuCl_6$	cub.	....	5.33	
Cs_2CrO_4	rhomb.	V_h^{16}	6.226, 11.135, 8.363	4
Cs_2GeF_6	cub., $(NH_4)_2PtCl_6$	O_h^5	8.99	4
Cs_2PbCl_6	cub.	O_h^5	10.416	
Cs_2PtCl_6	cub.	O_h^5	10.192	4
Cs_2SO_4	rhomb., K_2SO_4	V_h^{16}	6.24, 10.92, 8.22	4
$Cs_2S_2O_6$	hex.	....	6.326, ..., 11.535	2
$Cs_2S_2O_8$	monocl.	C_{2h}^5	8.13, 8.33, 6.46, $\beta =$ 95° 19′	2
Cs_2SeCl_6	cub.	O_h^5	10.260	
Cs_2SnCl_6	cub.	O_h^5	10.347	
Cs_2TeCl_6	cub.	O_h^5	10.445	
Cs_2TiCl_6	cub.	O_h^5	10.219	
Cs_2ZrCl_6	cub.	O_h^5	10.407	
$Cs_3As_2Cl_9$	hex.	D_3^2	7.37, ..., 8.91	1
Cs_3CoCl_5	tetr.	D_{4h}^{18}	9.18, ..., 14.47	4
$Cs_3Co(NO_2)_6$	cub.	....	11.15	4
$Cs_3Fe(CN)_6$	rhomb.	....	11.8, 10.1, 7.0	2
$Cs_3Tl_2Cl_9$	rhbdr.	D_{3d}^6	9.58, $\alpha =$ 83° 48′	2
$Cs_3W_2Cl_9$	hex.	C_{6h}^2	7.35, ..., 17.06	2
$CuAl_2$	tetr.	D_{4h}^{18}	6.052, ..., 4.878	4
$CuAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.070	8
CuBe	cub., CsCl	O_h^1	2.698	
$CuBe_2$	cub., Cu_2Mg	O_h^7	5.940	8
CuBr	cub., ZnS	T_d^2	5.681	4
$CuBr_2.2Br(NH_4).2H_2O$	tetr.	D_{4h}^{14}	7.98, ..., 8.41	2
CuCl	cub., ZnS	T_d^2	5.407	4
$CuCl_2.2Cl(NH_4).2H_2O$	tetr.	D_{4h}^{14}	7.63, ..., 7.97	2
$CuCo_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.039	8
$CuCo_2S_4$	cub., $MgAl_2O_4$	O_h^7	9.458	8
$CuFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.445	8
CuH	hex., ZnO	C_{6v}^4	2.893, ..., 4.614	2
CuI	cub., ZnS	T_d^2	6.047	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
$CuMg_2$	hex.		5.281, ..., 18.29	8
CuO	monocl.		4.66, 3.40, 5.09, α = 99° 30′	
CuPd	cub., CsCl	O_h^1	2.988	1
CuPt	hex.		3.779, α = 90° 54′	1
CuS	hex.	D_{6h}^4	3.802, ..., 16.43	6
$CuSO_4$	rhomb.		4.88. 6.66, 8.32	
$CuSO_4.5H_2O$	tricl.		6.07, 10.78, 5.89, α = 82° 5′, β = 107° 8′. γ = 102° 41′	2
CuSn	hex., NiAs	C_{6v}^4 or D_{6h}^4	4.190, ..., 5.086	2
CuZn	cub., CsCl	O_h^1	2.945	1
$Cu_{1.8}S$	cub., f.c.		5.564	4
Cu_2HgI_4	tetr.		6.08, ..., 6.135	
Cu_2HgI_4 (α) (>70°C)	cub.	T^2	6.103	1
Cu_2HgI_4 (β)			6.041, ... 6.115	
Cu_2Mg	cub.	O_h^7	7.029	8
Cu_2MnSn	cub., $AlCu_3$		6.167	4
Cu_2O (cuprite)	cub.	O_h^4	4.26	2
Cu_2S	cub., CaF_2	O_h^5	5.59	4
Cu_2Sb	tetr.		3.99, ..., 6.17	2
Cu_2Se (α)	cub., f.c.	O_h^5	5.840	4
Cu_2Zn_3	cub.		4.01	
Cu_3Pd	cub., $AuCu_3$		3.69	4
Cu_3Pt	cub., $AuCu_3$		3 71	1
Cu_3Sb			2.78, ... 4.37	
Cu_3Sn	hex.		2.75, ... 4.32	
Cu_5Zn_8	cub.	T_d^3	8.85	52
Cu_9Al_4	cub.	T_d^1	8.70	52
Cu_9Ga_4 (δ)	cub.		8.711	
$Cu_{31}Sn_8$	cub.		8.955	
Dy_2O_3	cub., Tl_2O_3	T_h^7	10.63	16
Er_2O_3	cub., Tl_2O_3	T_h^7	10.54	16
Eu_2O_3	cub., Tl_2O_3	T_h^7	10.84	16
$FeAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.12	8
$FeAl_3$	rhomb.	V_h^{23}	47.43, 15.46, 8.08	
FeAs (η)	rhomb.		3.366, 6.016, 5.428	4
$FeAs_2$	rhomb.	V_h^{12} or V_h^{13}	6.35, 4.86, 5.80	
FeB	rhomb.	V_h^{16}	5.495, 4.053, 2.946	4
$FeBe_2$	hex., $MgZn_2$	D_{6h}^4	4.212, ..., 6.834	4
$FeBe_5$	cub., Cu_2Mg	O_h^7	5.878	4
$FeBr_2$	hex., CdI_2	D_{3d}^3	3.740, ... 6.171	1
$[Fe(CN)_2]_3$	cub.		15.9	16

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
$FeCO_3$	hex., $NaNO_3$	D_{3d}^6	5.82, $\alpha = 47° 45'$	2
$Fe(CO)_4$	monocl.	C_{2h}^6	13.00, 11.41, $\beta = 85° 35'$	
$FeCl_2$	hex, $CdCl_2$	D_{3d}^5	6.20, $\alpha = 33° 33'$	1
$FeCl_3$	hex.	C_{3i}^2	5.92, ... , 17.26	6
(Fe, Co)S	hex.	C_{6v}^4	3.36, ... , 5.29	2
FeF_2	tetr., SnO_2	D_{4h}^{14}	4.670, ... , 3.297	2
$FeHSiW_{12}O_{40}.20H_2O$	tricl.	C_i	19.11, 22.50, 23.92, $\alpha = 87° 55'$, $\beta = 105° 57'$, $\gamma = 92° 25'$	8
$FeHSiW_{12}O_{40}.28H_2O$	rhbdr.	D_{3d}^5	16.46, $\alpha = 56° 30'$	2
$FeHSiW_{12}O_{40}.30H_2O$	cub.	O_h^7	23.10	8
FeI_2	hex., CdI_2	D_{3d}^3	4.04, ... , 6.75	1
FeO	cub., NaCl	O_h^5	4.294	4
FeOCl	rhomb.	V_h^{13}	3.75, 7.95, 3.4	2
$Fe(OH)_2$	hex., CdI_2	D_{3d}^3	3.24, ... , 4.47	1
FeP	rhomb.	. . . .	5.782, 5.177, 3.089	
FeS	hex.	C_{6v}^4	3.43, ... , 5.79	2
$FeSO_4$	rhomb.	. . . .	4.82, 6.84, 8.67	
$FeSO_4.7H_2O$	monocl.	C_{2h}^6	15.34, 12.98, 20.02, $\beta = 104° 15'$	16
$FeSO_4.(NH_4)_2SO_4.6H_2O$	monocl.	C_{2h}^5	9.28, 12.58, 6.22, $\beta = 106° 50'$	
$FeS + S_x$	hex.	C_{6v}^4	3.43, ... , 5.68	2
Fe (S, Se)	hex.	C_{6v}^4	3.54, ... , 5.91	2
FeS_2 (marcasite)	rhomb., $FeAs_2$	V_h^{12}	3.35, 4.40, 5.35	2
FeS_2 (pyrite)	cub.	T_h^6	5.404	4
FeSb	hex., NiAs	C_{6v}^4 or D_{6h}^4	4.06, ... , 5.13	2
$FeSb_2$ (ζ)	rhomb.	V_h^{12} or V_h^{13}	3.189, 5.819, 6.520	
FeSe	hex., NiAs	C_{6v}^4	3.61, ... , 5.87	2
$FeSe + Se_x$	hex.	C_{6v}^4	3.51, ... , 5.55	
FeSi	cub.	T^4	4.467	4
$FeSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.42, $\alpha = 96° 59'$	1
$FeSi_2$	tetr.	. . . .	2.69, ... , 5.08	1
$FeTa_2O_6$ (tapiolite)	tetr.	D_{4h}^{14}	4.74, ... , 9.21	2
FeTe	hex., NiAs	C_{6v}^4 or D_{6h}^4	3.800, ... , 5.651	2
Fe_2As (ϵ)	tetr.	. . . .	3.627, ... , 5.973	2
Fe_2B	tetr.	V_d^{11}	5.078, ... , 4.233	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol
			a, *b*, *c*, Ax. ang.	
$Fe_2(CO)_9$	hex.	C_{6v}^4 or D_{6h}^4	6.45. ..... 15.8	2
Fe_2O_3 (hematite)	hex.	D_{3d}^6	5.42, $\alpha = 55° 17'$	2
Fe_2O_3 (magnetic)	cub.	....	8.30	
$Fe_2O_3.H_2O$	rhomb., $Al_2O_3.H_2O$	....	4.55, 9.90, 3.01	2
Fe_2P (ζ)	hex.	D_3^2	5.852, ... , 3.453	3
Fe_2W	hex.	....	4.727. ....; 7.704	4
$Fe_3Al_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.497	8
Fe_3C	rhomb.	V_h^{16}	4.518, 5.069, 6.736	4
Fe_3Mo_2	hex.	....	4.743. ..... 25.63	8
Fe_3N (ϵ')	hex.	D_6^6	2.695, ... 4.362	
Fe_3O_4	cub., $MgAl_2O_4$	O_h^7	8.37	8
Fe_3P (ϵ)	tetr.	S_4^2	9.09, ..., 4.446	8
Fe_3W_2	hex.	....	4.731. ..... 25.76	8
Fe_3Zn_{10}	cub.	O_h^9	8.93	52
Fe_4N	cub.	....	3.789	1
GaAs	cub., ZnS	T_d^2	5.635	
$(Ga, In)_2O_3$	cub.	O_h^{10}	9.76	16
GaP	cub., ZnS	T_d^2	5.436	
GaSb	cub., ZnS	T_d^2	6.118	
Ga_2O_3	hex., Fe_2O_3	D_{3d}^6	5.281. $\alpha = 55° 35'$	2
$GdPMo_{12}O_{40}.30H_2O$	cub.	O_h^7	23.1	8
Gd_2O_3	cub., Tl_2O_3	T_h^7	10.79	16
GeI_4	cub., SnI_4	T_h^6	11.89	8
GeO_2	hex., α SiO_2	D_3^4	4.98. ....., 5.64	3
GeS	rhomb.	V_h^{16}	4.29, 10.42, 3.64	4
GeS_2	rhomb.	C_{2v}^{19}	11.66, 22.34, 6.86	24
HCl (−168°C)	cub.	....	5.50	4
HI	cub., HCl	....	6.18	4
HIO_3	rhomb.	$V^1 - V^4$	5.53, 5.92, 7.75	4
H_2O (ice)*	hex.	D_{6h}^4	4.535. ....., 7.41	4
H_2O_2	tetr.	....	4.02. ....., 8.02	4
H_2S (α, β & γ)	cub., f.c.	O_h^5	5.77	4
H_2Se (−170°C)	cub.	O_h^5	6.020	4
H_3BO_3	tricl.	....	7.04, 7.04, 6.56, $\alpha = 92° 30'$, $\beta = 101° 10'$. $\gamma = 120°$	4
$H_3PMo_{12}O_{40}.30H_2O$	cub.	O_h^7	23 1	8

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* See also *ice* under minerals.

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*. Ax ang	
$H_3PW_{12}O_{40}.5H_2O$	cub.	O_h^4	12.14	2
$H_3PW_{12}O_{40}.29H_2O$	cub.	....	23.28	8
$H_4N_4S_4$	rhomb.	V_h^1	12.08, 6.76, 7.86	4
HfF_4	monocl.	C_{2h}^6	9.45, 9.84, 7.62, $\beta =$ 94° 29′	12
HfO_2	cub., CaF_2	O_h^5	5.115	4
HfP_2O_7	cub.	T_h^6	8.18	4
$HgBr_2$	rhomb.	C_{2v}^{12}	4.67, 6.85, 12.45	4
$Hg(CN)_2$	tetr.	V_d^{12}	9.67, ..., 8 92	8
$HgCl_2$	rhomb.	V_h^{16}	5.963, 12.735. 4.325	4
HgI_2	rhomb.	C_{2v}^{12}	4.676, 7.32, 13 76	4
HgO	rhomb.	....	3.296, 3.513, 5.504	4
HgS (cinnabar)	hex.	D_3^4 or D_3^6	4.14, ..., 9.49	3
HgS (metacinnabarite)	cub., ZnS	T_d^2	5.84	4
HgSe	cub., ZnS	T_d^2	6.07	
HgTe	cub., ZnS	T_d^2	6.36	
Hg_2Br_2	tetr., Hg_2Cl_2	D_{4h}^{17}	4.65, ..., 11.10	2
Hg_2Cl_2	tetr.	D_{4h}^{17}	4.47, ..., 10.89	2
Hg_2I_2	tetr., Hg_2Cl_2	D_{4h}^{17}	4.92, ..., 11.61	2
Ho_2O_3	cub., Tl_2O_3	T_h^7	10.58	16
InSb	cub., ZnS	T_d^2	6.45	
In_2O_3	cub., Tl_2O_3	T_h^7	10.12	16
IrO_2	tetr., SnO_2	D_{4h}^{14}	4.49, ..., 3.14	
$KAl\ (SO_4)_2$	hex.	D_3^2	4.706, ..., 7.960	1
$KAl\ (SO_4)_2.12H_2O$	cub.	T_h^6	12.11	4
$KAlSi_3O_8$	monocl.	C_{2h}^3	8.57, 13.01, 7.23, $\beta =$ 116° 7′	4
KBr	cub., NaCl	O_h^5	6.578	4
$KBrO_3$	hex.	C_{3v}^5	4.403, $\alpha =$ 86° 0′	1
KCN	cub., NaCl	O_h^5	6.55	4
KCNO	tetr., KN_3	D_{4h}^{18}	6.070, ..., 7.030	4
KCNS	rhomb.	V_h^{11}	6.67, 6.65, 7.54	4
$KCbO_3$	cub. (?), $CaTiO_3$	....	4.01	
KCl	cub., NaCl	O_h^5	6.28	4
$KCl.MgCl_2.6H_2O$	rhomb.	V_h^6	9.53, 16.08. 22.25	12

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
$KClO_3$	monocl.	C_{2h}^2	4.647, 5.585, 7.085, $\beta = 109° 38'$	2
$KClO_4$	rhomb., $BaSO_4$	V_h^{16}	8.834, 5.650, 7.240	
$KClO_4$ (340°C)	cub.	T_d^2 or T^2	7.47	
$KCr(SO_4)_2$	hex., $KAl(SO_4)_2$	D_3^2	4.737, ..., 8.030	1
$KCr(SO_4)_2.12H_2O$	cub.	T_h^6	12.14	4
KF	cub., NaCl	O_h^5	5.33	4
KHC_2	tetr., CaC_2	....	4.28, ..., 8.42	4
KHF_2	tetr., KN_3	D_{4h}^{18}	5.67, ..., 6.81	4
KH_2PO_4	tetr.	V_h^{12}	7.43, ..., 6.97	4
KI	cub., NaCl	O_h^5	7.052	4
KIO_3	cub. (?), $CaTiO_3$	....	4.46	
KIO_4	tetr., $CaWO_4$	C_{4h}^6	8.13, ..., 12.63	4
KI_3	monocl.	....	9.36, $b = c = a$ approx., $\beta = 90° \pm$	4
$KLiSO_4$	hex.	C_6^6	5.13, ..., 8.60	2
$KMgF_3$	cub. (?), $CaTiO_3$	....	4.00	
$KMnO_4$	rhomb., $BaSO_4$	V_h^{16}	9.10, 5.69, 7.40	4
KNO_2	monocl., f.c.	C_s^3	4.45, 4.99, 7.31, $\beta = 114° 50'$	2
KNO_3	rhomb.	V_h^{16}	5.43, 9.17, 6.45	4
KN_3	tetr.	D_{4h}^{18}	6.094, ..., 7.056	4
$KNiF_3$	cub. (?), $CaTiO_3$	....	4.008	
$KOsNO_3$	tetr.	C_{4h}^6	....	4
$(KPbCl_3)_3.H_2O$	monocl.	C_i^1	14.35, 9.05, 14.50, $\beta = 113°$	4
KPb_2Br_5	tetr.	D_{4h}^{18}	8.14, ..., 14.1	4
$KReO_4$	tetr., $CaWO_4$	C_{4h}^6	5.615, ..., 12.50	4
KSH	rhbdr.	D_{3d}^5	4.37, $\alpha = 68° 51'$	
$KZnF_3$	cub. (?), $CaTiO_3$	....	4.050	
$K_2Ba[Co(NO_2)_6]$	cub.	....	10.45	4
$K_2Ba[Ni(NO_2)_6]$	cub.	....	10.67	4
$K_2Ca[Co(NO_2)_6]$	cub.	....	10.17	4
$K_2Ca[Ni(NO_2)_6]$	cub.	....	10.29	4
$K_2Cd(CN)_4$	cub., $MgAl_2O_4$	O_h^7	12.84	8
K_2CrO_4	rhomb., K_2SO_4	V_h^{16}	5.92, 10.40, 7.61	4
$K_2Cr_2O_7$ (α)	tricl.	....	7.50, 7.38, 13.40, $\alpha = 82° 0'$, $\beta = 96° 13'$, $\gamma = 90° 51'$	4
$K_2Cr_2O_7$ (β)	monocl.	....	7.47, 7.35, 12.97, $\beta = 91° 55'$	4
$K_2CuCl_4.2H_2O$	tetr., $(NH_4)_2CuCl_4.2H_2O$	D_{4h}^{14}	7.45, ..., 7.88	2

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
$K_2Hg(CN)_4$	cub., $MgAl_2O_4$	O_h^7	12.76	8
K_2OsBr_6	cub.		10.30	
K_2OsCl_6	cub.		9.729	
$K_2OsO_2Cl_4$	tetr., f.c.	D_{4h}^{17}	9.90, ..., 8.75	2
$K_2PbCo(NO_2)_6$	cub.		10.49	4
$K_2PbCu(NO_2)_6$	cub.		10.52	4
$K_2PbNi(NO_2)_6$	cub.		10.55	4
K_2PdCl_4	tetr., K_2PtCl_4	D_{4h}^1	7.04, ..., 4.10	1
K_2PtBr_6	cub., $(NH_4)_2PtCl_6$	O_h^5	10.35	4
K_2PtCl_4	tetr.	D_{4h}^1	6.99, ... 4.13	1
K_2PtCl_6	cub., $(NH_4)_2PtCl_6$	O_h^5	9.725	
$K_2Pt(SCN)_6$	hex.	D_{3d}^1	6.77, ... 10.45	1
K_2ReCl_6	cub., K_2PtCl_6	O_h^5	9.861	
K_2S	cub., CaF_2	O_h^5	7.35	
K_2SO_4	rhomb.	V_h^{16}	5.731, 10.008, 7.424	4
$K_2S_2O_5$	monocl.	C_{2h}^2	6.95, 6.19, 7.55	
$K_2S_2O_6$	hex.	D_3^2	9.756, ..., 6.274	3
$K_2S_2O_8$	tricl.	C_i'	5.10, 6.83, 5.40, $\alpha =$ 106° 54′, $\beta =$ 90° 10′. $\gamma =$ 102° 35′	
$K_2S_3O_6$	rhomb.	V_h^{16}	9.77, 13.63, 5.76	4
K_2SeBr_6	cub.		10.363	
K_2SeO_4	rhomb.	V_h^{16}	6.02, 10.40, 7.60	4
K_2SnCl_6	cub., $(NH_4)_2PtCl_6$	O_h^5	9.983	4
$K_2Sn(OH)_6$	hex. (rhbdr.)	D_{3d}^5	5.67, $\alpha =$ 70° 1′	1
$K_2Sr[Co(NO_2)_6]$	cub.		10.23	4
$K_2Sr[Ni(NO_2)_6]$	cub.		10.49	4
K_2TeCl_6	monocl.	C_{2h}^3	7.17, 7.17, 10.14, $\beta =$ 90° approx.	
$K_2Zn(CN)_4$	cub., $MgAl_2O_4$	O_h^7	12.54	8
$K_3Co(NO_2)_6$	cub.		10.44	4
$K_3Co(NO_2)_6.1\frac{1}{2}H_2O$	cub.		10.32	
$K_3Cr(CN)_6$	rhomb.	V_h^{14}	13.55, 10.60, 8.60	4
$K_3Fe(CN)_6$	monocl.	C_{2h}^5	13.42, 10.40, 8.38	4
$K_3Ir(CN)_6$	rhomb.	V_h^{14}	13.70, 10.53, 8.34	4
$K_3Mn(CN)_6$	rhomb.	V_h^{14}	13.56, 10.60, 8.50	4
$K_3Na(SO_4)_2$	hex.	D_{3d}^3	5.65, ..., 7.29	1
$K_3TlCl_6.2H_2O$	tetr.	D_{4h}^{17}	15.841, ... 18.005	14
$K_3W_2Cl_9$	hex.	C_{6h}^2	7.16, ..., 16.17	2

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang	
$K_4Co(NO_2)_6$	cub.	. . . .	10.32	
$K_4Ni(NO_2)_6$	cub.	. . . .	10.49	
$LaAlO_3$	cub. (?), $CaTiO_3$	. . . .	3.78	
$LaAl_4$	. . . .	. . . .	13.2 (?), ... , 10.2 (?)	16
LaC_2	tetr., CaC_2	D_{4h}^{17}	3.92, . . . , 6.55	2
LaF_3	hex., CeF_3	D_6^6	7.163, ... , 7.329	6
$LaGaO_3$	cub. (?), $CaTiO_3$	. . . .	3.89	
LaN	cub., f.c.	. . . .	5.275	
LaP	cub., f.c.	. . . .	6.013	
La_2O_3	hex.	D_{3d}^2	3.945, ... , 6.151	1
LiAl	cub., b.c.	. . . .	6.360	
$LiAl_5O_8$	cub.	O_h^7	7.903	
LiBr	cub., NaCl	O_h^5	5.49	4
$LiCbO_3$	hex., $MgTiO_3$	C_{3i}^2	5.47, α = 55° 43′	2
LiCd	cub.	. . . .	3.32	
$LiCd_3$	cub.	. . . .	8.62	8
LiCl	cub., NaCl	O_h^5	5.14	4
$LiCl.H_2O$	tetr.	. . . .	3.81, ... , 3.88	1
$LiClO_4.3H_2O$	hex.	C_{6v}^4	7.71, ... , 5.42	2
LiF	cub., NaCl	O_h^5	4.01	4
LiH	cub., NaCl	O_h^5	4.085	4
LiD	. . . .	. . . .	4.065	
$LiHg_3$	hex.	. . . .	6.240, ... , 4.794	2
LiI	cub., NaCl	O_h^5	6.00	4
$LiI.3H_2O$	hex.	C_{6v}^4	7.45, ... , 5.45	2
$LiIO_3$	hex.	D_6^6	5.469, ... , 5.155	2
$LiKSO_4$	hex.	C_6^6	5.13, ... , 8.00	2
LiN	hex.	. . . .	3.658, ... , 3.882	3
$LiNO_3$	hex., $NaNO_3$	D_{3d}^6	5.74, α = 48° 3′	2
$LiNaCO_3$	hex.	D_{3h}^1 or D_{3h}^3	8.22, ... , 3.27	3
LiOH	tetr.	D_{4h}^7	3.549, ... , 4.334	
$Li_2SO_4.H_2O$	monocl.	C_2^2	5.43, 4.83, 8.14, β = 107° 35′	2
LiZn (β')	hex.	. . . .	2.782, ... , 4.385	
LiZn (γ')	hex., pseudo	. . . .	4.362, ... , 2.510	
Li_2BeF_4	hex.	. . . .	8.15, α = 107° 40′	
Li_2MoO_4	hex., Be_2SiO_4	. . . .	8.77, α = 108° 10′	
Li_2O	cub., CaF_2	O_h^5	4.61	4
Li_2S	cub., CaF_2	O_h^5	5.70	4
Li_2SO_4	monocl.	C_{2h}^5	8.25, 4.95, 8.44, β = 107° 54′	4
Li_2Se	cub., CaF_2	O_h^5	5.94	

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
Li_2Te	cub., CaF_2	O_h^5	6.47	
Li_2WO_4	hex., Be_2SiO_4	C_{3i}^2	8.77, α = 108° 10′	
Li_3Hg	cub., $AlCu_3$	....	6.584	
Li_3N	cub.	....	5.50	
Lu_2O_3	cub., Tl_2O_3	O_h^{10}	10.37	16
$MgAl_2O_4$	cub.	O_h^7	8.090	8
MgAu	cub., CsCl	O_h^1	3.259	1
$MgBr_2$	hex., CdI_2	D_{3d}^3	3.815, ..., 6.256	1
$MgBr_2.6H_2O$	monocl.	C_{2h}^3	10.25, 7.40, 6.30, β = 93° 30′	2
$MgCO_3$	hex., $NaNO_3$	D_{3d}^6	5.61, α = 48° 12′	2
$MgCl_2$	hex., $CdCl_2$	D_{3d}^5	6.22, α = 33° 36′	1
$MgCl_2.6H_2O$	monocl.	C_{2h}^3	9.90, 7.15. 6.10, β = 94°	2
$MgCo_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.107	8
$MgCrO_4.7H_2O$	rhomb., $MgSO_4.7H_2O$	V^4	11.89, 12.01, 6.89	4
$MgCr_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.290	8
MgF_2	tetr., SnO_2	D_{4h}^{14}	4.66, ... 3.08	2
$MgFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.342	8
MgHg	cub., CsCl	O_h^1	3.442	1
MgI_2	hex.	....	4.14, ..., 6.88	
MgO	cub., NaCl	O_h^5	4.203	4
$MgO.Fe_2O_3$	cub.	....	8.36	8
$Mg(OH)_2$	hex., CdI_2	D_{3d}^3	3.11, ..., 4.74	1
MgPr	cub.	....	3.88	1
$MgPt(CN)_4.7H_2O$	tetr.	D_{4h}^{17}	14.6, ..., 6.26	2
MgS	cub., NaCl	O_h^5	5.190	4
$MgSO_3.6H_2O$	hemi. trig.	C_3^4	8.820, ..., 9.052, α = 96° 20′	
$MgSO_4$	rhomb.	....	4.82, 6.72, 8.33	
$MgSO_4.7H_2O$	rhomb.	V^4	11.91, 12.02, 6.87	4
$MgSO_4.(NH_4)_2SO_4.6H_2O$	monocl.	C_{2h}^5	9.28, 12.57, 6.20, β = 107° 6′	2
$Mg(SbO_3)_2.12H_2O$	hex.	D_{3d}^1	16.079, ..., 9.84	2
MgSe	cub., NaCl	O_h^5	5.451	4
$MgSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.43, α = 96° 3′	1
$MgSnF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.56, α = 96° 20′	1
MgTe	hex., ZnO	C_{6v}^4	4.52, ..., 7.33	2
$MgTiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.52. α = 96° 57′	1

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
$MgTiO_3$	hex.	C_{3i}^2	5.40, $\alpha = 55° 1'$	2
$MgWO_4$	monocl.	....	4.67, 5.66, 4.92, $\beta = 89° 35'$	2
$MgZn$	hex.	....	10.66, ..., 17.16	
$MgZn_2$	hex.	D_{6h}^4	5.17, ..., 8.50	2
$MgZn_5$	hex.	....	9.92, ..., 16.48	
$Mg_2Al_2O_4$	cub.	O_h^7	8.08	
Mg_2Pb	cub., CaF_2	O_h^5	6.75	4
Mg_2Si	cub., CaF_2	O_h^5	6.39	4
$Mg_2SiMo_{12}O_{40}.31H_2O$	cub.	O_h^7	23.04	8
Mg_2Sn	cub., CaF_2	O_h^5	6.78	4
Mg_2SnO_4	cub., $MgAl_2O_4$	O_h^7	8.58	8
Mg_2Zn_{11}	cub.	O_h	8.53	3
$Mg_3Al_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.510	8
Mg_3As_2	cub., Zn_3As_2	....	6.10	2
$Mg_3Cu_7Al_{10}$	cub.	....	8.29	
Mg_3N_2	cub., b.c.	....	9.93	12
Mg_3P_2	cub., Zn_3As_2	....	5.92	2
$MnAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.263	8
$MnAs$	rhomb.	....	6.38, 5.63, 3.62	
$MnBr_2$	hex., CdI_2	D_{3d}^3	3.82, ..., 6.19	1
$MnCO_3$	hex., $NaNO_3$	D_{3d}^6	5.84, $\alpha = 47° 45'$	2
$MnCl_2$	hex., $CdCl_2$	D_{3d}^5	6.20, $\alpha = 34° 35'$	1
$(Mn, Co)(Co, Mn)_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.268	8
$MnCr_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.487	8
MnF_2	tetr., SnO_2	D_{4h}^{14}	4.865, ..., 3.284	2
$MnFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.572	8
MnI_2	hex., CdI_2	D_{3d}^3	4.16, ..., 6.82	1
$MnMn_2O_4$	tetr., Mn_3O_4	D_{4h}^{19}	5.75, ..., 9.42	4
MnO	cub., NaCl	O_h^5	4.435	4
MnO_2	tetr., SnO_2	D_{4h}^{14}	4.44, ..., 2.89	2
$Mn(OH)_2$	hex., CdI_2	D_{3d}^3	3.34, ..., 4.68	1
MnP	rhomb.	....	5.905, 5.249, 3.167	
MnS	cub., NaCl	O_h^5	5.21	4
$MnSO_4$	rhomb.	....	4.86, 6.84, 8.58	
MnS_2	cub., FeS_2	T_h^6	6.10	4
$MnSb$	hex., NiAs	D_{6h}^4	4.120, ..., 5.784	2

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
MnSe	cub., NaCl	O_h^5	5.448	4
MnSi	cub., FeSi	T^4	4.548	
$MnSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.45, $\alpha = 96° 53'$	1
$MnSi_2$	tetr.	....	5 513, ... 17.422	16
MnTe	hex., NiAs	D_{6h}^4	4.124, ..., 6.698	2
$MnTe_2$	cub., FeS_2	T_h^6	6.943	4
Mn_2O_3	cub., Tl_2O_3	T_h^7	9.41	16
$Mn_2O_3.H_2O$	rhomb.	....	4.46, 5.28, 2.88	
Mn_2Sb	tetr.	D_{4h}^7	4.08, ... 5.56	
$Mn_3Al_2Si_3O_{12}$	cub., b.c.	O_h^{10}	11.603	8
Mn_3Si	hex.	....	6.898, ..., 4.802	4
Mn_4N	cub.	....	3.860	1
$Mo(CO)_6$	rhomb.	C_{2v}^9	12.02, 6.48, 11.23	4
MoO_2	tetr., SnO_2	D_{4h}^{14}	4.86, ... 2.79	2
MoO_3	rhomb.	D_{2h}^{16}	3.92, 13.94, 3.66	4
MoS_2	hex.	D_{6h}^4	3.15, ... 12.30	2
$MoSi_2$	tetr.	D_{2h}^{17}	3.20, ..., 7.86	2
NH_3 (−80°C)	cub.	T^4	5.15	4
$(NH_4)_3AlF_6$	cub., $(NH_4)_3FeF_6$	T_h^6	8.40	4
$NH_4Al(SO_4)_2$	hex., $KAl(SO_4)_2$	D_3^2	4.724, ..., 8.225	1
$NH_4Al(SO_4)_2.12H_2O$	cub.	T_h^6	12.18	4
NH_4BF_4	rhomb.	V_h^{16}	9.06, 5.64, 7.23	4
$(NH_4)_2BeF_4$	rhomb., K_2SO_4	V_h^{16}	5.8, 10.2, 7.5	
NH_4Br	cub., CsCl	O_h^1	4.047	1
NH_4Br(250°C)	cub., NaCl	O_h^5	6.90	4
NH_4Cl	cub., CsCl	O_h^1	3.866	1
NH_4Cl(250°C)	cub., NaCl	O_h^5	6.53	4
NH_4ClO_4	rhomb.	V_h^{16}	9.202, 5.816, 7.449	4
NH_4ClO_4(270°C)	cub., $KClO_4$	....	7.63	1
$(NH_4)_3Co(NO_2)_6$	cub.	....	10.81	4
$(NH_4)_2Cr_2O_7$	monocl.	....	7.78, 7.54, 13.27, $\beta =$ 93° 42′	4
$(NH_4)_2CuCl_4.2H_2O$	tetr.	D_{4h}^{14}	7.58, ..., 7.95	2
NH_4F	hex., ZnO	C_{6v}^4	4.39, ..., 7.02	2
$(NH_4)_3FeF_6$	cub.	O_h^5	9.10	4
$NH_4Fe(SO_4)_2$	hex., $KAl(SO_4)_2$	D_3^2	4.825, ..., 8.310	1

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants *a*, *b*, *c*, Ax. ang.	Mol.
$NH_4Fe(SO_4)_2.12H_2O$	cub.	T_h^6	12.14	4
NH_4HF_2	rhomb.	V_h^7	8.33, 8.14, 3.68	4
$NH_4(H_2PO_2)$	rhomb.	V_h^{21}	3.98, 7.57, 11.47	4
$(NH_4)H_2PO_4$	tetr., KH_2PO_4	V_d^{12}	7.530, ..., 7.542	4
$(NH_4)_3HfF_7$	cub.	O_h^4	9.400	4
NH_4I	cub., NaCl	O_h^5	7.244	4
$NH_4I(-17°C)$	cub., CsCl	O_h^1	4.37	1
NH_4IO_4	tetr., $CaWO_4$	C_{4h}^6	5.94, ..., 12.80	4
NH_4I_3	rhomb.	V_h^{16}	6.64, 9.66, 10.82	4
$(NH_4)_3MoO_3F_3$	cub., $(NH_4)_3FeF_6$	O_h^5	9.10	4
NH_4NO_3	rhomb.	V_h^{13}	4.928, 5.434, 5.732	2
NH_4N_3	rhomb.	D_{2h}^7	8.930, 8.642, 3.800	4
$(NH_4)_2PbCl_6$	cub., $(NH_4)_2PtCl_6$	O_h^5	10.135	4
$NH_4Pb_2Br_5$	tetr.	D_{4h}^{18}	8.39, ..., 14.34	4
$(NH_4)_2PdCl_4$	tetr., K_2PtCl_4	D_{4h}^1	7.21, ..., 4.26	1
$(NH_4)_2PtCl_6$	cub.	O_h^5	9.834	4
$(NH_4)_2Pt(SCN)_6$	hex., $K_2Pt(SCN)_6$	D_{3d}^1 or D_{3d}^3	6.77, ..., 10.45	1
NH_4SH	tetr.	. . . .	6.01, ..., 4.01	
$(NH_4)_2SO_4$	rhomb., K_2SO_4	V_h^{16}	5.951, 10.560, 7.729	4
$(NH_4)_2S_2O_8$	monocl.	C_{2h}^5	7.83, 8.04, 6.13, $\beta =$ 95° 9′	2
$(NH_4)_2SeCl_6$	cub.	O_h^5	9.935	
$(NH_4)_2SiF_6$	cub., $(NH_4)_2PtCl_6$	O_h^5	8.38	4
$(NH_4)_2SiF_6$	hex.	D_{3d}^3	5.76, ..., 4.77	
$(NH_4)_2SnCl_6$	cub., $(NH_4)_2PtCl_6$	O_h^5	10.038	4
$(NH_4)_2TeCl_6$	cub.	O_h^5	10.178	
$(NH_4)_3W_2Cl_9$	hex.	C_{6h}^2	7.16, ..., 16.17	2
$(NH_4)_3ZrF_7$	cub.	O_h^4	9.353	4
NO_2	cub.	T^5	7.77	6
$N_2H_6Cl_2$	cub., FeS_2	T_h^6	7.89	4
N_2O	cub., CO_2	T^4	5.77	4
N_4S_4	rhomb.	V_h^1	8.87, 8.47, 7.20	4
NaBr	cub., NaCl	O_h^5	5.94	4
$NaBrO_3$	cub., $NaClO_3$	T^4	6.71	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$NaCbO_3$	cub., $CaTiO_3$	O_h^1	3.89	1
NaCl (18°C)	cub.	O_h^5	5.62737	4
Rock salt			5.62768	
$NaClO_3$	cub.	T^4	6.570	4
$NaClO_4$ (380°C)	cub.		7.25	
$NaClO_4$	rhomb., $CaSO_4$	V_h^{17}	6.48, 7.06, 7.08	4
NaF	cub., NaCl	O_h^5	4.62	4
$NaHCO_3$	monocl.	C_{2h}^5	7.51, 9.70, 3.53, $\beta =$ 93° 19′	4
$NaHC_2$	tetr., CaC_2	D_{4h}^{17}	3.82, ..., 8.17	2
$NaHF_2$	hex. (rhbdr.), $CsCl_2I$	D_{3d}^5	5.17, $\alpha =$ 39° 44′	1
NaI	cub., NaCl	O_h^5	6.46	4
$NaIO_3$	rhomb.	V_h^{19}	5.75, 6.37, 4.05	2
$NaIO_4$	tetr., $CaWO_4$	C_{4h}^6	5.32, ..., 11.93	4
$NaIO_4.3H_2O$	hex.	C_3^4	5.58, $\alpha =$ 65° 1′	1
$NaNO_2$	rhomb.		3.55, 5.56, 5.37	2
$NaNO_3$	rhbdr.	D_{3d}^6	6.3108, $\alpha =$ 47° 15′ 59″	
NaN_3	hex. (rhbdr.), $CsCl_2I$	D_{3d}^5	5.48, $\alpha =$ 38° 43′	1
NaSH	rhdbr.	D_{3d}^5	3.99, $\alpha =$ 68° 5′	
$NaSb(AlO_3)_2$	hex.	D_{6h}^4	5.40, ..., 8.81	2
$Na_2B_4O_7.10H_2O$	monocl.	C_{2h}^6	11.82, 10.61, 12.30, $\alpha =$ 106° 35′	4
$Na_2CO_3.H_2O$ (73°C)	rhomb.		10.721. 6.440, 5.243	4
$Na_2Ca(CO_3)_2$	hex.		20.3, ..., 12.02	32
Na_2CaSiO_4	cub.		7.497	4
Na_2CrO_4	rhomb.	V_h^6	5.91, 9.23, 7.20	4
$Na_2Mg(CO_3)_2$	hex.	C_3^1	4.95, ..., 16.50	6
Na_2S	cub., CaF_2	O_h^5	6.53	4
Na_2SO_3	hex.		5.441, ..., 6.133	2
Na_2SO_4	rhomb.	V_h^{24}	5.85, 12.29, 9.75	8
Na_3AlF_6	monocl.	C_{2h}^1 or C_{2h}^2	5.39, 5.59, 7.76, $\beta =$ 90° 11′	2
$Na_4Ca(SiO_3)_3$	cub. (?)		7.547	
$Na_{15}Pb_4$	cub.	T_d^6	13.29	
$Na_{15}Sn_4$	rhomb.		9.79, 22.78. 5.56	2
NdAl	cub.		3.73	1
NdC_2	tetr., CaC_2	D_{4h}^{17}	3.82, ... 6.23	2
NdF_3	hex., CeF_3	D_6^6	7.021, ..., 7.196	6
$NdPMo_{12}O_{40}.30H_2O$	cub.	O_h^7	23.1	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
Nd_2O_3	hex., La_2O_3	D_{3d}^3	3.841, ..., 6.009	1
NiAl	cub., CsCl	O_h^1	2.82	1
$NiAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.045	8
$NiAl_3(\epsilon)$	rhomb.	C_{2h}^{16}	6.5982, 7.3515, 4.8021	4
NiAs	hex.	D_{6h}^4	3.61, ..., 5.03	2
NiAsS	cub., CoAsS	T^4	5.68	4
NiBe	cub., CsCl	O_h^1	2.603	
$NiBr_2$	hex.	....	3.71, ..., 18.30	
$NiBr_2$	rhbdr.	....	6.46, $\alpha = 16° 40'$	
$NiBr_2.6NH_3$	cub., $(NH_4)_2PtCl_6$	O_h^5	10.48	4
$NiCl_2$	hex., $CdCl_2$	D_{3d}^5	6.13, $\alpha = 33° 36'$	1
$NiCl_2.6NH_3$	cub., $(NH_4)_2PtCl_6$	O_h^5	10.09	4
(Ni, Co) $(Co, Ni)_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.112	8
NiF_2	tetr., SnO_2	D_{4h}^{14}	4.710, ..., 3.118	2
(Ni, Fe)S (synthetic)	hex.	C_{6v}^4	3.408, ..., 5.434	2
$NiFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.340	8
NiI_2	hex.	....	3.89, ..., 19.63	
NiI_2	rhbdr.	....	6.92, $\alpha = 16° 20'$	
$NiI_2.6NH_3$	cub., $(NH_4)_2PtCl_6$	O_h^5	11.01	4
$Ni(NH_3)_6(NO_3)_2$	cub., $(NH_4)_2PtCl_6$	T_h^6	10.96	4
NiO	cub., NaCl	O_h^5	4.172	4
$Ni(OH)_2$	hex., CdI_2	D_{3d}^3	3.07, ..., 4.605	1
NiS (β)	hex.	....	3.42, ..., 5.30	
NiS (γ)	rhbdr.	....	9.61, ..., 3.15	
NiS (synthetic)	hex., NiAs	D_{6h}^4	3.42, ..., 5.30	2
$NiSO_3.6H_2O$	hemi. trig.	C_3^4	8.773, ..., 9.013, $\alpha = 96° 18'$	
$NiSO_4$	rhomb.	....	4.62, 6.51, 8.49	
$NiSO_4.7H_2O$	rhomb., $MgSO_4.7H_2O$	V^4	11.86, 12.08, 6.81	4
NiS_2	cub., FeS_2	T_h^6	5.74	4
NiSb	hex., NiAs	D_{6h}^4	3.94, ..., 5.14	2
$Ni(SbO_3)_2.12H_2O$	hex.	D_{3d}^1	16.019, ..., 9.768	2
NiSbS	cub., CoAsS	T^4	5.91	4
NiSe (β)	hex., NiAs	D_{6h}^4	3.66, ..., 5.33	2
NiSe (γ)	rhbdr.	....	9.84, ..., 3.18	
NiSi	cub., FeSi	T^4	4.437	
$NiSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.21, $\alpha = 96° 20'$	1
NiSn	hex., NiAs	D_{6h}^4	4.081, ..., 5.174	2

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
$NiSnCl_6.6H_2O$	hex. (rhbdr.)	C_{3i}^2	7.09, $\alpha = 96° 45'$	1
NiTe	hex., NiAs	D_{6h}^4	3.957, ..., 5.354	2
$NiTiO_3$	hex., $MgTiO_3$	C_{3i}^2	5.448, $\alpha = 55° 0'$	2
$Ni_2SiMo_{12}O_{40}.31H_2O$	cub.	O_h^7	23.0	8
Ni_2SiO_4	rhomb.	....	4.705, 10.11, 5.914	
Ni_3C	hex.	....	2.646, ..., 4.329	
Ni_3S_2	cub. (?)	....	4.08	1
OsO_2	tetr., SnO_2	D_{4h}^{14}	4.51, ..., 3.19	2
OsS_2	cub., FeS_2	T_h^6	5.64	4
$OsSe_2$	cub., FeS_2	T_h^6	5.933	4
$OsTe_2$	cub., FeS_2	T_h^6	6.369	4
PH_4I	tetr., PbO	D_{4h}^7	6.34, ..., 4.62	2
$PSBr_3$	cub.	T_h^6	11.03	8
P_2O_5	hex.	....	11.12, ..., 1.12	12
$P_3N_3Cl_6$	rhomb.	V_h^{16}	....	4
$P_4N_4Cl_8$	tetr.	C_{4h}^4	10.79, ..., 5.93	2
$PbBr_2$	rhomb.	V_h^{16}	4.71, 8.02, 9.48	4
$PbCO_3$	rhomb., KNO_3	V_h^{16}	5.14, 8.45, 6.10	4
$PbCl_2$	rhomb., $HgCl_2$	V_h^{16}	4.496, 7.667, 9.153	4
$PbCrO_4$	monocl.	C_{2h}^5	6.82, 7.48, 7.16, $\beta =$ 102° 33′	4
PbF_2	....	....	3.80, 6.41, 7.61	4
PbF_2 (β)	cub , CaF_2	O_h^5	5.93	4
PbI_2	hex., CdI_2	D_{3d}^3	4.54, ..., 6.86	1
$PbMoO_4$	tetr., $CaWO_4$	C_{4h}^6	5.41, ..., 12.08	4
$Pb(NO_3)_2$	cub., $Ba(NO_3)_2$	T_h^6	7.84	4
PbO (red)	tetr., PbO	D_{4h}^7	3.98, ..., 5.01	2
PbO (yellow)	rhomb.	V_h^{19}	5.50, 4.72, 5.88	4
PbO_2	tetr., SnO_2	D_{4h}^{14}	4.97, ..., 3.40	2
PbS	cub., NaCl	O_h^5	5.97	4
$PbSO_4$	rhomb., $BaSO_4$	V_h^{16}	8.45, 5.38, 6.93	4
PbSe	cub., NaCl	O_h^5	6.14	4
PbTe	cub., NaCl	O_h^5	6.34	4
$PbTiO_3$ (375°C)	rhomb.	D_{2h}^1	4.000, 4.211, 3.875	
$PbWO_4$	tetr., $CaWO_4$	C_{4h}^6	5.44, ..., 12.01	4

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
Pb_2O	cub., Cu_2O	O_h^4	5.38	2
$Pb_3(PO_4)_2$	hex.	....	9.66, ..., 7.11	3
$PdAs_2$	cub., FeS_2	T_h^6	5.970	4
$Pd(NH_3)_4Cl_2.H_2O$	tetr.	D_{4h}^5(?)	10.302, ..., 4.34	2
PdO	tetr., PbO	D_{4h}^7	3.209, ..., 5.314	2
PdSb	hex., NiAs	D_{6h}^4	4.070, ..., 5.582	2
$PdSb_2$	cub., FeS_2	T_h^6	6.439	4
PdTe	hex., NiAs	D_{6h}^4	4.127, ..., 5.663	2
$PdTe_2$	hex., CdI_2	D_{3d}^3	4.028, ..., 5.118	1
PrC_2	tetr., CaC_2	D_{4h}^{17}	3.85, ..., 6.38	2
PrF_3	hex., CeF_3	D_6^6	7.061, ..., 7.218	6
PrN	cub., f.c.	....	5.155	
PrO_2	cub., CaF_2	O_h^5	5.36	4
PrP	cub., f.c.	....	5.86	
Pr_2O_3	hex., La_2O_3	D_{3d}^3	3.851, ..., 5.996	1
Pr_6O_{11}	cub.	....	10.98	
$PtAs_2$	cub., FeS_2	T_h^6	5.957	4
$PtBr_2$	cub., f.c.	....	10.35	4
PtP_2	cub., FeS_2	T_h^6	5.683	4
PtS_2	hex., CdI_2	D_{3d}^3	3.537, ..., 5.019	1
PtSb	hex., NiAs	D_{6h}^4	4.130, ..., 5.472	2
$PtSb_2$	cub., FeS_2	T_h^6	6.428	4
$PtSe_2$	hex., CdI_2	D_{3d}^3	3.724, ..., 5.062	1
PtSn	hex., NiAs	D_{6h}^4	4.103, ..., 5.428	2
$PtTe_2$	hex., CdI_2	D_{3d}^3	4.010, ..., 5.201	1
PtTl	hex.	....	5.605, ..., 4.639	3
RaF_2	cub.	....	6.368	4
$RbAl(SO_4)_2.12H_2O$	cub.	T_h^6	12.20	4
$RbBF_4$	rhomb.	V_h^{16}	9.07, 5.60, 7.23	4
RbBr	cub., NaCl	O_h^5	6.868	4
RbCl	cub., NaCl	O_h^5	6.571	4
RbCl(α) (temp. liq. air)	cub., CsCl	O_h^1	3.742	
$RbClO_4$	rhomb., $BaSO_4$	V_h^{16}	9.27, 5.81, 7.53	4
$RbClO_4$(320°C)	cub.	T_d^2	7.65	
RbF	cub., NaCl	O_h^5	5.63	4

Substance	System, struct. type	Space group	Lattice constants	Mol
			a, b, c, Ax. ang.	
RbI	cub., NaCl	O_h^5	7.325	4
$RbIO_3$	cub., $CaTiO_3$	O_h^1	4.52	1
$Rb(NO_3)$	rhomb.	C_{3v}^2	18.08, 10.45, 7.38	18
RbN_3	tetr., KN_3	D_{4h}^{18}	6.36, ... , 7.41	4
$RbPb_2Br_5$	tetr.	D_{4h}^{18}	8.41, ... , 14.5	4
RbSH	rhbdr.	D_{3d}^5	4.53, $\alpha = 69° 20'$	
$Rb_2CuCl_4.2H_2O$	tetr., $(NH_4)_2CuCl_4.2H_2O$	D_{4h}^{14}	7.81, ... , 8.00	2
Rb_2PbCl_6	cub.	O_h^5	10.195	
Rb_2PtCl_6	cub.	O_h^5	9.884	4
$Rb_2Pt(SCN)_6$	hex., $K_2Pt(SCN)_6$	D_{3d}^1 or D_{3d}^3	6.75, ... , 10.47	1
Rb_2SO_4	rhomb., K_2SO_4	V_h^{16}	5.949, 10.391, 7.780	4
$Rb_2S_2O_6$	hex.	D_3^2	10.144, ... , 6.409	3
Rb_2SeCl_6	cub.	O_h^5	9.978	
Rb_2SnCl_6	cub.	O_h^5	10.099	
Rb_2TeCl_6	cub.	O_h^5	10.233	
Rb_2TiCl_6	cub.	O_h^5	9.922	
Rb_2ZrCl_6	cub.	O_h^5	10.178	
$Rb_3Co(NO_2)_6$	cub.	. . . .	10.73	4
Rb_3N	tetr.	D_{4h}^1	4.497, ... , 3.707	1
$Rb_3W_2Cl_9$	hex.	C_{6h}^2	7.24, ... , 16.95	2
$Rh(NH_3)_5Cl)Cl_2$	rhomb.	V_h^{16}	13.32, 6.71, 10.42	4
RhS_2	cub., FeS_2	T_h^6	5.574	4
Rh_2O_3	hex., Fe_2O_3	D_{3d}^6	5.47, $\alpha = 55° 40'$	2
RuO_2	tetr., SnO_2	D_{4h}^{14}	4.51, ... , 3.11	2
RuS_2	cub., FeS_2	T_h^6	5.57	4
$RuSe_2$	cub., FeS_2	T_h^6	5.921	4
$RuTe_2$	cub., FeS_2	T_h^6	6.360	4
SaF_3	hex., CeF_3	D_6^6	6.98, ... , 7.15	6
Sa_2O_3	cub., Tl_2O_3	T_h^7	10.85	16
SbI_3	hex., AsI_3	C_3^1	7.466, ... , 20.89	6
SbSn(43–55 % Sb)	cub., NaCl	O_h^5	6.130	4
Sb_2O_3	cub., As_2O_3	O_h^7	11.06	16

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
Sb_2S_3	rhomb.	V_h^{16}	11.39, 11.48, 3.89	4
Sb_2Tl_7	cub.	....	11.59	6
$(Sc. In)_2O_3$	cub.	O_h^{10}	9.90	16
ScN	cub., NaCl	O_h^5	4.44	4
Sc_2O_3	cub., Tl_2O_3	T_h^7	9.79	16
SiC (I)	hex.	C_{3v}^5	12.78, $\alpha = 13° 55'$	15
SiC (II)	hex.	C_{6v}^4	3.095, ..., 15.17	6
SiC (III)	hex.	C_{6v}^4	3.095, ..., 10.10	4
SiC (IV)	cub., ZnS	T_d^2	4.348	
SiC (V)	hex.	....	43.15, $\alpha = 4° 6'$	51
SiI_4	cub.	T_h^6	11.99	8
SiO_2 (β cristobalite) (290°C)	cub.	O_h^7	7.12	8
SiO_2 (α quartz)	hex.	D_3^4 or D_3^6	4.903, ..., 5.393	3
SiO_2 (β quartz) (600°C)	hex.	D_6^4 or D_6^5	5.01, ... 5.47	
SiO_2 (α tridymite)	rhomb.	D_{6h}^4	9.88, 17.1, 16.3	64
SiO_2 (β tridymite)	hex.	D_{6h}^4	5.03, ..., 8.22	64
$SiO_3ZnO_2H_2$	rhomb.	C_{2v}^{20}	8.41, 5.14, 10.73, $\beta =$ 90°	4
SiP_2O_7	cub.	T_h^6	7.46	4
$SmPMo_{12}O_{40}.30H_2O$	cub.	O_h^7	23.1	8
SnAs	cub., NaCl	O_h^5	5.716	4
SnI_4	cub.	T_h^6	12.23	8
SnO	tetr., PbO	D_{4h}^7	3.77, ..., 4.77	2
SnO_2	tetr.	D_{4h}^{14}	4.72, ..., 3.16	2
SnP_2O_7	cub.	T_h^6	7.89	4
SnS_2	hex., CdI_2	D_{3d}^3	3.639, ..., 5.868	1
SnSb	rhbdr.	....	6.117, $\alpha = 89.70°$	
SnTe	cub., NaCl	O_h^5	6.285	4
Sn_3As_2	rhbdr.	D_{3d}^5	12.23, $\alpha = 19.22°$	7 at.
Sn_8Cu_{31}	cub.	....	17.91	
$SrCO_3$	rhomb., KNO_3	V_h^{16}	5.13, 8.42, 6.10	4
SrC_2	tetr., CaC_2	D_{4h}^{17}	5.81, ..., 6.68	2
$SrC_2O_4.2.5H_2O$	tetr.	....	12.795, ..., 7.509	8
$SrCl_2$	cub., CaF_2	O_h^5	7.00	4
$SrCl_2.6H_2O$	hex.	C_{3i}^2	7.906, ..., 4.07	1

Substance	System, struct. type	Space group	Lattice constants	Mol
			a, b, c, Ax. ang.	
SrF_2	cub., CaF_2	O_h^5	5.86	4
$SrMoO_4$	tetr., $CaWO_4$	C_{4h}^6	5.36, ..., 11.94	4
$Sr(NO_3)_2$	cub., $Ba(NO_3)_2$	T_h^6	7.81	4
SrO	cub., NaCl	O_h^5	5.10	4
$Sr(OH)_2.8H_2O$	tetr.	D_{4h}^1	6.41, ..., 5.807	1
SrO_2	tetr., CaC_2	D_{4h}^{17}	5.02, ..., 6.55	
$SrO_2.8H_2O$	tetr.	....	6.32, ..., 5.56	1
$SrPb_3$	tetr.	....	4.955, ..., 5.025	
SrS	cub., NaCl	O_h^5	5.87	4
$SrSO_4$	rhomb., $BaSO_4$	V_h^{16}	8.36, 5.36, 6.84	4
SrSe	cub., NaCl	O_h^5	6.23	4
SrTe	cub., NaCl	O_h^5	6.48	4
$SrTiO_3$	cub., $CaTiO_3$	O_h^1	3.92	1
$SrZrO_3$	cub., $CaTiO_3$	O_h^1	4.09	1
TaC	cub., NaCl	....	4.53	4
TaN	hex., ZnO	C_{6v}^4	3.05, ..., 4.94	2
Tb_2O_3	cub., Tl_2O_3	T_h^7	10.70	16
Tb_4O_7	cub.	....	10.55	
TeO_2	tetr., SnO_2	D_{4h}^{14}	4.79, ..., 3.77	2
TeO_6H_6	cub.	O_h^5	7.83	4
TeO_6H_6	monocl.	C_{2h}^5	5.54, 9.30, 9.74, $\beta =$ 104° 30′	4
ThB_6	cub.	....	4.32	1
ThC_2	tetr.	....	5.85, ... 5.28	4
ThO_2	cub., CaF_2	O_h^5	5.59	4
$TiBr_4$	cub.	....	11.25	
TiC	cub., NaCl	O_h^5	4.311	4
TiI_4	cub.	....	12.00	
TiN	cub., NaCl	O_h^5	4.40	4
TiO	cub., NaCl	O_h^5	4.235	4
TiO_2 (anatase)	tetr.	D_{4h}^{19}	3.73, ..., 9.37	4
TiO_2 (brookite)	rhomb.	V_h^{15}	9.166, 5.436, 5.135	8
TiO_2 (rutile)	tetr., SnO_2	D_{4h}^{14}	4.58, ..., 2.95	2
TiP_2O_7	cub.	T_h^6	7.80	4
TiS_2	hex., CdI_2	D_{3d}^3	5.691, ..., 3.397	1
$TiSe_2$	hex., CdI_2	D_{3d}^3	5.995, ... 3.533	1

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
$TiTe_2$	hex., CdI_2	D_{3d}^3	6.539, ..., 3.774	1
Ti_2O_3	hex., Fe_2O_3	D_{3d}^6	5.37, $\alpha = 56° 48'$	2
$TlAl(SO_4)_2.12H_2O$	cub.	T_h^6	12.21	4
TlBi	cub., CsCl	O_h^1	3.98	1
TlBr	cub., CsCl	O_h^1	3.97	1
TlCNS	rhomb.	V_h^{11}	6.80, 6.78, 7.52	4
TlCl	cub., CsCl	O_h^1	3.84	1
$TlClO_4$	rhomb., $BaSO_4$	V_h^{16}	9.42, 5.88, 7.50	4
$TlClO_4$(280°C)	cub., $KClO_4$	T_d^2	7.61	
TlF	rhomb., f.c.	V_h^{23}	5.180, 5.495, 6.080	4
$TlHF_2$	cub.	....	8.58	8
TiI	rhomb.	D_{2h}^{17}	5.24, 4.57, 12.92	4
TlN_3	tetr., KN_3	D_{4h}^{18}	6.21, ..., 7.37	
TlSb (Tl in excess)	cub., CsCl	O_h^1	3.84	1
Tl_2O_3	cub.	T_h^7	10.57	16
Tl_2PtCl_6	cub.	O_h^5	9.755	
Tl_2SnCl_6	cub.	O_h^5	9.970	
Tl_2TeCl_6	cub.	O_h^5	10.107	
$Tl_3Co(NO_2)_6$	cub.	....	10.72	4
$Tl_3W_2Cl_9$	hex.	C_{6h}^2	7.15, ..., 16.33	2
Tm_2O_3	cub., Tl_2O_3	T_h^7	10.52	16
UO_2	cub., CaF_2	O_h^5	5.47	4
$UO_2(NO_3)_2.6H_2O$	rhomb.	V_h^{17}	11.42, 13.15, 8.02	4
VC(ϵ)	cub., NaCl	O_h^5	4.30	4
VN	cub., NaCl	O_h^5	4.28	4
VO_2	tetr., SnO_2	D_{4h}^{14}	4.54, ..., 2.88	2
V_2O_3	hex., Fe_2O_3	D_{3d}^6	5.43, $\alpha = 53° 53'$	2
V_2O_5	....	....	11.48, 4.36, 3.55	2
WC	hex.	....	2.901, ..., 2.830	1
$W(CO)_6$	rhomb.	C_{2v}^9	11.90, 6.42, 11.27	4
WO_2	tetr., SnO_2	D_{4h}^{14}	4.86, ..., 2.77	2
WS_2	hex., MoS_2	D_{6h}^4	3.18, ..., 12.5	2
WSi_2	tetr.	D_{4h}^{17}	3.212, ..., 7.880	2

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
W_2C (β) (2600°C)	hex.		2.99, ..., 4.72	1
$YAlO_3$	cub., $CaTiO_3$	O_h^1	3.67	1
$(Y. Bi)_2O_3$	cub.	O_h^{10}	10.72	16
$YCbO_4$	tetr		7.76, ..., 11.32	8
YF_3	cub.		5.49	4
YPO_4	tetr., $ZrSiO_4$	D_{4h}^{19}	6.88, ..., 6.03	4
$YTaO_4$	tetr.		7.75, ..., 11.41	8
$(Y, Tl)_2O_3$	cub.	O_h^{10}	10.53	16
$Y(VO_3)_3$	tetr.	D_{4h}^{19}	7.126, ..., 6.197	4
Y_2O_3	cub., Tl_2O_3	T_h^7	10.60	16
Yb_2O_3	cub., Tl_2O_3	T_h^7	10.39	16
$ZnAl_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.099	8
$Zn(BrO_3)_2.6H_2O$	cub., $(NH_4)_2PtCl_6$	T_h^6	10.31	4
$ZnCO_3$	hex., $NaNO_3$	D_{3d}^6	5.704, $\alpha = 48° 6'$	2
$ZnCl_2$	hex., $CdCl_2$	D_{3d}^5	6.31, $\alpha = 34° 48'$	1
$ZnCo_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.108	8
$ZnCr_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.323	8
ZnF_2	tetr., SnO_2	D_{4h}^{14}	4.715, ..., 3.131	2
$ZnFe_2O_4$	cub., $MgAl_2O_4$	O_h^7	8.403	8
$Zn(NH_3)_2Br_2$	rhomb.	D_{2h}^{28}	8.12, 8.81, 8.41	4
$Zn(NH_3)_2Cl_2$	rhomb.	D_{2h}^{28}	7.78, 8.50, 8.08	4
ZnO	hex.	C_{6v}^4	3.24265, ..., 5.1948	2
$ZnO.Fe_2O_3$	cub.		8.41	8
$Zn(OH)_2$	rhomb.	V^4	5.16, 8.53, 4.92	4
ZnS (α) (wurzite)	hex., ZnO	C_{6v}^4	3.84, ..., 6.28	2
ZnS (β) (blende)	cub.	T_d^2	5.43	4
$ZnSO_4$	rhomb.		4.71, 6.73, 8.51	4
$ZnSO_4.7H_2O$	rhomb., $MgSO_4.7H_2O$	V^4	11.85, 12.09, 6.83	4
$ZnSO_4.(NH_4)_2SO_4.6H_2O$	monocl.	C_{2h}^5	9.20, 12.47, 6.23, $\beta = 106° 52'$	2
$ZnSe$	cub., ZnS	T_d^2	5.65	4
$ZnSiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.27, $\alpha = 96° 5'$	1
$ZnSnF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.54, $\alpha = 95° 51'$	1
$ZnSnO_3$	cub.		8.650	
$ZnTe$	cub., ZnS	T_d^2	6.07	4
$ZnTiF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.41, $\alpha = 96° 20'$	1
$ZnTiO_3$	cub.		8.460	

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
$ZnZrF_6.6H_2O$	hex., $NiSnCl_6.6H_2O$	C_{3i}^2	6.57, $\alpha = 96° 5'$	1
Zn_2SnO_4	cub., $MgAl_2O_4$	O_h^7	8.65	8
Zn_2TiO_4	cub., $MgAl_2O_4$	O_h^7	8.46	8
Zn_3As_2	cub.	....	5.81	2
Zn_3P_2	cub., Zn_3As_2	....	5.68	2
ZrC	cub., NaCl	O_h^5	4.73	4
$ZrCl_4$	cub., SnI_4	T_h^6	10.32	8
ZrF_4	monocl.	C_{2h}^6	9.46, 9.87, 7.64, $\beta =$ 94° 30′	12
ZrN	cub., NaCl	O_h^5	4.61	4
ZrO_2	cub., CaF_2	O_h^5	5.07	4
ZrO_2	hex.	....	3.598, ..., 5.875	
ZrO_2	monocl.	....	5.21, 5.26, 5.37, $\beta =$ 80° 32′	4
ZrO_2	tetr.	....	5.07, ..., 5.16	4
ZrP_2O_7	cub.	T_h^6	8.20	4
ZrS_2	hex., CdI_2	D_{3d}^3	3.68, ..., 5.85	1
$ZrSe_2$	hex., CdI_2	D_{3d}^3	3.79, ..., 6.18	1
$ZrSi_2$	rhomb.	V_h^{17}	3.72, 14.61, 3.67	4
ZrW_2	cub., f.c.	....	7.61	8

MINERALS

Name	Formula	Crystal system	Space group	Lattice constants	Mol.
				a, b, c, Ax. ang.	
Actinolite	$H_2Ca_2(Mg,Fe)_5(SiO_3)_8$	monocl.	....	9.8, 17.9, 5.27, $\beta =$ *ca* 74°	
Aenigmatite	....	tricl.	....	18.3, 18.3, 10.6, $\alpha =$ 96° 30′, $\beta =$ 96° 30′, $\gamma =$ 113° 30′	
Analcite	$NaAlSi_2O_6.H_2O$	cub.	....	13.64	
Andalusite	Al_2SiO_5	rhomb.	V_h^{12}	7.76, 7.90, 5.56	4
Anhydrite	$CaSO_4$	rhomb.	V_h^{17}	6.22, 6.96, 6.97	4
Anthophyllite	$H_2Mg_7(SiO_3)_8$	rhomb.	....	18.52, 18.04, 5.27	
Apatite	$Ca(F,Cl)Ca_4(PO_4)_3$	hex.	C_{6h}^2	9.37, . .., 6.88	2
Apophyllite	$4(Si_2O_5H_2.CaO_2H_2)KF(?)$	tetr.	....	12.71, ..., 15.86	
Aragonite	$CaCO_3$	rhomb.	V_h^{16}	4.94, 7.94, 5.72	4
Atopite	$(Ca,Mn,Na,)_2Sb_2(O, OH, F)_7$	cub.	....	10.27	8
Babingtonite	....	tricl.	....	6.73, 7.54, 12.43, $\alpha =$ 112° 22′, $\beta =$ 93° 48′, $\gamma =$ 86° 9′	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Name	Formula	Crystal system	Space group	Lattice constants	Mol.
				a, b, c, Ax. ang.	
Bastnäsite	$(Ce,La)FCO_3$	hex.	D_{3h}^3	7.094, ..., 4.859	3
Benitoite	$BaTiSi_3O_9$	hex.	....	6.60, ..., 9.71	
Beryl	$Be_3Al_2(SiO_3)_6$	hex.	D_{6h}^2	9.21, ..., 9.17	2
Berzeliite	$NaCa_2Mn_2As_3O_{12}$	cub.	....	12.36	
Bixbyite	$(Fe,Mn)_2O_3$	cub.	T_h^7	9.365	16
Boracite	$Mg_6Cl_2B_{14}O_{26}$	rhomb.	....	16.97, 16.97, 12.00	8
Bornite	Cu_5FeS_4	cub.	....	10.91	
Braggite	Approx. $Pt_9Pd_5Ni_2S_{16}$	tetr.	C_{4h}^2	6.37, ..., 6.58	8
Calaverite	AuTe	monocl.	....	7.18, 4.40, 5.07, β = 90° ± 30′	2
Calcite	$CaCO_3$	rhbdr.	D_{3d}^6	6.361, α = 46° 6′	2
Cancrinite	$3SiO_4AlNa.CaCO_3$(?)	hex.	....	12.60, ..., 5.18	
Chalcopyrite	$CuFeS_2$	tetr.	V_d^5	3.726, ..., 5.194	1
Chondrodite	$Mg_3[Mg(F,OH)]_2(SiO_4)_2$	monocl.	C_{2h}^5	4.733, 10.27, 7.87, α = 109° 2′	2
Chromite	$(Fe,Mg)Cr_2O_4$	cub.	O_h^7	8.35	8
Chrysoberyl	$BeAl_2O_4$	rhomb.	V_h^{16}	4.420, 9.390, 5.470	4
Chrysotile	$H_4Mg_3Si_2O_9$	rhomb.	....	14.66, 18.5, 5.33, β = 93° 16′	
Cinnabar	HgS	hex.	D_3^4 or D_3^6	4.14, ..., 9.49	3
Clinohumite	$Mg_7[Mg(F,OH)]_2(SiO_4)_4$	monocl.	C_{2h}^5	4.745, 10.27, 13.68, α = 100° 50′	2
Columbite	$(Fe,Mn)(Cb,Ta)_2O_6$	rhomb.	....	5.082, 14.24, 5.730	
Cooperite	PtS	tetr.	D_{4h}^9	4.91, ..., 6.10	8
Cordierite	$Mg_2Si_5O_{12}.2Al_2O_3$	rhomb.	....	9.78, 17.1, 9.33	
Covellite	....	hex.	D_{6h}^4	3.802, ..., 16.43	6
Cryolithionite	$Na_3Al_2Li_3F_{12}$	cub.	....	12.10	
Cumengeite	$PbCl_2CuO_2H_2$(?)	tetr.	....	15.17, ..., 24.71	
Cyanite	Al_2SiO_5	tricl.	C_i^1	7.09, 7.72, 5.56, β = 101° 2′	4
Danburite	$CaB_2Si_2O_8$	rhomb.	....	8.75, 8.01, 7.72	
Datolite	$CaSiO_3.HBO_2$	monocl.	....	9.64, 7.62, 4.82, β = 90° 9′	
Davynite	$3SiO_4AlNa.Ca(SO_4,Cl_2)$	hex.	....	12.80, ..., 5.35	
Dietzeite	$Ca(IO_3)_2.CaCrO_4$	monocl.	....	10.16, 7.30, 14.03, β = 106° 32′	4
Diopside	$CaMg(SiO_3)_2$	monocl.	C_{2h}^6	9.71, 8.89, 5.24, β = 74° 10′	
Dioptase	CuH_2SiO_4	hex.	....	14.66, ..., 7.83	
Dolomite	$CaMg(CO_3)_2$	hex., (rhbdr.)	C_{3i}^2	6.02, α = 47° 30′	1
Dysanalyte	$(CaTiO_3,NaCbO_3)$	cub.	....	3.826	
Enstatite	$MgSiO_3$	rhomb.	....	18.20, 8.86, 5.20	
Epididymite	$NaBeSi_3O_7(OH)$	rhomb.	....	12.71, 7.33, 13.62	
Euclase	$BeSiO_3.HAlO_2$	monocl.	....	4.63, 14.30, 4.71, β = 100° 16′	
Eudialyte	$(Na,Ca.Fe)_6ZrSi_6O_{18}(OH,Cl)$	hex.	....	13.01, α = 66° 44′	

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Name	Formula	Crystal system	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Eudidymite	$NaBeSi_3O_7(OH)$	monocl.	....	12.62, 7.37, 13.99, β = 103° 43′	
Finnemanite	$9PbO.3As_2O_3.PbCl_2$	hex.	....	10.21, ..., 6.97	1
Fluorite	CaF_2	cub.	O_h^5	5.451	4
Garnet	$(Fe'',Mn'')_3Al_2(SiO_4)_3$	cub.	O_h^{10}	11.40	8
Gehlenite	....	tetr.	....	11.11, ..., 5.06	
Granerite	$H_2Fe_7(SiO_3)_8$	monocl.	....	9.4, 17.9, 5.27, β = ca 74°	
Granite	$Al_2Ca_3(SiO_4)_3$	cub.	O_h^{10}	11.83	8
Haematophanite	$Pb(Cl,OH)_2.4PbO.2Fe_2O_3$	tetr.	....	7.80, ..., 15.23	3
Hardystonite	$Ca_2ZnSi_2O_7$	tetr.	....	7.83, ..., 4.99	
Haüynite	cub.	....	....	9.04	
Helvite	$Be_3(Mn,Fe)_3(SiO_4)_3MnS$	cub.	....	8.25	
Hematite	Fe_2O_3	hex.	D_{3d}^6	5.42, α = 55° 17′	2
Hemimorphite	$Zn_2SiO_4.H_2O$	rhomb.	....	8.41, 5.14, 10.73	
Heulandite	$H_4CaAl_2Si_6O_{18}.3H_2O$	monocl.	....	7.54, 17.97, 15.91, β = 83° 34′	
Hornblende	$H_2(Ca,Na,K)_{2-3}(Mg,Fe,Al)_5[(Si,Al)O_3]_8$	monocl.	....	ca 9.8, 17.9, 5.28, β = ca 74°	
Humite	$Mg_6[Mg(F,OH)]_2(SiO_4)_3$	rhomb.	V_h^{16}	4.738, 10.23, 20.86	4
Ice (α)	H_2O	hex.	D_{6h}(?)	4.52, ..., 7.34	4
Ice (β)	H_2O	rhbdr.	C_{3i} or C_3	4.52, ..., 7.34	4
Ice II (low temp.)	H_2O	rhomb., f.c.	V^5	7.80, 4.50, 5.56	8
Ice III	H_2O	rhomb.	V_h^{26}	10.20, 5.87, 7.17	16
Ilmenite	$FeTiO_3$	rhbdr.	C_{3i}^2	5.40	2
Jacobsite	$(Mg,Mn,Fe)Fe_2O_4$	cub.	O_h^7	8.42	8
Julienite	$Na_2Co(SCN)_4.8H_2O$	tetr.	....	9.22, ..., 5.56	1
Kaliophilite	$KAlSiO_4$	hex.	....	15.59, ..., 8.59	
Kernite	$Na_2B_4O_7.4H_2O$	monocl.	C_{2h}^4	6.96, 9.14, 15.52, β = 108° 52′	4
Krennerite	$AuTe_2$	rhomb.	C_{2v}^4	16.51, 8.80, 4.45	8
Kupfferite	$H_2Mg_7(SiO_3)_8$	monocl.	....	9.7, 17.8, 5.25, β = ca 74°	
Lautarite	$Ca(IO_3)_2$	monocl.	C_{2h}^5	7.18, 11.38, 7.32, β = 106° 22′	4
Leucite	$K_2O.Al_2O_3.4SiO_2$	tetr.	....	12.95, ..., 13.65	
Magneto-plumbite	$2(Pb,Mn)O.3Fe_2O_3$	hex.	....	6.06, ..., 23.69	4
Manganite	$Mn(OH)O$	monocl.	....	8.86, 5.24, 5.70, β = 90°	
Marcasite	FeS_2	rhomb.	V_h^{12}	3.35, 4.40, 5.35	2
Mauzeliite	$(Ca_8,Na_2)(Sb_8,Ti_2)O_{31}F_4$	cub.	....	12.30	
Melilite	$(Ca,Na)_2(Mg,Al)(Si,Al)_2O_7$	tetr.	....	7.73, ..., 5.01	
Meliphanite	$(Ca,Na)_2Be(Si,Al)_2(O,F)_7$	tetr.	....	7.47, ..., 4.92	
Metacinnabar	HgS	cub.	T_d^2	5.84	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Name	Formula	Crystal system	Space group	Lattice constants	Mol.
				a, b, c, Ax. ang.	
Metavoltine	$K_5H_7(SO_4)_6.3FeO_3H_3.H_2O$	hex.	. . . .	19.43, ..., 18.60	8
Miersite	$4AgI.CuI$	cub.	T_d^2	6.35	4
Millerite	NiS	hex., (rhbdr.)	C_{3v}^5	5.655, α = 116° 36′	3
Mimetite	$9PbO.3As_2O_5.PbCl_2$	hex.	. . . .	10.01, ..., 7.28	1
Monticellite	$CaMgSiO_4$	rhomb.	. . . .	4.815, 11.08, 6.37	
Mossite	$Fe(Cb, Ta)_2O_6$	tetr.	D_{4h}^{14}	4.71, ..., 9.12	2
Muscovite	$KH_2Al_2Si_3AlO_{12}$	monocl.	. . . .	5.18, 9.02, 20.04, β = 95° 30′	
Natrolite	$Na_2Al_2Si_3O_{16}.2H_2O$	rhomb.	C_{2v}^{19}	18.19, 18.62, 6.58	8
Nephelite	$NaAlSiO_4$	hex.	. . . .	10.09, ..., 8.49	
Neptunite	$Na_2FeSi_2O_6.Si_2TiO_6$	monocl.	. . . .	16.54, 12.64, 10.04, β = 115° 38′	
Norbergite	$Mg(F,OH)_2Mg_2SiO_4$	rhomb.	V_h^{16}	4.70, 10.2, 8.72	4
Olivine	$(Mg,Fe'')_2SiO_4$	rhomb.	V_h^5	4.77, ..., 6.00	4
Pentlandite	$(Ni,Fe)S$	cub.	O_h^5	10.00	32
Perovskite	$CaTiO_3$	cub.	O_h^1	3.80	1
Petalite	$LiAlSiO_4.3SiO_2$	monocl.	. . . .	11.77, 5.13, 15.17, β = 112° 44′	
Phenacite	Be_2SiO_4	hex.	. . . .	7.684, α = 108° 1′	
Plumboferrite	$PbO.2Fe_2O_3$	hex.	. . . .	11.86, ..., 47.14	42
Pollucite	$[Si_4Al_2O_{12}]Cs_2.H_2O$	cub.	O_h^{10}	13.71	2
Polydymite	Ni_3S_4	cub.	O_h^7	9.65	8
Proustite	Ag_3AsS_3	rhbdr. trig.	C_{3v}^6	. . . .	
Pseudo-boleite	$5PbCl_2.4CuO.6H_2O$	tetr.	. . . .	15.4, ..., 31.2	12
Pseudobrookite	Fe_2TiO_5	rhomb.	. . . .	9.78, 9.80, 3.65	4
Pyrargyrite	Ag_3SbS_3	rhbdr. trig.	C_{3v}^6	. . . .	
Pyrite	FeS_2	cub.	T_h^6	5.404	4
Quartz (α)	SiO_2	hex.	D_3^4 or D_3^6	4.903. . . . . . 5.393	3
Rhodonite	$Mn_4Ca(SiO_3)_5$	tricl.	. . . .	7.77, 12.45, 6.74, α = 85° 10′, β = 94° 4′, γ = 111° 29′	
Rutile	TiO_2	tetr.	D_{4h}^{14}	4.58, ..., 2.95	2
Scapolite	$nNa_4Al_3Si_9O_{24}Cl + m\ Ca_4Al_6Si_6O_{25}$	tetr.	C_{4h}^5	12.72, ..., 7.66	2
Scheelite	$CaWO_4$	tetr.	C_{4h}^6	5.24, ..., 11.38	4
Sillimanite	$Al_2O_3.SiO_2$	rhomb.	. . . .	7.43, 7.58, 5.74	
Skutterudite	$CoAs_3$	cub.	T_h^5	8.18	8
Sodalite	$Na_4Al_3Si_3O_{12}Cl$	cub.	. . . .	8.87	
Spinel	Al_2MgO_4	cub.	O_h^7	8.09	8
Spodumene	$Li_2O.Al_2O_3.4SiO_2$	monocl.	. . . . . .	9.50, 8.30, 5.24, β = 69° 40′	4
Staurolite	$Fe(OH)_2.2Al_2SiO_5$	rhomb.	V_h^{17}	7.82, 16.52, 5.63	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Name	Formula	Crystal system	Space group	Lattice constants	Mol.
				a, b, c, Ax. ang.	
Sulfohalite	$2Na_2SO_4.NaCl.NaF$	cub., f.c.	....	10.08	4
Sulvanite	Cu_3VS_4	cub.	T_d^2	5.370	1
Talc	$3MgO.4SiO_2.H_2O$	pseudo-hex. (monocl. or rhomb.)	C_s^4	5.25	
Tetrahedrite	Cu_3SbS_3	cub.	....	10.32	
Thortveitite	$Sc_2Si_2O_7$	monocl.	....	6.56, 8.58, 4.74, β = 103° 8′	
Tincalconite	$Na_2B_4O_7.5H_2O$	hex.	....	11.3, ..., 20.9	9
Tincalconite	$Na_2B_4O_7.5H_2O$	rhbdr.	C_{3i}^2	9.46, α = 71° 42′	3
Titanite	$CaTiSiO_5$	monocl.	....	6.55, 8.70, 7.43, β = 119° 43′	
Topaz	$Al_2F_2SiO_4$	rhomb.	V_h^{16}	4.64, 8.78, 8.37	4
Tourmaline	....	hex.	C_{3v}^1	16.23, ..., 7.26	
Tremolite	$H_2Ca_2Mg_5(SiO_3)_8$	monocl.	....	9.78, 17.8, 5.26, β = 73° 58′	
Tridymite (α)	SiO_2	rhomb.	D_{6h}^4	9.88, 17.1, 16.3	64
Tridymite (β)	SiO_2	hex.	D_{6h}^4	5.03, ..., 8.22	64
Trimerite	$Be(Ca,Mn)SiO_4$	hex.	....	16.11, ..., 7.60	
Tysonite	$(Ce, La\ \ldots)F_3$	hex.	D_{6h}^3	7.124, ..., 7.280	6
Vaterite	$CaCO_3$	hex.	....	4.120, ..., 8.556	2
Vesuvianite	....	tetr.	....	22.03, ..., 11.89	
Vivianite	$3FeO.P_2O_5.8H_2O$	monocl., one-f.c.	....	9.997, 13.37, 4.696, β = 104° 16′	
Voltaite	....	cub.	....	27.33	20
Willemite	Zn_2SiO_4	hex.	....	8.63, α = 107° 45′	
Wollastonite	$CaSiO_3$	monocl.	....	15.31, 7.35, 7.08, β = 95° 25′	
Wurtzite	....	hex.	C_{6v}^4	3.811, ..., 6.234	
Zircon	$ZrSiO_4$	tetr.	D_{4h}^{19}	6.58, ..., 5.93	4

METAL-ORGANIC COMPOUNDS

Substance	System. struct type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
Aluminum acetylacetone	monocl	C_{2h}^5	14.1, 7.42, 16.5, β = 98° 54′	4
Ammonium				
chlorofumarate	monocl.	C_2^2	9.30, 6.70, 6 735, β = 108° 25′	2
hydrogen fumarate	tricl.	C_i^1	7.00, 7.44, 6.56, α = 107° 1′, β = 117° 58′, γ = 69° 16′	2
oxalate + $1H_2O$	rhomb.	V^3	8.06, 10.34, 3.82	2
Barium				
dicalcium propionate	cub.	O_h^7	18.20	8
formate	rhomb.	V^4	6.78, 8 89, 7.68	4
succinate	tetr.	D_{4h}^{19}	7.57, ..., 10 28	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol
			a, *b*, *c*, Ax. ang.	
Beryllium				
oxalate + $3H_2O$....	rhomb.	V_h^{16}	6.37, 7.53, 12.45	4
oxyacetate..........	cub.	T_h^4	15.72	8
oxypivalate..........	monocl.	C_{2h}^6	19.3, 12.4, 35.4, β = 91° 21′	8
oxypropionate......	monocl.	....	16.00, 9.76, 9.15, β = 116° 7′	2
Bismuth				
chloride thiourea....	hex.	C_3^4	14.81, α = 111° 54′	1
cobalticyanide...... thiourea	hex.	D_{3d}^5	9.13, α = 100° 30′	1
Calcium				
barium propionate..	cub.	O^4	18.3	8
formate............	rhomb.	V_h^{15}	10.16, 13.38, 6.26	8
Chromium				
acetylacetone........	monocl.	C_{2h}^5	14.2, 7.62, 16.5, β = 99° 8′	4
Cobalt				
acetylacetone........	monocl.	C_{2h}^5	14.2, 7.50, 16.4, β = 98° 38′	4
Cupric				
formate + $2H_2O$....	monocl.	C_{2h}^5	8.952, 6.726, 8.235	4
Gallium				
acetylacetone (α)...	monocl.	C_{2h}^5	14.0, 7.63, 16.3, β = 99° 12′	4
acetylacetone (β)....	rhomb.	C_{2v}^7	8.20, 13.1, 16.3	4
acetylacetone (γ)...	rhomb.	C_{2v}^9	15.71, 13.74, 32.76	16
Germanium				
tetraphenyl..........	tetr.	V_d^4	11.60, ..., 6.85	2
Indium				
acetylacetone........	rhomb.	C_{2v}^7	8.24, 13.4, 16.5	4
Iron				
acetylacetone........	rhomb.	C_{2v}^9	15.74, 13.68, 33.0	16
Lead				
formate............	rhomb.	V^4	6.52, 8.75, 7.41	4
tetraphenyl..........	tetr.	V_d^4	12.06, ..., 6.50	2
Lithium				
acetate............	rhomb.	....	12.80. 11.63, 7.43	12
butyrate............	hex.	....	27.7, ..., 10.1	48
iso-butyrate.........	tetr.	....	19.75, ..., 9.25	24
caprylate...........	hex.	....	42.1, ..., 10.9	72
crotonate...........	hex.	....	24.8, ..., 10.7	48
formate............	monocl.	....	7.61, 6.03. 4.87, β = 95° 42′	4
formate + H_2O.....	rhomb.	C_{2v}^9	6.49, 10.01, 4.85	4
heptylate..........	tetr.	....	27.4 ...., 9.3	32
laurate............	tetr.	....	28.3, ..., 11.7	24
nonylate...........	tetr.	....	36.6, ..., 9.3	48
oleate.............	hex.	....	64.6, ..., 9.5	72
oxalate............	rhomb.	....	6.58, 7.74, 6.61	4
propionate.........	rhomb.	....	16.98, 12.15, 9.45	16
stearate...........	hex.	....	62.5, ..., 9.8	72
trimethylacetate....	cub.	....	18.56	36
undecylate.........	tetr.(?)	....	41.8, ..., 9.2	48
undecylenate.......	hex. (?)	....	52.6, ..., 9.5	72
valerate...........	tetr.(?)	....	24.5, ..., 9.4	32
iso-valerate.........	rhomb.(?)	....	11.7, 8.70, 6.93	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Manganese acetylacetone	monocl.	....	14.1, 7.68, 16.5, $\beta =$ 99° 24′	4
Potassium				
acid chloromaleate	rhomb.	V_h^{16}	7.62, 15.74, 10.95	8
bitartrate	....	....	7.614, 10.70, 7.80	4
borotartrate	rhomb.	V_2	4.88, 18.00, 7.65	2
chlorosulfoacetate	rhomb.	V_h^{14}	8.58, 8.60, 23.76	8
mesotartrate + $2H_2O$	tricl.	....	7.02, 6.90, 11.02, $\alpha =$ 95° 44′, $\beta =$ 102° 52′, $\gamma =$ 61° 46′	2
rhodium oxalate	hex.	D_3^4 or D_3^6	11.28, ..., 20.25	6
Rubidium tartrate	hex.	D_3^4 or D_3^6	7.17, ..., 13.19	3
Scandium acetylacetone	rhomb.	C_{2v}^7 or V_h^{13}	8.20, 13.52, 16.15	4
Silicon tetraphenyl	tetr.	V_d^4 or D_{4h}^9	11.50, 6.97	2
Silver uranyl acetate	tetr.	C_{4h}^6	12.98, ..., 28.10	16
Sodium				
acid acetate	cub.	T_h^7	15.9	24
palmitate (α) (below 42.7°C)	rhomb.	D_{2h}^9	8.06, 9.24, 47.70	8
palmitate (β) (above 42.7°C)	monocl.	C_{2h}^3	7.83, 5.40	4
stearate (α) (below 51.5°C)	rhomb.	D_{2h}^9	8.04, 9.24, 51.77	8
stearate (β) (above 51.5°C)	monocl.	C_{2h}^3	7.80, 5.33,	4
uranyl acetate	cub.	T^4	10.670	4
Strontium				
formate	rhomb.	V^4	6.86, 8.72, 7.24	4
formate + $2H_2O$	rhomb.	V^4	7.30, 11.99, 7.13	4
Thallium mesotartrate	tricl.	....	13.26, 16.12, 7.63, $\alpha =$ 75° 54′, $\beta =$ 86° 37′, $\gamma =$ 82° 14′	4
Tin tetraphenyl	tetr.	V_d^4	11.83, ... , 6.42	2
ORGANIC COMPOUNDS				
Acenaphthene	rhomb.	.. ..	8.32, 14.15, 7.26	4
Acetaldehyde ammonia	hex.	D_{3d}^5	8.18, $\alpha =$ 84° 50′	6
Acetamide	hex.	C_{3v}^6	8.05, $\alpha =$ 91° 17′	6
Acetonyl pyrrole	tetr.	C_4^2 or C_4^4	10.09, ..., 23.85	4
Acetoxybisnorallocholanic acid	monocl.	....	57.1, 7.69, 19.45, $\beta =$ 97.5°	
Acetylenedicarboxylic acid	monocl.	....	7.88, 9.04, 6.62, $\beta =$ 111° 6′	4
Acetylsalicylic acid	monocl.	C_{2h}^5	11.37, 6.54, 11.37, $\beta =$ 95.7°	4
Adipic acid	monocl.	C_{2h}^5	10.27, 5.16, 10.02, $\beta =$ 137° 5′	2

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
Aminoazobenzene (p)	monocl.	....	13.69, 5.604, 14.18, β = 81° 49′	4
Aminophenol (o)	rhomb.	V_h^{15}	7.26, 7.71, 19.51	8
Aminophenol (m)	rhomb.	C_{2v}^4	6.14, 11.10, 8.38	4
Aminophenol (α − p)	rhomb.	C_{2v}^5	8.25, 5.32, 13.06	4
Aminophenol (β − p)	rhomb.	C_{2v}^1	12.07, 11.85, 5.82	6
Anthracene	monocl.	C_s^4	8.58, 6.02, 11.18, β = 125°	2
Anthranilic acid I	rhomb.	V_h^{11}	....	8
Anthranilic acid II	rhomb.	V_h^5	....	8
Anthraquinone	rhomb.	V_h^{13}	12.05, 15.05, 2.69	2
Arabinose	rhomb.	V^4	6.48, 19.30, 4.81	4
Azelaic acid (α)	monocl.	C_{2h}^5	9.72, 4.83, 27.14, β = 129° 30′	4
Azelaic acid (β)	monocl.	C_{2h}^2	5.61, 9.58, 27.20, β = 136° 30′	4
Azobenzene	monocl.	C_{2h}^5	12.65, 6.06, 15.60, β = 114° 24′	4
Azotoluene (o)	monocl.	C_{2h}^5	13.93, 6.604, 14.55, β = 101° 4′	4
Azoxyphenetol (p)	monocl.	....	15.9, 5.42, 17.5, β = 94° 20′	
Behenolic acid	monocl.	C_{2h}^4 or C_{2h}^5	9.551, 4.686, 59.10. β = 53° 30′	4
Benzanthracene (1:2)	monocl.	C_2^2	7.91, 6.43, 23.96, β = 99°	4
Benzanthracene (2:3)	tricl.	....	7.94, 6.02, 13.5, α = 80° 40′, β = 67° 50′, γ = 92° 40′	2
Benzene (−20°C)	rhomb.	V_h^{15}	9.76, 7.39, 6.85	4
Benzene hexabromide	monocl.	C_{2h}^4	8.44, 4.04, 17.3, β = 116° 30′	2
Benzene hexachloride	monocl.	C_{2h}^4	8.10, 3.86, 16.68, β = 116° 50′	2
Benzil	hex.	D_3^4 or D_3^6	8.15, ..., 13.46	3
Benzoic acid	monocl.	....	5.44, 5.18, 21.6, β = 97° 5′	4
Benzophenone	....	D_2^4	10 17. 12.06, 7.98	4
Brassylic acid	monocl.	C_{2h}^5	9.63, 4.82, 37.95, β = 128° 20′	4
Bromostearic acid	monocl.	C_{2h}^4 or C_{2h}^5	11.039, 4.904, 52.84, β = 43° 17′	4
Carotene (β)	monocl.	C_{2h}^5	7.75, 9.5, 25.0, β = 105°	2
Catechol	monocl.	C_{2h}^3	17.46, 10.74, 5.48, β = 94° 15′	8
Cellobiose (d)	monocl.	C_2^2	5.00, 13.2, 11.1, β = 90°	2
Cellulose	tetr.	....	7.79, ..., 10.26	4
Cellulose hydrate	monocl.	....	8.14, 10.3, 9.14, β = 62°	4
Cellulose natural	monocl.	....	8.3, 10.3, 7.9, β = 84°	

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
Cetyl palmitate.......	monocl.	C_{2h}^5	5.61, 7.42, 88.79, β = 61.3	4
Chlorobromobenzene (*p*)	monocl.	....	15.15, 4.12, 5.81, β = 113° 9′	2
Chloronaphthalene tetrachloride (α)	monocl.	....	8.245, 10.1, 15.78, β = 116° 12′	4
Cholestane dibromide..	....	....	20.8, 11.27, 10.72, β = 90°	
Cholestanedione.......	....	....	19.6, 7.62, 7.9, β = 93°	
Cholesteryl acetate....	....	....	16.3, 9.35, 17.5, β = 73.6	
Chrysene.............	monocl.	C_{2h}^6	8.34, 6.18, 25.0, β = 115.8°	4
Cinnamic acid (*trans*)..	monocl.	....	11.65, 14.10. 4.26, β = 98° 36′	4
Cyanuric acid.........	pseud. rhomb.	C_{2h}^6	7.90, 6.74, 9.04, β = 90°	4
Cyanuric triazide......	hex.	....	8.73, ..., 5.96	2
Cyclohexane-α-diol-1,2	rhomb.	V_h^{15}	7.62, 8.55, 19.57	8
Cyclohexane-β-diol-1,4	monocl.	C_{2h}^5	6.32, 21.2, 7.27, β = 96.0°	6
Cyclohexane-γ-diol-1,2	monocl.	C_{2h}^6	19.13, 9.92, 7.23, β = 103.9°	8
Cyclohexyl diacetate-1, 4 (β)	monocl.	C_{2h}^5	13.56, 5.83, 6.72, β = 107.4°	2
Cyclopentenophenanthrene (1: 2-)	monocl.	C_{2h}^5	18.38, 5.83, 23.61, β = 114.3°	8
Dibenzalpentaerythritol	hex.	D_6^4	6.03, ..., 36.7	3
Dibenzcarbazole (1: 2: 5: 6-)	rhomb.	D_{2h}^{15} (?)	31.10, 9.65, 26.61, β = 90°	24
Dibenzcarbazole (1: 2: 7: 8-)	monocl.	C_{2h}^2 (?)	14.63, 7.64, 12.08, β = 96°	4
Dibenzcarbazole (1: 2: 7: 8-)	rhomb.	D_2^7 (?)	10.27, 10.26, 50.5, β = 90°	16
Dibenzcarbazole (3: 4: 5: 6-)	rhomb.	D_2^5 (?)	14.07, 6.10, 15.36, β = 90°	4
Dibenzyl.............	monocl.	C_{2h}^5	12.82, 6.18, 7.74, β = 116°	2
Dibromobenzene (*p*)...	monocl.	....	15.46, 4.11, 5.80, β = 112° 38′	2
Dibromotetramethylethane (*sym.*)	tetr.	....	10.45, ..., 8.14	4
Dichlorobenzene (*p*)...	monocl.	....	14.83, 4.10, 5.88, β = 112° 30′	2
Dichloronaphthalene tetrachloride	monocl.	C_s^4	7.8, 12.3, 13.9, β = 116° 14′	4
Dicyanodiamide.......	monocl.	C_{2h}^3	13.8, 4.4, 6.2, β = 90° 35′	4
Diethyl phthalyl ketone	tetr.	D_{4h}^{10}	7.25, ..., 20.47	4
Diiodoethane (*sym.*)...	monocl.	C_{2h}^5	....	2
Diiodoethane (*sym.*)...	rhomb.	V_h^{18}	7.582, 12.897, 5.810	4
Diiodoethylene (*sym.*).	monocl.	C_{2h}^5	....	2
Diiodoethylene (*sym.*) .	rhomb.	V_h^{18}	7.280, 13.310, 5.553	4
Dimesityl...........	monocl.	C_{2h}^5	8.21, 8.58, 22.25, β = 96° 30′	4

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.
Dimethyldiethyl ammonium chlorostannate	tetr.	....	9.06, ..., 14.12	2
Dimethylethyl sulfonium chlorostannate	cub.(?)	....	12.80	
Dimethylurea (1, 2)...	rhomb.	C_{2v}^7	4.53, 10.9, 5.14	2
Dinitrobenzene (o)	monocl.	C_{2h}^5	7.95, 13.0, 7.45, β = 112° 7′	4
Dinitrobenzene (m)....	rhomb.	V_h^{16}	13.3, 14.2, 3.82	4
Dinitrobenzene (p)....	monocl.	C_{2h}^5	11.3, 5.55, 5.8, β = 92° 18′	2
4, 6-Dinitro-1, 3-xylol..	monocl.	C_{2h}^2	11.5, 5.49, 7.2, β = 98°	2
Diphenic acid.........	rhomb.	....	14.12, 11.90, 13.75	8
Diphenyl.............	monocl.	C_{2h}^5	8.11, 5.67, 9.57, β = 94° 30′	2
Diphenylbenzene (p)..	monocl.	....	8.08, 5.60, 13.59, β = 91° 55′	2
Diphenylbutadiene....	monocl.	C_{2h}^2	7.71, 11.70, 13.31/sin β, β = 97°	
Diphenylfurazane....	....	D_2^4	11.89, 12.95, 6.99	4
Diphenylglyoxime (α).	monocl.	C_{2h}^6	25.08, 8.68, 11.92	8
Diphenylglyoxime peroxide	monocl.	C_{2h}^5	12.85, 6.27, 14.96	4
Distearin (α, α')......	hex. (?)	....	81.5, ..., 10.8	48
Dulcitol..............	monocl.	C_{2h}^5	8.61, 11.60, 9.05, β = 113° 45′	4
Durene..............	monocl.	C_{2h}^5	11.57, 5.77, 7.03, β = 113.3°	2
Elaidic acid..........	tetr. (?)	....	26.5, ..., 10.3	16
Ephedrine hydrobromide (d)	rhomb.	V^4	24.68, 6.93, 6.78	
Ephedrine hydrobromide (l)	monocl.	C_2^2	12.74, 6.20, 7.62, β = 100° 48′	
Ephedrine hydrochloride (d)	rhomb.	V^4	25.49, 6.48, 6.91	
Ephedrine hydrochloride (l)	monocl.	C_2^2	12.64, 6.15, 7.34, β = 102° 6′	
Ephedrine hydroiodide (d)	rhomb.	V^4	11.39, 6.83, 15.62	
Ephedrine hydroiodide (l)	rhomb.	V^3	25.66, 7.33, 19.14	
Ergosterol acetate.....	....	....	34.8, 7.58, 10.48, β = 92.6°	
Ergosterol acetate-maleic anhydride I	monocl.	C_2^2	31.1, 9.58, 10.60, β = 95.0°	
Ergosterol acetate-maleic anhydride II	monocl.	C_2^2	32.2, 7.91, 25.3, β = 92.1°	
Erythritol (i)........	tetr.	C_{4h}^6	12.76, ..., 6.83	8
Ethane..............	hex.	D_{6h}^4	4.46, ..., 8.19	2
Ethylene (−175°C)...	rhomb.	....	6.46, 4.87, 4.14	2
Ethylene diamine sulfate	tetr.	D_4^4 or D_4^8	5.96, ..., 17.99	4
Ethylene oxide dicarboxylic acid (cis.)	monocl.	C_{2h}^6	21.50, 6.90, 6.89, β = 91° 10′	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
Eulytine	cub.	T_d^6	10.272	4
Fluorene	monocl.	C_{2h}^5	8.48, 5.73, 19.24, β = 101° 53′	4
Fructose (*d*)	rhomb.	V^4	8.06, 10.06, 9.12	4
Fumaric acid	monocl.	C_{2h}^5	7.60, 15.11, 6.61, β = 111° 5′	6
Glucose (*d*)	rhomb.	V^4	10.40, 14.89, 4.99	4
Glutaric acid (α)	monocl.	C_{2h}^6	10.34, 5.08, 32.9, β = 129°	8
Glutaric acid (β)	monocl.	C_{2h}^6	10.06, 4.87, 17.4, β = 132° 35′	4
Glycine	monocl.	C_{2h}^5	5.1, 11.9, 5.43, β = 111° 38′	4
Glyoxaline	monocl.	C_{2h}^1	7.67, 5.44. 5.12, β = 63° 11′	2
Glyoxaline-4-sulfonic acid	tetr.	V_d^4	11.08, ..., 9.22	8
Guanidine carbonate	tetr.	D_4^4 or D_4^8	6.95, ..., 19.45	4
Guanidine dichromate	monocl.	....	(0.8232:1:0.6942), β= 100° 0′	
Guanidine monochromate	tricl.	....	(1.1013:1:1.041) (?), α = 82° 34′, β = 90° 10′, γ = 53° 20′	
Guanidine tartrate (*d*)	monocl.	....	(0.7056:1: 0.3366), β = 104° 57′	2
Guanidine trichromate	monocl.	....	(1.686:1: 2.138), β = 122° 48′	
Guanidonium bromide	rhomb.	V_h^{16}	6.77, 8.64, 8,305	4
Guanidonium iodide	hex.	C_{6v}^4	7.19, ..., 12.30	4
Harmine	rhomb.	....	19.22, 9.57, 5.78	4
Hexaminobenzene	cub.	O_h^3	15.14	16
Hexabromobutylene	monocl.	C_{2h}^5	11.5, 6.40, 10.0, β = 44° 27′	2
Hexachlorethane (above 71°C)	cub.	....	7.43	2
Hexachlorobenzene	monocl.	C_{2h}^5	8.07, 3.84, 16.61, β = 116° 52′	2
Hexachloroethane	rhomb.	V_h^{16}	11.51, 10.14, 6.39	4
Hexadecanedicarboxylic acid	monocl.	C_{2h}^5	9.76, 4.92, 25.10, β = 131° 10′	2
Hexaethylbenzene	tricl.	....	9.90, 9.84, 6.10, α = 58° 5′, β = 103° 54′, γ = 123° 43′	1
Hexahydrobenzene hexabromide (β)	cub.	T_h^6	10.49	4
Hexahydrobenzene hexachloride (β)	cub.	T_h^6	10.07	4
Hexamethylbenzene	tricl.	C_i^1	9.01, 8.926, 5.344, α = 44° 27′, β = 116° 43′, γ = 119° 34′	1
Hexamethylethane (above −125°C)	cub.	....	7.69	2
Hexamethylenetetramine	cub.	T_d^4	7.02	2
Hexane ($\alpha - n$)	rhomb.	....	3.51, 4.26, 11.6	1

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, *b*, *c*, Ax. ang.	
Hexane ($\beta - n$)	monocl.	....	3.87, 4.61, 12.0, $\beta =$ 120°	1
Hydrazobenzene	rhomb.	....	11.10, 9.93, 9.33	4
Hydrobenzoin, *iso*-	monocl.	C_2^2	12.40, 7.92, 5.81, $\beta =$ 92° 53′	2
Hydrocinnamic acid	monocl.	....	12.90, 9.20, 6.98, $\beta =$ 103° 36′	4
Hydroquinol	monocl.	....	13.58, 5.22, 8.13, $\beta =$ 107°	4
Hydroxycholestenone dibromide	....	....	15.35, 7.58, 11.55, $\beta =$ 93.7°	
Iodobenzoic acid (*o*)	monocl.	C_{2h}^5	11.30, 15.17, 4.336, $\beta =$ 90° 43′ 47″	4
Iodobenzoic acid (*m*)	monocl.	C_{2h}^5	6.206, 4.683, 25.14	4
Iodoform	hex.	C_6^6 or C_{6h}^2	6.87	2
Iodosuccinimide	tetr.	C_4^2 or C_4^4	6.29, ..., 15.55	4
Inositol (*i*)	monocl.	C_{2h}^5	6.64, 12.0, 19.7, $\beta =$ 105.8°	8
Inositol (*l*)	monocl.	C_2^2	6.17, 9.11, 6.83, $\beta =$ 106.6°	2
Inositol dihydrate (*i*)	monocl.	C_{2h}^5	8.98, 16.59, 6.49, $\beta =$ 109.8°	4
Lauric acid	monocl.	C_{2h}^1	9.76, 4.98, 36.9, $\beta =$ 48° 6′	4
Malachite	monocl.	C_{2h}^5	9.38, 11.95, 3.18, $\beta =$ 91° 3′	4
Maleic acid	monocl.	C_{2h}^5	7.49, 10.14, 7.12, $\beta =$ 117° 7′	4
Maleic anhydride	rhomb.	....	6.58, 11.43, 5.90	4
Malonic acid	tricl.	C_i^1	8.36, 5.33, 5.14, $\alpha =$ 94° 56′, $\beta =$ 103° 56′, $\gamma =$ 71° 30′	2
Malonic acid (α)	rhomb.	....	8.70, 11.53, 17.05, $\beta =$ 90°	16
Mannitol (*d*)	rhomb.	V^4	8.66, 16.58, 5.501	4
Mannose	rhomb.	V_4	7.62, 18.18, 5.67	4
Metaldehyde	tetr., b.c.	C_4^5	10.40, ..., 4.11	8
Methane	cub.	T_d^2	5.89	4
7-Methoxy-1: 2-cyclopentenophenanthrene	monocl.	C_{2h}^5	29.9, 5.68, 8.49, $\beta =$ 117.5°	4
7-Methoxy-3′: 3′-dimethyl-1:2-cyclopentenophenanthrene	monocl.	C_{2h}^5	8.75, 6.21, 28.02, $\beta =$ 95.0°	4
Methylbixin	monocl.	C_{2h}^5	10.56, 13.4, 20.62	4
Methyl glycoside (α)	rhomb.	....	10.80, 14.60, 5.61	4
Methyl oxalate	monocl.	C_{2h}^2	3.93, 11.84, 6.17, $\beta =$ 103° 22′	2
Methyl tartrate	rhomb.	V_2	18.50, 10.00, 8.45	8
Methyl urea	rhomb.	V^4	6.89, 6.96, 8.45	4
Methyl xyloside ($\beta - d$)	monocl.	C_2^2	7.82, 6.89, 7.74, $\beta =$ 113° 10′	2
Monoamyl ammonium bromide (*n*)	tetr.	....	5.00, ..., 16.95	

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
Monoamyl ammonium chloride (*n*)	tetr.	....	5.01, ..., 16.69	
Monoamyl ammonium iodide (*n*)	tetr.	....	5.18, ..., 17.42	
Monobutyl ammonium bromide (*n*)	tetr.	....	5.02, ..., 15.23	
Monobutyl ammonium chloride (*n*)	tetr.	....	5.02, ..., 14.85	
Monobutyl ammonium iodide (*n*)	tetr.	....	5.18, ..., 15.30	
Monodecyl ammonium iodide (*n*)	tetr.	....	5.18, ..., 28.09	
Monoethyl ammonium bromide	monocl.	....	8.32, 6.24, 4.63, $\beta =$ 86° 59′	
Monoethyl ammonium chloroplatinate	hex.	....	7.13, ..., 8.53	
Monoethyl ammonium chlorostannate	hex.	....	7.24, ..., 8.41	
Monoethyl ammonium iodide	monocl.	....	8.68, 6.63, 4.81, $\beta =$ 87° 54′	
Monoheptyl ammonium chloride (*n*)	tetr.	....	4.96, ..., 21.09	
Monoheptyl ammonium iodide (*n*)	tetr.	....	5.18, ..., 21.82	
Monohexyl ammonium bromide (*n*)	tetr.	....	4.93, ..., 19.78	
Monohexyl ammonium chloride (*n*)	tetr.	....	4.98, ..., 19.55	
Monohexyl ammonium iodide (*n*)	tetr.	....	5.18, ..., 19.50	
Monomethyl ammonium aluminum alum	cub.	....	12.44	
Monomethyl ammonium bromide	tetr.	....	5.09, ..., 8.76	
Monomethyl ammonium chloride	tetr.	....	4.28, ..., 5.13	
Monomethyl ammonium chloroplatinate	hex.	....	8.31, $\alpha =$ 48° 46′	
Monomethyl ammonium chlorostannate	hex.	....	8.42, $\alpha =$ 50° 14′	
Monomethyl ammonium iodide	tetr.	....	5.11, ..., 8.97	
Monomethyl triethyl ammonium chlorostannate	cub.	....	13.51	
Monomethyl triethyl phosphonium chlorostannate	cub.	....	13.93	
Monooctyl ammonium iodide (*n*)	tetr.	....	5.18, ..., 23.70	
Monopropyl ammonium bromide (*n*)	tetr.	....	4.57, ..., 7.36	
Monopropyl ammonium chloride (*n*)	tetr.	....	4.48, ..., 7.40	
Monopropyl ammonium iodide (*n*)	tetr.	....	4.85, ..., 7.33	
Myristic acid.........	hex.	....	57.4, ..., 11.4	72
Naphthalene.........	monocl.	C_{2h}^5	8.34, 5.98, 8.68, $\beta =$ 122° 44′	2
Naphthalene tetrabromide	monocl.	C_{2h}^4	10.75, 8.97, 13.25, $\beta =$ 112° 57′	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
Naphthalene tetrachloride	monocl.	C_{2h}^4	7.88, 10.30, 14.20, β = 112° 40′	4
Naphthol (α)	monocl.		13.1, 4.9, 13.4, β = 117° 10′	4
Naphthol (β)	monocl.		11.70, 4.28, 17.4, β = 119° 48′	4
Nitroaniline (*o*)	rhomb.	V_h^{17}	10.09, 29.44, 8.52	16
Nitroaniline (*m*)	rhomb.	C_{2v}^5	19.23, 6.48, 5.06	4
Nitrotoluene (*p*)	rhomb.	V_h^1	10.1, 11.18, 12.3	8
Nonicosane	rhomb.	V_h^{16}	7.45, 4.97, 77.2	4
Octane ($\alpha - n$)	rhomb.		3.50, 4.36, 15.0	1
Octane ($\beta - n$)	monocl.		3.87, 4.72, 14.4, β = 120°	1
Oxalic acid + $2H_2O$	monocl.		6.12, 3.61, 12.03, β = 106° 12′	2
Palmitic acid (α)			9.41, 5.00, 45.9, β = 50° 50′	4
Pentabromofluorethane	rhomb.	V_h^{16}	11.84, 10.75, 6.55	4
Pentaerythritol	tetr.	C_{4v}^9	6.16, ..., 8.76	2
Pentaerythritol tetra-acetate	tetr.	C_{4h}^4	12.18, ..., 5.58	2
Pentaerythritol tetra-formate	rhomb.	V_h^{15}	19.80, 9.90, 11.70	8
Pentaerythritol tetra-nitrate	tetr.	V_d^4	9.38, ..., 6.69	2
Pentamethylethanol	rhomb.	C_{2v}^{21}	21.35, 10.77, 7.84	8
Pentane ($\alpha - n$)	rhomb.		3.35, 4.31, 10.3	1
Pentane ($\beta - n$)	monocl.		3.86, 4.61, 10.0, β = 120°	1
Pentatriacontane	rhomb.	V_h^{16}	7.43, 4.97, 46.2	2
Phenanthrene	monocl.		8.60, 6.11, 19.24, β = 98° 15′	4
Phenylacetic acid	monocl.	C_{2h}^5	14.2, 4.90, 10.1, β = 101°	4
Phenylaminoacetic acid (*act.*)	rhomb.	C_{2v}^5	15.2, 5.05, 9.66	4
Phenylbutyric acid (γ)	monocl.	C_{2h}^5	17.8, 4.90, 10.3, β = 98° 30′	4
Phenylpropionic acid (β) (hydrocinnamic acid)	monocl.	C_{2h}^5	32.2, 9.83, 5.54, β = 101° 13′	8
Phenylvaleric acid (δ)	monocl.		(?), 7.13, 11.32	4
Phenylene diamine (*o*)	monocl.	C_{2h}^4	7.74, 7.56, 11.76, β = 121° 10′	4
Phenylene diamine (*m*)	rhomb.	V_h^1	11.97, 8.14, 23.61	16
Phenylene diamine (*p*)	monocl.	C_{2h}^2	8.29, 5.93, 24.92, β = 112° 58′	8
Phthalic acid (*o*)	monocl.		9.33, 7.13, 5.10, β = 94° 36′	2
Phthalic anhydride (*o*)	rhomb.		7.74, 13.66, 5.86	4
Phthalocyanine	monocl.	C_{2h}^5	19.85, 4.72, 14.8, β = 122.25°	2
Picric acid	rhomb.	C_{2v}^5	9.25, 19.08, 9.68	8

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	n
Pimelic acid	monocl.	C_{2h}^5	9.93, 4.82, 22.12, β = 130° 40′	4
Pyrene trinitrobenzene	tricl.	....	6.7, 8.4. 16, α = 87°, β = 84°, γ = 77°	2
Quaterphenyl	monocl.	C_{2h}^5	8.05, 5.55, 17.81, β = 95.8°	2
Quercitol	monocl.	....	6.83, 8.53, 6.45, β = 110° 57′	2
Quinol (α)	hex.	C_{3i}^1	22.07, ..., 5.62	18
Quinol (β)	hex.	C_3^1	16.24, ..., 5.53	9
Quinol (γ)	monocl.	C_{2h}^5	13.24, 5.20, 8.11, β = 73°	4
Quinone (α)	monocl.	....	11.40, 6.43, 6.85, β = 93° 20′	4
Resorcinol	rhomb.	C_{2v}^9	9.56, 10.5, 5.68	4
Rhamnose hydrate	monocl.	C_2^2	7.84, 7.84, 6.61	2
Saccharose	monocl.	....	10.65, 8.70, 8.00, β = 105° 44′	2
Salicylic acid	monocl.	....	11.56, 11.22, 4.93, β = 91° 22′	4
Sebacic acid	monocl.	C_{2h}^5	10.05, 4.96, 15.02, β = 133° 50′	2
Sorbose	rhomb.	V^4	6.12, 18.24, 6.43	4
Stearic acid	monocl.	C_{2h}^4 or C_{2h}^5	5.546, 7.381, 48.84, β = 63° 38′	4
Stearic acid (β)	....	....	5.68, 7.39, 50.7. β = 60°	4
Stearolic acid	monocl.	C_{2h}^4 or C_{2h}^5	9.551, 4.686, 49.15, β = 53° 4′	4
Stilbene	monocl.	C_{2h}^5	12.42, 5.73, 16.0, β = 114°	4
Stilbene	pseud. rhomb.	....	12.20, 5.72, 29.0	
Strychnine	rhomb.	V^4	11.92, 12.13, 11.30	4
Suberic acid	monocl.	C_{2h}^5	10.12, 5.06, 12.58, β = 135° 0′	2
Succinic acid (α)	monocl.	C_{2h}^3	5.70, 26.2, 7.57, β = 115° 45′	8
Succinic acid (β)	monocl.	C_{2h}^2	5.06, 8.81, 7.57, β = 133° 37′	2
Succinic anhydride	rhomb.	C_{2v}^1 or V_h^1	6.95, 11.66, 5.41	4
Succinimide	rhomb.	V_h^1	7.50, 9.60, 12.75	8
Tartaric acid (*dl*)	tricl.	C_i^1	7.18, 9.71, 4.98, α = 82° 20′, β = 118° 0′, γ = 72° 58′	2
Tartaric acid (*dl*) + H_2O	tricl.	C_i^1	8.09, 10.03, 4.81	2
Tartaric acid (*d*)	monocl.	C_2^2	7.70, 6.04, 6.20, β = 100° 17′	2
Tartaric acid (*meso-*)	tricl.	....	9.24, 6.33, 5.45, α = 70° 30′, β = 78° 0′, γ = 79° 30′	2
Tartramic acid	rhomb.	V_2	12.30, 7.96, 6.00	4
Tartramide	rhomb.	V_1	10.0, 12.2, 4.90	4
Tetrabromodimethylethane	tetr.	....	8.806 ....., 11.27	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants a, b, c, Ax. ang	Mol.
Tetrabromodimethylethane	rhomb.	V_h^{16}	11.70, 10.44, 6.57	4
Tetracarbonic acid methane, tetramethyl ester	tetr.	C_{4h}^2	9.12, ..., 7.02	2
Tetrachlorodibromoethane (*sym.*)	rhomb.	V_h^{16}	11.73, 10.37, 6.50	4
Tetrachlorodibromoethane (*unsym.*)	rhomb.	V_h^{16}	11.61, 10.35, 6.51	4
Tetraethyl ammonium iodide	tetr.	S_4^2	8.87, ..., 6.95	
Tetramethyl ammonium bromide	tetr.	D_{4h}^7	7.76, ..., 5.53	
Tetramethyl ammonium *per*chlorate	tetr.	....	8.290, ..., 6.006	
Tetramethyl ammonium chloride	tetr.	D_{4h}^7	7.78, ..., 5.53	
Tetramethyl ammonium chloroplatinate	cub.	....	12.65	
Tetramethyl ammonium chlorostannate	cub.	O_h^5	12.87	4
Tetramethyl ammonium fluosilicate	tetr.	C_{4h}^5	7.88, ..., 11.19	2
Tetramethyl ammonium iodide	tetr.	D_{4h}^7	7.96, ..., 5.75	
Tetramethyl ammonium *per*manganate	tetr.	D_{4h}^7	8.439, ..., 6.019	2
Tetramethyl ammonium methane	cub.	O_h^7	12.48	8
Tetranitromethane.....	cub.	T^4 or T_d^1	9.2	4
Tetraphenyl methane..	tetr.	V_d^4	10.86	2
Thallic dimethyl bromide	tetr., b.c.	D_{4h}^{17}	4.47. ....., 13.78	2
Thallic dimethyl chloride	tetr., b.c.	D_{4h}^{17}	4.29, ..., 14.01	2
Thallic dimethyl iodide	tetr., b.c.	D_{4h}^{17}	4.78, ..., 13.43	2
Thiophene (−170°C)..	tetr.	....	7.22, ..., 9.53	4
Thiourea.............	rhomb.	V_h^{16}	5.50, 7.68, 8.57	4
Tolane...............	pseud. rhomb.	....	12.80. 5.68. 28.4	
Toluidine (*o*).........	rhomb.	V^4	6.50. 7.48. 23.62	4
Toluidine (*p*).........	rhomb.	....	5.98, 9.05, 23.3	8
Toluolsulfamide (*o*).....	tetr.	C_{4h}^6	18.8, ..., 9.15	16
Tribromobenzonitrile (2,4,6)	monocl.	C_{2h}^2	12.50, 10.30, 4.87, β = 135° 36′	2
Trichlorotribromoethane	rhomb.	V_h^{16}	11.77, 10.44, 6.54	4
Triethyl ammonium bromide	hex.	....	8.56, ..., 7.49	
Triethyl ammonium chloride	hex.	....	8.38, ..., 7.08	
Triethyl ammonium iodide	hex.	....	8.78, ..., 7.74	
Triethyl methyl ammonium chlorostannate	cub.	....	13.51	4
Trimethyl ammonium chlorostannate	cub.	T_h^6	12.19	4

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, struct. type	Space group	Lattice constants	Mol.
			a, b, c, Ax. ang.	
Trimethyl ethyl ammonium chlorostannate	cub.	T_h^6	13.17	4
Trimethyl sulfonium chlorostannate	cub.	....	12.41	
Trimethylene trinitroamine	rhomb.	V_h^1	11.63, 13.25, 10.78	8
Trinitrocellulose	monocl.	....	13.9, 25.6, 9.0, β = 90°	
Triphenyl	monocl.	C_{2h}^5	8.14, 5.64, 14.1, β = 105°	2
Triphenylbenzene (*sym.*)	rhomb.	V_h^{16}	11.12, 19.8, 7.6	4
Triphenylbenzene (sym.) (1-3-5-)	rhomb.	C_{2v}^9	7.55, 19.76, 11.22	4
Triphenyl bromomethane	hex.	D_{3d}^5	10.8, α = 81° 30′	3
Triphenylene	rhomb.	....	13.20, 16.81, 5.26	4
Triphenylcarbinol	hex.	....	16.5, ..., 8.8	6
Triphenylmethane	rhomb.	....	15.16, 26.25, 7.66	8
Triphenyl methanol	hex.	D_{3d}^5	11.1, α = 107° 42′	3
Tyrosine hydrochloride (*d*)	monocl.	C_2^2	5.03, 8.97, 22.50, β = 101° 28′	4
Urea	tetr.	V_d^3	5.670, ..., 4.726	2
Veronal	rhomb.	V_h^{17}	....	4
Xylose	rhomb.	V^4	9.21. 12.48, 5.56	4

X-RAY CRYSTALLOGRAPHIC DATA

SUPPLEMENTARY TABLE

The following data have been reported since the original compilation. Key to references will be found at the end of the Table.

THE ELEMENTS

Substances	System, structure, type	Space group	Lattice constants	Atoms	Refs.
			a, b, c, Ax. ang.		
Au (20°)	cub.	......	4.0700	....	**ZK (1)**
Be	hex.	......	5.12, ..., 15.77	....	**GC (1)**
Li (20°C)	cub. b.c.	Oh_9	3.502	....	**ZC (7)**
Na (20°C)	cub. b.c.	......	4.282	2	**ZK (2)**
Ni (170°C)	hex.	......	2.65, ..., 4.32	....	**CR (1)**
U	rhomb.	V_h^{17}	2.852, 5.865, 4.945	4	**AC (1)**

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

INORGANIC COMPOUNDS

Substance	System, structure, type	Space group	Lattice constants	Mol.	Refs.
			a, *b*, *c*, Ax. ang.		
Ag_2Te	rhomb.	D_{6h}^1	13.0, 12.7, 12.2	57	**UT (1)**
$AgClO_3$	tetr.	C_{4h}^5	8.486, 7.894. 4.37	8	**ZK (39)**
AlB_{12}	monocl.	C_3^2 or C_3^3	8.50, 10.98, 9.40, 110° 54′	lg. no.*	**ZK (15)**
AlB_{12}	pseudo-cub.	......	14.50, ... 14.30	lg. no.*	**ZK (15)**
AlB_{12}	tetr.	C_4^6, D_4^4	10.28, ..., 14.30	lg. no.*	**ZK (15)**
$AlKFe(CN)_6$	cub.	......	9.78		**GC (2)**
Al_2Ca	cub.	O_h^7	8.02		**ZK (16)**
$AuPr_2CN$	rhomb.	C_{2v}^5	17.06, 22.36, 10.0	16	**PR (2)**
Bi_2O_3	monocl.	C_2^1 or C_2^2	5.83, 8.14, 7.48, $\beta =$ 67°.07	4	**AK (1)**
$Ca_3Al_2O_6$	cub.	......	15.24	24	**JR (1)**
$CoSb_2$	rhomb.	V_h^{12}	3.20, 5.78, 6.41		**ZC (1)**
$Co_2Fe(CN)_6$	cub.	......	10.1		**GC (2)**
$CrAs$	......	......	3.479, 6.210, 5.730		**ZC (3)**
Cr_2As	......	......	3.613 ...., 6.33		**ZC (3)**
Cr_3P	tetr.	S_4^2	9.12, ..., 4.56	8	**ZC (4)**
Cs_2CuCl_4	rhomb.	D_{2h}^{16}	9.69, 12.33, 7.58	4	**ZK (17)**
Cs_2SnBr_6	cub., f.c.	......	10.81	4	**ZK (18)**
$CuCl_4.2NH_3.(NH_4)_2$	tetr.	......	7.74, ... 8.84		**CR (2)**
$CuMg_2$	rhomb.	D_{2h}^{24}	5.273, 9.05, 18.21	16	**AK (2)**
$Cu_2Cr(CN)_6$	cub.	O_h^5	9.91		**GC (3)**
$Cu_2Fe(CN)_6$	cub.	......	10.0		**GC (2)**
$Cu_3[Co(CN)_6]_2$	cub.	O_h^5	9.91		**GC (3)**
$C_2N_2H_4$	monocl.	C_{2h}^6	15.00, 4.44, 13.12, $\beta =$ 115° 20′	8	**AC (7)**
EuS	cub., f.c.	O_h^5	5.957	4	**ZK (19)**
$FeKFe(CN)_6$	cub.	......	10.2		**GC (2)**
$Fe_2Fe(CN)_6$	cub.	......	10.2		**GC (2)**
$HgClC_2H_5S$	monocl.	C_{2h}^5	9.34, 7.45, 7.81, 82.5	4	**AK (3)**
$HgClCH_3S$	monocl.	C_{2h}^5	7.45, 7.37, 7.82, $\beta =$ 86.4	4	**AK (3)**
K_2CbF_7	monocl.	C_{2h}^5	5.58, 12.67, 8.50, $\beta =$ 90°	4	**AC (8)**
$K_2CdFe(CN)_6$	cub.	......	10.03		**GC (2)**
$K_2HgCl_4.H_2O$	......	D_{2h}^9	8.27, 11.63, 8.89	4	**ZK (20)**
K_2SNBr_6	tetr.	D_4^2	7.43, ..., 10.61		**ZK (18)**
$K_2SnCl_4.H_2O$	rhomb.	D_{2h}^{16}	8.21, 12.05, 9.10	4	**ZK (21)**

* Large number.

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System structure, type	Space group	Lattice constants a, b, c, Ax. ang.	Mol.	Refs.
K_2TaF_7	monocl.	C_{2h}^5	5.58, 12.67, 8.50, $\beta =$ 90°	4	**AC (8)**
$K_2ZnFe(CN)_6$	cub.	......	9.98		**GC (2)**
K_3ZrF_7	cub., f.c.	O_h^5	8.95	4	**AC (9)**
$K_4Mo(CN)_8.2H_2O$	rhomb.	D_{2h}^{16}	16.55, 11.70, 8.68	4	**AC (10)**
$KB_5O_8.4H_2O$ or $KB_5O_{10}H_2.(H_3O)_2$	rhomb.	C_{2v}^{17}	11.08, 11.14, 8.97	4	**ZK (22)**
$KBrCuBr_2$	monocl.	C_{2h}^2	4.28, 14.43, 9.71, $\beta =$ 108° 23′		**CR (3)**
KCl_4I	monocl.	C_{2h}^5	13.09, 14.18, 4.2, $\beta =$ 95° 7′	4	**ZK (23)**
KHF_2	tetr.	D_4	7.98, ..., 6.74	8	**RS (1)**
KNO_3	hex.	C_{3v}^5	4.365, ... $\alpha =$ 76° 56′	1	**ZC (5)**
LiCl (25°C)	cub.	O_h^5	5.12952	4	**ZC (6)**
$LiOH.H_2O$	monocl.	C_{2h}^3	7.37, 8.26, 3.19, $\beta =$ 110° 18′	4	**ZK (24)**
MnBi	hex.	......	4.3, 6.1	2	**CR (4)**
Mn_2Bi	rhomb.	......	4.30, 5.24, 6.30		**ZC (1)**
Mn_3P_2	tetr.	S_4^2	9.160, ..., 4.599	8	**ZC (4)**
$NaAu_2$.(18.4°C)	cub.	O_h^7	7.7872	8	**ZK (1)**
NaBr	cub.	O_h^5	5.96095	4	**ZC (5)**
$NaBrO_3$	cub.	T^4	6.71	4	**ZK (25)**
NaCN	rhomb.	......	3.74, 4.71, 5.61		**ZK (26)**
NaNCO	hex. (rhbdr.)	C_{3v}^5	3.576, ... 5.10	1	**CR (5)**
$NaHCO_2$	monocl.	C_{2h}^6	6.19, 6.72, 6.49, $\beta =$ 120° 42′	4	**AC (11)**
NaN_3	rhbdr.	......	5.488, ... $\alpha =$ 38° 43′		**CR (6)**
$Na_3(B_3O_6)$	hex. (rhbdr.)	D_{3d}^6	7.22, ... $\alpha =$ 111° 29′	6	**ZK (27)**
NH_4CdCl_3	rhomb.	D_{2h}^{16}	8.96, 14.87, 3.97	4	**AC (12)**
NH_4BrICl	rhomb.	V_h^{16}	6.13, 8.50, 9.94		**ZK (28)**
NH_4HgCl_3	tetr.	......	4.19, ..., 7.94		**ZK (29)**
$(NH_4)_2SnBr_6$	cub., f.c.	......	10.59	4	**ZK (18)**
$(NH_4)_3ZrF_7$	cub. f.c.	O_h^5	9.365.............	4	**AC (9)**
$(NH_4Cl)_2CuCl_2.2H_2O$	tetr.	D_{4h}^{14}	7.5139, ..., 8.245		**JC (1)**
$Ni_2Fe(CN)_6$	cub.	......	9.98		**GC (2)**
Ni_3P	tetr.	S_4^2	8.91, ..., 4.39	8	**ZC (4)**
$PbBr_2$	rhomb.	D_{2h}^{16}	9.48, 8.02, 4.17		**ZK (30)**
PbP_2O_7(300°)	cub. f.c.	T_h^6	8.01		**GC (4)**
$PdCl_2$	rhomb.	Pnmn*	3.81, 3.34, 11.0	2	**ZK (31)**
Pt_3O_4	cub.	......	6.226	2	**JC (2)**
Rb_2SNBr_6	cub. f.c.	......	10.64	4	**ZK (18)**

* Zurich notation.

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, structure, type	Space group	Lattice constants	Mol.	Refs.
			a, b, c, Ax. ang.		
$Rb_2S_2O_6$	hex. (rhbdr.)	D_3^2	10.02, ..., 6.35	3	**ZK (32)**
ScF_3	rhbdr.	D_3^7	5.667, ..., 7.017	1	**ZK (33)**
ScF_3	pseudo-cub.	D_3^7	4.022, ..., β = 89° 34½′	1	**ZK (33)**
$SrBr_2$	rhomb.	D_{2h}^{16}	9.20, 11.42, 4.3	4	**ZK (30)**
$Sr(OH)_2.8H_2O$	tetr.	D_{4h}^2	8.97, ..., 11.55	4	**ZK (34)**
TeO_2	monocl.	V_h^{15}	5.50, 11.75, 5.59	8	**ZK (35)**
TlSe	tetr.	D_{4h}^{18}	8.02, ..., 7.00		**ZK (36)**
Tl_2S	hex.	C_3^4	12.20, ..., 18.17	27	**ZK (37)**
$Zn(SbO_3)_2$	tetr., b.c.	D_{2d}^8	6.585, ..., 0.783	2	**ZK (38)**

Minerals

Name	Formula	Crystal system	Space group	Lattice constants	Mol.	Refs.
				a, b, c, Ax. ang.		
Albite	$Na_2O.Al_2O_3.6SiO$	monocl.	.....	7.94, 12.90, 7.12, β = 116°		**ZK (3)**
Axinite	$HCa_3Al_2BSi_4O_{16}$	....	....	7.13, 8.91, 9.14, α = 91° 51′, β = 102° 52′, γ = 81° 57′		**ZK (4)**
Nacrite	$Al_2O_3.2SiO_2.2H_2O$	monocl.	C_s^4	8.94, 5.14, 43.0, β = 90° 20′		**ZK (5)**
Schizolite	$HNa(Ca,Mn)_2Si_3O_9$	tricl.	......	8.09, 7.24, 7.05, α = 90°, β = 95°, γ = 101° 56′	2	**ZK (6)**

Metal-organic Compounds

Substance	System structure, type	Space group	Lattice constants	Mol.	Refs.
			a, b, c, Ax. ang.		
Cuprous acetate + H_2O	monocl.	C_{2h}^6	13.176, 8 463, 13.89, β = 117° .06′	8	**UP (1)**
Nickel acetate (ous) + $4H_2O$	monocl.	C_{2h}^5	8.46, 11.75, 4.754, β=93° 34′	2	**UP (1)**

Organic Compounds

Acetamide	hex.	C_{3v}^6	11.44, ..., 13.49	18	**AC (2)**
Bromanil	monocl.	C_{2h}^5	8.62, 6.22, 17.94, β = 102°	4	**ZK (7)**

X-RAY CRYSTALLOGRAPHIC DATA (Continued)

Substance	System, structure, type	Space group	Lattice constants	Mol.	Refs.
			a, b, c, Ax. ang.		
Chloranil	monocl.	C_{2h}^{5}	8.77, 5.78, 17.05, $\beta =$ 103½°	4	**ZK (8)**
Creatinine	monocl.	C_{2h}^{1}	14.86, 13.14, 5.85, $\beta =$ 110° 36′	8	**IJ (1)**
Cyclohexane (180°)	cub.	T_{h}^{2}	8.41	4	**PM (1)**
Dicetyl ether	monocl.	C_{2h}^{5}	5.49, 7.45, 86.45, $\beta =$ 63.2	4	**ZK (9)**
Diketopiperazine	monocl.	C_{2h}^{5}	5.19, 11.50, 3.96, $\beta =$ 83°	2	**AC (3)**
1, 8 Dimethylpicene	monocl.	C_{2}^{2}	8.16, 6.36, c sin $\beta =$ 11.92, $\beta = 84$		**ZK (10)**
Diphenylamine	monocl.	....	14.0, 13.9, 39.5	32	**IJ (2)**
Diphenylselenium dibromide	rhomb.	D_{2h}^{14}	13.95, 5.78, 15.40	4	**AC (4)**
Glycine	monoc.	C_{2h}^{5}	5.10, 11.96, 5.45, $\beta =$ 111° 38′	4	**AC (5)**
β-Glycine	monocl.	C_{2h}^{2}	5.07, 6.23, 5.37, $\beta =$ 113° 27′		**AJ (1)**
Hendecamethylcellotriose.	....	D_{2}^{4}	21.3, 34.5, 4.50	4	**CS (1)**
Insulin	hex. (rhbdr.)	C_{3}^{4}	74.8 ...., 30.9		**PR (1)**
Menthol	hex.	......	11.82	8	**JA (1)**
β-Octamethylcellobiose	....	D_{2}^{4}	12.0, 43.7, 4.50	4	**CS (1)**
n-Paraffin ($C_{30}H_{62}$)	rhomb.	D_{2h}^{16}	7.452, 4.965, 81.60	4	**ZK (11)**
Pentaerythrital (above 179.5°C)	cub., f.c.	......	8.963		**CS (2)**
Phenoxselenine	rhomb.	D_{2}^{4}	5.93, 7.85, 20.5	4	**PM (2)**
Phenoxtellurine	rhomb.	D_{2}^{4}	5.97, 8.16, 20.5	4	**PM (2)**
Phenoxthionine	rhomb.	D_{2}^{4}	5.94, 7.76, 20.5	4	**PM (2)**
Phenthiazine	rhomb.	C_{2v}^{9} or D_{2h}^{16}	5.91, 7.90, 2.10	4	**PM (2)**
Phloroglucine dihydrate	....	D_{2h}^{12}	6.80, 8.103, 13.70	4	**IJ (3)**
Selanthren	monocl.	C_{2h}^{5}	14.5, 6.24, 12.1, $\beta =$ 110° 20′	4	**PM (2)**
Succinic acid	monocl.	C_{2h}^{5}	5.10, 8.88, 7.61, $\beta =$ 133° 37′	2	**ZK (12)**
Sulfanilamide	rhomb.	D_{2h}^{15}	14.18, 5.6, 18.4, 1.476	8	**GC**
Thianthren	monocl.	C_{2h}^{5}	14.4, 6.11, 11.9 $\beta =$ 110° 0′	4	**PM (2)**
Tricyanobromomethane	rhomb.	D_{2h}^{11}	6.05, 11.33, 17.17	8	**ZC (2)**
Trimethylstibine dibromide	hex.	D_{3h}^{2}	7.38, ..., 8.90		**ZK (13)**
Trimethylstibine chloride	hex.	D_{3h}^{2}	7.27, ... 8.44		**ZK (13)**
Trimethylstibine diiodide	hex.	D_{3h}^{2}	7.53, ... 9.59		**ZK (13)**
Trinitrobenzene	rhomb.	V_{h}^{15}	12.77, 26.97, 9.74	16	**ZK (14)**
Trisodium-Tricyanmelamine Trihydrate	hex.	D_{3h}^{4}	10.23, ... 5.56		**AC (6)**

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DIFFRACTION DATA FOR CUBIC ISOMORPHS

From Volume 14, pages 689, 690, and 691 of the Analytical Edition of Industrial and Engineering Chemistry. (With permission.)

a, Å	Substance
A 4	
3.56	C (diamond)
5.42	Si
5.62	Ge
6.46	α-Sn
A 1	
3.517	Ni
3.554	α-Co
3.60	Taenite (57.7 % Fe, 40.8 % Ni, 0.5 % P)
3.608	Cu
3.63	γ-Fe (1370°K.)
3.797	Rh
3.831	Ir
3.880	Pd
3.88–4.04	Pd-H
3.912	Pt
4.041	Al
4.070	Au
4.077	Ag
4.30	Co-N
4.40–4.46	Ti-H
4.52	Ne (4°K.)
4.66	Zr-H
4.84	β-Tl
4.939	Pb
5.08	Th
5.14	α-Ce
5.296	β-La
5.43	A (4°K.)
5.56	Ca
5.59	Kr (20°K.)
5.70	Kr (92°K.)
6.05	Sr
6.20	X (88°K.)
A 2	
2.861	α-Fe
2.875	α-Cr
2.90	β-Fe (1070°K.)
2.93	δ-Fe (1700°K.)
3.03	V
3.03–3.41	V-C
3.140	Mo
3.157	W
3.295	Cb
3.30	Ta
3.32	β-Ti (1200°K.)
3.46	Li (~80°K.)
3.50	Li
3.61	β-Zr (1120°K.)
4.24	Na (~80°K.)
4.29	Na
5.02	Ba
5.20	K (120°K.)
5.33	K
5.62	Rb (~80°K.)
6.05	Cs (~80°K.)
B 1	
4.018	LiF
4.065	LiD
4.08	VO

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
B 1 (Continued)	
4.09	LiH
4.12	(Li_2TiO_3)
4.12–4.20	(Li_2TiO_3-MgO)
4.13	VN
4.14	CrN
4.14	VC
4.142	($63Li_2Fe_2O_4 \cdot 37Li_2TiO_3$)
4.173	NiO
4.207	MgO
4.282	MgO (1570°K.)
4.225	TiN
4.235	TiO
4.24	80 TiN-20 TiC
4.27	CoO
4.28	V-N
4.283	FeO (160°K.)
4.290	FeO (299°K.)
4.30	VC (ϵ-phase)
4.315	TiC
4.40	CbC
4.41	CbN
4.426	MnO (117°K.)
4.436	MnO (299°K.)
4.44	ScN
4.446	TaC
4.458	HfC
4.615	NaF
4.62	ZrN
4.69	CdO
4.69	ZrC
4.80	CaO
4.82	(Na_2CeO_3)
4.84	(Na_2PrO_3)
4.88	NaH
4.92	AgF
5.006	CaNH
5.13	SrO
5.14	LiCl
5.14	NdN
5.19	MgS
5.192	MnS (130°K.)
5.210	MnS (299°K.)
5.33	KF
5.45	MgSe
5.45	MnSe
5.45	SrNH
5.49	LiBr
5.52	BaO
5.545	AgCl
5.55–5.76	AgCl-AgBr
5.627	NaCl
5.63	RbF
5.68	CaS
5.69	SnAs
5.70	KH
5.755	AgBr
5.76–5.92	AgBr-AgI
5.83	NdP
5.83	NaCN
5.84	BaNH
5.87	SrS

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
B 1 (Continued)	
5.91	CaSe
5.94	PbS
5.95	NaBr
5.957	EuS
5.96	NdAs
6.00	PrAs
6.00	LiI
6.01	CsF
6.04	RbH
6.05	β-NaSH (>360°K.)
6.06	CeAs
6.13	LaAs
6.14	PbSe
6.23	SrSe
6.278	KCl
6.285	SnTe
6.31	NdSb
6.345	CaTe
6.35	PrSb
6.36	BaS
6.38	CsH
6.40	CeSb
6.44	PbTe
6.462	NaI
6.45	PrBi
6.48	LaSb
6.49	CeBi
6.53	KCN
6.53	NH_4Cl (>457°K.)
6.56	RbCl
6.57	LaBi
6.58	KBr
6.59	BaSe
6.60	β-KSH (>440°K.)
6.65	SrTe
6.82	RbCN
6.86	RbBr
6.90	NH_4Br (>411°K.)
6.93	β-RbSH (470°K.)
6.99	BaTe
7.052	KI
7.10	β-CsCl (>730°K.)
7.24	NH_4I (>255°K.)
7.325	RbI
H 0_5	
6.96 ± 0.04	$AgClO_4$ (453 ± 20°K.)
7.16 ± 0.10	$NaClO_4$ (618 ± 35°K.)
7.49 ± 0.02	$KClO_4$ (598 ± 15°K.)
7.65 ± 0.05	$TlClO_4$ (553°K.)
7.65 ± 0.02	NH_4ClO_4 (528 ± 15°K.)
7.68 ± 0.03	$RbClO_4$ (583 ± 10°K.)
7.97 ± 0.01	$CsClO_4$ (513 ± 10°K.)
B 3	
4.255	CuF
4.36	CSi IV
4.855	BeS
5.10	BeSe
5.304	(Cu, Fe, Mo, Sn)$_4$(S, As, Te)$_{3-4}$, cousite
5.41	CuCl
5.425	β-ZnS
5.43	AlP
5.44	GaP
5.58	BeTe
5.60	MnS (red)

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
B 3 (Continued)	
5.63	AlAs
5.635	GaAs
5.655	ZnSe
5.68	CuBr
5.82	β-CdS
5.84	HgS
5.86	InP
6.04	CdSe
6.04	InAs
6.05	CuI
6.07	HgSe
6.08	ZnTe
6.103	α-Cu_2HgI_4
6.12	AlSb
6.12	GaSb
6.13	SnSb
6.383	α-Ag_2HgI_4
6.40	HgTe
6.43	CdTe
6.45	InSb
6.48	AgI
B 32	
6.195	LiGa
6.209	LiZn
6.36	LiAl
6.687	LiCd
6.786	LiIn
7.297	NaIn
7.373	($CeMg_3$)
7.373	($PrMg_3$)
7.473	NaTl
B 20	
4.437	NiSi
4.438	FeSi
4.438	CoSi
4.548	MnSi
4.620	CrSi
B 2	
2.603	NiBe
2.606	CoBe
2.69	CuBe
2.813	PdBe
2.82	AlNi
2.945	CuZn
2.989	CuPd
3.146	AuZn
3.156	AgZn
3.168	AgLi
3.259	AuMg
3.275	AgMg
3.287	HgLi
3.325	AgCd
3.34	AuCd (670°K.)
3.424	LiTl
3.442	HgMg
3.628	MgTl
3.67	PrZn
3.70	CeZn
3.73	AlNd
3.74	α-RbCl (83°K.)
3.75	LaZn
3.82	TlCN
3.82	PrCd
3.84	TlSb

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
B 2 (Continued)	
3.835	TlCl
3.847	CaTl
3.86	NH_4Cl (<457°K.)
3.86	CeCd
3.88	MgPr
3.90	LaCd
3.97	TlBr
3.98	TlBi
4.024	SrTl
4.05	NH_4Br (<411°K.)
4.112	CsCl
4.20	TlI
4.20	CsCl (<720°K.)
4.25	CsCN
4.287	CsBr
4.29	CsSH
4.37	NH_4I (290°K.)
4.56	CsI
D 2_1	
4.07	YB_6
4.07	ErB_6
4.10	NdB_6
4.12	GdB_6
4.12	PrB_6
4.13	CeB_6
4.13	YbB_6
4.14	CaB_6
4.15	LaB_6
4.15	ThB_6
4.19	SrB_6
4.33	BaB_6
C 1	
4.33	Be_2C
4.619	Li_2O
5.06	$(3ZrO_2 \cdot MgO)$
5.07	ZrO_2
5.08	$(95ZrO_2 \cdot 5CeO_2)$
5.13	$(95HfO_2 \cdot 5CeO_2)$
5.38	PrO_2
5.40	CeO_2
5.40	CdF_2
5.406	CuF_2
5.45	CaF_2
5.47	UO_2
5.526	$(66CaF_2 \cdot 33YF_3)$
5.53	$(91CaF_2 \cdot 9ThF_4)$
5.54	HgF_2
5.55	Na_2O
5.58	ThO_2
5.59	Cu_2S
5.704	Li_2S
5.749	Cu_2Se
5.782	SrF_2
5.796	EuF_2
5.838	$(66SrF_2 \cdot 33LaF_3)$
5.91	$PtAl_2$
5.91	$PtGa_2$
5.935	β-PbF_2 (520°K.)
5.99	Al_2Au
6.005	Li_2Se
6.06	$AuGa_2$
6.19	BaF_2
6.34	Mg_2Si
6.35	$PtIn_2$
6.368	RaF_2

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
C 1 (Continued)	
6.379	Mg_2Ge
6.436	K_2O
6.50	Li_2Te
6.50	$AuIn_2$
6.526	Na_2S
6.763	Mg_2Sn
6.809	Na_2Se
6.81	Mg_2Pb
6.98	$SrCl_2$
7.314	Na_2Te
7.38	K_2S
7.65	RbS_2
7.676	K_2Se
8.152	K_2Te
C 15	
5.94	Be_2Cu
6.287	Be_2Ag
6.435	Be_2Ti
6.96	MgNiZn
7.03	Cu_2Mg
7.61	W_2Zr
7.79	Au_2Na
7.91	Au_2Pb
7.94	Au_2Bi
8.02	Al_2Ca
8.04	Al_2Ce
8.16	Al_2La
9.50	Bi_2K
C 2	
5.41	FeS_2
5.42	$(Fe, Ni)S_2$ (6.5 % Ni)
5.57	RbS_2
5.57	RuS_2
5.57	Bravoite (53.8 % NiS_2, 39.1 % FeS_2, 7.1 % CoS_2)
5.62	OsS_2
5.64	CoS_2
5.65	$(Cu, Ni, Co, Fe)(S, Se)_2$
5.68	PtP_2
5.74	NiS_2
5.85	$CoSe_2$
5.92	$RuSe_2$
5.93	$OsSe_2$
5.94	$PtAs_2$
5.97	$PdAs_2$
6.02	$NiSe_2$
6.096	MnS_2
6.36	$RuTe_2$
6.37	$OsTe_2$
6.43	$PtSb_2$
6.44	$PdSb_2$
6.64	$AuSb_2$
6.94	$MnTe_2$
C 3	
4.25	Cu_2O
4.73	Ag_2O
F 1	
5.55	CoAsS
5.68	NiAsS
5.90	NiSbS
	(Ni, Fe)AsS, plessite
	Ni(As, Sb)S, corynite
	Ni(Sb, Bi)S, kallilite
	(Co, Ni)SbS, willyamite

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
D 5_3	
8.13	Be_3N_2
9.37	$(Mn, Fe)_2O_3$
9.42	Mn_2O_3
9.74	Zn_3N_2
9.79	Sc_2O_3
9.94	Mg_3N_2
10.12	In_2O_3
10.15	Be_3P_2
10.37	Lu_2O_3
10.39	Yb_2O_3
10.52	Tm_2O_3
10.54	Er_2O_3
10.57	Tl_2O_3
10.58	Ho_2O_3
10.60	Y_2O_3
10.63	Dy_2O_3
10.70	Tb_2O_3
10.79	Gd_2O_3
10.79	Cd_3N_2
10.84	Eu_2O_3
10.85	Sm_2O_3
11.05	Nd_2O_3
11.40	α-Ca_3N_2
12.02	Mg_3P_2
12.33	Mg_3As_2
D 6_1	
11.05	As_4O_6
11.14	Sb_4O_6
D 1_1	
10.32	$ZrCl_4$
11.25	$TiBr_4$
(11.34)	(CBr_4) (>320°K.)
(11.62)	(CI_4)
11.89	GeI_4
11.99	SiI_4
12.00	TiI_4
12.23	SnI_4
E 2_1	
3.67	$YAlO_3$
3.75	$CdTiO_3$
3.78	$LaAlO_3$
3.80	$CaTiO_3$
3.83	$NaWO_3$
3.85	$(Na, Ce, Ca)(Ti, Cb)O_3$ Loparite
3.88	$NaTaO_3$
3.89	$LaGaO_3$
3.89	$NaCbO_3$
3.91	$SrTiO_3$
3.92	$CaSnO_3$
3.97	$BaTiO_3$
3.98	$KTaO_3$
3.99	$CaZrO_3$
4.00	$KMgF_3$
4.005	$KNiF_3$
4.01	$KCbO_3$
4.03	$SrSnO_3$
4.05	$KZnF_3$
4.07	$KCoF_3$
4.07	$SrHfO_3$
4.09	$SrZrO_3$
4.18	$BaZrO_3$
4.35	$BaPrO_3$

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
$E\ 2_1$ (Continued)	
4.38	$BaCeO_3$
4.46	KIO_3
4.48	$BaThO_3$
4.5	NH_4IO_3
4.52	$RbIO_3$
4.66	$CsIO_3$
5.12	$MgZrO_3$
5.20	$CsCdCl_3$
5.33	$CsCdBr_3$
5.44	$CsHgCl_3$
5.77	$CsHgBr_3$
$G\ 0_3$	
6.57	$NaClO_3$
6.71	$NaBrO_3$
$G\ 2_1$	
7.60	$Ca(NO_3)_2$
7.81	$Sr(NO_3)_2$
7.84	$Pb(NO_3)_2$
8.11	$Ba(NO_3)_2$
$H\ 1_1$	
8.045	$NiAl_2O_4$
8.07	$CuAl_2O_4$
8.07	$CoCo_2O_4$
8.07	$MgAl_2O_4$
8.08	$CoAl_2O_4$
8.08	$ZnAl_2O_4$
8.10	$FeAl_2O_4$
8.11	$(Ni, Co)(Co, Ni)_2O_4$
8.11	$(Zn, Co)Co_2O_4$
8.11	$MgCo_2O_4$
8.27	$MnAl_2O_4$
8.27	$(Mn, Co)(Co, Mn)_2O_4$
8.28	$MgGa_2O_4$
8.30	$NiCr_2O_4$
8.30	$MgCr_2O_4$
8.31	$ZnCr_2O_4$
8.32	$CoCr_2O_4$
8.32	$ZnGa_2O_4$
8.35	$NiFe_2O_4$
8.35	$Cu_2Cr_2O_4$
8.35	$FeCr_2O_4$
8.36	$MgFe_2O_4$
8.38	$CoFe_2O_4$
8.38	$NiMn_2O_4$
8.40	$ZnFe_2O_4$
8.40	$FeFe_2O_4$
8.42	$(Mn, Mg)Fe_2O_4$
8.42	$TiCo_2O_4$
8.43	$MnCr_2O_4$
8.43	$TiMg_2O_4$
8.43	$TiZn_2O_4$
8.44	$CuFe_2O_4$
8.47	FeV_2O_4
8.49	$MnCr_2O_4$
8.50	$TiFe_2O_4$
8.54	$MnFe_2O_4$
8.58	$CdCr_2O_4$
8.58	$SnMg_2O_4$
8.61	$SnCo_2O_4$
8.63	$SnZn_2O_4$
8.67	$CdFe_2O_4$
8.67	$TiMn_2O_4$
8.81	$MgIn_2O_4$
9.26	Ag_2MoO_4

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
H 1_1 (Continued)	
9.4	$CoCo_2S_4$
9.45	$(Co, Ni)_3S_4$
9.46	$CuCo_2O_4$
9.5	NiN_2S_4
9.92	$ZnCr_2S_4$
10.05	$MnCr_2S_4$
10.19	$CdCr_2S_4$
12.54	$K_2Zn(Cn)_4$
12.76	$K_2Hg(CN)_4$
12.84	$K_2Cd(CN)_4$
H 5_8	
10.08	$2Na_2SO_4 \cdot NaCl \cdot NaF$
H 4_{13}	
12.11	$KCr(SO_4)_2 \cdot 12H_2O$
12.12	$KAl(SO_4)_2 \cdot 12H_2O$
12.15	$NH_4Al(SO_4)_2 \cdot 12H_2O$
12.15	$NH_4Fe(SO_4)_2 \cdot 12H_2O$
12.20	$RbAl(SO_4)_2 \cdot 12H_2O$
12.21	$TlAl(SO_4)_2 \cdot 12H_2O$
12.31	$CsAl(SO_4)_2 \cdot 12H_2O$
12.44	$NH_3 \cdot CH_3Al(SO_4)_2 \cdot 12H_2O$ (β-alum)
Langbeinite	
9.93	$K_2Mg(SO_4)_3$
10.2	$K_2(Ca, Mg)(SO_3)_3$
H 2_1	
6.00	Ag_3PO_4
6.120	Ag_3AsO_4 (90°K.)
6.130	Ag_3AsO_4 (380°K.)
H 2_4	
5.37	Cu_3VS_4
J 1_1	
8.17	K_2SiF_6
8.35	$(NH_4)_2SiF_6$
8.38	$Rb_2CrF_5H_2O$
8.41	$Tl_2CrF_5H_2O$
8.42	$(NH_4)_2VF_5H_2O$
8.42	$Rb_2VF_5H_2O$
8.45	$Tl_2VF_5H_2O$
8.45	Rb_2SiF_6
8.58	Tl_2SiF_6
8.87	Cs_2SiF_6
8.99	Cs_2GeF_6
9.73	K_2PtCl_6
9.73	K_2OsCl_6
9.76	Tl_2PtCl_6
9.84	$(NH_4)_2PtCl_6$
9.86	K_2ReCl_6
9.88	Rb_2PtCl_6
9.92	Rb_2TiCl_6
9.94	$(NH_4)_2SeCl_6$
9.97	K_2SnCl_6
9.97	Tl_2SnCl_6
9.98	Rb_2SeCl_6
10.02	Rb_2PdBr_6
10.04	$(NH_4)_2SnCl_6$
10.08	$Ni(NH_3)_6Cl_2$
10.10	Rb_2SnCl_6
10.10	$Co(NH_3)_6Cl_2$
10.11	Tl_2TeCl_6
10.14	$(NH_4)_2PbCl_6$
10.14	K_2TeCl_6
10.15	$Fe(NH_3)_6Cl_2$
10.16	$Mg(NH_3)_6Cl_2$
10.17	Cs_2PtCl_6

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
J 1₁ (Continued)	
10.18	Rb_2ZrCl_6
10.18	$(NH_4)_2TeCl_6$
10.20	$Mn(NH_3)_6Cl_2$
10.20	Rb_2PbCl_6
10.22	Cs_2TiCl_6
10.23	Rb_2TeCl_6
10.25	$Zn(NH_3)_6(ClO_4)_2$
10.26	Cs_2SeCl_6
10.30	K_2OSBr_6
10.35	Cs_2SnCl_6
10.36	K_2SeBr_6
10.36	K_2PtBr_6
10.39	$Co(NH_3)_6Br_2$
10.4	$Ni(NH_3)_6Br_2$
10.41	Cs_2ZrCl_6
10.42	Cs_2PbCl_6
10.45	Cs_2TeCl_6
10.45	$Co(NH_3)_5H_2OSO_4Br$
10.46	$(NH_4)_2SeBr_6$
10.46	$Zn(NH_3)_6Br_2$
10.47	$Fe(NH_3)_6Br_2$
10.47	$Mg(NH_3)_6Br_2$
10.48	K_2SnBr_6
10.51	$Co(NH_3)_6SO_4Br$
10.52	$Mn(NH_3)_6Br_2$
10.54	$Sr_2Ni(NO_2)_6$
10.55	$Pb_2Ni(NO_2)_6$
10.57	$(NH_4)_2SnBr_6$
10.58	Rb_2SnBr_6
10.62	$Co(NH_3)_5H_2OSO_4I$
10.63	$Co(NH_3)_6SeO_4Br$
10.67	$Ba_2Ni(NO_2)_6$
10.71	$Ca(NH_3)_6Br_2$
10.71	$Co(NH_3)_6SO_4I$
10.77	Cs_2SnBr_6
10.79	$Co(NH_3)_6SeO_4I$
10.9	$Ni(NH_3)_6I_2$
10.91	$Co(NH_3)_6I_2$
10.96	$Zn(NH_3)_6I_2$
10.97	$Fe(NH_3)_6I_2$
10.98	$Mg(NH_3)_6I_2$
11.04	$Mn(NH_3)_6I_2$
11.04	$Cd(NH_3)_6I_2$
11.24	$Ca(NH_3)_6I_2$
11.27	$Ni(NH_3)_6(BF_4)_2$
11.3	$Co(NH_3)_6(BF_4)_2$
(11.3)	$Zn(NH_3)_6(ClO_4)_2$
11.34	$Mg(NH_3)_6(BF_4)_2$
11.34	$Fe(NH_3)_6(BF_4)_2$
11.37	$Mn(NH_3)_6(BF_4)_2$
11.38	$Cd(NH_3)_6(BF_4)_2$
11.41	$Ni(NH_3)_6(ClO_4)_2$
11.43	$Co(NH_3)_6(ClO_4)_2$
11.46	$Ni(NH_3)_6(SO_3F)_2$
11.49	$Co(NH_3)_6(SO_3F)_2$
11.52	$Fe(NH_3)_6(ClO_4)_2$
11.53	$Mg(NH_3)_6(ClO_4)_2$
11.54	$Cd(NH_3)_6Br_2$
11.54	$Fe(NH_3)_6(SO_3F)_2$
11.58	$Mn(NH_3)_6(ClO_4)_2$
11.59	$Cd(NH_3)_6(ClO_4)_2$
11.59	$Mn(NH_3)_6(SO_3F)_2$
11.62	$Cd(NH_3)_6(SO_3F)_2$
11.91	$Ni(NH_3)_6(PF_6)_2$

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
J 1_1 (Continued)	
11.94	$Co(NH_3)_6(PF_6)_2$
12.03	$Ni(NH_2 \cdot CH_3)_6I_2$
12.05	$Co(NH_2 \cdot CH_3)_6I_2$
12.19	$[NH(CH_3)_3]_2SnCl_6$
12.41	$[S(CH_3)_3]_2SnCl_6$
12.65	$[N(CH_3)_4]_2PtCl_6$
12.80	$[S(CH_3)_2C_2H_5]_2SnCl_6$
12.87	$[N(CH_3)_4]_2SnCl_6$
13.17	$[N(CH_3)_3C_2H_5]_2SnCl_6$
13.51	$[N(CH_3)(C_2H_5)_3]_2SnCl_6$
13.93	$[P(CH_3)(C_2H_5)_3]_2SnCl_6$
J 2_1 and Related Structures	
8.88	Li_3FeF_6
8.90	$(NH_4)_3AlF_6$
9.01	$(NH_4)_3CrF_6$
9.04	$(NH_4)_3VF_6$
9.10	$(NH_4)_3FeF_6$
9.10	$(NH_4)MoO_3F_3$
9.26	Na_3FeF_6
9.93	K_3FeF_6
9.96	$CuLi_2Fe(CN)_6$
10.0	$CuR_2Fe(CN)_6$ R = Na, K, Rb, NH_4, Tl
10.15	$K_2CdFe(NO_2)_6$
10.17	$K_2CaCo(NO_2)_6$
10.19	$K_2CaFe(NO_2)_6$
10.2	$Fe^{III}RFe^{II}(CN)_6$ R = Na, K, Rb, NH_4
10.22	$K_2HgFe(NO_2)_6$
10.23	$K_2SrCo(NO_2)_6$
10.25	$(NH_4)_2CaFe(NO_2)_6$
10.25	$NaTl_2Co(NO_2)_6$
10.28	$K_2CdNi(NO_2)_6$
10.28	$(NH_4)_2CdFe(NO_2)_6$
10.29	$K_2HgNi(NO_2)_6$
10.30	$K_2SrFe(NO_2)_6$
10.30	$Tl_2CaFe(NO_2)_6$
10.31	$K_2PbFe(NO_2)_6$
10.32	$K_2CaNi(NO_2)_6$
10.34	$(NH_4)_2SrFe(NO_2)_6$
10.37	$(NH_4)_2PbFe(NO_2)_6$
10.37	$Tl_2CdNi(NO_2)_6$
10.39	$Tl_2PbFe(NO_2)_6$
10.39	$NaRb_2Co(NO_2)_6$
10.40	$Tl_2SrFe(NO_2)_6$
10.4	$K_2PbCo(NO_2)_6$
10.41	$(NH_4)_2CdNi(NO_2)_6$
10.42	$Tl_2HgNi(NO_2)_6$
10.43	$K_2BaFe(NO_2)_6$
10.45	$K_2BaCo(NO_2)_6$
10.45	$K_3Co(NO_2)_6$
10.46	$(NH_4)_2HgNi(NO_2)_6$
10.47	$Rb_2HgNi(NO_2)_6$
10.49	$K_2SrNi(NO_2)_6$
10.49	$K_4Ni(NO_2)_6$
10.50	$(NH_4)_2BaFe(NO_2)_6$
10.54	$K_2LiBi(NO_2)_6$
10.55	$K_2PbNi(NO_2)_6$
10.55	$Tl_2BaFe(NO_2)_6$
10.58	Rb_2CdNi, $Cd(NO_2)_6$
10.58	$K_3Ir(NO_2)_6$
10.59	$Rb_2LiBi(NO_2)_6$
10.6	$K_2PbCu(NO_2)_6$
10.63	$K_2Rh(NO_2)_6$

DIFFRACTION DATA FOR CUBIC ISOMORPHS
(Continued)

a, Å	Substance
$J\ 2_1$ and Related Structures (Continued)	
10.63	$(NH_4)_2LiBi(NO_2)_6$
10.64	$Tl_2LiBi(NO_2)_6$
10.67	$K_2BaNi(NO_2)_6$
10.70	$NaCs_2Co(NO_2)_6$
10.70	$Ba_3[Rh(NO_2)_6]_2$
10.72	$Tl_3Co(NO_2)_6$
10.73	$Rb_3Co(NO_2)_6$
10.73	$(NH_4)_3Ir(NO_2)_6$
10.73	$Tl_3Ir(NO_2)_6$
10.77	$Rb_3Ir(NO_2)_6$
10.8	$(NH_4)_2Co(NO_2)_6$
10.81	$Cs_2Cd[Ni, Cd(NO_2)_6]$
10.82	$Co(NH_3)_5H_2OI_3$
10.83	$Rb_3Rh(NO_2)_6$
10.88	$K_2NaBi(NO_2)_6$
10.89	$Co(NH_3)_6I_3$
10.91	$Tl_3Rh(NO_2)_6$
10.91	$(NH_4)_3Rh(NO_2)_6$
10.94	$Cs_2LiBi(NO_2)_6$
10.95	$K_2AgBi(NO_2)_6$
10.98	$Rb_2NaBi(NO_2)_6$
10.99	$(NH_4)_2NaBi(NO_2)_6$
11.01	$Tl_2NaBi(NO_2)_6$
11.05	$Rb_2AgBi(NO_2)_6$
11.06	$Tl_2AgBi(NO_2)_6$
11.10	$(NH_4)_2AgBi(NO_2)_6$
11.15	$Cs_2NaBi(NO_2)_6$
11.15	$Cs_3Co(NO_2)_6$
11.17	$Cs_3Ir(NO_2)_6$
11.19	$Cs_3Bi(NO_2)_6$
11.19	$Cs_2AgBi(NO_2)_6$
11.21	$Co(NH_3)_6(BF_4)_3$
11.30	$Cs_3Rh(NO_2)_6$
11.32	$[Co(NH_3)_5 \cdot H_2O](ClO_4)_3$
11.39	$Co(NH_3)_6(ClO_4)_3$
11.67	$Co(NH_3)_6(PF_6)$
$K\ 6_1$	
7.46	SiP_2O_7
7.80	TiP_2O_7
7.98	SnP_2O_7
8.18	HfP_2O_7
8.20	ZrP_2O_7
8.61	UP_2O_7
$S\ 1_4$	
11.51	$Al_2(Mg, Fe)_3(SiO_4)_3$, pyrope
11.51	$Al_2Fe_3(SiO_4)_3$, almandite
11.60	$Al_2Mn_3(SiO_4)_3$, spessartite
11.87	$Al_2Ca_3(SiO_4)_3$, grossularite
11.89	$(Al, Fe)_2Ca_3(SiO_4)_3$, hessonite
11.95	$Cr_2Ca_3(SiO_4)_3$, uvarovite
12.03	$Fe_2Ca_3(SiO_4)_3$, andradite
12.10	$(Na, Li)_3AlF_6$, cryolithionite
12.35–12.46	$(Mg, Mn)_2(Ca, Na)_3AsO_4)_3$, berzelite
$S\ 6_1$	
13.68	$NaAlSi_2O_6H_2O$
$S\ 0_8$	
13.82	$Al_{13}Si_5O_{20}(OH, F)_{18}Cl$, zunyite
$S\ 6_2$	
8.87	$Na_4(AlSiO_4)_3Cl$, sodalite
Tetrahedrite	
10.19	$(Cu, Fe)_{12}As_4S_{13}$, binnite
10.2–10.6	$(Cu, Ag)_{10}(Zn, Fe)_2(Sb, As)_4S_{13}$

LIGHT

PHOTOMETRIC QUANTITIES, UNITS AND STANDARDS

Photometric quantities and units are also given in the section Quantities and Units under the sub-division Light.

Candle (or International Candle). The candle is the unit of luminous intensity. It is a specified fraction of the average horizontal candlepower of a group of 45 carbon-filament lamps preserved at the Bureau of Standards.

Candle (new unit). $\frac{1}{60}$ of the intensity of one square centimeter of a blackbody radiator at the temperature of solidification of platinum (2,046°K).

Foot-candle. Foot-candle = 1 lumen incident per ft^2 = 1.076 milliphots = 10.76 lux.

Lumen. The lumen is the unit of luminous flux. It is equal to the flux through a unit solid angle (steradian) from a uniform point source of one candle, or to the flux on a unit surface all points of which are at unit distance from a uniform point source of one candle.

Illumination. Illumination is the density of the luminous flux on a surface. It is the quotient of the flux by the area of the surface when the latter is uniformly illuminated.

Least Mechanical Equivalent of Light. One lumen at the wavelength of maximum visibility (0.556μ) equals 0.00161 watts (= 0.000385 gram calories per sec.); one watt at the same wavelength equals 621 lumens.

Relative Visibility. The relative visibility factor for a particular wavelength is the ratio of the visibility factor for that wavelength to the maximum visibility factor.

Values of the relative visibility are given as a part of the specification of the standard observer under Colorimetry.

Efficiency of a Source of Light. The efficiency of a source is the ratio of the total luminous flux to the total power consumed. In the case of an electric lamp it is expressed in lumens per watt.

Spherical Candlepower. The spherical candlepower of a lamp is the average candlepower of the lamp in all directions in space. It is equal to the total luminous flux of the lamp in lumens divided by 4π

Lambert is the unit of brightness equal to $1/\pi$ candle per square centimeter.

Footlambert is the unit of photometric brightness (luminance) equal to $1/\pi$ candle per square foot.

FLAME STANDARDS

Value of Various Former Standards in International Candles

Standard Pentane Lamp, burning pentane......	10.0	candles
Standard Hefner Lamp, burning amyl acetate..	0.9	"
Standard Carcel Lamp, burning colza oil.......	9.6	"

The *Carcel unit* is the horizontal intensity of the carcel lamp, burning 42 grams of colza oil per hour. For a consumption between 38 and 46 grams per hour the intensity may be considered proportional to the consumption.

The *Hefner unit* is the horizontal intensity of the Hefner lamp burning amyl acetate, with a flame 4 cm. high. If the flame is l mm. high, the intensity $I = 1 + 0.027(l - 40)$.

EFFICIENCIES OF ILLUMINANTS

Compiled by J. M. Smith and C. E. Weitz

The rating listed is the commercial rating of the lamp. The absolute efficiency is the equivalent power in light flux (0.556μ) per watt input. Efficiency is given in lumens per watt input.

Lamp	Rating, or Specification	Eff.	Ab. Eff.
Acetylene...............	1.0 liters per hour	0.67	0.0010
Arc, Electric			
Carbon, Enclosed d.c..	6.6 amps. opal globe & reflector	5.9	0.0087
Carbon, Open d.c.....	9.6 amps. clear globe	11.8	0.0173
High Intensity.......	150 amps. bare arc	18.5	0.0272
Magnetite d.c.........	6.6 amps.	21.6	0.0318

EFFICIENCIES OF ILLUMINANTS (Continued)

Lamp	Rating, or Specification	Eff.	Ab. Eff.
Gas burner, open flame..	Bray high pressure	0.22	0.00032
Gas mantle, incandescent			
High pressure........	0.578 lumens per BTU per hour	2.0	0.0030
Low pressure.........	0.350 lumens per BTU per hour	1.2	0.0018
Incandescent electric			
Carbon filament			
First commercial.....	....	1.6	0.0023
Squirted cellulose.....	....	3.3	0.0048
Metalized............	....	4.0	0.0059
Tungsten filaments			
Vacuum............	25 watt 120 volt (1,000 hrs. life)	10.6	0.0156
Gas filled............	40 watt 120 volt (1,000 hrs. life)	11.6	0.0171
Gas filled............	60 watt 120 volt (1,000 hrs. life)	13.9	0.0204
Gas filled............	100 watt 120 volt (750 hrs. life)	16.3	0.0239
Gas filled............	1000 watt 120 volt (1,000 hrs. life)	21.6	0.0318
Gas filled............	5000 watt 120 volt (75 hrs. life)	32.8	0.0482
Fluorescent lamps			
General line..........	20 watt standard warm white (T12)	50.0	0.0735
General line..........	40 watt " " " "	64.0	0.0940
General line..........	90 watt " " " (T17)	58.0	0.0850
Slimline.............	96T8 (120 ma.) Std. warm white	76.0	0.1115
Slimline.............	96T12 (425 ma.) " " "	69.0	0.1015
General line..........	40 W Daylight (T12)	54.0	0.0795
General line..........	40 W Green (T12)	84.0	0.1235
General line..........	40 W Blue (T12)	33.0	0.0485
General line..........	40 W Red (T12)	3.6	0.0053
Mercury lamps.........			
	400 W (E1)	50.0	0.0735
	1000 W (A6)	65.0	0.0955
Sodium...............	10,000 lumen	55.0	0.0808

APPROXIMATE BRIGHTNESS OF VARIOUS LIGHT SOURCES

Compiled by J. M. Smith and C. E. Weitz
Brightness of source is given in lamberts

Source		Lamberts*
Natural Sources		
Clear sky	Average brightness	2.5
Sun (as observed from earth's surface)	At meridian	519,000
Sun (" " " " ")	Near horizon	1885
Moon (" " " " ")	Bright spot	0.8
Combustion Sources		
Candle flame (sperm)	Bright spot	3.1
Kerosene flame (flat wick)	Bright spot	3.8
Illuminating—gas flame	Fish-tail burner	1.3
Welsbach mantle	Bright spot	20.0
Acetylene flame	Mees burner	34.0
Incandescent Electric lamps		
Carbon filament		165
Metalized carbon filament (Gem)		300
Tungsten filament	Vacuum lamp 10 lumens per watt	650
Tungsten filament	Gas filled lamp 20 lumens per watt	3800
Tungsten filament	750 watt projector lamp 26 lumens per watt	7500
Fluorescent Lamps		
20 watt T12 Standard warm white		1.67
40 watt T12 " " "		2.10
96T12 " " "		2.052

APPROXIMATE BRIGHTNESS OF VARIOUS LIGHT SOURCES (Continued)

Source		Lamberts*
Electric Arc Lamps		
Plain carbon arc	Positive crater 7 mm. non-rotating	55,000
High intensity carbon arc	Positive crater 8 mm. non-rotating	125,000
High intensity carbon arc	Positive crater 13.6 mm. non-rotating	220,000
High intensity carbon arc	Positive crater	314,000
Mercury Lamps		
Low pressure mercury arc	50″ AC rectified tube	6.6
400 W (H1)		440
1000 W (A6)	Water cooled	94,000
Sodium Lamps	10,000 lumens	18

* To convert lamberts to footlamberts multiply by 929.
To convert lamberts to candles/cm² divide by π.

WAVE LENGTHS OF VARIOUS RADIATIONS

	Ångstroms
Cosmic Rays	0.0005
Gamma Rays	0.005–1.40
X-Rays	0.1–100
Ultra Violet, below	4000
Limit of suns U.V. at earth's surface	2920
Visible Spectrum	4000–7000
Violet, representative, 4100, limits	4000–4240
Blue, representative, 4700, limits	4240–4912
Green, representative, 5200, limits	4912–5750
Maximum visibility	5560
Yellow, representative, 5800, limits	5750–5850
Orange, representative, 6000, limits	5850–6470
Red, representative, 6500, limits	6470–7000
Infra Red, greater than	7000
Hertzian Waves, beyond	2.20×10^6

BRIGHTNESS OF TUNGSTEN

Characteristics of Straight Tungsten Wire in a Vacuum
Forsythe and Worthing, 1924).

Temperature °K			Brightness Candles/cm²	$\frac{B}{dB}\,\frac{dt}{T}$
Absolute	Brightness	Color		
1000	966	1006	0.00012	22.0
1200	1149	1210	0.006	20.0
1400	1330	1414	0.11	17.2
1600	1509	1619	0.92	15.2
1800	1684	1825	5.05	13.7
2000	1857	2033	20.0	12.3
2200	2026	2242	61.3	11.2
2400	2192	2452	157.0	10.3
2600	2356	2663	347.0	9.6
2800	2516	2878	694.0	8.9
3000	2673	3094	1257.0	8.3
3200	2827	3311	2110.0	7.8
3400	2978	3533	3370.0	7.6
3655*	3165	3817	5740.0	7.3

* Melting-point of tungsten.

WAVE LENGTHS OF THE FRAUNHOFER LINES

Sun's Spectrum

At 15° C and 76 cm pressure. Wave length in Ångström units (Fabry and Buisson system).

Line	Due to	Wave length	Line	Due to	Wave length
U	Fe	2947.9	h	H	4101.750
t	Fe	2994.4	g	Ca	4226.742
T	Fe	3021.067	G	Fe	4307.914
s	Fe	3047.623		Ca	4307.749
S_1	Fe	3100.683	G'	H	4340.477
S_2	Fe	3100.326	F	H	4861.344
	Fe	3099.943	b_4	Fe	5167.510
R	Ca	3181.277		Mg	5167.330
	Ca	3179.343	b_2	Mg	5172.700
Q	Fe	3286.773	b_1	Mg	5183.621
P	Ti	3361.194	E_2	Fe	5269.557
O	Fe	3441.020	D_2	Na	5889.977
N	Fe	3581.210	D_1	Na	5895.944
M	Fe	3727.636	C	H	6562.816
L	Fe	3820.438	B	O	6869.955
K	Ca	3933.684	A	O	7621
H	Ca	3968.494		O	7594
			Z	....	8228.5
			Y	....	8990.0

WAVE LENGTHS FOR SPECTROSCOPE CALIBRATION

Source	Wave Length	Source	Wave Length
Potassium flame............	0.7699μ	E, solar..................	0.5270μ
Potassium flame............	0.7665	b_1, solar or magnesium flame	0.5184
Mercury I arc.............	0.6907	b_2, solar or magnesium flame	0.5173
B, solar..................	0.6869	Mercury I arc.............	0.4960
Lithium flame..............	0.6708	Mercury I arc.............	0.4916
C, solar or hydrogen tube	0.6563	F, solar or hydrogen tube...	0.4861
Mercury I arc.............	0.6234	Strontium flame...........	0.4608
D_1, solar or sodium flame...	0.5896	Mercury I arc.............	0.4358
D_2, solar or sodium flame...	0.5890	G', solar or hydrogen tube...	0.4340
Mercury I arc.............	0.5791	Mercury I arc.............	0.4047
Mercury I arc.............	0.5770	H_1, solar..................	0.3969
Mercury I arc.............	0.5461	K, solar..................	0.3934
Thallium flame.............	0.5351		

FLAME SPECTRA

Compiled by T. G. Kennard

Listed below are the prominent lines and bands given by volatile compounds when introduced into a gas flame. Additional, weaker lines are often observed. Wave lengths are stated in ångstroms, and in the case of bands refer to the position of the band head. Bands are designated by the symbol (b); the most sensitive or persistent lines or bands are designated by P.

Barium....	5137 (b) 5347 (b) 5535 (b) P	Boron....	5193 (b) 5440 (b) 5481 (b) P	Calcium..	5544 (b) 6182 (b) P 6203 (b) P

FLAME SPECTRA (Continued)

Cesium	4555.5	P	Potassium	4044.16	
	4593.18	P		4047.22	
	6213.0			7664.94	P
	6723.3			7699.01	P
	6973.3		Rubidium	4201.8	P
Indium	4101.76			4215.6	P
	4511.31	P		7800.30	
				7947.63	
Lithium	6103.59				
	6707.86	P	Sodium	5889.965	
				5895.932	
Manganese chloride	5158	(b)			
	5193	(b)	Strontium	6060	(b) P
	5230	(b)		6628	(b)
	5360	(b)		6747	(b)
	5392	(b)			
	5424	(b)	Thallium	5350.47	
	5592	(b)			

VELOCITY OF LIGHT (IN VACUO)

(2.99776 ± .00004) × 10^{10} cm/sec. (Birge, 1941)
(2.99793 ± .00002) × 10^{10} cm/sec. (Aslakson, 1949)
(2.99790 ± .00001) × 10^{10} cm/sec. (DuMond and Cohen, 1951)
299,776 km/sec. (Birge)
186,272 miles/sec. (Birge)

(2.997928 ± .000004) × 10^{10} cm/sec (Bearden and Thomsen 1955)

WAVE LENGTH OF THE PRINCIPAL LINES IN THE EMISSION SPECTRA OF THE ELEMENTS

SECTION I

Ultraviolet below 2000 A

Wave lengths are stated in angstroms

1 angstrom (A) = 10^{-8} cm = 10^{-4} microns (μ) = 10^{-1} millimicrons (mμ) = 100 $\mu\mu$

Intensities of lines are indicated by the numbers 1 to 10, the latter, the higher intensity, except as otherwise indicated.

Characteristics of the lines are indicated by symbols as follows:

I, II, III etc indicate lines produced by the neutral, ionized or doubly ionized atom respectively.

$_2$, $_3$, $_4$, etc. unresolved lines of 2, 3, or 4 components

n broad or nebulous
N very broad and diffuse
p persistent lines
P the most sensitive of the persistent lines
r easily reversed
R wide, self reversed

Aluminum

Wave length	Arc	Spark
III 695.82	..	3
III 696.23	..	2
III 854.98	..	3
III 856.80	..	3
II 1190.07	..	2
II 1191.83	..	2
II 1211.93	..	1
1310. ?	..	6
1319. ?	..	6
III 1384.	..	5
III 1606.	..	8
III 1612.	..	8
II 1671. p	..	10
II 1719.	..	9
II 1721.	..	9
II 1725.	..	10
II 1750.	..	2
1752.	..	3
II 1760.1	..	7
II 1761.9	..	7
II 1763.[illegible]	..	10$_{(2)}$
II 1765.7	..	7
II 1767.6	..	9
1777.	..	4
1792.	..	3
1818.3	..	2
III 1854.67 p	..	10
II 1858.15 p	..	7
II 1862.48 p	..	10
III 1862.90 p	..	10
II 1930.3	..	2
III 1935.2	..	7
II 1989.8	..	8

Antimony

Wave length	Arc	Spark
456.	..	1
691.	..	2
723.	..	3
805.	..	5
861.	..	6
976.	..	10
981.	..	10
1012.	..	10
1042.	..	10
1048.	..	10
1162.	..	10
1168.	..	10
1171.	..	10
1193.	..	10
1205.	..	10
1211.	..	10
1225.	..	10
1307.	..	10
1438.	..	10
1514.	..	10
1566.3	..	8
1585.	..	8
1712.	..	6
1725.	..	6
1731.	..	5
1762.	..	10
1783.	..	10
1810.	..	5
1867.	..	8
1870.6	..	10
1926.6	..	5

Argon

Wave length	Geissler tube
1333.7	5
1334.5	7
1335.8	7
1460.1	5
1589.5	4
1600.7	5
1669.7	7
1673.5	7
1675.6	7
1788.1	5
1820.0	7
1830.6	10
1831.4	9
1836.3	9
1843.1	9
1855.7	9
1865.9	8
1868.7	8
1873.2	10
1877.7	8
1879.7	8
1886.1	7

Arsenic

Wave length	Arc	Spark
529.	..	1
827.	..	5
873.	..	8
878.	..	8
926.	..	8
952.	..	8
956.	..	8
963.	..	10
984.	..	10
1001.	..	10
1009.	..	10
1081.	..	50
1093.	..	20
1106.	..	10

I. EMISSION SPECTRA BELOW 2000 A (Continued)

ARSENIC (Continued)

Wave length	Arc	Spark
1171.	..	15
1208.	..	30
1267.	..	40
1287.	..	10
1700.2	..	10
1733.0	..	15
1742.9	..	20
1890. p.	..	4r
1936. p	..	5
1972. p	..	4r

King's Intensity Scale

Wave length	Arc
1889.85	1000 R
1937.02	1000 R
1958.29	20 r
1972.03	1000 R
1989.71	200 R
1990.49	50 r
1994.25	25
1994.79	100 r

BARIUM

Wave length	Arc	Spark
1331.	..	2
1415.	..	3
1504.	..	4
1554.	..	3
1674.	..	4
II 1694.	..	6
II 1869.	..	5

BERYLLIUM

II 1036.32	..	3
II 1512.30	..	8
II 1512.45	..	10
II 1776.12	..	6
II 1776.34	..	8

BISMUTH

670.	..	1
791.	..	2
967.	..	3
1045.	..	10
1051.	..	10
1306.	..	10
1317.	..	15
1346.	..	10
1533.7	5	3

BISMUTH (Continued)

Wave length	Arc	Spark
1776.7	3	4
1787.1	3	4
1791.7	4	4
1823.5	3	5
1902.5	..	1
1959.6	..	3
1973.2	..	3

BORON

III 677.01 }	..	5
III 677.16 }		
III 758.47 }	..	3
III 758.68 }		
II 1624.4	..	$8_{(5)}$
I 1825.87 }	..	1
I 1826.41 }		

BROMINE

Wave length	Geissler tube
1251.8	4
1384.6	8
1488.6	8
1531.9	7
1540.8 p	6
1575.0	9
1576.5	6
1582.4	8
1633.6 p	10

CADMIUM

Wave length	Arc	Spark
396.	..	1
847.	..	10
1369.	..	20
1397.	..	20
1462.	..	20
1466.	..	8
1472.	..	8
1514.	..	20
1628.7	..	6
1707.5	..	8
1747.9	..	6
1768.8	..	6
1773.1	..	6
1844.5	..	10
1856.0	..	15
1873.6	..	15
1900.7	..	6

CADMIUM (Continued)

Wave length	Arc	Spark
1921.8	..	2
1939.	..	2
I 1942.	..	2
1995.	..	3

CALCIUM

404.	..	6
410.	..	6
537.	..	5
655.	..	6
669.	..	6
688.	..	5
718.	..	6
832.	..	10
840.	..	6
902.	..	10
II 1434.	..	6
II 1553.	..	7
II 1555.	..	$8_{(2)}$
1562.	..	4
1667.	..	5
II 1807.8	..	7
II 1815.0	..	8
II 1838.	..	$9_{(2)}$
II 1840.2	..	10
II 1843.7	..	6
II 1851.3	..	7

CARBON

Wave length	Arc	Spark	Geissler tube
313.	..	1	..
372.	..	1	..
III 459.7	..	6	..
II 533.9	..	1	..
III 538.4	..	7	..
II 543.4	..	2	..
II 560.5	..	2	..
574.4	..	6	..
II 594.9	4	5	..
II 636.2	..	2	..
651.	2	[illegible]$_{(2)}$	..
II 687.1	8	7	8
II 858.2	8	8	8
II? 904.	4	$10_{(4)}$	..
III 977.02	..	12	..
I 1010.1	9	10	..
II 1036.2	..	} 10	5
II 1036.8	..		5
1176.	10	$15_{(6)}$	..
1323.7	7	7	..
1329.1	8	} 4	..
1329.6	8		
1334.5 p	10	} 10	..
1335.7 p	10		

I. EMISSION SPECTRA BELOW 2000 A (Continued)

Carbon (Continued)

Wave length	Arc	Spark	Geissler tube
IV 1550.9	..	3	.....
I 1561.3	5	5	5
1657.	6	6(4)	.....
III 1930.98	5	7(2)	.....

Cerium

Wave length	Arc	Spark
399.	..	1
741.	..	5
830.	..	20
1332.	..	20
1373.	..	20

Cesium

1884.0	..	6
1889.2	..	6
1935.2	..	8

Chlorine

Wave length	Geissler tube
IV 538.08	3
556.4	4
561.5	4
574.3	4
586.9	4
V 629.33	6
V 633.18	6
V 635.31	6
V 639.24	5
653.7	4
663.2	4
712.6	4
VI 730.31	4
787.8	4
VII 800.70	3
VII 813.00	2
840.9	6
888.0	4
960.4	6
984.8	4
1008.6	4
1014.9	4
1070.9	4
1145.0	2
1547.2	3
1577.7	2
1821.9	2

Chromium

Wave length	Arc	Spark
202.6	..	1
438.3	..	4
456.8	..	4
464.0	..	4
469.8	..	4
575.3	..	5
619.9	..	6
629.9	..	6
637.8	..	6
648.7	..	5
667.1	..	5
681.3	..	5
840.	..	3
885.2	..	10
925.5	..	2
1004.4	..	3
1018.7	..	3
1816.4	..	10

Cobalt

342.	..	1
937.	..	5
1128.	..	3
1502.	..	3
1574.	..	5
1580.	..	5
1631.6	..	3
1772.7	..	5
1790.4	..	4
1846.	..	4
1882.2	..	4
1928.	..	6
1940.3	..	6
1950.	..	4
1955.2	..	4
1956.6	..	5
1969.4	..	5
1974.1	..	4

Copper

155.7	..	0
324.5	..	6
329.2	..	5
358.0	..	5
452.8	..	7
777.3	..	5
788.3	..	6
1594.	..	5
1642.	..	8
1652.	..	6
1670.	..	6
1672.	..	6
1679.	..	6
1687.	..	6
1702.	..	5
1722.	..	6
I 1741.	..	6

Copper (Continued)

Wave length	Arc	Spark
1750.	..	6
1769.	..	4
1783.	..	3
1840.	..	8
1979.2	4	1
1999.6	5	2

Fluorine

Wave length	Geissler tube
378.6	1
420.1	1
III 430.15	4
III 467.70	7
II 546.84	4
IV 572.65	4
II 605.67	8
II 606.27	7
II 606.81	9
II 606.95	4
II 607.48	7
II 608.06	8
III 656.10	7
III 656.86	6
III 658.34	8
IV 676.06	4
IV 677.17	5
IV 679.19	5
I 951.81	5
I 954.78	7
I 955.53	6
I 958.49	5

Gallium

Wave length	Arc	Spark
124.	..	0
425.	..	4
509.	..	3
511.	..	3
645.	..	2
800.4	..	5
828.8	..	5
839.9	..	5
860.4	..	5
874.4	..	6
909.3	..	5
938.5	..	6
989.5	..	6
1050.2	..	6
1102.7	..	7
1120.6	..	5
1133.6	..	6
1135.9	..	5

I. EMISSION SPECTRA BELOW 2000 A (Continued)

Gallium (Continued)

Wave length	Arc	Spark
1136.9	..	5
1156.1	..	7
1163.5	..	6
1170.4	..	9
1192.9	..	6
1195.0	..	6
1228.0	..	7
1258.8	..	9
1264.6	..	6
1267.1	..	7
1279.2	..	7
1285.3	..	7
1293.5	..	6
1295.9	..	10
1299.5	..	9
1303.5	..	10
1338.1	..	7
1414.4	..	10
1483.9	..	6
1495.4	..	10
1534.5	..	10
1586.3	..	8
1625.3	..	7
1799.2	..	7
1802.3	..	7
1813.9	..	9
1845.0	..	8

Germanium

Wave length	Arc	Spark
547.0	..	1
760.3	..	3
847.9	..	5
868.3	..	6
892.6	..	5
915.0	..	8
936.7	..	9
938.9	..	6
989.0	..	6
995.7	..	8
996.5	..	8
1004.2	..	6
1011.2	..	9
1016.5	..	8
1045.5	..	7
1058.8	..	6
1072.4	..	6
1088.3	..	8
1098.6	..	5
1105.0	..	6
1116.8	..	6
1138.0	..	8
1159.5	..	8
1160.8	..	8
1173.7	..	6
1183.4	..	8
1189.0	..	10

Germanium (Continued)

Wave length	Arc	Spark
1229.8	..	10
1237.0	..	6
1393.8	..	8
1402.8	..	6
1500.6	..	6
1733.	..	6

Gold

Wave length	Arc	Spark
458.	..	1
832.	..	5
854.	..	4
864.	..	5
975.	..	20
1402.	..	2
1435.	..	4
1488.	..	$4_{(2)}$
1500.	..	$4_{(2)}$
1534.	..	3
1562.	..	3
1590.	..	3
1600.	..	3
1622.	..	4
1629.	..	3
1639.	..	3
1659.	..	3
1673.	..	6
1694.	..	6
1699.	..	3
1720.	..	3
1726.	..	4
1727.	..	3
1740.	..	4
1767.	..	3
1784.	..	5
1795.	..	5
1802.	..	5
1822.4	..	4
1845.7	..	3
1850.1	..	2
1861.1	..	3
1871.1	..	3
I 1879.1	..	3
1886.3	..	4
1889.8	..	2
1903.9	..	2
I 1918.9	..	4
1921.0	..	4
I 1951.2	..	3
1977.3	..	3

Hafnium
King's Intensity Scale

Wave length	Arc	Spark
1623.06	..	12
1628.91	..	12

Hafnium (Continued)
King's Intensity Scale

Wave length	Arc	Spark
1774.81	..	10
1815.71	..	9
1919.52	..	20
1922.11	..	9
1922.74	..	12
1955.66	..	12
1963.75	..	9
1964.23	..	15

Helium

Wave length	Geissler tube
I 585.? p	10
II 1215.?	..
II 1640.? p	5

Hydrogen

972.54	..
992.	..
1025.73	..
1086.	..
1215.68 p	..

Indium

Wave length	Arc	Spark
161.8	..	0
583.	..	1
684.	..	2
752.	..	1
882.	..	4
954.7	..	4
973.	..	3
1031.5	..	5
1054.	..	6
1082.	..	6
1222.5	..	6
1233.	..	6
1320.	..	7
1381.	..	9
1406	..	8
1435.	..	5

I. EMISSION SPECTRA BELOW 2000 A (Continued)

Indium (Continued)

Wave length	Arc	Spark
III 1488.	..	8
1521.6	..	9
1533.5	..	9
II 1625.6	..	10
III 1749.2	1	12
1966.7	2	9
1977.3	2	8

Iodine

Wave length	Geissler tube
1234.2	3
1336.7	6
1355.5	6
1390.9	5
1425.7	8
1458.2	6
1459.2	6
1514.8	9
1518.3	7
1641.1	7
1642.5	7
1782.9 p	9
1830.4	10
1844.5	9
1876.4	7

Iron

Wave length	Arc	Spark
294.3	..	2
365.8	..	5
381.1	..	4
392.9	..	7
417.5	..	4
552.1	..	7
602.4	..	4
609.1?	..	9
666.9	..	4
669.9	..	4
859.9	..	4
863.2	..	3
929.2	..	3
983.8	..	3
1006.0	..	2
1017.6	..	6
1031.8	..	4
1062.1	..	2
1143.4	..	2
1186.4	..	2
1228.9	..	2
1254.1	..	2
1260.8	..	2
1272.2	..	2

Iron (Continued)

Wave length	Arc	Spark
1373.9	..	2
1387.8	..	2
1409.4	..	2
1430.6	..	2
1525.5	..	2
1532.3	..	2
1538.3	..	2
1597.7	..	2
1630.9	..	2
1702.0	..	3
1718.3	..	2
1724.0	..	2
1787.0	..	5
1788.3	..	5
1843.9	..	2
1869.7	..	4
1895.6	..	4
1913.3	..	4
1914.2	..	3
1953.6	..	2

Krypton
King's Intensity Scale

Wave length	Geissler tube
II 886.29	8
II 964.93	12
I 1164.88	20
I 1235.85	30

Lead

Wave length	Arc	Spark
884.	..	5
890.	..	3
894.	..	5
907.	..	7
927.	..	7
954.	..	3
1004.	..	3
1029.	..	10
1166.	..	7
1203.	..	7
1213.	..	3
1232.	..	7
1250.	..	10
1267.	..	7
1316.	..	10
1349.	..	3
1434.	..	10

Lead (Continued)

Wave length	Arc	Spark
1534.	..	7
1554.	..	10
1660.	..	2
1671.	..	2
1682.5 p	6	2
1726.	6	2
1781.	..	2
1796.5	6	3
1822.	8	3
1869.	..	5

Magnesium

Wave length	Arc	Spark
1231.6	..	2
1320.9	..	5
1323.2	..	4
II 1735.	1	6
II 1737.	2	7
1741.	5	..
1744.	5	..
II 1750.9	..	5
II 1753.6	..	6
I 1828.	3	..
1856.	5	..
1864.	4	..
1886.	5	..
1931.	6	..

Manganese

Wave length	Arc	Spark
311.	..	1
648.	..	2
893.	..	10
1113.	..	5
1118.	..	5
1438.	..	5
1573.?	..	5
1789.	..	10
1892.0	..	4
1904.	..	5
1952.1	..	3
1993.	..	5

Mercury

Wave length	Arc	Spark
I 1269 7	..	5
1527.	..	5
1592.	..	8
1599.	..	7
II 1650. p	..	10
1677.9	..	10
1738.3	..	8
1798.7	..	9
I 1849. P	10	10
II 1942. p	10	5

I. EMISSION SPECTRA BELOW 2000 A (Continued)

MOLYBDENUM

Wave length	Arc	Spark
1377.	..	1
1548.	..	4
1692.	..	2
1697.	..	4
1809.8	..	7

NICKEL

Wave length	Arc	Spark
1398.	..	2
1499.	..	2
1527.	..	2
1653.	..	6
1693.	..	7
1709.	..	6
1767.	..	6
1855.	..	5
1929.7	..	5
1979.3	..	6

NITROGEN

Wave length	Geissler tube
III 685.5	$5_{(4)}$
II 916.82	$2_{(4)}$
IV 922.02	..
IV 922.57	..
IV 923.18	..
IV 923.68	..
IV 924.31	..
III 989.90 p	2
III 991.66 p	3
1085.	$10_{(4)}$
1184.1	10
1200.4 p	10
V 1242.2	4
II 1276.0	$10_{(3)}$
1335.3	10
I 1492.83	3
I 1494.78	3
1561.1	7
1657.2	7
I 1742.81	5
I 1745.31	5

OXYGEN

Wave length	Arc	Spark
136.6	..	0
305.7	..	3
374.3	..	4
III 507.38	..	4
III 507.68	..	5
III 508.18	..	6
III 525.79	..	6
IV 553.33	..	5
IV 554.07	..	5
IV 554.52	..	5
IV 555.23	..	5
580.41	..	3
580.98	..	4
II 616.31	..	5
II 617.06	..	5
II 644.16	..	6
II 672.91	..	5
II 673.75	..	5
III 702.33	..	6
III 702.82	..	6
III 702.90	..	6
III 703.85	..	7
II 718.50	..	7
II 718.57	..	7
V 758.69	..	4
V 759.45	..	4
V 760.23	..	3
V 760.46	..	5
V 761.13	..	4
V 762.00	..	4
II 796.61	..	6
II 832.76	..	8
III 832.93	..	7
II 833.33	..	9
III 833.74	..	8
II 834.46	..	10
III 835.09	..	3
III 835.29	..	9
889.7	..	8
904.7	..	10
916.4	..	15
917.8	..	15
I 948.7	4	..
I 950.2	4	..
I 950.9	4	..
I 952.4	4	..
I 953.0	2	..
I 971.76	8	8
I 973.26	5	5
I 973.92	4	4
I 976.50	5	5
I 978.00	5	5
I 978.62	4	4
990.	..	$10_{(2)}$
991.5	..	$10_{(2)}$
1010.5	..	10
I 1026.0	9	5
I 1027.5	8	..
I 1028.2	7	..
1036.9	..	7
I 1039.26	8	8
I 1041.0	8	8
I 1041.71	5	7
1066.3	..	5
1085.2	..	10
1128.4	..	5
1132.3	..	10
1134.8	..	$10_{(2)}$
1152.6	..	6
1175.6	..	10
1200.	..	$10_{(3)}$
1217.62	..	10
1247.7	..	$10_{(3)}$
1277.	..	5
I 1302.3 p	10	..
I 1305.0 p	10	..
I 1306.1 p	10	..
I 1355.7	8	..
I 1358.7	5	..
1743.1	..	5
1760.9	..	8
1781.4	..	7
1787.0	..	7
II 1961.60	..	$3_{(3)}$

PALLADIUM

Wave length	Arc	Spark
II 1596.8	..	5
II 1625.8	..	5
II 1667.6	..	7
II 1693.4	..	6
II 1704.3	..	8
II 1741.0	..	6
II 1781.8	..	6

PHOSPHORUS

Wave length	Spark	Geissler tube
IV 823.21	5	..
IV 824.76	6	..
IV 827.95	6	..
III 859.69	6	..
V 865.48	4	..
V 871.42	5	..
III 913.99	4	..
III 917.14	5	..
III 918.69	5	..
III 921.86	5	..
III 998.03	5	..
III 1003.64	5	..
IV 1035.54	4	..
V 1118.02	10	..
V 1128.04	10	..
1671.5	..	3
1685.8	..	5
1693.8	..	4
1774.8 p	..	7
1782.7 p	..	7
1787.5 p	..	6
1834.5	..	4
I 1846.8	..	7

I. EMISSION SPECTRA BELOW 2000 A (Continued)

Phosphorus (Continued)

Wave length	Arc	Geissler tube
I 1851.11	6	6
I 1859.36	6	6

Platinum

Wave length	Arc	Spark
390.	..	1
696.	..	3
702.	..	3
714.	..	3
805.	..	3
930.	..	3
935.	..	3
1056.	..	3
1118.	..	3
1199.	..	3
1213.	..	3
1226.	..	5
1287.	..	5
1461.	..	4
1473.	..	4
1597.	..	3
1680.	..	5
1723.	..	4
1889.	..	5
1928.5	..	5

Potassium

382.5	..	2
470.4	..	4
612.5	..	3
765.7	..	3
1669.	..	4(2)
1703.	..	9
1771.	..	6
1787.	..	4
1944.	..	5

Scandium

791.	..	5
1214.	..	6
1603.	..	5
1880.	..	5
1993.	..	5

Selenium

Wave length	Arc	Spark
1854.	..	7
1960. p	10	10 r
1993.	5	..

Silicon

Wave length	Spark	Geissler tube
IV 361.6	..	1
IV 457.7	..	3
IV 749.7	..	3
IV 815.0	..	7
IV 818.0	..	7
IV 1066.3	..	8
III 1110.47	..	5
II 1194.89	..	5
III 1206.9	..	10
II 1260.66	..	8
II 1265.04	..	10
IV 1393.9	..	10
IV 1402.9	..	8
III 1500.39	..	5
II 1526.38 p	..	8
II 1533.55 P	..	10
II 1711.0	..	6
II 1808.14	..	8
II 1817.06	..	10
1885.	10	..
I 1988.97	5	..

Silicon I
King's Intensity Scale

Wave length	Arc
1629.96	8 r
1696.20	20 r
1697.96	20 r
1700.43	15 r
1769.78	15
1770.63	8
1770.94	10
1776.85	10
1783.23	8
1799.14	10
1809.05	30
1814.02	50
1814.09	30
1822.46	10
1836.52	20
1838.00	10
1841.16	10
1841.47	20 r
1843.77	15

Silicon I (Continued)
King's Intensity Scale

Wave length	Arc
1845.53	25 r
1846.13	12
1847.47	35 r
1848.16	20 r
1848.75	18
1850.68	50 r
1851.80	10
1852.48	25 r
1853.17	10
1873.11	8
1874.86	25
1875.82	10
1881.86	12
1887.71	12
1893.22	25
1901.34	50
1904.66	12
1976.96	15
1978.57	12
1980.00	10
1982.60	20
1985.73	20
1988.36	30

Silver

Wave length	Arc	Spark
1445.	..	5
1486.	..	4
1496.	..	4
1539.	..	4
1566.	..	6
1656.8	..	5
1674.	..	2
1693.	..	6
1722.	..	3
1751.	..	6
1769.	..	4
1772.	..	4
1794.	..	4
1802.	..	4
1816.	..	3
1839.	..	3
1860.	..	4
1873.	..	4
1880.	..	4
1889.	..	4
1916.3	..	4
1932.3	..	2
1956.9	..	3
1999.5	..	2

Sodium

1372.3	..	2
1376.6?	..	1

I. EMISSION SPECTRA BELOW 2000 A (Continued)

SODIUM (Continued)

Wave length	Arc	Spark
1659.7	..	4
1668.7	..	4
1669.3	..	4
1698.9?	..	10
1703.5	..	9
1749.3	..	8
1770.8	..	6
1773.5	..	6
1787.4	..	4

STRONTIUM

II 1613.	4	..
II 1620.	5	..
II 1769.	8	..
II 1778.	9	..

SULFUR

IV 661.42	6	..
IV 744.92	5	..
IV 748.40	5	..
IV 750.23	5	..
IV 753.75	6	..
V 786.51	6	..
IV 815.97	5	..
V 854.81	5	..
VI 933.42	5	..

TELLURIUM

509.	..	1
634.	..	1
813.	..	5
928.	..	4
931.	..	4
1004.	..	5
1007.	..	5
1064.	..	5
1107.	..	5
1117.	..	5
1123.	..	7
1150.	..	5
1167.	..	10
1174.	..	7
1216.	..	7
1219.	..	7
1223.	..	7
1291.	..	5
1297.	..	5
1345.	..	7
1461.	..	7
1826.	..	5

THALLIUM

Wave length	Arc	Spark
395.	..	1
662.	..	3
II 697.	..	4
II 817.	..	3
908.	..	2
IV 1029.	..	4
1082.	..	4
III 1266.	..	8
IV 1337.	..	4
1478.	..	4
1492.	..	4
III 1559.	..	10
II 1561.	..	8
III 1660.	..	10
II 1793.	..	9
II 1815.	..	10
II 1828.	..	6
II 1893.	..	10

TIN

392.	..	1
410.	..	2
502.	..	2
508.	..	2
752.	..	3
784.	..	3
892.	..	3
902.	..	15
907.	..	3
910.	..	3
956.	..	10
1019.	..	15
1044.	..	15
1058.	..	3
1062.	..	3
1086.	..	5
1089.	..	5
1132.	..	12
1158.	..	20
1224.	..	10
1251.	..	20
1314.7	..	10
1327.	..	7
1347.	..	4
1370.	..	4
1387.	..	5
1410.8	..	5
1437.7	..	10
1475.	..	6
1570.	..	4
1757.	..	10
1811.	..	10
1899.	3	10
1951.4	3 r	..
1983.4	3 r	..

TITANIUM

324.	..	1
781.6	..	10
834.0?	..	2
1113.4	..	5
1120.5	..	5

TITANIUM (Continued)

Wave length	Arc	Spark
1264.6	..	5
III 1294.3	..	2
III 1298.8	..	2
1437.3	..	5
1658.7	..	10
1671.2	..	10

TUNGSTEN

1550.2	..	3
1679.2	..	3
1785.5	..	5
1787.0	..	5
1788.3	..	5
1895.5	..	6

URANIUM

397.	..	1
764.	..	5
1587.	..	5
1833.	..	5
1981.	..	5
1985.	..	5

VANADIUM

483.0	..	5
684.5?	..	5
723.	..	3
1112.	..	2
1437.3	..	2
1454.	..	2

YTTRIUM III
King's Intensity Scale

Wave length	Intensity
989.21	1
996.37	2

ZINC

Wave length	Arc	Spark
677.9	..	5
I 1457.	..	8
I 1589.	..	10
I 1601.2	..	6
1620.0	..	6
1622.9	..	7
1629.4	..	9
1639.5	..	9
1645.0	..	8
1651.9	..	7
1673.2	..	7
1707.	..	7
1743.	..	10
1746.	..	8
1750.	..	7
1767.8	..	7
1811.	..	7
1834.	..	7
1839.3	..	6
1864.	..	5

SECTION II

2000 to 10,000 A

Wave lengths are given in angstroms
Intensities are given according to the M. I. T. Wave length Tables.
Characteristics of the lines are indicated by symbols as follows:

bh band head
d double line
l shaded or displaced to longer wavelengths (asymmetrical)
m mean value
n hazy, diffuse, nebulous
r narrow or wide self-reversal
s shaded or displaced to shorter wavelengths (asymmetrical)
w wide or complex
W Very wide or complex
( ) Discharge tube intensity
I line classified as emitted by normal atom
II line classified as emitted by singly ionized atom

ACTINIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4088.37	..	100	4359.09	..	30	4413.17	..	100
4168.40	..	100	4386.37	..	100	4812.25	..	60
4179.93	..	60						

ALUMINUM

II 2016.91	..	(80)	II 2650.10	..	(30)	II 4585.82	..	(40)
II 2087.00	..	(40)	I 2652.49	150 r	60	II 4588.19	..	(30)
II 2094.3	..	(50)	I 2660.39	150 r	60	II 4898.76	..	(30)
II 2094.8	..	(50)	II 2669.17	3	100	II 4902.77	..	(30)
II 2095.2	..	(40)	2748.86	..	(30 n)	II 5280.21	..	(50)
II 2099.68	..	(40)	2805.65	..	(30)	II 5283.77	..	(100)
II 2243.05	..	(30)	II 2868.52	..	(80)	II 5285.85	..	(50)
I 2263.45	60 r	25	II 2881.46	..	(30)	II 5312.32	..	(35)
I 2269.09	60 r	25	2884.20	..	(30)	II 5316.07	..	(70)
I 2367.06	150 r	50 r	II 3041.28	..	(50)	II 5371.84	..	(50)
I 2373.13	100 r	30	II 3074.66	..	(50)	II 5593.23	..	(200)
I 2373.36	200 r	100 r	I 3082.15	800	800	II 5853.62	..	(35)
I 2378.41	40	20	I 3092.71	1000	1000	II 5971.94	..	(35)
II 2392.15	..	(30)	3092.84	50 r	18	II 6001.76	..	(60)
II 2459.82	..	(30)	II 3428.92	..	(50)	II 6001.88	..	(50)
II 2475.26	..	(30)	II 3586.55	..	(200)	II 6006.42	..	(30)
II 2476.30	..	(30)	II 3586.69	..	(200)	II 6068.43	..	(60)
II 2540.12	..	(30)	II 3586.80	..	(200 wn)	II 6068.53	..	(30)
II 2545.60	..	(50)	II 3586.91	..	(500 n)	II 6231.76	..	(35)
II 2552.12	..	(40)	II 3587.06	..	(100)	II 6243.36	..	(80)
II 2556.01	..	(30)	II 3587.44	..	(80)	I 6695.97	..	(50)
II 2557.71	..	(40)	3612.47	..	(80 n)	I 7362.31	5 nl	(50)
II 2565.68	..	(30)	II 3651.06	..	(50)	I 7835.33	..	(40)
2567.99	200 r	80 r	II 3655.00	..	(100)	I 7836.15	..	(50)
2575.10	200 r	80 r	II 3900.68	..	(200)	II 8354.35	..	(50)
2575.41	30	30	I 3944.03	2000	1000	II 8359.57	..	(40)
II 2586.95	..	(50)	I 3961.53	3000	2000	II 8363.52	..	(30)
II 2597.18	..	(50)	II 3995.86	..	(30)	II 8640.70	..	(30)
II 2627.68	..	(60)	II 4026.5	..	(30)	I 8772.88	..	(80)
II 2631.55	..	(60)	II 4226.81	..	(35)	I 8773.91	..	(150)
II 2637.70	..	(40)	II 4227.50	..	(30)	I 8774.56	100	..
II 2638.26	..	(30)						

(Americium)*

ANTIMONY

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2068.38	300 r	3	I 3232.50	150	250 wn	II 5354.24	..	(200)
I 2175.89	300	40	3241 28	...	(350 Wn)	II 5464.08	..	(100)
2179.26	35	40	I 3267.50	150	150 Wn	II 5567.0	..	40
2201.40	40	25	3304.11	..	40 wn	II 5568.09	6	200 wn
2262.54	40	25	3383.14	40	50	II 5631.97	15	(40)
2306.50	35	30	3473.91	3	300 wn	II 5635.18	..	(40)
I 2311.47	150 r	50	II 3498.46	..	300 wn	II 5639.74	..	100 wn
2373.62	75	25	II 3520.47	..	(125)	II 5895.09	..	(150 wn)
2383.63	75	20	3559.24	2 n	50 wn	II 6004.6	..	200 n
2395.20	50	15	3596.96	..	(100)	II 6005.21	..	(200)
2422.14	50	20	3597.51	2	200 wnl	6079.55	20	100 n
2426.35	75	25	3637.83	2 n	60	II 6079.80	..	(60)
2445.51	75	30	II 3722.79	40 Ws	50	II 6129.98	10 n	150 n
2478.31	75	100	4033.54	70	60	6154.94	8 n	(40)
2510.53	50	20	II 4195.17	..	50	6647.44	..	(60)
I 2528.53	300 r	200	II 4596.90	..	(70)	6778.38	5	40
2574.11	30	40	II 4599.09	..	(40)	II 7275.	..	35
I 2598.06	200	100	II 4612.92	..	(50)	II 7428.	..	35
2612.30	50	60	II 4647.32	..	(80)	7844.41	100	..
2652.61	50	75	II 4711.26	..	(100)	7924.65	300	..
2670.64	50	35	II 4765.36	..	(40)	7969.6	50 n	..
2682.76	50	35	4784.03	..	(70)	8411.70	60	..
2692.25	40	40	II 4802.01	..	(40)	8572.61	200	..
2718.89	50	50	II 4877.24	..	(60)	8617.7	40 n	..
2769.94	100	75	II 4948.52	..	(50)	8619.52	150 n	..
2851.11	50	45	II 5010.42	..	(40)	8682.7	100 n	..
I 2877.91	250 W	150	5044.56	..	(100)	8700.1	50 Wn	..
2980.96	..	(125 nd)	5113.86	..	70	8735.7	40 Wn	..
3011.07	..	70	5141.2	..	40	9518.68	400	..
II 3022.19	..	60	II 5176.55	..	(50)	9578.68	400	..
3029.81	100	200 wn	II 5238.94	..	(50 wn)	9949.14	400 n	..
II 3040.67	..	(400 wn)						

ARGON

Wave length	Arc	Discharge Tube	Wave length	Arc	Discharge Tube	Wave length	Arc	Discharge Tube
2137.2	..	40	2313.74	..	60	3169.68	..	50
II 2152.6	..	60 n	2314.99	..	40	I 3172.96	..	150
II 2159.0	..	60 n	2316.31	..	100	3181.05	..	25
2162.74	..	60 n	2331.45	..	60	I 3200.39	..	100
2164.17	..	100	2337.79	..	60	I 3234.51	..	100
II 2171.41	..	60	2357.60	..	60	3249.82	..	25
II 2179.25	..	40	II 2360.07	..	40	I 3257.58	..	100
II 2183.3	..	40	2364.14	..	40	3293.66	..	25
2213.0	..	60	II 2383.50	..	40	I 3319.34	..	300
2218.87	..	60	2385.00	..	40	I 3323.82	..	30
2221.94	..	40	II 2387.96	..	40	I 3325.50	..	100
2222.93	..	60	2534.74	..	40	I 3373.48	..	300
2224.76	..	40	2544.72	..	40	II 3376.46	..	25
2227.70	..	60	2708.28	..	40	3388.54	..	25
II 2235.77	..	40	2806.16	..	40	I 3392.81	..	100
II 2238.2	..	60	II 2891.61	..	40	I 3393.75	..	250
2280.6	..	60	II 2942.90	..	100	I 3406.17	..	30
2282.05	..	40	II 2955.39	..	40	I 3461.08	..	300
2287.8	..	60	II 2979.05	..	40	3491.54	..	50
2298.17	..	40	II 3093.41	..	50	I 3506.46	..	30
2309.16	..	40	3139.02	..	25	3514.39	..	125

* See end of Section II.

II. EMISSION SPECTRA 2000–10,000 A (Continued)

ARGON (Continued)

Wave length	Arc	Discharge Tube	Wave length	Arc	Discharge Tube	Wave length	Arc	Discharge Tube
3545.58	..	300	I 4181.88	..	1000	I 4835.97	..	30
II 3545.84	..	125	I 4190.71	..	600	I 4836.69	..	150
3548.51	..	25	I 4191.03	..	1200	4847.90	..	80
I 3554.31	..	300	I 4198.32	..	1200	I 4876.26	..	200
I 3555.97	..	100	I 4200.67	..	1200	4879.90	..	300
I 3563.26	..	100	4228.18	..	40	I 4883.27	..	30
I 3564.27	..	100	II 4237.23	..	40	I 4886.29	..	30
I 3567.66	..	300	I 4251.18	..	800	I 4887.95	..	200
I 3572.29	..	300	I 4259.36	..	1200	I 4894.69	..	150
3576.62	..	300	I 4266.29	..	1200	II 4904.75	..	30
3582.35	..	50	4266.53	..	200	I 4921.04	..	80
I 3582.70	..	30	I 4272.17	..	1200	4933.24	..	30
3588.44	..	300	II 4277.55	..	80	I 4937.72	..	30
I 3606.52	..	1000	4282.90	..	40	I 4956.75	..	100
I 3632.68	..	300	I 4300.10	..	1200	4965.12	..	40
I 3634.46	..	300	II 4300.66	..	30	I 4989.94	..	80
II 3639.85	..	25	4331.25	..	200	5009.35	..	200
I 3643.09	..	100	4332.06	..	80	II 5017.16	..	60
I 3649.83	..	800	I 4333.56	..	1000	I 5032.02	..	60
I 3659.50	..	100	I 4335.34	..	800	I 5048.81	..	500
I 3670.64	..	300	II 4337.10	..	30	I 5054.18	..	300
I 3675.22	..	300	I 4345.17	..	1000	I 5056.53	..	200
I 3690.90	..	300	4348.11	..	500 n	I 5060.08	..	500
3729.29	..	200	4352.23	..	30	5062.07	..	200
I 3743.76	..	100	I 4363.79	..	80	I 5070.99	..	40
I 3770.37	..	400	II 4370.76	..	30	I 5073.08	..	200
3780.84	..	50	4371.36	..	80	I 5078.03	..	40
I 3781.36	..	300	4379.74	..	80	I 5087.09	..	60
3809.49	..	25	4400.09	..	30	I 5118.20	..	60
I 3834.68	..	800	4401.02	..	40	I 5127.78	..	60
3850.57	..	400	4420.90	..	40	5145.36	..	200
3868.53	..	50	I 4423.99	..	80	I 5151.39	..	200
3875.26	..	25	4426.01	..	300	I 5162.28	..	500
3891.97	..	25	4430.18	..	100	I 5177.53	..	40
I 3894.66	..	300	4431.02	..	80	I 5187.75	..	800
I 3899.86	..	100	II 4481.83	..	80	I 5192.72	..	60
3914.76	..	25	I 4510.73	..	1000	I 5210.49	..	200
3928.62	..	125	I 4522.32	..	800	I 5214.77	..	200
3932.55	..	25	4544.75	..	30	I 5216.28	..	60
3944.27	..	50	4545.08	..	200	I 5219.30	..	40
II 3946.10	..	25	4579.39	..	80	I 5221.27	..	500
I 3947.50	..	1000	I 4589.29	..	80	I 5229.86	..	40
I 3948.98	..	2000	II 4589.93	..	150	I 5241.10	..	60 n
3968.36	..	200	I 4596.10	..	1000	I 5246.24	..	40
3979.36	..	25	II 4609.60	..	300	I 5249.20	..	40
3992.06	..	25	I 4626.78	..	30	I 5252.79	..	300
4013.87	..	200	I 4628.44	..	1000	I 5254.48	..	60
4033.83	..	30	II 4637.25	..	30	5280.40	..	60
II 4035.47	..	30	I 4642.15	..	80	I 5286.08	..	60
4038.82	..	40	I 4647.49	..	40	I 5309.52	..	200
II 4042.91	..	80	4657.94	..	150	I 5317.73	..	60
I 4044.42	..	1200	I 4702.32	..	1200	I 5347.41	..	200
I 4045.97	..	150	I 4709.50	..	30	I 5373.49	..	500
I 4054.52	..	80	4726.91	..	200	I 5387.37	..	40
II 4072.01	..	150	4735.93	..	400	I 5389.10	..	40
4072.40	..	40	I 4746.82	..	80	I 5390.72	..	40
4082.40	..	30	I 4752.94	..	150	I 5393.97	..	200
4103.91	..	200	4764.89	..	150	I 5410.47	..	500
II 4131.73	..	80	I 4768.67	..	150	I 5421.35	..	500
4154.50	..	80	I 4798.74	..	30	I 5439.97	..	500
I 4158.59	..	1200	4806.07	..	500	I 5442.22	..	500
I 4164.18	..	1000	I 4834.10	..	30	I 5443.21	..	100

II. EMISSION SPECTRA 2000–10,000 A (Continued)

ARGON (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
I 5451.65	..	500	II 6114.92	..	100	I 7635.10	..	500
I 5457.37	..	200	I 6145.43	..	100	I 7670.04	..	50
I 5473.44	..	500	I 6155.23	..	60	I 7723.76	..	200
I 5490.13	..	60	I 6170.18	..	100	I 7724.21	..	200
I 5492.06	..	40	I 6173.11	..	100	I 7798.55	..	30
I 5495.87	..	1000	I 6212.51	..	100	I 7868.20	..	40
I 5506.11	..	500	I 6215.94	..	60	I 7891.07	..	100
I 5524.93	..	300	I 6307.66	..	30	I 7948.17	..	400
I 5528.93	..	40	I 6369.58	..	30	I 8006.16	..	600
I 5534.45	..	60	I 6384.72	..	100	I 8014.79	..	800
I 5540.90	..	40	I 6416.31	..	100	II 8017.55	..	60
I 5558.70	..	500	I 6538.11	..	30	I 8046.13	..	50
I 5559.62	..	200	I 6604.85	..	30	I 8053.31	..	100
I 5572.55	..	500	II 6638.24	..	30	I 8103.69	..	2000
I 5581.83	..	60	II 6643.79	..	100	I 8115.31	..	5000
I 5588.69	..	500	I 6660.64	..	100	II 8119.18	..	50
I 5597.46	..	500	I 6664.02	..	100	8178.84	..	40
I 5600.43	..	40	I 6677.28	..	30	I 8255.07	..	50
I 5601.08	..	60	II 6684.36	..	30	I 8264.52	..	1000
5606.73	..	500	I 6698.85	..	100	I 8384.73	..	60
I 5617.97	..	60	I 6719.20	..	100	I 8392.28	..	80
I 5620.89	..	60	I 6752.83	..	200	I 8408.21	..	2000
I 5623.76	..	60	I 6756.10	..	100	I 8424.65	..	2000
I 5635.54	..	60	I 6766.56	..	100	I 8490.30	..	40
I 5639.11	..	100	I 6827.24	..	30	I 8521.44	..	2000
I 5641.34	..	60	I 6871.29	..	150	I 8605.78	..	150
I 5648.66	..	200	I 6879.59	..	40	I 8620.47	..	100
I 5650.70	..	1500	I 6888.17	..	100	I 8667 94	:	400
I 5659.13	..	500	I 6937.67	..	100	I 8678.43	..	60
I 5681.90	..	500	I 6965.43	..	400	I 8761.72	..	200
I 5683.73	..	40	I 7030.26	..	100	II 8771.88	..	100
I 5689.64	..	200	I 7067.22	..	400	I 8784.59	..	30
I 5689.91	..	200	I 7068.73	..	30	I 8799.13	..	100
I 5700.86	..	60	I 7107.50	..	200	I 8849.97	..	150
I 5739.52	..	500	I 7125.80	..	30	I 8962.19	..	40
II 5772.12	..	100	I 7147.04	..	30	II 9917.59	..	50
I 5774.00	..	40	I 7158.83	..	30	I 9066.77	..	40
I 5783.52	..	40	I 7206.99	..	100	I 9073.34	..	50
I 5802.08	..	40	I 7272.94	..	100	I 9075.42	..	60
I 5834.26	..	60	I 7311.71	..	100	I 9122.97	..	500
I 5860.31	..	60	I 7316.00	..	30	I 9194.68	..	150
I 5882.62	..	100	I 7353.32	..	100	9198.61	..	50
I 5888.59	..	300	I 7372.12	..	100	I 9224.50	..	1000
I 5912.08	..	500	I 7383.98	..	400	I 9291.58	..	100
I 5928.80	..	200	I 7435.33	..	30	I 9354.22	..	200
I 5942.67	..	40	II 7440.46	..	90	I 9459.09	..	100
I 5987.29	..	40	I 7503.87	..	700	II 9475.20	:	30
I 6032.12	..	60	II 7505.13	..	100	I 9478.39	..	50
I 6043.23	..	100	I 7514.65	..	200	I 9657.78	..	1500
I 6052.72	..	30	II 7589.33	..	250	I 9666.86	..	50
I 6059.37	..	100	II 7618.03	..	80	I 9784.50	..	1000
I 6098.81	..	60	I 7618.33	..	30	II 9906.12	..	100 n
I 6105.64	..	60	I 7628.86	..	50			

ARSENIC

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2002.54	20 r	..	I 2013.32	25 r	8	I 2065.41	20	3
I 2003.34	300 r	10 n	2031.4	..	75	I 2069.83	18	3
I 2009.18	50 r	8	I 2047.59	25	3	2074.5	..	20

II. EMISSION SPECTRA 2000–10,000 A (Continued)

ARSENIC (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2113.01	50	5	II 4084.13	..	15	II 4787.29	..	15
I 2133.81	18	..	4119.85	..	50	II 4888.74	..	50
I 2144.10	50 r	..	II 4157.64	..	30	II 4985.60	..	50
I 2165.52	50 r	3	II 4197.61	..	30	II 5105.80	..	150
I 2271.36	25	1	II 4208.00	..	30	II 5107.80	..	150
I 2288.12	250 r	5	4243.26	..	100	5161.25	..	30
I 2344.03	25	..	4265.13	..	30	II 5182.32	..	30
I 2349.84	250 r	18	II 4315.86	..	50	II 5223.27	..	15
I 2369.67	40 r	20	II 4324.10	..	50	II 5231.50	..	60
I 2370.77	50 r	3	II 4336.85	..	100	II 5331.54	..	200
I 2381.18	75	4	II 4352.25	..	200	II 5385.52	..	15
I 2437.23	25	2	II 4353.02	..	100	II 5471.92	..	15
I 2456.53	100 r	8	II 4371.38	..	50	II 5497.98	..	200
I 2492.91	25	5	II 4404.53	..	15	II 5558.31	..	200
I 2780.20	75 r	75	II 4413.64	..	50	II 5651.53	..	200
II 2830.45	..	25	II 4427.38	..	200	II 5657.20	..	60
I 2860.45	50 r	50	II 4431.73	..	200	5685.74	..	60
I 2884.51	..	25	4456.86	..	15	II 5731.96	..	15
I 2898.71	25 r	40	4458.74	..	30	II 5783.51	..	20
2959.70	..	75	4461.27	..	30	5838.19	..	125
I 2990.99	10	18	II 4466.60	..	80	II 6022.81	..	150
3003.93	..	50	4474.60	..	200	6076.82	..	15
I 3032.84	125	70	4475.69	..	30	II 6110.30	..	150
II 3053.49	..	15	II 4494.59	..	200	II 6110.66	..	150
II 3058.10	..	15	II 4507.92	..	30	6136.01	..	15
I 3075.32	60	35	II 4516.14	..	15	II 6170.47	..	150
II 3116.63	..	150	II 4539.97	..	200	I 7960.26	25	..
I 3119.60	100	50	4543.76	..	200	I 8305.62	50	..
II 3126.99	..	15	II 4549.23	..	125	I 8428.94	100	..
II 3671.92	..	15	II 4552.37	..	50	I 8541.65	50	..
3683.58	..	15	4591.02	..	30	I 8564.71	100	..
II 3720.31	..	15	II 4602.73	..	200	I 8654.16	100	..
II 3749.77	..	100	4607.46	..	200	I 8821.76	150	..
II 3787.18	..	15	4627.80	..	200	I 8869.69	100	..
II 3842.82	..	50	II 4630.14	..	200	I 8935.58	50	..
II 3931.28	..	15	4648.32	..	30	I 8993.08	20	..
II 3948.74	..	50	II 4672.70	..	50	I 9134.81	15	..
3982.45	..	25	II 4707.82	..	200	I 9267.29	25	..
II 4006.34	..	50	II 4730.92	..	125	I 9300.62	50	..
II 4082.57	..	15						

BARIUM

II 2304.23	60 r	80 r	I 3993.40	100 r	50 r	4599.75	50	10
II 2335.27	60 r	100 r	II 4130.66	50 r	60 wn	I 4619.98	25	..
2347.58	30	40	II 4166.01	12	50	4628.33	40	4
II 2528.51	..	50 r	II 4216.04	..	(25)	4673.62	40	5
I 2596.68	40	..	II 4267.95	..	(80)	4691.62	100	40
II 2634.78	30	50	4283.11	25	20	I 4700.44	25	3
II 2647.29	10	40	II 4309.32	..	(80)	II 4708.94	..	(80)
I 2702.64	50	5 n	II 4325.73	..	(50)	I 4726.45	80	30
I 2785.26	50	..	4350.37	40	20	II 4843.46	..	(80)
2816.07	..	30	4402.55	80	10	I 4877.65	30 wn	8
I 3071.59	100 r	50 r	4431.90	60	30	II 4899.97	30 n	200 l
I 3261.96	40	..	I 4488.97	80	3	II 4934.09	400 n	400 n
I 3281.50	25	..	I 4493.64	60	5	II 4957.16	..	(50)
I 3322.87	30 r	..	4505.93	60	20	II 5013.08	..	50
I 3356.89	40 r	3	4523.24	60	10	5159.92	50 n	10
I 3501.12	1000	20	II 4524.95	80	30	I 5267.03	25	12
II 3891.78	18	25	II 4554.04	1000 r	200	II 5361.35	..	(40)
I 3909.92	50 r	20 r	4573.85	50	20	II 5391.60	..	(50)
I 3935.72	80 r	30 r	4579.67	75	40	I 5424.62	100 r	30 r

Barium (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 5519.11	200 wn	60	I 6693.88	600	100	I 7905.72	300	..
I 5535.55	1000 r	200 r	I 6771.85	60 n	...	I 7911.30	200	..
5680.20	60	...	I 6865.71	200	..	I 8210.24	200	..
I 5777.66	500 r	100 r	I 6867.87	100 n	..	I 8325.39	25	..
II 5784.18	..	(40)	I 7059.96	2000	..	I 8514.28	40 n	..
I 5800.28	100	20	I 7090.00	100 nl	..	I 8559.95	400	..
5805.69	70	..	I 7120.31	800 nl	..	I 8581.98	50 nl	..
I 5826.29	150 wn	..	I 7153.58	80 nl	..	I 8654.07	40	..
5853.68	300	100 n	I 7195.23	200	..	I 8799.76	100 n	..
I 5971.70	150	50	I 7228.81	200 nl	..	I 8860.99	80	..
5972.78	100	..	I 7280.27	1000	..	I 8914.96	100	..
II 5981.25	..	(40)	I 7375.53	50 nl	..	I 9189.58	70	..
I 5997.09	150 wn	50	II 7392.42	400	..	I 9215.36	25 n	..
I 6019.47	150 Wn	50	I 7409.96	30 nl	..	I 9219.72	125	..
I 6063.12	200 wn	60	I 7417.52	100	..	I 9253.09	25	..
I 6110.78	200 Wn	60	I 7459.75	300 nl	..	I 9308.16	50 n	..
6141.72	2000 wn	2000 wn	I 7476.18	30 n	..	I 9324.58	50 n	..
6341.68	90	50	I 7488.06	200	..	I 9367.49	40 n	..
6450.85	100	20	I 7610.46	60	..	I 9370.09	300	..
6482.91	100 Wn	50	I 7636.85	40	..	I 9455.98	100	..
6496.90	800 r	200 Wn	I 7642.88	100	..	I 9524.76	40 n	..
6498.76	60	20	I 7672.02	400	..	I 9589.37	50	..
6527.31	200	20	I 7706.50	25	..	I 9608.90	150	..
I 6595.32	1000	300	I 7751.73	40	..	I 9645.76	25 n	..
I 6654.05	50	..	I 7775.32	25	..	I 9713.77	25 n	..
I 6675.27	500	100	I 7780.43	300	...	I 9830.37	300 nl	..

Beryllium

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2056.52	100	..	I 3046.52	..	(15)	I 3865.43	30	..
I 2175.07	25	3	II 3046.68	10	(20)	I 3866.03	15	..
I 2348.61	2000 r	50	I 3110.84	20	..	I 4253.05	..	(20)
I 2350.68	25	2	I 3110.96	15	..	I 4253.76	..	(15)
II 2413.45	..	(25)	II 3130.42	200	200	II 4360.69	..	(35)
I 2494.56	30	..	II 3131.07	200	150	II 4361.02	..	(40)
I 2494.58	25	..	II 3197.16	..	15	4364.0	..	50
I 2494.73	30	20	I 3229.69	15	..	I 4407.91	20	(35)
I 2650.47	100	15	II 3241.65	5	(15)	I 4572.67	15	15
I 2650.55	30	..	II 3241.83	5	(50)	4573.1	..	40
I 2650.61	20	15	II 3274.64	..	(50)	4672.2	..	100
I 2650.64	25	..	I 3321.01	50	..	II 4673.46	..	(100)
I 2650.78	25	..	I 3321.09	100	15	II 4828.12	..	(25)
I 2898.19	15	..	I 3321.34	1000 r	30	5272.7	..	20
I 2898.27	20	..	I 3367.62	25	..	I 6981.00	15	..
I 2986.46	15	..	I 3455.20	20	..	I 8254.10	100	..
I 3019.34	30	..	I 3515.55	30	..			
I 3019.51	15	..	I 3813.42	50	..			

Bismuth

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2021.21	40 wn	15	I 2134.31	100 r	5 n	I 2400.88	200 r	100
2023.99	50	..	2152.91	50 r	..	2430.45	30	6
2041.96	100	15	2153.53	40 wn	..	2433.45	30	..
2049.69	25	20	2156.95	75 r	..	I 2448.06	50	8
I 2057.68	40	4 n	II 2186.92	..	30	2499.51	25	12
I 2061.70	300 r	100	I 2189.59	25 n	5 n	I 2515.69	100	25
2064.79	50	4 n	I 2228.25	100 r	50	I 2524.49	100	25
I 2110.26	250 r	50	I 2230.61	100 r	30 r	2532.57	25 wn	..
I 2133.63	100 W	40	I 2276.58	100 r	40	2582.14	35	5

II. EMISSION SPECTRA 2000–10,000 A (Continued)

BISMUTH (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2627.91	200 w	200	II 3588.5	..	(60)	II 5209.29	..	600 n
2596.61	100	100	I 3596.11	150 wn	50	II 5260.8	..	25
I 2696.76	25 r	15 r	3613.82	..	30	II 5269.71	8	30
I 2730.50	200	100	3695.55	..	50	5552.35	500 wnl	100 l
I 2780.52	200 w	100	II 3724.9	..	(60)	5742.55	30	10
I 2798.68	200	25	3792.8	..	500 n	II 5973.01	..	40
II 2803.48	2 n	30	II 3793.0	..	(25)	II 6058.96	..	(40)
I 2809.62	200 W	100	II 3811.14	..	(150)	II 6128.11	..	30
I 2863.75	80 w	18	II 3815.8	..	(300)	I 6134.82	50	30
I 2897.97	500 Wr	500 Wr	3816.17	..	25 n	II 6600.2	..	70
I 2938.30	300 w	300 w	II 3841.6	..	(25)	II 6808.6	..	70
I 2989.03	250 wn	100 wn	II 3845.8	..	(100)	II 7033.	..	25
I 2993.34	200 wn	100 wn	3846.03	..	100	7838.70	400 nl	..
I 3024.63	250 wn	50	II 3863.9	..	(100)	II 7965.	..	(50)
3034.87	30	30	3864.2	..	150 n	7975.9	30 Wn	..
I 3035.18	60 n	..	I 3888.23	40	2	II 8050.	..	(30)
II 3053.7	..	(60)	II 4079.21	2 n	(40 w)	II 8328.	..	(40)
I 3067.72	3000 nr	2000 wn	I 4121.53	125 wn	50	II 8388.	..	(40)
II 3111.67	..	(25)	II 4259.62	..	60 wn	II 8532.	..	(80)
3115.42	..	500	II 4302.14	2 n	50 wn	I 8544.52	40	..
3302.55	150	..	I 4308.18	50	12	8628.0	100 Wn	..
II 3355.1	..	(35)	II 4340.59	..	40 n	II 8653.	..	(60)
I 3397.21	100 wn	50	II 4379.4	25	20	I 8754.92	40	..
3405.33	40	10	II 4705.35	..	50	8761.53	100 wn	..
I 3405.66	60	..	I 4722.55	1000	100	II 8863.	..	60
II 3430.10	..	(25 d)	II 4730.3	..	(25)	I 8907.9	200 wn	..
II 3430.30	..	(35)	II 5091.29	2 n	30 wn	9058.6	50 Wl	..
II 3430.53	..	(60)	II 5118.2	..	25	9342.55	500 n	..
II 3430.83	..	(200)	II 5124.3	..	100 wn	9417.0	100 n	..
II 3431.23	..	(150)	II 5144.48	2	300 n	9650.1	50 n	..
II 3455.27	..	100 n	II 5201.01	..	30	9657.2	2000 d	..
I 3510.85	200 wn	30	II 5208.8	5 wn	70	9828.02	300	..

BORON

I 2088.93	100	15	2785.14	..	35	II 3452.28	5	30
I 2089.59	150	20	bh 2809.9	60	..	bh 3677.8	50	..
II 2363.88	..	15	bh 2850.6	50	..	bh 3679.1	200	..
bh 2364.5	50	..	bh 2892.2	200	..	II 3792.5	..	(500)
2369.96	..	20	bh 2934.9	100	..	bh 3830.2	50	..
II 2395.07	..	15	II 3032.28	..	10	bh 3847.0	100	..
bh 2398.5	200	..	bh 3043.6	100	..	bh 3848.7	200	..
II 2432.29	..	35	bh 3088.6	100	..	3871.39	..	20 n
2434.95	..	20	II 3179.35	5	100	bh 4037.4	25	..
bh 2437.1	250	..	3191.84	3	10	II 4121.95	..	20
I 2496.78	300	300	bh 3257.0	100	..	bh 4339.6	25	..
I 2497.73	500	400	II 3260.74	4	10	bh 4342.0	25	..
2514.39	..	50	3282.01	4	12	bh 4363.4	40	..
bh 2551.4	150	..	3302.51	..	10	bh 4365.9	25	..
II 2566.26	..	15	bh 3305.4	50	..	bh 4588.8	25	..
bh 2588.0	50	..	II 3323.34	..	10	bh 4615.4	40	..
bh 2675.3	60	..	II 3323.61	..	10	bh 4744.0	25	..
bh 2713.8	200	..	3360.09	2	20	bh 4746.9	25	..
bh 2753.4	100	..	II 3451.41	..	100	bh 5040.1	12	..
2779.26	..	100						

II. EMISSION SPECTRA 2000–10,000 A (Continued)

Bromine

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
2337.90	..	25	I 4614.60	..	100 l	5506.78	..	300
2386.74	..	25	4622.75	..	200	5536.30	..	50
2389.69	..	70	I 4643.52	..	25 l	5589.93	..	250
2395.34	..	25	4651.99	..	25	5600.83	..	30
2488.37	..	40	4678.69	..	200	5691.43	..	30
2521.66	..	50	4693.27	..	40	5718.91	..	30
2541.45	..	40	II 4704.86	..	250	5737.13	..	30
2556.93	..	25	4719.77	..	80	5783.31	..	40
2656.83	..	25	4742.70	..	200	5830.74	..	100
2660.49	..	25	I 4752.27	..	100	I 5833.43	..	80
2709.67	..	35	II 4766.00	..	50	I 5852.10	..	150
2713.74	..	25	4767.10	..	200	I 5940.53	..	60 l
2799.00	..	35	I 4775.21	..	25	I 6122.12	..	50 l
2872.59	..	25	4776.42	..	200	I 6148.62	..	200
2893.44	..	35	I 4780.31	..	125	I 6177.40	..	40
2972.22	..	25	II 4785.50	..	400	6285.04	..	25
3659.50	..	25	I 4802.65	..	25	I 6350.74	..	200 l
II 3891.63	..	25	II 4816.71	..	300	6352.94	..	25
II 3914.28	..	150	I 4834.46	..	25	I 6410.32	..	30
II 3924.10	..	35	II 4848.75	..	150	I 6544.61	..	100
3950.61	..	30	I 4849.37	..	25	I 6559.81	..	150
II 3980.39	..	25	4928.79	..	150	6567.53	..	25
4014.32	..	25	4930.66	..	50	I 6582.19	..	100
4140.21	..	30	I 4979.76	..	125 l	I 6631.64	..	200 l
I 4175.79	..	50	I 5002.70	..	40	I 6682.29	..	90
4179.64	..	40	5020.58	..	30	I 6692.16	..	70
II 4193.46	..	25	5038.77	..	60	I 6728.29	..	40
4202.50	..	25	5054.65	..	200	I 6786.77	..	30
4223.88	..	80	II 5182.36	..	100	I 6790.05	..	70
4236.88	..	25	5199.33	..	30	I 6861.21	..	30
4291.40	..	150	II 5238.23	..	100	I 6971.97	..	40
4365.60	..	200	5249.05	..	30	I 7005.21	..	200 l
I 4391.61	..	25	5304.10	..	30	I 7111.63	..	30
4393.56	..	25	5332.04	..	100	I 7142.28	..	40
I 4441.74	..	80	5335.11	..	70	7162.14	..	45
I 4472.62	..	125 l	I 5345.43	..	80 l	I 7184.34	..	30
I 4477.75	..	200 W	I 5395.52	..	150 l	7260.49	..	50
I 4490.43	..	25	5422.78	..	30	I 7348.56	..	500 l
I 4513.44	..	100 l	I 5450.06	..	30	I 7425.89	..	100
I 4525.62	..	125 l	I 5466.23	..	150 l	I 7513.01	..	50 l
I 4529.77	..	80	5479.99	..	30	I 8272.46	..	70 l
4542.93	..	250	5488.79	..	70	I 8446.55	..	50
I 4575.75	..	100 l	5495.06	..	150	I 8638.66	..	25
4579.95	..	25						

Cadmium

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2033.03	..	(20)	2239.86	80	30	II 2321.15	..	100 n
II 2036.79	..	(30)	II 2265.02	25 d	300	2321.94	..	(20)
II 2096.63	..	(100)	II 2265.81	..	30	2329.28	50	60
II 2144.38	50	200 r	2267.47	20	30	II 2377.63	..	15
2145.04	..	(20)	I 2288.02	1500 r	300 r	II 2418.70	..	20
II 2155.70	..	(30)	2288.74	..	20	II 2419.49	..	(25)
II 2188.55	..	(50)	2306.61	20	30	II 2469.84	..	(500)
2194.63	5	100 n	II 2312.84	1	200	II 2470.61	..	(50)
2195.35	..	15	2313.49	..	(30)	II 2487.94	..	15

CADMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2495.73	..	(30)	II 2911.64	..	(15)	I 3649.60	20	15
II 2499.85	..	15	II 2914.69	..	(45)	I 3729.06	15 r	..
II 2509.25	..	(30)	II 2929.28	..	50	II 4134.78	..	15
II 2516.34	..	25	2948.16	..	35	4414.63	..	200
I 2518.79	15 n	(1)	2951.82	..	25	II 4415.70	1	20
2525.39	25 n	..	I 2961.47	20	15	I 4678.16	200 W	200 W
I 2544.71	50	(5)	I 2980.63	1000 r	500	I 4799.92	300 w	300 w
II 2552.18	5 n	(100)	I 2981.34	200 r	(40)	I 5085.82	1000 wn	500
I 2553.56	25	(2)	I 2981.89	50	(10)	II 5337.49	5	25
I 2580.30	50	(5)	2987.2	..	(25)	II 5378.04	5	50
I 2592.14	30	..	2996.03	..	25	II 5381.82	2	20
I 2602.18	25 n	(5)	I 3005.41	25	4	I 5598.77	15	..
II 2618.97	..	(30)	3064.95	..	15 n	II 5843.17	3	(40)
I 2629.05	50	10	I 3080.83	150	100 l	I 6031.38	30	..
I 2632.24	40	(3)	I 3082.68	30	..	I 6099.18	300	..
I 2639.50	75	15	3084.87	10	40 n	I 6111.52	100	..
I 2660.40	50 n	(5)	II 3092.39	10	15	I 6116.19	50	..
I 2677.64	100	25	I 3133.17	200	300	I 6128.66	15	..
II 2680.08	..	(15)	II 3185.55	..	(15)	I 6198.22	15	..
II 2707.14	..	(30)	3217.8	..	(15)	I 6325.19	100	..
I 2712.57	75	20	3243.15	..	15	I 6329.97	30	..
2726.93	..	(15)	II 3250.17	..	100	II 6354.72	5	40
I 2733.86	50	25	I 3250.30	..	25	II 6359.93	10	50
II 2748.58	5	200	I 3252.52	300. .	300	I 6438.47	2000	1000
I 2756.79	50 n	..	I 3261.06	300	300	II 6464.98	5	50
I 2763.89	100 n	50	3298.97	15	..	II 6725.83	..	100
2764.11	50 n	25	II 3343.15	..	15	II 6759.26	..	30
I 2775.05	50	20	II 3385.40	..	(40)	I 6778.10	30	..
2780.28	..	(25)	I 3403.65	800	500 n	I 7132.27	30	..
2805.59	..	30	II 3417.40	10	15	7237.01	..	15
II 2823.19	..	(20)	I 3466.20	1000	500	II 7284.38	..	25
II 2834.19	..	(100)	I 3467.66	800	400	I 7346.2	1000	..
I 2836.91	200	80	3495.34	..	(100)	7383.9	1000	..
I 2862.31	15	10	I 3500.00	25	15	I 7385.3	800	..
I 2868.26	100	80	II 3535.69	5	15	7393.0	70	..
I 2880.77	200 r	125	I 3610.51	1000	500	I 7399.2	70	..
I 2881.23	50 r	(30)	I 3612.87	800	500	II 8066.99	..	15
2910.8	..	(30)	I 3614.45	60	100			

CALCIUM

II 2103.24	10	25	I 3099.34	10	2	I 3350.36	15	3
II 2112.76	10	25	I 3108.58	30	3	I 3361.92	125	10
I 2150.78	10	..	3117.65	10	2	I 3362.13	15	5
II 2197.79	20	40	I 3136.00	15	3	bh 3409.10	12	..
I 2200.72	20	..	I 3140.78	15	3	I 3468.48	20	3
II 2208.61	20	50	I 3150.74	50	2	I 3474.76	40	5
I 2275.47	40	5	I 3158.87	100	300 w	bh 3475.0	30	..
I 2398.56	100 r	20	I 3169.85	10	2 n	I 3487.59	100	2
II 2573.09	3	150	II 3179.33	100	400 w	bh 3564.0	20	..
I 2680.36	15	..	I 3180.52	20	..	I 3624.11	150	15
I 2721.64	20	2	II 3181.27	8	15	I 3630.75	150	9
I 2994.96	25	3	I 3209.93	30	2	I 3630.95	10	..
2997.31	25	5	I 3215.13	20	4 w	I 3644.41	200	15
I 2999.64	20	10	I 3225.90	80	10	I 3644.76	30	..
I 3000.86	20	6	I 3269.10	10	2	bh 3656.6	12	..
I 3006.86	25	5	I 3274.66	20	..	I 3675.31	10 n	2
I 3009.20	20	5	I 3286.07	30	2	I 3678.23	15	2 n
I 3080.83	20	2	I 3344.51	100	7	II 3706.03	15	40
I 3095.28	10	2	I 3350.21	100	10	II 3736.90	12	50

II. EMISSION SPECTRA 2000–10,000 A (Continued)

CALCIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3748.37	12	..	I 4454.78	200	5 nl	I 6162.17	40	45
I 3750.35	20	3	I 4455.89	100	75	I 6163.76	10	7
I 3753.57	30	3	I 4456.62	20	15	I 6166.44	15	5
I 3870.51	15	..	4499.90	..	10 n	I 6169.05	25	15
I 3875.81	50	..	I 4512.28	10	..	I 6169.56	40	20
II 3933.67	600 r	600 r	I 4526.93	100	3 wn	I 6439.07	150	50
I 3948.90	40	15	I 4578.56	80	5	I 6449.81	60	12
I 3957.05	80	3	I 4581.40	100	10	6455.60	10	7
II 3968.47	500 r	500 r	I 4585.87	125	10	I 6462.56	125	50
I 3972.57	12	..	I 4685.26	25	1	6471.66	40	15
I 3973.71	200	15	I 4878.13	100	10	I 6493.78	80	30
4030.3	10	2 n	5021.15	10	..	I 6499.65	30	15
I 4092.63	15	2	I 5041.62	30	..	I 6572.78	50	..
I 4094.93	15	7	I 5188.85	50	6 w	bh 6956.2	20	..
I 4098.53	15	3	I 5261.70	20	6	I 7148.15	500	..
4196.60	12 w	1 n	I 5262.25	20	8	I 7202.19	30	..
4207.28	..	10	I 5264.24	15	8	I 7203.17	200	..
I 4226.73	500 r	50 r	I 5265.56	20	10	I 7326.15	400	..
I 4240.46	10	10	I 5270.28	20	10	bh 8153.0	40	..
4248.96	2 n	10	5271.97	10	..	II 8498.02	300	..
I 4283.01	40	20	I 5349.47	12	12	II 8542.09	1000	..
I 4289.36	35	20	I 5581.97	20	12	bh 8652.2	20	..
I 4298.99	30	18	I 5588.75	35	25	II 8662.14	1000	..
I 4302.53	50	25	I 5590.11	15	10	bh 9228.9	20	..
I 4307.74	45	20	I 5594.45	35	20	9233.4	20	..
I 4318.65	60	20	I 5598.47	35	20	I 9688.6	15	..
I 4355.10	50	..	I 5601.26	15	10	bh 9700.0	10	..
4374.61	10	2 n	I 5602.84	15	10	I 9701.7	20	..
4399.64	..	10	I 5857.46	40	30	bh 9775.0	15	..
I 4425.44	100	20	I 6102.72	80	50	bh 9807.3	20	..
I 4434.96	150	25	I 6122.22	100	100	bh 9834.7	30	..
I 4435.69	100	15	I 6161.29	10	6			

CARBON

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
bh 2012.3	30	..	II 3876.41	..	60	II 5151.08	..	30
bh 2026.2	25	..	II 3876.67	..	40	bh 5239.3	70	..
bh 2047.5	30	..	II 3918.98	..	80	II 5259.62	..	30
bh 2068.8	30	..	II 3920.68	..	200	bh 5354.1	100	..
bh 2090.0	30	..	II 4074.53	..	50	I 5380.24	..	(300)
bh 2150.6	30	..	II 4074.89	..	40	bh 5473.3	70	..
bh 2162.6	30	..	II 4076.00	..	80	bh 5597.9	50	..
2163.60	..	30	II 4267.02	..	350	II 5648.08	..	30
bh 2173.4	30	..	II 4267.27	..	500	II 5662.51	..	50
bh 2196.9	30	..	II 4317.42	..	30	bh 5730.0	150	..
bh 2221.8	30	..	4348.07	..	(30)	I 5793.51	30	..
bh 2286.7	30	..	II 4368.14	..	(30 n)	bh 5858.2	400	..
bh 2312.0	30	..	I 4371.33	..	30	II 5889.97	..	60
bh 2382.0	30	..	II 4372.49	..	30	II 5891.65	..	30
bh 2408.0	30	..	II 4374.28	..	40	bh 5992.6	100	..
bh 2435.0	30	..	4410.06	..	30	II 6098.62	..	30
I 2478.57	400	(400)	II 4411.20	..	40	II 6578.03	..	500
II 2509.11	..	200	II 4411.52	..	40	II 6582.85	..	200
II 2511.71	..	60	bh 4612.7	50	..	I 6587.75	..	(50)
II 2512.03	..	400	II 4618.85	..	25 n	II 6779.74	..	50
II 2746.50	..	25	I 4762.41	..	(30)	II 6783.75	..	100
II 2747.31	..	40	I 4771.72	..	(30)	II 6791.30	..	30
bh 2785.4	30	..	I 4932.00	..	40	II 6800.50	..	30
bh 2799.7	50	..	I 5039.05	..	(30)	II 7231.12	..	100
II 2836.71	..	200	I 5041.66	..	(30)	II 7236.19	..	150 n
II 2837.60	..	40	I 5052.12	..	(100)	I 8335.19	..	(150)
II 3876.05	..	40	II 5132.96	..	30	9045.1*	150	..
II 3876.19	..	125	II 5145.16	..	70	I 9061.48	350	(200)

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* Also credited to nitrogen.

II. EMISSION SPECTRA 2000–10,000 A (Continued)

CARBON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 9062.53	..	(150)	I 9094.89	500	(300)	I 9602.8	60	..
I 9078.32	150	(70)	I 9111.85	150	(100)	I 9620.86	125	(5)
I 9088.57	200	(100)	I 9405.77	300	(200)	I 9658.49	250	(15)

CERIUM

2180.67	..	100	3343.86	50	6	II 3967.05	35	6
2222.04	..	100	II 3344.76	50	8	3968.47	35	35 w
2225.10	..	100	II 3349.97	30	1	II 3971.68	35	6
2242.33	..	60	3353.33	10	30	3978.65	35	6
2318.69	..	40	3357.21	30	3	3978.89	50	50
2350.15	..	50	3360.54	35	4	II 3980.88	35	8
2372.37	..	50	II 3366.55	30	3	II 3982.90	30	6
2380.16	..	50	3377.13	50	5 s	3984.67	40	8
2795.52	30 s	8	3379.17	30	2	II 3992.39	50	8
2814.81	40 d	..	3393.92	30	1	3993.82	50	6
2830.90	30	..	3417.45	30	5	II 3999.24	80	20
2833.31	50 d	..	II 3420.18	35	2	4003.77	40	18
2837.29	50 s	..	3422.71	30	10	I, II 4012.39	60	20
2852.12	50 d	1	3426.21	30	6	II 4014.90	60	12
2854.67	30 s	..	3441.21	35	5	II 4028.41	35	8
2874.13	30 w	..	3454.47	10	40	II 4031.34	40	8
2881.58	40	2	3476.84	35	10	II 4040.76	70	5
2908.42	30 s	..	3485.05	30	10	I, II 4042.58	50	3
2918.66	30 s	..	3488.55	35	5 n	I, II 4046.34	30	10
2990.87	40	1	3517.38	40	6	II 4053.51	40	8
2995.64	30	1	I, II 3520.52	30	2	4062.22	40	8
3008.79	40	3	3521.88	35	5	4071.81	30	5
II 3056.78	40	3	3534.05	35	10	4073.48	50	8
3063.01	40	10	II 3539.09	100	10	4073.73	30	3
3084.47	40 s	3	3560.80	300	2	4081.22	40	8
3110.28	30	1	3577.46	300	12	4083.23	35 d	6
II 3127.53	40	..	3590.60	50	1	4101.77	35	6
3130.33	30	1	3609.69	40	10	4104.42	30	1
3130.87	30	2	I, II 3623.84	60	5	4104.99	40	3
II 3145.28	30	..	I, II 3631.19	50	3	4106.13	30	2
II 3146.41	30	..	3660.64	40	10	II 4107.42	30	8
II 3164.15	40	..	3667.98	80 s	15	4110.38	35	10
3169.18	30	..	3725.67	40	10	4111.39	35	5
3176.80	30	..	3728.42	50	10	II 4113.73	30	3
3183.52	40	..	II 3803.10	35	5	4115.37	40	6
3186.13	40	..	I, II 3808.12	35	35	4117.01	30	6
II 3189.64	30	..	3815.83	50	5	4117.59	30	5
3201.71	50	10	3838.54	35	3	4127.37	30	12
3204.16	30	..	3840.45	30	35	II 4131.10	30	8
I, II 3218.38	30	2	3889.99	50	8	4133.80	35	8
3218.94	50	8	I, II 3895.12	40	6	4142.34	35	6
3220.87	30	..	I, II 3896.80	35	6	4142.40	30	30
II 3221.17	50	8	3898.27	80	6	4151.97	30	8
II 3231.24	30	10	3907.29	35	6	II 4159.03	30	5
II 3233.44	30	2	3908.41	30	6	II 4165.61	40	6
I, II 3234.16	40	8	II 3909.31	35	3	II 4185.33	30	4
II 3236.73	35	8	I, II 3912.44	50	5	II 4186.60	80	25
I, II 3246.67	35	3	3918.28	60	6	II 4187.32	35	15
3252.48	30	3	3919.81	45	2	4190.63	30	3
II 3254.01	30	4	I, II 3931.09	35	8	II 4193.87	35	5
3272.25	40	15	3933.73	60	60	II 4202.94	40	18
3274.86	35	8	II 3938.09	35	6	I, II 4214.04	35	4
I, II 3279.84	30	5	II 3940.34	35	6	4222.60	80	18
II 3285.22	35	5	II 3942.15	35	8	4226.73	50	30
I, II 3295.29	30	3	3942.75	50	20	4227.75	40	5
3300.15	30	3	II 3943.89	40	15	4231.74	30	5
3304.84	30	3	II 3952.54	60	30	4234.21	30	2
3312.21	30	5	3956.28	30	8	4236.02	30	1
I, II 3341.87	40	5	II 3960.91	40	8			

CERIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4239.91	35	4	4418.78	40	10	5079.68	30	..
4246.71	30	4	4429.27	35	5	5129.58	30	..
4248.68	60	8	4444.39	30	4	5159.69	30	..
4253.36	40 s	3	4444.70	35	6	5161.48	30	..
4255.78	40	6	4449.34	50	8	5187.45	50	..
4263.43	40	..	4450.73	35	5	5191.67	30 wn	..
II 4288.67	30	..	4460.21	60	20	5211.92	50 s	..
4289.94	50	25	4461.14	30	6	5245.92	30	..
4296.68	40	25	4463.41	35	6	5274.24	50	3
II 4300.33	40	15	4467.54	30	4	5353.53	50	30
4306.72	30	15	4471.24	35	8	5393.39	30	..
II 4310.70	30 s	3	4479.36	40	18	5409.22	50	..
II 4320.72	50	8	4483.90	40	10	5512.08	50 s	..
II 4330.44	50	5	4484.82	30	3	5522.99	100	..
4332.71	35 s	4	4486.91	40	15	5556.25	35	..
II 4349.79	40	5	4497.85	30	4	5564.96	40	..
I, II 4352.71	40	5	4523.08	35	25	5565.97	35	..
4364.66	30	6	4527.35	50	25	5601.30	50	..
4372.40	35	1	4528.47	30	15	5655.13	40	..
4373.82	40	4	4554.03	35 s	..	5669.97	50	..
4375.92	40	5	4562.36	40	40	5696.99	40	..
4380.06	30	2	4572.28	35 s	35	5699.23	40	..
4382.17	40	12	4593.93	30	30	5719.03	40	..
4391.66	40	15	4747.14	30	..	5773.12	30	..
4393.19	35	3	4882.46	30	..	5812.93	40	..
4394.78	30	3	4899.90	30	..	5940.85	40	..
4399.20	35	6	5009.09	30	..	6021.19	50	..
4407.28	40	3	5040.85	30	..	6043.39	30	..
4413.19	35	2	5048.82	30	..			

CESIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2254.94	..	(20)	2810.81	..	(20)	II 3925.58	..	(25)
II 2267.66	..	(20)	2817.98	..	(20)	II 3959.49	..	(20)
II 2273.88	..	(20)	2838.09	..	(20)	II 3965.19	..	(25)
2425.15	..	(20)	2845.67	..	(20)	4001.68	..	(20)
2427.65	..	(20)	2851.23	..	(20)	4006.54	..	(30)
2477.58	..	(20)	2859.32	..	(20)	4039.84	..	(50)
2485.42	..	(20)	2881.16	..	(20)	4043.42	..	(20)
2495.04	..	(20)	2886.67	..	(20)	II 4047.18	..	(20)
2525.68	..	(20)	2921.03	..	(20)	II 4067.96	..	(30)
2533.44	..	(20)	2931.11	..	(20)	II 4068.77	..	(30)
2543.92	..	(20)	2938.5	..	(20)	II 4151.27	..	(20)
2573.05	..	(20)	2995.34	..	(20)	4158.61	..	(18)
2591.17	..	(20)	II 3265.92	..	(30)	II 4213.13	..	(30)
2596.95	..	(20)	II 3267.13	..	(30)	II 4227.10	..	(50)
2600.36	..	(20)	II 3271.63	..	(20)	II 4228.35	..	(35)
2605.40	..	(20)	I 3347.44	30	..	4232.19	..	(25)
2609.43	..	(20)	II 3368.50	..	(30)	4234.41	..	(20)
2642.63	..	(20)	I 3398.14	60	..	4264.67	..	(50)
2644.7	..	(20)	I 3400.00	30	..	II 4277.10	..	(50)
2650.7	..	(20)	3476.88	100	..	II 4288.35	..	(35)
2678.92	..	(20)	I 3480.13	50	..	II 4300.64	..	(30)
2701.18	..	(20)	I 3611.52	200	..	II 4330.24	..	(20)
2706.79	..	(20)	I 3617.41	60	..	II 4363.27	..	(50)
2748.18	..	(20)	II 3785.42	..	(20)	II 4373.02	..	(30)
2755.20	..	(20)	II 3805.10	..	(25)	II 4384.43	..	(25)
2764.42	..	(20)	I 3876.39	300	..	4399.49	..	(20)
2776.42	..	(20)	I 3888.65	150	10	4403.85	..	(20)
2788.22	..	(20)	II 3906.93	..	(20)	II 4405.25	..	(35)

Cesium (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4410.21	..	(20)	II 5096.60	..	(40)	6586.02	35	..
4425.66	..	(20)	II 5227.00	..	(200)	I 6586.51	500	(5)
I 4435.71	..	(20)	II 5249.37	..	(80)	I 6628.65	35	12
II 4501.52	..	(35)	II 5274.04	..	(40)	6723.28	500	6
II 4526.72	..	(35)	II 5306.61	..	(25)	I 6870.45	200	(5)
II 4538.94	..	(30)	5348.95	..	(25)	II 6955.52	..	(20)
I 4555.35	2000 r	100	II 5349.16	..	(25)	6973.29	500	..
I 4593.18	1000 r	50 r	II 5358.53	..	(500)	I 6983.49	25	..
II 4603.75	..	(60)	II 5370.98	..	(80)	7228.53	500	(2)
II 4623.09	..	(20)	5302.79	..	(40)	I 7229.01	35 l	..
II 4646.51	..	(25)	II 5419.69	..	(60)	I 7279.95	35 l	..
II 4670.28	..	(20)	II 5563.02	..	(125)	7609.01	500 l	..
II 4701.79	..	(25)	5566.7	..	(40)	7944.11	800	..
II 4732.97	..	(20)	II 5814.18	..	(25)	7990.68	100 s	..
4733.06	..	(20)	II 5831.16	..	(60)	I 8015.71	200	..
II 4739.66	..	(20)	5832.6	..	(25)	8053.35	100 s	..
4763.62	..	(25)	I 5844.7	30 w	..	I 8078.92	100	..
II 4830.16	..	(30)	5925.65	..	(60)	I 8079.02	1000	..
II 4870.03	..	(30)	I 6010.33	50	(10)	I 8521.10	5000 r	..
II 4952.83	..	(30)	I 6034.09	35	(2)	I 8761.38	500	..
II 4972.59	..	(25)	II 6128.62	..	(20)	I 8943.50	2000 r	..
II 5043.80	..	(80)	I 6212.87	100	(10)	I 9172.24	1000	..
II 5052.70	..	(25)	6386.94	25 l	..	I 9208.46	200	..
II 5059.87	..	(25)						

Chlorine

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
2251.50	..	40	II 3353.39	..	125	II 3868.62	..	40
2253.16	..	30	II 3479.82	..	30	II 3913.92	..	30
II 2430.16	..	30	II 3509.39	..	40	II 4132.48	..	200
II 2434.10	..	50	II 3513.22	..	35	II 4147.09	..	30
II 2498.53	..	30	II 3522.14	..	40	II 4157.82	..	25
II 2502.75	..	40	II 3526.13	..	30	II 4208.08	..	30
II 2549.85	..	50	II 3750.00	..	30	II 4234.09	..	50
II 2646.88	..	25	II 3767.57	..	30	II 4235.49	..	25
II 2658.74	..	100	II 3774.25	..	25	II 4241.38	..	60
II 2667.36	..	40	II 3781.23	..	30	II 4253.51	..	75
II 2672.19	..	50	II 3793.75	..	25	II 4259.52	..	35
II 2676.95	..	150	II 3798.80	..	50	II 4270.61	..	25
II 2688.04	..	150	II 3805.24	..	75	II 4276.51	..	30
II 2754.10	..	25	II 3809.51	..	40	II 4291.76	..	50
II 2996.63	..	40	II 3810.10	..	30	II 4304.07	..	40
II 3022.93	..	30	II 3818.40	..	30	II 4307.42	..	75
II 3037.98	..	35	II 3820.25	..	100	II 4309.06	..	50
II 3058.00	..	40	II 3827.62	..	150	II 4336.26	..	45
II 3071.35	..	40	II 3843.26	..	100	II 4343.62	..	100
II 3092.22	..	50	II 3845.42	..	50	II 4372.91	..	80
II 3096.72	..	25	II 3845.68	..	75	I 4389.76	..	25
II 3276.81	..	40	II 3845.82	..	30	II 4490.00	..	50
II 3306.45	..	40	II 3851.02	..	100	I 4526.21	..	25
II 3307.90	..	50	II 3851.42	..	75	II 4569.42	..	50
II 3315.44	..	100	II 3851.69	..	30	II 4572.13	..	100
II 3316.86	..	50	II 3854.75	..	30	II 4721.43	..	25
II 3320.14	..	30	II 3860.83	..	150	II 4740.40	..	150
II 3329.12	..	150	II 3860.99	..	100	II 4755.64	..	50
II 3333.64	..	40	II 3861.34	..	50	II 4768.68	..	150

CHLORINE (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 4771.09	..	40	II 5104.08	..	25	II 6653.75	..	25
II 4778.93	..	45	II 5113.36	..	40	II 6661.68	..	75
II 4781.32	..	75	II 5173.15	..	25	II 6686.04	..	45
II 4781.82	..	50	II 5189.70	..	25	II 6713.43	..	40
II 4785.44	..	50	II 5217.92	..	100	II 6759.42	..	35
II 4794.54	..	250	II 5221.34	..	70	II 6831.62	..	30
II 4810.06	..	200	II 5423.25	..	150	II 6850.21	..	40
II 4819.46	..	200	II 5423.52	..	100	II 6952.13	..	25
II 4819.79	..	25	II 5424.36	..	25	I 7256.65	..	200
II 4896.77	..	200	II 5443.42	..	100	I 7414.12	..	150
II 4904.76	..	125	II 5444.25	..	60	I 7547.09	..	25
II 4917.72	..	125	II 5456.27	..	50	I 8221.76	..	25
II 4936.99	..	25	II 5457.02	..	75	I 8333.31	..	30
II 4970.12	..	50	II 5457.47	..	30	I 8375.97	..	40
II 4995.52	..	60	II 5790.50	..	25	I 8428.27	..	30
II 5078.25	..	150	II 6094.65	..	100	I 8575.27	..	25
II 5099.30	..	100	I 6140.25	..	30	I 8585.99	..	30
II 5102.86	..	30	6398.64	..	40	I 9744.33	..	30
II 5103.04	..	125	6434.80	..	25	I 9875.95	..	50

CHROMIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2039.31	25 n	..	I 2396.37	30	3	2639.43	30	..
II 2055.52	100	300	2397.77	5	35	2642.12	35	3
II 2061.49	100	200	I 2399.06	50	2	I 2653.59	12	35
II 2065.42	50	150	I 2399.58	40	..	II 2658.59	18	35
2117.56	..	50	I 2408.62	150 r	2 r	II 2671.81	30	15
2213.70	..	30	I 2408.75	40	1	II 2677.16	35	300 r
2226.70	..	30	2438.47	..	35	II 2678.79	10	80
2235.93	..	50	2474.07	35	..	II 2687.09	30	60
2237.58	..	40	I 2491.34	30	1	I 2688.04	30	..
2241.84	..	30	I 2492.57	50	..	I 2690.26	30	2
2243.31	..	25	I 2495.08	35	..	II 2691.04	35	125
2243.62	..	30	I 2496.31	125 r	2	2693.52	1	40
2256.05	..	50	2502.53	100 r	3	I 2696.54	30	1
2297.19	10	50	I 2504.31	150 r	3	2697.50	1	35
2314.74	8	50	I 2508.11	35	1	2697.91	3	35
2320.08	10	30	I 2508.98	25	1	II 2698.41	12	35
2324.89	..	50	2511.96	25	1	II 2698.69	12	35
2333.48	..	25	I 2516.92	35	2	2698.85	..	35
2345.33	8	60	I 2519.51	150 r	6	I 2700.59	30	2
I 2362.23	25	2 n	I 2528.01	35	1	I 2701.99	35	8
I 2365.97	25	8	I 2528.24	30	..	2703.55	..	50
I 2366.85	60	60	I 2530.45	35	1	II 2703.86	8	30
I 2368.49	30	2	2538.29	..	25	2708.79	3	40
I 2370.39	40	3	I 2541.35	60	3	2709.31	2	60
2372.89	40	3	I 2549.53	25	2	2710.23	50 n	..
I 2373.73	60	..	I 2557.15	35	2	2710.92	1	70
2381.48	3	25	I 2560.69	30	15	II 2712.31	30	70
I 2385.74	25	..	I 2571.74	50 r	35	II 2717.51	12	40
I 2389.46	25	..	I 2577.65	35	3	2720.07	5	35
2389.76	..	25	2584.10	1	25	2720.26	1	30
2392.37	25	2 n	I 2591.85	100 r	12	II 2722.75	30	80
I 2392.89	40	2 n	I 2603.57	30	1	2723.63	..	35
2394.01	..	50	2607.91	1	35	2724.04	1	40
I 2395.79	25	2 n	2622.86	25	2	I 2726.51	300 r	40

II. EMISSION SPECTRA 2000–10,000 A (Continued)

CHROMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2727.26	4	70	2826.75	70	3	2910.65	. .	50
2728.16	. .	25	2830.47	15	80 n	I 2910.90	60 r	8
I 2731.91	300 r	30	2832.46	2	125	I 2911.14	40	8
I 2736.47	300 r	50	2834.26	. .	125	2911.68	. .	40
2739.38	35	25	II 2835.63	100	400 r	2913.73	60 r	5
II 2740.09	20	60	2837.88	2	35	2915.23	1	25
2741.07	35	30	2838.79	3	80	2921.24	1	25
II 2742.03	15	50	2840.02	25	125	II 2921.82	4	60
2742.17	30	3	II 2843.25	125	400 r	2923.68	1	25
II 2743.64	30	125	2846.02	25	4	II 2926.16	2	40
2744.59	. .	40	2846.44	2	25	2927.08	2	80
2746.18	. .	25	2848.40	6	30	2929.44	. .	40
I 2748.29	300	5	2849.29	35	30	2930.85	. .	50
II 2748.98	35	200	II 2849.84	80	150 r	2932.70	2	25
II 2750.73	30	150	2851.36	20	80	2933.97	2 n	40
I 2751.60	30	. .	2853.22	5	100 r	2934.49	25 n	. .
II 2751.87	20	125	2855.07	4	100	2935.14	8	40
I 2752.88	300 r	40	II 2855.68	60	200 Wn	2940.22	. .	30
2754.28	3	50	II 2856.77	20	60	I 2941.88	12	25
2755.27	50 d	2	II 2857.40	20	80	2946.84	5	30
2756.30	1	100	2857.97	2	40	2947.50	. .	25
2756.93	. .	30 r	II 2858.65	18	30	2953.36	4	50
I 2757.10	300 r	10	II 2858.91	50	80 Wn	2953.71	6	25
II 2757.72	35	150	II 2860.93	60	100	2961.73	10	60
2758.62	. .	30	II 2862.57	80	300 r	2966.05	2	70
2758.98	1	40	II 2865.11	60	200 r	I 2967.64	60 r	30
2759.39	10	35	II 2866.74	80	125 r	I 2971.11	80 r	15
I 2761.75	300 r	35	2867.10	20	35	2971.91	8	30 Wn
II 2762.59	40	100	II 2867.65	80	100 r	I 2975.48	100 r	50
2763.06	35	4	II 2870.44	25	300 W	2979.74	10	60
2763.59	1	30	2871.45	. .	80	I 2980.79	75 r	50
2763.97	. .	30	I 2871.63	50	2	2985.32	10	60
I 2764.35	200 r	6	2873.19	25	. .	I 2985.85	25 r	15
2765.86	. .	35	II 2873.48	30	125	I 2985.99	25 r	15
II 2766.54	40	300 r	II 2873.82	20	40	I 2986.47	125 r	125
2767.54	30	8 d	II 2875.99	30	80 wn	I 2988.65	200 r	150
2768.59	1	60	II 2876.24	25	80 Wn	2989.19	10	90
I 2769.91	400 r	40	II 2877.98	30	100	I 2991.89	125 r	60
2773.31	1	40	2878.45	20	80	I 2994.07	150	50
2774.44	. .	100	I 2879.27	60	12	I 2995.10	200 r	75
2775.67	30		II 2880.87	20	25	I 2996.58	300 r	125
2776.65	. .	25	2881.14	25	2	I 2998.79	200 r	70
2777.67	40	1	2881.93	1	30	I 3000.89	150 r	125
2778.06	12	60	I 2886.99	100	18	3003.92	1	150
2780.30	. .	100	2887.77	. .	35	I 3005.06	300 r	125
I 2780.70	600 r	15	2888.74	3	40	3010.64	. .	40
2782.35	. .	35	I 2889.26	60 r	30	I 3013.03	80	40
2783.84	. .	35	2889.48	2	25	I 3013.71	200 r	150
2785.70	5	80	2891.10	10	40	I 3014.76	300 r	100
2786.49	1	30	2891.41	30	15	I 3014.91	300 r	100
2787.63	5	30	2891.88	. .	35	I 3015.19	200 r	80
2792.16	5	80	I 2893.25	80 r	10	3015.51	1	150
2795.82	35	3	2894.17	40	2	I 3017.57	300 r	200
2800.17	. .	40	II 2894.25	. .	25	I 3018.50	200 r	125
2800.77	12	150	2896.46	6	30	I 3018.82	200 r	60
2803.36	1	30	I 2896.75	60 r	30	I 3020.67	200 r	100
2808.02	. .	30	2897.70	3	25	I 3021.56	300 r	200 r
2812.01	8	80	2898.54	12	40	I 3024.35	300 r	125
2816.84	3	30	I 2899.21	50	25	3026.65	8	125
2818.36	8	80	2899.48	2	40	3028.12	2	125
2822.01	10	80	I 2905.49	60 r	8	I 3029.16	70	50
2822.37	20	100	I 2909.05	60 r	12	I 3030.24	200 r	150

CHROMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3031.35	40	30	3162.44	25	. .	II 3312.18	5	125
II 3032.93	10	100	3163.76	40	25	3313.72	30	1
I 3034.19	200 r	60	3169.19	2	50	3314.05	. .	30
3034.54	. .	30	I 3169.58	25	2	3314.56	10	100
I 3037.04	200 r	100	3172.08	2	200	3318.08	80 Wn	. .
I 3039.78	80	35	3173.56	. .	25	3323.25	25	. .
I 3040.86	500 r	200	3179.28	100	10 n	3324.35	10	60
3041.74	2	125	II 3180.70	30	150	3326.59	40	18
II 3042.79	1	100	II 3181.43	15	40	II 3328.35	20	40
3043.88	. .	50	3183.32	6	150	I 3329.05	30	6
3047.45	25	6	3184.34	. .	30	3330.60	80	. .
3050.14	10	150	3186.74	. .	30	3332.88	30	10
I 3053.88	3 r	150	3188.01	150 n	60 n	3333.60	125	3 n
3057.86	. .	30	I 3192.11	30	2	3334.69	150 wn	. .
II 3058.34	. .	30	II 3197.08	35	30 n	II 3336.33	18	80
II 3059.52	8	60	3198.11	40	10	II 3339.80	25	150
3065.07	20	50	3201.26	1	50	3341.43	50	1
II 3067.16	25	40	3205.10	1	40	II 3342.59	30	125
3073.68	35	25	II 3208.59	20	40	I 3343.34	30	10
3077.25	. .	40	II 3209.18	40	125	3343.74	30 n	. .
I 3077.83	25	125 r	3211.31	35	12	3346.02	35	35
3079.33	. .	25	3212.89	. .	30	3346.74	150 r	80 r
3083.60	. .	35	3216.56	3	125	II 3347.84	35	125
3084.45	. .	35	3217.40	30	20	3349.07	125	40
3087.88	. .	40	3218.69	80 wn	2 wn	3349.32	35	50
3093.49	1	100	3219.13	. .	30	3351.60	35	8
3093.95	. .	25	I 3226.55	30	1	I 3351.97	50	50
3095.86	125	3	3229.20	35	. .	3353.03	20	30
3096.13	1	100	I 3233.23	30	4	3353.13	15	50
3096.53	35	. .	3234.06	10	150	3353.61	30	. .
3098.16	. .	30	3237.73	40	30	3356.40	35 wn	. .
3103.47	. .	50	3238.09	30	20	3356.72	35 wn	. .
3107.57	2	125	3238.51	25	8	3357.41	6	125
3108.65	. .	35	3238.76	6	200	II 3358.50	40	200
3109.34	30	12	I 3240.95	35	2	3359.18	25	. .
3110.86	25	8	I 3244.11	30	4	II 3360.29	50	200
II 3111.94	. .	40	3251.58	30	. .	II 3361.77	10	100
II 3115.27	. .	30	3251.84	35	. .	I 3362.21	80	8
3115.64	. .	40	3252.49	. .	25 n	I 3362.71	40	. .
3116.74	. .	35	3254.94	50 wn	. .	II 3363.73	8	35
3117.26	1	30	3257.82	40	30	3365.52	25	2
II 3118.65	35	200	3258.77	. .	50	I 3367.53	50 wn	. .
3119.71	30	6	3259.97	50	30	II 3368.05	35	125
II 3120.37	40	150	3264.26	6	50	3370.23	30	1 n
II 3122.60	10	80	I 3266.63	35	4	3372.13	. .	30
II 3124.98	20	125	3269.76	. .	35	3374.60	25	2
II 3128.70	30	150	3270.72	50	1	3374.93	25	4
II 3132.06	25	125	3271.96	60 wn	. .	3376.15	25 n	. .
3134.31	3	50	3283.06	. .	35	3376.40	30	20
3135.34	1	25	3290.99	30 wn	. .	II 3378.34	25	150
II 3136.68	20	50	3291.76	10	200	I 3379.17	40	6
3144.41	50	12	3293.83	30	1	II 3379.37	6	100
II 3145.10	10	35	II 3295.43	10	200	I, II 3379.82	15	100
3145.77	. .	25	3298.32	30	8	3382.08	30	1
II 3147.23	25	150	3302.19	50 n	1 n	II 3382.68	35	200
3148.44	30	15	3302.88	30	2	I 3384.24	35	. .
3149.82	6	40	I 3304.33	30 n	. .	I 3384.64	40	1
3150.11	6	50	3305.23	25	. .	3385.33	30	2
3155.15	30	25	I 3307.75	40	8	3386.52	30	2
3158.02	1	35	3309.84	30	2	I 3388.71	40	4
II 3159.10	4	25	3310.65	2	200	3390.77	30	3
3159.59	60 wn	20 n	II 3311.93	6	125	II 3391.43	4	150

CHROMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 3392.99	10	100	I 3479.12	30	1	I 3748.61	40	30
II 3393.84	15	125	I 3479.31	35 r	. .	I 3749.00	125 r	125 r
3394.29	15	150	I 3480.29	30	1	II 3754.57	8	30
3395.61	2	100	I 3481.30	15	35	I 3757.17	50	30
3399.53	1	60	3481.54	30	30	I 3757.66	50	50
II 3402.40	25	80	3483.52	15	30	I 3758.04	50	35
II 3403.32	30	200	II 3484.15	8	35	I 3768.24	60	60
3403.59	35	3	3488.45	35	10	I 3768.73	35	25
3407.27	50 wn	1 wn	3494.97	35	25	I 3788.87	60	10
3408.04	40 wn	1 wn	II 3495.38	12	35	I 3789.72	50	10
II 3408.76	35	100	3502.31	35	6	I 3790.23	30	10
3409.40	60 wn	1 wn	3510.54	40	8	I 3790.45	50	15
3411.05	80 wn	3 wn	II 3511.84	20	50	I 3791.38	80	40
II 3421.21	50	200	3527.09	30	5	I 3792.14	60	40
II 3422.74	35	125	I 3550.63	70	60	I 3793.29	50	30
3425.98	25	2	3566.16	80 wn	12 wn	I 3793.88	50	30
3427.66	40	1	I 3572.75	25	5	I 3794.61	50	30
3431.28	35	8	I 3573.64	60	15	I 3797.13	50	30
3431.99	25	4	I 3574.04	50	15	I 3797.72	100	20
3432.32	25	6	I 3578.69	500 r	400 r	3801.20	35 n	3 n
II 3433.31	30	150	3582.62	35	12	I 3804.80	100	30
I 3433.60	50	35	II 3585.51	6	35	3806.83	35	35
I 3434.11	30	25	I 3593.49	500 r	400 r	I 3807.93	25	12
3435.82	30	12	3599.39	30	20	3812.25	40	15
I 3436.19	50	50	I 3601.67	50	30	3814.62	35	30
3439.37	30	2	I 3603.74	15	50	3815.43	35	12
I 3441.11	30	25	I 3605.33	500 r	400 r	I 3816.17	30	10
I 3441.44	80	90	3612.61	35	25	I 3817.84	30	20
3443.79	30	25	I 3615.64	30	10	I 3818.48	50	20
3445.62	100	80	3619.46	30	8	I 3919.56	60	40
I 3447.01	35	25	II 3631.69	10	60	I 3823.52	40	30
I 3447.43	35	35	3632.84	80	35	I 3825.39	40	15
I 3447.76	35	30	3634.99	25	12	I 3826.42	40	20
3450.83	25	4	I 3635.28	25	8	I 3830.03	150 w	50
I 3453.33	35	35	I 3636.59	60	30	I 3831.03	40	25
I 3453.74	30	25	I 3639.80	60	25	I 3834.73	25	12
3454.99	. .	100	I 3640.39	30	5	I 3836.07	25	8
3455.28	35	10	I 3641.47	30	25	I 3841.28	150	80
3455.60	50	35	I 3641.83	40	15	I 3848.98	80 d	50 d
3457.63	4	125	II 3643.20	5	30	I 3849.36	40 n	30 n
3458.09	35	15	I 3649.00	40	20	I 3850.04	40 r	40 r
3459.29	. .	35	3650.34	. .	40	I 3852.22	60	12
I 3460.43	40	30	I 3653.91	100	25	I 3854.22	40	15
3464.84	30	3	I 3656.26	80	25	I 3855.29	35	35
3465.25	35	30	II 3662.84	25	8	I 3855.57	30	30
3465.58	30	8	I 3663.21	35	20	I 3857.63	50	25
I 3467.02	50	20	3664.94	1	40	I 3858.89	35 wn	20 wn
3467.71	50	30	3667.45	. .	25	3862.55	25	20
3468.75	30	8	3676.32	40	15	I 3870.27	80 W	3 W
I 3469.59	50	15	II 3677.68	6	35	I 3874.53	70	12
I 3470.40	30	8	II 3677.89	3 l	70	I 3879.22	60	15
I 3470.53	25	6	3679.82	40	8	I 3881.21	60	18
I 3471.50	30	3	3697.99	. .	40	I 3881.86	50	6
3472.07	. .	80	II 3712.95	12 s	125	I 3883.29	60	80
I 3472.76	30	8	3715.43	. .	30	I 3883.66	30	20
3472.91	30	8	I 3730.81	60	12	I 3885.22	40	50
I 3473.61	35	10	I 3732.03	50	15	I 3886.79	125	125
3474.38	35	8	II 3738.38	6	40	I 3891.93	40	25
I 3474.86	35	3	I 3742.97	25	10	I 3894.03	60	40
I, II 3475.13	6	40	I 3743.58	40	40	I 3897.65	40	25
I 3477.16	25	5	I 3743.88	40	40	3902.11	40	30
I 3478.77	35	3	I 3744.49	30	12	I 3902.91	100	100

II. EMISSION SPECTRA 2000–10,000 A (Continued)

CHROMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3903.16	35	30	4056.05	30	8	4209.76	80	20
3907.78	30	10	4058.77	80	50	4211.35	100	30
I 3908.75	200	150	4065.72	80	35	I 4212.66	80	8
3912.00	40 wn	..	4066.94	25	30	4213.17	60	8
I 3915.84	125	80	4067.84	30	4	I 4216.36	60	25
I 3916.24	100	60	4074.86	25	10	I 4217.63	150	70
I 3916.98	30	8	4076.06	30	15	4221.57	80	35
I 3919.16	300 r	125	4077.09	35	10	I 4222.73	100	15
I 3921.02	150	40	4077.68	30	10	4224.51	60	12
3926.65	35	25	4081.74	25	2	4226.76	125	30
I 3928.64	150	40	4090.30	30	15	I 4230.48	70	8
3929.70	35 wn	..	4092.17	25	2	II 4230.64	...	(30)
3938.34	40	3	4099.02	30	8	4232.22	70	5
I 3941.49	200 r	60	4101.16	30	2	I 4232.87	60	..
3945.49	50	15	4104.87	35	8	4234.51	60	2
3945.97	50	7	I 4108.40	30	4	4237.71	70	..
3948.85	25	2	I 4109.58	40	10	I 4238.96	100	15
I 3951.10	50	8	I 4120.61	40	10	4240.70	200	30
I 3951.76	40	5	4121.26	35	8	II 4242.38	4	50
I 3952.40	60	18	4121.82	40	10	I 4248.34	30	2
I 3953.16	60	12	I 4122.16	30	5	4248.71	35	2
3960.76	40	8	4123.39	35	15	I 4252.24	35	10
I 3963.69	300	300	I 4126.52	100	50	I 4254.35	5000 r	1000 r
I 3969.06	80	50	4126.92	30	4	4255.50	30	30
I 3969.75	200	90	I 4127.64	30	10	I 4257.37	35	1
I 3971.25	80	50	4131.36	30	20	I 4259.16	35	1
I 3972.69	60	12	4134.39	25	3	I 4261.35	125	50
I 3976.66	300	300	4142.19	35	8	4261.61	35	8
I 3978.68	80	40	4146.69	25	2	II 4261.91	..	30
I 3979.80	80	20	4152.77	50	12	4262.13	40	8
I 3981.23	100	50	I 4153.07	40	6	4262.36	30	2
I 3983.91	200	60	I 4153.82	50	30	4263.14	125	80
I 3984.34	80	60	4161.41	50	30	4266.82	30	1
3989.99	80	40	4163.62	100	50	4268.79	30	3
I 3991.12	200	60	4165.52	80	35	4269.95	40	6
I 3991.67	100	50	4169.84	80	25	4271.06	30	12
I 3992.84	150	70	4170.20	70	15	I 4272.91	40	30
I 3993.97	60	20	4171.67	70	8	I 4274.80	4000 r	800 r
3998.86	25	2	4172.77	35	15	4275.97	30	15
3999.68	40	10	I 4174.79	100	40	4277.79	25 wn	..
4001.44	200	80	4175.23	30	8	4280.40	80	50
4003.92	30	12	4175.94	40	10	I 4284.22	..	30
4012.47	70	60	4177.90	40 n	1 n	I 4284.72	40	8
4014.69	40	8	4179.26	100	40	I 4289.72	3000 r	800 r
4018.20	35	8	4179.96	25	1	4291.96	35	20
4022.26	80	40	4184.89	35	10	I 4293.56	50	8
4023.74	40	15	4185.34	30	3	I 4295.76	125	40
4025.01	100	25	4186.36	50	10	I 4297.05	100	15
4026.17	100	35	4190.13	40	15	4297.74	125	30
4027.10	80	30	I 4191.27	70	15	I 4299.72	100	50
4028.02	35	...	I 4191.75	50	6	4300.51	100	20
4030.68	40	30	4192.10	40	15	4301.18	100	25
4031.13	30	6	4193.66	100	25	4302.77	40	2
I 4033.26	30	8	4194.95	70	25	I 4305.45	150	20
I 4037.29	80	12	4197.23	70	25	4307.49	35	1
4039.10	100	40	4198.52	100	30	4312.47	30	1
I 4042.25	30	1	4200.10	80	8	I 4319.64	100	20
4043.70	30	2	I 4203.59	100	20	I 4320.59	125	6
I 4046.76	30	3	I 4204.20	50	6	4321.24	70	2
4048.78	80	50	4204.47	80	30	4321.62	70	3
4049.78	30	6	4206.90	80	25	4323.52	100	15
I 4050.03	30	1	4208.36	100	25	4325.07	125	130
4051.33	35	8	4209.37	100	40	4332.57	125	2

Chromium (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 4337.57	500	300	I 4545.33	25	12	4727.15	80	20
4338.41	35	4	I 4545.96	200	125	4729.72	30	6
4338.80	50	8	4554.83	25	2	4730.71	100	50
I 4339.45	300 r	300	II 4555.03	..	40 n	4737.35	200	80
I 4339.72	150	150	4555.09	15	50	4743.11	40	..
I 4340.13	80	30	4556.17	40	12	I 4745.31	80	2
I 4343.16	60	12	II 4558.66	20	600 wn	4752.08	100	40
I 4344.51	400 r	300	I 4565.51	20	30	4754.74	80	..
4345.08	30	3	4569.64	50	10	I 4755.14	70	..
4346.83	200	40	4571.68	50	40	4756.11	300	100
4347.50	30	1	4575.12	25	5	4757.33	25	..
I 4351.05	100	150	4578.33	25	2	4757.59	35	1
I 4351.77	300	300	I 4580.06	300	125	4761.24	25	..
I 4359.63	200	150	4586.14	25	6	4764.29	200	35
4363.13	25	35	I 4587.87	30	..	I 4764.64	35	..
I 4371.28	200	150	II 4588.22	10	600 n	I 4766.63	80	6
I 4373.25	50	50	II 4591.39	200	125	4767.86	100	8
4374.16	50	60	II 4592.06	3	35 n	I 4770.67	35	..
4375.33	25	30	4592.54	25	1	4775.14	35	..
4377.55	25	10	4595.59	50	60	4783.08	25 n	..
I 4381.11	30	25	4600.10	20	50	I 4789.38	300	100
I 4384.98	150	200	I 4600.75	150	150	I 4790.34	100	1
I 4391.75	50	35	4605.82	30	..	4792.51	200	40
I 4397.25	25	5	I 4613.37	150	60	4796.17	125	1 n
4403.50	15 d	25	I 4616.14	300 r	200	4797.71	25	..
I 4410.30	25	8	II 4616.66	..	50	4801.03	200	70
I 4412.25	35	10	II 4618.83	6	80 n	4804.70	35	..
4413.87	25	15	4619.55	50	30	I 4806.25	80	..
I 4424.28	25	35	4621.96	50	40	4810.73	30	..
I 4428.50	25	6	4622.49	30	30	4814.26	100	..
4432.17	30	15	I 4626.19	100	125	4816.14	30	..
I 4458.54	50	125	4632.18	25	8	4823.92	25	..
I 4459.74	25	25	II 4634.09	5	80 n	II 4824.12	4	35
I 4460.77	25	..	I 4646.17	100	150	I 4829.38	200	40
I 4473.78	25	1	I 4646.81	35	3	4831.63	25	..
I 4475.34	40	6 n	4648.13	40	6	I 4836.86	80	..
4482.88	25	12	4648.87	50	3	4851.46	35	..
4488.05	25	15	4649.46	60	3	I 4857.29	25	..
4489.47	25	15	I 4651.28	100	100	I 4861.20	80	..
I 4491.68	25 d	1	I 4652.16	200 r	150	4861.84	125	8
4491.86	50	4	I 4654.74	70	8	4870.80	150	25
4492.31	80	15	4656.19	50	4	4880.04	25	..
I 4496.86	200	200	I 4663.33	40	25	I 4884.95	25	..
4498.73	30	15	I 4663.83	50	15	I 4885.78	60	..
4500.29	50	30	I 4664.80	70	20	4887.01	125	30
4501.11	40	30	4666.21	35	8	I 4888.53	100	..
4506.85	30	30	I 4666.51	50	25	4894.36	125	..
4511.90	80	100	I 4669.34	50	20	I 4903.24	125	..
I 4514.53	30	8	I 4680.54	50	25	4905.05	30	..
4515.44	25	10	4680.87	60	8	4920.94	50	..
4521.14	25	10	I 4689.37	80	35	4922.27	200	40
I 4526.47	50	30	4693.95	50	20	4930.18	35	..
I 4529.85	25	8	4695.15	50	4	4936.33	200	5
I 4530.74	150	125	I 4697.06	50	12	I 4942.49	125	3
I 4535.15	50	30	I 4698.46	60	12	4944.58	35	..
I 4535.72	125	100	I 4698.61	40	8	4954.81	100	8
I 4539.79	40	25	4699.59	30	1	4985.96	25	..
I 4540.50	40 d	40	I 4700.61	50	4	I 5013.32	60	2
4540.72	40 d	40	4706.10	30	1	I 5048.75	30	..
I 4541.07	30	8	I 4708.04	200	150	I 5051.90	50	..
4541.51	30	6	I 4718.43	200	150	I 5065.91	30	..
4542.62	30	8	4723.10	125	8	I 5067.71	50	..
I 4544.62	100	70	4724.42	125	10	I 5072.92	35	..

II. EMISSION SPECTRA 2000–10,000 A (Continued)

CHROMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 5091.89	25	..	I 5340.44	50	..	6789.17	40	..
I 5110.75	40	..	I 5345.81	300 r	25	I 6883.03	70 n	..
I 5113.13	25	..	I 5348.32	150 r	15	I 6924.13	60 n	..
5139.65	50	1	5400.61	30	1	I 6925.20	50 n	..
I 5144.67	30	..	I 5409.79	300 r	30	I 6978.48	125 wn	..
5166.23	80	2	I 5628.64	25	2	I 7355.90	80	..
I 5177.43	50 l	..	I 5694.73	35	..	I 7400.21	80	..
I 5184.59	60	1	I 5698.33	30	2	I 7462.31	80	..
I 5192.00	50	..	5783.11	30 n	..	I 8163.18	35	..
I 5196.44	50	3	5783.93	30 n	..	I 8235.89	30	..
I 5200.19	30	..	5787.99	50 wn	..	I 8287.38	25	..
I 5204.52	400 r	100	I 5791.00	40 wn	..	I 8947.15	50	..
I 5206.04	500 r	200	I 6330.10	200	8	I 8976.83	30	..
I 5208.44	500 r	100	I 6362.87	150	8	I 9009.91	100	..
5221.75	25	..	6421.37	35	..	I 9017.03	100	..
I 5238.97	60	..	6501.21	35	..	I 9021.65	100	..
I 5243.39	50	..	6529.20	40 n	..	I 9035.85	50	..
I 5247.56	60	15	I 6437.95	35	..	I 9208.27	25	..
I 5261.75	25	..	I 6572.90	25	..	I 9263.96	25	..
I 5264.15	100 r	20	I 6580.91	30	..	I 9290.38	75	..
I 5265.72	30	10	6594.67	60 wn	..	I 9446.95	75	..
I 5272.01	25	1	6597.56	40	..	I 9571.74	25	..
I 5287.19	40	..	6608.89	25	..	I 9574.24	50	..
I 5298.27	15 r	25	I 6630.01	50	..	I 9667.22	25	..
I 5300.75	25	4	I 6661.08	100	..	I 9670.49	50	..
I 5312.88	40	..	I 6669.26	80	..	I 9730.27	25	..
I 5318.77	30	..	6762.41	50	..	I 9734.51	50	..

COBALT

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2011.50	15	50	2299.75	4	30	II 2414.06	8	30
II 2022.34	18	75	II 2301.40	10	25	I 2414.46	40 r	15
II 2025.75	10 l	30	II 2307.86	25	50 w	I 2415.30	40 r	18
II 2027.02	15	50	II 2311.60	15	50	2417.33	25	..
II 2036.59	8	30	II 2314.05	25	35	2420.73	8	80
II 2058.81	10	40	II 2314.98	25	30	2422.56	30 w	3
II 2063.76	12	35	II 2324.32	20	50	I 2424.93	250 r	..
II 2065.53	10	35	I 2325.61	50 w	..	I 2429.23	25	3
2082.68	3	25	II 2326.48	20	30	I 2432.21	40 r	..
2104.73	25	2	II 2347.39	10	25	2432.52	..	80
2106.80	25	2	II 2353.42	10	35	2436.66	50 r	25
II 2174.54	15	25	I 2358.18	20	30	2446.02	2	40
I 2174.60	30 r	12	II 2363.79	25	50	2447.76	4	100 r
2178.95	25	..	II 2378.62	25	50 w	II 2449.16	12	30
II 2181.72	80	8	II 2383.46	15	30	2450.00	40	200
II 2192.49	2	25	II 2386.36	10	25	2459.49	1	30
II 2193.60	4	30	II 2388.91	10	35	II 2464.19	40	150
2200.69	80	..	2396.77	90	..	2467.06	2	80
II 2202.96	3	30	II 2397.39	4	25	I 2476.64	40 w	25
II 2207.92	..	30	I 2400.56	30	..	I 2483.61	..	25
2216.48	4	25	I 2400.84	30	2	II 2485.36	25	75
II 2245.13	15	35	2401.11	30	2	II 2486.44	1	40
2256.74	..	35	I 2401.60	30	2	2490.39	5	80
2260.01	2	25	I 2402.17	30 r	..	2493.93	30 w	1
2266.56	..	35	II 2404.17	30 w	50	2497.50	1	40
2281.88	3	25	I 2406.27	25	1	2498.83	2	80
I 2284.85	30	..	I 2407.25	100	2	II 2506.46	50 w	200 n
II 2286.16	40	300 l	II 2408.75	25 w	25	I 2507.68	40 w	8
II 2292.99	10	30	2410.51	40 w	..	2507.96	2	30
II 2299.42	..	25	I 2411.62	250 r	50	2517.41	..	40 W

Cobalt (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2519.82	40	200	II 2653.70	5	40	II 2834.94	2	75
2521.36	75 r	150	II 2663.53	15 w	60 w	I 2837.15	75 r	..
2522.94	..	30	II 2669.91	..	100 wn	I 2842.38	30	..
2524.60	..	30	I 2673.93	25	..	II 2845.63	..	50
II 2524.96	50 w	700	2679.76	75 W	..	II 2848.37	..	60 n
2528.18	..	40	2680.11	25	3	I 2850.04	75	..
II 2528.61	4	200	I 2685.34	75 w	..	I 2850.95	30	..
I 2528.97	50 r	..	2689.82	..	40	I 2859.66	40	..
I 2530.13	40 w	300	2693.01	..	25	I 2862.60	50	..
I 2532.17	..	75	2693.12	..	25	II 2870.03	..	50 wn
2533.81	5 r	60	I 2694.40	25	..	2871.24	..	100
I 2535.96	10 r	40	II 2694.68	25	200 w	2879.62	25	..
2540.65	6	40	I 2695.85	50 w	..	II 2880.29	..	50 wn
II 2541.94	40	300 n	II 2697.04	..	60	I 2882.22	30	..
I 2544.25	50 r	100	II 2702.11	..	25 wn	I 2886.44	50	2
2545.04	3	30	I 2705.85	15 w	100 w	2892.25	25	..
2546.74	1	50	II 2706.74	..	100 wn	I 2899.82	25	1
I 2548.34	20	75	II 2707.50	..	100 wn	2903.19	25	1
II 2550.02	..	60	2708.82	30	2	I 2919.55	30	..
I 2553.00	40 r	..	II 2709.05	..	30 wn	I 2927.67	50	1
I 2556.76	50 w	150	II 2714.42	12	200 W	I 2928.81	50	1 n
2557.35	2	30	I 2715.99	75 w	75	I 2929.51	75	..
II 2559.41	10	60 wn	2719.58	25	..	II 2930.43	..	150 wn
2560.09	1 d	60 wd	I 2722.11	50 w	..	II 2943.15	..	100 wn
2561.28	25	12 n	2731.11	50 W	15	I 2943.48	30	..
II 2564.04	15 w	100 wn	I 2740.46	50	4	2954.74	2	100
I 2567.35	50 r	..	I 2745.10	50	60	2955.39	30	..
2569.74	..	30	I 2746.03	50	..	2957.67	50	1
I 2572.24	50 w	12	I 2752.07	40	1	2966.90	30	..
2573.40	40	12	I 2758.54	30	..	I 2978.01	30	..
2573.54	30 r	12	I 2761.37	75	5	I 2987.16	75 r	50
2574.86	3	40	I 2764.19	100 r	..	I 2989.59	75 r	30
2576.10	30	..	2766.22	50	45	I 2995.15	50	1
I 2578.93	30	..	I 2766.39	50	3	I 3000.55	80	1
II 2580.33	15 w	100 wn	2769.08	..	35 n	I 3005.76	100	2
I 2580.84	50 W	4	2772.70	30 n	..	I 3013.60	60 r	4
II 2582.24	50 w	500 wn	I 2774.96	50	..	I 3015.68	60	2
2583.18	..	40 w	II 2775.18	30 n	100 n	I 3017.26	60	..
I 2585.34	50 W	..	I 2776.58	50	..	I 3017.55	100 r	5
II 2587.22	10 w	100 n	I 2778.82	75	8	3020.64	60	..
I 2590.59	75 W	..	I 2785.90	50	..	I 3022.36	60	2
2604.41	..	30	2790.28	30 n	..	I 3026.37	100	40
2605.68	30	200	I 2791.01	50	..	I 3034.43	80	2
I 2606.12	40	..	I 2792.44	40	3	I 3038.31	25	..
I 2610.76	40 w	1 n	2794.82	100 r	15	I 3039.57	70	..
2613.49	25	..	I 2796.23	50	5	I 3042.48	80 r	8
I 2614.13	30	..	I 2797.08	50	2	3044.00	400 r	..
II 2614.36	6	60 w	2802.71	100	200 n	I 3048.11	25	..
I 2616.26	40 w	2	I 2803.77	100	12	I 3048.89	150 r	..
I 2617.86	50 w	..	II 2807.17	1	25	I 3050.50	60	..
2618.91	..	30	II 2810.86	5	75 n	I 3050.93	60	..
I 2619.28	50 w	4	I 2811.13	50	..	I 3054.72	60	..
2619.80	..	40	I 2811.52	50 w	..	I 3060.05	150	1
I, II 2622.06	40 w	20	I 2814.98	25	..	I 3061.82	200 r	125
II 2622.43	30 r	15	I 2815.56	50 r	..	I 3062.20	60	1
I 2623.75	40	3	I 2818.60	30	..	I 3064.37	100	..
I 2627.64	50 W	..	I 2820.01	50	..	3071.96	80	2
I 2629.97	30	1	II 2821.74	30 n	10 n	I 3072.34	200 r	100
II 2632.24	10 w	40 w	I 2825.15	75 w	..	I 3073.52	60	2
2636.02	..	40	II 2825.24	5	200	I 3079.40	80	2
I 2648.63	5	40 w	I 2826.80	50 W	..	3082.62	150 r	50
I 2649.94	50 w	5	I 2833.92	40	..	I 3082.84	35	..
I 2650.27	50 w	25	I 2834.43	50	..	I 3086.40	80	2

Cobalt (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3086.78	200 r	..	I 3246.99	35	..	I 3374.30	60	..
I 3087.81	60	..	I 3247.18	80	..	I 3377.06	100	..
I 3089.59	100 r	..	I 3250.00	60	..	I 3378.36	30	2
I 3090.25	80	1	I 3254.21	300 r	..	3378.74	40	2
I 3095.72	60	2	I 3258.02	60	..	I 3381.50	100 W	..
I 3096.40	60	3	I 3260.82	70	4	I 3383.92	60	..
I 3096.70	60	3	I 3263.21	30	..	I 3385.22	250 r	15
I 3098.20	100 r	5	I 3264.84	35	2	I,II 3388.17	250 r	12
I 3099.67	50	..	I 3265.35	35	2	I 3390.40	30	2
I 3102.41	60	4	I 3271.78	60	..	I 3395.37	400 r	50
I 3103.74	80	2	I 3276.48	35	2	I 3405.12	2000 r	150
I 3103.98	60 r	..	I 3277.32	60 W	..	3405.82	30 r	..
I 3105.92	30	..	I 3278.84	70	2	I 3409.18	1000 r	125
I 3107.04	70	3	I 3279.26	60	2	I 3412.34	1000 r	100
I 3109.51	60	1 n	I 3283.46	80	..	I 3412.63	1000 r	40
I 3110.02	60	2	I 3288.77	60 W	..	I 3414.74	200 W	..
I 3110.82	60	2	I 3287.19	60	..	II 3415.78	100 r	20
I 3113.48	100	4	I 3293.86	40 r	..	I 3417.16	400 r	..
I 3118.25	60	2	I 3298.68	70	2	I 3417.67	25	..
I 3121.41	150 r	6	I 3303.88	60 r	..	I 3417.79	30	2
I 3121.57	60 r	3	I 3307.15	80	..	I 3420.79	80	2
I 3126.72	70	..	I 3308.49	30	..	I 3424.51	80	2
I 3127.25	100	..	I 3308.81	40	..	3428.23	100 W	2
I 3128.99	25	..	I 3312.15	60	2	3429.68	30	..
I 3129.48	40	2	I 3314.08	100	..	I 3431.57	500 r	40
I 3132.22	40	..	I 3318.40	35	..	I 3432.32	60 W	..
I 3136.73	60	..	I 3319.16	60	..	I 3433.04	1000 r	150
I 3137.33	150 r	..	3319.48	80	..	I 3437.69	150 Wn	..
I 3137.45	50	..	I 3319.82	35	2	I 3438.71	80 w	..
I 3137.75	60	2	I 3321.91	25	..	I 3438.91	30	..
I 3139.94	150 r	10	I 3322.20	100 W	..	I 3442.93	400 r	15
I 3145.02	30	..	I 3325.24	80	3	3443.20	25	2
I 3147.06	150 r	..	I 3326.56	60	..	I 3443.64	500 r	100
I 3149.31	60	..	3326.99	100	..	I 3446.09	60 n	..
I 3152.71	100	..	I 3328.21	40	..	II 3446.39	3	60
3154.68	100	..	I 3329.47	80	..	I 3449.17	500 r	125
I 3154.79	100	4 n	I 3333.39	100	..	I 3449.44	500 r	125
I 3158.77	150 r	..	I 3334.14	250 r	..	I 3453.50	3000 r	200
I 3159.66	100	2 n	I 3337.17	60	2	I 3455.23	2000 r	10
I 3161.65	60	..	I 3339.78	150 w	..	I 3456.93	30	2
I 3168.06	100	..	3341.34	60	2	I 3458.03	60 w	..
3169.77	100	..	I 3341.95	25	..	I 3461.18	100 wn	3
I 3174.90	80	..	I 3342.73	150 W	..	I 3462.80	1000 r	80
3177.27	100	..	I 3346.93	100	2	I 3465.80	2000 r	25
I 3182.12	80	2 n	I 3348.11	80	..	I 3471.38	80	25 wn
I 3185.95	40	..	I 3351.54	35	2	I 3474.02	3000 r	100
I 3186.35	70	..	II 3352.80	..	30	I 3474.53	30	2
I 3188.37	100	2 n	3354.21	30	..	I 3476.36	100 r	..
I 3189.76	60	3	I 3354.38	200 r	..	I 3478.55	40	2
I 3191.30	35	..	I 3356.47	150 W	2	I 3478.74	60	2
I 3192.22	35	..	I 3356.84	25	..	I 3480.02	80 W	2 n
I 3193.16	50	..	I 3359.08	35	..	I 3483.41	300 r	10
I 3198.66	60	2	I 3359.29	100	2	3485.37	100 wn	3
I 3199.32	35	..	I 3361.56	80	2	I 3489.40	100 r	25
I 3203.03	40	..	I 3362.80	80	..	I 3490.74	60	..
I 3210.23	80	2	I 3363.27	30	2	I 3491.32	200 r	8
I 3219.15	60	..	I 3363.76	80 r	..	I 3495.69	1000 r	25
I 3224.64	60	..	I 3364.25	30	2	I 3496.68	150 r	4
3226.98	80 r	..	I 3367.11	300 r	30	I 3496.79	30	..
I 3232.87	60	25	I 3370.33	80	2	II 3501.72	5	100
I 3235.54	60	..	II 3370.94	..	50	I 3502.28	2000 r	20
I 3237.03	100	..	I 3373.23	60	..	I 3502.62	60	5
I 3243.84	100	..	I 3373.97	60	..	I 3506.31	400 r	15

COBALT (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3509.84	400 r	40	I 3734.14	70	. .	I 3990.30	80	10
I 3512.64	400 r	100	I 3734.87	60	. .	I 3991.54	30	. .
I 3513.48	300 r	25	I 3735.93	200 r	. .	I 3991.69	60	6
I 3518.35	200 W	100	I 3740.19	60	. .	I 3994.54	60	. .
3519.82	2 n	25 n	I 3745.50	300 r	. .	I 3995.31	1000 r	20
I 3520.08	100 W	. .	I 3749.93	60	5	I 3997.91	200	20
I 3521.57	200 r	25	I 3751.63	100	60	I 4013.94	300	. .
I 3523.43	300 r	25	I 3754.35	30	3	I 4019.30	80	. .
I 3526.85	300 r	25	I 3755.45	100	. .	I 4020.90	500 w	. .
I 3529.03	200 r	. .	I 3759.69	30	. .	I 4023.40	200	. .
I 3529.81	1000 r	30	I 3760.39	30	. .	I 4027.04	200	4
I 3533.36	200 w	. .	I 3774.60	200 W	. .	I 4035.55	150	3
I 3543.26	35	. .	I 3777.54	200	. .	I 4045.39	400	. .
II 3545.04	2	30	I 3808.11	200 w	7	I 4052.92	40	. .
I 3550.59	200	. .	I 3811.07	30	. .	I 4057.20	100	. .
I 3558.78	40 w	. .	I 3812.47	100 w	. .	I 4058.19	100	. .
I 3560.89	200	25	I 3813.92	30 r	. .	I 4058.60	100	. .
I 3564.95	150 w	. .	I 3814.46	35	. .	I 4068.54	150	100
I 3569.38	400 r	100	I 3816.33	60	50 r	I 4076.13	70	. .
I 3574.96	200	25	I 3816.47	60	. .	I 4077.41	100 wn	2 n
I 3575.36	200 r	25	I 3816.87	70	5	I 4082.60	50	. .
II 3578.03	. .	30	I 3841.46	60	. .	I 4086.31	400	15
I 3584.80	25	. .	I 3842.05	400 r	20	I 4088.30	50	. .
I 3585.16	60	. .	I 3843.69	60	. .	I 4092.39	600 W	15
I 3587.19	200 r	50 n	I 3845.47	500 r	100	I 4092.85	25	10
I 3594.87	200 W	. .	I 3850.95	100	. .	I 4104.43	30	2
I 3602.08	200	35	3856.80	80	2	I 4104.75	50	. .
I 3605.36	60	. .	I 3861.16	300 r	15	I 4110.53	600	. .
I 3611.70	25	. .	I 3863.61	30	. .	I 4118.77	1000 r	. .
II 3621.18	15	50 n	I 3870.53	70	8	I 4121.32	1000 r	25
I 3627.81	200	. .	I 3873.11	500 r	80	4158.42	25 n	5
I 3631.39	50 W	25	I 3873.95	400 r	80	I 4187.25	50	3
3632.84	60	. .	I 3876.83	300 w	40	I 4233.99	100 W	. .
3634.71	70	10	I 3878.74	70 r	. .	I 4252.31	150	. .
I 3636.72	40	6	I 3881.87	300 r	30	I 4285.79	125	. .
I 3637.32	30	5	I 3884.61	100	. .	I 4339.62	50	. .
I 3639.44	200	20	I 3885.29	70	4	I 4371.13	25 wn	. .
I 3641.79	60	8	I 3894.08	1000 r	100	I 4445.04	40	2
I 3643.18	80	15	I 3894.98	300 r	3	I 4445.71	125	2
I 3645.19	60	3	I 3898.49	80 r	6	I 4466.89	300	5
I 3647.09	30	4	I 3906.29	150	. .	I 4469.55	300	5
I 3647.66	100	8	I 3909.93	200 W	. .	I 4471.55	100	4
3649.35	200	4	I 3917.11	80	10	I 4477.24	30 wn	. .
I 3652.54	200 r	. .	I 3920.73	25	. .	I 4478.32	100	3
I 3654.45	35	. .	I 3922.75	100	. .	I 4483.93	100	. .
I 3656.97	60	6	3933.65	80	. .	I 4484.51	60	. .
I 3662.16	100	25	I 3933.91	60	. .	I 4486.71	50	1
3676.55	100	35	I 3935.97	400 r	15	I 4494.75	100	. .
I 3683.05	200 r	. .	I 3940.89	100	. .	I 4514.19	60	2
I 3684.48	200 W	. .	I 3941.73	200 wn	. .	I 4517.11	300	6
I 3690.72	60	10	I 3945.33	200	15	I 4519.29	40	. .
I 3693.11	80	15	I 3952.33	40	4	I 4527.93	100	2 n
I 3693.48	35	10	I 3952.92	100	75	I 4530.96	1000 w	8
3702.24	200	. .	I 3957.93	100 r	. .	I 4533.99	500	8
I 3704.06	300 r	35	I 3960.99	60	10	I 4540.78	30	. .
I 3707.47	30	. .	I 3969.12	100 w	6	I 4543.81	500 W	. .
I 3708.82	100	. .	I 3972.53	100	6	I 4545.24	50	. .
I 3711.65	35	. .	I 3973.15	150 w	6	I 4549.66	600	. .
I 3712.18	40	8	I 3974.73	100	10	4552.44	25	. .
I 3726.66	30	. .	I 3975.32	30	5	I 4553.33	25	. .
I 3730.48	200 r	. .	I 3978.65	100	. .	I 4561.94	25	. .
I 3732.40	200 r	. .	I 3979.52	150 w	12	4564.17	35	1
I 3733.49	150	. .	I 3987.11	80	. .	I 4565.59	800 W	12

COBALT (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 4566.61	100	2 n	I 5122.77	150	..	I 5436.99	25	..
I 4570.02	300	..	I 5124.77	25 n	..	I 5444.57	400 w	..
I 4579.36	25	..	I 5125.69	100 w	..	I 5452.30	25	..
I 4580.14	300	3	I 5126.19	200	..	I 5454.55	300 w	..
I 4581.60	1000 w	10	I 5133.45	50 w	..	I 5469.30	125	..
I 4588.70	100	1	I 5145.51	80 w	..	I 5470.46	50	..
I 4594.63	400	..	I 5146.74	400 w	..	I 5477.08	40	..
I 4596.90	400	..	I 5149.79	100	..	I 5483.34	500 w	..
I 4601.16	30	..	I 5154.05	200 W	..	I 5483.96	150 w	..
I 4614.01	60	..	I 5156.34	300 w	..	I 5489.65	150 w	..
I 4620.82	25	..	I 5158.43	40	..	I 5523.29	300 w	..
I 4622.70	30	..	I 5158.84	40	..	I 5524.98	25 w	..
I 4623.04	150	..	I 5165.16	30	..	I 5530.77	500	..
I 4625.78	200	..	I 5176.08	500 r	..	I 5545.93	25 n	..
I 4628.94	125	..	5183.61	35	..	I 5590.73	500	..
I 4629.38	600 W	5	I 5192.35	100 w	..	5594.46	40	..
I 4644.32	70	..	5210.06	100	..	5598.48	50	..
I 4654.85	25	..	I 5210.84	50	..	I 5647.22	600 w	..
I 4657.39	100	35	I 5211.82	100	..	I 5659.11	25	..
I 4663.41	700 W	..	I 5212.71	300 w	..	I 5915.54	200 w	..
I 4682.38	500	..	I 5222.48	50	..	I 5935.39	150	..
I 4685.86	30	..	I 5230.22	300 r	..	I 5946.49	70	..
I 4693.21	500	25	5235.21	100 w	..	I 5991.88	900 r	..
I 4698.38	300	8	I 5247.93	500 w	..	I 6000.67	80	..
I 4699.19	25	..	I 5249.99	200 w	..	I 6006.35	50 n	..
I 4718.48	50	..	I 5254.65	200 w	..	I 6007.67	50 n	..
4721.41	8	100 n	I 5257.62	400 w	..	I 6013.58	30	..
I 4727.94	300	..	I 5265.82	25	..	6016.64	40	..
I 4732.06	40	..	I 5266.30	100	..	6021.79	50	..
I 4734.83	150	..	I 5266.49	500 w	..	I 6049.09	50 n	..
4737.77	150	1	I 5268.51	500 w	..	I 6082.43	300 W	..
I 4746.11	100	..	I 5276.19	400 w	..	I 6086.65	80	..
I 4749.68	500	100 n	I 5280.65	500 w	..	I 6093.13	200	..
I 4754.36	200	2	I 5283.49	125 w	..	I 6107.93	25	..
I 4756.72	100	..	I 5301.06	700 w	..	I 6116.98	80	..
I 4767.14	100	..	I 5312.66	400 w	..	6122.22	40	..
I 4768.08	300	10	I 5316.78	300 w	..	I 6122.65	125	..
I 4771.11	500 w	..	I 5325.28	300 w	..	6162.17	60	..
I 4776.32	300	..	I 5325.95	25	..	I 6188.99	200 w	..
I 4778.25	100	..	I 5331.47	500 w	80	I 6211.19	25	..
I 4780.01	500 w	500	I 5332.67	200 w	..	I 6230.97	200 w	..
I 4781.43	400	2 n	I 5333.65	100	..	I 6232.44	25	..
I 4785.07	50	..	I 5334.84	70	..	I 6249.51	125	..
I 4792.86	600 W	5	I 5336.17	50	..	I 6257.58	70	..
I 4795.85	100	..	I 5339.53	100 w	..	I 6273.03	70 w	..
I 4796.37	100	..	I 5341.33	300 w	..	I 6275.13	25	..
I 4813.48	1000 W	6	I 5342.71	800 w	..	I 6276.63	40	..
I 4813.98	100	2	I 5343.39	600 w	..	I 6282.63	300 w	..
I 4840.27	700 w	150	I 5347.49	80	..	6311.28	30 n	..
I 4843.46	300	..	I 5349.09	80	..	I 6313.05	50	..
I 4867.88	800 W	100	I 5352.05	500 w	..	I 6314.53	50	..
I 4899.52	400 W	..	I 5353.48	500 w	..	I 6320.41	80	..
I 4904.17	80	..	I 5358.92	40 w	..	6347.83	125	..
I 4928.28	200 W	..	I 5359.18	300 w	..	I 6351.42	25	..
4934.06	25	..	I 5362.77	500 w	..	I 6395.19	125	..
I 4953.19	50	..	5368.89	30	..	I 6417.82	200 r	..
I 4966.59	100	..	I 5369.58	500 w	..	I 6429.91	50	..
I 4971.96	150	..	I 5381.10	150	..	I 6430.34	30 n	..
I 4979.93	60	..	I 5381.75	150	..	6439.17	80	..
I 4988.04	500 r	..	I 5390.46	25	..	I 6444.69	25	..
I 5094.94	100	..	I 5401.98	100 w	..	I 6450.24	1000	..
I 5108.89	200 w	..	I 5407.51	100	..	I 6451.14	70 w	..
I 5113.23	100	..	I 5408.12	30	..	I 6454.99	200 w	..

COBALT (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
6462.58	60	..	I 7094.53	40	..	I 8043.33	80 n	..
I 6463.01	25 n	..	7102.55	25	..	I 8056.06	80 n	..
6474.57	25 w	..	I 7113.56	150 l	..	I 8066.49	60	..
I 6477.88	80	..	7122.25	50	..	I 8080.23	60	..
I 6490.34	70	..	I 7124.47	50	..	I 8093.96	80 n	..
6493.74	25	..	I 7134.32	200	..	I 8116.41	80	..
I 6551.44	80 w	..	I 7154.71	200	..	I 8137.08	80	..
I 6563.42	200 w	5	I 7159.18	250	..	I 8140.43	40	..
I 6595.90	150	..	I 7193.60	200 w	..	8150.19	50	..
I 6617.12	30	..	I 7250.12	80	..	I 8152.11	60	..
I 6617.53	30	..	I 7285.28	200	..	I 8160.65	40	..
6623.79	70 W	..	I 7315.73	25	..	I 8193.03	125	..
I 6632.44	150	..	I 7353.47	25	..	I 8208.66	80	..
I 6635.12	25 n	..	I 7354.59	150	..	I 8269.38	80 n	..
I 6678.81	125	..	I 7388.70	200	..	I 8283.48	50 n	..
6684.08	30	..	I 7417.38	300 W	..	I 8296.85	50 n	..
I 6684.87	30	..	I 7437.16	30	..	I 8299.95	60 n	..
6707.86	200 Wn	..	I 7457.36	200 W	..	I 8342.63	50 Wn	..
I 6756.57	25	..	I 7533.48	40	..	I 8372.84	80 n	..
I 6758.10	25	..	I 7553.99	200	..	I 8378.39	50	..
6767.60	35 n	..	I 7590.57	35	..	I 8379.47	35	..
6771.06	200 n	..	I 7610.24	35	..	I 8489.50	30	..
I 6784.85	25	..	I 7712.68	80	..	I 8574.57	50	..
I 6808.94	25 n	..	I 7734.23	40	..	I 8575.35	50	..
I 6814.94	150 r	..	I 7838.17	80	..	I 8586.74	30	..
I 6846.97	25	..	I 7840.05	40	..	I 8589.73	50	..
6858.38	25	..	I 7855.85	40 n	..	I 8661.09	60	..
I 6872.40	200 w	..	I 7869.90	80	..	I 8744.37	30	..
6908.08	30	..	I 7871.39	80	..	I 9037.91	60	..
I 6937.81	150	..	I 7908.71	80 n	..	I 9095.37	50	..
I 6997.22	200 w	..	I 7926.55	80 n	..	I 9344.92	30 n	..
I 7004.81	150	..	I 7957.76	40 n	..	I 9356.98	200	..
I 7016.61	300 W	..	I 7960.55	25 n	..	I 9544.53	300	..
I 7027.81	200 W	..	I 7966.08	40	..	I 9597.89	300	..
I 7032.52	25	..	I 7987.38	80	..	I 9746.05	50	..
I 7052.89	300 W	..	I 8007.27	80 n	..	I 9764.53	25	..
I 7054.04	200 W	..	I 8022.13	40	..	9785.39	40	..
I 7055.88	25	..	I 8024.73	40	..	I 9890.92	30	..
I 7084.99	500 W	..	I 8029.26	80	..			

COLUMBIUM (NIOBIUM)

2005.03	5	25	2131.18	12	40	2290.38	..	25 w
2010.00	5	25	2137.05	5	30	2295.68	15	30
2011.99	4	25	2137.54	5	40	2302.08	15	30
2017.28	3	25	2155.62	5	25	2309.23	10 l	30 l
2025.31	10	30	2160.27	5	50	2313.32	..	30 w
2029.32	10	50	2175.84	5	25	2334.81	3	25 w
2032.46	..	25 w	2176.76	8	30	2340.04	8	30
2037.94	3	25	2203.63	15	40	2362.05	..	25 w
2043.16	3	25	2206.01	..	25 w	2369.95	5	25
2043.52	2	25	2224.67	5	30 nl	2372.72	2	50
2049.87	2	40	2229.72	30	20	2376.40	8	60
2057.05	4	35	2242.58	5	50 nl	2387.52	10	25 wn
2060.27	..	25	2252.21	5	35	2388.27	5	25 w
2064.21	2	30	2265.59	..	50 Wn	2398.48	10	30
2082.89	6	25	2273.56	15	25	2404.89	5	50
2107.26	10	25	2274.13	12	300	2405.34	5 w	50 w
2109.42	15	50	2274.20	2	80	2405.85	5 w	50 w
2125.21	15	40	2281.51	..	25	2410.27	4 w	25 w
2126.54	15	50	2283.00	10	25 l	2412.46	5	100

COLUMBIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2412.80	..	40 n	2580.28	2	100	2753.01	5	50 n
2413.94	..	300	2583.99	10	800 wn	2753.14	2	80
2414.48	..	100	2586.10	..	40 wn	2754.52	10 w	100
2416.17	5	25	2587.40	..	30	2757.26	3	50
2416.99	8	200	2590.94	15	800	2757.51	2	30
2418.69	5	500	2593.76	2 n	100	2758.78	1	100 w
2421.91	..	80	2594.74	3	80	2768.13	10	100
2426.79	..	40	2598.88	..	150	2769.57	2	30
2431.68	1 w	40 w	2601.29	4	200	2780.24	30	200 r
2432.32	2 w	40 w	2604.75	2	40	2791.74	3	100
2433.79	3	100	2605.02	1	40	2793.05	10 w	100
2435.95	3	50	2605.07	1	40	2797.69	10	200
2437.41	4	100	2613.85	3	30 n	2810.81	3	100
2441.86	3 w	25 w	2613.93	1	30	2816.68	2	50
2442.14	3	80	2614.76	..	30	2827.08	8	50
2442.68	1	50 w	2616.22	2	30	2829.75	3	50
2445.83	..	100	2620.45	3	200	2830.57	1	30
2447.97	2	30	2628.67	..	30 wn	2835.12	5 d	100
2451.87	3	100	2632.52	4 w	300 n	2841.15	10	100
2456.99	1	200	2633.16		200	2842.65	10	100
2458.09	2	50	2641.06	2	30	2846.28	10	50
2460.40	..	200 W	2642.24	5	300	2849.56	2 w	100 w
2462.05	1	100	2646.26	8	200 wn	2859.04	1	50
2468.74	..	50	2651.12	3	200	2861.09	10	100
2469.41	1	80	2656.08	8	200	2865.61	5	30
2472.38	4 d	25	2658.03	..	200	2868.52	15	300
2474.81	2	30 n	2659.05	3 n	30	2875.39	50 r	300
2475.89	..	25 n	2660.03	2	30	2876.95	40 W	500 W
2477.38	5	200	2665.25	3	300	2879.49	25	2
2479.94	3	50	2666.59	5	50	2880.71	4 w	50
2483.88	3	80	2667.76	3	30	2883.18	100	800 r
2484.93	2	25	2671.93	20	200	2888.83	10	100
2488.75	..	40	2673.57	10	500	2893.07	..	100 W
2498.25	1	25	2675.94	10	100	2897.81	15	150
2499.75	..	200	2677.66	2	50	2899.24	20	500
2501.40	..	150	2680.06	4	80	2900.67	..	100 wn
2502.49	3	50	2686.39	2	300	2908.24	20 r	200
2508.54	..	25	2691.77	10	100	2910.59	10	100
2511.00	3	100	2697.06	10	500	2911.74	8	100
2511.97	..	50 n	2698.86	5	200	2917.05	10 w	100 r
2521.40	3	100	2702.20	10	100	2927.81	200	800 r
2525.81	3	80	2702.52	8	80	2931.47	3	50
2527.92	2	50	2704.26	2 w	50	2932.13	..	50
2530.97	2	100	2707.83	3	80	2932.66	1 n	80
2531.25	1	80	2715.34	2	100	2936.66	..	30
2533.19	2	80	2715.88	2	100	2941.54	50	300
2534.44	1	40	2716.31	3	30	2945.88	2	100
2540.61	2	150	2716.62	10	200	2946.90	3	30
2541.42	3	80	2721.98	10	200	2950.88	150	200
2544.80	5	300	2723.66	2	200	2972.57	40	100
2545.64	1	150	2730.32	2	200	2974.10	5	200
2548.63	2	80	2733.26	30	50	2977.68	1	300
2551.38	5	100	2733.46	3	40	2978.94	1	50
2553.49	1	30	2733.74	2	50	2979.87	2	30
2555.32	1	30	2734.35	5	80	2980.72	3	50
2555.63	2	80	2735.95	..	40	2982.11	10 w	80
2556.94	5	200	2737.09	5	100	2985.05	2 n	50
2557.94	..	100 n	2739.24	..	50	2990.26	5	200
2562.41	4	100	2740.18	3	50	2991.95	1	100
2564.07	1	30	2745.30	5 w	30 w	2993.96	..	50
2566.07	2	30	2745.73	3	50	2994.73	100	300
2571.33	4	100	2746.10	..	50 n	3002.21	5 W	30
2574.84	2	100	2750.58	2	30	3005.77	1	50

COLUMBIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3008.41	..	50	3263.37	3	500	3412.93	5	150
3022.74	5 w	100	3273.89	20 r	100 W	3413.21	1	40
3024.74	10 w	200	3283.46	2	100	3415.97	50	50
3028.44	50	200	3287.59	25	2	3420.63	5	50
3032.77	3	300	3291.06	10	100	3421.16	10 w	50 w
3034.95	1	100 w	3292.02	3	100	3422.85	1	30
3035.02	2	30	3294.36	2	100	3425.42	30 r	300
3039.81	5	300	3296.01	20	40	3425.85	50 r	30
3044.76	2	30	3297.05	3	50	3426.57	5	200
3048.20	1	50	3297.66	1	30	3427.45	30 r	30
3049.52	..	150	3301.49	1	100	3432.70	10	100
3053.64	1	30	3303.32	1	30	3436.96	20 r	50
3055.52	2	100	3304.72	1	30	3438.42	1	50 wn
3064.53	5 w	200	3305.61	1	100	3439.92	4	50
3065.26	10	200	3312.60	40	50	3440.59	15	80
3066.10	2	30	3319.58	4	50	3441.65	2	40
3071.56	10	50	3320.81	3	100	3444.28	1 n	50
3076.87	10 w	50	3323.89	1	50	3445.68	50	80
3080.35	8	100	3324.66	4	50	3448.22	3 n	50
II 3094.18	100	1000	3335.24	1 w	30 w	3448.67	1	30
3097.12	3 w	100 w	3335.42	30	40	3450.76	2	50
3127.53	10 w	50	3335.67	..	30 w	3451.64	1	30
3130.79	100	100	3341.60	3	50	3452.35	5	200
3145.40	10	100	3341.97	100 r	50	3453.97	..	100
3150.41	1	50	3346.29	..	40	3454.71	3	50
3152.16	2	50	3346.75	5	80	3454.91	3	80
3152.78	2	30	3348.28	1 n	50	3459.70	30	20
3153.37	1	30 n	3348.78	1	30	3463.03	5	30
3154.81	3 w	200 w	3349.06	80	100	3463.81	30	50
3171.79	..	25 n	3349.35	5	100	3465.86	30	40
3173.20	2	100	3349.52	30	5 n	3468.13	..	50
3175.85	5	50	3358.42	100	100	3470.25	3 n	100
3180.29	5	200	3360.90	3	50	3473.02	30	30
3184.22	5	150	3362.17	..	100	3474.67	100	4
3189.28	10 w	300 r	3365.58	5	50	3478.69	30	15
3191.10	100 w	300 w	3365.94	1	30	3478.78	2	50
3191.43	3	200	3369.16	5	50	3479.56	5	200
3194.27	2 w	150 w	3370.16	..	80	3482.95	2	100
II 3194.98	30	300	3370.61	3	30	3484.05	10	100
3198.22	1	50	3372.56	10 n	200	3488.83	2	30
3203.35	8	50	3374.09	..	30 n	3489.09	5	50
3204.97	10	150	3379.30	1	100	3491.03	30	50
3206.34	10	300	3380.94	..	200	3497.81	30	15
3207.33	5	30	3382.41	5	40 n	3498.63	30	50
3208.58	3 w	100 w	3386.24	5	100	3499.95	5	50
3215.59	50	200	3388.94	1	80	3500.74	..	30 n
3217.02	2 w	200 w	3390.63	30	50	3501.34	3	30
3222.07	5	30	3392.34	20 r	30	3510.26	15	200
3223.32	10	100	3394.97	2	50	3511.16	50	1
3225.48	150 w	800 wr	3395.72	1	30	3514.04	..	50
3229.56	5	50	3396.37	2	150	3515.42	20	300
3230.24	2	30	3397.32	..	50	3517.67	2	200
3236.40	10	200	3398.25	15	40	3522.36	..	50 W
3237.68	2	50	3399.40	20	30	3525.23	15 w	30 w
3238.02	20	200	3401.23	2	40	3528.48	3	50
3244.51	2 n	30	3402.02	..	50	3528.90	2	40
3247.47	50 w	100 w	3403.01	20 w	80 w	3533.66	20	30
3248.93	5	50	3405.41	80	50	3535.30	300	500
3250.27	5 n	100	3406.13	30	30	3537.47	30	30
3254.07	20	300	3406.95	1	30	3537.62	2	30
3254.88	1	50	3407.30	..	30	3540.96	15	500
3260.56	15	300	3408.68	5	50	3541.25	50	5
3261.69	1	50	3409.19	10	100	3542.56	5	30 d

COLUMBIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3550.45	40	30	3818.86	8	300	4286.99	15	30
3554.12	..	30	3824.88	30	50	4292.48	30	50
3559.60	2	100	3831.84	5	300	4296.16	10	30
3563.50	30	30	3845.90	10	30	4299.60	20	30
3567.10	5	30 w	3855.50	..	50 n	4300.99	30	30
3567.99	2	50	3858.95	20	50	4311.26	30	100
3568.51	10	50	3865.02	..	200 n	4321.49	..	30
3575.85	50	80	3867.92	30	20	4326.33	30	5
3580.27	100	300	3875.76	10	50	4337.56	10	30
3584.97	30	50	3877.56	50	20	4359.85	50	50
3589.11	50	30	3879.35	5	300	4367.97	2	50 n
3589.36	100	100	3883.14	30	30	4368.43	15	30
3591.20	2	50	3885.44	50	100	4377.96	10	30
3593.97	80	50	3885.68	15	30	4410.21	15	30
3602.56	30	30	3891.30	50	100	4437.22	40	50
3615.50	30	30	3894.03	15	30	4471.29	20	30
3619.51	5	200	3895.90	10	30	4492.96	1	50 n
3619.73	3	300	3898.28	3	200	4523.41	30	30
3628.18	1	50	3900.53	30	10	4527.65	1	30
3629.47	..	30	3914.70	30	100	4546.82	15	30
3633.31	3	30	3919.72	2	100	4564.53	20	30
3636.96	20 W	30 W	3920.20	30	100	4573.07	30	50
3637.83	20	30	3920.76	1	50 n	4579.45	5 n	30 n
3651.19	10	400	3936.02	5	200	4581.62	30	50
3659.61	15	500	3937.44	30	30	4606.77	50	50
3660.37	20	30	3938.55	..	100 n	4630.11	30	20
3664.69	30	30	3943.67	20	50	4648.95	50	20
3687.97	20 w	300 w	3949.45	1	50	4663.83	30	20
3695.90	4	200	3952.37	3	50	4666.24	30	15
3696.68	2	50	3964.28	1	50	4672.09	150	100
3697.85	50	50	3966.25	10	30	4675.37	50 w	30 w
3699.93	15 w	30 w	3967.37	..	50 n	4706.14	50	50
3703.16	20	30	3976.51	..	80 n	4708.29	50	30
3704.14	30	30	4000.60	2	50	4715.83	3	50 n
3707.92	3 W	100 W	4012.17	..	100	4733.89	30	30
3709.25	5	30	4016.08	5	30	4749.70	100	50
3713.01	100	80 n	4032.52	30	50	4810.60	100	10
3716.21	30 W	10 w	4039.53	30	50	4816.38	50	50
3717.07	8	1000	I 4058.94	1000 w	400 w	4848.37	150	100
3719.63	..	50 w	I 4079.73	500 w	200 w	4965.37	100	15
3720.46	5	100 n	I 4100.92	300 w	200 w	4967.78	150	50
3722.57	..	60 n	4104.17	3	30	4975.14	30	3
3723.44	1	30	4119.28	2	200	4988.97	150	10
3725.22	30 w	10 w	I 4123.81	200	125	5000.95	30	5
3726.24	30	100	4129.93	15	30	5017.75	80	10
3739.79	100	200	I 4137.09	100	60	5026.36	50	8
3740.72	3	50	4139.71	50	50	5039.04	200	30
3742.39	30	50	4152.58	100	300	5058.01	50	10
3744.00	30	30	4156.68	5	100	5065.25	80	10
3746.91	20	80	4163.66	60	40	5078.96	300	50
3759.55	40	50	4164.66	30	50	5095.30	50	30
3765.08	25 w	10 w	4168.13	100	80	5100.16	100	15
3777.67	20	30	4184.44	20	50	5110.91	30	2
3781.38	5	200	4185.54	1	30	5120.30	50	10
3787.06	30	30	4190.88	20	30	5134.75	200	15
3790.15	100 r	50 r	4214.67	..	100	5147.54	30	5
3791.21	80	80	4214.73	40	..	5152.63	100	10
3798.12	50	80	4217.94	50	50	5160.33	200	15
3802.92	50	50	4229.15	50	100	5164.38	150	20
3803.88	30	20	4252.97	30	50	5180.31	150	15
3804.74	20	50	4253.69	25	40	5186.98	50	10
3810.49	30	50	4255.44	30	50	5189.20	80	12
3815.51	20	30	4270.69	30	50	5193.07	100	20

II. EMISSION SPECTRA 2000–10,000 A (Continued)

COLUMBIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
5195.84	30	10	5900.62	200	200	7353.16	60	10
5219.09	100	10	5997.93	50	5	7382.50	150	30
5232.81	50	10	6251.76	30	10	7515.93	40	10
5247.38	30	2	6430.46	80	10	7574.58	100	20
5271.53	200	50	6433.22	30	4	7726.68	60	..
5276.19	200	50	6544.61	80	10	7873.41	25	..
5318.60	100	12	6614.15	25	8	7885.31	60	..
5334.87	50	10	6660.84	300	80	7938.89	30	..
5344.17	400	200	6677.33	200	50	8135.20	80	..
5350.74	150	50	6701.20	100	15	8240.00	50	..
5437.27	30	10	6723.62	100	30	8320.93	500	..
5504.58	30 w	3 n	6739.88	80	15	8346.08	60	..
5523.57	30	10	6828.11	150	30	8439.77	25	..
5551.35	30	10	6876.36	80	12	8475.98	150	..
5576.15	80	5	6886.33	30	8	8526.99	50	..
5642.11	80	20	6902.89	60	10	8560.54	30	..
5664.71	100 r	30 r	6908.07	40	8	8575.87	30	..
5665.63	100	30	6918.32	80	10	8697.55	40	..
5671.02	200	10	6990.32	100	15	8815.56	100	..
5753.06	..	30 n	7023.48	30	8	8905.78	30	..
5760.34	30	30	7046.81	200	40	9141.31	50	..
5776.07	30	3	7098.94	60	10	9323.54	40	..
5787.54	80	15	7102.01	30	8	9595.06	60	..
5838.64	200	100	7126.17	35	8	9626.88	100	..
5866.47	50	15	7159.43	100	15	9631.11	50	..
5874.70	30	5	7252.35	40	6	9676.75	50	..
						9912.26	25	..

COPPER

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2012.96	..	20	I 2138.51	25 wn	..	II 2230.95	..	15
II 2015.57	..	50	II 2146.98	..	15	II2231.57	..	15
II 2016.88	2	20	II 2148.97	15	25	I 2236.28	30	..
I 2024.33	50 r	6	II 2151.80	..	30	I 2238.45	40	..
II 2025.47	8	30	II 2161.31	..	40	II 2242.61	25	50 n
II 2027.18	..	15	I 2165.09	60 r	25	I 2244.26	25	9
II 2029.94	3	15 wn	I 2169.53	30	..	II 2246.99	30	500
II 2031.02	2	35	I 2171.76	30	..	II 2249.06	..	25
II 2035.84	12	30	II 2174.97	3	40	2255.08	1	30
II 2037.12	12	30	I 2178.94	30 r	12	I 2260.53	25	6
II 2043.79	15	35	II 2179.40	12	35	I 2263.08	30	10
II 2054.41	3 r	20 r	I 2181.72	50 r	15	II 2263.78	..	25
II 2054.97	15	35	II 2189.62	12	40	2265.46	..	15
II 2062.49	..	25	II 2192.26	25	500 n	II 2276.25	10	30
II 2066.32	..	20	II 2195.77	..	30	II 2278.44	..	20
II 2078.65	1	40	I 2199.58	50 r	20	II 2286.73	..	25
I 2079.46	15 n	..	I 2199.75	20 r	5 n	II 2290.99	..	25
II 2085.30	2	25	II 2210.26	20	40	I 2293.84	40 wn	10
II 2087.92	..	30	2212.83	..	20	II 2294.36	3	25
II 2093.61	2	20	I 2214.58	50 r	5 n	II 2299.44	..	15
II 2098.41	..	35	II 2215.10	..	15	I 2303.12	30	20
II 2104.78	8	25	I 2215.65	30	..	II 2309.61	..	18
I 2105.11	15	..	II 2218.10	25	40	I 2319.56	20	..
I, II 2112.09	15	40	II 2218.50	..	(25)	II 2336.20	3	20
II 2117.30	2	20	2218.62	2 r	15	2346.13	2	25
II 2122.97	15	50	II 2224.78	..	25	II 2348.82	15 d	20
II 2125.10	..	20	I 2225.70	150	20	II 2355.15	..	25
II 2126.03	15	35	II 2226.86	..	30	II 2356.65	5	25
I 2130.76	25	3	I 2227.77	40 r	25 r	2368.17	2	15
II 2134.35	30	40	II 2228.86	9	40	II 2369.89	20	30
II 2135.98	25	500 w	I, II 2230.08	30 r	20	2376.27	..	25

Copper (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2376.38	3	30	I 3073.80	70	20	I 3524.24	40	10
II 2384.84	..	15	I 3088.13	30	7	I 3527.48	50	10
2391.72	..	20	I 3093.99	150	50	I 3530.39	50	20
II 2400.11	5	100	I 3099.93	60	10	I 3533.75	50	15
II 2403.33	100	300	3108.45	15	1 n	I 3544.96	35	6
I 2406.66	150	50	I 3108.60	20	5	I 3594.02	15	2
II 2424.44	4	200	I 3116.35	50	12	I 3598.01	40 wn	..
I 2441.64	200	100	I 3120.43	25	3	I 3599.14	60	30
2444.44	..	20	I 3126.11	80	20	I, II 3602.03	50	25 W
II 2468.58	5	70	I 3128.70	70	15	I 3609.31	25	5
II 2473.33	5	20	I 3140.31	50	12	I 3610.81	25	6
2482.34	..	20	I 3142.44	60	15	I 3613.76	60	7
II 2485.79	5	50	I 3146.82	100	20	I 3614.22	50	6
II 2489.65	3	50	I 3149.51	50	2	I 3620.35	30	5
I 2492.15	200 r	50	I 3156.63	50	15	I 3621.24	20	5
II 2506.27	..	500 r	I 3169.68	50	20	I 3624.24	30 W	3 wn
II 2526.59	..	200	I 3194.09	70	60	I 3629.79	15	2
II 2526.73	..	50	I 3208.23	25	15	I 3632.56	25	3
II 2529.30	..	600	I 3223.43	20	10	I 3635.92	50	7
II 2544.80	..	700 r	I 3224.66	25	10	I 3641.69	60	5
II 2571.74	..	150	I 3231.17	15	10	I 3645.23	20	5
II 2590.53	1 n	250	I 3235.71	15	7	I 3655.86	20	7
I 2592.63	1000	50	I 3243.16	15	15	I 3665.73	20	5
II 2598.81	..	200	I 3247.54	5000 r	2000 r	I 3671.95	20	3
II 2600.27	1 n	200	I 3266.02	20	15	3676.88	25 wn	1 n
2609.31	..	30	I 3268.28	15	10	II 3686.55	..	25
I 2618.37	500 w	100	I 3273.96	3000 r	1500 r	I 3700.54	20	7
II 2666.29	..	20	I 3279.82	25	30	I 3712.01	20	4 n
II 2689.30	..	300	I 3282.72	25	15 W	I 3741.24	50	2
II 2700.96	20	400	I 3290.54	25	25	I 3743.36	40	40
II 2703.18	10	200	3301.23	..	15	I 3759.49	20	2 n
II 2713.50	50	300 w	I 3307.95	60	30	I 3771.90	30	5
2715.52	20 w	..	I 3317.22	60	20	I 3800.50	20	2 n
II 2718.77	40	300 w	I 3319.68	60	20	I 3805.30	20	2 n
I 2720.20	18	..	I 3329.64	60	10	I 3825.05	40	3
II 2721.67	..	150	3335.21	60	15	I 3860.46	30	7
I 2723.95	50	1 n	I 3337.84	70	50	I 3861.75	50	2
II 2745.28	30	30	I 3349.29	70	40	I 3925.27	50	2 n
I 2745.45	8	150	I 3354.47	30	10 n	I 4003.04	40	1 n
I 2766.37	500	25	I 3365.35	70	30	I 4022.66	400	25
I 2768.88	25	1 n	3370.45	..	15	II 4043.50	..	25
II 2769.67	5 n	400	I 3375.67	25	5	I 4050.66	30	..
I 2782.59	20	1 n	I 3381.12	15	5 n	I 4062.70	500 w	20
I 2783.55	18	..	I 3381.42	20	7	I 4063.29	30 w	7
I 2824.37	1000	300	I 3395.48	30	7	I 4073.27	15	..
II 2837.55	..	250	I 3396.32	30	3	I 4075.59	40	..
I 2858.22	30	2 n	I 3402.24	45	10	I 4080.55	30 w	
I 2858.73	30	2 n	I 3413.34	20	7	I 4104.23	30	1 n
II 2877.69	5	20	I 3420.17	15	3 n	I 4121.74	20	..
II 2884.38	..	30	I 3450.33	150	30	I 4123.29	30 w	1 n
I 2961.16	350	300	3454.69	40	10 n	I 4177.76	60 w	1
2991.75	15	..	I 3457.85	50	15	I 4242.26	20	..
I 2997.36	300	30	I 3459.43	25	2 n	I 4248.96	80	15
I 2998.38	20	2 n	I 3472.14	20	5	I 4259.43	25 wn	2 wn
I 3010.84	250	30	I 3475.99	25	10	I 4275.13	80	30
I 3012.00	50	6	I 3483.76	60	25	I 4378.20	200 w	30 w
I 3021.56	25	5	I 3487.57	30	5	I 4415.60	40 w	..
I 3022.61	30	3	I 3488.86	30	5	I 4480.36	200	20
I 3024.99	30	3	I 3498.06	20	5	II 4505.99	1	50
I 3036.10	200	50	I 3500.32	20	2 n	I 4507.5	50 w	30 wn
I 3044.03	20	1 n	I 3512.12	50	30	I 4509.39	150	30
I 3063.41	300	50	I 3517.04	20	3 n	I 4530.82	200	50
I 3068.91	15	..	I 3520.03	30	10	I 4539.69	100 W	80 W

COPPER (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 4555.92	2	70	II 5897.99	..	25	I 7039.37	15	..
I 4586.95	250 w	80 w	II 5941.17	..	50	II 7255.83	..	20
II 4649.27	..	60	II 5988.30	..	25	II 7326.02	..	15
I 4651.13	250	40	II 6000.10	..	40	II 7331.74	..	15
II 4674.76	200	30 W	II 6080.32	..	30	II 7399.89	..	20
II 4681.99	..	20	II 6114.47	..	20	II 7404.34	..	100
I 4697.49	60 w	5 w	6119.55	25	..	II 7438.15	..	15
I 4704.70	200	50	I 6127.73	80	..	II 7562.01	..	25
II 4812.94	..	15	I 6147.31	20	..	I 7570.09	50	..
II 4909.73	..	25	II 6150.42	..	20	II 7579.02	..	30
II 4931.65	..	25	II 6154.24	..	30	II 7652.36	..	30
II 4953.73	..	15	II 6172.02	..	20	II 7664.70	5	70
II 5006.79	..	30	II 6186.86	..	20	II 7738.68	..	30
II 5009.83	..	20	II 6188.69	..	20	II 7778.74	..	30
II 5012.61	..	20	II 6204.27	..	15	II 7805.19	..	25
I 5016.61	15	..	II 6208.46	..	15	II 7807.66	..	70
II 5021.28	..	20	II 6216.91	..	60	II 7825.66	..	50
II 5051.78	..	60	II 6219.82	..	30	II 7845.03	..	25
II 5058.90	..	30	I 6223.66	15	..	II 7895.83	..	20
II 5060.63	..	30	II 6261.83	..	40	II 7902.57	..	25
II 5065.45	..	40	I 6268.30	40	..	I 7933.13	150	..
II 5067.08	..	30	II 6273.33	..	60	II 7944.42	1	25
II 5072.29	..	20	II 6300.99	..	40	II 7988.17	..	60
II 5083.99	..	15	II 6305.96	..	15	II 8088.58	..	20
II 5088.26	..	30	II 6311.29	..	30	I 8092.63	400 W	..
II 5093.79	..	20	II 6312.83	..	20	II 8095.55	..	40
I 5105.54	500	..	I 6325.45	20	..	II 8192.28	..	30
I 5111.91	15	..	II 6357.45	..	15	II 8277.60	..	50
II 5120.74	..	20	II 6377.84	..	20	II 8283.21	..	60
II 5124.46	..	20	II 6414.62	..	20	II 8503.46	..	15
I 5153.23	600	..	II 6423.90	..	30	II 8511.04	..	40
II 5183.36	..	20	II 6441.70	..	40	II 9205.40	..	20
II 5207.13	..	20	II 6470.15	..	50	II 9735.94	..	15
I 5218.20	700	..	I 6474.20	15	..	II 9813.35	..	20
I 5220.07	100	..	II 6481.46	..	15	II 9837.94	..	25
II 5269.99	..	30	II 6484.46	..	20	II 9861.41	..	50
II 5276.52	..	15	II 6494.04	..	30	II 9864.26	..	40
I 5292.52	50	..	I 6565.54	15	..	II 9868.20	..	15
II 5641.30	..	20	I 6599.68	25	..	II 9881.57	..	15
II 5682.42	..	20	II 6621.61	20	..	II 9916.52	..	30
I 5700.24	350		I 6672.23	15	..	II 9918.05	..	15
II 5721.78	..	20	I 6741.42	50	..	II 9925.67	..	20
I 5782.13	1000	..	I 6905.94	40	..	II 9939.05	..	20 d
II 5806.00	..	25	I 6920.06	100	..	II 9960.46	..	15

DYSPROSIUM

2634.81	40	20	3128.41	40	10	3235.90	35 s	8
3026.16	30	4	3135.37	100	50	3251.26	100	100
3029.83	30	4	3140.64	40	20	3256.25	25	5
3043.14	30	10	3141.13	50	20	3280.10	70	5
3049.13	25	4	3156.52	50	20	3308.89	25	..
3060.65	30	10	3162.82	80	60	3312.7[illegible]	50	5
3062.62	25	10	3169.98	100	50	3316.32	50	4
3071.92	25	4	3177.88	30	5	3317.12	35	4
3073.54	30	8	3186.37	25	10	3319.89	150	9
3078.68	25	..	3187.68	25	10	3339.51	25	4
3103.25	30	1	3193.31	25	5	3340.01	80	4
3103.84	30	10	3206.40	40	5	3341.88	30	..
3109.77	40	20	3215.19	40	10	3353.59	35	5
3120.18	25	10	3216.63	25	15	3368.12	60	5

DYSPROSIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3385.03	25	8	3584.43	50	20	3931.54	200	..
3393.58	100	10	3585.07	300	100	3932.23	30	..
3407.80	150	9	3585.78	150	100	3942.54	30	5
3413.79	40	9	3590.67	30	20	3944.69	300	150
3414.83	35	5	3591.42	200	100	3946.94	30	..
3425.06	40	5	3591.82	80	20	3950.40	50	..
3429.44	50	5	3592.12	80	30	3954.57	40	..
3432.58	25	5	3595.05	200	100	3957.80	70	..
3434.37	80	30	3596.07	50	20	3968.39	300	..
3438.95	25	9	3600.34	20	30	3978.57	200	15
3440.94	25	5	3606.13	200	100	3979.48	30	..
3441.45	50	5	3612.79	25	10	3981.94	150	100
3445.58	80	8	3614.08	30	10	3983.66	150	8
3447.00	50	8	3618.52	80	10	3984.23	80	..
3449.90	40	5	3619.96	25	5	3991.33	40	..
3454.33	100	10	3620.18	80	20	3996.70	200	80
3456.01	40 W	..	3629.44	100	50	4000.45	400	300
3456.57	50	30	3633.26	25	..	4045.98	150	12
3460.97	100	3	3645.42	300	100	4050.58	30	15
3468.43	50	3	3648.81	50	30	4073.11	80	15
3473.70	80	40	3672.31	100	100	4077.97	150 r	100
3477.07	90	30	3673.15	25	5	4103.31	50	50
3494.50	100	5	3674.09	100	50	4103.88	30	4
3497.84	30	3	3676.56	6	30	4111.35	30	12
3498.67	50	50	3694.75	20	30	4143.10	40	8
3504.52	90	3	3698.17	10	30	4146.07	40	4
3505.46	70	2	3747.83	60	20	4167.97	50	12
3506.82	80	..	3753.51	50	20	4186.81	100 w	12
3517.27	70	4	3753.76	80	10	4191.63	40	2
3531.71	100	100	3757.37	200	50	4194.83	50	12
3534.96	125	..	3788.45	100	40	4201.32	30 w	..
3536.02	125	10	3806.28	25	80	4211.72	200	15
3538.52	150	40	3816.77	100	50	4215.17	50	8
3542.33	90	20	3836.51	100	40	4218.09	50	8
3544.21	25	10 n	3841.32	100	..	4221.10	60	8
3546.84	50	10	3846.36	25	..	4225.15	40	8
3550.23	200	100	3853.04	100	..	4239.87	50	4
3551.16	25	1	3866.59	25	..	4245.92	25	4
3560.15	40	20	3868.46	50	..	4247.36	30	4
3563.15	200	100	3868.81	60	..	4256.32	25	8
3563.70	50	30	3869.43	25	..	4291.93	25	..
3564.24	25	10	3869.87	100	..	4294.94	25	15
3568.99	100	..	3872.12	300	150	4308.62	100	12
3569.67	40	10	3873.99	100	..	4358.46	25	4
3573.84	80	80	3879.05	25	2	4394.98	25	4
3574.16	200	100	3882.00	25	..	4409.38	30	8
3576.25	300	..	3898.54	100	..	4589.38	70	15
3576.87	200	50	3901.34	25	..	4612.27	50	10
3577.99	150	50	3914.88	50	..	4731.85	30	10
3580.04	80	30	3915.60	80	..	7662.35	25	..
3582.03	25	10	3923.39	30	..			

ERBIUM

2128.07	..	250 w	2670.25	25	3	3187.78	25	12
2185.71	30	..	2833.06	25	..	3220.73	25	5
2191.24	..	200 W	2859.81	25	10	3223.31	25	5
2314.43	3	40	2904.47	25	5	3230.58	25	15
2327.36	..	150	2911.42	30	15	3249.34	25	8
2396.38	..	30	3095.88	25	8	3264.78	25	5

ERBIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3273.08	25	15	3630.24	25	6	4527.78	40	9
3289.36	25	8	3645.40	25 s	12	4643.69	50	15
3312.42	25	15	3664.44	40	20 n	4674.85	50	15
3323.20	25	4	3668.49	25	3	4781.02	35	2
3329.66	25	3	3683.47	25	..	4820.34	25	2
3332.70	25	2	3694.19	25 d	15	4831.16	25	..
3346.03	30	10	3729.53	25	7	4839.85	35	..
3364.09	25	7	3777.09	25	10 n	4845.65	50	..
3372.75	35	20	3787.27	25 d	5 d	4852.68	45	..
3374.17	25	5	3808.15	25	4	4854.86	40 s	..
3385.09	25 d	15 d	3835.26	25 d	2 d	4872.10	25	3
3391.99	30	12	3836.50	40	10	4883.67	30 n	..
3393.57	25	10	3880.66	25 wd	6 wd	4900.11	30	20
3398.94	40 wd	7 wd	3892.69	25	2	4935.50	35	..
3433.13	25	2	3896.23	30	15	5042.04	60	..
3434.37	25	8	3898.53	30	10	5127.40	25	..
3443.70	25	2	3906.32	25	12	5133.82	40	..
3456.00	25 d	10 d	3950.35	30	10 n	5164.76	30	..
3471.71	25	8	3973.04	25	..	5188.89	30	..
3476.30	30	7	3987.95	100 r	20	5218.25	30	..
3479.42	25	10	3996.69	25	..	5229.32	30	..
3480.44	25	8	4000.45	35	6	5255.05	50	..
3484.83	30 d	7 d	4007.97	35	7	5279.33	30	..
3485.86	25	6	4050.57	25	1	5302.30	30	..
3492.54	25 d	2 d	4057.82	30	..	5343.93	30	..
3496.86	25	20	4142.96	30	15	5344.51	30	..
3504.52	25	4 n	4180.87	25 w	..	5395.87	50	..
3515.58	25 w	5 w	4211.72	30	5	5414.64	50	..
3523.98	25	8	4230.20	25	..	5422.80	30	..
3531.71	40	25	4301.60	25	2	5454.27	30	..
3547.51	25 l	1 n	4308.63	30	3	5456.62	30	..
3549.85	25	20 s	4374.92	40 wn	25 wn	5485.93	30	..
3553.20	25	15	4384.70	30	5	5739.19	30	..
3584.52	25	15 n	4409.36	35	2	5757.62	30	..
3590.35	25	..	4419.61	25	4	5762.79	30	..
3599.83	30 w	20 s	4422.47	30	20	5826.79	50	..
3600.74	30 w	20 w	4449.70	30	1	5855.29	30	..
3616.57	30	20	4505.94	40	5	5881.14	30	..
3620.18	50	3	4518.64	40 w	1 n	5886.46	30	..
3620.94	25	15	4527.24	50	10	5902.09	30	..
3628.70	25	12 n						

EUROPIUM

2564.18	20	60	II 2729.39	100 d	60	2925.03	150 l	100
2580.60	25 w	..	2781.89	100 w	100 w	2947.30	30	..
2635.46	30	30 n	2802.86	150 w	..	2952.68	200 w	150
2638.76	300	200	II 2811.75	50	..	2959.48	30	..
2641.26	100 w	60	2813.95	300 w	300 wn	2960.23	150 W	..
2668.33	300 w	400	2816.18	50 w	50	2986.92	25	..
2673.41	125	50	2820.77	200 W	200 W	2991.34	80	40
2678.28	150	100	2828.69	200 W	150	3006.27	30	..
II 2685.65	150	100	II 2859.67	40	..	3022.15	25	10
2692.02	200	200	2862.57	100 W	70	3040.77	25 w	..
II 2701.12	60 n	60 n	2887.88	30	30	3054.93	400 w	3
2701.89	300 W	200	2892.54	40 w	30 n	3077.35	30	20
2705.26	50 l	..	2893.03	40	..	3097.46	200 w	5
2716.97	300	300	2893.85	150	100	3098.17	25 d	5
2723.92	30	..	2906.68	300 W	300	3111.43	200	..
2727.78	300 l	500	2909.01	40	..	3130.74	100 W	100

II. EMISSION SPECTRA 2000–10,000 A (Continued)

EUROPIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3149.88	40 w	20 w	3930.44	100 W	..	4692.63	60 w	2
3173.60	35	1	II 3930.50	1000 r	400 r	4698.14	300	2
3210.57	80	..	3943.08	50	15	4704.60	30 w	.
3212.81	200	20	3949.12	25 w	1	4709.82	30 W	2
3213.75	100	20 n	3949.59	50 W	..	4713.61	400	2
3241.40	25	1 n	3955.75	50 W	..	4717.22	60 W	2
3247.53	50 W	5	3961.14	50 W	..	4718.61	60 W	2
3280.68	1000 r	..	3964.89	40 wd	..	4724.06	30	..
3301.95	25	2	3967.13	25 W	..	4728.15	40	..
3308.02	20	30	3971.90	100 r wn	...	4736.61	60	..
3313.32	35	40	I 3971.99	1000 r wn	..	4739.17	80	..
3321.86	30	5	3978.45	30 W	..	4740.52	500	2
3334.33	50	5	4002.56	30	2	4755.94	60 w	..
3350.43	30	..	4003.71	18	25	4758.73	60 W	2
3369.05	40	5	II 4011.68	25	..	4762.91	60	2
3391.99	40	5	4012.82	20	25	4777.70	40	.
3396.58	100	10	4017.58	25 W	25	4867.60	30	3
3414.77	40	..	4036.11	50 W	..	4900.84	25	2
3425.02	50	4	4059.38	25	..	4911.41	30	6
3435.20	35	2	II 4129.74	150 r	50 r	4938.31	250 W	..
3440.99	40	25	II 4205.05	200 r	50	5013.14	125	1
3445.17	40	2	4235.60	400 r	..	5022.90	125	..
3454.76	40 W	2	4281.92	25	2	5029.48	500 w	..
3457.05	25	2	4322.57	60	..	5029.55	30	1
3457.57	25	1	4325.53	30 w	..	5033.54	60	2
3461.38	25	2	4329.36	100 W	2	5067.95	35	..
3466.42	30	2	4329.97	100 w	1	5096.41	30	.
3481.61	45 W	2	4331.18	80	..	5114.36	150	..
3505.30	25 w	5 w	4337.68	100 W	2	5124.77	60	..
3511.07	30 w	2	4345.90	80 W	1	5129.08	200	..
3511.85	25 w	1	4354.79	100 w	2	5133.48	150	
3521.09	50	4 n	I 4355.10	150	20	5160.07	200	..
3603.20	100 w	50	4370.46	60 W	2	5166.72	125	..
3606.71	50	..	I 4383.16	100 W	20	5199.85	500	..
3611.58	40	5	4387.88	200	..	5200.92	300	..
3616.15	40	10	4417.25	60 w	..	5206.43	40	..
3622.56	20 n	50	4435.53	2000	..	5213.37	150	..
3629.80	40	50 n	4435.60	400 r	100	5215.09	1000	.
3632.17	30	10	4464.56	30	..	5217.02	125	..
3660.60	30 d	..	4464.97	80	10	5223.48	700	..
3674.67	25	..	4471.99	30 w	2	5233.89	30	..
3678.27	50	..	II 4485.15	40	2	5236.12	25	.
3687.79	40 w	50 w	4522.58	500	..	5239.22	80	.
II 3688.44	1000 W	500 W	I 4522.60	200 r	200	5242.68	30	.
3693.82	25 w	1	4526.69	100	..	5248.61	80	..
3710.88	35 l	30 n	4586.44	30 w	..	5249.11	60	..
3713.46	50	2	4594.02	500 r	200	5263.04	30	..
I 3714.91	40	2	4597.33	40 W	..	5266.40	1000	.
3719.17	30	..	4611.52	50 w	..	5271.95	2000	.
3722.61	40 W	10	4616.49	30 w	..	5272.48	400	.
3724.99	250	50	4625.30	50 w	..	5275.66	20	..
3732.21	30 W	..	4627.12	(300 r)	..	5282.82	1000	..
3742.23	25 W	..	4627.22	50	15	5285.46	40	..
3770.23	15 W	25 W	4644.24	50	..	5285.73	40	..
3774.08	50 W	10 W	4653.48	25 w	..	5287.23	125	..
3781.39	25 W	30 W	4656.73	50	1	5289.25	125	..
3785.47	25 W	10 Wn	4660.37	50	1	5291.25	200	..
II 3799.01	100 wn	.	4661.87	80 r	20	5293.68	50 w	..
II 3819.66	500 wd	500 wd	4661.88	100	..	5294.60	300	..
3861.18	30 w	30 w	4665.07	30 W	..	5302.72	30	..
3865.56	30 W	..	4671.18	30	1	5303.87	300	..
3884.76	50 W	5 Wn	4685.25	60 W	..	5350.40	60 n	..
II 3907.11	1000 rW	500 r	4688.23	100	2	5351.67	150	..

EUROPIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
5352.82	80	..	5963.76	60	..	6692.98	40	..
5355.08	200	..	5966.07	1000	..	6693.97	500	..
5356.72	40	..	5967.16	2000 s	..	6710.50	25 W	..
5357.61	1000	..	5971.69	40	..	6744.96	100	..
5360.81	150	..	5972.78	300	..	6782.59	100	..
5361.59	300	..	5992.86	1000	..	6787.52	30 W	..
5376.91	200	..	6004.41	300	..	6802.79	500	..
5392.91	150	..	6005.68	60	..	6816.11	150 W	..
5402.79	1000	..	6012.21	300 W	..	6834.41	30 W	..
5405.31	40	..	6012.56	400	..	6841.05	50 W	..
5411.84	80	..	6015.58	150	..	6844.98	40 W	..
5421.08	125	..	6018.19	1000	..	6864.55	1000 W	..
5426.93	200	..	6023.16	200	..	6898.27	30 W	..
5443.56	125	..	6029.01	500	..	6903.71	200 W	..
5451.53	1000 s	..	6044.67	200	..	6914.82	40 W	..
5452.96	1000 s	..	II 6049.50	1000	..	7040.18	800	..
5472.33	1000 s	..	6057.36	600	..	7074.56	60	..
5488.65	500	..	6075.59	300	..	7077.09	800	..
5495.17	125	..	6077.37	100 W	..	7106.48	600 W	..
5510.55	300 s	..	6083.87	500	..	7164.67	50 W	..
5526.62	60	..	6099.38	600	..	7175.50	200 W	..
5533.24	30	..	6107.47	30	..	I 7194.85	700	..
5536.13	30	..	6108.13	150	..	I 7217.60	700	..
5542.54	80	..	6118.78	400 W	..	7224.72	150 W	..
5547.45	1000	..	6124.68	150	..	7258.74	100 W	..
5570.36	1000	..	I 6173.05	600	..	7262.80	200 W	..
5577.13	1000	..	6178.75	120	..	7281.57	50 W	..
5579.65	200 s	..	6188.10	500 W	..	7297.57	30 W	..
5580.04	300	..	6195.06	300	..	II 7301.16	700	..
5586.25	300	..	6233.74	100	..	7310.33	30 W	..
5586.77	200	..	6250.46	70	..	7313.64	60 W	..
5592.26	25	..	6262.28	600	..	7336.28	300 W	..
5599.81	40	..	6266.95	120	..	7356.65	30 W	..
5605.85	40	..	6288.34	300	..	7362.25	50 W	..
5618.81	125	..	6291.34	250	..	7369.69	200 W	..
5622.45	200 s	..	6299.76	500 W	..	I 7370.27	700	..
5632.56	200 s	..	II 6303.39	700	..	7389.15	40 W	..
5645.80	1000	..	6313.79	25 W	..	7404.41	30 W	
5673.84	200	..	6335.78	200	..	7426.57	500	..
5681.05	40	..	6350.04	600 W	..	7436.59	100 W	..
5684.27	125	..	6355.88	200	..	7470.53	30 W	..
5730.89	300	..	6369.24	300	..	7528.70	200	..
5738.99	300	..	6382.74	200	..	7583.91	400	..
5765.20	2000	..	6383.86	350	..	7742.58	400	..
5783.71	150 s	..	6400.93	700 W	..	7746.20	600	..
5792.72	30	..	6406.11	100	..	7803.32	30	..
5800.27	200	..	6410.10	500 W	..	7887.98	300	..
II 5818.74	1000	..	6411.34	500	..	8209.84	200	..
5820.00	30	..	6428.28	200	..	8226.82	100	..
5820.91	30	..	I 6437.69	700	..	8464.75	50	..
5831.05	2000 W	..	6439.97	40	..	8542.12	100	..
5845.76	30	..	6457.99	500	..	8642.69	300	..
5860.96	30	..	6470.75	30 W	..	8727.78	40	..
II 5872.97	300	..	6483.07	30	..	8790.87	40	..
5891.27	200	..	6493.90	40	..	8870.34	100	..
5895.29	25	..	6501.53	300	..	8917.65	60	..
5902.76	30	..	6519.60	500	..	8934.41	50	..
5909.95	30	..	6522.76	25	..	9018.00	50	..
5915.76	200 l	..	6567.87	600	..	9024.5	60	1
5926.53	80	..	6593.82	400	..	9058.0	80	..
5942.73	30	..	6603.60	80	..	9083.2	30	..
5953.50	30	..	6645.15	1000	..	9085.3	50	..
5953.83	40	..	6685.27	80	..	9898.30	40	..
5954.27	30	..						

FLUORINE

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 3059.96	..	60	bh 5771.9	100	..	bh 6417.7	100	..
II 3202.74	..	200	bh 5774.8	100	..	bh 6419.0	50	..
II 3501.42	..	200	bh 5777.6	100	..	bh 6499.0	80	..
II 3502.95	..	60	bh 5779.4	200	..	bh 6502.2	80	..
II 3503.09	..	400	bh 5780.5	50	..	bh 6505.5	100	..
II 3505.61	..	600	bh 5782.1	150	..	bh 6508.7	200	..
II 3541.76	..	100	bh 5784.8	100	..	bh 6512.0	300	..
II 3541.94	..	60	bh 5787.6	100	..	bh 6514.2	80	..
3577.23	..	60	bh 5790.3	100	..	bh 6517.5	100	..
3602.85	..	60 d	bh 5793.1	100	..	bh 6520.8	100	..
II 3640.89	..	100	bh 5795.9	100	..	bh 6524.2	150	..
II 3641.98	..	60	bh 5798.9	80	..	bh 6527.6	200	..
II 3704.51	..	60	bh 5801.8	80	..	I 6569.69	..	50
II 3847.09	..	800	bh 5804.7	80	..	bh 6610.5	50	..
II 3849.99	..	600	bh 5807.7	80	..	bh 6613.6	80	..
II 3851.67	..	200	bh 5810.6	50	..	bh 6616.6	100	..
II 4024.73	..	500	bh 5813.7	50	..	bh 6619.8	150	..
II 4025.01	..	150	bh 5816.7	50	..	bh 6622.9	200	..
II 4025.49	..	300	bh 5831.1	50	..	bh 6626.1	200	..
II 4083.92	..	40	bh 5831.5	50	..	bh 6629.4	200	..
II 4103.08	..	150	bh 5832.0	50	..	bh 6632.7	300	..
II 4103.52	..	300	bh 5832.6	50	..	bh 6642.0	50	..
II 4103.72	..	50	bh 6034.8	50	..	bh 6645.4	80	..
II 4103.87	..	50	bh 6036.9	50	..	bh 6648.7	100	..
II 4109.17	..	100	bh 6050.8	50	..	bh 6652.1	100	..
II 4116.55	..	50	bh 6056.9	50	..	bh 6655.6	100	..
II 4119.22	..	50	bh 6058.6	80	..	I 6690.47	..	60
II 4207.16	..	50	bh 6060.4	100	..	I 6708.28	..	40
II 4246.16	..	300 n	bh 6062.3	150	..	6773.97	..	100
II 4275.21	..	100 n	bh 6064.4	200	..	I 6795.52	..	60
II 4277.51	..	40 n	I 6239.64	..	300	I 6834.26	..	300
II 4299.18	..	150	bh 6290.7	50	..	I 6856.02	..	1000
II 4446.51	..	40 n	bh 6291.6	50	..	I 6870.22	..	150
II 4446.71	..	150 n	bh 6292.5	50	..	I 6902.46	..	500
II 4447.18	..	200 n	bh 6293.4	80	..	I 6909.82	..	150
II 4859.37	..	50	bh 6295.4	80	..	I 6966.35	..	70
bh 4950.8	100	..	bh 6296.5	100	..	I 7037.45	..	200
bh 4952.6	80	..	bh 6297.5	100	..	I 7127.99	..	150
bh 4954.3	50	..	bh 6298.7	100	..	I 7202.37	..	125
bh 4992.1	50	..	bh 6299.8	100	..	7309.03	.	50
bh 5000.6	80	..	bh 6300.9	150	..	I 7311.02	..	125
bh 5003.6	50	..	bh 6302.2	150	..	I 7314.51	..	40
bh 5291.0	200	..	bh 6303.5	150	..	I 7331.95	..	200
bh 5292.9	150	..	bh 6304.8	150	..	I 7398.68	..	400
bh 5296.8	100	..	bh 6306.1	100	..	I 7425.64	..	150
bh 5298.6	100	..	I 6348.50	..	200	I 7482.72	..	80
bh 5302.7	100	..	bh 6411.8	50	..	I 7489.14	..	50
bh 5304.4	100	..	bh 6412.9	80	..	I 7552.24	..	40
bh 5308.7	80	..	I 6413.66	..	150	I 7573.41	..	40
bh 5310.3	80	..	bh 6414.1	100	..	I 7607.17	..	45
bh 5314.7	50	..	bh 6415.3	100	..	I 7754.70	..	60
bh 5316.2	80	..	bh 6416.5	100	..	I 7800.22	..	50

GADOLINIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2781.40	30	40	3010.14	100	100	3100.51	100	80
2796.94	70	80	3027.61	100	60	3145.01	50	30
2809.72	60	80	3032.85	100	100	3331.39	100	80
2840.24	50	60	3034.06	100	60	3350.48	150	180
2881.58	40	..	3068.65	50	50	3358.63	100	100
2999.06	40	30	3082.00	100	60	3362.24	150	180

II. EMISSION SPECTRA 2000–10,000 A (Continued)

GADOLINIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3392.53	40	25	I 3934.80	100	50	4262.09	150	10
3407.60	100 r	100	3938.98	20	40	4266.60	50	..
3416.96	50	30	3942.64	60	30	4267.02	40	40
3418.73	50	25	3943.25	40	40	4268.74	40	40
3422.47	80	100	3945.54	200 W	150	4274.17	100	..
3432.99	50	40	3952.01	100	60	4280.50	200	100
3439.21	60	35	3953.37	100	50	4285.83	60	20
3439.78	50	50	3957.68	300 W	200	4286.12	60	20
3439.99	70	50	3963.66	50	60	4289.90	40	100
3450.38	100	100	I 3969.00	40	..	4296.08	200	4
3451.24	50	40	3969.26	200	..	4296.29	40	40
3463.98	100	125	3974.07	100	80	4297.18	100	4
3467.28	100	100	I 3979.34	100	30	4304.90	100	100
3468.99	150	150	3983.03	40	40	4306.35	200	80
3473.23	50	40	3987.22	100	100	4310.99	100	..
3481.36	150	150	3987.84	50	25	4313.85	200	80
3481.82	80	60	3996.32	100	100	4314.40	100	20
3491.97	50	25	4001.24	80	3	4316.06	150	60
3494.42	70	60	4009.21	50	2	4316.27	40	..
3505.52	60	60	4037.34	100	30	4320.53	60	20
3545.79	125	125	4037.91	100	30	4321.11	50	20
3549.36	125	125	4047.85	150 l	50	4321.21	40	..
3558.52	100 r	50	4049.44	80	20	4322.19	50	25
3584.96	100	100	4049.90	100	60	4324.07	100	..
3592.70	50	70	4053.30	100	80	I 4325.69	500 r	250
3604.88	50	12	I 4053.65	100	40	4327.10	500 r	100
3608.76	100	125	I 4054.73	80	20	4329.58	100	100
3629.52	40	60	I 4058.23	100	60	4330.62	100	..
3646.20	200 w	150	4059.88	50	20	4337.51	50	50
3654.64	200 w	200	4065.64	50 l	50 n	4341.29	200	125
3656.16	200 w	200	4070.29	80	..	4342.19	200	200
3662.27	200 w	200	4070.40	40	10	4344.30	50	..
3664.62	200 w	200	4073.21	80	80	4346.46	150	60
3671.22	150 w	100	4073.77	100	50	4346.63	50	20
3674.06	100 W	30	4085.65	100	80	4347.32	100	100
3684.12	200 W	150	4087.71	80	100	4360.93	200	..
3686.34	150 W	200	I 4090.42	100	20	4369.17	50	20
3687.76	200 w	200	I 4092.71	100	40	4369.77	250	150
3697.74	200 w	200 w	4098.91	100	100	4370.19	40	..
3699.75	200 W	250	4130.38	200	10	4373.84	200	80
3712.71	200 W	250	4131.48	50	50	4378.57	40	..
3713.58	100 W	80	4137.08	20	40	4380.64	100	125
3716.37	150 w	125	4162.74	50	..	4382.06	40	..
3717.49	100 w	50	4170.11	50	50	4383.14	30	40
3719.46	40	40	4175.54	50	..	4387.68	150	..
3722.03	50	30	4183.62	35	..	4389.88	40	40 n
3725.49	50	50	4184.26	150	150	4389.99	30	80
3730.86	100 W	100	4190.15	100 W	..	4390.95	100	100
3739.76	100	50	I 4190.78	100	40	4392.07	100	100
3740.05	50	50	4191.08	100	..	4397.52	100	5
3769.45	50	40	I 4191.62	40	15	4401.85	200	100
3770.70	50	60	4197.70	40	50	4403.14	100	100
3782.28	25	50	4212.02	150	50	4406.67	70	200
3796.39	150 w	150	4215.02	200	150	4408.26	100	150
3812.02	200 r	200 n	4217.19	100	100	4411.16	100	50
3813.98	100 w	60	4225.85	150	50	4414.16	100	60
3836.51	100 wn	60	4227.14	50	20	4414.73	100	50
3852.50	100	8	4238.78	200	200	4419.04	200	200
3894.71	150 W	80	4243.84	60	100	4421.24	100	8
3902.40	100	80	4246.55	150	3	4422.41	100	40
3905.65	50	50	4251.74	300	10	4426.15	50	2
3907.12	100 W	100	4253.37	50	4	4430.63	150	40
3916.59	150 w	100	4253.62	50	50	4431.77	60	1

GADOLINIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4436.22	30	100	4791.60	150	..	6645.18	150	..
4438.27	40	100	4799.87	25	60	6681.22	100	..
4446.48	80	2	4800.11	30	80	6718.14	40	..
4449.95	4	40	4801.08	200	200	6727.84	50	..
4466.55	200	150	4802.58	100	40 n	6730.76	100	..
4467.09	50	..	4803.55	100	40	6752.68	300	..
4471.30	50	..	4805.82	200	80	6753.90	100	..
4474.14	150	150	4807.46	100	40	6783.35	40	..
4476.14	100	..	4816.84	50	20	6786.32	125	..
4478.81	80	..	4821.71	150	80	6816.47	40	..
4481.07	70	100	4834.24	125	25	6820.91	50	..
4483.34	80	125	4835.27	100	10	6828.25	150	..
4486.36	25	80	4848.11	60	10	6846.60	500	..
4486.91	100	15	4856.19	80	..	6857.12	200	..
4497.13	150	80	4856.74	80	..	6887.62	35	..
4498.29	100	..	4859.23	50	..	6900.68	60	..
4506.22	100	50	4861.80	100	..	6916.57	200	..
4506.35	80	5	4862.61	100	2	6985.88	200	..
4506.94	50	20	4865.04	400	10	6991.93	150	..
4514.52	60	10	4866.41	100	..	6996.78	200	..
4519.66	150	100	4870.05	200	10	7006.16	80	..
4520.08	50	3	4871.52	100	..	7037.25	50	..
4522.84	50	4	4873.35	200	2	7118.91	40	..
4537.82	150	100	4875.97	100	10	7122.59	50	..
4540.02	80	200	4881.08	60	..	7147.36	50	..
4542.03	50	50	4881.38	50	..	7168.41	500	..
4548.01	50	50	4881.94	100	20	7172.29	50	..
4583.09	40	2	4883.20	100	..	7189.59	80	..
4597.92	25	40	4889.20	60	..	7194.87	50	..
4601.05	40	6	4894.32	200	4	7201.42	40	..
4614.50	50	25	4915.84	40	..	7228.05	40	..
4680.06	50	25	4930.71	80	..	7233.44	80	..
4683.34	100	50	4938.62	150	2	7252.72	80	..
4694.34	50	8	4942.57	100	..	7262.67	80	..
4697.49	100	4	4958.79	125	4	7291.35	60	..
4702.32	50	100	4961.50	100	..	7301.23	150	..
4703.14	50	20	4965.06	100	10 n	7313.28	150	..
4709.78	100	25	4969.16	100	..	7324.89	80	..
4712.82	25	40	5010.83	50	..	7327.09	40	..
4719.05	50	20	5015.06	100 W	..	7370.28	80	..
4723.73	100	200	5050.87	50	..	7373.83	40	..
4726.74	40	100	5125.54	50	..	7376.42	40	..
4728.47	150	100	6004.57	35	8	7377.59	40	..
4732.61	300	300	6305.14	100	..	7380.30	40	..
4734.44	100	40	6380.97	100	..	7385.91	40	..
4735.76	150	150	6382.19	60	..	7394.91	40	..
4738.13	50	50 n	6422.41	50	..	7405.76	40	..
4743.65	300	300	6462.58	50	..	7417.99	50	..
4758.71	35	..	6480.11	40	..	7426.56	80	..
4760.75	40	40	6538.14	50	..	7430.20	40	..
4767.25	100	25	6591.60	40	..	7441.89	200	..
4781.93	200	50	6634.35	150	..	7464.38	200	..
4784.64	100	50	6640.09	40	..	7489.47	40	..
4786.81	40	2						

GALLIUM

II 2091.34	..	(40)	I 2534.83	..	(20)	2659.87	5	12
2450.07	10	10	I 2607.47	..	(15)	I 2665.05	..	(40)
I 2482.76	..	(15)	I 2624.82	..	(25)	I 2691.29	..	(25)
2500.17	12	10 r	I 2632.66	..	(40)	II 2700.47	..	(70)

GALLIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2719.65	5	15	I 3872.56	30	..	5992.34	..	10
II 2780.15	..	(40)	II 3924.39	..	25 W	II 6334.2	..	(100)
I 2874.24	10	15 r	I 4032.98	1000 r	500 r	6396.61	..	20
I 2943.34	10	20 r	I 4172.06	2000 r	1000 r	6414.01	..	15
2944.17	10	15 r	II 5218.21	..	(10)	II 6419.4	..	(25)
3004.06	..	15	5360.09	2	12	II 6456.3	..	(15)
3375.30	..	12	II 5416.8	..	(10)	II 7198.7	..	(60)
3730.04	..	20	5844.22	..	12	II 7793.0	..	(10)

GERMANIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2041.69	5 r	150 r	2709.63	30	20	4260.80	20	10 n
2043.76	4 r	70 n	2740.43	10	10	I 4685.84	20	..
2065.20	4 r	50	2754.59	30	20	II 4741.94	..	50
2068.65	5 r	200 r	II 2845.48	..	12	II 4814.80	..	200
2198.70	10 r	2 n	I 3039.06	1000	1000	II 4824.20	..	10
2417.37	10	12	3067.01	60	40	II 5131.7	..	100
I 2497.96	8	10	I 3124.82	200	80	II 5178.58	..	100
2556.30	20	2	3255.34	..	100 Wn	II 5893.46	..	100
2592.54	20	15	I 3269.49	300	300	II 6021.14	..	25
I 2651.18	40	20	4179.04	..	25 wn	II 6336.31	..	10
I 2651.57	30	20	I 4226.57	200	50	II 6484.32	..	15
2691.34	25	15						

GOLD

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2012.00	15	18	2687.63	..	15	I 3204.74	50	30
2110.80	..	60	I 2688.71	2	20	I, II 3230.64	15	80
2125.34	..	30	I 2700.89	20	25	I 3308.31	50	15
I 2176.33	15	..	II 2732.01	..	30	I 3320.15	20	5
II 2188.98	..	15	I, II 2748.26	40	80	3349.40	15	5
2201.35	..	30	2780.83	..	20	I 3355.14	25	..
2215.76	..	15	II 2795.53	..	15	I 3553.57	20	10
2222.56	..	15	2802.19	..	200	I 3565.93	20	15
II 2229.03	..	50	II 2805.32	..	30	3580.08	20	15
II 2231.31	..	20	2819.95	..	150	I 3586.74	20	15
2242.71	..	30	2822.72	..	80	3591.99	15	5
2246.43	..	15	2825.45	10	40	3594.15	25	6
II 2246.68	..	18	2838.03	..	80	I 3598.08	35	10
II 2283.32	..	15	II 2847.09	..	25	3607.54	..	20
II 2291.52	..	15	2856.91	..	20	3614.00	..	20
II 2304.81	..	30	I 2883.45	15	20	II 3633.24	1	15
2314.64	..	15	I 2891.96	8	20	3682.86	20	10 n
II 2352.65	25	..	2893.42	..	30	3706.82	..	15 n
I, II 2364.56	20	8	I, II 2905.90	10	30	I 3795.90	20	3 n
2364.89	..	15 n	2907.06	..	25	II 3804.00	25	150
I 2376.24	25	3	II 2913.54	..	50	3816.13	20	40
I 2387.75	30	10	II 2918.37	..	25	II 3825.65	20	30
I 2404.81	20	4	I, II 2932.19	8	40	3829.38	25	20
I 2427.95	400 r	100	2954.39	..	50	3836.48	30	30
II 2477.71	..	15	II 2982.11	..	15	3871.35	25	20
2480.28	..	15 n	II 2990.28	..	50	3874.67	5	15
2503.32	..	30	II 2994.99	..	100	II 3880.20	..	20
I 2510.49	25	15	3014.23	5	15	3883.35	..	20
I 2544.19	30	8	I 3029.20	25	30	I 3897.89	30	25
I, II 2590.04	30	50	3033.18	25	30 n	I 3909.38	10	15
I 2641.49	5	20	I 3122.78	500 n	5	I 3914.72	15	3
I 2675.95	250 r	100	I 3194.71	25	20	3959.11	8	20

GOLD (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 4016.05	10	15	4587.89	. .	15	I 5726.82	35	10
I 4040.94	50	40	I 4607.34	30	15	I 5837.40	400 n	10
II 4052.81	. .	60	4607.50	. .	15 r	I 5862.94	30	5
I 4065.08	50	30	I 4792.60	200 W	60	I 5956.98	35	8
II 4076.33	4	25 w	I 4811.62	50	15	5962.72	35	3
I 4084.12	25	12	I 5064.61	40	10	II 6022.74	15	5
I 4241.77	40	30	I 5147.39	40	5	I 6160.1	20	. .
II 4259.89	. .	15	I 5230.26	40	15	I 6278.18	700	20
I 4315.09	40	18	I 5261.82	40	3	I 6652.6	15	. .
I 4437.27	50	10	I 5655.77	35	5	I 7510.75	20	. .
I 4488.25	40	30 l	I 5721.26	15	. .			

HAFNIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2028.18	25	15	II 2447.25	25	50	II 2789.73	20	30
II 2083.80	40	30	II 2453.34	12	25	II 2808.00	25	30
II 2088.77	50	50	II 2460.49	20	50	II 2813.86	25	30
II 2089.95	30	30	2461.72	. .	30	II 2814.47	25	40
II 2090.83	40	40	II 2464.19	30	100	II 2814.76	15	35
II 2096.18	100	150	II 2469.18	20	50	II 2820.22	40	100
II 2107.47	60	60	II 2473.91	15	25	II 2822.68	30	90
II 2123.68	40	40	II 2478.56	100	300 wn	II 2829.32	15	30
II 2124.59	50	80	2495.17	. .	60	2833.28	25	4
II 2129.10	60	100	II 2496.99	30	40	2845.28	25	5
II 2139.24	30	40	II 2512.69	25	50	II 2849.21	30	100
II 2156.44	25	25	II 2513.03	25	70	2850.96	25	5
II 2170.22	20	30	2515.16	1	40	II 2851.21	25	50
II 2175.36	25	30	II 2515.48	20	30	II 2852.01	20	50
II 2178.90	60	80	II 2516.88	35	100	II 2860.31	15	30
II 2190.22	30	30	II 2531.19	25	50	II 2861.01	40	90
II 2212.45	25	30	II 2551.40	25 d	125 d	II 2861.70	50	125
II 2254.01	60	80	II 2559.19	20	40	2866.37	50	12
II 2255.15	40	60	2560.74	. .	25	II 2869.82	25	20
II 2266.52	30	40	II 2563.61	20	35	II 2876.33	30	100
II 2266.83	60	80	II 2571.67	30	80	2887.13	25	3
II 2273.15	40	60	II 2573.90	25	100	2889.62	30	10
II 2277.16	150	150	II 2576.82	5	60	I 2898.26	50	12
II 2284.60	20	30	II 2578.14	25	30	II 2898.71	25	50
II 2291.64	30	40	II 2582.54	25	35	I 2904.41	30	6
II 2298.34	25	50	II 2606.37	25	50	2904.75	30	6
II 2321.14	50	60	II 2607.03	30	80	II 2909.91	30	20
II 2322.47	60	60	II 2613.60	20	80	I 2916.48	50	15
II 2323.25	40	60	II 2622.74	30	80	2918.58	30	8
II 2324.50	20	40	II 2638.71	40	100	II 2919.59	40	80
II 2324.89	40	80	II 2641.41	40	125	2924.61	25	2
II 2332.97	40	50	II 2647.29	40	125	II 2929.63	30	50
II 2337.33	30	30	II 2651.16	15	40	II 2937.79	50	100
II 2343.32	60	80	II 2657.84	20	25	I 2940.77	60	12
II 2347.44	80	125	II 2661.87	25	40	2958.02	30	5
II 2351.21	100	150	II 2665.97	20	35	II 2961.80	20	30
II 2380.30	30	60	II 2683.35	15	100	2964.88	50	10
II 2381.00	20	40	2687.22	. .	25	2966.93	25	4
II 2393.18	20	40	II 2706.73	10	50	II 2967.23	20	25
II 2393.36	50	80	II 2712.42	25	50	II 2968.81	30	30
II 2393.83	80	100	II 2738.76	40	100	II 2975.88	80	100
II 2405.42	25	50	II 2751.81	25	80	II 2977.59	30	25
II 2406.44	12	25	2753.61	. .	60	2980.81	50	10
II 2410.14	25	50	II 2756.91	15	40	2982.72	30	1
II 2417.69	25	40	2761.63	25	3	II 3000.10	40	30
II 2425.97	15	25	II 2773.36	25	60	3005.56	50	8
II 2433.57	15	50	II 2774.02	25	50	II 3012.90	80	100

HAFNIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3016.78	25	10	II 3569.04	20	50	4859.24	30	5
3018.31	60	10	3616.89	25	10	II 4904.52	12	25
II 3024.76	18	25	II 3644.35	25	50	II 4934.45	40	50
II 3025.29	30	30	II 3661.05	10	25	4975.25	25	4
II 3031.16	70	90	II 3665.35	20	25	II 4999.68	30	40
II 3046.08	25	25	II 3666.77	25	4	II 5040.82	100	150
3050.76	50	10	3672.27	25	3	II 5057.03	20	30
3057.02	70	10	3682.24	25	30	II 5079.65	40	60
3063.78	25	1	II 3698.39	10	25	5181.86	25	10
II 3064.68	10	30	II 3699.72	20	25	II 5187.75	20	30
3067.41	30	10	II 3701.15	15	40	II 5247.10	40	60
I 3072.88	80	18	II 3705.40	15	25	II 5260.44	30	40
3074.10	25	1	II 3719.28	15	30	II 5264.95	50	80
3074.79	30	4	II 3737.88	15	25	II 5298.06	80	100
II 3080.66	30	100	II 3762.51	2	25	II 5311.60	100	150
3080.84	25	5	II 3766.92	5	25	II 5324.26	20	30
3096.76	25	1	II 3797.92	25	25	II 5346.30	10	40
II 3101.40	60	90	3831.13	25	25	II 5444.07	20	30
II 3109.12	50	100	II 3877.10	4	30	II 5524.35	40	50
II 3110.87	30	40	II 3880.82	20	30	5550.60	30	5
3119.98	25	1	II 3979.40	6	40	5552.12	40	5
3131.81	40	10	4047.96	8	25	5719.18	40	10
II 3134.72	80	125	II 4093.16	25	20	II 5767.18	15	30
3137.51	30	10	4174.34	25	6	II 5809.50	20	30
II 3139.65	25	20	4294.79	25	2	II 5842.23	50	80
II 3140.76	25	25	II 4336.66	30	60 n	II 6248.95	80	100
II 3145.32	50	20	II 4350.51	20	40	6257.00	10	30
II 3162.61	40	30	4356.33	30	4	II 6531.66	2	30
3168.39	30	2	II 4367.90	25	20	II 6542.80	3	50
3172.94	30	8	II 4370.97	30	40	II 6557.91	10	100
II 3176.86	30	30	II 4417.35	25	50	II 6567.39	6	60
II 3193.53	25	25	4417.91	25	1	II 6584.53	4	40
II 3194.19	40	40	II 4422.74	15	25	II 6644.60	100	200
II 3199.99	20	30	4438.04	30	2	II 6647.06	30	100
II 3217.30	30	15	4457.34	25	2	II 6719.40	2	50
II 3220.61	25	35	4461.18	25	2	II 6754.61	60	100
II 3253.70	30	30	II 4486.13	25	30	6789.27	50	100
II 3255.28	20	30	II 4533.15	20	40	6818.94	100	200
II 3279.98	25	25	4540.93	50	2	6826.56	10	25
3312.86	30	10	4565.94	40	6	6850.07	20	60
II 3317.99	25	18	II 4599.44	10	25	II 6855.29	7	50
3332.73	40	10	II 4605.77	20	30	6858.70	15	50
II 3352.05	30	50	4608.09	25	4	6911.40	15	50
3358.91	25	2	II 4613.74	12	25 wn	II 6935.16	5	50
3378.93	25 r	20	4620.86	50	4	II 6980.91	100	200
II 3389.83	30	40	II 4622.70	20	60	II 7021.23	3	30
II 3394.59	20	25	4655.19	50	4	II 7030.33	30	150
II 3394.98	20	50	II 4664.12	50	100	7061.90	10	30
II 3399.79	60	100	4688.39	30	4	7063.83	40	100
II 3407.76	20	25	4699.01	30	4	7119.52	15	50
II 3410.17	25	60	II 4699.71	20	25	7131.81	150	250
II 3438.23	25	25	II 4719.10	30	40	7237.10	100	200
3472.40	25	10	4773.71	25	4	7240.87	70	150
II 3478.99	30	40	4782.74	40	5	II 7277.67	5	50
II 3505.23	20	50	4800.50	50	6	7320.05	15	25
II 3535.54	15	50	II 4817.21	15	40	II 7328.64	3	30
II 3552.70	20	35	4818.87	25	4	7624.40	30	..
II 3561.66	20	35	4837.23	35	4	II 7663.09	2	30

II. EMISSION SPECTRA 2000–10,000 A (Continued)

HELIUM

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 2252.71	..	10	I 3705.00	..	30	I 5015.67	..	100
II 2306.22	..	20	I 3732.86	..	10	I 5047.74	..	15
II 2385.42	..	30	I 3819.61	..	50	II 5411.55	..	50
II 2511.22	..	50	I 3867.48	..	15	I 5875.62	..	1000
I 2723.19	..	10	I 3888.65	..	1000	I 5875.87	..	10
II 2733.32	..	100	I 3964.73	..	50	II 6560.13	..	100
I 2763.80	..	20	I 4009.27	..	10	I 6678.15	..	100
I 2829.07	..	40	I 4026.19	..	70	I 7065.19	..	70
I 2945.10	..	100	I 4120.81	..	25	I 7065.70	..	10
I 3187.74	..	200	I 4143.76	..	15	I 7281.35	..	30
II 3203.14	..	100	I 4387.93	..	30	I 7816.16	..	12
I 3354.55	..	10	I 4437.55	..	10	I 9463.66	..	60
I 3447.59	..	15	I 4471.48	..	100	I 9516.70	..	30
I 3587.25	..	10	II 4685.75	..	300	I 9526.17	..	10
I 3613.64	..	30	I 4713.14	..	40	I 9702.76	..	10
I 3634.23	..	15	I 4921.93	..	50			

HOLMIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2431.03	..	20	3281.98	12	15	3837.45	15	6 n
2433.00	..	20	3289.38	10	20	3854.05	10	20
2439.33	..	20	3338.76	12	20	3861.68	40	20
2442.76	..	20	3343.56	20	20	3888.95	40	20
2452.69	..	20	3372.79	12	15	3891.02	200	40
2511.12	..	20	3398.98	40	60	3905.55	15	8
2597.51	..	20	3410.25	20	15	3905.78	30	6
2636.50	..	70	3414.92	30	30	3955.74	15	4
2677.95	..	20	3416.46	30	40	3998.28	40	6
2681.18	..	20	3421.64	20	20	4040.84	150	30
2774.70	..	300	3425.35	40	40	4045.43	200	80
2812.87	..	20	3428.13	40	40	4053.92	400	200
2814.74	10	20	3429.19	10	15	4101.09	40	40
2824.19	20	3	3453.13	30	20	4103.84	400	400
2826.63	3	20 n	3456.00	60	60	4108.63	100	40
2828.14	..	20 n	3461.96	20	20	4120.20	50	25
2831.60	..	70	3474.25	40	20	4125.65	20	15
2845.64	..	70 n	3484.73	40	30	4127.16	150	60
2847.50	..	40	3494.77	30	40	4136.24	40	25
2849.10	10	20	3515.58	40	40	4152.54	30	30
2867.82	..	40 n	3531.74	10	20	4152.75	30	40
2880.27	20	10	3545.97	20	20	4163.03	100	100
2880.99	20	10	3556.76	15	40	4173.23	50	..
2894.99	20	10	3574.78	10	20	4194.34	30	15
2897.36	..	20 n	3598.77	40	30	4254.43	100	20
2909.42	40	10	3626.70	20	15	4264.07	15	8
2928.79	..	100	3627.18	15	15	4350.73	40	15
2936.77	..	1000 r	3662.27	20	10	5468.46	20	..
2944.50	10	20	3674.77	8	15	5498.57	20	..
2945.83	3	70 n	3685.16	6	15	5553.14	30	..
2949.19	..	20	3692.65	10	15	5560.94	20	..
2953.11	20	10	3694.24	10	20	5566.52	100	..
2973.00	20	..	3748.17	60	40	5640.62	100	..
2979.63	20	40	3753.75	20	10 n	5659.58	20	..
3166.62	10	15	3757.26	40	30	5674.70	200	..
3171.71	10	15	3796.73	20	40	5681.41	20	..
3181.52	8	40	3810.70	20	40	5682.12	30	..
3278.15	10	15	3813.24	15	8 n	5691.47	200	..

HOLMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
5706.88	50	..	5892.56	50	..	5973.52	125	..
5751.12	30	..	5921.76	200	..	5982.90	200	..
5839.47	30	..	5933.71	200	..	6305.36	20	..
5860.28	200	..	5948.03	200	..	6550.97	20	..
5870.85	20	..	5955.98	100	..	6604.94	20	..
5882.99	200	..						

HYDROGEN, FIRST SPECTRUM*

Wave length	Geissler tube	Wave length	Geissler tube	Wave length	Geissler tube
3656.6	..	3673.7	..	3770.06	..
3657.6	..	3676.34	..	3797.91	..
3658.0	..	3679.35	..	3835.40	..
3660.3	..	3682.82	..	3889.06	..
3661.2	..	3686.83	..	3970.07	..
3662.2	..	3691.55	..	4101.74	..
3663.4	..	3697.15	..	4340.47	..
3664.6	..	3703.86	..	4861.33 p	..
3666.1	..	3711.98	..	6562.73	..
3667.7	..	3721.95	..	6562.85 p	..
3669.42	..	3734.37	..	9500.	..
3671.34	..	3750.15	..		

HYDROGEN, SECOND SPECTRUM*

3990.03	4	4849.32	5	5888.16	6
3991.9	4	4873.03	5	5931.4	7
4062.49	6	4928.7	9	5938.62	7
4069.65	6	4934.27	6	5949.91	7
4087.75	4	4973.26	6	5975.44	9
4171.29	5	5013.05	6	5982.55	7
4177.07	6	5055.07	6	6018.30	9
4205.10	7	5084.84	5	6027.98	6
4212.51	6	5113.18	5	6031.9	10
4412.25	5	5196.38	5	6070.00	7
4447.56	5	5266.04	5	6079.80	9
4460.96	6	5303.16	7	6090.93	6
4490.45	6	5336.51	5	6095.98	6
4498.10	6	5366.0	5	6121.78	10
4568.11	7	5388.2	7	6127.3	6
4572.72	6	5419.90	6	6135.35	8
4580.03	7	5434.84	5	6182.98	6
4582.60	6	5481.09	5	6199.38	6
4625.3	5	5505.5	5	6224.81	9
4627.96	6	5537.45	6	6238.37	7
4631.88	9	5688.20	6	6299.40	6
4634.0	9	5731.90	6	6327.04	8
4662.77	5	5736.86	7	6935.8	10
4683.78	6	5775.0	6	6940.4	10
4719.01	6	5812.58	9	6962.6	10
4723.00	6	5836.0	7	7072.	10
4797.74	5				

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* Intensity scale 1–10.

II. EMISSION SPECTRA 2000–10,000 A (Continued)

INDIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2334.57	..	(50 n)	II 4627.38	..	(150)	II 5555.43	..	(70)
I 2389.54	50 r	..	II 4638.10	..	(200)	II 5556.04	..	(100)
II 2447.90	..	(80)	II 4638.24	..	(125)	II 5576.75	..	(300)
II 2488.95	..	(60)	4638.86	3	70	II 5576.91	..	(150)
II 2498.59	..	(50)	II 4644.54	..	(125)	II 5577.04	..	(100)
II 2499.60	..	(80)	II 4644.65	..	(60)	II 5636.66	..	(150)
II 2554.40	..	(50)	II 4655.41	..	(45)	II 5636.75	..	(300)
II 2554.48	..	(50)	II 4655.52	..	(45)	5644.86	..	70
I 2560.23	150 r	50 r	II 4655.66	..	(50)	II 5708.31	..	(100)
I 2601.76	50 r	15 wn	II 4655.79	..	(100)	II 5708.52	..	(100)
II 2668.68	..	(50)	II 4681.11	..	(200)	II 5708.69	..	(70)
II 2683.12	..	(50)	4682.00	..	250 W	I 5709.75	50 wn	..
I 2710.26	800 r	200 rn	II 4685.22	..	(100)	II 5722.04	..	(70)
I 2713.93	200 r	125 wn	II 4907.15	..	(50)	I 5728.27	50	..
II 2749.70	..	(50)	II 4924.93	..	(80 n)	II 5852.83	..	(100)
I 2753.88	300 r	300 r	II 5043.55	..	(50)	II 5853.11	..	(150)
I 2775.35	80	30	II 5044.14	..	(50)	II 5853.43	..	(300)
I 2836.92	80	80	II 5109.36	..	(300 w)	II 5903.04	..	(70)
II 2865.68	..	(50)	II 5115.91	..	(100)	II 5903.14	..	(100)
I 2932.62	500	300	II 5116.75	..	(70)	II 5903.24	..	(100)
II 2941.05	..	(80)	II 5117.37	..	(50)	II 5903.37	..	(100)
I 2957.01	50	25	II 5117.41	..	(300)	II 5903.47	..	(70)
3008.31	..	500 W	II 5120.85	..	(100)	II 5903.63	..	(500)
I 3039.36	1000 r	500 r	II 5120.96	..	(150)	II 5903.75	..	(150)
II 3138.56	..	(50)	II 5121.10	..	(400)	II 5914.68	..	(70)
II 3138.64	..	(50)	II 5121.34	..	(50)	II 5914.83	..	(50)
II 3146.81	..	(50)	II 5129.94	..	(70)	II 5915.45	..	(50)
II 3155.77	..	(200)	II 5175.29	..	(400)	II 5915.63	..	(50)
II 3158.40	..	(100)	II 5175.42	..	(300)	II 5915.97	..	(100)
I 3256.09	1500 r	600 r	II 5175.56	..	(150)	II 5918.65	..	(70)
I 3258.56	500 r	300 r	II 5184.44	..	(300)	II 5918.78	..	(50)
II 3438.34	..	(50)	II 5184.66	..	(70)	II 6095.85	..	(50)
II 3795.21	..	(50)	II 5309.03	..	(70)	II 6095.96	..	(80)
II 3801.5	..	(50)	II 5309.40	..	(70)	II 6108.65	..	(50)
II 3889.78	..	(100)	II 5309.83	..	(100)	II 6108.99	..	(60)
II 4013.93	..	(80)	II 5402.94	..	(50)	II 6129.70	..	(60)
II 4016.24	..	(50)	II 5411.41	..	(300)	II 6132.74	..	(50)
II 4021.66	..	(50)	II 5418.48	..	(50)	II 6137.19	..	(50)
4024.83	..	100 wn	II 5418.73	..	(150 n)	II 6143.23	..	(80)
II 4027.79	..	(50 n)	II 5436.01	..	(50)	II 6161.15	..	(60)
II 4056.75	..	(50)	II 5436.28	..	(100)	II 6224.27	..	(60)
II 4056.94	..	(500)	II 5436.93	..	(150)	II 6468.89	..	(50)
II 4057.07	..	(100)	II 5437.40	..	(50)	II 6468.99	..	(80)
4057.87	80	10	II 5497.55	..	(70)	II 6540.96	..	(60)
4072.40	..	200 wn	II 5497.64	..	(50)	II 6541.22	..	(50)
I 4101.77	2000 r	1000 r	II 5507.33	..	(70)	II 6751.88	..	(60)
II 4205.08	..	(50)	II 5510.88	..	(70)	II 6765.96	..	(50)
II 4213.10	..	(50)	II 5512.82	..	(150)	II 6766.33	..	(50)
II 4219.83	..	(50)	II 5512.92	..	(100)	II 6783.72	..	(100)
II 4227.16	..	(50 n)	II 5512.99	..	(70)	I 6847.77	60	..
II 4327.33	..	(80)	II 5513.06	..	(70)	II 6891.66	..	(60)
II 4330.02	..	(50)	II 5513.10	..	(50)	II 6900.37	50	..
II 4372.87	..	(80)	II 5519.36	..	(500)	II 7183.19	..	(80)
II 4500.95	..	(50)	II 5523.00	..	(50)	II 7183.96	..	(50)
I 4511.32	5000 r	4000 r	II 5523.29	..	(50)	II 7254.10	..	(50)
II 4578.08	..	(50)	II 5523.61	..	(50)	II 7276.41	..	(50)
II 4578.39	..	(60)	II 5523.86	..	(70)	II 7277.59	..	(60)
4612.13	..	150	II 5523.91	..	(100)	II 7303.75	..	(50)
II 4617.16	..	(200)	II 5535.94	..	(70)	II 7350.37	..	(50)
II 4620.05	..	(80)	II 5536.55	..	(70)	II 7351.49	..	(50)
II 4620.24	..	(200)	II 5537.03	..	(50)	II 7351.58	..	(50)

II. EMISSION SPECTRA 2000–10,000 A (Continued)

IODINE

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
2023.80	..	100	3897.26	..	40	6007.51	..	50
2034.80	..	100	3931.01	..	400	6015.87	..	50
2049.45	..	150	3940.24	..	500	I 6024.13	..	300
2062.38	..	900	3994.98	..	35	I 6048.72	..	70
2081.29	..	40	II 4036.08	..	50	II 6068.95	..	50
2169.59	..	100	I 4050.09	..	35	II 6074.99	..	80
2229.97	..	400	4070.75	..	150	I 6082.46	..	1000
2250.03	..	100	4128.69	..	35	6084.80	..	40
2292.44	..	40	4220.96	..	80	6086.77	..	150
II 2331.54	..	40	I 4346.92	..	35	I 6125.53	..	100
II 2335.45	..	60	II 4408.96	..	250	II 6127.46	..	125
2342.38	..	150	II 4423.76	..	80	6132.94	..	50
2407.98	..	60	II 4428.22	..	35	I 6191.97	..	150
2419.16	..	60	II 4446.78	..	35	6195.51	..	100
2444.12	..	60	II 4452.88	..	700	I 6200.52	..	50
II 2461.13	..	60	4458.47	..	35 n	II 6204.87	..	70
II 2464.68	..	100	II 4473.44	..	80	I 6213.17	..	70
2491.61	..	40	II 4476.05	..	60	I 6213.91	..	70
2494.71	..	100	4499.58	..	35	6229.39	..	50
II 2499.32	..	60	4528.10	..	40	6232.85	..	50
II 2502.98	..	150	4621.89	..	35	6236.40	..	50
2526.88	..	40	4632.32	..	50	6257.49	..	40
II 2530.98	..	60	II 4632.43	..	35	6280.32	..	50
II 2533.62	..	100	I 4640.88	..	50	I 6294.08	..	300
2551.43	..	40	II 4666.52	..	250	I 6320.41	..	50
II 2559.72	..	40	II 4675.53	..	50	I 6320.60	..	100
2561.49	..	150	II 4676.94	..	80	6320.82	..	50
II 2564.40	..	70	I 4763.38	..	80	6330.45	..	50
II 2566.26	..	300	I 4862.31	..	700	6338.02	..	100
II 2582.81	..	400	I 4896.78	..	35	I 6338.97	..	100
II 2586.74	..	40	I 4917.03	..	100	6339.52	..	300
II 2588.68	..	40	II 4986.93	..	35	II 6339.97	..	100 n
II 2593.47	..	150	I 5119.28	..	500	6348.34	..	50
2625.00	..	40	II 5161.19	..	300	I 6359.19	..	60
2627.04	..	60	I 5204.20	..	50	I 6367.34	..	70
2635.30	..	60	I 5234.63	..	80	I 6371.76	..	100
2641.39	..	40	II 5245.70	..	80	6440.22	..	100
2674.80	..	60	I 5296.52	..	150	I 6444.51	..	100
2688.99	..	100	II 5338.19	..	300	6475.91	..	70
II 2698.32	..	50	5345.15	..	300	I 6488.18	..	150
2712.23	..	100	II 5369.87	..	40	6538.34	..	70
2730.13	..	50	5405.14	..	40	I 6566.48	..	400
2808.58	..	40	5405.65	..	40	6583.81	..	70
2836.92	..	40	II 5407.36	..	60	II 6585.19	..	70
2872.89	..	60	I 5427.10	..	50	I 6619.69	..	200
II 2878.64	..	400	I 5435.48	..	35	6661.16	..	100
2993.86	..	70	II 5435.84	..	125	6662.14	..	100
3055.37	..	350	II 5438.00	..	35	II 6665.97	..	70
3078.77	..	350	5464.61	..	900	I 6697.33	..	90
3081.66	..	100	5491.57	..	100	6698.53	..	50
3088.19	..	35	II 5496.92	..	900	I, II 6718.80	..	50
3149.46	..	35	II 5504.72	..	60	6727.00	..	70
3193.95	..	100	5522.05	..	35	6732.10	..	150
3288.35	..	35	5598.36	..	35	6736.60	..	50
3481.83	..	40	5600.31	..	50	6738.12	..	70
3561.18	..	40	II 5625.70	..	150	I 6739.50	..	50
II 3661.77	..	40 d	II 5678.06	..	80	I 6741.56	..	50
3686.55	..	70	II 5710.53	..	150	I 6773.56	..	50
3688 21	..	125	II 5738.29	..	50	I 6788.93	..	100
3724.81	..	50	II 5760.73	..	40	I 6789.32	..	50
I 3741.71	..	40	I 5764.33	..	100	I 6801.00	..	50
3742.13	..	40	I 5894.05	..	60	I 6812.19	..	50
I 3808.07	..	40	II 5950.26	..	50	II 6812.56	..	100

II. EMISSION SPECTRA 2000–10,000 A (Continued)

IODINE (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 6902.13	..	150	7085.22	..	150	I 7300.30	..	50
II 6958.78	..	1000	I 7088.00	..	100	II 7351.36	..	60
7018.32	..	50	I 7102.65	..	50	I 7402.10	..	300
II 7018.94	..	50	7122.09	..	60	I 7411.25	..	50
II 7032.99	..	70	II 7138.99	..	70 n	7416.55	..	50
7042.24	..	70 n	I 7142.09	..	100	I 7469.04	..	500
I 7063.60	..	50	I 7236.80	..	150	I 7490.58	..	70

IRIDIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2005.86	3	35	2204.96	5	300	2384.81	4	80
2017.41	..	50	2208.09	40	3 wn	2386.89	50 l	15
2017.99	2 n	40	2208.72	..	40	2390.62	40	6
2021.51	..	50	2208.96	2	50	2391.18	50	..
2022.83	4	50	2212.32	..	50	2398.75	10	150
2023.97	40	..	I 2220.37	50	10	I 2431.94	50	50
2028.65	5	50	2221.07	2	100	I 2452.81	35	2
2039.79	8	40	2232.25	30	50	I 2455.61	35	5
2041.69	2	50	I 2233.37	9	100	I 2467.30	40	5
2044.19	10	100	2234.38	5	80	I 2475.12	100	10
2044.83	4	75	2237.09	..	100	I 2481.18	50	10
2051.16	10	50	2238.29	..	80	I 2502.98	100 w	5
2057.23	6	50	2242.68	50	300	I 2533.13	100	20
2063.03	..	80	2245.76	10	150	I 2534.46	100	10
2065.79	..	80	2246.90	10	100	I 2537.22	35	10
2066.21	..	40	2257.50	2	50	I 2542.02	35	10
2070.51	6	60	I 2258.51	15	50	I 2543.97	200 n	100
2076.76	2	40	2259.27	..	35	I 2546.03	100 n	20
2079.71	..	40	2260.65	3	40	I 2564.18	40	8
2080.64	2	60	2265.16	5	50	I 2577.26	60	15
2084.49	..	80	2271.39	..	40	I 2592.06	100	20
2088.82	50	50	2281.02	2	50	2599.40	40	..
2096.20	1	80	2289.39	5	40	I 2608.25	50	10
2097.10	4	50	2290.80	3	50	I 2611.29	80	10
2099.62	..	40	I 2295.08	40	5	I 2619.88	35	5
2100.96	2 n	50	I 2304.21	100	..	I 2639.71	100 n	15
2103.87	..	50	2314.11	2	40	I 2644.19	35	5
2109.38	3 n	50	2314.90	10	40	I 2661.98	150 n	15
2111.96	2	40	2315.15	2	40	I 2662.63	40	10
2117.72	10	50	2323.63	..	50 l	I 2664.79	200 n	50
2126.81	25	200	2324.11	..	35	I 2668.99	50	5
2130.45	5	80	2324.70	5	80	I 2669.91	60	10
2131.66	..	50	2326.05	6	50	I 2671.84	50	10
2132.56	3	80	2329.41	5	50	I 2673.61	40	10
2148.22	25	50	I 2333.84	40	10	I 2676.83	35	10
2151.62	2 w	80	2340.04	10	35	I 2694.23	150 n	50
2152.68	50	200	I 2343.18	40	10	I 2712.74	40	10
2158.05	50	50	2353.17	4	50 w	I 2849.72	40 n	20 n
2160.74	10	50	2355.52	10	50	I 2882.63	40	6
2169.42	2	50	2355.96	..	35	2936.62	40	..
2175.01	..	50	2356.55	40	5	I 2988.98	35	..
2178.98	10	50	2357.95	8	50	I 2990.62	35	3
2190.38	..	150	2360.73	40	25	I 2996.08	50	2
2194.27	..	40	2363.04	50	25	I 2999.54	35	1
2196.44	5	50	2368.04	25	125	I 3002.25	50	10
2197.50	5	100	I 2372.77	100	40	I 3003.63	60	30
2198.85	50	15	2381.82	8	50	I 3005.21	35	20

IRIDIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3011.69	35	1	I 3661.71	50	30	I 4268.10	200	15
I 3016.43	35	2 n	I 3664.62	60	15	4286.62	200	3
3017.31	35	2 n	I 3674.98	100	50	4301.60	200	10
3019.23	35	2 n	I 3687.08	40	4	4310.59	150	8
3020.01	35	1	I 3725.38	50	20	4311.50	300	10
I 3025.82	50	3	3728.03	60	10	4351.30	50	..
I 3029.36	60	3	3731.36	50	50	4352.56	50	2
I 3032.41	50	1	3734.77	100	30	4372.13	40 w	..
3037.75	40	2	3738.53	60	10	4377.01	100	4
I 3040.47	35	2	I 3747.20	100	60	4392.59	100	4
I 3047.16	50	20	I 3768.68	60	10	4399.47	400	100
I 3057.28	35	2	3770.73	40	5	4403.78	300	10
I 3068.89	40	20	I 3771.60	40	4	4411.18	40	2
I 3086.44	35	2	3790.53	50	..	4426.27	400 w	10
I 3088.04	50	2	3800.12	150	100	4450.18	60	3
I 3120.76	50	2	3833.88	50	..	4478.48	200	10
I 3121.78	35	1	3915.38	150	50	4491.36	40	2 wn
I 3133.32	40	2 n	I 3934.84	200	50	4492.16	35	2
I 3140.41	50 r	1	I 3946.27	50	15	4495.35	100	3
I 3159.15	50 r	2 n	I 3976.31	10	70	4496.03	40	2
I 3219.51	35	2	I 3992.12	150	60	4532.87	80	2
I 3220.78	100	30	4020.03	80	100	4545.68	200	4
I 3229.28	35	2	4033.76	100	25	4548.48	100	5
I 3241.52	100	50	4040.08	40	5	4550.77	80	..
I 3266.44	50	10	4092.61	60	20	4568.09	100	3
I 3334.16	40	3	4100.15	100	3 n	4570.02	50	2
I 3448.97	60	10	4115.78	100	30	4616.39	200	5
I 3513.64	100 n	100	4117.60	50	3	4640.08	40	2 wn
I 3515.95	35	15	4155.70	80	5	4656.18	60	..
I 3522.03	..	50	4166.04	150	10	4728.86	150	3
I 3558.99	50	50	I 4172.56	150	12	4778.16	50	3
I 3573.72	8	100	4182.47	50	6	I 5449.50	35	2
I 3617.21	50	15	4183.21	40	4	6110.67	35	..
I 3628.67	100	30	4197.54	40	2	I 6830.01	50	..
I 3635.49	35	4 n	4217.76	40	3	I 6929.88	50	..
I 3636.20	50	25	4259.11	200	10	I 7183.71	40	..
3653.19	15	50	I 4265.30	60	2			

IRON

2017.07	2	10	2156.47	20	..	I 2186.89	6	12
2020.52	2	100	I 2157.79	10	4	I 2187.19	50 r	10
I 2100.79	15	2	I 2158.48	12	8	II 2187.69	..	12
I 2102.35	15	3	I 2159 89	12	2	II 2189.03	1	20
I 2108.95	10	2	II 2161.16	..	12	2190.77	20	2
I 2109.11	..	10	I, II 2162.02	5	25	I 2191.20	10	2
2125.01	30	..	2162.24	10 n	..	I 2191.84	100 r	12
2130.96	20	..	2163.37	12	..	I 2196.04	80 r	30
2132.01	12	3	II 2164.32	2	12	2199.57	10	..
2135.96	10	5	2165.86	20 n	1 n	I 2200.72	35	8
2141.47	10	..	I 2166.77	100 r	35	I 2201.12	10	..
2144.45	25	..	II 2167.88	..	10	II 2211.10	..	12
I 2145.19	12	2	2170.54	10	..	I 2213.65	2	35
2146.04	1	10	I 2171.29	10	3	II 2217.06	..	10
2149.17	10	..	II 2172.97	3	10	II 2219.89	2	20
II 2150.62	..	15	I 2175.45	8	25	II 2220.37	2	35
I 2151.10	8	10	I 2178.09	100 r	20	II 2221.16	..	25
2151.70	20	..	2183.83	..	12	2221.83	12	..
I 2153.00	10	1	2183.98	20	..	II 2222.45	..	10
2154.46	15	..	2186.48	50 r	80	II 2223.49	..	25

II. EMISSION SPECTRA 2000–10,000 A (Continued)

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2224.46	1	12	I 2292.52	15	2	II 2385.01	8	15
I 2228.17	10	6	II 2293.76	..	10	II 2388.63	25	30
II 2232.08	2	12	2293.85	10	6	I 2389.97	15	..
II 2233.91	..	35	I 2294.41	15	2	II 2391.47	8	20
2236.31	10	..	II 2294.61	15	5	II 2395.62	50	100 Wn
2237.90	..	12	I 2296.92	15	2	II 2399.24	20	30
2238.63	..	10	I 2297.79	35 r	6	II 2400.34	4	25
2240.63	20	3 n	II 2298.23	5	25	II 2402.60	10	20
2243.15	..	10 n	I 2299.22	15	4	II 2404.43	25	40
II 2244.39	..	10	I 2300.14	15	3	II 2404.88	50	100 wn
II 2245.50	..	50	2301.17	10	..	II 2406.66	50	1 wn
I 2245.65	12	..	I 2301.68	15	..	2407.23	20	2
II 2246.91	..	20	II 2303.35	..	15	II 2407.95	..	20
II 2247.69	..	50	2303.42	10	..	I 2408.04	10	..
I 2248.86	35	..	I 2303.58	10	3	II 2410.52	50	70 n
II 2249.17	10	50	I 2304.73	10	20	II 2411.07	35	70 n
II 2250.17	5	15	I 2306.17	10	..	II 2413.31	60	100 n
I 2250.78	10	..	2306.38	10	3	II 2415.06	1	50
II 2250.93	5	20	2307.31	..	25	II 2416.46	1	40 n
I 2251.87	12	70	2308.76	..	15	II 2417.87	10	100
II 2253.12	12	30	I 2308.99	20	5	II 2418.44	1	10 n
II 2254.08	..	10 n	II 2311.22	..	20	II 2422.68	3	70
II 2255.15	..	12	2311.29	..	35	II 2423.21	2	40
II 2255.76	..	20	II 2312.03	..	15	II 2424.14	25	70
I 2255.86	20	..	I 2313.10	25	3	II 2424.58	1	20
II 2256.43	..	10	II 2317.37	..	10 n	II 2425.36	..	20
II 2256.90	..	15 n	2318.17	10 w	..	II 2425.68	1	40
2259.51	25	..	I 2320.36	25	5	II 2425.93	..	10
II 2259.59	..	20	2322.95	..	10 wn	II 2428.29	1	10
II 2260.08	9	15	II 2327.39	10	25	II 2428.36	3	15
2260.60	10	..	II 2331.31	10	6	II 2428.79	1	15
II 2260.85	12	12	II 2332.80	15	40	II 2429.38	..	15
II 2262.68	6	12	II 2336.86	..	20 n	II 2430.07	15	70
II 2263.23	..	30	II 2338.00	15	35	2431.02	20	3 n
I 2264.39	35	5	2339.58	10 wn	..	II 2432.27	25	70
II 2264.59	..	20	II 2343.49	10	50	2432.87	5	40
I 2265.05	10	..	II 2343.96	5	10	II 2433.50	2	15
II 2265.99	4	10	II 2344.28	6	20	II 2434.24	3	10 n
I 2266.90	15	..	2345.07	20 n	..	2434.73	6	30
I 2267.47	15	..	II 2345.34	..	20	II 2434.94	6	20
II 2267.59	2	35	II 2348.10	5	20	II 2436.22	..	10
II 2268.14	..	12	II 2348.30	5	20	2436.34	25	..
II 2268.85	..	10	II 2354.47	5	15	II 2436.63	4	25 n
I 2269.10	12	..	II 2354.89	10	10	I 2438.18	30	4
I 2270.86	10	..	II 2357.01	..	10	II 2439.30	15	100
I 2271.78	35	..	II 2359.10	15	20	2439.74	20	12
I 2272.07	15	3	II 2360.00	10	8	2440.11	25	8
I 2272.82	20	..	II 2360.29	10	8	II 2440.42	1	40
I 2274.09	15	15	II 2362.02	8	15	2442.57	70	10
2275.19	10	..	2363.94	10 w	..	I 2443.87	40	4
I 2276.02	20	10	II 2364.83	15	30	II 2444.51	25	60
I 2277.10	15	..	II 2366.59	10	20	II 2445.56	15	40
I 2277.67	25	..	II 2368.59	15	25	II 2445.78	2	15
I 2279.92	15	40	II 2369.96	3	15 n	II 2446.10	3	35
I 2280.22	15	..	II 2372.63	10	..	II 2446.46	3	40
I 2283.65	10	..	II 2373.73	6	15	II 2447.20	1	30
I 2284.08	25	20	II 2375.19	..	15	II 2447.32	1	15
I 2287.25	20	6	II 2376.45	3	50 n	I 2447.71	70	100
I 2289.03	25	..	II 2379.27	12	15	II 2447.75	..	80
I 2290.06	10	..	II 2380.76	12	15	II 2449.96	1	30
I 2290.54	15	..	II 2382.04	40 r	100 r	II 2450.20	1	15
I 2291.12	15	..	II 2383.24	8	12	2450.44	15	..
I 2291.62	10	2	2384.39	20	5	II 2451.21	..	15

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2453.47	20	3	I 2487.06	25	10	II 2525.39	20	60
II 2453.80	1	10	I 2488.15	600 r	100 r	II 2526.07	3	20
II 2454.58	..	80	2488.95	10	1	II 2526.29	10	60
2455.56	15 n	..	II 2489.49	1	40	II 2527.10	1	60
II 2455.90	..	25 n	I 2489.75	200 r	2	I 2526.43	200 r	50
II 2456.64	..	15	II 2489.82	1	50	II 2527.69	1	30
II 2456.82	..	20	I 2490.64	200 r	10	2529.08	..	70
2457.59	70	30	II 2490.73	1	10	I 2529.13	80 r	5
II 2458.78	7	60	II 2490.86	..	15	2529.31	10	..
2458.96	..	10	I 2491.15	150 r	10	II 2529.55	15	100
II 2460.45	1	15 n	II 2491.39	..	30	I 2529.83	50 r	2
2460.60	15	..	2491.98	10	..	II 2530.11	2	30
2461.06	20	..	II 2492.34	..	30	2530.69	25	70
II 2461.28	5	50	II 2493.18	10	100	2532.53	10	..
II 2461.86	15	70	II 2493.26	10	100	II 2533.63	8	50
I 2462.18	50 r	3	I 2493.99	20	1	2533.80	12	..
I 2462.64	200 r	50	I 2494.25	10	..	II 2534.42	7	50
II 2463.28	6	60	I 2495.86	25	35	II 2535.48	..	20
I 2463.73	15	7	2496.53	40	15	I 2535.60	1000	..
II 2464.01	5	80	2496.99	20	1	II 2536.82	10	4
II 2464.90	4	50	2497.30	..	15	II 2538.20	2	35
I 2465.15	70	..	II 2497.82	15	50	II 2538.50	2	10
II 2465.20	..	50	I 2498.89	20	70	II 2538.81	15	30
2465.45	15	..	2500.93	12	40	2538.99	10	20
II 2465.91	7	100	I 2501.13	100 r	25	I 2539.36	15	..
II 2466.68	1	10	I 2501.69	20	4	2539.98	3	20 n
II 2466.82	1	30	II 2502.39	3	60	II 2540.66	6	30
I 2467.73	10	2	II 2503.32	5	50	I 2540.97	100 r	10
II 2468.29	1	30	II 2503.56	2	20	II 2541.10	1	15
2468.88	40	15	2503.65	80	..	2542.10	40	8
2469.51	2	40	II 2503.87	8	70	II 2542.73	1	40
II 2470.41	1	40	2505.01	10	1	II 2543.38	5	50
II 2470.66	8	50	II 2505.22	2	25	2543.65	700	..
I 2470.97	25	1	2505.49	10	1	2543.92	40	20
II 2472.07	..	25	2505.63	12	..	2544.71	100	5
I 2472.34	30	5	II 2506.09	2	70	II 2544.97	2	10
II 2472.43	..	15	2506.57	10	..	II 2545.22	4	25
I 2472.88	300 r	25	II 2507.01	1	10	I 2545.98	100 r	30
I 2472.91	1000	..	2507.90	40	6	II 2546.66	1	30
II 2474.76	..	60	2508.33	..	20 n	2546.87	40	1
2474.81	40	50	2508.75	20	1	II 2547.33	1	35
II 2475.55	..	10 n	II 2509.12	1	50	2548.08	50	..
2476.03	20 n	..	I 2510.83	300 r	50	II 2548.33	..	10
II 2476.27	..	35	II 2511.76	25	100	2548.74	..	12
I 2476.65	15	25	2512.10	..	30	II 2549.08	3	30
II 2477.34	1	40	2512.36	12	1	II 2549.39	1	10
II 2478.12	..	20	II 2512.52	..	40	II 2549.46	1	15
II 2478.57	4	40	II 2514.91	1	25	I 2549.61	70 r	2
II 2479.78	200 r	30	2515.10	..	30	II 2550.02	15	40
II 2480.16	10	80	I 2516.57	10	1	2550.51	25	..
II 2481.05	..	40	II 2517.12	10	60	II 2550.68	3	30
II 2481.57	..	15	I 2517.66	20	12	2551.09	25	1
II 2482.11	3	50	I 2518.10	200 r	50	2552.61	15	2
II 2482.65	1	50	II 2519.05	..	70	2552.77	20	..
I 2483 27	500 rn	50	2519.63	30	20	2553.18	10	20
II 2483.72	..	25	2520.88	80	..	II 2553.73	..	15
I 2484.19	100 r	5	II 2521.09	2	20	II 2555.07	20	20
II 2484.24	..	20	2521.81	1	60	2555.22	10	..
II 2484.56	..	10 n	II 2522.20	1	10	II 2555.44	2	35
2485.98	10	1	I 2522.85	300 r	50	2556.30	15	1
II 2486.34	..	80	2523.66	15	10	2556.86	20	1
2486.37	40	..	I 2524.29	100 r	50	II 2557.08	..	10
2486.69	30	3	2525.02	20	1	II 2557.50	1	50

II. EMISSION SPECTRA 2000–10,000 A (Continued)

Iron (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2558.48	10	20	I 2599.57	1000	..	I 2641.65	100	60
II 2559.24	..	20	2600.10	10	..	II 2642.01	..	20
II 2559.77	3	30	2600.20	10	..	I 2644.00	150	150
II 2559.93	2	15	2603.56	20	3	II 2645.08	..	20
II 2560.27	10	80	2604.76	20	1	I 2645.43	50	10
I 2560.56	15	..	2604.87	18	..	II 2646.22	..	10
I 2561.85	15	..	2605.04	..	80	I 2647.56	100	70
II 2562.10	2	25	II 2605.30	..	50	II 2649.46	..	70
I 2562.23	15	..	II 2605.41	..	40	II 2650.49	..	150 n
II 2562.53	50	150	I 2605.65	80	10	I 2651.71	60	60
2563.40	5	25 n	2605.90	..	20	II 2652.57	1	40
II 2563.47	70	125	2606.31	10	..	2656.15	70	40
I, II 2563.83	2	10	II 2606.50	..	80	I 2656.80	50	25
I 2564.55	15	..	I 2606.82	200	30	II 2657.92	..	20
2566.21	2	40	II 2607.09	300	400	II 2658.25	..	80
2566.29	3	10	2608.58	100	10	2658.47	20	2
2566.41	1	15	II 2608.85	..	20	2658.93	10	2
II 2566.62	3	15	II 2609.13	..	20	I 2660.40	40	15
II 2566.91	60	150	2609.22	10	1	I 2661.20	10	7
2567.87	12	..	II 2609.44	..	10	2661.31	12	10
II 2568.40	..	80	II 2609.87	..	40	I 2662.06	70	40
I 2568.86	20	10	I 2610.75	40	4	2662.31	25	10
II 2568.88	..	25	II 2611.07	20	80	II 2662.56	2 n	15 n
I 2569.60	20	1	II 2611.87	500	500	2663.78	10 n	3 n
I 2569.74	10	12	I 2612.77	50	10	2664.04	15	5
II 2569.76	..	60	2613.19	15	..	2664.26	..	10
2570.52	10	5	2613.24	10	2	II 2664.66	20	300
II 2570.84	70	100	II 2613.82	400	400	I 2666.40	70	10
II 2571.55	..	15	I 2614.49	40	5	II 2666.63	5	80
2572.97	1	15	II 2614.87	..	10	I 2666.82	80	15
II 2573.21	..	40	2615.42	25	10	I 2666.97	30	10
II 2574.37	50	150	II 2617.62	300	400	I 2667.92	50	20
2575.74	80	10	I 2618.02	150	60	2669.50	50	25
I 2576.69	40	5	I 2618.71	70	25	2669.93	..	25
II 2576.86	2	70	II 2619.08	5	150	II 2670.38	..	10
II 2577.92	30	100	II 2620.17	..	40	2670.80	10	4
I 2579.27	12	6 n	II 2620.41	70	40	II 2671.40	..	25 w
II 2579.41	1	10	II 2620.69	3	80	II 2672.15	1 Wn	25 w
2579.84	10	1	II 2621.67	200	400	II 2672.51	..	15 w
I 2580.06	10	..	2623.12	..	30	I 2673.21	30	15
II 2580.71	..	10	I 2623.37	25	10	2675.28	30	15
2581.11	1	25	I 2623.53	100	80	2676.11	15 w	7 w
2581.46	12	..	II 2623.73	..	20	2676.88	2	25
2582.30	50	..	2625.49	1	60	2678.05	20	10
II 2582.58	25	80	II 2625.67	300	60	I 2679.06	200	200
2583.75	250	..	II 2626.50	3	80	2680.16	20	8
I 2584.54	100	30	2627.14	1	10	I 2680.45	70	35
II 2585.88	70	100	II 2628.29	400	400	II 2680.79	..	12
II 2587.95	..	50	I, II 2629.59	60	150	II 2681.03	..	20
2587.99	40	..	II 2630.07	10	100	2681.59	50	25
II 2588.79	1	20	II 2631.05	200	125	2682.21	30	15
II 2590.54	2	35	II 2631.32	150	60	2682.52	..	40
2591.26	20	..	II 2631.61	10	50	2682.99	..	40
II 2591.54	50	100	I 2632.24	100	60	2683.95	15	8
2592.29	12	..	I 2632.60	80	40	2684.07	30	15
2592.78	20	100	2632.99	10	..	II 2684.75	3	400
2593.52	25	..	2633.19	..	80	II 2686.39	..	10
II 2593.73	15	70	2635.39	..	20	2686.75	50	6
2594.04	20	2	I 2635.81	300	200	2687.80	20	10
I 2594.15	20	2	I 2636.48	50	20	I 2689.21	150	150
II 2598.37	700	1000 n	II 2637.64	2	200	I 2689.83	40	40
2598.85	20	..	II 2639.55	1	100	2689.88	10	..
II 2599.40	1000	1000 n	II 2641.13	..	20	I 2690.07	30	30

Iron (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2691.73	..	35	II 2732.00	..	40	II 2762.44	..	10
I 2692.25	20	4	II 2732.45	8	20	2762.68	50	1
II 2692.60	..	300	2732.94	..	40	I 2762.78	25	10
I 2692.65	20	..	I 2733.58	300	200	I 2763.11	100	70
II 2692.84	15	20	I 2734.00	40	25	II 2763.91	1	25
II 2693.86	..	30	I 2734.27	50	25	2764.33	70	40
2694.54	100	35	I 2734.62	20	8	II 2764.78	..	20
2695.04	30	20	I 2735.47	125	100	2766.66	15	6
2695.53	40	30	I 2735.61	20	10	I 2766.91	90	40
2695.66	20	12	2736.78	10 n	2 n	II 2767.50	10	400 wn
2695.99	80	50	I 2737.31	300 r	150	I 2767.52	300	..
2696.28	90	50	II 2737.63	..	10	2768.11	35	8
I 2697.02	50	25	2737.64	10	..	2768.44	25	5
II 2697.31	2	15	2737.83	25	10	II 2768.93	40	100
II 2697.46	3	50	I 2738.21	10	2	II 2769.14	1	15
2698.16	35	6	II 2739.55	200	300 n	2769.30	90	10
I 2699.11	100	60	2741.11	10	3	II 2769.35	1	20
2701.91	20	5	II 2741.40	..	70	I 2769.67	60	20
2702.45	15	10	I 2742.02	35	15	II 2770.51	..	50
II 2703.99	30	400	I 2742.26	25	25	2770.70	20	7
II 2704.58	5	10	I 2742.41	50	50	II 2771.18	..	50
2706.01	60	40	II 2743.20	80	150	2771.89	12	6
I 2706.58	150	150	2743.56	50	15	I 2772.11	300	300
II 2707.13	..	70	I 2744.07	150	8	2772.33	50	10
2707.45	20	6	I 2744.53	70	50	2772.51	30	20
2708.57	80	50	2745.08	10	1	2772.83	15	4
II 2709.06	3	100	II 2746.16	..	10	2773.24	90	40
2709.99	40	10	II 2746.48	150	300 wn	2773.90	10	5
I 2710.55	80	35	II 2746.98	200	300 wn	II 2774.69	..	50
2711.46	12	3	I 2747.56	30	5	I 2774.73	80	10
I 2711.65	100	50	II 2749.18	40	40	II 2776.17	..	40
II 2711.84	4	100	II 2749.32	30	30	2776.40	100	30
II 2712.39	2	100	II 2749.48	15	20	II 2776.92	..	25 n
2714.06	20	3	I 2750.14	300 n	100	2778.07	30	10
II 2714.41	200	400	I 2750.72	15	..	I 2778.22	100	80
I 2714.87	40	15	2750.88	60	20	2778.84	70	40
I 2715.32	12	5	II 2751.12	..	70	II 2779.30	25	300
II 2716.22	20	150	2751.37	15	..	II 2779.91	..	40
2717.37	15	5	2751.81	15	5	II 2780.04	..	20
2717.79	50	25	2752.09	1	20	2780.54	10	2
I 2718.43	80	60	II 2752.16	..	10	2780.70	30	15
I 2719.02	500 r	300 r	2753.10	25	..	2780.89	10	3
2719.42	20	12	II 2753.29	25	150 n	I 2781.83	90	60
2720.20	35	25	I 2753.69	70	25	2782.05	12	6
I 2720.90	700 r	..	I 2754.04	90	35	II 2783.70	20	400
II 2721.82	..	30	2754.43	70	20	2784.01	12	3
II 2722.04	20	70	II 2754.91	..	18	2784.35	15	6
2722.74	..	80	2754.95	25	..	II 2785.21	..	40 n
I 2723.58	300	200	2755.18	15	..	2786.78	15	7
2724.68	10	2	II 2755.74	300	100	II 2787.26	..	10 n
II 2724.88	15	25	I 2756.26	300	100	I 2787.93	25	15
I 2724.96	25	15	I 2756.33	300	100	I 2788.10	150	150
I 2725.61	15	5	II 2756.51	10	7	I 2789.48	60	30
2726.05	100	80	II 2757.02	10	30	2789.80	50	25
2726.24	25	12	I 2757.32	100	60	II 2790.56	..	35
II 2726.51	..	15	2757.86	25	10	2791.01	..	10
II 2727.38	1 n	40	2758.51	2	25 n	2791.46	40	20
II 2727.54	150	150	II 2759.33	2	12	2791.79	60	40
2728.02	100	40	I 2759.82	100	60	2792.40	50	25
2728.82	50	15	2760.90	15	8	II 2793.89	8	150
I 2728.97	15	5	I 2761.78	200	..	2794.16	10	..
II 2730.74	80	150	II 2761.81	50	200	I 2794.70	50	30
I 2730.98	70	15	I 2762.03	100	60			

II. EMISSION SPECTRA 2000–10,000 A (Continued)

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2795.01	50	35	I 2843.63	125	100	2889.88	20	15
I 2795.54	90	60	I 2843.98	300	300	2889.99	15	8
2795.85	15 W	10	2845.54	125	7	2891.71	15	10
II 2796.65	..	20	I 2845.59	125	7	2891.91	25	10
I 2796.87	15	3	I 2846.82	20	12	2892.48	100	40
I 2797.77	150	80	II 2848.05	..	70	II 2892.83	2	20
II 2797.91	..	20	II 2848.12	..	10	I 2893.76	15	8
2799.15	50	10	I 2848.72	60	30	I 2893.88	25	20
II 2799.29	1	100	II 2849.61	..	50	2894.50	150	150
II 2799.72	..	10	I 2851.80	200	150	II 2894.78	..	80
2800.46	50	10	2852.13	150	80	I 2895.03	125	70
2803.12	35	15	II 2853.20	..	10	II 2895.21	..	80
I 2803.17	15	..	I 2853.69	15	7	II 2897.26	..	200
2803.62	50	20	2853.77	15	7	2898.35	100	30
II 2804.02	..	15	II 2855.67	2	200	2899.41	125	100
I 2804.52	300	200	II 2856.14	1	40	I 2901.38	100	80
2804.80	20	15	II 2856.93	..	15 n	2901.91	125	40
II 2805.31	..	15	II 2857.17	..	30	II 2902.47	1	35
II 2805.79	..	50	II 2857.41	..	10	2904.16	15	8
2806.07	15	5	2857.81	12	2	II 2906.12	..	40
I 2806.98	200	200	2857.99	12	2	2906.42	60	25
I 2807.24	15	8	II 2858.34	3	200	I 2907.52	100	80
2808.32	100	40	I 2858.90	100	30	II 2907.86	2	20
II 2809.81	1	100 n	II 2861.19	1	30	2908.86	80	40
2810.26	40	15	I 2862.50	100	50	2909.50	70	35
II 2811.27	..	40	I 2863.43	100	80	2910.92	10	4
2812.05	15	10	I 2863.86	125	100	I 2912.16	150	150
II 2812.49	2	25	II 2864.37	..	10	2914.20	10	5
I 2813.29	400	400	II 2864.97	..	50	I 2914.31	50	25
II 2813.61	5	60	I 2866.63	125	80	II 2917.09	..	20
2815.02	15	8	2867.31	60	30	II 2917.47	2	25
I 2815.51	40	25	2867.56	60	30	2918.03	125	100
II 2817.11	..	20 n	2868.21	15	8	2918.36	40	25
I 2817.51	100	60	II 2868.45	80	40	2918.82	15	8
2819.29	10	..	II 2868.87	5	60	2919.21	15	10
2820.81	20	15	I 2869.31	300	70	2919.85	80	35
I 2823.28	200	300	2869.83	10	5	I 2920.69	150	80
2825.56	150	150	II 2870.60	..	15	2920.99	12	7
I 2825.69	70	60	II 2871.06	..	40	II 2922.02	..	50
II 2826.03	..	25	II 2871.13	..	20	I 2922.38	10	4
2826.50	10	8	I 2872.34	150	50	2922.62	50	25
II 2827.43	..	25	II 2872.38	2	20	2923.29	50	35
2827.60	15	12	II 2873.40	..	300	2923.44	30	12
I 2827.89	70	50	2873.53	15	1	2923.85	100	70
II 2828.63	..	80	I 2874.17	300	200	2925.36	70	50
2828.81	100	60	2874.88	60	20	2925.79	15	6
2830.96	10	..	I 2875.30	125	50	I 2925.90	15	10
II 2831.56	1	500	II 2875.35	..	70	II 2926.59	150	400
I 2832.44	300	200	2876.01	15	..	2927.55	20	12
2833.40	10	8	2876.80	..	100	I 2928.10	10	4
2834.75	15	10	I 2877.30	200	125	I 2929.01	150	100
I 2835.46	100	100	II 2879.24	..	25	2929.12	10	10
I 2835.95	15	10	I 2880.58	15	5	I 2929.62	50	10
II 2836.19	3	10	II 2880.76	15	50	2931.43	10	3
II 2836.51	3	12	II 2880.83	1	25	2931.60	..	15
II 2836.72	..	20	II 2883.70	..	300	2931.81	10	6
II 2837.30	..	25	2883.73	30	..	II 2936.02	5	10
I 2838.12	150	150	II 2884.78	..	25 n	I 2936.90	700 r	500 r
II 2839.53	4	25	II 2885.93	..	70	2937.81	300	150
II 2839.82	..	10 n	I 2886.32	50	15	I 2939.08	80	20
2840.42	125	20	II 2887.31	3	20	II 2939.51	3	30
II 2840.65	..	70	2887.81	80	60	2940.59	200	80
II 2840.76	..	35	II 2888.09	..	80	I 2941.34	600	300

Iron (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2942.63	10	5	2991.64	100	80	3066.48	60	40
2943.57	12	6	I 2994.43	1000 r	600 r	I 3067.24	300	300
II 2944.40	70	600	2996.39	90	50	3067.94	15	10
2945.05	100	30	II 2997.30	..	60	I 3068.17	150	150
2945.70	10	5	I 2999.51	500	300	3073.98	40	25
2947.36	30	20	II 3000.06	..	10	3074.15	40	25
II 2947.66	10	100	I 3000.45	100	80	3074.44	40	25
I 2947.88	600 r	200	I 3000.95	800 r	300 r	I 3075.72	400	400
2948.43	80	70	II 3002.65	20	150	II 3077.17	1	300
I 2948.73	10	7	I 3003.03	200	100	3077.64	60	25
I 2948.95	10	4	3004.12	18	10	3078.02	100	80
2949.70	10	5	3005.31	70	40	I 3078.43	80	50
2950.24	700	300	I 3007.14	100	80	II 3078.70	4	15 n
2951.56	10	4	I 3007.28	80	60	3079.98	30	20
2953.49	100	50	I 3008.14	600 r	400 r	3080.11	30	15
II 2953.78	5	80	3009.09	80	60	I 3083.74	500	500
I 2953.94	400 r	150	I 3009.57	500	400	II 3089.39	..	10
2954.65	100	70	3011.48	125	125	3090.21	30	15
I 2956.70	25 n	8 n	3012.45	50	30	I 3091.58	300	200
I 2957.36	300	300	I 3014.17	70	35	3092.78	50	30
2959.34	60	25	3015.91	70	50	3093.36	70	40
II 2959.60	..	60	I 3016.18	200	150	I 3093.81	50	40
2959.68	150	10	I 3017.63	150	150	3093.88	40	30
2959.99	150	80	I 3018.98	150	150	I 3094.90	30	15
2960.30	60	30	I 3020.49	300 r	300 r	3095.27	10	6
2960.55	10	5	I 3020.64	1000 r	600 r	II 3096.30	2	30
II 2961.28	3	40	I 3021.07	700 r	300 r	3096.84	30	20
II 2964.63	8	150	I 3024.03	300	200	3097.81	20 n	10 n
II 2965.04	4	50	3025.28	50	30	I 3098.19	70	60
I 2965.25	400	150	3025.64	100	100	I 3099.90	60	60
2965.81	25	15	I 3025.84	400 r	300 r	I 3099.97	40	40
I 2966.90	1000 r	600 r	I 3026.46	200	200	I 3100.30	100	100
2968.48	30	20	I 3029.23	80	60	I 3100.67	100	100
I 2969.36	80	80	3030.15	300	300	3102.87	30	20
I 2969.48	60	60	3031.21	150	150	II 3105.17	..	60
II 2969.93	..	15	I 3031.64	200	200	II 3105.55	1	30
I 2970.10	400	200	3033.10	40	20	II 3106.56	1	30
II 2970.51	30	100	I 3034.54	70	40	3107.98	20	10
II 2970.68	..	10	3035.74	100	60	3110.28	40	30
I 2972.28	100	40	I 3037.39	700 r	400 r	3110.84	20	10
I 2973.13	500 r	400 r	3039.32	20	15	3111.82	10	6
I 2973.24	500 r	400 r	I 3040.43	400	400	3112.08	30	20
2974.78	10	6	I 3041.64	80	80	3113.59	25	10
II 2975.94	3	40	I 3041.74	100	80	II 3114.29	..	80
2976.13	100	60	I 3042.02	125	100	II 3114.68	..	10
I 2976.55	15	10	I 3042.66	300	200	II 3116.59	..	150
II 2979.09	..	30	II 3044.84	..	12	I 3116.63	150	..
II 2979.35	20	100	3045.08	150	100	3117.64	20	10
2980.54	100	70	3045.59	10	7	3119.49	100	80
II 2980.96	..	10	I 3047.60	800 r	500 r	3120.43	100	80
I 2981.45	300	200	3048.45	100	8	3120.87	80	50
I 2981.85	100	50	3049.36	25	8	3122.30	70	20
II 2982.06	..	90	3053.07	100	80	3123.35	10	4
II 2982.23	5	10	I 3053.44	80	50	3124.89	15	7
I 2983.57	1000 r	400 r	I 3055.26	200	150	I 3125.65	400	300
I, II 2984.83	200 r	400	3055.71	10	6	3126.17	150	70
II 2985.55	80	300	II 3056.80	4	25	3128.90	10	5
I 2986.46	100	60	I 3057.45	400	400	3129.10	15	8
II 2986.61	..	30	I 3059.09	600 r	400	I 3129.33	100	60
2986.65	15	..	I 3060.99	50	35	II 3131.72	..	35
I 2987.29	300	200	II 3062.23	2	400	3132.51	70	40
I 2988.47	60	30	3063.93	40	30	II 3133.05	..	35
2990.39	150	100	II 3065.31	..	60	I 3134.11	200	125

IRON (Continued)

Wave length	Arc	Spark
II 3135.36	1	100
3135.45	10	3
3136.50	60	40
3138.52	10	5
I 3139.66	15	8
3139.91	70	40
3140.39	100	80
I 3142.45	125	100
3142.88	80	70
3143.24	60	30
3143.99	200	150
I 3144.49	150	100
II 3144.76	..	50
3145.06	40	25
3147.29	20	10
3147.60	10	5
3147.79	40	15
3148.41	100	40
3150.30	60	30
3151.35	300	150
I 3151.87	40	15
I 3153.21	100	80
3153.37	15	15
3153.75	40	15
II 3154.21	400	..
3154.50	20	5
3155.30	50	35
3156.27	125	100
I 3157.04	150	100
3157.45	10	5
I 3157.89	100	100
I 3157.98	10	6
3160.20	70	50
3160.34	40	20
I 3160.66	150	125
I 3161.37	80	60
I 3161.95	200	150
I 3162.33	70	50
II 3162.80	1	100
II 3163.10	1	10
3163.87	40	25
I 3164.30	20	10
I 3165.01	100	60
I 3165.86	100	80
3166.44	100	80
II 3167.86	2	100
3167.92	100	30
3168.15	10	3
3168.86	30	15
II 3170.35	10	50
I 3171.35	100	80
I 3171.66	30	10
I 3172.07	100	100
3173.41	20	10
3173.61	20	20
3173.69	20	20
I 3175.45	200	200
3175.99	12	5
I 3176.36	20	10
II 3177.53	5	300
I 3178.01	300	150
3178.55	10	6
3178.97	30	15
II 3180.16	10	15
I 3180.23	300	300
I 3180.75	100	100
3181.52	80	70
3181.85	15	15
3181.91	15	15
3182.06	80	80
3182.97	125	70
II 3183.11	7	50
I 3184.62	60	40
I 3184.90	200	150
II 3185.32	..	25
II 3186.74	20	300
II 3187.29	..	60
3188.03	4	10
I 3188.57	150	100
I 3188.82	150	100
3190.02	30	10
I 3190.65	50	25
3190.82	40	20
3191.11	20	8
I 3191.66	200	150
II 3192.06	..	10
3192.41	12	6
I 3192.80	150	8
I 3193.23	100	70
I 3193.30	20	15
I, II 3193.80	10	50
I 3194.43	100	70
3194.60	60	20
II 3196.08	10	150
3196.13	100	..
I 3196.93	500	300
I 3196.99	150	..
3197.52	10	8
I 3199.52	300	200
I 3200.47	150	150
I 3200.78	25	15
3202.56	40	20
I 3205.40	300	200
I 3207.09	80	50
3208.47	100	80
3209.30	200	125
I 3210.24	150	100
II 3210.45	5	50
I 3210.83	150	100
3211.49	80	40
I 3211.68	80	50
3211.88	10	10
I 3211.99	70	50
II 3213.31	50	300
I 3214.04	400	200
II 3214.40	100	50
3215.42	10	4
I 3215.94	300	150
I 3217.38	200	125
I 3219.58	200	125
I 3219.81	100	80
I 3222.07	200	100
I 3225.79	300	150
I 3227.06	30	10
II 3227.75	200	300
I 3228.25	100	80
3228.90	80	40
I 3229.12	80	50
3229.59	10	5
3229.87	10	10
3229.99	20	20
I 3230.21	100	80
I 3230.97	300	200
II 3231.71	..	30
II 3232.79	..	50
3233.05	100	60
I 3233.97	300	150
I 3234.61	200	125
I 3236.22	300	200
II 3237.40	..	10
II 3237.82	1	100
I 3239.44	400	300
3243.11	50	20
3243.40	70	20
II 3243.72	..	60
I 3244.19	300	200
I 3245.98	200	150
3246.48	40	25
I 3246.96	100	70
II 3247.17	..	10
3247.21	10	10
I 3247.28	20	10
I 3248.21	200	150
3249.19	70	35
II 3249.66	..	10
3250.39	20	6
I 3250.63	60	40
I 3251.23	300	150
3252.44	90	40
3252.93	80	50
3253.60	100	80
3253.95	20	8
3254.36	200	150
3254.73	15	6
II 3255.89	20	100
3256.70	20	7
I 3257.24	25	12
I 3257.59	100	100
II 3258.77	..	150
II 3259.05	1	200
I 3259.99	150	100
3260.26	20	15
3261.33	25	7
3262.01	30	15
3262.28	50	25
I 3263.37	30	15
I 3264.51	80	60
I 3265.05	200	150
I 3265.62	300	300
II 3266.94	..	15
I 3268.24	125	100
3269.23	20	6
I 3271.00	300	300
3271.49	15	7
I 3271.68	25	15
3274.45	80	60
I 3276.47	100	50
II 3276.61	..	10
II 3277.35	40	200

II. EMISSION SPECTRA 2000–10,000 A (Continued)

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3278.73	100	60	3356.69	15	1	I 3451.62	15	4
3280.26	150	150	I 3359.49	15	3	I 3451.92	100	60
II 3281.30	15	100	3359.81	10	2	I 3452.28	150	8
3282.89	80	80	3366.79	50	25	3453.02	30	15
I 3284.59	200	125	3366.87	50	15	3458.31	60	25
II 3285.41	60	40	3367.16	10	3	3459.43	10	3
I 3286.02	30	15	3369.55	300	200	I 3459.92	80	50
I 3286.75	500	400	3370.79	300	200	I 3462.36	10	3
3288.65	15	6	I 3372.08	40	7	I 3465.86	500	400
3288.97	30	15	3378.68	150	80	I 3466.50	30	70
II 3289.35	..	40	I 3379.02	80	50	3466.89	10	4
3289.44	10	4	3380.11	200	25	II 3468.68	10	20
3290.72	15	7	I 3382.41	50	10	I 3468.85	30	12
I 3290.99	125	80	I 3383.70	100	70	3469.01	18	1
3292.02	150	125	I 3383.98	200	100	I 3469.83	35	10
I 3292.59	300	150	3387.41	35	8	I 3471.27	40	15
3293.14	10	5	I 3389.75	15	4	I 3471.34	40	15
II 3295.82	4	30	3392.01	20	6	3473.31	10	2
3296.47	12	6	I 3392.31	125	80	3474.44	10	6
II 3297.89	4	15	I 3392.66	300	200	I 3475.45	400	300
I 3298.13	200	150	3394.59	150	80	I 3476.70	300	200
3301.22	15	7	I 3396.98	125	25	3477.86	20	4
3303.57	70	10	I 3397.64	10	2	3478.63	20	6
I 3305.97	400	300	I 3399.34	200	200	I 3483.01	50	10
I 3306.35	200	150	I 3401.52	150	90	I 3485.34	100	50
3307.23	80	60	3402.26	150	150	3489.67	20	15
3310.34	100	80	I 3404.30	25	25	I 3490.57	400	300
3310.49	50	40	I 3404.36	100	50	II 3493.47	40	80
3314.45	15	6	3406.44	30	10	I 3495.29	100	60
3314.74	200	200	I 3406.80	100	60	I 3497.11	200	100
I 3317.12	100	80	I 3407.46	400	400	I 3497.84	200	200
3319.25	70	50	3409.20	40	4	3500.57	50	20
I 3320.65	20	10	3410.18	30	20	I 3504.86	10	5
3320.78	30	12	I 3410.90	10	2	3505.06	10	10
3322.48	150	100	3411.36	80	30	I 3506.50	50	30
II 3323.07	..	100	I 3413.13	400	300	3508.48	40	20
3323.74	150	150	I 3415.53	60	20	I 3508.53	20	10
I 3324.54	100	80	I 3417.84	150	100	I 3509.87	15	4
I 3325.46	100	80	I 3418.51	150	100	I 3510.45	15	8
I 3327.49	15	7	3422.49	40	10	I 3513.06	10	2
3328.87	150	100	I 3422.66	100	50	I 3513.82	400	300
3329.53	35	6	I 3424.29	200	150	3516.42	40	15
I 3331.61	125	70	3425.01	70	40	3516.56	30	4
3331.78	40	10	I 3426.39	80	20	I 3518.88	10	2
I 3334.22	150 n	100 n	I 3426.64	80	60	3520.85	10	4
3335.77	125	100	I 3427.12	50	50	I 3521.26	300	200
3336.25	40	30	I 3428.20	50	50	I 3521.84	50	20
3337.67	125	100	I 3431.81	50	20	I 3522.28	50	30
3338.64	70	25	3433.04	50	1 n	I 3522.89	10	3
I 3339.19	80	50	II 3436.11	5	15	3523.31	10	4
I 3339.58	10	5	3437.05	80	15	3524.07	50	40
I 3340.57	125	100	3437.95	15	7	I 3524.24	60	50
3341.90	100	80	3438.31	10	3 n	I 3526.04	80	50
I 3342.22	40	40	3439.87	15	7	I 3526.17	50	25
3342.29	20	20	I 3440.61	500	300	3526.38	20	10
I 3346.94	30	15	I 3440.99	300	200	I 3526.46	20	10
I 3347.93	150	100	I 3442.36	50	15	I 3526.68	80	50
I 3351.52	70	60	I 3442.68	30	5	I 3527.80	100	80
3351.74	80	60	I 3443.88	400	200	3529.82	125	80
I 3353.27	10	5	I 3445.15	300	150	I 3530.39	50	25
3354.06	40	40	3445.77	10	3	3533.01	50	75
3355.23	100	100	I 3447.28	100	60	I 3533.20	50	50
I 3356.40	35	8	I 3450.33	150	80	I 3536.19	40	10

II. EMISSION SPECTRA 2000–10,000 A (Continued)

Iron (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3536.56	300	200	I 3592.69	12	2	3644.80	20	6
I 3537.49	25	8	I 3594.64	125	100	I 3645.08	20	8
I 3537.73	25	15	I 3595.31	20	7	I 3645.49	15	7
I 3537.90	50	25	3596.20	15	5	3645.82	80	60
I 3540.12	100	60	3597.06	40	10	I 3647.43	20	15
I 3540.71	10	4	3599.15	10	5	I 3647.84	500	400
I 3541.09	200	200	3599.62	40	30	I 3649.30	60	25
I 3542.08	150	100	I 3602.08	20	5	I 3649.51	100	100
3543.39	10	2	3602.47	10	5	I 3650.03	70	30
3543.67	60	30	I 3602.53	50	30	I 3650.28	70	50
3544.63	50	6	I 3603.21	150	80	I 3651.10	10	3
I 3545.64	90	70	I 3603.82	20	12	I 3651.47	300	200
I 3547.20	25	8	3604.38	10	1	I 3653.76	25	10
I 3548.02	10	7	I 3605.21	12	2	I 3655.47	25	25
I 3549.87	15	5	I 3605.46	300	150	3655.67	15	2 n
3552.12	10	6	I 3606.68	200	150	3656.23	15	5
I 3552.83	80	50	I 3608.15	15	25	I 3657.14	20	7
3553.74	100	100	I 3608.86	500	400	I 3657.90	20	4
I 3554.12	50	20	I 3610.16	100	90	I 3659.52	125	80
I 3554.93	400	300	I 3610.70	10	3	I 3661.37	10	1
I 3556.88	300	150	I 3612.07	80	50	3662.85	30	5
3557.30	15	..	I 3612.94	20	4	I 3663.46	25	7
I 3558.52	400	300	3613.45	10	2	I 3664.54	35	8
3559.51	50	25	3614.12	10	3	3664.69	12	3
3560.70	50	15	3614.56	15	6	I 3666.25	20	7
I 3564.12	15	2	3615.20	10	1	3667.26	80	25
3564.53	30	15	I 3615.66	10	2	I 3667.99	60	10
I 3565.38	400	300	I 3616.57	30	7	I 3668.21	15	4
I 3565.59	10	4	3617.32	25	15	I 3669.16	50	30
I 3567.04	50	15	3617.79	125	80	I 3669.52	200	150
I 3567.38	10	2	I 3618.77	400	400	I 3670.03	100	..
I 3568.42	20	4	3619.39	12	1	3670.07	200	200
3568.82	15	7	3620.47	15	2	I 3670.81	20	6
I 3568.98	50	35	I 3621.46	125	100	3673.09	10	4
I 3570.10	300	300	I 3622.00	125	100	3674.41	12	5
3570.26	50	15	I 3623.19	100	80	3674.77	40	25
I 3571.23	40	6	I 3623.45	15	5	I 3676.31	200	100
I 3571.99	100	80	I 3623.77	35	7	I 3676.88	10	2
3573.40	50	20	I 3624.31	10	2	3677.31	40	30
3573.84	20	15	3624.81	12	2	3677.63	80	60
3573.89	40	30	I 3625.15	70	35	I 3678.86	100	50
I 3575.12	15	5	3627.04	10	3	I 3679.91	500	300
I 3575.25	10	5	I 3628.09	10	3	3680.80	12	7
3575.37	40	30	I 3630.35	40	15	I 3682.21	400	300
I 3575.98	80	25	I 3631.10	25	10	I 3683.06	200	100
3576.76	80	40	I 3631.46	500	300	I 3684.11	300	200
I 3578.38	40	5	3632.04	50	50	I 3686.00	150	125
I 3581.19	1000 r	600 r	3632.56	30	25	3686.26	10	4
3582.20	30	30	I 3632.98	12	8	I 3687.10	15	7
3583.34	50	15	3633.08	10	3	I 3687.46	400	300
I 3584.66	100	60	I 3634.33	15	5	I 3687.66	15	15
3584.96	30	25	3634.69	20	2	3688.48	40	8
I 3585.32	150	100	I 3635.20	12	2	I 3689.46	200	150
I 3585.71	125	80	I 3636.19	40	10	3690.46	15	6
3586.11	80	80	3636.23	15	10	3690.73	80	60
I 3586.99	200	150	I 3636.99	20	10	3693.03	15	7
I 3587.42	10	5	I 3637.25	12	5	I 3694.01	400	300
I 3587.76	50	25	I 3637.87	20	7	3695.05	200	150
I 3588.62	35	10	I 3638.30	100	80	I 3697.43	100	60
I 3588.91	10	4	I 3640.39	300	200	3698.60	40	20
I 3589.11	70	30	3642.81	20	..	I 3699.14	15	3
I 3589.46	50	30	3643.11	30	5	I 3701.09	300	200
I 3591.34	12	3	I 3643.63	20	8	3702.03	50	30

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3702.49	20	7	3773.70	40	10	I 3840.44	400	300
I 3703.56	30	25	I 3774.83	100	40	I 3841.05	500	400
I 3703.70	12	7	3776.46	125	70	3843.26	125	100
3703.82	15	10	3777.06	12	7	3844.28	10	1
I 3704.46	125	100	I 3777.45	20	10	3845.17	100	60
I 3705.57	700	500	3778.51	60	25	3845.70	10	6
I 3707.05	150	100	I 3778.70	10	4	3846.00	10	1
I 3707.82	80	50	I 3779.45	100	70	3846.41	50	75
I 3707.92	80	60	I 3781.19	40	12	I 3846.80	125	100
I 3709.25	600	400	3781.93	12	5	I 3849.97	500	400
I 3711.22	80	50	I 3782.46	10	2	I 3850.82	200	75
3711.41	50	25	3785.71	10	4	I 3852.57	150	100
I 3715.91	80	50	3785.95	125	80	I 3856.37	500	300
I 3716.45	150	100	I 3786.18	100	60	I 3859.22	100	100
I 3718.41	80	50	I 3786.68	125	50	I 3859.91	1000 r	600
I 3719.93	1000 r	700	3787.17	25	15	3861.34	80	50
I 3721.51	10	4	I 3787.88	500	300	I 3863.74	60	30
3721.92	15	10	3789.18	80	50	I 3865.53	600	400
I 3722.56	500	400	I 3790.09	200	100	I 3867.22	150	100
I 3724.38	200	150	I 3790.76	10	3	I 3867.92	30	8
3725.49	15	8	I 3792.16	40	20	I 3869.56	100	80
I 3726.92	100	70	I 3792.83	10	3	I 3871.75	100	60
I 3727.09	30	10	I 3793.48	10	5	I 3872.50	300	300
I 3727.62	200	150	I 3793.88	25	10	I 3873.76	125	80
I 3728.67	18	10	3794.34	80	50	3876.04	40	15
3730.39	70	40	I 3795.00	500	400	I 3878.02	400	300
3730.95	50	30	3797.52	300	200	I 3878.57	300 r	300
3731.38	40	20	3798.51	400	300	I 3878.68	30	..
3732.40	200	150	I 3799.55	400	300	3878.74	10	10
I 3733.32	400	300	3801.68	50	25	3883.29	70	40
I 3734.87	1000 r	600	I 3801.98	25	5	3884.36	80	35
I 3735.33	30	20	3802.28	25	10	I 3885.51	100	60
I 3737.13	1000 r	600	I 3804.01	40	10	I 3886.28	600	400
3738.31	100	100	3805.34	400	300	3888.82	40	15
I 3739.13	10	5	3806.22	40	20	3890.24	15	
3739.53	80	35	I 3806.70	200	150	3890.84	60	30
3740.25	70	35	I 3807.54	150	100	3891.93	100	70
I 3742.62	50	25	I 3808.73	100	70	I 3893.39	100	8
I 3743.36	200	150	3809.57	15	5	I 3893.91	10	4
3743.48	4	10	3810.76	70	25	I 3895.66	400	300
I 3744.10	40	20	I 3811.89	15	10	I 3897.45	10	5
I 3745.56	500	500	I 3812.96	400	300	3897.89	100	60
I 3745.90	150	100	3813.63	35	15	I 3898.01	80	50
3746.93	40	25	3813.89	50	25	I 3899.04	20	8
I 3748.26	500	200	I 3814.52	80	40	I 3899.71	500	300
I 3648.97	35	20	3814.78	10	5	I 3900.52	60	3 d
I 3749.49	1000 r	700	I 3815.84	700	700	I 3902.95	500	400
I 3752.42	12	4	I 3816.34	25	20	I 3903.90	100	80
I 3753.61	150	100	3817.65	50	15	I 3906.48	300	200
I 3754.50	2 n	10	I 3820.43	800	600	3906.75	10	10
3756.07	15	8	3821.18	100	100	3907.47	15	6
3756.94	80	10	I 3821.84	50	30	3907.94	100	60
3757.45	15	10	I 3824.44	150	100	I 3909.67	20	5
I 3758.23	700	700	I 3825.88	500	400	I 3909.83	40	12
I 3760.05	150	100	I 3827.82	200	200	I 3910.84	30	10
3760.53	100	70	3829.46	15	8	I 3913.63	100	25
I 3761.41	20	8	I 3830.76	10	3	I 3914.28	15	3
I 3763.79	500	400	I 3830.86	12	4	3916.73	100	80
3765.54	200	150	I 3833.31	100	60	I 3917.18	150	70
I 3767.19	500	400	I 3834.22	400	400	I 3918.32	20	10
I 3768.03	15	8	3836.33	100	60	3918.42	15	10
I 3769.99	80	30	I 3837.14	25	6	I 3918.65	60	40
I 3770.30	35	12	3839.26	100	75	I 3919.07	15	7

II. EMISSION SPECTRA 2000–10,000 A (Continued)

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3920.26	500	300	I 3997.40	300	150	I 4098.19	100	40
I 3922.91	600	400	I 3998.05	150	100	4100.17	10	1
I 3925.20	15	3	4000.45	35	10	I 4100.74	80	30
I 3925.65	80	50	I 4001.67	80	50	I 4101.27	40	10
I 3925.95	50	30	4003.77	30	80	I 4104.13	100	25
I 3927.92	500	300	4004.84	10	7	I 4106.44	10	2
I 3928.08	15	15	I 4005.25	250	200	I 4107.49	120	100
3929.12	10	5	4006.31	60	35	I 4109.07	12	2
3929.21	15	8	4006.63	20	15	I 4109.81	120	100
I 3930.30	600	400	I 4007.27	80	50	4112.97	70	10
I 3931.12	35	15	I 4009.72	120	100	I 4114.45	80	50
I 3932.63	80	40	I 4013.79	80	40	4114.96	10	2
I 3933.60	200	200	4013.82	200	. .	4118.55	200	100
I 3935.31	40	8	4014.53	200	100	4120.21	80	35
I 3935.81	100	8	I 4016.43	15	4	I 4121.81	100	40
I 3937.33	80	35	I 4017.15	80	50	I 4122.51	70	30
I 3940.88	150	80	I 4018.27	50	7	4123.74	80	20
I 3941.28	60	10	I 4021.87	200	100	4125.62	80	30
I 3942.44	100	70	I 4024.74	120	30	I 4125.88	25	15
I 3943.35	40	8	I 4029.64	80	25	I 4126.19	80	60
I 3944.90	15	8	I 4030.19	20	4	I 4127.61	100	80
3945.13	30	10	I 4030.49	120	60	4127.80	25	15
I 3947.00	50	20	4031.96	80	50	I 4130.04	20	3
I 3947.53	70	20	I 4032.63	80	15	I 4132.06	300	200
I 3948.11	125	50	4040.64	20	7	I 4133.86	50	7
3948.78	150	100	I 4043.90	25	7	I 4134.42	10	3
I 3949.96	150	100	I 4044.61	70	35	I 4134.68	150	100
3951.17	150	125	I 4045.81	400	300	4137.00	100	80
I 3952.60	80	50	I 4049.33	10	2	I 4139.92	40	30
I 3953.15	80	40	4049.87	30	3	I 4141.87	15	5
I 3955.35	25	5	4051.91	10	2	I 4143.42	200	100
3955.96	10	5	I 4054.83	25	5	I 4143.87	400	250
3956.46	100	100	I 4054.88	25	5	I 4146.07	15	3
I 3956.68	150	150	I 4055.04	40	10	I 4147.67	200	100
3957.03	50	15	I 4057.35	20	3	I 4149.37	100	35
3960.28	30	6	4058.23	80	25	I 4150.26	50	2
I 3961.14	25	7	I 4058.76	40	10	I 4152.17	70	5
I 3963.11	125	50	4059.72	15	8	I 4153.91	120	100
I 3964.52	80	25	I 4062.44	120	100	I 4154.50	100	80
I 3965.51	10	3	I 4063.28	10	10	I 4154.81	100	8
I 3966.07	100	70	I 4063.60	400	300	I 4156.80	100	80
I 3966.63	80	40	I 4065.39	15	6	I 4157.79	150	80
3967.42	125	100	4066.59	40	20	I 4158.80	100	25
I 3967.97	60	15	I 4066.98	100	80	I 4161.08	10	. .
I 3969.26	600	400	I 4067.27	80	70	4161.49	15	. .
3970.39	50	30	I 4067.98	150	100	I 4163.68	12	1
I 3971.33	200	125	I 4070.78	50	20	4165.42	12	2
3973.65	40	10	I 4071.74	300	200	4167.96	10	2
I 3974.40	10	1	I 4073.77	80	20	4168.95	10	1
3976.61	8	35	I 4074.79	80	40	I 4170.91	80	40
I 3976.86	30	10	I 4076.64	80	50	4172.13	80	50
I 3977.74	300	150	I 4078.36	80	40	I 4172.75	60	10
I 3981.77	150	100	I 4079.84	80	40	I 4173.32	25	5
I 3983.96	200	125	I 4080.22	60	10	I 4173.93	50	5
3985.39	125	40	I 4082.12	10	2	I 4174.92	100	25
I 3986.17	125	8	I 4083.55	10	2	I 4175.64	100	80
3989.01	15 wn	1 wn	I 4083.78	15	2	I 4176.57	100	50
3989.86	30	5	I 4084.50	120	80	I 4177.60	100	25
3990.38	70	25	I 4085.01	80	30	II 4178.87	10	10
I 3994.12	25	10	I 4085.32	100	70	I 4181.76	200	150
3995.20	10	. .	I 4087.10	50	5	I 4182.39	80	30
I 3995.99	60	20	I 4089.22	10	2	I 4184.89	100	80
3996.97	40	20	I 4095.98	80	40	I 4187.04	250	200

II. EMISSION SPECTRA 2000–10,000 A (Continued)

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 4187.80	200	150	4285.44	125	50	I 4450.31	12	2
I 4191.44	200	100	I 4286.99	10	1	I 4454.38	200	80
I 4191.68	20	6	I 4288.15	50	6	I 4455.03	20	1
I 4195.34	150	100	4290.38	35	5	I 4458.11	30	1
I 4195.62	25	3	I 4290.87	20	2	I 4459.12	400	200
I 4196.21	100	50	I 4291.47	125	20	I 4461.65	300	125
I 4198.31	250	150	I 4292.29	15	..	I 4464.78	35	3
I 4198.64	10	2	I 4294.13	700	400	I 4466.55	500	300
I 4199.10	300	200	I 4298.04	100	400	I 4469.38	200	100
I 4200.93	80	20	I 4299.24	500	400	4472.72	10	1
I 4202.03	400	300	I 4302.19	50	10	I 4476.02	500	300
4202.76	10	4	II 4303.17	12	15	I 4479.62	15	2
I 4203.57	10	1	I 4305.45	100	50	I 4480.14	10	2
I 4203.99	200	120	I 4307.91	1000 r	800 r	I 4482.17	150	70
I 4205.55	50	6	4309.04	40	20	I 4482.26	150	70
I 4206.70	125	25	I 4309.38	125	70	I 4482.75	20	2
I 4207.13	80	40	I 4315.09	500	300	I 4484.22	125	40
4208.61	100	50	4321.80	20	4	I 4485.68	50	2
I 4210.35	300	200	I 4325.76	1000	700	I 4489.74	100	12
4213.65	100	60	I 4326.76	10	4	I 4490.09	40	10
I 4215.42	60	15	4327.10	100	50	I 4490.76	40	1
I 4216.19	200	100	4330.15	10	2	I 4494.57	400	150
I 4217.55	200	100	I 4337.05	400	150	II 4508.28	40	30
I 4219.36	250	200	4343.26	20	3	II 4515.34	10	10
4220.35	80	40	4343.70	12	2	I 4517.53	30	3
I 4222.22	200	200	4346.56	50	10	II 4520.24	40	30
I 4224.18	200	80	I 4351.55	30	5	II 4522.63	60	50
I 4224.52	60	15	II 4351.76	30	30	I 4525.15	100	50
I 4225.46	80	20	I 4352.74	300	150	4526.42	10	1
I 4225.96	80	30	I 4358.50	70	20	I 4528.62	600	200
I 4226.43	80	25	I 4367.58	100	50	4529.68	10	2
I 4227.43	300	250	I 4367.91	60	70	I 4531.15	125	...
I 4229.76	20	2	I 4369.77	200	100	4547.85	200	100
I 4232.73	10	1	I 4373.57	50	3	II 4549.47	100	100
II 4233.17	100	100	I 4375.93	500	200	4550.79	50	..
I 4233.61	250	150	4382.77	10	10	4552.55	10	1
I 4235.94	300	200	I 4383.55	1000	800	II 4555.89	12	12
I 4238.04	80	15	II 4385.38	4	10	I 4556.12	150	35
II 4238.82	200	100	I 4387.90	150	35	I 4560.10	20	..
4239.73	30	10	I 4388.41	125	50	I 4568.78	10	1
I 4239.85	40	15	I 4389.25	35	2	I 4574.72	12	1
4240.37	30	5	I 4390.95	100	35	I 4581.52	60	2
4243.37	10	3	I 4395.29	80	..	II 4583.85	150	150
I 4245.26	80	40	4400.35	20	1	4587.14	12	2
4246 09	80	30	I 4401.30	60	15	I 4592.65	200	50
I 4247.43	200	100	I 4404.75	1000	700	4595.36	15	2
I 4248.23	150	40	I 4407.72	100	50	I 4596.06	10	2
I 4250.13	250	150	I 4408.42	125	60	I 4598.13	50	4
I 4250.79	400	250	4410.71	20	..	I 4602.01	20	2
I 4258.32	60	4	I 4415.12	600	400	I 4602.94	300	100
I 4258.61	12	2	I 4422.57	300	125	I 4607.65	50	5
I 4260.00	15	5	I 4427.31	500	200	I 4611.29	200	25
I 4260.48	400	300	I 4430.21	10	1	I 4613.22	30	2
I 4264.21	35	4	I 4430.62	200	8	I 4618.76	10	1
I 4264.74	12	2	I 4433.22	150	20	I 4619.30	100	8
I 4266.97	70	30	I 4433.79	30	2	I 4625.05	100	12
4267.83	125	60	I 4435.15	70	3	I 4630.13	10	2
4268.76	30	10	I 4436.93	15	2	I 4632.92	70	4
I 4271.16	400	300	I 4438.35	10	1	I 4635.85	12	1
I 4271.76	1000	700	I 4442.34	400	200	I 4637.52	100	10
I 4273.87	10	2	I 4443.20	200	100	I 4638.02	80	10
I 4276.68	10	1	I 4446.84	10	10	I 4643.47	35	2
I 4282.41	600	300	I 4447.72	200	100	I 4647.44	125	40

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 4654.50	20	3	I 4957.31	100	20	I 5133.68	200 n	1 n
I 4654.62	10	2	I 4957.61	300	150	II 5136.79	3	100
I 4667.46	150	20	4962.56	10 n	. .	I 5137.39	200 n	. .
I 4668.14	125	10	I 4966.10	300	1	I 5139.26	125	. .
I 4669.18	15	2	4969.93	50	. .	I 5139.48	200	40
I 4673.17	20	2	4970.50	20	. .	I 5141.75	100	100 n
I 4678.85	150	100	I 4973.11	100	. .	I 5142.54	100 n	. .
I 4691.41	80	10	I 4978.61	80	. .	I 5142.94	125	. .
4704.96	10	1	4982.51	200	. .	I 5145.10	10	. .
I 4707.28	100	12	I 4983.26	100 n	. .	I 5148.05	20	. .
4708.96	50	50	I 4983.85	200 n	. .	I 5148.26	35	. .
I 4709.10	20	2	I 4985.26	100	. .	I 5150.84	150	. .
I 4710.29	20	2	I 4985.56	100	. .	I 5151.91	70	. .
4714.07	50	50	I 4988.96	100 n	. .	5159.05	35 n	. .
I 4727.41	10	. .	I 4991.28	80	. .	I 5162.29	300 n	. .
I 4728.56	20	1	I 4994.13	200	. .	5164.61	70 n	. .
I 4729.70	25	25	4995.63	3	60	I 5165.42	50	. .
I 4733.60	15	1	4997.80	20	300	I 5166.30	125	. .
4735.85	10	1	I 5001.87	300	40	I 5167.49	700	150
I 4736.78	125	50	I 5002.81	20	. .	I 5168.90	80	. .
I 4741.53	12	1	5004.79	3	100	II 5169.03	2	200 n
4747.48	30	25 n	5005.72	200	. .	I 5171.60	300	60 n
I 4772.82	10	4	I 5006.13	300	5	5180.06	10	. .
I 4786.81	150	. .	I 5007.29	25 n	. .	I 5184.29	20	. .
I 4788.75	40	. .	5010.85	50	. .	I 5191.47	400	35
I 4789.65	100	. .	I 5012.07	300	. .	I 5192.36	400	50
I 4791.25	200	200 r	I 5014.96	500	. .	I 5194.95	200	15
4800.66	15	. .	II 5018.44	80	50	I 5195.48	100 n	. .
4821.05	200 n	200 n	I 5022.25	150	. .	5196.10	25 n	. .
I 4859.75	150	40	5023.48	10	300	II 5197.59	. .	10
I 4871.32	200	100	I 5027.14	60	. .	I 5198.71	80	. .
I 4872.15	100	30	5027.21	60	. .	5198.84	10	. .
I 4878.22	80	4	5028.14	100	. .	I 5202.34	300	10
I 4889.01	2 wn	150 n	II 5030.78	1	125	I 5204.58	125	. .
I 4890.77	100	15	I 5039.26	100	2 n	I 5208.60	200	8
I 4891.50	70	15	I 5041.08	125	. .	I 5215.18	200	5
I 4903.32	500	2	I 5041.76	300	. .	I 5216.28	300	10
I 4905.18	10	. .	I 5044.22	25	. .	I 5217.40	150	3
I 4907.74	25	. .	I 5048.45	50	. .	I 5225.53	60	. .
I 4909.39	50	. .	I 5049.82	400	1	I 5226.87	200	15
I 4910.03	100	. .	I 5051.64	200	. .	I 5227.19	400	60
I 4910.33	15	. .	I 5065.02	25 n	. .	5228.41	15 n	6 n
I 4910.57	15	. .	5065.20	15	. .	I 5229.87	200	15 n
I 4911.80	10	. .	I 5068.79	400	200	I 5232.94	800	150
I 4918.99	300	50	5070.96	1	70	I 5235.39	35	. .
I 4920.50	500	125	5073.56	. .	20 n	5242.49	125	5
4923.72	5	100	I 5074.76	80	. .	I 5243.79	20	. .
II 4923.92	30	50	I 5078.99	20 n	. .	I 5247.06	50	10
I 4924.78	100	. .	I 5079.24	100	. .	I 5250.21	30	. .
I 4925.29	1000 r	50 r	I 5079.75	100	. .	I 5250.65	150	. .
4927.45	50	6	I 5083.34	200	. .	5251.97	12	. .
4927.87	20	. .	5086.76	2	100	I 5253.48	70	. .
I 4930.33	25	. .	I 5090.79	40 n	. .	I 5254.96	50	. .
4933.35	50	30	I 5096.99	35 n	. .	I 5263.33	300	. .
4933.63	2	70	I 5098.71	200	. .	I 5266.58	500	40
I 4934.02	40	. .	I 5102.20	80	. .	I 5269.54	800	200
I 4938.18	100	. .	5106.44	25	. .	I 5270.36	400	80
I 4938.82	300	1	I 5107.45	100	. .	I 5273.17	80	4
I 4939.24	10 n	. .	I 5110.41	300	. .	I 5273.38	50	4
I 4939.69	150	2	I 5123.72	200	. .	II 5275.99	2	15
I 4946.40	5	40	I 5125.13	100 n	. .	5280.36	15	. .
4946.64	1	50	I 5127.36	100	. .	I 5281.80	300	20
I 4950.10	. .	10	I 5131.47	125	. .	I 5283.63	400	40

II. EMISSION SPECTRA 2000–10,000 A (Continued)

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 5284.09	..	70 n	I 5525.55	40	2	I 6003.03	30	15
5287.92	100	20	I 5534.66	20	..	I 6007.97	10 n	10 n
5288.53	30	..	II 5534.86	..	10	I 6008.58	18	10
I 5290.85	15	..	5535.41	50	..	6013.50	100	..
5298.78	12	..	5538.57	50	..	I 6016.65	100	..
I 5302.31	300	..	5539.28	30	..	I 6020.18	8	10 n
II 5303.42	25	25	5543.18	25	..	I 6021.83	300	..
I 5307.36	125	..	I 5543.93	10	..	I 6024.06	20	20 n
II 5316.61	..	150	I 5546.49	40	..	6027.06	6	12
I 5322.05	30	..	I 5554.89	100	..	I 6056.00	10	10 n
I 5324.18	400	70	I 5562.71	15 n	..	I 6065.49	50	30
I 5328.05	400	100	I 5563.60	100	5	I 6102.18	15	20 n
I 5328.53	150	35	I 5565.70	70	..	6103.33	..	40
5329.99	15	..	I 5567.40	30	..	I 6136.62	100	..
I 5339.94	200	30	I 5569.62	300	15	I 6137.00	10	..
I 5341.03	200	15	I 5572.85	300	25	I 6137.70	100	..
I 5343.47	12 n	..	I 5576.11	150	..	I 6141.76	10	..
I 5353.39	60	2	5584.76	25	2	6157.73	15	..
II 5362.86	..	15	I 5586.76	400	50	I 6170.50	15	..
5364.88	200 n	10 n	5594.66	10	..	I 6173.34	18	..
5365.40	40	..	I 5598.29	20	..	I 6191.56	100	20 n
5367.46	200 n	15 n	I 5602.96	45	35	I 6200.33	15	..
5369.96	150 n	20 n	I 5615.30	4	12	I 6213.44	20	..
I 5371.49	700	..	I 5615.65	400	300	I 6219.29	40	5
I 5373.71	15	..	I 5618.64	10	8	I 6230.73	60	50
5379.58	35	..	I 5624.55	150	125	I 6246.33	20	20 n
5383.37	400 n	40	5633.96	20	10	I 6252.56	60	25 n
I 5389.46	60	..	I 5638.27	40	20	I 6254.26	10	..
I 5391.47	25	..	I 5641.46	15	8	I 6265.14	12 n	5 n
I 5393.18	150	10	I 5655.50	10	5	I 6297.80	10 n	15 n
I 5397.13	400	50	I 5658.54	30	2	I 6301.52	50	50 n
I 5398.28	70	..	I 5658.83	100	80	I 6302.51	15 n	15 n
I 5400.50	125	..	I 5662.52	50	50	I 6318.02	40	25 n
5403.82	30	..	5686.52	10	8	I 6335.33	50	20 n
I 5404.15	300	35	I 5701.56	50	25	I 6336.84	60	35 n
I 5405.78	400	70	I 5705.98	15	10	I 6355.04	15 n	8 n
I 5409.13	10 n	..	I 5709.38	100 n	..	6380.75	25 n	8 n
I 5410.91	200	10	I 5717.84	10	2	I 6393.60	100	80 n
I 5415.21	500	20	I 5731.77	10	3	I 6400.02	200	150 n
5424.08	400	20	I 5753.14	40	20	I 6408.03	50	30 n
I 5429.70	500	40	I 5763.01	80	35	I 6411.66	100	80 n
I 5434.53	300	35	I 5775.09	12	2	I 6419.98	18 n	15 n
I 5445.04	150	..	I 5806.73	10	5 n	I 6421.35	60	40 n
I 5446.92	300	35	5816.38	15 d	10 n	I 6340.85	100	80
5449.78	10	...	5833.64	2	10	II 6446.43	..	20
I 5455.43	50	..	I 5859.61	15	12	I 6462.73	20	7 n
I 5455.61	300	30	I 5862.36	35	35	I 6481.87	12 n	80 wn
5457.65	18	2	5869.76	10	..	I 6494.98	400	150
I 5462.97	50	..	5875.37	15 n	..	6496.46	10	..
I 5463.28	100	..	I 5883.85	15	10	II 6516.05	..	20
I 5466.41	25	..	5905.68	12	8 n	I 6518.37	10 n	7 n
I 5473.92	100	..	5912.83	10	..	I 6546.24	150	50
5474.92	100	..	I 5914.16	50	25 n	I 6569.22	50	25 n
5476.29	12	...	I 5916.26	25	4	I 6575.02	12 n	15 n
I 5476.58	80	..	5927.81	10	..	I 6592.92	150	80
I 5480.87	10	..	I 5930.19	30	10 n	I 6593.88	30	18
I 5483.12	15	..	I 5934.68	15	12 n	I 6597.61	10	..
I 5487.14	50	5	I 5956.71	12	...	I 6609.12	25	12 n
I 5487.77	10 n	..	5975.36	10	10	I 6633.77	60 n	25 Wn
I 5497.52	150	5	I 5983.70	35	12 n	I 6663.45	70	25 n
I 5501.47	150	..	I 5984.80	50	20 n	I 6677.99	250	150
I 5506.78	150	10	I 5987.05	25 n	12 n	I 6705.12	12 n	12 wn
5514.63	50	10	5999.95	10 n	..	6726.78	15	..

IRON (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 6750.16	50	18 n	I 7306.61	25	12 n	I 8365.64	15	..
I 6752.73	9	12 wn	7307.96	30	..	I 8387.78	35	1
I 6810.25	15	18 n	II 7307.97	..	25 n	I 8468.41	20	..
6820.38	10	7 n	I 7311.10	60	25 n	I 8514.07	10	..
I 6828.61	18	25 n	II 7320.70	25	18 n	I 8611.81	10	..
I 6841.35	50	50 n	I 7351.56	18	7 n	I 8661.91	100	..
I 6843.67	30	35 n	7376.46	..	10 wn	I 8674.75	50	..
I 6855.18	60	80 n	I 7386.40	40	25 n	I 8688.63	150	..
I 6858.16	15	15 n	I 7389.42	100	80 n	I 8710.29	20 n	..
I 6885.77	10 n	8 n	7401.69	10	..	I 8713.19	10	..
I 6916.70	35	5 wn	I 7411.18	100	..	I 8757.19	50	..
I 6945.21	60	20 n	7418.67	10	..	I 8764.00	100	..
I 6951.26	10 n	..	I 7440.98	18 n	..	I 8790.62	10 n	..
I 6978.85	60	12 n	I 7445.78	150	..	I 8793.38	125	..
I 6999.90	25	..	II 7462.38	3	20	I 8804.62	10	..
I 7016.44	100	25 n	I 7476.30	12 n	..	I 8824.23	200	..
I 7023.00	40	30 n	I 7491.68	20	..	I 8838.43	30	..
I 7024.65	15	8 wn	I 7495.09	200	..	I 8866.96	150	..
I 7038.25	7	20 n	I 7507.28	40	..	I 8919.95	10	..
7067.44	..	10 n	I 7511.04	20	1	I 8945.20	20	..
I 7068.41	40	30	I 7531.17	80	..	I 8975.41	15	..
I 7090.40	50	25 n	I 7586.04	10	..	I 8999.56	100	..
I 7130.94	100	80 n	I 7653.76	80	..	I 9012.10	30	..
7132.99	15	10 n	I 7661.22	10	..	I 9024.47	15	..
I 7142.52	12 n	8 n	I 7664.30	15	..	I 9088.33	40	..
I 7145.32	15 n	10 n	I 7710.39	10	..	I 9089.41	30	..
I 7155.64	10 n	..	II 7711.73	25	15	I 9118.89	20	..
I 7164.47	200	100 n	I 7748.28	25	..	I 9258.31	20	..
I 7176.89	10 n	..	I 7780.59	25	..	I 9259.06	15	..
I 7187.34	500	300	I 7832.22	30	1	I 9350.44	10	..
I 7207.41	300	300	I 7937.17	40	1	I 9401.14	10 n	..
7219.69	12	18 n	I 7945.88	30	2	I 9414.14	20 n	..
I 7221.23	10	8 n	I 7998.97	35	1	I 9443.98	10 n	..
II 7222.39	..	15 n	I 8028.34	100	..	I 9513.24	10 n	..
I 7223.67	20	..	I 8046.07	25	1	I 9569.96	40 n	..
II 7224.51	..	12	I 8085.20	20	1 n	I 9626.56	30 n	..
I 7239.88	25	20 n	I 8198.95	20	..	I 9653.14	20	..
I 7244.86	18	..	I 8207.77	100	..	I 9738.62	200	..
I 7254.65	10 n	8 wn	I 8232.35	10	..	I 9753.13	10	..
I 7261.54	18 n	10 n	I 8248.15	10	..	I 9763.45	15	..
7264.99	..	10	8264.27	20	..	I 9763.91	15	..
7284.85	15	15 n	I 8327.06	40	2	I 9800.33	20	..
I 7288.76	30	20 n	I 8331.94	20	..	I 9861.79	30	..
I 7293.07	100	50 n	I 8339.43	18	..	I 9889.08	40	..

KRYPTON

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
2353.68	..	50	II 3200.40	..	50 n	I 3665.33	..	80
II 2464.77	..	100 n	II 3405.16	..	80 wnl	3669.01	..	150 nl
II 2592.48	..	60	II 3446.51	..	50 wn	I 3679.56	..	50
II 2712.40	..	80 n	II 3460.09	..	50	I 3679.61	..	50
2733.26	..	50	II 3503.25	..	50 wnl	II 3680.37	..	100 wnl
2795.81	..	80 n	II 3535.35	..	50 nl	II 3686.15	..	80 wnl
II 2816.46	..	60	II 3589.65	..	70 wnl	II 3718.02	..	300 nl
II 2833.00	..	100	II 3607.88	..	100 wnl	II 3718.63	..	200 nl
II 2967.25	..	80 wn	II 3631.87	..	200 nl	II 3721.35	..	150 nl
II 3150.93	..	80 n	II 3653.97	..	250 nl	II 3741.69	..	200 nl

II. EMISSION SPECTRA 2000–10,000 A (Continued)

Krypton (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 3744.80	..	150 ns	II 4481.85	..	50 wnl	I 5580.39	..	80
II 3754.24	..	80	II 4489.88	..	400 nl	II 5633.02	..	100 n
I 3773.42	..	50	I 4502.36	..	600	I 5649.56	..	100
II 3778.09	..	500 nl	II 4523.14	..	400 nl	I 5672.45	..	50
II 3783.13	..	500 nl	II 4556.61	..	200 nl	II 5681.89	..	400
II 3844.45	..	50 wnl	II 4577.20	..	800	II 5690.35	..	200 wns
II 3875.44	..	150 wnl	II 4582.85	..	300 nl	II 5752.98	..	60
II 3894.71	..	60 wnl	II 4592.80	..	150 wnl	II 5771.41	..	100
II 3906.25	..	150 nl	II 4598.49	..	50 nl	I 5832.86	..	100
II 3912.59	..	70	II 4604.02	..	60 nl	I 5866.75	..	50
II 3917.64	..	50 wnl	II 4610.65	..	60 nl	I 5870.92	..	3000
II 3920.14	..	200 nl	II 4615.28	..	500	I 5879.90	..	50
II 3954.78	..	90 wnl	II 4619.15	..	1000	II 5992.22	..	200
II 3994.83	..	100	II 4633.88	..	800	I 5993.85	..	60
II 3997.95	..	100 wnl	II 4658.87	..	2000	I 6012.16	..	50
II 4044.67	..	80	II 4680.41	..	500	I 6056.13	..	60
II 4050.42	..	50 wnl	II 4691.28	..	100	II 6168.80	..	50
II 4057.01	..	300 ns	II 4694.44	..	200 nl	II 6303.66	..	100
II 4065.11	..	300	II 4695.66	..	50 nl	II 6416.61	..	60 ns
II 4088.33	..	500	II 4739.00	..	3000	II 6420.18	..	300
II 4098.72	..	250	II 4752.02	..	100 nl	I 6421.03	..	100
II 4109.23	..	100 ns	II 4762.43	..	300	I 6456.29	..	200
4137.96	..	50 wn	II 4765.74	..	1000	II 6470.89	..	50
4139.11	..	100 wnl	II 4796.33	..	60 nl	II 6510.95	..	100
II 4145.12	..	250	II 4811.76	..	300	II 6570.07	..	150
II 4185.12	..	50	II 4825.18	..	300	I 6699.23	..	60
II 4236.64	..	100 nl	II 4832.07	..	800	II 6763.61	..	100
II 4250.58	..	150	II 4846.60	..	700	II 6764.43	..	80
II 4252.67	..	50 ns	II 4857.20	..	150	II 6771.22	..	50
II 4254.85	..	100 nl	II 4915.94	..	100 nl	I 6813.10	..	50
4259.44	..	80 ns	II 4945.59	..	300	I 6904.68	..	100
II 4268.57	..	60 wnl	II 4948.50	..	50 nl	II 7073.97	..	60
II 4268.81	..	100 wnl	II 4960.25	..	100 nl	II 7139.99	..	60
I 4273.97	..	1000	II 4978.89	..	100 nl	II 7213.13	..	250
I 4282.97	..	100	II 4982.83	..	50 nl	I 7224.10	..	100
II 4292.92	..	600	II 5013.29	..	100	I 7287.26	..	80
I, II 4300.49	..	200	II 5021.88	..	100	II 7289.78	..	400 n
II 4317.81	..	500 wnl	II 5022.40	..	200	II 7407.02	..	400 n
I 4318.55	..	400	II 5033.85	..	100 wnl	I 7425.54	..	60
I 4319.58	..	1000	II 5046.31	..	80 wnl	II 7435.78	..	200 n
II 4322.98	..	150 wnl	II 5086.52	..	250 nl	I 7486.86	..	100
II 4331.24	..	80 wn	II 5125.73	..	400 wnl	II 7524.46	..	300 n
II 4333.34	..	50 wn	II 5143.05	..	600 nl	I 7587.41	..	1000
I 4351.36	..	100	II 5166.80	..	80	I 7601.54	..	5000
II 4355.48	..	3000	II 5186.99	..	60 wns	II 7641.16	..	150
I 4362.64	..	500	II 5200.22	..	60 wns	I 7685.25	..	1000
II 4369.69	..	200	II 5208.32	..	500	I 7694.54	..	1000
I 4376.12	..	800	II 5229.52	..	60	II 7735.69	..	200 n
II 4381.52	..	100 n	II 5276.50	..	100 n	I 7746.83	..	150
II 4385.27	..	50 wnl	II 5308.66	..	200	7781.97	..	100 n
II 4386.54	..	300 nl	II 5322.77	..	60 nl	I 7806.52	..	50
I 4399.97	..	200	II 5333.41	..	500 n	I 7854.82	..	800
II 4400.87	..	100 nl	II 5346.76	..	60 nl	I 7913.42	..	200
I 4410.37	..	50	II 5446.34	..	80	I 7928.60	..	150
I 4418.76	..	50	II 5468.17	..	200 ns	I 7982.41	..	100
II 4422.70	..	100 ns	I 5490.94	..	50	II 7993.22	..	50 n
I 4425.19	..	100	II 5499.54	..	50	I 8059.50	..	1000
II 4431.67	..	500	I 5500.71	..	50	I 8104.02	..	500
II 4436.81	..	600	II 5522.94	..	60	I 8104.36	..	5000
II 4453.21	..	50 wns	II 5552.99	..	100 wns	I 8112.90	..	5000
I 4453.92	..	600	I 5562.23	..	500	I 8132.98	..	60
I 4463.69	..	800	II 5568.65	..	100	I 8190.05	..	3000
II 4475.00	..	800 ns	I 5570.29	..	2000	I 8195.07	..	50

KRYPTON (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
I 8218.40	..	80	I 8928.69	..	2000	II 9577.52	..	125
I 8263.24	..	2000	I 8977.99	..	50	9605.80	..	125 Wn
I 8272.35	..	100	II 9238.48	..	125	9619.61	..	100 Wn
8281.05	..	1000	II 9293.82	..	100 Wl	II 9663.34	..	50
I 8298.11	..	5000	II 9320.99	..	70 n	I 9704.22	..	50
I 8412.43	..	100	I 9352.23	..	100	9711.60	..	50 Wn
I 8508.87	..	3000	II 9361.95	..	80	I 9743.11	..	50
I 8560.89	..	50	I 9362.03	..	100	I 9751.76	..	2000
I 8764.11	..	150	II 9402.82	..	50 Ws	9803.14	..	125
I 8774.05	..	50	II 9470.93	..	50 Wn	I 9856.24	...	500
I 8776.75	..	5000						

LANTHANUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2187.87	3	40	I 3641.52	25	4	II 4067.39	150	80
2216.11	2	25	II 3645.41	100	60	II 4077.34	600	400
II 2256.76	2 n	30	I 3649.51	40	8	I 4079.18	25	3
2297.78	2 n	150	II 3650.17	100	60	II 4086.71	500	500
2379.42	..	60	II 3662.07	60	40	I 4089.61	40	5
2476.75	..	30 n	I 3672.02	25	3	II 4099.54	100	100
II 2487.59	..	40	I 3704.53	25	4	I 4104.88	40	2
II 2519.21	..	50	II 3705.82	50	80 n	II 4123.23	500	500
II 2560.37	..	50	II 3713.54	200	60	4133.33	15	25
II 2610.33	10	150	II 3714.86	60	40	II 4141.74	200	200
II 2672.91	3	30	II 3715.52	100	50	I 4143.94	25	15 n
II 2695.46	3	35	II 3725.05	25	15	II 4151.95	200	300
II 2791.51	2	25	II 3759.08	400	150	II 4152.77	40	50
II 2798.55	2	40 nl	II 3780.67	50	50	I 4160.26	40	50
II 2808.39	10 d	150	II 3790.82	400	300	I 4187.32	50	40
II 2840.50	3	25 nl	II 3794.77	400	200	II 4192.36	50	50
II 2855.90	3	50 nl	II 3840.71	50	70	II 4196.55	200	150
II 2880.64	4	40	II 3845.99	40	50	II 4204.04	200	25
II 2885.14	5	50	II 3849.01	200	150	II 4217.55	200	100
II 2893.07	6	60	II 3854.91	..	40	II 4230.95	150	50
II 2950.49	3	50	II 3864.49	100	150	II 4238.38	500	300
II 3104.59	200	50	II 3871.63	200	15	II 4249.99	100	50
I 3109.44	25	2	II 3886.37	400	200	I 4256.91	50	..
II 3142.76	150	50	I 3898.60	30	5	II 4263.58	150	150
3171.69	2 n	1000 wn	II 3916.04	400	400	II 4269.49	150	150
II 3193.02	15	60	II 3921.53	400	200	I 4271.16	30	..
II 3245.12	400	300	I 3927.56	40	..	II 4275.64	40	500
II 3249.35	300	80	II 3929.22	400	300	I 4280.26	50	30
II 3265.67	300	200	II 3936.22	100	50	II 4286.97	400	300
II 3303.11	400	150	II 3949.11	1000	800	II 4296.05	200	200
II 3337.49	800	300 wn	I 3953.68	30	..	II 4300.43	25	20
I 3342.22	80	5	II 3988.52	1000	800	I 4306.00	30	..
II 3344.56	300	200 wn	II 3995.75	600	300	II 4315.90	50	3 n
II 3376.33	100	50	I 4015.39	100	2 n	II 4322.50	150	150
II 3380.91	200	100 n	II 4023.59	50	15	II 4333.73	800	500
II 3411.76	5	25 nl	II 4025.88	50	50	II 4334.96	40	50
II 3452.18	50	40	II 4031.69	400	300	I 4340.73	50	3
II 3453.17	50	40	I 4037.21	50	3 n	II 4354.40	80	100
II 3512.92	50	15	II 4042.91	400	300	I 4354.80	40	3
3517.11	..	25 n	II 4050.08	60	60	II 4364.67	50	50
I 3574.43	30	8	I 4060.32	80	5	bh 4372.0	40	..
II 3628.82	80	40 n	I 4064.78	40	3	bh 4375.8	30	..
II 3637.15	50	40	I 4065.58	30	2	II 4378.10	40	30

LANTHANUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 4383.45	10	50	II 4946.47	100	50	II 5610.53	2	40
bh 4418.1	25	..	I 4949.77	200	..	bh 5626.0	100	..
bh 4418.2	50	..	II 4952.07	50	40	bh 5628.6	100	..
I 4427.57	30	50	II 4970.39	125	100	I 5631.21	50	..
bh 4428.1	30	..	II 4986.83	150	100	I 5648.25	150	..
bh 4428.2	40	..	II 4991.28	100	80	bh 5652.3	50	..
II 4429.90	200	300	I 4993.88	80	..	bh 5654.8	50	..
II 4432.95	25	5	II 4996.82	25	30	I 5657.73	50	..
bh 4438.0	30	..	II 4999.47	400	300	II 5671.55	10	100
bh 4443.0	25	..	II 5014.45	2	30 nl	I 5696.19	50	..
II 4455.79	40	25	I 5046.88	80	..	II 5712.40	20	40
II 4522.37	200	400	I 5050.57	80	4	I 5720.02	25	..
II 4525.30	100	100	I 5056.46	80	..	I 5740.66	100	1
II 4526.11	100	150	I 5067.90	30	..	I 5744.41	80	..
II 4530.56	15	25	I 5106.23	100	10	I 5761.84	60	..
II 4540.71	4	25	II 5114.57	150	200	II 5769.07	30	60
I 4541.79	30	5	II 5122.99	150	200	I 5769.35	70	..
II 4558.46	100	200	I 5145.42	100	10	I 5770.01	25	..
II 4559.29	100	150	II 5156.74	40	40	I 5789.25	125	..
I 4567.91	100	25	II 5157.43	40	100	I 5791.34	200	..
I 4570.03	80	25	I 5158.69	50	..	II 5797.59	80	150
II 4574.87	300	300	II 5163.61	25	40	II 5805.78	60	120
II 4580.06	80	100	II 5173.85	20	25 n	II 5808.33	25	60
II 4605.78	100	100	I 5177.31	150	30	I 5821.99	40	..
II 4613.39	100	100	II 5183.42	300	400	I 5829.73	25	..
II 4619.88	150	200	I 5183.92	25	..	I 5855.59	30	..
II 4645.28	25	40	II 5188.23	50	500	II 5863.71	40	80
II 4647.51	10	50	II 5204.15	50	300	bh 5866.4	40	..
II 4655.50	150	300	I 5211.87	300 r	5	bh 5869.5	50	..
II 4662.51	150	200	I 5234.27	200 r	8 W	II 5880.65	30	50
II 4663.76	100	200	I 5253.46	100	5	bh 5893.6	60	..
II 4668.91	200 r	300 r	II 5259.39	40	50	I 5894.85	25	..
II 4671.83	100	150	I 5271.20	100	20	bh 5896.7	80	..
II 4691.18	10	25	II 5290.84	60	100	II 5901.95	2	40
II 4692.50	200	300	II 5301.98	300 r	200	I 5917.63	25	..
II 4699.63	200 r	200 r	II 5302.62	50	150	bh 5920.8	50	..
II 4703.28	200 r	300 r	II 5303.56	100	125	II 5927.71	..	30
I 4708.19	25	2	I 5304.03	25	..	I 5930.63	150	..
II 4712.93	100 r	150	II 5340.67	80	100	I 5930.67	100	..
II 4716.44	100	200	I 5357.87	40	..	II 5973.53	15	120
II 4717.59	15	25	II 5377.09	30	200	I 6007.38	70	..
II 4719.95	200 r	300	II 5380.99	50	100	I 6038.61	50	..
II 4728.42	400 r	300	II 5381.92	15	100	II 6100.38	30	15
II 4740.28	150	300	bh 5407.7	30	..	I 6107.28	25	..
II 4743.08	300 r	300	bh 5433.0	30	..	I 6108.49	70	..
II 4748.73	100	200	I 5455.15	200	1	I 6111.72	50	..
I 4750.41	40	40	II 5458.69	5	50	II 6126.09	20	25
I 4766.89	100	10	II 5464.38	25	30	I 6127.06	25	..
I 4770.43	25	5	II 5480.74	5	40	II 6129.55	40	25
II 4804.04	150	150	II 5482.27	25	50	I 6134.39	70 r	..
II 4809.01	150	150	5501.34	200	50	I 6142.98	50	..
II 4824.07	150	150	I 5503.81	100	..	I 6165.70	100	..
II 4826.89	15	30	I 5506.00	50	..	II 6188.09	8	50
I 4839.52	40	10	I 5510.34	200	..	II 6203.51	8	25
II 4840.00	35	10	I 5517.34	30	..	I 6234.85	25	..
II 4850.58	25	20	II 5535.67	50	100	I 6238.59	25	..
II 4860.91	100	100	I 5541.26	50 W	..	I 6249.93	300	..
I 4878.85	20	30	I 5568.47	40	..	II 6262.30	125	150
II 4899.92	400	200	I 5588.34	40	..	I 6266.03	80	..
I 4901.86	50	..	bh 5599.9	50	..	II 6273.76	5	50
II 4920.97	500	400	bh 5600.0	100	..	I 6293.56	30	..
II 4921.78	500	400	bh 5602.4	100	..	II 6296.10	50	150
II 4934.82	150	100	bh 5602.5	200	..	II 6310.93	10	100

Lanthanum (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 6315.82	4	25	I 6661.40	70	..	II 7282.34	70	125
II 6320.39	70	100	II 6671.38	10	25	I 7334.17	100	..
I 6325.92	30	..	I 6692.87	50	..	I 7345.31	125	..
II 6390.48	70	100	I 6709.50	150	..	I 8247.44	40	..
I 6394.23	150	..	II 6714.09	4	40	I 8324.69	80	..
II 6399.05	15	200	II 6718.67	3	30	I 8346.53	70	..
I 6410.99	100	..	I 6748.12	25	..	I 8476.48	25	..
II 6443.05	8	25 n	I 6753.02	100	..	I 8545.44	35	..
II 6446.60	15	100	II 6774.23	100	120	I 8672.11	25 w	..
I 6454.53	125	..	II 6813.64	5	25	I 8674.43	50 W	..
I 6455.99	100	..	I 6823.75	50	..	I 8748.38	25	..
I 6468.43	25	..	II 6834.02	25	10	I 8825.82	25 w	..
I 6485.55	50	..	I 6917.22	25	..	I 8957.73	25	..
II 6498.19	25	125	I 6925.21	100	..	I 9079.08	50	..
II 6526.99	125	100	I 6934.99	50	..	I 9412.64	80	..
I 6543.15	125	..	II 6958.08	25	50	I 9438.29	100	..
I 6578.51	100	..	I 7023.67	100 n	..	I 9461.79	50	..
I 6593.47	25	..	I 7032.03	40	..	I 9542.09	40	..
I 6600.17	40	..	I 7045.96	125	..	I 9633.72	40	..
I 6608.26	50	..	II 7066.21	400	150	9640.81	30	..
I 6616.58	125	..	I 7068.36	100	..	I 9737.09	100	..
II 6642.79	10	25	II 7104.7	50	2	I 9881.24	100	..
I 6644.41	40	..	I 7158.05	125	..	I 9920.82	150	..
I 6650.80	100	..	I 7161.25	100	..			

Lead

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2059.63	500 wr	..	2864.51	..	60	3832.83	..	50
2061.74	8 r	40	2873.32	100 r	60	3841.62	..	60
2088.43	30 r	40 W	II 2948.72	..	125	I 3854.05	..	100
2115.02	30 r	8 w	II 3016.4	..	25	II 3909.17	..	40
I 2169.99	1000 r	1000 r	I 3043.90	..	100	I 3951.94	..	50 n
2175.58	40 w	..	I 3089.09	..	30	II 3971.3	..	(30)
2187.85	50	3	II 3117.7	..	(100)	I 4057.82	2000 r	300 r
II 2203.50	50 w	5000 r	II 3125.6	..	(50)	I 4272.63	..	30
2218.08	50	40	I 3137.83	..	100	4571.35	..	30
2237.43	50 w	30 w	I 3176.54	..	100	II 5042.5	..	(200)
2246.89	30 r	100 r	3220.54	50 n	5	II 5049.3	..	(35)
2253.95	40	5	3232.35	30	..	II 5070.7	..	(40)
2332.43	60	30	3240.19	30 n	..	II 5074.6	..	(40)
2388.77	40	18	I 3242.86	..	40	II 5111.9	..	(40)
2393.79	2500	1000	II 3261.0	..	(50)	II 5155.8	..	(25)
2399.58	35	12	3262.35	20 n	5 n	II 5163.8	..	(25)
2401.95	50	40	3276.19	..	60	II 5367.3	..	(40)
2411.73	75	15	3297.64	..	30	II 5372.1	..	(40)
2443.84	100 w	15	II 3451.7	..	(80)	II 5472.4	..	(25)
2446.18	150 w	15	I 3455.49	..	70	I 5523.5	..	25
2476.38	150 wn	25	II 3463.6	..	(50)	II 5544.6	..	(40)
II 2526.62	..	(100)	3483.39	..	30	II 5608.8	..	(40)
2562.28	..	100	bh 3485.7	30	..	II 5767.9	..	(40)
II 2576.55	..	(100)	3572.73	200	20	II 5876.7	..	(40)
2577.26	100 wn	40	I 3589.92	..	40	6001.88	40 nl	3 n
2613.65	50 r	5	3593.12	..	30	II 6009.7	..	(40)
2614.18	200 r	80	I 3639.58	300	50 n	6011.98	25 nl	..
II 2628.26	50	10	3671.39	..	70	II 6041.4	..	(35 d)
2650.4	100	80	3671.50	50	7	II 6075.8	..	(200)
2663.17	300 wn	40	I 3683.47	300	50	II 6081.5	..	(200)
2802.00	250 rn	100 n	I, II 3689.31		40	II 6160.0	..	(50)
2823.19	150 r	40	3739.95	150	60 n	II 6181.9	..	(30)
I 2833.07	500 r	80 r	II 3746.9	..	(30)	II 6229.7	..	(50)
2864.26	..	60	II 3786.00	..	40	II 6311.5	..	(40)

II. EMISSION SPECTRA 2000–10,000 A (Continued)

LEAD (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 6345.0	..	(25)	II 7050.7	..	(40)	II 8395.6	..	(100)
II 6518.2	..	(35)	II 7193.6	..	(100)	II 8545.0	...	(30)
II 6527.8	..	(25)	7229.11	50	..	II 8710.1	..	(30)
II 6569.4	..	(25)	II 7558.7	..	(100)	II 9050.7	..	(100)
II 6660.0	..	(500)	II 7632.2	..	(100)	II 9063.7	..	(100)
II 6790.8	..	(50)	8272.84	200 wl	..	9604.06	50 Wl	..
II 7013.2	..	(50)	II 8335.0	...	(25)	9674.56	100 Wl	..

LITHIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2425.68	30 w	..	I 3232.61	1000 r	500	I 4602.86	800	..
I 2475.29	100 w	5	I 3718.7	30	..	I 4971.99	500	..
I 2562.54	150	15	I 3794.72	60	..	I 6103.64	2000 r	300
II 2741.19	..	30	I 3915.0	200 wn	..	I 6240.1	300	..
I 2741.31	200	..	I 3985.79	100	..	I 6707.84	3000 r	200
2899.66	..	60	I 4132.29	400 wn	..	I 8126.52	1000	...
2988.5	..	15	I 4273.28	200 r	100 n			

LUTETIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2065.42	..	30 n	2989.27	50	4	4295.95	30	3
2104.40	..	40	3020.54	...	100	4309.57	25	2
2191.37	6	60	3056.72	50	100	4341.98	3	30 nl
2195.54	30	100	3057.90	3	150 n	4430.48	30	2
2236.17	..	150 n	3077.60	100	200	4450.81	40	2
2297.41	15	100	3081.47	80	8	4518.57	300	40
2381.69	..	30 n	3104.98	..	25 nl	4645.47	25 n	2
2392.19	30	100	3118.43	40	5	4648.21	25 n	2
2399.14	10	50	3171.36	40	5	4648.85	25 n	..
2419.21	8	40	3191.80	3	60 nl	4658.02	100	15
2469.27	10	40	3198.12	40	80	4785.42	100	200
2481.72	20	100	3254.31	50	150	4839.62	50	100
2563.52	1	80 n	3278.97	50	5	4904.88	60	5
2571.23	30	100	3281.74	60	5	4942.34	40	3
2578.79	40	125	3312.11	100	10	4994.13	250	400
2613.40	30	100	3359.56	150	15	5001.14	100	..
2615.42	100	250	3376.50	100	10	5135.09	200	20
2619.26	30	100	3385.50	30	4	5349.12	25	2
2657.80	50	150	3396.82	30	1	5402.57	150	10
2685.08	50 n	3	3397.07	50	20 r	5421.90	50	5
2701.71	40	150	3472.48	50	150	5437.88	30	3
2728.95	40	2	3507.39	100	150	5476.69	500	1000
2738.17	2	25 nl	3507.47	30	..	5736.55	150	15
2754.17	40	125	3508.42	30	3	5775.40	50	5
2772.58	5	150 n	3554.43	50	150	5800.59	30	2
2796.63	25	100	3567.84	100	7	5983.59	30	60
2821.23	2	50 nl	3623.99	20	40	5983.80	20	40
2834.35	5	40 n	3636.25	25	3	5984.15	20	40
2845.13	30 n	2	3647.77	100	5	5997.13	50	5
2847.51	40	125	3841.18	100	8	6004.52	400	40
2885.14	40 n	3	3876.63	50	100	6055.03	150 d	10
2894.84	60	200	3968.46	50	..	6159.94	50	200
2900.30	50	150	4054.45	25	3	6199.66	40	125
2911.39	100	300	4124.73	200	10	6221.87	500	1000
2951.69	20	80	4154.08	40	3	6228.14	10	40
2955.78	2	60 nl	4184.25	100	200	6235.36	25	100
2963.32	50	150	4277.50	30	3	6242.34	40	200
2969.82	30	100	4281.03	40	4	6345.35	60	4

LUTETIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
6441.14	40	..	6793.77	40	2	8178.16	40	..
6463.12	400	800	6917.31	50	..	8382.08	30	..
6477.67	30	2	7031.24	50	..	8459.19	150	..
6523.18	80	5	7096.34	30	..	8478.50	50	..
6611.28	30	..	7125.84	125	..	8508.08	100	..
6611.58	25	..	7237.98	40	..	8610.98	125	..
6611.71	100	150	7815.91	25	..	9696.03	30	..
6677.14	40	1	7911.62	30	..	9914.92	100	..

MAGNESIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2329.58	12	...	I 2846.75	18	4	I 3838.26	300	200
II 2449.57	20	..	I 2848.42	20	..	I 3844.97	2	10
I 2632.88	10	4	I 2851.65	25	..	II 3848.24	10	10
I 2649.02	12	..	I 2852.13	300 r	100 r	I 3848.77	2	12
II 2660.75	40	6	2915.52	20	12	I 3878.57	10	..
II 2660.82	40	6	II 2928.75	25	100	3892.12	3	12
I 2668.11	10 n	..	II 2936.54	20	..	I 3895.66	..	15
I 2669.54	12	..	I 2936.89	12	..	I 3904.03	2	12
I 2672.45	20	..	I 2938.54	25	..	I 3938.42	10 w	3
I 2693.71	10	..	I 2942.11	20	2 n	I 3986.73	15 w	3
I 2695.21	10	..	II 2967.87	10	..	I 4057.63	10 w	..
I 2698.14	12	..	II 2971.70	10	..	I 4351.91	15	2
I 2732.08	12	3	3073.99	8	10	II 4390.58	10	..
I 2733.57	25	..	I 3091.08	80	10	4481.16	..	50
I 2736.53	30	3	I 3092.99	125	20	II 4481.33	100	..
2776.69	30	20	I 3096.90	150	25	I 4571.15	20	2
2778.29	25	20	II 3104.71	15	..	bh 5007.3	12	..
2779.83	40	50	II 3104.80	15	..	I 5167.34	100 wn	50
2781.42	20	8	I 3229.37	25	..	I 5172.70	200 wn	100 wn
2782.97	15	15	I 3329.93	80	8	I 5183.62	500 wn	300
II 2790.79	40	80	I 3332.15	100	25	I 5528.46	60	30
II 2795.53	150	300	I 3336.68	125	60	II 6347.06	10	2
II 2798.06	30	80	I 3829.35	100 w	150	II 6545.44	10	2
II 2802.69	150	300	I 3832.31	250	200	I 8806.79	100	..

MANGANESE

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2003.82	50 r	25	2315.68	..	25	2437.91	..	25 wn
2012.12	..	30	2318.92	..	30	2452.53	3 n	100 wn
2092.13	30 r	20	2320.45	..	60	2453.17	..	40 wn
2093.39	30 r	18	2328.67	..	25	2458.69	..	80 wn
2097.54	18	30	2328.85	..	30	2460.88	25	3
2106.04	40 r	..	2332.14	..	25	2461.01	25	5
2109.58	40 r	12	2333.26	2	25	2466.21	...	50
2175.56	..	40	2334.94	..	25	2466.42	..	40
2184.88	8	30	2340.59	..	30	2472.89	125	100
2191.39	25	10	2358.45	8	25	2488.14	150	12
2213.82	60 r	10	2361.76	2 n	30	2490.64	125	3
2220.54	..	40 w	2366.91	..	40	2491.16	100	2
2229.97	..	60	II 2373.37	4	50	2518.15	..	40
2231.66	..	70	2374.30	..	30	2520.58	..	25 d
2269.87	2 n	70	2384.05	40	3	2527.44	150	12
2298.95	20 s	40	2387.02	2 n	35	2529.13	80	5 d
2304.99	40	60	2427.41	..	50 wn	2534.15	...	25 d
2308.18	..	25	2427.75	..	50 wn	II 2534.21	..	25
2310.96	25	..	2427.98	..	50 wn	2535.64	..	80
2312.69	...	40	2437.42	..	40 wn	2538.05	..	25

II. EMISSION SPECTRA 2000–10,000 A (Continued)

MANGANESE (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2541.11	..	80	2674.43	2	25	2937.92	25 Wn	..
2542.92	1	100	2675.51	..	25	2939.30	50	..
2543.45	4	100	2677.85	..	40	2940.39	40 Wn	..
2545.16	..	25	2679.16	..	40	2940.48	40 Wn	..
2548.74	8	150	2681.23	..	50	2941.04	25	1
2551.88	1	100 d	2683.82	..	25	2949.20	100	30
2553.26	..	50	2684.55	2	80	3007.65	40	40
2556.57	10	80 n	2685.94	12 n	100 w	3011.16	25	25
2556.89	3	40	2687.41	25	80 r	3011.37	25	25
2557.54	1	50	2688.25	3	100 n	3016.45	25	25
2558.59	..	80	2689.80	..	40	3022.75	50	25
2559.41	2	50	2690.98	..	25 w	3031.06	8	25
2559.66	..	40 d	2692.66	150	..	3040.60	50	25
2563.65	25	50 wn	2694.09	8	50	3041.22	25	25
2565.22	2	80	2695.36	100 r	50	3042.73	25 r	25
2570.94	..	80	2698.97	..	40	3043.36	40	40
2572.76	200	50	2701.70	150	40 n	3044.57	100 wn	40
2575.51	150	1	2703.99	100 wn	25	3045.59	40	20
II 2576.10	300 r	2000 r	2705.73	25	25 n	3045.81	25	12
2578.91	..	25 wn	2707.53	10	50 n	3047.03	60	60
2579.67	125	1	2708.45	15	50 n	3048.86	25	..
2582.96	..	50	2709.96	..	25	3054.36	75	40
2584.31	150 w	15	2710.33	12	40 n	3062.12	75	20
2588.96	..	80	2710.62	..	25 n	3066.02	75	..
2589.71	10	50 n	2711.58	2	125 n	3070.27	100	25
2592.94	150	3	2713.33	300 Wn	..	3073.13	75	20
II 2593.73	200 r	1000 r	2716.79	1	40	3079.63	125	40
2595.65	..	25	2722.08	1	50 n	3081.33	75	25
2595.76	200	25	2724.45	2	80	3082.05	50	..
2596.83	..	50 r	2725.92	..	50	3097.06	75 w	40
2598.90	5	100 wd	2726.14	300 Wn	..	3100.30	60	60
2602.72	..	80	2728.61	..	50	3101.56	50	50
2603.72	5	50	2738.86	25	..	3110.68	35	35
II 2605.69	100 r	500 r	2760.93	80	..	3115.46	50	25
2610.20	15	100 n	2771.43	25	..	3120.34	50	..
2616.51	..	60	2776.23	80	..	3142.67	50	..
2618.14	50	100 n	2778.56	60	..	3148.18	150	40
2618.91	40	12	2779.99	25	..	3161.04	150	50
2619.51	125	10	2782.73	50	..	3178.49	150	50
2619.98	50	12	2794.82	1000 r	5	3206.91	60	..
2622.90	200	15	2798.27	800 r	80	3212.88	100	100
2624.04	25 l	60	2801.06	600 r	60	3216.95	75	75
2624.80	25	12	2806.14	25	..	3224.76	75	40
2625.58	..	100 n	2809.11	25	..	3226.03	40	20
2626.64	125	5	2813.47	30	1	3228.09	100	100
2629.55	..	35	2815.02	25	75	3230.72	75	75
2630.57	100	15	2817.97	50	1	3233.97	75 wn	..
2632.35	12	80 n	2818.77	25	..	3235.00	30 n	..
2635.60	..	60	2821.45	40	..	3236.78	75	75
2638.17	25	80 n	2828.76	50 wn	..	3237.41	30 n	..
2639.83	12	80 n	2830.79	50	..	3240.40	60	30
2648.04	..	25	2858.66	50	..	3240.62	60	30
2648.94	1	50	2872.58	30	..	3243.78	100	75
2650.99	..	150	2882.90	25	..	3247.54	125	..
2652.48	3	100	2900.55	50	..	3248.52	100	100
2659.08	..	25	2902.20	50	..	3251.13	50	25
2662.54	..	50	2907.22	50	..	3252.95	75	50
2664.03	..	25	2914.60	150 Wn	..	3254.04	50	25
2666.77	8	50 n	2925.57	150 Wn	1 Wn	3256.14	75	50
2667.00	5	50 n	2928.68	25	..	3258.41	75	40
2671.80	..	50	2930.25	25	..	3260.23	75	50
2672.59	15	125 n	2933.06	80	15	3264.71	75	50
2673.37	..	50	2934.02	25	..	3267.79	40	40

MANGANESE (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3268.72	30	30	3809.48	150	..	4135.04	50	30
3270.35	30	30	3809.59	150	150	4137.26	40	5
3278.55	60	30	3816.75	60	50	4141.06	50	30
3280.76	60	30	3823.51	75 n	75	4147.53	40	20
3296.88	60	30	3823.89	50 n	50	4148.80	50	30
3298.22	50	25 n	3829.68	60	60	4155.52	40	5
3303.28	40	..	3833.86	75	75	4157.02	40	2 d
3311.90	75	..	3834.36	75 r	75	4176.60	100	40
3313.22	50	..	3839.78	100	125	4189.99	80	40
3314.42	30 n	..	3841.08	50	50	4201.76	40	20
3314.90	35	..	3843.98	75	100	4211.75	30	20
3317.30	100	30 n	3853.47	25	20	4220.61	60	20
3320.69	60	30 n	3856.53	15	30	4235.14	80	..
3330.67	75	..	3889.45	25	50	4235.29	80	100
3343.73	30	..	3894.71	40	40	4239.72	100	50
II 3441.99	75	75	3898.36	30	..	4257.66	100	40
II 3460.33	60	500	3899.33	12	25	4265.92	100	50
II 3474.13	12	400	3918.31	40	50	4281.10	100	50
II 3482.91	50	250	3926.47	40	50 l	4284.08	80	20
3488.68	50	200	3929.24	30	30	4300.20	60	5
II 3495.84	25	150	3929.65	12	25	4305.66	50	..
II 3496.81	10	30	3936.76	25	50	4312.55	100	20
II 3497.54	15	150	3942.85	75	75	4321.16	60	5
3531.85	40 r	30 r	3951.96	40	50	4323.40	50	..
3531.99	50 n	8	3952.84	60	75	4326.76	80	30
3532.12	50 n	30	3975.89	40	50	4337.42	80	..
3547.80	40 n	15	3977.08	50	100	4343.97	100	30
3548.03	40 n	15	3982.17	12	25	4359.80	25	..
3548.20	40 n	40	3982.58	20	30	4365.24	25	5
3569.49	25 n	8	3982.91	20	30	4368.88	50	..
3577.88	50	25	3985.24	75	100	4370.87	30	..
3586.54	50 n	40	3986.83	40	75	4374.95	150	20
3595.12	50	25	3987.10	30	60	4381.70	80	20
3607.54	75	40	3991.60	20	25	4382.63	80 n	
3608.49	60	40	3992.49	40	75	4388.08	60	..
3610.30	60	40	3997.21	12	25	4389.75	50	..
3619.28	75	50	4018.10	80	60	4408.08	60	5
3623.79	75	40	4026.43	50	40	4410.49	50	..
3629.74	100	30	I 4030.75	500 r	20	4411.88	100	20
3641.39	50	50 n	I 4033.07	400 r	20	4414.88	150	60
3660.40	75	75	I 4034.49	250 r	20	4419.78	100	20
3669.84	30	30	4035.73	50	60	4436.35	80	50
3670.52	25	15	4041.36	100	50	4447.15	60	..
3676.96	60	100	4048.75	60	60	4451.59	125	100
3682.09	25	40	4055.54	80	80	4453.00	50	20
3892.81	50	50	4057.95	80	20	4455.01	25	10
3693.67	50	60	4058.93	80	60	4455.32	25	15
3696.57	100	50	4061.74	80	30	4455.82	25	15
3701.73	60	30	4063.53	100	60	4458.26	25	20
3706.08	75	..	4068.00	50	20	4461.08	30	25
3718.93	75	100	4070.28	80	30	4462.02	40	60
3728.89	75	100	4075.25	25	5	4464.68	60	50
3731.93	75	100	4079.24	50	40	4470.14	80	40
3736.90	25	25	4079.42	50	40	4472.79	100	25
3746.62	25	25	4082.94	80	60	4479.40	60	..
3750.76	60	30	4083.63	80	60	4490.08	100	25
3763.38	20 s	20	4089.94	80	20	4491.65	50	5
3763.80	40	25	4092.39	30	20	4496.63	40	5
3776.53	25	25	4102.96	100	20	4498.90	150	40
3790.21	100	125	4105.36	50	20	4502.22	125	40
3799.26	50	50	4110.90	80 r	40	4503.87	60	5
3800.55	60	60	4113.24	40	20	4523.39	50	..
3806.72	50 n	20	4131.12	50	40	4529.79	50	.

Manganese (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4534.46	30	..	5117.94	30	..	6887.75	30	..
4538.46	40	..	5150.89	40	..	6942.52	100 n	..
4542.44	80	5	5196.59	30	..	6989.81	80	..
4544.41	60	5	5255.32	50	..	7069.84	60	..
4548.58	80	5	II 5295.29	..	(30)	7151.28	30 n	
4575.41	50	..	II 5296.97	..	(40)	7184.25	40	..
4579.67	50	..	II 5299.28	..	(50)	7247.82	40	..
4581.83	125	..	II 5302.32	..	(60)	7283.81	400 n	
4586.11	30 l	..	5341.06	200	100	7302.89	300 n	..
4605.36	150	15	5377.63	40	..	I 7326.51	500	..
4607.62	50	..	5394.67	50	..	I 7680.20	200	..
4626.54	80	15	5399.49	40	..	I 7712.42	100 n	..
4627.74	50	..	5407.42	60	..	I 7733.24	60 nl	..
4642.81	50	..	5413.69	30	..	I 7764.72	200 n	..
4645.03	40	..	5420.36	60	..	8212.43	50 n	..
4658.78	25	..	5432.55	40	..	8380.77	25	..
4671.69	100	5	5457.47	25	..	I 8654.63	40 n	..
4701.16	100	5	5470.64	50	..	I 8670.92	60 wl	..
4709.71	150	15	5481.40	50	..	I 8672.06	80 w	..
4727.48	150	20	5505.87	40	..	I 8673.97	100 w	..
4739.11	150	15	5516.77	50	..	I 8699.13	100 w	..
4754.04	400	60	5537.76	40	..	I 8701.05	150 w	..
4761.53	60	15	6013.50	100 n	5	I 8703.76	200 w	..
4762.38	100	40	6016.64	80 n	5	I 8734.60	30	..
4765.86	60	25	6021.80	80 n	5	I 8737.32	150 w	..
4766.43	80	30	II 6122.44	..	(80)	I 8740.93	500 W	..
4774.09	50	..	II 6125.85	..	(50)	I 8929.72	50 n	
4783.42	400	60	II 6128.72	..	(40)	I 9084.29	30	..
4797.70	25	..	II 6130.79	..	(30)	I 9114.02	40	..
4823.52	400	80	6384.67	25	..	I 9172.09	100	..
4838.24	50	..	6413.95	25	..	I 9243.29	150	..
4840.15	50	..	6440.97	60	..	I 9336.47	40 n	..
4844.31	80	5	6491.71	100	..	I 9429.58	30 n	..
4854.81	30	5	6605.53	30 n	..	I 9444.90	40	..
4862.05	40	5	6691.58	25	..	I 9608.56	100	..
4934.15	25	5	6833.92	40	..	I 9676.50	40	..
4965.88	50	2						

Mercury

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2022.19	..	(30)	I 2655.12	80	40	I 3023.48	60	10 n
II 2026.97	..	(100)	I 2698.85	25	30	I 3027.50	25	15
II 2052.93	..	(100)	I 2699.50	25	(5)	3035.10	..	(30)
II 2148.00	..	(60)	II 2705.36	..	(30)	II 3090.60	..	(200)
II 2224.71	..	(30)	I 2752.77	100 r	50	II 3116.24	..	(100)
II 2252.78	..	(50)	2752.84	40	10 n	I 3125.66	200	150
II 2260.26	..	(200)	2761.97	..	(40)	I 3131.55	400	300
II 2262.23	..	(100)	II 2814.93	..	(200)	I 3131.83	200	100
II 2345.55	10	30	II 2847.67	..	(300)	II 3191.03	..	(100)
II 2407.35	..	(25 n)	I 2847.83	15	100	II 3252.21	..	(30)
II 2414.13	..	(25 n)	I 2893.59	40	50	II 3264.06	..	(200)
2480.62	..	(40)	II 2909.36	..	(25)	II 3277.87	..	(50)
I 2482.01	30	5	II 2916.27	..	(30)	I 3341.48	100	100
I 2482.72	25	10	I 2925.41	60	50	II 3385.25	..	(200)
I 2483.83	30	5 n	II 2947.08	..	(25)	3390.06	..	50 wn
I 2534.77	30	30	II 2955.13	..	(100)	II 3451.69	..	(200)
I 2536.52	2000 r	1000 r	2967.28	100 w	100	3473.01	..	(30)
2552.87	..	(25)	2975.19	..	(50)	3492.77	..	(50)
2574.86	..	(25)	3004.47	..	(30)	II 3493.85	..	(100)
I 2652.04	100	60	II 3006.57	..	(50)	II 3524.19	..	(100)
I 2653.68	80	40	I 3021.50	80	40	3532.63	..	(200)

II. EMISSION SPECTRA 2000–10,000 A (Continued)

MERCURY (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3543.08	..	40	4103.87	..	(50)	II 5128.45	..	(150)
II 3549.42	..	(200)	II 4115.41	..	(50)	5146.26	..	(30)
3578.75	..	(40)	II 4120.6	..	(50)	5204.78	..	(40)
II 3604.09	..	(50)	4124.07	..	(30)	5210.79	..	(60)
II 3605.80	..	(200)	4140.38	..	(200)	II 5222.81	..	(80)
3606.92	..	(30)	4156.68	..	(50)	I 5354.05	..	(30 wn)
3613.61	..	(40)	4178.02	..	(50 n)	II 5425.25	..	(200)
3618.53	..	(50)	4180.95	..	(100)	I 5460.74	..	(2000)
3630.65	..	(100)	4206.10	..	(30)	I 5675.86	..	(80)
3638.34	..	(100)	4212.22	..	(30)	II 5677.17	..	(300)
3644.32	..	(40)	II 4212.53	..	(50)	I 5769.59	600	200
I 3650.15	200	500	4216.72	..	(50 n)	I 5789.66	..	(500)
I 3654.83	..	(200)	4227.29	..	(100)	I 5790.65	..	(1000)
I 3662.88	50	400	4227.87	..	(70)	I 5803.65	..	(70)
I 3663.28	500	400	4261.88	..	(70)	I 5859.38	..	(30)
I 3680.01	..	(40)	I 4339.23	150	20	II 5871.73	..	(40)
3774.52	..	(30)	I 4347.50	200	50	5890.16	..	(40)
II 3776.26	..	(30)	I 4358.35	3000 w	500	II 6089.79	..	(25)
II 3806.38	..	(200)	4376.19	..	(50)	6100.36	..	(25)
3826.61	..	(30)	II 4398.62	..	(300)	II 6149.50	..	(200)
3839.26	..	(50)	4402.06	..	(50)	II 6291.26	..	(50)
3845.15	..	(30)	II 4404.86	..	(50)	II 6394.94	..	(25)
3874.98	..	(30 n)	II 4425.22	..	(30)	6418.95	..	(25)
I 3906.41	25	15	4454.33	..	(30)	II 6715.2	..	(25)
II 3914.29	..	(100)	II 4455.49	..	(30)	I 6716.17	..	(80)
II 3918.92	..	(200)	4487.48	..	(300)	I 6888.74	..	(25)
3925.65	..	(100)	II 4492.81	..	(30)	I 6907.16	..	(125)
3942.24	..	(100)	II 4552.89	..	(30)	II 6938.1	..	(25)
3942.59	..	(100)	4630.14	..	(30)	I 7081.88	..	(125)
3945.09	..	(100)	II 4660.28	..	(200)	I 7091.99	..	(100)
3948.29	..	(100)	II 4704.63	..	(200)	7301.68	..	(25)
3960.24	..	(30)	II 4762.22	..	(100)	II 7346.37	..	(1000)
3968.03	..	(50)	4797.01	..	(300)	I 7371.71	..	(80)
II 3983.98	..	(400)	4825.62	..	(70)	II 7418.1	..	(40)
4006.27	..	(30)	II 4855.72	..	(100)	I 7454.33	..	(50)
I 4046.56	200	300	I 4916.04	..	(50)	I 7978.70	..	(70)
I 4077.81	150	150	4980.57	..	(70)			

MOLYBDENUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2015.11	12	40	2481.81	50 n	..	2636.67	25	150
2020.30	20	50 r	2506.19	..	40 n	2638.76	20	125
2273.26	..	100	2524.81	40 n	..	2640.99	40 n	40 wn
2294.96	..	50	2538.45	30	125	2644.35	30	60
2304.25	7	50	2540.45	40 n	1	2646.49	25	100
2332.12	8	80	2555.42	3	50	2653.35	25	150
2340.47	30	50	2564.34	3	40	2655.03	50 n	8
2341.59	9	60	2567.05	40 n	3	2658.11	40	5
2359.73	..	40	2572.34	60 n	10	2660.58	25	125
2401.93	10	40	2578.90	2	60	2671.83	1	100
2407.13	3	40	2591.97	40	1	2672.84	15	100
2410.09	..	60 n	2593.70	20	40	2673.27	1	100
2419.01	3	40	2602.80	25	100	2681.36	10	100
2420.18	1	40	2607.37	50 n	5	2683.23	20	150
2422.18	2	60	2609.22	..	40 wn	2684.14	40	150
2423.99	6	40	2613.08	40 n	20	2687.99	30	100
2435.96	10	50 n	2619.34	20	40	2692.61	2	40
2437.74	10	80 W	2621.07	40 n	1	2695.22	5	40
2457.77	10	60	2628.74	40	2	2696.83	1	40
2471.97	50 n	2	2629.85	50	6	2701.42	20	100
2477.57	2	50	2630.73	5	40	2704.93	1	50

MOLYBDENUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2712.35	1	40	3023.30	5	100	3289.01	40	30
2713.51	20	40	3025.00	50	4	3290.82	40	100
2717.35	20	100	3041.70	40	5	3292.31	10	300
2726.97	10	100	3046.80	50	2	3297.68	1	60
2729.68	15	60	3047.31	50	4	3305.56	40	30
2730.20	2	60	3052.32	10	50	3307.43	..	50
2738.60	1	40	3055.32	50	5	3312.94	1	50
2750.03	2	50	3061.59	50	3	3313.62	5	50
2751.47	50	5	3064.28	80	10	3320.90	3	80
2756.07	10	50 n	3067.64	10	50	3323.95	40	25
2761.53	40	20	3070.89	40	3	3325.23	..	40
2763.62	25	50 n	3074.37	60	15	3325.67	50	25
2769.76	10	100	3077.66	20	125	3327.30	40	20
2774.39	30	50 n	3079.88	40	3	3329.21	2	100
2775.40	80	100 n	3080.41	60	6	3332.52	..	80
2780.04	60	100 n	3082.22	4	40	3344.75	50	40
2784.99	100	200	3085.61	125	25	3346.40	2	50
2787.83	40	4	3087.62	30	200	3347.02	40	4
2807.75	60	80 n	3089.71	40	5	3358.12	60 W	30
II 2816.15	200	300 n	3092.07	30	100	3363.78	40	30
2826.54	40	5	3094.66	150	25	3367.97	2	100
2827.74	8	40	3100.87	40	2	3402.81	5 d	100
2834.39	20	40	3101.34	80	10	3434.79	50	12
2835.33	20	40	3112.12	40	10	3435.40	..	60 n
2842.15	2	40	3116.09	1	60	3446.08	1	40 n
II 2848.23	125	200 n	3121.99	5	150	3524.65	5	50 n
2849.38	50	5	3132.59	1000 r	300 r	3537.09	..	50
2850.67	1	40	3136.41	..	40	3544.62	40 n	2
2853.23	25	100 n	3136.46	1	40	3614.25	50 d	30
2863.81	30	100 n	3144.61	3	45	3623.70	..	50
2864.31	40	2	3151.63	2	40	3635.14	100 n	10
2864.66	40	3	3152.82	6	80	3651.11	2	50
II 2871.51	100	100 n	3155.64	..	50	3664.81	20	40
2872.88	2	50	3158.16	300 r	30 r	3688.31	4	150
2874.85	2	60	3170.35	1000 r	25 r	3692.64	3	150
2879.05	15	100 n	3172.74	3	50	3694.94	40	30
2888.15	1	40	3175.05	2	60	3702.55	10	150
II 2890.99	30	50 n	3176.33	..	50	3713.96	..	40
2894.45	50	80 n	3187.59	1	50	3720.25	10	40
2900.79	2	40	3192.10	3	50	3744.37	20	80
2903.07	20	100 n	3193.97	1000 r	50 r	3746.41	..	40 w
II 2909.12	25	40 n	3195.96	12	50	3748.13	1	50
2911.91	30	50 n	3208.83	150 r	60	3751.20	6	40 d
2913.81	1	50 w	3214.44	20	50	3755.54	1	50
2926.22	..	40	3216.07	..	50	3782.07	..	100
2927.54	3	40	3222.90	..	40	3783.18	..	40
2930.50	25	50 n	3228.21	40	25	3786.36	2	125
2934.30	30	50 n	3229.71	..	50	I 3798.25	1000 r	1000 r
2940.10	2	40	3233.14	50	30	3828.87	40	30
2941.22	2	40	3237.07	40	25	3833.75	80	25
2944.82	2	50 n	3238.40	..	40	3837.29	..	100 w
2946.01	20	40	3240.71	3	60	3857.20	..	60
2963.79	10	40	3250.75	2	100	I 3864.11	1000 r	500 r
2965.27	8	40	3253.78	1 d	50 d	3871.45	..	50
2971.91	2	40	3254.68	8	50	I 3902.96	1000 r	500 r
2972.61	20	50	3255.25	..	40	3915.44	6	50
2986.16	4	50	3256.21	40	25	3941.48	5	150
3002.21	40	3	3266.89	..	40	3961.50	5	500
3004.46	5	40	3270.90	50	25	3968.75	8	50
3013.76	100 n	5	3271.67	..	60	4013.21	1	40
3014.16	5	50	3276.34	2	40	4062.07	80	80
3018.55	1	100	3278.88	1	50	4081.44	50	50
3021.62	..	40	3284.62	..	40	4084.38	40	40

Molybdenum (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4107.47	30	40	4576.50	40	40	5533.05	200	100
4119.63	5	50	4595.16	40	40	5570.45	200	100
4120.10	25	50	4609.88	40	40	5632.47	100	50
4122.39	15	50	4626.47	100	80	5650.13	90	50
4125.62	..	50	4627.47	80	80	5689.14	80 l	40
4128.28	50	25	4662.76	40	40	5705.72	40	40
4128.83	40	40	4707.25	125	125	5722.73	80	60
4143.55	100	100	4717.92	50	50	5751.40	125	100
4148.94	40	25	4731.44	100	100	5791.85	100	60
4185.82	40	40	4758.50	40	40	5848.86	50 n	..
4188.32	100	80	4760.19	125	125	5849.73	70 n	10 n
4192.29	..	40	4764.42	50	50	5851.52	40 n	20 n
4209.65	4	80	4776.34	40	40	5858.27	200	200
4232.59	125	100	4782.94	40	40	5869.33	50	..
4244.80	4	80	4792.74	40	30	5888.33	150	100
4250.69	5	125	4796.52	40	40	5889.98	50 n	..
4251.87	60	60	4811.06	50	50	5893.38	70 n	15
4279.02	8	100	4819.25	80	60	5926.36	70 n	20
4284.60	125 n	80 n	4830.51	125	100	5928.88	100 n	..
4288.64	80	100	4868.00	50	40	6030.66	300	125
4292.13	100	80	4903.81	80	30	6101.87	40	4
4293.21	125	100	4941.66	40	25	6357.21	40	10
4311.65	2	40	4950.62	80	30	6424.37	100	20
4326.14	50	40	4957.54	60	25	6471.20	50	4
4326.74	50	50	4977.69	50	3	6619.13	300	15
4350.34	50	40	4979.11	100	30	6650.37	80	6
4358.32	..	40	4999.91	50	25	6707.85	300 W	..
4363.64	5	200	5059.88	40	20	6733.98	100	4
4369.04	40	25	5097.52	40	20	6746.27	50	3
4377.76	5	200	5172.94	70 n	25 n	6828.98	50	..
4381.64	150	150	5174.18	70 n	25 n	6914.01	40	..
4423.62	40	40	5200.17	40	20	7109.87	80	..
4433.50	4	125	5238.20	80 n	30 n	7134.08	40	..
4434.95	80	80	5240.88	80 n	40 n	7242.50	80	..
4442.20	40	30	5242.81	50 n	20 n	7245.85	60	..
4449.74	40	40	5259.04	60	20	7267.62	40	..
4457.36	50	50	5280.86	50	25	7391.36	50	..
4474.56	125	125	5360.56	100 n	70 n	7485.74	100	..
4474.65	80	..	5364.28	70 n	25 n	7720.77	50	..
4491.28	40	30	5473.37	50	25	8328.44	100	..
4519.59	..	40	5506.49	200 r	100	8389.32	150	..
4536.80	40	80						

Neodymium

2993.18	40	2	3824.79	40	30	3865.98	35	30
3134.90	40	30	3826.91	40 w	25 w	3905.89	40	30
3382.81	200	10	3828.17	50	40	3918.05	40	6
3555.72	100	15	3829.41	50	40	3920.96	40	15
3563.40	50	10	3829.63	40	30	3927.11	80	50 s
3590.35	400 W	300 W	3831.03	60 d	30	3934.82	60	30
3661.34	40	25	3833.03	60	30	3941.51	60	30
3735.60	10	50	3836.11	40	15	3951.15	40	30
3769.64	100	20	3836.54	80	100	3953.52	60	60
3778.14	40	40	3838.33	40	25	3957.46	60	40 s
3787.16	60 d	50	3838.72	50	25	3973.27	40	25
3801.37	60	40	3842.99	30	40	3975.20	40	30
3805.36	50	30	3847.85	60	50	3976.84	40	30
3817.67	40	40	3848.31	40	..	3979.48	40	30
3820.43	..	40	3852.38	60	50	3990.10	40	20
3821.77	50 w	40 w	3853.48	40	20	3991.74	60	40

NEODYMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3994.68	80	40	4542.05	50	5	4896.93	60	..
3998.69	40	15	4542.60	50	5	4901.85	35	..
4012.25	80	40	4559.67	40	..	4913.42	60	..
4040.80	40	40	4560.42	50	3	4920.69	60	..
4061.08	40	30	4563.22	50	4	4924.53	80	..
4123.88	40	20	4586.61	50	..	4944.83	50	..
4175.61	40	10	4621.94	40	..	4954.78	50	..
4232.38	40	15	4634.23	50	..	4959.13	35	..
4247.37	50	20	4641.10	80	..	4989.94	35	..
4256.48	40	20	4646.40	50	..	5130.60	40	2
4267.49	..	200 wn	4646.69	60	4	5191.45	40	..
4303.57	100	40	4649.67	40	..	5192.62	40	..
4325.77	100	30	4674.59	50	10	5234.19	50	..
4338.70	40	15	4680.73	50	1	5249.58	60	2
4358.17	50	20	4683.44	50	..	5255.51	50	3
4368.63	50	15	4684.04	40	..	5293.17	60	4
4385.66	40	20	4706.54	50	5	5319.82	60	2
4400.83	50	20	4706.96	40	..	5594.42	150	5
4411.05	50	20	4717.08	40	..	5620.54	200	5
4412.26	40	15	4719.03	50	..	5669.77	40	..
4424.34	50	50	4731.78	40	..	5688.52	150	..
4446.39	100	50	4749.75	40	..	5706.21	40	..
4451.57	100	50	4789.43	40	..	5708.28	60	..
4451.98	50	20	4811.34	60	60	5718.12	35	1
4462.98	60	20	4820.34	40	..	5740.86	35	..
4501.81	50	8	4825.48	100	8	5742.09	40	..
4506.58	50	3	4859.03	60	60	5804.02	100	..
4511.82	50	10	4866.73	35	..	6244.08	35	..
4516.35	40	3	4883.81	60	..	6310.49	50	..
4529.93	40	..	4891.06	40	..	6385.20	100	..
4541.27	50	4						

NEON

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
2595.21	..	50	I 2980.92	..	50	I 3351.74	..	25
I 2613.59	..	30	I 2982.66	..	250	II 3355.05	..	40
I 2616.62	..	25	I 2992.44	..	150	II 3367.20	..	25
I 2635.98	..	25	II 3001.65	..	25	I 3369.81	..	500
2645.51	..	50	I 3012.13	..	50	I 3369.91	..	700
I 2645.70	..	35	I 3012.95	..	50	I 3375.65	..	50
I 2647.42	..	150	I, II 3017.35	..	50	II 3388.46	..	25
I 2648.56	..	25	I 3030.31	..	50	I 3417.90	..	500
2651.01	..	50	II 3047.57	..	25	I 3418.01	..	50
I 2675.24	..	150	I 3057.39	..	250	I 3423.91	..	50
I 2675.64	..	150	I 3063.69	..	150	I 3447.70	..	150
II 2792.05	..	25	I 3076.97	..	150	I 3450.76	..	50
I 2795.10	..	35	I 3078.87	..	75	I 3454.19	..	75
I 2872.66	..	35	I 3079.17	..	75	I 3460.52	..	75
I 2911.46	..	25	I 3126.19	..	150	I 3464.34	..	75
I 2913.17	..	150	I 3147.70	..	25	I 3466.58	..	150
I 2932.72	..	75	I 3148.60	..	75	I 3472.57	..	500
I 2947.30	..	150	I 3153.40	..	50	II 3481.96	..	25
II 2955.73	..	40	I 3167.57	..	50	I 3498.06	..	75
I 2974.71	..	250	II 3218.21	..	75	I 3501.22	..	150
I 2975.52	..	35	II 3297.74	..	40	I 3510.72	..	50
I 2979.81	..	50	II 3323.75	..	40	I 3515.19	..	150
I 2980.64	..	40	II 3334.87	..	250	I 3520.47	..	1000

II. EMISSION SPECTRA 2000–10,000 A (Continued)

NEON (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 3542.90	..	40	II 4397.94	..	100	I 4593.24	..	50
II 3568.53	..	25	II 4409.30	..	150	I 4595.25	..	50
I 3593.53	..	500	II 4413.20	..	50	I 4609.36	..	30
I 3593.64	..	250	I, II 4416.82	..	50	I 4609.91	..	150
I 3600.17	..	75	II 4421.38	..	30	I 4614.39	..	100
I 3609.18	..	50	I 4421.56	..	50	II 4615.98	..	50
I 3633.66	..	75	I 4422.52	..	300	I 4617.84	..	70
II 3664.11	..	250	I 4424.80	..	300	I 4628.31	..	150
I 3682.24	..	75	I 4425.40	..	150	I 4628.46	..	30
I 3685.74	..	75	I 4427.75	..	30	I 4636.12	..	70
II 3694.20	..	250	II 4428.54	..	100	I 4636.63	..	70
3701.22	..	40	II 4430.90	..	50	I 4636.97	..	50
II 3709.64	..	40	I 4433.72	..	70	I 4639.59	..	30
II 3713.08	..	250	II 4439.30	..	30	I 4640.44	..	70
II 3727.08	..	125	II 4442.67	..	30	I 4644.83	..	40
II 3734.94	..	40	I 4444.98	..	30	I 4645.42	..	300
I 3754.22	..	50	II 4446.46	..	30	I 4649.90	..	70
II 3766.29	..	75	II 4456.95	..	70	I 4652.10	..	30
II 3777.16	..	75	I 4460.17	..	100	I 4653.70	..	50
II 3818.44	..	25	I 4465.65	..	50	I 4656.39	..	300
II 3829.77	..	40	I 4466.81	..	70	I 4661.10	..	150
I 4042.64	..	50	II 4468.91	..	70	I 4663.09	..	40
II 4062.90	..	30	II 4471.52	..	30	I 4666.65	..	50
I 4064.04	..	50	I 4475.66	..	100	I 4667.36	..	100
I 4068.83	..	30	I 4483.19	..	150	4669.02	..	50
I 4069.24	..	30	I 4488.09	..	300	I 4670.88	..	70
I 4080.15	..	50	I 4491.77	..	80	I 4678.22	..	300
II 4098.77	..	50	I 4491.84	..	50	I 4678.60	..	50
I 4128.07	..	30	I 4492.41	..	30	I 4679.13	..	150
I 4131.05	..	70	I 4493.70	..	50	I 4680.36	..	100
II 4133.65	..	30	I 4500.18	..	50	I 4681.20	..	50
II 4150.67	..	30	II 4508.21	..	30	I 4683.76	..	30
I 4164.80	..	50	II 4511.37	..	50	I 4687.67	..	100
I 4166.09	..	30	I 4514.89	..	70	I 4702.53	..	150
I 4174.37	..	70	I 4515.41	..	30	I 4704.39	..	1500
I 4175.22	..	60	I 4516.94	..	50	I 4708.85	..	1200
I 4175.49	..	40	I, II 4517.74	..	100	I, II 4710.06	..	1000
I 4198.10	..	70	II 4522.66	..	50	I 4710.48	..	30
II 4217.15	..	30	I 4525.76	..	70	I 4712.06	..	1000
II 4219.76	..	100	I 4526.18	..	50	4713.13	..	100
II 4231.60	..	50	I 4529.48	..	30	I 4714.34	..	70
4233.86	..	30	II 4535.47	..	30	I 4715.13	..	30
II 4250.68	..	50	I 4536.31	..	150	I 4715.25	..	30
II 4257.82	..	30	I 4537.68	..	300	I 4715.34	..	1500
I 4268.01	..	70	I 4537.75	..	1000	I 4717.61	..	70
I 4269.72	..	70	I 4538.31	..	300	I 4721.54	..	70
I 4270.23	..	50	I 4539.17	..	50	I 4725.14	..	70
I 4274.66	..	50	I 4540.38	..	50	I 4749.57	..	300
I 4275.56	..	70	I 4544.50	..	50	I 4750.69	..	30
II 4290.40	..	100	I 4552.60	..	30	I 4751.80	..	30
I 4303.25	..	30	II 4553.16	..	50	I 4752.73	..	1000
I 4306.24	..	70	I 4554.82	..	40	I 4754.44	..	100
I 4314.69	..	30	I 4555.39	..	30	I 4758.73	..	150
I 4334.12	..	70	I 4565.89	..	60	I 4780.34	..	50
I 4336.22	..	50	I 4566.83	..	40	I 4780.88	..	30
I 4362.69	.	30	II 4569.01	..	70	4788.93	..	300
I 4363.52	..	70	I 4573.56	..	50	I 4789.60	..	100
II 4369.77	..	70	I 4573.76	..	30	4790.22	..	50
I 4372.16	..	30	I 4575.06	..	300	I 4790.73	..	30
II 4379.50	..	100	II 4580.35	..	30	I 4810.06	..	150
I 4381.22	..	30	I 4582.03	..	150	I 4810.63	..	100
II 4391.94	..	150	I 4582.45	..	150	I 4814.34	..	50
I 4395.56	..	50	II 4588.13	..	30	I 4817.64	..	300

II. EMISSION SPECTRA 2000–10,000 A (Continued)

NEON (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
I 4818.79	..	150	I 5191.33	..	35	I 5811.42	..	300
I 4819.94	..	70	5193.13	..	150	I 5816.64	..	50
I 4821.92	..	300	I 5193.22	..	150	I 5820.15	..	500
I 4823.17	..	100	I 5203.89	..	150	I 5828.91	..	75
I 4823.37	..	50	I 5208.86	..	70	I 5852.49	..	2000
I 4825.53	..	50	I 5210.57	..	50	I 5868.42	..	75
I 4827.34	..	1000	I 5214.34	..	35	I 5872.15	..	75
I 4827.59	..	300	I 5222.35	..	50	5872.83	..	35
I 4837.31	..	500	I 5234.03	..	50	I 5881.89	..	1000
I 4842.94	..	50	I 5274.04	..	40	I 5902.46	..	50
I 4849.53	...	30	I 5280.07	..	50	I 5906.43	..	50
I 4851.50	..	60	I 5298.19	..	150	I 5913.63	..	250
I 4852.65	..	100	I 5304.76	..	70	I 5918.91	..	250
I 4863.08	..	100	I 5314.78	..	30	I 5922.71	..	25
I 4864.35	..	30	I 5316.81	..	25	I 5934.46	..	75
I 4865.50	..	100	I 5326.40	..	75	I 5939.32	..	50
I 4866.48	..	80	I 5330.78	..	600	I 5944.83	..	500
I 4867.01	..	70	I 5333.32	..	50	I 5961.63	..	70
I 4868.27	..	70	I 5341.09	..	1000	I 5965.47	..	500
I 4884.91	..	1000	I 5343.28	..	600	I 5966.17	..	35
I 4885.08	..	100	I 5349.21	..	150	I 5974.63	..	500
I 4892.09	..	500	I 5355.18	..	150	I 5975.53	..	600
I 4897.92	..	70	I 5355.42	..	150	I 5987.91	..	150
I 4899.01	..	50	I 5360.01	..	150	I 5991.67	..	75
I 4928.23	..	70	I 5360.44	..	35	I 6000.95	..	100
I 4830.94	..	50	I 5362.25	..	25	I 6029.99	..	1000
I 4939.04	..	100	I 5366.22	..	25	I 6046.16	..	50
I 4944.99	..	100	I 5372.31	..	75	I 6064.55	..	50
I 4955.38	..	150	I 5374.97	..	50	I 6074.34	..	1000
I 4957.03	..	1000	I 5383.26	..	25	I 6096.16	..	300
I 4957.12	..	150	I 5400.56	..	2000	I 6128.45	..	100
I 4973.54	..	100	I 5412.65	..	250	I 6142.51	..	100
I 4974.76	..	50	I 5418.55	..	150	I 6143.06	..	1000
I 4994.93	..	150 l	I 5420.15	..	50	I 6150.30	..	100
I 5005.16	..	500	I 5433.65	..	250	6154.09	..	70 w
I 5005.33	..	50	I 5448 51	..	150	I 6156.14	..	50
I 5011.00	..	25	I 5494.41	..	50	I 6163.59	..	1000
I 5022.87	..	25	I 5507.34	..	25	I 6174.89	..	70
I 5031.35	..	250	I 5533.68	..	75	I 6175.29	..	50
I 5035.99	..	35	I 5538.64	..	50	I 6182.15	..	150
I 5037.75	..	500	I 5559.09	..	35	I 6189.08	..	70
I 5052.93	..	25	I 5562.44	..	150	I 6193.08	..	50
I 5074.20	..	35	I 5562.77	..	500	I 6205.79	..	100
I 5076.58	..	35	I 5563.05	..	75	I 6213.88	..	150
I 5080.38	..	150	I 5576.05	..	35	I 6217.28	..	1000
I 5083.97	..	25	I 5589.38	..	50	I 6225.74	..	50
I 5099.04	..	25	I 5652.57	..	75	I 6246.73	..	100
I 5104.70	..	35	I 5656.03	..	75	I 6258.80	..	100
I 5113.67	..	75	I 5656.66	..	500	I 6266.49	..	1000
I 5116.50	..	150	I 5662.55	..	75	I 6273.01	..	70
I 5117.01	..	35	I 5684.65	..	25	I 6276.04	..	50
I 5120.51	..	25	I 5689.82	..	150	I 6293.77	..	100
I 5122.26	..	150	I 5715.34	..	35	I 6304.79	..	100
I 5122.34	..	150	I 5718.90	..	150	I 6313.69	..	150
I 5144.94	..	500	I 5719.22	..	500	I 6328.17	..	300
I 5145.01	..	500	I 5719.53	..	75	I 6330.90	..	150
I 5145.12	..	35	I 5748.30	..	500	I 6334.43	..	1000
I 5150.08	..	35	I 5748.65	..	70	I 6351.87	..	100
I 5151.96	..	75	I 5760.58	..	70	I 6365.01	..	100
I 5154.42	..	50	I 5764.42	..	700	I 6382.99	..	1000
I 5156.66	..	50	I 5770.31	..	50	I 6401.08	..	100
I 5158.89	..	50	I 5804.10	..	75	I 6402.25	..	2000
I 5188.61	..	150	I 5804.45	..	500	I 6409.75	..	150

Neon (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
I 6421.71	..	100	I 8128.93	..	60	I 8780.62	..	1000
I 6444.72	..	150	I 8136.41	..	300	I 8782.01	..	50
I 6506.53	..	1000	I 8248.70	..	30	I 8783.75	..	1000
I 6532.88	..	100	I 8259.38	..	150	I 8792.51	..	30
I 6598.95	..	1000	I 8266.08	..	200	I 8830.92	..	50
I 6602.91	..	100	I 8267.11	..	80	I 8853.87	..	700
I 6652.09	..	150	I 8300.33	..	600	I 8865.33	..	100
I 6666.89	..	100	I 8301.54	..	150	I 8865.76	..	500
I 6678.28	..	500	I 8365.75	..	150	I 8919.50	..	300
I 6717.04	..	70	I 8376.41	..	200	I 8988.58	..	200
I 6738.06	..	70	I 8377.61	..	800	I 9148.68	..	600
I 6929.47	..	1000	I 8417.18	..	100	I 9201.76	..	600
I 7024.05	..	500	I 8418.43	..	400	I 9220.05	..	400
I 7032.41	..	1000	I 8463.37	..	150	I 9221.59	..	200
I 7051.29	..	70	I 8484.45	..	80	I 9226.67	..	200
I 7059.11	..	200	I 8495.36	..	500	I 9275.53	..	100
7138.70	..	30	I 8544.70	..	60	I 9300.85	..	600
I 7173.94	..	1000	I 8571.36	..	100	I 9310.58	..	150
I 7245.16	..	1000	I 8582.91	..	60	I 9313.98	..	300
I 7304.82	..	30	I 8591.26	..	400	I 9326.52	..	600
I 7438.90	..	300	I 8634.65	..	600	I 9373.28	..	200
I 7472.42	..	50	I 8635.31	..	50	I 9425.38	..	500
I 7488.87	..	500	I 8647.05	..	300	I 9432.94	..	40
I 7535.77	..	300	I 8654.38	..	2000	I 9459.21	..	300
I 7544.05	..	100	I 8654.51	..	400	I 9486.68	..	500
I 7839.08	..	30	I 8679.49	..	500	I 9534.17	..	500
I 7927.13	..	40	I 8681.92	..	500	I 9547.40	..	300
I 7937.01	..	70	I 8704.15	..	200	I 9665.42	..	1000
I 7943.18	..	200	I 8771.70	..	400	I 9900.58	..	40
I 8082.46	..	200	I 8778.75	..	150	I 9902.31	..	30
I 8118.55	..	100						

(Neptunium)*

Nickel

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2004.29	..	30	II 2125.90	4	25	II 2278.77	12	25
II 2019.04	2	30	II 2126.80	2	25 w	II 2287.08	100	500
II 2020.97	..	30	II 2128.57	5	30	I, II 2302.99	10 s	35
II 2029.19	..	25	II 2161.22	10	30	I 2310.96	50 r	10 s
II 2032.30	2	25	II 2165.56	20	40 r	I 2312.34	30 W	6
II 2053.29	3	25	II 2174.67	12	30	II 2316.04	15	25 W
II 2054.32	..	25	II 2175.16	15	25	I 2317.16	30 r	12
II 2066.41	2	25	II 2180.47	4	40	I 2320.03	30 r	5 l
II 2080.85	3	35	II 2185.50	4	30	I 2325.79	30 r	9
I 2082.86	25	2	II 2188.05	4	25	II 2336.58	..	150
II 2084.86	..	25	II 2201.41	10	30	II 2336.68	..	30
I 2088.98	30 d	..	II 2206.70	20	30 n	II 2375.42	10	30
II 2090.10	3	25	II 2216.47	20	40 wn	II 2387.76	6	30
I 2095.73	25	2	II 2220.40	10	25	I 2401.84	40 r	10
II 2097.10	4	35	II 2222.94	15	25 w	II 2405.17	..	80
II 2103.38	..	25	II 2224.87	15	25	II 2413.05	..	50
II 2107.96	2	45	I 2244.53	40	..	II 2416.14	40	250 n
II 2111.72	25	9	II 2253.86	100	300	I 2423.33	25	4
II 2113.51	3	45	I 2259.57	300 w	..	II 2433.57	..	80
2124.11	30	..	II 2264.46	150	400	I 2434.41	40 w	..
I 2124.81	25	3	II 2270.21	100	400	2436.67	30 l	20
II 2125.11	4	25	II 2277.28	5	25	II 2437.89	40 w	200

* See end of Section II.

II. EMISSION SPECTRA 2000–10,000 A (Continued)

NICKEL (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2450.99	100 n	30	II 2825.24	..	125	I 3361.56	500 W	20
I 2453.99	40 W	8	I 2834.55	40	15	I 3362.81	100	..
II 2455.53	..	40	I 2838.96	25	..	I 3365.77	400 w	12
I 2466.96	40 W	..	II 2842.42	..	150	I 3366.17	400 W	12
II 2473.15	80	500	II2863.70	..	250	I 3366.81	60	1
I 2476.87	40 W	2	II 2864.15	..	300 wn	I 3367.89	80	..
II 2484.33	..	50 wn	I 2907.46	40	..	I 3369.57	500 r	100
I 2489.51	40	6	I 2943.91	50 r	20	I 3371.99	400	10
2490.70	40	..	I 2981.65	80 r	20	I 3374.22	400	6
II 2505.84	..	50	I 2984.13	50 r	10	3376.33	25	..
II 2510.87	50 n	250 n	I 2992.59	80 r	10	I 3380.57	600 r	100
I 2524.22	50 r	..	I 2994.46	125 r	10	I 3380.88	200	12
II 2525.39	..	300 Wn	I 3002.49	1000 r	100	I 3391.05	400	40
I 2432.08	30	..	I 3003.63	500 r	80	I 3392.99	600 r	..
2535.97	25	..	I 3012.00	800 r	125 W	I 3401.17	40	1
II 2539.10	..	250 w	I 3019.14	200 r	30	I 3403.43	40	..
I 2540.02	40	1	I 3031.87	200	..	II 3407.30	..	25
II 2545.90	20	900 n	I 3037.93	800 r	100	I 3409.58	300	..
II 2547.19	..	100	I 3045.00	200	10	I 3413.48	500	15
II 2549.56	..	150	I 3050.82	1000 r	..	I 3413.94	300	10
II 2551.03	..	80	I 3054.32	400 r	100	I 3414.76	1000 r	50 wn
II 2555.11	..	1000 n	I 3057.64	400 r	125	I 3420.74	30	3
II 2557.87	..	80	I 3064.62	200 r	50	I 3421.34	30	8
II 2560.30	..	500 n	I 3080.75	200	60	I 3423.71	600 r	25
I 2561.42	40	..	II 3087.08	..	150	I 3433.56	800 r	50 wn
II 2565.37	..	150 wn	I 3097.12	200	50	I 3437.28	600 r	40
II 2566.08	..	600 n	I 3099.11	200	50	I 3446.26	1000 r	50 n
II 2583.99	..	200	I 3101.55	1000 r	150	I 3452.89	600 r	50
II 2587.25	..	50	I 3101.88	400 r	150	I 3458.47	800 r	50 n
II 2588.31	..	80	I 3105.47	200	35	I 3461.65	900 r	50 n
II 2601.13	..	2000 n	I 3107.71	25	..	I 3467.50	300	15
II 2605.35	..	250 n	I 3114.12	300	50	I 3469.49	300	20
II 2606.39	..	600 n	I 3129.31	125	..	I 3472.54	800 r	40
II 2610.09	..	900 n	I 3134.11	1000 r	150	I 3483.77	500 r	30
II 2611.65	..	125	I 3145.72	200	3	I 3485.89	150	30
II 2615.19	..	900 n	I 3181.7	50	1 n	I 3492.96	1000 r	100 n
II 2626.56	..	500 n	I 3183.25	25	..	I 3500.85	500 wn	80
II 2630.28	..	150 w	I 3184.37	150	3	I 3502.59	100	..
II 2631.52	..	100 wn	I 3195.57	125	..	I 3507.69	100	12
II 2632.89	..	2000 wn	I 3197.11	300	..	I 3510.34	900 r	50 n
II 2647.06	..	500 wn	3200.42	30	..	I 3513.93	200	40 n
II 2648.72	..	80	I 3202.14	25	..	I 3515.05	1000 r	50 n
II 2655.47	..	400 wn	I 3221.27	35	..	I 3518.63	90	8
II 2655.91	..	500 Wn	I 3221.65	300	4	I 3519.77	500 n	30
II 2665.25	..	125	I 3225.02	300	6	I 3523.44	100	..
II 2670.33	..	80	I 3226.98	100	..	I 3524.54	1000 r	100 wn
II 2679.24	..	500 wn	I 3232.96	300 r	35	I 3527.98	200	15
II 2684.41	..	600 wn	I 3234.65	300	15	I 3530.59	30	..
II 2690.64	1	250 n	I 3243.06	400 r	15	I 3548.18	400	25
I 2696.49	2	50	I 3248.46	150	2	I 3551.53	50	12
II 2708.79	..	500	I 3249.44	30	..	I 3553.48	50	10
II 2742.99	..	500	I 3250.74	125	1	I 3561.75	70	12
I 2746.75	125	50	I 3271.12	125	1	I 3566.37	2000 r	100 wn
II 2759.02	..	500 wn	I 3282.70	100	..	I 3571.87	1000 r	40 n
II 2760.67	..	40	I 3282.83	25	1	II 3576.76	2	40 n
II 2768.78	..	250 wn	I 3286.95	100	1	I 3587.93	200	12
II 2775.33	..	250 wn	I 3304.95	25	..	I 3597.70	1000 r	50 n
I 2798.65	125	..	I 3310.20	50	..	I 3602.28	150	15
2802.27	50	15	I 3312.32	70	2	I 3606.85	100 r	..
I 2805.08	50	15	I 3315.66	400 r	20	I 3609.31	200	15
II 2805.67	..	200 n	I 3320.26	400 w	15	I 3610.46	1000 r	..
II 2808.36	..	40	I 3322.31	400	10	I 3612.74	400	50 n
I 2821.29	125	125	I 3359.11	60	..	I 3619.39	2000 r	150 n

II. EMISSION SPECTRA 2000–10,000 A (Continued)

NICKEL (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3624.73	150	15	I 4712.07	30	..	I 5084.08	300 w	2
I 3634.94	50	10	I 4714.42	1000	8	I 5094.42	25	..
I 3661.95	50	6	I 4715.78	200	2	I 5096.87	50	..
I 3664.09	300	30	I 4731.81	100	2	I 5099.32	80	..
I 3669.24	150	10	I 4732.46	100	..	I 5099.95	150 w	..
I 3670.43	150	20	I 4752.12	30	..	I 5102.97	40	..
I 3674.15	200	50 r	I 4752.43	150	..	I 5115.40	80	5 wn
I 3688.41	150	15	I 4754.77	100	..	I 5125.21	50	..
I 3693.93	50	..	I 4756.52	250	3	I 5129.38	80	..
I 3722.48	200	20	I 4762.63	150	1 n	I 5137.07	150	1
I 3730.75	25	..	I 4763.95	150	1	I 5139.25	50	..
I 3736.81	300	15	I 4786.29	25	..	I 5142.77	100	..
I 3739.23	100	10	I 4786.54	300 W	2	I 5146.48	150	1
I 3749.04	50	5	I 4806.99	150 W	1	I 5155.14	50	..
II 3769.45	2	50 n	I 4808.86	25	..	I 5155.76	80	1
I 3775.57	500 n	40 n	I 4821.14	25	2	I 5168.66	70	..
I 3778.06	25	5	I 4829.03	300 w	2 n	I 5176.56	70	2
I 3783.53	500	40 n	I 4831.18	200	2	I 5184.58	50	..
I 3792.34	25	5	I 4832.70	70	..	I 5235.35	30	2
I 3793.61	50	..	I 4838.65	150	4	I 5353.41	40	..
I 3807.14	800 W	40 n	I 4852.56	150	..	I 5371.35	30	..
3831.69	300	10	I 4865.41	400 w	1	I 5411.23	40	2
I 3832.87	25	..	I 4857.38	100	..	I 5424.65	30	..
3858.30	800 r	70 n	I 4863.93	30	..	I 5435.87	50	..
I 3889.67	30	10 n	I 4866.27	300 w	1	I 5476.91	400 w	8
I 3970.50	40 w	..	I 4870.84	100	..	I 5578.73	50	..
I 3972.17	100	6	I 4873.44	200	2 n	I 5587.86	50	..
I 3973.56	800	10	I 4874.81	25	..	I 5592.28	150 r	1
I 3974.65	40 n	..	I 4886.99	30	..	I 5593.73	40	2 n
I 3984.14	30 wn	..	I 4904.41	400 W	1	I 5614.79	50	..
I 3993.95	30 n	..	I 4912.03	100	..	I 5625.33	30	..
II 4067.05	..	30	I 4913.97	200	..	I 5641.88	25	..
I 4195.53	30	..	I 4918.36	200 W	1	I 5682.20	50	..
I 4200.46	40	..	I 4918.71	40	..	I 5694.99	40	..
I 4201.72	30	..	I 4925.58	100	..	I .709.56	100 w	(1)
I 4284.68	25	10	I 4935.83	150	1	I 5711.90	50	..
I 4288.00	150	..	I 4937.34	400 w	..	I 5715.09	50	..
I 4295.89	100	2 n	I 4945.46	90	..	I 5748.34	40	..
I 4325.61	70	..	I 4953.20	150	..	I 5754.67	150 w	..
I 4331.64	200	12	I 4971.35	100	..	I 5760.85	50	..
I 4359.58	100	10	I 4976.34	40	..	I 5805.23	50	..
I 4384.54	25	1	I 4980.16	500 W	1	I 5857.75	50	..
I 4401.55	1000 W	30	I 4984.13	500 W	1	I 6086.29	100	..
I 4410.52	25	4	I 4996.85	80	..	I 6108.12	200	..
I 4436.98	25	5	I 4998.23	150	..	I 6111.06	25	..
I 4459.04	400	20	I 5000.33	150 w	..	I 6116.18	150	..
I 4462.46	150	20	I 5010.04	25	..	I 6163.42	100	..
I 4519.99	25	..	I 5010.96	50	..	I 6175.42	300	..
I 4546.93	50	2	I 5012.46	70	2 n	I 6176.81	400 w	..
I 4547.23	30	..	I 5014.24	25	..	I 6186.74	30	..
I 4592.53	200	2	I 5017.59	100 w	1	I 6191.19	500	1
I 4600.37	200	..	I 5018.29	70 w	..	I 6223.99	30	..
I 4604.99	300	10 n	I 5035.37	300 w	5	I 6256.36	600 w	10
I 4606.23	100	..	I 5035.96	70 w	..	I 6314.67	300	..
I 4648.66	400 w	3	I 5038.60	50	..	I 6327.60	25	..
I 4655.66	40	..	I 5041.08	30	..	I 6339.15	50	..
I 4666.99	50	..	I 5042.19	80	..	I 6482.81	35	..
I 4667.77	100	..	I 5048.85	80	2 n	I 6586.32	40	..
I 4686.22	200	1	I 5051.53	50	..	I 6643.64	300 w	..
I 4698.41	30	..	I 5079.96	30	..	I 6767.78	300	..
I 4701.34	100	..	I 5080.52	200 w	3	I 6772.36	200	..
I 4701.54	150	..	I 5081.11	150 w	2	I 6813.60	30	..
I 4703.81	200	..	I 5082.35	100 w	..			

NICKEL (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 6842.07	60	..	I 7182.00	200	..	I 7522.78	40	..
I 6876.71	25	..	I 7197.03	200	..	I 7525.14	30	..
I 6914.57	300	..	I 7261.93	300	..	I 7555.60	40	..
I 6955.06	80	..	I 7291.48	100	..	I 7574.08	30	..
I 7001.57	30	..	I 7327.67	25	..	I 7617.00	60	..
I 7024.86	50	..	I 7381.94	40	..	I 7714.32	60	..
I 7030.06	100	..	I 7385.24	150	..	I 7715.63	40	..
I 7034.42	30	..	I 7386.21	100	..	I 7727.66	80	..
I 7062.97	35	..	I 7393.63	600	..	I 7788.95	60	..
I 7110.91	100	..	I 7409.39	400	..	I 7797.62	80	..
I 7122.24	1000 W	..	I 7414.51	200	..	I 7917.48	30	..
I 7167.01	35	..	I 7422.30	600	..	I 9520.06	50	..

**Niobium

Wave length	Arc	Discharge tube
II 2095.47	..	50
II 2286.73	..	25
2308.55	..	35
2308.90	..	35
II 2496.88	..	25
II 2522.27	..	25
II 2590.91	..	25
II 2709.82	..	50
II 2799.20	..	25
II 2823.67	..	25
2879.73	..	25 n
2885.25	..	50 n
2892.86	..	25 n
II 3006.86	..	50
II 3437.16	..	35
3650.19	..	70
I 3822.07	..	35
I 3830.39	..	150
II 3838.39	..	25
II 3919.00	..	35
II 3955.85	..	35
II 3994.99	..	300
I 4099.94	..	150
I 4109.98	..	1000
I 4114.00	..	30
I 4137.63	..	50
I 4143.65	..	30
I 4151.46	..	1000
I 4214.73	..	25
I 4223.04	..	25
4236.98	..	30 n
II 4241.80	..	100 n
4305.46	..	30
4358.27	..	250
II 4432.71	..	30 n
II 4447.03	..	300
4492.40	..	40
4494.67	..	25
4530.37	..	25
II 4601.49	..	100
II 4607.17	..	50
II 4609.60	..	30
II 4613.89	..	30
II 4621.40	..	50
II 4630.55	..	300
II 4643.11	..	100

NITROGEN

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 4788.13	..	25	I 5999.47	..	90
II 4803.27	..	30	I 6008.48	..	800
I 4935.03	..	250	6075.83	..	30
II 4994.36	..	30	II 6167.82	..	50
II 5001.13	..	150	II 6173.40	..	30
II 5001.47	..	200	II 6242.52	..	70
II 5005.14	..	500	II 6284.30	..	30
II 5007.32	..	150	II 6340.67	..	50
II 5010.52	..	100	II 6357.00	..	30
II 5016.39	..	70	II 6379.63	..	70
II 5025.66	..	100	I 6420.47	..	30
II 5045.10	..	200	I 6437.01	..	30
II 5073.60	..	30	6440.95	..	25
II 5175.89	..	30	I 6441.70	..	70
II 5179.50	..	70	I 6457.93	..	25
II 5320.75	..	50	I 6468.32	..	30
I 5328.70	..	70	II 6482.07	..	300
II 5351.21	..	30	I 6482.74	..	500
I 5356.77	..	50	I 6483.75	..	30
I 5378.45	..	30	I 6484.88	..	500
II 5462.62	..	30	I 6491.28	..	25
II 5480.10	..	30	I 6499.52	..	25
II 5495.70	..	70	II 6610.58	..	100
II 5530.27	..	50	I 6622.53	..	30
II 5535.39	..	70	I 6637.01	..	50
II 5543.49	..	30	I 6644.96	..	500
II 5551.95	..	30	I 6653.41	..	70
I 5560.37	..	200	I 6706.20	..	50
5563.84	..	30 n	6708.81	..	50
I 5564.37	..	200	I 6723.12	..	500
I 5616.54	..	60	I 6733.48	..	100
I 5623.20	..	40	I 6741.29	..	30
II 5666.64	..	300	I 6752.40	..	50
II 5676.02	..	100	I 6758.60	..	50
II 5679.56	..	500	II 6942.9	..	30
II 5686.21	..	100	I 6945.22	..	40
II 5710.76	..	100	II 7139.8	..	30
II 5747.29	..	50	I 7423.88	..	50
I 5752.64	..	30	I 7442.56	..	100
II 5767.43	..	30	I 7468.79	..	200
I 5829.53	..	60	I 8216.46	..	35
II 5927.82	..	50	9045.1*	150	..
II 5931.79	..	150	I 9060.6	..	125
II 5941.67	..	200	I 9386.5	..	70
II 5952.39	..	30	I 9392.5	..	120

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* Also listed for carbon.

** See under Columbium.

II. EMISSION SPECTRA 2000–10,000 A (Continued)

Osmium

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2045.36	50	20	2872.40	50	8	I 3156.25	500 r	15 wn
2117.96	80	20	2874.95	50	15	3156.77	100	3
2119.79	125	30	I 2909.06	500 r	400	3157.24	100	2
2127.97	5	50	2912.33	50	50	3161.44	80	12
2137.11	100	30	2919.79	100	15	3161.73	100	10
2156.31	50	3	3003.48	60	12	3164.61	60	12
2158.53	50	25	3013.07	150	20	3166.51	200	20
2159.52	60	..	3015.65	100	15	3168.28	100	15
2159.98	60	5	3017.25	100	25	3173.20	100	15
2161.00	50	1	I 3018.04	300 r	50	3173.93	80	30
2164.85	25	50	3019.37	100	20	3178.06	150	20
2167.75	50	10	I 3030.69	500	40	3178.24	80	10
2188.97	50	..	3032.81	50	15	3181.88	100	12
2194.39	40	100	3040.90	200	100	3182.57	100	15
2205.74	20	50	3042.74	20	50	3185.33	150	12
2206.27	25	50	3043.50	100	15	3186.98	100	15
2231.16	12	50	3043.64	60	12	3187.33	80	12
2255.85	125	2	3044.41	50	10	3189.46	125	15
2260.11	25	50	3044.91	100	12	3194.23	125	15
2261.73	25 l	50 l	3049.46	80	15	3194.63	50	10
2270.17	60	15	3050 39	100	50	3195.08	100	12
2272.54	4 w	50	3051.17	80	15	3213.31	50	40
2279.11	100	25	3054.97	50	10	3223.86	100	8
2282.26	100	125	3055.21	80	15	3227.28	125	12
2283.67	50	15	I 3058.66	500 r	500	3229.21	125	5
2336.80	50	80	3060.30	100	30	3231.42	150	12
2362.77	50	12	3062.19	100	30	I 3232.05	500 r	20
2367.35	50	80	3066.12	50	10	3232.54	150	10
2369.24	50	12	3069.94	125	15	3234.20	150	12
2371.18	50	15	3074.08	125	20	3234.73	100	10
2377.03	50	30	3074.96	125	20	3238.63	100	20
2377.61	50	15	3077.06	100	12	3241.04	80	20
2396.77	100	12	3077.44	80	8	3252.01	50	15
2423.07	25	80	3077.72	100	30	3254.91	60	12
2424 97	50	8	3078.11	125	15	3256.92	80	12
2461.42	50	10	3078.38	125	15	3260.30	60	10
I 2488.55	50 w	15	3084.60	60	10	I 3262.29	500 r	50
2492.37	50 r	8 r	3086.27	50	10	3262.75	100	20
2513.25	50	8	3087.75	50	10	3264.69	100 n	10
2542.51	50	8	3088.27	60	12	I 3267.94	400 r	30
2580.03	15	100 w	3090.08	100	15	3269.21	200	20
2581.96	80 s	5	3090.30	100	12	3275.20	200	15
2590.75	75	8 l	3090.49	80	15	3277.97	80	8
2613.06	50	10	3093.59	125	15	3290.26	200	20
I 2637.13	150	30	3101.53	125	20	I 3301.56	500 r	50
2644.11	75	10	3104.98	200 d	15 d	3306.23	80	12
2658.60	50	10	3105.99	150	20	3310.91	200	30
2689.82	50	10	3108.98	125	15	3315.42	50	15
2699.59	50	8	3109.38	125	20	3324.33	50 d	15 d
2706.70	50	8	3111.09	100	20	3327.49	80	15
2714.64	50 r	10	3114.81	50	12	I 3336.15	200 r	50
2720.04	75	15	3116.47	50	15	3351.73	50	12
2721.86	75	10	3118.12	80	15	3357.97	100	15
2732.80	75	15	3118.33	150	20	3361.15	80	20
2761.42	50	10	3124.94	150 n	10 wn	3364.12	100	12
2796.73	100	15	3129.23	60	15	3370.20	50	10
2804.07	80	20	3131.11	125	30	I 3370.59	300 r	30
2806.91	100 w	1	3140.31	60	12	3378.68	50	10
2814.20	50	25	3140.94	50	12	3384.00	80	5
I 2838.63	100 r	100	3145.96	60	10	I 3387.84	100	15
2844.40	50	25	3152.07	80	15	I 3401.86	200	20
2850.76	75	25	3152.67	150	18	I 3402.51	200	15
2860.96	100	25	3153.61	125	20	3427.67	80	15

OSMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3444.46	50	12	I 3790.14	80	30	4189.91	60	3
3445.55	80	15	3790.73	100	20	4195.14	100 s	1
3449.20	100	20	I 3793.91	125	300	4202.06	100	4
3455.03	50	15	3800.44	50	15	4211.85	150	50
3458.38	200	12	3827.14	50	20	I 4260.85	200	200
3459.02	100	10	I 3836.06	150	20	I 4293.95	60	6
3465.43	60	12	3840.30	150	20	4311.40	150	9
3478.53	100	15	3843.66	80	12	4328.68	60	4
3487.46	50	15	I 3849.94	125	20	4365.67	60	4
3498.54	80	15	3853.44	100	15	4370.66	50	3
3501.16	100	15	I 3857.09	150	15	4394.86	150	6
3504.66	300	20	I 3865.47	125	200	4402.74	50	3
3518.72	200	30	I 3876.77	300	50	I 4420.47	400 r	100
3523.64	150	30	3878.57	50	12	4436.32	80	3
3526.03	80	20	3881.86	125	20	4447.35	200	3
I 3528.60	400 r	50	3900.39	50	12	4479.81	80 l	1
3530.06	100	20	3901.71	150	20	4484.76	100	1
I 3532.80	100	20	3928.54	50	10	4488.60	60	..
3542.71	150	10	3929.99	80	12	4524.87	80	2
I 3559.79	150	10	3938.59	125	20	4529.67	80	2
I 3560.85	150 r	100	3939.57	50	12	4537.61	50	..
3562.34	50	20	3949.78	50	10	4539.92	100	2
3569.77	100	30	3960.51	50	15	4548.66	100	5
3587.31	60	15	3961.02	125	20	4550.41	150	10
I 3598.11	300	30	I 3963.63	500	50	4551.30	150	8
3601.83	60	20	3964.96	60	12	4595.04	80	4
3604.47	15	100	3969.67	100	100	4597.16	100	4
I 3616.57	150	20	3975.44	50	12	4616.78	150	6
3619.43	60	25	I 3977.23	300	40	4631.83	100	5
I 3640.33	200	40	3988.18	50	12	4663.82	100	5
3648.81	100	10	3996.80	50	10	4692.06	80	3
3654.49	100	15	3998.93	80	12	4743.89	60	..
I 3656.90	150	30	4003.48	50	6	4793.99	300	6
I 3670.89	200	20	4004.02	50	6	4815.96	60	..
3689.06	200	30	4018.26	60	4	4865.60	80	1
3703.25	100	30	4037.84	80 l	4	4899.21	60	..
3706.56	50	15	4041.92	100 l	6	4912.60	80	..
3712.84	50	12	4066.69	100	100	5039.12	50	..
3713.73	100	20	4074.69	80	6	5149.74	80	..
I 3720.13	80	40	4088.44	100 n	3	5376.79	50	..
3732.85	200 r	5 n	4091.82	100	12	5416.34	80	..
3746.47	100	20	4100.30	60	3	5416.69	50	..
I 3752.52	400 r	100	4112.02	150	9	5443.31	50	..
3766.30	100	20	4128.96	60	3	5523.53	100	..
3768.14	80	15	4135.78	200	50	5584.44	50	..
3774.40	60	15	4137.84	100	3	5721.93	80	..
3774.62	60	12	4158.78	50	1	5780.81	50	..
3776.25	50	15	4172.57	60	3	5800.60	50	..
3776.99	150	20	4173.23	100	6	5857.76	80	..
I 3782.19	400 r	200	4175.63	100	4	5995.99	50	..

OXYGEN

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 2293.33	..	50	2493.75	..	50	II 3134.79	..	100 l
II 2300.36	..	70	2517.41	..	50	II 3287.57	..	70 l
II 2433.53	..	250	II 2575.30	..	100	II 3390.26	..	100
II 2445.55	..	300	II 2733.40	..	150	II 3470.77	..	100

OXYGEN (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
I 3692.44	..	50	II 4369.28	..	50	I 5435.16	..	70
II 3727.30	..	50	II 4395.95	..	80	I 5435.76	..	100
II 3749.47	..	125	II 4414.89	..	300	I 5436.83	..	200
I 3823.47	..	125	II 4416.97	..	150	I 5512.70	..	70 n
II 3911.95	..	150	II 4443.04	..	50	I 5554.94	..	100 n
I 3947.33	..	300	II 4448.20	..	70	5750.42	..	70
I 3947.51	..	50	II 4452.41	..	70	5950.60	..	70
I, II 3954.38	..	100	II 4465.45	..	50	I 5958.53	..	100 n
II 3973.27	..	125	II 4467.83	..	50	I 6046.34	..	150
II 4069.63	..	60	II 4590.94	..	300	I 6155.99	..	150
II 4069.90	..	125	II 4596.13	..	150	I 6156.78	..	300
II 4072.16	..	300	II 4609.39	..	60 n	I 6158.20	..	1000
II 4075.87	..	800	II 4638.86	..	70	6261.31	..	70
II 4078.85	..	70	II 4641.83	..	150	6366.28	..	50
II 4085.12	..	70	II 4649.15	..	300	6374.29	..	70
II 4089.27	..	60 n	II 4650.85	..	70	I 6453.69	..	100
II 4092.94	..	80	II 4655.36	..	50	I 6454.55	..	150
II 4097.24	..	70	II 4661.65	..	125	I 6456.07	..	500
II 4103.01	..	50	II 4676.25	..	125	II 6640.90	..	70
II 4104.73	..	50	II 4699.21	..	100	I 6654.12	..	50
II 4105.00	..	125	II 4705.32	..	300	II 6721.21	..	300
II 4112.02	..	50	II 4710.00	..	60	II 6721.35	..	70
II 4119.22	..	300	II 4751.34	..	50	I 6727.87	..	70
II 4120.27	..	50	I 4772.89	..	50	II 6895.29	..	70
II 4121.46	..	50	I 4773.76	..	70	II 6906.54	..	50
II 4132.82	..	100	I 4803.00	..	50	I 7002.22	..	50
II 4153.31	..	200	II 4906.80	..	50	I 7157.36	..	70
II 4169.23	..	50	II 4924.50	..	60	I 7476.47	..	70
II 4185.45	..	150	II 4941.02	..	50	I 7771.93	..	1000
II 4189.79	..	500	II 4942.97	..	100	I 7774.14	..	300
4222.78	..	50	I 4967.40	..	50	I 7775.43	..	100
4233.32	..	100	I 4967.86	..	80	I 7947.57	..	1000
II 4253.74	..	50 n	I 4968.76	..	100	I 7950.8	..	100
II 4253.98	..	100 n	I 5019.34	..	50	I 7952.18	..	50
II 4275.47	..	50 n	I 5020.13	..	70	7995.09	..	50
II 4303.78	..	60 n	I 5146.06	..	70	I 8221.83	..	2000
II 4317.16	..	150	II 5206.61	..	60	I 8227.69	..	1000
II 4319.65	..	150	I 5275.08	..	50	I 8230.02	..	1000
II 4336.85	..	70	I 5299.00	..	70	I 8233.0	..	1000
II 4345.57	..	125	I 5328.98	..	100	I 8235.41	..	50
II 4347.43	..	70	I 5329.59	..	150	I 8426.37	..	50
II 4349.43	..	300	I 5330.66	..	500	I 8446.39	..	2000
II 4366.91	..	100	5408.59	..	50	8819.60	..	70
I 4368.30	..	1000						

PALLADIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2001.49	..	40	II 2231.59	10	60	II 2372.15	5	50
2003.80	..	40	II 2270.11	..	(40)	2382.57	..	40 n
II 2045.62	..	100	2270.21	..	40 wn	II 2383.40	..	50 wn
II 2137.24	..	40	II 2296.51	20	60	I 2385.01	..	50 wn
II 2162.27	3	40	II 2302.01	..	60	II 2388.29	2	40
II 2198.24	..	40	II 2307.50	..	50	II 2406.34	..	60
II 2202.35	..	40	II 2331.41	..	40	II 2406.74	1	150
II 2212.1[illegible]	5	50	II 2351.34	10	60	II 2408.74	..	100
II 2214.04	..	40	II 2357.63	3	40	II 2413.39	..	40
II 2218.16	..	40	2367.96	10	60	II 2414.73	..	150

PALLADIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2418.73	..	50	II 2658.72	20	300	II 3272.56	..	60 n
II 2424.48	..	100	II 2661.14	..	100	I 3287.25	300 w	25
II 2426.87	..	50	II 2679.58	..	100	I 3302.13	1000 wn	200 n
II 2433.10	..	50	II 2684.76	..	100	II 3327.23	..	50 n
II 2435.32	..	50	II 2687.66	..	150	I 3373.00	800 r	500 wn
II 2446.18	..	100	II 2688.55	..	200	I 3380.67	150 w	2 n
II 2446.71	..	50	II 2698.55	..	200	I 3404.58	2000 r	1000 r
I 2447.91	200 r	100	2714 32	..	150	I 3421.24	2000 r	1000 r
II 2448.16	..	100	II 2714.90	..	200	I 3433.45	1000 n	500 n
II 2469.25	..	150	II 2727.89	..	200	I 3441.40	800 n	2 n
II 2470.01	..	150	II 2731.61	..	(50)	II 3451.35	..	400 n
II 2471.15	..	150	II 2742.60	..	100	I 3460.77	300 r	600 n
II 2472.51	..	150	II 2763.09	300 r	30 r	II 3468.54	..	50 n
I 2476.42	300 r	50	II 2837.12	..	(40)	I 3481.15	500 r	2 n
II 2489.61	..	75	II 2839.89	..	100	I 3489.77	150 W	35
II 2496.69	..	100	II 2841.03	..	100	I 3516.94	1000 r	500 r
II 2498.78	4	150 n	II 2854.58	4	500 n	I 3553.08	100 r	15 wn
II 2508.92	..	(50)	II 2857.73	..	100	3566.63	60	..
II 2514.48	..	200	II 2893.09	..	100	I 3571.15	40 n	40 n
II 2534.60	..	100	I 2922.49	200	25	I 3609.55	1000 r	700 r
II 2537.17	..	100	II 2954.39	..	60 n	I 3634.69	2000 r	1000 r
II 2537.97	..	100	II 2980.65	..	200 r	I 3690.34	300 n	1000 w
II 2539.36	..	50 wn	II 2999.55	..	100 n	I 3718.91	300	200
II 2544.83	..	200	I 3002.65	100 r	60	I 3799.19	200 W	150
II 2550.66	..	150	I 3009.78	50 r	10	I 3832.29	150	150
II 2551.85	..	100 n	II 3018.50	..	50 n	I 3894.20	200 W	200 W
II 2561.02	..	200	I 3027.91	150	200 n	I 3958.64	500 w	200
II 2565.51	2	200	II 3032.20	2	100 n	I 4087.34	500	100
II 2569.55	20	150	3050.08	..	100 n	I 4140.83	100 r	..
II 2575.49	..	100	II 3052.15	..	150 n	I 4169.84	200	50
II 2576.40	..	100	II 3059.43	..	150 w	I 4212.95	500 W	300 W
II 2577.10	3	150	I 3065.31	10	100	I 4473.59	60	6
II 2583.85	..	200	I 3066.10	150	2	I 4788.17	200 n	4 n
II 2584.13	..	75	I 3114.04	400 w	500 w	4817.51	40	8
I 2593.27	3	100	I 3142.81	300	100	I 5110.81	100	2
II 2595.97	3	150	II 3155.59	..	40	I 5117.01	50	4
II 2602.76	20	200	II 3161.95	..	100 n	I 5163.84	300	8
II 2609.86	..	200	II 3170.26	..	50 wn	I 5234.86	50	2
II 2613.43	..	100	II 3210.45	..	60 n	I 5295.63	200	10
II 2628.25	..	200	I 3218.97	300	8	I 5395.24	50	2
II 2635.94	50	300	I 3242.70	2000 wn	600 r	I 5542.80	100	2
II 2637.07	..	100	II 3243.13	..	60 n	I 5547.02	50	2
II 2640.18	..	70	I 3251.64	200	500	I 5619.44	50	2
II 2642.17	..	100	I 3258.78	300	200 n	I 5670.07	100	..
II 2649.47	..	200	II 3267.35	..	200 n	I 5695.09	50	..
II 2657.56	..	200						

PHOSPHORUS

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 2496.00	..	50	3162.34	..	50	II 3308.85	..	100 w
II 2497.33	..	100	3163.87	..	50	3364.43	..	100
II 2500.92	..	50	3171.84	..	50	3371.10	..	70
I 2534.01	50	20	II 3175.14	..	70	II 3372.70	..	50
I 2535.65	100	30	3184.82	..	50	II 3377.52	..	50 n
I 2553.28	80	20	3186.24	..	50	3378.76	..	50
I 2554.93	60	20	3219.30	..	100 w	3395.35	..	50

II. EMISSION SPECTRA 2000–10,000 A (Continued)

PHOSPHORUS (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 3404.33	..	50	4057.39	..	50	4675.78	..	70
3406.93	..	50	4059.27	..	100	II 4678.94	..	100 l
3413.51	..	70	4080.04	..	150	II 4700.79	..	50 l
II 3419.24	..	100	II 4109.19	..	70	4724.25	..	75
II 3424.87	..	100	II 4117.09	..	50	4727.46	..	100
II 3426.19	..	50	II 4127.49	..	70	II 4792.06	..	70 l
II 3470.82	..	50	4143.84	..	50	4854.69	..	70
II 3472.87	..	70	4178.36	..	300 w	II 4864.38	..	50 l
3474.14	..	70	4222.15	300	150 w	4872.33	..	50
3485.00	..	50	4246.88	70	150 w	4876.98	..	50 l
3488.77	..	70	4249.57	..	100	II 4927.16	..	50 l
II 3490.44	..	70	II 4288.52	..	50	II 4943.41	..	150 l
II 3502.99	..	70	4385.33	..	100 l	II 4954.32	..	70 l
II 3507.36	..	100 w	4400.99	..	50 l	II 4969.64	..	150 l
3516.15	..	70	4414.28	..	100	5040.74	..	70 l
II 3518.60	..	50 n	II 4414.60	..	70	5141.49	..	50
II 3530.24	..	70	4420.64	..	70	II 5152.20	..	50
II 3556.48	..	100	4428.15	..	70	5156.72	..	50
II 3566.42	..	70	4443.87	..	50	5176.38	..	70
3577.60	..	50 d	II 4452.44	..	150 l	II 5191.40	..	100
3583.60	..	50	4462.94	..	70	5235.52	..	70
3617.09	..	100 w	II 4463.70	..	70	II 5253.48	..	300 w
II 3631.40	..	50	II 4467.97	..	50	II 5296.09	..	300 w
3653.38	..	100 w	II 4475.26	..	150 l	5303.21	..	50
3659.26	..	50	4479.74	..	70	II 5316.07	..	150 w
II 3664.19	..	100 w	4485.29	..	50	5344.72	..	150 w
3668.59	..	50	II 4499.17	..	150 l	II 5345.81	..	50
II 3676.26	..	100 w	II 4522.92	..	50	5386.87	..	150 w
II 3706.05	..	150 w	4523.73	..	50	II 5409.65	..	150 w
II 3715.85	..	50	II 4530.78	..	150 l	II 5425.92	..	150 w
II 3717.62	..	70	4540.20	..	70	5437.28	..	70
II 3728.66	..	50 d	4541.12	..	70	II 5450.65	..	100 l
3733.26	..	50	4546.03	..	70	5460.85	..	100
3744.21	..	70	4548.40	..	50	II 5483.55	..	70 l
II 3768.70	..	50	II 4554.80	..	100	II 5499.71	..	150
3802.07	..	100	II 4558.03	..	100 l	II 5507.13	..	70 l
II 3827.44	..	150 l	II 4565.21	..	100 l	II 5541.18	..	50
3885.17	..	150 l	II 4587.90	..	300 w	5544.49	..	50
3895.02	..	100	II 4589.78	..	300 w	II 5583.33	..	70 l
3904.78	..	100	II 4601.96	..	300 w	II 5588.25	..	70 l
3914.26	..	100 l	II 4622.70	..	50 n	II 6024.14	..	50
3922.71	..	50	II 4626.60	..	70	II 6043.05	..	150
3933.37	..	50	II 4628.70	..	50	I 9525.78	100	..
3951.50	..	70	4637.16	..	50	I 9593.54	70	..
3957.62	..	100	4641.72	..	50	I 9734.74	50	..
3997.16	..	70	4649.05	..	50	I 9750.79	70	..
II 4019.45	..	50	II 4658.11	..	100 l	I 9796.79	100	..
II 4044.49	..	150 w						

PLATINUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2036.46	15	40	I 2401.87	300	30	I 2418.06	300	50
I, II 2144.23	35	100	I 2403.09	400	50	II 2421.87	50	100
I 2165.17	1000 r	25	II 2405.73	..	100 wn	I 2428.03	100	10
2180.31	150	15	II 2410.33	..	50	I 2428.20	100	20
I 2292.39	400	100	I 2413.04	60	10	I 2429.10	100	.

II. EMISSION SPECTRA 2000–10,000 A (Continued)

PLATINUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2434.46	20	40	I 2719.04	1000 w	100 w	I 3240.20	40	6
I 2436.69	300	20	I 2729.91	500	50	3250.35	40	8
I 2440.06	800 w	100 wn	I 2733.96	1000 n	200 n	I 3251.98	100	1
II 2442.63	20	40	I 2734.50	100	10	3290.22	150	10
II 2450.44	25	50	I 2738.48	100	5	I 3301.86	300	250 W
I 2450.97	400	10	II 2743.49	6	40 n	I 3315.05	200	10
2467.44	800 r	100	I 2747.61	150	2	I 3323.79	150	10
II 2467.59	5	100	I 2753.86	100	4	I 3343.90	100	80
I 2471.01	100	20	I 2754.92	200	5 n	I 3408.13	250 W	60
2483.37	40	2	I 2769.84	50	2	I 3427.93	50	6
I 2487.17	600 r	20	I 2771.67	500	15	3483.43	70	10
I 2490.12	300	20	I 2773.24	50	5	I 3485.27	150	200 r
I 2495.82	40	10	I 2773.99	50	2	I 3628.11	300 W	20
I 2498.50	400	50	II 2774.78	10	100 wn	I 3638.79	250	10
I 2504.04	60	5	I 2793.27	100	5	I 3643.17	60	8
2505.93	150	10	II 2794.21	10	100 wn	I 3663.09	50	2
I 2508.50	300	20	II 2799.99	20	80 n	I 3671.99	80	10
II 2513.88	6	50	I 2803.24	400	5	I 3674.04	80	4
I 2514.07	150	10 n	2818.25	70	4	I 3699.91	80	5
I 2515.03	150	20	II 2822.27	10	60 n	3818.69	40	10
I 2515.58	500	20	I 2830.29	1000 r	600 r	I 3900.73	40	3
I 2529.41	80	..	I 2834.71	80	5	I 3922.96	100	20 r
I 2536.49	100	10	II 2860.68	30	150 n	I 3925.34	60	3
I 2539.20	400	20	II 2865.05	20	80 n	I 3948.39	60	5
I 2549.46	80	10	II 2875.85	20	80 n	I 3966.36	80	40
I 2552.25	150	20	II 2877.52	40	200 n	I 3996.57	50	..
II 2568.59	1	40	I 2888.20	50	..	I 4118.69	400	10
II 2572.62	15	50	I 2893.86	500	25	I 4164.56	100	80
2596.00	200	20	I 2897.87	400	15	I 4192.43	100	2
I 2603.14	300	20	I 2905.90	100	15	I 4288.06	75	1 n
II 2616.75	10	60	I 2912.26	300	25	I 4327.06	80	4
I 2619.57	300	5	I 2913.54	300	25	I 4391.83	50	3
II 2625.33	35	60	I 2919.34	150	40	I 4442.55	800	25
I 2627.39	40	5	I 2921.38	100	6	I 4498.76	100	5 n
I 2628.03	1000 w	100	I 2929.79	800 r	200 w	I 4520.90	40	2 n
I 2639.35	500	50	I 2997.97	1000 r	200 r	I 4552.42	60	10
I 2645.37	40	5	II 3001.17	3	50 w	5044.04	60	1
I 2646.89	1000 n	100	I 3002.27	200	30	5059.48	60	3
I 2650.86	700	100	3017.88	60	10	5227.66	80	2
I 2658.17	100	10	II 3031.22	10	40 n	5301.02	150	10
I 2658.70	40	5	I 3036.45	200	10	5368.99	50	1
I 2659.45	2000 r	500 r	I 3042.64	200 r	250 r	5390.79	50	2
2674.57	200	10	I 3064.71	2000 r	300 r	5475.77	60	2
I 2677.15	800 w	200 w	I 3071.94	60	15	5478.49	50	2
II 2679.13	6	50	I 3139.39	300	80	5840.12	80	..
II 2692.24	4	40	3141.66	150	5 n	5844.84	40	2
I 2698.43	500	50	I 3156.56	150	50	6326.58	50	..
I 2702.40	1000	300	I 3200.71	100	40	6523.45	80	..
I 2705.89	1000 wn	200 wn	I 3204.04	250	100	6710.42	50	..
2713.13	200	10	I 3230.29	100	6	6760.02	100	..
II 2717.62	4	40	I 3233.42	40	10	I 7113.73	80	..

(Plutonium)*

POLONIUM

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
2450.0	..	10	2558.1	..	20			

* See end of Section II.

POTASSIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2036.9	..	(40)	2836.2	..	(10)	II 3966.69	..	(30)
2054.9	..	(18)	I 2992.21	15 r	..	II 3972.55	..	(30)
2077.9	..	(80)	2993.4	..	(10)	II 3991.77	..	(15)
2082.1	..	(10)	I 3034.82	30 n	..	II 3995.10	..	30
2085.2	..	(20)	II 3062.18	..	(20)	II 4001.20	..	(40)
2089.8		(40)	II 3075.00	..	(10)	II 4012.10	..	(20)
2097.65	..	(10)	I 3102.03	50 r	..	II 4017.51	..	(15)
2100.0	..	(10)	I 3102.25	20 r	..	II 4024.92	..	(15)
2110.05	..	(10)	II 3105.00	..	(30)	II 4039.69	..	(15)
2114.2	..	(10)	II 3169.80	..	(10)	II 4042.59	..	(30)
2122.0	..	(20)	II 3190.07	..	(20)	I 4044.14	800	400
2127.25	..	(20)	I 3217.02	100 r	20 n	I 4047.20	400	200
2128.9	..	(20)	I 3217.50	50 r	25	II 4065.21	..	(15)
2130.75	..	(20)	II 3220.60	..	(15)	II 4093.70	..	(20)
2132.8	..	(10)	II 3258.81	..	(10)	II 4112.07	..	(15)
2137.56	..	(30)	II 3290.65	..	(10 n)	II 4114.95	..	(30)
2144.5	..	(18)	II 3301.60	..	(10)	II 4134.72	..	(40)
2149.42	..	(10)	3345.32	..	(30)	II 4149.17	..	(20)
2155.3	..	(20)	3373.60	..	(30)	II 4186.23	..	(60)
2175.12	..	(10)	II 3380.62	..	(30)	II 4209.50	..	(15)
2177.92	..	(10)	II 3384.86	..	(30)	II 4222.97	..	(40)
2186.93	..	(40)	II 3392.63	..	(10)	II 4225.60	..	(40)
II 2190.0	..	(40)	II 3404.24	..	(30)	II 4263.31	..	(40)
2196.7	..	(10)	II 3440.05	..	(40)	II 4284.85	..	(10)
II 2210.53	..	(20)	I 3446.72	150 r	100 r	II 4288.65	..	(15)
2213.1	..	(20)	I 3447.70	100 r	75 r	II 4304.94	..	(40)
2217.23	..	(10)	II 3481.11	..	(30)	II 4309.08	..	(40)
2221.58	..	(30)	II 3529.53	..	(10)	4332.02	..	(10)
2240.89	..	(40)	II 3530.71	..	(40)	II 4339.98	..	(20)
2250.92		(30)	II 3562.15	..	(15)	II 4362.96	..	(20)
II 2255.29	..	(10)	II 3608.87	..	(10)	II 4388.13	..	(40)
2260.32	..	(30)	II 3618.43	..	(20)	II 4423.72	..	(10)
2260.6	..	(30)	3626.42	..	(15)	II 4466.66	..	(20)
2262.1	..	(10)	II 3637.00	..	(10)	II 4505.34	..	(30)
2265.04	..	(30)	II 3668.63	..	(10)	II 4595.61	..	(40)
2270.9	..	(30)	II 3676.05	..	(10)	II 4608.42	..	(40)
2280.05	..	(10)	II 3681.52	..	(30)	II 4659.32	..	(40)
2300.9	..	(10)	II 3716.59	..	(20)	II 4744.92	..	(15)
2306.58	..	(10)	II 3721.34	..	(20)	II 4829.21	..	(100)
2315.22	..	(20)	II 3739.12	..	(20)	I 4869.70	10	..
2319.15	..	(30)	II 3744.40	..	(20)	II 4938.75	..	(10)
2324.33	..	(10)	II 3756.63	..	(10)	II 4943.24	..	(30)
2340.15	..	(10)	II 3767.37	..	(30)	I 4950.82	10	..
II 2342.30	..	(10)	II 3783.19	..	(30)	I 4956.04	10	..
2348.3	..	(20)	II 3800.14	..	(30)	I 4965.04	15	..
2350.2	..	(10)	II 3816.55	..	(30)	II 5005.34	..	(15)
II 2358.70	..	(50)	II 3817.54	..	(40)	II 5056.18	..	(60)
2370.25	..	(30)	II 3821.30	..	(10)	I 5084.21	20 l	..
2379.5	..	(18)	II 3844.02	..	(10)	I 5097.14	25 n	..
2393.4	..	(10)	II 3861.41	..	(10)	I 5099.18	25 l	..
2402.0	..	(10)	II 3873.75	..	(20)	I 5112.20	30 l	..
2410.4	..	(10)	II 3878.62	..	(15)	II 5310.21	..	(25)
2436.6	..	(20)	II 3883.36	..	(10)	I 5323.23	40 l	..
2446.0	..	(20)	II 3897.87	..	(60)	I 5339.67	40 l	..
2470.4	..	(10)	II 3899.24	..	(10)	I 5342.97	30 l	..
2474.2	..	(10)	II 3900.11	..	(10)	I 5359.52	40 l	..
2538.6	..	(10)	II 2933.05	..	(20)	II 5470.06	..	(40)
II 2550.02	..	(20)	II 3926.34	..	(20)	II 5536.01	..	(10)
2662.4	..	(10)	3934.46	..	(20)	II 5642.67	..	(25)
2736.0	..	(20)	II 3942.50	..	(30)	II 5772.32	..	(15)
2803.8	..	(30)	II 3955.21	..	(30)	I 5782.60	60	..
II 2808.99	..	(10)	II 3956.10	..	(10)	I 5801.96	50 n	20
II 2819.26	..	(10)	II 3959.78	..	(10)	I 5812.52	30	..

POTASSIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 5832.09	50	..	II 6307.24	..	(40)	I 7698.98	5000 r	200
6050.	..	(12)	II 6427.69	..	(20)	I 9591.8	50 Wl	..
6119.95	..	(10)	6911.30	300	..	I 9950.5	20 n	..
6120.22	..	(60)	I 6938.98	500	..	I 9955.2	10 n	..
II 6246.46	..	(30)	I 7664.91	9000 r	400			

PRASEODYMIUM

2230.37	..	40	3826.29	80 d	50 d	4008.71	150	50
2297.77	..	100	3830.72	100	60	4015.39	50	30
2445.52	..	40	3842.36	80	40	4020.99	40	30
3101.27	40	2	3844.56	50	10	4025.54	40	25
3121.57	50	4	3846.60	70 d	30	4031.75	50	30
3245.46	40	4	3850.83	50	15	4033.86	50	35
3499.09	40	3	3851.62	200 w	150 w	4039.36	50	20
3544.00	40 r	10 r	3852.80	100	50	4044.82	50	35
3615.16	40	4	3854.90	80 w	30	4051.15	50	30
3630.97	50	20	3865.46	200 r	125 r	4054.84	50	40
3641.62	50	5	3876.18	80	30	4056.54	100	60
3646.30	50	15	3877.22	125 w	80 w	4062.82	150	50
3660.37	40	20	3879.21	100	80	4068.80	40	15
3668.83	100	40	3880.47	80	60	4079.79	50	35
3685.26	60	8	3885.19	100 w	40 w	4081.02	50	25
3687.04	60 d	20 d	3889.33	150	70	4081.90	75	30
3687.20	50 d	15 d	3902.47	60	40	4087.21	50	3
3689.40	40	10	3908.03	100	50	4094.97	50	12
3694.69	40	4 n	3908.43	100	60	4100.75	200	50
3699.51	40	10	3912.90	150	80	4113.89	30 w	70 w
3714.06	50	20	3913.56	80	30	4118.48	250 d	50 d
3729.11	40	7	3915.47	40	20	4141.26	150	50
3733.03	40 d	20	3918.86	100	30	4143.14	200	50
3734.41	40	30	3924.14	100	15	4164.19	200	50
3739.19	80	30	3925.46	125	100	4171.82	75	40
3741.01	40	15	3927.45	80	35	4172.27	75	40
3751.00	40	30	3929.26	40	30	4179.42	200	40
3752.29	40 d	30 d	3935.82	125	50	4189.52	100	50
3761.87	150	100	3937.03	50	8	4191.61	40	25
3764.81	100	50	3938.31	40	30	4206.74	50	50
3768.93	50	30	3940.15	80	15	4211.86	50 d	25 d
3771.77	40 d	20 d	3947.63	125 d	60 d	4222.98	125	40
3772.85	80 d	20	3949.44	150	100	4225.33	50	40
3774.06	100	50	3953.52	150	100	4241.02	50	12
3778.75	40	20	3960.60	50	25 n	4247.66	60	35
3781.64	100 d	50 d	3962.44	60	50	4251.49	40 w	15 w
3783.86	100 d	30 d	3964.26	60	50	4263.80	50	5 w
3785.50	50	20	3964.82	125 d	80 d	4272.27	50	35
3788.93	50 d	25 d	3965.26	100	50	4280.10	60	30
3792.52	100	8	3966.57	100 d	70 d	4282.44	75	40
3793.79	40 d	30 d	3967.13	40 d	25 d	4297.76	50	40
3794.38	50 d	25 d	3971.16	100	60	4302.10	60	5 w
3796.92	40 d	20 d	3971.69	60	40	4303.59	100	60
3799.68	50	25	3972.16	125	80	4305.76	150	90
3800.30	100	50	3976.29	50	10	4311.10	50	10 w
3803.11	50 d	20	3982.06	125	100	4316.06	50	8
3804.85	25 w	50 w	3986.17	40	15	4317.84	40	5 w
3809.16	80	40	3989.72	200	125	4323.55	100	35
3816.17	40	40	3994.83	300	25	4328.42	50	15
3818.28	125	100	3997.05	100	40	4328.98	50	10
3821.82	50	50	3999.19	50 d	40 d	4329.41	50	20
3823.18	125	25	4000.19	50	25	4330.44	50	3 w

PRASEODYMIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4333.15	40	10	4487.82	40	3 w	4822.98	125	10 w
4333.91	150	100	4488.17	40	10	4826.65	40 wn	..
4334.62	40	6 w	4496.43	200	125	4832.07	100 w	..
4335.75	80	20	4510.16	200	125	4837.04	80 w	..
4338.69	100	50	4517.59	40 w	15 w	4848.55	125 w	..
4342.81	40	5 w	4520.78	40	15	4859.04	40 w	..
4344.33	150 w	80 w	4534.15	150	80	4865.24	40	2
4347.49	100	40	4535.92	125	100	4877.82	50 w	5 w
4350.40	70	25	4548.54	60	30	4906.98	50	..
4351.85	80	60	4552.26	60	..	4914.03	60	..
4354.91	80	30	4563.13	100	40	4924.59	80	..
4359.11	70	25	4570.56	40	15	4936.00	50	..
4359.79	100	40	4576.32	50	15	4939.73	100	..
4362.98	50	20	4578.14	40 w	3 w	4940.30	50	..
4368.33	125	90	4612.07	60	15	4951.36	150	..
4371.61	125	40 w	4628.75	200	50 w	4956.64	40 w	..
4373.81	40	10	4632.28	40	1	4989.27	50	..
4374.41	50	15	4635.69	40	..	5018.58	50	1
4379.33	100 w	2	4639.55	60	2	5019.75	50	1
4380.32	50	20	4643.50	60 w	5 w	5026.97	80	1
4384.80	40	15	4646.06	50	8	5045.53	40	1
4396.12	80	50	4651.52	125	40 w	5110.38	80	2
4399.33	40	20	4664.65	100	15	5110.77	80	3
4403.60	100	40	4672.08	100	25 w	5129.52	100	..
4405.85	100	100	4684.94	125	10 w	5133.42	60	1
4408.84	125	100	4687.81	50	1	5135.12	50	2
4412.15	50	15	4695.77	60	2	5161.74	40	1
4413.76	90	40	4707.54	80	10 w	5173.90	100	4
4419.06	80	30	4707.94	50	10 w	5219.05	50	2
4419.67	100	50	4708.15	50	10 w	5220.11	80	3
4421.23	100	35 w	4709.52	40	1	5259.74	125	3
4424.59	90	35	4726.35	40 w	..	5285.63	40	1
4429.24	200	125	4728.63	40 w	6 w	5292.10	60 w	..
4431.89	40	5 w	4730.69	60	1	5292.63	50	2
4432.34	80	10 w	4734.18	100 w	8 w	5352.40	80	2
4438.18	50	20	4736.69	125	1	5381.26	60	2
4446.98	50	30 wn	4744.16	80	..	5509.15	50	2
4449.87	125	80	4744.92	100	10 w	5707.61	100 w	..
4450.21	40 w	20 w	4746.93	100	25 w	5779.29	50	..
4451.95	80	20	4755.98	50	2	5823.72	60 w	1
4454.38	60	15	4756.13	50 d	2 n	6017.80	40	2
4458.34	90	10 w	4757.94	100 w	5 w	6055.13	100 w	..
4465.98	90	30	4762.73	60	10	6161.19	50	2
4468.71	125	100	4765.22	80 w	5 w	6165.94	50	2
4477.26	125	30 w	4783.35	125	10 w	6359.04	40 w	..
4485.54	40	5 w	4801.15	40	3	6673.78	40	..

II. EMISSION SPECTRA 2000–10,000 A (Continued)

PROMETHIUM

The following list of lines in the emission spectrum of promethium ($_{61}Pm^{147}$) is based on the determinations of Meggers, Scribner and Bozman, Jour. of Res. Bureau of Standards **46,** 85, 1951. Intensities are given on a relative scale. In addition to abbreviations given at the beginning of the table the following are used in this list:

c = complex; h = hazy

Wave length	Arc and spark	Wave length	Arc and spark	Wave length	Arc and spark	Wave length	Arc and spark
2632.00	15	3408.06	10	3686.77	8	3810.27	7 h
2638.46	7	3408.67	8 + Sm	3687.26	10	3813.73	10
2671.05	10	3418.71	5	3687.65	20	3815.82	10
2787.72	5 w	3427.40	50	3689.47	7	3819.26	20
2820.10	10 h	3441.16	12	3689.78	40	3819.62	5
2822.15	8 h	3449.81	40	3691.11	5	3820.07	5
2830.99	5 h	3460.25	25	3691.70	10	3820.51	30
2840.82	10 w	3462.91	20	3692.52	30	3823.52	8 + Cr
2841.86	15 w	3467.20	5 h	3694.78	10	3824.83	10
2848.21	8 w	3478.62	15 + Ca	3697.50	30	3825.90	5 + Fe
2850.80	5	3480.62	20	3699.00	15	3828.34	8
2857.46	20 c	3481.97	8	3702.64	40	3829.08	5
2860.97	12 d + Cr	3514.84	10	3704.53	15	3830.46	8
2885.08	5	3541.70	6	3708.34	15 sd	3830.73	9
2952.25	5	3544.03	5 d	3711.72	80	3831.53	15 d + Sm
2982.84	6	3544.91	6 d	3715.73	20	3840.52	8
3004.59	10	3551.13	5	3718.88	10 + Sm	3842.93	40
3008.85	10	3559.47	10	3721.72	20	3845.36	25
3018.47	8	3561.62	6	3721.96	8	3848.74	15
3047.99	8	3562.13	7	3723.11	10	3852.15	5
3054.14	7	3562.99	8	3724.87	6 + Sm	3863.16	8
3060.48	8	3565.32	20	3728.26	10 d	3863.62	12 d
3061.20	6	3572.99	5	3730.46	5 h	3867.94	8
3066.34	5	3576.15	5	3732.51	10	3868.55	6 l
3072.41	30	3580.11	15	3734.31	10	3869.83	7
3086.02	15	3585.70	6 d	3742.51	30	3871.84	5
3090.19	12	3595.11	5	3745.86	50	3875.34	8
3091.86	15	3600.56	5	3747.10	30	3877.63	80 c
3104.24	6	3604.09	8	3750.08	50	3881.37	18 d + Sm
3108.11	15	3607.00	8	3751.59	6	3882.07	10
3115.36	10	3610.74	20	3753.25	10	3886.56	15
3117.22	10	3611.80	6	3753.76	10 d	3887.35	5
3118.76	10	3613.29	15	3758.37	5	3892.16	100
3157.27	6	3620.14	15	3763.46	7	3895.74	6 h
3169.08	6	3622.28	5	3767.49	5	3899.78	40
3172.77	10	3629.85	20	3768.97	20	3907.25	5
3174.51	6	3634.26	30 + Sm	3770.97	9	3907.83	8
3182.54	6	3641.65	10 + Sm	3771.98	12	3909.51	25
3183.88	8 + Sm	3647.23	5	3774.58	10 h	3910.26	100
3185.18	6	3649.98	10	3775.65	6	3917.12	7
3187.20	8 + Sm	3651.25	10	3776.02	5	3919.09	100 l
3211.79	5	3652.13	8	3776.62	10 h	3921.80	15
3218.61	5	3655.80	8	3777.13	5	3931.55	10
3239.62	6	3657.59	8	3778.75	6 l	3936.47	80 l
3236.63	6 + Sm	3658.40	10	3781.57	6	3940.13	8
3307.05	20 + Sm	3659.39	30	3782.39	5	3940.60	10
3310.66	8 + Sm	3665.50	9	3784.20	6	3944.23	30 h
3311.76	6	3666.26	10	3791.20	15	3946.85	10
3321.21	15 + Sm	3667.31	7	3795.66	40	3947.22	15
3358.14	10	3669.86	6	3798.17	15	3949.69	10
3360.21	8	3678.49	20	3798.39	10 h	3952.13	6
3364.44	8	3678.63	18	3799.49	5	3954.29	8
3366.05	5	3680.41	10	3802.28	7	3957.74	100
3377.68	9	3681.73	6 + Sm	3802.48	15	3959.74	7
3384.68	6 + Sm	3683.67	6	3806.06	25	3959.96	6
3391.28	10	3685.41	5	3809.04	5	3972.13	6

PROMETHIUM (Continued)

Wave length	Arc and spark	Wave length	Arc and spark	Wave length	Arc and spark	Wave length	Arc and spark
3973.49	5	4225.06	8	4564.85	10	5354.56	6 sd
3980.73	50 l	4228.35	10	4578.60	5	5386.79	5
3983.10	10	4234.14	15	4615.85	10	5390.48	5
3987.90	10	4238.26	20 h	4628.70	7	5394.83	6
3992.99	5	4240.29	5	4734.26	5	5397.32	8
3995.05	30 + N	4254.78	6	4739.08	10	5401.60	7
3998.96	100	4277.52	10	4759.00	10	5410.43	20
4009.97	50	4287.78	6	4762.57	15	5424.52	20
4012.71	20	4295.11	7	4773.46	6	5424.76	18
4014.20	25	4303.51	5	4798.97	8	5429.03	15
4019.34	20	4303.86	20	4801.33	7	5453.03	5 + Sm
4021.34	5 l	4305.49	5	4811.94	5	5467.62	10
4022.90	8	4313.12	5	4824.15	8 c	5491.65	5 wc
4023.28	5	4315.36	10	4829.48	5 d	5495.44	15
4023.70	15	4325.88	25	4837.66	5	5513.30	6 c
4026.00	10	4328.29	6	4840.69	5	5515.79	8
4028.20	25	4330.06	10	4860.73	10	5516.41	10
4028.84	5 h	4330.60	5	4892.51	5	5521.61	5
4032.45	7	4332.04	20	4913.18	5 d	5531.61	8
4036.48	5	4336.53	30	4932.99	5	5534.95	18
4040.74	15 d	4337.45	20	4943.28	8	5546.09	80
4045.37	20	4340.52	15	4959.45	8	5546.76	5
4049.36	7	4342.11	30	4971.41	10	5556.86	12
4051.50	30	4354.16	6	4975.36	8	5558.38	15
4055.20	60 l	4360.79	5 h	4997.10	15	5561.72	20
4058.07	6	4365.07	10	5016.14	10	5576.01	80
4065.65	15	4365.99	5 l	5044.30	5 + Sm	5610.90	7
4066.45	5	4372.88	6	5045.28	6	5634.45	7
4069.08	5	4381.17	18 + Ca	5058.29	15	5638.32	5
4069.90	10	4381.87	20	5067.32	10	5641.28	20
4075.85	60	4387.05	5	5080.50	15	5649.72	6
4081.74	10 d	4388.76	20	5089.32	15	5712.42	8 s
4082.49	10	4404.26	10	5094.80	6	5740.81	5
4083.07	6	4414.09	10	5097.26	15	5753.72	5 c
4086.10	50 w	4417.98	100	5100.73	5	5765.36	6 c
4090.79	5	4418.15	8	5121.44	25	5768.11	20
4096.19	5	4419.35	10 + Sm	5127.33	15	5772.19	10 c
4100.03	5	4421.15	15 + Sm	5145.11	8	5778.89	6
4104.83	6	4423.99	5	5146.27	10	5806.29	5
4122.45	5	4432.51	40	5153.82	40	5810.14	6
4123.97	15 + Sm	4443.67	15	5169.69	30	5823.91	50
4135.11	9	4445.41	50	5171.57	50	5827.84	8 c
4139.72	15	4446.90	60	5185.01	10	5834.96	5 c
4140.46	25 d	4451.81	5	5194.03	30	5841.00	8
4142.87	10	4452.84	10 + Sm	5208.08	50	5868.79	30 c
4151.40	8	4453.96	80	5215.95	15	5875.31	20 c
4151.60	10	4458.94	5	5224.84	8	5878.76	10 c
4156.07	5	4459.95	20	5225.10	25	5899.76	15
4161.21	10	4465.80	5 h	5236.25	50	5901.87	8
4161.50	15	4471.50	20	5236.64	30	5917.39	6 c
4162.03	6	4473.23	30	5246.31	40	5927.17	25 c
4171.46	6	4475.05	7	5251.84	5	5946.49	40 c
4172.79	7	4475.31	5	5262.40	15	5950.82	7
4179.66	5	4477.46	20	5270.62	50	5960.08	10 c
4185.74	20	4492.05	25	5293.91	20	5963.00	15
4192.92	30	4500.14	60	5302.01	8	5967.83	6 c
4194.70	20	4509.37	10 + Cu	5308.84	10	5987.13	10 c
4204.10	5	4513.54	10	5318.58	15	5997.09	15 + Ba
4207.21	10	4522.65	8	5319.80	8	6018.29	5
4216.30	10	4525.19	60	5346.12	8	6025.70	8 c
4222.15	20	4529.20	80	5348.26	8	6027.11	20

PROMETHIUM (Continued)

Wave length	Arc and spark	Wave length	Arc and spark	Wave length	Arc and spark	Wave length	Arc and spark
6030.08	7	6306.56	5	6520.37	5	6680.89	20
6038.31	5 hc	6314.20	10	6523.05	7	6686.2	5 wc
6050.15	8 c	6334.02	6 c	6529.49	6	6690.09	15
6052.57	15 c	6366.00	5 ld	6536.68	6 h	6692.65	7
6067.00	10 c	6383.74	6	6544.33	5 h	6706.27	10
6069.84	5 c	6401.28	6	6558.48	10 h	6714.81	5 h
6074.68	7 dc	6415.98	5	6567.27	10?	6726.95	8
6076.40	10	6420.83	6	6576.03	8	6749.91	5
6085.41	20	6422.59	5	6586.39	10	6755.11	6
6100.16	6	6424.85	5	6592.29	10	6756.45	20
6101.10	6	6426.00	8	6598.11	8	6772.29	30
6114.90	10	6428.61	6	6613.93	5 h	6776.07	5 h
6159.53	10	6429.65	10	6623.14	5 h	6783.09	10
6184.52	10	6430.92	5	6625.54	10 h	6793.56	6
6201.82	6	6436.57	10	6649.97	8	6796.87	10
6208.91	20	6446.05	5	6652.50	6	6798.92	8
6263.25	10	6467.36	7	6659.05	40	6811.68	20
6289.93	8 + Sm	6474.31	8	6661.25	10	6831.09	6 h
6304.17	5 l	6519.43	20	6668.94	9	6858.58	5

(Protactinium)*

RADIUM**

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
II 2169.9	..	125	II 2795.21	..	125	II 3851.90	..	25
II 2369.73	..	50	II 2813.76	..	400	II 3894.55	..	25
II 2460.55	..	50	II 2836.46	..	25	II 4194.09	..	80
II 2475.50	..	125	II 3033.44	..	150	II 4244.72	..	40
II 2586.61	..	50	I 3101.80	..	75	II 4340.64	..	1000
II 2643.73	..	125	II 3649.55	..	1000	II 4436.27	..	200
II 2708.96	..	200	II 3814.42	..	2000	II 4533.11	..	300

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* See end of Section II.

** See next page for additional Radium items.

II. EMISSION SPECTRA 2000–10,000 A (Continued)

RADIUM (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
I 4641.29	..	40	I 5505.50	..	25	I 6438.9	..	30
II 4682.28	..	800	I 5553.57	..	250	I 6446.20	..	1000
I 4699.28	..	40	I 5555.85	..	500	I 6487.32	..	1000
I 4825.91	..	800	I 5601.5	..	35	I 6532.08	..	30
I 4856.57	..	100	I 5616.66	..	250	6545.93	..	30
II 4859.41	..	100	I 5660.81	..	1000	6585.41	..	50
II 4927.53	..	100	II 5661.73	..	50	II 6593.34	..	500
I 5041.56	..	35	II 5728.83	..	25	I 6599.47	..	30
I 5081.03	..	50	5755.45	..	25	II 6719.32	..	500
5097.56	..	250	I 5778.28	..	35	I 6758.2	..	50
I 5205.93	..	250	I 5795.78	..	35	I 6903.1	..	30
5263.96	..	25	I 5811.58	..	35	I 6980.22	..	1000
I 5283.28	..	250	II 5813.63	..	500	II 7078.02	..	70
I 5320.29	..	250	5957.67	..	35	I 7118.50	..	1000
I 5399.80	..	250	I 6151.19	..	30	I 7141.21	..	2000
I 5400.23	..	500	I 6167.03	..	70	I 7225.16	..	1000
I 5406.81	..	500	I 6200.30	..	1000	I 7310.27	..	500
I 5482.13	..	100	II 6247.16	..	50	I 7838.12	..	100
I 5488.32	..	25	I 6336.90	..	500	II 8019.70	..	200
I 5501.98	..	250						

RADON

2756.3	..	25	3429.7	..	60	4604.40	..	200
2808.4	..	40	3479.5	..	30	I 4609.38	..	250
2812.1	..	25	3615.0	..	30	4625.48	..	500
2826.5	..	70	3621.0	..	250	4644.18	..	300
2830.6	..	70	3626.5	..	25	4680.83	..	500
2836.3	..	25	3634.8	..	250	4701.70	..	50
2838.5	..	70	3664.81	..	25	I 4721.76	..	150
2842.1	..	150	3679.0	..	30	I 4749.27	..	25
2868.7	..	70	3688.3	..	40	4768.59	..	100
2883.8	..	25	I 3739.89	..	25	4817.15	..	100
2887.2	..	125	I 3753.65	..	50	4829.2	..	35
2892.7	..	150	I 3917.20	..	25	4856.2	..	35
3006.8	..	300	3931.82	..	250	4891.1	..	35
3010.8	..	100	I 3941.72	..	25	4915.5	..	35
3032.5	..	40	I 3952.36	..	25	4950.0	..	35
3036.8	..	60	3957.15	..	25	4978.84	..	300
3037.7	..	40	3971.67	..	80	5044.8	..	35
3045.2	..	60	3981.68	..	150	5084.48	..	300
3054.3	..	250	4017.75	..	150	5582.4	..	200
3064.6	..	40	4045.3	..	35	5715.9	..	80
3068.9	..	100	4114.56	..	80	I 5722.58	..	30
3077.7	..	30	4166.43	..	500	5888.6	..	80
3100.19	..	50	4187.81	..	35	5894.4	..	30
3105.7	..	60	4203.23	..	200	I 5932.60	..	25
3106.7	..	30	I 4226.06	..	50	I 5951.57	..	25
3114.6	..	50	I 4307.76	..	400	I 6627.23	..	30
3169.7	..	30	I 4335.78	..	35	I 6751.81	..	40
3175.6	..	40	I 4349.60	..	5000	I 7055.42	..	400
3192.0	..	30	4371.53	..	30	I 7268.11	..	200
3196.9	..	30	4383.30	..	35	I 7291.00	..	40
3241.5	..	40	I 4435.05	..	200	I 7450.00	..	600
3254.5	..	30	I 4459.25	..	250	I 7809.82	..	100
3306.7	..	100	4507.83	..	80	I 8099.51	..	100
3312.8	..	100	I 4508.48	..	250	I 8270.96	..	100
3330.0	..	40	4546.8	..	35	I 8600.07	..	100
3356.5	..	40	I 4577.72	..	250	I 9327.02	..	50
3377.2	..	30						

II. EMISSION SPECTRA 2000–10,000 A (Continued)

RHENIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2017.88	40	6	I 2647.12	100	..	I 3054.90	40	..
2023.66	10	50	2649.05	100	..	I 3058.79	50	..
2092.49	18	50	I 2651.90	100	..	I 3067.39	60	..
2097.16	40	10	2654.12	50	..	3069.94	125	..
2109.25	50	8	2663.63	150	..	3071.16	50	..
2112.28	6	40	2670.80	50	..	3072.96	40	..
2167.96	40	12	2671.84	60	..	I 3082.43	100 w	..
2176.23	40	8	I 2674.34	100	..	I 3084.21	40	..
2198.94	40	10	2683.56	50	..	3088.77	60	..
2214.27	100 W	100 W	2688.53	100	..	I 3093.65	60	..
2226.45	60	12	2690.26	50 n	..	3095.06	40	..
2238.64	40	4 n	I 2697.27	50	..	I 3100.67	100	..
2256.22	40	7	I 2715.47	100	..	I 3108.81	125	..
2275.25	300 r	300 r	I 2722.71	50	..	I 3110.86	100	..
2276.65	40	3	2732.21	40	..	3118.19	200	..
2301.82	..	40	2733.04	40 w	..	I 3121.37	100	..
2327.28	7	40	I 2753.05	40	..	I 3128.95	100 W	..
2335.75	40	9	2758.00	60 w	..	I 3151.63	150 w	..
2368.54	7	40	I 2763.31	40 w	..	I 3153.79	80	..
2381.14	40	7	2763.80	50	..	I 3158.31	200	..
2405.05	100	..	2766.40	50 w	..	I 3168.38	150 w	..
2405.60	80	..	I 2770.42	60	..	3177.71	80	..
2421.76	50	..	2781.45	40	..	I 3182.87	100	..
2431.53	50	..	I 2783.57	150 w	..	I 3184.75	150	..
2432.17	100 W	..	2790.94	40	..	I 3185.56	200	..
2441.48	40	..	2791.29	60	..	I 3192.37	40	..
2446.99	100 W	..	2807.87	50 w	..	I 3194.48	50 w	..
2449.71	40	..	2814.68	50	..	I 3200.04	50 w	..
2461.18	125	..	2816.33	40	..	3204.20	300	..
2461.86	80	..	I 2819.95	150 W	..	I 3211.76	40	..
2483.92	150	..	2834.06	100 r	..	3212.94	50	..
2485.81	50	..	2837.55	40	..	3227.46	40 w	..
2486.78	50 w	..	I 2840.35	40	..	3235.94	50	..
2487.23	50	..	I 2850.98	40	..	I 3252.26	40	..
2501.72	80	..	2867.20	40	..	I 3258.85	100	..
2502.38	60	..	I 2871.81	50	..	3259.55	100	..
2504.60	80	..	I 2375.29	80	..	3261.55	50	..
I 2508.99	125	..	2883.45	60	..	3268.08	40	..
2516.12	125	..	I 2887.67	125	..	I 3268.48	40	..
I 2520.01	50	..	2891.88	40	..	I 3296.70	80	..
2521.59	100 r	..	I 2896.02	125 w	..	I 3296.99	60	..
2534.80	100 w	..	I 2902.48	125 W	..	I 3301.60	50	..
2545.49	60	..	I 2905.58	50	..	I 3303.75	40	..
2552.03	80	..	2909.82	40	..	I 3313.95	40	..
2556.51	100	..	I 2924.60	40 W	..	I 3322.48	150	..
2558.05	60	..	2927.40	125 w	..	I 3335.37	100	..
2564.19	50	..	2930.62	50	..	I 3338.17	150	..
2573.77	60	..	I 2943.14	60	..	I 3342.26	200	..
2586.79	100	..	I 2965.12	100	..	I 3344.35	150	..
2587.14	40 w	..	I 2965.76	150 w	..	I 3346.20	100	..
2592.87	50 w	..	I 2968.05	40	..	I 3353.21	40	..
I 2594.85	40	..	I 2976.29	50 w	..	3355.29	60 n	..
I 2595.24	60	..	2978.16	40	..	I 3359.20	40	..
2599.86	80	..	2980.83	40	..	I 3362.75	40	..
2603.87	100	..	I 2988.48	40	..	3379.05	50	..
2614.56	60	..	I 2992.37	100	..	I 3379.72	80	..
2620.02	60	..	I 2999.59	125	..	3390.24	40	..
2620.35	50	..	3001.13	40	..	I 3399.30	200 w	..
2623.31	50 w	..	I 3004.14	40	..	I 3404.72	100	..
2631.58	80	..	I 3006.43	40	..	I 3405.89	150	..
2633.62	40	..	I 3016.02	80 W	..	3408.68	100	..
I 2636.64	125	..	3016.49	100	..	I 3417.80	40 r	..
2642.76	125	..	I 3030.45	100	..	I 3419.40	80	..

II. EMISSION SPECTRA 2000–10,000 A (Continued)

RHENIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3420.76	40	..	I 3962.48	100	..	5278.24	100	..
I 3424.60	300 W	..	I 4023.35	40 w	..	5317.28	40 w	..
I 3427.62	50	..	I 4029.64	80	..	5321.26	40	..
I 3437.72	100	..	I 4033.31	40	..	5327.46	100	..
3441.26	40	..	I 4110.90	40	..	5331.90	80	..
3449.37	100 r	..	I 4121.63	50	..	5369.81	40	..
I 3451.81	100	..	I 4133.41	200	..	5377.04	300 W	..
I 3453.50	40	..	I 4136.45	150 w	..	5532.66	100	..
I 3460.47	1000 W	..	I 4144.36	125 w	..	5563.21	150 w	..
I 3464.72	100	..	I 4149.97	40 w	..	5584.75	40 w	..
I 3467.95	100 w	..	4170.39	40	..	5667.90	100	..
I 3480.38	50	..	I 4182.98	150 r	..	5740.30	50 w	..
I 3480.85	50	..	I 4194.67	40	..	5752.95	200 w	..
3482.24	40	..	I 4221.08	100	..	5776.84	300 w	..
I 3503.06	80	..	I 4227.46	200 W	..	5815.87	50 w	..
I 3512.29	50	..	I 4257.59	125 w	..	5834.33	200	..
3516.65	60	..	4291.18	100 w	..	5852.02	40 w	..
3517.33	50	..	I 4315.71	40 w	..	5943.24	100	..
I 3537.47	80 w	..	I 4332.26	50	..	6145.80	50 w	..
I 3549.89	40	..	I 4358.69	80	..	I 6146.82	50	..
3551.31	40 w	..	4367.58	80	..	I 6217.99	40 w	..
I 3558.95	50 w	..	4391.33	60 w	..	I 6229.44	40 w	..
3568.23	40	..	4392.49	100	..	I 6243.22	50 w	..
I 3579.13	50	..	4394.38	100 r	..	I 6307.72	100 w	..
3580.13	80	..	4406.40	60	..	I 6321.89	100 w	..
I 3580.97	40 w	..	4415.82	40	..	I 6350.75	100 r	..
I 3583.02	100 w	..	4440.44	40	..	I 6511.48	60	..
3610.49	40	..	4454.67	100	..	I 6577.15	50 W	..
I 3617.08	50	..	4467.94	50	..	I 6592.54	60 w	..
I 3637.84	50	..	4477.99	40 w	..	I 6605.19	100 W	..
I 3642.99	100	..	4478.39	40 w	..	6652.40	80 W	..
I 3651.97	40	..	4507.03	40 w	..	6751.22	50	..
I 3689.52	100 W	..	4513.30	300	..	6752.03	50	..
I 3691.50	100 w	..	4516.63	80	..	6813.42	200 w	..
3697.70	150 w	..	4519.74	40 d	..	I 6829.96	200 w	..
I 3703.24	40	..	4522.72	100	..	I 6971.53	150	..
I 3709.94	40	..	4523.88	40	..	I 7006.65	100	..
I 3717.29	150 W	..	4529.93	40 w	..	I 7024.13	125	..
I 3725.77	40 n	..	4605.73	50	..	I 7228.03	40	..
I 3735.33	40	..	4614.70	50	..	I 7246.67	300	..
I 3740.10	50 W	..	4625.98	40	..	I 7273.84	150	..
I 3745.44	40 W	..	4630.84	50	..	7292.67	300	..
I 3777.66	40	..	4695.01	40	..	7352.03	50	..
I 3787.53	80	..	4705.03	40 w	..	I 7578.72	200 w	..
3795.80	40 W	..	4727.62	40	..	I 7611.90	100	..
I 3796.60	60	..	4748.38	50 w	..	I 7620.25	200 wl	..
I 3797.59	40	..	4791.42	200 w	..	I 7640.93	400 wl	..
I 3817.56	40	..	I 4889.17	2000 w	..	I 7869.60	100 wl	..
I 3834.23	50	..	4923.93	150	..	I 7898.47	40	..
I 3836.32	40	..	4946.74	100	..	I 7912.94	400 wl	..
I 3843.45	50	..	I 4985.99	40 W	..	I 7980.75	300 wl	..
I 3869.92	40	..	5058.56	40	..	I 8417.14	300	..
I 3875.25	40	..	5096.50	100	..	I 8527.73	300 Wl	..
I 3876.89	60	..	5104.63	50 w	..	I 8675.65	50 Wl	..
I 3917.27	100 w	..	5120.32	40	..	8786.77	40 Wl	..
3920.88	40 W	..	5126.69	50 w	..	9383.74	40	..
I 3929.84	100	..	5178.91	100 W	..	9710.52	50	..
I 3936.90	40	..	5270.98	200 W	..	I 9949.90	200 W	..
I 3945.91	40	..	5275.53	500 w	..	I 9955.45	60 W	..

RHODIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2013.74	..	100	2377.81	..	50	2609.17	3	200
2017.45	..	80	2382.89	50	5	I 2622.57	50	25
2023.74	..	70	2383.40	50	10	2625.40	2	200 Wn
2036.70	..	80	2386.14	80	8	I 2625.88	60	25
2037.60	..	50	2390.62	10	50 w	2628.12	1	150
2040.19	2	100	2396.55	2	200	2630.33	2	50
2048.65	..	200	2405.22	1	50	2638.74	2	100
2051.25	2	100	I 2407.88	60	5	2639.25	2	100
2059.16	..	50	2410.69	2	50	I 2652.66	100	25
2064.17	3	100	2411.94	2	50	2657.32	..	70
2076.83	..	100	2415.84	100	200	2659.11	..	100
2085.58	..	100	2420.98	30	100	2674.44	1	200 w
2089.48	..	80	2427.34	2	50	2676.25	1	100
2091.07	..	100	2438.79	2	100	I 2680.63	60	10
2096.05	..	80	2443.71	4	100	2681.60	..	100
2097.83	3 n	200	2444.06	2	100	2683.56	1	200
2098.99	15	300	I 2444.27	100 w	3	2684.21	2	150
2100.52	2	100	2447.85	4	200 w	2689.62	1	100
2100.76	50	..	2448.28	2	100	2691.12	1	60
2102.45	..	50	2455.70	15	200 W	2700.59	2	80
2104.89	..	100	2456.18	5	150	I 2703.73	150	25
2111.69	..	150	2458.90	50	300	2705.63	100	300 wn
2112.70	3	80	2461.04	80	200 wn	I 2707.23	100	4
2113.70	..	70	2463.44	2	150	I 2709.52	50	2
2116.87	3 w	50	2466.15	1	100	I 2714.41	150	5
2118.50	2 w	200	2467.23	..	50	I 2715.04	50	2
2139.43	..	100	I 2470.39	70	5	2715.31	50	500 wn
2163.18	..	50	I 2471.47	70	8	I 2716.82	50	3
2167.32	..	80	2471.77	3	100	I 2717.51	100	5
2187.58	..	50 l	2482.73	2	100	2717.98	..	50
2199.96	..	50	I 2483.33	100 r	5	I 2718.54	150	20
2203.55	15	50 w	2485.82	2	50	2720.14	100	6
2205.02	..	100	2487.47	100	8	I 2720.52	50	2
2206.35	..	80	2490.77	100	1000 wn	I 2728.94	200	200
2226.53	50	..	2491.85	2	400 n	I 2736.76	100	3
2237.71	..	100	I 2492.30	100	10	2737.40	30	400 wn
2240.00	..	50	2495.95	2	50	2739.92	10	300
2246.38	..	50	2501.27	50 r	50	2747.63	1	100
2261.75	2	100	2503.84	2	150	I 2752.84	50	2
2263.43	5	200	2505.10	2	200	2761.26	1	50
2264.14	50	25	2510.65	5	200 wn	2764.83	15 r	125
2276.21	..	50	I 2515.75	60	10	2766.54	5	150
2276.96	20	150	2517.52	..	150	I 2767.73	100	4
2284.08	..	200	2520.53	10	1000 wn	2768.23	50	4
2290.03	25	500	2534.57	2 w	100 w	I 2771.51	100	8
2294.12	1	50	2537.04	15	100	2775.77	5	125
2295.12	5	50	2537.73	4	50	I 2778.05	100	3
2298.26	..	150	2542.16	1	50	2778.15	2	100
2305.95	..	100 wn	2543.94	15	100 r	I 2779.54	100	6
2312.65	2	100	2545.35	8	150	2781.80	1	150
2321.86	..	80	2545.69	50	10	I 2783.03	150	10
2322.58	50	10	I 2555.36	100	60	I 2791.16	100	1 n
I 2333.31	8	125	2557.20	1	100	I 2796.63	100	1
2334.77	25 l	500	2557.92	1	50	I 2826.67	100	50 d
2336.84	1	125	2559.90	5	700	I 2827.31	50	..
2346.44	2	100	2561.92	..	50	I 2834.12	70	30
2349.68	3	125	2568.83	2	100	I 2836.69	60	..
2350.35	..	50	2569.07	3	125	I 2856.16	60	30 n
2357.43	2	50 wn	2581.69	1	150	I 2862.93	150	60
2359.18	15	100	2587.29	2	100	2864.40	70	10
2359.57	..	50	2592.16	..	80	2871.35	100	10 n
2366.88	3	50	2597.07	3	150	2873.62	60	10
2368.34	50	2	2603.32	..	100	I 2878.65	50	10

RHODIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2882.37	80	10	3451.15	50	2	I 4135.27	300	150
I 2889.11	80	1 n	I 3455.22	300	12	4154.37	60	1
I 2889.84	70	30	I 3455.42	50	2	I 4196.50	100	50
I 2899.95	70	30	I 3457.07	100	4	I 4211.14	15	200
I 2907.21	100	30	I 3457.93	125	10	I 4288.71	400	100
2910.17	50	12	I 3462.04	1000	150	I 4373.04	60	10
I 2912.62	50	20	I 3469.62	100	10	I 4374.80	1000 W	500
I 2915.42	80	40	I 3470.66	500	125	I 4379.92	60	25
I 2924.02	100	..	I 3472.25	100	8	I 4528.72	500 r	60
2929.11	100	10	I 3474.78	700	125	I 4569.00	100	25
I 2931.94	80	20	I 3478.91	500	100	I 4675.03	100	50
I 2968.66	125	30	I 3494.44	50	3	I 4842.43	50	..
I 2977.68	125	30	I 3498.73	500	60	4843.99	100	60
I 2986.20	150	60	I 3502.52	1000	150	4851.63	80	30
I 2986.99	80	20	I 3507.32	500	125	I 4963.71	100	..
I 3023.91	100	2	I 3511.78	50	3	I 5090.63	150	1
I 3028.43	80	..	I 3513.10	50	3	I 5155.54	150	1
3067.30	80	1	I 3525.66	50	2	5158.69	80	1
I 3083.96	150	2	I 3528.02	1000 w	150	5175.97	200	1
I 3114.91	100	2	I 3538.14	100	10	I 5184.19	100	1
I 3121.75	150	..	I 3538.26	50	4	5193.14	200	3
I 3123.70	150	2	I 3541.91	50	10	I 5237.16	100	2
I 3130.79	60	2	I 3543.95	150	40	I 5269.27	50	1
I 3137.71	100	..	I 3549.54	150	50	I 5292.14	80	1
3151.36	80	2	I 3570.18	400 r	150	I 5354.40	300	5
3152.60	80	3	I 3583.10	200	125	I 5379.09	100	3
3155.77	150	2	I 3596.19	200	50	I 5381.48	100	..
I 3179.73	50	..	I 3597.15	200	100	I 5390.44	125	3
I 3185.59	100	20	I 3612.47	200	50	5404.73	50	1
I 3189.05	100	20	I 3626.59	150	60	5424.07	100	2
I 3191.19	300	50	I 3639.51	125	70	5535.04	80	1
I 3194.55	50	10 n	I 3657.99	500 W	200 W	I 5544.58	50	1
I 3197.13	50	10	I 3666.21	70	30	I 5599.42	300 w	3
I 3214.32	70	20	I 3690.70	125	50	I 5686.38	100	1
I 3217.88	60	20	I 3692.36	500 nd	150 wd	I 5806.91	100	1
I 3218.28	60	..	I 3700.91	150 d	150 d	I 5831.58	80	1
I 3237.66	60	20	I 3713.02	100	100 r	I 5983.60	200	2
I 3263.14	200	40	I 3735.28	70	2	6102.72	100	..
I 3271.61	200	60	I 3737.12	50	1	I 6319.53	50	..
I 3283.57	150	..	3737.27	50	10	I 6414.72	50	..
I 3289.14	150	50	I 3748.22	200	100	I 6752.35	150	..
3289.64	50 r	5	I 3765.08	100	70	6965.67	200	..
I 3294.28	60	25	3788.47	50	25	I 6979.15	25	..
I 3300.46	100	20	I 3793.22	200	60	I 7101.64	60	..
I 3323.09	1000	200	I 3799.31	25	100	I 7104.45	80	..
I 3331.09	50	10	I 3805.92	25	50	I 7268.18	125	..
I 3338.54	200	50	I 3806.76	50	50	I 7270.82	200	..
I 3344.20	100	20	I 3818.19	50	25	I 7271.94	80	..
I 3359.89	100	50	I 3822.26	100	100	I 7442.39	100	..
I 3362.18	100	20	I 3828.48	100	60	I 7475.74	100	..
I 3368.37	300	50	I 3833.89	25	50	I 7495.24	100	..
I 3372.25	300	200	I 3856.51	50	20	I 7772.90	100	..
I 3396.85	1000 w	500	I 3872.39	50	3	I 7791.61	100	..
I 3399.70	500	60	I 3934.23	100	2	7824.91	200	..
I 3406.55	50	8	I 3942.72	60	25	I 7830.05	80	..
3412.27	300	60	I 3958.86	200	100	I 7846.50	50	..
3434.89	1000 r	200 r	I 4082.78	100	50	I 8029.91	150	..
3440.53	2	100	I 4119.68	100	25	I 8036.11	100	..
I 3447.74	50	5	I 4121.68	150	50	I 8045.40	125	..
I 3450.29	100	10	I 4128.87	300	150	I 8136.20	50	..

RUBIDIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2217.12	..	(100)	3492.76	..	(300)	I 6159.62	400	..
2254.24	..	(70)	3511.19	..	(60)	II 6199.09	..	100
2291.76	..	(80)	II 3521.44	..	(200)	I 6206.31	800	100
2304.14	..	(125)	II 3531.60	..	(100)	I 6298.33	1000	150
2312.45	..	(100)	II 3541.22	..	(100)	I 6299.22	300	50
2333.38	..	(80)	I 3587.08	200	40	6310.04	..	50
2337.05	..	(125)	I 3591.59	80	20	II 6458.35	..	400
2345.35	..	(100)	II 3940.57	..	(200)	6498.31	..	50
2349.80	..	(80)	I 4201.85	2000 r	500	II 6555.62	..	100
2364.28	..	(150)	I 4215.56	1000 r	300	6560.84	..	150
2365.08	..	(70)	4242.6	..	(150)	II 6775.06	..	200
2365.97	..	(80)	4348.3	..	(80)	II 6805.65	..	50
2373.22	..	(70)	II 4622.45	..	50	II 7042.45	..	150
2380.44	..	(125)	II 4776.41	..	(100)	I 7279.99	400	50
2381.30	..	(100)	II 5152.09	..	100	II 7316.50	..	(50)
2807.63	..	(70)	I 5362.60	50	..	I 7408.17	500	..
2956.12	..	(70)	I 5431.53	100	..	I 7618.93	1000	..
3198.77	..	(60)	II 5522.79	..	100	I 7757.65	1000	..
3286.47	..	(60)	I 5578.78	150	..	I 7759.43	400	..
II 3321.54	..	(60)	II 5635.99	..	100	I 7800.23	9000 r	..
II 3340.60	..	(60)	I 5648.10	400	..	I 7925.26	100	..
3347.00	..	(60)	I 5653.74	200	..	I 7925.54	70	..
I 3348.72	100	..	II 5699.16	..	100	I 7947.60	5000 r	..
I 3350.89	150	..	I 5724.45	600	..	I 8271.41	200	..
II 3434.26	..	(60)	I 5724.95	50	..	I 8271.71	100	..
3439.34	..	(200)	I 6070.75	600	50	I 8868.51	70	..
II 3461.57	..	(200)						

RUTHENIUM

2238.33	50	..	2402.72	100	150 r	2507.01	60	80
2241.07	60	..	2407.92	60	50	I 2508.27	50	2
2253.64	50	..	2420.82	60	2	2508.67	..	50
2255.52	80	3	2422.57	50	1 n	2509.07	50	20
2272.09	100	3	2422.92	60	8	2512.81	80	2
2278.19	80	..	2429.60	60	..	2513.32	50	80
2279.57	100	10	2432.93	60	..	2515.28	60	2
2285.38	80	1	2434.88	50	..	2517.32	60	80
2287.68	60	1	2454.92	60	5	2517.62	50	..
I 2291.18	60	1	2455.53	80	100 r	2518.40	3	50
2299.29	50	..	2456.44	60	50	2519.21	20	80
2300.37	50	..	2456.57	60	50	2521.61	60	1
2302.54	80	3	2458.62	60	2	2524.86	10	80
2320.70	50	..	2462.94	60	..	2526.83	50	20
2322.01	60	2	2464.70	50	4	2528.04	..	60
2340.69	60	4	2474.04	50	1 Wn	2528.88	60	2
2342.72	60	10	2475.41	100	3	I 2533.24	50	..
2342.85	60	40	2476.31	50	..	2534.00	4	80
2348.33	50	..	2476.88	60	2	2535.59	..	100
2349.34	60	4	2478.93	80	60	2539.72	12	100
2351.33	60	4	I 2481.11	12	80	2540.30	10	100
2357.91	60	100	2489.91	60	..	2541.28	50	..
2370.17	60	..	2493.69	20	80	2543.25	50	150
2375.27	80	5	2494.02	80	..	2544.22	60	6
2375.63	50	80	2494.48	50	60	2547.67	5	80
2381.99	50	150	2495.69	80	35	2549.18	5	150
2387.90	60	3	2497.68	50	1 n	2549.58	50	3
2392.42	80	6	2498.42	60	40	2549.79	3	100
2393.25	80	1	2498.57	60	40	2551.98	10	150
2393.97	50	..	2499.78	50	4	2556.31	50	..
2396.71	60	80	2501.48	60	1	2557.13	5	50

RUTHENIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2558.53	50	1	2636.82	..	50	2717.86	..	50
2560.26	60	5	2638.51	60	4	I 2719.51	100	30
2563.15	50	1	2639.12	60	5	2719.72	12	50
2564.58	50	2	2639.87	50	..	I 2721.56	60	5
2565.18	50	..	2640.33	60	5	I 2722.65	60	1
2565.70	4	50	2641.62	..	100	2723.10	..	50
2566.23	..	50	2642.79	..	150	2724.06	60	4
I 2568.77	60	8	I 2642.96	150	..	2724.87	..	100
2570.97	50	..	2644.61	8	100	2725.47	80	200
2571.08	6	100	2646.02	20	150	2726.97	60	10
2573.54	5	50	2647.31	50	5	2728.83	60	..
2576.08	..	50	2648.78	30	150	2729.45	60	..
2579.02	12	80	2650.40	50	..	I 2730.33	60	2
2580.80	50	3	I 2651.29	60	5	I 2730.93	80	5
2581.14	60	2	2651.84	100	9	2731.90	50	..
2584.14	50	3	2653.95	..	80	2733.59	80	4
2585.73	50	..	2656.25	20	150	2734.35	80	200
2589.41	..	60	2657.19	..	50	2735.72	60	60
2589.57	60	3	I 2659.61	80	12	2736.48	12	80
2590.97	12	100	2661.17	20	100	2736.81	30	60
2591.12	50	..	2661.61	80	150	2737.59	..	50
2591.24	..	50	2661.86	50	..	2737.79	..	60
2592.02	60	6	I 2664.76	60	5	2738.89	60	2
2594.85	60	4	2667.39	10	150	I 2739.22	60	5
2595.80	..	100	2667.79	..	80	2742.35	4	50
2597.15	..	50 n	2667.97	50	..	2743.53	50	50
2598.77	4	50	2669.42	..	100	2743.94	50	100
2602.25	..	100	2673.01	8	50	2744.45	30	50
2604.12	..	80	2673.48	50	3	2745.25	12	150
2605.35	50	4	2673.60	50	3	2745.83	50	80
2605.86	50	3	2674.19	..	50	2746.07	50	8
I 2609.06	80	12	2675.52	..	50	2747.97	50	100
2610 08	..	60	2676.19	8	100	2749.68	50	10
2611.05	50	5	2676.35	50	3	2750.35	50	..
2611.51	3	80	2678.76	100	300	2752.10	..	60
2612.07	100	30	2680.54	5	50	2752.45	50	..
2612.51	..	80	I 2686.29	80	12	2752.77	50	150
2614.07	60	3	2687.07	..	50	2753.44	50	50
2614.59	50	4	2687.50	12	100	I 2754.61	50	1
2615.09	60	100	2688.11	8	100	2757.81	50	..
2617.07	..	50	2689.90	50	..	2762.31	50	3
2617.79	50	4	2692.06	8	200	2763.42	50	15
2619.35	..	60	2693.29	80	2 n	2764.72	50	1
2619.67	50	5	I 2700.15	..	100	2765.13	..	80
2620.61	50	5	2700.48	50	..	2765.44	50	150
2623.83	50	..	2700.99	..	50	2765.87	..	50
2626.21	50	..	2701.34	60	8	2766.55	..	100
2626.35	20	50	I 2702.83	80	8	2768.93	60	200
2626.47	50	..	2703.80	60	3	2770.30	60	3
2627.65	60	1	2704.57	..	100	2770.70	60	..
2628.73	..	100	2707.29	..	60	2771.07	..	100
2630.02	..	50	2707.97	50	3	2772.45	..	150
2630.23	50	1 n	2709.20	60	8	2772.61	50	..
2631.09	..	50	2710.23	50	100	2774.48	60	2
2631.57	60	3	2712.41	80	300	2775.18	50	..
2632.13	50	2	2713.07	..	80	2775.63	50	150
2632.50	50	1	2713.19	60	2	I 2775.91	50	..
2632.71	..	80	2713.58	..	100	2777.39	..	50
2633.46	50	1 n	2713.74	60	2 n	2777.50	5	50
2633.80	..	80	2715.78	50	..	2778.38	..	150
2635 86	30	100	2716.12	..	100	2778.99	50	50
2636.54	8	100	2716.58	..	80	I 2782.21	50	1
2636.67	60	..	2717.40	50	100	2784.53	60	100

Ruthenium (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2785.65	60	200	2919.61	80	12	3048.49	50	5
2787.83	60	150	2927.54	50	200	I 3048.78	60	9
2788.71	..	50	2933.24	20	150	3049.17	2	70
2792.33	10	100	2935.52	10	80	I 3054.94	70	12
2792.64	50	1	I 2940.36	50	3	3056.86	12	150
2799.91	..	50	2942.25	30	100	3059.17	50	..
2802.81	50	150	2943.92	50	5	3060.23	20	50
2803.50	50	4	2945.10	6	50	3060.49	8	50
2804.88	..	60	2945.67	60	300	3064.84	70	60
2806.74	50	100	I 2946.99	60	12	3068.26	60	8
2808.23	50	..	I 2949.50	80	12	I 3073.34	50	5
I 2810.03	50	12	I 2952.50	60	2	3073.51	10	80
I 2810.55	50	200	I 2954.49	100	20	I 3076.78	50	3
2813.30	..	75	2955.36	50	1	I 3080.90	50	6
2813.71	50	125	I 2958.00	60	5	3081.38	4	50
I 2817.09	50	4	2961.53	5	50	I 3083.15	50	3
I 2818.36	50	12	2961.69	60	3	3086.07	60	6
I 2818.95	50	3	2963.40	60	150	I 3089.14	60	12
2821.42	5	100	I 2963.71	60	5	I 3089.80	60	5
2822.03	50	5	I 2965.16	80	20	3090.23	50	6
2822.55	30	150	2965.55	60	200	3091.87	50	5
2823.18	20	80	I 2968.95	60	6	3093.90	30	100
2825.06	..	60	2973.99	50	5	3094.39	50	3
2825.46	..	80	2976.59	60	200	3094.56	6	50
2826.22	..	80	2976.92	60	5	3096.57	70	60
2826.68	..	100	2977.23	50	80	I 3099.28	70	60
I 2829.16	50	8	2977.48	30	60	I 3100.84	70	50
2831.84	10	50	2978.64	50	150	3103.41	3	50
2833.78	..	80	2979.96	60	80	3105.28	50	40
2840.54	60	8	2980.96	10	50	I 3105.41	50	1
2841.12	..	125	2981.93	60	3	I 3106.84	50	3
2841.68	50	200	I 2988.95	250	100	3107.58	10	50
2844.71	..	150	2991.62	50	100	I 3107.71	60	5
2848.58	50	3	I 2993.27	60	9	I 3110.55	60	6
2849.29	3	100	I 2994.96	80	40	I 3111.91	50	5
I 2854.07	60	35	2995.99	4	50	3112.68	50	3
2854.72	2	60	2996.89	60	5	I 3113.40	50	..
2856.55	..	50	2998.35	80	8	I 3118.07	50	50
2857.78	4	60	2998.89	50	100	3118.68	50	3
I 2860.02	60	12	2999.81	8	50	I 3124.17	60	8
I 2861.41	60	35	I 3001.64	60	5	3124.61	50	2
2862.88	6	60	3004.60	50	2	I 3125.96	70	12
2863.32	30	80	3005.13	..	60	3126.61	12	50
I 2866.64	60	25	3006.59	70	15	3127.91	10	100
2870.55	..	50	3008.26	50	3	3129.60	50	1
2871.64	50	5	3008.80	50	5	I 3129.84	60	4
2873.31	4	60	I 3012.92	60	4	3132.88	60	5
2874.98	80	50	I 3013.36	60	5	I 3134.80	10	100
2879.06	..	60	3015.41	8	50	3135.80	10	80
2879.75	50	12	3017.24	100	50	3136.55	60	6
2882.12	30	200	3017.81	10	60	3140.48	50	..
2886.54	60	50	I 3020.88	60	40	I 3140.97	60	6
2897.71	6	60	3027.79	12	50	3143.65	20	80
2898.22	..	60	I 3033.45	70	10	3144.26	60	8
2900.42	..	50	I 3034.06	60	5	I 3147.21	50	3
I 2905.65	50	12	I 3035.47	60	4	3147.45	6	80
2909.74	..	150	3036.47	50	150	3150.69	60	60
2913.17	50	3	I 3037.96	50	5	3153.82	60	12
2913.97	..	50	I 3038.18	80	5	I 3156.82	50	..
2914.30	50	..	I 3040.31	60	10	I 3158.89	60	12
I 2916.25	100	25	3042.47	70	12	I 3159.92	70	25
2917.77	60	2	I 3042.83	60	5	3163.18	12	100
2918.50	..	60	I 3045.71	60	12	3164.95	3	70

Ruthenium (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3167.47	5	100	3341.09	50	5	I 3509.72	50	2
3168.52	100	25 r	3341.66	70	50	I 3514.49	70	40
3174.13	50	3	I 3344.53	60	6	3519.63	70	30
3175.15	20	100	3345.32	60	5	3520.13	60	40
3176.29	50	3	I 3347.61	60	6	I 3528.68	60	12
3177.05	60	200	3348.01	50	3	3531.39	60	9
3179.26	50	50 r	I 3348.70	50	2	3532.81	60	12
I 3186.04	80	25	I 3351.93	50	4	3535.83	60	12
I 3188.34	60	50	3353.65	50	4	3536.57	50	..
I 3189.98	50	50	I 3359.09	70	20	I 3537.95	70	25
3195.15	...	100	I 3362.00	60	8	I 3539.37	60	15
3196.59	50	2	3362.33	50	5 n	3541.63	60	10
3201.26	2	100	I 3368.45	100	60	3570.59	12	60
I 3223.27	60	35	3369.28	12	60	3587.20	5	70
I 3226.37	50	12	I 3371.86	70	18	I 3589.21	60	100
I 3228.53	50	150	I 3373.98	60	4	I 3593.02	60	150
I 3232.75	50	4	I 3374.65	80	18	I 3596.17	30	100
3234.43	3	50	3378.02	60	12	3599.76	12	100
3238.53	100	45	I 3379.60	60	18	3634.93	50	100
I 3238.77	50	1	I 3380.17	60	15	3657.55	..	50
I 3239.60	50	5	3385.14	60	35	I 3661.35	60	100
I 3241.23	60	12	I 3385.71	50	4	3663.37	5	60
3242.16	80	..	I 3388.71	80	20	3669.49	50	70
3243.50	70	12	I 3389.50	60	18	3690.03	5	100
I 3254.54	50	9	3391.89	50	6	I 3696.59	50	15
3254.71	50	9	3392.54	100	40	3700.99	50	20
3256.33	50	3	3399.37	60	3	3726.10	12	60
I 3258.04	50	8	I 3401.74	100	50	I 3726.93	100	150
3258.97	10	60	3405.88	50	2	I 3728.03	100	150
I 3259.67	60	9	3406.59	50	3	I 3730.43	12	70
I 3260.35	100	50	3409.28	100	40	I 3742.28	70	100
I 3266.44	50	9	3411.64	80	20	3742.78	50	50
I 3268.21	60	12	I 3412.80	50	5	3753.54	30	60
3268.79	4	60	I 3414.64	50	5	I 3755.93	30	60
I 3273.08	60	20	3416.18	50	4	I 3760.03	20	50
I 3274.71	60	25	I 3417.35	1	70	3767.35	50	50
I 3294.11	60	200	3420.08	60	8	I 3777.59	60	50
I 3296.11	50	10	3428.31	100	100	3781.18	50	40
I 3296.65	50	5	3429.54	60	25	I 3786.05	70	100
3297.26	50	4	I 3430.77	70	45	I 3790.51	70	150
I 3297.95	50	6	I 3432.21	50	12	I 3798.90	70	100
I 3298.41	50	25 r	3432.74	70	40	I 3799.35	70 r	100
I 3299.33	50	4	I 3433.26	60	25	3808.68	50	30
I 3301.59	70	40	I 3435.19	60	20	3817.27	50	60
3303.99	60	8	I 3436.74	300 r	150	I 3819.03	50	30
I 3304.82	50	3	I 3438.37	70	35	3822.09	50	25
I 3306.17	60	12	I 3440.20	100	30	3831.79	60	50
I 3307.98	50	..	3446.07	50	6	3835.05	50	6
I 3315.05	50	12	3446.49	50	..	3839.69	50	30
I 3315.23	60	25	3448.95	70	20	I 3850.43	50	10
I 3316.39	80	..	I 3452.90	60	6	3856.46	50	8
3316.91	5	50	I 3456.62	60	8	3857.55	50	25
I 3317.89	50	12	I 3463.14	60	4	3862.65	2	60
3318.82	50	8	3467.05	50	3	I 3867.84	60	35
I 3324.99	60	12	3472.23	60	9	I 3892.21	50	40
3327.71	50	6	I 3473.75	70	35	I 3901.24	50	12
3332.05	60	10	I 3481.30	70	35	3909.07	30	50
3332.64	60	5	3483.16	50	8	3923.46	60	100
I 3335.69	70	12	I 3483.29	60	10	I 3925.92	60	100
3336.64	50	4	I 3494.25	50	8	3931.75	50	70
I 3337.82	60	8	3495.97	60	10	3933.68	5	200
3339.55	100	60	I 3498.94	500 r	200	3945.57	50	100
3339.78	10	70	3509.20	10	100	3964.90	50	40

RUTHENIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3968.46	12	200	I 4342.07	60	40	5093.83	60	..
I 3978.44	60	70	4361.21	40	50	I 5136.55	125	..
I 3979.42	60	60	I 4372.21	125	100	I 5147.24	60	..
I 3984.86	60	70	I 4385.39	125	40	I 5155.14	125	..
3987.79	3	50	I 4385.65	125	50	I 5171.03	150	..
I 4022.16	40	100	I 4390.43	150 r	80	I 5195.02	100	..
I 4023.83	25	60	I 4397.80	150	..	I 5284.08	100	..
4039.21	25	50	I 4410.03	150	80	5304.86	60	..
I 4051.40	125	200	I 4421.46	60	..	I 5309.27	125	..
I 4052.19	25	50	I 4428.46	125	..	5334.70	60	..
I 4054.05	40	100	I 4439.76	125	50	5335.93	100	..
I 4064.46	20	60	I 4449.34	125	100	5361.77	100	..
4068.37	40	60	I 4460.03	150	80	5401.04	125	..
I 4076.73	60	25	I 4473.93	100	..	5454.82	100	..
4080.60	125	300	4480.45	60	..	I 5484.32	60	..
I 4085.43	40	50	I 4498.14	125	40	5510.71	100	..
I 4097.79	25	125	I 4516.89	100	..	I 5559.75	60	..
I 4101.74	20	60	I 4517.82	60	..	I 5636.23	100	..
I 4112.74	125	200	I 4530.85	60	..	I 5699.05	125	..
4113.38	40	50	I 4554.51	1000 r	200	6663.14	100	..
I 4144.16	150	200	I 4584.44	150 r	80	6690.00	300	..
I 4145.74	125	150	I 4591.10	60	..	6824.09	200	..
I 4146.77	100	70	I 4592.52	100	..	6911.48	100	..
I 4148.37	60	15	I 4599.08	100	..	6923.23	300	..
I 4161.66	25	50	I 4635.69	125	..	6982.01	200	..
I 4167.51	100	150	4645.09	100	30	I 7027.98	250	..
4196.87	60	50	4647.61	125	..	7238.92	200	..
I 4197.58	100	100	I 4654.31	125	..	7393.93	150	..
I 4198.87	60	100	I 4681.79	100	..	7468.91	150	..
I 4199.90	150	300	I 4684.02	100	..	7475.40	50	..
I 4206.02	100	40	I 4709.48	150	80	7485.79	150	..
I 4212.06	125	80	I 4731.33	60	..	7499.75	200	..
4214.44	100	40	I 4757.84	125	..	I 7559.61	100	..
I 4217.27	100	20	I 4869.15	125	..	7771.88	100	..
I 4220.67	60	..	I 4903.05	60	..	7774.14	100	..
I 4230.31	60	..	I 4938.43	60	..	7775.41	60	..
I 4241.05	100	20	I 4980.35	60	..	I 7791.86	100	..
I 4243.06	100	40	5057.29	60	..	I 7847.80	100	..
I 4297.71	60	50	I 5057.33	100	..	7881.49	100	..
I 4307.59	20	50						

SAMARIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3183.92	60	40	II 3418.51	50	10	II 3710.87	100 r	7
II 3207.18	50	9	3445.62	150 r	10 r	II 3712.76	100	100
3211.75	100	15	II 3568.26	40	50	II 3718.88	100	5
II 3215.24	50	15	II 3592.59	40	50	3719.45	50	10
3218.60	100	25	II 3609.48	60	100	3721.84	100	50
II 3230.54	100	30	II 3621.22	60	10	II 3726.80	100 r	3
3236.63	100	40	II 3626.99	50	40	II 3728.47	100	100
II 3239.64	100	25	II 3634.27	100	25	II 3731.26	50	10
II 3241.14	50	10	II 3649.51	100	30	II 3735.97	50	8
II 3250.36	50	10	II 3661.35	100	50	II 3743.86	50	25
II 3253.93	50	8	II 3662.25	50	50	II 3770.73	25	50
II 3254.38	100	15	II 3670.82	100	50	3771.35	50 d	2
II 3276.74	50	10	II 3674.05	50	10	3778.13	40	100
3298.10	60	60	3687.88	50	..	3783.81	50 d	10 d
II 3306.37	100	40	II 3692.22	90	40	II 3787.20	100	35
II 3321.18	50	15	II 3693.99	100	150	II 3830.30	50	10
3327.90	50	20	II 3700.59	50	30	3836.51	50	25
II 3382.41	100	40	3700.93	50	4	3848.81	150 d	10
II 3402.46	50	10	II 3708.66	50	25	3854.20	300 wn	25

II. EMISSION SPECTRA 2000–10,000 A (Continued)

SAMARIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3875.17	50	10	II 4378.23	100	100	II 4719.84	125	. .
3877.47	50	8	II 4384.29	50	50	II 4726.03	100	. .
II 3885.28	50	50	II 4390.86	150	150	4728.44	150	. .
II 3891.18	50	8	4401.17	50	30	II 4741.73	80	. .
II 3896.97	50	50	II 4403.36	50	50	II 4745.67	250	. .
3903.41	60	60	II 4409.34	100	100	4750.72	60	. .
II 3922.38	60	60	II 4417.58	80	80	II 4755.37	100	. .
II 3928.27	60	60	II 4420.53	200	200	4760.26	150	. .
II 3933.59	200	200 n	II 4421.14	150	150	II 4774.14	100	. .
II 3941.87	50	40	II 4424.34	300	300	II 4777.84	100	. .
II 3948.11	50	50	II 4433.88	200	200	II 4781.84	60	. .
3959.53	50	40	II 4434.32	200	200	4783.10	150	. .
3962.99	50	40	4444.26	100	100	4785.87	100	. .
II 3966.05	60	50	II 4452.71	200	200	4789.96	50	. .
II 3971.39	50	30	II 4454.63	100	100	II 4791.58	150	. .
II 3979.19	50	50	II 4458.51	150	200	II 4798.87	50 r	. .
II 3983.14	100	60	II 4467.34	200	200	II 4815.81	125	80
II 4007.49	50	25	4470.89	60	60	II 4829.58	200	. .
II 4035.10	50	3	II 4472.42	100	100	II 4833.33	80	. .
II 4084.40	80	. .	II 4473.01	150	150	II 4834.63	100	. .
II 4106.60	100	5	4478.66	100	100	II 4836.67	50	. .
II 4118.55	50	60	II 4499.48	100	100	II 4837.65	100	. .
II 4210.34	50	20	II 4511.83	100	100	4841.70	100	. .
II 4220.65	100	100	4515.10	100	. .	II 4844.21	150	. .
II 4223.71	50	20	II 4519.63	150	80	II 4847.77	150	. .
II 4234.57	60	40	4522.54	60	. .	4848.33	100	. .
II 4236.74	60	50	II 4523.91	100	50	II 4854.37	125	. .
II 4237.66	60	50	4532.44	60	. .	II 4859.57	80	. .
II 4244.70	100	80	II 4537.95	50	25	II 4869.98	125	. .
II 4249.54	50	40	4542.05	50	. .	4883.78	60	. .
II 4251.79	200	200	II 4543.94	100	50	4883.98	80	. .
II 4256.40	150	150	II 4552.66	80	40	II 4893.34	150	. .
II 4258.56	50	40	II 4554.44	60	. .	II 4894.30	60	. .
II 4262.68	200	150	II 4560.42	50	. .	II 4900.74	100	. .
II 4265.07	60	25	II 4566.20	100	50	4904.98	60	. .
II 4279.66	100	100	II 4577.69	100	50	4910.41	150	. .
II 4279.95	50	40	II 4584.83	60	50	II 4913.26	150	. .
II 4280.78	200	200	II 4591.83	100	. .	4918.98	125	. .
4281.00	50	30	II 4593.53	50	50	II 4920.37	125	. .
II 4285.48	200	200	II 4595.30	100	60	II 4936.02	80	. .
II 4286.64	100	60	II 4604.18	60	. .	II 4938.10	125	. .
II 4292.18	100	60	4611.26	50	. .	4946.31	60	. .
4296.75	100	50	II 4615.69	50	40	II 4948.63	125	. .
II 4304.94	100	100	II 4642.23	100	40	II 4952.37	125	. .
II 4309.00	200	150	II 4646.68	50	. .	II 4953.05	50	. .
II 4318.93	300	300	4663.55	60	. .	II 4961.94	100	. .
4319.53	50	15	II 4669.65	50	40	II 4964.56	80	. .
II 4323.28	125	100	II 4674.59	80	40	II 4972.17	80	. .
II 4329.02	300	300	II 4676.91	100	50	4975.99	80	. .
4330.01	80	15	4681.56	50	. .	II 4981.71	50	. .
II 4334.15	200	200	II 4687.18	100	. .	II 4989.44	60	. .
4336.13	100	30	4688.73	50	. .	II 4992.03	80	. .
II 4345.85	100	100	II 4693.63	50	. .	II 5016.61	80	. .
II 4347.80	150	60	II 4699.34	50	. .	II 5023.51	60	. .
II 4350.46	150	150	II 4704.41	200	. .	II 5028.44	200	. .
4352.10	125	100	II 4710.65	50	. .	5036.21	50	. .
II 4360.71	100	60	II 4713.07	100	. .	5044.28	150	. .
II 4362.03	150	150	II 4714.63	50	. .	II 5052.75	150	2
4362.91	60	25	II 4715.27	100	. .	II 5057.75	100	1
II 4363.45	60	50	4716.11	150	. .	II 5069.44	150	1
II 4368.03	60	60	4717.09	80	. .	5071.19	100	. .
II 4373.46	50	50	II 4717.74	100	. .	II 5100.20	50	. .
II 4374.97	200	200	II 4718.35	100	. .	5100.30	60	. .

SAMARIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 5103.08	150	. .	II 5831.01	80	. .	II 6617.61	50 d	. .
II 5104.47	125	1	II 5831.77	40 r	. .	II 6628.88	50 d	. .
II 5112.29	125	1	II 5836.36	100 d	. .	II 6630.61	50 d	. .
II 5116.68	100	1	5867.79	50	. .	II 6632.28	100	. .
5117.16	80	1	5897.38	100	. .	II 6637.17	60 d	. .
5122.14	80	. .	5919.33	60	. .	II 6649.02	50	. .
5124.83	50	. .	II 5932.89	50	. .	II 6651.61	80 d	. .
5154.27	125 d	1	II 5938.84	50 d	. .	II 6656.19	100	. .
II 5155.02	125	1	II 5965.71	125	. .	II 6667.22	50 d	. .
II 5166.05	125 d	. .	II 5994.65	60	. .	I 6671.48	50	. .
5169.60	50 d	. .	II 5997.32	60	. .	6679.1	80	. .
5172.74	80	1	6001.68	50	. .	II 6679.24	80	. .
5175.42	60	1	II 6011.24	60	20	II 6681.53	60 d	. .
5178.06	100 d	. .	II 6017.39	50 d	. .	II 6687.79	80 d	. .
5200.59	200	1	6044.99	60	. .	II 6693.55	100 d	. .
II 5202.73	50	. .	6084.13	50	. .	II 6707.45	50 d	. .
5228.78	60	. .	II 6123.60	50 d	. .	II 6712.62	50	. .
5234.17	50 d	. .	II 6149.10	60	. .	II 6731.84	500 d	. .
5251.89	150	. .	II 6181.05	50 d	. .	II 6734.06	400 d	. .
5271.40	150	. .	II 6182.89	60 d	. .	II 6734.81	400 d	. .
II 5272.81	50 d	. .	6192.64	50	. .	6735.34	100 d	. .
5282.91	100	. .	II 6237.66	50	. .	II 6754.68	50	. .
5302.91	50	. .	II 6246.76	80	. .	II 6756.94	50	. .
II 5312.21	100	. .	II 6256.66	80	. .	II 6766.52	50 d	. .
5320.60	100	. .	II 6267.28	150	. .	II 6778.61	200 d	. .
5321.87	50 d	4	II 6289.93	60	. .	II 6781.17	50 d	. .
5341.29	80	. .	II 6291.82	100 d	. .	II 6790.03	300 d	.
5364.36	50	. .	II 6300.19	50	. .	II 6794.20	200	. .
5368.36	80	. .	II 6301.12	50	. .	II 6829.81	100	. .
5387.98	50	3	II 6307.06	60	. .	II 6844.71	150 d	. .
5405.24	80	. .	6321.74	60	. .	II 6846.54	100 d	. .
5416.05	100	. .	6325.58	50 d	. .	II 6854.50	60 d	. .
5453.02	100	. .	II 6327.47	100	. .	II 6856.03	300 d	. .
5466.73	80	. .	6353.49	50	5	I 6860.93	800 d	. .
5493.72	80	. .	6357.19	50	1	II 6861.06	500 d	. .
5498.21	80	. .	II 6368.28	50 d	. .	II 6862.82	100 d	. .
5512.10	80	. .	II 6389.87	100	. .	II 6872.42	100 d	. .
5516.14	200	. .	II 6390.84	100	.	II 6909.81	50 d	. .
II 5537.07	50	. .	II 6417.51	100 d	. .	II 6930.41	50 d	. .
5548.95	80	. .	II 6426.62	100 d	. .	II 6941.56	50	. .
5550.40	125	. .	6428.31	50 d	. .	II 6950.51	100	. .
5573.43	80	. .	II 6431.03	50 d	. .	II 6955.27	400 d	. .
5574.91	50	. .	II 6431.96	50	. .	II 7020.41	500	. .
II 5600.85	200	. .	II 6470.46	60 d	. .	I 7026.64	100	. .
II 5603.19	100 d	. .	II 6472.34	150 d	. .	II 7039.22	500 n	.
5621.80	60	. .	II 6484.52	100	. .	II 7042.23	400 n	. .
5626.01	60	. .	II 6487.62	60	. .	II 7051.52	400 nd	. .
5637.27	80	. .	II 6490.75	60 d	. .	7074.67	50	. .
5659.86	60	. .	II 6498.67	100 d	. .	II 7082.37	400 n	. .
5686.73	50	20	6526.64	50	. .	I 7088.30	60	. .
5719.12	60	20	6529.70	50	. .	I 7091.22	60	. .
5732.95	100	. .	II 6542.76	200	. .	I 7095.51	100	.
5740.88	80	. .	II 6549.77	100 d	. .	I 7096.37	60	. .
5741.19	60	. .	6562.94	50 d	. .	I 7104.57	150	. .
II 5759.50	60	. .	II 6569.31	500 d	. .	I 7106.24	80	. .
5773.77	100	. .	II 6570.67	200 d	. .	7115.96	50	. .
5778.33	50	. .	II 6574.38	100	. .	7119.81	60	. .
5779.25	50	. .	II 6585.21	150 d	. .	I 7131.80	80	. .
5781.89	100	. .	6588.92	100	. .	7136.01	50	. .
II 5786.99	200	. .	II 6589.73	400 d	. .	II 7149.60	150	. .
5800.50	80	. .	II 6601.83	150 d	. .	I 7213.82	60	. .
5802.82	80	. .	II 6604.56	200 d	. .	II 7218.09	50	. .
5814.87	60	. .	II 6614.82	50 d	. .	II 7240.90	200	. .

SAMARIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 7279.25	100	..	II 7749.30	200	..	8065.16	150	..
7290.23	80	..	II 7755.20	125 d	..	II 8068.46	800	..
I 7332.65	100	..	I 7755.32	80	..	II 8070.37	50 d	..
7338.04	50	..	I 7794.50	100	..	8090.80	60	..
I 7347.30	100	..	I 7801.54	150	..	8091.15	80	..
7364.10	50	..	7812.75	60 d	..	II 8117.16	150 d	..
I 7371.51	50	..	II 7820.15	150 d	..	II 8125.12	125 d	..
II 7376.69	60	..	7831.40	60 d	..	II 8161.90	200 d	..
7405.00	50	..	II 7835.08	400 d	..	8184.43	50 d	..
7444.56	150	..	II 7837.27	400	..	II 8195.50	200 d	..
I 7445.41	100	..	II 7844.82	60 d	..	8203.98	80	..
7070.76	100	..	I 7859.53	100	..	8206.30	80 d	..
II 7502.39	50 d	..	II 7863.65	100 d	..	8208.25	60	..
II 7541.42	100 d	..	II 7880.07	100 d	..	II 8218.76	300	..
7544.74	50	..	I 7895.96	200	..	8230.33	100	..
7562.94	50 d	..	7913.49	60	..	II 8240.98	150	..
II 7570.95	150 d	..	II 7914.96	200 d	..	II 8289.26	125 d	..
7572.29	80 d	..	I 7919.44	80	..	II 8300.88	80 d	..
II 7578.09	60 d	..	II 7928.14	800	..	8301.34	100	..
II 7585.77	60 d	..	7931.15	50	..	II 8305.79	500 d	..
I 7607.74	80	..	I 7931.92	200	..	8315.45	150	..
II 7637.94	60 d	..	II 7937.09	100 d	..	II 8348.68	150 d	..
II 7645.09	200 d	..	7940.31	150	..	8383.71	150 d	..
7645.82	80	..	II 7948.12	100 d	..	II 8387.77	100 d	..
II 7648.02	100 d	..	7968.32	50	..	II 8432.64	200 d	..
II 7655.78	50 d	..	II 8001.61	200 d	..	II 8473.54	100 d	..
II 7667.20	50 d	..	II 8014.92	200 d	..	II 8485.99	400 d	..
7672.49	50	..	8016.17	80	..	II 8510.90	200 d	..
II 7678.79	60 d	..	II 8025.12	400	..	II 8543.22	150 d	..
7695.78	100	..	II 8026.32	500 d	..	II 8617.03	50 d	..
II 7712.04	60 d	..	II 8032.03	200 d	..	II 8708.43	60 d	..
II 7728.56	200 d	..	II 8048.70	400	..	II 8717.89	50 d	..
7736.26	150 d	..						

SCANDIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2552.36	25	40	II 3651.80	50	45	II 4670.40	100	300 wn
II 2560.23	10	30	3787.15	30	10	I 4728.77	50	25
2699.10	3	25	3828.18	30	30	I 4729.23	100	50 n
II 2822.13	50	20	3836.52	25	25	I 4734.09	100	60 n
II 2826.66	10	25	II 3843.00	25	20	I 4737.64	100	60 n
II 3045.71	15	25	I 3907.48	125	25	I 4741.02	100	60 n
II 3065.11	12 d	25	I 3911.81	150	30	I 4743.81	100	60 n
I 3269.90	30	12	I 3933.38	60	60	I 4753.15	80	40
I 3273.62	35	12	I 3996.61	40	10	I 4779.35	80	40
II 3353.73	50	60	I 4020.40	50	20	bh 4858.1	30	..
II 3359.68	50	25	I 4023.22	60	..	II 5031.02	50	200 n
II 3361.27	25	9	I 4023.69	100	25	I 5081.55	100	100
II 3361.93	25	9	I 4047.79	25	10	I 5083.71	100	80
II 3368.95	50	20	I 4082.40	25	10	I 5085.55	80	70
II 3372.15	7	150	II 4246.83	80	500	I 5086.95	60	25
II 3535.73	15	30	II 4314.08	50	150	I 5087.15	40	20
II 3558.54	15	40	II 4320.74	50	40	I 5099.23	100 r	80
II 3567.70	15	40	II 4325.01	50	40	II 5239.82	30	125
II 3572.52	30	50	II 4351.61	60	10	I 5349.29	30	..
II 3576.34	18	45	II 4374.45	100	25	I 5356.10	40	..
II 3580.93	12	40	II 4384.81	25	10	I 5481.99	60	..
II 3613.84	40	70	II 4400.35	150	30	I 5484.62	60	..
II 3630.74	50	70	II 4415.56	100	25	I 5514.21	60	..
II 3642.78	60	50	II 4431.37	50	3	I 5520.50	80	..
II 3645.31	50	50	bh 4536.6	40	..	II 5526.81	100	300 wn

II. EMISSION SPECTRA 2000–10,000 A (Continued)

SCANDIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 5657.87	30	..	bh 6072.7	100	..	II 6279.76	10	25
I 5671.80	300 W	..	bh 6079.3	100	..	I 6305.67	80	60
I 5686.83	200	..	bh 6101.9	30	..	II 6309.90	5	25
I 5700.23	400 r	..	bh 6109.9	40	..	I 6413.35	10	25
I 5711.75	100	..	bh 6116.0	40	..	bh 6446.2	30	..
bh 6017.1	40	..	I 6210.68	20	25	6835.03	25	..
bh 6036.2	200	..	I 6239.78	3 n	30	I 7741.17	50	..
bh 6064.3	80	..	II 6245.63	6	30	I 7800.44	40	..

SELENIUM

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
I 2039.85	..	1000	II 4401.02	..	100	II 6055.96	..	1000
I 2062.79	..	800	II 4406.58	..	70	II 6065.83	..	80
I 2074.79	..	100	II 4432.33	..	60	II 6101.96	..	200
I 2164.16	..	100	II 4434.92	..	40	II 6123.49	..	60
I 2413.52	..	125	II 4446.02	..	200	II 6135.04	..	70
2496.05	..	100	II 4449.15	..	300	I 6138.46	..	60
I 2547.98	..	60	II 4467.60	..	300	I 6177.71	..	80
2591.41	..	150	II 4516.25	..	70	I 6242.21	..	80
II 3038.66	..	60	II 4563.95	..	200	I 6266.23	..	200
II 3041.31	..	60	II 4599.96	..	70	I 6269.15	..	80
II 3134.42	..	70	II 4604.34	..	300	I 6283.16	..	200
II 3141.13	..	100	II 4618.77	..	100	I 6283.96	..	200
3935.36	..	60	I, II 4623.77	..	150	I 6284.47	..	300
4002.07	..	60	4636.65	..	150	I 6303.42	..	1000
II 4003.08	..	60	II 4648.44	..	800	I 6325.57	..	500
II 4007.90	..	150	I 4664.20	..	150	II 6422.90	..	125
I 4011.88	..	200	I, II 4664.98	..	150	I 6444.25	..	100
I 4012.96	..	150	I 4667.80	..	70	II 6483.06	..	200
I 4014.77	..	70	I 4730.78	..	1000	II 6488.34	..	100
II 4018.52	..	70	I 4739.03	..	800	II 6490.48	..	500
II 4030.07	..	150	II 4740.97	..	600	6534.44	..	125
II 4062.06	..	70	I 4742.25	..	500	II 6534.95	..	300
II 4070.16	..	500	II 4763.65	..	800	I 6679.43	..	70
II 4091.95	..	70	II 4840.63	..	800	I 6699.56	..	125
II 4097.91	..	60	II 4844.96	..	800	I, II 6721.37	..	60
II 4108.83	..	800	I 4886.99	..	70	I 6746.43	..	200
II 4126.57	..	150	II 4975.66	..	300	I 6768.50	..	80
II 4129.15	..	200	II 4992.75	..	300	I 6805.24	..	200
4132.76	..	200	II 5068.65	..	250	I 6815.28	..	70
II 4136.28	..	100	II 5096.57	..	350	I 6830.89	..	100
4152.34	..	80	II 5142.14	..	500	I 6831.27	..	400
II 4159.75	..	70	II 5175.98	..	600	I 6990.65	..	300
II 4175.32	..	800	II 5227.51	..	600	I 6991.77	..	200
II 4180.94	..	800	II 5253.63	..	100	I 7010.92	..	500
II 4195.51	..	100	II 5271.22	..	150	I 7012.75	..	200
II 4211.83	..	200	II 5305.35	..	500	I 7013.85	..	400
II 4212.58	..	200	I 5365.47	..	125	I 7062.06	..	1000
4215.02	..	150	I 5369.91	..	175	I 7063.79	..	70
II 4248.00	..	100	I 5374.14	..	150	I 7299.51	..	200
II 4280.36	..	150	II 5401.01	..	75	I 7328.97	..	300
II 4282.10	..	100	II 5522.42	..	750	I 7370.82	..	80
II 4320.39	..	100	II 5566.93	..	500	I 7380.34	..	60
4322.19	..	60	II 5591.16	..	500	I 7383.88	..	100
I 4328.70	..	200	II 5623.13	..	300	II 7391 99	..	125
I, II 4330.28	..	200	II 5842.68	..	60	I, II 7426.81	..	100
I 4339.59	..	200	II 5866.27	..	75	I 7429.27	..	200
II 4382.87	..	800	I 5962.01	..	100			

II. EMISSION SPECTRA 2000–10,000 A (Continued)

SILICON

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2058.13	15	..	I 4102.95	12	10	I 7165.62	100 n	..
I 2082.01	15	..	4128.11	..	20 w	I 7184.89	10	..
I 2084.47	20	..	4130.96	..	25 w	I 7226.20	10	..
I 2122.99	10	..	4552.50	..	40	I 7235.32	10	..
I 2124.15	200 r	50	4567.66	..	30	I 7235.86	10	..
I 2163.78	10 w	..	4574.66	..	20	I 7250.69	40	..
2192.22	..	(10)	4828.84	..	12	I 7275.28	50	..
I 2207.98	18	15	I 5645.66	20	..	I 7289.25	200	..
I 2210.91	30	30	I 5665.60	20	..	I 7290.21	10	..
I 2211.75	12	12	I 5684.52	30	..	I 7373.02	10 w	..
I 2216.68	40	40	I 5690.47	25	..	I 7405.85	300	..
I 2218.08	10	15	I 5701.14	15	..	I 7409.11	100	..
2287.06	..	(10)	I 5708.44	40	2 n	I 7415.37	15	..
I 2289.61	10	..	I 5754 25	40	..	I 7416.00	200	..
I 2303.02	10	6	I 5772.26	30	..	I 7423.54	500	..
2356.35	..	(10)	I 5780.45	15	..	I 7424.63	20	..
I 2435.16	150	80	I 5793.13	18	..	I 7680.35	100 w	..
I 2438.78	30	20	I 5797.91	25	..	7913.47	10 n	..
I 2443.38	15	15	I 5948.58	50	5	7918.38	200	..
I 2452.14	20	20	I 6145.08	10 n	..	7930.23	..	(150)
I 2506.90	300	200	I 6145.22	15 n	..	I 7932.20	300 w	..
I 2514.33	300	200	I 6155.22	20 n	..	7943.94	500 w	..
I 2516.12	500	500	I 6155.32	50 n	..	7970.26	10 n	..
2517.45	..	10	I 6156.00	10 n	..	8093.32	25 n	..
I 2519.21	300	300	I 6243.86	10 n	..	I 8230.67	15	..
I 2524.12	400	400	I 6244.56	10 n	..	I 8444.00	15 w	..
I 2528.52	400	500	I 6244.74	12 n	..	I 8501.50	20 w	..
I 2532.38	30	40	I 6254.25	25 n	..	I 8502.38	30 w	..
2559.20	..	(15)	I 6254.55	15 nl	..	I 8556.64	100 n	..
I 2568.64	15	10	6347.01	2	50	8648.89	100 nl	..
I 2577.13	10	..	6371.09	2	30	8728.38	10 w	..
I 2631.31	60	50	6976.53	25 n	..	I 8742.60	100	..
I 2881.58	500	400	I 7003.58	50 n	..	I 8752.17	200	..
I 2970.35	20	20	I 7005.84	50 n	..	8892.97	25 w	..
I 2987.65	100	100	I 7017.68	10 n	..	8949.33	15 w	..
I 3905.53	20	15 W	I 7034.96	50 n	..	I 9413.59	100	..

SILVER

II 2000.68	..	30	II 2205.95	..	50 wn	II 2321.55	..	25 w
II 2015.90	..	25	II 2208.50	..	25 wn	II 2324.68	15	100 wn
II 2033.93	..	25	II 2219.70	..	15 n	II 2325.05	4	25 wn
I 2061.17	25	10 n	II 2226.11	..	20 n	II 2331.37	18	150 wn
II 2065.91	4	80	II 2229.52	..	25 wn	II 2357.92	15	100 n
I 2069.83	10	3	2238.41	..	10	II 2358.86	..	100 Wn
II 2075.61	..	10 wn	II 2240.38	..	20 n	II 2362.18	..	80 w
II 2113.83	20	150 wn	2241.34	..	10	II 2364.00	..	100 Wn
II 2120.45	5	80	II 2241.81	..	10 n	II 2365.67	..	20 n
I 2120.91	..	15	II 2243.44	..	15 n	2375.06	300 wn	300 wn
II 2125.52	..	25 wn	II 2246.41	25	300 ns	II 2383.21	..	25
II 2129.12	..	10	II 2248.74	15	150 wn	II 2386.33	..	25 n
II 2145.61	8	150	II 2253.46	..	50 wn	II 2390.54	..	60 n
2161.94	..	15	II 2275.26	..	50 wn	II 2392.96	..	25 n
II 2166.50	5	100 w	II 2277.41	..	25 wn	II 2402.57	..	30 wn
II 2170.86	..	30 n	II 2279.98	10	125 n	II 2409.02	..	10 n
II 2171.70	..	10	2286.46	..	12	II2411.35	25	150 n
II 2186.77	10	100	II 2296.04	..	20 Wn	II 2411.59	..	(20)
2191.86	..	10	2309.64	150 n	200 n	II 2413.18	50	300 n
II 2202.10	..	50 wn	II 2312.41	25 wn	50 w	II 2420.07	..	100 nw
II 2203.66	..	20 n	II 2317.03	15	100	II 2422.59	..	10 wn
II 2204.40	..	10 n	II 2320.25	15	150 w	II 2428.20	1	40 wn

II. EMISSION SPECTRA 2000–10,000 A (Continued)

SILVER (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2429.64	..	150 wn	II 2712.06	3	200 n	I 3508.09	10	1
II 2436.57	..	20 wn	2721.77	20	25	3538.27	10	2
II 2437.80	60	500 wn	II 2743.90	..	50	3542.61	30	5
II 2444.21	..	80 w	II 2756.51	5	200	I 3624.71	25 n	..
II 2446.32	..	25 wn	II 2767.52	30	200	I 3682.47	50	4
II 2447.93	30	200 wn	II 2786.49	10	10 n	3683.32	..	10
II 2453.33	..	125 n	2795.53	10	10	I 3709.25	10	3
II 2460.31	..	80 wn	II 2799.66	20	100 n	I 3810.86	100 wn	10 n
II 2462.24	5	80 n	II 2801.93	..	10 w	I 3840.80	20	3 n
II 2472.92	..	25 n	II 2815.54	3	80 wn	3933.62	80	80
II 2473.80	20	150 n	2824.37	150 wn	200 w	3942.95	5 n	10 n
II 2477.28	..	150 wn	II 2873.65	3	100 wn	3961.3	15	5
II 2480.41	..	15 n	II 2882.20	..	10 n	3968.22	100	60
II 2485.77	1	10 n	II 2896.49	2	150 wn	I 3981.64	30	20
II 2504.08	..	50 n	II 2902.07	5	200 wn	3985.19	2	20
II 2506.60	15	50 n	II 2920.04	..	100 wn	4005.32	10	2
II 2535.07	..	(10)	II 2929.35	20	40	4045.82	10	2
II 2535.31	10	25	II 2934.23	10	200 n	I 4055.26	800 r	500 r
II 2553.41	2	10	II 2938.55	200	200 wn	4085.87	..	25
2562.91	..	10	3012.93	..	10	I 4210.94	200 n	30 n
II 2564.42	..	15 wn	3099.12	10	8	I 4212.68	150 n	20 n
II 2567.16	..	15 wn	3130.01	25 n	15 n	4311.07	5	25 l
2575.74	10 n	3 n	3179.24	2	15 n	4385.06	..	12
II 2580.74	1	150 wn	3180.71	2 n	15	4395.93	10	30
II 2595.63	..	40 wn	II 3184.15	..	20	4396.32	100	..
II 2598.68	10	10 n	II 3223.51	1	25 n	I 4476.08	40	8
II 2606.16	10	200 wn	3233.15	..	10	I 4668.48	200	70
II 2614.59	..	300 wn	3244.95	..	10 n	4874.18	30	..
II 2617.01	..	(10 n)	3247.55	15	15	4888.28	9	20
II 2625.67	6	15 n	3267.35	..	12	5123.68	4	30
2628.58	1	25	II 3269.82	..	10	I 5209.07	1500 r	1000 r
II 2656.66	1 n	15 n	I 3280.68	2000 r	1000 r	5434.2	2	10 n
II 2656.92	..	20 n	3352.08	..	10 n	I 5465.49	1000 r	500 r
II 2660.46	30	150	3382.89	1000 r	700 r	I 5471.55	500 n	100
II 2681.38	..	100 wn	3469.21	10	8	I 5545.94	30 l	..
II 2688.35	..	10 wn	3475 78	..	20	I 7687.78	20	..
II 2711.21	1 n	300 wn	3501.68	8 n	20 n			

SODIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2493.15	..	(40)	II 2974.99	15	(60)	I 3302.32	600 r	300 r
II 2531.55	6	(60)	II 2979.66	35	(40)	I 3302.99	300 r	150 r
II 2611.81	..	(80)	II 2984.43	20	(80)	II 3533.01	50	(200)
II 2660.99	..	(80)	II 3015.40	..	(60)	II 3631.27	12	(100)
II 2671.83	12	(60)	II 3029.07	..	(60)	II 3711.07	8	(60)
II 2678.09	6	(40)	II 3037.07	8	(40)	I 4494.27	60	..
I 2680.33	60 r	10	II 3045.59	..	(40)	I 4497.72	70	..
I 2680.44	40 r	..	II 3053.66	8	(60)	I 4664.86	80	..
II 2809.51	8	(40)	II 3056.16	35	(60)	I 4668.60	200	100
II 2841.72	20	(80)	II 3074.33	8	(60)	I 4982.84	200 wn	100
I 2852.83	100 r	20	II 3078.31	12	(60)	I 5149.09	400	..
I 2853.03	80 r	15	II 3092.73	50	(200)	I 5153.64	600	..
II 2859.48	2	(40)	II 3129.37	35	(60)	I 5670.18	100 wn	..
II 2871.27	6	(40)	II 3135.48	12	(40)	I 5675.70	150 wn	..
II 2881.14	8	(60)	II 3149.27	12	(40)	I 5682.66	80	..
II 2893.95	8	(60)	II 3163.73	35	(60)	I 5688.22	300	..
II 2904.91	20	(80)	II 3179.05	6	(40)	I 5889.95	9000 r	1000 r
II 2917.52	8	(40)	II 3189.78	35	(60)	I 5895.92	5000 r	500 r
II 2919.05	6	(40)	II 3212.19	35	(60)	I 6154.23	500	100
II 2937.72	6	(40)	II 3257.96	35	(60)	I 6160.76	500	100
II 2947.44	6	(40)	II 3274.22	15	(40)	I 8183.27	500 r	..
II 2951.23	40	(100)	II 3285.75	40	(100)	I 8194.81	1000 r	..

II. EMISSION SPECTRA 2000–10,000 A (Continued)

STRONTIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2165.96	25 r	15	I 4305.45	40	..	5486.12	40	8
I 2569.47	25 r	5	I 4319.05	25 n	..	5504.17	60	25
I 2931.83	30	8	I 4319.12	50	20	5521.83	50	10
I 3301.74	100	10	I 4337.66	30 n	..	5540.05	20	30
I 3307.53	200	10 s	I 4337.89	150	50	I 5543.36	30	5
I 3322.23	100	8	4406.85	50 n	..	I 6345.75	25	4
I 3329.99	100	10	I 4438.04	25	..	I 6363.94	25	4
I 3351.25	300	15	I 4607.33	1000 r	50 r	6369.96	25	5
I 3366.33	100	10	I 4722.28	30	..	I 6380.75	30	8
II 3380.71	150	200	I 4741.92	30	..	I 6386.50	35	10
II 3464.45	200	200	I 4784.32	30	..	I 6388.24	35	10
II 3474.89	80	50	I 4811.88	40	..	6408.47	50	20
I 3499.67	50	..	I 4832.07	200	8	6503.99	35	20
bh 3503.8	30	..	I 4872.49	25	..	I 6546.79	25	5
I 3548.08	50	..	4876.32	200	60	I 6550.25	100	10
I 3629.14	30	..	I 4891.98	40	..	I 6617.26	150	..
I 3653.27	30	8	I 4962.26	40	..	I 6643.54	100	..
I 3705.90	30	10	I 5156.07	80	18	I 6791.05	200	..
I 3780.46	30	..	5222.20	70	8	I 6878.38	500	..
I 3807.38	50	..	5225.11	70	8	I 6892.59	100	..
I 3865.46	50	..	5229.27	70	8	I 7070.10	1000	..
I 3969.26	30	..	5238.55	90	15	I 7167.24	100 nl	..
I 4030.38	40	..	5256.90	90	25	I 7232.27	50 nl	..
II 4077.71	400 r	500 W	I 5329.82	40	2	I 7309.41	200	..
I 4161.80	30	..	5450.84	30	..	I 7621.50	100	..
II 4215.52	300 r	400 W	5480.84	100 n	30	I 7673.06	200 ns	..

SULFUR

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
2089.90	..	300	II 4463.58	..	200	5606.10	..	700
2098.14	..	300	4464.42	..	100	5639.98	..	500
3497.34	..	100	II 4483.42	..	100	5640.36	..	500
II 3616.92	..	60	II 4524.95	..	150	5659.93	..	600
II 3669.05	..	60	4549.55	..	80	I 6052.63	..	125
3867.56	..	150	II 4552.38	..	200	6286.35	..	300
II 3923.48	..	200	II 4656.74	..	80	6287.06	..	1000
II 3933.29	..	80	II 4716.23	..	600	6305.51	..	1000
II 3998.79	..	60	II 4815.51	..	800	6312.68	..	1000
II 4028.79	..	200	II 4924.08	..	60	6384.89	..	300
II 4032.81	..	125	II 4925.32	..	100	6397.30	..	300
II 4142.29	..	150	4993.51	..	150	6398.05	..	300
II 4145.10	..	250	5428.69	..	250	6413.71	..	500
II 4153.10	..	600	5432.83	..	600	6455.36	..	70
II 4162.70	..	600	5453.88	..	750	6538.57	..	60
4174.30	..	150	5473.63	..	750	I 6748.79	..	80
II 4189.71	..	250	5564.93	..	150	I 6757.10	..	150
II 4267.80	..	60	5578.86	..	70	7040.92	..	70
II 4294.43	..	80						

II. EMISSION SPECTRA 2000–10,000 A (Continued)

SULFUR (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
I 7244.77	..	80	8585.60	..	200	9437.11	..	150
7281.04	..	70	I 8680.45	..	200	9633.78	..	70
7578.96	..	70	I 8694.71	..	200	9649.94	..	250
7629.82	..	200	I 8874.53	..	150	9672.34	..	200
I 7679.60	..	70	I 8882.47	..	70	9680.80	..	200
I 7686.13	..	150	I 8884.23	..	150	9693.68	..	200
I 7696.73	..	200	I 9035.92	..	100	9697.33	..	150
I 7923.95	..	300	I 9212.91	..	200	9739.74	..	150
I 7931.63	..	200	I 9228.11	..	200	9741.93	..	70
7967.43	..	200	I 9237.49	..	200	9932.26	..	150
8314.73	..	200	9413.46	..	150	9949.84	..	150
I 8452.18	..	70	9421.93	..	150	9958.90	..	150

TANTALUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2101.85	3	40	2544.80	40	..	2615.66	50	1
2146.87	10	40	2546.80	80	..	2624.12	60	..
2193.88	15	40	2549.38	100	..	2625.46	40	..
2217.82	8	40	2551.07	150	..	2632.27	15	80
2330.79	..	60	2551.19	150	..	2633.79	10 wn	80 wn
2364.24	10	40	2551.73	100	4 n	2635.93	50 n	..
2381.13	15	40	2554.62	50	100	2636.67	70	1
2381.52	8	40	2554.91	50 n	50 n	2636.90	100	3
2387.06	20	50	2555.05	50	..	2643.89	50	..
2396.30	80	..	2557.71	50	100	2644.60	20 W	50 W
2406.55	60	..	2559.43	100	2	2645.10	80	30 n
2416.89	100	150	2560.68	70	..	2646.22	50	2
2417.86	20 W	40	2562.10	100	..	2646.37	125	2
2421.85	8	40	2563.33	50	..	2646.77	50 n	50
2427.64	150	1	2563.70	80	..	2647.47	200	10
2429.71	20 l	40	2569.13	40	40 n	2651.22	..	80
2432.70	300 r	400	2573.54	125	1	2651.48	50	..
2436.51	10 n	40	2573.79	100	1	2653.27	200	15
2438.64	40	4	2574.38	80	..	2656.61	200 r	2
2443.94	50	..	2575.47	80	..	2658.86	25	50
2444.67	50	200	2577.37	80 d	150 d	2661.34	200	10
2454.21	50	..	2577.78	90	1	2661.89	60	..
2454.48	60	..	2579.05	3 n	100 n	2664.23	10 n	100 n
2458.68	40	..	2579.62	80	..	2665.60	80 d	40 n
2460.55	50	..	2580.16	150	..	2668.07	80	..
2465.26	60	..	2584.03	80 w	200	2668.62	1	100
2470.90	60	40	2584.60	40	..	2675.90	150	200
2472.13	80	..	2593.08	150	1	2680.06	30	50
2474.62	150	1	2593.66	80 d	100	2680.66	30	40
2478.22	60	..	2595.26	50	2	2681.87	50	..
2482.58	50	50	2595.59	40 d	50 n	2684.28	150	2
2488.40	60	..	2596.45	80	150	2691.31	150	..
2488.70	200	150	2598.21	2 s	50	2692.39	100	1
2504.45	200	1	2599.40	100	30	2694.76	50	..
2507.45	150	1	2600.14	80	..	2696.81	125	1
2511.69	2 d	100 d	2601.05	50	5 wn	2698.30	150	3
2512.04	5	800	2602.38	40	..	2702.80	40 d	30 wn
2512.65	100	..	2603.57	5	300	2703.06	60	..
2519.78	50	..	2607.84	20 n	150	2704.31	50	..
2526.02	100	80	2608.63	125	4	2706.69	50	1
2526.35	100	..	2608.99	80	1	2709.27	40	150
2526.45	150	..	2611.34	100	..	2710.13	200	3
2526.66	50	..	2612.61	50	40	2714.67	200	8
2532.12	80	100	2614.17	200 wn	..	2717.18	100	..
2535.60	50 n	..	2615.25	40	..	2718.38	80	..
2536.23	100 W	..	2615.46	50	1	2720.76	150	1

TANTALUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2721.83	50	..	2844.25	400 r	50	2957.60	100	30
2725.42	20 w	100	2844.46	200	200 l	2963.06	40	10
2727.43	50	150	2844.76	150	30	2963.32	300	100
2727.78	200	40	2845.35	150	10	2963.91	50	10
2732.06	40	3	2846.75	150 ns	10 n	2965.13	40	800
2732.92	100 W	5	2848.06	150	15	2965.54	150	50
2736.25	300 s	8 s	2848.52	300	50	2965.92	30	80
2739.26	2	80	2849.82	15 Ws	50 W	2969.47	150	80
2740.21	100	10 n	2850.49	200	100	2969.90	50 n	10 n
2746.68	100	5	2850.98	400	150	2975.56	200	50
2747.25	50	5	2852.35	5	100 l	2976.10	40 l	5 n
2748.78	400	50	2857.28	60	5	2976.26	2 wn	150
2749.83	200	50	2858.43	100	300	2976.76	3 n	40
2752.29	150	8	2862.02	40	10	2978.18	..	150 l
2752.49	300	300	2864.50	125	30	2978.75	200 r	30
2758.31	200	40	2867.41	5 n	150	2986.81	20 d	100
2761.55	80	..	2868.65	150	40	2988.58	40	20
2761.68	200	150	2871.42	200	50	2989.05	40 W	5 n
2762.05	1	40 l	2873.36	200 W	40 n	2989.50	200	15
2763.37	25 d	60 d	2873.56	150	50 l	2991.25	50	10
2766.12	40 n	20	2874.17	150	15	3010.84	5	70
2770.78	50 wn	1	2876.11	50 r	5	3011.12	100 W	25
2771.83	3 n	100	2877.69	15	80 n	3011.88	100 w	15
2774.88	100	3	2878.95	40 r	3	3012.54	125	100 l
2775.11	100 W	80	2879.52	50 s	10 n	3025.16	70	15
2775.35	80	15	2879.74	150	10	3027.51	125	35 w
2775.88	200	30	2880.02	150	50	3028.78	50	7
2779.10	150 w	5 n	2882.33	3	80	3037.50	8 n	100
2781.37	50	4	2889.38	40	5	3040.98	50	7 w
2784.97	50	100	2891.04	150 W	30 n	3042.06	5	100
2787.69	400 r	40	2891.84	500 W	100	3045.96	150	50 w
2788.30	150	3	2892.00	80 n	10	3048.86	100	15
2790.71	150	10	2895.10	125	15	3049.56	150	30
2791.37	25	150	2896.44	2 n	50	3052.53	..	70 l
2791.67	100	10	2899.04	200	15	3056.61	1 wn	70 l
2796.34	400	80	2900.36	200	40	3057.12	25 w	125
2796.56	150	..	2900.75	3 n	100 l	3058.64	50	3
2797.76	100 d	100 d	2901.05	100	3	3060.29	125	35 W
2798.40	150	..	2902.05	1000 w	200	3063.56	70	15
2800.57	150 W	40 n	2904.07	300 w	40	3069.24	150	70
2802.07	300	80	2905.24	80	100	3077.24	150 w	50 w
2806.30	300	50	2905.74	40	3	3078.23	50	5
2806.58	200	50	2908.91	150	10	3079.95	50 w	5 n
2810.92	200 W	40 W	2914.12	200	30	3081.85	50	5
2811.72	1	150	2915.34	150 w	50	3085.53	70	18
2814.31	50 r	50	2915.49	150	40	3087.76	5 wn	70
2814.80	125	5	2918.96	2	50	3092.44	50	15
2815.01	150	15	2925.19	100	5	3093.87	50	15
2815.12	100	4	2925.26	100 W	40 ws	3095.39	70 w	18 w
2817.10	80 d	100	2925.66	100	4	3101.03	..	100 W
2817.50	80 l	10	2926.46	100	10	3103.25	70	15
2819.37	100	5	2932.69	400	80 w	3110.81	..	70 w
2824.81	60 W	5 n	2933.55	400	150	3112.92	1	50 l
2826.18	60	5	2934.85	40	4	3113.90	50	35 w
2827.18	200	10	2938.43	50	3	3115.86	50	18 w
2827.55	3 d	100 d	2939.28	200	40 n	3117.44	70	10
2828.58	75	100	2940.06	100 l	40 w	3124.97	50	20
2833.64	300 w	40 w	2940.21	150	50	3127.76	18 w	100
2836.62	80 r	2	2942.14	150	40	3129.55	50	7
2838.24	2	150	2946.91	150	10	3129.95	50	8
2840.39	2	50	2951.92	400 wl	200	3130.58	100 W	35
2842.81	200	50	2952.99	30 n	100 n	3132.64	250 w	25
2843.51	3	80	2956.84	1 n	100 l	3135.89	35	100

II. EMISSION SPECTRA 2000–10,000 A (Continued)

TANTALUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3137.44	3	50	3317.93	200	25 W	4067.23	40	10 n
3141.38	1 n	50 l	3318.53	70	3	4067.91	100	40
3142.95	10	50	3318.84	125	35	4085.80	5	80 W
3147.37	70	50	3325.74	50	3	4123.17	50 r	4 w
3148.03	50	7	3331.01	18	200 w	4129.38	200	40
3150.85	50 w	35 w	3332.41	50	3	4136.20	80	30
3157.95	3 r	50	3337.80	100	18 s	4147.89	40	30
3162.72	70	7	3339.91	15	70	4175.21	100	40 n
3163.13	70 r	35	3358.53	70	25 W	4176.99	15	40
3163.82	40	5	3361.64	125 W	50 W	4181.15	40	25
3168.18	. .	70	3366.66	50	15 w	4205 88	100	30
3170.29	250 w	35	3371.54	70	20	4206.40	50	20
3172.87	50	25 n	3376.49	15 n	70	4268.25	50	15 n
3173.59	70	10	3379.51	18 r	50 r	4271.51	40	5 wn
3176.29	70	18	3406.66	70 w	18 s	4286.38	80	20 n
3180.95	100	35	3406.93	70	15	4302.98	125 W	40 W
3182.57	70 r	18	3414.14	18 W	100 W	4355.14	80	10 n
3184.55	70	18	3419.75	50 w	5 n	4360.83	40 s	5
3191.16	50	5	3430.94	50	70	4378.82	40	2
3192.25	70	18 w	3436.00	70 w	18 w	4386.07	50	15
3194.84	1 n	40	3437.37	7	300 wn	4398.45	40	10
3198.67	125	18	3439.00	. .	70 W	4402.50	100	20 n
3198.94	. .	70 l	3440.24	18	50	4415.74	40	10
3199.22	. .	70 l	3446.91	2 W	150 W	4441.03	60	2 n
3201.98	40	7	3463.77	50	. .	4441.68	100 l	2 n
3206.39	70	15	3480.52	70	200 ws	4480.93	200 w	10 n
3207.85	70	15	3497.85	70	5	4494.97	50	2
3216.92	100 w	18 w	3503.87	70	10 n	4496.50	100	2
3221.31	70	15 s	3504.98	70	2	4509.29	60	2
3223.83	200 W	50 W	3511.04	100	35 w	4510.98	200 W	50 W
3227.32	70 l	10	3527.06	50	2 n	4511.50	300	40 W
3229.24	300 w	70 w	3565.63	. .	50 l	4521.09	200	10 n
3229.88	35 n	50	3566.72	50	5 l	4527.49	150	5
3230.85	200	18 w	3573.44	15	70 w	4530.85	300	50
3234.69	70	10	3584.21	50	7 n	4547.15	150	2
3237.85	70	7 n	3595.64	70	5	4551.95	400	8
3239.99	200	18 w	3607.41	70	35	4553.69	200 l	2
3242.05	125	15	3625.24	70 r	2 n	4556.35	200	5
3242.83	125	10	3626.62	125	18	4565.85	200	15
3245.28	70	2	3642.06	125	18	4566.86	100	2 n
3246.90	35 n	. .	3731.02	50	3	4573.29	200	2 n
3248.52	100	3 n	3763.44	12	60	4574.31	300	20
3250.36	70	3	3784.25	150	50 w	4580.69	200 W	10
3256.77	100	1	3792.01	50	10	4583.17	150	10
3259.87	50	3	3796.21	. .	50	4601.42	60	100 wn
3260.18	125	18 w	3833.74	40	200	4602.19	100	2
3263.76	70	2	3889.46	. .	40 W	4604.85	200 W	. .
3269.14	70 r	7 l	3894.67	. .	40 n	4619.51	300	10
3271.19	70 wn	18 w	3922.42	5	50	4622.96	50	1
3273.13	70	3 n	3922.78	100	15	4633.06	150	3 n
3274.95	200	35 W	3922.91	100	10 n	4661.12	300	5 n
3275.68	70	35	3970.10	100	40	4669.14	300	15
3275.94	50	1 n	3973.18	1	400 W	4678.02	40	2
3279.29	50 r	3	3979.28	50 n	3 n	4681.87	200	50
3287.26	50	. .	3981.01	2	40	4684.87	100	2
3292.48	70	3	3996.17	100	30 n	4685.27	80	2
3293.93	70	10	4026.94	40	30	4688.84	40	. .
3295.33	125 W	20 w	4029.94	50	5	4691.90	400	5 n
3299.77	70	10	4033.07	100	10	4693.35	150	3
3302.76	50	1 n	4040.87	50	5 n	4701.32	150	2 n
3304.37	70	15	4041.06	40	4 n	4706.09	200	2
3309.78	70	5	4061.40	50	30	4722.88	200	. .
3311.16	300 w	70 w	4064.63	40	5	4730.12	100	5

II. EMISSION SPECTRA 2000–10,000 A (Continued)

TANTALUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4740.16	100 r	100	5518.91	100 W	..	6428.60	40	..
4756.51	150	10	5548.32	60	..	6430.79	150	..
4780.93	50	200 l	5584.02	60	..	6444.61	40	..
4812.75	150	5	5598.75	60	..	6450.36	200	..
4819.53	100	..	5620.68	80 w	..	6455.83	40	..
4825.43	150	..	5645.91	80	..	6485.37	500	..
4832.18	100	..	5664.90	60	..	6502.43	40	..
4846.45	100	2	5688.25	100 w	..	6505.52	100	..
4852.17	80	2	5699.24	80 w	..	6514.39	200	..
4871.70	50 w	1	5704.31	40	..	6516.10	200	..
4883.95	150	3	5706.28	50	..	6561.60	40	..
4904.59	80 W	2	5746.71	60 l	..	6574.84	200	..
4907.73	50	1	5755.81	40	..	6611.95	300	..
4914.95	50	1	5766.56	80 w	..	6621.30	200	..
4920.11	150 W	3	5767.91	100 w	..	6673.73	200	..
4921.27	50	2	5776.77	80	..	6675.53	400	..
4923.47	60 W	1	5780.02	60	..	6684.00	40	..
4926.00	60	2	5780.71	80	..	6740.73	80	..
4936.42	100 s	..	5811.10	100	..	6771.74	100	..
4937.63	40	2	5816.51	40 w	..	6774.25	100 w	..
4968.53	60 W	1	5849.68	80 w	..	6788.99	50	..
4969.69	40 l	1	5849.95	60 w	..	6810.46	40	..
4976.20	40	1	5865.87	40 w	..	6813.25	200	..
5012.52	60	..	5866.61	60	..	6866.23	200	..
5037.37	60	..	5877.35	100	..	6875.27	200	..
5043.32	60	..	5882.29	80	..	6900.55	80	..
5067.87	60	..	5901.91	80	..	6902.10	150	..
5076.37	50	..	5918.95	80 s	..	6927.38	150	..
5087.37	60	..	5931.05	40 s	..	6928.54	150	..
5090.71	60	..	5931.68	40	..	6951.26	100	..
5115.84	80	..	5939.76	80 l	..	6953.88	50	..
5136.47	60	40	5944.02	80	..	6966.13	150	..
5141.62	40	..	5997.23	200 W	..	6995.39	200	..
5156.56	80 W	..	6009.89	40	..	7005.07	50	..
5161.81	80 w	..	6015.89	40	..	7006.96	100	..
5163.65	40	..	6020.72	300 r	..	7025.03	80	..
5212.74	60	..	6045.39	200 l	..	7039.07	40	..
5218.45	40 l	..	6047.25	150 l	..	7081.30	50	..
5218.66	40	..	6053.64	150 l	..	7125.72	80	..
5230.80	60 w	..	6090.82	50 w	..	7148.63	150	..
5244.77	40 w	..	6101.57	150	..	7172.90	150	..
5279.82	60 w	..	6140.07	40 l	..	7250.27	80	..
5295.01	40	..	6144.56	50	..	7296.32	40	..
5328.38	40	..	6152.54	60	..	7301.74	200	..
5336.13	40	..	6154.50	200	..	7346.41	100	..
5341.05	150 w	80	6158.84	80 w	..	7352.86	150	..
5342.25	80	..	6189.66	50	..	7356.96	100	..
5349.09	80	..	6249.79	100	..	7369.09	100	..
5354.68	80 r	..	6256.68	300	..	7407.89	150	..
5388.51	40 W	..	6266.37	50 W	..	7440.17	40	..
5389.30	100 W	..	6268.70	200	..	7467.75	40	..
5395.99	80 w	..	6281.33	50	..	7485.90	300	..
5402.51	80	30	6309.58	100	..	7814.03	50	..
5404.95	80	..	6325.08	100	..	7842.76	50	..
5419.13	80 r	..	6332.91	50	..	7882.37	150	..
5431.66	60 w	..	6341.17	50	..	7950.19	50	..
5435.27	80	..	6346.02	40	..	8026.50	50	..
5461.29	80	..	6356.14	100	..	8248.95	50	..
5475.54	40	..	6360.84	100	..	8264.85	40	..
5490.11	60	..	6373.05	50	..	8281.62	50	..
5494.78	50	..	6389.45	100	..	8447.62	70	..
5499.44	60 s	..						

II. EMISSION SPECTRA 2000–10,000 A (Continued)

TELLURIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2001.59	600	..	4048.89	..	(70)	4885.22	..	(100)
2039.79	300	..	4073.57	..	(300)	4893.58	..	(70)
2070.9	150	..	4169.77	..	(100)	4894.94	..	(150)
I 2081.03	400	..	4179.24	..	(70)	4904.43	..	(100)
2107.20	100	..	4220.42	..	(100)	5449.82	..	(75)
2107.63	100	..	4251.15	..	(70)	5576.40	..	(100)
I 2142.75	600	..	4261.08	..	(300)	5649.30	..	(250)
I 2147.19	..	(150)	4273.40	..	(70)	5708.07	..	(250)
I 2159.79	100	..	4285.84	..	(70)	5741.66	..	(70)
2166.88	100	..	4293.35	..	(70)	5755.87	..	(250)
I 2208.83	200	(2)	4294.25	..	(70)	5765.25	..	(70)
I 2383.25	500	300	4364.02	..	(400)	5851.09	..	(75)
I 2385.76	600	(300)	4377.10	..	(70)	5936.21	..	(75)
2403.00	..	(100)	4396.00	..	(100)	5974.70	..	(250)
2426.39	..	(100)	4398.45	..	(70)	5985.64	..	(75)
2469.62	..	(300)	4401.89	..	(100)	5993.12	..	(75)
2499.75	..	(300)	4421.14	..	(70)	5993.94	..	(75)
2537.80	..	(300)	4434.96	..	(70)	6014.49	..	(100)
2564.58	..	(150)	4478.73	..	(800)	6047.44	..	(100)
2635.55	..	(350)	4494.47	..	(100)	6136.81	..	(70)
2793.24	..	(300)	4545.97	..	(70)	6153.89	..	(70)
2858.29	2	(100)	4557.84	..	(300)	6166.84	..	(100)
2868.86	..	(100)	4569.71	..	(70)	6202.29	..	(70)
2895.49	..	(300 n)	4602.37	..	(800)	6230.80	..	(300)
2942.16	..	(100 n)	4641.19	..	(70)	6245.61	..	(150)
2949.52	..	(100)	4654.38	..	(800)	6266.21	..	(70)
2967.21	..	(300)	4664.34	..	(800)	6293.61	..	(100)
2975.91	..	(100)	4665.33	..	(70)	6367.10	..	(70)
3017.51	..	(350)	4686.95	..	(300)	6412.15	..	(70)
3023.29	..	(100)	4706.53	..	(70)	6422.96	..	(70)
3047.00	..	(350)	4711.16	..	(70)	6437.06	..	(1000)
3073.53	..	(100)	4731.27	..	(70)	6487.09	..	(70)
3218.44	..	(100)	4766.03	..	(150)	6537.01	..	(100)
3251.37	..	(150)	4784.85	..	(70)	6648.52	..	(100)
3306.99	..	(150)	4796.10	..	(70)	6676.01	..	(70)
3329.25	..	(100)	4831.29	..	(800)	I 6843.94	..	(70)
3585.34	..	(350)	4864.10	..	(800)	6930.51	..	(70)
4006.50	..	(100)	4866.22	..	(800)	7038.95	..	(70)

TERBIUM

2540.12	3	50	3372.72	50	..	3561.74	200	200
2571.78	..	40	3413.76	50	30	3568.51	50	50
2619.61	..	40	3420.34	50	15	3579.20	50	50
2658.91	..	500	3446.40	50	..	3585.03	15	50
2800.51	10	40	3454.06	80	30	3596.38	50	15
2885.14	..	70	3457.03	50	8	3600.44	8	50
2891.41	3	500	3468.03	50	15	3611.33	50	8
2956.21	10	40	3472.79	50	15	3615.66	50	15
3078.86	30	80	3500.27	50	..	3625.54	50	15
3147.04	50	3	3500.84	70	15	3628.20	100	15
3218.93	50	50	3507.45	50	8	3638.46	80	50
3219.95	50	50	3509.17	200	200	3641.66	70	30
3252.34	50	30	3510.10	50	8	3645.38	50	15
3274.24	70	..	3519.76	50	15	3647.75	50	..
3281.40	50	15	3523.66	30	50	3650.40	50	100
3293.07	50	100	3525.61	50	8	3654.88	70	30
3294.04	50	3	3531.70	15	50	3658.88	100	100
3324.40	70	50	3540.24	50	50	3663.12	50	15
3339.00	50	8	3543.86	50	15	3664.64	50	8
3349.42	30	50	3546.52	50	8	3676.35	100	200

TERBIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3677.89	70	8	4002.18	40 w	2	4493.08	100	..
3682.26	50	30	4002.58	50	5	4511.52	40	..
3691.15	50	50	4005.55	100 d	125	4563.68	50	..
3694.75	50	8	4019.12	40	5	4578.69	70	..
3702.85	50	200	4024.07	40 W	1	4641.98	40	..
3703.92	70	100	4031.64	50	3	4645.26	60 W	..
3711.74	200	30	4033.04	125	5	4658.38	40	..
3755.24	50	100	4052.86	40 w	2	4702.42	80	..
3765.14	70	100	4061.57	40	2	4752.52	100	80
3767.50	75	8	4066.21	40	3	5065.79	40	..
3776.49	100	100	4100.90	50 d	2	5089.12	40	..
3806.85	50	50	4144.45	80	10	5228.12	40	..
3840.26	50	..	4178.97	50 d	2 n	5262.11	40	..
3842.49	40	50	4200.99	40	4	5319.23	40	..
3848.75	100	200	4226.44	50	..	5354.88	40	..
3874.18	200	200	4276.75	50 w	2 n	5369.72	40	..
3899.19	200	100	4278.51	200	100	5375.97	40	..
3901.35	50	8	4318.85	150	30	5470.34	40	..
3919.54	40	15	4325.83	100	..	5514.54	50	..
3922.74	50	8	4326.48	150	4	5516.24	50	..
3925.45	150	200	4332.13	40	2	5524.12	40	..
3935.25	50	8	4336.50	40	..	5685.76	40	..
3939.60	200	200	4338.45	100	3	5747.58	60	..
3946.87	150	30	4340.63	40	2	5785.18	40	..
3957.97	60 d	15	4342.50	50 w	..	5803.15	40	..
3958.36	100 w	15	4353.19	50	..	5851.07	40	..
3976.82	150	200	4356.84	60	..	5967.32	40	..
3981.88	80	200	4409.51	40 w	..			

THALLIUM

2066.8	..	30	I 2609.77	30 r	..	I 3529.43	1000	800
I 2168.61	30 r	..	II 2675.76	..	(30)	II 3540.05	..	(20)
I 2207.00	30 r	3	II 2676.03	..	(30)	II 3560.77	..	(25)
I 2237.85	60 r	3	II 2705.55	..	(20)	I 3652.95	150	50
II 2292.97	..	(20)	I 2709.23	400 r	200 r	I 3775.72	3000	1000 r
II 2297.88	..	35	I 2710.67	30 r	10	II 3793.95	..	(25)
II 2298.08	..	40	I 2767.87	400 r	300 r	II 3832.30	..	(30)
II 2298.16	..	20	II 2780.25	..	(20)	II 3869.19	..	(18)
2298.95	30	150	II 2801.81	..	(25)	II 3887.15	..	(30)
I 2315.98	60 r	..	I 2826.16	200 r	100 r	4223.05	..	(25)
I 2379.69	100 r	200 r	II 2833.31	..	(25)	II 4274.98	..	(100)
2380.34	20	60	II 2849.80	..	(200)	II 4306.80	..	(40)
II 2451.94	..	30	I 2895.41	30 s	15 s	II 4340.53	..	(20)
2452.70	..	100	I 2918.32	400 r	200 r	II 4490.77	..	(25)
II 2468.95	..	15	I 2921.52	200 r	100 r	II 4737.05	..	(40)
II 2469.07	..	20	I 2945.04	50 l	25 l	II 4981.35	..	(15)
2469.76	..	30	II 2948.73	..	(30)	II 5078.54	10	30 w
II 2477.40	..	(20)	II 3029.01	..	(15)	I 5109.47	15	..
2502.3	..	20	II 3091.61	..	25	II 5152.14	..	50 w
II 2507.39	..	(20)	II 3091.66	..	50	I 5350.46	5000 r	2000 r
II 2507.70	..	(30)	II 3187.74	..	(50)	I 5488.79	15	..
I 2517.41	30 r	..	I 3229.75	2000	800	I 5527.90	30	..
II 2530.67	..	(100)	II 3291.01	..	(40)	I 5583.98	15	..
II 2530.82	..	(60)	II 3319.91	..	(35)	II 5949.04	20	15 wn
II 2530.88	..	(80)	II 3321.17	..	(25)	II 5949.57	..	35
2531.6	..	100	II 3322.30	..	(25)	II 6111.50	..	(20)
I 2552.53	80 r	1	II 3369.15	..	(40)	II 6154.03	..	(20)
I 2580.14	100 r	80 r	II 3381.00	..	(20)	II 6167.38	..	(20)
I 2585.59	30 r	2	II 3460.48	..	(20 d)	II 6179.98	..	(100)
I 2608.99	80 r	10	I 3519.24	2000 r	1000 r	II 6239.46	..	15

THALLIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 6549.77	300	50 nl	II 7073.9	..	(20)	II 9130.	..	(60)
I 6713.69	100	40	II 8445.8	..	(15)	I 9130.5	20	..
II 6950.5	..	30	II 8632.9	..	(15)	I 9171.1	20	..
II 6966.43	..	40	II 8664.1	..	(30)	I 9512.4	30	..

THORIUM

2301.22	..	30	2982.05	150	5	3245.76	12	15
2324.70	..	15	2985.25	15	12	3256.27	10	15
2363.09	..	15	2988.23	15	20	3262.67	12	15
2391.52	..	15 wn	2991.06	15	10	3273.88	10	15
2413.49	5	20	2993.80	12	15	3287.74	12	15
2427.99	3	25	3000.92	30 d	10	3290.59	..	40 n
2431.74	2	30	3002.39	15	12	3300.49	..	30 n
2463.69	..	25	3006.93	12	15	3304.24	15	3
2473.98	..	15	3008.49	15	12	3310.25	8	15
2475.33	..	15	3009.72	15	10	3313.65	4	50 n
2501.12	..	20 n	3015.72	15	10	3325.13	10	15
2512.74	..	15 d	3025.43	20 d	5	3334.60	10	15
2545.10	..	20	3026.58	15	15	3337.87	12	15
2545.34	15	4	3034.07	15	15	3339.56	..	20 n
2547.90	15	10	3035.11	15	15	3377.43	..	20 n
2549.51	..	15	3045.57	12	15	3392.04	10	15
2554.73	..	15 d	3046.95	12	20	3402.70	10	15
2555.20	..	15	3049.09	20	20	3469.93	12	15
2564.36	..	20 wn	3060.18	12	15	3479.18	15	10
2565.60	10	15	3061.70	12	15	3493.53	30	15
2566.59	15 s	10 n	3063.03	25 d	25 d	3538.75	..	50
2567.83	..	20	3067.73	12	20	3635.37	15	10
2571.61	..	25	3078.83	10	25 n	3700.77	15	10
2576.69	15	5	3080.22	12	15	3702.87	10	20
2589.06	20	10	3083.35	12	15 n	3706.77	15	10
2597.05	20	5	3088.47	20	20	3711.31	30	20
2600.63	..	15	3090.10	15	10	3712.54	15	8
2600.88	15	4	3097.96	1	50 n	3717.83	20	10
2641.49	15	10	3102.66	15	12	3718.17	15	10
2658.67	15	10	3105.75	15	20	3718.66	20 n	8
2680.96	..	25	3107.03	15	15	3719.44	30	10
2684.29	15	15	3108.30	15	20	3720.31	15	10
2686.16	..	40 d	3110.02	15	15	3721.83	40	30
2692.42	20	20	3111.83	20 d	8 d	3722.19	35	25
2703.96	15	15	3112.35	..	20 n	3724.74	30	20
2708.18	10	20	3119.48	15	15	3726.73	30	20
2752.17	15	12	3122.96	20	20	3727.90	15	5
2768.85	15	15	3124.39	12	15	3730.38	15	3
2824.68	..	25 d	3139.31	10	15	3738.85	20	20
2832.32	18	25	3146.04	12	15	3739.79	20	5
2837.30	15	10	3148.04	3	40 n	3740.85	40	20
2870.41	18	20	3150.46	12	15	3741.19	80	80
2885.04	12	15	3154.73	15	15	3742.25	20	10
2887.82	18	18	3175.73	12	15	3742.92	20	8
2896.71	..	20 Wd	3180.20	15	15	3744.74	15	10
2898.93	..	25 wn	3208.02	18	10	3745.98	15	20
2899.72	15	12	3216.62	3	20 n	3747.55	30	30
2917.39	25 d	6	3221.29	15	40 n	3750.15	20	5
2925.05	10 s	15 n	3225.36	12	15	3752.57	40	50
2932.52	..	25 wn	3228.97	12	15	3754.04	20 w	5 w
2976.02	15	10	3230.87	15	12	3754.60	20	10
2978.64	1	100 n	3232.12	3	25 n	3756.32	50 r	20 r
2980.34	15	10	3238.12	12	15	3759.31	20	10

THORIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3670.28	20	5	3904.09	20	20	4381.86	30	30
3761.10	15	8	3905.19	30	30	4391.11	50	40
3762.88	20	20	3912.28	15	15	4416.24	15	8
3763.33	15	8	3913.01	15	15	4432.97	25	15
3765.25	20	10	3915.21	15 n	1 n	4439.13	20	15
3767.90	20	15	3916.73	15	10	4440.58	15	6
3771.38	30 w	20 w	3927.18	15	10	4440.87	20	10
3773.76	20	20	3927.42	15	10	4465.34	30 s	15
3775.32	20	5	3929.67	30	20	4480.82	25	10
3775.94	20	10	3932.23	15	10	4487.50	20	10
3777.12	40	20	3937.04	15	10	4488.68	25	12
3777.91	15	10	3937.93	15	10	4510.53	30	20
3778.78	15	10	3938.73	15 w	10 w	4537.07	20	8
3779.81	20	10	3945.51	20	15	4593.64	..	50 wn
3780.51	20	10	3946.15	20	20	4631.76	15	10
3780.85	20	5	3948.97	30	30	4651.56	30	15
3780.97	15	3	3950.39	30	30	4694.09	15	10
3781.69	20	10	3951.52	20	20	4740.52	20	15
3783.02	20	20	3960.34	10	15	4752.41	20	12
3783.30	20	15	3972.16	15	8	4863.18	20	10
3783.82	15	5	3976.42	15	20	4872.93	20	..
3785.65	15	15	3981.11	20	20	4882.46	5	20 wl
3786.88	15	15	3988.01	50	30	4919.81	50	20
3787.19	40 w	20 w	3994.55	30	10	4921.61	20	..
3789.12	20	20	3996.07	15	10	4987.14	15	4
3793.49	20 w	8	4003.32	15	15	5017.25	50	10
3793.79	20	8	4005.55	20 w	30 w	5028.61	40 W	10 wd
3795.39	20	10	4007.03	20	20	5049.81	30 w	5
3795.75	20 w	10 w	4011.75	15	15	5198.83	15	..
3803.08	15	15	4012.50	15	15	5247.65	20 d	3
3805.82	20	15	4022.09	20	15	5277.50	15 d	3
3811.38	20	10	4025.61	20	20	5325.14	15 d	3
3813.06	15	20	4036.57	15	15	5390.46	18	5
3814.59	15	15	4041.21	20	10	5415.43	20 d	3
3817.37	20	10	4050.89	15 n	5	5425.68	15 d	3
3817.73	15	15	4069.21	40	30	5435.90	15	2
3820.81	20	20	4085.04	15	15	5539.90	18 d	4
3821.43	15	15	4094.75	15	15	5548.16	15 s	..
3823.08	20 w	10 w	4100.83	18	18	5707.09	20	5
3824.35	20 w	20 w	4108.43	15	15	5720.18	18 d	..
3824.76	20 d	10	4116.72	12	15	5815.43	18 d	2
3829.41	40 w	20 w	4140.24	15 s	15 s	5989.03	20	5
3833.04	20 w	10 w	4165.47	20 w	10 w	6112.82	15	3
3834.61	15 w	10 w	4208.89	15	15	6120.55	15	3
3836.50	50 w	50 w	4247.99	15	12	6261.06	15	2
3839.70	15	15	4273.36	20	15	6274.11	25	3
3841.96	20	20	4277.32	20	12	6279.17	20	2
3845.02	20 w	10 w	4281.07	20	10	6342.86	15	..
3854.55	20	20	4281.42	15	10	6457.28	15	..
3863.39	20	20	4282.04	30	25	6462.65	30 s	..
3872.73	30	20	4309.99	15	12	6531.35	15	..
3884.83	20	15	4327.14	15	7	6989.66	20	..
3900.89	30	30	4374.79	15	10	7168.89	15	..
3903.09	15	5						

THULIUM

2338.36	2	50	2480.13	60	20	2552.49	..	50
2357.04	3	80	2489.46	2	100	2561.65	60	30
2361.23	1	60	2509.08	80	40	2588.27	40	80
2406.63	2	60	2519.80	1	50	2607.05	50	30

II. EMISSION SPECTRA 2000–10,000 A (Continued)

THULIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2624.34	80	40	3266.63	70	50	3996.52	200	40
2679.57	30	50	3267.41	50	40	4094.18	300	30
2721.19	60	100	3269.00	40	150	4105.84	300	30
2744.09	20	50	3291.00	125	80	4138.36	80	8
2785.08	60	30	3302.45	125	80	4187.62	300	30
2794.60	60	20	3309.80	80	60	4199.92	100	20
2797.27	60	100	3310.59	60	20	4203.73	250	25
2827.02	20	50	3316.87	60	20	4242.15	500	100
2827.92	50	100	3354.86	30	50	4359.93	300	30
2869.22	100	300	3362.61	250	200	4386.42	200	10
2890.93	60	15	3374.51	60	30	4481.27	400	50
2918.27	25	50	3397.50	100	50	4519.58	50	1
2925.65	20	60	3399.95	50	40	4522.57	200	300
2926.75	80	60	3425.08	200	300	4529.37	80	5
2935.99	80	300	3425.63	100	50	4555.26	25	50
2951.26	30	150	3429.97	100	100	4556.67	35	70
2959.65	20	60	3431.20	50	50	4561.84	50	10
2965.87	50	100	3441.51	150	80	4599.00	80	..
2981.49	60	100	3453.66	150	80	4615.93	200	300
2986.52	50	150	3462.20	250	200	4626.31	50	20
2990.54	80	30	3535.52	80	25	4626.55	50	3
3015.29	125	100	3536.21	40	60	4634.24	80	10
3026.07	60	30	3536.57	60	20	4677.85	50	2
3042.35	50	..	3565.90	40	50	4681.92	50	2
3050.73	50	150	3566.47	60	20	4733.32	80	5
3054.05	30	60	3608.77	100	20	4831.21	50	80
3056.06	40 d	100	3643.65	60	40	4957.19	50	5
3073.08	60	150	3668.08	80	20	5009.76	50	50
3073.50	25	60	3678.86	50	40	5034.21	100	100
3073.85	15	50	3700.26	150	80	5307.11	100	20
3087.02	30	60	3701.36	150	80	5631.41	80	10
3093.12	30	60	3717.92	100	10	5675.83	100	100
3096.97	15	50	3725.06	60	15	5764.29	50	..
3098.59	80	60	3734.13	150	50	5895.63	80	20
3099.61	10	50	3744.07	100	10	6181.41	40	50
3131.26	400	500	3751.82	50	5	6430.95	15	60
3133.89	200	200	3761.33	250	150	6460.28	400	80
3144.89	25	60	3761.92	200	120	6604.97	300	60
3151.03	200	200	3795.76	250	150	6657.73	70	10
3157.34	200	150	3817.40	60	15	6721.37	60	20
3168.19	25	60	3838.20	80	60	6779.77	300	50
3172.82	200	200	3848.02	400	250	6844.27	250	30
3173.58	50	100	3883.13	100	10	6845.76	200	20
3210.57	40	50	3883.43	150	30	7481.09	100	..
3212.01	50	40	3887.35	80	8	7490.22	100	..
3235.45	80	40	3900.79	80	50	7558.36	200	..
3236.80	100	80	3916.47	80	8	7731.57	150	..
3240.23	100	80	3929.58	70	50	7856.10	60	..
3241.53	150	125	3949.27	50	5	7927.52	50	..
3249.84	10	50	3958.10	200	40	7930.85	100	..
3258.04	125	60	3995.58	100	..	8017.90	200	..
3261.66	30	100						

TIN

2039.5	..	200	2199.34	30	60 r	2268.91	100 r	100 r
2113.90	25 r	5 r	II 2209.66	25 w	60 r	2286.68	60	40
I 2148.74	50 r	20	2231.72	30	60	2317.23	100 r	100 r
II 2152.22	..	(100)	II 2246.05	100 r	100 r	2334.81	100 r	100 r
2152.5	30	..	2251.15	25	50	2354.84	150 r	150 r
2194.49	30 r	60	2265.98	..	(40)	2408.15	30	30

Tin (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2419.49	. .	(40)	3032.77	50	20	6149.67	15	50
2421.69	150 r	200 r	I 3034.12	200 wn	150 wn	6154.60	12	25
2429.49	200 r	250 r	3141.81	20	30	II 6453.58	6	300 wnn
2445.01	. .	(50)	I 3175.02	500 n	400 nr	6462.36	4	300 wn
II 2449.79	. .	25	3218.68	18	50	6563.24	. .	50 W
II 2483.40	125	125	I 3262.33	400 n	300 n	II 6844.20	. .	(50 nl)
II 2486.99	. .	(30)	II 3283.21	. .	(50)	II 7191.40	. .	(40)
2495.72	100	100	II 3283.51	. .	100 n	II 7741.80	. .	(30)
2504.59	. .	(30)	3330.59	100 n	100 n	I 7754.96	100	. .
2523.91	60	60	II 3351.97	. .	(60)	8030.5	100 nl	. .
2531.11	40	15 W	3352.43	. .	100 n	8039.3	40 nl	. .
2546.55	100	100	3399.04	. .	25 Wn	I 8100.3	40 nl	. .
2558.05	30	6	3655.78	30	25 n	I 8114.10	200	. .
2571.59	100	125	3800.99	200 n	150 n	8121.0	30 nl	. .
2594.42	60	80	4511.30	200	. .	8349.35	30 n	. .
2661.25	100	80	I 4524.74	500 wn	50	I 8357.04	80	. .
2706.51	200 r	150 r	4585.64	. .	25 wn	8422.72	300 nl	. .
2779.82	80	100	II 5561.95	. .	(40)	I 8552.60	500	. .
2785.03	60	60	II 5588.92	2 n	(50)	8681.7	50 Wn	. .
2787.93	50	50	5631.68	50	200	I 9018.9	30 Wn	. .
2813.58	50	50	II 5799.18	2 n	(30)	9410.86	50 Wl	. .
I 2839.99	300 r	300 r	5925.48	8	25	I 9415.37	80 nl	. .
2850.62	80	100 wn	5970.30	10	30	9616.40	150 n	. .
I 2863.33	300 r	300 r	6037.70	12	50	9741.4	100 nd	. .
2913.54	100 wn	125 wn	6054.90	12	30	9805.38	300 Wl	. .
II 2919.82	.	(30)	6068.94	12	25	9850.52	500 l	. .
I 3009.15	300 n	200 n						

Titanium

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2154.70	3	60	II 2780.56	. .	60 wn	II 2926.75	.	50 wn
II 2450.44	10	100	II 2786.00	. .	60 wn	II 2931.26	. .	150 wn
II 2478.65	. .	50	II 2788.02	. .	70 nd	II 2936.17	. .	100 wn
II 2524.64	15	60	II 2800.61	. .	150 wn	II 2938.70	. .	100 wn
II 2525.60	35	125	I 2802.50	100	15	I, II 2941.99	100	150
II 2531.25	30	125	II 2805.01	. .	200 wn	II 2943.13	. .	60 wn
II 2534.62	25	80	II 2810.30	6	150	II 2945.47	. .	100 wn
II 2535.87	20	60	II 2817.87	10	200	I 2948.25	100	30
I 2555.99	15	80	II 2820.00	. .	70 wn	II 2954.76	. .	150 wn
II 2571.03	20	70	II 2821.42	. .	70 wn	I 2956.13	125	25
I 2599.91	70	10	II 2827.21	. .	80 wn	II 2958.99	. .	150 wn
I 2605.15	100	12	II 2828.15	2	200 n	2977.80	. .	50 wn
I 2611.28	80	15	II 2828.9	. .	150 wn	II 2979.20	. .	100 wn
I 2632.42	50	7	II 2832.16	25	100	II 2990.16	. .	80 wn
II 2635.63	. .	50 wn	II 2836.64	. .	100 wn	2995.75	10 n	70 wn
II 2638.70	. .	100 wn	II 2839.80	. .	100 wn	II 3017.19	15	200
I 2641.10	150	20	II 2841.94	40	125	II 3022.82	. .	150 wn
II 2642.15	. .	150 wn	II 2846.09	. .	70 wn	II 3023.86	. .	100 wn
I 2644.26	100	12	II 2851.10	20	80	II 3029.73	12	150
II 2646.11	. .	200 wn	II 2856.24	. .	100 wn	II 3043.85	3	50
I 2669.60	60	1	2857.81	.	70 wn	3045.08	2	50 wn
I 2679.93	100	12	2861.99	. .	100 wn	II 3046.68	10	60
2698.52	. .	200 n	2870.04	. .	100 wn	II 3056.74	12	70
II 2716.25	5	70	II 2877.44	30	100	II 3058.09	12	70
I 2733.26	60	15	II 2884.11	35	125	II 3071.24	12	70
I 2739.81	50	3	2888.63	. .	70 wn	II 3072.11	25	125
II 2746.71	. .	150 wn	2890.61	. .	50 wn	II 3072.97	35	200 r
II 2751.70	. .	200 wn	II 2891.07	20	50	II 3075.22	40	300 r
II 2752.88	. .	50 wn	2906.68	. .	100 wn	II 3078.64	60	500 r
I 2758.07	70	4	2913 33	. .	50 wn	II 3088.02	70	500 r
II 2764.82	15	70	2916.10	. .	50 wn	II 3089.40	12	100

TITANIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 3090.05	. .	100 wn	II 3321.70	15	125	I 3708.65	50	3
II 3097.19	20	150	II 3322.94	80	300 r	I 3709.96	80	25
II 3103.80	20	200	II 3326.76	15	125	I 3717.40	80	50
II 3105.08	12	100	II 3329.46	80	200 r	II 3721.64	60	125
II 3106.23	25	150	II 3332.11	40	125	I 3722.57	100	60
3110.67	10	100	II 3335.19	60	150	I 3724.57	100	50
II 3112.05	7	70	II 3337.85	12	60	I 3725.16	150	60
II 3117.67	15	200	II 3340.34	80	100	I 3729.81	500	150
II 3119.80	4	150	I, II 3341.87	100	300 r	I 3741.06	150 r	40
II 3122.06	2	50	II 3343.77	60	70	II 3741.64	30	200
I, II 3128.64	12	70 wn	II 3346.73	60	60	I 3752.85	200	80
II 3130.80	25	100	II 3349.03	125	800 r	I 3753.63	80	35
II 3143.76	18	125	II 3349.41	100	400 r	II 3757.69	30	100
II 3148.04	25	150	I 3354.63	100	20	II 3759.29	100	400 r
II 3152.25	30	125	II 3361.21	100	600 r	II 3761.32	100	300 r
II 3154.19	20	100	I 3361.26	80 r	50 r	I 3771.65	70	30
II 3155.67	25	125	I, II 3366.18	20	50	I 3775.72	3000	1000 r
II 3161.20	30	125	I 3370.44	80	15	II 3776.06	8	60
II 3161.77	35	150	I 3371.45	100	15	I 3789.29	50	15
II 3162.57	50	200 r	II 3372.80	80	400 r	I 3868.40	50	8
3164.91	1	50	II 3380.28	25	150 r	I 3895.25	70	10
II 3168.52	70	300 r	II 3383.76	70	300 r	II 3900.54	30	50 n
II 3174.80	. .	100	I 3385.95	80	25	I 3904.78	70	35
II 3181.84	. .	50 wn	3387.84	60	125	3913.46	40	70
I 3186.45	150	80	II 3394.57	70	200	I 3914.33	50	10
II 3190.87	40	200 r	II 3402.42	15	90	3924.53	70	35
I 3191.99	100	20	II 3407.20	12	50	I 3929.87	70	35
I 3199.91	200	150	II 3416.96	7	50	I 3947.77	70	35
II 3202.54	25	200	II 3444.31	60	150	I 3948.67	80 n	40
II 3214.75	20	80	II 3452.47	12	100	I 3956.34	100	50
II 3217.06	40	150	II 3456.39	25	125	I 3958.21	150	100
II 3218.27	15	150	II 3461.50	80	125	I 3962.85	80	35
II 3222.84	20	150 r	II 3465.56	6	60	I 3964.27	80	40
II 3224.24	15	150	II 3477.18	60	100	I 3981.76	100	70
II 3228.60	30	100	II 3483.80	. .	70 wn	I 3982.48	80	30
II 3229.19	30	60	II 3504.89	20	150	I 3989.76	150	100
II 3229.42	15	70	II 3510.84	40	125	I 3998.64	150	100
II 3232.28	30	100	II 3535.41	15	125	I 4003.81	50	70
II 3234.52	100	500 r	II 3596.05	50	125	I 4008.06	50	7
II 3236.57	70	300 r	I 3598.72	70	30	I 4008.93	80	35
II 3239.04	60	300 r	I 3610.16	100	70	I 4009.66	60	25
II 3239.66	25	80	II 3624.82	60	125	II 4012.39	35	50
II 3241.99	60	300 r	I 3635.46	200	100	I 4013.58	70 n	7 n
I, II 3248.60	25	200 r	II 3641.33	60	150	I 4015.38	70 n	10 n
II 3251.91	50	150	I 3642.67	300	125	I 4017.77	70 n	8
II 3252.91	60	200 r	I 3646.20	70	25	I 4021.83	100	20
II 3254.25	35	125	I 3652.95	150	50 l	I 4024.57	80	35
II 3263.69	10	70	I 3653.50	500	200	I 4026.54	70	10
II 3271.65	35	125	I 3654.59	100	40	II 4028.34	20	80
II 3272.08	25	100	I 3658.10	150	60	I 4030.51	80	18
II 3275.29	8	50	II 3659.76	50	150	I 4035.83	50	5
II 3276.77	12	70	I 3660.63	90	18	I 4055.02	80	30
II 3278.29	25	100	II 3662.24	40	100	I 4058.14	50	6
II 3278.92	40	150	I 3668.97	100	40	I 4060.26	60	25
II 3282.33	30	150	I 3671.67	150	70	I 4064.22	50	15
II 3287.65	40	200	II 3685.19	150	700 r	I 4065.10	80	35
I 3292.07	70	40	I 3689.91	100	40	I 4078.47	125	50
I 3299.41	50	35	I 3694.45	80	20	I 4082.46	60	25
I 3308.39	50	10	3700.08	60	5	I 4112.71	70	20
II 3308.81	35	100	I 3702.29	60	20	I 4127.54	70	15
I 3309.50	60	25	I 3704.29	70	25	I 4137.29	50	15
II 3315.32	12	100	II 3706.23	30	125	I 4159.64	60	15
II 3318.02	60	125	I 3707.53	100	10	II 4163.65	35	150

II. EMISSION SPECTRA 2000–10,000 A (Continued)

TITANIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 4171.90	15	70	I 4465.81	100	40	I 4928.34	100	4
I 4180.87	100	20 n	II 4468.49	80	150	I 4938.29	70	2
I 4186.12	100	40	I 4471.24	100	40	I 4975.35	80	4
I 4203.46	50	10	I 4474.85	80	30	I 4978.20	70	3
I 4249.12	60 n	3 n	I 4479.70	70	35	I 4981.73	300	125
I 4256.04	80	15	I 4481.26	100	60	I 4989.15	100	4
I 4258.53	70	7	II 4488.32	10	125	I 4991.07	200	100
I 4261.6	70	8	I 4489.09	100	40	I 4997.10	50	4
4263.13	125	35	I 4496.15	60	60	I 4999.51	200	80
I 4270.14	50	3	II 4501.27	60	100	I 5001.01	80	2
I 4274.58	100	40	I 4512.74	100	60	I 5007.21	200	40
I 4276.43	50	20	I 4518.03	100	60	I 5009.65	50	2
I 4278.23	50	15	I 4522.80	100	70	I 5013.30	80	7
I 4281.38	80	20	I 4527.31	100	50	I 5014.24	100	30
I 4282.71	70	25	I 4533.24	150	40	I 5016.17	100	15
I 4286.01	100	40	II 4533.97	30	150	I 5020.03	100	80
I 4287.40	100	50	I 4534.78	100	40	I 5022.87	100	18
I 4289.07	125	50	I 4535.57	80	50	I 5024.84	100	15
II 4290.23	35	60	I 4544.69	150	60	I 5025.58	100	8
I 4290 94	70	30	I 4548.77	125	25	I 5035.91	125	30
II 4294.12	60	80	II 4549.63	100	200	I 5036.47	125	25
I 4295.76	100	40	4552.46	150	50	I 5038.40	100	20
I 4298.66	125	50	I 4555.49	125	60	I 5039.95	125	25
I 4299.23	70	20	I 4559.92	50	5	I 5052.87	50	3
I 4299.64	60	10	II 4563.77	100	200	I 5064.65	150	35
II 4300.05	40	100	II 4571.98	150	300	I 5065.99	50	2
I 4300.56	125	20	II 4589.95	40	100	I 5087.07	70	1
I 4301.09	150	50	I 4617.27	200	100	I 5113.44	80	2
II 4301.93	25	50	I 4623.09	125	40	I 5120.42	100	4
I 4305.92	300	150	I 4629.34	70	7	I 5145.47	100	4
II 4307.90	100	100	I 4639.37	80	18	I 5147.48	90	3
II 4312.87	35	100	I 4639.95	60	15	I 5152.20	90	2
I 4314.80	100	20	I 4645.19	100	10	I 5173.75	125	20
I 4318.64	100	50	I 4650.02	60	4	II 5188.70	80	100
I 4321.66	70	25	I 4656.47	150	70	I 5192.97	150	25
I 4325.13	100	40	I 4667.59	150	8	I 5210.39	200	35
I 4326.35	60	25	I 4675.12	50	5	I 5219.71	60	2
II 4337.92	70	125	I 4681.92	200	100	I 5223.64	50	1
II 4344.29	12	50	I 4691.34	125	25	I 5224.32	70	8
I 4360.49	60	15	I 4698.76	100	20	I 5224.95	90	6
II 4386.85	8	80	I 4710.19	100	25	II 5226.55	30	50 n
I 4393.92	60	12	I 4722.62	80	8	I 5238.58	50	100
II 4395.03	50	150	I 4731.17	50	6	I 5255.83	40	80
II 4399.77	40	100	I 4742.79	100	40	I 5265.98	70	3
I 4404.27	50	30	I 4758.12	125	60	I 5283.45	50	2
II 4411.08	7	100	I 4759.28	100	8	I 5295.79	50	1
I 4416.54	70	10	II 4779.95	10	100 n	I 5297.26	70	2
I 4417.28	80	20	I 4792.49	70	12	I 5351.08	50	60
II 4417.72	40	80	I 4799.80	80	15	I 5397.09	60	. .
I 4421.76	60	15	II 4805.10	15	125	I 5409.61	50	1
I 4422.82	80	25	I 4805.43	70	4	I 5474.23	30	50
I 4426.05	80	25	I 4820.41	125	30	I 5477.71	70	2
I 4427.10	125	60	I 4840.87	125	25	5490.15	70	2
I 4434.00	100	50	I 4848.47	60	2	I 5503.90	60	3
I 4440.35	80	35	I 4856.01	100	10	I 5512.53	125	12
II 4443.80	80	125	I 4868.26	100	8	I 5514.35	70	10
I 4449.15	150	80	I 4870.14	100	18	I 5514.54	80	15
II 4450.49	12	50	I 4885.08	150	25	I 5565.49	80	2
I 4450.90	150	60	I 4899.91	150	20	I 5644.14	150	200
I 4453.32	150	70	II 4911.18	12	100	I 5648.58	80	60
I 4453.71	80	40	I 4913.62	125	15	I 5662.16	100	100
I 4455.33	150	80	I 4919.87	80	3	I 5675.44	90	125
I 4457.43	150	100	I 4921.77	100	5	I 5679.94	50	. .

TITANIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 5689.47	80	80	I 6261.10	300	100	8377.85	200	..
I 5702.67	60	40	I 6303.75	200	..	I 8382.54	300	..
I 5711.88	50	40	I 6312.24	80	..	I 8382.82	200	..
I 5715.13	70	60	I 6318.03	50	..	I 8396.87	200	..
I 5739.51	70	80	I 6336.10	80	..	I 8412.36	300	..
I 5762.27	70 n	50	I 6366.35	80	..	I 8426.52	200	..
I 5766.35	70 W	50	I 6546.28	80	..	I 8434.94	200	..
I 5774.05	70 W	50	I 6554.23	125	150	I 8435.70	150	..
I 5785.98	100 W	60	I 6556.07	150	..	I 8438.93	100	..
I 5804.26	100 n	50	I 6565.62	50	..	I 8450.89	70	..
I 5823.71	35	50	I 6599.11	100	..	I 8467.15	300	..
I 5866.46	300	400	6743.12	100	..	I 8468.50	300	..
I 5880.31	60	125	I 6861.47	50	..	I 8496.04	60	..
I 5899.32	150	150	I 7038.80	100	..	I 8518.05	60	..
I 5918.55	80	..	I 7209.44	150	..	I 8518.32	100	..
I 5922.12	100	100	I 7216.20	50	..	I 8539.38	60	..
5932.13	80	..	I 7244.86	150	..	I 8548.12	100	..
I 5937.82	60	..	I 7251.72	125	..	I 8569.77	50	..
I 5941.76	100	..	I 7299.71	50	..	I 8598.18	60	..
I 5953.17	150	250	I 7318.39	80	..	I 8675.39	150	..
I 5965.84	150	200	I 7344.72	200	..	I 8682.99	125	..
I 5978.56	125	150	7357.74	200	..	I 8692.33	100	..
I 5999.68	70	..	7364.11	150	..	I 8734.69	70	..
I 6064.63	80	20	I 7440.60	100	..	I 8766.64	70	..
I 6085.23	100	60	I 7489.61	150	..	I 9546.03	50	..
I 6091.17	125	25	I 7949.17	50	..	I 9599.51	50	..
I 6098.67	60	..	I 7978.88	100	..	I 9638.24	200	..
I 6126.21	150	60	I 8024.84	50	..	I 9647.40	80	..
I 6146.22	400	..	I 8068.24	50	..	I 9675.55	200	..
I 6215.28	100	50	I 8306.31	50	..	I 9705.59	100	..
I 6220.49	100	30	I 8307.41	60	..	I 9728.34	60	..
I 6221.41	80	..	I 8334.37	70	..	I 9743.55	50	..
I 6258.10	200	100	I 8353.15	50	..	I 9787.65	50	..
I 6258.70	300	250	I 8364.24	150	..			

TUNGSTEN

2008.07	12	25	2110.34	10	25	2239.78	..	18
2015.78	6	20	II 2116.94	8	15	2241.08	10	15
2016.40	4	20	II 2118.87	10	20	II 2245.21	10	20
2022.05	4	15	2135.04	..	20	II 2248.26	12	15
II 2026.08	7	25	II 2138.15	10	25	II 2248.75	20	25
II 2029.98	10	30	2152.14	3	20	2260.07	15	3
II 2035.89	8	20	2156.42	5	25	2263.53	7	25
2037.58	3	18	2160.91	..	30	II 2270.24	12	20
II 2054.68	9	20	2163.89	12	25	2277.58	20	10
II 2065.57	10	20	II 2166.32	10	30	II 2294.54	20	20
II 2071.21	10	25	2169.48	15	5	II 2303.83	10	15
2075.59	10	20	II 2173.54	10	15	2331.30	15	..
2078.35	6	25	2186.73	8	15	II 2337.74	8	20
2079.11	12	30	2194.52	10	15	2358.81	10	20
2088.19	12	30	II 2204.48	12	30	2360.43	15	5
2089.14	10	20	II 2206.59	10	15	2363.06	15	5
2092.08	..	25	2214.80	10	20	2364.22	5	15
2093.80	8	15	2215.34	6	15 w	2368.97	..	15
II 2094.75	10	18	II 2216.01	10	15	2370.04	5	25
2098.25	10	20	II 2219.72	15	4	II 2370.60	2	18
2098.60	10	20	II 2220.94	8	18	2382.99	15	3
2100.67	10	25	II 2225.89	10	18	II 2390.37	10	20
2105.76	6	20	I 2229.63	10	20	II 2392.93	8	15
2106.18	10	20	II 2237.06	10	15	II 2397.09	18	30

II. EMISSION SPECTRA 2000–10,000 A (Continued)

TUNGSTEN (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2401.86	2 n	15	II 2489.23	10	20	2622.21	15	10 d
2402.44	15	20	II 2492.93	6	25	II 2623.11	2	20
2404.24	10	15	2495.26	20	5	2623.89	..	15 d
2405.26	10	15	II 2496.64	10	20	2624.47	1	15 s
2405.69	15	8	II 2497.48	10	15	2625.21	15	7
2407.78	1	15	2499.22	2	15	2633.13	15	12
2408.28	3	15	II 2499.69	10	15	II 2633.88	1	15
2409.23	..	15	2506.03	10	15	2634.58	1	20
2409.49	..	15	II 2509.96	1	15	II 2635.38	3	18
2410.44	..	20	II 2510.47	3	15	II 2637.57	6	15
II 2411.81	2	15	2513.45	..	15	II 2643.12	12	15
2414.81	..	25	2518.14	6	15	2643.29	2	20
2415.68	15	9	2519.88	15	2	2646.19	15	10 d
2417.60	..	15	2520.45	15	10	2647.74	10	20
2418.25	..	15	2521.32	15	2	II 2653.57	10	15
2419.34	2	20	II 2522.04	10	20	2656.54	15	5
2420.49	2	15	2528.91	3	15	II 2658.04	10	20
2423.28	..	15	2530.99	9	15	2662.83	15	10
2423.94	..	15	2534.15	2	15	II 2664.32	10	20
2424.22	20	7	II 2534.82	2	15	2666.08	..	15
2426.51	1	20	2537.14	1	15	II 2666.49	8	20
II 2435.01	3	30	2539.31	6	15	2667.67	..	15
2435.96	30	10	II 2539.90	2	20	II 2669.30	15	30 d
II 2440.43	2	15	2542.60	1	15	II 2670.39	3	15
2443.61	15	8	2545.34	15	9	2671.47	15	5
2444.06	18	9	2547.14	20	10	2673.59	7	20
2444.94	..	15	2553.16	12	15	II 2677.79	8	20
II 2446.39	10	30	2554.67	4	15	2678.88	20	10
2448.22	..	15	II 2554.86	15	10	2681.41	20	18
2448.39	15	5	II 2555.09	10	15	2685.05	2	15
II 2449.69	2 n	15	2559.49	3	15	2686.99	4 d	20
II 2451.48	15	20	2560.12	15	8	2687.37	15	3
2451.99	12	15	2563.16	8	30	II 2688.22	8 s	20
2454.71	15	10	2563.91	7	15	2690.71	..	15
2454.97	15	10	II 2567.61	7	15	2691.09	15	8
2456.53	15	5	2568.85	2	15	II 2694.38	9	18
2458.57	1	15	II 2569.25	15	25	2694.59	..	18
2459.29	18	10	II 2571.44	15	30	2695.67	20	12
II 2459.88	..	15	2573.53	15	..	2696.89	..	18
2462.79	15	10	2576.16	2	20	2697.51	15	3
2463.95	2	15	II 2576.36	2	15	II 2697.71	15	25
2464.31	15	2	2576.86	..	15	2699.59	15	10
II 2464.63	3	20	2577.02	15	4	2700.01	15	10
2465.20	12	20	2579.26	2	20	2700.31	..	15
2465.64	..	20 d	II 2579.54	8	25	II 2701.48	2	18
II 2466.52	12	20	II 2581.20	7	20	2702.11	8	25
2466.85	15	7	2584.38	15	10	II 2703 06	3 d	15
2468.41	...	20 r	II 2585.96	8	20	2703.46	2	20
II 2470.80	5 d	20	2586.94	75	30	II 2706.70	6	20
2471.74	1	15	II 2589.17	15 d	25	2707.02	6	15
2472.51	15	5	2594.54	4	15 l	2708.58	10	15
2474.15	20	10	2595.57	2	20	II 2709.57	6	15
2475.59	1	20	II 2596.86	1	15 s	II 2710.78	6 d	15
II 2477.80	15	30	II 2598.74	12	20	2712.69	1	20
2480.13	25	10	II 2601.43	2	15	II 2715.34	8	20
2480.95	20	3	2601.96	15	6	2715.49	20	8
2481.44	25	3	2602.51	10	25	II 2716.31	8	20
II 2484.00	2	15	II 2603.02	5	15	2717.17	4	15
2484.40	2	15	2612.19	10	15	II 2718.04	10	20
2484.73	20	6	2613.82	15	9	2718.90	25	20
2486.30	15	2 n	II 2615.44	6	20	2719.33	15	20 Ws
2487.49	15	5	2618.08	..	15	II 2720.40	4 d	18
2488.77	10	20	2620.23	12	15	2721.66	9 s	15

TUNGSTEN (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
II 2722.81	8	25	2934.99	15	12	II 3358.60	10	40
2724.08	2	15	2936.67	10	20	II 3361.11	10	15
2724.35	20	10	II 2940.20	4	18	3366.72	. .	15
II 2729.62	10	25 d	2944.39	30	20	II 3376.14	9	40
2729.94	1	15	2946.98	20	18	II 3379.02	4	15
2733.18	15	9	2950.44	. .	20	3383.12	. .	18
2734.77	10	20	II 2952.29	12 s	30	II 3401.89	7	40
2736.57	. .	15	II 2987.29	8	15	3410.17	. .	15
2737.37	. .	20	II 3000.62	4	20	3416.62	7	20
2740.79	5	25	II 3002.28	1	15	3421.13	3 d	20
2742.47	5	25	II 3010.76	8 d	20	3424.45	2	15
2742.90	3	25	II 3021.99	15	20	II 3440.63	5	20
II 2745.03	2	25	II 3024.50	9	20 l	II 3449.87	6	25
2746.73	12	20	3024.92	15	12	3455.02	. .	20
2752.24	2	20 l	3033.57	12	15	3460.42	. .	15
II 2753 05	15	10 d	II 3036.66	8	20	3463.25	10	15
2760.74	8	20	II 3039.57	2	20	II 3463.51	8	25
II 2761.59	10	25	II 3051.29	10	30 l	3475.29	. .	25
2762.34	20	10	II 3063.41	. .	20	II 3486.13	5	20
II 2764.27	20	60	II 3063.97	2	20	II 3490.92	7	15
2766.32	. .	20	II 3069.28	6	15	3495.25	12	20 l
II 2768.33	10	20 l	II 3071.72	8	15	II 3529.56	10	20
2768.98	18	10	3077.52	2	40 wn	3536.27	3	15
2769.74	15	10	3095.87	2	20	II 3549.05	5	25
2770.88	25	12	II 3100.74	2	20	II 3555.17	6	15
2772.48	10	60	II 3103.52	2	15	3570.65	15	15
2774.48	15	20 l	3111.12	9	15	II 3572.48	10	35
II 2776.50	12 d	25	II 3144.50	. .	15	II 3592.42	9	35
2778.69	3	20	II 3149.85	10	15	3596.18	. .	15
II 2780.28	10	20	3151.29	5	20	3611.85	. .	20
II 2782.13	4	30	3152.47	10	15	II 3613.79	10	30
II 2785.63	3	20	3155.09	10	20	3617.52	35	20
II 2786.31	2 d	15	II 3160.02	9	30	3628.38	3	20 d
II 2790.42	2	15	3163.42	12	15 l	3628.93	. .	15
II 2799.03	8	20	3169.93	10	15	3631.95	15	10
II 2801.05	6	15	3170.20	15	9	II 3641.41	12	40
II 2805.92	9	30	II 3175.94	8	20 l	II 3645.60	4	20
2808.51	. .	20 l	II 3177.21	8 d	25	II 3646.52	10 l	35
2808.94	1	15	II 3178.02	8 d	20	II 3657.59	10	25
2812.25	3 d	20	3179.97	6 d	20	II 3657.88	5	15
2818.06	15	20	3187.13	. .	20	3672.59	1	18
2819.05	2	15	II 3189.24	10	20	3682.09	25	20
II 2822.57	12	30	3197.56	. .	20	3691.88	4 d	20 d
2829.82	15 l	10	3198.33	1	15	3694.51	10	20 l
2830.10	4	20 l	3201.58	7	20	3707.93	20	20
2831.38	25	10	II 3203.34	4	20	3708.51	3	35
2833.63	15	12	II 3206.41	6 d	15	3712.21	. .	18
II 2834.21	. .	30	3209.96	2	25	II 3716.08	9	18
2847.13	2	15	3215.26	. .	15	3722.25	12	15
2848.03	15	12	II 3243.34	5	20	3741.71	12	20
2852.10	1 d	18 n	II 3251.22	10	18	3742.68	15 d	12 d
2853.49	12	15 n	3262.28	. .	18	3745.56	. .	25
2859.48	3	15	3300.82	15 l	12	3756.87	6	15
2866.06	15	10	3304.47	10 w	20	3757.92	15	20
II 2868.73	6	25	3308.34	3 d	25	3758.94	. .	15
II 2886.89	3	20	3311.38	15 l	12	3760.13	15	10
2889.77	2	20	II 3317.40	1	15	3768.45	20	18
2896.45	15	25	3326.19	15	12	3773.70	20	18
2903.50	. .	15	3331.67	15 l	12	3774.14	. .	18
II 2904.07	3	18	II 3338.62	5	15	3780.77	20	18
2918.63	8	20	II 3342.46	10	30	3792.77	15	15
II 2924.98	2	15	II 3345.86	10	15 l	3803.68	. .	15 w
2925.80	. .	15 l	3348.29	2	15 l	3809.23	25	20

II. EMISSION SPECTRA 2000–10,000 A (Continued)

TUNGSTEN (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3810.38	15	15	4316.81	15	7	4646.15	15	3
3817.48	18	15	4332.13	15	7	4657.44	50	12
3824.39	12	15	4335.57	2	15	4659.87	200	70
3835.05	15	20	4347.00	20	7	4661.97	15	2
3838.50	15	20	II 4348.12	50	40	4668.46	20	3
3846.21	20	20	4355.16	15	9	4676.63	20	2
3847.49	18	15	4361.81	20	9	4677.69	25	3
3859.98	15	30	4364.79	25	12	4679.04	15	2
3867.97	30	35	4372.53	25	10	4680.52	150	40
3881.39	20	20	4378.49	25	12	4683.54	20	10
3896.93	2	15	4384.86	25	15	4693.73	50	12
3897.91	12	15	4389.84	15	6	4698.63	15	1
3900.91	..	15	4394.08	20	9	4700.41	50	4
II 3935.44	7 d	20	4403.95	20	9	4702.47	15	5
3936.98	12	15	4408.28	25	12	4706.17	15	1
3980.64	12	15	4412.20	20	10	4711.19	15	3
3983.29	12	25	4415.07	15	6	4712.49	18	5
4001.89	..	15	4420.47	30	10	4720.40	15	3
I 4008.75	45	45	4425.91	15	6	4725.13	40	3
4015.22	25	30	4436.90	30	12	4729.65	30	15
4019.23	18	15	4438.29	15	7	4745.57	25	1 wn
4044.29	15	12	4441.81	20	10	4757.55	60	10
4045.60	12	15	4445.15	20	6	4757.78	15	1
4064.79	15	12	4449.01	20	6	4758.21	15	1
4070.61	15	12	4455.46	15	5	4773.91	30	2
4074.36	50	45	4456.11	15	5	4787.94	15	1
4081.30	2	25	4458.09	15	5	4788.43	15	1
4082.97	12	15	4460.50	25	7	4797.54	15	2
4095.70	12	15 w	4463.50	15	7	4799.92	50	10
4102.70	35	30	4466.35	20	10	4807.37	15	1
4109.76	20	20	4466.73	20	10	4835.02	15	..
4142.26	15	9	4481.28	15	6	4843.83	50	12
4145.16	15	8	4484.19	35	20	4854.09	30	..
4154.67	15	10	4493.97	15	7	4858.61	15	..
4157.04	3	25	4494.51	20	12	4878.28	30	..
4168.66	10	15	4495.31	20	6	4886.91	50	10
4170.53	15	7	4504.86	30	10	4888.39	20	..
4171.18	25	12	4512.91	30	10	4890.29	15	..
II 4175.59	7	25	4513.30	30	10	4892.44	25	..
4203.82	15	6	4529.76	15	4	4902.32	15	..
4204.41	20	10	4530.37	15	4	4910.74	30	..
4207.05	25	12	4534.71	15	5	4916.18	20	..
4219.38	25	15	4535.05	15	5	4931.56	30	..
4222.05	15	8	4536.66	15	6	4948.59	15	..
4226.91	15	3	4542.89	15	3	4953.09	25	..
4234.35	25	7	4543.51	25	10	4972.57	15	..
4241.45	30	10	4546.49	30	10	4977.24	15	..
4244.37	40	20	4551.85	35	10	4979.85	25	..
4258.53	15	5	4556.87	15	5	4982.60	40	5
4259.36	30	20	4563.59	15	5	4983.54	20	..
4263.31	25	15	4570.65	30	10	4984.17	15	..
4266.54	15	8	4586.85	30	5	4984.72	15	..
4269.39	40	30	4588.75	40	15	4986.94	40	1 n
4269.78	15	10	4592.42	20	10	4989.09	15	..
4274.55	20	12	4592.57	15	5	4994.10	30	..
4275.49	15	10	4599.96	50	10	5002.79	15	10
4276.75	15	10	4600.44	20	4	5006.16	40	7
4286.01	15	8	4609.91	50	10	5007.23	15	2
4294.10	20	10	4613.32	50	10	5013.46	15	..
I 4294.61	50	50	4620.55	20	7	5015.32	40	5
I 4302.11	60	60	4634.81	20	7	5039.03	15	1 n
4303.33	..	15	4641.80	20	6 w	5040.36	35	1 n
4306.87	20	15	4642.56	30	8	5053.30	60	10

TUNGSTEN (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
5054.61	25	3	5435.06	20	..	5851.56	25	..
5055.53	20	..	5456.59	18	..	5856.62	15	..
5069.15	50	3	5475.11	15	..	5864.63	20	..
5071.73	40	3	5477.80	25	20	5880.22	15	..
5105.48	15	..	5486.01	20	..	5902.66	20	..
5110.36	20	..	5487.78	15	..	5947.58	15	..
5130.11	15	..	5492.32	50	50	5965.86	25	..
5138.40	20	..	5500.51	15	15	5972.52	25	..
5145.77	18	..	5503.45	45	1	6012.81	30	3
5183.97	20	..	5514.70	50 w	8	6021.54	25	..
5192.72	30	..	5531.52	18	..	6081.48	25	1
5203.26	30	..	5533.26	25	..	6128.27	15	2
5204.51	40	..	5568.07	15	..	6153.73	15	1
5206.19	30	..	5631.26	15	..	6154.86	15	1
5212.79	20	5	5631.97	15	..	6203.51	15	1
5224.67	50	8	5642.04	15	..	6285.90	30	2
5242.99	25	1 n	5648.38	50 w	50 w	6292.03	30	2
5254.54	18	..	5674.42	30	..	6404.20	25	2
5255.42	20	..	5675.38	15	..	6708.18	20	..
5259.35	20	..	5697.82	35	..	8017.18	25	..
5263.21	15	..	5723.06	15	..	8055.60	20	..
5275.55	20	..	5735.09	50 W	25	8123.79	20	..
5318.87	20	..	5749.22	15	..	8338.01	15	..
5337.37	15	..	5793.07	20	..	8358.67	15	..
5348.95	30	..	5796.51	20	..	8585.06	50	..
5350.44	18	..	5804.87	25 w	12	8594.37	20	..
5351.90	20	..	5838.99	25	..	8613.26	15	..
5368.70	15	..	5845.26	18	..	8865.50	15	..
5388.20	15							

URANIUM

2158.61	..	20	2538.43	15	6	2698.06	20	50
2194.79	2	15	2556.19	15	12	2706.95	15 d	20 d
2219.28	15	2	2562.94	15	6	2713.49	..	15 wn
2237.44	..	15	2565.41	30	30	2730.07	2	15 n
2248.03	..	25	2572.65	..	15 n	2730.31	18	8
2273.36	..	15	2577.32	18	6	2731.27	15	8
2276.05	..	20	2587.07	6	15 n	2733.97	10	15
2282.78	..	25	2591.25	18	12	2741.75	18	6
2283.72	..	15	2593.57	18	6	2743.40	..	20 n
2306.91	..	25	2597.69	25	15	2746.16	25	6
2318.47	..	25	2608.20	25	6	2748.45	18	15
2324.80	2	20	2609.26	15	2	2751.93	2 d	20 n
2326.45	..	20	2628.93	15	10	2754.15	20	35
2349.60	..	15	2632.98	15	8	2762.85	15	20
2351.87	..	20	2633.03	5	15	2793.94	25	30
2377.87	2	15	2635.53	25	50	2795.23	18	12
2378.16	..	35	2641.93	18	8 n	2802.56	15	30
2397.32	..	20	2645.47	20	25	2807.05	18	30
2401.28	..	15	2649.07	15	15	2809.95	20	20
2403.42	..	30	2651.84	3	15 n	2811.34	35	30
2412.69	4	15	2654.58	15	6 n	2817.96	18	30
2423.70	15	4	2660.14	15	10	2819.83	6	25
2484.01	15	4	2664.15	18	20	2821.12	20	35
2484.22	10	15	2675.12	15	10	2824.28	25	30
2489.78	12	15	2675.88	15	10	2826.19	18	12 n
2500.86	18	12	2683.28	25	25	2828.90	18	20
2513.33	1	20	2684.04	15 r	10	2832.06	35	50
2518.97	15	6	2691.04	15	30	2833.82	15	25
2521.80	5	15	2695.49	12	30	2839.89	18	20

URANIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2842.09	15	12	3057.91	20 d	20 d	3516.85	6	15
2844.99	18	8	3062.54	12	15	3523.56	4	15
2847.34	15	4	3072.78	20	20	3528.69	6	15
2849.48	18	15	3073.81	15 r	10 r	3531.11	8	20
2852.75	15	15 n	3084.24	15	12	3531.64	15	1
2853.57	15	10	3088.99	20	15	3533.57	10	20
2858.90	35	25	3091.25	15 rd	12 rd	3540.46	6	15
2860.47	35	30	3093.01	20	20	3546.38	1	15
2860.80	15	12	3104.16	20	20	3550.82	12	20
2861.13	10	15	3111.62	15	15	3553.44	15	..
2862.41	15	10	3115.93	8	15	3555.32	15	6
2864.28	18 n	12 n	3126.17	12	20	3561.80	12	30
2865.68	30	50	3129.73	8	15	3565.75	1	15 n
2870.97	18	20	3130.56	..	15	3566.60	30	10
2874.08	15	10	3139.56	25	25	3569.06	12	20
2875.20	18	12	3141.54	5	15	3577.08	15	3
2880.49	12	15	3147.09	12	15	3581.84	6	15
2882.74	18	20	3149.21	18 d	18 d	3582.02	6	15
2886.45	15	6 n	3153.12	12	15	3584.88	30	12
2887.25	25	25	3156.07	6	15	3590.32	5	15
2889.63	30	50	3157.86	10	15	3591.56	4	15
2894.14	12	15	3159.82	8	15	3594.95	8	15
2894.51	15	15	3165.28	6	18	3599.84	6	18
2906.80	15	30	3176.21	20	15	3608.96	18	10
2906.91	18 r	15 n	3177.33	15	18	3609.68	15	12
2908.27	12	30	3200.13	15	15	3620.08	15	2 n
2909.25	6	15	3229.50	18	25	3622.70	15	1
2914.25	18	25	3261.72	15	10	3623.05	12	15
2914.63	12	15	3263.11	25	8	3625.98	5	15 wd
2921.68	10	15	3265.81	25	18	3630.73	8	20
2925.57	15	25	3270.12	20	25	3633.29	8 d	15 d
2928.60	15	35	3288.21	25	20	3639.49	25	..
2930.80	4	30 n	3293.59	30	5	3640.76	8	20
2932.61	10	25	3297.89	6	18	3640.95	8	20
2936.45	12	20	3300.68	15 n	8 n	3644.24	18	2
2941.92	15	30	3312.70	15 r	..	3645.03	8	15
2943.89	10	25	3322.12	18	12	3654.89	25	..
2954.39	12	15	3341.66	12	15	3657.32	6	15
2954.77	10	15	3361.73	15	8	3659.16	15	1
2956.06	10	60	3371.29	8	15	3662.66	15 r	2
2960.94	15	25	3378.20	15	1	3667.97	15	8
2964.25	6	15	3386.13	6	15	3670.07	15	18
2966.12	15	25	3390.39	18	10	3672.58	8	15
2967.89	15	20	3398.99	15	..	3676.56	3	15
3009.42	15 d	2 d	3422.35	18 r	15 r	3678.75	6	15
3016.96	15	12	3423.05	12 d	15 d	3680.88	20	1
3019.29	8	15	3424.56	20	15	3682.04	6	15
3021.22	10	15	3429.03	18 r	2 n	3685.77	15	1
3024.38	25 r	20 r	3435.53	15 d	..	3693.70	4	18
3024.51	18	15	3436.78	12	15	3700.57	12	18
3025.03	12 n	20 n	3442.96	15	..	3701.52	10	25
3027.69	15	8	3486.30	5	15	3716.13	18	..
3029.13	20	15	3488.81	8	15	3725.65	3	15
3031.99	15	15	3489.37	20	1	3729.82	8	15
3035.96	15	8	3490.24	12	20	3738.05	8	20
3037.91	..	20	3493.33	6	15	3748.68	15	25
3039.26	15	12	3494.84	6	15	3752.66	6	15
3043.79	15	8	3496.41	8	15	3760.88	10	15
3046.84	6	15	3499.33	6	15	3763.27	12	25
3047.57	15	20	3500.08	15	2	3765.34	18	1
3048.63	15	8	3505.07	8	15	3768.80	15	12
3051.14	15 r	10 r	3509.67	10	15	3769.53	4	18
3053.30	..	15	3514.61	18	5	3772.81	6	20

II. EMISSION SPECTRA 2000–10,000 A (Continued)

URANIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
3773.42	20	40	3914.27	10	18	4125.13	15	1
3779.05	8	15	3915.22	15	1	4128.34	18	20
3780.72	15	20	3915.88	20	30	4133.49	15	..
3782.84	25	40	3923.05	15	6	4136.81	15	8
3783.84	20	25	3924.27	15	15	4141.23	20	30
3785.35	..	15 n	3926.22	30	6	4146.61	15	..
3793.10	12	18	3928.83	15	..	4153.98	15	5
3793.28	20	12	3930.98	12	35	4155.41	12	18
3796.54	10	15	3931.49	25	6	4162.43	18	3 n
3796.84	12	15	3932.03	35	50	4169.05	20	2 n
3798.84	15	1	3935.38	15	18	4171.59	30	30
3801.15	20	...	3940.49	10	15	4172.97	10	15
3801.95	15	..	3942.83	20	8	4179.00	15	12
3808.94	20	..	3943.82	35	5	4204.37	15	10
3809.22	15	12	3944.13	8	15	4209.49	15	1
3809.92	15	2 n	3946.68	15	10	4210.45	10	15
3811.48	15	..	3952.95	15	...	4211.62	18	..
3811.62	15	...	3953.58	6	15	4213.88	20	4
3811.99	18	6	3954.66	20	30	4222.37	18	8
3812.58	15	4 n	3955.38	8	15	4228.76	18	12
3813.79	20	15	3957.81	10	15	4231.68	25	..
3814.07	25	15	3962.79	15	8	4232 04	15	15
3821.96	15	...	3966.57	20	30	4234.53	18	15
3825.03	15	..	3973.94	15	4	4241.67	40	50
3829.80	15	...	3978.80	8	18	4244.37	25	25
3831.46	25	25	3983.91	5	15	4246.26	30	2
3831.86	15	3 n	3985.79	25	30	4252.43	15	20
3833.02	20 r	15	3988.88	12	15	4266.33	15	..
3836.52	6	15	3990.42	18	20	4267.93	15	4
3837.27	15	..	3994.98	8	20 wn	4269.61	20	30
3839.63	30	2	3998.24	5	18	4273.97	12	15
3851.73	15	2	4002.34	10	18	4280.66	18	3
3854.23	20	..	4004.06	15	20	4282.03	30	30
3854.65	20	30	4005.70	25	3	4287.87	15	18
3859.58	20	30	4009.17	8	15	4288.84	20	2
3860.63	1	15 n	4017.72	25	25	4290.88	15	15
3863.40	5	20	4018.99	25	15	4293.30	18	5
3865.92	20	25	4026.02	25	25	4295.10	15	1
3871.04	30	1	4039.78	15	2	4297.11	18	18
3871.38	3 n	20 n	4042.75	40	10	4301.47	15	15
3874.04	15	15	4044.42	18	25	4304.14	15 r	1
3876.13	15	2	4047.61	18	3	4306.78	40 r	4
3879.55	18	..	4050.04	25	35	4313.15	20	1 n
3879.71	20	3	4051.91	20	25	4313.88	15	10
3881.46	30	20	4054.31	12	15	4316.49	15	1 r
3882.36	18	18	4062.55	12	18	4328.74	20	1
3883.33	10	18	4063.12	15	1	4341.69	50	50
3884.68	8 n	20	4067.76	12	20	4347.19	18	18
3887.45	20	..	4071.11	15	25	4355.74	10	20
3887.70	20	10	4077.79	15	6	4362.05	30	3
3890.36	35	30	4080.61	12	20	4362.26	15	18
3891.82	18	1	4088.25	25	18	4371.76	18	1
3892.68	20	30	4090.13	25	40	4372.57	15	18
3894.12	30	4	4095.75	18	25	4372.76	18	5
3895.27	12	20	4096.35	20	5	4382.34	18	5
3896.78	20	25	4099.27	20 r	1	4387.31	15	4
3897.06	8	18	4101.90	18	1	4393.59	40	6
3897.26	15	5	4103.12	18	1 n	4399.63	15	6
3901.55	15	...	4106.93	25	10	4413.14	15	4
3902.56	18	18	4116.10	25	35	4418.47	15	..
3904.30	8	15	4122.35	15	4	4426.68	18	15
3904.85	8	15	4123.96	20 r	1	4426.94	20	1
3911.67	18	18	4124.72	30	25	4427.65	12	15

URANIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
4433.89	15	12	4646.60	25	40	5620.79	30	1
4440.74	20	20	4663.75	18	3	5669.45	18	..
4462.33	15	18	4666.86	25	40	5723.63	15	1
4462.97	18	30	4669.31	8	15	5780.61	40	..
4465.13	20	25	4671.41	20	30	5798.55	35	1
4472.33	50	80	4685.72	10	18	5802.13	20	..
4477.71	20	25	4689.07	30	40	5836.05	30	..
4490.83	18	25	4702.05	8	18	5837.71	30	1
4510.32	20	30	4702.52	10	20	5845.27	20	..
4515.28	25	40	4722.73	40	50	5870.95	15	..
4516.72	15	1	4731.60	40	50	5915.40	125	..
4521.59	4	15	4755.73	8	15	5971.52	50	..
4538.19	25	40	4769.26	6	15	5976.34	50	..
4543.63	50	80	4772.70	6	18	5986.12	25	..
4545.58	20	25	4858.08	15	15	5997.33	25	..
4549.85	12	20	4885.13	18	..	6077.30	40	..
4551.98	15	1	4899.29	25	25	6171.87	30	..
4555.09	20	40	4910.34	15	1	6293.35	15	..
4557.80	3	15	4928.44	20	1	6359.30	30	..
4559.65	15	..	5008.22	30	25	6372.47	50	..
4567.69	20	40	5027.40	40	4	6379.64	15	..
4568.23	4 n	18	5160.33	18	20	6389.80	18	..
4569.91	25	40	5164.16	15	1	6392.78	20	..
4570.99	6	25	5184.59	12	15	6395.45	100	..
4573.69	30	40	5257.04	15	18	6449.17	100	..
4579.64	12	15	5278.18	12	15	6465.00	25	..
4581.72	8	18	5280.39	30	4	6503.59	15	..
4584.85	10	15	5308.54	25	3	6518.94	15	..
4601.13	18	25	5311.88	18	18	6555.01	15	..
4603.66	25	40	5475.72	20	18	6620.52	15	..
4605.15	12	25	5480.27	15	25	6826.93	25	..
4609.86	15	20	5481.22	30	25	7074.81	25	..
4611.44	12	25	5482.55	12	18	7128.91	20	..
4618.39	5	20	5492.97	60	50	7379.70	15	..
4620.22	25	12	5511.50	30	2	7425.50	18	..
4622.43	12	18	5527.85	25	40	7533.91	20	.
4627.08	30	60	5564.19	40	3	7784.13	20	.
4631.62	30	3	5570.68	15	15	7881.94	15	.
4641.66	10	15	5610.90	30	1			

VANADIUM

II 2004.78	..	50	2222.70	..	100	2325.12	..	100
II 2014.19	2	50	2228.30	..	100	2328.93	..	100
2133.05	..	50	I 2229.74	12	80	2330.46	8	300
II 2134.12	30	125	2232.91	..	500	2331.29	..	50
II 2137.31	10	80	2240.62	..	100	2331.77	..	300
II 2138.16	8	50	2241.53	..	200	2333.60	..	50
II 2140.09	10	80	2285.45	..	100	2334.21	..	250
II 2141.98	10	80	2288.63	..	80	2335.49	3	50
II 2143.05	10	50	2290.54	..	50 wn	2336.10	2	50
II 2147.46	2	100	2292.85	..	250	2337.13	..	100
II 2151.82	..	50	2294.99	5	100	2337.32	..	80
2185.38	4	50	2297.85	..	100	I 2340.49	50	3
2201.67	..	50	2309.84	..	125	2342.14	4	125
2202.50	..	60	2311.35	..	150	2343.11	..	250
2209.22	..	50	2314.19	..	100	2346.34	..	125
2214.02	..	100	2318.07	..	250	2347.15	..	150
2216.03	2	100	2318.99	..	150	2349.81	3 w	150
2217.41	..	150	2323.83	..	300	2351.26	2	50
2218.43	..	125	I 2324.75	50	..	2351.54	..	50

II. EMISSION SPECTRA 2000–10,000 A (Continued)

VANADIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2352.18	5	200	2648.47	2	60	2830.40	10	60
2357.80	2 n	60	2649.36	2	100 n	2836.52	20	80
2358.74	..	300	I 2651.90	50	4	2845.24	18	80
2367.65	..	80	2655.68	10	100 n	2846.57	50	20 n
2371.07	..	500	I 2661.42	100	80	2847.57	15	150
2372.17	..	100	2663.25	12	100	2849.05	7	50
2373.06	..	200	2670.23	2	70	I 2852.87	60	7 n
2380.92	6	50	2672.00	50	300 r	2854.34	20	100 r
2382.47	..	100 w	2673.23	10	60	I 2855.22	50	1
2383.00	8	80	2677.80	70	300 r	I 2857.94	50	7 n
2385.82	..	100	2678.57	30	150 r	I 2859.97	50	10
2389.70	5	100	2679.32	70	300 r	2869.13	25	150 r
2393.57	..	500	2682.87	50	200 r	I 2870.55	50 r	20 r
2399.68	..	150	I 2683.09	35	150 r	2873.18	4	50
2404.18	1	90	2687.96	150	500 r	2877.69	15	100 r
2430.04	..	70	I 2688.71	35	100 r	II 2879.16	50	35
2444.97	2	60	2689.88	50	150 r	II 2880.03	25	150 r
2446.70	1	50	2690.24	50	200 r	II 2882.50	35	200 r
2447.61	..	70	2690.79	70	300 r	II 2884.78	40	200 r
2458.29	1	70	2694.74	2	70	2888.25	20	125 r
2465.28	2	100	I 2696.99	70	2	II 2889.62	40	150 r
2475.46	2	60	2697.74	100	50 r	II 2891.64	40	200 r
2475.87	..	60	2698.38	30	300	II 2892.44	30	150 r
2479.05	15	150	I 2698.73	70	15 n	II 2892.66	30	150 r
2479.52	15	150	2700.94	125	500 r	II 2893.32	50	300 r
2483.07	20	150	2702.19	80	300 r	II 2896.21	35	150 r
2503.02	7	100	2705.22	25	50	II 2903.08	35	150 r
2506.22	10	150	2706.17	100	400 r	II 2906.46	40	150 n
I 2506.90	50 r	35	2706.70	60	200 r	II 2907.47	40	150 n
2516.12	25	100	2707.86	70	150	II 2908.82	70 r	400 r
I 2519.62	125 r	50	2710.16	6	60	2910.02	35	150 r
II 2523.95	10	100	2711.74	50	150 r	II 2910.39	35	150 r
I 2526.21	150	150 r	2713.05	40	80	II 2911.06	30	200 r
2527.90	35	300 r	2714.20	60	100	I 2914.93	60	50 r
2528.47	50	150 r	2715.69	50	300 r	II 2919.99	10	70 r
2528.84	25	150 r	I 2722.56	100	40	II 2920.38	20	125 r
I 2530.18	100	70 r	2726.55	7	80	I 2923.62	50 r	150 r
II 2534.52	10	80	2728.64	50	400 r	II 2924.02	70 r	300 r
I 2545.98	50	10	I 2731.35	80	50	II 2924.64	60	200 r
II 2548.69	10	80	2739.71	50	80	II 2930.81	30	150 r
II 2549.28	20	150	2747.47	6	60	2932.32	12	80
I 2552.65	75 r	10	2753.40	50	200 r	II 2934.40	10	50 n
2554.22	..	50 wn	2760.70	25	100 n	I 2938.25	2	60
2555.91	2	80	2765.67	50	200 n	II 2941.37	40	300 r
I 2562.13	50	4	II 2766.45	40	100 n	II 2941.49	12	150 r
2571.06	4	70	2768.56	35	150 r	I 2942.35	80 r	20 n
I 2574.02	60	50	2771.40	6	50 n	II 2944.57	50	300 r
II 2574.52	9	80	2772.01	2	80 n	2948.07	2	70
2576.48	1	50	2774.28	25	100 r	2949.17	6	80
2583.01	..	50	2774.72	20	50 n	II 2950.35	25	100 r
2584.96	2	100	2775.76	12	70 n	II 2952.07	35	150 r
2593.05	..	50 n	II 2777.73	40 n	100 r	2955.58	1	60
2595.10	..	70 n	2778.58	..	60 n	I 2957.52	20	125 r
2615.40	..	50 wn	2781.45	4	125 n	I 2962.77	60	60 r
2616.25	4	70	2784.27	4	50 n	2972.25	2	50
2622.73	..	50 n	2797.02	12	80 n	2975.65	4	50
II 2628.74	4	50 n	2797.79	12	70 n	2976.20	6	50
2629.71	1	70 n	2798.76	25	80 n	I 2977.54	50	6
2630.67	30	150 n	2799.45	25	100 n	2981.20	4	60
2640.85	2	50	2810.27	50	50	2982.75	4	50
2644.35	12	100 n	2817.50	18	50	2983.55	10	60
2645.84	15	100	2822.44	4	70 n	2985.17	1	60
I 2647.71	50	10 n	2825.87	7	70 n	II 2988.02	10	80

II. EMISSION SPECTRA 2000–10,000 A (Continued)

VANADIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2990.95	50	5	3138.06	..	70	I 3365.55	125	80
2994.54	2 n	50	3139.74	15	150	I 3376.06	80	60
II 2995.99	5	70	3141.48	5	100	I 3377.62	60	30
II 3001.20	20	200 r	3142.47	15	100 r	3382.53	..	125
II 3003.46	8	70	3143.47	1	50	I 3384.60	60	40
3005.81	..	50	3144.70	1	60	I 3400.39	100	8
3006.50	..	50	II 3145.34	25	60	I 3402.57	60	25
II 3007.28	2	50	3146.23	2	70	3404.42	..	50 n
3008.50	..	50	3146.81	2	50	3451.04	..	60
3008.61	3	70	3148.74	..	50	3453.08	..	60
3012.01	2	50	3151.32	8 w	150 w	3457.15	2	150
3013.10	10	70	3155.41	5	100	3469.52	2	100
II 3014.82	10	100	3161.31	1	50	3470.26	..	70
II 3016.78	15	80	II 3164.83	10	100	3477.52	..	100
3022.57	2	50	3165.89	1	80	II 3479.84	20	80
II 3024.98	2	60	3167.44	5	150 r	I 3482.19	40	50
II 3028.04	2	50	3174.54	1	80	II 3485.92	8	70
II 3033.82	20	90 r	I 3183.41	200 r	100 r	II 3493.17	15	100
3042.26	6	80	I 3183.98	500 r	400 r	3497.03	..	150
I 3043.12	60	7	I 3185.40	500 r	400 r	II 3499.82	3	50
I 3043.55	60	40	II 3187.71	35	100 r	II 3504.44	60	200
3048.21	10	125 r	II 3188.51	35	100 r	I 3505.69	50	35
3048.89	10	50	II 3190.68	50	150 r	3507.54	..	50
3050.73	1	50	I 3193.92	100	20	3509.04	2	150
I 3052.19	50	5	I 3198.01	100 r	30 r	II 3520.02	5	50
II 3053.39	10	90 r	I 3202.38	100 r	20 r	3521.84	20	80
I 3053.65	90 r	..	I 3207.41	80 r	20	II 3524.71	10	60
3053.89	10	60 r	II 3208.35	10	100	II 3530.77	40	100
3055.94	..	50 w	I 3212.43	70	50	II 3538.24	10	100
I 3056.33	125 r	70 r	II 3214.75	20	100	I 3543.50	50	50
I 3060.46	150 r	100 r	I, II 3217.11	30	80 n	II 3545.20	40	300 r
3063.25	30	80 r	3226.92	1	50	I 3553.27	80	30
I 3066.37	400 r	125 r	3231.95	8	100	II 3560.60	10	50
3070.12	..	50	II 3237.87	30	100 n	II 3566.18	25	100
3072.71	70 r	40 r	3250.78	10	50	I 3577.87	50	40
I 3073.82	60	20 r	3251.87	10	50	3578.64	35 d	80 d
3081.25	5	50	I 3254.77	40	80 n	I 3580.82	50	50
I 3082.11	80 r	2 n	II 3263.32	..	50	I 3583.70	60	30
3083.21	2	50	II 3267.70	30	80 r	II 3589.76	80	600 r
I 3083.54	60	..	II 3271.12	25	50 r	II 3592.02	50	300 r
3092.72	100 r	50 r	II 3276.12	50	200 r	II 3593.33	30	300 r
II 3093.11	100 r	400 r	3281.11	3	50	I 3600.03	50	40
3094.20	20	125 r	3282.53	12	80	3604.38	..	50 n
3100.93	20	100	II 3289.39	10	70	I 3606.69	80	70
II 3102.30	70	300 r	3290.24	2	70	3618.93	..	100
3108.70	3	50	3293.15	..	50	3620.47	10	50
3109.37	1	70	3297.52	..	60	3621.21	15	80
II 3110.71	70	300 r	I 3298.14	50	15	3625.61	4	125
3113.57	7	100	II 3298.74	12	80	3627.71	4	50
II 3118.38	70	200 r	3301.65	..	80	I 3629.31	50	2
3120.73	12	80	3304.47	..	125	3632.12	..	70
II 3121.14	60	200 r	3308.48	..	80	3635.87	50	25 n
3122.89	12	300 r	3316.88	..	60	I 3639.02	70	60
3125.00	4	50	3317.91	..	80	I 3641.10	100 n	30 wn
II 3125.28	80	200 r	3318.91	..	60	I 3644.71	80	50
II 3126.21	60	100 r	3321.54	3	150	I 3648.97	80	50
3128.28	2	60	I 3329.85	100	40	I 3656.71	80	20 n
3128.69	3	70	3335.48	1 n	60	I 3661.38	10	150
II 3130.27	50	200 r	3337.85	2	150	I 3663.59	150	1 wn
3132.59	80 r	20	3345.90	..	125	I 3665.14	100	50 n
II 3133.33	50	200 r	3353.77	2	100	I 3667.74	80	25 n
3134.92	30	150 r	I 3356.35	125	60	3669.41	20 W	300
3136.51	20	200	3361.51	..	200	I 3671.20	100	70

VANADIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 3672.40	100	40 n	I 3858.68	50	15	I 5393.18	100	..
I 3673.40	150	80 n	I 3862.22	80	20	I 5401.93	100	100
I 3675.70	100	70	I 3864.86	100 r	50 r	I 5415.26	75	75
I 3676.68	300	150 n	II 3866.74	5	50	5434.17	50	50
I 3677.08	25	70	I 3867.60	70	35	I 5507.75	60	60
I 3680.11	125	50 n	I 3871.08	60	35	I 5592.41	50	50
I 3683.13	100	60	I 3875.07	70 r	50	I 5604.94	60	20
I 3686.26	100	100	I 3876.09	50	30	I 5624.60	100	..
I 3688.07	200	200 r	II 3878.71	35	100	I 5626.01	150	..
I 3690.28	200	125	I 3879.66	50	5	I 5627.64	200	80
I 3692.22	200 r	150 r	II 3884.84	4	70	I 5646.11	150	150
I 3694.62	60	5	I 3890.18	100	30	I 5657.44	150	60
I 3695.33	125	70 n	I 3892.86	60	35	I 5668.36	75	50
I 3695.86	150	100 r	I, II 3896.16	50	40	I 5670.85	150	70
3700.34	10	100	I 3900.17	50	2 n	5683.22	50	2
I 3703.58	200 r	100 r	I 3901.15	50	3 n	I 5698.52	300	300
I 3704.70	200 r	150 r	I 3906.75	50	20	I 5703.56	200	60
I 3705.03	100	70	3908.32	50	2 n	I 5706.98	200	..
I 3706.03	50	50	I 3909.89	50 w	30 w	I 5716.21	60	30
3708.72	100	60	I 3912.21	50	20	I 5727.03	150	150
3711.12	..	80	II 3914.33	25	70 wn	I 5727.66	75	..
I 3713.96	60	10	I 3922.43	80	40	I 5731.25	250	100
3715.47	70	400 r	I 3927.93	50	40	I 5737.06	100	100
II 3718.16	5	70	I 3930.02	50	20	I 5743.45	60	20
I 3721.99	70	20	I 3934.01	100	30	I 5750.65	50 W	..
II 3727.34	40	200	I 3937.53	50	20	I 5772.42	50	25
3728.34	20	150	I 3943.66	50	18	I 5776.68	50	25
I 3729.03	80	15	II 3951.97	35	50	I 5784.38	50	30
3732.76	70 r	500 r	I 3979.14	50	8	I 5786.16	75	..
I 3737.99	50	5	I 3988.83	70	35	I 5807.14	75	40
I 3738.76	100	7	I 3990.57	125	40	I 5817.06	50	..
I 3740.24	100	10	I 3992.80	60	20	I 5817.53	100 n	..
I 3741.50	80	8	I 3998.73	100	25	I 5830.72	100	80
3745.80	35	600	II 4002.94	6	80	I 5846.30	100	100 n
I 3747.98	50	4	II 4035.63	40	80	I 5924.57	250 W	..
3751.23	4	100	4053.59	..	70	5928.85	..	60 n
I 3751.78	50	2	4065.08	2	100	I 5978.91	100	..
I 3755.70	70	3	I 4067.74	50	15	I 5980.78	50	..
I 3759.32	50	2	I 4090.58	60	25	I 6039.73	100	10
I 3763.14	80	6 n	I 4111.78	100 Wr	100 Wr	I 6058.14	60	..
II 3770.97	30	60	I 4332.82	60	40	I 6077.36	300 n	2
I 3776.16	50	2	I 4341.01	60	30	I 6081.44	100	10
I 3778.68	60	4	I 4342.83	50	30	I 6090.22	60	15
I 3794.96	50 n	50 n	I 4379.24	200 r	200 r	I 6199.19	100	8
I 3799.91	60	50	I 4384.72	125 r	125 r	I 6213.87	50	3
I 3803.47	50	40	I 4389.97	80 r	60 r	I 6216.37	60	10
I 3807.50	80	50	I 4395.23	60 r	40 r	I 6224.50	50	5
I 3808.52	50	30	I 4400.57	60	40	I 6230.74	70	10
I 3809.60	70	40	I 4488.89	60 n	30 n	I 6251.82	70	8
I 3813.49	50	..	4564.59	..	150	I 6274.65	50	8
3815.39	1	150 n	4600.15	1	60 n	I 6285.16	50	10
I 3819.96	60	35	I 4670.49	60 r	40 r	I 6292.83	50	10
I 3821.49	50	30	I 5002.33	90	90	I 7338.92	50	..
I 3822.01	70	40	I 5014.62	125	125	I 8027.39	80 w	..
I 3835.56	50	12	5064.12	50	50	I 8093.45	80	..
I 3839.00	60	10	I 5128.43	75	75 n	I 8116.80	150	..
I 3843.51	50	15	I 5138.42	50	50 n	I 8161.07	150 w	..
I 3844.44	100	50 n	I 5139.53	50	50	I 8171.35	50	..
I 3847.33	100	70 n	I 5148.72	60	60	I 8186.71	80	..
I 3849.32	60	25	5176.77	60	50	I 8187.38	50	..
I 3851.17	50	15	I 5192.99	100	75 n	I 8198.87	60	..
I 3855.37	50 r	50 r	I 5240.87	50	50	I 8203.07	100	..
I 3855.84	200	200	I 5353.41	50	50	I 8241.61	60	..

Vanadium (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 8253.51	80	..	I 8919.80	100 w	..	I 9366.92	50	..
I 8255.88	70	..	I 8932.93	50 w	..	I 9435.58	80	..
I 8282.37	80	..	I 9046.71	50	..	I 9611.60	80	..
I 8342.03	50	..	I 9341.20	100	..	I 9614.68	50	..

Xenon

Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube	Wave length	Arc	Discharge tube
2475.89	..	50	I 4524.68	..	400	II 4991.17	..	50 wnl
II 2864.73	..	100	II 4532.49	..	100	II 5012.83	..	50 n
II 2895.22	..	80 n	II 4540.89	..	200 nl	I 5028.28	..	200
II 2979.32	..	200	II 4545.23	..	200 wnl	II 5044.92	..	100
3017.43	..	50 n	II 4555.94	..	100 wnl	II 5080.62	..	500
II 3121.87	..	150	II 4577.06	..	100 wn	II 5122.42	..	150
II 3366.72	..	150 n	I 4582.75	..	300	II 5125.70	..	50
II 3461.26	..	50 n	II 4585.48	..	200 wnl	II 5178.82	..	50
II 3907.91	..	50 nl	II 4592.05	..	150 wnl	II 5188.11	..	100
I 3948.16	..	60	II 4603.03	..	300 n	II 5191.37	..	200
I 3950.92	..	125	II 4611.89	..	700	II 5192.10	..	50
I 3967.54	..	200	II 4615.06	..	50 nl	5247.75	..	50
II 4037.29	..	50	II 4615.50	..	100	II 5260.44	..	300
II 4037.59	..	100	II 4617.50	..	50	II 5261.95	..	200
II 4057.46	..	100 wnl	I 4624.28	..	1000	II 5268.31	..	50
I 4078.82	..	100	II 4651.94	..	100	II 5292.22	..	800
II 4098.89	..	50 n	II 4668.49	..	50	II 5309.27	..	150
I 4109.71	..	60	I 4671.23	..	2000	II 5313.87	..	500
I 4116.11	..	80	II 4672.20	..	50 nl	II 5339.38	..	500
II 4158.04	..	100 wnl	4676.46	..	100 wnl	II 5363.27	..	80
II 4180.10	..	500 n	I 4690.97	..	100	II 5368.07	..	100
4193.15	..	200 n	I 4697.02	..	300	II 5372.39	..	200
I 4193.53	..	150	II 4698.01	..	150 nl	I 5392.79	..	100
I 4203.69	..	50	II 4715.18	..	80	II 5419.15	..	1000
II 4208.48	..	200 n	II 4731.19	..	50 nl	II 5438.96	..	400
II 4209.47	..	100 n	I 4734.15	..	600	II 5445.52	..	80
II 4213.72	..	200 n	II 4769.05	..	100	II 5450.45	..	100
II 4215.60	..	100	II 4773.19	..	50	II 5460.39	..	200
II 4223.00	..	200 n	II 4779.18	..	50	II 5472.61	..	500
II 4238.25	..	200 n	II 4787.77	..	50	II 5531.07	..	300
II 4245.38	..	200 n	I 4792.62	..	150	I 5552.38	..	80
II 4251.57	..	50 wnl	I 4807.02	..	500	I 5566.61	..	100
II 4296.40	..	200 n	II 4818.02	..	100	5572.19	..	50
II 4310.51	..	200 n	II 4823.41	..	150 n	I 5581.78	..	50
II 4330.52	..	500 wnl	I 4829.71	..	400	II 5591.61	..	50 wn
4369.20	..	100 wn	I 4843.29	..	300	II 5616.67	..	150
II 4373.78	..	50 wnl	II 4844.33	..	1000	I 5618.88	..	80
I 4383.91	..	100	II 4862.54	..	400 nl	II 5659.38	..	150
I 4385.77	..	70	II 4876.50	..	200 nl	II 5667.56	..	300
II 4393.20	..	200 wn	II 4883.53	..	300 n	I 5695.75	..	100
4395.77	..	200 wnl	II 4884.15	..	50 wn	I 5696.48	..	80
II 4406.88	..	100 wnl	II 4887.30	..	150 n	II 5699.61	..	100
II 4414.84	..	150	II 4890.09	..	150 n	I 5715.72	..	70
II 4416.07	..	80 wnl	I 4916.51	..	500	II 5716.19	..	50 wn
4448.13	..	200 wn	II 4919.66	..	125	I 5716.25	..	80
4462.19	..	500 wnl	II 4921.48	..	500	II 5719.61	..	100
II 4480.86	..	200 wnl	I 4923.15	..	500	II 5726.91	..	200
I 4500.98	..	500	4971.71	..	100 wnl	II 5751.03	..	200
II 4521.86	..	50 nl	II 4972.71	..	200 n	II 5758.65	..	150
II 4524.21	..	100	II 4988.77	..	150 n	II 5776.39	..	150

II. EMISSION SPECTRA 2000–10,000 A (Continued)

XENON (Continued)

Wave length	Arc	Discharge tube	Wave length	Arc	Dicharge tube	Wave length	Arc	Discharge tube
I 5814.50	..	60	I 6554.20	..	50 nl	I 7881.32	..	100
II 5815.96	..	50	6595.01	..	400	I 7887.39	..	300
I 5823.89	..	300	I 6595.56	..	100	7942.54	..	50
I 5824.80	..	150	II 6597.25	..	200	I 7967.34	..	500
II 5835.5	..	50 wn	II 6598.84	..	50	7981.1	..	50 nw
I 5875.02	..	100	II 6620.02	..	100	7992.34	..	50 wn
II 5893.29	..	150	I 6632.46	..	50	8008.45	..	150 n
I 5894.99	..	100	I 6666.96	..	60	I 8029.67	..	100
II 5905.13	..	100	I 6668.92	..	150	8031.64	..	50 n
II 5917.44	..	50	II 6694.32	..	200	8038.26	..	50 n
I 5931.24	..	80	II 6702.25	..	50	I 8057.26	..	200
I 5934.17	..	100	I 6728.01	..	200	I 8061.34	..	150
II 5945.53	..	200	I 6777.57	..	50	I 8101.98	..	100
II 5958.03	..	50	II 6788.71	..	80	8151.80	..	60
II 5971.13	..	150	II 6790.37	..	50	I 8171.02	..	100
II 5976.46	..	800	II 6805.74	..	400	I 8206.34	..	700
II 6008.92	..	100	I 6827.31	..	200	I 8231.63	..	5000
II 6036.20	..	500	I 6846.61	..	60	I 8266.52	..	500
II 6051.15	..	700	I 6848.82	..	50	I 8280.12	..	5000
II 6093.56	..	150	I 6866.84	..	50	8297.55	..	50 n
II 6097.59	..	600	I 6872.11	..	700	I 8346.82	..	2000
II 6101.43	..	200	I 6882.15	..	300	II 8347.24	..	50
II 6115.08	..	50	II 6910.22	..	50	I 8347.45	..	60
II 6146.45	..	50	I 6925.53	..	100	I 8409.19	..	2000
I 6163.66	..	90	I 6935.62	..	50	I 8576.01	..	200
I 6163.93	..	80	6942.11	..	400 wn	I 8624.24	..	80
I 6178.30	..	150	I 6976.18	..	100	I 8648.54	..	200
I 6179.66	..	125	II 6990.88	..	700	I 8692.20	..	100
I 6182.42	..	300	II 7082.15	..	100	I 8696.86	..	200
II 6194.07	..	250	I 7119.60	..	500	I 8737.37	..	300
I 6198.26	..	100	7147.50	..	50 wns	I 8758.20	..	100
I 6200.89	..	60	II 7149.03	..	150	I 8819.41	..	5000
6206.16	..	100	II 7164.83	..	300	I 8862.32	..	300
I 6261.21	..	50	I 7257.94	..	60	I 8908.73	..	200
II 6270.82	..	250	II 7284.34	..	50	I 8930.83	..	200
II 6277.54	..	200	I 7285.30	..	60	I 8952.25	..	1000
II 6284.41	..	50	II 7301.80	..	100	I 8952.78	..	50
I 6286.01	..	100	I 7316.27	..	70	I 8981.05	..	100
I 6292.65	..	50	I 7321.45	..	80	I 8987.57	..	200
II 6300.86	..	125	I 7336.48	..	50	I 9032.18	..	50
I 6318.06	..	500	II 7339.30	..	150	I 9045.45	..	400
II 6343.96	..	200	I 7386.00	..	100	I 9096.13	..	50
II 6356.35	..	300	I 7393.79	..	150	I 9162.65	..	500
II 6375.28	..	80	II 7548.45	..	150	I 9167.52	..	100
II 6397.99	..	50	I 7584.68	..	200	I 9374.76	..	100
I 6469.70	..	300	II 7618.57	..	50	I 9412.01	..	60
I 6472.84	..	150	I 7642.02	..	500	I 9445.34	..	80
I 6487.76	..	125	I 7643.91	..	100	I 9513.38	..	200
I 6498.72	..	100	II 7670.66	..	100	I 9685.32	..	150
I 6504.18	..	200 n	I 7783.66	..	50	I 9718.16	..	100
II 6512.83	..	150	II 7787.04	..	50	I 9799.70	..	2000
II 6528.65	..	100	I 7802.65	..	100	I 9923.20	..	2000
I 6533.16	..	100						

YTTERBIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2098.40	..	50 n	2126.72	40	200	2185.69	60	100
2102.72	20	200	2154.16	..	80 n	2224.45	20	40
2109.60	..	100 n	2155.51		40	2257.01	4	40
2116.65	50	250	2161.60	100	250	2265.65	3	50

YTTERBIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2282.99	5	50	3426.04	40	15	5211.60	40	2
2305.33	8	100	3428.46	25	80	5240.50	10	40
2314.48	4	50	3431.12	40	15	5244.11	50	5
2337.95	2	40	3438.72	4	80	5257.49	15	100
2512.06	10	50	3438.84	20	100	5277.07	200	6
2552.15	10	40	3446.88	10	50	5279.55	15	100
2555.31	. .	50 n	3454.07	40	250	5300.94	6	60
2567.63	5	150	3458.28	12	100	5307.12	40	. .
2579.58	5	200	3464.37	200 r	50 r	5335.16	150	400
2581.12	20	100	3476.30	80	10	5345.67	20	100
2599.15	2	50	3478.84	40	300	5345.83	10	50
2621.12	2	100	3485.76	20	40	5347.20	40	200
2638.09	1	60	3507.83	12	60	5351.32	50	3
2642.55	3	80	3520.29	10	70	5352.96	100	250
2644.32	5	40	3560.33	20	50	5358.64	15	100
2651.71	2	60	3560.73	8	100	5426.91	2	60
2652.23	2	60	3606.47	15	60	5432.73	5	100
2653.75	50	200	3611.31	12	50	5449.29	20	100
2665.03	10	60	3619.81	30	100	5478.52	10	50
2666.08	5	150	3669.71	50	80	5481.94	50	2
2666.97	5	150	3675.09	50	200	5505.50	40	2
2672.65	20	80	3690.58	10	50	5539.06	200	5
2677.37	. .	40	3694.20	500 r	1000 r	5556.48	1500	50
2750.48	20	150	3722.29	7	60	5588.47	30	100
2776.27	6	40	3724.21	15	50	5651.99	50	80
2803.48	. .	40	3847.86	40 w	. .	5720.01	300	8
2818.75	. .	80	3887.31	6	40	5730.02	4	60
2830.98	2	40	3900.86	50	10	5771.67	30	50
2851.12	10	50	3904.83	12	150	5819.43	7	100
2867.04	4	40	3987.99	1000 r	500 r	5834.01	60 n	1
2891.38	50 n	100	3990.89	60	20	5837.16	50	150
2906.34	. .	40	4077.27	30	100	5897.22	7	100 n
2911.52	5	40	4089.68	50	7	5898.80	3	50 n
2914.21	10	60	4135.10	15	50	5935.06	3	40
2915.27	10	40	4180.83	10	100	5946.02	4	100
2919.35	15	90	4218.57	3	50	5991.50	50	150
2945.90	10	60	4316.97	20	40	6007.42	4	80 n
2970.56	150	150	4370.81	15	40	6152.57	60	80
2983.98	10	70	4439.21	45	10	6246.97	40	60
2994.80	10	80	4515.15	45	100	6260.80	4	50
3002.61	15	150	4553.56	20	60	6274.79	100	150
3005.76	10	100	4576.20	90	10	6355.40	2	50 n
3017.56	3	40	4582.36	80	6	6400.40	200 n	4 n
3029.55	1	40 n	4590.83	40	. .	6417.97	125	3
3031.11	100 n	30	4598.37	25	70	6432.73	30	40
3042.65	5	50	4726.07	45	200	6463.15	10	100
3107.90	10	60	4781.88	50	5	6474.74	5	50
3201.16	4	40	4786.60	50	200	6489.10	800	40
3275.81	12	100	4820.24	15	60	6492.74	3	50
3289.37	500 r	1000 r	4836.95	18	100	6643.54	50	. .
3289.85	1000	. .	4935.50	200	10	6667.85	1000	20
3304.56	15	40	4937.23	6	80	6727.62	30	60
3304.76	12	40	5009.52	20	50	6768.70	80	2
3305.73	30	125	5074.34	200	5	6799.61	1000	50
3333.07	20	60	5076.76	50	1	7350.09	40	. .
3343.06	6	40	5104.43	1	50	7527.56	80	. .
3375.48	30	100	5135.98	6	50	7699.49	2000	. .
3391.10	10	40	5147.03	3	50	9760.37	100	. .

YTTRIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2243.06	25	35 w	3800.03	25	5	II 5087.42	50	100
II 2422.18	20	30	II 3818.34	30	50	II 5119.12	7	20
II 2460.62	10	30 n	II 3832.89	30	80	II 5123.21	10	30
I 2490.42	20	3	II 3878.29	15	15	II 5200.41	60	150
II 2734.97	5	15	II 3930.67	20	25	II 5205.72	50	80
II 2785.23	7	20	II 3950.36	60	100	I 5240.81	20	..
II 2785.59	5	18	3968.43	10	30	II 5402.78	30	50
II 2800.10	10	20	II 3982.59	60	100	I 5438.23	20	2
II 2813.65	7 d	20 n	I 4047.63	50	10	I 5466.47	150	20
II 2834.57	2	18	4076.35	30	8	II 5473.40	10	20
II 2840.96	7	18	I 4077.37	50	40	II 5480.75	10	15
II 2854.42	10	18	I 4083.71	50	10	II 5497.40	20	40
II 2856.29	8	15	I 4102.38	150	30	II 5509.90	30	40
II 2858.08	7	15	II 4124.91	7	18	II 5521.70	4	40
I 2886.46	15	6	I 4128.30	150	30	I 5527.54	100	15
2919.05	18	6	I 4142.84	100	25	II 5544.61	10	80
II 2930.14	8	20	I 4167.51	50	10	I 5577.42	15	2
2945.95	2	100	I 4174.13	100	8	I 5581.87	100	10
I 2948.40	20	5 n	II 4177.55	50	50	I 5630.12	80	..
II 2956.04	7	15 n	II 4204.70	15	15	I 5644.68	15	2
2980.54	8	30	I 4220.64	15	7	II 5662.92	20	400
II 3026.47	7	20	4226.73	5	15	I 5706.72	15	1
II 3036.59	10	40	II 4235.73	3	20	II 5728.88	3	25
II 3053.27	10 n	20 n	I 4235.94	60	30	bh 5730.1	15	..
II 3055.22	8	50	I 4251.20	25	8	bh 5746.9	20	..
II 3086.86	12	50	II 4279.3	3	15	bh 5764.2	20	..
II 3093.77	9 d	15 d	I 4302.29	30	8	bh 5800.0	15	..
II 3128.79	10	40	II 4309.63	50	50	bh 5818.6	15	..
II 3129.93	8	50	I 4348.79	100	..	bh 5939.1	100	..
II 3135.17	10	18	II 4358.73	60	50	bh 5956.4	80	..
II 3173.05	20	70	I 4366.03	20	..	bh 5973.0	600	..
II 3179.42	20	30	II 4374.93	150	150	bh 5987.6	300	..
II 3195.61	30	50	II 4398.01	150	100	bh 6003.6	200	..
II 3200.27	30	40	I 4422.59	60	60	bh 6019.9	150	..
II 3203.32	30	50	I 4505.95	50	50	bh 6030.6	100	..
II 3216.68	40	70	I 4527.23	40	50	bh 6053.8	50	..
II 3242.28	60	100	I 4527.79	25	40	bh 6072.8	15	..
3289.85	15	10	I 4643.69	50	100	bh 6089.4	30	..
II 3308.47	10	20	bh 4650.2	15	..	bh 6096.8	30	..
II 3327.87	60	60	I 4658.32	8	15	bh 6107.8	15	..
II 3330.88	4	30	I 4674.85	80	100	bh 6114.7	20	..
II 3362.00	12	25	II 4682.32	60	100	bh 6132.1	200	..
3372.77	15	3	I 4728.53	60	4	bh 6148.4	100	..
II 3448.81	18	18	I 4760.97	50	25	bh 6165.1	80	..
II 3496.08	20	35	II 4786.58	15	25	bh 6182.2	60	..
II 3549.01	12	50	I 4786.88	15	15	bh 6199.8	50	..
I 3571.43	15	2	bh 4817.4	20	..	bh 6218.0	40	..
I 3576.05	15	2	bh 4818.2	30	..	bh 6236.7	30	..
II 3584.51	20	15	II 4823.31	15	10	bh 6275.0	15	..
3587.75	15	2	4829.35	3	15 n	I 6435.00	150	50
I 3592.91	80	25	I 4839.87	20	25	bh 6501.2	15	..
II 3600.73	100	300	I 4845.67	30	30	bh 6518.3	15	..
II 3601.92	18	60	I 4852.69	30	15	I 6538.60	50	10
II 3611.05	40	60	II 4854.87	100	150	II 6613.74	15	12
II 3628.71	40	50	I 4859.85	50	5	I 6650.62	15	4
II 3633.12	50	100	II 4883.69	20	300	I 6687.60	50	10
II 3664.61	100	100	II 4900.12	20	300	6699.26	18	4
II 3668.49	7	20	I 4906.11	6	20	I 6713.19	15	4
II 3696.62	6	20 n	I 4908.99	4	15	I 6793.70	70	15
II 3710.29	80	150	I 4921.89	10	30	II 6795.40	12	20
II 3747.55	12	15	4950.66	3	15	I 6845.24	15	5
II 3774.33	12	100	II 4982.14	8	50	II 6896.01	5	15
II 3788.70	30	30	bh 5025.3	20	..	I 6950.27	20	10

YTTRIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 6979.85	15	6	I 7346.46	40	4	I 9231.58	80	..
I 7191.65	20	5	II 7450.30	15	10	I 9494.81	60	..
II 7264.18	15	20	II 7881.90	25	10			

ZINC

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
2012.62	..	(250)	I 2600.94	10 wn	..	3639.53	20	(5)
II 2024.66	..	(25)	I 2608.56	200	50	II 3683.47	20	(15)
II 2025.51	200	200	I 2608.64	300	100	3739.99	20	..
II 2040.00	..	(250)	II 2614.30	..	(10)	II 3793.91	10	..
II 2057.51	..	(20)	I 2670.53	200	4	II 3806.37	3	15
II 2061.91	100	100	2682.84	..	10	II 3840.34	3	(50)
II 2063.61	2	20	I 2684.16	300	6	II 3842.26	..	(15)
2077.14	..	(10)	I 2712.49	300	8	I 3883.34	50	2 n
II 2085.53	..	(20)	II 2738.43	..	(10)	I 3965.43	15	..
2136.46	..	(10)	I 2751.39	10 n	..	II 3989.23	..	(100)
I 2138.56	800 r	500	I 2756.45	200	100	II 4057.71	80	..
II 2148.15	..	(50)	2758.86	..	(10)	I 4113.21	10	..
II 2210.87	..	50	I 2770.86	300	25	I 4292.88	25	25
II 2253.06	..	(10)	I 2770.98	300	150	I 4298.33	25	25
II 2265.51	..	(10)	I 2781.23	25	5 n	4300.81	..	(25)
II 2266.00	..	(250)	II 2782.83	..	(20)	I 4629.81	35	..
2312.72	10	..	I 2800.87	400	300	I 4680.14	300 w	200 n
II 2390.78	..	25	I 2801.06	100	20	I 4722.16	400 w	300 n
2393.81	15 n	..	II 2801.79	..	(25)	I 4810.53	400 w	300 n
II 2428.86	..	(10)	II 2804.69	..	(10)	II 4911.66	15	(25)
II 2435.52	..	10	2826.13	3	(10)	II 4924.04	15	(30)
2439.42	..	(25)	2832.95	..	(25)	I 5069.58	15	..
I 2449.72	10	..	II 2882.15	..	(25)	I 5181.99	200	2
I 2463.47	20	2	II 2902.26	..	(50)	II 5585.21	12	(1)
I 2469.38	12 r	..	I 3018.35	125	40	I 5777.11	10	15
I 2479.74	30	..	I 3035.78	200	100	II 5894.35	3	(30)
I 2491.48	100	50	I 3072.06	200	125	II 6021.26	3	(15)
I 2493.32	25	..	I 3075.90	150	50	II 6102.54	6	(20)
II 2502.00	20	400 w	II 3172.18	..	(12)	II 6111.56	8	(10)
I 2515.81	150 w	20	II 3196.29	..	(15)	II 6214.59	3	(12)
I 2530.09	10 l	..	I 3282.33	500 r	300	I 6362.35	1000 Wn	500
I 2542.32	40 n	..	II 3299.39	..	(15)	I 6479.15	10	..
II 2557.96	10	300	I 3302.59	800	300	II 6482.98	4	(15)
I 2562.61	10 n	..	3302.94	700 r	300 r	II 6483.27	..	(30)
II 2564.45	..	(25)	II 3305.96	..	(20)	I 6928.32	15	..
II 2568.08	50 n	10	I 3345.02	800	300	II 7478.79		(50)
I 2569.87	100 n	5	I 3345.57	500	100	II 7588.48	..	(50)
II 2570.72	..	10 r	I 3345.93	150	50	II 7612.90	..	(20)
2575.60	..	(10)	II 3381.04	..	(20)	II 7732.50	..	(50)
I 2582.44	100	..	3624.07	10	3	II 7757.86	..	(30)
I 2582.49	300	40	3631.93	15	(1)	I 7799.36	10	..

ZIRCONIUM

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2248.05	40	..	II 2542.10	100	50	II 2726.49	50	50
2285.23	100	..	II 2550.74	100	50	II 2732.72	40	30
II 2291.11	80	15	II 2567.64	100	100	II 2734.85	40	40
II 2294.04	50	10	II 2568.87	100	200	II 2752.21	40	40
II 2295.48	40	8	II 2571.39	300 r	400 r	I 2798.27	100	..
2303.14	100	..	II 2678.63	80	100	I 2814.90	70	1
2331.57	..	100 w	II 2700.13	50	50	I 2837.23	100	..
II 2449.85	50	20	II 2711.51	40	20	II 2844.58	50	50
I 2539.65	50	..	II 2722.61	50	50	I 2848.52	100	..

II. EMISSION SPECTRA 2000–10,000 A (Continued)

ZIRCONIUM (Continued)

Wave length	Arc	Spark	Wave length	Arc	Spark	Wave length	Arc	Spark
I 2875.98	70	1	II 3843.02	40	40	I 4688.45	50	..
I 2985.39	50	3	I 3864.33	50	20	I 4710.07	60	..
I 3011.75	100	4	I 3890.32	150	6	bh 4736.9	60	..
II 3020.47	50	30	I 3891.38	100	5	I 4739.48	100	..
I 3029.51	60	5	I 3900.52	100	..	I 4772.31	100	..
II 3236.58	20	40	II 3914.34	70	8	I 4784.92	40	..
I 3254.28	40	40	I 3921.79	100	4	I 4815.63	40	..
II 3273.05	50	80	I, II 3929.53	100	6	bh 5437.0	40	..
II 3279.26	50	50	II 3958.22	500	150	bh 5456.5	40	..
II 3306.28	80	80	3961.59	500	8	bh 5551.7	60	..
II 3326.80	100	100	I 3968.26	100	4	bh 5553.1	60	..
II 3356.09	50	40	I 3975.29	50	1	bh 5610.1	60	..
II 3357.26	50	40	II 3991.13	100	60	bh 5629.0	80	..
II 3387.87	100	100	I 4027.20	100	4	bh 5629.5	100	..
II 3388.30	50	40	I 4028.95	40	1	bh 5658.1	50	..
II 3391.97	300	400	II 4029.68	40	15	I 5664.51	50	..
II 3399.35	100	40	I 4035.89	40	2	I 5680.90	50	..
II 3404.83	40	35	I 4055.03	100	5	bh 5718.1	150	..
II 3410.25	50	50	I 4064.15	100	6	bh 5724.1	70	..
II 3430.53	50	50	I 4072.70	100	3	bh 5748.1	100	..
II 3438.23	250	200	I 4081.21	150	7	bh 5778.5	60	..
I 3447.36	150 w	3	II 4149 20	100	100	I 5797.74	50	..
II 3463.02	18	40	II 4161.21	40	30	bh 5860.1	80	..
II 3479.39	60	80	I 4166.36	50	4	I 5879.80	60	..
II 3481.15	50	80	I 4183.32	40	1	bh 5908.5	60	..
II 3496.21	100	100	I 4201.46	50	3	I 6121.91	60	..
II 3505.67	40	30	I 4213.86	40	3	I 6124.84	40	..
I 3509.32	40	5	I 4227.76	150	8	I ·127.44	500	..
I 3519.60	100	10	I 4239.31	100	5	I 6134.55	300	..
I 3547.68	200	12	I 4240.34	100	1	I 6140.46	40	..
II 3551.95	30	40	I 4241.20	100	2	I 6143.20	300	..
II 3556.60	15	50	I 4241.69	100	2	I 6299.66	50	..
II 3572.47	60	80	I 4256.04	60	..	I 6313.02	200	..
I 3575.79	100	5	I 4268.02	40	1	I 6470.21	40	..
I 3601.19	400	15	I 4290.21	40	20	I 6489.64	50	..
II 3611.89	15	40	I 4294.79	40	1	I 6762.38	50	..
II 3613.10	40	40	I 4302.89	100	1	I 6769.16	50	..
II 3614.77	40	80	I 4341.13	50	4	I 6953.84	80	..
I 3623.86	40	7	I 4347.89	40	5	I 6966.44	40	..
II 3636.45	200	30	II 4457.43	40	7	I 6990.84	50	..
I 3663.65	100	10	bh 4471.5	40	..	I 7097.70	100	..
II 3671.27	40	30	I 4575.51	50	..	I 7102.91	80	..
II 3674.72	100	40	bh 4619.8	80	..	I 7103.72	50	..
II 3698.17	50	80	bh 4637.8	100	..	I 7111.68	40	..
II 3709.26	50	30	bh 4640.6	150	..	I 7169.09	150	..
II 3751.59	25	40	bh 4644.7	40	..	I 8070.08	100	..
I 3780.54	40	15	I 4687.80	125	..	I 8132.99	80	..
3825.27	40	60						

II. EMISSION SPECTRA 2000–10,000 A (Continued)

Spectra of Heavy Elements

Abridged from Tomkins and Fred, Journal of the Optical Society of America **39**, 357, 1949

Spectra were obtained by the copper spark method. Intensities were obtained as the reciprocal of the limiting dilution at which lines would be visually observed.

Abbreviations:

n	Nebulous or diffuse
P	Most sensitive of the persistent lines
w or vw	Showing hyperfine structure

AMERICIUM

Wave length	Intensity	Wave length	Intensity	Wave length	Intensity
2661.6	20	2982.2	100	3696.4	200
2664.8	20	2993.5	50	3706.2	100
2668.8	20	2994.4	20	3707.9	100
2686.9	20	3004.3	200	3710.3	100
2691.4	100	3020.7	100	3712.9	50
2706.4	50	3021.1	50	3720.0	50
2716.5	50	3028.0	200	3720.5	50
2720.5	20	3028.8	20	3721.2	20
2725.4	20	3037.4	20	3725.4	50
2727.6	20	3037.8	100	3733.0	20
2728.7	200	3047.6	20	3734.7	20
2731.9	20	3057.4	20	3737.1	20
2732.1	20	3059.1	50	3737.6	50
2735.4	100	3071.3	100	3740.4	50
2739.6	100	3082.8	100	3748.3	20
2742.3	50	3162.1	500	3749.4	50
2743.2	100	3162.9	100	3751.0	50
2746.6	100	3203.3	100	3752.6	100
2747.0	100	3314.0	100	3753.2	100
2749.4	500	3332.1	100	3757.7	200
2749.8	20	3362.5	50	3761.6	500
2753.4	20	3392.0	50	3767.1	20
2755.3	200	3428.0	20	3769.0	20
2755.9	200	3431.6	20	3774.3	20
2756.7	500	3439.8	200	3777.4	500
2776.0	50	3446.0	50	3788.7	50
2776.5	50	3448.2	50	3789.0	20
2796.8	50	3452.0	100	3801.7	100
2812.9	200	3509.5	50	3848.9	100
2815.3	100	3510.2	100	3871.5	500
2816.0	50	3547.9	100	3892.9	20
2816.4	50	3559.6	50	3896.0	20
2832.3 P	2000	3561.8	50	3901.5	50
2852.2	100	3562.6	200	3904.2	100
2861.6	50	3569.2	100	3914.3	100
2873.3	100	3570.0	100	3916.0	500
2881.6	50	3573.1	100	3921.5	500
2888.5	200	3573.6	100	3926.2	1000
2893.3	100	3581.2	200	3936.2	100
2899.6	100	3584.7	100	3942.7	20
2911.2	500	3593.7	100	3943.8	50
2920.6	500	3615.8	20	3944.0	100
2928.0	100	3616.5	20	3944.5	50
2937.0	100	3617.4	20	3945.2	20
2957.0	200	3631.4	50	3946.0	50
2966.8	500	3639.5	20	3948.0	20
2969.4 P	500	3673.1	200	3950.3	20
2972.6	200	3683.4	50	3952.5	500

AMERICIUM (Continued)

Wave length	Intensity	Wave length	Intensity	Wave length	Intensity
3963.3	50	4108.8	20	4234.0	20
3973.1	100	4109.5	20	4248.4	500
3975.2	50	4109.9	20	4249.4	20
3982.6	20	4124.5	20	4249.9	50
3984.6	50	4127.4	20	4252.0	20
3991.9	50	4128.3	20	4261.8	50
4000.6	50	4128.9	20	4262.4	20
4003.0	20	4130.7	20	4265.6	200
4006.2	20	4136.7	20	4272.2	20
4009.2	100	4137.7	20	4278.2	20
4013.7	100	4144.0	20	4289.3	100
4017.9	20	4148.0	20	4289.9	20
4019.7	100	4149.9	20	4300.9	20
4020.2	50	4154.7	50	4302.5	20
4021.3	20	4182.6	20	4302.8	20
4027.4	50	4184.0	20	4309.7	100
4027.8	50	4184.3	20	4309.9	50
4032.9	20	4186.6	50	4324.6	500
4033.5	20	4188.2	500	4332.8	100
4036.4	200	4188.8	20	4335.6	50
4057.8	50	4189.6	20	4337.2	20
4069.8	50	4197.6	20	4341.8	20
4079.7	20	4198.7	20	4348.3	50
4080.5	20	4200.0	50	4349.3	50
4089.3	1000	4219.4	20	4366.7	100
4099.0	20	4221.0	20	4372.4	50
4102.3	20	4226.8	100	4374.9	50
4107.0	20	4233.6	20		

NEPTUNIUM

Wave length	Intensity	Wave length	Intensity	Wave length	Intensity
2655.0	20	2971.0	20	3722.3	20 w
2669.6	20	2974.3	50	3794.9	20
2678.2	20	2974.9	50	3829.2 P	50 vw
2733.7	20	3026.4	50	3832.3	20 w
2734.5	20	3027.3	20	3865.2	20
2785.2	20	3029.1	20	3888.2	20 w
2789.8	20	3052.0	50 w	3949.2	20
2833.6	20	3057.5	20	3987.0	20
2841.0	20	3070.3	20 w	3988.6	20
2841.5	20	3078.0	50	3989.8	20
2864.1	20	3084.7	20	4028.9	20 w
2864.4	20	3090.4	20	4108.4	20 w
2865.5	20	3092.0	20	4164.5	50
2866.0	20	3092.5	20	4256.7	20
2867.6	20	3171.6	20	4258.1	20 w
2869.8	20 vw	3402.5	20	4279.6	20 w
2873.3	20	3590.6	20	4290.9 P	50
2956.6	50	3665.6	20 w	4307.8	20
2957.9	50	3708.3	20 w	4336.6	20
2968.2	20				

PLUTONIUM

Wave length	Intensity	Wave length	Intensity	Wave length	Intensity
2677.0	20	2784.4	50	2809.0	20
2684.8	20	2787.2	20	2815.6	50
2693.3	20	2806.0	20	2826.2	20
2781.3	50	2808.4	50	2833.2	50

II. EMISSION SPECTRA 2000–10,000 A (Continued)

PLUTONIUM (Continued)

Wave length	Intensity	Wave length	Intensity	Wave length	Intensity
2835.5	100	3042.5	20	3895.9	20
2898.0	50 n	3043.0	20	3904.1	50
2899.8	20	3069.3	20	3907.2 P	100
2904.3	20	3091.2	20	3910.3	20
2905.0	50	3091.9	20	3912.5	50
2910.3	50	3092.7	50	3913.4	50
2912.7	20	3093.3	20	3928.0	20
2913.7	20	3104.1	20	3928.5	20
2914.2	20	3105.0	20	3931.2	20
2914.9	20	3105.9	20	3949.2	20
2915.6	50	3123.8	20	3953.0	20
2918.0	20	3136.5	20	3958.9	20
2925.2	100	3159.2	50	3961.5	50
2925.8	50	3179.3	20	3962.8	20
2926.3	20	3221.4	20	3963.6	20
2928.2	50	3231.8	20	3967.3	20
2930.9	20	3232.6	20	3972.2	50
2932.4	20	3312.6	20	3975.4	50
2933.2	20	3401.0	20	3976.0	20
2933.8	20	3585.9	20	3980.4	20
2937.6	50	3632.1	20	3985.5	100
2938.9	100	3709.1	20	3988.5	20
2941.3	50	3718.1	20	3989.7 P	100
2945.2	50	3720.2	20	3991.5	20
2945.9	50	3720.6	20	3992.2	20
2950.0	20	3721.5	20	4015.9	20
2951.6	50 vw	3726.0	50	4021.5	50
2954.3	100	3726.8	50	4064.6	20
2964.5	20	3732.1	20	4066.8	20
2966.7	20	3753.6	20	4078.0	20 n
2967.3	20	3755.9	20	4101.0	20
2968.9	50	3758.3	20	4102.0	20
2970.2	50	3773.6	20	4116.4	20
2972.3	100	3775.7	20	4141.2	20
2977.1	20	3792.2	20	4196.2	50
2977.8	50	3803.6	20	4229.7	20
2978.4	20	3810.2	20	4254.4 (Cr ?)	20
2980.0	50	3812.3	20	4254.8	20
2981.2	20	3814.9	20	4256.0	20
2986.9	20	3823.9	20	4257.9	20
2988.1	100	3827.5	20	4273.3	100
2991.5	20	3835.5	20	4280.3	20
2993.9	100	3836.9	20	4289.1	20 n
2996.4	100	3852.7	50	4330.6	20
3000.4	100	3874.2	20	4337.2	20
3008.9	50	3878.6	20	4352.7	50
3009.6	50	3887.4	20	4358.1	20
3028.8	20	3892.7	20		

PROTACTINIUM

Wave length	Intensity	Wave length	Intensity	Wave length	Intensity
2640.3	100	2743.9	200	2832.6	50
2644.9	20	2755.9	20	2835.5	50
2651.6	20	2793.3	50	2843.3	50
2670.5	50	2796.2	100	2845.5	50
2672.1	50	2808.0	20	2855.4	20
2697.5	50	2811.5	50	2870.0	50
2732.2	100	2815.4	20	2871.4	50
2743.2	100	2826.6	50	2873.3	50

II. EMISSION SPECTRA 2000–10,000 A (Continued)

PROTACTINIUM (Continued)

Wave length	Intensity	Wave length	Intensity	Wave length	Intensity
2891.0	20	3067.7	20	3909.6	20
2893.0	100	3070.3	20	3911.3	20
2906.3	20	3075.6	20	3921.5	20
2906.9	50	3076.7	20	3928.7	50
2907.5	50	3082.3	20	3944.0	20
2909.0	50	3083.2	50	3945.9	20 vw
2909.6	100	3092.6	20	3952.6	20
2922.8	50	3093.2	50	3956.6	20
2928.3	50	3103.8	20	3957.8	100 vw
2932.9	20	3105.9	50	3961.5	50
2934.3	50	3111.7	50	3967.3	20
2940.2	100	3117.7	20	3970.0	50
2943.0	50	3131.2	20	3975.4	20
2943.5	100	3136.9	20	3982.2	20
2954.6	50	3157.6	20	3983.3	20
2959.7	100	3170.8	20	3988.3	20
2968.0	50	3171.5	20	4012.9	50 vw
2969.0	50	3178.2	20 vw	4018.2	50 vw
2970.7	20	3179.6	20 vw	4029.9	20 vw
2972.4	20	3204.2	20	4046.9	20
2974.0	50	3205.4	20	4047.6	20
2977.2	20	3214.0	50	4051.8	20
2980.5	100	3221.9	20	4056.1	50 vw
2981.9	20 vw	3240.5	20	4070.4	50 vw
2982.9	20	3332.8	20	4074.3	20
2983.4	20	3545.0	50	4087.8	20 vw
2984.7	50	3632.4	50	4089.4	20 vw
2987.0	20	3643.8	20	4090.4	20
2987.9	100	3663.2	20	4099.2	20
2991.6	20 vw	3674.9	20	4102.1	50 vw
2992.7	50	3679.8	20	4107.9	20
2994.9	50	3692.8	20	4108.4	20
2997.7	50	3716.8	20	4128.7	20
3004.6	100	3729.3	20	4129.3	20
3005.7	50	3735.7	20	4139.6	20
3009.5	50	3737.8	20	4160.1	50
3015.2	50	3754.3	20 vw	4161.0	20
3023.5	50	3765.7	20	4161.5	20
3025.3	100	3780.9	20	4164.2	50
3033.6	50	3795.6	20	4176.1	20 vw
3034.3	50	3802.8	20	4192.1	50
3036.7	20	3807.4	20	4196.9	50
3039.0	20	3814.0	20	4197.8	50
3042.0	100	3818.2	20	4205.3	20
3042.7	50	3823.6	20	4210.4	20
3045.6	50	3828.4	20	4217.2	100
3051.8	20 vw	3849.9	50 vw	4230.6	50
3053.5 P	100	3856.9	50 vw	4248.1	100
3054.6 P	100	3868.5	20	4286.7	50
3057.9	20	3875.9	50	4291.3	50
3059.1	20	3892.6	20	4299.4	20
3060.3	20	3905.0	20	4371.7	20
3060.9	20	3908.0	50 vw		
3066.4	50	3909.1	20		

SECTION III

Infrared above 10,000 Angstroms

Wave lengths are given in angstroms

Intensities are shown by the numbers 1 to 10 except where otherwise indicated.
Characteristics of lines are indicated by symbols as follows: 2, 3, 4, etc. unresolved line of 2, 3, or 4 components.

I, II, III, etc. classes of spectra emitted by the neutral, ionized, or doubly ionized atom respectively.

b	widened, not sharp
c	complex, hyperfine structure
d	double
h	hazy
H	very hazy
l	shaded or displaced to longer wave lengths
r	narrow, self reversed
v	violet, shaded or displaced to shorter wave lengths
w	wide, hyperfine structure
W	very wide, hyperfine structure

ALUMINUM

Wave length	Arc
I 11255.	..
I 13125.	..
I 13151.	..
I 16720.	..
I 16752.	..
I 21098.	..
I 21166.	..
I 39108.	..

ANTIMONY

10080.	4
10263.	4
10587.	5
10678.	10
10743.	5
10840.	5
10880.	3
11013.	2
11082.	2
11109.	2
11190.	1
11268.	4
11864.	4
12118.	2

ARGON (4)
King's Intensity Scale

Wave length	Geissler tube
10470.051	500
10478.10	200
10506.47	100
10529.32	50
10673.55	500
10681.78	200
10683.40	50

ARGON (4) (Cont.)
King's Intensity Scale

Wave length	Geissler tube
10700.98	80
10712.77	40
10733.87	50
10759.13	60
10770.35	15
10773.35	30
10861.04	25
10880.96	150
10892.37	30
10947.90	20
10950.74	120
11078.87	200
11106.44	60
11118.75	20
11133.86	20
11248.33	8
11393.66	50
11441.83	80
11467.57	30
11488.12	150
11580.39	8
11668.72	100
11719.51	30
11733.26	20
11943.50	25
12112.31	25
12139.73	20
12402.83	20
12439.34	20
12456.13	15
12487.67	15

BARIUM (2)

Wave length	Arc
King's Intensity Scale	
10001.09	300
10032.12	200
10129.68	10

BARIUM (2) (Cont.)

Wave length	Arc
King's Intensity Scale	
10188.23	50 h
10233.22	500 h,l
10274.04	50 h,l
10349.03	8 h,l
10370.34	10 h
10471.26	100
10649.07	10
1–10 Intensity Scale	
II 10651.	8
10692.	2
11016.	4
11116.	2
I 11304.	2
11608.	2
11886.	5
11978.	2
II 12084.	5
12554.	3
12815.	1
13057.	1
I 13207.	4
13811.	4
13957.	2
14078.	4
14160.	3
14211.	3
14325.	3
I 15000.	4
17065.	1
17182.	1
18204.	2
19075.	2
19988.	3
I 20712.	4
I 21477.	2
22221.	2
22313.	2
23255.	3
I 25516.	5

III. EMISSION SPECTRA ABOVE 10,000 A (Continued)

Barium (Cont.)

Wave length	Arc
26221.	2
27751.	3
I 29224.	5
29791.	4
30469.	2
I 30687.	2
I 30934.	3

Beryllium

10283.	5
10674.	4
12141.	7
12329.	4
12355.	6
13227.	6
14904.	3
15006. 15013.	3
15393. 15400.	6
15951.	..
16794.	2
17571.	2
21560.	3
21897.	2 (2)
22239.	2
23097. 23110.	6

Bismuth

10106.	2
10302.	2
10540.	1
11073.	1
11556.	1
11711.	10
11995.	1
12167.	4
12691.	3
14332.	3
25554.	1

Cadmium

I 10394.6	10
I 11268.	4
I 11630.	2
I 13979.	10
I 14327.	10
I 14354.	8
I 14473.	8
I 14849.	2
I 15154.	10
15258.	7
I 15711.	7
I 16402.	2
I 16432.	6
I 16482.	6
I 39086.	..

Calcium

Wave length	Arc
I 10345.	10
I 12822.	5 (2)
13038.	3
I 16145.	2
I 16162.	2
I 16200.	3
16433.	1
I 19311.	4
I 19453.	5
I 19507.	3
I 19777.	6
19817.	1
I 19857.	4
I 19865.	4
I 19918.	1
I 19936.	3
I 19947.	1
I 22610.	1
I 22625.	3
I 22656.	4

Carbon (15)
King's Intensity Scale

Wave length	Intensity
10683.18	25
10685.44	10
10691.36	50
10707.44	8
10729.59	8

Cesium

Wave length	Arc
I 10026.	10
I 10124.	10
I 13589.	8
I 13605.	..
I 14695.	10
I 29317.	8
I 30103.	6
I 30963.	4
I 34893.	7
I 36128.	2
I 39180.	1
I 42202.	4
I 68070.	2
69310.	2
71110.	1
I 71930.	1
74250.	1

Chromium (12)

King's Intensity Scale

10080.32	15
10486.24	20
10509.96	10

Chromium (12) (Cont.)

Wave length	Arc
King's Intensity Scale	
10647.66	12
10667.53	15
10672.17	18
10801.37	12
10816.91	8
10821.62	12
10905.83	25
10929.90	10
10957.19	12
11015.63	30
11157.03	25
11310.69	12
11331.88	10
11339.16	15
11390.63	15
11397.96	12
11472.93	10
11484.50	15
11610.48	15
1–10 Intensity Scale.	
13462.	2
15680.	3
15861.	3
18479.	3
18584.	3
18654.	3
18717.	2
25460.	2
25490.	1
25560.	1
25584.	2
25665.	1
25709.	1
25785.	1
25816.	1
25850.	2
25902.	1
26232.	2

Cobalt

10020.7	..
10189.2	..
10206.1	..
10210.8	..
10213.3	..
10236.4	..
10272.9	..
10284.6	..
10366.6	..
11275.5	..
11293.5	..
11340.8	..
11453.4	..
11634.	2
11895.	1
14062.	4
14559.	2

III. EMISSION SPECTRA ABOVE 10,000 A (Continued)

COBALT (Cont.)

Wave length	Arc
14611.	4
14681.	2
14958.	3
15210.	2
16133.	5
16257.	5
16388.	3
16447.	2
16574.	3
17005.	5
17080.	3
18176.	3
18274.	2
19779.	3

COLUMBIUM (9)
King's Intensity Scale

10003.85	30 c
10042.54	10 c
10067.4	20 c,d?
10181.33	10 c
10203.44	8 c
10419.54	10 c
10563.7	10 c

COPPER (11)

King's Intensity Scale

10146.78	50 b
10172.00	20

1–10 Intensity Scale

I 16008.	5
I 16653.	4
I 18194.	7
I 18229.	5

HELIUM (4), (5)
King's Intensity Scale

Wave length	Geissler tube
10027.73	40
10031.16	15
10138.50	10
10311.32	40
10667.60	30
10829.081	500
10830.250	1500
10830.341	2500
10912.92	100
10916.98	50
11012.97	30

HELIUM (4), (5) (Cont.)
King's Intensity Scale

Wave length	Geissler tube
11044.95	40
11969.07	20
I 20581.	20
I 40540.	..

HYDROGEN

10900.	..
12817.	..
18751.	..
26300.	..
40500.	..
74000.	..

IRON

Wave length	Arc
10063.	2
10144.	3
11641.	3
11884.	5
11975.	8
12034.	3
13564.	5
13899.	5
14237.	4
14288.	4
14402.	10
14513.	8
14558.	4
14711.	2
14828.	2
15054.	2
15213.	4
15296.	4
15396.	3
15625.	3
15771.	4
15815.	3
15821.	3
16166.	2
16317.	2
25987.	3
26229.	2

King's Intensity Scale (13)

Wave length	Intensity
10469.59	20
10532.21	10
11119.80	10
11439.06	15

IRON (Cont.)
King's Intensity Scale (13) (Cont.)

Wave length	Intensity
11607.57	12
11689.98	8
11973.01	8

KRYPTON (4), (7), (8)
King's Intensity Scale

Wave length	Geissler tube
10017.97	20 H,v
10042.27	20 H,l
10065.96	10
10077.66	10
10120.96	30
10147.68	10
10167.61	10 H
10221.46	1000
10296.93	80
10360.37	100
10361.15	100
10374.44	10
10389.28	8 h
10428.40	10
10592.97	30
10593.01	100
10608.43	20
10626.70	8
10699.33	20
10874.84	20
10874.92	100
11187.13	40
11257.74	80
11259.16	50
11457.52	80
11792.47	10
11819.43	100
11997.15	10
12204.54	10

LANTHANUM (1)
King's Intensity Scale

Wave length	Arc
10005.73	50
10141.20	10
10154.74	40
10184.60	20
10274.85	10
10281.34	10
10294.68	10 d
10349.08	40
10357.70	20

III. EMISSION SPECTRA ABOVE 10,000 A (Continued)

LANTHANUM (1) (Cont.)
King's Intensity Scale

Wave length	Arc
10450.82	20
10461.69	15
10522.09	10
10612.56	10

LEAD

Wave length	Arc
10291.	10
10500.	10
10651.	6
10888.	1
10971.	3
12564.	4
13102.	4
14744.	3
15315.	3

LITHIUM

Wave length	Arc
I 12232.	1
13566.	2
I 17552.	2
18697.	5
I 19290.	1
23991.	2
I 24467.	8
I 26875.	2
26891.	1
I 40475.	1
I 74360.	1

MAGNESIUM

Wave length	Arc
I 10813.	3
I 10963.	1
I 10970.	3
11054.?	2
I 11828.	10
I 12083.	5
I 14877.	10
I 15028.	6
I 15759.	1
I 15768.	4
I 17108.	6
I 23963.	1
I 23977.	1
I 23991.	1

MANGANESE (3)
King's Intensity Scale

Wave length	Arc
10052.9	20 h
10212.34	8 h

MANGANESE (Cont.)
1-10 Intensity Scale

Wave length	Arc
11378.	2
11614.	4
11782.	6
12307.?	..
I 12900.	8
12976.	4
I 13294.	5
I 13318.	3
13416.	8
13500.	10
I 13626.	10
13685.	8
I 13864.	10
I 13997.	10
14970.	3
15218.	8
15263.	10
15965.	10
17336.	8
17608.	2

MERCURY

Wave length	Arc
I 10140.	10
I 11287.	9
I 11888.	1
I 13570.	6
I 13673.	8
I 13950.	4
15295.	5
I 16921.	2 (2)
I 17073.	2
I 17110.	2
18333.	1
19701.	1 (2)
I 23253.	1
36492.	2
I 39425.	10
40159.	8

NEON (4), (7)
King's Intensity Scale

Wave length	Geissler tube
10005.54	20
10007.31	30
10295.40	80
10562.43	200
10620.70	40
10764.09	12
10766.15	10
10798.12	150
10844.54	200
10888.53	8
11020.93	10
11044.06	15
11049.80	20
11143.09	300

NEON (4), (7) (Cont.)
King's Intensity Scale

Wave length	Geissler tube
11160.29	10
11177.59	300
11390.53	110
11409.24	100
11522.82	150
11525.11	90
11536.41	50
11601.62	25
11614.18	80
11688.08	10
11766.87	60
11789.11	50
11789.93	10
11984.99	10
12066.38	15

NICKEL

Wave length	Arc
10195.	5
10301.	3
10330.	3
10378.	4
10980.	5
11198.	4
11591.	3
13553.	2
13722.	5
13829.	3
13969.	2
14102.	2
14874.	3
16313.	2
16363.	10
16409.?	5
16495.	2
16868.	2
16999.	6
17986.	2
18040.	2

OXYGEN

Wave length	Arc
I 11287.	4
I 11294.	2
I 11300.	2
I 13163.	1

POTASSIUM (2)
King's Intensity Scale

Wave length	Arc
10480.3	3 H
10487.7	1 H
11022.3	10 H,W
11690.17	10
11769.41	3
11773.05	15 r

III. EMISSION SPECTRA ABOVE 10,000 A (Continued)

POTASSIUM (Cont.)
1-10 Intensity Scale

Wave length	Arc
I 11028.0	10
I 11689.76	10
I 11771.73	10
I 12434.3	10
I 12523.0	9
I 15165.8	10
27065.6	2
I 27215.0	1
I 31395.	8
I 31596.8	4
I 36372.7	1
I 36626.4	3
I 37075.6	3
I 37354.3	4
I 37370.7	1
I 40115 5	6
I 62030.	2
I 62360.	2
I 64310.	1
I 64610.	1
I 74260.	1
I 84520.	1
I 85100.	1

RHENIUM (3)
King's Intensity Scale

10064.02	10 c,W
10128.78	15
10169.85	100 c,W
10175.68	20 w
10206.32	20
10332.57	10 c,W
10639.44	10 c,W

RUBIDIUM (2)

King's Intensity Scale

10055.2	30 H,v
10076.1	500 H,l
10284.8	4 H,l
10305.3	2 H,l

1-10 Intensity Scale

I 10082.	10
I 13237.	10
I 13444.	10
I 13667.	10
I 14754.	10
I 15290.	10
I 38511.	3
I 39827.	3
I 39898.	6
I 46190.	1
I 46960.	8
I 52313.	2
I 64360.	2
I 65670.	2
72690.	2
I 74280.	3

SILICON (16)
King's Intensity Scale

Wave length	Arc
10288.83	25
10371.23	50
10585.12	100
10603.38	60
10627.81	20 b
10660.98	50
10689.52	20 b
10694.14	50 b
10727.21	75 b
10749.40	60
10786.86	50
10827.09	100
10844.02	25 b
10869.54	125
10885.16	10 b
10979.27	35
11018.00	70
11187.74	20 b
11290.01	10 b
11984.20	20
11991.57	10
12031.49	25

SILVER

I 12551.	1
I 16819.	3
I 17415.	1
I 18307.	1
I 18382.	1
39889.	5
39951.	8

SODIUM (2)

King's Intensity Scale

10745.9	4
10748.7	2
11381.62	6
11403.96	10

1-10 Intensity Scale

Wave length	Arc	Spark
I 18459.5	10	. .
I 40449.	8 r	. .
I 74430.	1 r	. .
I 90480.	. .	3
I 90850.	. .	4

STRONTIUM (2)

Wave length	Arc
King's Intensity Scale	
10036.59	300
10327.29	1000
10914.83	200
1-10 Intensity Scale	
I 11242.	10
17137.	. .
17170.	. .
17446.	. .
I 20262.	10
20705.	. .
20767.	. .
I 26024.	6
26714.	. .
26806.	. .
I 26915.	6
26947.	. .
I 27356.	6
28516.	. .
28964.	. .
I 29225.	6
I 30110.	5
30482.	. .
I 30665.	. .

THALLIUM

I 10292.	6
*I 10492.	5
*I 10496.	8
I 11482.	5
I 11513.	10
I 11594.	8
*11691.	1
I 12492.	2
*12728.	2
I 12736.	10
I 13014.	10
I 14515.	10
I 14593.	1
*I 14598.	3
I 16123.	10
I 16340.	10
*20486.	1
*21397.	1
I 21803.	3
*27024.	1
I 27889.	4
I 33393.	1
*I 35680.	1
*I 35950.	2
I 38131.	5
I 39215.	2
*I 39247.	2
39286.	6
I 51058.	2
I 55590.	1
I 70230.	1
*I 71170.	1

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* Doubtful or uncertain.

III. EMISSION SPECTRA ABOVE 10,000 A (Continued)

Tin

Wave length	Arc
10458.	1
10808.	1
10896.	4
11194.	7
11279.	10
11457.	6
11618.	6
11672.	2
11740.	9
11827.	4
11853.	4
11934.	10
12983.	5
13022.	2

Titanium (14)
King's Intensity Scale

Wave length	Intensity
10120.90	10
10145.48	8
10396.85	25
10460.07	10
10496.14	30
10553.02	8
10584.66	25
10607.78	10
10661.61	20
10677.04	10
10689.52	15
10726.33	18
10732.89	8
10774.92	12
10896.10	8
11243.90	10
11246.88	8
11403.89	8

Vanadium (10)
King's Intensity Scale

Wave length	Arc
10203.45	10
10848.0	20
10993.4	15
11107.7	10

Xenon (4), (6)
King's Intensity Scale

Wave length	Geissler tube
10023.72	50
10060.96	10
10084.79	20
10107.34	80
10125.47	20
10188.36	10
10251.07	20
10484.83	8
10515.15	10
10527.84	40
10549.76	20
10706.78	150
10758.86	100
10838.34	1000
10895.32	200
11085.25	250
11127.20	100
11130.81	8
11141.09	50
11162.67	10
11175.5	1
11214.89	5
11289.10	10
11309.56	5
11415.04	15
11491.22	15
11537.4	1
11614.08	25
11742.26	50
11793.56	10
11857.31	6
11857.86	2
11874.36	1
11912.10	2
11951.1	1
11953.00	3
12084.80	3
12235.24	5
12257.81	1
12623.40	5

Zinc

Wave length	Arc
I 10970.	4
I 10979.	4
I 11054.2	10
I 13053.2	10
I 13150.4	10
I 13197.5	10
I 13781.4	2
I 13786.1	4
I 14038.5	10
I 15679.7	4
I 16485.7	4
I 16503.9	4
16504.0	4

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SPARK SPECTRUM OF AIR

INTERNATIONAL ÅNGSTROMS

Wave length	Intensity	Element	Wave length	Intensity	Element	Wave length	Intensity	Element
2 287.9	1	N	3 727.34	4	O	4 145.90	3	N
2 318.5	1	O	3 729.3	1	N	4 153.5	3	O
2 382.1	2	....	3 749.51	5	O	4 169.36	1	O
2 395.62	1	....	3 754.5	1	O	4 176.2	2	N
2 399.	1	....	3 759.8	1	O	4 185.5	4	O
2 404 9	2	....	3 770.9	1	N	4 189.8	6	O
2 406 9	1	....	3 804.0	1	O	4 199.3	0	N
2 433 6	1	O	3 830.7	1	N	4 206.7	2	N
2 445 5	1	O	3 839.1	2	N	4 211.1	1	N
2 507 2	2	....	3 842.8	1	N	4 223.3	1	N
2 514 5	1	....	3 845.1	0	N	4 228.	2	N
2 599 5	2	....	3 848.04	1	O	4 236.8	3	N
2 739 8	1	....	3 850.6	1	N	4 241.75	2	N
2 746.7	1	....	3 851.2	1	O	4 253.7	2	O
2 749.	1	....	3 856.7	1	N	4 266.4	2	N
2 755.9	2	....	3 864.6	1	O	4 275.9	1	N
2 795.5	1	....	3 882.3	2	O	4 303.7	1	O
2 858.3	1	....	3 893.3	1	N	4 317.11	3	O
2 927.5	1	....	3 907.6	1	O	4 319.62	3	O
3 007.	1	O	3 909.1	1	N	4 325.7	1	O
3 047.0	1	....	3 912.1	3	O	4 327.5	1	O
3 059.15	2	....	3 919.10	6	N	4 328.5	1	O
3 130.1	1	....	3 933.6	9	?	4 331.04	1	N
3 135 3	1	O	3 940.2	1	N	4 331.9	1	O
3 139.3	2	O	3 945.1	1	O	4 336.8	2	O
3 158.7	1	....	3 947.45	1	O	4 345.54	3	O
3 265.2	1	O	3 954.4	1	O	4 347.44	2	O
3 288.9	1	....	3 955.9	4	N	4 348 0	2	N
3 301.9	1	....	3 968.4	1	A(?)	4 349.40	4	O
3 312.5	1	O	3 973.30	4	O	4 351.3	2	O
3 318.8	1	....	3 982.76	2	O	4 361 6	0	N
3 320.7	2	O	3 995.1	10	N	4 366.87	3	O
3 325.	1	O	4 014.0	1	O	4 369.2	1	O
3 329.5	2	N	4 025.7	1	N	4 371.4	1	N
3 331.8	2	N	4 034.9	2	N	4 379.6	1	N
3 344.8	1	...	4 041.3	3	N	4 392.4	0	N(?)
3 354.08	1	O	4 057.8	1	N	4 396.0	1	O
3 365.8	1	N	4 063.2	1	N	4 401.2	1	N
3 367.3	1	N	4 069.90	8	O	4 414.9	6	O
3 370.9	1	N	4 072.25	8	O	4 417 0	5	O
3 374.0	2	N	4 075.93	8	O	4 425.9	1	N
3 377.2	2	O	4 078.9	2	O	4 430.1	1	N
3 390.3	2	O	4 085.20	2	O	4 432 4	2	N
3 408 3	2	O	4 089.1	1	O	4 434.0	0	N
3 437.32	3	N	4 093.00	2	O	4 443.3	1	O
3 450.9	1	....	4 097 2	3	N	4 447 04	6	N
3 471.2	2	....	4 103 3	2	N	4 452 4	2	O
3 491.9	2	....	4 105.00	3	O	4 460.1	1	N
3 514 8	1	....	4 110.84	2	O	4 465.4	2	O
3 560 6	1	....	4 112.09	1	O	4 467.8	2	O
3 570.3	1	....	4 114.0	0	O	4 469.4	1	O
3 577 2	1	....	4 119.3	4	O	4 477.7	1	N
3 589.0	1	....	4 120.5	2	O	4 507.62	2	N
3 594 6	1	....	4 121.5	2	O	4 514.8	2	N
3 609 8	1	....	4 124.1	2	O	4 529.9	2	N
3 639.6	3	....	4 129.5	1	O	4 544.8	1	N
3 702.9	1	....	4 132.88	2	O	4 552.5	2	N
3 707.3	1	O	4 133.70	2	N	4 590.93	3	O
3 709.2	1	O	4 142.2	1	O	4 596.12	3	O
3 712.7	2	O	4 143.7	1	O	4 601.48	4	N

SPARK SPECTRUM OF AIR (Continued)

INTERNATIONAL ÅNGSTROMS

Wave length	Intensity	Element	Wave length	Intensity	Element	Wave length	Intensity	Element
4 607.14	4	N	5 016.4	2	N	5 952.4	4	N
4 609.4	1	N	5 022.9	1	N	6 158.1	0	O
4 613.84	3	N	5 025.7	2	N	6 171.0	2	O
4 621.39	4	N	5 032.	0	....	6 284.3	1	N
4 630.53	10	N	5 045.1	2	N	6 341.5	0	N
4 634.0	1	N	5 061.8	0	N	6 358.1	0	N
4 638.8	2	O	5 073.5	0	N	6 370.7	0	....
4 640.5	1	N	5 136.	0	....	6 379.3	2	N
4 641.8	3	O	5 143.6	0	O	6 456.	0	O
4 643.1	4	N	5 150.	0	....	6 482.0	5	N
4 649.1	4	O	5 160.1	0	O	6 563.2	3	H
4 650.8	2	O	5 172.	1	N	6 610.4	6	N
4 654.5	1	N	5 173.4	1	N	6 640.7	0	....
4 661.6	5	O	5 175.9	2	N	6 654.8	2	....
4 674.9	1	N	5 179.4	1	N	6 721 2	1	....
4 676.2	3	O	5 183.2	0	O	6 811.9	0	....
4 697.6	0	N(?)	5 185.1	0	N	6 864.	0	....
4 699.2	3	O	5 190.6	1	N	6 887.6	1	....
4 703.1	0	O	5 206.5	1	O	6 950.	0N	....
4 705.1	1	N	5 250.6	1	N(?)	6 965.9	1	A
4 705.4	3	O	5 263.	0	....	7 067.6	0	A
4 709 9	2	O	5 281.7	0	N	7 157.4	9	O(?)
4 718.4	2	N	5 320.5	1	N	7 384.5	1	A
4 735.7	1	N	5 325.1	0	O	7 424.0	8	N
4 751.2	1	O	5 328.6	0	N	7 432.9	0	....
4 764.6	1	N	5 338.7	1	N	7 442.7	10	N
4 774.2	1	N	5 341.2	1	N	7 458.7	0	....
4 779.8	2	N	5 351.2	0	N	7 468.7	10	N
4 781.2	0	N(?)	5 356.4	0	N	7 479.	0	O
4 788.2	4	N	5 411.5	1	N	7 505.8	0	A
4 793.7	2	N	5 432.1	0	N(?)	7 515.2	0	A
4 803.3	5	N	5 452.1	1	N	7 635.7	1	A
4 805.9	1	N	5 454.1	1	N	7 772.1	10	O
4 810.3	2	N	5 462.8	1	N	7 774.3	7	O
4 847.7	1	N(?)	5 478.1	0	N	7 775.6	6	O
4 856.8	1	O	5 480.1	1	N	7 947.8	4	O
4 860.3	1	N	5 495.7	2	N	7 951.1	3	O
4 871.6	0	O	5 526.2	2	N	7 952.3	2	O
4 879 7	1	N	5 530.2	3	N	8 185.3	4	N
4 890.9	0	O	5 535.2	5	N	8 188.4	4	N
4 895.3	1	N	5 543.4	3	N	8 200.7	1	N
4 906.8	1	O	5 552.0	2	N	8 211.1	2	N
4 924.6	2	O	5 566.	0	N	8 216.7	7	N
4 934.8	1	N	5 592.3	0	O	8 223.5	4	N
4 941 0	1	N	5 645.6	1	N	8 230.2	0	O
4 942.5	1	N	5 666.6	5	N	8 242.8	4	N
4 943.0	1	O	5 675.9	3	N	8 446.8	5	O
4 955.	1	O	5 679.5	10	N	8 594.	0	....
4 964.7	0	N	5 686.2	3	N	8 630.0	0	....
4 987.4	1	N	5 710.7	2	N	8 680.6	2	N
4 991.3	1	N	5 730.6	2	N	8 683.7	1	N
4 994.4	3	N	5 747.5	1	N	8 686.4	0	N
5 001.4	6	N	5 767.4	2	N	8 692.	0	....
5 005.2	6	N	5 927.8	4	N	8 703.8	0	N
5 007.4	3	N	5 931.8	7	N	8 712.0	0	N
5 010.6	2	N	5 940.5	1	N	8 719.2	0	N
5 013.9	0	....	5 941.6	10	N			

STANDARD WAVE LENGTHS

Primary Standard

Wave length of the red cadmium line in air, 760 mm. pressure 15°C., measures of Benoit, Fabry and Perot 1907,

6438.4696 Ångström units

Secondary Standards

Lines of the Iron Arc

Selected lines from list by Ch. Fabry: *International Critical Tables,* 1929. Wave lengths in international Ångströms, atmospheric pressure, 15°C.

Wave-length	Wave-length	Wave-length	Wave-length	Wave-length
3370.789	3935.816	4592.655	5232.948	6065.489
3399.337	3977.744	4602.945	5266.564	6137.697
3485.343	4021.870	4647.437	5371.493	6191.563
3513.821	4076.638	4691.414	5405.779	6230.729
3556.882	4118.549	4707.282	5434.527	6265.141
3606.682	4134.680	4736.782	5455.613	6318.023
3640.392	4147.673	4789.654	5497.520	6335.338
3676.314	4191.436	4878.219	5506.783	6393.606
3677.630	4233.609	4903.318	5569.626	6430.852
3724.381	4282.406	4919.001	5586.763	6494.985
3753.615	4315.087	5001.872	5615.652	6546.245
3805.346	4375.933	5012.072	5658.825	6592.920
3843.261	4427.313	5049.825	5709.396	6677.994
3850.820	4466.556	5083.343	5763.013	6750.157
3865.527	4494.568	5110.414	5857.759 Ni	
3906.482	4531.152	5167.491	5892.882 Ni	
3907.937	4547.851	5192.353	6027.058	

Iron, Wave Lengths in the Ultraviolet Spectrum

The following table presents the results of interferometer measurements made by Meggers and Humphreys and reported in the Jour. Research of B. of S. **18**, 543, 1937. The standard iron arc was used as a source and the wave lengths in air at 15°C. and 76 mm are given in international Ångströms.

λ_{air} A	λ_{air} A	λ_{air} A	λ_{air} A
2100.795	2163.368	2240.627	2287.632
2102.349	2163.860	2245.651	2291.122
2108.955	2164.547	2248.858	2292.5227
2110.233	2165.861	2249.177	2293.8454
2112.966	2172.581	2253.1251	2294.4059
2115.168	2173.212	2255.861	2296.9247
2130.962	2176.837	2259.511	2297.785
2132.015	2180.866	2260.079	2299.2180
2135.957	2183.979	2264.3894	2300.1397
2138.589	2186.890	2265.053	2301.6818
2139.695	2187.192	2270.8601	2303.4225
2141.715	2191.202	2271.781	2303.579
2145.188	2196.040	2272.0670	2308.9971
2147.787	2200.7227	2274.0085	2313.1022
2150.182	2201.117	2276.0247	2320.3561
2151.099	2207.068	2277.098	2327.3940
2153.004	2210.686	2279.922	2331.3067
2154.458	2211.234	2283.653	2332.7975
2157.792	2228.1704	2284.087	2338.0052
2161.577	2231.211	2287.2477	2344.2802

STANDARD WAVE LENGTHS (Continued)

Iron, Wave Lengths in the Ultraviolet Spectrum (Continued)

λ_{air} A	λ_{air} A	λ_{air} A	λ_{air} A
2354.8888	2584.5349	2863.864	3191.6583
2359.1039	2585.8753	2869.3075	3196.9288
2359.997	2598.3689	2874.1722	3200.4741
2360.294	2611.8725	2877.3005	3205.3992
2362.019	2613.8240	2894.5050	3215.9398
2364.8269	2617.6160	2895.0352	3217.3796
2366.592	2621.6690	2899.4156	3222.0682
2368.595	2625.6663	2912.1581	3225.7883
2370.497	2628.2923	2920.6906	3236.2226
2371.4285	2635.8082	2929.0081	3239.4362
2374.517	2643.9972	2941.3430	3244.1887
2375.193	2647.5576	2953.9400	3254.3628
2379.2756	2651.7059	2957.3654	3257.5937
2380.7591	2662.0563	2959.9924	3271.0014
2384.386	2673.2127	2965.2551	3280.2613
2388.6270	2679.0608	2981.4448	3284.5892
2389.9713	2689.2117	2987.2919	3286.7538
2399.2396	2699.1060	2990.3923	3298.1328
2404.430	2706.5812	2999.5123	3305.971
2406.6593	2711.6548	3003.0311	3306.356
2410.5172	2714.413	3009.5698	3314.7421
2411.0663	2718.4352	3015.9129	3323.7374
2413.3087	2723.5770	3024.0330	3328.8669
2431.025	2727.540	3030.1491	3337.6655
2438.1811	2735.473	3037.3891	3340.5659
2442.5674	2739.5467	3040.4281	3347.9262
2443.8707	2746.4833	3047.6059	3355.2285
2447.7086	2746.9823	3055.2631	3370.7845
2453.4746	2749.325	3057.4452	3380.1111
2457.5956	2755.7366	3059.0874	3383.9808
2465.1479	2763.1078	3067.2433	3396.9772
2468.8782	2767.5208	3075.7204	3399.3343
2474.8131	2778.2205	3083.7419	3401.5196
2487.0643	2781.8347	3091.5777	3407.4608
2496.5324	2797.7751	3116.6329	3413.1335
2507.8987	2804.5200	3125.653	3427.1207
2519.6279	2806.9840	3134.1113	3443.8774
2530.6938	2813.2861	3143.9896	3445.1506
2542.1007	2823.2753	3157.0388	3465.8622
2551.0936	2832.4350	3160.6582	3476.7035
2562.5348	2838.1193	3175.4465	3485.3415
2575.7442	2845.5945	3178.0137	3490.5746
2576.1033	2851.7970	3184.8948	3497.8418

Iron, Wave Lengths in the Infrared

From interferometer measurements by Meggers, Jour. Research of B. of S. **14,** 33, 1935. The integrated light from the iron arc was used as a source. Wave lengths in air at 15°C and 760 mm are given as well as the intensity.

λ_{air} A	Intensity	λ_{air} A	Intensity	λ_{air} A	Intensity
7164.469	250	7418.674	5	7583.796	50
7187.341	800	7445.776	200	7586.044	150
7207.406	500	7495.088	400	7620.538	25
7389.425	80	7511.045	800	7661.223	30
7401.689	4	7531.171	60	7664.302	80
7411.178	100	7568.925	30	7710.390	25

STANDARD WAVE LENGTHS (Continued)

Iron, Wave Lengths in the Infrared (Continued)

λ_{air} A	Intensity	λ_{air} A	Intensity	λ_{air} A	Intensity
7748.281	125	8387.781	1200	9089.413	30
7780.586	300	8439.603	20	9118.888	25
7832.224	400	8468.413	300	9147.800	2 *n*
7912.866	6	8514.075	150	9210.030	6
7937.166	700	8526.685	8	9258.30	10 *n*
7945.878	600	8582.267	15	9350.46	6
7994.473	20	8611.807	40	9359.420	3
7998.972	700	8621.612	10	9362.370	4
8028.341	50	8661.908	600	9372.900	6
8046.073	600	8674.751	60	9430.08	3
8080.668	10 *n*	8688.633	1500	9513.24	8 *n*
8085.200	500	8757.192	25	9569.960	15 *n*
8096.874	10	8764.000	20 *n*	9626.562	12 *n*
8198.951	80	8793.376	25 *n*	9653.143	15
8207.767	40	8804.624	......	9738.624	100
8220.406	1500	8824.227	250	9753.129	10
8232.347	50	8838.433	30	9763.450	10
8239.130	8	8866.961	60	9763.913	12
8248.151	30	8945.204	10 *n*	9800.335	8 *n*
8293.527	20	8975.408	10	9861.793	12
8327.063	1200	8999.561	200	9889.082	15
8331.941	200	9012.098	10	10065.080	30
8339.431	80	9079.599	4	10145.601	40
8360.822	8	9088.326	50	10216.351	50
8365.642	25				

Helium

Merrill. Bulletin 14, Bureau of Standards 1917.

λ_{air}	λ_{air}	λ_{air}	λ_{air}
2945.104	3888.646	4387.928	5047.736
3187.743	3964.727	4471.479	5875.620
3613.641	4026.189	4713.143	6678.149
3705.003	4120.812	4921.928	7065.188
3819.606	4143.759	5015.675	7281.349

From Meggers and Humphreys, Jour. Research of B. of S **13.** 293, 1934.

λ_{air} A	λ_{air} A	λ_{air} A	λ_{air} A
10829.081	10830.250	10830.341	. . . .

Neon

From Meggers and Humphreys, Jour Research of B. of S **13.** 293, 1934. The source was an "end on" Geissler tube. Values are given for the wave length in air at 15°C and 760 mm pressure, and referred to the primary standard (Cd 6438.4696 A) and also to the red lines of neon. For complex lines the value for the principal component is given.

λ_{air} A Ne Std.	λ_{air} A Cd Std.	λ_{air} A Ne Std.	λ_{air} A Cd Std.	λ_{air} A Ne Std.	λ_{air} A Cd Std.
4334.125	....	4395.556	....	4425.400	....
4363.524	....	4422.519	....	4433.721	....
4381.220	....	4424.800	....	4460.175	....

STANDARD WAVE LENGTHS (Continued)

Neon (Continued)

λ_{air} A Ne Std.	λ_{air} A Cd Std.	λ_{air} A Ne Std.	λ_{air} A Cd Std.	λ_{air} A Ne Std.	λ_{air} A Cd Std.
4466.807	....	4957.0334	....	5965.474	....
4475.656	....	4957.122	....	5974.628	....
4483.190	....	4994.930	....	....	5975.5343
4488.0928	....	5005.160	....	5987.9069	....
4500.182	....	5011.003	....	....	6029.9968
4517.736	....	5022.870	....	....	6074.3376
4525.764	....	5031.3484	....	....	6096.1630
4537.751	....	5037.7505	....	6128.4513	6128.4502
4540.376	....	5074.200	....	....	6143.0627
4552.598	....	5080.383	....	....	6163.5937
4565.888	....	5104.705	....	6182.146	....
4573.759	....	5113.675	....	....	6217.2812
4575.060	....	5116.503	5116.501	....	6266.4952
4582.035	....	5122.257	....	....	6304.7893
4582.450	....	5144.9376	....	....	6334.4276
4609.910	....	5151.963	....	....	6382.9914
4614.391	....	5154.422	....	6402.247	6402.248
4617.837	....	5156.664	....	....	6506.5277
4628.309	....	5188.612	....	....	6532.8824
4636.125	....	5193.130	....	....	6598.9528
4636.634	....	5193.224	....	....	6678.2766
4645.416	....	5203.8950	....	....	6717.0430
4649.904	....	5208.863	....	....	6929.4679
4656.3923	....	5210.573	....	7024.0508	....
4661.104	....	5222.351	....	7032.4134	7032.4125
4670.884	....	5234.028	....	7059.109	7059.108
4678.218	....	5298.190	....	7173.9389	7173.9390
4679.135	....	5304.756	....	7245.1668	7245.1668
4687.671	....	5326.396	....	7438.8990	7438.8988
4704.395	....	5330.7766	5330.778	7488.8722	7488.8717
4708.854	....	5341.091	5341.093	7535.7750	7535.774
4715.344	....	5343.284	....	7544.046	....
4725.145	....	5355.422	....	7943.1802	7943.1802
4749.572	....	5360.012	....	8082.4580	8082.4585
4752.7313	....	5374.975	....	8118.5495	8118.549
4758.728	....	5400.5619	5400.5620	8136.4060	8136.4058
4780.338	....	5433.649	....	8259.380	....
4788.9258	....	5448.508	....	8266.076	8266.077
4790.218	....	5562.769	....	8300.3258	8300.3257
4800.111	....	5656.6585	....	8377.6068	8377.6070
4810.0625	....	5662.547	....	8418.4274	8418.4275
4817.636	....	5689.8164	5689.817	8495.3600	8495.3604
4821.924	....	5719.2254	5719.224	8591.2584	8591.2585
4827.338	....	5748.299	5748.298	8634.6480	8634.649
4827.587	....	5764.418	5764.4182	8654.3835	8654.383
4837.3118	....	5804.4488	5804.450	8679.491	....
4852.655	....	5820.1548	5820.1553	8681.920	....
4863.074	....	....	5852.4878	8780.6223	8780.6220
4865.505	....	5872.828	....	8783.755	8783.755
4866.476	....	....	5881.8950	8853.867	8853.864
4884.915	....	5902.464	5902.4634	8865.759	....
4892.090	....	5906.429	....	9486.680	....
4928.235	....	5913.633	....	9535.167	....
4939.041	....	....	5944.8340	9665.424	....
4944.987	....				

STANDARD WAVE LENGTHS (Continued)

Neon$_{\text{I}}$, Ultraviolet Lines

From Humphreys, Jour. Research of B. of S. **20,** 17, 1938. The source was an "end on" Geissler tube. Values are given for the wave length in dry air at 15°C and 760 mm of Hg pressure and referred to the Krypton secondary standards.

λ_{air} A	λ_{air} A	λ_{air} A	λ_{air} A
3369.8086	3450.7653	3501.2165	3609.1793
3369.9081	3454.1952	3510.7214	3633.6646
3375.6498	3460.5245	3515.1908	3682.2428
3417.9036	3464.3389	3520.4717	3685.7359
3418.0066	3466.5786	3593.5259	3701.2250
3423.9127	3472.5711	3593.6398	3754.2160
3447.7029	3498.0644	3600.1693	

Argon

From Meggers and Humphreys, Jour. Research of B. of S. **13,** 293, 1934.

λ_{air} A Ne Std.	λ_{air} A Cd Std.	λ_{air} A Ne Std.	λ_{air} A Cd Std.	λ_{air} A Ne Std.	λ_{air} A Cd Std.
3948.977	....	4887.9465	....	7030.262	....
4044.4173	....	5162.2845	....	7067.2170	7067.2177
4054.5250	....	5187.7458	....	7147.0406	7147.0412
4158.5896	4158.5895	5221.270	....	7272.9357	7272.9356
4164.1788	4164.1789	5252.786	....	7372.117	....
4181.8826	4181.8825	5421.346	....	7383.9800	7383.9800
....	4190.7098	5451.650	....	7503.8676	7503.8667
....	4191.0270	5495.8720	....	7514.6510	7514.653
4198.316	4198.3160	5506.112	....	7635.1053	7635.1055
4200.674	4200.6738	5558.702	....	7723.7597	7723.761
4251.1842	....	5572.548	....	7724.2064	7724.206
4259.3603	4259.3607	5606.732	....	7891.075	....
4266.2853	4266.2855	5650.7034	....	7948.1754	7948.1756
4272.1680	4272.1678	5739.517	....	8006.1556	8006.155
4300.0995	4300.1000	5834.263	....	8014.7856	8014.785
4333.5595	4333.5601	5860.315	....	8053.307	....
4335.3370	4335.3363	5888.592	....	8103.6922	8103.6922
4345.1666	....	5912.084	....	8115.3115	8115.3095
4363.7936	....	5928.805	....	8264.5209	8264.5210
4423.9936	....	6032.124	....	8408.208	8408.207
4510.7322	4510.7324	6043.230	....	8424.647	8424.646
4522.3216	....	6052.721	....	8521.4407	8521.4406
4589.2884	....	6059.373	....	8667.9430	8667.9435
4596.0964	....	6105.645	....	9122.9660	9122.9664
4628.4398	....	6170.183	....	9224.498	9224.498
4702.3151	....	6173.106	....	9354.218	....
4752.9381	....	6416.315	....	9657.7841	....
4768.6716	....	6752.832	....	9784.5010	....
4876.2596	....	6965.4302	6965.4304	10470.051	....

STANDARD WAVE LENGTHS (Continued)

Argon$_{I}$

From Humphreys, Jour. Research of B. of S. **20.** 17, 1938. The source was an "end on" Geissler tube. Values are given for the wave length in dry air at 15°C and 760 mm of Hg pressure, referred to the Krypton secondary standards.

λ_{air} A	λ_{air} A	λ_{air} A	λ_{air} A
3319.3446	3690.8957	4158.5906	4272.1690
3373.481	3770.3688	4164.1800	4300.1011
3393.7517	3781.3609	4181.8838	4333.5612
3461.0780	3834.6785	4190.7127	4335.3380
3554.3061	3894.6602	4191.0296	4345.1682
3567.6565	3947.5043	4198.3170	4510.7333
3606.5224	3948.9788	4200.6751	4522.3238
3632.6837	4044.4182	4251.1852	4596.0970
3634.4605	4045.9658	4259.3618	4628.4410
3649.8324	4054.5254	4266.2867	4702.3164

Krypton

Meggers, Journal Optical Society of America, 1921.

λ_{air} A	λ_{air} A	λ_{air} A	λ_{air} A
4273.9696	4362.6422	4502.354	6456.290
4282.967	4376.122	4807.065	7587.414
4318.552	4399.969	5562.224	7601.544
4319.580	4453.9174	5570.2872	
4355.478	4463.690	5870.9137	

Krypton$_{I}$

From Hunphreys. Jour. Research of B. of S. **20,** 17. 1938. The source was the "end on" Geissler tube. Values are given for the wave length in air at 15°C and 760 mm of Hg pressure.

λ_{air} A	λ_{air} A	λ_{air} A	λ_{air} A
3424.9433	3615.4755	3796.8839	4184.4726
3431.7217	3628.1570	3800.5437	4263.2881
3434.1423	3632.4896	3812.2155	4302.4455
3495.9900	3665.3259	3837.7028	4410.3685
3502.5537	3668.7363	3837.8162	4416.8838
3503.8981	3679.5609	3845.9778	4418.7626
3511.8963	3679.6111	3982.1699	4425.1908
3522.6747	3698.0452	3991.0797	4550.2985
3539.5416	3773.4241	3991.2581	4812.6367
3540.9538			

Titanium, Vacuum Arc Spectrum

From the measurements by Kiess. Jour. Research ot B. of S. **1,** 75. 1928. Wave lengths in air at 15°C. 760 mm.

λ_{air} A	Intensity	λ_{air} A	Intensity	λ_{air} A	Intensity
2941.995	60 *r*	3075.225	40	3130.804	15
2948.255	60 *r*	3078.645	45	3148.033	12
2956.133	70 *R*	3088.027	60	3161.755	20

STANDARD WAVE LENGTHS (Continued)

Titanium, Vacuum Arc Spectrum (Continued)

λair A	Intensity	λair A	Intensity	λair A	Intensity
3168.519	30	3694.445	10	4282.702	12
3186.451	60 *r*	3717.393	20	4286.006	25
3190.801	20	3722.568	15	4287.405	22
3191.994	80 *R*	3724.570	20	4289.068	25
3199.915	100 *R*	3725.155	20	4294.101	8
3202.535	12	3729.806	50 *r*	4295.751	22
3214.240	12	3741.059	60 *r*	4298.664	40
3217.056	15	3752.860	80 *r*	4305.910	60
3222.843	15	3759.291	40	4307.900	12
3229.397	10	3761.320	40	4312.861	7
3234.517	60	3771.652	25	4314.801	25
3236.573	50	3786.043	20	4318.631	10 *n*
3239.037	40	3798.276	6	4321.655	8 *n*
3241.984	40	3866.446	15 *n*	4325.134	9 *n*
3261.596	25	3875.262	20 *n*	4337.916	10
3287.657	10	3895.243	30 *n*	4346.104	5
3292.078	20	3900.546	50	4360.487	4
3314.422	10	3904.785	40 *n*	4369.682	5 *n*
3318.024	8	3913.464	40	4372.383	3
3322.936	20	3914.334	35	4393.925	8
3326.762	5	3921.423	30	4395.031	25
3329.455	20	3924.527	50	4399.767	3
3332.111	8	3929.875	40	4417.274	15
3335.192	20	3947.770	40	4421.754	6
3340.344	15	3948.670	60	4422.823	10
3341.875	50 *r*	3956.336	60	4426.054	10
3349.399	40	3958.206	80	4427.098	40
3354.634	60 *r*	3962.851	35	4430.366	7
3358.271	10	3964.269	35	4434.003	15
3361.213	40	3981.761	70 *R*	4436.586	4
3370.436	40 *r*	3989.758	80 *R*	4440.345	10
3371.447	80 *R*	3998.635	100 *R*	4443.802	25
3377.577	30 *r*	4008.926	35	4449.143	30
3380.278	15	4013.587	12 *n*	4450.896	25
3383.761	40	4015.377	12 *n*	4453.312	30
3385.944	40 *r*	4017.771	15 *n*	4453.708	20
3387.834	15	4024.573	35	4455.321	30
3394.574	15	4026.539	25 *n*	4457.428	40
3444.306	15	4030.512	25 *n*	4465.807	20
3461.496	20	4035.828	10	4468.493	25
3477.181	15	4055.011	20	4471.238	20
3480.525	12	4058.139	7	4474.852	8
3491.053	8	4060.263	20	4481.261	30
3504.890	8	4065.094	15	4482.688	10
3510.840	10	4078.471	30	4489.089	20
3535.408	10	4082.456	20	4496.146	20
3547.020	15	4099.166	8	4501.270	25
3596.048	10	4112.708	20	4503.762	4 *n*
3598.714	15	4122.143	10	4512.734	40
3610.154	12	4127.531	15	4518.022	50
3624.826	8	4137.284	10 *n*	4522.798	40
3635.462	80 *r*	4150.963	10	4527.305	35
3641.330	10	4159.634	9	4533.238	80
3642.675	80 *r*	4163.644	8	4544.688	30
3646.198	12	4171.897	5	4548.764	35
3653.497	100 *r*	4186.119	25	4549.622	25
3654.592	15	4237.889	7	4552.453	35
3658.097	20	4249.114	5 *n*	4555.486	30
3660.631	12	4256.025	8 *n*	4559.920	6
3668.965	15	4258.523	4 *n*	4563.761	15
3671.672	20	4263.134	15	4571.971	15
3685.192	40	4274.584	15	4599.226	5
3689.916	15	4281.371	10	4617.269	30

STANDARD WAVE LENGTHS (Continued)
Titanium, Vacuum Arc Spectrum (Continued)

λ_{air} A	Intensity	λ_{air} A	Intensity	λ_{air} A	Intensity
4623.098	25	5014.185	25	5512.529	25
4629.335	15	5014.277	25	5565.476	9
4645.193	12	5016.162	20	5644.137	18
4656.468	25	5020.028	25	5648.570	5
4667.585	25	5022.871	25	5662.154	12
4675.118	10	5024.842	20	5675.413	9
4681.908	30	5025.570	18	5689.465	10
4691.336	20	5035.908	25	5715.123	9
4698.766	20	5036.468	25	5739.464	9
4710.186	18	5038.400	25	5766.330	4 *n*
4715.295	4	5039.959	22	5774.037	5 *n*
4731.172	9	5052.879	8	5785.979	5 *n*
4742.791	20	5062.112	7	5804.265	5 *n*
4758.120	25	5064.654	25	5866.453	35
4759.272	25	5087.055	8	5899.295	25
4778.259	10	5113.448	10	5903.317	5
4792.482	10	5120.420	12	5918.548	10
4799.797	12	5145.465	12	5922.112	18
4805.416	12	5147.483	10	5937.806	6
4820.410	20	5173.742	30	5941.755	12
4840.874	25	5192.971	35	5953.162	30
4856.012	20	5210.386	40	5965.828	30
4868.264	18	5224.301	15	5978.543	25
4870.129	20	5224.928	8	5999.668	8
4885.082	20	5265.967	10	6064.631	9
4899.910	20	5283.441	8	6085.228	20
4913.616	20	5295.781	4	6091.175	20
4919.867	10	5297.236	6	6126.217	20
4921.768	12	5298.429	4	6258.103	40
4928.342	12	5369.635	4	6258.706	50
4938.283	8	5389.996	3	6261.101	35
4975.344	10	5397.093	4	6303.754	10
4978.191	10	5409.609	6	6312.240	10
4981.732	60	5429.139	6	6336.104	8
4991.067	50	5477.695	8	6366.354	8
4997.099	8	5481.426	6	6546.276	20
4999.504	45	5488.210	5	6554.226	30
5007.209	40	5490.151	12	6556.066	25
5009.652	7	5503.897	8	6743.124	10

Xenon

Meggers, Journal Optical Society of America, 1921

λ_{air}	λ_{air}	λ_{air}
4500.978	4624.275	4807.019
4524.680	4671.225	4829.705
4582.746	4697.020	4844.333
4603.028	4734.154	4923.246

Wave Lengths in the Vacuum Ultraviolet

J. C. Boyce, Rev. Mod. Phys. 13, 34, (1941)

Copper (Shenstone, 1936)

λA	Intensity	P.E. in .001 A	λA	Intensity	P.E. in .001 A	λA	Intensity	P.E. in .001 A
685.139	8	2	1065.781	20	1	1393.126	10	2
685.396	2	2	1066.133	20	2	1399.355	3	2
724.487	15	2	1069.193	50	2	1402.776	15	2
735.519	20	2	1088.393	20	2	1442.136	15	2
736.031	25	2	1106.446	3	2	1444.131	2	2
810.997	15	2	1109.742	1	2	1473.976	25	2
813.882	20	2	1185.899	2	2	1496.686	35	4
826.995	30	2	1214.553	1	2	1517.630	20	2
866.440	5	2	1219.332	1	2	1519.491	50	2
876.719	20	2	1241.961	2	1	1535.004	25	2
883.837	5	2	1248.790	5	2	1540.391	30	2
884.824	5	2	1250.045	10	2	1541.701	75	2
911.654	1	2	1265.504	15	1	1558.344	30	2
912.022	0	2	1266.308	10	1	1565.925	40	2
992.951	25	1	1274 069	3	2	1566.411	40	2
1001.010	8	1	1274.463	3	2	1569.216	10	2
1004.053	30	1	1275.570	30	2	1590.164	40	3
1008.568	30	1	1281.458	8	4	1593.557	60	3
1011.433	2	1	1297.549	2	2	1598.402	40	3
1012.595	25	1	1298.394	15	2	1602.387	40	3
1018.705	50	1	1299.267	10	2	1604.848	20	3
1019.652	15	1	1308.296	30	2	1606.834	40	3
1022.100	5	1	1309.463	15	2	1608.638	25	3
1027.830	50	1	1314.147	15	2	1610.298	15	3
1028.326	25	1	1314.335	30	2	1617.914	20	3
1031.764	8	1	1325.511	3	2	1621.426	60	3
1035.160	8	1	1326.394	10	2	1649.457	25	3
1036.468	60	1	1350.592	15	2	1656.326	20	3
1039.345	60	2	1351.837	25	2	1660.005	20	3
1044.742	80	1	1355.304	15	2	1663.003	30	3
1049.363	20	2	1359.010	20	2	1944.586	25	4
1049.754	50	1	1359.935	5	2	1970.489	15	4
1054.690	60	1	1362.598	20	2	1979.947	50	4
1055.795	40	2	1363.501	5	2	1989.849	30	4
1058.796	40	2	1370.558	2	2	2000.339	60	4
1059.094	60	1	1371.840	20	2			

STANDARD WAVE LENGTHS (Continued)

Iron (Green, 1939)

λA	Intensities		λA	Intensities		λA	Intensities	
	Schüler tube	Spark		Schüler tube	Spark		Schüler tube	Spark
1550.273	1	..	1637.398	15	2	1702.044	25	25
1559.084	20	2	1640.150	12	2	1709.551	0	..
1563.788	25	2	1643.576	15	2	1712.998	20	25
1566.821	20	1	1652.482	0	..	1718.100	2	..
1568.017	8	..	1654.476	5	1	1720.611	20	20
1569.674	12	..	1658.771	15	2	1724.962	8	1
1570.244	20	1	1659.479	20	10	1726.391	12	8
1572.754	1	..	1663.220	15	2	1815.411	0	1
1573.826	5	..	1670 990	1	..	1818.516	2	1
1574.769	0	..	1674.254	2	1	1826.994	1	1
1574.921	20	1	1676.854	1	..	1833.073	0	..
1577.167	1	..	1685.952	5	1	1842.283	0	..
1584.949	15	..	1686.454	8	1	1848.771	12	2
1612.805	20	8	1691.272	8	1	1851 526	1	..
1623.090	8	1	1693.475	0	..	1859 744	15	10
1625.520	20	8	1693.935	0	..	1898.535	10	2
1632.665	1	..	1696 794	8	..	1903.384	1	..
1633.906	15	2	1699.195	2	..	1904.785	15	5
						2001.025	30	30

Hydrogen

(Paschen, 1929)

λA	λA
923.148	949.739
926.222	972.532
930.745	1025.717
937.799	1215.664

Helium

(He II)(Paschen, 1929)

λA	λA	λA
234.3452	949.326	1084.940
237.3297	958.696	1215.129
243.0244	972.109	1640.409
256.3145	992.361	
303.7788	1025.270	

Carbon, Nitrogen, Oxygen (More and Rieke, 1936)

El.	λA	Int.	El.	λA	Int.	El.	λA	Int.
O II	832.764	0	N I	1176.502	1	C II	1335.703	18*d*
O II	833.332	1	N I	1199.550	7	N I	1494.670	4
O II	834.467	2	N I	1200.218	6	C I	1560.313	8*d*
O I	990.205	4*d*	N I	1200.707	5	C I	1560.702	15*d*
O I	990.794	3	O I	1217.643	2	C I	1656 271	8*d*
O I	999.493	2	O I	1302.174	8	C I	1656.994	15*d*
N II	1083.996	2	O I	1304.858	8	C I	1657.388	5*d*
N II	1084.582	3	O I	1306.023	6	C I	1657.908	8*d*
N I	1134.168	3	C I	1328.820	3	C I	1658.135	8*d*
N I	1134.417	3	C I	1329.099	5			
N I	1134.979	4	C II	1334.534	15*d*			

PERSISTENT LINES OF THE ELEMENTS

Spectra of the neutral atom, the singly ionized atom, and the doubly ionized atom are indicated by I, II, and III, respectively. The most sensitive lines are indicated by an asterisk (*). The symbol "D" preceding the intensity indicates the discharge-tube spectrum. Wave lengths are given in International Ångstrom units.

Wave lengths and intensities of lines between 2000 and 9999 ångstroms have been given according to the M.I.T. Wavelength Tables.

ARRANGED BY ELEMENTS

Element	Wave length	Intensity	
		Arc	Spark
A I	*1048.26		
	1066.70		
	6965.430	....	D 400
	7067.217	....	D 400
	7503.867	....	D 700
	8115.311	....	D 5000
Ag I	*3280.683	2000	1000
	3382.891	1000	700
	5209.067	1500	1000
	5465.487	1000	500
Ag II	2246.412	25	300
	*2437.791	60	500
Al I	3082.155	800	800
	3092.713	1000	1000
	3944.032	2000	1000
	*3961.527	3000	2000
Al II	1671.0		
	1856.00		
	1858.13		
	1862.48		
	2631.553	....	40
	*2669.166	3	100
	2816.179	10	100
	6231.76	....	30
	6243.36	....	100
Al III	1854.67		
	1862.90		
As I	1889.9		
	*1890.5		
	1936.9		
	1972.0		
	2288.12	250	5
	2349.84	250	18
	2369.67	40	
	2370.77	50	3
	2456.53	100	8
	2780.197	75	75
	2860.452	50	50
	2898.71	25	40
Au I	*2427.95	400	100
	2675.95	250	100
	2802.19	....	200
B I	2496.778	300	300
	*2497.733	500	400
B II	1362.46		
	3451.41	5	30
	3452.33		
Ba I	3071.591	100	50
	5424.616	100	30
	5519.115	200	60
	*5535.551	1000	200
	5777.665	500	100
Ba II	2304.235	60	80
	2335.269	60	100
	3891.785	18	25
	4130.664	50	60
	*4554.042	1000	200
	4934.086	400	400
Be I	*2348.610	2000	50
	2650.781	25	
	3321.013	50	
	3321.086	100	
	3321.343	1000	30
Be II	*3130.416	200	200
	3131.072	200	150
Bi I	2061.70	300	100
	2276.578	100	40
	2780.521	200	100
	2809.625	200	100
	2897.975	500	500
	2938.298	300	300
	2989.029	250	100
	*3067.716	3000	2000
	4722.552	1000	100
Bi II	1909.41		
Br I	1540.8		
	1633.8		
Br II	*4704.86	....	D 250
	4785.50	....	D 400
	4816.71	....	D 300
C I	*2478.573	400	D 400
C II	1334.54		
	1335.72		
	2836.710	....	200
	2837.602	....	40
	4267.02	....	350
	4267.27	....	500
C III	2296.89	....	200
Ca I	*4226.728	500	50
	4425.441	100	
	4434.960	150	
	4454.781	200	
	4455.880		
	4456.62		
Ca II	3158.869	100	300
	3179.332	100	400
	*3933.666	600	600
	3968.468	500	500
Cb I	*4058.938	1000	400
	4079.729	500	200
	4100.923	300	200
	4123.810	200	125
	4137.095	100	60
Cb II	*3094.183	100	1000

PERSISTENT LINES OF THE ELEMENTS (Continued)

ARRANGED BY ELEMENTS (Continued)

Element	Wave length	Intensity		Element	Wave length	Intensity	
		Arc	Spark			Arc	Spark
Cb II	3130.786	100	100	Dy I	4077.974	150	100
	3163.402	15	8		4167.966	50	12
	3194.977	30	300		4211.719	200	15
	3225.479	150	800	Er I	3499.104	18	15
Cd I	*2288.018	1500	300		3692.652	20	12
	3261.057	300	300		3906.316	25	12
	3403.653	800	500	Eu I	*4594.02		
	3466.201	1000	500	Eu II	4129.737	150	50
	3610.510	1000	500		*4205.046	200	50
	6438.4696	2000	1000	F I	6856.02	....	D 1000
Cd II	*2144.382	50	200		6902.46	....	D 500
	2265.017	25	300	Fe I	3581.20		
	2312.84	1	200		*3719.935	1000	700
	2573.09	3	150		3737.133	1000	600
	2748.58	5	200		3745.564	500	500
Ce II	4012.388	60	20		3745.903	150	100
	4040.762	70	5		3748.264	500	200
	4165.606	40	6	Fe II	*2382.039	40	100
	*4186.599	80	25		2395.625	50	100
Cl I	1379.6				2404.882	50	100
	1396.5				2410.517	50	70
Cl II	4794.54	....	D 250		2413.309	60	100
	4810.06	....	D 200	Ga I	2874.244	10	15
	4819.46	....	D 200		2943.637	10	20
Co I	*3453.505	3000	200		4032.982	1000	500
	3465.800	2000	25		*4172.056	2000	1000
	3529.813	1000	30	Gd I	3646.196	200	150
Co II	*2286.156	40	300		3768.405	20	20
	2307.857	25	50	Ge I	*2651.178	40	20
	2363.787	25	50		2651.575	30	20
	2378.622	25	50		2709.626	30	20
	2388.918	10	35		3039.064	1000	1000
	2519.822	40	200		3269.494	300	300
	3405.120	2000	150		4226.570	200	50
Cr I	*4254.346	5000	1000	H I	1215.7		
	4274.803	4000	800		4861.327	....	D 500
	4289.721	3000	800		6562.79	....	D 3000
	5204.518	400	100	He I	584.4		
	5206.039	500	200		*3888.646	....	D 1000
	5208.436	500	100		5875.618	....	D 1000
Cr II	*2835.633	100	400	He II	303.8		
	2843.252	125	400		1640.5		
	2849.838	80	150		4685.75	....	D 300
	2855.676	60	200	Hf I	2898.259	50	12
	2860.934	60	100		2904.408	30	6
Cs I	4555.355	2000	100		2916.481	50	15
	4593.177	1000	50		2940.772	60	12
	*8521.10	5000			3072.877	80	18
	8943.50	2000			4093.161	25	20
Cu I	*3247.540	5000	2000	Hf II	2513.028	25	70
	3273.962	3000	1500		2516.881	35	100
	5105.541	500			*2641.406	40	125
	5153.235	600			2773.357	25	60
	5218.202	700			2820.224	40	100
Cu II	*2135.976	25	500		3134.718	80	125
	2192.260	25	500	Hg I	*1849.68		
	2246.995	30	500		2536.519	2000	1000
Dy I	4000.454	400	300		3650.146	200	500
	4045.983	150	12		3654.833	....	D 200

PERSISTENT LINES OF THE ELEMENTS (Continued)

ARRANGED BY ELEMENTS (Continued)

Element	Wave length	Intensity		Element	Wave length	Intensity	
		Arc	Spark			Arc	Spark
Hg I	3663.276	500	400	Mn II	*2576.104	300	2000
	4046 561	200	300		2593.729	200	1000
	4358.35	3000	500		2605.688	100	500
	5460.740	....	D 2000	Mo I	*3798.252	1000	1000
Hg II	1649.8				3864.110	1000	500
	1942.3				3902.963	1000	500
Ho I	3748 17	60	40	Mo II	*2816.154	200	300
	3891.02	200	40		2848.232	125	200
Ho II	2936.77	....	1000		2871.508	100	100
I I	1782.9				2890.994	30	50
	2062.38	....	D 900		2909.116	25	40
I II	5161.188	....	D 300	N I	1199.5		
	5464 61	....	D 900		1200.2		
In I	3039.356	1000	500		1200.7		
	3256 090	1500	600		*4099.94	....	D 150
	3258.564	500	300		4109.98	....	D 1000
	4101.773	2000	1000	N II	5666.64	....	D 300
	*4511.323	5000	4000		5676.02	....	D 100
Ir I	2543.97				5679.56	....	D 500
	2849.725	40	20	N III	989.8		
	2924.792	25	15		991.6		
	*3220.780	100	30		4097.31	....	D 100
	3437.015	20	15		4103.37	....	D 80
	3513.645	100	100	Na I	3302.323	600	300
K I	4044.140	800	400		3302.988	300	150
	4047.201	400	200		5682.657	80	
	*7664.907	9000			5688.224	300	
	7698.979	5000			*5889.953	9000	1000
Kr I	5570.2895	....	D 2000		5895.923	5000	500
	5870.9158	....	D 3000	Nd I	3951.154	40	30
La I	5455.146	200	1		4177.321	15	25
	5930.648	250			*4303.573	100	40
	*6249.929	300		Ne I	735.95		
La II	*3949.106	1000	800		743.73		
	4077.340	600	400		5400.562	....	D 2000
	4123.228	500	500		5832.488		
Li I	3232.61	1000	500		5852.488	....	D 2000
	4603.00	800			6402.246	....	D 2000
	6103.642	2000	300	Ni I	*3414.765	1000	50
	*6707.844	3000	200		3492.956	1000	100
Lu I	4518.57	300	40		3515.054	1000	50
Lu II	*2615.43				3524.541	1000	100
	2894.84	60	200	Ni II	2216.47		
	2911.39	100	300		2253.86	100	300
	3397.07	50	20		2264.457	150	400
	3472.48	50	150		2270.213	100	400
	3554.43	50	150		*2287.084	100	500
Mg I	*2852.129	300	100	O I	1302.27		
	3829.350	100	150		1304.96		
	3832.306	250	200		1306.12		
	3838.258	300	200		*7771.928	....	D 1000
	5167.343	100	50		7774.138	....	D 300
	5172.699	200	100		7775.433	....	D 100
	5183.618	500	300	Os I	*2909.061	500	400
Mg II	*2795.53	150	300		3058.66	500	500
	2802.695	150	300		3262.290	500	50
Mn I	*4030.755	500	20		3267.945	400	30
	4033.073	400	20		3301.56		
	4034.490	250	20		3752.54		

PERSISTENT LINES OF THE ELEMENTS (Continued

ARRANGED BY ELEMENTS (Continued)

Element	Wave length	Intensity		Element	Wave length	Intens'ty	
		Arc	Spark			Arc	Spark
Os I	3782.20			Ru I	*3498.942	500	200
	4420.468	400	100		3596.179	30	100
P I	1774.8			Ru II	2678.758	100	300
	1782.7				2692.065	8	200
	1787.5				2712.410	80	300
	2136.8				2945.668	60	300
	2149.8				2965.546	60	200
	2534.01	50	D 20		2976.586	60	200
	2535.65	100	D 30	S I	1807.4		
	2536.38				1820.5		
	2553.28	80	D 20		1826.4		
	2554.02				4694.13	....	D 500
	2554.93	60	D 20		4695.45	....	D 30
Pb I	2169.994	1000	1000		4696.25	....	D 15
	2614.178	200	80		9212.91	....	D 200
	2833.069	500	80		9228.11	....	D 200
	3639.580	300	50		9237.49	....	D 200
	3683.471	300	50	Sb I	*2068.38	300	3
	*4057.820	2000	300		2175.890	300	40
Pb II	1682.4				2311.469	150	50
	*2203.505	50	5000		2528.535	300	200
	5608.8	....	D 40		2598.062	200	100
Pd I	*3404.580	2000	1000		2877.915	250	150
	3421.24	2000	1000		3232.499	150	250
	3516.943	1000	500		3267.502	150	150
	3609.548	1000	700	Sc I	3907.476	125	25
	3634.695	2000	1000		*3911.810	150	30
Pd II	*2296.53				4020.399	50	20
	2488.921	10	30		4023.688	100	25
	2498.784	4	150		5671.80		
	2505.739	3	30	Sc II	*3613.836	40	70
	2658.722	20	300		3630.740	50	70
	2854.581	4	500		3642.785	60	50
Pr I	4062.817	150	50	Se I	*1960.2		
Pr II	*4179.422	200	40		2039.851	....	D 1000
	4189.518	100	50		2062.788	....	D 800
	4225.327	50	40		4730.78	....	D 1000
Pt I	2659.454	2000	500		4739.03	....	D 800
	2830.295	1000	600		4742.25	....	D 500
	2929.794	800	200	Si I	2506.899	300	200
	2997.967	1000	200		2516.123	500	500
	*3064.712	2000	300		2528.516	400	500
Ra I	*4825.91	....	D 800		*2881.578	500	400
Ra II	*3814.42	....	D 2000		3905.528	20	15
	4682.28	....	D 800	Si II	1526.83		
Rb I	4201.851	2000	500		*1533.55		
	4215.556	1000	300	Sm I	*4296.75		
	*7800.227	9000		Sm II	3568.27		
	7947.60	5000			4390.865	150	150
Re I	*3460.47	1000			*4424.342	300	300
	4889.17	2000			4434.321	200	200
Rh I	3323.092	1000	200	Sn I	*2839.989	300	300
	3396.85	1000	500		2863.327	300	300
	*3434.893	1000	200		3009.147	300	200
	3657.987	500	200		3034.121	200	150
	3692.357	500	150		3175.019	500	400
Rn I	7055.42	....	D 400		3262.328	400	300
	7450.00	....	D 600		4524.741	500	50
Ru I	3436.737	300	150	Sn III	*2152.22		

PERSISTENT LINES OF THE ELEMENTS (Continued)

ARRANGED BY ELEMENTS (Continued)

Element	Wave length	Intensity	
		Arc	Spark
Sr I	*4607.331	1000	50
	4832.075	200	8
	4872.493	25	
	4962.263	40	
Sr II	3380.711	150	200
	3464 57	200	200
	3474.887	80	50
	*4077.714	400	500
	4215.524	300	400
	4305.447	40	
Ta I	*3311.162	300	70
	3318.840	125	35
	3406.664	70	18
Tb I	3509.17	200	200
	3561.74	200	200
	3848.75	100	200
	3874.18	200	200
Te I	*2142.75	60	
	2383.25	500	D 300
	2385.76	600	D 300
	2530.70	....	D 30
	2769.67	....	D 30
Th I	3538.75	....	50
	3601.040	8	10
	4019.137	8	8
Th II	3290.59	....	40
Ti I	3635.463	200	100
	3642.675	300	125
	3653.496	500	200
	*4981.733	300	125
	4991.066	200	100
	4999.510	200	80
	5007.213	200	40
	5014.25		
Ti II	*3349.035	125	800
	3361.213	100	600
	3372.800	80	400
	3383.761	70	300
Tl I	2767.87	400	300
	2918.32	400	200
	3229.75	2000	800
	3519.24	2000	1000
	3775.72	3000	1000
	*5350.46	5000	2000
Tm I	3462.21	200	100
	3761.333	250	150
	3761.917	200	120
Tm II	*3848.02		
U I	3552.172	8	12
	3672.579	8	15
	4241.669	40	50
V I	3183.406	200	100
	3183.982	500	400
	3185.396	500	400
	*4379.238	200	200
	4384.722	125	125
V I	4389.974	80	60
V II	*3093.108	100	400
	3102.299	70	300
	3110.706	70	300
	3118.383	70	200
	3125.284	80	200
W I	4008.753	45	45
	4294.614	50	50
	*4302.108	60	60
W II	*2204.49		
	2397.091	18	30
	2589.167	15	25
	3215.560	10	9
	3613.790	10	30
Xe I	1295.8		
	1469.9		
	4500.977	....	D 500
	4624.276	....	D 1000
	4671.226	....	D 2000
Y I	4643.695	50	100
	*4674.848	80	100
	5466.47		
Y II	3242.280	60	100
	3600.734	100	300
	3633.123	50	100
	*3710.290	80	150
	3774.332	12	100
	3788.697	30	30
Yb I	3289.37	500	1000
	*3987.994	1000	500
Yb II	*3694.203	500	1000
Zn I	*2138.56	800	500
	3282.333	500	300
	3302.588	800	300
	3345.020	800	300
	4680.138	300	200
	4722.159	400	300
	4810.534	400	300
	6362.347	1000	500
Zn II	*2025.51	200	200
	2061.91	100	100
	2502.001	20	400
	2557.958	10	300
Zr I	3519.605	100	10
	3547.682	200	12
	*3601.193	400	15
	4687.803	125	
	4710.075	60	
	4739.478	100	
	4772.312	100	
	4815.62		
Zr II	*3391.975	300	400
	3438.230	250	200
	3496.210	100	100
	3572.473	60	80

PERSISTENT LINES OF THE ELEMENTS (Continued)

ARRANGED BY WAVE LENGTHS

Wave length	Element	Intensity		Wave length	Element	Intensity	
		Arc	Spark			Arc	Spark
303.8	He II			*2138.56	Zn I	800	500
584.4	He I			*2142.75	Te I	60	
735.95	Ne I			*2144.382	Cd II	50	200
743.73	Ne I			2149.8	P I		
989.8	N III			*2152.22	Sn II		
991.6	N III			2169.994	Pb I	1000	1000
*1048.26	A I			2175.890	Sb I	300	40
1066.70	A I			2192.260	Cu II	25	500
1199.5	N I			*2203.505	Pb II	50	5000
1200.2	N I			*2204.49	W II		
1200.7	N I			2216.47	Ni II		
1215.7	H I			2246.412	Ag II	25	300
1295.8	Xe I			2246.995	Cu II	30	500
1302.27	O I			2253.86	Ni II	100	300
1304.96	O I			2264.457	Ni II	150	400
1306.12	O I			2265.017	Cd II	25	300
1334.54	C II			2270.213	Ni II	100	400
1335.72	C II			2276.578	Bi I	100	40
1362.46	B II			*2286.156	Co II	40	300
1379.6	Cl I			*2287.084	Ni II	100	500
1396.5	Cl I			*2288.018	Cd I	1500	300
1469.9	Xe I			2288.12	As I	250	5
1526.83	Si II			*2296.53	Pd II		
*1533.55	Si II			2296.89	C III	....	200
1540.8	Br I			2304.235	Ba II	60	80
1633.8	Br I			2307.857	Co II	25	50
1640.5	He II			2311.469	Sb I	150	50
1649.8	Hg II			2312.84	Cd II	1	200
1671.0	Al II			2335.269	Ba II	60	100
1682.4	Pb II			*2348.610	Be I	2000	50
1774.8	P I			2349.84	As I	250	18
1782.7	P I			2363.787	Co II	25	50
1782.9	I I			2369.67	As I	40	
1787.5	P I			2370.77	As I	50	3
1807.4	S I			2378.622	Co II	25	50
1820.5	S I			*2382.039	Fe II	40	100
1826.4	S I			2383.25	Te I	500	D 300
*1849.6	Hg I			2385.76	Te I	600	D 300
1854.67	Al III			2388.918	Co II	10	35
1856.00	Al II			2395.625	Fe II	50	100
1858.13	Al II			2397.091	W II	18	30
1862.48	Al II			2404.882	Fe II	50	100
1862.90	Al III			2410.517	Fe II	50	70
1889.9	As I			2413.309	Fe II	60	100
*1890.5	As I			*2427.95	Au I	400	100
1909.41	Bi II			*2437.791	Ag II	60	500
1936.9	As I			2456.53	As I	100	8
1942.3	Hg II			*2478.573	C I	400	D 400
*1960.2	Se I			2488.921	Pd II	10	30
1972.0	As I			2496.778	B I	300	300
*2025.51	Zn II	200	200	*2497.733	B I	500	400
2039.851	Se I	....	D 1000	2498.784	Pd II	4	150
2061.70	Bi I	300	100	2502.001	Zn II	20	400
2061.91	Zn II	100	100	2505.739	Pd II	3	30
2062.38	I I	....	D 900	2506.899	Si I	300	200
2062.788	Se I	....	D 800	2513.028	Hf II	25	70
*2068.38	Sb I	300	3	2516.123	Si I	500	500
*2135.976	Cu II	25	500	2516.881	Hf II	35	100
2136.8	P I			2519.822	Co II	40	200

PERSISTENT LINES OF THE ELEMENTS (Continued)

ARRANGED BY WAVE LENGTHS (Continued)

Wave length	Element	Intensity		Wave length	Element	Intensity	
		Arc	Spark			Arc	Spark
2528.516	Si I	400	500	2860.452	As I	50	50
2528.535	Sb I	300	200	2860.934	Cr II	60	100
2530.70	Te I	....	D 30	2863.327	Sn I	300	300
2534.01	P I	50	D 20	2871.508	Mo II	100	100
2535.65	P I	100	D 30	2874.244	Ga I	10	15
2536.38	P I			2877.915	Sb I	250	150
2536.519	Hg I	2000	1000	*2881.578	Si I	500	400
2543.97	Ir I			2890.994	Mo II	30	50
2553.28	P I	80	D 20	2894.84	Lu II	60	200
2554.02	P I			2897.975	Bi I	500	500
2554.93	P I	60	D 20	2898.259	Hf I	50	12
2557.958	Zn II	10	300	2898.71	As I	25	40
2573.09	Cd II	3	150	2904.408	Hf I	30	6
*2576.104	Mn II	300	2000	*2909.061	Os I	500	400
2589.167	W II	15	25	2909.116	Mo II	25	40
2593.729	Mn II	200	1000	2911.39	Lu II	100	300
2598.062	Sb I	200	100	2916.481	Hf I	50	15
2605.688	Mn II	100	500	2918.32	Tl I	400	200
2614.178	Pb I	200	80	2924.792	Ir I	25	15
*2615.43	Lu II			2929.794	Pt I	800	200
2631.553	Al II	....	40	2936.77	Ho II	....	1000
*2641.406	Hf II	40	125	2938.298	Bi I	300	300
2650.781	Be I	25		2940.772	Hf I	60	12
*2651.178	Ge I	40	20	2943.637	Ga I	10	20
2651.575	Ge I	30	20	2945.668	Ru II	60	300
2658.722	Pd II	20	300	2965.546	Ru II	60	200
2659.454	Pt I	2000	500	2976.586	Ru II	60	200
*2669.166	Al II	3	100	2989.029	Bi I	250	100
2675.95	Au I	250	100	2997.967	Pt I	1000	200
2678.758	Ru II	100	300	3009.147	Sn I	300	200
2692.065	Ru II	8	200	3034.121	Sn I	200	150
2709.626	Ge I	30	20	3039.064	Ge I	1000	1000
2712.410	Ru II	80	300	3039.356	In I	1000	500
2748.58	Cd II	5	200	3058.66	Os I	500	500
2767.87	Tl I	400	300	*3064.712	Pt I	2000	300
2769.67	Te I	....	D 30	*3067.716	Bi I	3000	2000
2773.357	Hf II	25	60	3071.591	Ba I	100	50
2780.197	As I	75	75	3072.877	Hf I	80	18
2780.521	Bi I	200	100	3082.155	Al I	800	800
*2795.53	Mg II	150	300	3092.713	Al I	1000	1000
2802.19	Au I	....	200	*3093.108	V II	100	400
2802.695	Mg II	150	300	*3094.183	Cb II	100	1000
2809.625	Bi I	200	100	3102.299	V II	70	300
*2816.154	Mo II	200	300	3110.706	V II	70	300
2816.179	Al II	10	100	3118.383	V II	70	200
2820.224	Hf II	40	100	3125.284	V II	80	200
2830.295	Pt I	1000	600	*3130.416	Be II	200	200
2833.069	Pb I	500	80	3130.786	Cb II	100	100
*2835.633	Cr II	100	400	3131.072	Be II	200	150
2836.710	C II	....	200	3134.718	Hf II	80	125
2837.602	C II	....	40	3158.869	Ca II	100	300
*2839.989	Sn I	300	300	3163.402	Cb II	15	8
2843.252	Cr II	125	400	3175.019	Sn I	500	400
2848.232	Mo II	125	200	3179.332	Ca II	100	400
2849.725	Ir I	40	20	3183.406	V I	200	100
2849.838	Cr II	80	150	3183.982	V I	500	400
*2852.129	Mg I	300	100	3185.396	V I	500	400
2854.581	Pd II	4	500	3194.977	Cb II	30	300
2855.676	Cr II	60	200	3215.560	W I	10	9

ARRANGED BY WAVE LENGTHS (Continued)

Wave length	Element	Intensity		Wave length	Element	Intensity	
		Arc	Spark			Arc	Spark
*3220.780	Ir I	100	30	3474.887	Sr II	80	50
3225.479	Cb II	150	800	3492.956	Ni I	1000	100
3229.75	Tl I	2000	800	3496.210	Zr II	100	100
3232.499	Sb I	150	250	*3498.942	Ru I	500	200
3232.61	Li I	1000	500	3499.104	Er I	18	15
3242.280	Y II	60	100	3509.17	Tb I	200	200
*3247.540	Cu I	5000	2000	3513.645	Ir I	100	100
3256.090	In I	1500	600	3515.054	Ni I	1000	50
3258.564	In I	500	300	3516.943	Pd I	1000	500
3261.057	Cd I	300	300	3519.24	Tl I	2000	1000
3262.290	Os I	500	50	3519.605	Zr I	100	10
3262.328	Sn I	400	300	3524.541	Ni I	1000	100
3267.502	Sb I	150	150	3529.813	Co I	1000	30
3267.945	Os I	400	30	3538.75	Th I	....	50
3269.494	Ge I	300	300	3547.682	Zr I	200	12
3273.962	Cu I	3000	1500	3552.172	U I	8	12
*3280.683	Ag I	2000	1000	3554.43	Lu II	50	150
3282.333	Zn I	500	300	3561.74	Tb I	200	200
3289.37	Yb I	500	1000	3568.27	Sm II		
3290.59	Th II	....	40	3572.473	Zr II	60	80
3301.56	Os I			3581.20	Fe I		
3302.323	Na I	600	300	3596.179	Ru I	30	100
3302.588	Zn I	800	300	3600.734	Y II	100	300
3302.988	Na I	300	150	3601.040	Th I	8	10
*3311.162	Ta I	300	70	*3601.193	Zr I	400	15
3318.840	Ta I	125	35	3609.548	Pd I	1000	700
3321.013	Be I	50		3610.510	Cd I	1000	500
3321.086	Be I	100		3613.790	W II	10	30
3321.343	Be I	1000	30	*3613.836	Sc II	40	70
3323.092	Rh I	1000	200	3630.740	Sc II	50	70
3345.020	Zn I	800	300	3633.123	Y II	50	100
*3349.035	Ti II	125	800	3634.695	Pd I	2000	1000
3361.213	Ti II	100	600	3635.463	Ti I	200	100
3372.800	Ti II	80	400	3639.580	Pb I	300	50
3380.711	Sr II	150	200	3642.675	Ti I	300	125
3382.891	Ag I	1000	700	3642.785	Sc II	60	50
3383.761	Ti II	70	300	3646.196	Gd I	200	150
*3391.975	Zr II	300	400	3650.146	Hg I	200	500
3396.85	Rh I	1000	500	3653.496	Ti I	500	200
3397.07	Lu II	50	20	3654.833	Hg I	...	D 200
3403.653	Cd I	800	500	3657.987	Rh I	500	200
*3404.580	Pd I	2000	1000	3663.276	Hg I	500	400
3405.120	Co I	2000	150	3672.579	U I	8	15
3406.664	Ta I	70	18	3683.471	Pb I	300	50
*3414.765	Ni I	1000	50	3692.357	Rh I	500	150
3421.24	Pd I	2000	1000	3692.652	Er I	20	12
*3434.893	Rh I	1000	200	*3694.203	Yb II	500	1000
3436.737	Ru I	300	150	*3710.290	Y II	80	150
3437.015	Ir I	20	15	*3719.935	Fe I	1000	700
3438.230	Zr II	250	200	3737.133	Fe I	1000	600
3451.41	B II	5	30	3745.564	Fe I	500	500
3452.33	B II			3745.903	Fe I	150	100
*3453.505	Co I	3000	200	3748.17	Ho I	60	40
*3460.47	Re I	1000		3748.264	Fe I	500	200
3462.21	Tm I	200	100	3752.54	Os I		
3464.57	Sr II	200	200	3761.333	Tm I	250	150
3465.800	Co I	2000	25	3761.917	Tm I	200	120
3466.201	Cd I	1000	500	3768.405	Gd I	20	20
3472.48	Lu II	50	150	3774.332	Y II	12	100

ARRANGED BY WAVE LENGTHS (Continued)

Wave length	Element	Intensity	
		Arc	Spark
3775.72	Tl I	3000	1000
3782.20	Os I		
3788.697	Y II	30	30
*3798.252	Mo I	1000	1000
*3814.42	Ra II	....	D 2000
3829.350	Mg I	100	150
3832.306	Mg I	250	200
3838.258	Mg I	300	200
*3848.02	Tm II		
3848.75	Tb I	100	200
3864.110	Mo I	1000	500
3874.18	Tb I	200	200
*3888.646	He I	....	D 1000
3891.02	Ho I	200	40
3891.785	Ba II	18	25
3902.963	Mo I	1000	500
3905.528	Si I	20	15
3906.316	Er I	25	12
3907.476	Sc I	125	25
*3911.810	Sc I	150	30
*3933.666	Ca II	600	600
3944.032	Al I	2000	1000
*3949.106	La II	1000	800
3951.154	Nd I	40	30
*3961.527	Al I	3000	2000
3968.468	Ca II	500	500
*3987.994	Yb I	1000	500
4000.454	Dy I	400	300
4008.753	W I	45	45
4012.388	Ce II	60	20
4019.137	Th I	8	8
4020.399	Sc I	50	20
4023.688	Sc I	100	25
*4030.755	Mn I	500	20
4032.982	Ga I	1000	500
4033.073	Mn I	400	20
4034.490	Mn I	250	20
4040.762	Ce II	70	5
4044.140	K I	800	400
4045.983	Dy I	150	12
4046.561	Hg I	200	300
4047.201	K I	400	200
*4057.820	Pb I	2000	300
*4058.938	Cb I	1000	400
4062.817	Pr I	150	50
4077.340	La II	600	400
*4077.714	Sr II	400	500
4077.974	Dy I	150	100
4079.729	Cb I	500	200
4093.161	Hf II	25	20
4097.31	N III	....	D 100
*4099.94	N I	....	D 150
4100.923	Cb I	300	200
4101.773	In I	2000	1000
4103.37	N III	....	D 80
4109.98	N I	....	D 1000
4123.228	La II	500	500
4123.810	Cb I	200	125
4129.737	Eu II	150	50
4130.664	Ba II	50	60
4137.095	Cb I	100	60
4165.606	Ce II	40	6
4167.966	Dy I	50	12
*4172.056	Ga I	2000	1000
4177.321	Nd I	15	25
*4179.422	Pr II	200	40
*4186.599	Ce II	80	25
4189.518	Pr II	100	50
4201.851	Rb I	2000	500
*4205.046	Eu II	200	50
4211.719	Dy I	200	15
4215.524	Sr II	300	400
4215.556	Rb I	1000	300
4225.327	Pr II	50	40
4226.570	Ge I	200	50
*4226.728	Ca I	500	50
4241.669	U I	40	50
*4254.346	Cr I	5000	1000
4267.02	C II	....	350
4267.27	C II	....	500
4274.803	Cr I	4000	800
4289.721	Cr I	3000	800
4294.614	W I	50	50
*4296.75	Sm I		
*4302.108	W I	60	60
*4303.573	Nd I	100	40
4305.447	Sr II	40	
4358.35	Hg I	3000	500
*4379.238	V I	200	200
4384.722	V I	125	125
4389.974	V I	80	60
4390.865	Sm II	150	150
4420.468	Os I	400	100
*4424.342	Sm II	300	300
4425.441	Ca I	100	
4434.321	Sm II	200	200
4434.960	Ca I	150	
4454.781	Ca I	200	
4455.880	Ca I		
4456.62	Ca I		
4500.977	Xe I	....	D 500
*4511.323	In I	5000	4000
4518.57	Lu I	300	40
4524.741	Sn I	500	50
*4554.042	Ba II	1000	200
4555.355	Cs I	2000	100
4593.177	Cs I	1000	50
*4594.02	Eu I		
4603.00	Li I	800	
*4607.331	Sr I	1000	50
4624.276	Xe I	....	D 1000
4643.695	Y I	50	100
4671.226	Xe I	....	D 2000
*4674.848	Y I	80	100
4680.138	Zn I	300	200
4682.28	Ra II	....	D 800
4685.75	He II	....	D 300
4687.803	Zr I	125	

PERSISTENT LINES OF THE ELEMENTS (Continued)

ARRANGED BY WAVE LENGTHS (Continued)

Wave length	Element	Intensity		Wave length	Element	Intensity	
		Arc	Spark			Arc	Spark
4694.13	S I	....	D 500	5466.47	Y I		
4695.45	S I	....	D 30	5519.115	Ba I	200	60
4696.25	S I	....	D 15	*5535.551	Ba I	1000	200
*4704.86	Br II	....	D 250	5570.2895	Kr I	....	D 2000
4710.075	Zr I	60		5608.8	Pb II	....	D 40
4722.159	Zn I	400	300	5666.64	N II	....	D 300
4722.552	Bi I	1000	100	5671.80	Sc I		
4730.78	Se I	....	D 1000	5676.02	N II	....	D 100
4739.03	Se I	....	D 800	5679.56	N II	....	D 500
4739.478	Zr I	100		5682.657	Na I	80	
4742.25	Se I	....	D 500	5688.224	Na I	300	
4772.312	Zr I	100		5777.665	Ba I	500	100
4785.50	Br II	....	D 400	5832.488	Ne I		
4794.54	Cl II	....	D 250	5852.488	Ne I	....	D 2000
4810.06	Cl II	....	D 200	5870.9158	Kr I	....	D 3000
4810.534	Zn I	400	300	5875.618	He I	....	D 1000
4815.62	Zr I			*5889.953	Na I	9000	1000
4816.71	Br II	....	D 300	5895.923	Na I	5000	500
4819.46	Cl II	...	D 200	5930.648	La I	250	
*4825.91	Ra I	....	D 800	6103.642	Li I	2000	300
4832.075	Sr I	200	8	6231.76	[illegible] II	....	30
4861.327	H I	....	D 500	6243.36	Al II	....	100
4872.493	Sr I	25		*6249.929	La I	300	
4889.17	Re I	2000		6362.347	Zn I	1000	500
4934.086	Ba II	400	400	6402.246	Ne I	....	D 2000
4962.263	Sr I	40		6438.4696	Cd I	2000	1000
*4981.733	Ti I	300	125	6562.79	H I	....	D 3000
4991.066	Ti I	200	100	*6707.844	Li I	3000	200
4999.510	Ti I	200	80	6856.02	F I	....	D 1000
5007.213	Ti I	200	40	6902.46	F I	....	D 500
5014.25	Ti I			6965.430	A I	....	D 400
5105.541	Cu I	500		7055.42	Rn I	....	D 400
5153.235	Cu I	600		7067.217	A I	....	D 400
5161.188	I II	....	D 300	7450.00	Rn I	....	D 600
5167.343	Mg I	100	50	7503.867	A I	....	D 700
5172.699	Mg I	200	100	*7664.907	K I	9000	
5183.618	Mg I	500	300	7698.979	K I	5000	
5204.518	Cr I	400	100	*7771.928	O I	....	D 1000
5206.039	Cr I	500	200	7774.138	O I	....	D 300
5208.436	Cr I	500	100	7775.433	O I	....	D 100
5209.067	Ag I	1500	1000	*7800.227	Rb I	9000	
5218.202	Cu I	700		7947.60	Rb I	5000	
*5350.46	Tl I	5000	2000	8115.311	A I	....	D 5000
5400.562	Ne I	....	D 2000	*8521.10	Cs I	5000	
5424.616	Ba I	100	30	8943.50	Cs I	2000	
5455.146	La I	200	1	9212.91	S I	....	D 200
5460.740	Hg I	....	D 2000	9228.11	S I	....	D 200
5464.61	I II	....	D 900	9237.49	S I	....	D 200
5465.487	Ag I	1000	500				

INDEX OF REFRACTION

INDEX OF REFRACTION

Indices of refraction for elements, inorganic, metal-organic and organic compounds and minerals will be found in the tables of physical constants for the various classes of substances in the section Properties and Physical Constants.

Values for compounds not there listed and data subsequently collected are given below.

Indices not otherwise indicated are for sodium light, λ = 589.3 mμ. Other wave lengths are indicated by the value in millimicrons or symbol in parentheses which follows the index. Wave lengths are indicated as follows: He, λ = 587.6 mμ; Li, λ = 670.8 mμ; Hg, λ = 579.1 mμ; A, λ = 759.4 mμ; C, λ = 656.3 mμ; D, λ = 589.3 mμ; F, λ = 486.1 mμ.

Temperatures are understood to be 20°C for liquids, or ordinary room temperatures in the case of solids. Other temperatures appear as superior figures with the index.

Indices for the elements and inorganic compounds will be understood to be for the solid form except as indicated by the abbreviation liq.

ELEMENTS

See also under Physical Constants of Inorganic Compounds and Index of Refraction of Gases.

Name	Formula	Index
Bromine (liq.)	Br_2	1.661^{15}
Cadmium (liq.)	Cd	0.82 (579 mμ)
(sol.)		1.12
Chlorine (liq.)	Cl_2	1.385
" (gas)		1.000768
Hydrogen (liq.)	H_2	$1.0974^{-252.83}$(579 mμ)
Iodine (sol.)	I_2	3.34
(gas)		1.001920
Lead	Pb	2.6 (579 mμ)
Mercury (liq.)	Hg	1.6–1.9
Nitrogen (liq.)	N_2	1.2053^{-190}
Oxygen (liq.)	O_2	1.221^{-181}
Phosphorus (yel.) (sol.)		2.1442^{25}
Selenium	Se_8	3.00, 4.04
" (amor.) (sol.)		2.92
Sodium (liq.)	Na	0.0045
(sol.)		4.22
Sulfur (liq.)	S_8	1.929^{110}
" (amor.) (sol.)		1.998
" (rhombic, α)		1.957, 2.0377, 2.2454
Tin (liq.)	Sn	2.1

INORGANIC COMPOUNDS

See also under Physical Constants of Inorganic Compounds.

Aluminum carbide	Al_4C_3	2.7, 2.75 (700 mμ)
chloride	$AlCl_3.6H_2O$	1.560, 1.507
oxide	Al_2O_3	1.665–1.680, 1.63–1.65
Alums. See under appropriate element.		
Ammonium antimonyl tartrate	$2(NH_4.SbO.C_4H_4O_6).H_2O$	β1.6229 (C)
*ortho*arsenate, di-H	$NH_4H_2AsO_4$	1.5766, 1.5217
bromide	NH_4Br	1.7108
*per*chlorate	NH_4ClO_4	1.4818, 1.4833, 1.4881
chloroplatinate	$(NH_4)_2PtCl_6$	1.8
fluoride	NH_4F	$\omega < 1.328$
" acid	NH_4HF_2	1.385, 1.390, 1.39
hydrogen malate (*d*)	$NH_4C_4H_5O_5$	β1.503
nitrate	NH_4NO_3	1.413, 1.611(He), 1.63

Name	Formula	Index
Ammonium sulfate, acid	NH_4HSO_4	1.463, 1.473, 1.510
tartrate (*dl*)	$(NH_4)_2C_4H_4O_6.2H_2O$	β1.564
thiocyanate	NH_4CNS	1.546, 1.685, 1.692
uranyl acetate	$NH_4C_2H_3O_2.UO_2(C_2H_3O_2)_2$	1.4808, 1.4933
Antimony bromide	$SbBr_3$	>1.74+
iodide, tri-	SbI_3	2.78 (Li), 2.36
Barium cadmium bromide	$BaCdBr_4.4H_2O$	β1.702
cadmium chloride	$BaCdCl_4.4H_2O$	β1.651
calcium propionate	$BaCa_2(C_3H_5O_2)_6$	1.4442
fluochloride	$BaCl_2.BaF_2$	1.640, 1.633
fluoride	BaF_2	1.475 also 1.4741
Barium oxide	BaO	1.980
*ortho*phosphate, di-	$BaHPO_4$	1.617, 1.63±, 1.635
propionate	$Ba(C_2H_5CO_2)_2.H_2O$	β1.5175
sulfide, mono-	BaS	2.155
Cadmium ammonium chloride	$CdCl_2.4NH_4Cl$	1.6038, 1.6042
cesium sulfate	$CdSO_4.Cs_2SO_4.6H_2O$	1.498, 1.500, 1.506
fluoride	CdF_2	1.56
magnesium chloride	$(CdCl_2)_2.MgCl_2.12H_2O$	1.49, 1.5331, 1.5769
oxide	CdO	2.49 (Li)
potassium chloride	$CdCl_2.4KCl$	1.5906, 1.5907
" cyanide	$Cd(CN)_2.2KCN$	1.4213
rubidium sulfate	$CdSO_4.Rb_2SO_4.6H_2O$	1.4798, 1.4848, 1.4948
Calcium aluminate	$Ca_3Al_2O_6$	1.710
borate	$CaO.B_2O_3$	1.540, 1.656, 1.682
carbide	CaC_2	>1.75
copper acetate	$CaCu(C_2H_3O_2)_4.6H_2O$	1.436, 1.478
cyanamide	$CaCN_2$	1.60, >1.95
dithionate	$CaS_2O_6.4H_2O$	1.5516, 1.5414
*pyro*phosphate	$Ca_2P_2O_7$	1.585, 1.60±, 1.605
platinocyanide	$CaPt(CN)_4.5H_2O$	1.623, 1.644, 1.767
strontium propionate	$Ca_2Sr(C_3H_5O_2)_6$	1.4871, 1.4956
sulfide (oldhamite)	CaS	2.137
sulfite	$CaSO_3.2H_2O$	1.590, 1.595, 1.628
thiosulfate	$CaS_2O_3.6H_2O$	1.545, 1.560, 1.605
Carbon dioxide (liq.)	CO_2	1.195^{15}
Cerium dithionate	$Ce_2(S_2O_6)_3.15H_2O$	β1.507
Cesium *per*chlorate	$CsClO_4$	1.4752, 1.4788, 1.4804
nitrate	$CsNO_3$	1.55, 1.56
selenate	Cs_2SeO_4	1.5989, 1.5999, 1.6003
thallium chloride	$Cs_3Tl_2Cl_9$	1.784, 1.774
Chromium cesium sulfate	$CrCs(SO_4)_2.12H_2O$	1.4810
oxide (ic)	Cr_2O_3	2.5
potassium cyanide (ic)	$CrK_3(CN)_6$	1.5221, 1.5244, 1.5373
sulfate (ic)	$Cr_2(SO_4)_3.18H_2O$	1.564
thallium sulfate	$CrTl(SO_4)_2.12H_2O$	1.5228
Cobalt acetate	$Co(C_2H_3O_2)_2.4H_2O$	β1.542
aluminate (Thenard's Blue)	$Co(AlO_2)_2$	>1.78 (red), 1.74 (blue)
ammonium selenate	$CoSeO_4.(NH_4)_2SeO_4.6H_2O$	1.5246, 1.5311, 1.5396
cesium sulfate	$CoCs_2(SO_4)_2.6H_2O$	1.5057, 1.5085, 1.5132
chloride (ous)	$CoCl_2.2H_2O$	<1.625, <1.671, >1.67
potassium selenate	$CoSeO_4.K_2SeO_4.6H_2O$	1.5135, 1.5195, 1.5358
rubidium sulfate	$CoSO_4.Rb_2SO_4.6H_2O$	1.4859, 1.4916, 1.5014
selenate	$CoSeO_4.6H_2O$	β1.5225, γ1.5227
Copper ammonium selenate	$CuSeO_4.(NH_4)_2SeO_4.6H_2O$	1.5213, 1.5355, 1.5395
ammonium sulfate	$CuSO_4.(NH_4)_2SO_4.6H_2O$	1.4910, 1.5007, 1.5054
cesium sulfate	$CuSO_4.Cs_2SO_4.6H_2O$	1.5048, 1.5061, 1.5153
chloride (ic)	$CuCl_2.2H_2O$	1.644, 1.684, 1.742
formate	$Cu(CHO_2)_2.4H_2O$	1.4133, 1.5423, 1.5571

INDEX OF REFRACTION (Continued)

INORGANIC COMPOUNDS (Continued)

Name	Formula	Index
Copper oxide (ous) (cuprite)	Cu_2O	2.705
potassium chloride	$CuCl_2.2KCl.2H_2O$	1.6365, 1.6148
“ cyanide (ous)	$CuK_3(CN)_4$	1.5215
“ selenate	$CuSeO_4.K_2SeO_4.6H_2O$	1.5096, 1.5235, 1.5387
“ sulfate	$CuSO_4.K_2SO_4.6H_2O$	1.4836, 1.4864, 1.5020
strontium formate	$Cu(HCO_2)_2.2[Sr(HCO_2)_2]$ $8H_2O$	1.4995, 1.5199, 1.5801
sulfate (ic)	$CuSO_4$	1.724, 1.733, 1.739
Cyanogen	C_2N_2	1.327^{18} (liq.)
Germanium bromide, tetra-	$GeBr_4$	1.6269
Gold sodium chloride	$AuNaCl_4.2H_2O$	α1.545, γ1.75+
Hafnium oxychloride	$HfOCl_2.8H_2O$	1.557, 1.543
Ice	H_2O	1.3049, 1.3062 (A), 1.3091, 1.3104 (D), 1.3133, 1.3147 (F)
Iron ammonium chloride	$Fe(NH_4)_2Cl_4$	1.6439
ammonium selenate	$FeSeO_4.(NH_4)_2SeO_4.6H_2O$	1.5201, 1.5260, 1.5356
cesium sulfate (ic)	$FeCs(SO_4)_2.12H_2O$	1.4839
“ “ (ous)	$FeSO_4.Cs_2SO_4.6H_2O$	1.5003, 1.5035, 1.5094
rubidium sulfate	$FeRb(SO_4)_2.12H_2O$	1.48234
sulfate (ic)	$Fe_2(SO_4)_3$	1.802, 1.814, 1.818
thallium sulfate	$FeTl(SO_4)_2.12H_2O$	1.52365
Lanthanum sulfate	$La_2(SO_4)_3.9H_2O$	1.564, 1.569
Lead *ortho*arsenate, di-	$PbHAsO_4$	1.8903, 1.9097, 1.9765
nitrate	$Pb(NO_3)_2$	1.782
Lithium ammonium sulfate	$LiNH_4SO_4$	β1.437 (Li)
ammonium tartrate (*d*)	$LiNH_4(C_4H_4O_6).H_2O$	β1.567, γ1.5673
“ “ (*dl*)	$LiNH_4(C_4H_4O_6).H_2O$	β1.5287
bromide	$LiBr$	1.784
chloride	$LiCl$	1.662
dithionate	$Li_2S_2O_6.2H_2O$	1.5487, 1.5602, 1.5788
oxide	Li_2O	1.644
potassium sulfate	$LiKSO_4$	1.4723, 1.4717
“ tartrate	$LiK(C_4H_4O_6).H_2O$	β1.5226 (red)
rubidium tartrate (*d*)	$LiRb(C_4H_4O_6).H_2O$	β1.552
sodium tartrate (*dl*)	$LiNa(C_4H_4O_6).2H_2O$	β1.4904
Magnesium ammonium selenate	$MgSeO_4.(NH_4)_2SeO_4.6H_2O$	1.5070, 1.5093, 1.5169
ammonium sulfate	$Mg(NH_4)_2.(SO_4)_2.6H_2O$	1.4716, 1.4730, 1.4786
*ortho*borate	$3MgO.B_2O_3$	1.6527, 1.6537, 1.6748
cesium sulfate	$MgCs_2(SO_4)_2.6H_2O$	1.4857, 1.4858, 1.4916
chlorostannate	$MgSnCl_6.6H_2O$	1.5885, 1.5970
fluosilicate	$MgSiF_6.6H_2O$	1.3439, 1.3602
platinocyanide	$MgPt(CN)_4.7H_2O$	1.5608, 1.91
Magnesium potassium selenate	$MgK_2(SeO_4)_2.6H_2O$	1.4969, 1.4991, 1.5139
potassium sulfate	$MgK_2(SO_4)_2.6H_2O$	1.4607, 1.4629, 1.4755
rubidium sulfate	$MgRb_2(SO_4)_2.6H_2O$	1.4672, 1.4689, 1.4779
silicate	$MgSiO_3$	1.651, 1.654 (calc.), 1.660
sulfide	MgS	2.271 also 2.268
Manganese borate	$Mn_3B_4O_9$	1.617, 1.738, 1.776
cesium sulfate	$MnCs_2(SO_4)_2.6H_2O$	1.4946, 1.4966, 1.5025
chloride	$MnCl_2.4H_2O$	1.555, 1.575, 1.607
rubidium sulfate	$MnRb_2(SO_4)_2.6H_2O$	1.4767, 1.4807, 1.4907
sulfate (ous)	$MnSO_4.4H_2O$	1.508, 1.518, 1.522
“ “	$MnSO_4.5H_2O$	1.495, 1.508, 1.514
Mercury chloride (ic)	$HgCl_2$	1.725, 1.859, 1.965
cyanide (ic)	$Hg(CN)_2$	1.645, 1.492
iodide (ic) (red)	HgI_2	2.748, 2.455
Nickel ammonium selenate	$Ni(NH_4)_2.(SeO_4)_2.6H_2O$	1.5291, 1.5372, 1.5466
cesium sulfate	$NiCs_2(SO_4)_2.6H_2O$	1.5087, 1.5129, 1.5162

INDEX OF REFRACTION (Continued)
INORGANIC COMPOUNDS (Continued)

Name	Formula	Index
Nickel chloride	$NiCl_2.6H_2O$	α1.535, γ1.61
fluoride, acid	$NiF_2.5HF.6H_2O$	1.392, 1.408
potassium selenate	$NiK_2(SeO_4)_2.6H_2O$	1.5199, 1.5248, 1.5339
rubidium sulfate	$NiRb_2(SO_4)_2.6H_2O$	1.4895, 1.4961, 1.5052
selenate	$NiSeO_4.6H_2O$	1.5393, 1.5125
Platinum potassium dibromonitrite	$PtK_2(NO_2)_2Br_2.H_2O$	1.626, 1.6684, 1.757
Potassium carbonate	K_2CO_3	1.426, 1.531, 1.541
carbonate, acid	$KHCO_3$	1.380, 1.482, 1.578
*per*chlorate	$KClO_4$	1.4731, 1.4737, 1.4769
chloroplatinate	K_2PtCl_6	1.827 (577 mμ)
chloroplatinite	K_2PtCl_4	1.64, 1.67
*di*chromate	$K_2Cr_2O_7$	1.7202, 1.7380, 1.8197
cyanide	KCN	1.410
fluoborate	KBF_4	1.3239, 1.3245, 1.3247
fluoride	KF	1.352 (1.361)
“	$KF.2H_2O$	1.345, 1.352, 1.363
fluosilicate	K_2SiF_6	1.3391
*per*iodate	KIO_4	1.6205, 1.6479
lithium ferrocyanide	$K_2Li_2Fe(CN)_6.3H_2O$	1.5883, 1.6007, 1.6316
*hypo*phosphate	$K_2H_2P_2O_6.2H_2O$	1.4893, 1.5314, 1.5363
“	$K_2H_2P_2O_6.3H_2O$	1.4768, 1.4843, 1.4870
ruthenium cyanide	$K_4Ru(CN)_6.3H_2O$	β1.5837
silicate	K_2SiO_3	1.520, 1.521, 1.528
thiocyanate	$KCNS$	1.532, 1.660, 1.730
thionate, tetra-	$K_2S_4O_6$	1.5896, 1.6057, 1.6435
“ penta-	$2K_2S_5O_6.3H_2O$	1.565, 1.63, 1.655
Rhodium cesium sulfate	$RhCs(SO_4)_2.12H_2O$	1.5077
Rubidium *per*chlorate	$RbClO_4$	1.4692, 1.4701, 1.4731
chromate	Rb_2CrO_4	β1.71, γ1.72
dithionate	$Rb_2S_2O_6$	1.4574, 1.5078
fluoride	RbF	1.396
selenate	Rb_2SeO_4	1.5515, 1.5537, 1.5582
Ruthenium sodium nitrate	$RuNa_2(NO_2)_5.2H_2O$	1.5889, 1.5943, 1.7163
Selenium oxide	SeO_2	$>$1.76
Silver cyanide	$AgCN$	1.685, 1.94
nitrate	$AgNO_3$	1.729, 1.744, 1.788
phosphate	Ag_2HPO_4	1.8036, 1.7983
potassium cyanide	$AgK(CN)_2$	1.625, 1.63
Sodium ammonium tartrate (*d*)	$NaNH_4(C_4H_4O_6).4H_2O$	1.495, 1.498, 1.499
ammonium tartrate (*dl*)	$NaNH_4(C_4H_4O_6).H_2O$	β1.473 (red)
*ortho*arsenate	$NaH_2AsO_4.H_2O$	1.5382, 1.5535, 1.5607
“	$NaH_2AsO_4.2H_2O$	1.4794, 1.5021, 1.5265
bromide	$NaBr$	1.6412
carbonate	Na_2CO_3	1.415, 1.535, 1.546
Sodium carbonate, acid	$NaHCO_3$	1.376, 1.500, 1.582
cyanide	$NaCN$	1.452
iodide	NaI	1.7745
molybdate	$3Na_2O.7MoO_3.22H_2O$	β1.627
nitrate	$NaNO_3$	1.5874, 1.3361
phosphate	$NaH_2PO_4.2H_2O$	1.4401, 1.4629, 1.4815
“	$Na_2HPO_4.7H_2O$	1.4412, 1.4424, 1.4526
*hypo*phosphate	$Na_3HP_2O_6.9H_2O$	1.4653, 1.4738, 1.4804
silicate	Na_2SiO_3	1.513, 1.520, 1.528
sulfate, acid	$NaHSO_4.H_2O$	1.43, 1.46, 1.47
sulfite	Na_2SO_3	1.565, 1.515
“ acid	$NaHSO_3$	1.474, 1.526, 1.685
tartrate, acid (*d*)	$NaH(C_4H_4O_6).H_2O$	β1.533
thiocyanate	$NaCNS$	1.545, 1.625, 1.695

INORGANIC COMPOUNDS (Continued)

Name	Formula	Index
Sodium tungstate	$Na_2WO_4.2H_2O$	1.5526, 1.5533, 1.5695
vanadate	$Na_3VO_4.10H_2O$	1.5305; ω1.5398, ε1.5475
"	$Na_3VO_4.12H_2O$	1.5095, 1.5232
Strontium dichromate	$SrCr_2O_7.3H_2O$	1.7146, 1.7174, 1.812
fluoride	SrF_2	1.442 (1.438)
oxide	SrO	1.870
*ortho*phosphate, acid	$SrHPO_4$	1.608, 1.62±, 1.625
sulfide, mono-	SrS	2.107
Sulfur nitride	S_4N_4	α1.908, β2.046
Thallium chloride, mono-	$TlCl$	2.247
iodide, mono-	TlI	2.78
Tin iodide (ic)	SnI_4	2.106
Uranyl potassium sulfate	$UO_2.SO_4.K_2SO_4.2H_2O$	1.5144, 1.5266, 1.5709 (580 mμ)
Vanadium ammonium sulfate	$VNH_4(SO_4)_2.12H_2O$	1.475
Zinc ammonium selenate	$Zn(SeO_4).(NH_4)_2SeO_4.6H_2O$	1.5240, 1.5300, 1.5385
bromate	$Zn(BrO_3)_2.6H_2O$	1.5452
cesium sulfate	$ZnCs_2(SO_4)_2.6H_2O$	1.5022, 1.5048, 1.5093
chloride	$ZnCl_2$	1.687, 1.713
fluosilicate	$ZnSiF_6.6H_2O$	1.3824, 1.3956
potassium cyanide	$ZnK_2(CN)_4$	1.4115
" selenate	$ZnK_2(SeO_4)_2.6H_2O$	1.5121, 1.5181, 1.5335
" sulfate	$ZnK_2(SO_4)_2.6H_2O$	1.4775, 1.4833, 1.4969
rubidium sulfate	$ZnRb_2(SO_4)_2.6H_2O$	1.4833, 1.4884, 1.4975
silicate	$ZnSiO_3$	1.616, 1.62±, 1.623
Zirconium ammonium fluoride	$Zr(NH_4)_3F_7$	1.433

ORGANIC COMPOUNDS

See also under Physical Constants of Organic Compounds.

Name	Index
Allontoin, solid	α1.579, γ1.660
Dimethyl thiophene (α, α′), liq	$1.51693^{13.4}$ (He)
" " (β, β′), liq	1.52217^{15} (He)
Ethyl carbylamine, liq	1.3659^{24}
Ethylidene cyanhydrin, liq	$1.40582^{18.4}$
Hexyl acetylene (n), liq	$1.4208^{12.5}$

MISCELLANEOUS

Albite glass	1.4890	Magdala red	1.90
Amber	1.546	Obsidian	1.482–1.496
Anorthite glass	1.5755	Paraffin	$1.43295^{38.3}$ (C)
Asphalt	1.635	Quartz, fused	1.45640 (656 mμ)
Bell metal	1.0052		1.45843 (589 mμ)
Borax, amorphous, fused	1.4630		1.46190 (509 mμ)
Canada balsam	1.530		1.47503 (361 mμ)
Ebonite	1.66 (red)		1.49634 (275 mμ)
Fuchsin	2.70		1.53386 (214 mμ)
Gelatin, Nelson's No. 1	1.530		1.57464 (185 mμ)
Gelatin, various	1.516–1.534	Resin, aloes	1.619 (red)
Gum Arabic	1.480 (1.514) (red)	colophony	1.548 (red)
		copal	1.528 (red)
Hoffman's violet	2.20	mastic	1.535 (red)
Ivory	1.539, 1.541	Peru balsam	1.593
		Rubber (natural)	1.5191 (D line 25°C)

MOLECULAR REFRACTION

The molecular refraction of a substance may be computed by the following relation,—

$$N = \frac{M(n^2 - 1)}{d(n^2 + 2)}$$

where N is the molecular refraction for a specified wave length and temperature, M, the molecular weight, d, the density and n the refractive index for the specified conditions.

LIQUIDS FOR INDEX BY IMMERSION METHOD

Liquid	N_D 24° C
Trimethylene chloride	1.446
Cineole	1.456
Hexahydrophenol	1.466
Decahydronaphthalene	1.477
Isoamylphthalate	1.486
Tetrachloroethane	1.492
Pentachloroethane	1.501
Trimethylene bromide	1.513
Chlorobenzene	1.523
Ethylene bromide + Chlorobenzene	1.533
o-Nitrotoluene	1.544
Xylidine	1.557
o-Toluidine	1.570
Aniline	1.584
Bromoform	1.595
Iodobenzene + Bromobenzene	1.603
Iodobenzene + Bromobenzene	1.613
Quinoline	1.622
α-Chloronaphthalene	1.633
α-Bromonaphthalene + α-Chloronaphthalene	1.640–1.650
α-Bromonaphthalene + α-Iodonaphthalene	1.660–1.690
Methylene iodide + Iodobenzene	1.700–1.730
Methylene iodide	1.738
Methylene iodide saturated with sulfur	1.78
Yellow phosphorus, sulfur and methylene iodide (8:1:1 by weight)	2.06
Can be diluted with methylene iodide to cover range 1.74–2.06. For precautions in use, cf. West, Am. Mineral, **21**, p. 245–9 (1936).	

HEAVY LIQUIDS FOR MINERAL SEPARATION

Liquid	Density
Tetrabromethane (sym.) Can be diluted with carbon tetrachloride (1.595) or benzene (0.894).	2.964, 20°/4°
Methylene iodide Can be diluted with carbon tetrachloride or benzene.	3.325, 20°/4°
Thallium formate, aq Can be diluted with water.	3.5
Thallium malonate-thallium formate, aq Can be diluted with water.	4.9

For preparation and recovery of these liquids, cf. U. S. Bureau Mines. Rept. Inv. #2897 (1928).

INDEX OF REFRACTION OF WATER

Alcohol and Carbon Bisulfide

For sodium light, λ = .5893

Temp. °C	Water, pure relative to air	Ethyl Alcohol 99.8 relative to air	Carbon Bisulfide relative to air
14	1.33348	....	....
15	1.33341	....	1.62935
16	1.33333	1.36210	1.62858
18	1.33317	1.36129	1.62704
20	1.33299	1.36048	1.62546
22	1.33281	1.35967	1.62387
24	1.33262	1.35885	1.62226
26	1.33241	1.35803	1.62064
28	1.33219	1.35721	1.61902
30	1.33192	1.35639	1.61740
32	1.33164	1.35557	1.61577
34	1.33136	1.35474	1.61413
36	1.33107	1.35390	1.61247
38	1.33079	1.35306	1.61080
40	1.33051	1.35222	1.60914
42	1.33023	1.35138	1.60748
44	1.32992	1.35054	1.60582
46	1.32959	1.34969	....
48	1.32927	1.34885	....
50	1.32894	1.34800	....
52	1.32860	1.34715	....
54	1.32827	1.34629	....
56	1.32792	1.34543	....
58	1.32755	1.34456	....
60	1.32718	1.34368	....
62	1.32678	1.34279	....
64	1.32636	1.34189	....
66	1.32596	1.34096	....
68	1.32555	1.34004	....
70	1.32511	1.33912	....
72	1.32466	1.33820	....
74	1.32421	1.33728	....
76	1.32376	1.33626	....
78	1.32332	....	....
80	1.32287	....	....
82	1.32241	....	....
84	1.32195	....	....
86	1.32148	....	....
88	1.32100	....	....
90	1.32050	....	....
92	1.32000	....	....
94	1.31949	....	....
96	1.31897	....	....
98	1.31842	....	....
100	1.31783	....	....

ABSOLUTE INDEX FOR PURE WATER FOR SODIUM LIGHT

Temperature	Index	Temperature	Index
15° C.	1.33377	60° C.	1.32754
20	1.33335	65	1.32652
25	1.33287	70	1.32547
30	1.33228	75	1.32434
35	1.33157	80	1.32323
40	1.33087	85	1.32208
45	1.33011	90	1.32086
50	1.32930	95	1.31959
55	1.32846	100	1.31819

INDEX OF REFRACTION OF GLASS

Relative to Air

Variety.	Wave length in microns.							
	.361	.434	.486	.589 (Na)	.656	.768	1.20	2.00
Zinc crown	1.539	1.528	1.523	1.517	1.514	1.511	1.505	1.497
Higher dispersion crown	1.546	1.533	1.527	1.520	1.517	1.514	1.507	1.497
Light flint	1.614	1.594	1.585	1.575	1.571	1 567	1.559	1.549
Heavy flint	1.705	1.675	1.664	1.650	1.644	1.638	1.628	1.617
Heaviest flint	...	1.945	1.919	1.890	1.879	1.867	1.848	1.832

INDEX OF REFRACTION OF ROCK SALT, SYLVINE, CALCITE, FLUORITE AND QUARTZ

(Compiled from data of Martens, Paschen, and others.)

Wave length.	Rock salt.	Sylvine, KCl.	Fluorite.	Calcspar, ordinary ray.	Calcspar, extraordinary ray.	Quartz, ordinary ray.	Quartz, extraordinary ray.
0.185	1.893	1.827	......	......	......	1.676	1.690
0.198	.....	......	1.496	......	1.578	1.651	1.664
0.340	.....	......	......	1.701	1.506	1.567	1.577
0.589	1.544	1.490	1.434	1.658	1.486	1.544	1.553
0.760	.....	......	1.431	1.650	1.483	1.539	1.548
0.884	1.534	1.481	1.430				
1.179	1.530	1.478	1.428				
1.229	.....	......	......	1.639	1.479		
2.324	.....	......	......	......	1.474	1.516	
2.357	1.526	1.475	1.421				
3.536	1.523	1.473	1.414				
5.893	1.516	1.469	1.387				
8.840	1.502	1.461	1.331				

INDEX OF REFRACTION OF GLASS

Index of refraction of optical glass made at the Bureau of Standards. Composition refers to the raw material combined, not to the finished glass.

Composition	Ordinary Crown	Borosilicate Crown	Barium flint	Light Barium flint	Light flint	Dense barium flint	Medium flint	Dense flint
(Composition percentage)								
SiO_2	67.0	64.2	53.7	48.0	53.9	37.0	45.6	39.0
Na_2O	12.0	9.4	1.7	2.0	1.0	....	3.4	3.0
K_2O	5.0	8.3	8.3	6.1	7.6	2.7	4.1	4.0
B_2O_3	3.5	11.0	2.7	4.0	....	5.0	....	....
BaO	10.6	6.1	14.3	29.5	....	47.0	....	....
ZnO	1.5	....	2.5	10.0	....	7.7	....	....
As_2O_3	0.4	0.4	....	1.4	0.3	....	....	....
CaO	....	1.0	....	....	2.0	....	3.0	4.0
PbO	....	....	16.7	....	35.2	....	44.0	49.0
Sb_2O_3	....	....	....	....	....	....	....	1.0
Wave length, Å	(Index of Refraction)							
Hg 4046.8	1.53189	1.53817	1.58851	1.59137	1.60507	1.63675	1.65788	1.69005
Hg 4047.1	1.53147	1.53775	1.58791	1.59084	1.60430	1.63619	1.65692	1.68894
H 4340.7	1.52818	1.53468	1.58327	1.58698	1.59860	1.63189	1.64973	1.68079
Hg 4358.6	1.52798	1.53450	1.58299	1.58674	1.59826	1.63163	1.64931	1.68030
H 4861.5	1.52326	1.53008	1.57646	1.58121	1.59029	1.62548	1.63941	1.66911
Hg 4916.4	1.52283	1.52967	1.57587	1.58071	1.58958	1.62492	1.63854	1.66814
Hg 5461.0	1.51929	1.52633	1.57105	1.57657	1.58380	1.62033	1.63143	1.66016
Hg 5769.6	1.51771	1.52484	1.56894	1.57473	1.58128	1.61829	1.62834	1.65671
Hg 5790.5	1.51760	1.52475	1.56881	1.57460	1.58112	1.61817	1.62815	1.65650

INDEX OF REFRACTION OF GLASS (Continued)

Index of refraction of optical glass made at the Bureau of Standards.
Composition refers to the raw material combined, not to the finished glass.

(Index of Refraction) Continued

Wave Length, A	Ordinary Crown	Borosilicate Crown	Barium flint	Light Barium flint	Light flint	Dense barium flint	Medium flint	Dense flint
Na 5893.2	1.51714	1.52430	1.56819	1.57406	1.58038	1.61756	1.62725	1.65548
Hg 6234.6	1.51573	1.52297	1.56634	1.57242	1.57818	1.61576	1.62458	1.65250
H 6563.0	1.51458	1.52188	1.56482	1.57107	1.57638	1.61427	1.62241	1.65007
Li 6708.2	1.51412	1.52145	1.56423	1.57054	1.57567	1.61369	1.62157	1.64913
K 7682.0	1.51160	1.51908	1.56100	1.56762	1.57183	1.61047	1.61701	1.64405

Dispersion

	Ordinary Crown	Borosilicate Crown	Barium flint	Light Barium flint	Light flint	Dense barium flint	Medium flint	Dense flint
n_D	1.51714	1.52430	1.56819	1.57406	1.58038	1.61756	1.62725	1.65548
$n_F - n_C$	0.00868	0.00820	0.01164	0.01014	0.01391	0.01121	0.01700	0.01904
$\frac{n_D - 1}{n_F - n_C} = \nu$	59.6	63.9	48.8	56.6	41.7	55.1	36.9	34.4
$n_D - n_F$	0.00612	0.00578	0.00827	0.00715	0.00991	0.00792	0.01216	0.01363
$n_F - n_{G'}$	0.00492	0.00460	0.00681	0.00577	0.00831	0.00641	0.01032	0.01168
$n_D - n_C$	0.00256	0.00242	0.00337	0.00299	0.00400	0.00329	0.00484	0.00541

OPTICAL CONSTANTS OF METALS

The following table gives the refractive index n, the absorption index k, the angle of principle incidence $\overline{\phi}$, the angle of principle azimuth $\overline{\psi}$ and the percent of light reflected R.

The reduction of amplitude of the wave of the wave length λ after traveling any distance d in the medium is given by the ratio $1 : e^{\frac{2\pi dk}{\lambda}}$. $\overline{\phi}$ is the angle of incidence for which the phase change between the two rectangular components vibrating in and normal to the plane of incidence is 90°. $\overline{\psi}$ is the azimuth at which circularly polarized light results. These quantities are connected by the following relations

$$k = \tan 2\overline{\psi}(1 - \cot^2 \overline{\phi}), \qquad n = \frac{\sin \overline{\phi} \tan \overline{\phi}}{(1+k^2)^{\frac{1}{2}}}(1 + \tfrac{1}{2} \cot^2 \overline{\phi})$$

Metal	λ	$\overline{\phi}$		$\overline{\psi}$		Computed				Authority
						n	k	nk	R	
	μ	°	′	°	′					
Aluminum	0.589	....		....		1.44	....	5.32	83.	Drude
Antimony	.589	....		....		3.04	....	4.94	70.	"
Bismuth (prism)	white	....		....		2.26	....	....	....	Kundt, 1889
Bronze	.527	....		....		1.18	....	....	....	Jamin
	.589	....		....		1.12	....	....	....	"
Cadmium	.589	....		....		1.13	....	5.01	85.	Drude
Chromium	.579	....		....		2.97	....	4.85	70.	Wartenburg, 1910
Cobalt	0.231	64	31	29	39	1.10	1.30	1.43	32.	Minor
	.275	70	22	29	59	1.41	1.52	2.14	46.	"
	.500	77	5	31	53	1.93	1.93	3.72	66.	"
	.650	79	0	31	25	2.35.	1.87	4.40	69.	Ingersoll
	1.00	81	45	29	6	3.63	1.58	5.73	73.	"
	1.50	83	21	26	18	5.22	1.29	6.73	75.	"
	2.25	83	48	26	5	5.65	1.27	7.18	76.	"
Columbium	.579	....		....		1.80	....	2.11	41.	Wartenburg, 1910
Copper	.231	65	57	26	14	1.39	1.05	1.45	29.	Minor
	.347	65	6	28	16	1.19	1.23	1.47	32.	"
	.500	70	44	33	46	1.10	2.13	2.34	56.	"
	.650	74	16	41	30	0.44	7.4	3.26	86.	Ingersoll
	.870	78	40	42	30	0.35	11.0	3.85	91.	"
	1.75	84	4	42	30	0.83	11.4	9.46	96.	"
	2.25	85	13	42	30	1.03	11.4	11.7	97.	"
	4.00	87	20	42	30	1.87	11.4	21.3	....	Först-Fréed
	5.50	88	00	41	50	3.16	9.0	28.4	....	" "
Gold Electrolytic	.257	....		....		0.92	....	1.14	28.	Meier, 1903
	.441	....		....		1.18	....	1.85	42.	"
	.589	....		....		0.47	....	2.83	82.	"
	1.00	81	45	44	00	0.24	28.0	6.7	....	Först-Fréed
	2.00	85	30	43	56	0.47	26.7	12.5	....	" "
	3.00	87	05	43	50	0.80	24.5	19.6	....	" "
	5.00	88	15	43	25	1.81	18.1	33.	....	" "
Iodine	.589	....		....		3.34	....	0.57	30.	Meier, 1903
Iridium	.579	....		....		2.13	....	4.87	75.	Wartenburg, 1916
	1.00	82	10	29	20	3.6	1.60	5.8	....	Eaton and Conn, 1952
	2.00	84	40	28	10	6.0	1.58	9.5	....	Eaton and Conn, 1952
	3.00	85	40	26	40	8.0	1.37	11.0	....	Eaton and Conn, 1952
	5.00	87	20	24	00	12.5	1.13	14.1	....	Eaton and Conn, 1952
Iron	.257	....		....		1.01	0.88	....	16.	Meier, 1903
	.441	....		....		1.28	1.37	....	28.	" "
	.589	....		....		1.51	1.63	....	33.	" "

OPTICAL CONSTANTS OF METALS
(Continued)

Metal	λ	$\bar{\phi}$		$\bar{\psi}$		Computed				Authority
						n	k	nk	R	
	μ	°	′	°	′					
Lead	.589	.....		.....		2.01	.....	3.48	62.	Drude
Magnesium	.589	.....		.....		0.37	.....	4.42	93.	"
Manganese	.579	.....		.....		2.49	.....	3.89	64.	Wartenburg, 1910
Mercury (liq.)	.326	.....		.....		0.68	.....	2.26	66.	Meier, 1903
	.441	.....		.....		1.01	.....	3.42	74.	"
	.589	.....		.....		1.62	.....	4.41	75.	"
	.668	.....		.....		1.72	.....	4.70	77.	"
Nickel	0.420	72	20	31	42	1.41	1.79	2.53	54.	Tool
	0.589	76	1	31	41	1.79	1.86	3.33	62.	Drude
	0.750	78	45	32	6	2.19	1.99	4.36	70.	Ingersoll
	1.00	80	33	32	2	2.63	2.00	5.26	74.	"
	2.25	84	21	33	30	3.95	2.33	9.20	85.	"
	.275	.....		.....		1.09	1.16	.....	24.	Meier, 1903
	.441	.....		.....		1.16	1.23	.....	25.	"
	.589	.....		.....		1.30	1.97	.....	43.	"
Platinum	1.00	82	00	30	30	3.4	1.82	6.2	....	Eaton and Conn, 1952
	2.00	84	45	29	40	5.7	1.70	9.7	....	Eaton and Conn, 1952
	3.00	86	00	28	50	7.7	1.59	12.3	....	Eaton and Conn, 1952
	5.00	87	15	27	00	11.5	1.37	15.7	....	Eaton and Conn, 1952
Electrolytic	.257	.....		.....		1.17	1.65	.....	37.	Meier, 1903
	.441	.....		.....		1.84	.....	3.16	58.	"
	.589	.....		.....		2.63	.....	3.54	59.	"
	.668	.....		.....		2.91	.....	3.66	59.	"
Potassium	.665	65	27	43	56	.066	26.8	.....	93.8	Duncan, 1913
	.589	62	58	43	42	.068	22.1	.....	92.	"
	.472	57	9	43	0	.070	14.3	.....	86.9	"
	.546	.....		.....		1.09	1.16	.....	24.	Morgan, 1922
Rhodium	.579	.....		.....		1.54	.....	4.67	78.	Wartenburg, 1910
Selenium	.400	.....		.....		2.94	2.31	.....	44.	Wood
	.490	.....		.....		3.12	1.49	.....	35.	"
	.589	.....		.....		2.93	0.45	.....	25.	"
	.760	.....		.....		2.60	0.06	.....	20.	"
Silicon, 95 %	pure .579	75	38	.....		3.87	0.116	.....	35.7	Wartenburg, 1910
	.589	.....		.....		4.18	0.09	.....	38.	Ingersoll
	1.25	.....		.....		3.67	0.08	.....	33.	"
	2.25	.....		.....		3.53	0.08	.....	31.	"
99.75 % pure	0.589	76	45	.....		4.24	0.118	.....	37.8	Littleton, 1912
Silver	0.226	62	41	22	16	1.41	0.75	1.11	18.	Minor
	.293	63	14	18	56	1.57	0.62	0.97	17.	"
	.316	52	28	15	38	1.13	0.38	0.43	4.	"
	.332	52	1	37	2	0.41	1.61	0.65	32.	"
	.395	66	36	43	6	0.16	12.32	1.91	87.	"
	.500	72	31	43	29	0.17	17.1	2.94	93.	"
	.589	75	35	43	47	0.18	20.6	3.64	95.	"
	.750	79	26	44	6	0.17	30.7	5.16	97.	Ingersoll
	1.00	82	0	44	2	0.24	29.0	6.96	98.	"
	1.50	84	42	43	48	0.45	23.7	10.7	98.	"
	2.25	86	18	43	34	0.77	19.9	15.4	99.	"
	3.00	87	10	42	40	1.65	12.2	20.1	....	Först-Fréed
	4.50	88	20	41	10	4.49	7.42	33.3	....	" "
Sodium	.665	72	11	44	29	0.051	55.0	.....	97.7	Duncan, 1913
	.589	68	51	44	29	.044	55.0	.....	97.1	"
	.546	68	48	44	20	.052	42.6	.....	96.5	"

OPTICAL CONSTANTS OF METALS

(Continued)

Metal	λ	$\bar{\Phi}$	$\bar{\Psi}$	Computed				Authority
				n	k	nk	R	
	μ	° ′	° ′					
Sodium	.472	66 29	44 9	.057	33.3	.....	95.2	Duncan, 1913
	.435	66 0	44 6	.058	31.7	.....	94.8	"
(liq.)	.589	.....	.....	.004	.....	2.61	99.	Drude
(solid)	.546	.....	.....	.047	47.3	....	96.9	Morgan, 1922
Sodium-Potassium								
17.3% K	.546	.....	.....	.081	27.2	.....	94.6	"
45. % K	.546	.....	.....	1.08	16.8	.....	90.4	"
66. % K	.546	.....	.....	.137	12.5	.....	87.0	"
74.2% K	.546	.....	.....	.124	12.8	.....	86.9	"
84.3% K	.546	.....	.....	.088	17.6	.....	90.2	"
Steel								
0.44% C	.589	77 15	.....	2.50	1.30	.....	57.4	Littleton, 1912
1.28% C	.589	77 22	.....	2.66	1.28	.....	57.5	"
3.5 % C	.589	77 35	.....	2.77	1.23	.....	57.0	"
	0.226	66 51	28 17	1.30	1.26	1.64	35.	Minor
	.257	68 35	28 45	1.38	1.35	1.86	40.	"
	.325	69 57	30 9	1.37	1.53	2.09	45.	"
	.500	75 47	29 2	2.09	1.50	3.14	57.	"
	.650	77 48	27 9	2.70	1.33	3.59	59.	Ingersoll
	1.50	81 48	28 51	3.71	1.55	5.75	73.	"
	2.25	83 22	30 36	4.14	1.79	7.41	80.	"
Tantalum	.579	.....	.....	2.05	.....	2.31	44.	Wartenburg
Tellurium								
axis horizontal	.590	.....	.....	3.07	.563	.....	34.	Van Dyke, 1922
axis vertical	.590	.....	.....	2.68	.632	.....	30.	Van Dyke, 1922
Tin	.589	.....	.....	1.48	.....	5.25	82.	Drude
Tungsten	.579	76 0	.....	2.76	0.98	.....	48.6	Wartenburg
	.589	78 31	.....	3.46	0.94	.....	54.5	Littleton, 1912
Vanadium	.579	.....	.....	3.03	.....	3.51	58.	"
Zinc	.257	.....	.....	0.55	.....	0.61	20.	Meier, 1903
	.441	.....	.....	0.93	.....	3.19	73.	"
	.589	.....	.....	1.93	.....	4.66	74.	"
	.668	.....	.....	2.62	.....	5.08	73.	"

DISPERSION

The dispersion for various types of optical glass is shown in the following table. n_D =index of refraction for the D line (of the solar spectrum) and n_F and n_C the index for the F and C lines respectively ($n_F - n_C$) shows the dispersion for these two wave lengths.

Glass.	n_D	$(n_F - n_C)$
Light phosphate crown	1.5159	.00737
Barium-silicate crown	1.5399	.00909
High-dispersion crown	1.5262	.01026
Borate flint	1.5686	.01102
Extra light flint	1.5398	.01142
Heavy flint	1.7174	.02434
Heaviest flint	1.9626	.04882

INDEX OF REFRACTION, AQUEOUS SOLUTIONS

Substance	Density	Temp. °C	Index for λ = .5893 (Na)	Observer
Ammonium chloride.......	1.067	27.05	1.379	Willigen
Ammonium chloride.......	1.025	29.75	1.351	Willigen
Calcium chloride..........	1.398	25.65	1.443	Willigen
Calcium chloride..........	1.215	22.9	1.397	Willigen
Calcium chloride..........	1.143	25.8	1.374	Willigen
Hydrochloric acid.........	1.166	20.75	1.411	Willigen
Nitric acid...............	1.359	18.75	1.402	Willigen
Potash (caustic)..........	1.416	11.0	1.403	Frauenhofer
Potassium chloride........	Normal	solution	1.343	Bender
Potassium chloride........	Double	normal	1.352	Bender
Potassium chloride........	Triple	normal	1.360	Bender
Soda (caustic)............	1.376	21.6	1.413	Willigen
Sodium chloride...........	1.189	18.07	1.378	Schutt
Sodium chloride...........	1.109	18.07	1.360	Schutt
Sodium chloride...........	1.035	18.07	1.342	Schutt
Sodium nitrate............	1.358	22.8	1.385	Willigen
Sulfuric acid.............	1.811	18.3	1.437	Willigen
Sulfuric acid.............	1.632	18.3	1.425	Willigen
Sulfuric acid.............	1.221	18.3	1.370	Willigen
Sulfuric acid.............	1.028	18.3	1.339	Willigen
Zinc chloride.............	1.359	26.6	1.402	Willigen
Zinc chloride.............	1.209	26.4	1.375	Willigen

INDEX OF REFRACTION OF FUSED QUARTZ

λ mμ, 15° C	n, 18° C	λ mμ, 15° C	n, 18° C
185.467	1.57436	434.047	1.46690
193.583	1.55999	435.834	1.46675
202.55	1.54727	467.815	1.46435
214.439	1.53386	479.991	1.46355
219.462	1.52907	486.133	1.46318
226.503	1.52308	508.582	1.46191
231.288	1.51941	533.85	1.46067
250.329	1.50745	546.072	1.46013
257.304	1.50379	589.29	1.45845
274.867	1.49617	643.847	1.45674
303.412	1.48594	656.278	1.45640
340.365	1.47867	706.520	1.45517
396.848	1.47061	794.763	1.45340
404.656	1.46968		

INDEX OF REFRACTION OF AIR (15°C, 76 cm Hg)

Corrections for reducing wavelengths and frequencies in air (15°C, 76 cm Hg) to vacuo

The indices were computed from the Cauchy formula $(n - 1)10^7 = 2726.43 + 12.288/(\lambda^2 \times 10^{-8}) + 0.3555/(\lambda^4 \times 10^{-16})$. For 0°C and 76 cm Hg the constants of the equation become 2875.66, 13.412 and 0.3777 respectively, and for 30°C and 76 cm Hg 2589.72, 12.259 and 0.2576. Sellmeier's formula for but one absorption band closely fits the observations: $n^2 = 1 + 0.00057378\lambda^2/(\lambda^2 - 595260)$. If $n - 1$ were strictly proportional to the density, then $(n - 1)_0/(n - 1)t$ would equal $1 + \alpha t$ where α should be 0.00367. The following values of α were found to hold:

λ	0.85μ	0.75μ	0.65μ	0.55μ	0.45μ	0.35μ	0.25μ
α	0.003672	0.003674	0.003678	0.003685	0.003700	0.003738	0.003872

The indices are for dry air (0.05 ± % CO_2). Corrections to reduce to dry air the indices for moist air may be made for any wavelength by Lorenz's formula, $+0.000041(m/760)$, where m is the vapor pressure in mm. The corresponding frequencies in waves per cm and the corrections to reduce wavelengths and frequencies in air at 15°C and 76 cm Hg pressure to vacuo are given. E.g., a light wave of 5000 angstroms in dry air at 15°C, 76 cm Hg becomes 5001.391 A in vacuo; a frequency of 20,000 waves per cm correspondingly becomes 19994.44.

Wave-length, λ angstroms	Dry air $(n-1) \times 10^7$ 15°C 76 cm Hg	Vacuo correction for λ in air $(n\lambda - \lambda)$ add	Frequency waves per cm $\frac{1}{\lambda}$ in air	Vacuo correction for $\frac{1}{\lambda}$ in air $\left(\frac{1}{n\lambda} - \frac{1}{\lambda}\right)$ subtract	Wave-length, λ angstroms	Dry air $(n-1) \times 10^7$ 15°C 76 cm Hg	Vacuo correction for λ in air $(n\lambda - \lambda)$ add	Frequency waves per cm $\frac{1}{\lambda}$ in air	Vacuo correction for $\frac{1}{\lambda}$ in air $\left(\frac{1}{n\lambda} - \frac{1}{\lambda}\right)$ subtract
2000	3256	.651	50,000	16.27	5500	2771	1.524	18,181	5.04
2100	3188	.670	47,619	15.18	5600	2769	1.551	17,857	4.94
2200	3132	.689	45,454	14.23	5700	2768	1.578	17,543	4.85
2300	3086	.710	43,478	13.41	5800	2766	1.604	17,241	4.77
2400	3047	.731	41,666	12.69	5900	2765	1.631	16,949	4.68
2500	3014	.754	40,000	12.05	6000	2763	1.658	16,666	4.60
2600	2986	.776	38,461	11.48	6100	2762	1.685	16,393	4.53
2700	2962	.800	37,037	10.97	6200	2761	1.712	16,129	4.45
2800	2941	.824	35,714	10.50	6300	2760	1.739	15,873	4.38
2900	2923	.848	34,482	10.08	6400	2759	1.766	15,625	4.31
3000	2907	.872	33,333	9.69	6500	2758	1.792	15,384	4.24
3100	2893	.897	32,258	9.33	6600	2757	1.819	15,151	4.18
3200	2880	.922	31,250	9.00	6700	2756	1.846	14,925	4.11
3300	2869	.947	30,303	8.69	6800	2755	1.873	14,705	4.05
3400	2859	.972	29,411	8.41	6900	2754	1.900	14,492	3.99
3500	2850	.998	28,571	8.14	7000	2753	1.927	14,285	3.93
3600	2842	1.023	27,777	7.89	7100	2752	1.954	14,084	3.88
3700	2835	1.049	27,027	7.66	7200	2751	1.981	13,888	3.82
3800	2829	1.075	26,315	7.44	7300	2751	2.008	13,698	3.77
3900	2823	1.101	25,641	7.24	7400	2750	2.035	13,513	3.72
4000	2817	1.127	25,000	7.04	7500	2749	2.062	13,333	3.66
4100	2812	1.153	24,390	6.86	7600	2749	2.089	13,157	3.62
4200	2808	1.179	23,809	6.68	7700	2748	2.116	12,987	3.57
4300	2803	1.205	23,255	6.52	7800	2748	2.143	12,820	3.52
4400	2799	1.232	22,727	6.36	7900	2747	2.170	12,658	3.48
4500	2796	1.258	22,222	6.21	8000	2746	2.197	12,500	3.43
4600	2792	1.284	21,739	6.07	8100	2746	2.224	12,345	3.39
4700	2789	1.311	21,276	5.93	8250	2745	2.265	12,121	3.33
4800	2786	1.338	20,833	5.80	8500	2744	2.332	11,764	3.23
4900	2784	1.364	20,406	5.68	8750	2743	2.400	11,428	3.13
5000	2781	1.391	20,000	5.56	9000	2742	2.468	11,111	3.05
5100	2779	1.417	19,607	5.45	9250	2741	2.536	10,810	2.96
5200	2777	1.444	19,230	5.34	9500	2740	2.604	10,526	2.88
5300	2775	1.471	18,867	5.23	9750	2740	2.671	10,256	2.81
5400	2773	1.497	18,518	5.13	10000	2739	2.739	10,000	2.74

INDEX OF REFRACTION, GASES

Values are relative to a vacuum and for a temp. of 0° C. and 760 mm. pressure.

(From Smithsonian Tables)

Substance	Kind of light	Indices of refraction	Observer
Acetone	*D*	1.001079–1.001100	
Air	*D*	1.0002926	Perreau
Ammonia	white	1.000381–1.000385	
Ammonia	*D*	1.000373–1.000379	
Argon	*D*	1.000281	Rayleigh
Benzene	*D*	1.001700–1.001823	
Bromine	*D*	1.001132	Mascart
Carbon dioxide	white	1.000449–1.000450	
dioxide	*D*	1.000448–1.000454	
disulfide	white	1.001500	Dulong
disulfide	*D*	1.001478–1.001485	
monoxide	white	1.000340	Dulong
monoxide	white	1.000335	Mascart
Chlorine	white	1.000772	Dulong
Chlorine	*D*	1.000773	Mascart
Chloroform	*D*	1.001436–1.001464	
Cyanogen	white	1.000834	Dulong
Cyanogen	*D*	1.000784–1.000825	
Ethyl alcohol	*D*	1.000871–1.000885	
ether	*D*	1.001521–1.001544	
Helium	*D*	1.000036	Ramsay
Hydrochloric acid	white	1.000449	Mascart
Hydrochloric acid	*D*	1.000447	Mascart
Hydrogen	white	1.000138–1.000143	
Hydrogen	*D*	1.000132	Burton
sulfide	*D*	1.000644	Dulong
sulfide	*D*	1.000623	Mascart
Methane	white	1.000443	Dulong
Methane	*D*	1.000444	Mascart
Methyl alcohol	*D*	1.000549–1.000623	
Methyl ether	*D*	1.000891	Marcast
Nitric oxide	white	1.000303	Dulong
Nitric oxide	*D*	1.000297	Mascart
Nitrogen	white	1.000295–1.000300	
Nitrogen	*D*	1.000296–1.000298	
Nitrous oxide	white	1.000503–1.000507	
Nitrous oxide	*D*	1.000516	Mascart
Oxygen	white	1.000272–1.000280	
Oxygen	*D*	1.000271–1.000272	
Pentane	*D*	1.001711	Mascart
Sulfur dioxide	white	1.000665	Dulong
Sulfur dioxide	*D*	1.000686	Ketteler
Water	white	1.000261	Jamin
Water	*D*	1.000249–1.000259	

COEFFICIENT OF TRANSPARENCY OF UVIOL GLASS FOR THE ULTRA-VIOLET

For a thickness of 1 mm.

Wave length, microns	0.280	0.309	0.325	0.346	0.361	0.383	0.397
Uviol crown	0.56	0.95	0.990	0.996	0.999	1.000	1.000

REFLECTION OF LIGHT BY GLASS IN AIR

The table gives the percentage *R* of light reflected by one surface of glass having a refractive index of 1.55 relative to air. The angle of incidence is *i*, and the angle of refraction is *r*. The two components of the polarized light are marked $\parallel$ and $\perp$ according to the electric vector of the vibration. (Computed according to Fresnel's formula.)

i	*r*	$\parallel$	$\perp$	*R*
0	0° 0′	4.65	4.65	4.65
10	6° 26′	4.84	4.47	4.66
20	12° 45′	5.45	3.92	4.68
30	18° 49′	6.64	3.00	4.82
40	24° 30′	8.77	1.75	5.26
50	29° 37′	12.54	0.46	6.50
60	33° 58′	19.35	0.12	9.73
70	37° 19′	31.99	4.00	18.00
80	39° 27′	55.74	23.34	39.54
90	40° 11′	100.00	100.00	100.00

REFLECTION BY TRANSPARENT MEDIA IN AIR

For Normal Incidence

The table gives the per cent of the normally incident light which is reflected by transparent media of various indices of refraction. *n* = index of refraction, *R* = reflected light, *i* = angle of incidence = 0.

(Computed from Fresnel's formula.)

n	*R*	*n*	*R*	*n*	*R*
1.0	0.00	1.7	6.72	2.4	17.0
1.1	0.23	1.8	8.16	2.5	18.4
1.2	0.83	1.9	9.63	2.6	19.8
1.3	1.70	2.0	11.11	2.7	21.1
1.4	2.78	2.1	12.6	2.8	22.5
1.5	4.00	2.2	14.1	2.9	23.8
1.6	5.33	2.3	15.5	3.0	25.0

COEFFICIENT OF TRANSPARENCY OF GLASS FOR THE INFRA-RED

Normal incidence, thickness 1 cm.

Wave length, microns. . .	0.7	1.1	1.7	2.3	2.7	3.1
Crown, borate.	1.00	.55	.21	.025	.04	
borosilicate.	. . .	.74	.61	.33	.034	.021
Flint, light.	1.00	.91	.82	.45	.083	.019
heavy.	1.00	1.00	1.00	1.00	.45	.019

INDEX OF REFRACTION OF AQUEOUS SOLUTIONS OF SUCROSE (CANE SUGAR)

The table gives the index of refraction for λ = 0.5893 of aqueous sugar solutions at 20°C from 0–85% sugar. Corrections for temperatures other than 20° are given at the end of the table.

Per cent sugar		.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
00.	1.3	330	331	333	334	336	337	338	340	341	342
1.		344	345	347	348	350	351	353	355	356	357
2.		359	361	362	363	365	367	368	369	371	373
3.		374	375	377	378	380	381	382	384	385	387
4.		388	389	391	393	394	395	397	399	400	401
5.		403	405	406	407	409	411	412	413	415	417
6.		418	419	421	423	424	425	427	429	430	431
7.		433	435	436	437	439	441	442	443	445	447
8.		448	450	451	453	454	456	458	459	461	462
9.		464	465	467	469	470	471	473	475	476	477
10.		479	481	482	483	485	487	488	489	491	493
11.		494	496	497	499	500	502	504	505	507	508
12.		510	512	513	515	516	518	520	521	523	524
13.		526	527	529	531	532	533	535	537	538	539
14.		541	543	544	546	547	549	551	552	554	555
15.		557	559	560	562	563	565	567	568	570	571
16.		573	575	576	578	580	582	583	585	587	588
17.		590	592	593	595	596	598	600	601	603	604
18.		606	608	609	611	612	614	616	617	619	620
19.		622	624	625	627	629	631	632	634	636	637
20.		639	641	642	644	645	647	649	650	652	653
21.		655	657	658	660	662	663	665	667	669	670
22.		672	674	675	677	679	681	682	684	686	687
23.		689	691	692	694	696	698	699	701	703	704
24.		706	708	709	711	713	715	716	718	720	721
25.		723	725	726	728	730	731	733	735	737	738
26.		740	742	744	745	747	749	751	753	754	756
27.		758	760	761	763	765	767	768	770	772	773
28.		775	777	779	780	782	784	786	788	789	791
29.		793	795	797	798	800	802	804	806	807	809
30.		811	813	815	816	818	820	822	824	825	827
31.		829	831	833	834	836	838	840	842	843	845
32.		847	849	851	852	854	856	858	860	861	863
33.		865	867	869	870	872	874	876	878	879	881
34.		883	885	887	889	891	893	894	896	898	900
35.		902	904	906	907	909	911	913	915	916	918
36.		920	922	924	926	928	929	931	933	935	937
37.		939	941	943	945	947	949	950	952	954	956
38.		958	960	962	964	966	968	970	972	974	976
39.		978	980	982	984	986	987	989	991	993	995
40.		997	999	*001	*003	*005	*007	*008	*010	*012	*014
41.	1.4	016	018	020	022	024	026	028	030	032	034
42.		036	038	040	042	044	046	048	050	052	054
43.		056	058	060	062	064	066	068	070	072	074
44.		076	078	080	082	084	086	088	090	092	094
45.		096	098	100	102	104	107	109	111	113	115
46.		117	119	121	123	125	127	129	131	133	135
47.		137	139	141	143	145	147	150	152	154	156
48.		158	160	162	164	166	169	171	173	175	177
49.		179	181	183	185	187	189	192	194	196	198
50.		200	202	204	206	208	211	213	215	217	219
51.		221	223	225	227	229	231	234	236	238	240
52.		242	244	246	249	251	253	255	257	260	262
53.		264	266	268	270	272	275	277	279	281	283
54.		285	287	289	292	294	296	298	300	303	305
55.		307	309	311	313	316	318	320	322	325	327

INDEX OF REFRACTION OF AQUEOUS SOLUTIONS OF SUCROSE (CANE SUGAR) (Continued)

Per cent sugar		.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
55.	1.4	307	309	311	313	316	318	320	322	325	327
56.		329	331	333	336	338	340	342	344	347	349
57.		351	353	355	358	360	362	364	366	369	371
58.		373	375	378	380	382	385	387	389	391	394
59.		396	398	400	403	405	407	409	411	414	416
60.		418	420	423	425	427	429	432	434	436	439
61.		441	443	446	448	450	453	455	457	459	462
62.		464	466	468	471	473	475	477	479	482	484
63.		486	488	491	493	495	497	500	502	504	507
64.		509	511	514	516	518	521	523	525	527	530
65.		532	534	537	539	541	544	546	548	550	553
66.		558	561	563	565	567	570	572	574	577	579
67.		581	584	586	588	591	593	595	598	600	602
68.		605	607	609	612	614	616	619	621	623	625
69.		628	630	632	635	637	639	642	644	646	649
70.		651	653	656	658	661	663	666	668	671	673
71.		676	678	681	683	685	688	690	693	695	698
72.		700	703	705	708	710	713	715	717	720	722
73.		725	727	730	732	735	737	740	742	744	747
74.		749	752	754	757	759	762	764	767	769	772
75.		774	777	779	782	784	787	789	792	794	797
76.		799	802	804	807	810	812	815	817	820	822
77.		825	827	830	832	835	838	840	843	845	848
78.		850	853	855	858	860	863	865	868	871	873
79.		876	878	881	883	886	888	891	893	896	898
80.		901	904	906	909	912	914	917	919	922	925
81.		927	930	933	935	938	941	943	946	949	951
82.		954	956	959	962	964	967	970	972	975	978
83.		980	983	985	988	991	993	996	999	*001	*004
84.	1.5	007	009	012	015	017	020	022	025	028	030
85.		033									

TEMPERATURE CORRECTIONS

Below 20°C the correction should be subtracted from the per cent sugar. Above 20°C the correction is to be added to the per cent sugar.

Temp. °C	Approximate per cent sugar									
	5	10	15	20	30	40	50	60	70	75
15	0.25	0.27	0.31	0.31	0.34	0.35	0.36	0.37	0.36	0.36
16	0.21	0.23	0.26	0.27	0.29	0.31	0.31	0.32	0.31	0.29
17	0.16	0.18	0.20	0.20	0.22	0.23	0.23	0.23	0.20	0.17
18	0.11	0.12	0.14	0.14	0.15	0.16	0.16	0.15	0.12	0.09
19	0.06	0.07	0.08	0.08	0.08	0.09	0.09	0.08	0.07	0.05
21	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
22	0.12	0.14	0.14	0.14	0.14	0.14	0.15	0.14	0.14	0.14
23	0.18	0.20	0.20	0.21	0.21	0.21	0.23	0.21	0.22	0.22
24	0.24	0.26	0.26	0.27	0.28	0.28	0.30	0.28	0.29	0.29
25	0.30	0.32	0.32	0.34	0.36	0.36	0.38	0.36	0.36	0.37
26	0.36	0.39	0.39	0.41	0.43	0.43	0.46	0.44	0.43	0.44
27	0.43	0.46	0.46	0.48	0.50	0.51	0.55	0.52	0.50	0.51
28	0.50	0.53	0.53	0.55	0.58	0.59	0.63	0.60	0.57	0.59
29	0.57	0.60	0.61	0.62	0.66	0.67	0.71	0.68	0.65	0.67
30	0.64	0.67	0.70	0.71	0.74	0.75	0.80	0.76	0.73	0.75

INDEX OF REFRACTION OF MALTOSE HYDRATE SOLUTIONS

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The following table gives the refractive index of maltose solutions for $\lambda = 5893$ A at 20° and 25°C.

Percent	n_D^{20}	n_D^{25}	Δn	$\Delta n/\Delta t$
1	1.33438	1.33389	0.00049	0.00010
2	1.33579	1.33528	.00051	.00010
3	1.33720	1.33668	.00052	.00010
4	1.33862	1.33810	.00052	.00010
5	1.34006	1.33952	.00054	.00011
6	1.34150	1.34095	.00055	.00011
7	1.34295	1.34239	.00056	.00011
8	1.34442	1.34384	.00058	.00012
9	1.34589	1.34530	.00059	.00012
10	1.34738	1.34677	.00061	.00012
11	1.34887	1.34825	.00062	.00012
12	1.35039	1.34974	.00065	.00013
13	1.35190	1.35124	.00066	.00013
14	1.35343	1.35276	.00067	.00013
15	1.35497	1.35428	.00069	.00014
16	1.35652	1.35582	.00070	.00014
17	1.35808	1.35737	.00071	.00014
18	1.35965	1.35893	.00072	.00014
19	1.36124	1.36051	.00073	.00015
20	1.36283	1.36209	.00074	.00015
21	1.36444	1.36369	.00075	.00015
22	1.36606	1.36530	.00076	.00015
23	1.36770	1.36692	.00078	.00016
24	1.36934	1.36856	.00078	.00016
25	1.37100	1.37021	.00079	.00016
26	1.37267	1.37187	.00080	.00016
27	1.37435	1.37355	.00080	.00016
28	1.37604	1.37524	.00080	.00016
29	1.37775	1.37694	.00081	.00016
30	1.37946	1.37865	.00081	.00016
31	1.38120	1.38038	.00082	.00016
32	1.38294	1.38213	.00082	.00016
33	1.38470	1.38388	.00082	.00016
34	1.38647	1.38565	.00081	.00016
35	1.38825	1.38744	.00081	.00016

INDEX OF REFRACTION OF MALTOSE HYDRATE SOLUTIONS (Continued)

Percent	n_D^{20}	n_D^{25}	Δn	$\Delta n/\Delta t$
36	1.39004	1.38924	0.00080	0.00016
37	1.39185	1.39105	.00080	.00016
38	1.39367	1.39287	.00080	.00016
39	1.39551	1.39471	.00080	.00016
40	1.39735	1.39656	.00079	.00016
41	1.39922	1.39843	.00079	.00016
42	1.40109	1.40031	.00078	.00016
43	1.40298	1.40221	.00077	.00016
44	1.40488	1.40411	.00077	.00015
45	1.40680	1.40603	.00077	.00015
46	1.40873	1.40797	.00076	.00015
47	1.41067	1.40992	.00075	.00015
48	1.41263	1.41188	.00075	.00015
49	1.41460	1.41385	.00075	.00015
50	1.41658	1.41584	.00074	.00015
51	1.41858	1.41784	.00074	.00015
52	1.42059	1.41986	.00073	.00015
53	1.42262	1.42189	.00073	.00015
54	1.42466	1.42392	.00074	.00015
55	1.42672	1.42598	.00074	.00015
56	1.42878	1.42804	.00074	.00015
57	1.43087	1.43012	.00075	.00015
58	1.43296	1.43221	.00075	.00015
59	1.43508	1.43431	.00077	.00015
60	1.43720	1.43643	.00077	.00015
61	1.43934	1.43855	.00079	.00016
62	1.44150	1.44069	.00081	.00016
63	1.44367	1.44283	.00084	.00017
64	1.44585	1.44499	.00086	.00017
65	1.44805	1.44716	.00089	.00018

REFLECTION OF LIGHT BY METALS

The table gives the per cent of normally incident light which is reflected by the polished surface of various metals.

Wave length.	Antimony.	Bronze (68 Cu, 32 Sn).	Copper, commercial.	Gold, electrolytic.	Iron.	Magnalium, Mach's.	Magnesium.	Mercury, backed glass.
.251	....	30	25.9	38.8	....	67.0		
.288	....	....	24.3	34.0	....	70.6		
.305	....	....	25.3	31.8	....	72.2		
.326	....	....	24.9	28.6	....	75.5		
.357	....	....	27.3	27.9	....	81.2		
.385	....	53	28.6	27.1	....	83.9		
.420	....	....	32.7	29.3	....	83.3		
.450	....	....	37.0	33.1	....	83.4	....	72.8
.500	....	63	43.7	47.0	55	83.3	72	70.9
.550	....	....	47.7	74.0	....	82.7	....	71.2
.600	53	64	71.8	84.4	57	83.0	73	69.9
.650	....	....	80.0	88.9	....	82.7	....	71.5
.700	....	....	83.1	92.3	59	83.3	....	72.8
.800	....	....	88.6	94.9	....	84.3		
1.00	55	70	90.1	......	65	84.1	74	
2.0	60	80	95.5	96.8	78	86.7	77	
3.0	65	86	97.1	......	84	87.4	80	
4.0	68	88	97.3	96.9	89	88.7	83	
9.0	72	93	98.4	98.0	94	90.6	93	

Wave length.	Nickel, electrolytic.	Platinum, electrolytic.	Silver, chemically deposited.	Silver-backed glass.	Speculum metal.	Steel.	Tungsten.
.251	37.8	33.8	34.1	......	29.9	32.9	
.288	42.7	38.8	21.2	......	37.7	35.0	
.305	44.2	39.8	9.1	......	41.7	37.2	
.326	45.2	41.4	14.6	......	......	40.3	
.357	48.8	43.4	74.5	......	51.0	45.0	
.385	49.6	45.4	81.4	......	53.1	47.8	
.420	56.6	51.8	86.6	......	56.4	51.9	
.450	59.4	54.7	90.5	85.7	60.0	54.4	
.500	60.8	58.4	91.3	86.6	63.2	54.8	19
.550	62.6	61.1	92.7	88.2	64.0	54.9	
.600	64.9	64.2	92.6	88.1	64.3	55.4	51
.650	66.6	66.5	94.7	89.1	65.4	56.4	
.700	68.8	69.0	95.4	89.6	66.8	57.6	54
.800	69.6	70.3	96.8	......	......	58.0	
1.00	72.0	72.9	97.0	......	70.5	63.1	62
2.0	83.5	80.6	97.8	......	80.4	76.7	85
3.0	88.7	88.8	98.1	......	86.2	83.0	90
4.0	91.1	91.5	98.5	......	88.5	87.8	93
9.0	95.6	95.4	98.7	......	92.2	92.9	95

REFLECTION OF LIGHT BY METALS

The table gives the percent of normally incident light which is reflected by the polished surface of various metals.

Coblentz, 1906, 1911

Wave length	Aluminum	Cadmium	Cobalt	Graphite	Iridium	Molybdenum	Palladium	Rhodium	Silicon
.5	..	..	..	22	..	46	..	76	34
.6	..	..	..	24	..	48	..	77	32
.8	..	..	..	25	..	52	..	81	29
1.0	71	72	67	27	78	58	72	84	28
2.0	82	87	72	35	87	82	81	91	28
4.0	92	96	81	48	94	90	88	92	28
7.0	96	98	93	54	95	93	94	94	28
10.0	98	98	97	59	96	94	97	95	28
12.0	98	99	97	..	96	95	97	..	..

Wave length	Tantalum	Telurium	Tin	Vanadium	Zinc	Wave length	Tungsten*	Stellite*
.5	38	..	..	57	..	.15	....	32
.6	45	49	..	58	..	.20	....	42
.8	64	48	..	60	..	.30	....	50
1.0	78	50	54	61	80	.50	50	64
2.0	90	52	61	69	92	.75	52	67
4.0	93	57	72	79	97	1.00	576	689
7.0	94	68	81	88	98	2.00	900	747
10.0	..	..	84	..	98	3.00	943	792
12.0	95	..	85	..	99	4.00	948	825
						5.00	953	848
						9.00	....	880

*Coblentz, Emerson, 1917.

RELATIVE STIMULATION OF THE THREE PRIMARY COLOR SENSATIONS BY DIFFERENT WAVE LENGTHS

Wave length . . .	0.36μ	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54
Red.	0.0	0.0	2.0	1.0	1.0	1.0	3.0	9.0	23.0	39.0
Green.	0.0	0.0	0.0	0.0	0.0	2.0	7.0	23.0	6.10	87.0
Blue.	0.0	10.5	29.0	52.0	76.0	78.0	68.0	46.0	16.0	7.0

Wave length . . .	0.56μ	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.74
Red.	56.0	69.0	71.5	59.0	30.0	12.0	5.0	2.0	1.0	0.0
Green.	86.0	67.0	37.0	10.0	2.5	1.0	0.0	0.0	0.0	0.0
Blue.	4.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

REFLECTION OF LIGHT BY METALS (Continued)

Coblentz, Bulletin 379, Bureau of Standards 1920

Wave-length in $\mu - 0.001$mm.	Silver	Monel metal	Stellite	Zinc
0.45	88.0	56.5	63.5	54.0
0.50	90.0	57.8	65.8	55.0
0.55	91.5	59.0	68.3	56.0
0.60	92.7	60.2	70.1	57.5
0.65	93.5	61.8	71.0	60.0
0.70	94.1	63.7	71.8	61.0
0.75	94.7	65.6	72.4	61.5
0.80	95.1	67.2	73.0	61.5
0.90	96.0	70.0	73.5	55.5
0.95	96.3	71.1	....	51.0
1.00	96.5	72.3	74.0	49.0
1.05	96.7	73.0	....	53.5
1.10	96.9	73.6	....	62.5
1.20	97.2	74.8	74.5	74.7
1.40	97.4	77.0	75.0	85.8
1.50	97.6	78.2	75.3	88.4
1.75	97.8	81.2	76.0	92.0
2.00	97.9	83.8	76.8	94.0
2.50	98.0	87.0	78.6	95.3
3.00	98.0	88.7	80.0	95.5
8.50	98.0	89.5	81.4	95.8
4.00	98.0	91.0	82.8	96.2

TRANSMISSION FACTORS FOR "GROUND" GLASS

Luckiesh

	Side toward light	Transmission Factor	
		Narrow beam	Diffuse
Sand blasted	Rough	0.783	0.702
	Smooth	.739	.695
Etched, fine	Rough	.794	.709
	Smooth	.758	.704

COEFFICIENTS OF REFLECTION OF MAGNESIUM CARBONATE AND MAGNESIUM OXIDE

Frank Benford, 1947

λ, A	4500	5000	5500	6000	6500
$MgCO_3$	0.967	0.977	0.983	0.987	0.989
MgO	0.980	0.986	0.991	0.994	0.995

DIFFUSE REFLECTING POWER

The diffuse reflecting power, or ratio of total luminous flux reflected to that received, measured for the various regions of the spectrum. The wave lengths given are those of maximum energy. — Coblentz, Bulletin, 196, Bureau of Standards 1912.

Material	Reflecting power %					
	0.54 μ	0.60	0.95	4.4	8.8	24.0
Lampblacks						
paint	....	3.2	3.4	3.2	3.8	4.4
paraffin-candle	....	....	0.97	....	....	....
rosin	....	....	...1.3	1.3	....	3.0
sperm candle	....	....	1.1	.9	1.3	4.0
camphor	....	....	1.3	1.2	1.6	5.7
acetylene	....	....	0.6	.8	1.2	2.1
Platinum black						
electrolytic	....	....	1.1	1.4	2.1	4.2
Pigments						
cobalt oxide, Co_2O_3	....	3.02	3.92	13.9	14.6	5.9
	....	....	4.04	....	11.8	....
	....	....	2.49	....	....	....
copper oxide, CuO	....	....	23.5	15.2	....	4.4
chromium oxide, Cr_2O_3	24.1	27.0	44.6	32.9	5.0	8.2
lead oxide, PbO	....	51.8	....	50.6	25.6	9.5
red iron oxide, Fe_2O_3	....	26.3	41.0	29.9	3.7	9.1
yttrium oxide, Y_2O_3	....	73.8	....	34.4	11.1	10.0
lead chromate, $PbCrO_4$	61.2	70.2	....	41.2	4.74	7.4
aluminum oxide, Al_2O_3	....	84.1	87.7	20.8	2.34	6.5
					1.64	....
thorium oxide, ThO_2	....	86.0	....	46.9	7.11	10.0
zinc oxide, ZnO	....	82.2	86.4	8.5	3.2	5.1
					2.1	
magnesium oxide, MgO	....	86.3	....	16.0	2.5	9.1
calcium oxide, CaO	....	85.4	....	22.3	3.6	6.2
zirconium oxide, ZrO_2	82.2	85.8	84.1	23.2	5.1	5.4
lead carbonate, $PbCO_3$		86.8	90.8	29.2	9.3	6.9
	....	89.9	92.8	....	....	....
		.....	94.5	....	13.2	....
magnesium carbonate, $MgCO_3$	....	85.2	89.4	10.8	4.1	8.8
Paints						
white lead No. 103	....	76.2	79.3	....	....	....
" " " 102	....	74.3	....	....	....	....
zinc lead white No. 107	....	69.6	....	....	....	....
" oxide No. 104	....	68.1	72.1	....	....	....
white lead 50% zinc oxide 50% } No. 209	....	70.8	....	....	....	....
Miscellaneous						
asphalt (pavement)	....	14.8	....	....	....	....
black felt	....	13.9	21.2	....	....	....
		22.5	25.6	....	....	....
black velvet	....	1.75	....	3.66	2.7	....
bluestone (sandstone) SiO_2	....	18.4	8.1	17.6	11.0	....
blue flannel	....	17.5	....	....	....	....
Brick:						
light buff	....	48.4	....	....	....	....
darker	....	40.0	....	....	....	....
red brick	...	30.1	....	....	12.4	....
darker & glazed	....	23.4	....	....	....	....
Cotton cloth:						
diamine fast red 8 B L	....	43.8	....	....	....	....
diamine fast black C B —	....	33.1	....	....	....	....
columbia fast black R	....	28.7	....	....	....	....
diamine aldehyde black	....	29.5	....	....	....	....
sulphur black A W L —	....	2.43	2.57	....	....	....

DIFFUSE REFLECTING POWER (Continued)

The diffuse reflecting power, or ratio of total luminous flux reflected to that received, measured for the various regions of the spectrum. The wave lengths given are those of maximum energy. — Coblentz, Bulletin, 196, Bureau of Standards 1912.

Material	Reflecting power %					
	0.54 μ	0.60	0.95	4.4	8.8	24.0
Woolen Cloth:						
lanacyl blue B N —	....	25.1	....	....	....	....
salacine blue black A E —	....	14.6	17.8	....	....	....
" black PB —	....	11.8	15.1	....	....	....
Linen:						
starched, dull finish	....	81.2	....	....	....	....
deep blue cloth (Navy Dept.)	....	17.0	....	....	....	....
lighter shade	....	18.2	....	....	....	....
Feldspar, $KAlSi_3O_8$	....	....	86.7	38.2	10.3	9.7
cleavage surface	....	39.4	....	....	14.6	....
Granolith (pavement)	....	16.9	....	....	....	....
Green Leaf (tulip tree)	....	21.9	38.0	5.6	....	....
Indiana limestone, $CaCO_3$	....	42.9	....	20.3	5.0	....
Quartz (powder, French Flint) SiO_2	....	81.0	41.5	7.9	9.0	....
Slate (dark clay)	....	6.7	....	13.4	20.0	....
White marble $CaCO_3$ ground, unpolished	....	53.5	....	6.4	5.1	....
cleavage, surface	....	40.8	....	....	....	....
White paper	....	71.7	74.7	18.2	5.0	....
two thicknesses	....	73.4	....	....	....	....
White paper, (Bond)	....	75.2	....	....	....	....

DIFFUSED REFLECTION

Albedo

Giving the percent of diffused reflection of "white light" for various surfaces. *Sumpner, Zöllner* and others.

Material	Reflections	Material	Reflections
Wood, pine	40	Parchment	
Cardboard		1 sheet	22
yellow	30	2 sheets	35
white	60–70	Cloth	
Painted surface,		black	1
yellow	40	tracing	35
white washed	50	white	60–70
Paper		Velvet	
tracing	22	black	0.4
ordinary white	60–70		
blotting	70–80	Loam, sandy	24
chocolate color	4		
brown	13	Earth, moist	8
blue	25		
yellow	25	Marl, argillaceous	16

REFLECTION COEFFICIENTS

Coefficients of Reflection of Miscellaneous Surfaces for Monochromatic Radiation in the Visible Spectrum
(J. L. Michaelson)

Material	Wave lengths (μ)			
	0.400	0.500	0.600	0.700
Carbon Black in Oil	0.003	0.003	0.003	0.003
Clay,				
Kaolin (treated)	0.82	0.81	0.82	0.82
Kaolin (untreated)	0.75	0.79	0.85	0.86
White Georgia	0.94	0.92	0.93	0.94
Magnesium oxide	0.97	0.98	0.98	0.98
Paint,				
Lithopone	0.95	0.98	0.98	0.98
$MgCO_3$-Vynal Acetate Lacquer	0.90	0.88	0.88	0.88
ZnO-Milk	0.74	0.84	0.85	0.86
Paper,				
Blotting	0.64	0.72	0.79	0.79
Calendered	0.64	0.69	0.73	0.76
Crepe, green	0.23	0.49	0.19	0.48
Crepe, red	0.03	0.02	0.21	0.69
Crepe, yellow	0.17	0.44	0.75	0.79
News Print Stock	0.38	0.61	0.63	0.78
Peach,				
Green	0.18	0.17	0.62	0.63
Ripe	0.10	0.10	0.41	0.42
Pear,				
Green	0.04	0.12	0.29	0.41
Ripe	0.08	0.19	0.46	0.53
Pigment,				
Chrome Yellow	0.05	0.13	0.70	0.77
French Ochre	0.06	0.14	0.50	0.56
Porcelain Enamel,				
Blue	0.44	0.10	0.05	0.23
Orange	0.09	0.09	0.59	0.69
Red	0.05	0.03	0.08	0.62
White	0.77	0.73	0.72	0.70
Yellow	0.11	0.46	0.62	0.62
Talcum, Italian	0.94	0.89	0.88	0.88
Wheat Flour	0.75	0.87	0.94	0.97

REFLECTION COEFFICIENTS OF SURFACES FOR "INCANDESCENT" LIGHT

Material	Nature of Surface	Coefficient	Authority
Aluminum, "Alzak"	Diffusing	0.77–0.81	3
"Alzak"	Specular	0.79–0.83	3
on Glass	First Surface	0.82–0.86	4
Polished	Specular	0.69	3
Black Paper	Diffusing	0.05–0.06	4
Chromium	Specular	0.62	4
Copper	Specular	0.63	4
Gold	Specular	0.75	1
Magnesium oxide	Diffusing	0.98	5
Nickel	Specular	0.62–0.64	1, 3
Platinum	Specular	0.62	1
Porcelain Enamel	Glossy	0.76–0.79	3
Porcelain Enamel	Ground	0.81	3
Porcelain Enamel	Matt.	0.72–0.76	3
Silver	Polished	0.93	1
Silvered Glass	Second Surface	0.88–0.93	3
Snow	Diffusing	0.93	2
Steel	Specular	0.55	1
Stellite	Specular	0.58–0.65	4

(1) Hagen and Rubens. (2) Nutting, Jones, and Elliot. (3) J. E. Bock. (4) Frank Benford. (5) J. L. Michaelson.

PROPERTIES OF TUNGSTEN

Jones and Langmuir, General Electric Review

Temp. °K	Resistivity microhm cm	Electron emission amp./cm²	Evaporation g/cm² sec	Vapor pressure dynes/cm²	Thermal expansion per cent l_0 at 293°	Atomic heat cal./g. atom./°C.
300	5.65	. . . .	. . . .	. . . .	.003	6.0
400	8.06	. . . .	. . . .	. . . .	.044	6.0
500	10.56	. . . .	. . . .	. . . .	.086	6.1
600	13.23	. . . .	. . . .	. . . .	.130	6.1
700	16.09	. . . .	. . . .	. . . .	.175	6.2
800	19.00	. . . .	. . . .	. . . .	.222	6.2
900	21.94	. . . .	. . . .	. . . .	.270	6.3
1000	24.93	1.07×10^{-15}	5.32×10^{-34}	1.98×10^{-29}	.320	6.4
1100	27.94	1.52×10^{-13}	2.17×10^{-30}	1.22×10^{-25}	.371	6.4
1200	30.98	9.73×10^{-12}	3.21×10^{-27}	1.87×10^{-22}	.424	6.5
1300	34.08	3.21×10^{-10}	1.35×10^{-24}	8.18×10^{-20}	.479	6.7
1400	37.19	6.62×10^{-9}	2.51×10^{-22}	1.62×10^{-17}	.535	6.8
1500	40.36	9.14×10^{-8}	2.37×10^{-20}	1.54×10^{-15}	.593	7.0
1600	43.55	9.27×10^{-7}	1.25×10^{-18}	8.43×10^{-14}	.652	7.1
1700	46.78	7.08×10^{-6}	4.17×10^{-17}	2.82×10^{-12}	.713	7.2
1800	50.05	4.47×10^{-5}	8.81×10^{-16}	6.31×10^{-11}	.775	7.4
1900	53.35	2.28×10^{-4}	1.41×10^{-14}	1.01×10^{-9}	.839	7.6
2000	56.67	1.00×10^{-3}	1.76×10^{-13}	1.33×10^{-8}	.904	7.7
2100	60.06	3.93×10^{-3}	1.66×10^{-12}	1.28×10^{-7}	.971	7.8
2200	63.48	1.33×10^{-2}	1.25×10^{-11}	9.88×10^{-7}	1.039	8.0
2300	66.91	4.07×10^{-2}	8.00×10^{-11}	6.47×10^{-6}	1.109	8.2
2400	70.39	1.16×10^{-1}	4.26×10^{-10}	3.52×10^{-5}	1.180	8.3
2500	73.91	2.98×10^{-1}	2.03×10^{-9}	1.71×10^{-4}	1.253	8.4
2600	77.49	7.16×10^{-1}	8.41×10^{-9}	7.24×10^{-4}	1.328	8.6
2700	81.04	1.63	3.19×10^{-8}	2.86×10^{-3}	1.404	8.7
2800	84.70	3.54	1.10×10^{-7}	9.84×10^{-3}	1.479	8.9
2900	88.33	7.31	3.30×10^{-7}	3.00×10^{-2}	1.561	9.0
3000	92.04	1.42×10	9.95×10^{-7}	9.20×10^{-2}	1.642	9.2
3100	95.76	2.64×10	2.60×10^{-6}	2.50×10^{-1}	1.724	9.4
3200	99.54	4.78×10	6.38×10^{-6}	6.13×10^{-1}	1.808	9.5
3300	103.3	8.44×10	1.56×10^{-5}	1.51	1.893	9.6
3400	107.2	1.42×10^{2}	3.47×10^{-5}	3.41	1.980	9.8
3500	111.1	2.33×10^{2}	7.54×10^{-5}	7.52	2.068	9.9
3600	115.0	3.73×10^{2}	1.51×10^{-4}	1.53×10	2.158	10.1
3655	117.1	4.79×10^{2}	2.28×10^{-4}	2.33×10	2.209	10.2

PROPERTIES OF TUNGSTEN

Roeser and Wensel, National Bureau of Standards

Temp. °K	Normal brightness new candles per cm²	Spectral emissivity		Color emissivity	Total emissivity	Brightness temp. 0.65μ	Color temp.
		0.65μ	0.467μ				
300	....	0.472	0.505	.....	0.032		
400	....	.....	.....	.....	.042		
500	....	.....	.....	.....	.053		
600	....	.....	.....	.....	.064		
700	....	.....	.....	.....	.076		
800	....	.....	.....	.....	.088		
900	....	.....	.....	.....	.101		
1000	0.0001	.458	.486	.395	.114	966	1007
1100	0.001	.456	.484	.392	.128	1059	1108
1200	0.006	.454	.482	.390	.143	1151	1210
1300	0.029	.452	.480	.387	.158	1242	1312
1400	0.11	.450	.478	.385	.175	1332	1414
1500	0.33	.448	.476	.382	.192	1422	1516
1600	0.92	.446	.475	.380	.207	1511	1619
1700	2.3	.444	.473	.377	.222	1599	1722
1800	5.1	.442	.472	.374	.236	1687	1825
1900	10.4	.440	.470	.371	.249	1774	1928
2000	20.0	.438	.469	.368	.260	1861	2032
2100	36	.436	.467	.365	.270	1946	2136
2200	61	.434	.466	.362	.279	2031	2241
2300	101	.432	.464	.359	.288	2115	2345
2400	157	.430	.463	.356	.296	2198	2451
2500	240	.428	.462	.353	.303	2280	2556
2600	350	.426	.460	.349	.311	2362	2662
2700	500	.424	.459	.346	.318	2443	2769
2800	690	.422	.458	.343	.323	2523	2876
2900	950	.420	.456	.340	.329	2602	2984
3000	1260	.418	.455	.336	.334	2681	3092
3100	1650	.416	.454	.333	.337	2759	3200
3200	2100	.414	.452	.330	.341	2837	3310
3300	2700	.412	.451	.326	.344	2913	3420
3400	3400	.410	.450	.323	.348	2989	3530
3500	4200	.408	.449	.320	.351	3063	3642
3600	5200	.406	.447	.317	.354	3137	3754

EMISSIVITY AND ABSORPTION

These data are the result of investigations made by the Bureau of Standards, the British National Physical Laboratory, General Electric Research Laboratories, and several eastern universities, and were collected by W. J. King of the General Electric Company.

Low Temperature Total Emissivities

Silver, highly polished	0.02	Brass, polished	0.60
Platinum “ “	0.05	Oxidized copper	0.60
Zinc “ “	0.05	Oxidized steel	0.70
Aluminum, “ “	0.08	Bronze paint	0.80
*Monel metal, polished	0.09	Black gloss paint	0.90
Nickel “	0.12	White lacquer	0.95
Copper “	0.15	White vitreous enamel	0.95
Stellite “	0.18	Asbestos paper	0.95
Cast iron “	0.25	Green paint	0.95
Monel metal, oxidized	0.43	Gray paint	0.95
Aluminum paint	0.55	Lamp black	0.95

Coefficient of Absorption of Solar Radiation

Silver, highly polished	0.07	Stellite, polished	0.30
Platinum “ “	0.10	Light cream paint	0.35
Nickel “ “	0.15	Monel metal, polished	0.40
*Aluminum	0.15	Light yellow paint	0.45
Magnesium carbonate	0.15	Light green paint	0.50
Zinc oxide	0.15	Aluminum paint	0.55
*Steel	0.20	Zinc, polished metal	0.55
Copper	0.25	Gray paint	0.75
White lead paint	0.25	Black matte	0.97
Zinc oxide paint	0.30		

* Questionable because of scant or inconsistent data.

TOTAL EMISSIVITY

Roeser and Wensel, National Bureau of Standards

Material	Temp. °C	Emissivity	Material	Temp. °C	Emissivity
Alloys			Iron, rusted	25	0.65
20Ni-25Cr-55Fe, oxidized	200	0.90	wrought, dull	25	0.94
	500	0.97	oxidized	350	0.94
60Ni-12Cr-28Fe, oxidized	270	0.89	Lead, unoxidized	100	0.05
	560	0.82	oxidized	200	0.63
80Ni-20Cr, oxidized	100	0.87	Mercury, unoxidized	25	0.10
	600	0.87		100	0.12
	1300	0.89	Molybdenum, unoxidized	1000	0.13
Aluminum, unoxidized	25	0.022		1500	0.19
	100	0.028		2000	0.24
	500	0.060	Monel metal, oxidized	200	0.43
oxidized	200	0.11		600	0.43
	600	0.19	Nickel, unoxidized	25	0.045
Bismuth, unoxidized	25	0.048		100	0.06
	100	0.061		500	0.12
Brass, oxidized	200	0.61		1000	0.19
	600	0.59	oxidized	200	0.37
unoxidized	25	0.035		1200	0.85
	100	0.035	Platinum, unoxidized	25	0.037
Carbon, unoxidized	25	0.081		100	0.047
	100	0.081		500	0.096
	500	0.079		1000	0.152
Chromium, unoxidized	100	0.08		1500	0.191
Cobalt, unoxidized	500	0.13	Silica brick	1000	0.80
	1000	0.23		1100	0.85
Columbium, unoxidized	1500	0.19	Silver, unoxidized	100	0.02
	2000	0.24		500	0.035
Copper, unoxidized	100	0.02	Steel, unoxidized	100	0.08
	liquid	0.15		liquid	0.28
oxidized	200	0.6	oxidized	25	0.80
	1000	0.6		200	0.79
calorized	100	0.26		600	0.79
	500	0.26	Steel plate, rough	40	0.94
calorized, oxidized	200	0.18		400	0.97
	600	0.19	calorized, oxidized	200	0.52
Fire brick	1000	0.75		600	0.57
Gold, unoxidized	100	0.02	Tantalum, unoxidized	1500	0.21
	500	0.03		2000	0.26
Gold enamel	100	0.37	Tin, unoxidized	25	0.043
Iron, unoxidized	100	0.05		100	0.05
oxidized	100	0.74	Tungsten, unoxidized	25	0.024
	500	0.84		100	0.032
	1200	0.89		500	0.071
cast, unoxidized	100	0.21		1000	0.15
	liquid	0.29		1500	0.23
cast, oxidized	200	0.64		2000	0.28
	600	0.78	Zinc, unoxidized	300	0.05
cast, strongly oxidized	40	0.95			
	250	0.95			

SPECTRAL EMISSIVITY

Prepared by Roeser and Wensel, National Bureau of Standards

Spectral Emissivity of Materials, Surface Unoxidized for 0.65μ

Element	Solid	Liquid	Element	Solid	Liquid
Beryllium	0.61	0.61	Thorium	0.36	0.40
Carbon	0.80–0.93	....	Titanium	0.63	0.65
Chromium	0.34	0.39	Tungsten	0.43	
Cobalt	0.36	0.37	Uranium	0.54	0.34
Columbium	0.37	0.40	Vanadium	0.35	0.32
Copper	0.10	0.15	Yttrium	0.35	0.35
Erbium	0.55	0.38	Zirconium	0.32	0.30
Gold	0.14	0.22	Steel	0.35	0.37
Iridium	0.30	....	Cast Iron	0.37	0.40
Iron	0.35	0 37	Constantan	0.35	
Manganese	0.59	0.59	Monel	0.37	
Molybdenum	0.37	0.40	Chromel P (90Ni-10Cr)	0.35	
Nickel	0.36	0.37	80Ni-20Cr	0.35	
Palladium	0.33	0.37	60Ni-24Fe-16Cr	0.36	
Platinum	0.30	0.38	Alumel (95Ni; Bal. Al, Mn, Si)	0.37	
Rhodium	0.24	0.30			
Silver	0.07	0.07	90Pt-10Rh	0.27	
Tantalum	0.49	....			

Spectral Emissivity of Oxides

The emissivity of oxides and oxidized metals depends to a large extent upon the roughness of the surface. In general, higher values of emissivity are obtained on the rougher surfaces.

Material	Range of observed values	Probable value for oxide formed on smooth metal	Material	Range of observed values	Probable value for oxide formed on smooth metal
Aluminum oxide	0.22–0.40	0.30	Alumel (oxidized)	....	0.87
Beryllium oxide	0.07–0.37	0.35	Cast Iron (oxidized)	....	0 70
Cerium oxide	0.58–0.80	....	Chromel P (90Ni-10Cr) (oxidized)	....	0.87
Chromium oxide	0.60–0.80	0.70			
Cobalt oxide	....	0.75	80Ni-20Cr (oxidized)	....	0.90
Columbium oxide	0.55–0.71	0.70	60Ni-24Fe-16Cr (oxidized)	....	0.83
Copper oxide	0.60–0.80	0.70			
Iron oxide	0.63–0.98	0.70	55Fe-37.5Cr-7.5 Al (oxidized)	....	0.78
Magnesium oxide	0.10–0.43	0.20			
Nickel oxide	0.85–0.96	0.90	70Fe-23Cr-5Al-2Co (oxidized)	... ...	0.75
Thorium oxide	0.20–0.57	0.50			
Tin oxide	0.32–0.60	....	Constantan (55Cu-45Ni) (oxidized)	....	0.84
Titanium oxide	... .	0.50			
Uranium oxide	....	0 30	Carbon Steel (oxidized)	....	0.80
Vanadium oxide	....	0.70	Stainless Steel (18-8) (oxidized)	....	0.85
Yttrium oxide	....	0.60			
Zirconium oxide	0.18–0.43	0.40	Porcelain	0.25–0.50	

PIGMENTS AND DYES

The tables which follow give the fraction of incident light reflected by pigments or transmitted by dyes. The pigments were in dry powdered form and the dye solutions, except where indicated, in distilled water. Wave lengths are given in microns.

(*Luckiesh, 1917*)

Pigment	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
American vermilion	0.08	0.06	0.05	0.05	0.06	0.06	0.09	0.11	0.24	0.39	0.53	0.61	0.66	0.65
Venetian red	.05	.05	.05	.05	.05	.06	.07	.12	.19	.24	.28	.30	.32	.32
Tuscan red	.07	.07	.07	.08	.08	.08	.08	.12	.16	.18	.20	.22	.23	.24
Indian red	.08	.07	.07	.07	.07	.07	.07	.11	.15	.18	.20	.22	.23	.24
Burnt sienna	.04	.04	.04	.04	.05	.06	.09	.14	.18	.20	.21	.23	.24	.25
Raw sienne	.12	.13	.13	.13	.18	.26	.35	.43	.46	.46	.45	.44	.45	.43
Golden ochre	.22	.22	.23	.27	.40	.53	.63	.71	.75	.74	.73	.73	.73	.72
Chrome yellow, ochre	.08	.09	.07	.07	.10	.19	.30	.46	.60	.62	.66	.82	.81	.80
Yellow ochre	.20	.20	.21	.24	.32	.42	.53	.63	.64	.61	.60	.59	.59	.59
Chrome yellow (medium)	.05	.05	.06	.08	.18	.48	.66	.75	.78	.79	.81	.81	.81	.81
Chrome yellow (light)	.13	.13	.18	.30	.56	.82	.88	.89	.90	.89	.88	.87	.85	.84
Chrome green (light)	.10	.10	.14	.23	.26	.23	.20	.17	.14	.11	.09	.08	.07	.06
Chrome green (medium)	.07	.07	.10	.21	.21	.17	.13	.11	.09	.07	.06	.06	.06	.05
Cobalt blue	.59	.58	.49	.35	.23	.15	.11	.10	.10	.10	.11	.15	.20	.25
Ultramarine blue	.67	.54	.38	.21	.10	.06	.04	.03	.03	.04	.05	.07	.10	.17

PIGMENTS AND DYES (Continued)

Red Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	70
Carmen ruby opt.	....	....	....	....	....	....	....	....	....	0.04	0.18	0.37	0.49	0.60
Amido naphthol red	....	....	....	....	....	....	....	....	0.04	.38	.75	.92	.96	.96
Coccinine	....	....	....	....	....	....	....	0.04	.56	.96	.98	.98	.98	.98
Erythrosine	0.06	....	....	....	....	....	0.10	.53	.90	.95	.96	.96	.96	.96
Hematoxyline	.01	0.03	0.07	0.13	0.14	0.12	.13	.25	.44	.54	.63	.73	.78	.82
"	....	....	....	....	....	....	....	.01	.02	.04	.09	.15	.21	.25
Alizarine red	.01	.01	.02	.03	.04	.06	.11	.22	.39	.54	.65	.72	.77	.79
Acid rosolic (pure)	.04	.03	.01	....	....	....	.02	.38	.78	.88	.90	.91	.92	.92
Rapid filter red	....	....	....	....	....	.01	.10	.47	.86	.95	.96	.96	.96	.96
Aniline red fast extra A	....	....	....	....	....	.02	.12	.34	.55	.72	.84	.88	.90	.92
Pinatype red fast	....	....	....	....	....	....	....	....	.11	.35	.55	.65	.68	.69
Eosine (yellowish)	....	....	....	....	....	....	....	....	.06	.40	.63	.74	.82	.85
Eosine	....	....	....	....	....	....	.01	.54	.87	.93	.92	.92	.92	.92
Naphthalinrot in absolute alcohol	....	....	....	....	....	....	....	....	.06	.28	.43	.50	.57	.61
Rose bengal	.80	.70	.34	.06	.01	....	.14	.82	.96	.97	.98	.98	.98	.98
Rose bengal	.01	....	....	....	....	....	....	.09	.57	.83	.89	.92	.94	.96
Cobalt ammonium sulfate	.60	.56	.48	.37	.38	.53	.70	.82	.86	.90	.90	.90	.90	.89
Cobalt nitrate	.69	.51	.40	.31	.32	.48	.67	.82	.87	.90	.90	.90	.90	.90

PIGMENTS AND DYES (Continued)

Yellow Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Tartrazine	....	....	....	....	0.07	0.52	0.75	0.86	0.91	0.95	0.96	0.97	0.98	0.98
Chrysoidin	....	....	....	....	....	....	....	....	.02	.23	.50	.71	.79	.79
Aurantia	....	....	....	....	....	.03	.23	.53	.82	.92	.96	.96	.96	.96
Aniline yellow phosphine	....	....	....	....	.02	.20	.43	.60	.67	.75	.81	.85	.86	.87
Fluorescein	0.15	0.01	....	....	.48	.91	.97	.98	.98	.98	.98	.98	.98	.98
Aniline yellow fast, S	....	....	0.01	0.07	.43	.84	.96	.96	.96	.96	.96	.96	.96	.96
Methyl orange, indicator	....	....	....	....	....	....	.01	.31	.70	.79	.80	.81	.81	.81
Auramin	....	....	.01	.39	.77	.83	.84	.86	.87	.88	.90	.92	.93	.93
Uranine	.15	.01	....	.01	.58	.96	.97	.97	.97	.97	.97	.97	.97	.97
Uranine naphthaline	....	....	....	.04	.53	.77	.82	.83	.84	.85	.86	.86	.87	.87
Orange B Naphthol	....	....	....	....	....	.01	.43	.88	.95	.96	.97	.97	.97	.97
Safranine	....	....	....	....	....	....	....	....	.03	.27	.64	.85	.93	.93
Martius gelb	....	....	....	.01	.43	.84	.91	.94	.95	.95	.95	.95	.95	.95
Naphthol yellow	....	....	.01	.18	.74	.91	.96	.97	.98	.98	.98	.98	.98	.98
Potassium bechromate, sat. sol.	....	....	....	....	....	.10	.60	.84	.88	.89	.89	.89	.89	.88
Cobalt chromate	.17	.36	.62	.82	.88	.90	.92	.93	.95	.96	.96	.96	.96	.95

PIGMENTS AND DYES (Continued)

Green Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Naphthol green	0.02	0.04	0.07	0.21	0.30	0.36	0.29	0.16	0.07	0.02	0.01	....	....	....
Brilliant green	.04	.39	.69	.52	.23	.04	....	....	....	....	....	0.02	0.23	0.64
Filter blue green	.35	.49	.64	.70	.60	.37	.13	.02	....	....	....	....	....	....
Filter blue green	.06	.14	.23	.40	.26	.08	.01	....	....	....	....	....	....	....
Malachite green	....	.12	.20	.08	.01	....	....	....	....	....	....	....	.12	.50
Malachite green	....	.01	.04	.01	....	....	....	....	....	....	....	....	.02	.23
Malachite green	....	....	.01	....	....	....	....	....	....	....	....	....	....	.10
Saurgrun	.03	.29	.57	.57	.39	.19	.04	.01	....	....	....	....	.04	.30
Methylengrun	.28	.31	.32	.26	.17	.07	.02	.01	....	....	....	....	.03	.28
Methylengrun	.14	.16	.17	.13	06	.01	....	....	....	....	....	....	.02	.14
Aniline green naphthol B	.02	.06	.14	.24	.34	.40	.32	.14	.04	.01	....	....	....	....
Aniline green naphthol B	....	....	.02	.06	.10	.15	.09	.02	....	....	....	....	....	....
Neptune green	....	.40	.63	.41	.13	.01	....	....	....	....	....	....	....	.05
Neptune green	....	.19	.36	.18	.02	....	....	....	....	....	....	....	....	.02
Cupric chloride	.77	.84	.89	.92	.92	.89	.80	.67	.52	.36	.19	.06	.02	....

PIGMENTS AND DYES (Continued)

Blue Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Turnbull's blue	0.58	0.60	0.56	0.51	0.38	0.28	0.18	0.09	0.05	0.03	0.01	....	....	....
Victoria blau	.52	.23	.09	.01	....	....	....	....	....	.01	.04	0.21	0.49	0.73
Prussian blue (soluble)	.66	.71	.76	.69	.60	.46	.32	.20	.12	.07	.05	.03	.03	....
" " "	.06	.09	.09	.05	.02	.01	....	....	....	....	....	....	....	....
Wasser blau	.89	.75	.51	.26	.07	.01	....	....	.01	.02	.06	.18	.37	.60
" "	.85	.66	.42	.17	.03	.01	....	....	....	.01	.03	.10	.26	.48
Resorcine blue	.25	.18	.06	.02	.01	....	....	....	.01	.02	.14	.41	.64	.72
Toluidin blau	.66	.31	.13	.03	.01	....	....	....	....	....	.01	.04	.16	.40
Patent blue	.83	.91	.84	.76	.65	.46	.24	.08	.02	....	....	.06	.42	.78
" "	.15	.25	.17	.05	....	....	....	....	....	....	....	....	....	.12
Dianil "	.77	.69	.59	.48	.35	.24	.15	.09	.05	.05	.07	.14	.29	.53
" "	.38	.30	.18	.10	.04	.01	....	....	....	....	....	....	.02	.12
Filter "	.84	.79	.66	.44	.27	.17	.14	.19	.36	.56	.74	.81	.88	.92
" "	.35	.29	.18	.04	....	....	....	....	.02	.08	.23	.44	.62	.71
Aniline blue, methyl	.92	.88	.78	.52	.27	.09	.03	.02	.02	.04	.08	.16	.25	.45
" " "	.44	.31	.13	....	....	....	....	....	....	....	....	....	....	....

PIGMENTS AND DYES (Continued)

Purple Dyes

Dye-Solution	0.44	.46	.48	.50	.52	.54	.56	.58	.60	.62	.64	.66	.68	.70
Ethyl violet in gelatine (dry)	0.97	0.87	0.67	0.28	0.04	....	....	....	....	0.05	0.33	0.73	0.88	.91
Ethyl violet in gelatine (wet)	.83	.79	.45	.07	.01	....	0.01	0.03	0.05	.15	.42	.76	.91	.93
Magenta	.21	.08	.02	.01	....	....	.01	.22	.73	.93	.97	.97	.97	.97
"	....	....	....	....	....	....	....	....	.07	.48	.81	.92	.95	.95
Gentian violet	.89	.83	.64	.44	.26	0.19	.15	.10	.13	.42	.75	.92	.93	.94
" "	.11	.01	....	....	....	....	....	....	....	....	.01	.15	.48	.66
Rosazeine	.50	.28	.02	....	....	....	....	.06	.55	.90	.98	.98	.98	.98
"	....	....	....	....	....	....	....	....	....	.07	.54	.90	.95	.95
Iodine (dense)	....	....	....	....	....	....	....	....	....	....	.01	.03	.11	.23
Rhodamine B	.81	.71	.45	.13	.02	....	....	.23	.83	.96	.96	.96	.95	.94
Acid violet	.84	.76	.68	.50	.33	.26	.27	.34	.49	.70	.84	.96	.96	.96
" "	.29	.08	.01	....	....	....	....	.01	.09	.32	.63	.84	.94	.94
Cyanine in alcohol	.07	.01	....	....	....	....	....	....	....	....	....	.01	.13	.23
Xylene red	.39	.23	.01	....	....	....	....	.01	.27	.79	.97	.97	.97	.96
" "	....	....	....	....	....	....	....	....	.01	.31	.79	.96	.96	.95
Methyl violet B	.25	.04	....	....	....	....	....	....	....	....	.03	.26	.63	.89

TRANSMISSION OF COLORED GLASSES

If I_o is the intensity of radiation entering a layer of some medium and I the intensity reaching the opposite surface, the ratio I/I_o is called the transmittance. In practice the ratio of intensity of radiation passing through a glass sample to that incident on its surface is often measured and plotted as transmission. The transmission is the result of two factors, the transmittance of the glass and the losses by reflection. These losses amount to about 4% for each glass-air surface; the transmission of a sample is about 92% of its transmittance. Since the reflection losses differ slightly with different samples, the correction is often determined and applied when the transmission is measured. Values which are thus corrected are marked * at the head of the column.

In order to obtain the transmittance for thicknesses other than those listed it is convenient to transform the tabular values to terms of βt in the equation $I/I_o = e^{\beta t}$ where t is the thickness (in millimeters) and β a constant for a particular sample. The base 10 is conveniently used in place of e so that βt becomes the common logarithm of the transmittance, or $\beta t = \log I/I_o$. Using the corrected value of the transmittance for a specific thickness, found in the table, the value of βt may be found, changed to the value for the new thickness and the transmittance for the second thickness computed.

For example: The tabular value of transmission for sample **CG** 396 at $\lambda = .46\mu$ is given as 0.80 for a thickness of 2 mm. It is desired to find the transmittance for 5 mm.

The corrected value of the transmittance for 2 mm is 0.80/.92 or about 0.871. Log .871 = 9.94002–10. Writing this as a wholly negative number the equation becomes $\beta t = -.05998$. For $t = 5$ $\beta t = -.05998 \times 5/2 = -.14995$ or changing to the more familiar form gives 9.85005–10 which is the logarithm of the new transmittance which is found to be .708. The transmission will be .92 × .708 or .651.

In order to identify the glasses listed, the manufacturer's number is given preceded by an abbreviation of the maker's name, as follows: **AO,** American Optical Co.; **BL,** Bausch & Lomb Optical Co.; **CE,** Chicago Eye Shield Co.; **CG,** Corning Glass Works. Data for Jena glasses are given separately in section II of the table.

This table has been compiled with the assistance of: Mr. H. P. Gage, Corning Glass Works; Mr. J. Liautaud, Chicago Eye Shield Co.; Mr. W. B. Rayton, Bausch & Lomb Optical Co.; Mr. A. J. Weinstein of the Fish-Shurman Corporation.

Abbreviations Used

abs., absorbing
bl., blue
col., colorless
didym., didymium
dk., dark
fl., fluorescent
grn., green
ht., heat
lant., lantern
lt., light
med., medium
neut., neutral
purp., purple
pyrom., pyrometer
rd red
sext., sextant
sig., signal
tr., transmitting
u.v., ultra-violet
v., very
viol., violet
yel., yellow

TRANSMISSION OF COLORED GLASSES

Section I.—Glasses of American Manufacture

Wave-length μ	**AO** Crown 1.50 neut. 1.68 mm	**BL** Crookes 1 neut. 2 mm	**BL** Crookes 2 neut. 2 mm	**BL** Crookes 3 neut. 2 mm	**BL** Smoke A neut. 2 mm	**BL** Smoke B neut. 2 mm	**BL** Smoke C neut. 2 mm	**CG 254** black ht. tr. 1 mm	**CG 255** sext. red 1 mm	**CG 241** Se red pyrom. 38%
0.22	...	*	*	*	*	*	*	....	....	....
.24	...	....	...	...	...	...	...	....	....	....
.26	...	....	...	...	...	...	...	....	....	....
.28	0	....	...	...	...	...	...	....	....	....
.30	.10	.00	.00	.00	.00	.00	.00	....	....	....
.32	.56	.00	.00	.00	.00	.00	.00	....	....	....
.34	.83	.00	.00	.00	.44	.14	.00	....	....	....
.36	.89	.06	.22	.20	.83	.60	.32	....	....	....
.38	.91	.72	.70	.65	.89	.74	.61	....	0	....
.40	.92	.86	.80	.74	.90	.76	.64	....	.07	....
.42	.92	.89	.75	.54	.85	.70	.43	....	.05	....
.44	.92	.91	.77	.46	.82	.54	.28	....	.015	....
.46	.92	.93	.80	.47	.83	.53	.28	....	.005	....
.48	.92	.94	.82	.51	.84	.55	.33	....	.005	....
.50	.92	.95	.83	.55	.85	.59	.35	....	.000	....
.52	.92	.96	.85	.57	.85	.59	.34	....	.005	....
.54	.92	.97	.86	.58	.85	.59	.33	....	.005	....
.56	.92	.97	.84	.57	.85	.60	.33	....	.015	....
.58	.92	.80	.69	.49	.85	.60	.33	....	.030	....
.60	.92	.99	.85	.58	.85	.59	.32	....	.040	....
.62	.92	1.00	.89	.61	.85	.58	.32	....	.060	0
.64	.92	1.00	.90	.63	.85	.60	.33	....	.070	.067
.66	.92	1.00	.92	.66	.87	.65	.39	0	.090	.508
.68	.92	1.00	.94	.73	.90	.73	.52	.006	.120	.660
.70	...	.99	.97	.90	.95	.88	.75	.012	.150	.667
.72	...	....	...	...	...	...	...	.018	.200	.660
1.0	...	.98	.92	.85	.93	.75	.74	.724	.860	....
1.5	...	.95	.89	.87	.91	.82	.74	.845	.920	....
2.0	...	.94	.89	.83	.90	.81	.72	.812	.920	....
2.5	...	.89	.82	.80	.88	.80	.74	.818	.915	....
3.0	...	.55	.53	.53	.59	.61	.56	.672	.743	....
3.5	...	.31	.25	.33	.35	.33	.31	.549	.670	....
4.0	...	.26	.34	.32	.31	.28	.28	.325	.390	....
4.5	...	.23	.20	.21	.22	.22	.23	.030	....	....
5.0	...	.11	.09	.09	.10	.12	.10	....	....	....

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION I.—GLASSES OF AMERICAN MANUFACTURE (Continued)

Wave-length μ	CG 242 Se red dark 100 %	CG 244 Se red lant. 225 %	CG 245 Se red traffic 300 %	CG 246 Se red lt. house 125 %	CG 346 amber A 2.5 mm	BL Kali-chrome A yellow 2 mm	BL Kali-chrome C yellow 2 mm	CG 348 yel. lant. Y 4	CG 351 yel. traffic Y 3	CG 338 yel. noviol C
0.22	.....	.....	....	....	....	*	*	.....	.....	....
.24	.....	.....	....	....	....	...	...	.....	.....	....
.26	.....	.....	....	....	....	...	...	.....	.....	....
.28	.....	.....	....	....	....	...	...	.....	.....	....
.30	.....	.....	....	....	....	.00	.00	.....	.....	....
.32	.....	.....	....	....	....	.00	.00	.....	.....	....
.34	.....	.....	....	....	....	.00	.00	.....	.....	....
.36	.....	.....	....	....	....	.00	.00	0	.....	....
.38	....	.....	....	....	0	.21	.00	.0008	....	....
.40	.....	.....	.....	....	.045	.50	.00	.0010	.....	....
.42	.....	.....	....	....	.105	.65	.00	.0020	.....	....
.44	.....	.....	....	....	.200	.74	.00	.0039	.....	....
.46	.....	.....	....	....	.330	.81	.00	.0075	.....	.000
.48	.....	.....	....	....	.465	.85	.02	.0137	.....	.380
.50	.....	.....	....	....	.585	.90	.46	.0289	0	.650
.52	.....	.....	....	....	.680	.93	.87	.0826	.0003	.765
.54	.....	.....	....	....	.750	.94	.93	.157	.289	.813
.56	0	0	....	....	.795	.94	.97	.544	.784	.820
.58	.0001	.0001	.000	.100	.835	.95	.98	.848	.844	.825
.60	.0005	.024	.148	.730	.855	.96	.98	.882	.864	.825
.62	.019	.680	.722	.828	.875	.97	.97	.890	.874	....
.64	.630	.832	.832	.844	.865	.97	.97	.893	.883	....
.66	.828	.855	.850	.850	.869	.97	.97	.894	.889	....
.68	.847	.863	....	.847	.879	.97	.97	.894	.891	....
.70	.853	.862	.850	.835	.889	.97	.97	.892	.891	....
.72	.854	.859	....	.825	.900	...	...	.888	.890	....
1.0	.605	.....	....	....	....	.96	.87	.....	.....	....
1.5	.703	.....	....	....	....	.95	.89	.....	.....	....
2.0	.805	.....	....	....	....	.95	.90	.....	.....	....
2.5	.730	.....	....	....	....	.89	.85	.....	.....	....
3.0	.330	.....	....	....	....	.59	.60	.....	.....	....
3.5	.275	.....	....	....	....	.30	.34	.....	.....	....
4.0	.230	.....	....	....	....	.22	.27	.....	.....	....
4.5	.023	.....	....	....	....	.16	.17	.....	.....	....
5.0	.....	.....	....	....	....	.08	.10	.....	.....	....

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION I.—GLASSES OF AMERICAN MANUFACTURE (Continued)

Wave-length μ	**CG 038** lt. yel. noviol A	**CG 306** lt. yel. noviol O 2 mm	**CG 330** sig. yel. 210% 2.5 mm	**CG 375** U yel. fluor. 5 mm	**BL** Fieuzal A green 2 mm	**BL** Fieuzal B green 2 mm	**BL** Fieuzal C green 2 mm	**BL** Anti-glare green 2 mm	**BL** Green 19 green 2 mm	**BL** Ht. abs. green 2 mm
0.22	....	....	.....	.....	*	*	*	*	*	*
.24	....	....	.....	.....	...	...	...	...	...	...
.26	....	....	.....	.....	...	...	...	...	...	...
.28	....	....	.....	.....	...	...	...	...	...	...
.30	....	....	.....	.....	.00	.00	.00	.00	.00	.00
.32	....	....	.....	.....	.00	.00	.00	.00	.00	.00
.34	....	....	.....	0	.00	.00	.00	.00	.00	.03
.36	....	0	0	.190	.00	.00	.00	.00	.00	.22
.38	....	.120	.008	.323	.11	.00	.00	.02	.00	.43
.40	....	.473	.0075	.0622	.30	.02	.00	.14	.00	.51
.42	0	.635	.0076	.0367	.40	.05	.01	.27	.00	.55
.44	.550	.745	.0113	.184	.49	.14	.05	.29	.00	.58
.46	.702	.795	.0271	.407	.64	.29	.13	.43	.01	.61
.48	.765	.825	.0636	.518	.70	.38	.19	.50	.03	.65
.50	.787	.855	.1324	.581	.77	.48	.25	.55	.05	.66
.52	.802	.875	.241	.833	.82	.57	.33	.57	.14	.67
.54	.813	.880	.367	.858	.86	.65	.40	.58	.19	.67
.56	.820	.885	.492	.863	.86	.67	.43	.57	.17	.65
.58	.825	.885	.589	.868	.86	.46	.43	.56	.09	.62
.60	.825	.880	.654	.878	.85	.64	.41	.53	.04	.58
.62	....	.883	.693	.878	.84	.61	.39	.50	.01	.53
.64	....	....	.713	.880	.83	.59	.31	.45	.01	.48
.66	....	....	.721	.884	.82	.56	.35	.40	.01	.43
.68	....	....	.723	.893	.81	.54	.33	.36	.01	.38
.70	....	....	.720	.900	.80	.53	.31	.31	.01	.33
.72	....	....	.712	.902	...	...	...	...	...	...
1.0	....	....	.....	.910	.58	.29	.12	.11	.19	.09
1.5	....	....	.....	.880	.61	.40	.20	.15	.50	.15
2.0	....	....	.....	.862	.73	.52	.32	.27	.71	.25
2.5	....	....	.....	.705	.73	.51	.37	.34	.85	.32
3.0	....	....	.....	.090	.51	.35	.27	.27	.70	.20
3.5	....	....	.....	.010	.34	.25	.21	.17	.43	.15
4.0	....	....	.....	.....	.24	.24	.21	.15	.41	.09
4.5	....	....	.....	.....	.16	.11	.11	.11	.32	.07
5.0	....	....	.....	.....	.08	.06	.07	.05	.06	.06

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION I.—GLASSES OF AMERICAN MANUFACTURE (Continued)

Wave-length μ	**BL** red free green 2 mm	**CG 396** green 2 mm	**CG 428** bl. grn. 2 mm	**CG 440** sig. grn. 150 % 5.78 mm	**CG 401** sext. green 1 mm	**CG 502** blue 2 mm	**CG 503** dk. blue 2 mm	**CG 556** sig. blue 100 % 5 mm	**CG 554** blue 101 % 2.8 mm	**CG 590** lt. bl. 4.6 mm
0.22	*	....	....	.....	.....	....	....	.....	....	....
.24	...	....	....	.....	.....	....	....	.....	....	....
.26	...	....	....	.....	.....	....	....	.....	....	....
.28	...	....	....	.....	.....	....	....	.....	....	....
.30	.00	0	0	.....	.....	....	....	.....	....	....
.32	.00	.020	.004	.....	.....	....	....	0	....	....
.34	.00	.280	.266	.....	.....	....	....	.060	....	....
.36	.00	.530	.652	0	.....	....	....	.370	....	....
.38	.00	.670	.780	.073	.....	....	....	.650	....	.417
.40	.00	.735	.830	.237	0	.631	.766	.780	.700	.650
.42	.04	.760	.845	.366	.0494	.782	.832	.800	.730	.653
.44	.10	.785	.860	.480	.124	.825	.830	.795	.700	.550
.46	.17	.800	.865	.588	.252	.822	.791	.727	.635	.462
.48	.23	.815	.860	.638	.429	.787	.698	.458	.400	.380
.50	.25	.820	.835	.618	.592	.703	.547	.205	.175	.316
.52	.22	.820	.770	.526	.670	.578	.380	.049	.050	.258
.54	.13	.805	.660	.366	.653	.441	.236	.012	.015	.200
.56	.06	.790	.515	.205	.538	.281	.105	.022	.030	.205
.58	.02	.760	.375	.0952	.397	.171	.050	.005	.005	.170
.60	.01	.720	.255	.0375	.260	.088	.018	.0008	0	.121
.62	.00	.670	.175	.0134	.161	.038	.005	.0006	0	.099
.64	.00	.610	.105	.0051	.107	.035	.005	.0003	0	.080
.66	.00	.555	.075	.0019	.0762	.024	.003	.0003	0	.082
.68	.00	.495	.050	.....	.0632	.082	.005	.002	.015	.095
.70	.00	.430	.040	.....	.0508	.054	.015	.008	.060	.103
.72	...	.370	.030	.....	.049	.269	.173	.009	.080	....
1.0	.07	.068	....	.....	.050	....	....	.....	....	....
1.5	.10	.172	....	.....	.180	....	....	.....	....	....
2.0	.35	.279	....	.....	.525	....	....	.....	....	....
2.5	.54	.400	....	.....	.780	....	....	.....	....	....
3.0	.46	....	....	.....	.250	....	....	.....	....	....
3.5	.29	....	....	.....	.150	....	....	.....	....	....
4.0	.28	....	....	.....	.110	....	....	.....	....	....
4.5	.20	....	....	.....	0	....	....	.....	....	....
5.0	.08	....	....	.....	.....	....	....	.....	....	....

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION I.—GLASSES OF AMERICAN MANUFACTURE (Continued)

Wave-length μ	**BL** Blue O blue 2 mm	**BL** Blue A blue 2 mm	**BL** Blue B blue 2 mm	**BL** Blue C blue 2 mm	**CG 511** violet 2.15 mm	**CG 557** lt. purp. 6.2 mm	**CG 555** purp. 4.8 mm	**CG 512** didym. 5 mm	**CG 507** purp. 3 mm	**CG 227** gold ruby 3 mm
0.22	*	*	*	*	.....	.....	.....	.....	.....	....
.24	.....	...	...	...	.....	.....	.....	.....	.....	....
.26	.....	...	...	...	.....	.....	.....	.....	.....	....
.28	.....	...	...	...	.....	.....	.....	.....	.....	....
.30	.020	.11	.08	.11	.....	.....	.....	.....	.....	....
.32	.450	.68	.65	.60	0	.....	.....	.....	.....	....
.34	.79	.88	.87	.87	.0018	.....	.....	.....	.212	....
.36	.88	.94	.93	.97	.082	.....	.....	.....	.552	....
.38	.94	.97	.96	.98	.326	.795	.783	.....	.728	....
.40	.98	.98	.97	.98	.502	.861	.845	.731	.726	.090
.42	1.00	.99	.98	.97	.462	.834	.786	.731	.490	.100
.44	1.00	.99	.98	.95	.326	.810	.705	.530	.225	.105
.46	.99	.99	.98	.92	.138	.781	.589	.548	.092	.100
.48	.99	.97	.93	.81	.014	.665	.318	.530	.045	.090
.50	.99	.94	.83	.66	.0003	.497	.1015	.652	.028	.055
.52	.99	.91	.73	.52	.....	.302	.0163	.601	.0299	.015
.54	.98	.89	.69	.45	.....	.185	.0028	.790	.033	.005
.56	.97	.88	.67	.43	.....	.257	.0092	.811	.050	.005
.58	.96	.87	.64	.40	.....	.160	.0017	.0082	.0727	.045
.60	.96	.86	.62	.37	.....	.095	.0002	.184	.100	.185
.62	.96	.84	.61	.35	.....	.109	.0004	.849	.128	.365
.64	.96	.85	.60	.36	.....	.0935	.0002	.851	.156	.515
.66	.96	.87	.64	.39	.....	.132	.0008	.849	.177	.615
.68	.97	.91	.75	.52	.....	.360	.035	.736	.201	.695
.70	.98	.97	.93	.81	.....	.710	.400	.804	.230	.740
.72	.....	...	...	...	.....	.852	.795	.845	.267	.740
1.0	.99	.98	.99	.99	.....	.....	.....	.....	.793	....
1.5	.96	.95	.89	.83	0	.....	.....	.....	.902	....
2.0	.97	.94	.92	.87	.100	.....	.....	.....	.863	....
2.5	.95	.87	.87	.91	.387	.....	.....	.....	.732	....
3.0	.81	.50	.55	.72	.320	.....	.....	.....	.155	....
3.5	.49	.33	.35	.41	.250	.....	.....	.....	.007	.....
4.0	.39	.31	.31	.33	.305	.....	.....	.....	.015	....
4.5	.31	.21	.19	.29	.156	.....	.....	.....	0	....
5.0	.11	.09	.12	.11	0	.....	.....	.....	.....	....

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION I.—GLASSES OF AMERICAN MANUFACTURE (Continued)

Wave-length μ	CG G 984 B green	CG G 985 B blue	CG 585 bl. purp. tr. u.v. 1 mm	CG 597 rd. purp. tr. u.v. 1 mm	CG 587 rd. purp. tr. u.v. 2 mm	CG 586 violet tr. u.v. 5 mm	CG 584 red tr. u.v. 1 mm	CG 774 neut. pyrex 2 mm	CG 970 neut. corex D 2 mm	CG 980 neut. corex A 2 mm
0.22	...	0	....	....	....	.....	....	....	0	.0115
.24	0	.02	....	....	....	.....	....	....	.0027	.237
.26	.38	.18	....	....	....	.....	....	....	.039	.531
.28	.34	.46	0	0	0	.....	....	0	.305	.753
.30	.12	.68	.153	.116	.039	0	.129	.120	.700	.840
.32	.36	.78	.650	.570	.342	.0004	.555	.610	.860	.879
.34	.73	.84	.860	.850	.640	.097	.791	.830	.902	.884
.36	.79	.86	.910	.913	.795	.290	.830	.900	.....	.885
.38	.75	.86	.925	.890	.700	.080	.714	.913	.....	.....
.40	.45	.81	.900	.714	.265	0	.115	.913	.....	.887
.42	.11	.67	.840	.260	.045	.....	0	....	.....	.....
44	.02	.41	.765	.065	.010	.....	....	.913	.....	.893
.46	.01	.16	.620	.025	.010	.....	....	....	.....	.....
.48	.03	.04	.390	.025	.005	.....	....	.917	.....	.897
.50	...	...	.199	.026	.000	.....	....	....	.....	.....
.52	...	...	.090	.026	.005	.....	....	.918	.....	.900
.54	...	...	.053	.028	.005	.....	....	....	.....	.....
.56	...	...	.104	.027	.010	.....	....	.918	.....	.900
.58	...	...	.029	.030	.005	.....	....	....	.....	.....
.60	...	...	.014	.065	.000	.....	....	.919	.....	.900
.62	...	...	.020	.034	.000	.....	....	....	.....	.....
.64	...	...	.018	.045	.000	.....	0	.919	.....	.900
.66	...	...	.033	.160	.005	.....	.010	....	.....	.....
.68	...	...	.146	.350	.035	.....	.080	.919	.....	.900
.70	...	...	.505	.505	.255	.....	.290	.919	.....	.....
.72	...	...	.760	.595	.520	.....	.405	....	.....	.900
1.0	...	...	.850	.450	....	.....	....	.915	.....	.900
1.5	...	...	.425	.610	....	.....	....	.914	.....	.898
2.0	...	...	.645	.415	....	.....	....	.904	.....	.857
2.5	...	...	.805	.450	....	.....	....	....	.....	.744
3.0	...	...	.595	.485	....	.....	....	....	.....	.018
3.5	...	...	.520	.393	....	.....	....	....	.....	.017
4.0	...	...	.580	.422	....	.....	....	....	.....	.....
4.5	...	...	.310	....	....	.....	....	....	.....	.....

TRANSMISSION OF COLORED GLASSES (Continued)

Section I.—Glasses of American Manufacture (Continued)

Wave-length μ	**CG** 986 rd. purp. corex A 3 mm	**BL** Weld. 3 yel. grn. 1 mm	**BL** Weld. 4 yel. grn. 1 mm	**BL** Weld. 5 yel. grn. 0.5 mm	**BL** Weld. 8 yel. grn. 0.5 mm	**BL** Weld. 12 yel. grn. 0.5 mm	**CE** Cesco-weld no. 3 ht. abs.	**CE** Cesco-weld no. 4 ht. abs.	**CE** Cesco-weld no. 5 ht. abs.	**CE** Cesco-weld no. 6 ht. abs.
0.22	....	*	*	*	*	*	....	....	....	....
.24	0	...	...	...	...	...	....	....	....	....
.26	.135	...	...	...	...	...	....	....	....	....
.28	.412	...	...	...	...	...	....	....	....	....
.30	.625	.00	.00	.00	.00	.00	....	....	....	....
.32	.793	.00	.00	.00	.00	.00	....	....	....	....
.34	.814	.00	.00	.00	.00	.00	....	....	....	....
.36	.797	.03	.03	.06	.11	.00	....	....	....	....
.38	.430	.06	.09	.13	.18	.01	....	.000	.000	....
.40	.075	.09	.12	.14	.21	.03	....	.001	.001	....
.42	.023	.10	.13	.14	.16	.02	0	.002	.001	....
.44	.000	.09	.14	.15	.15	.02	.001	.004	.000	....
.46	.000	.13	.19	.21	.17	.03	.013	.009	.001	.000
.48	.000	.22	.27	.27	.20	.05	.032	.025	.005	.001
.50	.000	.31	.25	.25	.25	.07	.070	.047	.010	.003
.52	.000	.40	.42	.41	.29	.08	.160	.082	.031	.008
.54	.000	.46	.44	.45	.31	.09	.180	.094	.032	.013
.56	.000	.46	.43	.45	.32	.10	.174	.087	.030	.012
.58	.000	.43	.39	.43	.31	.09	.157	.063	.026	.010
.60	.001	.36	.31	.38	.27	.08	.120	.037	.014	.006
.62	.003	.29	.25	.31	.23	.07	.068	.020	.007	.002
.64	.010	.24	.20	.26	.20	.06	.042	.010	.004	.001
.66	.025	.19	.15	.21	.19	.05	.025	.004	.001	.000
.68	.128	.15	.12	.18	.17	.05	.016	.001	.000	.000
.70	.231	.12	.09	.16	.15	.04	.009	.001	.000	.000
.72	.240	...	...	...	...	...	.008	....	.001	.000
1.0	.095	.07	.04	.09	.04	.03	.002	.000	.000	.000
1.5	.009	.03	.02	.04	.07	.02	.000	.000	.000	.000
2.0	.026	.07	.04	.10	.12	.04	.002	.000	.000	.000
2.5	.081	.11	.10	.15	.19	.07	.010	.002	.000	.000
3.0	0	.14	.11	.20	.22	.11	.012	.001	.001	.000
3.5	....	.16	.13	.14	.28	.14	.014	.003	.002	.000
4.0	....	.20	.17	.30	.33	.21	.024	.008	.007	.001
4.5	....	.21	.17	.37	.29	.26	.022	.005	.012	.004
5.0	....	.06	.05	.20	.15	.30	.000	.000	.001	.000

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES*

Wave-length μ	UG 1 dk. viol. tr. u.v. 1 mm	UG 2 dk. viol. tr. u.v. 1 mm	UG 3 violet 1 mm	UG 4 dark violet 1 mm	BG 1 blue tr. u.v. 1 mm	BG 2 blue tr. u.v. 1 mm	BG 3 blue tr. u.v. 1 mm	BG 5 dk. blue abs. red 1 mm	BG 6† dk. blue 1 mm
.281	....	0.01	....	....	0.04	....	0.13	....	....
.302	0.17	.27	....	0.09	.40	0.04	.60	....	...
.312	.37	.50	0.04	.22	.64	.16	.77	....	....
.334	.69	.80	.55	.59	.93	.63	.92	....	....
.366	.85	.84	.91	.77	.97	.84	.96	0.09	0.06
.405	.08	.02	.85	.07	.97	.70	.86	.33	.34
.436	....	....	.50	.01	.86	.42	.63	.47	.48
.480	....	....	.17	.02	.44	.02	.10	.39	.33
.509	....	....	.12	.01	.14	....	.01	.19	.12
.546	....	....	.15	.02	.04	....	....	.06	.02
.578	....	....	.21	....	.05	....	....	.04	.02
.644	....	....	.35	....	.01	....	....	.01	.01
.700	.01	.12	.46	.21	.51	.32	.06	.13	.08
.775	.34	.30	.64	.52	.94	.84	.90	.13	.14
.85	.22	.19	.79	.39	.97	.83	.98	.10	.10
.95	.11	.12	.93	.39	.93	.74	.94	.12	.12
1.05	.07	.09	.97	.37	.86	.61	.81	.15	.15
1.15	.05	.07	.98	.32	.76	.50	.64	.19	.18
1.30	.04	.06	.99	.28	.58	.41	.39	.24	.23
1.45	.04	.06	.99	.27	.45	.38	.27	.29	.27
1.60	.03	.06	.99	.26	.40	.37	.19	.34	.31
1.80	.04	.06	.99	.25	.44	.38	.20	.42	.38
2.00	.04	.06	.99	.32	.50	.41	.28	.49	.46
2.40	.11	.11	.98	.51	.69	.51	.47	.68	.66
3.00	.17	.19	.86	.35	.55	.35	.49	.37	.36

* Data furnished by courtesy of the Fish-Schurman Corp., New York, Importers of Jena Glasses. All values are corrected for reflection losses.

† Discontinued.

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	BG 7 dk. blue abs. red 1 mm	BG 9 blue-green 1 mm	BG 10 blue-green 1 mm	BG 11 lt. blue (Nd) 1 mm	BG 12 blue abs. red 1 mm	BG 13 med. blue 1 mm	BG 14 bright blue 1 mm	BG 15 blue 1 mm	BG 16 blue 1 mm
.281	....	....	....	0.02	....	....	....	....	....
.302	....	....	....	.21	....	....	....	....	....
.312	....	0.01	....	.38	0.02	....	0.13	0.03	....
.334	0.02	.21	0.12	.80	.39	....	.71	.33	0.04
.366	.26	.67	.60	.95	.75	0.35	.92	.73	.57
.405	.51	.90	.78	.97	.86	.77	.98	.86	.80
.436	.70	.94	.84	.96	.85	.87	.98	.89	.84
.480	.79	.96	.88	.93	.48	.87	.98	.90	.86
.509	.73	.96	.88	.95	.12	.85	.96	.90	.86
.546	.50	.95	.87	.99	.02	.77	.90	.90	.84
.578	.26	.93	.86	.70	.01	.64	.75	.89	.81
.644	.03	.86	.74	1.00	....	.35	.46	.80	.68
.700	....	.74	.63	0.99	.04	.21	.30	.65	.54
.775	....	.56	.42	.90	.08	.14	.24	.47	.36
.85	.01	.46	.31	.92	.08	.14	.27	.36	.25
.95	.02	.38	.25	.98	.12	.19	.35	.28	.20
1.05	.04	.34	.24	.99	.18	.24	.45	.24	.18
1.15	.08	.33	.26	.99	.18	.30	.55	.24	.17
1.30	.15	.36	.31	.98	.16	.43	.69	.30	.21
1.45	.24	.42	.39	.97	.19	.52	.78	.41	.28
1.60	.35	.49	.47	.96	.22	.61	.84	.45	.38
1.80	.48	.56	.53	.97	.27	.73	.90	.49	.44
2.00	.58	.59	.55	.97	.53	.81	.93	.54	.44
2.40	.74	.64	.58	.93	.79	.88	.94	.61	.55
3.00	.56	.50	.46	.54	.55	.59	.63	.51	.44

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	BG 17 col. abs. heat 1 mm	VG 2* yellow-green 1 mm	VG 3 green (Nd) 1 mm	GG 1 col. abs. u.v. 1 mm	GG 2 col. abs. u.v. 1 mm	GG 3 light yellow 1 mm	GG 4 light green 1 mm	GG 5 bright yellow 1 mm	GG 6 medium yellow 1 mm
.281	....	....	....	....	....	....	....	....	....
.302	0.03	....	....	0.02	....	0.03	....	0.01	0.02
.312	.11	....	....	.13	....	.05	....	.02	.05
.334	.46	....	0.01	.47	....	.09	0.03	.03	.11
.366	.89	....	.49	.86	0.72	.16	.01	.09	.14
.405	.97	....	.27	.98	.98	.21	.40	.14	.21
.436	.98	0.05	.06	.99	.99	.85	.67	.40	.36
.480	.98	.37	.02	1.00	1.00	.99	.92	.99	.73
.509	.98	.59	.38	1.00	1.00	1.00	.95	1.00	.98
.546	.98	.61	.06	1.00	1.00	1.00	.97	1.00	1.00
.578	.98	.44	.69	1.00	1.00	1.00	.96	1.00	1.00
.644	.97	.10	....	1.00	1.00	1.00	.94	1.00	1.00
.700	.93	.08	.85	1.00	1.00	1.00	.96	1.00	0.99
.775	.78	.07	.59	1.00	1.00	0.99	.99	0.99	.98
.85	.61	.06	.32	1.00	1.00	.98	.99	.99	.97
.95	.42	.09	.36	1.00	1.00	.98	.99	.98	.96
1.05	.32	.13	.22	1.00	1.00	.97	.99	.98	.95
1.15	.30	.18	.20	1.00	1.00	.97	.99	.98	.95
1.30	.33	.27	.39	1.00	1.00	.97	.99	.97	.95
1.45	.36	.37	.34	1.00	1.00	.98	.99	.97	.96
1.60	.43	.47	.22	1.00	1.00	.98	.99	.98	.96
1.80	.46	.57	.38	1.00	1.00	.98	.99	.98	.97
2.00	.42	.65	.47	1.00	0.99	.98	.99	.98	.97
2.40	.39	.75	.30	0.96	.98	.96	.98	.97	.94
3.00	.27	.54	.12	.50	.70	.62	.64	.62	.62

* Discontinued.

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	GG 7 medium yellow 1 mm	GG 8 greenish-yellow 1 mm	GG 9 greenish-yellow 1 mm	GG 10 dk. grn.-yellow 1 mm	GG 11 deep yellow 1 mm	GG 12 yellow, grn. fl. 1 mm	OG 1 yellow-orange 1 mm	OG 2 orange 1 mm	OG 3 red-orange 1 mm
.281	....	....	....	....	....	....	....	....	....
.302	....	....	0.01	....	....	....	....	....	....
.312	0.01	....	.01	....	....	....	....	....	....
.334	.04	....	....	....	....	0.03	....	....	....
.366	.05	....	....	....	....	.74	....	....	....
.405	.12	0.05	.01	....	....	.53	....	....	....
.436	.16	.26	.14	0.09	0.01	.71	....	....	....
.480	.65	.75	.78	.59	.24	.90	....	....	....
.509	.99	.88	.88	.85	.97	.96	0.01	....	....
.546	.99	.99	.93	.97	.99	.99	.91	0.14	....
.578	1.00	.99	.92	.95	.99	1.00	.99	.94	0.48
.644	1.00	.92	.89	.83	.99	1.00	.99	.99	1.00
.700	1.00	.92	.91	.86	.99	1.00	.99	.99	1.00
.775	0.99	.98	.95	.96	.98	1.00	.99	.99	0.99
.85	.99	.98	.98	.99	.97	1.00	.99	.99	.99
.95	.98	.99	.99	.99	.96	1.00	.99	.99	.98
1.05	.98	1.00	.99	.99	.96	1.00	.99	.99	.98
1.15	.97	1.00	.99	1.00	.96	1.00	.99	.99	.98
1.30	.96	1.00	.99	1.00	.96	1.00	.99	.99	.98
1.45	.96	1.00	.99	0.99	.96	1.00	.99	.99	.98
1.60	.97	1.00	.99	.99	.96	0.99	.99	.99	.98
1.80	.98	.99	.99	.99	.97	.99	.98	.99	.98
2.00	.98	.99	.99	.99	.97	.99	.98	.99	.99
2.40	.95	.96	.97	.94	.95	.98	.97	.97	.97
3.00	.65	.68	.69	.44	.66	.67	.62	.60	.63

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	RG 1 bright red 1 mm	RG 2 pure red 1 mm	RG 3 dark red 1 mm	RG 4 dark red 1 mm	RG 5 dark red 1 mm	RG 6 blood color 1 mm	RG 7 infra-red 1 mm	RG 8 v. dk red. 1 mm	RG 9 infra-red 1 mm
.281	....	....	....	....	....	....	....	....	....
.302	....	....	....	....	....	0.12	....	....	....
.312	....	....	....	....	....	.20	....	....	....
.334	....	....	....	....	....	.34	....	....	....
.366	....	....	....	....	....	.44	....	....	....
.405	....	....	....	....	....	.49	....	....	....
.436	....	....	....	....	....	.50	....	....	....
.480	....	....	....	....	....	.44	....	....	....
.509	....	....	....	0.02	....	.31	....	....	....
.546	....	....	....	.05	....	.18	....	....	....
.578	....	....	....	.10	....	.40	....	....	....
.644	0.96	0.92	0.54	.55	0.02	.93	....	0.01	....
.700	.98	.98	.70	.73	.96	.98	0.02	.71	0.20
.775	.98	.98	.81	.82	.98	.99	.18	.99	0.98
.85	.98	.98	.88	.87	.98	.99	.41	.99	.97
.95	.98	.98	.92	.91	.98	.99	.74	.99	.92
1.05	.98	.98	.94	.93	.98	.99	.91	.99	.80
1.15	.98	.98	.95	.94	.99	.99	.96	.99	.62
1.30	.98	.98	.97	.96	.99	.99	.97	.99	.38
1.45	.98	.98	.97	.97	.99	.99	.98	.99	.25
1.60	.98	.98	.98	.98	.99	.99	.99	.99	.19
1.80	.98	.98	.98	.98	.99	.99	.99	.99	.20
2.00	.98	.98	.98	.99	.99	.99	.99	.99	.27
2.40	.96	.95	.94	.97	.97	.96	.99	.97	.45
3.00	.65	.65	.56	.67	.58	.63	.85	.58	....

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	NG 1 v. dk. neut. 0.1 mm	NG 2 med. dk. neut. 0.1 mm	NG 3 dk. neut. 1 mm	NG 4 med. neut. 1 mm	NG 5 neut. 1 mm	NG 6 light neut. 1 mm	NG 7 blue-gray 1 mm
.281	....	0.05	....	....	....	....	....
.302	....	.30	....	....	....	....	....
.312	....	.36	....	....	....	....	....
.334	....	.46	....	....	0.02	0.07	0.01
.366	0.21	.47	0.02	0.07	.22	.53	.17
.405	.29	.45	.08	.18	.37	.89	.37
.436	.32	.46	.12	.23	.43	.92	.44
.480	.36	.50	.15	.29	.46	.89	.34
.509	.36	.52	.17	.30	.46	.89	.29
.546	.36	.56	.17	.31	.46	.89	.33
.578	.36	.58	.17	.31	.46	.89	.26
.644	.37	.62	.17	.30	.46	.87	.19
.700	.45	.77	.16	.28	.43	.86	.34
.775	.50	.80	.12	.21	.34	.85	.34
.85	.49	.80	.08	.17	.27	.86	.29
.95	.48	.81	.07	.14	.21	.87	.24
1.05	.50	.85	.07	.14	.19	.89	.21
1.15	.54	.85	.06	.16	.19	.91	.21
1.30	.59	.86	.09	.21	.22	.93	.21
1.45	.63	.88	.15	.26	.26	.95	.22
1.60	.67	.89	.20	.30	.31	.96	.26
1.80	.71	.90	.22	.34	.38	.96	.34
2.00	.73	.91	.26	.37	.43	.97	.40
2.40	.78	.93	.34	.39	.48	.96	.44
3.00	.72	.87	.20	.19	.21	.72	.25

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	UG 5 dk. viol. tr. u. v. 1 mm	UG 6 tr. infra-red 1 mm	UG 7 tr. infra-red 1 mm	BG 18 blue-green 1 mm	BG 19 nearly neutral 1 mm	BG 20 didymium 1 mm	BG 21 neutral 1 mm	BG 22 light blue-green 1 mm	BG 23 blue 1 mm
.281	0.93	....	....	....	0.04	....	0.01	....	....
.302	.98	....	....	....	.38	0.04	.26	....	....
.312	.99	....	....	....	.60	.09	.46	0.03	0.01
.334	.98	....	....	0.03	.87	.41	.75	.42	.33
.366	.91	....	....	.21	.95	.91	.93	.83	.81
.405	.39	....	....	.50	.96	.95	.97	.92	.93
.436	.11	....	....	.70	.97	.89	.98	.94	.94
.480	.03	....	....	.87	.96	.82	.99	.94	.94
.509	.01	....	....	.90	.95	.81	.99	.94	.91
.546	....	....	....	.87	.94	.99	.99	.94	.76
.578	....	....	....	.68	.92	.33	.98	.93	.50
.644	.01	....	0.01	.25	.83	.99	.93	.83	.19
.700	.72	....	.05	.12	.67	.99	.85	.73	.10
.775	.57	....	.25	.08	.43	.98	.65	.58	.05
.85	.50	0.10	.54	.07	.21	.98	.48	.49	.06
.95	.51	.50	.80	.09	.08	.99	.29	.44	.10
1.05	.53	.77	.91	.13	.04	.99	.19	.44	.17
1.15	.46	.89	.95	.20	.02	.99	.16	.45	.26
1.30	.30	.96	.98	.32	.02	.98	.15	.51	.40
1.45	.25	.98	.99	.45	.04	.89	.18	.59	.53
1.60	.27	.99	.99	.59	.06	.90	.23	.66	.65
1.80	.31	.99	.99	.72	.09	.94	.29	.71	.77
2.00	.36	.99	.99	.80	.10	.91	.30	.71	.84
2.40	.34	.99	.99	.80	.09	.90	.29	.75	.92
3.00	.08	.70	.65	.32	.05	.82	.12	.43	.72

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	BG 24 magenta 1 mm	VG 4 greenish yellow 1 mm	VG 5 bright greenish yellow 1 mm	VG 6 bright blue-green 1 mm	VG 7 greenish yellow 1 mm	VG 8 darker blue-green 1 mm	VG 9 yellow green 1 mm	GG 13 neutral abs. u. v. 1 mm
.281	0.92	....	....	....	....	....	....	....
.302	.96	....	....	....	....	....	....	....
.312	.97	....	....	....	....	....	....	....
.334	.99	....	....	....	....	....	....	....
.366	.99	....	....	....	....	....	....	0.20
.405	.97	....	....	0.07	0.02	0.03	....	.92
.436	.89	0.06	0.03	.32	.15	.16	0.03	.98
.480	.35	.39	.55	.69	.50	.55	.47	.99
.509	.19	.69	.83	.80	.75	.73	.69	.99
.546	.11	.85	.87	.77	.84	.71	.64	.99
.578	.04	.77	.79	.60	.78	.48	.44	.99
.644	.24	.47	.50	.23	.58	.13	.10	.99
.700	.91	.48	.46	.17	.61	.08	.07	.99
.775	.95	.55	.48	.15	.67	.08	.06	.99
.85	.92	.59	.52	.15	.70	.09	.06	.99
.95	.88	.63	.59	.21	.75	.14	.09	.99
1.05	.84	.67	.66	.30	.79	.21	.16	.99
1.15	.81	.71	.72	.39	.83	.31	.25	.99
1.30	.75	.78	.80	.54	.87	.45	.39	.99
1.45	.73	.83	.87	.65	.90	.57	.54	.99
1.60	.72	.87	.91	.74	.92	.65	.65	.99
1.80	.71	.91	.94	.83	.94	.75	.76	.99
2.00	.70	.94	.95	.87	.95	.82	.82	.99
2.40	.58	.96	.96	.91	.95	.92	.90	.98
3.00	.21	.85	.79	.66	.63	.75	.65	.68

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	GG 14 dark yellow 1 mm	GG 15 bright yellow 1 mm	OG 4 orange yellow 1 mm	OG 5 orange red 1 mm	RG 9 infra-red 1 mm	RG 10 infra-red 1 mm	NG 8 neutral 1 mm	NG 9 neutral 1 mm
.281	....	0.01	....	....	....	....	....	....
.302	....	.05	....	....	....	....	....	....
.312	....	.08	....	....	....	....	....	....
.334	....	.15	....	....	....	....	0.17	....
.366	....	.26	....	....	....	....	.65	....
.405	....	.46	....	....	....	....	.78	0.02
.436	....	.94	....	....	....	....	.80	.04
.480	....	.99	0.02	....	....	....	.83	.04
.509	0.95	.99	.64	....	....	....	.84	.04
.546	.99	.99	.97	0.92	....	....	.87	.04
.578	.99	.99	.99	.99	....	....	.86	.04
.644	.99	.99	.99	.99	....	0.09	.83	.04
.700	.99	.99	.99	.99	0.23	.20	.82	.08
.775	.99	.99	.99	.99	.94	.75	.79	.09
.85	.99	.99	.99	.99	.95	.92	.73	.06
.95	.99	.99	.99	.99	.83	.94	.67	.04
1.05	.99	.99	.99	.99	.65	.96	.65	.03
1.15	.99	.99	.99	.99	.42	.98	.65	.04
1.30	.99	.99	.99	.99	.25	.99	.69	.07
1.45	.99	.99	.99	.99	.22	.99	.76	.12
1.60	.99	.99	.99	.99	.23	.99	.79	.16
1.80	.99	.99	.99	.99	.28	.99	.80	.18
2.00	.99	.99	.99	.99	.37	.99	.81	.20
2.40	.98	.97	.99	.98	.61	.99	.84	.30
3.00	.68	.74	.72	.65	.45	.69	.63	.13

TRANSMISSION OF COLORED GLASSES (Continued)

SECTION II.—JENA GLASSES (Continued)

Wave-length μ	WG 1 neutral 1 mm	WG 2 neutral 1 mm	WG 3 neutral 1 mm	WG 4 neutral 1 mm	WG 5 neutral 1 mm	WG 6 neutral 1 mm	WG 7 neutral 1 mm	WG 8 neutral 1 mm
.281	....	....	....	....	....	0.25	0.60	0.96
.302	....	....	....	....	0.23	.73	.89	.98
.312	....	....	....	0.24	.68	.87	.94	.99
.334	....	0.03	0.60	.88	.96	.97	.99	1.00
.366	0.46	.86	.97	.99	1.00	1.00	1.00	1.00
.405	.98	.99	1.00	1.00	1.00	1.00	1.00	1.00
.436	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.480	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.509	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.546	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.578	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.644	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.700	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.775	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.85	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.30	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.45	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.99
1.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.98
1.80	1.00	1.00	1.00	1.00	1.00	1.00	.99	.96
2.00	1.00	1.00	1.00	.99	.99	.99	.99	.92
2.40	1.00	.99	1.00	.98	.98	.97	.97	.79
3.00	.84	.81	.82	.79	.77	.57	.66	.51

TRANSMISSION OF WRATTEN FILTERS

Compiled by Allie C. Peed, Jr. for The Eastman Kodak Company

Data condensed from Kodak Wratten Filters for Scientific and Technical Use published by the Eastman Kodak Company, manufacturers of the filters.

The following pages give (1) percentage luminous transmittance at wave lengths from 400 to 700μ at intervals of 10μ for the standard illuminant "C" adopted by the International Commission of Illumination, (2) dominant wave length in millimicrons, and (3) percentage of excitation purity. Values of wave length followed by "c" indicate the complementary wave lengths of purple filters which do not have a dominant wave length.

All colorimetric specifications are based on the 1931 standard ICI colorimetric and luminosity data.

The transmittance data are given as representing standard samples of the filters. They are intended only for the information of users in choosing filters which will meet their requirements. Values taken from the tables of data should not be used by research workers as representing precisely the absorption characteristics of a particular filter. If such precise data are needed, they should be determined for the particular filter being used.

Where the spectra extend into the ultraviolet this fact is indicated by an asterisk (*) in the transmission tables immediately beneath the filter number, and quantitative data are not given. The manufacturer should be consulted for this information. Transmission in the ultraviolet of wave lengths less than 330μ will be eliminated in the case of cemented filters, as glass absorbs ultraviolet radiation of wave lengths shorter than about 330μ.

Stability ratings are given as three letter combinations following the filter description in the table below. In establishing the stability classifications each filter is exposed to a selected light source for a specific time interval. The following grading system is used to describe the result:

Class A—stable
Class B—relatively stable
Class C—somewhat unstable
Class D—unstable

The classification letters, for example, AAA, describe the stability to the following three exposure tests in this order:

1. Two weeks' exposure to daylight in a south window
2. Twenty-four hours' exposure to a "Fade-Ometer"
3. Two weeks' exposure at two feet from a 1000-watt tungsten lamp.

Filters are supplied in two forms; as lacquered gelatin film, or as a gelatin film cemented between pieces of optical glass. Filters in glass are cemented between sheets of plane-parallel glass, which is surfaced in quantities and is of sufficient accuracy for general photographic work, and for most scientific purposes.

Most Wratten Gelatin Filters are stocked in 2- or 3-inch squares. Stocks of 2- or 3-inch square filters cemented in glass are maintained only in filters usually used for general photographic work.

The booklet "Kodak Filters and Lens Attachments" gives more valuable information on this subject.

FILTER DATA

No.	Description, use, and stability
	Colorless
0	For compensating thickness of other gelatin filters in optical systems, AAA.
1	Absorbs ultraviolet below 360 mμ, DDD.
1A	Kodak Skylight Filter—Reduces excess bluishness in outdoor color photographs in open shade under a clear, blue sky, ACA.
	Yellows
2B	Absorbs ultraviolet below 410 mμ, ACA.
3	Light yellow, CCD.
3N5	No. 3 plus 0.5 neutral density, AAA.
4	Light yellow—Approximate correction on panchromatic materials for outdoor scenes, including sky, CCC.
6	K1—Light yellow—Partial correction outdoors, BBA.
8	K2—Yellow—Full correction outdoors on Type B panchromatic materials. Widely used for proper sky, cloud, and foliage rendering. Green separation for Fluorescence Process, AAA.

TRANSMISSION OF FILTERS (Continued)

No.	Description, use, and stability
8N5	No. 8 plus 0.5 neutral density, AAA.
9	K3—Deep yellow. Moderate contrast in outdoor photography (with black-and-white films), AAA.
11	X1—Greenish yellow. Correction for tungsten light on Type B panchromatic materials; also for daylight correction with Type C panchromatic materials in making outdoor portraits, darkening skies, or lightening foliage, AAA.
12	Minus blue. Haze cutting in aerial photography, AAA.
13	X2—Yellow green. Correction for Type C panchromatic materials in tungsten light, ABA.
15	G—Deep yellow. Overcorrection in landscape photography. Contrast control in copying and in aerial infrared photography, AAA.
16	Blue absorption, AAB.
18A	Transmits ultraviolet and infrared only (glass), AAA.
	Oranges and Reds
21	Blue and blue-green absorption, CBB.
22	Yellow-orange. For increasing contrast in blue preparations in microscopy. Mercury yellow, BAC.
23A	Light red. Two-color projection—contrast effects, BAB.
24	Red for two-color photography (daylight or tungsten). White-flame-arc tricolor projection, AAB.
25	A—Tricolor red for direct color separation. Contrast effects in commercial photography and in outdoor scenes. Two-color general viewing. Aerial infrared photography and haze cutting, AAA.
26	Stereo red, AAA.
29	Red color separation from transparencies and for the Kodak Fluorescence Process. Strong contrast effects. Copying blueprints. Tungsten tricolor projection, AAA.
	Magentas and Violets
30	Green absorption, BBC.
31	Green absorption, CCA.
32	Minus green, CCD.
33	Strong green absorption, CCB.
34	Violet, CDD.
34A	Blue separation—Kodak Fluorescence Process, DCC.
35	Contrast in microscopy, CDD.
36	Dark violet, CCC.
	Blues and Blue-greens
38	Red absorption, BCA.
38A	Red absorption. Increasing contrast in visual microscopy, BBB.
39	Contrast control in printing motion-picture duplicates (glass), AAA.
40	Green for two-color photography (tungsten), CBC.
44	Minus red—Two-color general viewing, DDD.
44A	Minus red, DDD.
45	Contrast in microscopy, DDD.
45A	Highest resolving power in visual microscopy, CDC.
46	Blue projection (experimental), DDD.
47	Tricolor blue for direct color separation and from Kodak Ektacolor Film for Dye Transfer. Contrast effects in commercial photography. Tungsten and white-flame-arc tricolor projection, BBC.
47B	Tricolor blue for color separation from transparencies and from Kodak Ektacolor Film for Graphic Arts, BBB.
48	Green and red absorption, CBC.
48A	Green and red absorption, AAB.
49	Dark blue, BCB.
49B	Very dark blue, BBB.
50	Very dark blue. Mercury violet, CCC.
	Greens
52	Light green, AAB.
53	Medium green, CCB.
54	Very dark green, AAA.
55	Stereo green, BBC.
56	Very light green, CBC.

TRANSMISSION OF FILTERS (Continued)

No.	Description, use, and stability
57	Green for two-color photography (daylight), CBC.
57A	Light green, BBC.
58	Tricolor green for direct color separation. Contrast effects in commercial photography and microscopy, BBC.
59	Green for tricolor projection (white-flame-arc), BBB.
59A	Very light green, BBB.
60	Green for two-color photography (tungsten), BDC.
61	Green color separation from transparencies and Kodak Ekta-color Film. Tricolor projection (tungsten), ABC.
64	Red absorption (light), CDB.
65	Red absorption, ADB.
65A	Red absorption, CCD.
66	Contrast effects in microscopy and medical photography, DDC.
67A	Red absorption (light). Two-color projection, CDC.
	Narrow-band
70	Dark red. Infrared photography. Color separation for Kodak Ektacolor Film (with tungsten), ABC.
72B	Dark orange-yellow, CCC.
73	Dark yellow-green, ABB.
74	Dark green. Mercury green, BBC.
75	Dark blue-green, ACC.
76	Dark violet (compound filter), DDD.
77	Transmits 546 mμ mercury line (glass plus gelatin), AAA.
77A	Transmits 546 mμ mercury line (glass plus gelatin), AAA.
	Photometrics
78	Bluish. Photometric filter (visual), BAB.
78AA	Bluish. Photometric filter (visual), BAA.
78A	Bluish. Photometric filter (visual), AAA.
78B	Bluish. Photometric filter (visual), AAA.
78C	Bluish. Photometric filter (visual), BAA.
86	Yellowish. Photometric filter (visual), BBA.
86A	Yellowish. Photometric filter (visual), AAA.
†86B	Yellowish. Photometric filter (visual), BCA.
†86C	Yellowish. Photometric filter (visual), AAA.
	Light Balancing
80A	For Kodachrome Film, Daylight Type, and photographic flood lamps, ABA.
81	Yellowish. For warmer color rendering.
81A	Yellowish. For Kodak Ektachrome Film, Type B, with photographic flood lamps.
81B	Yellowish. For warmer color rendering.
81C	Yellowish. For Kodachrome Film, Type A, with flash lamps.
81D	Yellowish. For Kodachrome Film, Type A, with flash lamps.
81EF	Yellowish. For Kodak Ektachrome Film, Type B, with flash lamps.
82	Bluish. For cooler color rendering.
82A	Bluish. For Kodachrome Film, Type A, with 3200 K lamps.
82B	Bluish. For cooler color rendering.
82C	Bluish. For cooler color rendering.
83	Yellowish. For 16 mm Commercial Kodachrome Film and daylight exposure, BBB.
85	Orange. For Type A Kodak color films and daylight exposure, BAA.
85B	Orange. For Kodak Ektachrome Film, Type B, and daylight exposure, BAB.
	Miscellaneous
79	Photographic sensitometry. Corrects 2360 K to 5500 K, AAA.
87	For infrared photography. Absorbs visual.
87C	Absorbs visual, transmits infrared.
88A	For infrared photography. Absorbs visual.
89B	For infrared photography, AAA.
90	Narrow-band viewing filter for judging brightness scale of scenes, CCD.
96	Neutral filters for controlling luminance, AAB.
97	Dichroic absorption, AAA.
102	Correction filter for Barrier-layer photocell, ABA.
106	Correction filter for S-4 type photocell, AAA.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance												
	No. 0 *	No. 1 *	No. 1A *	No. 2B *	No. 3	No. 3N5 *	No. 4	No. 6 *	No. 8	No. 8N5	No. 9	No. 11 *	No. 12 *
400	88.0	85.0	59.0	19.0	......	......	......	7.40	......	......	......	......	......
10	88.5	85.5	76.0	48.0	......	......	......	8.32	......	......	......	......	......
20	88.9	86.0	82.0	67.0	......	......	......	10.4	......	......	......	0.16	......
30	89.3	86.5	84.6	75.3	0.36	......	......	13.5	......	......	......	0.29	......
40	89.6	87.0	86.0	80.0	1.78	......	......	18.9	......	......	......	0.56	......
50	89.8	87.4	86.8	83.0	11.5	1.59	......	27.6	......	......	......	1.32	......
60	89.9	87.8	87.2	85.2	38.0	9.40	6.9	39.0	0.25	0.16	......	4.00	......
70	90.1	88.2	87.5	86.7	68.0	18.5	42.0	52.3	5.50	2.0	1.78	12.0	......
80	90.3	88.5	87.3	88.1	80.8	23.5	74.0	65.8	19.0	6.3	8.31	26.0	......
90	90.4	88.7	86.8	88.8	85.2	25.5	84.7	76.8	41.0	13.2	20.7	43.7	......
500	90.5	88.9	86.3	89.5	86.9	26.3	87.5	83.5	63.5	20.0	34.5	55.0	1.50
10	90.6	89.1	85.5	89.9	87.8	26.7	88.5	87.0	78.0	24.3	48.8	60.0	17.3
20	90.7	89.3	84.8	90.3	88.4	27.0	89.1	88.4	84.1	26.7	62.0	60.2	55.0
30	90.7	89.5	84.3	90.5	89.0	27.2	89.4	89.0	86.5	28.0	76.0	57.8	77.8
40	90.8	89.7	84.0	90.6	89.5	27.5	89.6	89.4	87.7	28.6	83.8	54.2	86.0
50	90.8	89.9	83.9	90.7	89.8	27.8	89.8	89.7	88.4	29.0	87.0	50.0	88.4
60	90.9	90.1	84.1	90.8	90.1	27.9	90.0	89.9	88.8	29.3	88.3	44.8	89.4
70	90.9	90.2	84.8	90.9	90.4	28.0	90.2	90.1	89.2	29.5	88.8	38.9	89.7
80	90.9	90.3	86.0	90.9	90.6	28.4	90.4	90.3	89.5	29.6	89.1	33.1	90.1
90	91.0	90.4	87.4	91.0	90.7	29.0	90.6	90.5	89.8	29.8	89.3	27.6	90.3
600	91.0	90.5	88.5	91.1	90.8	29.5	90.8	90.6	90.1	29.9	89.5	22.7	90.4
10	91.0	90.5	89.5	91.2	90.9	29.5	90.9	90.7	90.3	29.6	89.7	19.0	90.5
20	91.0	90.6	90.2	91.3	91.0	29.3	91.0	90.8	90.5	29.4	89.8	14.9	90.7
30	91.0	90.6	90.6	91.3	91.0	29.1	91.1	90.9	90.7	29.1	89.9	11.4	90.8
40	91.1	90.7	90.8	91.4	91.1	29.0	91.2	91.0	90.9	28.8	90.0	9.10	90.9
50	91.1	90.7	91.0	91.4	91.2	29.4	91.3	91.1	91.0	28.9	90.1	8.05	91.0
60	91.1	90.8	91.1	91.5	91.3	29.6	91.4	91.2	91.1	29.2	90.1	7.50	91.1
70	91.1	90.8	91.1	91.5	91.4	29.8	91.5	91.2	91.2	29.4	90.2	7.05	91.2
80	91.1	90.9	91.1	91.6	91.5	30.0	91.5	91.3	91.3	29.5	90.2	6.50	91.2
90	91.1	90.9	91.1	91.7	91.6	30.2	91.6	91.4	91.4	29.7	90.3	6.10	91.2
700	91.1	91.0	91.1	91.8	91.7	31.0	91.6	91.5	91.5	30.2	90.3	6.20	91.3
Luminous transmit.	90.8	89.9	85.9	90.5	88.3	27.4	87.8	87.5	82.7	27.0	76.6	40.2	73.8
Dominant wave lgth.	571.0	575.0	498.0	570.0	569.5	570.5	569.5	570.3	571.8	572.0	574.4	550.3	576.1
Excitation purity.	0.8	1.5	1.2	5.7	50.0	56.3	64.0	44.7	85.2	84.0	91.4	60.7	97.8

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance												
	No. 13 *	No. 15 *	No. 16	No. 18A *	No. 21	No. 22	No. 23A	No. 24	No. 25	No. 26	No. 29	No. 30 *	No. 31 *
400	......	......	......	......	......	......	......	......	......	......	......	48.6	13.8
10	......	......	......	......	......	......	......	......	......	......	......	47.4	14.5
20	......	......	......	......	......	......	......	......	......	......	......	48.5	16.4
30	0.18	......	......	......	......	......	......	......	......	......	......	50.1	25.5
40	0.50	......	......	......	......	......	......	......	......	......	......	49.4	42.7
50	1.35	......	......	......	......	......	......	......	......	......	......	43.0	50.2
60	4.08	......	......	......	......	......	......	......	......	......	......	26.5	40.4
70	11.0	......	......	......	......	......	......	......	......	......	......	13.8	22.6
80	23.5	......	......	......	......	......	......	......	......	......	......	5.00	8.20
90	39.0	......	......	......	......	......	......	......	......	......	......	0.63	1.85
500	50.8	......	......	......	......	......	......	......	......	......	......	......	0.12
10	55.2	1.00	......	......	......	......	......	......	......	......	......	......	......
20	56.5	16.0	3.00	......	......	......	......	......	......	......	......	......	......
30	55.0	52.1	22.0	......	......	......	......	......	......	......	......	......	......
40	51.0	70.7	48.0	......	2.50	......	......	......	......	......	......	......	......
50	46.0	84.3	69.5	......	29.0	0.25	......	......	......	......	......	......	......
60	39.2	87.5	79.5	......	65.0	19.0	......	......	......	......	......	0.10	......
70	32.0	88.7	84.0	......	80.6	60.0	11.0	......	......	......	......	10.0	......
80	25.1	89.3	86.3	......	85.4	81.0	47.0	4.55	......	......	......	45.0	......
90	18.2	89.7	87.8	......	87.3	87.0	69.6	37.3	12.6	2.90	......	76.0	0.63
600	13.5	90.0	89.0	......	88.1	88.5	82.7	72.3	50.0	30.0	......	87.4	26.0
10	9.60	90.1	89.6	......	88.7	89.0	85.8	82.9	75.0	63.2	10.0	89.5	67.2
20	6.40	90.2	90.0	......	89.0	89.5	87.2	86.4	82.6	78.9	45.3	90.2	84.0
30	3.66	90.3	90.2	......	89.5	89.8	87.9	87.8	85.5	84.0	71.4	90.5	88.1
40	2.20	90.4	90.3	......	89.9	90.0	88.5	88.5	86.7	86.1	82.7	90.7	89.8
50	1.58	90.5	90.4	......	90.2	90.1	89.0	89.0	87.6	87.2	86.6	90.8	90.2
60	1.74	90.6	90.5	......	90.4	90.2	89.4	89.3	88.2	88.1	88.4	90.9	90.4
70	2.62	90.6	90.6	......	90.5	90.3	89.6	89.7	88.5	88.5	89.4	91.0	90.5
80	3.55	90.7	90.7	......	90.5	90.4	89.8	89.9	89.0	88.9	90.0	91.1	90.7
90	4.48	90.7	90.8	0.25	90.6	90.5	90.0	90.2	89.3	89.2	90.3	91.1	90.8
700	5.25	90.8	90.8	1.20	90.6	90.6	90.2	90.3	89.5	89.5	90.4	91.1	91.0
Luminous transmit.	34.5	66.2	57.7	0.0014	45.6	35.8	25.0	17.8	14.0	11.7	6.3	26.6	12.9
Dominant wave lgth.	542.0	579.3	582.7	700.0	588.9	595.1	602.7	610.6	615.1	619.0	631.6	498.6_c	513.1_c
Excitation purity.	57.5	99.0	99.3	100.0	99.9	99.9	100.0	100.0	100.0	100.0	100.0	62.4	81.9

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance												
	No. 32 *	No. 33 *	No. 34 *	No. 34A *	No. 35 *	No. 36 *	No. 38 *	No. 38A *	No. 39 *	No. 40	No. 44 *	No. 44A *	No. 45
400	38.0	0.85	64.0	......	48.0	36.5	60.5	33.4	85.2	......	0.44	2.52	......
10	37.9	0.71	70.1	0.1	57.0	45.5	66.5	41.2	78.2	......	0.36	3.39	......
20	40.0	1.17	72.0	40.0	57.6	45.5	72.5	53.0	70.5	......	0.63	6.30	......
30	43.0	1.69	68.4	69.7	47.5	32.7	75.3	58.0	63.3	......	3.63	17.4	......
40	55.5	5.36	58.2	68.7	29.5	15.2	76.2	58.8	53.6	......	13.1	32.7	5.00
50	66.0	14.3	42.3	56.2	12.3	3.7	75.9	57.6	42.5	......	25.4	41.8	19.0
60	66.0	12.4	25.2	40.5	3.5	0.35	74.8	55.2	28.5	3.16	36.5	48.1	29.5
70	57.0	5.00	12.1	23.8	0.25	.....	73.4	51.9	17.3	21.6	46.5	51.7	34.4
80	40.0	0.50	2.7	9.2	.....	.....	71.6	48.5	10.2	44.7	53.6	52.9	35.7
90	21.0	.....	0.2	2.3	.....	.....	69.5	44.6	4.00	61.4	56.8	52.2	34.5
500	9.56	.....	.....	0.33	.....	.....	66.7	40.2	1.33	70.2	55.8	49.8	29.7
10	2.51	.....	.....	......	.....	.....	63.9	35.8	0.35	72.4	50.9	44.8	21.5
20	0.13	.....	.....	......	.....	.....	60.8	31.7	.....	70.5	42.1	36.8	11.5
30	.....	.....	.....	......	.....	.....	57.0	27.2	.....	64.8	30.5	26.8	3.80
40	.....	.....	.....	......	.....	.....	52.6	22.3	.....	55.5	18.6	16.8	0.85
50	.....	.....	.....	......	.....	.....	48.0	17.6	.....	44.2	8.99	8.20	......
60	.....	.....	.....	......	.....	.....	42.8	12.9	.....	32.5	3.59	2.95	......
70	.....	.....	.....	......	.....	.....	37.0	8.78	.....	20.3	0.80	0.91	......
80	.....	.....	.....	......	.....	.....	30.6	5.65	.....	9.56	......	0.10	......
90	.....	.....	.....	......	.....	.....	25.5	3.48	.....	3.20	......	......	......
600	6.04	.....	.....	......	.....	.....	20.9	2.09	.....	1.10	......	......	......
10	41.0	0.80	.....	0.13	.....	.....	16.8	1.15	.....	0.32	......	......	......
20	75.0	24.9	.....	1.0	.....	.....	12.9	0.59	.....	......	......	......	......
30	86.1	60.8	.....	6.3	.....	.....	10.0	0.28	.....	......	......	......	......
40	89.0	78.0	0.4	22.0	.....	.....	7.79	0.13	.....	......	......	......	......
50	90.0	85.0	4.0	45.0	0.1	.....	6.68	......	.....	......	......	......	......
60	90.6	87.5	20.7	65.0	3.0	0.21	6.20	......	.....	......	......	......	......
70	90.7	88.7	45.2	77.3	19.0	7.5	5.91	......	.....	......	......	......	......
80	90.8	89.4	66.5	85.0	43.5	29.0	5.41	......	0.50	0.80	......	......	......
90	90.9	89.8	78.8	88.2	66.0	55.0	4.90	......	4.06	6.99	0.18	......	......
700	91.0	90.0	85.0	89.8	77.7	71.3	5.00	......	17.8	23.5	1.60	......	1.00
Luminous transmit.	12.5	5.2	1.3	2.9	0.45	0.25	42.5	17.3	1.2	33.6	15.6	14.4	5.2
Dominant wave lgth.	551.7_c	498.0_c	424.0	564.8_c	566.8_c	566.4_c	483.5	478.9	450.6	516.2	589.1	483.4	481.5
Excitation purity.	79.6	88.3	94.4	91.4	96.3	97.8	41.8	69.8	98.9	48.5	72.9	77.2	88.4

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance												
	No. 45A	No. 46 *	No. 47 *	No. 47B *	No. 48 *	No. 48A *	No. 49 *	No. 49B *	No. 50 *	No. 52 *	No. 53 *	No. 54	No. 55
400	......	1.20	7.80	16.0	0.96	5.65	3.30	1.70	0.45	2.18	......	......	......
10	......	0.60	17.4	29.5	3.16	10.0	4.23	2.00	0.39	1.51	......	......	......
20	......	0.80	34.0	43.6	8.25	16.0	6.93	3.55	0.59	0.80	......	......	......
30	1.00	5.98	47.0	50.0	15.0	21.0	11.2	7.00	2.63	0.44	......	......	......
40	8.81	19.0	50.3	47.2	22.6	25.0	18.9	13.0	8.90	0.41	......	......	......
50	17.4	30.1	48.3	36.0	30.3	26.2	25.6	17.4	14.0	0.69	......	......	......
60	20.9	33.8	43.4	25.0	33.2	22.9	24.0	14.8	12.3	1.45	......	......	0.20
70	21.6	32.1	36.2	13.2	29.6	16.5	15.7	7.60	5.36	2.70	0.10	......	2.90
80	20.5	27.0	28.5	4.5	22.4	9.55	6.93	2.76	1.55	4.90	0.71	......	13.1
90	18.0	20.2	19.6	1.3	14.1	4.27	2.14	0.40	0.10	8.50	2.14	......	34.2
500	14.4	11.1	11.3	0.17	7.30	1.58	0.46	......	......	13.3	4.47	......	53.4
10	10.1	4.39	5.64	......	2.64	0.48	......	......	......	18.2	7.24	0.10	67.0
20	5.60	1.66	1.91	......	0.50	......	......	......	......	23.7	10.7	0.31	69.3
30	2.52	0.35	0.36	......	......	......	......	......	......	28.5	14.0	0.64	65.1
40	0.64	......	......	......	......	......	......	......	......	32.1	16.6	0.89	56.7
50	0.10	......	......	......	......	......	......	......	......	33.1	17.3	0.93	45.0
60	......	......	......	......	......	......	......	......	......	31.0	15.4	0.62	33.1
70	......	......	......	......	......	......	......	......	......	25.6	11.4	0.21	20.7
80	......	......	......	......	......	......	......	......	......	19.1	6.90	......	9.00
90	......	......	......	......	......	......	......	......	......	12.6	3.60	......	2.70
600	......	......	......	......	......	......	......	......	......	7.78	1.41	......	0.40
10	......	......	......	......	......	......	......	......	......	4.17	0.40	......	......
20	......	......	......	......	......	......	......	......	......	2.34	0.15	......	......
30	......	......	......	......	......	......	......	......	......	1.38	......	......	......
40	......	......	......	......	......	......	......	......	......	0.80	......	......	......
50	......	......	......	......	......	......	......	......	......	0.54	......	......	......
60	......	......	......	......	......	......	......	......	......	0.36	......	......	......
70	......	......	......	......	......	......	......	......	......	0.27	......	......	......
80	......	......	......	......	......	......	......	......	......	0.23	......	......	0.66
90	0.20	0.25	......	......	......	......	......	......	......	0.19	......	......	6.90
700	2.24	0.85	......	......	......	......	......	......	......	0.17	......	......	27.8
Luminous transmit.	2.8	2.4	2.8	0.78	1.86	0.88	0.69	0.36	0.26	20.1	9.0	0.032	31.4
Dominant wave lgth.	477.6	470.4	463.7	479.8	466.5	458.0	457.9	455.5	455.9	553.3	551.1	546.1	530.2
Excitation purity.	89.7	94.9	95.8	69.1	96.1	98.3	98.9	99.3	99.4	77.3	89.7	97.0	68.4

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance												
	No. 56	No. 57	No. 57A	No. 58	No. 59 *	No. 59A *	No. 60	No. 61	No. 64 *	No. 65	No. 65A *	No. 66 *	No. 67A *
400	.....	.....	.....	.....	.....	.....	.....	.....	9.00	.....	.....	12.3	1.10
10	.....	.....	.....	.....	.....	.....	.....	.....	9.20	.....	.....	13.0	0.93
20	.....	.....	.....	.....	.....	.....	.....	.....	8.75	0.23	.....	15.0	1.28
30	.....	.....	.....	.....	.....	0.16	.....	.....	9.20	0.61	0.16	18.4	3.16
40	.....	.....	0.19	.....	.....	0.37	.....	.....	11.3	1.58	1.32	23.2	6.40
50	.....	.....	0.87	.....	0.40	1.26	0.19	.....	15.5	4.10	5.50	31.2	10.5
60	0.16	0.44	2.56	.....	1.90	4.57	1.38	.....	23.3	9.00	13.0	42.2	17.7
70	3.12	3.10	7.80	0.23	7.70	13.2	5.38	.....	34.4	16.8	24.9	55.5	28.5
80	13.0	13.1	21.6	1.38	21.0	30.0	15.0	0.33	46.8	24.9	36.6	68.4	41.4
90	34.5	31.9	41.7	4.90	41.5	50.8	32.0	4.00	56.6	31.3	45.1	77.6	52.1
500	59.0	50.5	58.8	17.7	59.0	66.0	48.4	16.6	62.1	33.7	45.8	82.7	57.9
10	73.0	60.6	67.9	38.8	67.7	73.0	57.2	32.3	62.9	32.4	39.7	84.6	58.8
20	79.0	63.3	70.1	52.2	69.8	75.1	59.2	40.0	59.1	27.5	29.7	84.0	55.4
30	79.9	61.0	67.6	53.6	67.2	73.2	55.5	39.6	51.6	20.7	17.8	82.6	47.5
40	77.5	55.0	61.8	47.6	61.5	68.5	47.5	34.5	41.3	13.7	7.90	79.1	36.6
50	72.6	47.1	53.5	38.4	54.0	62.0	36.8	26.3	28.0	6.50	2.40	73.7	25.0
60	66.1	37.3	43.3	27.8	45.0	54.4	25.2	17.3	16.2	1.66	0.32	67.1	14.2
70	58.0	26.5	31.6	17.4	35.0	44.5	14.4	9.70	7.95	0.40	.....	58.8	5.50
80	46.1	16.6	19.4	9.0	24.0	33.0	6.3	4.40	3.10	.....	.....	47.2	1.40
90	33.8	8.69	9.70	3.50	14.0	22.0	1.82	1.66	0.80	.....	.....	34.5	0.28
600	24.0	3.70	4.50	1.50	7.95	14.6	0.48	0.38	.....	.....	.....	24.4	.....
10	18.7	1.60	2.00	0.41	4.90	10.5	0.10	.....	.....	.....	.....	18.5	.....
20	13.2	0.49	0.87	.....	2.70	6.92	.....	.....	.....	.....	.....	13.7	.....
30	7.22	.....	0.22	.....	1.00	3.16	.....	.....	.....	.....	.....	7.70	.....
40	3.02	.....	.....	.....	0.17	1.07	.....	.....	.....	.....	.....	3.00	.....
50	1.48	.....	.....	.....	.....	0.50	.....	.....	.....	.....	.....	1.46	.....
60	1.91	.....	.....	.....	.....	0.91	.....	.....	.....	.....	.....	1.91	.....
70	7.95	.....	.....	.....	0.63	3.00	.....	.....	.....	.....	.....	6.17	.....
80	23.0	.....	0.16	.....	4.00	10.0	.....	.....	.....	.....	.....	19.9	.....
90	44.1	.....	1.15	.....	12.0	20.0	2.10	.....	0.10	.....	0.20	42.6	.....
700	64.8	.....	3.17	0.53	22.6	30.0	8.70	.....	4.50	.....	2.18	63.1	0.40
Luminous transmit.	52.8	32.5	37.2	23.7	38.7	45.8	26.1	16.8	25.0	9.6	9.8	58.3	22.4
Dominant wave lgth.	552.3	536.4	534.0	540.2	538.3	541.4	525.7	536.8	497.3	496.6	492.7	512.3	499.8
Excitation purity	78.2	69.2	62.1	88.1	66.0	59.3	62.2	85.4	55.0	67.8	77.4	21.5	55.8

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance											
	No. 70	No. 72B	No. 73	No. 74	No. 75	No. 76 *	No. 77	No. 77A	No. 78 *	No. 78AA *	No. 78A *	No. 78B *
400	......	......	......	......	......	0.22	......	......	37.2	43.0	56.0	64.1
10	......	......	......	......	......	0.18	......	......	41.7	46.0	58.6	66.5
20	......	......	......	......	......	0.29	......	......	44.2	48.7	61.0	68.4
30	......	......	......	......	......	1.38	......	......	44.6	49.8	61.8	69.5
40	......	......	......	......	......	3.50	......	......	44.2	49.7	61.8	70.0
50	......	......	......	......	......	3.50	......	......	41.7	48.0	61.0	69.4
60	......	......	......	......	1.97	1.92	......	......	38.0	44.9	58.7	67.5
70	......	......	......	......	10.0	0.51	......	......	33.8	40.3	55.0	65.4
80	......	......	......	......	17.4	......	......	......	27.5	35.6	51.0	62.9
90	......	......	......	......	18.0	......	......	......	23.5	30.9	47.1	59.8
500	......	......	......	......	13.0	......	......	......	19.5	26.5	43.5	57.0
10	......	......	......	0.96	7.35	......	0.30	0.10	15.8	23.4	40.0	54.2
20	......	......	......	7.95	3.20	......	9.10	5.35	13.8	20.3	36.9	51.4
30	......	......	......	14.6	0.83	......	13.5	1.90	11.8	17.8	34.4	49.3
40	......	......	......	12.9	0.14	......	46.1	35.0	10.5	16.6	32.7	48.1
50	......	......	......	7.60	......	......	78.0	71.8	9.56	14.9	31.2	46.7
60	......	......	2.24	3.06	......	......	75.8	63.1	8.53	13.2	29.4	45.0
70	......	......	5.97	0.83	......	......	8.00	......	7.77	12.1	28.0	43.6
80	......	......	4.56	0.12	......	......	1.00	......	7.41	11.6	27.5	43.1
90	......	1.26	2.00	......	......	......	0.32	......	6.93	11.1	27.0	42.9
600	......	5.89	0.56	......	......	......	16.2	1.60	6.45	10.40	26.0	41.8
10	......	5.25	0.10	......	......	......	52.1	32.1	5.50	9.20	24.1	40.0
20	......	2.88	......	......	......	......	83.0	78.0	4.80	7.70	21.8	37.6
30	......	1.26	......	......	......	......	84.9	79.5	3.94	6.50	19.7	35.5
40	......	0.48	......	......	......	......	88.1	86.5	3.46	5.60	18.6	34.2
50	0.63	0.14	......	......	......	......	89.8	89.2	3.24	5.50	18.4	33.6
60	10.5	......	......	......	......	......	89.8	89.0	3.16	5.60	18.5	34.0
70	35.0	......	......	......	......	......	85.5	79.5	3.39	5.80	18.7	34.1
80	55.2	......	......	......	......	......	76.1	62.5	3.45	6.10	19.0	34.5
90	70.0	......	......	......	......	0.13	75.0	62.4	3.51	6.10	19.3	34.8
700	79.0	......	......	......	0.14	1.24	86.5	83.0	3.90	6.50	20.2	36.0
Luminous transmit.	0.31	0.74	1.3	4.0	1.9	0.046	32.3	25.5	10.7	15.8	31.6	46.7
Dominant wave lgth.	675.6	604.9	574.9	538.6	487.7	449.2	579.9	581.5	471.1	473.4	475.7	477.2
Excitation purity.	100.0	100.0	100.0	96.7	90.4	99.7	99.0	99.1	63.0	54.5	33.7	20.7

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance											
	No. 78C *	No. 79 *	No. 80A *	No. 81 *	No. 81A *	No. 81B *	No. 81C *	No. 81D *	No. 81EF *	No. 82 *	No. 82A *	No. 82B *
400	74.9	24.0	67.6	77.7	65.1	55.1	46.1	38.2	30.7	83.0	80.1	76.7
10	76.6	26.0	73.1	78.1	65.9	55.8	46.6	38.4	31.5	83.7	80.8	78.0
20	77.9	29.0	76.8	79.0	67.6	57.7	49.0	41.0	34.3	84.6	81.6	79.2
30	78.9	31.0	7.77	80.5	70.2	61.0	52.5	45.5	38.6	85.1	82.2	79.7
40	79.4	32.2	76.5	81.9	72.8	64.5	57.2	50.0	43.2	85.4	82.4	79.7
50	79.5	32.7	73.0	83.0	74.8	67.2	60.5	53.9	47.4	85.4	82.4	79.2
60	79.3	31.4	69.0	83.7	76.0	69.1	63.0	56.5	50.2	85.0	81.7	78.0
70	78.6	28.8	63.6	84.3	77.1	70.6	64.2	58.1	52.0	84.6	80.7	76.3
80	77.8	25.6	57.6	84.6	77.8	71.3	65.0	59.0	53.0	84.0	79.3	74.4
90	76.7	22.2	51.3	84.9	78.3	71.8	65.7	60.0	54.0	83.3	78.0	72.1
500	75.5	19.3	45.2	85.3	78.6	72.6	66.4	60.8	55.4	82.6	76.6	70.2
10	74.2	16.8	39.4	85.4	79.0	72.9	66.5	61.1	56.2	82.0	75.3	68.3
20	73.0	14.2	34.2	85.5	79.5	73.2	67.0	61.6	57.0	81.4	74.0	66.5
30	72.1	12.7	30.0	86.0	80.4	74.5	68.8	62.5	59.5	81.0	73.1	65.5
40	71.5	11.8	27.1	86.5	81.5	76.0	71.0	66.1	62.7	80.8	72.7	65.0
50	70.7	11.0	24.8	86.8	82.3	77.0	72.0	67.3	64.5	80.6	72.4	64.5
60	69.8	9.76	23.5	87.0	82.6	77.6	72.5	68.0	65.3	80.4	71.8	63.8
70	69.0	8.81	22.6	87.1	82.7	77.8	72.7	68.3	65.8	80.2	71.5	63.2
80	68.8	8.50	22.6	87.1	82.8	78.0	73.0	68.5	66.0	80.2	71.5	63.2
90	68.6	8.29	23.2	87.4	83.1	78.2	74.0	69.5	66.5	80.3	71.7	63.4
600	68.0	7.56	23.7	87.6	84.0	79.1	75.6	72.0	68.1	80.2	71.5	63.0
10	66.7	6.45	23.2	88.1	85.0	81.0	78.5	75.0	71.6	79.3	70.3	61.5
20	65.0	5.13	21.0	88.8	86.1	83.1	80.8	78.0	74.7	78.4	68.5	59.0
30	63.8	4.17	18.2	89.2	87.0	84.2	82.1	79.8	77.0	77.5	66.9	56.9
40	63.0	3.47	15.8	89.4	87.4	85.1	83.0	80.8	78.4	76.8	65.5	55.0
50	62.7	3.16	14.5	89.5	87.7	85.6	83.5	81.5	79.2	76.5	64.8	54.1
60	63.0	3.09	13.8	89.8	88.0	86.0	84.1	82.1	80.1	76.2	64.6	53.7
70	63.3	3.16	13.4	90.0	88.2	86.5	84.8	83.0	80.9	76.1	64.5	53.7
80	63.4	3.16	12.7	90.1	88.5	87.0	85.5	83.7	81.8	76.1	64.4	53.5
90	63.6	3.16	11.7	90.3	89.0	87.5	86.1	84.6	82.9	76.2	64.2	53.4
700	65.0	3.31	11.5	90.5	89.2	88.0	86.8	85.5	84.0	77.1	64.6	54.1
Luminous transmit.	70.4	11.3	28.4	86.8	82.0	76.9	72.0	67.4	64.0	80.7	72.5	64.6
Dominant wave lgth.	479.8	474.8	471.7	576.7	577.5	577.8	577.4	579.5	579.0	477.5	476.6	475.6
Excitation purity.	6.8	52.8	45.9	2.9	6.0	8.7	10.7	14.7	19.0	3.0	6.3	10.2

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance												
	No. 82C *	No. 83 *	No. 85 *	No. 85B *	No. 86 *	No. 86A *	No. 86B *	No. 86C *	No. 89B	No. 90	No. 96 *	No. 97	No. 102 *
400	73.4	13.5	6.0	1.59	0.50	8.00	20.0	44.0	......	.....	4.28	.....	1.12
10	75.0	13.1	18.0	9.32	0.81	12.2	26.1	55.0	......	.....	4.91	.....	0.96
20	76.4	13.5	28.4	15.5	1.55	16.7	31.6	62.0	......	.....	5.50	.....	0.89
30	77.2	14.1	33.4	19.0	2.88	21.5	37.5	66.6	......	.....	6.17	.....	0.96
40	77.2	15.6	36.2	20.8	5.50	27.8	44.0	70.8	......	.....	6.92	.....	1.23
50	76.6	17.8	38.1	22.1	9.10	34.2	50.1	74.3	......	.....	7.50	.....	1.86
60	75.2	21.0	40.4	24.3	13.5	40.4	55.4	76.8	......	.....	7.81	.....	3.23
70	73.2	25.5	43.0	27.5	17.8	45.0	59.5	78.7	......	.....	8.15	0.22	6.45
80	70.7	30.2	45.3	30.9	21.3	48.7	62.5	80.2	......	.....	8.47	0.43	14.0
90	68.1	35.8	47.2	34.3	24.5	51.2	64.6	81.2	......	.....	8.60	0.39	21.6
500	65.7	43.5	48.9	38.3	26.8	52.8	66.0	81.7	......	.....	8.73	0.15	30.7
10	63.5	46.3	49.2	40.7	27.9	53.4	66.4	81.9	......	.....	8.85	.....	41.4
20	61.5	47.2	48.2	40.6	28.6	53.7	66.6	82.0	......	.....	8.90	.....	51.3
30	59.9	48.3	48.3	40.7	30.4	55.0	67.6	82.4	......	.....	9.01	.....	59.4
40	59.1	49.6	49.2	41.6	32.5	56.5	69.0	83.0	......	.....	9.07	.....	64.2
50	58.3	51.8	51.0	43.2	35.0	58.5	70.2	83.5	......	.....	9.20	.....	66.7
60	57.2	56.5	55.8	47.1	41.2	63.0	73.0	84.6	......	9.00	9.30	.....	66.3
70	56.2	65.0	64.5	56.0	53.0	70.9	78.1	86.8	......	30.5	9.20	.....	63.0
80	56.1	75.5	75.0	68.1	67.5	79.0	84.0	88.9	......	34.3	9.19	.....	58.0
90	56.0	83.0	83.0	78.1	76.5	85.2	87.5	89.9	......	25.2	9.54	.....	51.9
600	55.0	87.3	87.2	85.0	85.0	88.1	89.3	90.6	......	16.1	9.64	.....	45.2
10	53.0	89.3	88.9	88.0	88.1	89.8	90.3	91.0	......	11.3	9.73	.....	37.8
20	50.2	90.4	90.0	89.6	89.6	90.5	90.7	91.1	......	7.40	9.56	.....	30.5
30	47.4	90.8	90.5	90.3	90.4	90.8	90.9	91.2	......	2.94	9.27	.....	25.0
40	45.2	91.0	90.7	90.7	90.7	91.1	91.1	91.3	......	0.76	9.10	.....	20.6
50	44.1	91.1	90.9	90.9	91.0	91.2	91.2	91.4	......	0.29	9.07	.....	17.5
60	43.6	91.3	91.0	91.0	91.1	91.3	91.3	91.5	......	0.41	9.00	.....	15.2
70	43.5	91.5	91.0	91.2	91.2	91.4	91.4	91.6	......	2.30	9.13	.....	13.7
80	43.1	91.5	91.0	91.3	91.3	91.4	91.5	91.6	0.10	9.52	9.03	0.44	12.8
90	42.8	91.5	91.0	91.3	91.3	91.5	91.6	91.6	1.58	28.5	9.21	5.02	12.1
700	43.5	91.5	91.0	91.3	91.3	91.5	91.6	91.6	11.2	51.9	9.52	18.7	12.0
Luminous transmit.	58.1	61.4	62.5	55.5	49.7	67.1	75.5	85.4	0.017	9.8	9.1	0.041	50.8
Dominant wave lgth.	477.2	581.5	587.7	585.7	585.7	581.7	579.6	577.6	700	583.1	572.4	555.0$_c$	564.9
Excitation purity.	14.5	55.4	30.3	48.0	69.7	37.1	24.1	9.0	100	100.0	12.1	48.0	80.0

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance												
	No. 106	CC-05R *	CC-10R *	CC-20R *	CC-30R *	CC-40R *	CC-50R *	CC-05B *	CC-10B *	CC-20B *	CC-30B *	CC-40B *	CC-50B *
400	......	81.0	73.0	61.5	51.6	42.5	36.4	87.0	85.5	82.2	80.2	77.0	74.1
10	......	81.0	72.4	60.0	50.0	40.0	33.9	87.5	86.4	84.0	82.5	80.3	78.4
20	0.10	81.0	72.0	58.6	48.2	38.2	31.9	87.7	87.2	85.0	84.0	82.2	80.7
30	0.20	81.1	71.6	57.7	47.0	36.8	30.5	88.0	87.5	85.3	84.3	82.5	81.1
40	0.35	81.2	71.5	57.2	46.4	36.0	29.7	88.1	87.5	85.0	83.5	81.3	79.8
50	0.58	81.4	71.6	57.2	46.4	36.1	29.6	88.1	87.2	83.9	81.9	78.7	76.6
60	0.98	81.7	72.4	58.5	47.5	37.5	31.0	87.9	86.4	82.5	79.5	75.9	72.9
70	1.5	82.3	73.7	60.6	49.9	40.0	33.6	87.5	85.3	80.3	76.2	72.0	67.9
80	2.3	82.8	74.9	62.0	52.0	42.5	35.9	87.0	84.0	77.8	72.5	67.5	62.7
90	3.5	83.2	75.8	63.5	53.9	44.8	37.9	86.2	82.4	74.2	68.3	62.3	56.6
500	5.2	83.3	76.6	64.6	55.2	46.1	39.4	85.2	80.5	71.2	63.8	56.7	50.1
10	7.7	83.0	76.1	64.0	54.5	46.0	38.5	84.4	78.6	67.7	58.7	51.0	44.5
20	10.7	82.4	74.9	61.5	51.6	42.5	35.0	83.5	77.0	64.0	54.4	46.0	38.6
30	15.1	81.6	73.5	59.4	48.5	38.5	31.5	82.6	75.2	61.5	50.7	41.6	34.1
40	20.2	81.2	72.5	57.8	46.5	36.6	29.4	82.1	73.9	59.5	48.3	39.0	31.3
50	25.7	81.1	72.4	57.1	45.6	35.6	28.7	81.5	73.0	58.0	46.6	36.9	29.5
60	31.0	81.4	72.8	58.0	46.9	36.4	29.7	81.4	72.7	57.5	45.9	35.9	28.6
70	35.6	82.5	74.5	60.6	49.2	39.2	32.7	81.4	73.0	57.9	46.3	36.1	28.7
80	43.2	83.9	77.3	65.0	54.6	45.0	38.6	81.9	73.9	59.3	47.9	37.8	30.5
90	53.8	85.7	80.7	71.0	61.8	53.5	47.6	82.7	75.1	61.6	50.3	40.8	33.4
600	65.6	87.6	84.0	77.0	70.5	64.0	58.7	83.4	76.3	63.5	53.0	43.5	36.0
10	77.0	89.0	86.5	82.0	77.8	73.0	69.8	83.6	76.7	64.5	54.6	44.7	37.8
20	82.8	90.0	88.9	86.2	83.5	80.8	78.3	83.5	76.5	64.3	54.4	44.3	37.5
30	86.0	90.6	89.9	88.1	87.2	85.1	84.2	83.2	76.6	63.1	53.2	42.5	35.6
40	87.6	91.1	90.5	89.8	89.2	88.0	87.5	82.8	74.5	61.6	51.5	40.2	33.7
50	88.7	91.2	90.8	90.5	90.3	89.5	89.2	82.5	74.0	60.6	50.3	39.0	32.4
60	89.5	91.3	91.1	90.8	90.6	90.4	90.1	82.5	73.8	60.1	49.5	38.4	31.8
70	90.0	91.4	91.3	91.0	90.9	90.8	90.7	82.3	73.3	59.6	49.0	37.7	31.0
80	90.5	91.6	91.5	91.2	91.1	91.0	91.1	82.0	72.8	58.6	48.2	36.5	30.0
90	90.8	91.7	91.7	91.4	91.4	91.3	91.1	81.9	72.5	58.1	47.2	35.4	29.0
700	91.0	91.9	91.9	91.5	91.5	91.4	91.2	82.2	73.0	58.5	47.5	35.6	29.0
Luminous transmit.	34.6	83.7	77.0	65.3	55.9	47.3	41.3	82.8	75.5	62.3	52.0	42.8	35.7
Dominant wave lgth.	589.4	605.0	597.8	604.2	605.8	605.5	608.5	459.0	462.0	460.0	461.0	463.2	462.5
Excitation purity.	95.2	2.0	4.7	8.5	12.3	17.3	21.4	2.8	6.3	13.2	20.2	27.7	34.2

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance											
	CC-05G *	CC-10G *	CC-20G *	CC-30G *	CC-40G *	CC-50G *	CC-05Y *	CC-10Y *	CC-20Y *	CC-30Y *	CC-40Y *	CC-50Y *
400	80.0	73.1	58.8	48.0	39.7	32.0	81.0	74.5	61.3	50.5	43.0	34.5
10	80.7	72.9	57.8	46.5	38.1	30.3	80.6	73.2	59.0	47.4	39.5	30.5
20	81.0	72.8	57.3	45.8	37.3	29.5	80.4	72.6	57.8	46.0	37.5	29.0
30	81.4	72.7	57.0	45.5	36.5	29.0	80.4	72.5	57.5	45.6	36.5	28.7
40	81.6	73.0	57.3	45.8	36.6	29.1	80.6	72.8	57.8	46.5	36.8	29.5
50	82.1	73.9	58.4	46.9	38.1	30.6	81.2	74.0	59.5	48.5	38.5	31.5
60	83.0	75.5	61.4	50.3	41.5	34.3	82.5	76.0	63.0	52.5	42.5	36.2
70	84.4	78.0	65.4	55.8	47.0	40.5	83.9	78.5	67.5	48.2	48.8	43.5
80	85.6	80.4	70.0	61.8	53.5	47.8	85.3	81.2	72.3	64.9	56.2	54.0
90	86.8	83.0	75.2	68.9	61.3	57.0	87.0	84.4	78.0	72.4	66.0	64.0
500	87.9	85.9	80.3	76.4	70.7	68.0	88.4	87.2	84.0	81.0	77.0	75.5
10	88.7	87.5	83.8	80.9	77.8	75.3	89.5	89.0	88.0	86.6	85.5	84.2
20	89.0	88.1	84.9	82.3	79.5	77.5	90.0	90.0	89.6	89.1	89.0	88.5
30	89.0	88.0	84.6	81.7	79.4	77.0	90.4	90.4	90.0	89.7	89.9	89.6
40	89.0	87.6	83.7	80.5	77.8	74.8	90.7	90.7	90.6	90.4	90.2	90.0
50	88.6	87.1	82.4	78.6	75.8	72.2	90.9	90.9	90.8	90.6	90.4	90.3
60	88.1	86.3	80.9	76.2	72.9	68.8	91.0	91.0	90.9	90.8	90.7	90.6
70	87.5	85.3	79.0	73.5	69.3	64.8	91.3	91.3	91.0	90.9	90.8	90.7
80	87.0	84.1	77.0	70.4	65.3	60.3	91.4	91.4	91.1	91.0	90.8	90.7
90	86.4	82.8	74.5	67.2	61.9	55.9	91.4	91.4	91.2	91.1	90.9	90.8
600	85.7	81.5	72.0	64.1	57.7	51.7	91.4	91.4	91.3	91.2	90.9	90.8
10	85.0	80.0	69.5	60.7	53.7	47.3	91.4	91.4	91.3	91.2	90.9	90.9
20	84.0	78.5	66.5	57.2	49.8	42.5	91.4	91.4	91.3	91.2	91.0	90.9
30	83.0	76.9	63.8	53.7	45.5	38.0	91.5	91.5	91.4	91.3	91.0	91.0
40	82.2	75.6	61.5	50.8	42.0	34.6	91.5	91.5	91.4	91.3	91.0	91.0
50	81.9	74.9	60.1	49.1	40.2	32.5	91.5	91.5	91.4	91.3	91.1	91.1
60	81.5	74.4	59.4	48.1	39.5	31.5	91.5	91.5	91.4	91.3	91.1	91.1
70	81.4	74.0	58.8	47.5	38.5	31.0	91.5	91.5	91.4	91.4	91.2	91.2
80	81.1	73.5	58.1	46.6	37.6	29.9	91.5	91.5	91.4	91.4	91.2	91.2
90	81.1	73.2	57.6	46.0	36.6	28.9	91.5	91.5	91.4	91.4	91.3	91.3
700	81.5	73.5	58.0	46.4	36.5	28.7	91.5	91.5	91.4	91.4	91.3	91.3
Luminous transmit.	87.2	84.5	77.8	72.2	67.7	63.3	90.4	90.1	89.1	88.2	87.4	86.9
Dominant wave lgth.	553.0	555.5	555.0	554.0	554.3	553.4	572.0	571.3	571.4	571.3	571.3	571.2
Excitation purity.	2.3	5.2	10.9	15.8	21.1	25.9	5.3	9 6	18.8	28.3	35.7	42.0

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF WRATTEN FILTERS (Continued)

Wave length	Percent transmittance											
	CC-05M *	CC-10M *	CC-20M *	CC-30M *	CC-40M *	CC-50M *	CC-05C *	CC-10C *	CC-20C *	CC-30C *	CC-40C *	CC-50C *
400	87.6	86.6	85.6	84.2	82.3	80.9	87.3	86.0	83.9	82.3	80.4	78.8
10	88.2	87.7	86.6	85.7	84.6	83.6	88.2	87.5	85.2	84.5	83.4	82.7
20	88.6	88.0	87.0	85.9	85.2	84.4	88.7	88.1	86.5	86.0	85.3	84.8
30	88.7	88.0	86.9	85.6	84.4	83.6	89.0	88.6	87.5	87.0	86.3	85.9
40	88.7	87.9	86.0	84.7	82.5	81.4	89.3	89.0	87.7	87.3	86.6	86.1
50	88.6	87.5	84.9	82.8	80.0	78.1	89.5	89.1	87.8	87.5	86.6	86.0
60	88.4	86.5	83.1	80.0	76.1	73.7	89.6	89.1	87.7	87.3	86.4	85.7
70	87.8	85.2	80.8	76.4	71.3	68.0	89.7	89.0	87.5	87.0	85.8	85.2
80	87.0	83.6	77.9	72.1	65.8	61.7	89.7	89.0	87.2	86.5	85.3	84.3
90	86.0	81.8	74.4	67.0	60.0	55.0	89.7	89.0	87.0	86.0	84.4	83.4
500	85.0	79.7	70.5	61.7	53.7	48.1	89.6	89.0	86.5	85.2	83.5	82.3
10	83.8	77.5	66.7	56.5	47.7	41.6	89.6	88.7	86.0	84.4	82.4	80.8
20	82.7	75.3	63.4	52.0	42.8	36.3	89.5	88.5	85.2	83.5	81.1	79.2
30	81.8	73.7	60.5	48.6	39.0	31.9	89.4	88.0	84.3	82.4	79.6	77.3
40	81.3	72.5	58.6	46.6	36.7	29.8	89.2	87.5	83.4	81.0	77.7	75.0
50	81.2	72.2	58.0	46.0	36.0	29.1	88.9	87.0	82.3	79.0	75.3	72.2
60	81.5	72.8	58.3	46.5	36.7	29.7	88.5	86.1	80.5	76.7	72.7	69.0
70	82.5	74.6	60.5	49.8	40.2	32.3	88.0	85.0	78.5	74.0	69.3	65.0
80	84.0	77.3	64.9	55.6	46.2	39.0	87.5	83.8	76.1	70.9	65.4	60.5
90	85.8	80.8	70.6	63.3	54.9	48.7	87.0	82.5	73.9	67.5	61.6	55.8
600	88.0	84.5	77.1	71.6	64.9	59.9	86.4	81.0	71.2	64.1	57.6	51.3
10	89.3	87.0	82.2	79.2	74.9	70.7	85.5	79.5	68.5	60.4	53.4	36.2
20	90.2	88.9	86.1	84.1	81.4	79.2	84.5	77.9	65.5	56.7	49.2	42.3
30	90.6	90.0	88.7	87.4	86.0	84.5	83.8	76.3	62.7	53.1	45.0	38.0
40	90.8	90.5	90.0	89.3	88.7	87.6	83.3	75.1	60.8	50.4	42.0	34.9
50	91.0	90.7	90.5	90.2	90.0	89.7	82.8	74.4	59.5	48.8	40.2	32.9
60	91.1	91.0	90.8	90.8	90.4	90.4	82.5	74.0	58.5	48.0	39.4	32.0
70	91.2	91.2	91.0	91.0	90.7	90.7	82.4	73.6	57.9	47.2	38.6	31.0
80	91.3	91.3	91.2	91.1	91.0	91.0	82.0	73.0	57.5	46.0	37.5	29.9
90	91.4	91.4	91.4	91.3	91.3	91.3	82.0	72.8	57.4	45.5	36.7	29.1
700	91.5	91.5	91.5	91.5	91.5	91.5	82.5	74.0	58.5	46.4	37.3	29.8
Luminous transmit.	84.2	77.9	67.1	58.1	50.0	44.0	88.0	85.1	78.9	74.8	70.5	66.7
Dominant wave lgth.	541.0_c	547.5_c	551.2_c	550.0_c	550.3_c	551.2_c	489.2	487.5	486.5	486.2	486.1	485.5
Excitation purity.	3.5	7.4	14.4	21.5	28.3	34.0	1.6	4.1	8.9	12.8	17.5	20.2

* Some transmission below 400μ. Consult the manufacturer.

TRANSMISSION OF FILTERS (Continued)

Wave length	Percent transmittance			
	No. 87	No. 87C	No. 88A	No. 89B
700	.....	.....	....	11.2
10	.....	.....	....	32.4
20	.....	.....	....	57.6
30	.....	.....	7.4	69.1
40	0.10	.....	32.8	77.6
50	2.19	.....	56.3	83.1
60	7.95	.....	69.2	85.0
70	17.4	.....	74.2	86.1
80	31.6	.....	77.6	87.0
90	43.7	.....	79.7	87.7
800	53.8	0.32	81.4	88.1
10	61.7	3.20	82.6	88.4
20	69.2	8.90	83.7	88.6
30	74.1	17.8	84.7	88.8
40	77.7	28.2	85.5	89.0
50	81.4	41.0	86.1	89.2
60	84.0	53.8	86.6	89.4
70	85.4	61.6	87.2	89.6
80	86.8	69.2	87.5	89.8
90	87.8	74.1	87.8	89.9
900	88.4	78.5	88.0	90.0
10	88.8	81.5	88.2	90.1
20	89.1	83.6	88.4	90.2
30	89.1	85.1	88.6	90.3
40	89.1	86.0	88.8	90.4
50	89.1	87.0	89.0	90.5

TRANSMISSIBILITY FOR RADIATIONS

Ratio of the transmitted light to the incident light for a definite thickness of the substance, usually 1 cm.

GLASS.

Glass in general is opaque to the ultra-violet and infra-red. Uviol glass is transparent to the longer radiations of the ultra-violet.

Coefficient of transparency of glass for visible and ultra-violet radiations.

Wave length microns	Normal incidence, thickness 1 cm.								
	0.309	0.330	0.347	0.357	0.361	0.375	0.384	0.388	0.396
Crown, ordinary	...	...	...	...	...	.947			
Crown, borosilicate	0.08	0.65	0.88	...	0.95	...	0.972	0.975	0.986
Flint, ordinary	...	...	...	0.72	...	...	...	0.904	
Flint, heavy	...	...	0.01	...	0.16	...	0.58		

Wave length, microns	Normal incidence, thickness 1 cm.								
	0.400	0.415	0.419	0.425	0.434	0.455	0.500	0.580	0.677
Crown, ordinary	0.964	...	0.952	...	0.960	0.981	...	0.986	0.990
Crown, borosilicate	...	0.985	...	0.993	...	...	0.993		
Flint, ordinary	...	0.959	...	...	...	...	1.00		
Flint, heavy	...	...	...	0.905					

QUARTZ

Quartz is very transparent to the ultra-violet and to the visible spectrum, but opaque for the infra-red beyond 7.0μ.

(Pflüger.)

Wave length, microns	0.19	0.20	0.21	0.22
Transmission for 1 mm	.67	.84	.92	.94

FLUORITE

Fluorite is very transparent to the ultra-violet, nearly to 0.10μ. Coefficient of transparency at $\lambda = 186$ is found by Pflüger to be 0.80.

For the infra-red tne values are given in a table below.

TRANSMISSIBILITY FOR RADIATIONS (Continued)

ROCK SALT AND SYLVINE AND FLUORITE

TRANSPARENCY FOR THE INFRA-RED.

Thickness 1 cm.

Wave length, microns.	Rock salt	Sylvine KCl	Fluorite
8.			.844
9.	0.995	1.000	.543
10.	.995	.988	.164
12.	.993	.995	.010
14.	.931	.975	.000
16.	.661	.936	
18.	.275	.862	
19.	.096	.758	
20.7	.006	.585	
23.7	.000	.155	

PHOSPHORESCENCE BY CATHODE RAYS

SUBSTANCES LUMINOUS UNDER EXCITATION BY CATHODE RAYS

Substance (with calcium oxide)	Wave lengths of principal bands in microns (Urbain, 1909)
Dysprosium oxide	0.480, 0.489, 0.585, 0.675
Europium oxide	0.416–0.426, 0.469
Europium oxide	0.589–0.593, 0.613, 0.625
Neodymium oxide	0.392, 0.419–0.429, 0.458
Praesodymium oxide	0.488, 0.604, 0.606, 0.626, 0.634

One part	100 parts	Wave length	Color	Observer
Antimony oxide	calcium oxide	0.560	yellow	Bruninghaus, 1910
Antimony trisulfide	calcium sulfide	0.569	yellow	Bruninghaus, 1910
Bismuth oxide	calcium oxide	0.522	blue	Bruninghaus, 1910
Bismuth sulfate	calcium sulfate	0.640	red	Bruninghaus, 1910
Manganous carbonate	magnesium carbonate	0.620	red	Bruninghaus, 1910
oxide	calcium oxide	0.589	yellow	Lecoq & Boisbaudran 1886
phosphate	calcium phosphate $Ca_3(PO_4)_2$	0.633	red	Bruninghaus, 1910
sulfate	calcium sulfate	0.540	green	Lecoq & Boisbaudran 1886
sulfide	calcium sulfide	0.589	yellow	Bruninghaus, 1910

FLUORESCENCE OF ORGANIC SUBSTANCES IN SOLUTION

Excitation by White Light.

Substance.	Solvent.	Wave length microns.	Observer.
Anthracene......	alcohol	0.400 0.430 0.436	Stark & Meyer, 1907
Eosine..........	alcohol or water	0.589	Nichols & Merritt, 1907
Esculine.........	alcohol	0.460	Nichols & Merritt, 1907
Fluorescein......	water (alkaline)	0.542	Nichols & Merritt, 1907
Naphthalin, red..	alcohol	0.632	Nichols & Merritt, 1907
Quinine sulfate...	water	0.437	Nichols & Merritt, 1907
Resorcin blue....	water	0.65	Nichols & Merritt, 1907
Rhodamin.......	water	0.554	Nichols & Merritt, 1907

FLUORESCENCE

Gases and Vapors.

Gas or vapor.	Condition.	Excitation.	Color or wave length of emitted light.	Observer.
Iodine...	Vapor at ordinary temperature.	Mercury arc $\lambda = .546\mu$	Strongest bands $\lambda = .5460\mu, .5774\mu$ .5730, .5796	Wood, 1911
Mercury .	Vapor at ordinary temperature	Spark between aluminum electrodes	Broad band $\lambda = .5900 - .3000$	Wood, 1909
Oxygen ..	....	Mercury arc in quartz tube	Strongest lines $\lambda = .1849, .1851$ (ultra-violet)	Streubing, 1910
Potassium	Vapor, 300°–400° C.	White light	Many strong lines from .6416–.6768, strongest .6544 and .6584	Wood & Carter, 1908
Rubidium	Vapor, at 270° C.	White light (elec. arc)	Strong red band $\lambda = .6900 - .6620$.	Dunoyer, 1912
Sodium ..	Vapor at 350° C.	White light (elec. arc)	D, $\lambda = .5893$ (mean)	Dunoyer, 1912

FLUORESCENT SUBSTANCES

By Jack De Ment

The emission of light from matter under the influence of an exciting agent is termed fluorescence. When emission persists after removal of the exciting agent the process is termed phosphorescence. Both are practically identical, except in the duration of light emission, and may harmoniously be explained on the same basis. Luminescence is the term covering both phenomena although candoluminescence, emission due to incandescent heat, may also be included. Fluorescence is classified according to the exciting agent(s) and special terms are derived therefrom.

Excitation includes over 30 processes by which energy is introduced into, and/or released from, the luminescent system; visible light (photoluminescence); low temperature heat (thermoluminescence); friction (triboluminescence); cold (baroluminescence); ion streams (ionoluminescence); cathode rays (cathodoluminescence); crystallization (crystalloluminescence); sound waves (sonoluminescence); Hertzian waves; radioelement radiations, e.g., alpha, beta (positrons), and gamma rays (radio-luminescence, etc.); neutrons: metabolic processes (bioluminescence); and a large number and wide variety of chemical reactions (chemiluminescence); etc. Terms such as radiophotoluminescence and tribothermoluminescence denote the exciting action of more than one agent.

Ultraviolet light is used with most success in ordinary studies on luminescent substances. Most effectively suited for general excitation of inorganic chemicals, phosphors, certain minerals, etc., whose exact absorption characteristics are unknown, is short wavelength ultraviolet light (Hg = 2537A, resonance radiation) filtered through a medium (usually glass) possessing peak transmission in this region and minimal transmission elsewhere, especially in the visible. For general excitation of organic and metal-organic compounds, and a few minerals, as well as tissues, long wavelength (Hg = 3650A) radiation is employed. All ultraviolet light must be filtered before adequate results are obtained.

Slight discordance is noted in the fluorescence of certain substances, especially in minerals and impure inorganic chemicals. Fluorescence may be affected by purity, age and source of the compound, particle size, water-content, and the solvent and concentration of solute. A great many substances, however, emit characteristic fluorescence which serves for detection and estimation in extremely small amounts, particularly after treatment with solvents, acids, or alkalis. The science of fluorochemistry embraces the applications of fluorescence and ultraviolet light to chemistry. The references should be consulted for additional details on fluorescent chemicals and fluorochemical analysis.

The following table gives the character of fluorescence for various substances when excited by radiation of wave length 3650 angstrom units, except where otherwise noted.

Key to Abbreviations

acet	acetone	KOH	potassium hydroxide
alk	alkalis, alkaline	l	light
al	ethyl alcohol	m	medium
b	bright	oxid	oxidation
bz	benzene	oxy	oxyacids
d	dark	p	pale
dil	dilute	s	strong
dl	dull	sl	slight
dp	deep	soln	solutions
H_2O	water	xyl	xylene

FLUORESCENT SUBSTANCES (Continued)

Name	Character of fluorescence	Solvent or treatment	References
Abietic acid	green	—	4, 6
Acetaldehyde	blue-green	—	4
Acetanilid	bluish-violet	—	4
Acetoacetanilid	b. blue-white	—	4, 6
Acetophenone	brownish	—	2, 4
p-Acetylaminophenol	whitish	—	4
Acetyl homoumbelliferone	blue	KOH	7
2-Acetyl purpurin	yellowish	—	7
Acetylsalicylic acid	p. blue	—	4
Acridine	green	H_2O	4
Acridine picrate	yellow-green	H_2O	4, 6
Acridone	s. blue	al.	4
Acrylic aldehyde	bluish	—	4
Adenine sulfate	blue-white	—	4, 8
Ajacine	blue	al.	6
β-Alanine	purple-blue	—	4
dl-Alanine	rose-white	—	4
Alizarin	yellow	—	1
Aloin	red-yellow	—	4
Alloxan	violet	—	4
Allylamine picrate	crimson	—	4
Aluminum distearate	b. blue	—, xyl.	4
Aluminum monstearate	b. blue	—, xyl.	4
Aluminum palmitate	blue-white	—	4
Aluminum tristearate	b. blue	—, xyl.	4
Ambergris	m blue	al.	4
Aminoacetal picrate	b. red-orange	—	4
p-Aminobenzoic acid	blue	—	4
2-Amino-5-chlorobenzoic acid	b. blue-white	—	4
Aminohydrastin	s. blue	—	1
Aminophyllin	s. blue-green	—	4
Aminopyrine	s. blue	—	4
Ammonium acetate	blue	—	4
Ammonium benzoate	blue	—	4
Ammonium mandelate	b. blue-white	—	4
Ammonium salicylate*	s. blue	—	1, 4
Amyl salicylate	purple	—	4
Anemonine	yellowish	—	4
Anisic aldehyde	p. brown	—	4
Anthracene	l. blue	—	4
Anthracene [+ chrysene]	brilliant green	—	4
Anthracene-1-carboxylic acid	blue	alk.	7
Anthracene-2-carboxylic acid	blue	alk.	7
Anthracene-1, 9-dicarboxylic acid	bluish	acids	6
Anthralin	green	NaOH soln.	7
Anthraquinone	orange	—	4
Apoharmine	green	H_2SO_4 + formalin	7
Apomorphine	b. blue	—	4
Apoquinine	violet	—	4
Arecoline	purplish	—	4
Arecoline hydrobromide	lavender	—	4
l (+)-Arginine monohydrochloride	s. lavender	—	4
Ascorbic acid	lavender	—	4
dl-Aspartic acid	purplish-white	—	4
l(+)-Aspartic acid	purple-blue	—	4
Asterin hydrochloride	bluish	—	6
Atropine	bluish-white	—	4
Atropine sulfate	p. bluish	—	4

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* Exciting wave length not given.

FLUORESCENT SUBSTANCES (Continued)

Name	Character of fluorescence	Solvent or treatment	References
Auramine	b. yellow	H_2O, etc.	1, 2, 3, 4, 5
Azulmic acid	green	KOH soln.	7
Barium citrate*	bluish	—	4
Barium formate	blue-violet	—	1
Barium platinocyanide	b. green	with H_2O xln.	1
Barium salicylate	s. blue	—	1
Barium stearate	blue-white	—	4
Barium succinate	violet	—	1
4,5-Benzisocoumaranene	green	H_2SO_4 soln.	7
Benzocain	blue	—	4
Benzyl acetate	b. violet	—	2
Benzyl ether	greenish-purple	—	4
Benzyl salicylate	violet	—	4
Berberine	yellow	—	1, 5
Berberine hydrochloride	yellow-green	—	4
Beryllium salicylate	s. blue	—	4
Bismuth subgallate	crimson	—	4
Bismuth subsalicylate	sl. lavender	—	4
Boldine	bluish	—	4
Borneol	whitish	—	2
5-Bromosalicylic acid	white	—	4
Butyl acetyl ricinoleate	d. blue-green	—	4
Butyl borate	p. bluish	—	4
Butyl chloride	p. bluish	—	4
Butyl lactate	sl. bluish	—	4
N-Butyl-2-naphthylamine	violet	—	7
Butyl oleate	green-yellow	—	4
Butyl ricinoleate	yellow-green	—	4
Butyl stearate	p. blue	—	4
Butyrone	bluish	—	4
Cadmium 8-hydroxyquinolinate	yellow-green	al.	4
Calcium benzoate	lavender	—	4
Calcium *p*-caseinate	yellow-blue	—	4
Calcium 8-hydroxyquinolinate	dk. green	al.	4
Calcium iodo-di (triethanolamine) theobromine	b. blue-green	—	4
Calcium *o*-iodoxybenzoate	b. blue		4
Calcium linoleate	blue-purple	—	6
Calcium mandelate	blue	—	4
Calcium pantothenate	d. lavender	—	4
Calcium salicylate	blue	—	1, 4
Calcium stearate	s. blue	—	4
Calcium uranyl acetate	greenish-blue	—	9
Campherol	blue	H_2SO_4	6
Carbon dioxide (solid)	blue to violet	—	4
Chlorophyll A	red	—	1, 4
Chlorophyll B	brown-red	—	1, 4
Chromium stearate	lavender-blue	—	4
Cobalt resinate	d blue	—	10
Cobaltous linoleate	brown-green	—	10
Cobaltous stearate	b. blue	—	4
Cupric salicylate†	green-blue	—	4
Cyanomaclurin	bluish	KOH fusion	6
Decacyclene	green	—	1
Decyl naphthalene	s blue	—	4
Dehydrocholic acid	violet-blue	—	4
Delphinine	p. green	—	4
Diallyl barbituric acid	violet	—	4

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* Exciting wave length not given.
† Exciting wave length 2537.

Name	Character of fluorescence	Solvent or treatment	References
4, 4′-Dibromodiphenyl	white	—	4
Didymium salicylate	lavender	—	4
6, 4′-Dihydroxyflavone diethyl ether*	green	—	7
7, 2′-Dihydroxyflavone diethyl ether	blue	H_2SO_4 soln.	7
3, 6-Dihydroxyxanthone	blue-violet	—	4
1 (−)-Diiodotyrosine dihydrate	purple	—	4
Dilantin	purplish	—	6
Dimethyl phthalate	green	—	4
2, 4-Dimethylpyrrole	blue	—	6, 7
3, 5-Dimethylpyrrole-2, 4-dicarboxylic acid	blue	260°C	6
Di-1-Naphthastilbene	violet	—	7
1′, 2′, 8′, 9′-Dinaphthazine	blue	al., bz.	7
1′, 2′, 7′, 8′-Dinaphthazine	yellow-green	bz.	7
2, 2′-Dinaphthyl	blue	—	6
2, 2′-Dinaphthylamine	blue	—	6
1, 1′-Dinaphthyl ether	bluish	—	7
1, 2-Di(2-Xenoxy) ethane	white	—	4
Dodecacyclene	olive green	—	1
Emetine	yellow	—	4
Enanthic aldehyde	b. yellow-blue	—	4
Esculetin	dp. violet	—	1
Erbium salicylate	sky blue	—	4
Ergometrine	blue	—	2
Ergotine	yellow-brown	—	4
Ergotoxine	blue	—	2
Erythrosine	greenish	—, H_2O	2
Erythritol tetranitrate	dp. violet	—	4
Ethanolamine hydrochloride	violet	—	4
Ethyl acetate	p. bluish	—	4
Ethylene glycol monoethyl ether laurate	b. bluish	—	4
Ethylene glycol monoethyl ether ricinoleate	s. green-blue	—	4
Ethylene glycol monoethyl ether stearate	s. yellow-blue	—	4
Ethylene glycol monolaurate	b. blue	—	4
Ethylene glycol monooleate	bluish	—	4
Ethylene glycol monoricinoleate	green-blue	—	4
4-Ethoxyacridone	green	H_2O	4
Ethyl β-naphtholate	violet	—	2
Ethyl salicylate	greenish	—	1, 4
Eucaine	gray	—	4
Ferric 8-hydroxyquinolinate	bluish-black	al.	4
Ferrous 8-hydroxyquinolinate	blue-brown	al.	4
Ferrous stearate	b. crimson	—	4
Flavazin S	b. orange	H_2O	1
Fluorene-2-sulfonic acid	dp. yellow	—	1
Fluorescein	b. green	alk. soln.	1, 2, 4, 5
Fluorescin	b. green	oxid. then KOH	4, 6
Fraxetin	blue-green	—	1
Fraxin	blue-green	—	1
Fumaric acid	l. yellow	—	1
Furfuryl alcohol	d. yellow	—	4
Furfuraldehyde	reddish	—	4
Gallium gluconate	p. blue	—	4

* Exciting wave length not given.

FLUORESCENT SUBSTANCES (Continued)

Name	Character of fluorescence	Solvent or treatment	References
Gallium 8-hydroxyquinolinate	yellowish	al.	4
Gallium salicylate	b blue	—	4
Germanium salicylate	b. blue	—	4
1 (+)-Glutamic acid	violet-white	—	4
Glutathione	b. lavender	—	4
Glyceric aldehyde	p. blue	—	4
Glyceryl citrate	bluish	—	4
Glyceryl α, γ-diphenyl ether	lavender-blue	—	4
Glyceryl furfural	violet-blue	—	4
Glyceryl α,-mono-*n*-butyl ether	p. blue-green	—	4
Glyceryl monohydroxystearate	p. bluish	—	4
Glyceryl monooleate	b. yellow-blue	—	4
Glyceryl monoricinoleate	blue-green	—	4
Glyceryl monostearate	b. yellow-blue	—	4
Glyceryl phthalate	yellow-blue	—	4
Glyceryl tartrate	b. blue	—	4
Glyceryl tristearate	b. violet-blue	—	4
Glycine	purplish-blue	—	4
Glycol dilaurate	yellow-blue	—	4
Glycollic acid	blue	—	4
Glycol monolaurate [polymerized]	b. blue	—	4
Glycol maleate [polymerized]	blue-yellow	—	4
Glycol monooleate [polymerized]	b. blue-brown	—	4
Glycol monostearate [polymerized]	brown-yellow	—	4
Glycol phthalate [polymerized]	b. bluish	—	4
Glycylglycine	purple-white	—	4
Glycyl-l (−)-leucine	purplish-white	—	4
Glyoxal	blue	—	4
Guanine [free base]	purple	—	8
Guanine hydrochloride	purple	—	8
Harmine	blue	—	3, 4
sym-Hemimellitenol	bluish	—	7
Heroin	yellow-grey	—	4
Heroin sulfate	yellowish	—	4
Hematoporphyrin	red	al, CCl$_4$, etc.	1
Hexaeikosicyclene	olive-green	—	1
Hexamethylenetatramine	l. purple	—	4
Homatropine methyl bromide	lavender	—	4
Homoumbelliferone methyl ether	blue	H$_2$SO$_4$	7
Hydrastin	b. greenish	—	1
Hydrastine salicylate	greenish-white	—	4
Hydrastine chloride	b. blue	—	1
Hydrofuramide	b. pink	—	4
Hydroquinone	blue-violet	—	4
Hydroxyperylene	green	—	7
2-Hydroxyphenanthrene methyl ether	blue	—	7
p-Hydroxyphenyl glycocoll	violet	—	4
3-Hydroxyquinoline	bluish	—	6, 7
7-Hydroxyquinoline	green	alk. soln.	7
6-Hydroxyquinoline methyl ether	blue	acids	7
Hyoscyamin	red-violet	—	1
Hypoxanthine	violet	—	8
Indium *o*-iodoxybenzoate	p. lavender	—	4
Indium salicylate	b. blue-green	—	4
α-Ionone	greenish	—	2, 4
β-Ionone	green-brown	—	2, 4

FLUORESCENT SUBSTANCES (Continued)

Name	Character of fluorescence	Solvent or treatment	References
Isocytosine	violet-white	—	8
Isodibenzanthrone	brown	$PhNO_2$	7
Isoharman	blue-violet	H_2SO_4 soln.	7
Isoguanine	purple-white	—	8
Lanthanum 8-hydroxyquinolinate	yellow-green	al.	4
Lanthanum *o*-iodoxybenzoate	p. violet	—	4
Lanthanum salicylate	s. blue	—	4
Lead linoleate	d. green	—	10
Lead naphthenate	b. blue-green	—	4
Lead sebacate	b. lavender-white	—	4
Lead stearate	b. blue	—	4
Lithium benzoate	whitish-violet	—	4
Lithium salicylate	b. blue-green	—	4
Lithium stearate	bluish	—	4
Lotoflavin	bluish	KOH fusion	6
Luteolin	bluish	KOH fusion	6
Luteolinidium chloride	green	H_2SO_4	7
1 (+)-Lysine dihydrochloride	purple-white	—	4
Lysine hydrochloride	p. purple	—	4
1 (+)-Lysine hydrochloride	b. blue	—	4
Magnesium 8-hydroxyquinolinate	golden-yellow	al., H_2O, etc.	4
Magnesium salicylate	purple-green	—	4
Magnesium stearate	blue-white	—	4
Magnesium uranyl acetate*	emerald green	—	9
Malonic acid	bluish-white	—	1
Manganous 8-hydroxyquinolinate	s. green	al.	4
Manganous stearate	dp. rose	—	4
Manganese resinate	d. violet	—	10
Mannitol glyceryl monolaurate	dp. green-brown	—	4
Mannitol glyceryl monooleate	b. brown-blue	—	4
Mannitol glyceryl monostearate	blue-gray	—	4
Mannitol triricinoleate	dp. green	—	4
Menthol	greenish	—	2
2-Mercaptobenzothiazole	reddish-brown	—	4
Mercuric salicylate	greenish	—	1
Mercurochrome	b. green	alk. soln.	5
Mercurophen	s. crimson	—	4
Mercurous benzoate	purple	—	4
Mercury dibromofluorescein	yellow-green	alk. soln.	4
Mericyl alcohol	blue-yellow	—	4
Mesobilirubin	reddish	—	1
Mesobilirubinogen	reddish	—	1
dl-Methionine	b. lavender	—	4
Methyl acetophenone	grey-brown	—	4
Methyl acridine*	green	—	11
N-Methyl anthranilic acid	blue	alk. soln.	7
N-Methyl anthranilic acid phenyl ester	blue	—	7
2-Methyl benzanthrone sulfonic acid	yellow	—	4
Methyl benzyl ether	blue-green	—	4
5-Methyl chromone	blue	H_2SO_4 soln.	7
6-Methyl chromone	blue	H_2SO_4 soln.	7
7-Methyl chromone	blue	H_2SO_4 soln.	7
β-Methyl esculin	blue	H_2O, etc.	4
2-Methylgenistein	blue-green	H_2SO_4	7

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* Exciting wave length not given.

Name	Character of fluorescence	Solvent or treatment	References
Methyl glycolphenetidin	violet	—	4
Methyl hexalin	green-blue	—	4
Methyl hydrastin	blue-green	—	1
Methyl hydrastinine hydrochloride	blue	—	6
4-Methyl indole	blue-green	—	1
7-Methyl indole	yellow-green	—	1
Methyl pentadecyl ketone	blue-brown	—	4
Methyl terephthalic acid	l. blue	—	1
Methyl tridecyl ketone	blue-yellow	—	4
β-Methyl umbelliferone	b. blue	H_2O, al.	4, 6
Methyl undecyl ketone	yellow-blue	—	4
Monoamyl naphthalene	dp. blue	—	4
Monobromoisovaleryl barbiturate	lavender	—	4
Monoethyl glycol ether	blue-yellow	—	4
Morin	blue-green	H_2SO_4	3, 4, 6
Morindin chloride	greenish	H_2SO_4 soln.	7
Morphenol	green	acids	7
Munjistin	green	AcOH	7
Musk ambrette	yellow-brown	—	2
Musk ketone	yellow-brown	—	2
Musk xylol	yellow-brown	—	2
Mycolic acid	blue	—	4
Myosalvarsan	green	alk. soln.	2
Myristic aldehyde	brownish-yellow	—	4
Myristone	yellowish	—	4
Naphthalene	l. blue	—	1
1,8-Naphthalenediamine-3,6-disulfonic acid	green	alk. soln.	7
Naphthastyril	green	al.	7
β-Naphthol	blue	—	4
2-Naphthol-1,3,6,7-tetrasulfonic acid	blue-green	alk. soln.	7
2-Naphthol-1,3-7-trisulfonic acid	blue-green	alk. soln.	7
2-Naphthol-3,6,7-trisulfonic acid	blue-green	alk. soln.	7
2-Naphthol-3,6-8-trisulfonic acid	green	NaOH soln.	7
1-Naphthylamine-2,5-disulfonic acid	blue-green	acids and alk.	7
1-Naphthylamine-2,7-disulfonic acid	bluish	alk. soln.	7
1-Naphythylamine-2,8-disulfonic acid	green	alk. soln.	7
1-Naphthylamine-3,7-disulfonic acid	blue	acids and alk.	7
1-Naphthylamine-4,6-disulfonic acid	blue	acids and alk.	7
1-Naphthylamine-4,7-disulfonic acid	blue	acids and alk.	7
2-Naphthylamine-1,6-disulfonic acid	bluish	—	7
2-Naphthylamine-1,7-disulfonic acid	violet-blue	KOH soln.	7
2-Naphthylamine-3,6-disulfonic acid	violet-blue	—	7
2-Naphthylamine-4,7-disulfonic acid	blue	KOH soln.	7
2-Naphthylamine-4,8-disulfonic acid	blue	alk. soln.	7

Name	Character of fluorescence	Solvent or treatment	References
2-Naphthylamine-5,7-disulfonic acid	green	alk.	7
2-Naphthylamine-6,8-disulfonic acid	blue	alk.	7
1-Naphthylamine-5-sulfonic acid	green	alk.	7
2-Naphthylamine-5-sulfonic acid	red-blue	alk.	7
2-Naphthylamine-6-sulfonic acid	blue	alk.	7
2-Naphthylamine-8-sulfonic acid	blue	acids and alk.	7
2-Naphthylamine-1,3,6,7-tetrasulfonic acid	violet-blue	alk. soln.	7
1-Naphthylamine-2,4,6-trisulfonic acid	blue	—	7
1-Naphthylamine-3,5,7-trisulfonic acid	green	alk. soln.	7
1-Naphthylamine-2,5,7-trisulfonic acid	green	—	7
2-Naphthylamine-1,3,7-trisulfonic acid	violet-blue	—	7
2-Naphthylamine-1,5,7-trisulfonic acid	blue	alk.	7
2-Naphthylamine-3,5,7-trisulfonic acid	green	alk. soln.	7
2-Naphthylamine-3,6,7-trisulfonic acid	blue	alk.	7
2-Naphthylamine-3,6,8-trisulfonic acid	sky blue	alk.	7
2-Naphthylamine-4,6,8-trisulfonic acid	b. blue	—	7
N-α-Naphthylanthranilic acid	blue-green	H_2SO_4 soln.	7
Naringenin	bluish	KOH fusion	6
Neodymium citrate	blue	—	4
Neodymium salicylate	b. blue-green	—	4
Neosynephrine hydrochloride	p. violet	—	4
Nickel formate	carmine red	—	1
Nickel stearate	grey-purple	—	4
Nicotinamide	b. blue	—	4
Nicotinic acid	purple-white	—	4
Nicotine	azure blue	—	2
2-Nitro-2-methyl-1,3-propanediol	p. violet	—	4
2-Nitro-2-methyl-1-propanol	p. lavender	—	4
α-Nitro-β-naphthol	scarlet	—	4
2-*o*-Nitrophenylhydrazone	green	amyl al.	7
α-Nitroso-β-naphthol	reddish	—	4
6-Nitrothymol	bluish	bz.	7
3-Nitroxanthone	green	H_2SO_4 soln.	7
Norharman	blue	acids	7
Norharmine hydrocloride	b. blue	—	7
Norleucine	purple-blue	—	4
dl-Norvaline	purple	—	4
Nucleic acid	lavender-rose		4
Nupercaine	violet	—	4
Octodecacyclene	green	—	1
Octohydrodecacyclene	olive-green	—	1
Orcin	yellow-green	—	1
Orcinaurine	green	H_2O	4
dl-Ornithine hydrochloride	purple-white	—	4
p-Oxybenzoic acid	l. violet	—	1
2-Oxy-6,8-diaminopurine	green-blue	—	8

FLUORESCENT SUBSTANCES (Continued)

Name	Character of fluorescence	Solvent or treatment	References
β-Oxynaphthionic acid	green-yellow	—	4
Oxypeucedanine	bluish	KOH fusion	6
Palmitic aldehyde	blue-white	—	4
Parabanic acid	blue	—	4
Paraldehyde	b. bluish	—	4
Pentacene	blue	—	4
Pentachloroethane	green-blue	—	2
Pentamethylenetetrazol	blue-violet	H_2O	4
Percaine	b. blue	—	7
Perlatolic acid	green	$CHCl_3$ + alk.	7
Perylene	blue	—	7
Perylene-3,10-dicarboxylic acid	green	alk.	7
Perylene-3,9-dicarboxylic acid dichloride	yellow-green	—	7
Phaetophytin	red	—	2
Phenanthrene	l. blue	—	1
o-Phenoxyphenyl benzoate	lavender-blue	—	4
N-Phenylacridone	blue	AcOH	7
dl-Phenylalanine	lavender-white	—	4
N-Phenyl-2-amino-5-naphthol-7-sulfonic acid	violet	Na_2CO_3 soln.	7
9-Phenylanthracene	blue	—	7
N-Phenylanthranil	green-blue	—	7
1-Phenylbenzanthrone	orange-red	H_2SO_4 soln.	7
10-Phenylbenzanthrone	golden-yellow	H_2SO_4 soln.	7
5-Phenylbenzpyrene	green-yellow	—	1
6-Phenyl-10-benzyl-1, 2-dibenzanthracene	greenish-yellow	—	1
2-Phenylcoumarone	blue	H_2SO_4 soln.	7
3-Phenylcoumarone	blue	Hot H_2SO_4	7
3-Phenylcyclohexanone	green	al.-H_2SO_4	7
10-Phenyl-5, 10-dihydroacridine	blue	al.	7
o-Phenylenediamine	b. violet	—	4
p-Phenylenediamine	b. blue	—	4
Phenyl mercuric acetate	violet	—	4
Phenyl mercuric chloride	p. lavender	—	4
Phenyl mercuric nitrate	white	—	4
Phenyl mercuric nitrite	bluish	—	4
Phenyl mercuric sulfate	violet	—	4
2-Phenylnaphthalene	blue	—	7
Phenyl-α-naphthylamine	l. blue	—	4
Phenyl-β-naphthylamine	l. blue	—	4
4-Phenylquinaldine	blue	dil. acids	7
4-Phenylquinoline	blue	dil. acids	7
8-Phenylquinoline	yellow-green	—	7
Phenyl salicylate	strong blue	—	4
Phenyl-*o*-tolylguanidine	l. bluish-purple	—	4
Phloroglucinol	b. blue	—	1, 4, 6
Phloxine	yellow	water	4
Phycoerythrin	orange	—	2
Picrotoxine	yellow	—	4
Podophyllin	green	—	2
Polyamyl naphthalene	d. blue	—	4
Potassium ammonium platinocyanide*	green	—	1
Potassium benzoate	bluish	—	4
Potassium opianate	blue	—	4
Potassium platinocyanide*	green	—	1
Potassium salicylate	violet-blue	—	4
Potassium stearate	blue-white	—	4

* Exciting wave length not given.

FLUORESCENT SUBSTANCES (Continued)

Name	Character of fluorescence	Solvent or treatment	References
Potassium succinate	bluish-white	—	1
Proflavine	green	H_2O	4, 5
Protoporphyrin	red	—	2
Psychotrine	blue	—	7
Pyocyanine	green-yellow	CCl_4	2
Pyramidon	s. blue	—	4
Pyrene	blue	—	1
Pyridanthrone	yellow	H_2SO_4 soln.	7
Pyridoxine hydrochloride	b. blue	—	4
Quinetine	blue	H_2SO_4 soln.	7
Quinidine	p. blue	—	4
Quinine	b. blue	dil. oxy.	1, 2, 3, 4, 5
Quinine bisulfate	b. blue-green	dil. oxy.	4
Quinine hydrochloride	l. blue	dil. oxy.	4
Quinine monosulfate	blue	dil. oxy.	4
Quinine salicylate	b. blue-green	—	4
Quinoline	green	—	1
Rhamnetin	greenish-blue	H_2SO_4 soln.	4, 6
Rhodacene	red	—	7
Rhodamine	b. red-orange	H_2O, al., etc.	1, 2, 3, 4, 5
Rhodium salicylate	b. purple	—	4
Riboflavin	b. orange	—	4
Rose bengal	green	al. etc.	2
Saccharin	whitish	—	2
Salicylic acid	blue	—	4
Samarium gluconate	m. blue	—	4
Samarium 8-hydroxyquinolinate	yellow-red	—	4
Samarium salicylate	b. blue	—	4
Santonin	violet	—	4
Saponarin	blue	H_2SO_4 soln	7
dl-Serine	purplish-white	—	4
Silver 8-hydroxyquinolinate	yellow	—	4
Silver succinate	b. yellow	—	1
Sodium barbiturate	violet	—	4
Sodium benzoate	violet	—	1
Sodium benzyl morrhuate	b. yellow-green	—	4
Sodium 5-ethyl (1-methyl-1-butenyl) barbiturate	b. light blue	—	4
Sodium isoamyl barbiturate	bluish	—	4
Sodium isoamylethyl barbiturate	bluish	—	4
Sodium methyl salicylate	b. blue-green	—	4
Sodium *o*-nitrophenolate	red	—	4
Sodium oleate	blue-green	—	1
Sodium salicylate	b. blue-green	—	4
Sodium selenocyanide	bluish	H_2O	4
Sodium stearate	p. blue	—	4
Sorbitol lactate	dp. blue-green	—	4
Sorbitol tartrate	b. yellow-blue	—	4
Sorbitol triricinoleate	green	—	4
Stearic aldehyde	blue	—	4
trans-Stilbene	blue	—	7
Strontium benzoate	lavender	—	4
Strontium 8-hydroxyquinolinate	l. green	al.	4
Strontium lactate	yellow	—	1
Strontium stearate	blue-white	—	4
Strychnine	blue-white	—	4
Styrene	p. blue	—	6

FLUORESCENT SUBSTANCES (Continued)

Name	Character of fluorescence	Solvent or treatment	References
Sulfanilamide	violet	—	4
Sulforicinic acid	b. yellow-blue	—	4
Syntropin	lavender	—	4
Syringetin	green	H_2SO_4 soln.	7
Tartrazin	b. orange	al.	1
Thallium carbonate	blue	—	1
Thalloperazine	red-green	H_2SO_4 soln.	7
Theobromine	b. blue-green	—	4
Theobromine calcium salicylate	b. blue-green	—	4
Thiamine hydrochloride	dl. lavender-white	—	4
Thiochrome	blue	in soln.	3
Thioflavin S	yellow	H_2O	1, 4
Thioindigo	red-yellow	xyl.	7
Thioxanthone	green	H_2SO_4 son.	1
Thorium cyanide	pink	—	4
Thorium formate	b. blue	—	1
Thorium 8-hydroxyquinolinate	d. green	al.	4
Thorium *o*-iodoxybenzoate	m. blue	—	4
Thorium salicylate	b. blue	—	4
Thymol iodide	s. crimson	—	4
Tin stearate	cream	—	4
Titanium 8-hydroxyquinolinate	yellowish	—	4
Titanium stearate	grey-blue	—	4
Tetrahydrofurfuryl alcohol	blue	—	4
Tetradihydroxydesoxyyohimbine	b. blue	—	1
5,7,2′,4′-Tetrahydroxyflavone-2′4′-dimethyl ether	blue	H_2SO_4 soln.	7
7,2′,4′,6′-Tetrahydroxyflavone	green	H_2SO_4 soln.	7
7,3′,4′,5′-Tetrahydroxyflavone	green-yellow	—	7
1,4,5,8-Tetrahydroxy-2-methyl anthraquinone	red	H_2SO_4 soln.	7
6,3′,4′,5′-Tetrahydroxyflavone-3′,4′,5′-trimethyl ether	green	H_2SO_4 soln.	7
7,3′,4′5′-Tetrahydroxyflavone tetramethyl ether	violet	al.	7
5,6,7,8-Tetramethylalloxazin	yellow-violet	—	1
1,3,6,8-Tetramethylanthracene	green	AcOH	7
2,4,5,8-Tetramethyl quinoline	blue-violet	acids	7
2,3,5,6-Tetraphenyl pyridine	blue	H_2SO_4 soln.	8
α-Tocopherol	bl. blue-green	—	4
N-*p*-Tolyl-l-naphthylamine	blue	—	7
N-*m*-Tolyl-2-naphthylamine	blue	—	7
Transentin	b. yellow-green	H_2O	4, 6
Triethyl trimethylene triamine	d. yellow-green	—	4
6,7,4′-Trihydroxyflavone	green	H_2SO_4 soln.	7
5,6,7-Trimethylalloxazin	greenish-yellow	—	1
6,7,8-Trimethylalloxazin	greenish-yellow	—	1
Tris(hydroxymethyl)aminomethane	green-blue	—	4
Tris(hydroxymethyl)nitromethane	dp. pink	—	4
Umbelliferone	blue-violet	—	1
Uracil	violet	—	4, 8
Uranine	b. yellow	H_2O, al., etc.	1, 2, 3, 4, 5, 6
Uranyl compounds*	usually b. yellow	—	9, 2, 3, 4, 6
Uric acid	m. violet	—	2

* Exciting wave length not given.

FLUORESCENT SUBSTANCES (Continued)

Name	Character of fluorescence	Solvent or treatment	References
Urobilin	reddish	—	1
Vanadic 8-hydroxyquinolinate	dp. green	al.	4
Vanadic *o*-iodoxybenzoate	orange-red	—	4
Vanadous salicylate	lavender	—	4
Vanadyl cyanide	green	—	4
Vanillin	b. pink	—	4
Veronal	yellow-grey	—	2
Xanthanol	green	H_2SO_4 soln.	6
Xanthone	b. blue	H_2SO_4 soln.	4
Yangonin	blue	acet., MeOH	7
Yttrium gluconate	b. blue	—	4
Yttrium 8-hydroxyquinolinate	orange-red	al.	4
Yttrium *o*-iodoxybenzoate	bluish	—	4
Yttrium salicylate	b. dp. blue	—	4
Zinc butyl xanthate	dp. purple	—	6
Zinc dimethyldithiocarbamate	purple	—	4
Zinc fluoresceinate	b. green	alk. soln.	6
Zinc 8-hydroxyquinolinate	b. green	al.	4
Zinc hydroxyquinoline sulfonate	b. yellow	—	2
Zinc palmitate	blue-white	—	4
Zinc resinate	cream-white	—	10, 2
Zinc salicylate	b. blue	—	1
Zinc sebacate	white	—	4
Zinc stearate	b. blue	—	4
Zinc sulfanilate	blue-purple	—	4
Zinc uranyl acetate*	greenish	—	9
Zinc urobilinate	b. dp. green	—	2, 3, 4
Zinc valerate	lavender	—	4
Zirconium 8-hydroxyquinolinate	yellowish	al.	4

* Exciting wave length not given.

Key to References

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COLORIMETRY

Selected from Judd, Jour. Opt. Soc. Amer. **23,** 359 (1933)

Recommendations of the International Commission on Illumination

Standard Illuminants

A. Gas-filled tungsten incandescent lamp of color temperature 2848° K.

B. Noon Sunlight. Lamp as above in combination with the Davis-Gibson filter for converting color temperature 2848° to 4800° K.

The filter is to be composed of a layer one centimeter thick of each of two separate solutions B_1 and B_2, contained in a double cell of colorless optical glass.

Solution B_1

Copper sulfate ($CuSO_4{\cdot}5H_2O$)	2.452	g
Mannite ($C_6H_8(OH)_6$)	2.452	g
Pyridine (C_5H_5N)	30.0	cc
Distilled water to make	1000	cc

Solution B_2

Cobalt ammonium sulfate ($CoSO_4{\cdot}(NH_4)_2SO_4{\cdot}6H_2O$)	21.71	g
Copper sulfate ($CuSO_4{\cdot}5H_2O$)	16.11	g
Sulfuric acid (density 1.835)	10.0	cc
Distilled water to make	1000	cc

C. Average Daylight. Lamp as in **A** in combination with Davis-Gibson filter for converting color temperature 2848° to 6500° K.

The filter is composed of a layer one centimeter thick of each of two separate solutions C_1 and C_2, contained in a double cell made of colorless optical glass.

Solution C_1

Copper sulfate ($CuSO_4{\cdot}5H_2O$)	3.412	g
Mannite ($C_6H_8(OH)_6$)	3.412	g
Pyridine (C_5H_5N)	30.0	cc
Distilled water to make	1000	cc

Solution C_2

Cobalt ammonium sulfate ($CoSO_4{\cdot}(NH_4)_2SO_4{\cdot}6H_2O$)	30.580	g
Copper sulfate ($CuSO_4{\cdot}5H_2O$)	22.520	g
Sulfuric acid (density 1.835)	10.0	cc
Distilled water to make	1000	cc

See R. Davis and K. S. Gibson Bur. Stds. Misc. Pub. No. 114, Jan. 1931 or Bur. Stds. Jour. Research **7,** 796 (1931).

Standard Coordinate System

The tristimulus system of color specification is based on four chosen stimuli consisting of homogeneous radiant energy of wave lengths

700.0 **546.1** **435.8**

mμ and of standard illuminant B (see above).

To establish the system of specification coordinates are assigned as follows:

Stimulus	x	y	z
700.0 mμ	0.73467	0.26533	0.00000
546.1 mμ	0.27376	0.71741	0.00883
435.8 mμ	0.16658	0.00886	0.82456
Standard illuminant B:	0.34842	0.35161	0.29997

The Standard Observer

The "standard observer" is determined below by the specification for the equal energy spectrum both in fractions, x, y, z of the total amount for each wave length interval of 5 mμ and directly $\bar{x}$, $\bar{y}$, $\bar{z}$. The fractional values are known as the **trilinear coordinates** or **trichromatic coefficients** of the spectrum; the direct values as the **distribution functions** or coefficients.

The sum of the trichromatic coefficients is unity, that is $x + y + z = 1$. Therefore the value of z may be and often is omitted from a specification.

Relative Visibility

The value of $\bar{y}$ given in the table is the standard visibility function or relative visibility.

Wave length mμ	Trichromatic coefficients			Distribution coefficients for equal energy			Wave length mμ
	x	y	z	$\bar{x}$	$\bar{y}$ (Rel. Vis.)	$\bar{z}$	
380	0.1741	0.0050	0.8209	0.0014	0.0000	0.0065	380
385	0.1740	0.0050	0.8210	0.0022	0.0001	0.0105	385
390	0.1738	0.0049	0.8213	0.0042	0.0001	0.0201	390
395	0.1736	0.0049	0.8215	0.0076	0.0002	0.0362	395
400	0.1733	0.0048	0.8219	0.0143	0.0004	0.0679	400
405	0.1730	0.0048	0.8222	0.0232	0.0006	0.1102	405
410	0.1726	0.0048	0.8226	0.0435	0.0012	0.2074	410
415	0.1721	0.0048	0.8231	0.0776	0.0022	0.3713	415
420	0.1714	0.0051	0.8235	0.1344	0.0040	0.6456	420
425	0.1703	0.0058	0.8239	0.2148	0.0073	1.0391	425
430	0.1689	0.0069	0.8242	0.2839	0.0116	1.3856	430
435	0.1669	0.0086	0.8245	0.3285	0.0168	1.6230	435
440	0.1644	0.0109	0.8247	0.3483	0.0230	1.7471	440
445	0.1611	0.0138	0.8251	0.3481	0.0298	1.7826	445
450	0.1566	0.0177	0.8257	0.3362	0.0380	1.7721	450
455	0.1510	0.0227	0.8263	0.3187	0.0480	1.7441	455
460	0.1440	0.0297	0.8263	0.2908	0.0600	1.6692	460
465	0.1355	0.0399	0.8246	0.2511	0.0739	1.5281	465
470	0.1241	0.0578	0.8181	0.1954	0.0910	1.2876	470
475	0.1096	0.0868	0.8036	0.1421	0.1126	1.0419	475
480	0.0913	0.1327	0.7760	0.0956	0.1390	0.8130	480
485	0.0687	0.2007	0.7306	0.0580	0.1693	0.6162	485
490	0.0454	0.2950	0.6596	0.0320	0.2080	0.4652	490
495	0.0235	0.4127	0.5638	0.0147	0.2586	0.3533	495
500	0.0082	0.5384	0.4534	0.0049	0.3230	0.2720	500
505	0.0039	0.6548	0.3413	0.0024	0.4073	0.2123	505
510	0.0139	0.7502	0.2359	0.0093	0.5030	0.1582	510
515	0.0389	0.8120	0.1491	0.0291	0.6082	0.1117	515
520	0.0743	0.8338	0.0919	0.0633	0.7100	0.0782	520
525	0.1142	0.8262	0.0596	0.1096	0.7932	0.0573	525
530	0.1547	0.8059	0.0394	0.1655	0.8620	0.0422	530
535	0.1929	0.7816	0.0255	0.2257	0.9149	0.0298	535
540	0.2296	0.7543	0.0161	0.2904	0.9540	0.0203	540
545	0.2658	0.7243	0.0099	0.3597	0.9803	0.0134	545
550	0.3016	0.6923	0.0061	0.4334	0.9950	0.0087	550
555	0.3373	0.6589	0.0088	0.5121	1.0002	0.0057	555
560	0.3731	0.6245	0.0024	0.5945	0.9950	0.0039	560
565	0.4087	0.5896	0.0017	0.6784	0.9786	0.0027	565
570	0.4441	0.5547	0.0012	0.7621	0.9520	0.0021	570

The Standard Observer (Continued)

Wave length mμ	Trichromatic coefficients			Distribution coefficients for equal energy			Wave length mμ
	x	y	z	$\bar{x}$	$\bar{y}$ (Rel. Vis.)	$\bar{z}$	
575	0.4788	0.5202	0.0010	0.8425	0.9154	0.0018	575
580	0.5125	0.4866	0.0009	0.9163	0.8700	0.0017	580
585	0.5448	0.4544	0.0008	0.9786	0.8163	0.0014	585
590	0.5752	0.4242	0.0006	1.0263	0.7570	0.0011	590
595	0.6029	0.3965	0.0006	1.0567	0.6949	0.0010	595
600	0.6270	0.3725	0.0005	1.0622	0.6310	0.0008	600
605	0.6482	0.3514	0.0004	1.0456	0.5668	0.0006	605
610	0.6658	0.3340	0.0002	1.0026	0.5030	0.0003	610
615	0.6801	0.3197	0.0002	0.9384	0.4412	0.0002	615
620	0.6915	0.3083	0.0002	0.8544	0.3810	0.0002	620
625	0.7006	0.2993	0.0001	0.7514	0.3210	0.0001	625
630	0.7079	0.2920	0.0001	0.6424	0.2650	0.0000	630
635	0.7140	0.2859	0.0001	0.5419	0.2170	0.0000	635
640	0.7190	0.2809	0.0001	0.4479	0.1750	0.0000	640
645	0.7230	0.2770	0.0000	0.3608	0.1382	0.0000	645
650	0.7260	0.2740	0.0000	0.2835	0.1070	0.0000	650
655	0.7283	0.2717	0.0000	0.2187	0.0816	0.0000	655
660	0.7300	0.2700	0.0000	0.1649	0.0610	0.0000	660
665	0.7311	0.2689	0.0000	0.1212	0.0446	0.0000	665
670	0.7320	0.2680	0.0000	0.0874	0.0320	0.0000	670
675	0.7327	0.2673	0.0000	0.0636	0.0232	0.0000	675
680	0.7334	0.2666	0 0000	0.0468	0.0170	0.0000	680
685	0.7340	0.2660	0.0000	0.0329	0.0119	0.0000	685
690	0.7344	0.2656	0.0000	0.0227	0.0082	0.0000	690
695	0.7346	0.2654	0.0000	0.0158	0.0057	0.0000	695
700	0.7347	0.2653	0.0000	0.0114	0.0041	0.0000	700
705	0.7347	0.2653	0.0000	0.0081	0.0029	0.0000	705
710	0.7347	0.2653	0.0000	0.0058	0.0021	0.0000	710
715	.7347	0.2653	0.0000	0.0041	0.0015	0.0000	715
720	0.7347	0.2653	0.0000	0.0029	0.0010	0.0000	720
725	0.7347	0.2653	0.0000	0.0020	0.0007	0.0000	725
730	0.7347	0.2653	0.0000	0.0014	0.0005	0.0000	730
735	0.7347	0.2653	0.0000	0.0010	0.0004	0.0000	735
740	0.7347	0.2653	0.0000	0.0007	0.0003	0.0000	740
745	0.7347	0.2653	0.0000	0.0005	0.0002	0.0000	745
750	0.7347	0.2653	0.0000	0.0003	0.0001	0.0000	750
755	0.7347	0.2653	0.0000	0.0002	0.0001	0.0000	755
760	0.7347	0.2653	0.0000	0.0002	0.0001	0.0000	760
765	0.7347	0.2653	0.0000	0.0001	0.0000	0.0000	765
770	0.7347	0.2653	0.0000	0.0001	0.0000	0.0000	770
775	0.7347	0.2653	0.0000	0.0000	0.0000	0.0000	775
780	0.7347	0.2653	0.0000	0.0000	0.0000	0.0000	780
			Totals	21.3713	21.3714	21.3715	

SPECIFIC ROTATION

Specific rotation or rotatory power is given in degrees per decimeter for liquids and solutions and in degrees per millimeter for solids; + signifies right handed rotation, − left. Specific rotation varies with the wave length of light used, with temperature and, in the case of solutions, with the concentration. When sodium light is used, indicated by D in the wave length column, a value of λ = 0.5893 may be assumed.

Optical rotatory power for a large number of organic compounds will be found in the International Critical Tables, Vol. VII; for sugars, Vol. II.

SOLIDS

Substance	Wave length μ	Rotation deg./mm	Substance	Wave length μ	Rotation deg./mm
Cinnabar (HgS)...	D	+32.5	Quartz (continued)........	0.3609	+63.628
Lead hyposulfate..	D	5.5		0.3582	64.459
Potassium hyposulphate........	D	8.4		0.3466	69.454
Quartz............	0.7604	12.668		0.3441	70.587
	0.7184	14.304		0.3402	72.448
	0.6867	15.746		0.3360	74.571
	0.6562	17.318		0.3286	78.579
	0.5895	21.684		0.3247	80.459
	0.5889	21.727		0.3180	84.972
	0.5269	27.543		0.2747	121.052
	0.4861	32.773		0.2571	143.266
	0.4307	42.604		0.2313	190.426
	0.4101	47.481		0.2265	201.824
	0.3968	51.193		0.2194	220.731
	0.3933	52.155		0.2143	235.972
	0.3820	55.625	Sodium bromate	D	2.8
	0.3726	58.894	Sodium chlorate	D	3.13

LIQUID

Liquid	Temp. °C	Wave length μ	Specific rotation deg./dm
Amyl alcohol....................	......	D	− 5.7
Camphor........................	204	D	+ 70.33
Cedar oil........................	15	D	− 30 to −40
Citron oil........................	15	D	+ 62
Ethyl malate $(C_2H_5)_2C_4H_4O_5$......	11	D	− 10.3 to −12.4
Menthol..........................	35.2	D	− 49.7
Nicotine $C_{10}H_{14}N_2$...............	10–30	D	−162
	20	0.6563	−126
	20	0.5351	−207.5
	20	0.4861	−253.5
Turpentine $C_{10}H_6$................	20	D	− 37
	20	0.6563	− 29.5
	20	0.5351	− 45
	20	0.4861	− 54.5

SPECIFIC ROTATION (Continued)

SOLUTIONS

Corrections for values of the specific rotation for concentration are given in the last column. c indicates concentration in grams per 100 milliliters of solution; d indicates the concentration in grams per 100 grams of solution.

Substance	Solvent	Temp. °C	Wave length μ	Specific rotation deg./dm	Correction for concentration or temperature
Albumen	water	..	D	− 25 to − 38	
Arabinose	water	20	D	− 105.0	
Camphor	alcohol	20	D	+ 54.4	$- .135d$ for $d = 45$–91
	benzene	20	D	+ 56	$- .166d$ for $d = 47$–90
	ether	..	D	+ 57	
Dextrose *d*-glucose $C_6H_{12}O_6$	water	20	D	+ 52.5	$+ .025d$ for $d = 1$–18
			.5461	+ 62.03	$+ .04257c$ for $c = 6$–32
Galactose	water	..	D	+ 83.9	$+ .078d - .21t$ for $d = 4$–36 and $t = 10$–30°C
l-Glucose (β)	water	20	D	− 51.4	
Invert sugar $C_6H_{12}O_6$	water	20	D	− 19.7	$- .036c$ for $c = 9$–35 $\alpha_t = \alpha_{20} + .304(t - 20) + .00165(t - 20)^2$ for $t = 3$–30°C
		25	.5461	− 21.5	
Lactose	water	20	D	+ 52.4	$+ .072\,(20° - t)$ for $c = 5$
			.5461	+ 61.9	$+ .085(20° - t)$ for $c = 5$
Levulose fruit sugar	water	25	D	− 88.5	$- .145d$ for $d = 2.6$–18.6
		25	.5461	− 105.30	
Maltose	water	20	D	+ 138.48	$- .01837d$ for $d = 5$–35
		25	.5461	+ 153.75	
Mannose	water	20	D	+ 14.1	$c = 10.2$
Nicotine	water	20	D	− 77	for $d = 1$–16
	benzene	20	D	− 164	for $d = 8$–100
Potassium tartrate	water	20	D	+ 27.14	$+ .0992c - .00094c^2$ for $c = 8$–50
Quinine sulfate	water	17	D	− 214	
Santonin	alcohol	20	D	− 161.0	$c = 1.78$
		20	D	+ 693	$c = 4.05$
	chloroform	20	D	− 202.7	$+ .309d$ for $d = 75$–96.5
	alcohol	20	.6867	+ 442	$c = 4.05$
			.5269	+ 991	$c = 4.05$
			.4861	+ 1323	$c = 4.05$
Sodium potassium tartrate (Rochelle salt)	water	20	D	+ 29.75	$- .0078c$
Sucrose (cane sugar) $C_{12}H_{22}O_{11}$	water	20	D	+ 66.412	$+ .01267d - .000376d^2$ for $d = 0$–50 $\alpha_t = \alpha_{20}[1 - .00037(t - 20)]$ for $t = 14$–30°C

SPECIFIC ROTATION (Continued)

Sucrose dissolved in water, 20°C.

μ	Spec. rot.	μ	Spec. rot.	μ	Spec. rot.
670.8 (Li)	+50.51	510.6 (Cu)	+90.46	435.3 (Fe)	+128.5
643.8 (Cd)	55.04	508.6 (Cd)	91.16	433.7 (Fe)	129.8
636.2 (Zn)	56.51	481.1 (Zn)	103.07	431.5 (Fe)	130.7
589.3 (Na)	66.45	480.0 (Cd)	103.62	428.2 (Fe)	133.6
578.2 (Cu)	69.10	472.2 (Zn)	107.38	427.2 (Fe)	134.2
578.0 (Hg)	69.22	468.0 (Zn)	109.49	423.1 (Fe)	134.9
570.0 (Cu)	71.24	467.8 (Cd)	109.69	419.1 (Fe)	140.0
546.1 (Hg)	78.16	438.4 (Fe)	126.5	414.4 (Fe)	144.2
521.8 (Cu)	86.21	437.6 (Fe)	127.2	388.9 (Fe)	166.7
515.3 (Cu)	88.68	435.8 (Hg)	128.49	383.3 (Fe)	171.8
				382.6 (Fe)	173.1

Substance	Solvent	°C	μ	Spec. rot.	Correct.
Tartaric acid (ord.)	water	20	D	+15.06 − .131c	
		20	.6563	7.75	for $d = 41$
		20	D	8.86	
		20	.5351	9.65	
		20	.4861	9.37	
Turpentine	alcohol	20	D	−37 − .00482d − .00013d	for d = 0–90
	benzene	20	D	−37 − .0265d	for d = 0–91
Xylose	water	20	D	+19.13	d = 2.7

OPTICAL ROTATION OF ACIDS AND BASES

Optical rotation of acids and bases commonly used in the resolution of racemic substances. Compiled by F. E. Ray.

Name	Formula	Solvent	Conc. %	a_D
Bromocamphor-sulfonic acid K salt	$C_{10}H_{15}O_4BrS$	H_2O	....	72.1
Camphorsulfonic acid	$C_{10}H_{16}O_4S$	H_2O	....	23.9
Chlorocamphor-sulfonic acid	$C_{10}H_{15}ClO_4S$	H_2O	....	49.6
Codeinesulfonic acid	$C_{18}H_{21}NO_6S$	H_2O	3	−190.1
Hydroxybutyric acid	$C_4H_8O_3$	H_2O	3.3	− 24.8
Lactic acid	$C_3H_6O_3$	H_2O	10.5	3.8
Malic acid	$C_4H_6O_5$	H_2O	....	2.4
Mandelic acid	$C_8H_8O_3$	H_2O	2.01	155.5
Methylene-camphor	$C_{11}H_{16}O$	C_2H_5OH	....	127
Phenylsuccinic acid	$C_{10}H_{10}O_4$	C_2H_5OH	1.5	148
Tartaric acid	$C_4H_6O_6$	C_2H_5OH and H_2O	....	3 to 25*
Brucine	$C_{23}H_{26}N_2O_4$	C_2H_5OH	5.4	− 85
Cinchonidine	$C_{19}H_{22}N_2O$	C_2H_5OH	1.0	−111.0
Cinchonine	$C_{19}H_{22}N_2O$	$CHCl_3$	0.6	+209.6
Cocaine	$C_{17}H_{21}NO_4$	50 % C_2H_5OH	1.1	− 35.4
Coniine	$C_8H_{17}N$	$CHCl_3$	4	8.0
Codeine	$C_{18}H_{21}NO_3$	C_2H_5OH	5	−135.8
Hydrastine	$C_{21}H_{21}NO_6$	50 % C_2H_5OH	0.2	115
Menthol	$C_{10}H_{20}O$	C_2H_5OH	9.6	− 50.6
Menthylamine	$C_{10}H_{21}N$	C_2H_5OH	11.3	− 31.9
Narcotine	$C_{22}H_{23}NO_7$	$CHCl_3$	2.6	±200.0
Quinidine	$C_{20}H_{24}N_2O_4$	C_2H_5OH	1.0	+233.6
Quinine	$C_{20}H_{24}N_2O_2$	C_6H_6	0.6	−136
Thebaine	$C_{19}H_{21}NO_3$	$CHCl_3$	5	−229.5
Strychnine	$C_{21}H_{22}N_2O_2$	C_2H_5OH	0.9	−128

* Varies greatly with temperature, solvent, and conc.

MAGNETO-OPTIC ROTATION

Revised by Park L. Turrill

Verdet's Constant: $\rho = \dfrac{\alpha}{tH \cos \theta}$

The specific power of magnetic rotation ρ, is expressed in the above formula, where α is the total angle of rotation in minutes, t the thickness of the substance in centimeters through which the light beam passes, H the magnetic field intensity in gauss, and θ the angle between the direction of the magnetic field and the path of light. Determinations made with sodium light. $\lambda_D = 5893$ Å.

Values from the Smithsonian Tables, the International Critical Tables, and the literature.

GASES

Substance	Pressure (atmospheres)	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^6$	Observer	Year
Atmospheric air	1	20	6.83	Becquerel	1880
Carbon dioxide	1.1	6.5	8.61	Siertsema	1895
Carbon disulfide	0.98	70	23.49	Bichat	1879
Ethylene	1	20	34.48	Becquerel	1880
Nitrogen	1	20	6.92	Becquerel	1880
Nitrous oxide	1	20	6.28	Becquerel	1880
Oxygen	1	20	31.39	Becquerel	1880
Sulfur dioxide	3.3	20	38.40	Bichat	1880

LIQUIDS, ORGANIC

		$\rho \times 10^3$		
Acetic acid	15.1	11.09	Schwers	1912
Acetic acid	31.5	10.86	Schwers	1912
Acetone	15.2	10.35	Schwers	1912
Acetone	32.0	10.19	Schwers	1912
Amyl alcohol	15	13.1	Becquerel	1880
Benzine	20	29.7	Jahn	
Carbon disulfide	0	43.41	Becquerel	1885
	15.6	42.4	Schwers	1912
	18.0	43.0	Chaudier	1913
	20	42.26	Bichat	1880
	34	41.1	Schwers	1912
Carbon tetrachloride	15	16.03	Schwers	1912
Carvane	14.9	18.4	Herngrist	1914
Chloroform	20	16.4	Jahn	
Citranellal	16.4	15.1	Herngrist	1914
Diethyl malate	15.3	12.4	Herngrist	1914
Diethyl tartrate	15.2	12.3	Herngrist	1914
Dimethyl malate	15.3	11.8	Herngrist	1914
Dipropyl tartrate	15.4	12.6	Herngrist	1914
Ethanol	25.0	11.12	Theuvenet	1910
Isobutyl alcohol	16.1	12.66	Schwers	1912
Isobutyric acid	15.3	11.35	Schwers	1912
Isovaleric acid	15.0	12.08	Schwers	1912
Limonene	15.6	16.5	Herngrist	1914
Menthone	16.7	13.7	Herngrist	1914
Methyl chloride	18	12.9	Chaudier	1913
Pulegone	14.9	16.4	Herngrist	1914
n-Propanol	17.3	11.81	Schwers	1912
Toluene	28.4	26.9	Becquerel	1880
Xylene	15	22.1	Becquerel	1880

MAGNETO-OPTIC ROTATION (Continued)

LIQUIDS, INORGANIC

Substance	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^3$	Observer	Year
Antimony pentachloride	16	70.4	Becquerel	1885
Arsenic trichloride	16	42.53	Becquerel	1885
Hydrogen peroxide	10	11.5	Giguère and Feeny	 1943
Nitric acid, fuming	16	8.75	Becquerel	1885
Nitrogen	−195.5	4.15	Chaudier	1913
Nitrous oxide	−92	5.54	Siertsema	1904
Oxygen	−182.5	7.82	Chaudier	1913
Phosphorus, fused	33	132.6	Becquerel	1877
Phosphorus, trichloride	16	27.7	Becquerel	1885
Silicon tetrachloride	16	18.9	Becquerel	1885
Sulfur, fused	114	80.9	Becquerel	1877
Sulfur dioxide	−10	18	Chaudier	1913
Sulfur monochloride	16	41.8	Becquerel	1885
Titanium tetrachloride	13.4	14.71	Siertsema	1915
Water (λ = 5956 Å)	0	13.11	Rodger and	....
	20	13.08	Watson	1895
	30	13.06		
	40	13.02		
	60	12.94		
	80	12.82		
	90	12.74		

SOLUTIONS, AQUEOUS

Substance	Density	Temp. °C	Verdet's Constant (minutes) $\rho \times 10^3$	Observer	Year
Ammonium hydroxide	0.8918	....	15.3	Perkin	1884
Antimony trichloride	......	....	29.9	Becquerel	1885
Barium bromide	1.5399	20	21.5	Jahn	....
Barium chloride	1.2897	20	16.8	Jahn	....
Bismuth nitrate	......	....	19.22	Becquerel	1885
Cadmium chloride	1.3179	20	16.5	Jahn	....
Calcium chloride	1.1504	20	16.5	Humburg	1893
Ferric chloride	1.6933	15	−202.6	Becquerel	1885
Ferrous chloride	1.4331	15	2.5	Becquerel	1885
Hydriodic acid	1.2966	15	25.8	Perkin	1884
Hydrobromic acid	1.2039	15	19.4	Perkin	1884
Hydrochloric acid	1.0758	20	16.71	Schwers	1912
Lithium chloride	1.0619	20	14.5	Jahn	....
Magnesium sulfate	1.1147	16	3.6	Schönrock	1893
Manganous sulfate	1.1212	16	4.0	Schönrock	1893
Mercuric chloride	1.0381	16	13.7	Schönrock	1893
Mercuric cyanide	1.0638	16	7.1	Schönrock	1893
Nickelous chloride	1.4685	....	27.3	Becquerel	1885
Nitric acid	1.3366	15	10.5	Perkin	1884
Potassium bicarbonate	1.1906	20	14.0	Humburg	1893
Potassium bichromate	1.0786	15	12.6	Verdet	1863
Potassium bromide	1.1424	20	16.3	Humburg	1893
Potassium carbonate	1.1960	20	14.0	Jahn	....
Potassium chloride	1.6000	15	16.3	Becquerel	1885

MAGNETO-OPTIC ROTATION (Continued)

SOLUTIONS, AQUEOUS (Continued)

Substance	Density	Temp. °C.	Verdet's Constant (minutes) $\rho \times 10^3$	Observer	Year
Potassium iodide	1.6743	15	34.1	Becquerel	1885
Potassium nitrate	1.0634	20	13.0	Humburg	1893
Potassium sulfate	1.0475	20	13.3	Jahn	....
Silver nitrate	......	....	18.03	Becquerel	1885
Sodium bromide	1.1351	20	16.5	Jahn	....
Sodium carbonate	1.1006	20	14.0	Humburg	1893
Sodium chloride	1.2051	16	18.2	Becquerel	1885
Sodium sulfate	1.0061	20	13.5	Humburg	1893
Stannous chloride	1.3280	15	26.6	Verdet	1863
Sulfuric acid	1.5507	15	12.18	Schwers	1912
Zinc chloride	1.2851	16	19.6	Verdet	1863
SOLUTIONS, IN ETHYL ALCOHOL					
Cadmium bromide	1.0446	20	15.9	Humburg	1893
Cadmium chloride	0.8303	20	11.8	Humburg	1893
Cadmium iodide	1.0988	20	19.9	Humburg	1893
Calcium bromide	0.9966	20	15.4	Humburg	1893
Mercuric chloride	0.9988	16	10.9	Schönrock	1893
Mercuric chloride	0.8857	16	12.1	Schönrock	1893
Mercuric cyanide	0.8527	16	6.4	Schönrock	1893
Mercuric cyanide	0.8348	16	5.3	Schönrock	1893
Mercuric iodide	0.8072	16	24.4	Schönrock	1893
Strontium bromide	0.9636	20	14.0	Humburg	1893
Strontium chloride	0.8313	20	11.8	Humburg	1893
SOLIDS					
Amber		19	−9.60	Quincke	1885
Calcium fluoride (fluorite)		16	8.83	Becquerel	1885
Carbon (diamond)		16	12.8	Becquerel	1877
Carbon dioxide		26	2.07	Chaudier	1913
Glass, Jena (barium crown)		18	22.0	duBois	1894
(phosphate crown)		18	16.1	duBois	1894
(light flint)		18	31.7	duBois	1894
(heavy flint)		18	60.8	duBois	1894
(very heavy flint)		18	88.8	duBois	1894
Potassium chloride (sylvite)		16	28.58	Becquerel	1885
Sodium chloride (rock salt)		16	35.85	Becquerel	1885
Sodium tetraborate (borax)		16	17.2	Becquerel	1885
Silicon (quartz)		20	16.64	Borel	1903
Stannous chloride		16	44.	Becquerel	1885
Zinc sulfide, β		16	225.	Becquerel	1885

TRANSPARENCY TO OPTICAL DENSITY CONVERSION TABLE

Transparency of a layer of material is defined as the ratio of the intensity of the transmitted light to that of the incident light. Opacity is the reciprocal of the transparency. Optical density is the common logarithm of the opacity.

Thus,

$$\text{Transparency} = \frac{I_t}{I_i}$$

$$\text{Opacity} = \frac{1}{\text{Transparency}} = \frac{I_i}{I_t}$$

$$\text{Optical density} = \log_{10}\left(\frac{I_i}{I_t}\right)$$

where I_i = Intensity of incident light
I_t = Intensity of transmitted light.

TRANSPARENCY TO OPTICAL DENSITY CONVERSION TABLE (Continued)

Trans.	Density	Trans.	Density	Trans.	Density	Trans.	Density
0.000	—	**.050**	1.301	**.100**	1.0000	**.150**	.8239
.001	3.000	.051	1.292	.101	.9957	.151	.8210
.002	2.699	.052	1.284	.102	.9914	.152	.8182
.003	2.523	.053	1.276	.103	.9872	.153	.8153
.004	2.398	.054	1.268	.104	.9830	.154	.8125
.005	2.301	.055	1.260	.105	.9788	.155	.8097
.006	2.222	.056	1.252	.106	.9747	.156	.8069
.007	2.155	.057	1.244	.107	.9706	.157	.8041
.008	2.097	.058	1.237	.108	.9666	.158	.8013
.009	2.046	.059	1.229	.109	.9626	.159	.7986
.010	2.000	**.060**	1.222	**.110**	.9586	**.160**	.7959
.011	1.959	.061	1.215	.111	.9547	.161	.7932
.012	1.921	.062	1.208	.112	.9508	.162	.7905
.013	1.886	.063	1.201	.113	.9469	.163	.7878
.014	1.854	.064	1.194	.114	.9431	.164	.7852
.015	1.824	.065	1.187	.115	.9393	.165	.7825
.016	1.796	.066	1.180	.116	.9356	.166	.7799
.017	1.770	.067	1.174	.117	.9318	.167	.7773
.018	1.745	.068	1.168	.118	.9281	.168	.7747
.019	1.721	.069	1.161	.119	.9244	.169	.7721
.020	1.699	**.070**	1.155	**.120**	.9208	**.170**	.7696
.021	1.678	.071	1.149	.121	.9172	.171	.7670
.022	1.658	.072	1.143	.122	.9137	.172	.7645
.023	1.638	.073	1.137	.123	.9101	.173	.7620
.024	1.620	.074	1.131	.124	.9066	.174	.7594
.025	1.602	.075	1.125	.125	.9031	.175	.7570
.026	1.585	.076	1.119	.126	.8996	.176	.7545
.027	1.569	.077	1.114	.127	.8962	.177	.7520
.028	1.553	.078	1.108	.128	.8928	.178	.7496
.029	1,538	.079	1.102	.129	.8894	.179	.7471
.030	1.523	**.080**	1.097	**.130**	.8861	**.180**	.7447
.031	1.509	.081	1.092	.131	.8827	.181	.7423
.032	1.495	.082	1.086	.132	.8794	.182	.7399
.033	1.482	.083	1.081	.133	.8761	.183	.7375
.034	1.469	.084	1.076	.134	.8729	.184	.7352
.035	1.456	.085	1.071	.135	.8697	.185	.7328
.036	1.444	.086	1.066	.136	.8665	.186	.7305
.037	1.432	.087	1.060	.137	.8633	.187	.7282
.038	1.420	.088	1.055	.138	.8601	.188	.7258
.039	1.409	.089	1.051	.139	.8570	.189	.7235
.040	1.398	**.090**	1.046	**.140**	.8539	**.190**	.7212
.041	1.387	.091	1.041	.141	.8508	.191	.7190
.042	1.377	.092	1.036	.142	.8477	.192	.7167
.043	1.367	.093	1.032	.143	.8447	.193	.7144
.044	1.357	.094	1.027	.144	.8416	.194	.7122
.045	1.347	.095	1.022	.145	.8386	.195	.7100
.046	1.337	.096	1.018	.146	.8356	.196	.7077
.047	1.328	.097	1.013	.147	.8327	.197	.7055
.048	1.319	.098	1.009	.148	.8297	.198	.7033
.049	1.310	.099	1.004	.149	.8268	.199	.7011
.050	1.301	**.100**	1.000	**.150**	.8239	**.200**	.6990

TRANSPARENCY TO OPTICAL DENSITY CONVERSION TABLE (Continued)

Trans.	Density	Trans.	Density	Trans.	Density	Trans.	Density
.200	.6990	**.250**	.6021	**.300**	.5229	**.350**	.4559
.201	.6968	.251	.6003	.301	.5215	.351	.4547
.202	.6946	.252	.5986	.302	.5200	.352	.4535
.203	.6925	.253	.5969	.303	.5186	.353	.4522
.204	.6904	.254	.5952	.304	.5171	.354	.4510
.205	.6882	.255	.5935	.305	.5157	.355	.4498
.206	.6861	.256	.5918	.306	.5143	.356	.4486
.207	.6840	.257	.5901	.307	.5128	.357	.4473
.208	.6819	.258	.5884	.308	.5114	.358	.4461
.209	.6799	.259	.5867	.309	.5100	.359	.4449
.210	.6778	**.260**	.5850	**.310**	.5086	**.360**	.4437
.211	.6757	.261	.5834	.311	.5072	.361	.4425
.212	.6737	.262	.5817	.312	.5058	.362	.4413
.213	.6716	.263	.5800	.313	.5045	.363	.4401
.214	.6696	.264	.5784	.314	.5031	.364	.4389
.215	.6676	.265	.5768	.315	.5017	.365	.4377
.216	.6655	.266	.5751	.316	.5003	.366	.4365
.217	.6635	.267	.5735	.317	.4989	.367	.4353
.218	.6615	.268	.5719	.318	.4976	.368	.4342
.219	.6596	.269	.5702	.319	.4962	.369	.4330
.220	.6576	**.270**	.5686	**.320**	.4949	**.370**	.4318
.221	.6556	.271	.5670	.321	.4935	.371	.4306
.222	.6536	.272	.5654	.322	.4921	.372	.4295
.223	.6517	.273	.5638	.323	.4908	.373	.4283
.224	.6498	.274	.5622	.324	.4895	.374	.4271
.225	.6478	.275	.5607	.325	.4881	.375	.4260
.226	.6459	.276	.5591	.326	.4868	.376	.4248
.227	.6440	.277	.5575	.327	.4855	.377	.4237
.228	.6421	.278	.5560	.328	.4841	.378	.4225
.229	.6402	.279	.5544	.329	.4828	.379	.4214
.230	.6383	**.280**	.5528	**.330**	.4815	**.380**	.4202
.231	.6364	.281	.5513	.331	.4802	.381	.4191
.232	.6345	.282	.5498	.332	.4789	.382	.4179
.233	.6326	.283	.5482	.333	.4776	.383	.4168
.234	.6308	.284	.5467	.334	.4763	.384	.4157
.235	.6289	.285	.5452	.335	.4750	.385	.4145
.236	.6271	.286	.5436	.336	.4737	.386	.4134
.237	.6253	.287	.5421	.337	.4724	.387	.4123
.238	.6234	.288	.5406	.338	.4711	.388	.4112
.239	.6216	.289	.5391	.339	.4698	.389	.4101
.240	.6198	**.290**	.5376	**.340**	.4685	**.390**	.4089
.241	.6180	.291	.5361	.341	.4673	.391	.4078
.242	.6162	.292	.5346	.342	.4660	.392	.4067
.243	.6144	.293	.5331	.343	.4647	.393	.4056
.244	.6126	.294	.5317	.344	.4634	.394	.4045
.245	.6108	.295	.5302	.345	.4622	.395	.4034
.246	.6091	.296	.5287	.346	.4609	.396	.4023
.247	.6073	.297	.5272	.347	.4597	.397	.4012
.248	.6056	.298	.5258	.348	.4584	.398	.4001
.249	.6038	.299	.5243	.349	.4572	.399	.3990
.250	.6021	**.300**	.5229	**.350**	.4559	**.400**	.3979

TRANSPARENCY TO OPTICAL DENSITY CONVERSION TABLE (Continued)

Trans.	Density	Trans.	Density	Trans.	Density	Trans.	Density
.400	.3979	**.450**	.3468	**.500**	.3010	**.550**	.2596
.401	.3969	.451	.3458	.501	.3002	.551	.2589
.402	.3958	.452	.3449	.502	.2993	.552	.2581
.403	.3947	.453	.3439	.503	.2984	.553	.2573
.404	.3936	.454	.3429	.504	.2975	.554	.2565
.405	.3925	.455	.3420	.505	.2967	.555	.2557
.406	.3915	.456	.3410	.506	.2959	.556	.2549
.407	.3904	.457	.3401	.507	.2950	.557	.2541
.408	.3893	.458	.3391	.508	.2941	.558	.2534
.409	.3883	.459	.3382	.509	.2933	.559	.2526
.410	.3872	**.460**	.3372	**.510**	.2924	**.560**	.2518
.411	.3862	.461	.3363	.511	.2916	.561	.2510
.412	.3851	.462	.3354	.512	.2907	.562	.2503
.413	.3840	.463	.3344	.513	.2899	.563	.2495
.414	.3830	.464	.3335	.514	.2890	.564	.2487
.415	.3819	.465	.3325	.515	.2882	.565	.2479
.416	.3809	.466	.3316	.516	.2873	.566	.2472
.417	.3799	.467	.3307	.517	.2865	.567	.2464
.418	.3788	.468	.3298	.518	.2857	.568	.2457
.419	.3778	.469	.3288	.519	.2848	.569	.2449
.420	.3768	**.470**	.3279	**.520**	.2840	**.570**	.2441
.421	.3757	.471	.3270	.521	.2831	.571	.2434
.422	.3747	.472	.3260	.522	.2823	.572	.2426
.423	.3737	.473	.3251	.523	.2815	.573	.2418
.424	.3726	.474	.3242	.524	.2807	.574	.2411
.425	.3716	.475	.3233	.525	.2798	.575	.2403
.426	.3706	.476	.3224	.526	.2790	.576	.2396
.427	.3696	.477	.3215	.527	.2782	.577	.2388
.428	.3685	.478	.3206	.528	.2774	.578	.2381
.429	.3675	.479	.3197	.529	.2766	.579	.2373
.430	.3665	**.480**	.3188	**.530**	.2757	**.580**	.2366
.431	.3655	.481	.3179	.531	.2749	.581	.2358
.432	.3645	.482	.3170	.532	.2741	.582	.2351
.433	.3635	.483	.3161	.533	.2733	.583	.2343
.434	.3625	.484	.3152	.534	.2725	.584	.2336
.435	.3615	.485	.3143	.535	.2717	.585	.2328
.436	.3605	.486	.3134	.536	.2703	.586	.2321
.437	.3595	.487	.3125	.537	.2700	.587	.2314
.438	.3585	.488	.3116	.538	.2692	.588	.2306
.439	.3575	.489	.3107	.539	.2684	.589	.2299
.440	.3565	**.490**	.3098	**.540**	.2676	**.590**	.2291
.441	.3556	.491	.3089	.541	.2668	.591	.2284
.442	.3546	.492	.3080	.542	.2660	.592	.2277
.443	.3536	.493	.3072	.543	.2652	.593	.2269
.444	.3526	.494	.3063	.544	.2644	.594	.2262
.445	.3516	.495	.3054	.545	.2636	.595	.2255
.446	.3507	.496	.3045	.546	.2628	.596	.2248
.447	.3497	.497	.3036	.547	.2620	.597	.2240
.448	.3487	.498	.3028	.548	.2612	.598	.2233
.449	.3478	.499	.3019	.549	.2604	.599	.2226
.450	.3468	**.500**	.3010	**.550**	.2596	**.600**	.2219

TRANSPARENCY TO OPTICAL DENSITY CONVERSION TABLE (Continued)

Trans.	Density	Trans.	Density	Trans.	Density	Trans.	Density
.600	.2219	**.650**	.1871	**.700**	.1549	**.750**	.1249
.601	.2211	.651	.1864	.701	.1543	.751	.1244
.602	.2204	.652	.1857	.702	.1537	.752	.1238
.603	.2197	.653	.1851	.703	.1531	.753	.1232
.604	.2190	.654	.1844	.704	.1524	.754	.1226
.605	.2182	.655	.1838	.705	.1518	.755	.1221
.606	.2175	.656	.1831	.706	.1512	.756	.1215
.607	.2168	.657	.1824	.707	.1506	.757	.1209
.608	.2161	.658	.1818	.708	.1500	.758	.1203
.609	.2154	.659	.1811	.709	.1493	.759	.1198
.610	.2147	**.660**	.1805	**.710**	.1487	**.760**	.1192
.611	.2140	.661	.1798	.711	.1481	.761	.1186
.612	.2132	.662	.1791	.712	.1475	.762	.1180
.613	.2125	.663	.1785	.713	.1469	.763	.1175
.614	.2118	.664	.1778	.714	.1463	.764	.1169
.615	.2111	.665	.1772	.715	.1457	.765	.1163
.616	.2104	.666	.1765	.716	.1451	.766	.1158
.617	.2097	.667	.1759	.717	.1445	.767	.1152
.618	.2090	.668	.1752	.718	.1439	.768	.1146
.619	.2083	.669	.1746	.719	.1433	.769	.1141
.620	.2076	**.670**	.1739	**.720**	.1427	**.770**	.1135
.621	.2069	.671	.1733	.721	.1421	.771	.1129
.622	.2062	.672	.1726	.722	.1415	.772	.1124
.623	.2055	.673	.1720	.723	.1409	.773	.1118
.624	.2048	.674	.1713	.724	.1403	.774	.1113
.625	.2041	.675	.1707	.725	.1397	.775	.1107
.626	.2034	.676	.1701	.726	.1391	.776	.1102
.627	.2027	.677	.1694	.727	.1385	.777	.1096
.628	.2020	.678	.1688	.728	.1379	.778	.1090
.629	.2013	.679	.1681	.729	.1373	.779	.1085
.630	.2007	**.680**	.1675	**.730**	.1367	**.780**	.1079
.631	.2000	.681	.1668	.731	.1361	.781	.1073
.632	.1993	.682	.1662	.732	.1355	.782	.1068
.633	.1986	.683	.1655	.733	.1349	.783	.1062
.634	.1979	.684	.1649	.734	.1343	.784	.1057
.635	.1972	.685	.1643	.735	.1337	.785	.1051
.636	.1965	.686	.1637	.736	.1331	.786	.1046
.637	.1959	.687	.1630	.737	.1325	.787	.1040
.638	.1952	.688	.1624	.738	.1319	.788	.1035
.639	.1945	.689	.1618	.739	.1314	.789	.1029
.640	.1938	**.690**	.1612	**.740**	.1308	**.790**	.1024
.641	.1932	.691	.1605	.741	.1302	.791	.1018
.642	.1925	.692	.1599	.742	.1296	.792	.1013
.643	.1918	.693	.1593	.743	.1290	.793	.1007
.644	.1911	.694	.1586	.744	.1284	.794	.1002
.645	.1904	.695	.1580	.745	.1278	.795	.0996
.646	.1898	.696	.1574	.746	.1273	.796	.0991
.647	.1891	.697	.1568	.747	.1267	.797	.0985
.648	.1884	.698	.1562	.748	.1261	.798	.0980
.649	.1877	.699	.1555	.749	.1255	.799	.0975
.650	.1871	**.700**	.1549	**.750**	.1249	**.800**	.0969

TRANSPARENCY TO OPTICAL DENSITY CONVERSION TABLE (Continued)

Trans.	Density	Trans.	Density	Trans.	Density	Trans.	Density
.800	.0969	**.850**	.0706	**.900**	.0458	**.950**	.0223
.801	.0964	.851	.0701	.901	.0453	.951	.0218
.802	.0958	.852	.0696	.902	.0448	.952	.0214
.803	.0953	.853	.0690	.903	.0443	.953	.0209
.804	.0948	.854	.0685	.904	.0438	.954	.0204
.805	.0942	.855	.0680	.905	.0434	.955	.0200
.806	.0937	.856	.0675	.906	.0429	.956	.0195
.807	.0931	.857	.0670	.907	.0424	.957	.0191
.808	.0926	.858	.0665	.908	.0419	.958	.0186
.809	.0921	.859	.0660	.909	.0414	.959	.0182
.810	.0915	**.860**	.0655	**.910**	.0410	**.960**	.0177
.811	.0910	.861	.0650	.911	.0405	.961	.0173
.812	.0904	.862	.0645	.912	.0400	.962	.0168
.813	.0899	.863	.0640	.913	.0395	.963	.0164
.814	.0894	.864	.0635	.914	.0391	.964	.0159
.815	.0888	.865	.0630	.915	.0386	.965	.0155
.816	.0883	.866	.0625	.916	.0381	.966	.0150
.817	.0878	.867	.0620	.917	.0376	.967	.0146
.818	.0872	.868	.0615	.918	.0371	.968	.0141
.819	.0867	.869	.0610	.919	.0367	.969	.0137
.820	.0862	**.870**	.0605	**.920**	.0362	**.970**	.0132
.821	.0856	.871	.0600	.921	.0357	.971	.0128
.822	.0851	.872	.0595	.922	.0353	.972	.0123
.823	.0846	.873	.0590	.923	.0348	.973	.0119
.824	.0841	.874	.0585	.924	.0343	.974	.0114
.825	.0835	.875	.0580	.925	.0339	.975	.0110
.826	.0830	.876	.0575	.926	.0334	.976	.0106
.827	.0825	.877	.0570	.927	.0329	.977	.0101
.828	.0820	.878	.0565	.928	.0325	.978	.0097
.829	.0815	.879	.0560	.929	.0320	.979	.0092
.830	.0809	**.880**	.0555	**.930**	.0315	**.980**	.0088
.831	.0804	.881	.0550	.931	.0310	.981	.0083
.832	.0799	.882	.0545	.932	.0306	.982	.0079
.833	.0794	.883	.0540	.933	.0301	.983	.0074
.834	.0788	.884	.0535	.934	.0296	.984	.0070
.835	.0783	.885	.0530	.935	.0292	.985	.0066
.836	.0778	.886	.0526	.936	.0287	.986	.0061
.837	.0773	.887	.0521	.937	.0282	.987	.0057
.838	.0767	.888	.0516	.938	.0278	.988	.0052
.839	.0762	.889	.0511	.939	.0263	.989	.0048
.840	.0757	**.890**	.0506	**.940**	.0269	**.990**	.0044
.841	.0752	.891	.0501	.941	.0264	.991	.0039
.842	.0747	.892	.0496	.942	.0260	.992	.0035
.843	.0742	.893	.0491	.943	.0255	.993	.0030
.844	.0736	.894	.0487	.944	.0250	.994	.0026
.845	.0731	.895	.0482	.945	.0246	.995	.0022
.846	.0726	.896	.0477	.946	.0241	.996	.0017
.847	.0721	.897	.0472	.947	.0237	.997	.0013
.848	.0716	.898	.0467	.948	.0232	.998	.0009
.849	.0711	.899	.0462	.949	.0227	.999	.0004
.850	.0706	**.900**	.0458	**.950**	.0223	**1.000**	.0000

These pages are reserved for future expansion and revision of Section IV.

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DEFINITIONS AND FORMULAS

The chemical terms have been compiled with the collaboration of
B. Clifford Hendricks

AB-.—A prefix attached to the names of the practical electric units to indicate the corresponding unit in the cgs electromagnetic system (emu), e.g. abampere, abvolt.

Abcoulomb.—The abcoulomb, the emu of charge, is defined as the charge which passes a given surface in one second if a steady current of one abampere flows across the surface. Its dimensions are, therefore, $\text{cm}^{\frac{1}{2}}\,\text{gm}^{\frac{1}{2}}$, which differ from the dimensions of the statcoulomb by a factor which has the dimensions of a speed. This relationship is connected with the fact that the ratio $2K_e/K_m$ must have the value of the square of the speed of light in any consistent system of units. It follows further that

$$1 \text{ abcoulomb} = 2.998(10)^{10} \text{ statcoulomb},$$

the speed of light in vacuo being $2.998(10)^{10}$ cm/sec.

Abegg's rule.—For use in regard to a helical periodic system. If the maximum positive valence exhibited by an element be numerically added to its maximum negative valence, there is evidently a tendency for the sum to equal 8. This tendency is exhibited especially by the elements of the 4th, 5th, 6th and 7th groups and is known as Abegg's rule.

Absolute humidity.—See *Humidity*

Absolute pressure.—See *Pressure*

Absolute temperature.—Temperature reckoned from the absolute zero. See *Temperature*

Absolute units.—A system of units based on the smallest possible number of independent units. Specifically, units of force, work, energy and power not derived from or dependent on gravitation.

Absolute zero.—The temperature at which a gas would show no pressure if the general law for gases would hold for all temperatures. It is equal to $-273.16°$C or $-459.69°$F.

Absorption.—1. Penetration of a substance into the body of another. 2. Transformation into other forms suffered by radiant energy passing through a material substance.

Absorption coefficient.—See *Absorption factor*

Absorption factor.—The ratio of the intensity loss by absorption to the total original intensity of radiation. If I_o represents the original intensity, I_r, the intensity of reflected radiation, I_t, the intensity of the transmitted radiation, the absorption factor is given by the expression

$$\frac{I_o - (I_r + I_t)}{I_o}$$

Also called coefficient of absorption.

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Absorption, Lambert's law.—If I_o is the original intensity, I the intensity after passing through a thickness x of a material whose absorption coefficient is k,

$$I = I_o e^{-kx}$$

The **index of absorption** k' is given by the relation $k = (4\pi k'n)/\lambda$ where n is the index of refraction and λ the wave length in vacuo. The **mass absorption** is given by k/d when d is the density. The transmission factor is given by I/I_o.

Absorption spectrum.—The spectrum obtained by the examination of light from a source, itself giving a continuous spectrum, after this light has passed through an absorbing medium in the gaseous state. The absorption spectrum will consist of dark lines or bands, being the reverse of the emission spectrum of the absorbing substance.

When the absorbing medium is in the solid or liquid state the spectrum of the transmitted light shows broad dark regions which are not resolvable into lines and have no sharp or distinct edges.

Absorptive power or absorptivity for any body is measured by the fraction of the radiant energy falling upon the body which is absorbed or transformed into heat. This ratio varies with the character of the surface and the wave length of the incident energy. It is the ratio of the radiation absorbed by any substance to that absorbed under the same conditions by a black body.

Abvolt.—The cgs electromagnetic unit of potential difference and electromotive force. It is the potential difference that must exist between two points in order that one erg of work be done when one abcoulomb of charge is moved from one point to the other. One abvolt is 10^{-8} volt.

Acceleration.—The time rate of change of velocity in either speed or direction. Cgs unit,—one centimeter per second per second. Dimensions,—$[l\ t^{-2}]$.—See *Angular acceleration*

Acceleration due to gravity.—The acceleration of a body freely falling in a vacuum. The International Committee on Weights and Measures has adopted as a standard or accepted value, 980.665 cm/sec² or 32.174 ft/sec².

Acceleration due to gravity at any latitude and elevation.—If ϕ is the latitude and H the elevation in centimeters the acceleration in cgs units is, $g = 980.616 - 2.5928 \cos 2\phi + 0.0069 \cos^2 2\phi - 3.086 \times 10^{-6} H$. (Helmert's equation)

Accelerators.—Machines for speeding up subatomic particles to energies running into millions of electron volts.—See *Betatron, cyclotron*, etc.

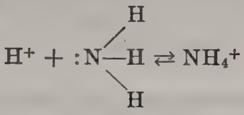
Achromatic.—A term applied to lenses signifying their more or less complete correction for chromatic aberration.

Acid.—For many purposes it is sufficient to say that an acid is a hydrogen-containing substance which dissociates on solution in water to produce one or more hydrogen ions. More generally, however, acids are defined according to other concepts. The Brönsted concept states that an acid is any compound which can furnish a proton. Thus NH_4^+ is an acid since it can give up a proton:

$$NH_4^+ \rightleftarrows NH_3 + H^+$$

and NH_3 is a base since it accepts a proton.

A still more general concept is that of G. N. Lewis which defines an acid as anything which can attach itself to something with an unshared pair of electrons. Thus in the reaction



the NH_3 is a base because it possesses an unshared pair of electrons. This latter concept explains many phenomena, such as the effect of certain substances other than hydrogen ions in the changing of the color of indicators. It also explains acids and bases in non-aqueous sytems as liquid NH_3 and SO_2.

Actinide Series.—Elements of atomic numbers 89 to 103 analogous to the lanthanide series of the so-called rare earths.

Action is measured by the product of work by time. Cgs units of action are the erg-second and the joule-second. Dimensions,—$[m\ l^2\ t^{-1}]$. Planck's quantum or constant of action is 6.554×10^{-27} erg-seconds.

Active mass of a substance is the number of gram molecular weights per liter in solution, or in gaseous form.

Activity coefficient.—A factor which, when multiplied by the molecular concentration yields the active mass. The activity coefficient is evaluated by thermodynamic calculations, usually from data on the emf of certain cells, or the lowering of the freezing point of certain solutions. It is a correction factor which makes the thermodynamic calculations correct.

Adiabatic.—A body is said to undergo an adiabatic change when its condition is altered without gain or loss of heat. The line on the pressure volume diagram representing the above change is called an adiabatic line.

Adsorption.—The condensation of gases, liquids, or dissolved substances on the surfaces of solids is called adsorption.

Air columns, frequency of vibration in—See *Organ pipes*

Allobar.—A form of an element differing in isotopic composition from the naturally occurring form.

Allotropy.—The property shown by certain elements or being capable of existence in more than one form, due to differences in the arrangement of atoms or molecules.—See *Monotropic* and *Enantiotropic*

Alpha (α)-particle, or alpha-ray.—One of the particles emitted in radioactive decay. It is identical with the nucleus of the helium atom and consists, therefore, of two protons plus two neutrons bound together. A moving alpha particle is strongly ionizing and so loses energy rapidly in traversing through matter. Natural alpha particles will traverse only a few centimeters of air before coming to rest.

Alternating current, (A-C).—Current in which the charge-flow periodically reverses, as opposed to direct current, and whose average value is zero. Alternating current usually implies a sinusoidal variation of current and voltage. This behavior is represented mathematically in various ways:

$$\mathrm{I} = I_0 \cos (2\pi ft + \phi)$$
$$\mathrm{I} = I_0 \angle\phi$$
$$\mathrm{I} = I_1 e^{j\omega t}$$

where f is the frequency; $\omega \equiv 2\pi f$, the pulsatance, or radian frequency; ϕ the phase angle; I_0 the amplitude; and I_1 the complex amplitude. In the complex rotation, it is understood that the actual current is the real part of I. For circuits involving also a capacitance C in farads and L in henrys, the impedance becomes,

$$\sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC}\right)^2}$$

Altitudes with the barometer.—If b_1 and b_2 denote the corrected barometer readings at two stations, t the mean of the temperatures, t_1 and t_2 of the air at the two stations, e_1 and e_2 the tension of water vapor at the two stations, h the mean height above sea level, ϕ the latitude; then the difference in elevation in centimeters is $H = 1{,}843{,}000 (\log b_1 - \log b_2) (1 + 0.00367t) (1 + 0.0026 \cos 2\phi + 0.00002h + \frac{3}{8}k)$, where

$$k = \tfrac{1}{2}\left(\frac{e_1}{b_1} + \frac{e_2}{b_2}\right)$$

An approximate formula, sufficient for differences not over 1000 meters is

$$H = 1{,}600{,}000 \frac{b_1 - b_2}{b_1 + b_2} (1 + 0.004t).$$

Amorphous.—Without definite form, not crystallized.

Ampere's rule.—A positive charge moving horizontally is deflected by a force to the right if it is moving in a region where the magnetic field is vertically upward. This may be generalized to currents in wires by recalling that a current in a certain direction is equivalent to the motion of positive charges in that direction. The force felt by a negative charge is opposite to that felt by a positive charge.

Amplitude.—The maximum value of the displacement in an oscillatory motion.

AMU.—The atomic mass unit, a unit of mass equal to one-sixteenth the mass of the atom of oxygen of mass number 16.

$$1 \text{ amu} = 1.657 \times 10^{-24} \text{ grams.}$$

In terms of energy, 1 amu = 931 mev = 1.49×10^{-3} ergs.

Angle.—The ratio between the arc and the radius of the arc. Units of angle,—the radian, the angle subtended by an arc equal to the radius; the degree, $\frac{1}{360}$ part of the total angle about a point. Dimensions,—a numeric.

Angstrom.—A unit of length, used especially in expressing the length of light waves, equal to one ten-thousandth of a micron, or one hundred-millionth of a centimeter (1×10^{-8} cm).

Angular acceleration.—The time rate of change of angular velocity either in angular speed or in direction of the axis of rotation (precession). Cgs unit,—one radian per second per second. Dimensions,—$[t^{-2}]$.

If the initial angular velocity is ω_o, and the velocity after time t is ω_t, the angular acceleration,

$$\alpha = \frac{\omega_t - \omega_o}{t}$$

The angular velocity after time t,

$$\omega_t = \omega_o + \alpha t$$

The angle swept out in time t,

$$\theta = \omega_o t + \tfrac{1}{2}\alpha t^2$$

The angular velocity after movement through the arc θ,

$$\omega = \sqrt{\omega_o{}^2 + 2\alpha\theta}$$

In the above equations, for angular displacement in radians, angular velocity will be in radians per second and angular acceleration in radians per second per second.

Angular aperture of an objective is the largest angular extent of wave surface which it can transmit.

Angular harmonic motion or harmonic motion of rotation.—Periodic, oscillatory angular motion in which the restoring torque is proportional to the angular displacement. Torsional vibration.

Angular momentum or moment of momentum.—Quantity of angular motion measured by the product of the angular velocity and the moment of inertia. Cgs unit,—unnamed, its nature is expressed by g-cm²/sec. Dimensions,—$[m\, l^2\, t^{-1}]$.

The angular momentum of a mass whose moment of inertia is I, rotating with angular velocity ω, is $I\omega$.

Angular velocity.—Time rate of angular motion about an axis. Cgs unit,—one radian per second. Dimensions,—$[t^{-1}]$.

If the angle described in time t is θ, the angular velocity,

$$\omega = \frac{\theta}{t}$$

θ in radians and t in seconds gives ω in radians per second.

Anhydride (of acid or base).—An oxide which when combined with water gives an acid or base.

Anion.—A negatively charged ion.

Anode.—The electrode at which oxidation occurs in a cell. It is also the electrode toward which anions travel due to the electrical potential. In spontaneous cells the anode is considered negative. In non-spontaneous or electrolytic cells the anode is considered positive.

Apochromat.—A term applied to photographic and microscope objectives indicating the highest degree of color correction.

Archimedes principle.—A body wholly or partly immersed in a fluid is buoyed up by a force equal to the weight of the fluid displaced. A body of volume V cm^3 immersed in a fluid of density ρ grams per cm^3 is buoyed up by a force in dynes,

$$F = \rho g V$$

where g is the accleration due to gravity.

A floating body displaces its own weight of liquid.

Area, unit of.—The square centimeter. The area of a square whose sides are one centimeter in length. Other units of area are similarly derived. Dimensions,—$[l^2]$.

Arrhenius theory of electrolytic dissociation states that the molecule of an electrolyte can give rise to two or more electrically charged atoms or ions.

Astigmatism is an error of spherical lenses peculiar to the formation of images by oblique pencils. The image of a point when astigmatism is present will consist of two focal lines at right angles to each other and separated by a measurable distance along the axis of the pencil. The error is not eliminated by reduction of aperture as is spherical aberration.

Atom.—The smallest particle of an element which can enter into a chemical *combination*. All chemical compounds are formed of atoms, the difference between compounds being attributable to the nature, number, and arrangement of their constituent atoms.—See *isotopes, nuclear atom*

Atomic bomb.—An explosive that derives its energy from the fission of atomic nuclei.

Atomic energy.—1. The constitutive internal energy of the atom which was absorbed when it was formed. 2. Energy derived from the mass converted into energy in nuclear transformations.—See *Einstein's formula*

Atomic mass (**atomic weight**).—The mass of a neutral atom of a nuclide. It is usually expressed in terms of the physical scale of atomic masses, that is, in atomic mass units (amu). See AMU

Atomic number.—The number (Z) of protons within the atomic nucleus. The electrical charge of these protons determines the number and arrangement of the outer electrons of the atom, and thereby the chemical and physical properties of the element.

Atomic structure.—According to the currently accepted view, the atom consists of a central part, called nucleus, and a number of *electrons* (called orbital or planetary electrons) circling about the latter, like planets about the sun. The nucleus is of a high specific weight; it contains most of the mass of the entire atom (its mass is considered equal to the atomic mass) and is composed of positively charged particles, called *protons* (the number of which always equals the atomic number, (Z), and particles of 0 charge, called neutrons (the number of which equals the difference between the atomic weight and the atomic number, $A - Z$). The diameter of the nucleus is between 10^{-13} and 10^{-12} cm, and the relatively vast distance in which the orbital electrons circle about it is illustrated by the fact that this nuclear diameter is only 10^{-4} to 10^{-5} of the entire atomic diameter. While the nucleus carries an integral number of positive charges (an integral number of protons) each of $1{\cdot}6 \times 10^{-19}$ coulomb, each electron carries one negative charge of $1{\cdot}6 \times 10^{-19}$ coulomb, and the number of orbital electrons is equal to the number of protons in the nucleus (i.e. to the atomic number, Z), so that the atom as a whole has a net charge of 0. The electrons are arranged in successive shells (q.v.) around the nucleus; the maximum number of electrons in each shell is determined by natural laws, and the extranuclear electronic structure of the atom is characteristic of the element. The electrons in the inner shells are tightly bound to the nucleus; this inner structure can be altered by high-energy particles, γ-rays of radium, or x-rays. The electrons in the outer shells are responsible for the chemical properties of the element.—See *Bohr's atomic theory*, *Heisenberg's theory*, *shell and subshell*

Atomic theory.—All elementary forms of matter are composed of very small unit quantities called atoms. The atoms of a given element all have the same size and weight. The atoms of different elements have different sizes and weights. Atoms of the same or different elements unite with each other to form very small unit quantities of compound substances called molecules.

Atomic weight.—Atomic weight is the relative weight of the atom on the basis of oxygen as 16. For a pure isotope, the atomic weight rounded off to the nearest integer gives the total number of nucleons (neutrons and protons) making up the atomic nucleus. If these weights are expressed in grams they are called gram atomic weights.—See *Isotopes and Atomic Mass*

Avogadro's law.—Equal volumes of different gases at the same pressure and temperature contain the same number of molecules.

Avogadro's number.—The number of molecules in one mole or gram-molecular weight of a substance. A number of values of the Avogadro number, which is usually denoted by N, have been found by various methods, generally lying within a range of 1% about the value 6.02×10^{23}.

Avogadro's principle (or theory).—The numbers of molecules present in equal volumes of gases at the same temperature and pressure are equal.

Babo's law.—The addition of a non-volatile solid to a liquid in which it is soluble lowers the vapor pressure of the solvent in proportion to the amount of substance dissolved.

Balmer series of spectral lines. The wave lengths of a series of lines in the spectrum of hydrogen are given in angstroms by the equation

$$\lambda = 3646 \frac{N^2}{N^2 - 4}$$

where N is an integer having values greater than 2.

Bar.—International unit of pressure 10^6 dyne/cm². Unfortunately some writers have used this term for 1 dyne/cm². 1 bar = 0.987 atmosphere.

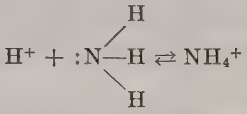
Barn.—Unit for measuring capture cross sections (q.v.) of elements. One barn = 10^{-24} cm² per nucleus.

Barye.—Cgs pressure unit = one dyne/cm².

Bases.—For many purposes it is sufficient to say that a base is a substance which dissociates on solution in water to produce one or more hydroxyl ions. More generally, however, bases are defined according to other concepts. The Brönsted concept states that a base is any compound which can accept a proton. Thus NH_3 is a base since it can accept a proton to form ammonium ions.

$$NH_3 + H^+ \rightleftarrows NH_4^+$$

A still more general concept is that of G. N. Lewis which defines a base as anything which has an unshared pair of electrons. Thus in the reaction



$$H^+ + :\overset{H}{\underset{H}{N}}-H \rightleftarrows NH_4^+$$

the NH_3 is a base because it possesses an unshared pair of electrons. This latter concept explains many phenomena, such as the effect of certain substances other than hydrogen ions in the changing of the color of indicators. It also explains acids and bases in non-aqueous systems as liquid NH_3 and SO_2.

Beat(s).—Two vibrations of slightly different frequencies f_1 and f_2 when added together, produce in a detector sensitive to both these frequencies, a regularly varying response which rises and falls at the "beat" frequency $f_b = |f_1 - f_2|$. It is important to note that a resonator which is sharply tuned to f_b alone will not resound at all in the presence of these two beating frequencies.—See *Combination Frequencies*

Beat frequencies.—The beat of two different frequencies of signals on a non-linear circuit when they combine or beat together. It has a frequency equal to the difference of the two applied frequencies.

Beer's law.—If two solutions of the same colored compound be made in the same solvent, one of which is, say, twice the concentration of the other, the absorption due to a given thickness of the first solution should be equal to that of twice the thickness of the second.

Mathematically this may be expressed $l_1c_1 = l_2c_2$ when the intensity of light passing through the two solutions is a constant and if the intensity and wave length of light incident upon each solution are the same.

Bernoulli's theorem.—At any point in a tube through which a liquid is flowing the sum of the pressure energy, potential energy, and kinetic energy is constant. If p is pressure; h, height above a reference plane; d, density of the liquid, and v, velocity of flow,

$$p + hdg + \tfrac{1}{2}\, dv^2 = \text{a constant.}$$

Berthelot principle of maximum work.—Of all possible chemical processes which can proceed without the aid of external energy, that process always takes place which is accompanied by the greatest evolution of heat. This law holds good for low temperatures only and does not account for endothermic reactions.

Beta (β)**-particle, (Beta ray).**—One of the particles which can be emitted by a radioactive atomic nucleus. It has a mass about $\frac{1}{1837}$ that of the proton. The negatively charged beta particle is identical with the ordinary electron, while the positively charged type (positron) differs from the electron in having equal but opposite electrical properties. The emission of an electron entails the change of a neutron into a proton inside the nucleus. The emission of a positron is similarly associated with the change of a proton into a neutron. Beta particles have no independent existance inside the nucleus, but are created at the instant of emission.—See *Neutrino*

Betatron.—An accelerator used to impart high velocities to electrons (beta particles). Propellant is an electromagnetic field. A five to six Mev betatron can produce X-rays equivalent to the gamma readiation of 10 to 20 grams of radium.

Bevatron.—A six or more billion electron volt accelerator of protons and other atomic particles. Makes use of a Cockcroft-Walton transformer cascade accelerator and a linear (q.v.) as well as an electromagnetic field in the build-up.

Black body.—If, for all values of the wave length of the incident radiant energy, all of the energy is absorbed the body is called a black body.

Bohr's atomic theory.—The theory that atoms can exist for a duration solely in certain states, characterized by definite electronic orbits, i.e. by definite energy levels of their extranuclear electrons, and in these stationary states they do not emit radiation; the jump of an electron from an orbit to another of a smaller radius is accompanied by monochromatic radiation.

Boyle's law for gases.—At a constant temperature the volume of a given quantity of any gas varies inversely as the pressure to which the gas is subjected. For a perfect gas, changing from pressure p and volume v to pressure p' and volume v' without change of temperature,

$$pv = p'v'$$

Breeder, Reactor (Breeder pile).—A nuclear chain reactor in which transmutation produces a greater number of fissionable atoms than the number of parent atoms consumed.

Brewster's law.—The tangent of the polarizing angle for a substance is equal to the index of refraction. The polarizing angle is that angle of incidence for which the reflected polarized ray is at right angles to the refracted ray. If n is the index of refraction and θ the polarizing angle, $n = \tan \theta$.

Brightness is measured by the flux emitted per unit emissive area as projected on a plane normal to the line of sight. The unit of brightness is that of a perfectly diffusing surface giving out one lumen per square centimeter of projected surface and is called the lambert. The millilambert (0.001 lambert) is a more convenient unit. **Candle per square centimeter** is the brightness of a surface which has, in the direction considered, a luminous intensity of one candle per cm^2.

British thermal unit.—The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at, or near, its point of maximum density (39.1°F). The btu is eqivalent to 0.252 kilogram-colorie.

Brownian movement.—A continuous agitation of particles in a colloidal solution caused by unbalanced impacts with molecules of the surrounding medium. The motion may be observed with a microscope when a strong beam of light is caused to traverse the solution across the line of sight.

Bulk modulus.—The modulus of volume elasticity,

$$M_B = \frac{p_2 - p_1}{\dfrac{v_1 - v_2}{v_1}}$$

where p_1, p_2; v_1, v_2 are the initial and final pressure and volume respectively.

Calorie.—The amount of heat necessary to raise 1 gram of water at 15°C, 1°C.

Calutron.—An apparatus operating on the principle of the mass spectrograph and used for separating U^{235} from U^{238}.

Candle (or International Candle).—The candle is the unit of luminous intensity. It is a specified fraction of the average horizontal candlepower of a group of 45 carbon-filament lamps preserved at the Bureau of Standards.

Candle (new unit).—$\frac{1}{60}$ of the intensity of one square centimeter of a blackbody radiator at the temperature of solidification of platinum (2,046°K).

Capacitance is measured by the charge which must be communicated to a body to raise its potential one unit. Electrostatic unit capacitance is that which requires one electrostatic unit of charge to raise the potential one electrostatic unit. The farad = 9×10^{11} electrostatic units. A capacitance of one farad requires one coulomb of electricity to raise its potential one volt. Dimensions,—$[\epsilon\, l]$; $[\mu^{-1}\, l^{-1}\, t^2]$.

A conductor charged with a quantity Q to a potential V has a capacitance,

$$C = \frac{Q}{V}$$

Capacitance of a spherical conductor of radius r,

$$C = Kr$$

Capacitance of two concentric spheres of radii r and r'

$$C = K\frac{rr'}{r - r'}$$

Capacitance of a parallel plate condenser, the area of whose plates is A and the distance between them d,

$$C = \frac{KA}{4\pi d}$$

Capacitances will be given in electrostatic units if the dimensions of condensers are substituted in cm. K is the dielectric constant of the medium.

Capillary constant or specific cohesion,

$$a^2 = \frac{2T}{(d_1 - d_2)g} = hr$$

where T is surface tension, d_1 and d_2, the densities of the two fluids, g the acceleration due to gravity, h the height of rise in a capillary tube of radius r.—See *Surface tension*

Carnot cycle.—A sequence of operations forming the working cycle of an ideal heat engine of maximum thermal efficiency. It consists of isothermal expansion, adiabatic expansion, isothermal compression, and adiabatic compression to the initial state.

Catalytic agent.—A substance which by its mere presence alters the velocity of a reaction, and may be recovered unaltered in nature or amount at the end of the reaction.

Cathode.—The electrode at which reduction occurs. It is the negative electrode in a cell through which current is being forced, but it is the positive pole of a battery. In a vacuum tube, the cathode is the electrode from which electrons are liberated.—See *Anode*

Cation.—A positively charged ion.

Cauchy's dispersion formula.

$$n = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} + \cdots$$

An empirical expression giving an approximate relation between the refractive index n of a medium and the wavelength λ of the light; A, B, and C being constants for a given medium.

Centipoise.—A standard unit of *viscosity*, equal to 0.01 poise, the c.g.s. unit of viscosity. Water at 20°C has a viscosity of 1.002.

Centripetal force.—The force required to keep a moving mass in a circular path. Centrifugal force is the name given to the reaction against centripetal force.

Chain Reaction.—In general, any self-sustaining process, whether molecular or nuclear, the products of which are instrumental in, and directly contribute to the propagation of the process. Specifically, a *fission chain reaction*, where the energy liberated or particles produced (fission products) by the fission of an atom cause the fission of other atomic nuclei, which in turn propagate the fission reaction in the same manner.

Charles' law or Gay-Lussac's law.—The volumes assumed by a given mass of a gas at different temperatures, the pressure remaining constant, are, within moderate ranges of temperature, directly proportional to the corresponding absolute temperatures.

Chemiluminescence.—Emission of light during a chemical reaction.

Christiansen effect.—When finely powdered substances, such as glass or quartz, are immersed in a liquid of the same index of refraction complete transparency can only be obtained for monochromatic light. If white light is employed the transmitted color corresponds to the particular wave-length for which the two substances, solid and liquid have exactly the same index of refraction. Due to differences in dispersion the indices of refraction will match for only a narrow band of the spectrum.

Chromatic aberration.—Due to the difference in the index of refraction for different wave lengths, light of various wave lengths from the same source cannot be focused at a point by a simple lens. This is called chromatic aberration.

Cloud chamber.—An apparatus containing moist air or other gas which on sudden expansion condenses moisture to droplets on dust particles or other nuclei. Thus charged particles or ions in the space become nuclei and their numbers and behavior, when properly illuminated, may be studied.

Colligative property.—A property numerically the same for a group of substances, independent of their chemical nature.

Colloid.—A phase dispersed to such a degree that the surface forces become an important factor in determining its properties.

In general particles of colloidal dimensions are approximately 10 angstroms to 1 micron in size. Colloidal particles are often best distinguished from ordinary molecules due to the fact that colloidal particles cannot diffuse through membranes which do allow ordinary molecules and ions to pass freely.

Coma.—An aberration of spherical lenses, occurring in the case of oblique incidence, when the bundle of rays forming the image is unsymmetrical. The image of a point is comet shaped, hence the name.

Combination frequencies.—Two vibrations of arbitrary frequencies f_1 and f_2 when applied simultaneously to a nonlinear (distorting) device will excite it to a motion containing not only the original frequencies, but also members of a set of "combination" frequencies given by $f_c = mf_1 + nf_2$ where m and n are integers. A resonator sharply tuned to any one of these frequencies which may be produced in the nonlinear device will resound to it with an amplitude depending on the type of nonlinearity. The superheterodyne radio receiver depends on this phenomenon.

Combining volumes.—Under comparable conditions of pressure and temperature the volume ratios of gases involved in chemical reactions are simple whole numbers.

Combining weight of an element or radical is its atomic weight divided by its valence.

Combining weights, law of.—If the weights of elements which combine with each other be called their "combining weights," then elements always combine either in the ratio of their combining weights or of simple multiples of these weights.

Component substances, law of.—Every material consists of one substance, or is a mixture of two or more substances, each of which exhibits a specific set of properties, independent of the other substances.

Compounds are substances containing more than one constituent element and having properties, on the whole, different from those which their constituents had as elementary substances. The composition of a given pure compound is perfectly definite, and is always the same no matter how that compound may have been formed.

Compressibility.—Reciprocal of the bulk modulus.

Compton effect, (Compton recoil effect).—Elastic scattering of photons by electrons results in decrease in frequency and increase of wave length of x-rays and gamma-rays when scattered by free electrons.

Concentration.—The amount of a substance in weight, moles, or equivalents contained in unit volume.

Condensers in parallel and series.—If c_1, c_2, c_3, etc. represent the capacitances of a series of condensers and C their combined capacitance,—

when in parallel, $C = c_1 + c_2 + c_3 \cdots$

when in series, $\frac{1}{C} = \frac{1}{c_1} + \frac{1}{c_2} + \frac{1}{c_3} \cdots$

Conductance, the reciprocal of resistance, is measured by the ratio of the current flowing through a conductor to the difference of potential between its ends. The practical unit of conductance, the mho, the conductance of a body through which one ampere of current flows when the potential difference is one volt. The conductance of a body in mho is the reciprocal of the value of its resistance in ohms. Dimensions,—$[\epsilon\, l\, t^{-1}]\cdot[\mu^{-1}\, l^{-1}\, t]$.

Conductivity, electrical, is measured by the quantity of electricity transferred across unit area, per unit potential gradient per unit time. Reciprocal of resistivity. **Volume conductivity** or specific conductance, $k = 1/\rho$ where ρ is the volume resistivity. **Mass conductivity** $= k/d$ where d is density. **Equivalent conductivity** $\Lambda = k/c$ where c is the number of equivalents per unit volume of solution. **Molecular conductivity** $\mu = k/m$ where m is the number of moles per unit volume of solution. Dimensions: volume conductivity,—$[\epsilon\, t^{-1}]$; $[\mu^{-1}\, l^{-2}\, t]$,—mass conductivity,—$[\epsilon\, m^{-1}\, l^3\, t^{-1}]$; $[\mu^{-1}\, m^{-1}\, lt]$.

Conductivity, thermal.—Time rate of transfer of heat by conduction, through unit thickness, across unit area for unit difference of temperature. It is measured as calories per second per square centimeter for a thickness of one centimeter and a difference of temperature of 1°C. Dimensions,—$[m\, l\, t^{-3}\, \theta^{-1}]$.

If the two opposite faces of a rectangular solid are maintained at temperatures t_1 and t_2 the heat conducted across the solid of section a and thickness d in a time T will be,

$$Q = \frac{K(t_2 - t_1)aT}{d}$$

K is a constant depending on the nature of the substance, designated as the specific heat conductivity. K is usually given for Q in calories, t_1 and t_2 in °C, a in cm², T in sec, and d in cm.—See *Heat conductivity*

Conductors.—A class of bodies which are incapable of supporting electric strain. A charge given to a conductor spreads to all parts of the body.

Conjugate foci.—Under proper conditions light divergent from a point on or near the axis of a lens or spherical mirror is focused at another point. The point of convergence and the position of the source are interchangeable and are called conjugate foci.

Conservation of energy, (Chem).—In a chemical change there is no loss or gain but merely a transformation of energy from one form to another.

Conservation of energy, law of.—Energy can neither be created nor destroyed and therefore the total amount of energy in the universe remains constant.

Conservation of mass.—In all ordinary chemical changes, the total of the reactants is always equal to the total mass of the products.

Conservation of momentum, law of.—For any collision, the vector sum of the momenta of the colliding bodies after collision equals the vector sum of their momenta before collision. If two bodies of masses m_1 and m_2 have, before impact velocities v_1 and v_2 and after impact velocities u_1 and u_2.

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

Constitutive property.—A property which depends on the constitution or structure of the molecule.

Cooling.—Processing highly radioactive materials to attain lesser radioactivity for subsequent use or handling.

Cosmic rays.—Highly penetrating radiations which strike the earth, assumed to originate in interstellar space. They are classed as: primary, coming from the assumed source, and secondary, those induced in upper atmospheric nuclei by collisions with primary cosmic rays.

Cosmotron.—A particle accelerator capable of giving them energies to billions of electron volts.

Coulomb.—A unit quantity of electricity. It is the quantity of electricity which must pass through a circuit to deposit 0.0011180 grams of silver from a solution of silver nitrate. An ampere is one coulomb per second. A coulomb is also the quantity of electricity on the positive plate of a condenser of one-farad capacity when the electromotive force is one volt.

Couple.—Two equal and oppositely directed parallel but not colinear forces acting upon a body form a couple. The moment of the couple or torque is given by the product of one of the forces by the perpendicular distance between them. Dimension,—$[m\ l^2\ t^{-2}]$.

Couple acting on a magnet of magnetic moment ml in a field of strength H. If the magnet is perpendicular to the direction of the field

$$C = Hml = HM$$

If the angle between the magnet and the field is θ

$$C = Hml \sin \theta$$

The couple will be in dyne-cm for cgs electromagnetic units of H, m and l.

Critical mass.—The minimum mass the fissile material must have in order to maintain a spontaneous fission chain reaction. For pure U^{235} it is computed to be about 20 pounds.

Critical temperature is that temperature above which a gas cannot be liquefied by pressure alone. The pressure under which a substance may exist as a gas in equilibrium with the liquid at the critical temperature is the **critical pressure.**

Cross section, (Nuclear cross section).—A measure of the probability of a particular process. The nuclear cross section is expressed by a/bc, where a is the number of processes occurring, b the number of incident particles, and c the number of target nuclei per cm^2. There are nuclear cross sections for fission, for slow neutron capture, for Compton collision, and for ionization by electron impact.

Cryohydrate.—The solid which separates when a saturated solution freezes. It contains the solvent and the solute in the same proportions as they were in the saturated solution.

Crystal.—A homogeneous portion of a substance bounded by plane surfaces making definite angles with each other, giving a regular geometrical form.

Curie.—Unit for measuring radioactivity. One Curie = that quantity of any radioactive isotope undergoing 3.7×10^{10} disintegrations per second.

Curie's law.—The intensity of magnetization,

$$I = \frac{AH}{T}$$

where H, is the magnetic field strength, T the absolute temperature and A Curie's constant. Used for paramagnetic substances.

Curie point.—All ferro-magnetic substances have a definite temperature of transition at which the phenomena of ferromagnetism disappear and the substances become merely paramagnetic. This temperature is called the "Curie Point" and is usually lower than the melting point.

Curie-Weiss law.—The Curie law was modified by Weiss to state that the susceptibility of a paramagnetic substance above the Curie point varies inversely as the excess of the temperature above that point.

This law is not valid at or below the Curie point.

Current (electric).—The rate of transfer of electricity. The transfer at the rate of one electrostatic unit of electricity in one second is the electrostatic unit of current. The electromagnetic unit of current is a current of such strength that one centimeter of the wire in which it flows is pushed sideways with a force of one dyne when the wire is at right angles to a magnetic field of unit intensity. The practical unit of current is the **ampere,** a transfer of one coulomb per second, which is one tenth the electromagnetic unit. The **international ampere** is the unvarying electric current which, when passed through a solution of silver nitrate in accordance with certain specifications, deposits silver at the rate of 0.00111800 gram per second. The international ampere is equivalent to 0.999835 absolute ampere. The **ampere-turn** is the magnetic potential produced between the two faces of a coil of one turn carrying one ampere. Dimensions,—$[\epsilon^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{3}{2}}\ t^{-2}]$; $[\mu^{-\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{1}{2}}\ t^{-1}]$.

Current in a simple circuit.—The current in a circuit including an external resistance R and a cell of electromotive force E and internal resistance r,

$$I = \frac{E}{R + r}$$

If E is in volts and r and R in ohms the current will be in amperes.

For two cells in parallel,

$$I = \frac{E}{R + \frac{r}{2}}$$

For two cells in series,

$$I = \frac{2E}{R + 2r}$$

Cyclotron.—The magnetic resonance accelerator for imparting very great velocities to heavier nuclear particles without the use of excessive voltages.

Dalton's law of partial pressures.—The pressure exerted by a mixture of gases is equal to the sum of the separate pressures which each gas would exert if it alone occupied the whole volume. This fact is expressed in the following formula:

$$PV = V(p_1 + p_2 + p_3, \text{etc.})$$

Decay.—Diminution of a radioactive substance due to nuclear emission of alpha or beta particles, gamma rays or positrons.

Declination.—The angle between the vertical plane containing the direction of the earth's field at any point and a plane containing the geographic north and south meridian.

Decomposition is the chemical separation of a substance into two or more substances, which may differ from each other and from the original substances.

Definite proportions, law of.—In every sample of each compound substance the proportions by weight of the constituent elements are always the same.

Degree of freedom.—The number of the variables determining the state of a system (usually pressure, temperature, and concentrations of the components) to which arbitrary values can be assigned.

Density.—Concentration of matter, measured by the mass per unit volume. Dimensions,—$[m\ l^{-3}]$.

Deuteron.—Nucleus of the deuterium atom or the ion of deuterium. Its structure—one neutron and one proton.

Dew point.—The temperature at which condensation of water vapor in the air takes place.

Diamagnetic materials.—Are those within which an externally applied magnetic field is slightly reduced because of an alteration of the atomic electron orbits produced by the field. Diamagnetism is an atomic-scale consequence of the Lenz law of induction. The permeability of diamagnetic materials is slightly less than that of empty space.

Dielectric constant of a medium is defined by ϵ in the equation

$$F = \frac{QQ'}{\epsilon r^2}$$

where F is the force of attraction between two charges Q and Q' separated by a distance r in a uniform medium.

Dielectrics or insulators or non-conductors.—A class of bodies supporting an electric strain. A charge on one part of a non-conductor is not communicated to any other part.

Diffraction.—That phenomena produced by the spreading of waves around and past obstacles which are comparable in size to their wavelength.

Diffraction grating.—If s is the distance between the rulings, d the angle of diffraction, then the wave length where the angle of incidence is 90° is (for the nth order spectrum),

$$\lambda = \frac{s \sin d}{n}$$

If i is the angle of incidence, d the angle of diffraction, s the distance between the rulings, n the order of the spectrum, the wave length is, $\lambda = \frac{s}{n} (\sin i + \sin d)$.

Diffusion.—If the concentration (mass of solid per unit volume of solution) at one surface of a layer of liquid is d_1 and at the other surface d_2, the thickness of the layer h and the area under consideration A, then the mass of the substance which diffuses through the cross-section A in time t is,

$$m = \Delta A \frac{(d_2 - d_1)t}{h}$$

where Δ is the coefficient of diffusion.

Diffusivity or coefficient of diffusion is also given by Δ in the equation

$$\frac{dQ}{dt} = -\Delta \left(\frac{dc}{dx}\right) dy\, dz$$

where dQ is the amount passing through an area $dy\, dz$ in the direction of x in a time dt where dc/dx is the rate of increase of volume concentration in the direction of x. Dimensions,—$[l^2\, t^{-1}]$.

Diffusivity of heat is given by Δ in the equation

$$\frac{dH}{dt} = -\Delta s d \frac{dT}{dx}\, dy\, dz$$

where dH is the quantity of heat passing through the area $dy\,dz$ in the direction of x in a time dt. The rate of variation of temperature along x is given by dT/dx, s is specific heat and d, density. Dimensions,—$[l^2\,t^{-1}]$.

Dimensional formulae.—If mass, length, and time are considered fundamental quantities, the relation of other physical quantities and their units to these three may be expressed by a formula involving the symbols l, m and t respectively, with appropriate exponents. For example; the dimensional formula for volume would be expressed,—$[l^3]$; velocity,—$[lt^{-1}]$; force—$[m\,lt^{-2}]$. Other fundamental quantities used in dimensional formulae may be indicated as follows: θ, temperature, ϵ the dielectric constant of a vacuum; μ, the magnetic permeability of a vacuum.

Diminution of pressure at the side of a moving stream. If a fluid of density d moves with a velocity v, the diminution of pressure due to the motion is (neglecting viscosity),

$$p = \tfrac{1}{2}\,dv^2$$

Dip.—The angle measured in a vertical plane between the direction of the earth's magnetic field and the horizontal.

Dipole.—(1) A combination of two electrically or magnetically charged particles of opposite sign which are separated by a very small distance. (2) Any system of charges, such as a circulating current, which has the properties that: (a) no forces act on it in a uniform field; (b) a torque proportional to $\sin\,\theta$, where θ is the angle between the dipole axis and a uniform field, does act on it; (c) it produces a potential which is proportional to the inverse square of the distance from it.

Dipole moment.—A mathematical entity; the product of one of the charges of a dipole unit by the distance separating the two dipolar charges. In terms of the definition of a dipole (2), the dipole moment $\mathbf{p}$ is related to the torque $\mathbf{T}$, and the field strength $\mathbf{E}$ (or $\mathbf{B}$) through the equation:

$$\mathbf{T} = \mathbf{p} \times \mathbf{E}.$$

Dipole moment, molecular.—It is found from measurements of dielectric constant (i.e. by its temperature dependence, as in the **Debye equation for total polarization**) that certain molecules have permanent dipole moments. These moments are associated with transfer of charge within the molecule, and provide valuable information as to the molecular structure.

Dispersion.—The difference between the index of refraction of any substance for any two wave lengths is a measure of the dispersion for these wave lengths, called the coefficient of dispersion.

Dispersion forces.—The force of attraction between molecules possessing no permanent **dipole.** The interaction energy is given by

$$U_D = -\frac{3}{4}\,h\,\frac{V_0\alpha^2}{r^6}$$

where h is Planck's constant, V_0 a characteristic frequency of the molecule, r the distance between the molecules, and α the polarizability.

Dispersive power. If n_1 and n_2 are the indices of refraction for wave lengths λ_1 and λ_2 and n the mean index or that for sodium light, the dispersive power for the specified wave length is,

$$\omega = \frac{n_2 - n_1}{n - 1}$$

Displacement is a reaction in which an elementary substance displaces and sets free a constituent element from a compound.

Displacement or elongation at any instant. The distance of a vibrating or oscillating particle from its position of equilibrium.

Distribution law.—A substance distributes itself between two immiscible solvents so that the ratio of its concentrations in the two solvents is approximately a constant (and equal to the ratio of the solubilities of the substance in each solvent). The above statement requires modification if more than one molecular species is formed.

Doppler effect, (Light).—The apparent change in the wave-length of light produced by the motion in the line of sight of either the observer or the source of light.

Doppler effects.—Effects on the apparent frequency of a wave train produced (1) by motion of the source toward or away from the stationary observer, and (2) by motion of the observer toward or from the stationary source; the motion in each case being with reference to the (supposedly stationary) medium.

For sound waves, the observed frequency f_0, in cycles/sec., is given by

$$\mathrm{f}_0 = \frac{v + w - v_0}{v + w - v_s} f_s$$

where v is the velocity of sound in the medium, v_0 is the velocity of the observer, v_s is the velocity of the source, w is the velocity of the wind in the direction of sound propagation, and f_s is the frequency of source.

For optical waves

$$f_0 = f_s \sqrt{\frac{c + v_r}{c - v_r}}$$

where v_r is the velocity of the source relative to the observer and c is the speed of light.

Dosimeter.—A gadget worn by those who work about radioactive sources to record the amount of exposure the wearer has had to radioactivity.

Double decomposition consists of a simple exchange of the parts of two substances to form two new substances.

Dulong and Petit, law of.—The specific heats of the several elements are inversely proportional to their atomic weights. The atomic heats of solid elements are constant and approximately equal to 6.3. Certain elements of low atomic weight and high melting point have, however, much lower atomic heats at ordinary temperatures.

Eddy current.—A current induced in a mass of conducting material by a varying magnetic field. Also called *Foucault current.*

Einstein theory for mass-energy equivalence.—The equivalence of a quantity of mass m and a quantity of energy E by the formula $E = mc^2$. The conversion factor c^2 is the square of the velocity of light.

Elasticity.—The property by virtue of which a body resists and recovers from deformation produced by force.

Elastic limit.—The smallest value of the stress producing permanent alteration.

Elastic moduli.

Young's modulus by stretching.—If an elongation s is produced by the weight of the mass m, in a wire of length l, and radius r, the modulus,

$$M = \frac{mgl}{\pi r^2 s}$$

Young's modulus by bending, bar supported at both ends. If a flexure s is produced by the weight of mass m, added midway between the supports separated by a distance l, for a rectangular bar with vertical dimensions of cross-section a and horizontal dimension b, the modulus is,

$$M = \frac{mgl^3}{4sa^3b}$$

For a cylindrical bar of radius r,

$$M = \frac{mgl^3}{12\pi r^4 s}$$

For a bar supported at one end. In the case of a rectangular bar as described above,

$$M = \frac{4mgl^3}{sa^3b}$$

For a round bar supported at one end,

$$M = \frac{4mgl^3}{3\pi r^4 s}$$

Modulus of rigidity.—If a couple C ($= mgx$) produces a twist of θ radians in a bar of length l and radius r, the modulus is

$$M = \frac{2Cl}{\pi r^4 \theta}$$

The substitution in the above formulae for the elastic coefficients of m in grams, g in cm per sec², l, a, b, and r in cm, s in cm, and C in dyne-cm will give moduli in dynes per cm^2. The dimensions of elastic moduli are the same as of stress,—$[m\, l^{-1}\, t^{-2}]$.

Coefficient of restitution.—Two bodies moving in the same straight line, with velocities v_1 and v_2 respectively, collide and after impact move with velocities v_3 and v_4. The coefficient of restitution is

$$C = \frac{v_4 - v_3}{v_2 - v_1}$$

Electric field intensity is measured by the force exerted on unit charge. Unit field intensity is the field which exerts the force of one dyne on unit positive charge. Dimensions,—$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^{-1}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-2}]$.

The field intensity or force exerted on unit charge at a point distant r from a charge q in a vacuum

$$H = \frac{q}{r^2}$$

If the dielectric in the above cases is not a vacuum the dielectric constant ϵ must be introduced. The formula becomes

$$H = \frac{q}{\epsilon r^2}$$

The value of ϵ is frequently considered unity for air. If the dielectric constant of a vacuum is considered unity the value for air at 0°C and 760 mm pressure is 1.000576.

Electrochemical equivalent of an ion is the mass liberated by the passage of unit quantity of electricity.

Electrolysis.—If a current i flows for a time t and deposits a metal whose electrochemical equivalent is e, the mass deposited is

$$m = eit$$

The value of e is usually given for mass in grams, i in amperes and t in seconds.

Electrolytic dissociation or ionization theory.—When an acid, base or salt is dissolved in water or any other dissociating solvent, a part or all of the molecules of the dissolved substance are broken up into parts called ions, some of which are charged with positive electricity and are called cations, and an equivalent number of which are charged with negative electricity and are called anions.

Electrolytic solution tension theory (or the Helmholtz double layer theory).—When a metal, or any other substance capable of existing in solution as ions, is placed in water or any other dissociating solvent, a part of the metal or other substances passes into solution in the form of ions, thus leaving the remainder of the metal or substances charged with an equivalent amount of electricity of opposite sign from that carried by the ions. This establishes a difference in potential between the metal and the solvent in which it is immersed.

Electromotive force is defined as that which causes a flow of current. The electromotive force of a cell is measured by the maximum difference of potential between its plates. The electromagnetic unit of potential difference is that against which one erg of work is done in the transfer of electromagnetic unit quantity. The **volt** is that potential difference against which one joule of work is done in the transfer of one coulomb. One volt is equivalent to 10^8 electromagnetic units of potential. The **international** volt is the electrical potential which when steadily applied to a conductor whose resistance is one international ohm will cause a current of one international ampere to flow. The international volt = 1.00033 absolute volts. The electromotive force of a Weston standard cell is 1.0183 int. volts at 20°C. Dimensions,—$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-1}]$, $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-2}]$.

Electromotive series is a list of the metals arranged in the decreasing order of their tendencies to pass into ionic form by losing electrons.

Electron.—The electron is a small particle having a unit negative electrical charge, a small mass, and a small diameter. Its charge is $(4.80223 \pm .00007) \times 10^{-10}$ absolute electrostatic units, its mass $\frac{1}{1837}$ that of the hydrogen nucleus, and its diameter about 10^{-2} cm. Every atom consists of one nucleus and one or more electrons. Cathode rays and Beta rays are electrons.

Electron-volt (ev).—Energy acquired by any charged particle carrying unit electronic charge when it falls through a potential difference of one volt. 1 electron-volt = $(1.60207 \pm .00007 \times 10^{-12}$ erg. Multiples of this unit are also in common use: the kilo-, million-, and billion electron-volt. 1 kev = 10^3 ev; 1 mev = 10^6 ev; and 1 bev = 10^9 ev.

An ev is associated through the Planck constant with a photon of wave length 1.2395 microns.

Elements are substances which cannot be decomposed by the ordinary types of chemical change, or made by chemical union.

Emissive power or emissivity is measured by the energy radiated from unit area of a surface in unit time for unit difference of temperature between the surface in question and surrounding bodies. For the cgs system the emissive power is given in ergs per second per square centimeter with the radiating surface at 1° absolute and the surroundings at absolute zero.—See *Radiation formula*

Enantiotropic.—Crystal forms capable of existing in reversible equilibrium with each other.

Energy.—The capability of doing work. **Potential energy** is energy due to position of one body with respect to another or to the relative parts of the same body. **Kinetic energy** is energy due to motion. Cgs units,—the erg, the energy expended when a force of one dyne acts through a distance of one centimeter; the joule is 1×10^7 ergs. Dimensions,—$[m\,l^2\,t^{-2}]$.

The potential energy of a mass m, raised through a distance h, where g is the acceleration due to gravity is

$$E = mgh.$$

The kinetic energy of mass m, moving with a velocity v, is

$$E = \tfrac{1}{2}mv^2.$$

Energy will be given in ergs if m is in grams, g in cm per sec², h in cm and v in cm per sec.

Energy of a charge in ergs where Q is the charge and V the potential in electrostatic units.

$$E = \tfrac{1}{2}QV.$$

Energy of the electric field.—If H is the electric field intensity in electrostatic units and K the specific inductive capacity, the energy of the field in ergs per cm³ is

$$E = \frac{KH^2}{8\pi}$$

Energy of rotation.—If a mass whose moment of inertia about an axis is I, rotates with angular velocity ω about this axis, the kinetic energy of rotation will be,

$$E = \tfrac{1}{2}I\omega^2$$

Energy will be given in ergs if I is in g-cm² and ω in radians per sec.

Enthalpy, or heat content, is a thermodynamic quantity. It is equal to the sum of the internal energy of a system plus the product of the pressure-volume work done on the system. Thus

$$\mathrm{H} = \mathrm{E} + \mathrm{pv}$$

where H = enthalpy or heat content
E = internal energy of the system
p = pressure
v = volume.

Entropy.—Entropy is the capacity factor for isothermally unavailable energy. The increase in the entropy of a body during an infinitesimal stage of a reversible process is equal to the infinitesimal amount of heat absorbed divided by the absolute temperature of the body. Thus for a reversible process

$$dS = \frac{Q}{T}$$

Every spontaneous process in nature is characterized by an increase in the total entropy of the bodies concerned in the process.

Equilibrium, chemical.—A state of affairs in which a chemical reaction and its reverse reaction are taking place at equal velocities, so that the concentrations of reacting substances remain constant.

Equilibrium constant.—The product of the concentrations (or activities) of the substances produced at equilibrium in a chemical reaction divided by the product of concentrations of the reacting substances, each concentration raised to that power which is the coefficient of the substance in the chemical equation.

Equivalent weight or combining weight of an element or ion is its atomic or formula weight divided by its valence. Elements entering into combination always do so in quantities proportional to their equivalent weights.

In oxidation-reduction reactions the equivalent weight of the reacting substances is dependent upon the change in oxidation number of the particular substance.

Ettinghausen's effect (Von Ettinghausen's).—When an electric current flows across the lines of force of a magnetic field an electromotive force is observed which is at right angles to both the primary current and the magnetic field: a temperature gradient is observed which has the opposite direction to the Hall electromotive force.

Eutectic.—A term applied to the mixture of two or more substances which has the lowest melting point.

Expansion of gases.

Charles' law or Gay-Lussac's law.—The volume of a gas at constant pressure increases proportionately to the absolute temperature. If V_1 and V_2 are volumes of the same mass of gas at absolute temperatures, T_1 and T_2,

$$\frac{V_1}{V_2} = \frac{T}{T_2}$$

For an original volume V_o at 0°C the volume at t°C (at constant pressure) is

$$V_t = V_o(1 + 0.00367t).$$

General law for gases.

$$p_t v_t = p_o v_o \left(1 + \frac{t}{273}\right)$$

where p_o, v_o, p_t, v_t represent the pressure and value at 0° and t°C. or

$$\frac{p_1 v_1}{T_1} = \frac{p_2 v_2}{T_2}$$

where p_1, v_1 and T_1 represent pressure, volume and absolute temperature in one case and p_2, v_2 and T_2 the same quantities for the same mass of gas in another.

The law may also be expressed:

$$pv = RmT$$

where m is the mass of gas at absolute temperature T. R is the **gas constant** which depends on the units used. **Boltzmann's molecular gas constant** is obtained by expressing m in terms of the number of molecules.

For volume in cm^3, pressure in dynes per cm^2 and temperature in Centigrade degrees on the absolute scale $R = 8.3136 \times 10^7$.

Reduction of a gas volume to 0°C, 760 mm pressure.—If V is the original volume of a gas at temperature t and pressure H, the volume at 0°C and 760 mm pressure will be,

$$V_o = \frac{V}{(1 + \alpha t)} \frac{H}{760}$$

If d is the original density the density at 0°C and 760 mm pressure will be

$$d_o = d(1 + \alpha t) \frac{760}{H}$$

$$\alpha = 0.00367 \text{ approximately.}$$

Falling bodies.—For bodies falling from rest conditions are as for uniformly accelerated motion except that $v_o = O$ and g is the acceleration due to gravity. The formulae become,—air resistance neglected,

$$v_t = gt,\ s = \tfrac{1}{2}gt^2,\ v_s = \sqrt{2gs}.$$

For bodies projected vertically upward,—if v is the velocity of projection, the time to reach greatest height, neglecting the resistance of the air,

$$t = \frac{v}{g}$$

Greatest height,

$$h = \frac{v^2}{2g}$$

—See *Projectiles*

Faraday's laws.—In the process of electrolytic changes equal quantities of electricity charge or discharge equivalent quantities of ions at each electrode.

One gram equivalent weight of matter is chemically altered at each electrode for 96,501 int. coulombs, or one faraday, of electricity passed through the electrolyte.

Faraday effect.—The rotation of the plane of polarization produced when plane-polarized light is passed through a substance in a magnetic field, the light traveling in a direction parallel to the lines of force. For a given substance, the rotation is proportional to the thickness traversed by the light and to the magnetic field strength.

Fermat's principle.—The path followed by light (or other waves) passing through any collection of media from one specified point to another, is that path for which the time of travel is least.

Fission.—A nuclear reaction from which the atoms produced are each approximately half the mass of the parent nucleus. In other words, the atom is split into two approximately equal masses. There is also the emission of extremely great quantities of energy since the sum of the masses of the two new atoms is less than the mass of the parent heavy atom. The energy released is expressed by Einstein's equation.

Fleming's rule.—A simple rule for relating the directions of the flux, motion, and e.m.f. in an electric machine. The forefinger, second finger and thumb, placed at right-angles to each other, represent respectively the directions of flux, e.m.f., and motion or torque. If the right hand is used the conditions are those obtaining in a generator and if the left hand is used the conditions are those obtaining in a motor.

Fluidity.—The reciprocal of viscosity. The cgs unit is the rho, the reciprocal of the poise. Dimensions,—$[m^{-1}\,lt]$.

Fluorescence.—The property of emitting radiation as the result of absorption of radiation from some other source. The emitted radiation persists only as long as the exposure is subjected to radiation which may be either electrified particles or waves. The fluorescent radiation generally has a longer wave length than that of the absorbed radiation. If the fluorescent radiation includes waves of the same length as that of the absorbed radiation it is termed resonance radiation.

Foot-candle.—Foot-candle = 1 lumen incident per foot^2 = 1.076 milliphots = 10.76 lux.

Footlambert is the unit of photometric brightness (luminance) equal to $1/\pi$ candle per square foot.

Force.—That which changes the state of rest or motion in matter, measured by the rate of change of momentum. Absolute unit,—the **dyne,** the force which will produce an acceleration of one centimeter per second per second in a gram mass. The gram weight or weight of a gram mass is the cgs gravitational unit. The poundal is that force which will give an acceleration of one foot per second per second to a pound mass. Dimensions,—$[m\,lt^{-2}]$.

The force F required to produce an acceleration a in a mass m is given by

$$F = ma.$$

If m is substituted in grams and a in cm per sec^2, F will be given in dynes.

Force between two charges, Coulomb's law.—If two charges q and q' are at a distance r in a vacuum, the force between them is,

$$F = \frac{qq'}{r^2}$$

The force will be given in dynes if q and q' are in electrostatic units and r in cm.

Force between two magnetic poles.—If two poles of strength m and m' are separated by a distance r in a medium whose permeability is μ (unity for a vacuum), the force between them is,

$$F = \frac{mm'}{\mu r^2}$$

Force will be given in dynes if r is in cm and m and m' are in cgs units of pole strength.

The strength of a magnetic field at a point distance r from an isolated pole of strength m is

$$H = \frac{m}{\mu r^2}$$

The field will be given in gauss if m and r are in cgs units.

Formula, chemical.—A combination of symbols with their subscripts representing the constituents of a substance and their proportions by weight.

Fraunhofer's lines.—When sunlight is examined through a spectroscope it is found that the spectrum is traversed by an enormous number of dark lines parallel to the length of the slit. These dark lines are known as Fraunhofer's lines. Kirchoff conceived the idea that the sun is surrounded by layers of vapors which act as filters of the white light arising from incandescent solids within and which abstract those rays which correspond in their periods of vibration to those of the components of the vapors. Thus reversed or dark lines are obtained due to the absorption by the vapor envelop, in place of the bright lines found in the emission spectrum.

Frequency in uniform circular motion or in any periodic motion is the number of revolutions or cycles completed in unit time. Cgs units,—cycles per second. Dimension,—$[t^{-1}]$.

Frequency of vibrating strings.—The fundamental frequency of a stretched string is given by

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

where l is the length, T, the tension and m the mass per unit length.

For a string or wire of circular section of length l, tension T, density d, and radius r, the frequency of the fundamental is

$$n = \frac{1}{2rl}\sqrt{\frac{T}{\pi d}}$$

The frequency in vibrations per second will be given if T is in dynes, r and l in cm and d in g per cm^3.

Friction, coefficient of.—The coefficient of friction between two surfaces is the ratio of the force required to move one over the other to the total force pressing the two together.

If F is the force required to move one surface over another and W, the force pressing the surfaces together, the coefficient of friction,

$$k = \frac{F}{W}$$

Fundamental units.—See *Mass, Length and Time*

Fusion (atomic).—A nuclear reaction involving the combination of smaller atomic nuclei or particles into larger ones with the release of energy from mass transformation. This is also called a thermo-nuclear reaction by reason of the extremely high temperature required to initiate it.

Gal.—1 gal = cm/sec./sec. Therefore, where the value of gravity is 980 this is the same as 980 gals. The milligal is now quite commonly used since it is approximately one part in a million of the normal gravity of the earth.

Gamma (γ) rays (nuclear x-rays).—May be emitted from radioactive substances. They are quanta of electromagnetic wave energy similar to but of much higher energy than ordinary x-rays. The energy of a quantum is equal to $h\nu$ ergs, where h is Planck's constant (6.6252×10^{-27} erg sec) and ν is the frequency of the radiation. Gamma rays are highly penetrating, an appreciable fraction being able to traverse several centimeters of lead.

Gas.—A state of matter in which the molecules are practically unrestricted by cohesive forces. A gas has neither definite shape nor volume.

Gas thermometer.—Where P_o, P_s and P_x represent the total pressure with the bulb at 0°C, at the boiling-point of water and at the unknown temperature respectively, t_s the temperature of steam and t_x the unknown temperature,

$$t_x = t_s \frac{P_x - P_o}{P_s - P_o}$$

(approximately). The total pressure on the gas in the bulb is the algebraic sum of barometric pressure at the time and that measured by the manometer.

Gauss.—The cgs emu of magnetic induction (flux density). It is equal to 1 maxwell per cm^2. It has such a value that if a conductor 1 cm long moves through a magnetic field at a velocity of 1 cm, in an induction mutually perpendicular, the induced emf is one abvolt.

Gay-Lussac's law.—See *Charles' law*

Gay-Lussac's law of combining volumes.—If gases interact and form a gaseous product, the volumes of the reacting gases and the volumes of the gaseous products are to each other in simple proportions, which can be expressed by small whole numbers.

Geiger counter.—Detector for radioactivity depending upon ionized particles that affect its mechanism. As its name indicates, it both detects and makes a count of them possible.

Gibbs' phase rule.—$F = C + 2 - P$, F, the number of degrees of freedom of a system, is the number of variable factors (temperature, pressure and concentration) of the components, which must be arbitrarily fixed in order that the condition of the system may be perfectly defined. C, the number of the components of the system, is chosen equal to the smallest number of independently variable constituents by means of which the composition of each phase participating in the state of equilibrium can be expressed in the form of a chemical equation; the components must be chosen from among the constituents which are present when the system is in a state of true equilibrium and which take part in that equilibrium; as components are chosen the smallest number of such constituents necessary to express the composition of each phase participating in the equilibrium, zero and negative quantities of components being permissible; in any system the number of components is definite, but may alter with changes in conditions of experiment; a qualitative but not quantitative freedom of selection of components is allowed, the choice being influenced by suitability and simplicity of application. P, the number of phases of the system, are the homogeneous, mechanically separable and physically distinct portions of a heterogeneous system; the number of phases capable of existence varies greatly in different systems; there can never be more than one gas or vapor phase since all gases are miscible in all proportions, a heterogeneous mixture of solid substances forms as many phases as there are substances present.

Gilbert.—The cgs emu of magnetomotive force. 1 gilbert $= 10/4\pi$ ampere-turns.

Graham's law.—The relative rates of diffusion of gases under the same conditions are inversely proportional to the square roots of the densities of those gases.

Gram atom or gram atomic weight.—The mass in grams numerically equal to the atomic weight.

Gram equivalent of a substance is the weight of a substance displacing or otherwise reacting with 1.008 grams of hydrogen or combining with one-half of a gram atomic weight (8.00 grams) of oxygen.

Gram mole, gram formula weight, gram equivalent.—Mass in grams numerically equal to the molecular weight, formula weight or chemical equivalent, respectively.

Gram molecular weight or gram molecule.—A mass in grams of a substance numerically equal to its molecular weight. Gram mode.

Gravitation.—The universal attraction existing between all material bodies. The force of attraction between two masses m and m', separated by a distance r, k being the constant of gravitation,

$$F = k\frac{mm'}{r^2}$$

(If m and m' are given in grams, and r in centimeters, F will be in dynes if $k = 6.670 \times 10^{-8}$.)

Half-life.—Used to measure the rate of radioactive decay of disintegration. The time lapse during which a radioactive mass loses one half of its radioactivity.

Hall effect.—When a steady current is flowing in a steady magnetic field, electromotive forces are developed which are at right angles both to the magnetic force and to the current and are proportional to the product of the intensity of the current, the magnetic force and the sine of the angle between the directions of these quantities.

Hardness.—Property of substances determined by their ability to abrade or indent one another. An arbitrary scale of hardness is based upon ten selected minerals. For metals the diameter of the indentation made by a hardened steel sphere (Brinnell) or the height of rebound of a small drop hammer (Shore Scleroscope) serve to measure hardness.

Harmonic motion.—See *Simple harmonic motion and Angular harmonic motion*

Heat capacity.—That quantity of heat required to increase the temperature of a system or substance one degree of temperature. It is usually expressed in calories per degree centigrade.

Molar heat capacity is the quantity of heat necessary to raise the temperature of one molecular weight of the substance one degree.

Heat effect.—The heat in calories developed in a circuit by an electric current of I amperes flowing through a resistance of R ohms, with a difference of potential E volts for a time t seconds.

$$H = \frac{RI^2t}{4.18} = \frac{Eit}{4.18}$$

Heat equivalent, or latent heat, of fusion.—The quantity of heat necessary to change one gram of solid to a liquid with no temperature change. Dimensions,—$[l^2\ t^{-2}]$.

Heat of combustion of a substance is the amount of heat evolved by the combustion of 1 gram molecular weight of the substance.

Heat quantity.—The cgs unit of heat is the **calorie,** the quantity of heat necessary to change the temperature of one gram of water from 3.5°C to 4.5°C (called a small calorie). If the temperature change involved is from 14.5 to 15.5°C, the unit is the normal calorie. The mean calorie is $\frac{1}{100}$ the quantity of heat necessary to raise one gram of water from 0°C to 100°C. The large calorie is equal to 1000 small calories. The British thermal unit is the heat required to raise the temperature of one pound of water at its maximum density, 1°F. It is equal to about 252 calories. Dimensions of energy,—$[m\ l^2\ t^{-2}]$.

Hehner number (value).—A number expressing the percentage (i.e. grams per hundred grams) of water-insoluble fatty acids in an oil or fat.

Heisenberg's theory of atomic structure.—The currently accepted view of the structure of atom, formulated by Heisenberg in 1934, according to which the atomic nuclei are built of nucleons, which may be protons or neutrons, while the extranuclear shells consist of electrons only. The nucleons are held together by nuclear forces of attraction, with exchange forces operating between them. The number of protons is equal to the atomic number (Z) of the element, the number of neutrons is equal to the difference between the mass number and the atomic number ($A - Z$). The number of excess neutrons, i.e. the excess of neutrons over protons, is of paramount importance for the radioactive properties or stability of the element.

Henry's law.—The mass of a slightly soluble gas that dissolves in a definite mass of a liquid at a given temperature is very nearly directly proportional to the partial pressure of that gas. This holds for gases which do not unite chemically with the solvent.

Hess' law of constant heat summation.—The amount of heat generated by a chemical reaction is the same whether reaction takes place in one step or in several steps, or all chemical reactions which start with the same original substances and end with the same final substances liberate the same amounts of heat, irrespective of the process by which the final state is reached.

Hooke's law.—Within the elastic limit of any body the ratio of the stress to the strain produced is constant.

Humidity, absolute.—Mass of water vapor present in unit volume of the atmosphere, usually measured as grams per cubic meter. It may also be expressed in terms of the actual pressure of the water vapor present.

Huygens' theory of light.—This theory states that light is a disturbance traveling through some medium, such as the ether. Thus light is due to wave motion in ether.

Every vibrating point on the wave-front is regarded as the center of a new disturbance. These secondary disturbances traveling with equal velocity, are enveloped by a surface identical in its properties with the surface from which the secondary disturbances start and this surface forms the new wave-front.

Hydrogen equivalent of a substance is the number of replaceable hydrogen atoms in 1 molecule or the number of atoms of hydrogen with which 1 molecule could react.

Hydrogen ion concentration.—The concentration of hydrogen ions in solution when the concentration is expressed as gram-ionic weights per liter. A convenient form of expressing hydrogen ion concentration is in terms of the negative logarithm of this concentration. The negative logarithm of the hydrogen ion concentration is called pH. The significance of pH is still in dispute (ref. J. Am Chem. Soc. 60, 1094 (1938)).

Water at 25°C has a concentration of H ion of 10^{-7} and of OH ion of 10^{-7} moles per liter. Thus the pH of water is 7 at 24°C. A greater accuracy is obtained if one substitutes the thermodynamic activity of the ion for its concentration.

Hydrolysis is a double decomposition reaction involving the splitting of water into its ions and the formation of a weak acid or base or both.

Hydrostatic pressure at a distance h from the surface of a liquid of density d,

$$P = hdg.$$

The total force on an area A due to hydrostatic pressure,

$$F = PA = Ahdg.$$

Force in dynes and pressure in dynes per cm² will be given if h is in cm, d in g per cm³ and g in cm per sec².

Hyperon.—Any article with mass intermediate between that of the neutron and the deuteron.—See *Meson*

Hysteresis.—The magnetization of a sample of iron or steel due to a magnetic field which is made to vary through a cycle of values, lags behind the field. This phenomenon is called hysteresis.

Steinmetz' equation for hysteresis gives the loss of energy in ergs per cycle per cm³,

$$W = \eta B^{1.6}$$

where B is the maximum induction in maxwells per cm² and η the coefficient of hysteresis.

Illumination on any surface is measured by the luminous flux incident on unit area. The units in use are: the **lux,** one lumen per square meter; the **phot,** one lumen per square centimeter and the lumen per square foot. Since at unit distance from a point source of unit intensity the illumination is unity, unit illumination may be defined as that produced by a unit source at unit distance, hence the **meter-candle** or **candle-meter** which is equal to the lux and the **foot-candle** equivalent to one lumen per square foot.

Indeterminancy principle (**Uncertainty principle**).—The postulate that it is impossible to determine simultaneously both the exact position and the exact momentum of an electron. So this aspect of electronics can only be expressed as a probability.

Index of refraction for any substance is the ratio of the velocity of light in a vacuum to its velocity in the substance. It is also the ratio of the sine of the angle of incidence to the sine of the angle of refraction. In general, the index of refraction for any substance varies with the wave length of the refracted light.

Indicators are substances which change from one color to another when the hydrogen ion concentration reaches a certain value, different for each indicator.

Induced electromotive force in a circuit is proportional to the rate of change of magnetic flux through the circuit.

$$E = -\frac{d\phi}{dt}$$

where $d\phi$ is the change of magnetic flux in a time dt. The induced current will be given by

$$I = \frac{d\phi}{Rdt}$$

where R is the resistance of the circuit.

Inductance.—The change in magnetic field due to the variation of a current in a conducting circuit causes an induced counter electromotive force in the circuit itself. This phenomenon is known as **self-induction.** If an electromotive force is induced in a neighboring circuit the term mutual induction is used. Inductance may thus be distinguished as self- or mutual and is measured by the electromotive force produced in a conductor by unit rate of variation of the current. Units of inductance are the centimeter (absolute electromagnetic) and the henry, which is equal to 10^9 centimeters of inductance. The **henry** is that inductance in which an induced electromotive force of one volt is produced when the inducing current is changed at the rate of one ampere per second. Dimensions,—$[\epsilon^{-1}\, l^{-1}\, t^2]$; $[\mu l]$.

Induction.—Any change in the intensity or direction of a magnetic field causes an electromotive force in any conductor in the field. The induced electromotive force generates an induced current if the conductor forms a closed circuit.

Inertia.—The resistance offered by a body to a change of its state of rest or motion, a fundamental property of matter. Dimension,—$[m]$.

Intensity of illumination in candle meters of a screen illuminated by a source of illuminating power P candles at a distance r meters, for normal incidence,

$$I = \frac{P}{r^2}$$

If two sources of illuminating power P_1 and P_2 produce equal illumination on a screen when at distances r_1 and r_2 respectively,

$$\frac{P_1}{r_1{}^2} = \frac{P_2}{r_2{}^2} \qquad \text{or} \qquad \frac{P_1}{P_2} = \frac{r_1{}^2}{r_2{}^2}$$

If I_o is the intensity of illumination when the screen is normal to the incident light, I the intensity when an angle θ

$$I = I_o \cos \theta$$

Intensity of magnetization is given by the quotient of the magnetic moment of a magnet by its volume. Unit intensity of magnetization is the intensity of a magnet which has unit magnetic moment per cubic centimeter. Dimensions,—$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{3}{2}}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^{-1}]$.

Intensity of radiation is the rate of transfer of energy across unit areas by the radiation. In all forms of energy transfer by waves (radiation) the intensity I is given by I = Uv where U is the energy density of the wave in the medium, and v is the velocity of propagation of the wave. The energy density U is always proportional to the square of the wave amplitude.

Intensity of sound depends upon the energy of the wave motion. The intensity is measured by the energy in ergs transmitted per second through one square centimeter of surface. The energy in ergs per cm^3 in a sound wave is given by

$$E = 2\pi^2 dn^2 a^2$$

where d is density in g per cm^3, n is frequency in vib. per sec and a is amplitude in cm. The energy reaching the ear in unit time will also be proportional to the velocity of propagation.

Iodine number (**value**).—A number expressing the percentage (i.e. grams per 100 grams) of iodine absorbed by a substance. It is a measure of the proportion of unsaturated linkages present and is usually determined in the analysis of oils and fats.

Ion.—An ion is an atom or group of atoms that is not electrically neutral but instead carries a positive or negative electric charge. Positive ions are formed when neutral atoms or molecules lose valence electrons; negative ions are those which have gained electrons.

Ionization potential.—The work (expressed in electron volts) required to remove a given electron from its atomic orbit and place it at rest at an infinite distance. It is customary to list values in electron volts (ev.) 1 ev. = 23,053 calories per mole.

Isobars.—For chemistry, elements of the same atomic mass but of different atomic numbers. The sum of their nucleons is the same but there are more protons in one than in the other.

Isomerism.—Existence of molecules having the same number and kinds of atoms but in different configurations.

Isothermal.—When a gas passes through a series of pressure and volume variations without change of temperature the changes are called isothermal. A line on a pressure-volume diagram representing these changes is called an isothermal line.

Isotopes.—Two or more nuclides having the same atomic number, hence constituting the same element, but differing in mass number. Isotopes of a given element have the same number of nuclear protons but differing numbers of neutrons. Naturally occurring chemical elements are usually mixtures of isotopes so that observed (non-integer) atomic weights are average values for the mixture.—See *Atomic number*

Joule-Thomson effect.—The cooling which occurs when a highly compressed gas is allowed to expand in such a way that no external work is done is known as the Joule-Thomson effect. This cooling is inversely proportional to the square of the absolute temperature.

Kepler's laws.

I. The planets move about the sun in ellipses, at one focus of which the sun is situated.

II. The radius vector joining each planet with the sun describes equal areas in equal times.

III. The cubes of the mean distances of the planets from the sun are proportional to the squares of their times of revolution about the sun.

Kerr effect.—When plane polarized light is incident on the pole of an electromagnet, polished so as to act like a mirror, the plane of polarization of the reflected light is not the same when the magnet is "on" as when it is "off." It was found that the direction of rotation was opposite to that of the currents exciting the pole from which the light was reflected.

Kinetic theory, expression for pressure.

$$P = \tfrac{1}{3}Nmv^2$$

where N is the number of molecules in unit volume, m the mass of each molecule and v^2 the mean square of the velocity of the molecules.

Kinetic theory of gases.—1738.—Gases are considered to be made up of minute, perfectly elastic particles which are ceaselessly moving about with high velocities, colliding with each other and with the walls of the containing vessel. The pressure exerted by a gas is due to the combined effect of the impacts of the moving molecules upon the walls of the containing vessel, the magnitude of the pressure being dependent upon the kinetic energy of the molecules and their number.

Kirchhoff's laws.

I. The algebraic sum of the currents which meet at any point is zero.

II. In any closed circuit the algebraic sum of the products of the current and the resistance in each conductor in the circuit is equal to the electromotive force in the circuit.

Kirchhoff's laws of radiation.—The relation between the powers of emission and the powers of absorption for rays of the same wave-length is constant for all bodies at the same temperature. First, a substance when excited by some means or other possess a certain power of emission; it tends to emit definite rays, whose wave-lengths depend upon the nature of the substance and upon the temperature. Second, the substance exerts a definite absorptive power, which is a maximum for the rays it tends to emit. Third, at a given temperature the ratio between the emissive and the absorptive power for a given wave-length is the same for all bodies, and is equal to the emissive power of a perfectly black body.

Kohlrausch's law.—When ionization is complete, the conductivity of an electrolyte is equal to the sum of the conductivities of the ions into which the substance dissociates.

Kundt's law.—On approaching an absorption band from the red side of the spectrum the refractive index is abnormally increased by the presence of the band, while the approach is from the blue side and the index is abnormally decreased.

Lambert is the unit of brightness equal to $1/\pi$ candle per square centimeter.

Lambert's law of absorption.—Each layer of equal thickness absorbs an equal fraction of the light which traverses it.

Lambert's law of illumination.—The illumination of a surface on which the light falls normally from a point source is inversely proportional to the square of the distance of the surface from the source. If the normal to the surface makes an angle with the direction of the rays, the illumination is proportional to the cosine of that angle.

Lanthanide series (Lanthanides).—Rare earth elements of atomic numbers 57 through 71, which have chemical properties similar to lanthanum (#57).

Latent heat of vaporization.—The quantity of heat necessary to change one gram of liquid to vapor without change of temperature, measured as calories per gram. Dimensions,—$[l^2\, t^{-2}]$.

Lattice energy.—The energy required to separate the ions of a crystal to an infinite distance from each other.

LeChatelier's principle.—If some stress is brought to bear upon a system in equilibrium, a change occurs, such that the equilibrium is displaced in a direction which tends to undo the effect of the stress.

Length, units of.—The centimeter, one of the three fundamental units of the cgs system, is one one-hundredth the length of the International Prototype Meter, at Paris, at zero degrees centigrade. The meter is 1,553,164.13 times the wave length of the red cadmium line in air, 760 mm pressure, 15°C. The standard in the British system is the yard, the prototype of which is kept by the British government. The United States standard yard is defined as $\frac{3600}{3937}$ meter.

Lenses.—For a single thin lens whose surfaces have radii of curvature r_1 and r_2 whose principal focus is F, the index of refraction n, and conjugate focal distances f_1 and f_2,

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = (n - 1)\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

For a thick lens, of thickness t,

$$F = \frac{n r_1 r_2}{(n - 1)[n(r_1 + r_2) - t(n - 1)]}$$

Combinations of lenses.—If f_1 and f_2 are the focal lengths of two thin lenses separated by a distance d the focal length of the system,

$$F = \frac{f_1 f_2}{f_1 + f_2 - d}$$

Lenz's law.—When an electromotive force is induced in a conductor by any change in the relation between the conductor and the magnetic field, the direction of the electromotive force is such as to produce a current whose magnetic field will oppose the change.

Line of force.—A term employed in the description of an electric or magnetic field. A line such that its direction at every point is the same as the direction of the force which would act on a small positive charge (or pole) placed at that point. A line of force is defined as starting from a positive charge (or pole) and ending on a negative charge (or pole).

The line (of force) is also used as a unit of magnetic flux, equivalent to the maxwell.

Lissajous figures.—The path described by a particle which is simultaneously displaced by two simple harmonic motions at right angles, when the periods of the two motions are in the ratio of two small whole numbers, shows a variety of characteristic curves called Lissajous figures.

Liquid.—A state of matter in which the molecules are relatively free to change their positions with respect to each other but restricted by cohesive forces so as to maintain a relatively fixed volume.

Loschmidt's number.—The number of molecules per unit volume of an ideal gas at 0°C and normal atmospheric pressure.

$$n_o = 2.687 \times 10^{19} \text{ per cm}^3.$$

Loudness.—The psychological response of the ear which is related to the physical quantity *intensity*. The loudness of a sound depends on frequency also since the ear responds more strongly to some frequency bands than to others. The loudness is roughly related to the cube root of the intensity, and for many purposes it is convenient to represent loudness as proportional to the logarithm of the intensity.

Lumen.—The lumen is the unit of luminous flux. It is equal to the luminous flux through a unit-solid angle (steradian) from a uniform point source of one candle, or to the flux on a unit surface all points of which are at unit distance from a uniform point source of one candle.

Luminous flux.—The total visible energy emitted by a source per unit time is called the total luminous flux from the source. The unit of flux, the **lumen,** is the flux emitted in unit solid angle (steradian) by a point source of one candle luminous intensity. A uniform point source of one candle intensity thus emits 4π lumens.

Luminous intensity or candle-power is the property of a source of emitting luminous flux and may be measured by the luminous flux emitted per unit solid angle. The accepted unit of luminous intensity is the **international candle.** The **Hefner unit,** which is equivalent to 0.9 international candles, is the intensity of a lamp of specified design burning amyl acetate, called the Hefner lamp.

The mean horizontal candle-power is the average intensity measured in a horizontal plane passing through the source. The mean spherical candle-power is the average candle-power measured in all directions and is equal to the total luminous flux in lumens divided by 4π.

Magnetic field due to a current.—The intensity of the magnetic field in oersted at the center of a circular conductor of radius r in which a current I in absolute electromagnetic units if flowing,

$$H = \frac{2\pi I}{r}$$

If the circular coil has n turns the magnetic intensity at the center is,

$$H = \frac{2\pi n I}{r}$$

The magnetic field in a long solenoid of n turns per centimeter carrying a current I in absolute electromagnetic units

$$H = 4\pi n I$$

If I is given in amperes the above formulae become,—

$$H = \frac{2\pi I}{10r}, \qquad H = \frac{2\pi n I}{10r}, \qquad H = \frac{4\pi n I}{10}$$

Magnetic field due to a magnet.—At a point on the magnetic axis prolonged, at a distance r cm from the center of the magnet of length $2l$ whose poles are $+m$ and $-m$ and magnetic moment M, the field strength in oersted is,

$$H = \frac{4mlr}{(r^2 - l^2)^2}$$

If r is large compared with l,

$$H = \frac{2M}{r^3}$$

At a point on a line bisecting the magnet at right angles, with corresponding symbols,

$$H = \frac{2ml}{(r^2 + l^2)^{\frac{3}{2}}}$$

For large value of r,

$$H = \frac{M}{r^3}$$

Magnetic field intensity or magnetizing force.—Is measured by the force acting on unit pole. Unit field intensity, the oersted, is that field which exerts a force of one dyne on unit magnetic pole. The field intensity is also specified by the number of lines of force intersecting unit area normal to the field, equal numerically to the field strength in oersted. Magnetizing force is measured by the space rate of variation of magnetic potential and as such its unit may be the **gilbert per centimeter.** The gamma (γ) is equivalent to 0.00001 oersted. Dimensions,—$[\epsilon^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-2}]$; $[\mu^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^{-1}]$.

Magnetic flux through any area perpendicular to a magnetic field is measured as the product of the area by the field strength. The units of magnetic flux, the **maxwell** is the flux through a square centimeter normal to a field of one gauss. The line is also a unit of flux. It is equivalent to the maxwell. Dimensions,—$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-1}]$.

Magnetic induction resulting when any substance is subjected to a magnetic field is measured as the magnetic flux per unit area taken perpendicular to the direction of the flux. The unit is the maxwell per square centimeter or its equivalent, the gauss. Dimensions,—$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{3}{2}}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^{-1}]$.

If a substance of permeability μ is placed in a magnetic field H the magnetic induction in the substance,

$$\mathbf{M} = \mu H.$$

If I is the magnetic moment for unit volume, or intensity of magnetization,

$$\mathbf{M} = H + 4\pi I.$$

The susceptibility,

$$\kappa = \frac{I}{H}, \qquad \mu = 1 + 4\pi\kappa.$$

Magnetic moment of a magnet is measured by the torque experienced when it is at right angles to a uniform field of unit intensity. The value of the magnetic moment is given by the product of the magnetic pole strength by the distance between the poles. Unit magnetic moment is that possessed by a magnet formed by two poles of opposite sign and of unit strength, one centimeter apart. Dimensions,—$[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{5}{2}}\, t^{-1}]$; $[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}]$.

If the poles are separated by a distance which is great compared with the dimensions of the magnet, the magnetic moment of a magnet of length 1 whose poles have values of $+m$ and $-m$ is,

$$\mathrm{m} = ml.$$

Magnetic permeability is a property of materials modifying the action of magnetic poles placed therein and modifying the magnetic induction resulting when the material is subjected to a magnetic field or magnetizing force. The permeability of a substance may be defined as the ratio of the magnetic induction in the substance to the magnetizing field to which it is subjected. The permeability of a vacuum is unity. Dimensions,—$[\epsilon^{-1}\, l^{-2}\, t^{2}]$; $[\mu]$.

Magnetic pole or quantity of magnetism.—Two unit quantities of magnetism concentrated at points unit distance apart in a vacuum repel each other with unit force. If the distance involved is one centimeter and the force one dyne, the quantity of magnetism at each point is one cgs unit of magnetism. Dimensions,—$[\epsilon^{-\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{1}{2}}]$; $[\mu^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{3}{2}}\ t^{-1}]$.

Magnetic potential or magnetomotive force at a point is measured by the work required to bring unit positive pole from an infinite distance (zero potential) to the point. The unit is the *gilbert*, that magnetic potential against which an erg of work is done when unit magnetic pole is transferred. Dimensions, —$[\epsilon^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{3}{2}}\ t^{-2}]$; $[\mu^{-\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{1}{2}}\ t^{-1}]$.

Magnifying power of an optical instrument is the ratio of the angle subtended by the image of the object seen through the instrument to the angle subtended by the object when seen by the unaided eye. In the case of the microscope or simple magnifier the object as viewed by the unaided eye is supposed to be a distance of 25 cm (10 in.).

Mass.—Quantity of matter. **Units of mass**—the gram is $\frac{1}{1000}$ the quantity of matter in the International Prototype Kilogram; one of the three fundamental units of the cgs system. The British standard of mass is the pound, of which a standard is preserved by the government. The United States standard mass is the avoirdupois pound defined as 1/2.20462 kilogram.

Mass action, law of.—At a constant temperature the product of the active masses on one side of a chemical equation when divided by the product of the active masses on the other side of the chemical equation is a constant, regardless of the amounts of each substance present at the beginning of the action.

At constant temperature the rate of the reaction is proportional to the concentration of each kind of substance taking part in the reaction.

Mass by weighing on a balance with unequal arms.—If W_1 is the value for one side, W_2 the value for the other, the true mass,

$$W = \sqrt{W_1 W_2}.$$

Mass defect.—Difference between atomic mass and mass number of a nuclide.—See *Packing fraction*

Mass-energy equivalence.—The equivalence of a quantity of mass and a quantity of energy when the two quantities are related by the equation $E = mc^2$. The conversion factor c^2 is the square of the velocity of light. The relationship was developed from **relativity theory,** but has been experimentally confirmed.

Maxwell.—The cgs emu magnetic flux is the flux through a cm² normal to a field at 1 cm from a unit magnetic pole.

Maxwell's rule.—A law stating that every part of an electric circuit is acted upon by a force tending to move it in such a direction as to enclose the maximum amount of magnetic flux.

Mechanical equivalent of heat is the quantity of energy which, when transformed into heat, is equivalent to unit quantity of heat; 4.18×10^7 ergs = 1 calorie (20°C).

Meson.—Two types of particles of mass intermediate between that of the electron and proton have been discovered in cosmic radiation and in the laboratory. The one particle with mass about $215m_e$ is called μ-meson, the other with about $280m_e$ π-meson. Mesons of both positive and negative charge have been found and there is now reasonably good evidence for neutral mesons. Both types of mesons decay spontaneously. Some evidence exists for a meson of mass about $1000m_e$.

Metallic elements in general are distinguished from the non-metallic elements by their lustre, malleability, conductivity and usual ability to form positive ions. **Non-metallic** elements are not malleable, have low conductivity and never form positive ions.

Mev.—Mev = million electron volts.

Minimum deviation.—The deviation or change of direction of light passing through a prism is a minimum when the angle of incidence is equal to the angle of emergence. If D is the angle of minimum deviation and A the angle of the prism, the index of refraction of the prism for the wave length used is,

$$n = \frac{\sin \frac{1}{2}(A + D)}{\sin \frac{1}{2}A}$$

Mixtures consist of two or more substances intermingled with no constant percentage composition, and with each component retaining its essential original properties.

Moderator.—A material used for slowing down neutrons in an atomic pile or reactor. Usually graphite or "heavy water" is deuterium oxide.

Modulus of elasticity.—The stress required to produce unit strain, which may be a change of length (Young's modulus): a twist or shear (modulus of rigidity or modulus of torsion) or a change of volume (bulk modulus), expressed in dynes per square centimeter. Dimensions,—the same as of stress, $[m\, l^{-1}\, t^{-2}]$.

Mol volume.—The volume occupied by a mol or a gram molecular weight of any gas measured at standard conditions is 22.414 liters.

A **molal solution** contains one mole per 1000 grams of solvent.

A **molar solution** contains one mole or gram molecular weight of the solute in one liter of solution.

Mole.—Mass numerically equal to the molecular weight. It is most frequently expressed as the gram molecular weight, i. e. as the weight of one mole expressed in grams.

Molecular volume.—Volume occupied by one mole. Numerically equal to the molecular weight divided by the density.

Molecular weight.—The sum of the atomic weights of all the atoms in a molecule.

Molecule.—The smallest unit quantity of matter which can exist by itself and retain all the properties of the original substance.

Moment of force or torque.—The effectiveness of a force to produce rotation about an axis, measured by the product of the force and the perpendicular distance from the line of action of the force to the axis. Cgs unit—the dyne-centimeter. Dimensions,—$[m\, l^2\, t^{-2}]$. If a force F acts to produce rotation about a center at a distance d from the line in which the force acts, the force has a torque,

$$L = Fd.$$

Moment of inertia.—A measure of the effectiveness of mass in rotation. In the rotation of a rigid body not only the body's mass, but the distribution of the mass about the axis of rotation determines the change in the angular velocity resulting from the action of a given torque for a given time. Moment of inertia in rotation is analogous to mass (inertia) in simple translation. The cgs unit is g-cm². Dimensions,—$[m\, l^2]$.

If m_1, m_2, m_3, etc. represent the masses of infinitely small particles of a body; r_1, r_2, r_3, etc. their respective distances from an axis of rotation, the moment of inertia about this axis will be

$$I = (m_1r_1^2 + m_2r_2^2 + m_3r_3^2 + \cdots)$$

or

$$I = \Sigma(mr^2)$$

Momentum.—Quantity of motion measured by the product of mass and velocity. Cgs unit—, one gram-centimeter per second. Dimensions,—$[m\, l\, t^{-1}]$.

A mass m moving with velocity v has a momentum,

$$M = mv.$$

If a mass m has its velocity changed from v_1 to v_2 by the action of a force F for a time t,

$$mv_2 - mv_1 = Ft.$$

Monochromatic emissive power is the ratio of the energy of certain defined wave lengths radiated at definite temperatures to the energy of the same wave lengths radiated by a black body at the same temperature and under the same conditions.

Monotropic.—Crystal forms one of which is always metastable with respect to the other.

Mosley's law.—The frequencies of the characteristic X-rays of the elements show a strict linear relationship with the square of the atomic number.

Motion, laws of.—See *Newton's law of motion*

Multiple proportions, law of.—If two elements form more than one compound, the weights of the first element which combine with a fixed weight of the second element are in the ratio of integers to each other.

Negatron.—1. A term used for electron when it is necessary to distinguish between (negative) electrons and positrons. 2. A four element vacuum tube which displays a negative resistance characteristic.

Nernst effect.—When heat flows across the lines of magnetic force, there is observed an electromotive force in the mutually perpendicular direction.

Neutralization is a reaction in which the hydrogen ion of an acid and the hydroxyl ion of a base unite to form water, the other product being a salt.

Neutrino.—A neutral particle of very small (possibly zero) rest mass and of spin quantum number $\frac{1}{2}$. Postulated by Fermi in explaining the beta decay process.

Whenever a beta particle is emitted from a radioactive nucleus a neutrino is also created and ejected. The neutrino and beta particle share between them the available energy and momentum. The neutrino, like the photon, carries no electrical charge and has no mass other than that associated with its energy. Neutrinos are exceedingly penetrating, and are able to traverse millions of miles of matter without appreciable attenuation.

Neutron.—A neutral elementary particle of mass number 1. It is believed to be a constituent particle of all nuclei of mass number greater than 1. It is unstable with respect to beta-decay, with a half life of about 12 minutes. It produces no detectable primary ionization in its passage through matter, but interacts with matter predominantly by collisions and, to a lesser extent, magnetically. Some properties of the neutron are: rest mass, 1.00894 atomic mass unit; charge, 0; spin quantum number, $\frac{1}{2}$; magnetic moment, -1.9125 nuclear Bohr *magnetons*.

Neutron cross section.—See *cross section*

Newton's law of cooling.—The rate of cooling of a body under given conditions is proportional to the temperature difference between the body and its surroundings.

Newton's law of motion.

I. Every body continues in its state of rest or of uniform motion in a straight line except in so far as it may be compelled to change that state by the action of some outside force.

II. Change of motion is proportional to force applied and takes place in the direction of the line of action of the force.

III. To every action there is always an equal and opposite reaction.

Nodal points.—Two points on the axis of a lens such that a ray entering the lens in the direction of one, leaves as if from the other and parallel to the original direction.

A **normal salt** is an ionic compound containing neither replaceable hydrogen nor hydroxyl ions.

A **normal solution** contains one gram molecular weight of the dissolved substance divided by the hydrogen equivalent of the substance (that is, one gram equivalent) per liter of solution.

Nuclear atom.—The atom of each element consists of a small dense nucleus which includes most of the mass of the atom. The nucleus is made up of roughly equal numbers of neutrons and protons. The positive charges of the protons enables the nucleus to surround itself with a set of negatively charged electrons which move around the nucleus in complicated orbits with well defined energies. The outermost electrons which are least tightly bound to the nucleus play the dominant part in determining the physical and chemical properties of the atom. There are as many electrons in orbits as there are protons in the nucleus.

Nuclear fusion.—See *fusion*

Nuclear isomers.—Isotopes of elements having the same mass number and atomic number but differing in radioactive properties such as half-life period.

Nucleon.—Any particle found in the structure of an atom's nucleus. The most plentiful ones are neutrons and protons.

Nucleus.—The dense central core of the atom, in which most of the mass and all of the positive charge is concentrated. The charge on the nucleus, an integral multiple of Z of the electronic charge, is the essential factor which distinguishes one element from another. Z is called the atomic number and gives the number of protons in the nucleus, which includes a roughly equal number of neutrons. The mass number A gives the total number of neutrons plus protons.—See *Isotopes and Nuclear Atom*

Nuclide.—A species of atom distinguished by the constitution of its nucleus. The nuclear constitution is specified by the number of protons, Z; number of neutrons, N; and energy content. (Or, by the atomic number, Z; mass number A $(= N + Z)$ and atomic mass.)

Numerical aperture is the sine of half the angular aperture, used as a measure of the optical power of an objective.

Oersted.—The cgs emu of magnetic intensity exists at a point where a force of 1 dyne acts upon a unit magnetic pole at that point, i.e., the intensity 1 cm from a unit magnetic pole.

Ohm's law.—Current in terms of electromotive force E and resistance R.

$$I = \frac{E}{R}.$$

The current is given in amperes when E is in volts and R in ohms.

Organ pipes.—The frequency of vibration of a closed pipe or other air column of length l, where V is the velocity of sound in air, for the fundamental and first three overtones respectively is,

$$n_o = \frac{V}{4l}, \quad n_1 = \frac{3V}{4l}, \quad n_2 = \frac{5V}{4l}, \quad n_3 = \frac{7V}{4l}$$

For an open pipe,

$$n_o = \frac{V}{2l}, \quad n_1 = \frac{2V}{2l}, \quad n_2 = \frac{3V}{2l}, \quad n_3 = \frac{4V}{2l}$$

Oxidation is any process which increases the proportion of oxygen or acid-forming element or radical in a compound.

Packing fraction.—Packing fraction is the difference between the actual mass of the isotope and the nearest whole number divided by the mass number. Thus the packing fraction is equal to $(M - A)/A$ where M is the actual mass and A is the mass number. For example, one of the chlorine isotopes has a mass of 32.9860. The packing fraction for this isotope is

$$\frac{32.9860 - 33.0000}{33.0000} = -0.00042$$

Packing fractions are usually expressed as parts per 10,000 and so the packing fraction for this isotope of chlorine is written as -4.2. Since oxygen is taken as the standard, elements with positive packing fractions are less stable than oxygen, those with negative packing fractions are more stable.

It is positive for nuclides with mass number 16 or greater than 180 and negative for most others.

Paramagnetic materials.—Those within which an applied magnetic field is slightly increased by the alignment of electron orbits. The slight diamagnetic effect in materials having magnetic dipole moments is overshadowed by this paramagnetic alignment. As the temperature increases this paramagnetism disappears leaving only diamagnetism. The permeability of paramagmetic materials is slightly greater than that of empty space.

Pascal's law.—Pressure exerted at any point upon a confined liquid is transmitted undiminished in all directions.

Peltier effect.—When a current flows across the junction of two unlike metals it gives rise to an absorption or liberation of heat. If the current flows in the same direction as the current at the hot junction in a thermoelectric circuit of the two metals, heat is absorbed; if it flows in the same direction as the current at the cold junction of the thermoelectric circuit heat is liberated.

Pendulum.—For a simple pendulum of length l, for a small amplitude, the complete period,

$$T = 2\pi \sqrt{\frac{l}{g}} \quad \text{or} \quad g = 4\pi^2 \frac{l}{T^2}$$

T will be given in seconds if l is in cm and g in cm per sec². For a sphere suspended by a wire of negligible mass where d is the distance from the knife edge to the center of the sphere whose radius is r, the length of the equivalent simple pendulum,

$$l = d + \frac{2r^2}{5d}$$

If the period is P for an arc θ, the time of vibration in an infinitely small arc is approximately

$$T = \frac{P}{1 + \frac{1}{4} \sin^2 \frac{\theta}{4}}$$

For a compound pendulum, if a body of mass m be suspended from a point about which its moment of inertia is I with its center of gravity a distance h below the point of suspension, the period

$$T = 2\pi \sqrt{\frac{I}{mgh}}$$

Period in uniform circular motion is the time of one complete revolution. In any oscillatory motion it is the time of a complete oscillation. Dimension,—$[t]$.

Periodic law.—Elements when arranged in the order of their atomic weights or atomic numbers show regular variations in most of their physical and chemical properties.

Permeance, the reciprocal of reluctance. Unit permeance is the permeance of a cylinder one square centimeter cross-section and one centimeter length taken in a vacuum. Dimensions—$[\epsilon^{-1} l^{-1} t^2]$; $[\mu l]$.

Phase of oscillatory motion.—The fraction of a whole period which has elapsed since the moving particle last passed through its middle position in a positive direction.

Photographic density.—The density D of silver deposit on a photographic plate or film is defined by the relation

$$D = \log O$$

where O is the opacity. If I_o and I are the incident and transmitted intensities respectively the opacity is given by I_o/I. The transparency is the reciprocal of the opacity or I/I_o.

Photon.—A photon (or γ-ray) is a quantum of electromagnetic radiation which has zero rest mass and an energy of h (Planck's constant) times the frequency of the radiation. Photons are generated in collisions between nuclei or electrons and in any other process in which an electrically charged particle changes its momentum. Conversely photons can be absorbed (i.e., annihilated) by any charged particle.

Piezo-electric effect.—The phenomenon exhibited by certain crystals of expansion along one axis and contraction along another when subjected to an electric field. Conversely compression of certain crystals generate an electrostatic voltage across the crystal. Piezoelectricity is only possible in crystal classes which do not possess a center of symmetry.

Pinch effect.—When an electric current, either direct or alternating, passes through a liquid conductor, that conductor tends to contract in cross-section, due to *electromagnetic* forces.

Pitch.—Psychological response of the ear, primarily dependent upon the frequency of vibration of the air. The intensity of the sound also has a certain effect on the pitch. Pitch of a screw is the axial distance between adjacent turns of a single thread on the screw.

Planck's constant (h).—A universal constant of nature which relates the energy of a quantum of radiation to the frequency of the oscillator which emitted it. It has the dimensions of action (energy × time). Expressed by $E = h\nu$ where E is the energy of the quantum and ν is its frequency. Its numerical value is 6.624×10^{-27} erg-sec.

Plutonium.—A fissile element, artificially produced in the pile by neutron bombardment of U^{238}.

Poise.—A unit of coefficient of viscosity, defined as the tangential force per unit area (dynes/cm^2) required to maintain unit difference in velocity (1 cm/sec) between two parallel planes separated by 1 cm of fluid;

$$1 \text{ poise} = 1 \text{ dyne sec/cm}^2 = 1 \text{ gm/cm sec.}$$

Poisson's ratio is the ratio of the transverse contraction per unit dimension of a bar of uniform cross-section to its elongation per unit length, when subjected to a tensile stress.

Polarized light.—Light which exhibits different properties in different directions at right angles to the line of propagation is said to be polarized. Specific rotation is the power of liquids to rotate the plane of polarization. It is stated in terms of specific rotation or the rotation in degrees per decimeter per unit density.

Polymorphism.—The ability to exist in two or more crystalline forms.

Positron.—A particle of the same mass M_e, as an ordinary electron. It has a positive electrical charge of exactly the same amount as that of an ordinary electron (which is sometimes called negatron). Positrons are created either by the radioactive decay of certain unstable nuclei or, together with a negatron, in a collision between an energetic (more than one Mev) photon and an electrically charged particle (or another photon). A positron does not decay spontaneously but on passing through matter it sooner or later collides with an ordinary electron and in this collision the positron-negatron pair is annihilated. The rest energy of the two particles, which is given by Einstein's relation $E = \mathrm{mc}^2$ and amounts to 1.0216 mev altogether, is converted into electromagnetic radiation in the form of one or more photons.

Potential (electric) at any point is measured by the work necessary to bring unit positive charge from an infinite distance. Difference of potential between two points is measured by the work necessary to carry unit positive charge from one to the other. If the work involved is one erg we have the electrostatic unit of potential. Dimensions,—$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-1}]$, $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-2}]$.

The potential at a point due to a charge q at a distance r in a medium whose dielectric constant is ϵ is,

$$V = \frac{q}{\epsilon r}$$

Power.—The time rate at which work is done. Units of power,—the watt, one joule (ten million ergs) per second; the kilowatt is equal to 1000 watts; the horse-power, 33,000 foot-pounds per minute, is equal to 746 watts. Dimensions,—$[m\, l^2\, t^{-3}]$.

If an amount of work W is done in time t the power or rate of doing work is

$$P = \frac{W}{t}$$

Power will be obtained in watts if W is expressed in joules (10^7 ergs) and t in sec.

Power in watts for alternating current,

$$P = EI \cos \phi$$

where E and I are the effective values of the electromotive force and current in volts and amperes respectively and ϕ the phase angle between the current and the impressed electromotive force.

The ratio,

$$\frac{P}{EI} = \cos \phi$$

is called the power factor.

Power developed by a direct current.—The power in watts developed by an electric current flowing in a conductor, where E is the difference of potential at its terminals in volts, R its resistance in ohms, and I the current in amperes,

$$P = EI = RI^2$$

The work done in joules in a time t sec is,

$$W = EIt{:}RI^2t.$$

Power ratios in telephone engineering are measured in **decibels.** The gain or loss of power expressed in decibels is ten times the logarithm of the power ratio. By reference to an arbitrarily chosen "power level" the actual power may be expressed in decibels. The numerical values thus used will not be proportional to the actual power level but roughly to the sensation on the ear produced when the electrical power is converted into sound. A difference of 1 decibel in the power supply to a telephone receiver produces approximately the smallest change in volume of sound which a normal ear can detect.

Pressure.—Force applied to, or distributed, over a surface; measured as force per unit area. Cgs unit,—the barye, one dyne per square centimeter. The megabarye is equal to 10^6 dynes per square centimeter. Pressure is also measured by the height of the column of mercury or water which it supports. Dimensions,—$[m\, l^{-1}\, t^{-2}]$.

The pressure due to a force F distributed over an area A,

$$P = \frac{F}{A}$$

Absolute pressure.—Pressure measured with respect to zero pressure. *Gauge pressure*—pressure measured with respect to that of the atmosphere.

Principal focus of a lens or spherical mirror is the point of convergence of light coming from a source at an infinite distance.

Projectiles.—For bodies projected with velocity v at an angle a above the horizontal, the time to highest point of flight.

$$t = \frac{v \sin a}{g}$$

Total time of flight to reach the original horizontal plane,

$$T = \frac{2v \sin a}{g}$$

Maximum height,

$$h = \frac{v^2 \sin^2 a}{2g}$$

Horizontal range,

$$R = \frac{v^2 \sin 2a}{g}$$

In the above equations the resistance of the air is neglected. g is the acceleration due to gravity.

Proton.—An elementary particle having a positive charge equivalent to the negative charge of the electron but possessing a mass approximately 1837 times as great. The proton is in effect the positive nucleus of the hydrogen atom.

Purkinje effect.—A phenomenon associated with the human eye, making it more sensitive to blue light when the illumination is poor (less than about 0.1 lumen per sq. ft.) and to yellow light when the illumination is good.

Quality or timbre of a sound depends on the coexistence with the fundamental of other vibrations of various frequencies and amplitudes.

Quantity of electricity or charge.—The electrostatic unit of charge, the quantity which when concentrated at a point and placed at unit distance from an equal and similarly concentrated quantity, is repelled with unit force. If the distance is one centimeter and force of repulsion one dyne and the surrounding medium a vacuum, we have the electrostatic unity of quantity. The electrostatic unit of quantity may be defined as that transferred by electrostatic unit current in unit time. The quantity transferred by one ampere in one second is the coulomb, the practical unit. The faraday is the electrical charge carried by one gram equivalent. The coulomb = 3 × 10^9 electrostatic units. Dimensions,—

$$[\epsilon^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-1}];\ [\mu^{-2}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}].$$

Quantum.—Unit quantity of energy postulated in the quantum theory. The *photon* is a quantum of the electromagnetic field, and in nuclear field theories, the *meson* is considered to be the quantum of the nuclear field.

Radiation.—The emission and propagation of energy through space or through a material medium in the form of waves.

The term may be extended to include streams of sub-atomic particles as alpha-rays, or beta-rays, and cosmic rays as well as electromagnetic radiation. Often used to designate the energy alone without reference to its character. In the case of light this energy is transmitted in bundles (photons).

Radiation formula, Planck's.—The emissive power of a black body at wave length λ may be written

$$E_\lambda = \frac{c_1\lambda^{-5}}{e^{c_2/\lambda T} - 1}$$

where c_1 and c_2 are constants with numerical values 3.7403 × 10^8 microwatts per cm^2 per 0.01μ zone of spectrum and 14384 micron degrees, respectively and T the absolute temperature.

Radioactive nuclides.—Are atoms that disintegrate by emission of corpuscular or electromagnetic radiations. The rays most commonly emitted are alpha or beta or gamma rays. The three classes are:

1. Primary, which have life-times exceeding 10^8 years. These may be alpha-emitters or beta-emitters.
2. Secondary, which are formed in radioactive transformations starting with U^{238}, U^{235}, or Th^{232}.
3. Induced, having geologically short lifetimes and formed by induced nuclear reactions occurring in nature. All these reactions result in transmutation.

Radius of gyration may be defined as the distance from the axis of rotation at which the total mass of a body might be concentrated without changing its moment of inertia. The product of total mass and the square of the radius of gyration will give (the) moment of inertia.

Rankine scale of temperature.—The absolute Fahrenheit scale.

°F + 459.69 = °R; thus 0° Rankine = 459.69°F.

Raoult's law.—Molar weights of non-volatile non-electrolytes when dissolved in a definite weight of a given solvent under the same conditions lower the solvent's freezing point, elevate its boiling point and reduce its vapor pressure equally for all such solutes.

Reduction is any process which increases the proportion of hydrogen or base-forming elements or radicals in a compound. Reduction is also the gaining of electrons by an atom, an ion, or an element thereby reducing the positive valence of that which gained the electron.

Reflection coefficient or reflectivity is the ratio of the light reflected from a surface to the total incident light. The coefficient may refer to diffuse or to specular reflection. In general it varies with the angle of incidence and with the wavelength of the light.

Reflection of light by a transparent medium in air. (Fresnel's formulae).—If i is the angle of incidence, r the angle of refraction, n_1 the index of refraction for air (nearly equal to unity), n_2 index of refraction for a medium, then the ratio of the reflected light to the incident light is,

$$R = \frac{1}{2}\left(\frac{\sin^2 (i - r)}{\sin^2 (i + r)} + \frac{\tan^2 (i - r)}{\tan^2 (i + r)}\right)$$

If $i = 0$ (normal incidence), and $n_1 = l$ (approximate for air),

$$R = \left(\frac{n_2 - 1}{n_2 + 1}\right)^2$$

Refraction.—See *Index of refraction; Snell's law.*

Refraction at a spherical surface.—If u be the distance of a point source, v the distance of the point image or the intersection of the refracted ray with the axis, n_1 and n_2 the indices of refraction of the first and second medium, and r the radius of curvature of the separating surface,

$$\frac{n_2}{v} + \frac{n_1}{u} = \frac{n_2 - n_1}{r}$$

If the first medium is air the equation becomes,

$$\frac{n}{v} + \frac{1}{u} = \frac{n - 1}{r}$$

Refractivity is given by $(n - 1)$ when n is the index of refraction; the **specific refractivity** is given by $\frac{n - 1}{d}$ where d is the density. **Molecular refractivity** is the product of specific refractivity by the molecular weight.

Relative humidity.—The ratio of the quantity of water vapor present in the atmosphere to the quantity which would saturate at the existing temperature. It is also the ratio of the pressure of water vapor present to the pressure of saturated water vapor at the same temperature.

Reluctance is that property of a magnetic circuit which determines the total magnetic flux in the circuit when a given magnetomotive force is applied. Unit, the reluctance of one centimeter length and one square centimeter cross-section of space taken in a vacuum. Dimensions,—$[\epsilon l\, t^{-2}]$; $[\mu^{-1}\, l^{-1}]$.

Reluctivity or specific reluctance is the reciprocal of magnetic permeability. The reluctivity of empty space is taken as unity. Dimensions,—$[\epsilon l^2\, t^{-2}]$; $[\mu^{-1}]$.

Resistance is a property of conductors depending on their dimensions, material and temperature which determines the current produced by a given difference of potential. The practical unit of resistance, the **ohm** is that resistance through which a difference of potential of one volt will produce a current of one ampere. The **international ohm** is the resistance offered to an unvarying current by a column of mercury at 0°C, 14.4521 grams in mass, of constant cross-sectional area and 106.300 centimeters in length, sometimes called the legal ohm. Dimensions,—$[\epsilon^{-1}\, l^{-1}\, t]$; $[\mu l\, t^{-1}]$.

Resistance of a conductor at 0°C, of length l, cross-section s and specific resistance ρ

$$R_o = \rho \frac{l}{s}$$

The resistivity may be expressed as ohm-cm when R is in ohms, l in cm and s in cm².

Resistance of a conductor at a temperature t whose resistance at 0°C is R_o and whose temperature resistance coefficient is α

$$R_t = R_o(1 + \alpha t)$$

Resistance of conductors in series and parallel.—The total resistance of any number of resistances joined in series is the sum of the separate resistances. The total resistance of conductors in parallel whose separate resistances are r_1, r_2, r_3 . . . r_n is given by the formula

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} \cdots + \frac{1}{r_n}$$

Where R is the total resistance. For two terms this becomes,

$$R = \frac{r_1 r_2}{r_1 + r_2}$$

Resistance, specific (Resistivity).—A proportionality factor characteristic of different substances equal to the **resistance** that a centimeter cube of the substance offers to the passage of electricity, the current being perpendicular to two parallel faces. It is defined by the expression:

$$R = \rho \frac{l}{A}$$

where R is the resistance of a uniform conductor, l is its length, A is its cross sectional area, and ρ is its resistivity. Resistivity is usually expressed in ohm-centimeters.

Resolving power of a telescope or microscope is indicated by the minimum separation of two objects for which they appear distinct and separate when viewed through the instrument.

Resonance (chemical).—The moving of electrons from one atom of a molecule or ion to another atom of that molecule or ion. It is simply the oriented movement of the bonds between atoms.

Restitution, coefficient of, for two bodies on impact.—The ratio of the difference in velocity, after impact to the difference before impact.

Reversible reaction.—One which can be caused to proceed in either direction by suitable variation in the conditions of temperature, volume, pressure or of the quantities of reacting substances.

Roentgen.—A radiation unit, that amount of radiation that will produce one electrostatic unit of ions per cubic centimeter volume.

Rotatory power is the power of rotating the plane of polarized light, given in general by θ/l where θ is the total rotation which occurs in a distance l.

The **molecular** or **atomic rotatory power** is the product of the specific rotatory power by the molecular or atomic weight. Magnetic rotatory power is given by

$$\theta/e\,H\cos\alpha$$

where H the intensity of the magnetic field, and α the angle between the field and the direction of the light.

Rydberg formula.—A formula, similar to that of Balmer, for expressing the wave-numbers (ν) of the lines in a spectral series:

$$\nu = R\left[\frac{1}{(n+a)^2} - \frac{1}{(m+b)^2}\right]$$

where n and m are integers and $m > n$, a and b are constants for a particular series, and R is the *Rydberg constant*, 109677.8 cm^{-1} for hydrogen.

Salt.—Any substance which yields ions, other than hydrogen or hydroxyl ions. A salt is obtained by displacing the hydrogen of an acid by a metal.

Scintillometer.—An instrument which detects radiation by emitting flashes of light.

Seebeck effect.—If a circuit consists of two metals, one junction hotter than the other, a current flows in the circuit. The direction of the flow depends on the metals and the temperature of the junctions.

Sensitiveness of a balance.—Assuming the three knife edges of a balance to lie on a straight line,—if M is the weight of the beam, h the distance of the center of gravity below the knife edge, L the length of the balance arms and m a small mass added to one pan, the deflection θ produced is given by

$$\tan \theta = \frac{mL}{Mh}.$$

Shell.—According to *Pauli's exclusion principle* (q.v.), the extranuclear electrons do not circle around the nucleus all in orbits of the same radius, but are arranged in orbits at various distances from the nucleus. The extranuclear orbital electrons are thus assumed to be arranged in a series of concentric spheres, called *shells*, which are designated, in the order of increasing distance from the nucleus, as K, L, M, N, O, P, and Q shells. The number of the electrons which each of these shells can contain is limited. All electrons arranged in the same shell have the same principal quantum number. The electrons in the same shell are grouped into various subshells (q.v.), and all the electrons in the same subshell have the same orbital angular momentum.—See *Subshell*

Simple harmonic motion.—Periodic oscillatory motion in a straight line in which the restoring force is proportional to the displacement. If a point moves uniformly in a circle, the motion of its projection on the diameter (or any straight line in the same plane) is simple harmonic motion.

If r is the radius of the reference circle, ω the angular velocity of the point in the circle, θ the angular displacement at the time t after the particle passes the mid-point of its path, the linear displacement,

$$x = r \sin \theta = r \sin \omega t.$$

The velocity at the same instant,

$$v = r\omega \cos \theta = \omega \sqrt{r^2 - x^2}$$

The acceleration,

$$a = -\omega^2 x.$$

The force for a mass m,

$$F = m\omega^2 x = -\frac{4\pi^2 m x}{T^2}$$

The period,

$$T = 2\pi \sqrt{\frac{x}{a}}$$

In the above equations the cgs system calls for x and r in cm, v in cm per sec, a in cm per sec^2, T in sec, m in grams, F in dynes, θ in radians and ω in radians per sec.

Simple machine.—A contrivance for the transfer of energy and for increased convenience in the performance of work.

Mechanical advantage is the ratio of the resistance overcome to the force applied. Velocity ratio is the ratio of the distance through which force is applied to the distance through which resistance is overcome.

Efficiency is the ratio of the work done by a machine to the work done upon it.

If a force f applied to a machine through a distance S results in a force F exerted by the machine through a distance s, neglecting friction,

$$fS = Fs.$$

The theoretical mechanical advantage or velocity ratio in the above case is, $\frac{S}{s}$.

Actually the force obtained from the machine will have a smaller value than will satisfy the equation above. If F' be the actual force obtained, the practical mechanical advantage will be, $\frac{F'}{f}$.

The efficiency of the machine,

$$E = \frac{F's}{fS}.$$

Snell's law of refraction.—If i is the angle of incidence, r the angle of refraction, v the velocity of light in the first medium, v' the velocity in the second medium, the index of refraction n,

$$n = \frac{\sin i}{\sin r} = \frac{v}{v'}.$$

Solid.—A state of matter in which the relative motion of the molecules is restricted and they tend to retain a definite fixed position relative to each other, giving rise to crystal structure. A solid may be said to have a definite shape and volume.

Solid angle.—Measured by the ratio of the surface of the portion of a sphere enclosed by the conical surface forming the angle, to the square of the radius of the sphere. Unit of solid angle,—the steradian, the solid angle which encloses a surface on the sphere equivalent to the square of the radius. Dimensions,—unity.

Solubility of one liquid or solid in another is the mass of a substance contained in a solution which is in equilibrium with an excess of the substance. Under these conditions the solution is said to be saturated. Solubility of a gas is the ratio of concentration of gas in the solution to the concentration of gas above the solution.

Solubility product or precipitation value is the product of the concentrations of the ions of a substance in a saturated solution of the substance. These concentrations are frequently expressed as moles of solute per liter of solution.

Solute.—That constituent of a solution which is considered to be dissolved in the other, the solvent. The solvent is usually present in larger amount than the solute.

A **solution** is **saturated** if it contains at given temperature as much of a solute as it can retain in the presence of an excess of that solute.

A **true solution** is a mixture, liquid, solid or gaseous, in which the components are uniformly distributed throughout the mixture. The proportion of the constituents may be varied within certain limits.

Solvent.—That constituent of a solution which is present in larger amount; or, the constituent which is liquid in the pure state, in the case of solutions of solids or gases in liquids.

Specific gravity.—The ratio of the mass of a body to the mass of an equal volume of water at 4°C or other specified temperature. Dimensions,—unity.

Specific heat of a substance is the ratio of its thermal capacity to that of water at 15°C. Dimensions,—unity.

If a quantity of heat H calories is necessary to raise the temperature of m grams of a substance from t_1 to t_2°C, the specific heat, or more properly, thermal capacity of the substance,

$$s = \frac{H}{m(t_2 - t_1)}.$$

Specific heat by the method of mixtures.—Where a mass m_1 of the substance is heated to a temperature t_1, then placed in a mass of water m_2 at a temperature t_2 contained in a calorimeter with stirrer (of same material) of mass m_3, specific heat of the calorimeter c, t_3 the final temperature

$$m_1 s(t_1 - t_3) = m_3 c + m_2(t_3 - t_2).$$

Black's ice calorimeter.—If a body of mass m and temperature t melts a mass m' of ice, its temperature being reduced to 0°C, the specific heat of the substance is,

$$s = \frac{80\ 1m'}{mt}$$

Bunsen's ice calorimeter.—A body of mass m at temperature t causes a motion of the mercury column of l centimeters in a tube whose volume per unit length is v. The specific heat is

$$s = \frac{884lv}{mt}$$

Specific inductive capacity.—The ratio of the capacitance of a condenser with a given substance as dielectric to the capacitance of the same condenser with air or a vacuum as dielectric is called the specific inductive capacity. The ratio of the dielectric constant of a substance to that of a vacuum.

Specific rotation.—If there are n grams of active substance in v cubic centimeters of solution and the light passes through l centimeters, r being the observed rotation in degrees, the specific rotation (for 1 centimeter),

$$[\alpha] = \frac{rv}{nl}$$

Specific volume is the reciprocal of density. Dimensions,—$[m^{-1}\, l^3]$.

Spectral series are spectral lines or groups of lines which occur in an orderly sequence.

Speed.—Time rate of motion measured by the distance moved over in unit time. Cgs unit,—one centimeter per second. Dimension,—$[l\, t^{-1}]$.

Spherical aberration.—When large surfaces of spherical mirrors or lenses are used the light divergent from a point source is not exactly focused at a point. The phenomenon is known as spherical aberration. For axial pencils the error is known as axial spherical aberration; for oblique pencils, coma.

Spherical mirrors.—If R is the radius of curvature, F principal focus, and f_1 and f_2 any two conjugate focal distances,

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{F} = \frac{2}{R}$$

If the linear dimensions of the object and image be O and I respectively and u and v their distances from the mirror,

$$\frac{O}{I} = \frac{u}{v}$$

Spin.—In nuclear physics, used to describe the angular momentum of elementary particles or of nuclei.

Standard conditions for gases.—Measured volumes of gases are quite generally recalculated to 0 degrees C temperature and 760 mm pressure, which have been arbitrarily chosen as standard conditions.

Stark effect.—The splitting of a single spectrum line into multiple lines which occurs when the emitting material is placed in a strong electric field. The observed effect depends on the angle between the direction of the field and the direction of observation. The effect is due to the shifting of the energy states of certain orbits which all have the same energy in zero field.

Statcoulomb.—The unit of electric charge in the metric system. 3×10^9 statcoulombs = 1 coulomb.

Stationary or standing waves are produced in a medium by the simultaneous transmission, in opposite directions of two similar wave motions. Fixed points of minimum amplitude are called **nodes.** A **segment** extends from one node to the next. An **antinode** or **loop** is the point of maximum amplitude between two nodes.

Stefan-Boltzman law of radiation.—The energy radiated in unit time by a black body is given by, $E = K(T^4 - T_o^4)$, where T is the absolute temperature of the body, T_o the absolute temperature of the surroundings, and K a constant.

Stoichiometric.—Pertaining to weight relations in chemical reactions.

Stoke.—See under viscosity.

Stoke's law.—1. Gives the rate of fall of a small sphere in a viscous fluid. When a small sphere falls under the action of gravity through a viscous medium it ultimately acquires a constant velocity,

$$V = \frac{2ga^2(d_1 - d_2)}{9\eta}$$

where a is the radius of the sphere, d_1 and d_2 the densities of the sphere and the medium respectively, and η the coefficient of viscosity. V will be in cm per sec if g is in cm per sec^2, a in cm, d_1 and d_2 in g per cm^3 and η in dyne-sec per cm^2 or poises.

2. The empirical law stating that the wavelength of light emitted by a fluorescent material is longer than that of the radiation used to excite the fluorescence. In modern language the emitted photons carry off less energy than is brought in by the exciting photons; the details accord with the energy conservation principle.

Strain.—The deformation resulting from a stress measured by the ratio of the change to the total value of the dimension in which the change occurred. Dimensions,—unity.

Stress.—The force producing or tending to produce deformation in a body measured by the force applied per unit area. Cgs units,—one dyne per square centimeter. Dimensions,—$[m\, l^{-1}\, t^{-2}]$.

Subshell.—The electrons within the same shell (energy level) of the atom are characterized by the same principal quantum number (n), and are further divided into groups according to the value of their azimuthal quantum numbers (l); the electrons which possess the same azimuthal quantum number for the same principal quantum number are considered to occupy the same subshell (or sublevel). The individual subshells are designated with the letters s, p, d, f, g, and h, as follows:

l value	designation of subshell
0	s
1	p
2	d
3	f
4	g
5	h

An electron assigned to the s-subshell is called an s-electron, one assigned to the p-subshell is referred to as a p-electron, etc. In formulae of electron structure, the value of the principal quantum number (n) is prefixed to the letter indicating the azimuthal quantum number (l) of the electron; thus, e.g., a $4f$-electron is an electron which has the principal quantum number 4 (i.e. assigned to the N-shell) and the orbital angular momentum 3(f-subshell).

Surface density of electricity.—Quantity of electricity per unit area. Dimensions,—$[\epsilon^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^{-1}]$; $[\mu^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{3}{2}}]$.

Surface density of magnetism.—Quantity of magnetism per unit area. Dimensions,—$[\epsilon^{-1}\, m^{\frac{1}{2}}\, l^{-\frac{3}{2}}]$, $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{-\frac{1}{2}}\, t^{-1}]$.

Surface tension.—Two fluids in contact exhibit phenomena, due to molecular attractions which appear to arise from a tension in the surface of separation. It may be expressed as dynes per cm or as ergs per square centimeter. Dimensions, —$[m\, t^{-2}]$.

The total force along a line of length l on the surface of a liquid whose surface tension is T,

$$F = lT.$$

Capillary tubes.—If a liquid of density d rises a height h in a tube of internal radius r the surface tension is,

$$T = \frac{rhdg}{2}$$

The tension will be in dynes per cm if r and h are in cm, d in g per cm^3 and g in cm per sec^2.

Drops and bubbles.—Pressure in dynes per cm^2 due to surface tension on a drop of radius r cm for a liquid whose surface tension is T dynes per cm,

$$P = \frac{2T}{r}$$

For a bubble of mean radius r cm,

$$P = \frac{4T}{r}.$$

Susceptibility (magnetic) is measured by the ratio of the intensity of magnetization produced in a substance to the magnetizing force or intensity of field to which it is subjected. The susceptibility of a substance will be unity when unit intensity of magnetization is produced by a field of one gauss. Dimensions,—$[\epsilon^{-1}\, l^{-2}\, t^2]$, $[\mu]$.

Tangent galvanometer.—A tangent galvanometer with n turns, of radius r, in the earth's field H, has a deflection θ. The current flowing is,

$$i = \frac{Hr}{2\pi n} \tan \theta$$

If $\frac{2\pi n}{r} = G$ (the galvanometer constant).

$$i = \frac{H}{G} \tan \theta$$

Temperature may be defined as the condition of a body which determines the transfer of heat to or from other bodies. Particularly it is a manifestation of the average translational kinetic energy of the molecules of a substance due to heat agitation. The customary unit of temperature is the **Centigrade** degree, $\frac{1}{100}$ the difference between the temperature of melting ice and that of water boiling under standard atmospheric pressure. The degree **Fahrenheit** is $\frac{1}{180}$, and the degree **Reaumur** $\frac{1}{80}$ the same difference of temperature.

The fundamental temperature scale is the absolute, thermodynamic or **Kelvin scale** in which the temperature measure is based on the average kinetic energy per molecule of a perfect gas. The zero of the Kelvin scale is −273.18°C. The temperature scale adopted by the International Bureau of Weights and Measures is that of the constant volume hydrogen gas thermometer. The magnitude of the degree in both these scales is defined as $\frac{1}{100}$ the difference between the temperature of melting ice and that of boiling water at 760 mm pressure. Frequently the Kelvin scale is defined as degrees C + 273.16 and the Rankine scale as degrees F + 459.69°F.

The fundamental temperature scale is now defined by means of the equation

$$\theta(\mathrm{X}) = 273.16^\circ\mathrm{K}\,\frac{\mathrm{X}}{\mathrm{X}_3}$$

where θ denotes the temperature; X the thermometric property (P, V, . . .); the subscript 3 refers to the triple point of water; and 273.16°K is the arbitrary fixed point for the temperature associated with the triple point of water.

The ideal gas temperature θ, (numerically equal to the Kelvin temperature), in particular, is defined by either of the two equations:

$$\theta = \begin{cases} 273.16^\circ \lim\limits_{\mathrm{P}_3\to 0} \dfrac{\mathrm{P}}{\mathrm{P}_3}, \text{ const. V} \\ \\ 273.16^\circ \lim\limits_{\mathrm{P}\to 0} \dfrac{\mathrm{V}}{\mathrm{V}_3}, \text{ const. P} \end{cases}$$

Temperature resistance coefficient.—The ratio of the change of resistance in a wire due to a change of temperature of 1°C to its resistance at 0°C. Dimension,—$[\theta^{-1}]$.

Thermal capacity of a substance is the quantity of heat necessary to produce unit change of temperature in unit mass. It is ordinarily expressed as calories per gram per degree Centigrade. Numerically equivalent to specific heat.

Thermal capacity or water equivalent.—The total quantity of heat necessary to raise any body or system unit temperature, measured as calories per degree centigrade in the cgs system. Dimension,—$[m]$.

Thermal expansion.—The coefficient of linear expansion or expansivity is the ratio of the change in length per degree C to the length at 0°C. The coefficient of volume expansion (for solids) is approximately three times the linear coefficient. The coefficient of volume expansion for liquids is the ratio of the change in volume per degree to the volume at 0°C. The value of the coefficient varies with temperature. The coefficient of volume expansion for a gas under constant pressure is nearly the same for all gases and temperatures and is equal to 0.00367 for 1°C. Dimension,—$[\theta^{-1}]$.

If l_o is the length at 0°C, α the coefficient of linear expansion, the length at t_oC is,

$$l_t = l_o(1 + \alpha t).$$

General formula for thermal expansion.—The rate of thermal expansion varies with the temperature. The general equation giving the magnitude m_t (length or volume) at a temperature t, where m_o is the magnitude at 0°C, is

$$m_t = m_o(1 + \alpha t + \beta t^2 + \gamma t^3 \cdots)$$

where α, β, γ, etc. are empirically determined coefficients.

Volume expansion.—If V represents volume and β the coefficient of expansion,

$$V_t = V_o(1 + \beta t).$$

For solids,

$$\beta = 3\alpha \text{ (approximately).}$$

Thermal neutrons.—Neutrons slowed down by a moderator to an energy of a fraction of an electron volt—about 0.025 ev. at 15°.

Thermionic emission.—Electron or ion emission due to the temperature of the emitter. The rate of emission increases rapidly with the increase of temperature. It is also very sensitive to the state of the surface.

Thermodynamics, law of.

I. When mechanical work is transformed into heat or heat into work, the amount of work is always equivalent to the quantity of heat.

II. It is impossible by any continuous self-sustaining process for heat to be transferred from a colder to a hotter body.

Thermoelectric power is measured by the electromotive force produced by a thermocouple for unit difference of temperature between the two junctions. It varies with the average temperature and is usually expressed in microvolts per degree C. It is customary to list the thermoelectric power of the various metals with respect to lead. Dimensions,—$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-1}\, \theta^{-1}]$; $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, t^{-1}\, \theta^{-1}]$.

Thomson thermoelectric effect is the designation of the potential gradient along a conductor which accompanies a temperature gradient. The magnitude and direction of the potential varies with the substance.

The coefficient of the Thomson effect or specific heat of electricity is expressed in joules per coulomb per degree Centigrade. Dimensions,—$[\epsilon^{-\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{1}{2}}\, t^{-1}\, \theta^{-1}]$, $[\mu^{\frac{1}{2}}\, m^{\frac{1}{2}}\, l^{\frac{3}{2}}\, t^{-2}\, \theta^{-1}]$.

Time, unit of.—The second, $\frac{1}{86400}$ of a mean solar day. One of the three fundamental units of the cgs system.

Torque produced by the action of one magnet on another.—The turning moment experienced by a magnet of pole strength m' and length $2l'$ placed at a distance r from another magnet of length $2l$ and pole strength m, where the center of the first magnet is on the axis (extended) of the second and the axis of the first is perpendicular to the axis of the second,

$$C = 8\frac{mm'll'}{r^3} = \frac{2MM'}{r^3}$$

If the first magnet is deflected through an angle θ, the expression becomes,

$$C = \frac{2MM'}{r^3}\cos\theta$$

Torsional vibration.—See *Angular harmonic motion*

Total reflection.—When light passes from any medium to one in which the velocity is greater, refraction ceases and total reflection begins at a certain critical angle of incidence θ such that

$$\sin\theta = \frac{1}{n}$$

where n is the index of the first medium with respect to the second. If the second medium is air n has the ordinary value for the first medium. For any other second medium,

$$n = \frac{n_1}{n_2}$$

where n_1 and n_2 are the ordinary indices of refraction for the first and second medium respectively.

Tractive force of a magnet.—If a magnet with induction B has a pole face of area A the force, is,

$$F = \frac{B^2A}{8\pi}$$

If B and A are in cgs units, F will be in dynes.

Transmutation.—A nuclear change producing a new element from an old one.

Transuranic elements.—Elements of atomic numbers above 92. All of them are radioactive and are products of artificial nuclear changes. All are members of the actinide group.

Triangle or polygon of forces.—If three or more forces acting on the same point are in equilibrium, the vectors representing them form, when added, a closed figure.

Tritium.—An isotope of hydrogen with a mass of three, structure, two neutrons, and one proton in its nucleus.

Uncertainty principle.—See *Indeterminancy*

Uniform circular motion.—If r is the radius of a circle, v the linear speed in the arc, ω the angular velocity and T the period or time of one revolution,

$$\omega = \frac{v}{r} = \frac{2\pi}{T}$$

The acceleration toward the center is

$$a = \frac{v^2}{r} = \omega^2 r = \frac{4\pi^2 r}{T^2}$$

The centrifugal force for a mass m,

$$F = \frac{mv^2}{r} = m\omega^2 r = \frac{4\pi^2 mr}{T^2}$$

In the above equations ω will be in radians per second and a in cm per sec^2 if r is in cm, v in cm per sec and T in sec. F will be in dynes if mass is in grams and other units as above.

Application to the solar system.—If M is the mass of the sun, G the constant of gravitation, P the period of the planet and r the distance of the planet from the sun, then the mass of the sun

$$M = \frac{4\pi^2 r^3}{GP^2}, \ (G = 6.670 \times 10^{-8} \text{ for cgs units}).$$

If P is the period and r the distance of a satellite revolving around the planet, the above expression for M gives the mass of the planet. The formula is written on the assumption that the orbit of the planet or satellite is circular, which is only approximately true.

Uniformly accelerated rectilinear motion.—If v_o is the initial velocity, v_t the velocity after time t, the acceleration,

$$a = \frac{v_t - v_o}{t}$$

The velocity after time t,

$$v_t = v_o + at$$

Space passed over in time t,

$$s = v_o t + \tfrac{1}{2}at^2$$

Velocity after passing over space s,

$$v = \sqrt{v_o^2 + 2as}$$

Space passed over in the nth second

$$s = v_o + \tfrac{1}{2}a(2n - 1).$$

In the above and following similar equations the values of the space, velocity, and acceleration must be substituted in the same system. For space in *cm*, velocity will be in *cm* per sec and acceleration in *cm* per sec per sec.

Unit.—Specific magnitude of a quantity, set apart by appropriate definition, which is to serve as a basis of comparison or measurement for other quantities of the same nature.

Valence of an atom of an element is that property which is measured by the number of atoms of hydrogen (or its equivalent) one atom of that element can hold in combination if negative, or can displace in a reaction if it is positive.

Valence electrons of the atom are electrons which are gained, lost or shared in chemical reactions.

Van der Waals' equation of state.—This equation is expressed by:

$$\left(p + \frac{a}{v^2}\right)(v - b) = RT$$

It makes allowance both for the volume occupied by the molecules and for the attractive force between the molecules. b is the effective volume of molecules in one mole of gas. a is a measure of the attractive force between the molecules. For values of R, a, and b see index for table of Van der Waal's constants for gasses.

Van't Hoff's principle.—If the temperature of interacting substances in equilibrium is raised, the equilibrium concentrations of the reaction are changed so that the products of that reaction which absorb heat are increased in quantity, or if the temperature for such an equilibrium is lowered, the products which evolve heat in their formation are increased in amounts.

Vapor. The words **vapor** and **gas** are often used interchangeably. **Vapor** is more frequently used for a substance which, though present in the gaseous phase, generally exists as a liquid or solid at room temperature. **Gas** is more frequently used for a substance that generally exists in the gaseous phase at room temperature. Thus one would speak of iodine or carbon tetrachloride vapors and of oxygen gas.

Vapor pressure.—The pressure exerted when a solid or liquid is in equilibrium with its own vapor. The vapor pressure is a function of the substance and of the temperature.

Vectors, composition of.—If the angle between two vectors is A, and their magnitude a and b, their resultant,

$$C = \sqrt{a^2 + b^2 + 2ab \cos A}.$$

Velocity.—Time rate of motion in a fixed direction. Cgs units,—one centimeter per second. Dimensions,—$[l\ t^{-1}]$.

If s is space passed over in time t, the velocity,

$$v = \frac{s}{t}$$

Velocity of a compressional wave.—The velocity of a compressional wave in an elastic medium, in terms of elasticity E (bulk modulus) and density d,

$$V = \sqrt{\frac{E}{d}}$$

For the velocity of sound in air, where p is the pressure and d the density,

$$V = \sqrt{\frac{1.4p}{d}}$$

Velocity of efflux of a liquid.—If h is the distance from the opening to the free surface of the liquid, the velocity of efflux is

$$V = \sqrt{2gh}$$

The above is the theoretical discharge velocity disregarding friction and the shape of orifice. For water issuing through a circular opening with sharp edges of area, A, the volume discharged per second is given approximately by,

$$Q = 0.62A\ \sqrt{2gh}$$

Velocity of sound, variation with temperature.—The velocity in meters per sec at any temperature t in °C is given approximately by

$$V = V_o \sqrt{1 + \frac{t}{273}}$$

$$V = 331.5 + .607t$$

The **variation with humidity** is given by the equation

$$V_d = V_h \sqrt{1 - \frac{e}{p}\left(\frac{\gamma_\omega}{\gamma_a} - \frac{5}{8}\right)}$$

where V_d is the velocity in dry air, V_h that in air at barometric pressure p in which the pressure of water vapor is e. γ_ω and γ_a are the specific heat ratios for water vapor and for air respectively.

Velocity of a transverse wave in a stretched cord. If T is the tension of the cord and m the mass per unit length,

$$V = \sqrt{\frac{T}{m}}$$

Velocity of water waves.—If the depth h is small compared with the wave length, the velocity,

$$V = \sqrt{gh}$$

In deep water for a wave length λ,

$$V = \sqrt{\frac{g\lambda}{2\pi}}$$

If the wavelength is very small, less than about 1.6 cm, the velocity increases as the wave length decreases and is expressed by the following,

$$V = \sqrt{\frac{2\pi T}{\lambda d} + \frac{g\lambda}{2\pi}}$$

where T is the surface tension and d the density of the liquid V will be given in cm per sec if h and λ are in cm, g in cm per sec^2, T in dynes per cm and d in g per cm^3.

Velocity of a wave.—The velocity of propagation in terms of wavelength λ and the period T or frequency n is,

$$V = \frac{\lambda}{T} = n\lambda$$

Viscosity.—All fluids possess a definite resistance to change of form and many solids show a gradual yielding to forces tending to change their form. This property, a sort of internal friction, is called viscosity; it is expressed in dyne-seconds per cm² or poises. Dimensions,—$[m\,l^{-1}\,t^{-1}]$. If the tangential force per unit area, exerted by a layer of fluid upon one adjacent is one dyne for a space rate of variation of the tangential velocity of unity, the viscosity is one poise.

Kinematic viscosity is the ratio of viscosity to density. The c. g. s. unit of kinematic viscosity is the **stoke.**

Flow of liquids through a tube; where l is the length of the tube, r its radius, p the difference of pressure at the ends, η the coefficient of viscosity, the volume escaping per second,

$$v = \frac{\pi p r^4}{8 l \eta} \text{ (Poiseuille).}$$

The volume will be given in cm³ per second if l and r are in cm, p in dynes per cm² and η in poises per dyne-seconds per cm².

Visibility is measured by the ratio of the luminous flux in lumens to the total radiant energy in ergs per second or in watts.

Volt.—The unit of electromotive force. It is the difference in potential required to make a current of one ampere flow through a resistance of one ohm.

Volume, unit of.—The cubic centimeter, the volume of a cube whose edges are one centimeter in length. Other units of volume are derived in a similar manner. Dimension,—$[l^3]$.

Wave motion.—A progressive disturbance propagated in a medium by the periodic vibration of the particles of the medium. Transverse wave motion is that in which the vibration of the particles is perpendicular to the direction of propagation. Longitudinal wave motion is that in which the vibration of the particles is parallel to the direction of propagation.

Weight.—The force with which a body is attracted toward the earth. Cgs unit,—the dyne. Dimensions,—$[m\,l\,t^{-2}]$.

Although the weight of a body varies with its location, the weights of various standards of mass are often used as units of force as,—pound weight, or pound force, gram weight, etc. The weight of mass m, where g is the acceleration due to gravity,

$$W = mg.$$

The weight will be given in dynes when m is in grams and g in cm per sec².

Wheatstone's bridge.—If the resistances r_1, r_2, r_3, and r_4 form the arms of a Wheatstone's bridge in order as the circuit (omitting cell and galvanometer connections) is traced, when the bridge is balanced,

$$\frac{r_1}{r_2} = \frac{r_4}{r_3} \quad \text{or} \quad \frac{r_1}{r_4} = \frac{r_2}{r_3}$$

Wien's displacement law.—When the temperature of a radiating black body increases, the wave length corresponding to maximum energy decreases in such a way that the product of the absolute temperature and wave length is constant.

$$\lambda_{max} T = w$$

w is known as **Wien's displacement constant.**

Work.—When a force acts against resistance to produce motion in a body the force is said to do work. Work is measured by the product of the force acting and the distance moved through against the resistance. Cgs units of work,—the erg, a force of one dyne acting through a distance of one centimeter. The joule is 1×10^7 ergs. Dimensions,—$[m\, l^2\, t^{-2}]$. The foot-pound is the work required to raise a mass of one pound a vertical distance of one foot where $g = 32.174$ ft./sec². The foot-poundal is the work done by a force of one poundal acting through a distance of one foot. The International joule, a unit of electrical energy, is the work expended per second by a current of one International ampere flowing through one International ohm. The kilowatt-hour is the total amount of energy developed in one hour by a power of one kilowatt.

If a force F act through a space s, the work done is

$$W = Fs$$

Work will be given in ergs if F is in dynes and s in cm.

Work done in rotation. If a torque L dyne-cm acts through an angle θ radians, the work done in ergs is

$$W = L\theta$$

X-rays.—A type of radiation of higher frequency than visible light but lower than gamma rays. Usually produced by high energy electrons impinging upon a metal target.

Zeeman effect.—The splitting of a spectrum line into several symmetrically disposed components, which occurs when the source of light is placed in a strong magnetic field. The components are polarized, the directions of polarization and the appearance of the effect depending on the direction from which the source is viewed relative to the lines of force.

MEASURES AND UNITS

FUNDAMENTAL STANDARDS

The primary standard of **length** is defined as the distance between two lines at 0° C on a platinum-iridium bar known as the **International Prototype Meter** deposited at the International Bureau of Weights and Measures. The International Prototype Meter is 1553164.13 times the wave length of the red cadmium line in air, 760 mm pressure, 15° C

The primary standard of **mass** is defined as the mass of the **International Prototype Kilogram** of platinum-iridium kept at the International Bureau of Weights and Measures at Sèvres. It is equal to the mass of 0.001000027 cubic meter of pure water at 4° C and 760 mm pressure.

The primary standard of **capacity** is the **liter** which is the volume of one kilogram of pure water at the temperature of maximum density and under normal atmospheric pressure.

The primary standard of **time** is the **mean solar second,** one eighty six thousand four hundredth ($\frac{1}{86400}$) part of a mean solar day.

The standard scale of **temperature** adopted by the International Committee of Weights and Measures 1887 is based on the variations in pressure of hydrogen at constant volume. The hydrogen is taken at an initial pressure, at the temperature of melting ice, of one meter of mercury (0° C, sea level, latitude 45°). The scale is defined by taking the temperature of melting ice as 0° and that of condensing steam under 760 mm pressure as 100°. This is known as the Centigrade (C) scale.

The **absolute** or **thermodynamic temperature scale** proposed by Lord Kelvin is based on the average kinetic energy per molecule of a perfect gas. The temperature of melting ice is 273.18° and that of the boiling point of water 373.18°. This is frequently referred to as the Kelvin (K) scale.

International Electrical Units

Adopted in the United States January 1, 1948

1 international ohm = 1.000495 absolute ohms
1 international volt = 1.00033 absolute volts
1 international ampere = 0.999835 absolute ampere
1 international coulomb = 0.999835 absolute coulomb
1 international henry = 1.000495 absolute henries
1 international farad = 0.999505 absolute farad
1 international watt = 1.000165 absolute watts
1 international joule = 1.000165 absolute joules

WEIGHTS AND MEASURES

Metric System

LENGTHS

Millimeters (mm)	Centimeters (cm)	Decimeters (dm)	Meters (m)	U. S. equivalent
1	0.1	0.01	0.001	0.0393700 inch
10	1	.1	.01	0.393700 inch
100	10	1	.1	3.93700 inches 0.328083 foot
1,000	100	10	1	39.3700 inches 3.28083 feet

Meters (m)	Dekameters (dkm)	Hectometers (hm)	Kilometers (km)	U. S. equivalent
1	0.1	0.01	0.001	1.09361 yards 0.198838 rod
10	1	.1	.01	10.9361 yards 1.98838 rods
100	10	1	.1	19.8838 rods
1,000	100	10	1	0.621372 mile

Millionth microns ($\mu\mu$)	Ångströms (A)	Milli-microns ($m\mu$)	Microns (μ)	Centi-meters (cm)	U. S. equivalent inches
1	0.01	0.001	10^{-6}	10^{-10}	3.93700×10^{-11}
100	1	.1	10^{-4}	10^{-8}	3.93700×10^{-9}
1,000	10	1	10^{-3}	10^{-7}	3.93700×10^{-8}
10^6	10^4	1,000	1	10^{-4}	3.93700×10^{-5}

1 myriameter = 10,000 meters = 6.21372 miles.

AREA

Sq. milli-meters (mm²)	Sq. centi-meters (cm²)	Sq. deci-meters (dm²)	Sq. meters or centares (m², ca)	U. S. equivalent
1	0.01	0.0001	0.000001	0.00155000 sq. in.
100	1	.01	.0001	0.155000 sq. in.
10,000	100	1	.01	15.5000 sq. in.
1,000,000	10,000	100	1	10.76387 sq. ft.

Metric System (Continued)

AREA (Continued)

Sq. meters or centares (m², ca)	Sq. dekameters or ares (dkm², a)	Sq. hectometers or hectares (hm², ha)	Sq. kilometers (km²)	U. S. equivalent
1	0.01	0.0001	0.000001	0.039537 sq. rod
100	1	.01	.0001	0.02471044 acre
10,000	100	1	.01	2.471044 acres
1,000,000	10,000	100	1	0.3861006 sq. mile

VOLUME

Cu. millimeters (mm³)	Cu. centimeters (cm³, cc)	Cu. decimeters (dm³)	Cu. meters (m³)	U. S. equivalent
1	0.001	0.000001	0.000000001	0.0000610234 cu. in.
1,000	1	.001	.000001	0.0610234 cu. in.
1,000,000	1,000	1	.001	61.0234 cu. in.
1,000,000,000	1,000,000	1,000	1	35 3144 cu. ft. 1.30794 cu. yd.

1 stere = 1 cubic meter

CAPACITY

1 liter is the volume of pure water at 4° C and 760 mm pressure which weighs 1 kilogram. 1 liter = 1.000027 cubic decimeter = 1000.027 cubic centimeters.

Milliliters (ml)	Centiliters (cl)	Deciliters (dl)	Liters (l)	U. S. equivalent
1	0.1	0.01	0.001	16.2311 minims 0.0610250 cu. inch
10	1	.1	.01	2.70518 fl. drams
100	10	1	.1	3.38147 fl ounces
1,000	100	10	1	270.518 fl. drams 33.8147 fl. ounces

Liters (l)	Dekaliters (dkl)	Hectoliters (hl)	Kiloliters (kl)	U. S. equivalent
1	0.1	0.01	0.001	1.05671 liq. quarts 0.264178 gallon 1.81620 dry pints 0.908102 dry quart
10	1	.1	.01	18.1620 dry pints 9.08102 dry quarts 1.13513 pecks
100	10	1	.1	2.83782 bushels
1,000	100	10	1	....

WEIGHTS AND MEASURES (Continued)

Metric System (Continued)

MASS

Milligrams (mg)	Centigrams (cg)	Decigrams (dg)	Grams (g)	U. S. equivalent
1	0.1	0.01	0.001	0.015432356 grain
10	1	.1	.01	0.15432356 grain
100	10	1	.1	1.5432356 grains
1,000	100	10	1	15.432356 grains 0.5643833 dram av. 0.03527396 ounce av.

Grams (g)	Deka-grams (dkg)	Hecto-grams (hg)	Kilo-grams (kg)	U. S. equivalent
1	0.1	0.01	0.001	0.771618 scruple 0.2572059 dram apoth. 0.03215074 ounce apoth. 0.002204622 pound av.
10	1	.1	.01	5.643833 drams av.
100	10	1	.1	3.527396 ounces av.
1,000	100	10	1	2.2046223 pounds av. 2.6792285 pounds troy or apoth.

1 kilogram = 15,432.35639 grains = 0.00110231 short ton = 0.00098421 long ton.
1 metric carat = 200 milligrams = 3.0864712 grains.
1 myriagram = 10,000 grams = 10 kilograms = 22.04622 pounds avoirdupois.
1 quintal (metric) = 100 kilograms = 220.4622 pounds avoirdupois.
1 millier or tonne = 1,000 kilograms = 2,204.622 pounds avoirdupois = 2,679.229 pounds troy = 0.98420640 long ton = 1.1023112 short tons.

PREFIXES

The prefixes mega-, meaning one million, and micro-, one millionth, are used in connection with various simple and derived units of the metric system.

WEIGHTS AND MEASURES (Continued)

U. S. System

Miscellaneous Units and Equivalents

LENGTHS

The United States standard yard is defined as 3600/3937the meter.

Inches (in.)	Feet (ft.)	Yards (yd.)	Rods (rd.)	Miles (mi.)	Metric equivalent
1	0.083333	0 027778	0.00505051	0.0000157828	2.54001 cm
12	1	.33333	.0606061	.000189394	0.304801 m
36	3	1	.181818	.000568182	0.914402 m
198	16.5	5.5	1	.003125	5.029210 m
63,360	5,280	1,760	320	1	1.60935 km

1 mil = 0.001 inch = 25.4001 microns = .0254001 millimeter.
1 hand = 4 inches = 10.1600 centimeters.
1 span = 9 inches = 22.86005 centimeters.
1 fathom (fath.) = 6 feet = 1.828804 meters.
1 link (li.) = 0.66 foot = 7.92 inches = 20.11684 centimeters.
1 rod (rd.) = 25 links = 5.029210 meters
1 surveyor's or Gunter's chain (ch.) = 4 rods = 100 links = 66 feet = 20.11684 meters.
1 engineer's or Ramsden's chain = 100 links of one foot each = 100 feet = 30.4801 meters.
International nautical mile = 1.152 statute miles = 1,852 meters = 6,076.10333 feet of arc on the Earth's surface at the equator.
1 British yard = 3 feet = 36 inches = 0.914399 meter.
1 British inch = 2.539998 centimeters.
1 British mile = 1,760 yards = 1.60934 kilometers.
1 furlong (fur.) = 40 rods = 220 yards = 660 feet = 201.168 meters.
1 pole (British) = 5.5 yards = 5.0292 meters = approximately 1 rod.
1 British fathom = 6.00 feet.
1 toise = 6 Paris feet = 1.94904 meters.
1 Paris foot (pied) = 12 Paris inches = 0.324839 meter.
1 Paris inch (pouce) = 12 Paris lines = 2.70700 centimeters.
1 Paris line (ligne) = 0.225583 centimeter.
1 light year = 5.9×10^{12} miles = 9.5×10^{12} kilometers.
1 point (type sizes) = $\frac{1}{72}$ or 0.01389 inch.
1 line = $\frac{1}{12}$ or 0.083333 inch.
1 cubit = 18 inches.

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

AREA

Sq. inches (sq. in.)	Sq. feet (sq. ft.)	Sq. yards (sq. yd.)	Sq. rods (sq. rd.)	Acres (A.)	Sq. miles (sq. mi.)	Metric equivalent
1	0.0069444	....	....	....	....	6.451626 sq. cm
144	1	0.111111	....	....	....	0.09290341 sq. m
1,296	9	1	0.03305785	....	....	0.8361307 sq. m
	272.25	30.25	1	0.00625	....	25.29295 sq. m
	43,560	4,840	160	1	0.0015625	40.46873 sq. dkm
	27,878,400	3,097,600	102,400	640	1	2.589998 sq. km

1 square mil = .000001 square inch = .00064516 square millimeter.
1 circular mil = area of a circle whose diameter is one mil = .00000078540 square inch.
1 square link = 62.7264 square inches = 404.6873 square centimeters.
1 square rod (sq. rd.) = 625 square links = 25.29295 square meters.
1 square chain (sq. ch.) = 16 square rods = 404.6873 square meters.
1 acre (A.) = 10 square chains = 4,046.873 square meters.
1 British square yard = 9 square feet = 0.836126 square meter.
1 British square foot = 144 square inches = 9.29029 square decimeters.
1 British square inch = 6.45159 square centimeters.
1 square perch (British) = 30.25 square yards = 25.293 square meters.
1 rood (British) = 40 square perches = 10.117 ares or square dekameters.
1 acre (British) = 4 roods.

VOLUME

Cubic inches (cu. in.)	Cubic feet (cu. ft.)	Cubic yards (cu. yd.)	Metric equivalent
1	0.000578704	....	16.3872 cu. cm
1,728	1	0.0370370	0.0283170 cu. m
46,656	27	1	0.764559 cu. m

1 board foot (bd. ft.) = 144 cubic inches = 2,359.8 cubic centimeters.
1 cord = 128 cubic feet = 3.625 cubic meters.
1 British cubic foot = 1,728 cubic inches = 0.0283168 cubic meter.
1 British cubic yard = 27 cubic feet = 0.764553 cubic meter.
1 cubic foot = 6.229 British gallons = 7.481 U. S. gallons.
1 cubic yard = 168.17 British gallons.

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

CAPACITY—LIQUID MEASURE

Gills (gi.)	Pints (pt.)	Quarts (qt.)	Gallons (gal.)	Cubic inches	Metric equivalent
1	0.25	0.125	0.03125	7.21875	118.292 milliliters
4	1	.5	.125	28.875	0.473167 liter
8	2	1	.25	57.749	0.946333 liter
32	8	4	1	231	3.785332 liters

1 gill = 4 fluid ounces = 1.18292 deciliters.
1 gallon (U. S.) of water at 15° weighs about 8.337 pounds avoirdupois or 3.7820 kilograms = 0.83268 British gallon.
1 hogshead = 63 gallons.
1 firkin = 9 gallons = 34.06799 liters.
1 tun = 252 gallons.
1 British gill = 1.4206 deciliters.
1 British pint = 4 gills = 0.56825 liter.
1 British quart = 2 pints = 1.13650 liters.
1 British gallon = 4 quarts = 277.420 cubic inches = 0.16054 cubic foot = 4.5459631 liters.
1 British gallon of water at 15° C weighs 10 pounds = 1.20094 U. S. gallons.

APOTHECARIES' FLUID MEASURE

Minims (min. or ♏)	Fluid drams (fl. dr. or ʒ)	Fluid ounces (fl. oz. or ℥)	Pints (pt.)	Metric equivalent
1	0.016667	0.0020833	......	0.0616102 milliliter
60	1	.125	......	3.69661 milliliters
480	8	1	0.0625	29.5729 milliliters
7,680	128	16	1	0.473167 liter

1 fluid ounce = 1.80469 cubic inches.
1 gallon = 128 fluid ounces = 8 pints.
1 British Imperial gallon = 8 pints = 160 fluid ounces = 4.5459631 liters.
1 British fluid ounce = 8 drachms = 28.4130 cubic centimeters.
1 British fluid drachm = 60 minims = 3.5515 cubic centimeters.
1 British minim = 0.059194 cubic centimeter.

DRY MEASURE

Pints (pt.)	Quarts (qt.)	Pecks (pk.)	Bushels (bu.)	Cubic inches	Metric equivalent
1	0.5	0.0625	0.015625	33.6003	0.550599 liter
2	1	.125	.03125	67.2006	1.101198 liters
16	8	1	.25	537.605	8.80958 liters
64	32	4	1	2,150.42	35.2383 liters

1 British peck = 2 British gallons = 554.6 cubic inches = 9.09193 liters.
1 British bushel = 8 British gallons = 2,219.3 cubic inches = 36.3677 liters = 1.03205 U. S. bushels.
1 British quarter = 8 bushels = 2.909 hectoliters.
1 U. S. bushel = 0.96895 British bushel.

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

MASS

Note: Three systems are in use,—avoirdupois, troy and apothecaries'. The grain is the same in all.

AVOIRDUPOIS—COMMERCIAL

The U. S. Standard pound avoirdupois is defined as 453.5924277 grams.

Grains (gr.)	Drams (dr. av.)	Ounces (oz. av.)	Pounds (lb. av.)	Tons (short) (tn.)	Metric equivalent
1	0.03657143	....	....	......	0.064798918 g
27.34375	1	0.0625	....	......	1.771845 g
437.5	16	1	0.0625	......	28.349527 g
7,000	256	16	1	0.0005	453.5924 g 0.4535924 kg
....	....	32,000	2,000	1	907.18486 kg

1 pound avoirdupois is the mass of 27.692 cubic inches of water weighed in air at 4° C, 760 mm pressure.
1 short hundredweight (cwt.) = 100 pounds = 45.359243 kilograms.
1 short ton = 20 short hundredweight = 2,430.56 troy pounds = 907.18486 kilograms.
1 stone (British) = 14 pounds = 6.350 kilograms.
1 quarter (British) = 28 pounds = 12.70 kilograms.
1 long hundredweight (British) = 4 quarters = 112 pounds = 50.802352 kilograms.
1 long ton (British) = 20 long hundredweight = 1,016.04704 kilograms.
1 long ton = 1.12000 short tons = 2,722.22 troy pounds = 1.01605 metric tons.
1 short ton = 0.892857 long ton = 29,166.66 troy or apothecaries' ounces = 0.907185 metric ton.
1 avoirdupois pound = 1.21528 troy or apothecaries' pounds = 14.5833 troy ounces.
1 avoirdupois ounce = 0.911458 troy or apothecaries' ounce.

TROY WEIGHT

Grains (gr.)	Pennyweights (dwt.)	Ounces (oz. t.)	Pounds (lb. t.)	Metric equivalent
1	0.041667	0.0020833	....	64.798918 mg 0.064798918 g
24	1	.05	0.0041667	1.555174 g
480	20	1	.083333	31.103481 g
5,760	240	12	1	373.24177 g

1 troy pound = 5,760/7,000 or 0.822857 avoirdupois pound = 13.1657 avoirdupois ounces.
1 carat (1877) = 3.168 grains = 205.6 milligrams.
1 troy ounce = 1.09714 avoirdupois ounces.
1 troy pound = 0.00036735 long ton = 0.00041143 short ton = 0.00037324 metric ton.

WEIGHTS AND MEASURES (Continued)

U. S. System (Continued)

APOTHECARIES' WEIGHT

Grains (gr.)	Scruples (℈ or s. ap.)	Drams (ʒ or dr ap.)	Ounces (℥ or oz. ap.)	Pounds (lb. ap.)	Metric equivalent
1	0.05	0.016667	0.0020833	....	64.798918 mg
20	1	.33333	.041667	0.0034722	1.2959784 g
60	3	1	.125	.0104167	3.8879351 g
480	24	8	1	.083333	31.103481 g
5,760	288	96	12	1	373.24177 g

TIME

Seconds (sec.)	Minutes (min.)	Hours (hr.)	Days (da.)	Years (yr.)
1	0.0166667	0.000277778		
60	1	.0166667	0.000694446	
3,600	60	1	.0416667	
86,400	1,440	24	1	
......	....	....	365.2422	1 (common)
......	....	....	365.256	1 (sidereal)

1 lunar month (mo.) = 29 days 12 hours 44 minutes.
1 sidereal second = 0.997270 mean solar second.

ANGLE

Seconds (″)	Minutes (′)	Degrees (°)	Circumference	Radians
1	0.0166667	0.000277778	0.00000771605	0.00000484814
60	1	.0166667	.0000462963	.000290888
3,600	60	1	.00277778	.0174533
1,296,000	21,600	360	1	6.28319
206,265	3,437.75	57.2958	0.159155	1

1 radian = 57° 17′ 44.8″ = $1/2\pi$ of a circumference.
2π radians = 360° = 1 circumference.
π radians = 180°.
$\pi/2$ radians = 90°.
$\pi/4$ radians = 45°.
1 grade = $\frac{1}{400}$ circumference = 100 centesimal minutes = 0.0157079 radian.
1 centesimal minute = 100″ centesimal seconds.

SOLID ANGLE

1 steradian = $1/4\pi$ of the solid angle around a point.

UNITS AND CONVERSION FACTORS

Each unit named is followed by its equivalent in one or more other units of the same quantity. While the list of equivalents is incomplete it is intended to include all those which will be in common use

Symbols in the dimensional formulae given after the headings have the following significance: m, mass, l, length; t, time; θ, temperature; ϵ, dielectric constant of a vacuum; μ, permeability of a vacuum.

Mass, Length, Time, Angle, Area and Volume

Acre (A.) (U. S.).—0 0015625 square mile, 10 square chains (Gunter's), 160 square rods or square perches; 4840 square yards; 4.3560×10^4 square feet, 1×10^5 square links (Gunter's), 0.4046873 hectare or square hectometer, 40 46873 ares or square dekameters; 4046.873 square meters

Acre (A.) (British).—4 roods (British), 4840 square yards (British), 0.4046849 hectare or square hectometer, 4046 849 square meters

Ångstrom Unit (Å. or Å. U.).—3.937×10^{-9} inch, 0.003937 millionths of an inch, 1×10^{-10} meter, 1×10^{-8} centimeter, 1×10^{-4} micron (μ); 0.1 milli-micron or micro-millimeter; 100 millionth microns or micro-microns ($\mu\mu$)

Are (a).—3.8610×10^{-5} square mile, 0.02471044 acre (U. S.): 119 60 square yards; 1076.4 square feet, 0.01 hectare, 1 square dekameter, 100 square meters

Astronomical unit.—$1\ 495\times10^8$ kilometers

Bag (British).—3 bushels (dry), 0 109107 cubic meter

Barleycorn (British).—1/3 inch, 0.84667 centimeter

Barrel (bbl.) (U. S., dry).—3.281 bushels, 105.0 quarts (dry); 7056 cubic inches for dry commodities except cranberry barrel which=5826 cubic inches; 0 11562 cubic meter

Barrel (bbl.) (U. S., liquid).—31.5 gallons, 0 11924 cubic meter; 42 gallons (oil)

Barrel (bbl.) (British, dry).—36 gallons (British), 0 16366 cubic meter

Board Foot (bd. ft.).—1/12 cubic foot, 144 cubic inches (1 foot×1 foot×1 inch); 2359.8 cubic centimeters

Bolt (U. S., cloth.).—120 linear feet; 36.576 meters.

Bucket (British, dry).—4 gallons (British); 1.8184×10^4 cubic centimeters.

Bushel (bu.) (U. S., dry).—0.304785 barrel; 0.96895 bushel (British); 1 2444 cubic feet, 4 pecks, 32 quarts (dry); 64 pints (dry); 2150 42 cubic inches; 0.035239 cubic meter; 0.35238 hectoliter, 3.5238 dekaliters; 35 238 liters; 3.5239×10⁴ cubic centimeters.

Bushel (bu.) (British, dry).—⅛ or 0.125 quarter (British, capacity); 1/3 or 0.33333 bag (British); 1.03205 bushels (U S); 1 2843 cubic feet; 8 gallons (British); 2219.3 cubic inches; 0.363677 hectoliter, 3 63677 dekaliters; 36.3677 liters; 3 6369×10⁴ cubic centimeters

Butt (British, dry).—126 gallons; 0.57281 cubic meter.

Cable Length (British & U S.).—720 feet; 219.46 meters.

Carat (c) (metric)—3.08647 grains; 0.2 gram; 200 milligrams

Carat (c) (1877).—3 168 grains, 205.6 milligrams.

Cental—100 pounds, 45.359 kilograms.

Centare (ca).—1 196 square yards, 10 764 square feet; 1550 square inches; 0.01 are, 1 square meter

Centigram (cg).—0 1543236 grain; 0.01 gram.

Centiliter (cl).—0.33815 ounce (fluid, U. S.); 0.61025 cubic inch; 2.705179 drams (fluid, U S.); 0.01 liter; 10.00027 cubic centimeters.

Centimeter (cm).—0 01093611 yard (U. S.); 0.01093614 yard (British); 0.032808 foot (U S or British); 0.39370 inch (U S. or British), 4.4330 lignes (Paris lines); 393.70 mils; 0.01 meter; 10 millimeters; 1×10⁴ microns; 1×10⁷ milli-microns or micro-millimeters; 1×10⁸ Ångström units.

Chain (ch.) (Engineer's or Ramden's).—100 feet; 100 links of 1 foot each; 30 4801 meters

Chain (ch.) (Surveyor's or Gunter's).—0.1 furlong; 0.0125 mile, 4 rods; 22 yards; 66 feet, 100 links, 792 inches; 20.117 meters, 2011 7 centimeters

Chaldron (U S., dry)—*36 bushels (U S); 1.2686 cubic meters

Chaldron (British, dry).—*32 bushels (British); 1 1638 cubic meters

Circle (cir)—2π or 6 2832 radians, 12 signs; 360 degrees

Circular Inch.—Area of circle, diameter of which is one inch: 0 78540 square inch, 5.0671 square centimeters.

Circular Mil.—Area of circle, diameter of which is one mil or 1/1000 inch; 7.854×10^{-7} square inch; 0.78540 square mil; 5.0671×10^{-6} square centimeter; 5.0671×10^{-4} square millimeter.

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*Variable.

Circular Millimeter.—0.0078540 square centimeter; 0.78540 square millimeter.

Circumference.—2π or 6.28319 radians; 360 degrees; 400 grades; 2.1600×10^{4} minutes; 1.296000×10^{6} seconds.

Clove or Customary Stone (British).—8 pounds; 3.6287 kilograms.

Coomb (British, dry).—4 bushels; 0.14548 cubic meter.

Cord (cd.).—8 cord feet; 128 cubic feet (8 feet×4 feet×4 feet); 3.625 cubic meters.

Cord-Foot (cd. ft.)—⅛ or 0.125 cord; 16 cubic feet (4 feet × 4 feet × 1 foot).

Cubic Centimeter (cm^3).—1.3079×10^{-6} cubic yard; 2.7496×10^{-5} bushel (British); 2.83776×10^{-5} bushel (U. S.); 3.531445×10^{-5} cubic foot (U. S.); 3.531477×10^{-5} cubic foot (British); 2.1997×10^{-4} gallon (British); 2.6417×10^{-4} gallon (U. S.); 4.2376×10^{-4} board foot; 8.7988×10^{-4} quart (liquid, British), 9.0808×10^{-4} quart (dry, U. S.); 0.0010567 quart (liquid, U. S.); 0.0018162 pint (dry, U. S.); 0.0021134 pint (liquid, U. S.); 0.033814 ounce (fluid, U. S.); 0.035195 ounce (fluid, British); 0.061023 cubic inch; 0.27051 dram (fluid, U. S.); 0.28157 drachm (fluid, British); 16.231 minims (U. S.); 16.894 minims (British); 1×10^{-6} cubic meter; 9.9997×10^{-4} liter; 0.001 cubic decimeter; 0.99997 milliliter; 1000 cubic millimeters.

Cubic Decimeter (dm^3).—0.0013079 cubic yard; 0.035314 cubic foot; 61.023 cubic inches; 0.001 cubic meter; 0.99997 liter; 1000 cubic centimeters.

Cubic Dekameter (dkm^3).—1000 cubic meters.

Cubic Foot ($ft.^3$ or cu. ft.) (U. S.).—1/128 or 0.0078125 cord. 0.01 register ton (British); 1/27 or 0.037037 cubic yard; 1/16 or 0.0625 cord-foot; 0.77861 bushel (British); 0.80357 bushel (U. S.); 6.229 gallons (British); 7.481 gallons (U. S.); 12 board feet; 25.714 quarts (dry, U. S.); 29.922 quarts (liquid, U. S.); 59.844 pints (liquid, U. S.); 1728 cubic inches; 0.02831701 cubic meter; 28.316 liters; 2.8317×10^{4} cubic centimeters.

Cubic Foot ($ft.^3$ or cu. ft.) (British).—0.02831677 cubic meter; 2.831677×10^{4} cubic centimeters.

Cubic Inch ($in.^3$ or cu. in.) (U. S.).—2.143347×10^{-5} cubic yard; 4.65025×10^{-4} bushel (U. S.); 5.78704×10^{-4} cubic foot; 0.00186010 peck; 0.0043290 gallon (U. S.); 1/144 or 0.006944 board foot; 0.014881 quart (dry, U. S.); 0.017316 quart (liquid, U. S.); 0.0297616 pint (dry); 0.5541 ounce (fluid); 4.4329 drams (fluid); 1.6387162 × 10^{-5} cubic meter; 0.0163868 liter; 1.63868 centiliters; 16.3868 milliliters; 16.387162 cubic centimeters; 1.6387162 × 10^4 cubic millimeters.

Cubic Inch (in.^{3} or cu. in) (British).—4.5081 × 10^{-4} bushel (British); 5.7870 × 10^{-4} cubic foot (British); 0.0018031 peck (British); 0.003606 gallon (British); 16.3870253 cubic centimeters.

Cubic Hectometer (hm^3).—1 × 10^6 cubic meters.

Cubic Kilometer (km^3).—1 × 10^9 cubic meters.

Cubic Meter (m^3).—0.2759 cord; 1.3079428 cubic yards (U. S.); 1.307954 cubic yards (British); 28.3776 bushels (U. S.); 35.314445 cubic feet (U. S.); 35.31477 cubic feet (British); 264.173 gallons (U. S.); 1056.7 quarts (liquid); 2113.4 pints (liquid, U. S.); 6.1023 × 10^4 cubic inches; 1 stere; 999.973 liters; 1000 cubic decimeters; 1 × 10^6 cubic centimeters; 1 × 10^9 cubic millimeters.

Cubic Millimeter (mm^3).—6.1023 × 10^{-5} cubic inch; 0.01623 minim (U. S.); 0.01689 minim (British); 1 × 10^{-9} cubic meter; 0.001 cubic centimeter.

Cubic Yard (yd.^{3} or cu. yd.) (U. S.).—27 cubic feet; 168.17 gallons (British); 202.0 gallons (U. S.); 807.9 quarts (liquid, U. S.); 1616 pints (liquid, U. S.); 4.6656 × 10^4 cubic inches; 0.76455945 cubic meter; 764.54 liters; 7.6455945 × 10^5 cubic centimeters.

Cubic Yard (yd.^{3} or cu. yd.) (British).—27 cubic feet; 0.76455285 cubic meter.

Cubit.—18 inches; 45.72 centimeters.

Dalton.—1/16 the mass of an atom of oxygen; 1.650 × 10^{-24} gram.

Day (da) (tropical, mean solar).—24 hours (mean solar); 1440 minutes (mean solar); 8.6400 × 10^4 seconds (mean solar).

Day (da) (sidereal).—8.6164 × 10^4 seconds (mean solar).

Decigram (dg.).—1.543236 grains; 0.1 gram.

Deciliter (dl).—0.176 pint (British); 3.38147 ounces (fluid, U. S.); 0.1 liter; 100.0027 cubic centimeters.

Decimeter (dm).—0.3280833 foot (U. S.); 0.3280843 foot (British); 3.93700 inches (U. S.); 3.937011 inches (British); 0.1 meter.

Decistere (ds).—0.1 stere or cubic meter.

Degree (°).—1/360 or 0.0027778 circumference or revolution; 1/90 or 0.01111 quadrant; 0.017453 radian; 60 minutes; 3600 seconds.

Dekagram (dkg).—0.35273957 ounce (avoirdupois); 5.64383 drams (avoirdupois); 0.01 kilogram; 10 grams.

Dekaliter (dkl).—0.27497 bushel (British); 0.28378 bushel (U. S.); 1.13513 pecks (U. S.); 9.08102 quarts (U. S., dry); 18.162 pints (dry, U. S.); 10 liters; 10.00027 cubic decimeters.

Dekameter (dkm).—1.98838 rods (U. S.); 10.93611 yards (U. S.); 10.93614 yards (British); 393.70 inches; 10 meters.

Dekastere (dks).—10 steres or cubic meters.

Drachm (fluid) (dr. fl. or ʒ fl.) (British).—⅛ or 0.125 ounce (fluid, British); 60 minims; 3.5515 cubic centimeters.

Dram (apothecaries' or troy) (dr. ap. or t. or ʒ ap. or t.)—(Same as British Drachm)—0.008571429 pound (avoidrupois); 1/96 or 0.010416667 pound (apothecary or troy); ⅛ or 0.12500 ounce (apothecary or troy); 0.1371429 ounce (avoirdupois); 2.194286 drams (avoirdupois); 2.5 pennyweights; 3 scruples; 60 grains; 3.8879351 grams.

Dram (avoirdupois) (dr. av. or ʒ av.).—1/256 or 0.00390625 pound (avoirdupois); 0.0047471788 pound (apothecary or troy); 0.056966146 ounce (apothecary or troy); 0.0625 ounce (avoirdupois); 0.4557292 dram (apothecary or troy); 1.139323 pennyweights; 1.3671875 scruples; 27.34375 grains; 1.771845 grams; 1771.845 milligram.

Dram (fluid) (dr. fl. or ʒ fl.) (U.S.).—0.00390625 quart (liquid, U. S.); 0.0078125 pint (liquid, U. S.); 0.03125 gill (U. S.); ⅛ or 0.125 ounce (fluid); 0.225586 cubic inch; 60 minims; 3.6966 milliliters; 3.6967 cubic centimeters.

Ell.—45 inches; 114.30 centimeters.

Em, Pica (printing industry).—1/6 or 0.16667 inch; 0.42333 centimeter.

Fathom (fath.) (nautical).—6 feet, 1.828804 meter.

Firkin (fir.) (U. S.).—9 gallons (U. S.); 34.068 liters.

Firkin (fir.) (British).—9 gallons (British); 40.914 liters.

Fluid Ounce (fl. oz.)—See **Ounce (Fluid)**.

Foot (ft.) (U. S.)—1.6447 × 10^{-4} mile (nautical); 1.893939 × 10^{-4} mile (statute); 0.00151515 furlong; 0.0151515 chain (Gunter's); 0.0606061 rod; 1/6 or 0.16667 fathom; 1/3 or 0.33333 yard; 12 inches; 0.3048006 meter, 30.48006 centimeter; 473404 wave-lengths of red line of cadmium.

Foot (ft.) (British).—0.4 pace (British); 30.47997 centimeters.

Foot (Paris).—(See **Pied**).

Furlong (fur.) (U. S. or British).—⅛ or 0.125 mile (U. S.); 10 chains(Gunter's); 40 rods, 220 yards; 660 feet; 201.168 meters.

Gallon (gal.) (U.S.).—1 U. S. gallon of water at 62°F weighs 3.7820 kilograms or 8.337 pounds (avoirdupois); 0.004951 cubic yard; 0.031746 barrel (liquid, U. S.); 0.13368 cubic foot; 0.83268 gallons (British); 4 quarts (liquid); 8 pints (liquid); 32 gills; 128 ounces (fluid); 231.00 cubic inches; 6.1440 × 10^4 minims; 0.0037854 cubic meter; 3.7853 liters; 3785.4 cubic centimeters.

Gallon (gal.) (British Imperial) (Canadian).—1 British gallon of water at 62°F has a mass of 10 pounds (avoirdupois); 0.02778 barrel (dry, British), ⅛ or 0.125 bushel (dry, British); 0.16054 cubic foot; 0.5 peck (British); 1.20094 gallons (U. S.); 4 quarts (liquid, British); 8 pints (liquid, British); 32 gills (liquid, British); 160 ounces (fluid, British); 277.3 cubic inches; 4.54596 liters; 4546.1 cubic centimeters.

Geepound—**See Slug.**

Gill (gi.) (U. S.).—1/32 or 0.03125 gallon (U. S.); ⅛ or 0.125 quart (liquid, U. S.); ¼ or 0.25 pint (liquid, U. S.); 4 ounces (fluid); 7.21875 cubic inches; 32 drams (fluid); 1920 minims; 0.118292 liters; 118.295 cubic centimeters.

Gill (gi.) (British).—1/32 or 0.03125 gallon (British); ¼ or 0.25 pint (liquid, British); 5 ounces (fluid, British); 0.14206 liter; 142.07 cubic centimeters.

Grade—1/400 or 0.0025 circumference; 0.0157079 radian; 0.9 degree; 100 centesimal minutes.

Grain (gr.).—1/7000 or 1.42857 × 10^{-4} pound (avoirdupois); 1/5760 or 1.736111 × 10^{-4} pound (apothecary or troy); 0.0020833 ounce (apothecary or troy); 0.0022857 ounce (avoirdupois); 0.016667 dram (apothecary or troy); 0.03657143 dram (avoirdupois); 0.0416667 pennyweight (troy); 0.05000 scruple (apothecary); 0.064798918 gram; 0.3240 carat (metric); 64.798918 milligram.

Gram (g).—0.00220462 pound (avoirdupois); 0.00267923 pound (apothecary or troy); 0.0321507 ounce (apothecary or troy); 0.0352739 ounce (avoirdupois); 0.257206 dram (apothecary or troy); 0.564383 dram (avoirdupois); 0.6430149 pennyweight; 0.771618 scruple; 15.4324 grains; 1 × 10^{-6} ton (metric); 1 × 10^{-4} myriagram; 0.001 kilogram; 5 carats (metric); 1000 milligrams; 1 × 10^6 microgram.

Hand.—4 inches; 10.160 centimeters.

Hectare (ha)—2.471044 acres (U. S.); 2.471058 acres (British); 395.367 square rods (U. S.); 1.195985 × 10^4 square yards (U. S.); 1.0764 × 10^5 square feet; 100 ares; 1 × 10^4 square meters.

Hectogram (hg).—3.52739 ounces (avoirdupois); 100 grams.

Hectoliter (hl).—2.7497 bushels (British); 2.8378 bushels (U. S.); 11.3513 pecks (U. S.); 100 liters.

Hectometer (hm).—19.8838 rods; 109.3611 yards (U. S.); 109.3614 yards (British); 328.08 feet (U. S.); 100 meters.

Hemisphere.—0.5 sphere; 4 spherical right angles; 6.2832 steradians.

Hogshead (hhd.) (British).—63 gallons (British); 10.114 cubic feet; 0.28640 cubic meters.

Hogshead (hhd.) (U. S.).—63 gallons (U. S.); 8.4218 cubic feet; 0.23848 cubic meter.

Hour (hr.) (tropical, mean solar).—0.0059524 week; 0.041667 day (mean solar); 60 minutes (mean solar); 3600 seconds (mean solar).

Hundredweight (cwt.) (short).—100 pounds; 0.044643 ton (long); 0.05 ton (short); 4 quarters (British); 1600 ounces (avoirdupois); 0.0453592 ton (metric); 45.3592 kilograms.

Hundredweight (cwt.) (long).—112 pounds; 0.05 ton (long); 4 quarters (British); 50.8023 kilograms.

Inch (in.) (U. S.).—1.57828×10^{-5} mile; 0.00126263 chain (Gunter's); 0.00505051 rod; 1/36 or 0.027778 yard; 1/12 or 0.08333 foot; 0.126263 link (Gunter's); 72 points (printer's type); 1000 mils; 2.540005 centimeter; 25.40005 millimeters; 2.5400×10^{8} Ångström unit; 39450.33 wave lengths of red line of cadmium.

Inch (in.) (British).—1/36 or 0.027778 yard (British); 1/9 or 0.1111 quarter (British, linear); 2.539998 centimeters; 25.39998 millimeter.

Inch (Paris).—See **Pouce.**

Kilderkin (British).—18 gallons (British); 0.081830 cubic meter.

Kilogram (kg).—9.842064×10^{-4} ton (long); 0.0011023112 ton (short); 0.019684 hundredweight (long); 0.022046223 hundredweight (short); 0.07874 quarter (British); 2.2046223 pounds (avoirdupois); 2.6792285 pounds (apothecary or troy); 32.150742 ounces (apothecary or troy); 35.273957 ounces (avoirdupois); 257.21 dram (apothecary or troy); 564.38 dram (avoirdupois); 643.01 pennyweight; 771.62 scruples; 1.54324×10^{4} grains; 0.001 ton (metric); 1000 grams.

Kiloliter (kl). -1.3080 cubic yards; 35.316 cubic feet; 264.18 gallons (liquid, U. S.); 1.000027 cubic meters; 1000 liters.

Kilometer (km).—1.0567×10^{-13} light year; 0.53961 mile (nautical); 0.62137 mile (statute); 1093.6 yards; 3280.8 feet; 0.1 myriameter; 1000 meters; 1×10^{5} centimeters.

Knot as a unit of length.—1 nautical mile, which see. The knot is properly a unit of speed or velocity. See under that heading.

Last (**British**).—*80 bushels; 2.9095 cubic meters.

League (**statute**).—3 statute miles; 4.8280 kilometers.

League (**nautical**).—3 nautical miles; 5.5597 kilometers.

Light Year (**yr.**).—5.9×10^{12} miles; 9.4637×10^{12} kilometers.

Ligne (**Paris line**).—1/12 or 0.083333 pouce or Paris inch; 0.225583 centimeter.

Line (**British**) (obsolete)—1/12 or 0.08333 inch; 0.21167 centimeters.

Link (**li.**) (**Engineer's or Ramden's**).—0.01 chain (Engineer's); 1 foot; 12 inches; 30.480 centimeter.

Link (**li.**) (**Surveyor's or Gunter's**).—1.2500×10^{-4} mile 0.01 chain (Gunter's); 0.04 rod; 0.22 yards; 0.66 foot; 7.92 inches; 0.2011684 meter; 20.11684 centimeters.

Liter (**l**).—0.0013080 cubic yard; 0.027497 bushel (British); 0.028378 bushel (U. S.); 0.21998 gallon (British); 0.26417762 gallon (U. S.); 0.035316 cubic foot; 0.10999 peck (British); 0.11351 peck (U. S.); 0.87990 quart (British); 0.908102 quart (dry, U. S.); 1.056710 quarts (liquid, U. S.); 1.7598 pints (British); 1.8162 pints (dry, U. S.); 2.1134 pints (liquid, U. S.); 7.0392 gills (British); 8.4538 gills (U. S.); 33.8147 ounces (fluid, U. S.); 35.196 ounces (fluid, British); 61.025 cubic inches; 270.5179 drams (fluid, U. S.); 0.001000027 cubic meter; 1.000027 cubic decimeter; 1000.027 cubic centimeter.

Megameter.—1×10^{6} meter.

Meter (**m**).—5.3961×10^{-4} mile (nautical); 6.2137×10^{-4} mile (statute); 0.00497096 furlong; 0.0497096 chain (Gunter's); 0.198838 rod (U. S.); 0.54681 fathom; 1.093611 yards (U. S.); 1.093614 yards (British); 3.0784 pied (French foot); 3.280833 feet (U. S.); 3.280843 feet (British); 4.970960 links (Gunter's); 39.3700 inches (U. S.); 39.3701 inches (British); 1×10^{-6} megameter; 0.001 kilometer; 100 centimeters; 1×10^{9} milli-microns or micro-millimeters; 1×10^{10} Angstrom unit; 1×10^{12} millionth microns ($\mu\mu$) 1.55316413×10^{6} wave-lengths of red line of cadmium.

Metric carat (**c**) See **Carat** (**metric**).

Metric Ton (**t**) See **Tonne.**

Microgram (μ**g or** γ).—1×10^{-6} gram; 0.001 milligram.

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*Variable.

Microliter (μl or λ).—1×10^{-6} liter.

Micromicron ($\mu\mu$).)—1×10^{-12} meter.

Micron (μ).—3.937×10^{-5} inch; 0.039370 mil; 39.37 millionths of an inch; 1×10^{-6} meter; 1×10^{-4} centimeter; 0.001 millimeter; 1000 milli-microns or micro-millimeters; 1×10^{4} Ångström units.

Mil.—0.001 inch; 0.00254001 centimeter; 0.0254001 millimeter; 25.4001 microns.

Mile (mi.) (U. S., statute).—1.69×10^{-13} light year; 0.86836 mile (nautical); 8 furlongs; 80 chains (Gunter's); 320 rods; 1760 yards; 5280 feet; 8000 links (Gunter's); 6.3360×10^{4} inches; 0.160935 myriameters; 1.60935 kilometers; 1609.35 meters.

Mile (mi.) (British).—1.60934 kilometers.

International nautical mile = 1.151 statute miles = 1,852 meters = 6,076.10333 feet.

Millier (t) See **Tonne.**

Milligram (mg). — 2.2046×10^{-6} pound (avoirdupois); 2.67923×10^{-6} pound (apothecary or troy); 3.215074×10^{-5} ounce (apothecary or troy); 3.52739×10^{-5} ounce (avoirdupois); 2.57206×10^{-4} dram (apothecary or troy); 5.64383×10^{-4} dram (avoirdupois); 6.43015×10^{-4} pennyweight; 7.71618×10^{-4} scruple; 0.01543236 grain; 1×10^{-6} kilogram; 0.001 gram; 0.005 carat (metric).

Milliliter (ml).—0.0084538 gill (U. S.); 0.0338147 ounce (fluid, U. S.); 0.035196 ounce (fluid, British); 0.061025 cubic inch; 0.2705179 dram (fluid, U. S.); 16.2311 minims (U. S.); 0.001 liter; 1.000027 cubic centimeter.

Millimeter (mm).—0.0393700 inch (U. S.); 0.0393701 inch (British); 39.37 mils; 0.001 meter; 0.1 centimeter; 1000 microns.

Milli-Micron or Micro-Millimeter (mμ).—1×10^{-9} meter; 1×10^{-7} centimeter; 0.001 micron; 10 Ångström units.

Millionth Micron or Micro-Micron ($\mu\mu$).—1×10^{-12} meter; 1×10^{-10} centimeter; 0.01 Ångström units.

Minim (min. or ♍) (British).—0.059194 cubic centimeter.

Minim (min. or ♍) (fluid, U. S.).—1/61440 or 1.6276×10^{-5} gallon (U. S.); 1.3021×10^{-4} pint (liquid, U. S.); 5.2083×10^{-4} gill (U. S.); 1/480 or 0.0020833 ounce (fluid, U. S.); 1/60 or 0.016667 dram (fluid, U. S.); 0.061610 milliliter; 0.061612 cubic centimeter; 61.612 cubic millimeter.

Minute (′) (angle).—1.8519×10^{-4} quadrant; 2.90888×10^{-4} radian; 1/60 or 0.016667 degree; 60 seconds.

Minute (min.) (time).—9.9206×10^{-5} week; 6.94446×10^{-4} day; 0.016667 hour; 60 seconds.

Month (mo.) (mean calendar).—30.42 days; 730 hours; 4.3800×10^{4} minutes; 2.628×10^{6} seconds.

Month (mo.) (lunar).—29 days 12 hours 44 minutes.

Myriagram (Mg).—22.04622 pounds (avoirdupois); 10 kilograms; 1×10^{4} grams.

Myriameter (Mm).—6.21372 miles; 10 kilometers; 1×10^{4} meters.

Nail (British).—2.25 inch; 5.715 centimeters.

Noggin (British).—1/32 or 0.03125 gallon (liquid); 142.06 cubic centimeters.

Ounce (Fluid) (oz. fl. or ℥ fl.) (U. S.).—1/128 or 0.0078125 gallon (U. S.); 0.03125 quart (liquid, U. S.); 1/16 or 0.0625 pint (liquid); ¼ or 0.25 gill (U. S.); 1.80469 cubic inches; 8 drams (fluid); 480 minims; 0.0295729 liter; 0.295729 deciliter; 29.5729 milliliters; 29.5737 cubic centimeters.

Ounce (fluid) (oz. fl. or ℥ fl.) (British).—0.006250 gallon (British); 8 drachms (fluid, British); 480 minims; 28.4130 cubic centimeters.

Ounce (avoirdupois) (oz. av. or ℥ av.).—2.790179×10^{-5} ton (long); 3.125×10^{-5} ton (short); 6.25×10^{-4} hundredweight (short); 1/16 or 0.062500 pound (avoirdupois); 0.075954861 pound (apothecary or troy); 0.9114583 ounce (apothecary or troy); 7.29166 drams (apothecary or troy); 16 drams (avoirdupois); 18.22917 pennyweights; 21.875 scruples (apothecary); 437.5 grains; 2.83495×10^{-5} ton (metric); 28.349527 grams.

Ounce (apothecary or troy) (oz. ap. or t. or ℥ ap. or t.).—3.4285×10^{-5} ton (short); 0.06857143 pound (avoirdupois); 0.08333 pound (apothecary or troy); 1.09714 ounces (avoirdupois); 8 drams (apothecary or troy); 17.55428 drams (avoirdupois); 20 pennyweights (troy); 24 scruples; 480 grains; 31.103481 grams; 3.1103481×10^{4} milligrams.

Pace.—2½ feet; 30 inches (British); 76.2 centimeters.

Palm (British).—3 inches; 7.62 centimeters.

Parsec.—19×10^{12} miles; 3.084×10^{13} kilometers.

Peck (pk.) (U. S.).—¼ or 0.25 bushel; 8 quarts; 16 pints; 537.605 cubic inches; 0.880958 dekaliter; 8.80958 liters.

Peck (pk.) (British).—2 gallons (British); 554.6 cubic inches; 9.0919 liters.

Pennyweight (dwt.) (troy).—0.003428571 pound (avoirdupois); 0.0041667 pound (apothecary or troy); 1/20 or 0.05

ounce (apothecary or troy); 0.0548571 ounce (avoirdupois); 0.8777143 dram (avoirdupois); 24 grains; 1.55517 grams; 1555.17 milligrams.

Perch (British & U. S.).—1 rod; 16.5 feet; 5.0292 meters.

Perch (masonry).—24.75 cubic feet.

Pied (French foot).—1/6 or 0.16667 toise (French); 12 Paris inches; 0.3248 meter.

Pint (pt.) (dry, U. S.).—1/64 or 0.015625 bushel; 0.0625 peck; 0.5 quart; 33.600 cubic inches; 0.550599 liter; 550.61 cubic centimeters.

Pint (pt.) (liquid, U. S.).—6.1881×10^{-4} cubic yard; 0.016711 cubic foot; 1/8 or 0.125 gallon (U. S.); 0.5 quart (U. S.); 0.83268 British pint; 4 gills (U. S.); 16 fluid ounces (U. S.); 28.875 cubic inches; 128 fluid drams; 7680 minims; 0.473167 liter; 473.167 milliliters; 473.179 cubic centimeters.

Pint (pt.) (liquid, British).—1/8 or 0.125 gallon (British); 0.5 quart (British); 1.20094 U. S. pints; 4 gills (British); 20 fluid ounces (British); 0.56825 liter; 568.25 milliliters; 568.26 cubic centimeters.

Point (printer's type).—1/72 or 0.01389 inch; 0.035278 centimeter.

Pole (British).—1 rod; 5.5 yards; 16.5 feet; 5.0292 meters.

Pottle (British).—1/2 gallon (liquid); 2.273 cubic decimeters.

Pouce (Paris inch).—1/12 or 0.083333 pied or Paris foot; 12 lignes or Paris lines; 2.70700 centimeters.

Pound (avoirdupois) (lb. av.) (U. S. or British).—Is the mass of 27.681 cubic inches of water weighed in air at 4° C, 760 mm pressure; 4.464286×10^{-4} ton (long); 5×10^{-4} ton (short); 0.0089286 hundredweight (long); 0.01 hundredweight (short); 1.2152778 pounds (apothecary or troy); 14.5833 ounces (apothecary or troy); 16 ounces (avoirdupois); 116.6667 drams (apothecary or troy); 256 drams (avoirdupois); 291.6667 pennyweights; 350.01 scruples; 7000 grains; 4.5359243×10^{-4} ton (metric); 0.4535924 kilogram; 453.5924 grams.

Pound (apothecary or troy) (lb. ap. or t.) (U. S. or British).—3.6735×10^{-4} ton (long); 4.1143×10^{-4} ton (short); 0.822857 pound (avoirdupois); 12 ounces (apothecary or troy); 13.165714 ounces (avoirdupois); 96 drams (apothecary or troy); 210.6514 drams (avoirdupois); 240 pennyweights; 288 scruples; 5760 grains; 3.7324×10^{-4} ton (metric); 0.3732418 kilogram; 373.2418 grams.

Puncheon (British).—70 gallons (British); 84 wine gallons; 0.31823 cubic meter.

Quadrant.—1.57080 radians; 90 degrees; 5400 minutes.

Quart (qt.) (U. S., dry).—1/32 or 0.03125 bushel; 0.038889 cubic foot; ⅛ or 0.125 peck; 2 pints (dry); 67.2006 cubic inches; 1.10120 liters; 1101.23 cubic centimeters.

Quart (qt.) (U. S., liquid).—0.033421 cubic foot; ¼ or 0.25 gallon; 2 pints (liquid); 8 gills; 32 ounces (fluid); 57.749 cubic inches; 256.00 drams (fluid); 0.946333 liter; 946.358 cubic centimeters.

Quart (qt.) (British, liquid).—¼ gallon (British); 2 pints (liquid, British); 1.13650 liters; 1136.52 cubic centimeters.

Quarter (U. S., mass).—¼ short ton or 500 pounds; 226.795 kilograms.

Quarter (U. S., mass).—¼ long ton or 560 pounds; 254.01 kilograms.

Quarter (British, capacity)—8 bushels; 2.909 hectoliters.

Quarter (British, linear).—1 span; ¼ yard; 9 inches; 22.860 centimeters.

Quarter (British, mass).—¼ short hundredweight or 25 pounds; 11.340 kilograms.

Quarter (British, mass).—¼ long hundredweight or 28 pounds; 12.70 kilograms.

Quartern (British, dry).—½ gallon; 2273.1 cubic centimeters.

Quartern (British, liquid).—1/32 gallon; 142.07 cubic centimeters.

Quintal (q) (metric).—1.96841 hundredweights (long); 220.46 pounds; 100 kilograms; 1×10^5 grams.

Quintal* (q) (U. S. or British).—100 or 112 pounds.

Quire.—25 sheets.

Radian.—$1/2\pi$ or 0.159155 circumference or revolution; 0.637 quadrant; 57.29578 degrees; 57° 17′ 44.8″; 3437.75 minutes; 2.06265×10^5 seconds.

Ream.—500 sheets.

Register Ton (British).—100 cubic feet; 2.8317 cubic meters.

Revolution.—4 quadrants; 2π or 6.2832 radians; 360 degrees.

Rod (rd.) (surveyor's measure).—0.003125 mile; 0.025 furlong; 0.25 chain (Gunter's); 1 perch; 5.5 yards; 16.5 feet; 25 links; 198 inches; 5.029210 meters.

Rod (rd.) (British, volume).—1000 cubic feet; 28.317 cubic meters.

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*Variable.

Rood (British).—¼ or 0.25 acre; 40 square perches; 1210 square yards; 10.117 ares or square dekameters.

Rope (British).—20 feet; 6.0960 meters.

Sack (British).—3 bushels; 0.10911 cubic meter.

Scruples (apothecary) (s. ap. or ℈).—0.002857143 pound (avoirdupois); 0.003472222 pound (apothecary or troy); 0.041667 ounce (apothecary or troy); 0.0457143 ounce (avoirdupois); 1/3 or 0.33333 dram (apothecary or troy); 0.7314286 dram (avoirdupois); 0.833333 pennyweight; 20 grains; 1.2959784 grams; 1295.9784 milligrams.

Seam (British).—8 bushels; 0.29095 cubic meter.

Second (Angle) (″).—4.84814×10^{-6} radian; 2.7778×10^{-4} degree; 0.016667 minute.

Second (sec) (time, mean solar).—1.1574×10^{-5} day (mean solar); 1.1606×10^{-5} day (sidereal); 2.7778×10^{-4} hour (mean solar); 0.016667 minute (mean solar); 1.00273791 seconds (sidereal).

Second (sec) (time, sidereal).—0.997270 second (mean solar).

Sign (s).—30 degrees.

Skein.—360 feet; 109.73 meters.

Slug.—1 geepound; 32.174 pounds; 14.594 kilograms.

Space, Entire (solid angle).—4π or 12.5664 steradians.

Span.—⅛ fathom; 1 quarter (British, linear); 9 inches; 22.86005 centimeters.

Sphere (solid angle).—2 hemispheres; 4π or 12.5664 steradians.

Spherical Right Angle.—⅛ or 0.125 sphere; ¼ or 0.25 hemisphere; $\pi/2$ or 1.5708 steradians.

Square Centimeter (cm^2).—2.47104×10^{-7} square chain; 3.95367×10^{-6} square rod; 1.1960×10^{-4} square yard; 0.0010764 square foot; 0.00247104 square link; 0.15500 square inch; 1.5500×10^{5} square mils; 1.9735×10^{5} circular mils; 127.32 circular millimeters; 1×10^{-4} square meter; 0.01 square decimeter; 100 square millimeters.

Square Chain (sq. ch.) (Gunter's).—1.5625×10^{-4} square mile; 16 square rods; 484 square yards; 4356 square feet; 1×10^{4} square links; 6.27264×10^{5} square inches; 404.6873 square meters.

Square Decimeter (dm^2).—15.500 square inch; 0.01 square meter; 100 square centimeters.

Square Degree.—3.0462×10^{-4} steradian.

Square Dekameter (dkm^2).—0.02471044 acre (U. S.); 119.60 square yards; 1 are; 100 square meters.

Square Foot ($ft.^2$ or sq. ft.) (U. S.).—3.58701×10^{-8} square mile; 2.29568×10^{-5} acre; 2.29568×10^{-4} square chain; 0.00367309 square rod; 1/9 or 0.111111 square yard; 2.29568 square links; 144 square inches; 9.290341×10^{-4} are; 0.09290341 square meter; 929.0341 square centimeters.

Square Foot ($ft.^2$ or sq. ft.) (British).—0.09290289 square meter.

Square Hectometer (hm^2).—2.471044 acres (U. S.); 2.471058 acres (British); 1×10^4 square meters.

Square Inch ($in.^2$ or sq. in.) (U. S.).—1.59423×10^{-6} square chain; 1/144 or 0.0069444 square foot; 1/1296 or 0.000771605 square yard; 0.0159423 square link; 1×10^6 square mils; 1.27324×10^6 circular mils; 6.4516258×10^{-4} square meter; 6.4516258 square centimeters; 645.16258 square millimeters.

Square Inch ($in.^2$ or sq. in.) (British). 6.4515898 square centimeters.

Square Kilometer (km^2).—0.3861006 square mile (U. S.); 247.1044 acres (U. S.); 247.1058 acres (British); 1.1960×10^6 square yards; 1.0764×10^7 square feet; 1×10^6 square meters.

Square Link ($li.^2$ or sq. li.) (Gunter's).—1×10^{-5} acre; 1×10^{-4} square chain; 0.0016 square rod; 0.0484 square yard; 0.4356 square foot; 62.7264 square inches; 0.040469 square meter; 404.69 square centimeters.

Square Meter (m^2).—3.8610×10^{-7} square mile; 2.471044×10^{-4} acre (U. S.); 2.471058×10^{-4} acre (British); 0.00247104 square chain (Gunter's); 0.039537 square rod; 1.195985 square yards (U. S.); 1.195992 square yards (British); 10.76387 square feet (U. S.); 10.76390 square feet (British); 24.7104 square links (Gunter's); 1550.0 square inches; 1×10^{-6} square kilometer; 1×10^{-4} hectare or square hectometer; 0.01 are; 1 centare 1×10^4 square centimeters; 1×10^6 square millimeters.

Square Mil.—1×10^{-6} square inch; 1.2732 circular mils; 6.4516×10^{-6} square centimeter; 6.4516×10^{-4} square millimeter.

Square Mile ($mi.^2$ or sq. mi.).—640 acres; 6400 square chains; 1.02400×10^5 square rods; 3.0976×10^6 square yards; 2.78784×10^7 square feet; 2.589998 square kilometers; 258.9998 hectares; 2.589998×10^6 square meters.

Square Millimeter (mm^2).—0.0015500 square inch; 1550.0 square mils; 1973.5 circular mils; 1×10^{-6} square meter; 0.01 square centimeter; 1.2732 circular millimeters.

Square Perch (British & U. S.).—1/160 or 0.00625 acre; 30.25 square yards; 25.293 square meters.

Square Pole (British).—30.25 square yards.

Square Rod (rd. ^{2} or sq. rd.).—9.765625×10^{-6} mile; 0.00625 acre; 0.0625 square chain (Gunter's); 30.25 square yards; 272.25 square feet; 625 square links (Gunter's); 3.9204×10^4 square inches; 0.0025293 hectare or square hectometer; 25.293 square meters or centares.

Square Yard (yd. ^{2} or sq. yd.) (U. S.).—3.22831×10^{-7} square mile; 2.06612×10^{-4} acre; 0.00206612 square chain; 0.0330579 square rod or square perch; 9 square feet; 20.6612 square link 1296 square inches; 8.36131×10^{-5} hectare; 0.0083613 square dekameter or are; 0.83613 square meter or centare; 8361.31 square centimeters.

Square Yard (yd. ^{2} or sq. yd.) (British).—2.0661×10^{-4} acre (British); 8.2645×10^{-4} rood (British); 0.836126 square meter.

Steradian.—$1/4\pi$ of the solid angle around a point; 0.07958 sphere; 0.15916 hemisphere; 0.6366 spherical right angle; 3282.8 square degrees.

Stere (s).—0.1 dekastere; 1 cubic meter; 10 decisteres; 999.973 liters.

Stone (British).—14 pounds (avoirdupois); 6.350 kilograms.

Strike (British).—2 bushels (dry); 0.072738 cubic meter.

Toise (French).—6 Paris feet; 1.9490365 meters (legal, 1799); 1.949090 meters (measured, 1887).

Ton (long) (tn. l.) (U. S. or British).—1.12000 tons (short); 22.400 hundredweights (short); 2240 pounds (avoirdupois); 2722.22 pounds (apothecary or troy); 3.5840×10^4 ounces (avoirdupois); 1.0160470 metric tons; 1016.0470 kilograms.

Ton (short) (tn. sh.) (U. S.).—0.89286 ton (long); 20 hundredweights (short); 2000 pounds (avoirdupois); 2430.56 pounds (apothecary or troy); 2.916666×10^4 ounces (apothecary or troy); 3.2000×10^4 ounces (avoirdupois); 0.907185 ton (metric); 907.185 kilograms.

Tonne (t) (metric ton, millier).—0.984206 ton (long); 1.10231 tons (short); 22.046223 hundredweights (short); 2204.62 pounds (avoirdupois); 2679.23 pounds (apothecary or troy); 3.527396×10^4 ounces (avoirdupois); 1000 kilograms; 1×10^6 grams.

Township (U. S.).—36 square miles; 2.3040×10^4 square yards; 93.240 square kilometers.

Tun.—252 gallons.

Week (wk.).—168 hours; 1.0080×10^4 minutes; 6.04800×10^5 seconds.

Wey (British, capacity).—*40 bushels.

Wey (British, mass).—*252 pounds.

Yard (yd.) (U. S.).—5.68182 × 10^{-4} mile; 0.00454545 furlong; 0.0454545 chain (Gunter's); 0.181818 rod; 3 feet; 4.54545 links (Gunter's); 36 inches; 3600/3937 or 0.91440183 meter; 91.440183 centimeters.

Yard (yd.) (British).—0.18182 pole (British); 4 quarters (British, linear); 0.9143992 meter (present legal equivalent of Imperial yard); 91.43992 centimeters; 1.420212 × 10^6 wave lengths of red line of cadmium.

Year (yr.) (leap).—366 days; 8784 hours.

Year (yr.) (tropical, mean solar).—365.2422 day (mean solar); 8765.8128 hours (mean solar); 3.15569 × 10^7 seconds (mean solar).

Year (yr.) (sidereal).—365.256 days (mean solar); 8766.144 hours (mean solar).

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*Variable.

Reciprocal Units

x per **Ångström** = 1 × 10^8 x per centimeter.

x per **circular mil** = 1.9735 × 10^5 x per square centimeter.

x per **circular millimeter** = 127.324 x per square centimeter.

x per **circumference** = 0.159155 x per radian.

x per **cubic foot** = 3.5314 × 10^{-5} x per cubic centimeter.

x per **cubic inch** = 0.061023 x per cubic centimeter.

x per **cubic yard** = 1.3079 x per cubic meter.

x per **day (mean solar)** = 1.15741 × 10^{-5} x per second (mean solar).

x per **degree** = 57.29578 x per radian.

x per **entire space** = 0.079577 x per steradian.

x per **foot** = 0.032808 x per centimeter.

x per **gallon (British)** = 2.1997 × 10^{-4} x per cubic centimeter.

x per **gallon (U. S.)** = 2.6417 × 10^{-4} x per cubic centimeter.

x per **grain** = 0.01543236 x per milligram.

x per **hemisphere** = 0.15916 x per steradian.

x per **hour (mean solar)** = 2.77778 × 10^{-4} x per second (mean solar).

x per **inch** = 0.39370 x per centimeter.

x per **liter** = 9.9997×10^{-4} x per cubic centimeter.

x per **micron** = 1.0000×10^{4} x per centimeter.

x per **mil** = 393.70 x per centimeter.

x per **mile** = 0.62137 x per kilometer.

x per **minute** = 3437.75 x per radian.

x per **minute (mean solar)** = 0.0166667 x per second (mean solar).

x per **ounce (avoirdupois)** = 0.035274 x per gram.

x per **ounce (apothecary or troy)** = 0.032151 x per gram.

x per **ounce (fluid, British)** = 0.035195 x per cubic centimeter.

x per **ounce (fluid, U. S.)** = 0.033814 x per cubic centimeter.

x per **pound (avoirdupois)** = 0.00220462 x per gram.

x per **quart (dry, U. S.)** = 9.0808×10^{-4} x per cubic centimeter.

x per **quart (liquid, U. S.)** = 0.0010567 x per cubic centimeter.

x per **quart (British)** = 8.7988×10^{-4} per cubic centimeter.

x per **second** = 2.06265×10^{5} x per radian.

x per **second (sidereal)** = 1.002738 x per second (mean solar).

x per **square degree** = 3282.8 x per steradian.

x per **square foot** = 0.0010764 x per square centimeter.

x per **square inch** = 0.15500 x per square centimeter.

x per **square meter** = 1×10^{-4} x per square centimeter.

x per **square mile** = 0.38610 x per square kilometer.

x per **square millimeter** = 100.0000 x per square centimeter.

x per **square yard** = 1.19599×10^{-4} x per square centimeter.

x per **ton (2000 pounds)** = 0.00110231 x per kilogram.

x per **ton (2240 pounds)** = 9.8421×10^{-4} x per kilogram.

x per **year (mean solar)** = 0.00273781 x per day (mean solar) = 3.16888×10^{-8} x per second (mean solar).

Velocity [lt^{-1}]

Centimeter per second.—3.728×10^{-4} mile per minute; 0.02237 mile per hour; 0.032808 foot per second; 0.03600 kilometer per hour; 0.6000 meter per minute; 1.9685 feet per minute.

Degree per second.—0.002778 revolution per second; 0.017453 radian per second; 0.1667 revolution per minute.

Foot per minute.—0.005080 meter per second; 0.011364 mile per hour; 0.016667 foot per second; 0.01829 kilometer per hour; 0.3048 meter per minute; 0.5080 centimeter per second.

Foot per second.—0.011364 mile per minute; 0.5921 knot; 0.6818 mile per hour; 1.0973 kilometers per hour; 18.29 meters per minute; 30.4801 centimeters per second.

Kilometer per hour.—0.016667 kilometer per minute; 0.27778 meter per second; 0.5396 knot; 0.6214 mile per hour; 0.9113 foot per second; 16.67 meters per minute; 27.7778 centimeters per second; 54.68 feet per minute.

Kilometer per minute.—0.6215 mile per minute; 37.284 miles per hour; 60 kilometers per hour; 1666.7 centimeters per second; 3280.8 feet per minute.

Knot.—1 nautical mile per hour; 1.1516 miles per hour; 1.689 feet per second; 1.853 kilometers per hour; 51.48 centimeters per second; 6080.20 feet per hour.

Meter per minute.—0.03728 mile per hour; 0.05468 foot per second; 0.06 kilometer per hour; 1.6667 centimeters per second; 3.281 feet per minute.

Meter per second.—0.03728 mile per minute; 0.06000 kilometer per minute; 2.2369 miles per hour; 3.281 feet per second; 3.600 kilometers per hour; 196.8 feet per minute.

Mile per hour.—0.016667 mile per minute; 0.8684 knot; 1.4667 feet per second; 1.6093 kilometers per hour; 26.82 meters per minute; 44.7041 centimeters per second; 88 feet per minute.

Mile per minute.—52.104 knot; 1.609 kilometers per minute; 60 miles per hour; 88 feet per second; 2682.2 centimeters per second.

Radian per second.—0.1592 revolution per second; 9.549 revolutions per minute; 57.296 degrees per second.

Revolution per day.—7.2722×10^{-5} radian per second.

Revolution per minute (R.P.M.).—0.01667 revolution per second; 0.10472 radian per second; 6 degrees per second.

Revolution per second.—6.2832 radians per second; 60 revolutions per minute; 360 degrees per second.

Velocity of light.—2.9986×10^{10} centimeters per second.

Acceleration [$l\ t^{-2}$]

Centimeter per second per second.—0.02237 mile per hour per second; 0.03281 foot per second per second; 0.03600 kilometer per hour per second.

Foot per second per second.—0.304801 meter per second per second; 0.6818 mile per hour per second; 1.097 kilometer per hour per second; 30.4801 centimeter per second per second.

Gravity, standard.—32.174 feet per second per second; 980.665 centimeters per second per second.

Kilometer per hour per second.—0.27778 meter per second per second; 0.6214 mile per hour per second; 0.9133 foot per second per second; 27.778 centimeters per second per second.

Meter per second per second.—2.237 miles per hour per second; 3.2808 feet per second per second; 3.600 kilometers per hour per second; 100.00 centimeters per second per second.

Mile per hour per minute.—0.74507 centimeter per second per second.

Mile per hour per second.—0.44704 meter per second per second; 1.467 feet per second per second; 1.609 kilometers per hour per second; 44.704 centimeters per second per second.

Radians per second per second.—0.1592 revolution per second per second; 9.549 revolutions per minute per second; 572.96 revolutions per minute per minute.

Revolution per minute per second.—0.10420 radian per second per second.

Revolution per minute per minute.—2.778×10^{-4} revolution per second per second; 0.0017453 radian per second per second; 0.01667 revolution per minute per second.

Revolution per second per second.—6.2832 radians per second per second; 60 revolutions per minute per second; 3600 revolutions per minute per minute.

Density [$m\ l^{-3}$]

Demal.—1 gram equivalent per cubic decimeter.

Grain per cubic foot.—2.288 grams per cubic meter.

Gram per cubic centimeter.—3.405×10^{-7} pound per mil-foot; 0.03613 pound per cubic inch; 8.3452 pounds per gallon

(U. S.); 10.022 pounds per gallon (British); 62.43 pounds per cubic foot.

Gram per cubic meter.—0.437 grains per cubic foot.

Gram per milliliter.—(Numerically equal to specific gravity t°/4°); 0.999973 gram per cubic centimeter.

Kilogram per cubic meter.—3.613 × 10^{-5} pound per cubic inch; 0.001 gram per cubic centimeter; 0.06243 pound per cubic foot.

Mercury at 0°C.—13.5951 grams per cubic centimeter (Internationally accepted conventional value to be used in expressing pressures in terms of columns of mercury.)

Pound per cubic foot.—5.787 × 10^{-4} pound per cubic inch; 0.016018 gram per cubic centimeter; 16.018 kilograms per cubic meter.

Pound per cubic inch.—27.680 grams per cubic centimeter; 2.768 × 10^4 kilograms per cubic meter.

Pound per mil foot.—2.9369 × 10^6 grams per cubic centimeter.

Pound per gallon (U. S.).—0.119826 gram per cubic centimeter.

Pound per gallon (British).—0.099776 gram per cubic centimeter.

Slug per cubic foot.—0.5154 gram per cubic centimeter.

Mass Concentration

Gram per metric ton.—1.0000 milligram per kilogram.

Gram per ton (2000 pound).—1.1023 milligrams per kilogram.

Gram per ton (2240 pound).—0.9842 milligram per kilogram.

Karat (1 of gold to 24 of mixture).—41.667 milligrams per gram.

Milligram per assay ton (Equals one troy ounce per 2000 pound (avoirdupois).)—34.276 milligrams per kilogram.

Milligram per kilogram.—0.002 pound (avoirdupois) per ton (2000 pound); 0.029175 milligram per assay ton; 0.032000 ounce (avoirdupois) per ton (2000 pound); 1 gram per metric ton.

Ounce (avoirdupois) per ton (2000 pound.).—31.2500 milligrams per kilogram.

Ounce (avoirdupois) per ton (2240 pound).—27.9018 milligrams per kilogram.

Pound (avoirdupois) per ton (2000 pound).—500.000 milligrams per kilogram.

Pound (avoirdupois) per ton (2240 pound).—446.429 milligrams per kilogram.

Flow $[l^3t^{-1}]$

Cubic centimeter per second.—0.0021186 cubic foot per minute.

Cubic foot per minute.—0.1247 gallon per second; 0.4720 liter per second; 62.4 pounds of water per minute; 472.0 cubic centimeters per second.

Cubic foot per second.—2.2222 cubic yards per minute; 448.83 gallons per minute; 1699.3 liters per minute.

Cubic yard per minute.—0.45 cubic foot per second; 3.367 gallons per second; 12.74 liters per second.

Gallon per second.—0.297 cubic yard per minute; 8.0192 cubic feet per minute.

Gallon per minute.—0.002228 cubic foot per second; 0.06308 liter per second.

Liter per minute.—5.885×10^{-4} cubic foot per second; 0.004403 gallon per second.

Liter per second.—0.078493 cubic yard per minute; 2.12 cubic feet per minute; 15.85 gallons per minute (U. S.).

Miner's Inch.—1.2 cubic feet per minute.

Pounds of water per minute.—0.01603 cubic foot per minute.

Force $[mlt^{-2}]$

Conversion factors between the absolute and gravitational units of force, torque, energy and power are dependent on the value of g, the acceleration due to gravity. The standard value of g adopted by the International Committee on Weights and Measures is 980.665 cm / sec². This value or its equivalent, 32.174 ft. / sec², is used except where otherwise noted.

Dyne.—2.2481×10^{-6} pound weight; 7.2330×10^{-5} poundal; 0.0010197 gram weight; 0.015737 grain weight.

Grain weight.—63.546 dynes.

Gram weight—0.070932 poundal; 980.665 dynes.

Kilogram weight.—70.932 poundals; 9.80665×10^5 dynes.

Newton.—1×10^5 dynes.

Poundal.—0.031081 pound weight; 14.098 grams weight; 1.3825×10^4 dynes.

Pound weight.—32.174 poundals; 453.59 grams weight; 4.4482×10^5 dynes.

Ton weight (2000 pound).—8.8964×10^8 dynes.

Ton weight (2240 pound).—9.9640×10^8 dynes.

RECIPROCAL FORCE $[m^{-1}\, l^{-1}\, t^2]$

x per **gram weight**$=0.0010197\ x$ per dyne.

x per **poundal**$=7.2330 \times 10^{-5}\ x$ per dyne.

x per **pound weight**$=2.2481 \times 10^{-6}\ x$ per dyne.

Pressure $[m\, l^{-1}\, t^{-2}]$

Atmosphere (normal).—Pressure exerted by 76 cm of Hg, density 13.5951 g / cm^3, $g=980.665$ cm / sec^2; 0.0073480 ton (2000 pound) per square inch; 1.0133 bars; 1.0581 tons (2000 pound) per square foot; 14.696 pounds per square inch; 29.921 inches of mercury at 32° F; 33.899 feet of water at 39.1° F; 760 millimeters of mercury at 0° C; 1033.2 grams per square centimeter; 2116.2 pounds per square foot; 1.0332×10^4 kilograms per square meter; 1.01325×10^6 dynes per square centimeter.

Bar.—0.98692 atmosphere; 14.504 pounds per square inch, 1.01971×10^4 kilograms per square meter; 1.000×10^6 dynes per square centimeter. (This value accords with the only internationally accepted use of this term; but "bar" has also been used to denote a pressure of one dyne per square centimeter).

Barye.—1.0000 dyne per square centimeter.

Centimeter of mercury at 0 °C.—0.013158 atmosphere; 0.19337 pound per square inch; 0.44604 foot of water; 27.845 pounds per square foot; 135.95 kilograms per square meter; 1.33322×10^4 dynes per square centimeter.

Centimeter of water at 4 °C.—980.638 dynes per square centimeter.

Dyne per square centimeter.—9.8692×10^{-7} atmosphere; 1×10^{-6} bar; 1.4504×10^{-5} pound per square inch; 2.9530×10^{-5} inch of mercury at 32 °F; 4.0148×10^{-4} inch of water at 4 °C; 7.5006×10^{-4} millimeter of mercury; 0.00101971 gram per square centimeter; 0.00101974 centimeter of water at 4 °C; 0.0020886 pound per square foot; 0.0101971 kilogram per square meter.

Foot of water at 4 °C or 39.1 °F.—0.029499 atmosphere; 0.43352 pound per square inch; 0.88265 inch of mercury at

32°F; 62.426 pounds per square foot; 304.79 kilograms per square meter.

Gram (weight) per square centimeter.—9.6784×10^{-4} atmosphere; 0.014223 pound per square inch; 0.73556 millimeter of mercury at 0°C; 2.0482 pound per square foot; 10 kilograms per square meter; 980.665 dynes per square centimeter.

Inch of mercury at 32°F.—0.033421 atmosphere; 0.49116 pound per square inch; 1.13299 feet of water at 39.1°F; 13.595 inches of water at 4°C; 70.727 pounds per square foot; 345.31 kilograms per square meter; 3.38639×10^{4} dynes per square centimeter.

Inch of water at 4°C.—0.0024583 atmosphere; 0.036127 pound per square inch; 0.073554 inch of mercury; 0.57818 ounce per square inch; 5.2022 pounds per square foot; 25.399 kilograms per square meter; 2490.82 dynes per square centimeter.

Kilogram (weight) per square centimeter.—14.223 pounds per square inch; 73.556 centimeters of mercury at 0°C; 980,665 dynes per square centimeter.

Kilogram (weight) per square meter.—9.6784×10^{-5} atmosphere; 0.0014223 pound per square inch; 0.0028959 inch of mercury; 0.0032809 foot of water; 0.073556 millimeter of mercury; 0.1 gram per square centimeter; 0.20482 pound per square foot; 98.0665 dyne per square centimeter.

Kilogram (weight) per square millimeter.—0.71114 ton (2000 pounds) per square inch; 1×10^{6} kilograms per square meter; 9.80665×10^{7} dynes per square centimeter.

Millimeter of mercury at 0°C.—0.0013158 atmosphere; 0.019337 pound per square inch; 1.3595 grams per square centimeter; 2.7845 pounds per square foot; 13.595 kilograms per square meter; 1333.22 dynes per square centimeter.

Ounce (weight) per square inch.—0.0625 pound per square inch; 4309.2 dynes per square centimeter.

Pound (weight) per square foot.—4.7254×10^{-4} atmosphere; 4.7880×10^{-4} bar; 0.0069445 pound per square inch; 0.016018 foot of water at 39.1°F; 0.35913 millimeter of mercury at 0°C; 0.48824 gram per square centimeter; 4.8824 kilograms per square meter; 478.80 dynes per square centimeter.

Pound (weight) per square inch.—5×10^{-4} ton (2000 pound) per square inch; 0.068046 atmosphere; 0.068947 bar; 0.070307 kilogram per square centimeter; 2.0360 inches of mercury at 32°F; 2.3066 feet of water at 39.1°F; 5.1715 centimeters of mercury at 0°C; 27.673 inches of water at 4°C; 51.715 millimeters of mercury; 70.307 grams per square centimeter; 703.07 kilograms per square meter; 6.8947×10^{4} dynes per square centimeter.

Ton (2000 pound) (weight) per square foot.—0.94509 atmosphere; 13.889 pounds per square inch; 9764.8 kilograms per square meter; 9.5760×10^5 dynes per square centimeter.

Ton (2240 pound) (weight) per square foot.—10.7251×10^5 dynes per square centimeter.

Ton (2000 pound) (weight) per square inch.—1.4062 kilograms per square millimeter; 2000 pounds per square inch; 1.4062×10^6 kilograms per square meter; 1.3789×10^8 dynes per square centimeter.

Ton (2240 pound) (weight) per square inch.—1.5749 kilograms per square millimeter; 152.42 atmospheres; 1.5444×10^8 dynes per square centimeter.

Work and Energy $[m\, l^2\, t^{-2}]$

British thermal unit (mean) (BTU).—2.930×10^{-4} kilowatt-hour; 3.9292×10^{-4} horse power-hour; 0.25198 kilogram-calorie or large calorie (mean); 0.2930 watt-hour; 10.409 liter-atmospheres; 107.56 kilogram-meters; 251.98 gram-calories (mean); 777.97 foot-pounds; 1054.8 joules (absolute); 0.3676 cubic foot-atmospheres; 2.5030×10^4 foot-poundals; 1.0548×10^{10} ergs.

British thermal unit (39 °F) (BTU).—1060.4 joules (absolute).

British thermal unit (60 °F) (BTU).—1054.6 joules (absolute).

Calorie.—*See* gram-calorie or kilogram-calorie.

Centigrade thermal unit (15 °C) (CTU).—1898.3 joules (absolute).

Centimeter-dyne.—*See* erg.

Centimeter-gram force.—*See* gram-centimeter.

Cheval-vapeur heure.—2.6478×10^6 joules (absolute).

Cubic centimeter-atmosphere (normal).—0.101325 joule (absolute).

Cubic foot atmosphere.—2.7203 British thermal unit (mean); 28.313 liter-atmospheres; 292.59 kilogram-meters; 680.74 gram-calories (mean); 2116.3 foot-pounds; 2869.4 joules (absolute).

Erg.—2.3889×10^{-11} kilogram-calorie (mean); 9.4805×10^{-11} British thermal unit (mean); 1.0197×10^{-8} kilogram-meter; 2.3889×10^{-8} gram-calorie (mean); 7.3756×10^{-8} foot-pound; 1×10^{-7} joule; 2.3730×10^{-6} foot-poundal; 0.0010197 gram-centimeter; 1 dyne-centimeter.

Foot-Pound.—3.7662×10^{-7} kilowatt-hour; 5.0505×10^{-7} horse power-hour; 3.2389×10^{-4} kilogram-calorie (mean); 3.7662×10^{-4} watt-hour; 4.7253×10^{-4} cubic foot-atmosphere; 0.0012854 British thermal unit (mean); 0.013381 liter-atmosphere; 0.138255 kilogram-meter; 0.32389 gram-calorie (mean); 1.35582 joule (absolute); 32.174 foot-poundals; 1.3825×10^{4} gram-centimeters; 1.35582×10^{7} ergs or centimeter-dynes.

Foot-poundal.—3.9952×10^{-5} British thermal unit (mean); 4.1589×10^{-4} liter-atmosphere (normal); 0.0042972 kilogram-meter; 0.010067 gram-calorie; 0.031081 foot-pound; 0.042140 joule; 4.21402×10^{5} ergs.

Gram-calorie (mean).—1.5593×10^{-6} horse power hours; 0.001 kilogram-calorie; 0.0011628 watt-hour; 0.001459 cubic foot-atmosphere; 0.0039685 British thermal unit (mean); 0.041311 liter-atmosphere; 0.42685 kilogram-meter; 3.0874 foot-pounds; 4.186 joules (absolute); 99.334 foot-poundals.

Gram-calorie (15 °C).—4.185 joules (absolute).

Gram-calorie (20 °C).—4.181 joules (absolute).

Gram-centimeter.—2.3427×10^{-8} kilogram-calorie (mean); 9.2972×10^{-8} British thermal unit (mean); 1×10^{-5} kilogram-meter; 2.3427×10^{-5} gram-calorie (mean); 7.233×10^{-5} foot-pound; 9.80665×10^{-5} joule (absolute); 980.7 ergs.

Horse power hour. (**HP hr. or h. p. hr.**).—0.7457 kilowatt-hour; 641.30 kilogram-calories (mean); 745.7 watt-hours; 2545.0 British thermal units (mean); 2.7374×10^{5} kilogram-meters; 1.9800×10^{6} foot-pounds; 2.6845×10^{6} joules (absolute).

Horse power hour (**electrical, U. S. & British**).—2.6856×10^{6} joules (absolute).

International volt (v) **electronic charge**).—1.5927×10^{-19} joule (absolute).

International volt (v) **Faraday.**—9.6541×10^{4} joules (absolute).

Joule (absolute).—2.778×10^{-7} kilowatt-hour; 3.725×10^{-7} horse power-hour; 2.3889×10^{-4} kilogram-calorie (mean); 2.778×10^{-4} watt-hour; 3.485×10^{-4} cubic foot-atmosphere; 9.480×10^{-4} British thermal unit (mean); 0.009869 liter-atmosphere; 0.10197 kilogram-meter; 0.23889 gram-calorie (mean); 0.23895 gram-calorie at 15 °C; 0.23918 gram-calorie at 20 °C; 0.73756 foot-pound; 0.999835 joule (International); 1 watt-second; 23.730 foot-poundals; 1.0197×10^{4} gram-centimeters; 1×10^{7} ergs.

Joule (**International**).—1.000165 joule (absolute).

Kilogram-calorie or large calorie (mean).—0.0011628 kilowatt-hour; 0.0015593 horse power-hour; 1.1628 watt-hour; 3.9685 British thermal units (mean); 426.85 kilogram-meters; 1000 small or gram-calories; 3087.4 foot-pounds; 4186 joules; 4.2686×10^{7} gram-centimeters; 4.186×10^{10} ergs.

Kilogram-meter.—2.7235×10^{-6} kilowatt hour; 3.6530×10^{-6}

horse power-hour; 0.0027235 watt-hour; 0.0034177 cubic foot-atmosphere; 0.0092972 British thermal unit (mean); 0.096782 liter-atmosphere; 2.3427 gram-calories (mean); 7.2330 foot-pounds; 9.80665 joules (absolute); 232.71 foot-poundals; 1×10^5 gram-centimeters; 9.80665×10^7 ergs.

Kilowatt-hour.—1.3410 horse power-hours; 1000 watt-hours; 3413.0 British thermal units (mean); 3.6710×10^5 kilogram-meters; 8.6001×10^5 gram-calories (mean); 2.6552×10^6 foot-pounds; 3.6000×10^6 joules (absolute).

Large Calorie.—*See* kilogram-calorie.

Liter-atmosphere (normal).—3.7745×10^{-5} horse power-hour; 0.035319 cubic foot-atmosphere; 0.09607 British thermal unit (mean); 10.333 kilogram-meters; 24.206 gram-calories (mean); 74.735 foot-pounds; 101.328 joules (absolute); 2404.5 foot-poundals.

Liter-atmosphere (lat. 45°, g=980.616).—101.323 joules (absolute).

Megalerg.—1×10^6 ergs.

Meter-kilogram.—*See* kilogram-meter.

Watt-hour.—0.001 kilowatt-hour; 0.0013410 horse power-hour; 0.86001 kilogram-calorie (mean); 3.4130 British thermal units (mean); 367.10 kilogram-meters; 860.01 gram-calories (mean); 2655.3 foot-pounds; 3600 joules.

Power $[m\, l^2\, t^{-3}]$

British thermal unit (BTU) (mean) per minute.—0.023575 horse power; 17.580 watts (absolute).

British thermal unit (BTU) (mean) per second.—1.4145 horse power; 1054.8 watts (absolute).

British thermal unit (BTU) (39°F) per second.—1060.4 watts (absolute).

British thermal unit (BTU) (60°F) per second.—1054.6 watts (absolute).

Cheval-vapeur.—For electrical purposes usually used as 736 watts. *See* Force de cheval.

Erg per second.—1×10^{-10} kilowatt; 1.3412×10^{-10} horse power; 1.4333×10^{-9} kilogram-calorie (mean) per minute; 5.688×10^{-9} British thermal unit (mean) per minute; 7.3756×10^{-8} foot-pound per second; 1×10^{-7} watt; 4.4254×10^{-6} foot-pound per minute; 1 dyne-centimeter per second.

Foot-pound per minute.—2.2597×10^{-5} kilowatt; 3.0303×10^{-5} horse power; 3.072×10^{-5} horse power (metric); 3.2389×10^{-4}

kilogram-calorie (mean) per minute; 0.0012854 British thermal unit (mean) per minute; 0.016667 foot-pound per second; 0.022597 watt.

Foot-pound per second.—0.0013558 kilowatt; 0.0018182 horse power; 0.019433 kilogram-calorie (mean) per minute 0.077124 British thermal unit (mean) per minute; 1.35582 watt (absolute).

Force de cheval (cheval-vapeur).—*See* horse power (metric).

Gram-centimeter per second.—9.80665×10^{-5} watt (absolute).

Hectowatt.—100 watts.

Horse power (h. p. or HP).—0.70696 British thermal unit (mean) per second; 0.7452 kilowatt ($g=980$); 0.74570 ($g=980.665$) kilowatt; 1.0139 horse power (metric) or cheval-vapeur; 10.688 kilogram-calories (mean) per minute; 42.418 British thermal units (mean) per minute; 550 foot-pounds per second; 745.2 watts ($g=980$); 745.70 watts ($g=980.665$); 3.3000×10^4 foot-pounds per minute.

Horse power, electrical (U. S. & British).—746.00 watt (absolute) (Commonly used in rating electrical machinery).

Horse power, metric (cheval vapeur).—0.98632 horse power (U. S.); 75 kilogram-meters per second; 735.499 watts; 3.2549×10^4 foot-pounds per minute.

Kilogram-calorie (mean) per minute.—0.093557 horse power; 51.457 foot-pounds per second; 69.767 watts.

Kilogram calorie (mean) per second.—4.186 kilowatts.

Kilogram-meter per second.—9.80665 watts (absolute).

Kilowatt.—0.23889 kilogram-calorie (mean) per second; 0.94827 British thermal unit (mean) per second; 1.3410 horse power; 1.3597 horse power (metric); 14.333 kilogram-calories (mean) per minute; 56.896 British thermal units (mean) per minute; 737.56 foot-pounds per second; 1000 watts; 4.4254×10^4 foot-pounds per minute; 2.6552×10^6 foot-pounds per hour.

Lumen.—0.001496 watt.

Metric horse power.—*See* horse power, metric.

Watt (absolute).—0.001 kilowatt; 0.0013410 horse power; 0.0013596 force de cheval or horse power (metric); 0.01433 kilogram-calorie (mean) per minute; 0.056896 British thermal unit (mean) per minute; 0.73756 foot-pound per second; 1 joule per second; 44.254 foot-pounds per minute; 1×10^7 ergs per second.

Watt (International).—1.000165 watt (absolute).

Watt of maximum visibility radiation.—668 lumens.

Action $[m\, l^2\, t^{-1}]$

Calorie (15°C) second.—6.3854×10^{33} quanta.

Calorie (15°C) second / N_o*—1.0535×10^{10} quanta.

Joule second.—1.5258×10^{33} quanta.

Joule second / N_o*.—2.5173×10^{9} quanta.

Planck's quantum.—6.624×10^{-27} erg second.

Volt electronic-charge second.—2.4292×10^{14} quanta.

Volt faraday second.—1.4724×10^{38} quanta.

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*N_o denotes Avogadro's number, the number of molecules per gram mole.

Torque or Moment of Force $[m\, l^2\, t^{-2}]$

Dyne-centimeter.—1.0197×10^{-8} kilogram-meter; 7.3757×10^{-8} pound-foot; 8.8511×10^{-7} pound-inch; 2.3731×10^{-6} poundal-foot.

Kilogram-meter.—9.8066×10^{7} dyne-centimeters.

Pound-foot.—1.3558×10^{7} dyne-centimeters.

Poundal-foot.—4.2140×10^{5} dyne-centimeters.

Pound-inch.—1.1298×10^{6} dyne-centimeters.

Moment of Area $[l^4]$

Square centimeter-centimeter squared.—0.02402 square inch-inch squared.

Square foot-foot squared.—2.074×10^{4} square inch-inch squared.

Square inch-inch squared.—4.823×10^{-5} square foot-foot squared; 41.62 square centimeter-centimeter squared.

Moment of Inertia $[m\, l^2]$

Gram-centimeter squared (g cm^2).—2.3730×10^{-6} pound-foot squared; 3.4172×10^{-4} pound-inch squared.

Kilogram-centimeter squared.—0.0023730 pound-foot squared; 0.3417 pound-inch squared.

Pound-foot squared.—144 pound-inches squared; 421.40 kilogram-centimeters squared; 4.2140×10^{5} gram-centimeters squared.

Pound-inch squared.—0.006945 pound-foot squared; 2.9264 kilogram-centimeters squared; 2926.4 gram-centimeters squared.

Thermal Units

TEMPERATURE

Degree Centigrade (°C).—0.8 or 4 / 5 degree Réaumur; 1.00 degree absolute, Kelvin; 1.8 or 9 /5 degrees Fahrenheit.

Degree Fahrenheit (°F).—0.44444 or 4 /9 degree Réaumur; 0.55556 or 5 /9 degree Centigrade.

Degree Réaumur (°R).—1.25 or 5 /4 degrees Centigrade; 2.25 or 9 /4 degrees Fahrenheit.

Temperature, absolute Centigrade or Kelvin (K) scale.—$x°\,K = T\,°C + 273.18$.

Temperature, degrees Centigrade (°C).—$x\,°C = 5/9\,(T\,°F - 32)$; $x\,°C = 5/4\,T\,°R$.

Temperature, degrees Fahrenheit (°F).—$x\,°F = 9/5\,T\,°C + 32$; $x\,°F = 9/4\,T\,°R + 32$.

Temperature, degrees Réaumur (°R).—$x\,°R = 4/9\,(T\,°F - 32)$; $x°R = 4/5\,T°C$.; Rankine = °F + 459.60.

THERMAL CAPACITY OF A SUBSTANCE

British thermal unit (mean) per pound per °F.—1 gram-calorie per gram per °C; 4.186 joules per gram per °C.

Gram-calorie (mean) per gram per °C.—1 British thermal unit (60 °F) per pound per °F; 4.186 joules per gram per °C.

Joule per gram per °C.—0.2389 gram-calorie (mean) per gram per °C; 0.2389 British thermal unit (mean) per pound per °F.

THERMAL CAPACITY OF A BODY. WATER EQUIVALENT

British thermal unit (60 °F) per °F.—453.59 gram-calories per °C; 1898.3 joules per °C.

Gram-calorie (15°) per °C.—0.0022046 British thermal unit (60 °F) per °F; 4.185 joules per °C.

Joule per °C.—5.268×10^{-4} British thermal unit (60 °F) per °F; 0.2389 gram-calorie per °C.

HEAT EQUIVALENT. LATENT HEAT

British thermal unit (mean) per pound.—0.5556 gram-calorie (mean) per gram; 2.325 joules per gram.

Gram-calories (mean) per gram.—1.8 British thermal units (mean) per pound; 4.186 joules per gram.

Joule per gram.—0.2389 gram-calories (mean) per gram; 0.4301 British thermal unit per pound.

THERMAL CONDUCTIVITY

British thermal unit (mean) per square foot per second for a temperature gradient of 1 °F per inch=5.191 joules (absolute) per square centimeter per second for a temperature gradient of 1 °C per centimeter=1.2404 gram-calories (15 °C) per square centimeter per second for a temperature gradient of 1 °C per centimeter.

Gram-calorie (15 °C) per square centimeter per second for a temperature gradient of 1 °C per centimeter=4.185 joules (absolute) per square centimeter per second for a temperature gradient of 1 °C per centimeter=0.80620 British thermal units (mean) per square foot per second for a temperature gradient of 1 °F per inch.

Joule per square centimeter per second for a temperature gradient of 1 °C per centimeter=0.2389 gram-calorie (15 °C) per square centimeter per second for a temperature gradient of 1 °C per centimeter=0.1926 British thermal unit per square foot per second for a temperature gradient of 1 °F per inch.

Photometric Units

Bougie Decimale (intensity of source).—1.0 International candle (approximately).

Candle (International) (intensity of source).—0.104 Carcel unit (approximately); 1.0000 International lumen per steradian; 1 Pentane candle (approximately); 1 English sperm candle (approximately); 1.11 Hefner unit (approximately).

Candle per square centimeter (surface brightness).—3.1416 lamberts; 3141.6 millilamberts.

Candle per square inch (surface brightness).—0.48695 lambert; 486.95 millilamberts.

Carcel unit (intensity of source).—9.6 International candle (approximately).

English sperm candle (intensity of source).—1.0 International candle (approximately).

Foot-candle (illumination of a surface).—1 lumen incident per square foot; 1.0764 milliphots; 10.764 lumen per square meter; 10.764 lux.

Hefner unit (intensity of source).—0.90 International candle (approximately).

Lambert (surface brightness).—0.3183 candle per square centimeter; 2.054 candles per square inch; 1 lumen emitted per square centimeter of a perfectly diffusing surface.

Lumen (flux of luminous energy).—Is emitted by 0.07958 spherical candle power. A source of one spherical candle power emits 4π or 12.566 lumens.

Lumen per square centimeter per steradian (surface brightness).—3.1416 lambert.

Lumen per square foot (illumination of a surface).—1 foot-candle; 10.764 lumens per square meter.

Lumen per square foot per steradian (surface brightness).—3.3816 millilambert.

Lumen per square meter (surface illumination).—1×10^{-4} phot; 0.092902 foot candle or lumen per square foot.

Lux (illumination of a surface).—1×10^{-4} phot; 0.1 milliphot; 0.092902 foot-candle; 1.000 lumen per square meter.

Meter-candle (illumination of a surface).—1.000 lumen per square meter.

Millilambert (surface brightness).—0.929 lumen emitted per square foot (perfect diffusion).

Milliphot (illumination of a surface).—0.001 phot; 0.929 foot-candle.

Pentane candle (intensity of source).—1.0 International candle (approximately).

Phot (illumination of a surface).—1 lumen incident per square centimeter; 1000 milliphots; 1.000×10^4 lumens per square meter; 1×10^4 lux.

Stilb (surface brightness).—1 candle per square centimeter.

Viscosity

VISCOSITY $[ml^{-1}t^{-1}]$

Gram weight second per square centimeter.—980.665 poise.

Poise.—1.00 gram per centimeter per second.

Pound weight second per square foot.—478.8 poise.

Pound weight second per square inch.—6.895×10^4 poise.

KINEMATIC VISCOSITY $[l^2 t^{-1}]$

Inch squared per second.—6.451 centimeters squared per second.

Poise centimeter cubed per gram.—1.000 centimeter squared per second.

Poise foot cubed per pound.—62.43 centimeters squared per second.

Poise inch cubed per gram.—16.387 centimeters squared per second.

RECIPROCAL VISCOSITY (FLUIDITY) $[m^{-1} lt]$

Rhe.—1.000 per poise.

Diffusivity; Coefficient of Diffusion $[l^2 t^{-1}]$

Centimeter squared per day.—1.1574×10^{-5} centimeter squared per second.

Inch squared per second.—6.4516 centimeters squared per second.

Liter per centimeter per day.—0.011574 centimeter squared per second.

Surface Tension $[mt^{-2}]$

Dyne per centimeter.—0.01 erg per square millimeter; 0.10197 milligram weight per millimeter; 1 erg per square centimeter; 2.5901 milligram weight per inch.

Erg per square centimeter.—0.01000 erg per square millimeter; 1.0000 dyne per centimeter.

Erg per square millimeter.—100.00 dynes per centimeter; 100.00 ergs per square centimeter.

Milligram weight per inch.—0.38609 dyne per centimeter.

Milligram weight per millimeter.—9.80665 dynes per centimeter.

Rotatory Power $[l^{-1}]$

Degree per centimeter.—0.017453 radian per centimeter.

Degree per foot.—5.7261×10^{-4} radian per centimeter.

Degree per inch.—0.0068714 radian per centimeter.

Minute per centimeter.—2.9089×10^{-4} radian per centimeter.

Radian per centimeter.—57.296 degrees per centimeter; 145.50 degrees per inch; 1746.4 degrees per foot; 3437.7 minutes per centimeter.

ELECTRICAL UNITS

Electrical units are designated as "absolute" when based on the electromagnetic cgs system, "International" when based on legal definitions of the ohm, Weston cell or silver voltammeter

The basis of International units is indicated as follows: "(a)" based on a silver deposit of 1 11800 mg per International ampere second; "(v)" based on the International ohm and Weston cell,—1.018300 volts at 20°C.

New adjusted values of International units were adopted in the United States on January 1, 1948. Relations between absolute and International units given below are based on these values.

Quantity or Charge $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-1}]$, $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}]$

Abcoulomb.—*See* electromagnetic cgs unit electrical quantity.

Ampere-hour (absolute).—3600.0 coulomb (absolute)

Coulomb (absolute).—0.1000 electromagnetic cgs unit or abcoulomb; 1.000165 International coulombs; 2.99796×10^{9} electrostatic cgs units or statcoulombs; 6.281×10^{18} electronic charges.

Electromagnetic cgs unit or abcoulomb.—10.0000 coulombs (absolute); 2.99796×10^{10} electrostatic cgs units or statcoulombs

Electronic charge.—1.5921×10^{-20} electromagnetic cgs unit or abcoulomb; 1.5921×10^{-19} coulomb (absolute), 4.774×10^{-10} electrostatic cgs unit or statcoulomb

Electrostatic cgs unit or statcoulomb.—3.33560×10^{-11} electromagnetic cgs unit or abcoulomb, 3.33560×10^{-10} coulomb (absolute), 2.0947×10^{9} electronic charges

Electrostatic foot-pound second unit.—1.1952×10^{-6} coulomb (absolute); 117.58 electromagnetic cgs units or abcoulombs; 3583.9 electrostatic cgs units or statcoulombs

Faraday.—9.6500×10^{4} coulombs (absolute); 9.6517×10^{4} International coulombs; 2.89365×10^{14} electrostatic cgs units or statcoulombs

International coulomb.—0.999835 coulomb (absolute)

Statcoulomb.—*See* electrostatic cgs unit

RECIPROCAL QUANTITY $[\epsilon^{-\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{3}{2}}t]$; $[\mu^{\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{1}{2}}]$

x per **ampere-hour** $= 2.7778 \times 10^{-4}$ x per coulomb (absolute)

x per **coulomb (absolute)** $= 0.999835$ x per International coulomb *x* per electromagnetic cgs unit=0.1000 *x* per coulomb (absolute)

x per electronic charge=6 281$\times10^{18}$ *x* per coulomb (absolute)

x per electrostatic cgs unit=2 99796$\times10^{9}$ *x* per coulomb (absolute)

x per faraday=1 0363$\times10^{-5}$ *x* per coulomb (absolute)

Current $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-2}]$; $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$

Abampere.—*See* electromagnetic cgs unit.

Ampere (absolute).—1.0363$\times10^{-5}$ faraday per second; 0.1 electromagnetic cgs unit or abampere; 1.000165 International amperes (U. S. 1948); 2.99796$\times10^{9}$ electrostatic cgs units or statamperes

Electromagnetic cgs unit or abampere.—10.0000 amperes (absolute); 2 99796$\times10^{10}$ electrostatic cgs units or statamperes.

Electrostatic cgs unit or statampere.—3.33560$\times10^{-11}$ electromagnetic cgs unit or abampere; 3.33560$\times10^{-10}$ ampere (absolute)

Faraday per second —9.6500$\times10^{4}$ ampere (absolute).

International ampere (U. S. 1948).—0.999835 ampere (absolute).

International ampere (a) —Based on the deposit of 0 00111800 grams of silver per second; 0 99993 ampere (absolute)

International ampere (v) —As defined by the International ohm and volt, 0 99990 ampere (absolute)

International ampere (U S before 1911) —0.99916 International ampere (v)

International ampere (England before 1906) —0 99870 International ampere (v)

International ampere (England 1906-8).—0.99894 International ampere (v)

International ampere (England 1909-10) —0.99990 International ampere (v)

International ampere (France before 1911).—0.9998 International ampere (v)

International ampere (Germany before 1911).—0.99968 International ampere (v)

Statampere.—*See* electrostatic cgs unit

Electrical Field Strength $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{-\frac{1}{2}}t^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-2}]$

Electrostatic cgs unit of potential per centimeter.—299.796 volts per centimeter (absolute).

Electrostatic cgs unit of potential per inch.—118.05 volts per centimeter (absolute).

Electromagnetic cgs unit of potential per centimeter.—1.0000 $\times 10^{-8}$ volt per centimeter (absolute).

Electromagnetic cgs unit of potential per inch.—3.9370$\times 10^{-9}$ volt per centimeter (absolute).

Volt per inch.—0.39370 volt per centimeter.

Potential $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-2}]$

Abvolt.—*See* electromagnetic cgs unit.

Electromagnetic cgs unit or abvolt.—3.33560$\times 10^{-11}$ electrostatic cgs unit or statvolt; 1.0000$\times 10^{-8}$ volt (absolute).

Electrostatic cgs unit or statvolt.—299.796 volts (absolute); 2.99796$\times 10^{10}$ electromagnetic cgs units or abvolts.

International volt (U. S. 1948).—1.00033 volts (absolute)

International volt (a).—Based on the International ohm and ampere; 1.00045 volts (absolute).

International volt (v).—Based on the acceptance of the electromotive force of a Weston cell at 20 °C as 1.0183 International volts; 1.00042 volts (absolute).

International volt (U. S. before 1911).—0.99916 International volt (v).

International volt (England before 1906).—0.99870 International volt (v).

International volt (England 1906-8).—0.99894 International volt (v).

International volt (England 1909-10).—0.99990 International volt (v).

International volt (Germany and France, before 1911).—0.99968 International volt (v).

Statvolts.—*See* electrostatic cgs unit.

Volt (absolute).—0.0033356 electrostatic cgs unit or statvolts; 0.999670 International volt (U. S. 1948); 1$\times 10^{8}$ electromagnetic cgs units or abvolts.

Resistance [$\epsilon^{-1}l^{-1}t$]; [$\mu l t^{-1}$]

Abohm.—*See* electromagnetic cgs unit.

Board of trade unit (England 1903).—0.9984 International ohm.

Electromagnetic cgs unit or abohm.—1.11263×10^{-21} electrostatic cgs unit or statohm; 1×10^{-15} megohm; 1.0000×10^{-9} ohm (absolute); 0.001 microhm.

Electrostatic cgs unit or statohm.—8.98776×10^{11} ohms (absolute); 8.98776×10^{20} electromagnetic cgs units or abohms.

International ohm.—The resistance of a uniform column of mercury at 0°C, 106.300 centimeters long, having a mass of 14.4521 grams; 1.000495 ohms (absolute); 1.0016 board of trade unit (England 1903); 1.0630 Siemens unit.

International ohm (France before 1911).—0.9999 International ohm.

"Legal ohm" of 1884 (England).—0.99718 International ohm.

Megohm.—1×10^{6} ohms.

Microhm.—1.11263×10^{-18} electrostatic cgs unit or statohm; 1×10^{-12} megohm; 1×10^{-6} ohm; 1000 electromagnetic cgs units or abohms.

Ohm (absolute).—1.11263×10^{-12} electrostatic cgs unit or statohm; 1×10^{-6} megohm (absolute); 0.999505 International ohm; 1×10^{6} microhms (absolute); 1×10^{9} electromagnetic cgs units or abohms.

Siemens unit.—0.94073 International ohm.

Statohm.—*See* electrostatic cgs unit.

Volume Resistivity [$\epsilon^{-1}t$]; [$\mu l^{2}t^{-1}$]

Electromagnetic cgs unit (abohm)-centimeter.—9.99505×10^{-10} International ohm-centimeter; 0.001 microhm-centimeter; 0.0060153 ohm-mil*-foot.

Electrostatic cgs unit-centimeter.—8.98776×10^{11} ohm-centimeters (absolute).

International annealed copper standard (20°C).—Volume resistivity of annealed copper; 1.7241 microhm-centimeters.

International ohm-centimeter.—1.000495 ohm-centimeters (absolute).

Microhm-centimeter.—1.0000×10^{-6} ohm-centimeter; 0.3937 microhm-inch; 6.0153 ohm-mil*-foot; 1000 abohm-centimeters.

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*The unit thus marked refers to the diameter of a wire of circular cross section.

Microhm-inch.—2.5400 microhm-centimeters.

Ohm-centimeter (absolute).—0.999505 International ohm-centimeter; 1×10^{6} microhm-centimeters.

Ohm inch.—2.5400×10^{6} microhm-centimeters.

Ohm-meter-millimeter².—100.0000 microhm-centimeters.

Ohm-meter-millimeter*.—78.540 microhm-centimeters.

Ohm-mil*-foot.—0.16624 microhm-centimeter; 166.24 electromagnetic cgs unit (abohm) centimeters.

Mass Resistivity $[\epsilon^{-1}ml^{-3}t]$; $[\mu ml^{-1}t^{-1}]$

Electromagnetic cgs unit.—9.9951×10^{-6} International ohm-meter-gram.

Electrostatic cgs unit.—8.9869×10^{15} International ohm-meter-gram.

International ohm-meter-gram.—1.000495 ohm (absolute)-meter-gram.

Ohm (absolute)-meter-gram.—0.999505 International ohm-meter-gram.

Ohm-centimeter-gram.—D† ohm-centimeter; 1.0000×10^{4} ohm-meter-gram.

Ohm-mile-pound.—1.7513×10^{-4} ohm-meter-gram.

Volume Conductivity $[\epsilon t^{-1}]$; $[\mu^{-1}l^{-2}t]$

Electromagnetic cgs unit or abmhos per centimeter cube (ohm^{-1}-centimeter^{-1}).—166.2 mhos per mil* foot; 1000 megmhos per centimeter cube; 1.000495×10^{9} International ohm^{-1}-centimeter^{-1}.

Electrostatic cgs unit.—1.11318×10^{-12} International ohm^{-1}-centimeter^{-1}.

International annealed copper standard (20°C).—0.5800 microhm^{-1}-centimeter^{-1}.

International ohm^{-1}-centimeter^{-1}.—0.999505 ohm^{-1}-centimeter^{-1} (absolute).

Megmhos per centimeter cube.—0.001 abmhos per centimeter cube; 0.1662 mhos per mil* foot; 2.540 megmhos per inch cube; 1 microhm^{-1}-centimeter^{-1}.

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†D represents the density in grams per centimeter cubed.

*The unit thus marked refers to the diameter of a wire of circular cross section.

Megmhos per inch cube.—0.39370 megmhos per centimeter cube; 1 microhm^{-1}-inch^{-1}.

Mho centimeter cube.—1 ohm^{-1}-centimeter^{-1}.

Microhm^{-1}-centimeter^{-1}.—1.0000×10^6 ohm^{-1}-centimeter^{-1}; 1 megmho per centimeter cube.

Microhm^{-1}-inch^{-1}.—0.39370 microhm^{-1}-centimeter^{-1}; 1 megmho per inch cube.

Ohm^{-1}-centimeter^{-1} (absolute).—1 mho per centimeter cube; 1.000495 International ohm^{-1}-centimeter.$^{-1}$

Ohm^{-1}-inch^{-1}.—3.9370×10^{-7} microhm^{-1}-centimeter^{-1}.

Ohm^{-1} (meter, millimeter*)$^{-1}$.—0.012732 microhm^{-1}-centimeter^{-1}.

Ohm^{-1} (meter, millimeter^2)$^{-1}$.—0.01000 microhm^{-1}-centimeter^{-1}.

Ohm^{-1} (mil, foot)$^{-1}$.—6.0153 microhm^{-1}-centimeter^{-1}.

100% conductivity (20 °C).—0.5800 microhm^{-1}-centimeter^{-1}.

Mass Conductivity [$\epsilon m^{-1} l^3 t^{-1}$]; [$\mu^{-1} m^{-1} l t$]

x per **electromagnetic cgs unit** $= 1.000495 \times 10^5$ x per International ohm-meter-gram.

x per **electrostatic cgs unit** $= 1.1132 \times 10^{-16}$ x per International ohm-meter-gram.

x per **International ohm-meter-gram** $= 0.999505$ x per ohm (absolute)-meter-gram.

x per **ohm (absolute)-meter-gram** $= 1.000495$ x per International ohm-meter-gram.

x per **ohm-centimeter-gram** $= 1.0000 \times 10^{-4}$ x per ohm-meter-gram.

x per **ohm-mile-pound** $= 0.0057100$ x per ohm-meter-gram.

Capacitance [ϵl]; [$\mu^{-1} l^{-1} t^2$]

Electromagnetic cgs unit or abfarad.—1.0000×10^9 farads (absolute); 1×10^{15} microfarads; 8.98776×10^{20} electrostatic cgs units or statfarads.

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*The unit thus marked refers to the diameter of a wire of circular cross section.

Electrostatic cgs unit (statfarad or centimeter).—1.11263×10^{-21} electromagnetic cgs unit or abfarad; 1.11263×10^{-12} farad (absolute); 1.11263×10^{-6} microfarad.

Farad (absolute).—1×10^{-9} electromagnetic cgs unit or abfarad; 1.000495 International farad; 1×10^{6} microfarads; 8.98776×10^{11} electrostatic cgs units or statfarads.

International farad.—0.999505 farad (absolute).

Microfarad.—1×10^{-15} electromagnetic cgs unit or abfarad; 1×10^{-6} farad; 8.98776×10^{5} electrostatic cgs units or statfarads.

Micromicrofarad.—1×10^{-12} farad.

Statfarad.—*See* electrostatic cgs unit.

Inductance $[\epsilon^{-1} l^{-1} t^{2}]$; $[\mu l]$

Abhenry.—*See* electromagnetic cgs unit.

Electromagnetic cgs unit (abhenry or centimeter).—1.11263×10^{-21} electrostatic cgs unit or stathenry; 1.0000×10^{-9} henry (absolute); 1×10^{-6} millihenry.

Electrostatic cgs unit or stathenry.—8.98776×10^{11} henry (absolute); 8.98776×10^{14} millihenries; 8.98776×10^{20} abhenries.

Henry (absolute).—1.11263×10^{-12} electrostatic cgs unit or stathenry; 0.999505 International henry; 1000 millihenries; 1×10^{9} electromagnetic cgs units or abhenries.

International henry.—1.000495 henry (absolute).

Millihenry.—1.11263×10^{-15} stathenry; 0.001 henries; 1×10^{6} abhenries.

Stathenry.—*See* electrostatic cgs unit.

Thermoelectric Units

THERMOELECTRIC POWER $[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1} \theta^{-1}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{3}{2}} t^{-2} \theta^{-1}]$

Electromagnetic cgs unit of potential per °C.—0.010000 microvolt per °C (absolute).

Electromagnetic cgs unit of potential per °F.—0.018000 microvolt per °C (absolute).

Electrostatic cgs unit of potential per °C.—2.9986×10^{8} microvolt per °C (absolute).

Electrostatic cgs unit of potential per °F.—5.3975×10^{8} microvolt per °C (absolute).

Microvolt per °F.—1.8000 microvolt per °C.

PELTIER COEFFICIENT $[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{3}{2}} t^{-2}]$

Calorie (15 °C) per ampere-hour.—0.011625 joule per electromagnetic unit quantity.

Calorie (15 °C) per coulomb.—41.850 joules per electromagnetic unit quantity.

Joule per ampere-hour (absolute).—9.2636×10^{-14} joule per electrostatic unit quantity; 0.0027778 joule per electromagnetic unit quantity.

Joule per coulomb.—10.000 joules per electromagnetic unit quantity.

Joule per electron.—6.2811×10^{19} joules per electromagnetic unit quantity.

Joule per faraday.—1.0363×10^{-4} joule per electromagnetic unit quantity.

COEFFICIENT OF THOMSON EFFECT

$[\epsilon^{-\frac{1}{2}} m^{\frac{1}{2}} l^{\frac{1}{2}} t^{-1}\ \theta^{-1}]$; $[\mu^{\frac{1}{2}} m^{\frac{1}{2}} t^{-2}\ \theta^{-1}]$

Joule per coulomb per °F.—1.8000 joules per coulomb per °C

Joule per electromagnetic unit quantity per °F.—0.1800 joule per coulomb per °C.

Joule per electron per °C.—6.2811×10^{18} joules per coulomb per °C.

Joule per electrostatic unit quantity per °C.—2.9986×10^{9} joules per coulomb per °C.

Joule per electrostatic unit quantity per °F.—5.3975×10^{9} joules per coulomb per °C.

Joule per faraday per °C.—1.0363×10^{-5} joule per coulomb per °C.

Volt per °C.—1.0000 joule per coulomb per °C.

Piezoelectric Constant $[\epsilon^{\frac{1}{2}} m^{-\frac{1}{2}} l^{\frac{1}{2}} t]$; $[\mu^{-\frac{1}{2}} m^{-\frac{1}{2}} l^{-\frac{1}{2}} t^2]$

Coulomb per kilogram weight.—3057.7 electrostatic unit quantity per dyne.

Electromagnetic unit quantity per kilogram weight.—3.0577×10^4 electrostatic unit quantity per dyne.

Electromagnetic unit quantity per pound weight—6.7411×10^4 electrostatic unit quantity per dyne.

Electron per kilogram weight.—4.868 $\times 10^{-16}$ electrostatic unit quantity per dyne.

Electrostatic unit quantity per kilogram weight.—1.0197 $\times 10^{-6}$ electrostatic unit quantity per dyne.

Electrostatic unit quantity per pound weight.—2.2481 $\times 10^{-6}$ electrostatic unit quantity per dyne.

Faraday per kilogram weight.—2.9507 $\times 10^{8}$ electrostatic unit quantity per dyne.

Flux of Magnetic Induction; Magnetic Flux; Pole Strength

$$[\epsilon^{-\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{1}{2}}];\ [\mu^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{3}{2}}\ t^{-1}]$$

Electromagnetic cgs unit (unit pole).—4π maxwell (absolute).

Electrostatic cgs unit.—2.99796 $\times 10^{10}$ maxwells (absolute).

International maxwell (U. S. 1948).—1.00033 maxwells (absolute).

Kilolines.—1000 maxwells.

Line.—1.0000 maxwell (absolute).

Maxwell (absolute).—3.3356 $\times 10^{-11}$ electrostatic cgs unit; 0.999670 International maxwell; 1.0000 line.

Megaline.—1 $\times 10^{6}$ maxwells.

Volt-second.—1 $\times 10^{8}$ maxwells.

Weber.—1 volt-second; 1 $\times 10^{8}$ maxwells.

Magnetic Field Intensity $[\epsilon^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{1}{2}}\ t^{-2}];\ [\mu^{-\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{-\frac{1}{2}}\ t^{-1}]$

The name oersted was given to the unit of field intensity formerly known and given below as the gauss, by the International Electrotechnical Commission in 1930.

Ampere-turn per centimeter.—1.2566 gauss.

Ampere-turn per inch.—0.49474 gauss.

Electromagnetic cgs unit.—1.0000 gauss (absolute).

Electrostatic cgs unit.—3.33560 $\times 10^{-11}$ gauss (absolute).

Gamma (γ).—1.0000 $\times 10^{-5}$ gauss.

Gauss (absolute.)—0.79580 ampere-turn per centimeter; 1 electromagnetic cgs unit; 1 gilbert per centimeter; 1.000165 International gauss; 2.0213 ampere-turns per inch; 6.452 lines per square inch; 1 $\times 10^{5}$ gamma (γ); 2.99796 $\times 10^{10}$ electrostatic cgs units.

Gilbert per centimeter.—1.0000 gauss; 2.021 ampere-turns per inch.

International gauss (U. S. 1948).—0.999835 gauss (absolute).

Lines per square centimeter.—1 gauss.

Lines per square inch.—0.1550 gauss.

Magnetomotive Force; Magnetic Potential

$[\epsilon^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{3}{2}}\ t^{-2}]$; $[\mu^{-\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{\frac{1}{2}}\ t^{-1}]$

Abampere-turn.—10 ampere-turns; 12.566 gilberts.

Ampere-turn.—0.1 abampere-turn; 1.2566 gilberts.

Electromagnetic cgs unit.—1.00000 gilbert (absolute).

Electrostatic cgs unit.—3.33560 × 10^{-11} gilbert (absolute).

Gilbert (**absolute**).—0.07958 abampere-turn; 0.7958 ampere-turn; 1.000165 International gilbert.

Reluctance $[\epsilon\ l\ t^{-2}]$; $[\mu^{-1}\ l^{-1}]$

Since 1930 oersted has been used as the name for magnetic field intensity. The oersted as used below is equivalent to one ampere-turn per maxwell.

Electromagnetic cgs unit.—1.0000 oersted (absolute).

Electrostatic cgs unit.—1.1122 × 10^{-21} oersted (absolute).

International oersted.—0.999505 oersted (absolute).

Oersted (**absolute**).—1.000495 International oersted.

Magnetic Induction; Intensity of Magnetization

$[\epsilon^{-\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{-\frac{3}{2}}]$; $[\mu^{\frac{1}{2}}\ m^{\frac{1}{2}}\ l^{-\frac{1}{2}}\ t^{-1}]$

Since 1930 the name gauss has been used for unit magnetic induction, one maxwell per square centimeter.

Electromagnetic cgs unit.—1.00000 maxwell (absolute) per square centimeter.

Electrostatic cgs unit.—2.9986 × 10^{10} maxwells (absolute) per square centimeter.

International maxwell per square centimeter.—1.00033 maxwells (absolute) per square centimeter.

Line per square centimeter.—1.00000 maxwell per square centimeter.

Line per square inch.—0.15500 maxwell per square centimeter.

Maxwell per square centimeter (absolute).—0.999670 International maxwell per square centimeter.

Maxwell per square inch.—0.15500 maxwell per square centimeter.

Dielectric Constant; Electrical Inductivity; Magnetic Permeability; Susceptibility.

Electromagnetic cgs unit.—8.9916×10^{20} electrostatic cgs units.

Foot-pound-second electromagnetic unit.—0.0010764 electromagnetic cgs unit; 9.6784×10^{17} electrostatic cgs units.

Foot-pound-second-electrostatic unit.—1.0000 electrostatic cgs unit.

Magnetic Effects

COEFFICIENT OF LEDUC EFFECT $[\epsilon^{-\frac{1}{2}} m^{-\frac{1}{2}} l^{-\frac{1}{2}} t^2]$; $[\mu^{\frac{1}{2}} m^{-\frac{1}{2}} l^{\frac{1}{2}} t]$

x centimeters per **ampere-turn**$=0.79577$ x per gauss.

x centimeters per **gilbert**$=1.0000$ x per gauss.

x per **electrostatic cgs unit**$=2.9986\times10^{10}$ x per gauss.

x inches per **ampere-turn**$=2.0213$ x per gauss.

COEFFICIENT OF HALL EFFECT $[\epsilon^{-\frac{3}{2}} m^{-\frac{1}{2}} l^{-\frac{1}{2}} t^3]$; $[\mu^{\frac{1}{2}} m^{-\frac{1}{2}} l^{\frac{5}{2}}]$

Electrostatic cgs unit.—2.6962×10^{31} electromagnetic cgs unit.

Volt centimeter per ampere gauss (absolute).—1.0000×10^{9} electromagnetic cgs unit.

Volt inch per ampere gauss (absolute).—2.5400×10^{9} electromagnetic cgs unit.

COEFFICIENT OF ETTINGHAUSEN EFFECT $[\epsilon^{-1} m^{-1} l^{-1} t^4 \theta]$; $[\mu m^{-1} l t^2 \theta]$

°C centimeter per ampere gauss (absolute).—10.000 °C centimeter per electromagnetic cgs unit.

°C centimeter per electrostatic cgs unit.—8.9916×10^{20} °C centimeter per electromagnetic cgs unit.

°F inch per ampere gauss (absolute).—45.720 °C centimeter per electromagnetic cgs unit.

COEFFICIENT OF NERNST EFFECT $[\epsilon^{-1}\, t\, \theta^{-1}]$; $[\mu l^2\, t^{-1}\, \theta^{-1}]$

Electrostatic cgs unit per °C.—8.9916×10^{20} electromagnetic cgs unit per °C.

Volt per gauss °C (absolute).—1.0000×10^8 electromagnetic cgs unit per °C.

Volt per gauss °F (absolute).—1.8000×10^8 electromagnetic cgs unit per °C.

VERDET'S CONSTANT $[\epsilon^{-\frac{1}{2}}\, m^{-\frac{1}{2}}\, l^{-\frac{3}{2}}\, t^2]$; $[\mu^{\frac{1}{2}}\, m^{-\frac{1}{2}}\, l^{-\frac{1}{2}}\, t]$

Minute per ampere-turn.—1.2566 minute per electromagnetic cgs unit.

Minute per gilbert.—1.0000 minute per electromagnetic cgs unit.

Radian per gilbert.—3437.7 minute per electromagnetic cgs unit.

RELATIONS OF ELECTRICAL UNITS

1 ohm $= 10^9$ electromagnetic $= 1/9 \times 10^{-11}$ electrostatic
1 volt $= 10^8$ electromagnetic $= 1/3 \times 10^{-2}$ electrostatic
1 ampere $= 10^{-1}$ electromagnetic $= 3 \times 10^9$ electrostatic
1 coulomb $= 10^{-1}$ electromagnetic $= 3 \times 10^9$ electrostatic
1 farad $= 10^{-9}$ electromagnetic $= 9 \times 10^{11}$ electrostatic
1 farad = 1,000,000 microfarads
1 henry $= 10^9$ electromagnetic $= 1/9 \times 10^{-11}$ electrostatic

VALUE OF THE GAS CONSTANT R FOR VARIOUS UNITS

8.3170×10^7 ergs per °C per mole
1.9869 calories (15°) per °C per mole

Units of pressure	Units of volume.	R per gram molecule.
Atmospheres	Volume at 0° C.	0.003662
Atmospheres	cm³	82.057
Atmospheres	liters	0.082054
Atmospheres	cubic meters	8.2057×10^{-5}
Dynes per cm² [barye]	cm³	8.3144×10^7
Kilograms per m² [g = 980.6]	cm³	8.48×10^5
		R per lb. molecule. °F
Pounds per sq.in.	cu.in.	18510.
Pounds per sq.in.	cu.ft.	10.73
Atmospheres	cu.in.	1260
Atmospheres	cu.ft.	0.7302

FACTORS FOR CONVERSION OF ENERGY UNITS

(From Perkins' Introduction to General Thermodynamics, John Wiley & Sons, publishers, by permission.)

	Gram-calories (4° C)	B.T.U.*	Joules	Foot-pounds	Kilogr.-meters	Liter-atmos.	Cu.ft.-atmos.	Foot-poundals	Horse-power hours
Gram-calorie....	1.	3.968×10^{-3}	4.185	3.087	.4267	4.130×10^{-2}	1.459×10^{-3}	99.31	1.5591×10^{-6}
B.T.U..........	252.	1	1055.	777.9	107.5	10.41	.3676	25030.	3.929×10^{-4}
Joule...........	.2389	9.482×10^{-4}	1.	.73756	.1019	9.869×10^{-3}	3.485×10^{-4}	23.73	3.725×10^{-7}
Foot-pound.....	.3240	1.286×10^{-3}	1.356	1.	.13826	1.3381×10^{-2}	4.7253×10^{-4}	32.174	5.0505×10^{-7}
Kilogr.-meter ...	2.343	9.298×10^{-3}	9.806	7.2327	1.	9.678×10^{-2}	3.4177×10^{-3}	232.7	3.6529×10^{-6}
Liter-atmos.....	24.21	9.607×10^{-2}	101.32	74.733	10.333	1.	3.5319×10^{-2}	2403.8	3.7734×10^{-5}

* At temp. of maximum density.

CONVERSION OF PRESSURE UNITS

(From Perkins' Introduction to General Thermodynamics, John Wiley & Sons, publishers, by permission.)

	Dynes per sq. cm	Grams per sq. cm	Kilo. per sq. meter	Mm of mercury	Atmospheres	Lbs. per sq. in.	Lbs. per sq. ft.
Dynes per sq. centimeter..	1.	1.0198×10^{-3}	1.0198×10^{-2}	7.5010×10^{-4}	9.8697×10^{-7}	1.4504×10^{-5}	2.0887×10^{-3}
Gram per sq. centimeter...	980.3	1	10	7.3551×10^{-1}	9.6777×10^{-4}	1.4223×10^{-2}	2.0481
Kilogram per sq. meter....	98.06	10^{-1}	1	7.3551×10^{-2}	9.6777×10^{-5}	1.4223×10^{-3}	2.0481×10^{-1}
Millimeter of mercury.....	1332.	1.3595	13.595	1	1.3158×10^{-3}	1.9337×10^{-2}	2.7845
Atmosphere......	1013200.	1033.3	10333	760	1	14.696	2116.32
Pound per square inch.....	68944	70.308	703.12	51.715	6.8046×10^{-2}	1	144
Pound per square foot.....	478.78	4.883×10^{-1}	4.883	3.5912×10^{-1}	4.7252×10^{-4}	6.9445×10^{-3}	1

In the two tables above the numbers show the value of the energy or pressure unit named at the left in the units named at the top. For example, 1 gram-calorie is equivalent to 3.968×10^{-3} B.T.U.

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10

Length

INCHES	MILLIMETERS	INCHES	CENTIMETERS	FEET	METERS	U. S. YARDS	METERS	U. S. MILES	KILOMETERS
0.03937	= 1	0.3937	= 1	1	= 0.304801	1	= 0.914402	0.62137	= 1
0.07874	= 2	0.7874	= 2	2	= 0.609601	1.093611	= 1	1	= 1.60935
0.11811	= 3	1	= 2.54001	3	= 0.914402	2	= 1.828804	1.24274	= 2
0.15748	= 4	1.1811	= 3	3.28083	= 1	2.187222	= 2	1.86411	= 3
0.19685	= 5	1.5748	= 4	4	= 1.219202	3	= 2.743205	2	= 3.21869
0.23622	= 6	1.9685	= 5	5	= 1.524003	3.280833	= 3	2.48548	= 4
0.27559	= 7	2	= 5.08001	6	= 1.828804	4	= 3.657607	3	= 4.82804
0.31496	= 8	2.3622	= 6	6.56167	= 2	4.374444	= 4	3.10685	= 5
0.35433	= 9	2.7559	= 7	7	= 2.133604	5	= 4.572009	3.72822	= 6
1	= 25.4001	3	= 7.62002	8	= 2.438405	5.468056	= 5	4	= 6.43739
2	= 50.8001	3.1496	= 8	9	= 2.743205	6	= 5.486411	4.34959	= 7
3	= 76.2002	3.5433	= 9	9.84250	= 3	6.561667	= 6	4.97096	= 8
4	= 101.6002	4	= 10.16002	13.12333	= 4	7	= 6.400813	5	= 8.04674
5	= 127.0003	5	= 12.70003	16.40417	= 5	7.655278	= 7	5.59233	= 9
6	= 152.4003	6	= 15.24003	19.68500	= 6	8	= 7.315215	6	= 9.65608
7	= 177.8004	7	= 17.78004	22.96583	= 7	8.748889	= 8	7	= 11.26543
8	= 203.2004	8	= 20.32004	26.24667	= 8	9	= 8.229616	8	= 12.87478
9	= 228.6005	9	= 22.86005	29.52750	= 9	9.842500	= 9	9	= 14.48412

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Area

SQUARE INCHES	SQUARE MILLIMETERS	SQUARE INCHES	SQUARE CENTIMETERS	SQUARE FEET	SQUARE METERS	SQUARE YARDS	SQUARE METERS	SQUARE MILES	SQUARE KILOMETERS
0.00155	**1**	0.1550	**1**	**1**	0.09290	**1**	0.8361	0.3861	**1**
0.00310	**2**	0.3100	**2**	**2**	0.18581	1.1960	**1**	0.7722	**2**
0.00465	**3**	0.4650	**3**	**3**	0.27871	**2**	1.6723	**1**	2.5900
0.00620	**4**	0.6200	**4**	**4**	0.37161	2.3920	**2**	1.1583	**3**
0.0075	**5**	0.7750	**5**	**5**	0.46452	**3**	2.5084	1.5444	**4**
0.00930	**6**	0.9300	**6**	**6**	0.55742	3.5880	**3**	1.9305	**5**
0.01085	**7**	**1**	6.452	**7**	0.65032	**4**	3.3445	**2**	5.1800
0.01240	**8**	1.0850	**7**	**8**	0.74323	4.7839	**4**	2.3166	**6**
0.01395	**9**	1.2400	**8**	**9**	0.83613	**5**	4.1807	2.7027	**7**
1	645.16	1.3950	**9**	10.764	**1**	5.9799	**5**	**3**	7.7700
2	1,290.33	**2**	12.903	21.528	**2**	**6**	5.0168	3.0888	**8**
3	1,935.49	**3**	19.355	32.292	**3**	**7**	5.8529	3.4749	**9**
4	2,580.65	**4**	25.807	43.055	**4**	7.1759	**6**	**4**	10.3600
5	3,225.81	**5**	32.258	53.819	**5**	**8**	6.6890	**5**	12.9500
6	3,870.98	**6**	38.710	64.583	**6**	8.3719	**7**	**6**	15.5400
7	4,516.14	**7**	45.161	75.347	**7**	**9**	7.5252	**7**	18.1300
8	5,161.30	**8**	51.613	86.111	**8**	9.5679	**8**	**8**	20.7200
9	5,806.46	**9**	58.065	96.875	**9**	10.7639	**9**	**9**	23.3100

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Volume												AREA—Continued		
CUBIC INCHES		CUBIC MILLI-METERS	CUBIC INCHES		CUBIC CENTI-METERS	CUBIC FEET		CUBIC METERS	CUBIC YARDS		CUBIC METERS	ACRES		HECTARES
0.000061	=	1	0.0610	=	1	1	=	0.02832	1	=	0.7646	1	=	0.4047
0.000122	=	2	0.1220	=	2	2	=	0.05663	1.3079	=	1	2	=	0.8094
0.000183	=	3	0.1831	=	3	3	=	0.08495	2	=	1.5291	2.471	=	1
0.000244	=	4	0.2441	=	4	4	=	0.11327	2.6159	=	2	3	=	1.2141
0.000305	=	5	0.3051	=	5	5	=	0.14159	3	=	2.2937	4	=	1.6187
0.000366	=	6	0.3661	=	6	6	=	0.16990	3.9238	=	3	4.942	=	2
0.000427	=	7	0.4272	=	7	7	=	0.19822	4	=	3.0582	5	=	2.0234
0.000488	=	8	0.4882	=	8	8	=	0.22654	5	=	3.8228	6	=	2.4281
0.000549	=	9	0.5492	=	9	9	=	0.25485	5.2318	=	4	7	=	2.8328
1	=	16,387.2	1	=	16.3872	35.314	=	1	6	=	4.5874	7.413	=	3
2	=	32,774.3	2	=	32.7743	70.629	=	2	6.5397	=	5	8	=	3.2375
3	=	49,161.5	3	=	49.1615	105.943	=	3	7	=	5.3519	9	=	3.6422
4	=	65,548.6	4	=	65.5486	141.258	=	4	7.8477	=	6	9.884	=	4
5	=	81,935.8	5	=	81.9358	176.572	=	5	8	=	6.1165	12.355	=	5
6	=	98,323.0	6	=	98.3230	211.887	=	6	9	=	6.8810	14.826	=	6
7	=	114,710.1	7	=	114.7101	247.201	=	7	9.1556	=	7	17.297	=	7
8	=	131,097.3	8	=	131.0973	282.516	=	8	10.4635	=	8	19.768	=	8
9	=	147,484.5	9	=	147.4845	317.830	=	9	11.7715	=	9	22.239	=	9

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10 (Continued)

Capacity

The following equivalents are computed on the basis 1 liter = 1.000027 cubic decimeters.

MILLI-LITERS	U. S. LIQUID OUNCES	MILLI-LITERS	U. S. APOTHE-CARIES' DRAMS	U. S. APOTHE-CARIES' SCRUPLES	MILLI-LITERS	U. S. LIQUID QUARTS	LITERS	U. S. LIQUID GALLONS	LITERS
1	=0.03382	1	=0.2705	0.8116	= 1	1	=0.94633	0.26418	=1
2	=0.06763	2	=0.5410	1	= 1.2322	1.05671	=1	0.52836	=2
3	=0.10144	3	=0.8116	1.6231	= 2	2	=1.89267	0.79253	=3
4	=0.13526	3.6967	=1	2	= 2.4644	2.11342	=2	1	=3.78533
5	=0.16907	4	=1.0821	2.4347	= 3	3	=2.83900	1.05671	=4
6	=0.20289	5	=1.3526	3	= 3.6967	3.17013	=3	1.32089	=5
7	=0.23670	6	=1.6231	3.2462	= 4	4	=3.78533	1.58507	=6
8	=0.27052	7	=1.8936	4	= 4.9288	4.22684	=4	1.84924	=7
9	=0.30433	7.3932	=2	4.0573	= 5	5	=4.73167	2	=7.57066
29.573	=1	8	=2.1641	4.8693	= 6	5.28355	=5	2.11342	=8
59.146	=2	9	=2.4347	5	= 6.1610	6	=5.67800	2.37760	=9
88.719	=3	11.0898	=3	5.6809	= 7	6.34026	=6	3	=11.35600
118.292	=4	14.7864	=4	6	= 7.3932	7	=6.62433	4	=15.14133
147.864	=5	18.4831	=5	6.4924	= 8	7.39697	=7	5	=18.92666
177.437	=6	22.1797	=6	7	= 8.6254	8	=7.57066	6	=22.71199
207.010	=7	25.8763	=7	7.3040	= 9	8.45368	=8	7	=26.49732
236.583	=8	29.5729	=8	8	= 9.8576	9	=8.51700	8	=30.28266
266.156	=9	33.2695	=9	9	=11.0898	9.51039	=9	9	=34.06799

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10 (Continued)

Capacity

The following equivalents are computed on the basis 1 liter = 1.000027 cubic decimeters

U. S. DRY QUARTS	LITERS	U. S. PECKS	LITERS	DEKA-LITERS	U. S. PECKS	U. S. BUSHELS	HECTO-LITERS	U. S. BUSHELS PER ACRE	HECTO LITERS PER HECTARE
0 9081	=1	0.11351	= 1	0.8810	= 1	1	=0.35238	1	=0 87078
1	=1.1012	0.22703	= 2	1	= 1.1351	2	=0.70477	1 14840	=1
1 8162	=2	0.34054	= 3	1 7620	= 2	2 837819	=1	2	=1.74156
2	=2.2024	0 45405	= 4	2	= 2.2703	3	=1.05715	2 29680	=2
2 7243	=3	0.56756	= 5	2.6429	= 3	4	=1.40953	3	=2.61233
3	=3.3036	0.68108	= 6	3	= 3.4054	5	=1.76192	3 44519	=3
3 6324	=4	0.79459	= 7	3.5238	= 4	5.675638	=2	4	=3.48311
4	=4.4048	0.90810	= 8	4	= 4.5405	6	=2.11430	4.59359	=4
4 5405	=5	1	= 8.80958	4.4048	= 5	7	=2.46668	5	=4.35389
5	=5.5060	1.02161	= 9	5	= 5.6756	8	=2.81907	5.74199	=5
5 4487	=6	2	=17.61916	5.2857	= 6	8 513457	=3	6	=5.22467
6	=6.6072	3	=26.42875	6	= 6 8108	9	=3.17145	6.89039	=6
6.3568	=7	4	=35.23833	6.1667	= 7	11.351276	=4	7	=6.09545
7	=7.7084	5	=44.04791	7	= 7.9459	14 189095	=5	8	=6.96622
7 2649	=8	6	=52.85749	7.0477	= 8	17.026914	=6	8.03879	=7
8	=8.8096	7	=61.66708	7 9286	= 9	19.864733	=7	9	=7.83700
8.1730	=9	8	=70.47666	8	= 9.0810	22.702552	=8	9.18719	=8
9	=9.9108	9	=79.28624	9	=10.2161	25.540371	=9	10.33558	=9

COMPARISON OF METRIC AND CUSTOMARY UNITS FROM 1 TO 10—Continued

Weight (or Mass)

GRAINS	GRAMS	AVOIRDUPOIS OUNCES	GRAMS	TROY OUNCES	GRAMS	AVOIRDUPOIS POUNDS	KILOGRAMS	TROY POUNDS	KILOGRAMS
1	= 0.06480	0.03527	= **1**	0.03215	= **1**	**1**	= 0.45359	**1**	= 0.37324
2	= 0.12960	0.07055	= **2**	0.06430	= **2**	**2**	= 0.90718	**2**	= 0.74648
3	= 0.19440	0.10582	= **3**	0.09645	= **3**	2.20462	= **1**	2.67923	= **1**
4	= 0.25920	0.14110	= **4**	0.12860	= **4**	**3**	= 1.36078	**3**	= 1.11973
5	= 0.32399	0.17637	= **5**	0.16075	= **5**	**4**	= 1.81437	**4**	= 1.49297
6	= 0.38879	0.21164	= **6**	0.19290	= **6**	4.40924	= **2**	**5**	= 1.86621
7	= 0.45359	0.24692	= **7**	0.22506	= **7**	**5**	= 2.26796	5.35846	= **2**
8	= 0.51839	0.28219	= **8**	0.25721	= **8**	**6**	= 2.72155	**6**	= 2.23945
9	= 0.58319	0.31747	= **9**	0.28936	= **9**	6.61387	= **3**	**7**	= 2.61269
15.4324	= **1**	**1**	= 28.3495	**1**	= 31.10348	**7**	= 3.17515	**8**	= 2.98593
30.8647	= **2**	**2**	= 56.6991	**2**	= 62.20696	**8**	= 3.62874	8.03769	= **3**
46.2971	= **3**	**3**	= 85.0486	**3**	= 93.31044	8.81849	= **4**	**9**	= 3.35918
61.7294	= **4**	**4**	= 113.3981	**4**	= 124.41392	**9**	= 4.08233	10.71691	= **4**
77.1618	= **5**	**5**	= 141.7476	**5**	= 155.51740	11.02311	= **5**	13.39614	= **5**
92.5941	= **6**	**6**	= 170.0972	**6**	= 186.62088	13.22773	= **6**	16.07537	= **6**
108.0265	= **7**	**7**	= 198.4467	**7**	= 217.72437	15.43236	= **7**	18.75460	= **7**
123.4589	= **8**	**8**	= 226.7962	**8**	= 248.82785	17.63698	= **8**	21.43383	= **8**
138.8912	= **9**	**9**	= 255.1457	**9**	= 279.93133	19.84160	= **9**	24.11306	= **9**

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES

From 1 to 10 Units

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
0.00036735	0.00041143	0.00037324	0.37324	0.822857	1.
0.00044643	0.00050000	0.00045359	0.45359	1.	1.21528
0.00073469	0.00082286	0.00074648	0.74648	1.64571	2.
0.00089286	0.00100000	0.00090718	0.90718	2.	2.43056
0.00098421	0.00110231	0.00100000	1.	2.20462	2.67923
0.00110204	0.00123429	0.00111973	1.11973	2.46857	3.
0.00133929	0.00150000	0.00136078	1.36078	3.	3.64583
0.00146939	0.00164571	0.00149297	1.49297	3.29143	4.
0.00178571	0.00200000	0.00181437	1.81437	4.	4.86111
0.00183673	0.00205714	0.00186621	1.86621	4.11429	5.
0.00196841	0.00220462	0.00200000	2.	4.40924	5.35846
0.00220408	0.00246857	0.00223945	2.23945	4.93714	6.
0.00223214	0.00250000	0.00226796	2.26796	5.	6.07639
0.00257143	0.00288000	0.00261269	2.61269	5.76000	7.
0.00267857	0.00300000	0.00272155	2.72155	6.	7.29167
0.00293878	0.00329143	0.00298593	2.98593	6.58286	8.
0.00295262	0.00330693	0.00300000	3.	6.61387	8.03769
0.00312500	0.00350000	0.00317515	3.17515	7.	8.50694
0.00330612	0.00370286	0.00335918	3.35918	7.40571	9.
0.00357143	0.00400000	0.00362874	3.62874	8.	9.72222

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES (Continued)

From 1 *to* 10 *Units*

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
0.00393683	0.00440924	0.00400000	4.	8.81849	10.71691
0.00401786	0.00450000	0.00408233	4.08233	9.	10.93750
0.00492103	0.00551156	0.00500000	5.	11.0231	13.39614
0.00590524	0.00661387	0.00600000	6.	13.2277	16.07537
0.00688944	0.00771618	0.00780000	7.	15.4324	18.75460
0.00787365	0.00881849	0.00800000	8.	17.6370	21.43383
0.00885786	0.00992080	0.00900000	9.	19.8416	24.11306
0.89287	1.	0.90718	907.18	2,000.	2,430.56
0.98421	1.10231	1.	1,000.	2,204.62	2,679.23
1.	1.12000	1.01605	1,016.05	2,240.00	2,722.22
1.78571	2.	1.81437	1,814.37	4,000.00	4,861.11
1.96841	2.20462	2.	2,000.00	4,409.24	5,358.46
2.	2.24000	2.03209	2,032.09	4,480.00	5,444.44
2.67857	3.	2.72155	2,721.55	6,000.00	7,291.67
2.95262	3.30693	3.	3,000.00	6,613.87	8,037.69
3.	3.36000	3.04814	3,048.14	6,720.00	8,166.67
3.57143	4.	3.62874	3,628.74	8,000.00	9,722.22
3.93683	4.40924	4.	4,000.00	8,818.49	10,716.91
4.	4.48000	4.06419	4,064.19	8,960.00	10,888.89
4.46429	5.	4.53592	4,535.92	10,000.00	12,152.78

COMPARISON OF THE VARIOUS TONS AND POUNDS IN USE IN THE UNITED STATES (Continued)

Long tons	Short tons	Metric tons	Kilograms	Avoirdupois pounds	Troy pounds
4.92103	5.51156	5.	5,000.00	11,023.11	13,396.14
5.	5.60000	5.08024	5,080.24	11,200.00	13,611.11
5.35714	6.	5.44311	5,443.11	12,000.00	14,583.33
5.90524	6.61387	6.	6,000.00	13,227.73	16,075.37
6.	6.72000	6.09628	6,096.28	13,440.00	16,333.33
6.25000	7.	6.35029	6,350.29	14,000.00	17,013.89
6.88944	7.71618	7.	7,000.00	15,432.36	18,754.60
7.	7.84000	7.11232	7,112.32	15,680.00	19,055.56
7.14286	8.	7.25748	7,257.48	16,000.00	19,444.44
7.87365	8.81849	8.	8,000.00	17,636.98	21,433.83
8.	8.96000	8.12838	8,128.38	17,920.00	21,777.78
8.03571	9.	8.16466	8,164.66	18,000.00	21,875.00
8.85786	9.92080	9.	9,000.00	19,841.60	24,113.06
9.	10.08000	9.14442	9,144.42	20,160.00	24,500.00

LENGTHS – CENTIMETERS TO INCHES

0.1 *to* 100 *Units*

1 centimeter = 0.393700 inches

The values found in the body of the table give, in inches, the lengths indicated in centimeters at the top and side.

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0		0.03937	0.07874	0.11811	0.15748	0.19685	0.23622	0.27559	0.31496	0.35433
1	0.39370	0.43307	0.47244	0.51181	0.55118	0.59055	0.62992	0.66929	0.70866	0.74803
2	0.78740	0.82677	0.86614	0.90551	0.94488	0.98425	1.0236	1.0630	1.1024	1.1417
3	1.1811	1.2205	1.2598	1.2992	1.3386	1.3780	1.4173	1.4567	1.4961	1.5354
4	1.5748	1.6142	1.6535	1.6929	1.7323	1.7717	1.8110	1.8504	1.8898	1.9291
5	1.9685	2.0079	2.0472	2.0866	2.1260	2.1654	2.2047	2.2441	2.2835	2.3228
6	2.3622	2.4016	2.4409	2.4803	2.5197	2.5591	2.5984	2.6378	2.6772	2.7165
7	2.7559	2.7953	2.8346	2.8740	2.9134	2.9528	2.9921	3.0315	3.0709	3.1102
8	3.1496	3.1890	3.2283	3.2677	3.3071	3.3465	3.3858	3.4252	3.4646	3.5039
9	3.5433	3.5827	3.6220	3.6614	3.7008	3.7402	3.7795	3.8189	3.8583	3.8976

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
10	3.9370	3.9764	4.0158	4.0551	4.0945	4.1339	4.1732	4.2126	4.2520	4.2913
11	4.3307	4.3701	4.4094	4.4488	4.4882	4.5276	4.5669	4.6063	4.6457	4.6850
12	4.7244	4.7638	4.8031	4.8425	4.8819	4.9213	4.9606	5.0000	5.0394	5.0787
13	5.1181	5.1575	5.1968	5.2362	5.2756	5.3150	5.3543	5.3937	5.4331	5.4724
14	5.5118	5.5512	5.5905	5.6299	5.6693	5.7087	5.7480	5.7874	5.8268	5.8661
15	5.9055	5.9449	5.9842	6.0236	6.0630	6.1024	6.1417	6.1811	6.2205	6.2598
16	6.2992	6.3386	6.3779	6.4173	6.4567	6.4961	6.5354	6.5748	6.6142	6.6535
17	6.6929	6.7323	6.7716	6.8110	6.8504	6.8898	6.9291	6.9685	7.0079	7.0472
18	7.0866	7.1260	7.1653	7.2047	7.2441	7.2835	7.3228	7.3622	7.4016	7.4409
19	7.4803	7.5197	7.5590	7.5984	7.6378	7.6772	7.7165	7.7559	7.7953	7.8346
20	7.8740	7.9134	7.9527	7.9921	8.0315	8.0709	8.1102	8.1496	8.1890	8.2283
21	8.2677	8.3071	8.3464	8.3858	8.4252	8.4646	8.5039	8.5433	8.5827	8.6220
22	8.6614	8.7008	8.7401	8.7795	8.8189	8.8583	8.8976	8.9370	8.9764	9.0157
23	9.0551	9.0945	9.1338	9.1732	9.2126	9.2520	9.2913	9.3307	9.3701	9.4094
24	9.4488	9.4882	9.5275	9.5669	9.6063	9.6457	9.6850	9.7244	9.7638	9.8031
25	9.8425	9.8819	9.9212	9.9606	10.000	10.039	10.079	10.118	10.157	10.197
26	10.236	10.276	10.315	10.354	10.394	10.433	10.472	10.512	10.551	10.591
27	10.630	10.669	10.709	10.748	10.787	10.827	10.866	10.905	10.945	10.984
28	11.024	11.063	11.102	11.142	11.181	11.220	11.260	11.299	11.339	11.378
29	11.417	11.457	11.496	11.535	11.575	11.614	11.654	11.693	11.732	11.772

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
30	11.811	11.850	11.890	11.929	11.968	12.008	12.047	12.087	12.126	12.165
31	12.205	12.244	12.283	12.323	12.362	12.402	12.441	12.480	12.520	12.559
32	12.598	12.638	12.677	12.717	12.756	12.795	12.835	12.874	12.914	12.953
33	12.992	13.031	13.071	13.110	13.150	13.189	13.228	13.268	13.307	13.346
34	13.386	13.425	13.465	13.504	13.543	13.583	13.622	13.661	13.701	13.740
35	13.780	13.819	13.858	13.898	13.937	13.976	14.016	14.055	14.094	14.134
36	14.173	14.213	14.252	14.291	14.331	14.370	14.409	14.449	14.488	14.528
37	14.567	14.606	14.646	14.685	14.724	14.764	14.803	14.842	14.882	14.921
38	14.961	15.000	15.039	15.079	15.118	15.157	15.197	15.236	15.276	15.315
39	15.354	15.394	15.433	15.472	15.512	15.551	15.591	15.630	15.669	15.709
40	15.748	15.787	15.827	15.866	15.905	15.945	15.984	16.024	16.063	16.102
41	16.142	16.181	16.220	16.260	16.299	16.339	16.378	16.417	16.457	16.496
42	16.535	16.575	16.614	16.654	16.693	16.732	16.772	16.811	16.850	16.890
43	16.929	16.968	17.008	17.047	17.087	17.126	17.165	17.205	17.244	17.283
44	17.323	17.362	17.402	17.441	17.480	17.520	17.559	17.598	17.638	17.677
45	17.717	17.756	17.795	17.835	17.874	17.913	17.953	17.992	18.031	18.071
46	18.110	18.150	18.189	18.228	18.268	18.307	18.346	18.386	18.425	18.465
47	18.504	18.543	18.583	18.622	18.661	18.701	18.740	18.779	18.819	18.858
48	18.898	18.937	18.976	19.016	19.055	19.094	19.134	19.173	19.213	19.252
49	19.291	19.331	19.370	19.409	19.449	19.488	19.528	19.567	19.606	19.646

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
50	19.685	19.724	19.764	19.803	19.842	19.882	19.921	19.961	20.000	20.039
51	20.079	20.118	20.157	20.197	20.236	20.276	20.315	20.354	20.394	20.433
52	20.472	20.512	20.551	20.591	20.630	20.669	20.709	20.748	20.787	20.827
53	20.866	20.905	20.945	20.984	21.024	21.063	21.102	21.142	21.181	21.220
54	21.260	21.299	21.339	21.378	21.417	21.457	21.496	21.535	21.575	21.614
55	21.654	21.693	21.732	21.772	21.811	21.850	21.890	21.929	21.968	22.008
56	22.047	22.087	22.126	22.165	22.205	22.244	22.283	22.323	22.362	22.402
57	22.441	22.480	22.520	22.559	22.598	22.638	22.677	22.716	22.756	22.795
58	22.835	22.874	22.913	22.953	22.992	23.031	23.071	23.110	23.150	23.189
59	23.228	23.268	23.307	23.346	23.386	23.425	23.465	23.504	23.543	23.583
60	23.622	23.661	23.701	23.740	23.779	23.819	23.858	23.898	23.937	23.976
61	24.016	24.055	24.094	24.134	24.173	24.213	24.252	24.291	24.331	24.370
62	24.409	24.449	24.488	24.528	24.567	24.606	24.646	24.685	24.724	24.764
63	24.803	24.842	24.882	24.921	24.961	25.000	25.039	25.079	25.118	25.157
64	25.197	25.236	25.276	25.315	25.354	25.394	25.433	25.472	25.512	25.551
65	25.591	25.630	25.669	25.709	25.748	25.787	25.827	25.866	25.905	25.945
66	25.984	26.024	26.063	26.102	26.142	26.181	26.220	26.260	26.299	26.339
67	26.378	26.417	26.457	26.496	26.535	26.575	26.614	26.653	26.693	26.732
68	26.772	26.811	26.850	26.890	26.929	26.968	27.008	27.047	27.087	27.126
69	27.165	27.205	27.244	27.283	27.323	27.362	27.402	27.441	27.480	27.520

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
70	27.559	27.598	27.638	27.677	27.716	27.756	27.795	27.835	27.874	27.913
71	27.953	27.992	28.031	28.071	28.110	28.150	28.189	28.228	28.268	28.307
72	28.346	28.386	28.425	28.465	28.504	28.543	28.583	28.622	28.661	28.701
73	28.740	28.779	28.819	28.858	28.898	28.937	28.976	29.016	29.055	29.094
74	29.134	29.173	29.213	29.252	29.291	29.331	29.370	29.409	29.449	29.488
75	29.528	29.567	29.606	29.646	29.685	29.724	29.764	29.803	29.842	29.882
76	29.921	29.961	30.000	30.039	30.079	30.118	30.157	30.197	30.236	30.276
77	30.315	30.354	30.394	30.433	30.472	30.512	30.551	30.590	30.630	30.669
78	30.709	30.748	30.787	30.827	30.866	30.905	30.945	30.984	31.024	31.063
79	31.102	31.142	31.181	31.220	31.260	31.299	31.339	31.378	31.417	31.457
80	31.496	31.535	31.575	31.614	31.653	31.693	31.732	31.772	31.811	31.850
81	31.890	31.929	31.968	32.008	32.047	32.087	32.126	32.165	32.205	32.244
82	32.283	32.323	32.362	32.402	32.441	32.480	32.520	32.559	32.598	32.638
83	32.677	32.716	32.756	32.795	32.835	32.874	32.913	32.953	32.992	33.031
84	33.071	33.110	33.150	33.189	33.228	33.268	33.307	33.346	33.386	33.425
85	33.465	33.504	33.543	33.583	33.622	33.661	33.701	33.740	33.779	33.819
86	33.858	33.898	33.937	33.976	33.016	34.055	34.094	34.134	34.173	34.213
87	34.252	34.291	34.331	34.370	34.409	34.449	34.488	34.527	34.567	34.606
88	34.646	34.685	34.724	34.764	34.803	34.842	34.882	34.921	34.961	35.000
89	35.039	35.079	35.118	35.157	35.197	35.236	35.276	35.315	35.354	35.394

LENGTHS — CENTIMETERS TO INCHES (Continued)

	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
90	35.433	35.472	35.512	35.551	35.590	35.630	35.669	35.709	35.748	35.787
91	35.827	35.866	35.905	35.945	35.984	36.024	36.063	36.102	36.142	36.181
92	36.220	36.260	36.299	36.339	36.378	36.417	36.457	36.496	36.535	36.575
93	36.614	36.653	36.693	36.732	36.772	36.811	36.850	36.890	36.929	36.968
94	37.008	37.047	37.087	37.126	37.165	37.205	37.244	37.283	37.323	37.362
95	37.402	37.441	37.480	37.520	37.559	37.598	37.638	37.677	37.716	37.756
96	37.795	37.835	37.874	37.913	37.953	37.992	38.031	38.071	38.110	38.150
97	38.189	38.228	38.268	38.307	38.346	38.386	38.425	38.464	38.504	38.543
98	38.583	38.622	38.661	38.701	38.740	38.779	38.819	38.858	38.898	38.937
99	38.976	39.016	39.055	39.094	39.134	39.173	39.213	39.252	39.291	39.331

LENGTHS — METERS TO FEET

From 1 *to* 1,000 *Units*

Reduction factor: 1 meter = 3.280833333 feet

The values found in the body of the table give, in feet, the length indicated in meters at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	....	3.2808	6.5617	9.8425	13.123	16.404	19.685	22.966	26.247	29.527
10	32.808	36.089	39.370	42.651	45.932	49.212	52.493	55.774	59.055	62.336
20	65.617	68.897	72.178	75.459	78.740	82.021	85.302	88.583	91.863	95.144
30	98.425	101.71	104.99	108.27	111.55	114.83	118.11	121.39	124.67	127.95
40	131.23	134.51	137.80	141.08	144.36	147.64	150.92	154.20	157.48	160.76
50	164.04	167.32	170.60	173.88	177.16	180.45	183.73	187.01	190.29	193.57
60	196.85	200.13	203.41	206.69	209.97	213.25	216.53	219.82	223.10	226.38
70	229.66	232.94	236.22	239.50	242.78	246.06	249.34	252.62	255.90	259.19
80	262.47	265.75	269.03	272.31	275.59	278.87	282.15	285.43	288.71	291.99
90	295.27	298.56	301.84	305.12	308.40	311.68	314.96	318.23	321.52	324.80

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
100	328.08	331.36	334.64	337.93	341.21	344.49	347.77	351.05	354.33	357.61
110	360.89	364.17	367.45	370.73	374.01	377.30	380.58	383.86	387.14	390.42
120	393.70	396.98	400.26	403.54	406.82	410.10	413.38	416.67	419.95	423.23
130	426.51	429.79	433.07	436.35	439.63	442.91	446.19	449.47	452.75	456.04
140	459.32	462.60	465.88	469.16	472.44	475.72	479.00	482.28	485.56	488.84
150	492.12	495.41	498.69	501.97	505.25	508.53	511.81	515.09	518.37	521.65
160	524.93	528.21	531.49	534.78	538.06	541.34	544.62	547.90	551.18	554.46
170	557.74	561.02	564.30	567.58	570.86	574.15	577.43	580.71	583.99	587.27
180	590.55	593.83	597.11	600.39	603.67	606.95	610.23	613.52	616.80	620.08
190	623.36	626.64	629.92	633.20	636.48	639.76	643.04	646.32	649.61	652.89
200	656.17	659.45	662.73	666.01	669.29	672.57	675.85	679.13	682.41	685.69
210	688.97	692.26	695.54	698.82	702.10	705.38	708.66	711.94	715.22	718.50
220	721.78	725.06	728.34	731.63	734.91	738.19	741.47	744.75	748.03	751.31
230	754.59	757.87	761.15	764.43	767.71	771.00	774.28	777.56	780.84	784.12
240	787.40	790.68	793.96	797.24	800.52	803.80	807.08	810.37	813.65	816.93
250	820.21	823.49	826.77	830.05	833.33	836.61	839.89	843.17	846.45	849.74
260	853.02	856.30	859.58	862.86	866.14	869.42	872.70	875.98	879.26	882.54
270	885.82	889.11	892.39	895.67	898.95	902.23	905.51	908.79	912.07	915.35
280	918.63	921.91	925.19	928.48	931.76	935.04	938.32	941.60	944.88	948.16
290	951.44	954.72	958.00	961.28	964.56	967.85	971.13	974.41	977.69	980.97

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
300	984.25	987.53	990.81	994.09	997.37	1,000.7	1,003.9	1,007.2	1,010.5	1,013.8
310	1,017.1	1,020.3	1,023.6	1,026.9	1,030.2	1,033.5	1,036.7	1,040.0	1,043.3	1,046.6
320	1,049.9	1,053.1	1,056.4	1,059.7	1,063.0	1,066.3	1,069.6	1,072.8	1,076.1	1,079.4
330	1,082.7	1,086.0	1,089.2	1,092.5	1,095.8	1,099.1	1,102.4	1,105.6	1,108.9	1,112.2
340	1,115.5	1,118.8	1,122.0	1,125.3	1,128.6	1,131.9	1,135.2	1,138.4	1,141.7	1,145.0
350	1,148.3	1,151.6	1,154.9	1,158.1	1,161.4	1,164.7	1,168.0	1,171.3	1,174.5	1,177.8
360	1,181.1	1,184.4	1,187.7	1,190.9	1,194.2	1,197.5	1,200.8	1,204.1	1,207.3	1,210.6
370	1,213.9	1,217.2	1,220.5	1,223.8	1,227.0	1,230.3	1,233.6	1,236.9	1,240.2	1,243.4
380	1,246.7	1,250.0	1,253.3	1,256.6	1,259.8	1,263.1	1,266.4	1,269.7	1,273.0	1,276.2
390	1,279.5	1,282.8	1,286.1	1,289.4	1,292.6	1,295.9	1,299.2	1,302.5	1,305.8	1,309.1
400	1,312.3	1,315.6	1,318.9	1,322.2	1,325.5	1,328.7	1,332.0	1,335.3	1,338.6	1,341.9
410	1,345.1	1,348.4	1,351.7	1,355.0	1,358.3	1,361.5	1,364.8	1,368.1	1,371.4	1,374.7
420	1,377.9	1,381.2	1,384.5	1,387.8	1,391.1	1,394.4	1,397.6	1,400.9	1,404.2	1,407.5
430	1,410.8	1,414.0	1,417.3	1,420.6	1,423.9	1,427.2	1,430.4	1,433.7	1,437.0	1,440.3
440	1,443.6	1,446.8	1,450.1	1,453.4	1,456.7	1,460.0	1,463.3	1,466.5	1,469.8	1,473.1
450	1,476.4	1,479.7	1,482.9	1,486.2	1,489.5	1,492.8	1,496.1	1,499.3	1,502.6	1,505.9
460	1,509.2	1,512.5	1,515.7	1,519.0	1,522.3	1,525.6	1,528.9	1,532.1	1,535.4	1,538.7
470	1,542.0	1,545.3	1,548.6	1,551.8	1,555.1	1,558.4	1,561.7	1,565.0	1,568.2	1,571.5
480	1,574.8	1,578.1	1,581.4	1,584.6	1,587.9	1,591.2	1,594.5	1,597.8	1,601.0	1,604.3
490	1,607.6	1,610.9	1,614.2	1,617.5	1,620.7	1,624.0	1,627.3	1,630.6	1,633.9	1,637.1

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
500	1,640.4	1,643.7	1,647.0	1,650.3	1,653.5	1,656.8	1,660.1	1,663.4	1,666.7	1,669.9
510	1,673.2	1,676.5	1,679.8	1,683.1	1,686.3	1,689.6	1,692.9	1,696.2	1,699.5	1,702.8
520	1,706.0	1,709.3	1,712.6	1,715.9	1,719.2	1,722.4	1,725.7	1,729.0	1,732.3	1,735.6
530	1,738.8	1,742.1	1,745.4	1,748.7	1,752.0	1,755.2	1,758.5	1,761.8	1,765.1	1,768.4
540	1,771.7	1,774.9	1,778.2	1,781.5	1,784.8	1,788.1	1,791.3	1,794.6	1,797.9	1,801.2
550	1,804.5	1,807.7	1,811.0	1,814.3	1,817.6	1,820.9	1,824.1	1,827.4	1,830.7	1,834.0
560	1,837.3	1,840.5	1,843.8	1,847.1	1,850.4	1,853.7	1,857.0	1,860.2	1,863.5	1,866.8
570	1,870.1	1,873.4	1,876.6	1,879.9	1,883.2	1,886.5	1,889.8	1,893.0	1,896.3	1,899.6
580	1,902.9	1,906.2	1,909.4	1,912.7	1,916.0	1,919.3	1,922.6	1,925.8	1,929.1	1,932.4
590	1,935.7	1,939.0	1,942.3	1,945.5	1,948.8	1,952.1	1,955.4	1,958.7	1,961.9	1,965.2
600	1,968.5	1,971.8	1,975.1	1,978.3	1,981.6	1,984.9	1,988.2	1,991.5	1,994.7	1,998.0
610	2,001.3	2,004.6	2,007.9	2,011.2	2,014.4	2,017.7	2,021.0	2,024.3	2,027.6	2,030.8
620	2,034.1	2,037.4	2,040.7	2,044.0	2,047.2	2,050.5	2,053.8	2,057.1	2,060.4	2,063.6
630	2,066.9	2,070.2	2,073.5	2,076.8	2,080.0	2,083.3	2,086.6	2,089.9	2,093.2	2,096.5
640	2,099.7	2,103.0	2,106.3	2,109.6	2,112.9	2,116.1	2,119.4	2,122.7	2,126.0	2,129.3
650	2,132.5	2,135.8	2,139.1	2,142.4	2,145.7	2,148.9	2,152.2	2,155.5	2,158.8	2,162.1
660	2,165.4	2,168.6	2,171.9	2,175.2	2,178.5	2,181.8	2,185.0	2,188.3	2,191.6	2,194.9
670	2,198.2	2,201.4	2,204.7	2,208.0	2,211.3	2,214.6	2,217.8	2,221.1	2,224.4	2,227.7
680	2,231.0	2,234.2	2,237.5	2,240.8	2,244.1	2,247.4	2,250.7	2,253.9	2,257.2	2,260.5
690	2,263.8	2,267.1	2,270.3	2,273.6	2,276.9	2,280.2	2,283.5	2,286.7	2,290.0	2,293.3

LENGTHS—METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
700	2,296.6	2,299.9	2,303.1	2,306.4	2,309.7	2,313.0	2,316.3	2,319.5	2,322.8	2,326.1
710	2,329.4	2,332.7	2,336.0	2,339.2	2,342.5	2,345.8	2,349.1	2,352.4	2,355.6	2,358.9
720	2,362.2	2,365.5	2,368.8	2,372.0	2,375.3	2,378.6	2,381.9	2,385.2	2,388.4	2,391.7
730	2,395.0	2,398.3	2,401.6	2,404.9	2,408.1	2,411.4	2,414.7	2,418.0	2,421.3	2,424.5
740	2,427.8	2,431.1	2,434.4	2,437.7	2,440.9	2,444.2	2,447.5	2,450.8	2,454.1	2,457.3
750	2,460.6	2,463.9	2,467.2	2,470.5	2,473.7	2,477.0	2,480.3	2,483.6	2,486.9	2,490.2
760	2,493.4	2,496.7	2,500.0	2,503.3	2,506.6	2,509.8	2,513.1	2,516.4	2,519.7	2,523.0
770	2,526.2	2,529.5	2,532.8	2,536.1	2,539.4	2,542.6	2,545.9	2,549.2	2,552.5	2,555.8
780	2,559.0	2,562.3	2,565.6	2,568.9	2,572.2	2,575.5	2,578.7	2,582.0	2,585.3	2,588.6
790	2,591.9	2,595.1	2,598.4	2,601.7	2,605.0	2,608.3	2,611.5	2,614.8	2,618.1	2,621.4
800	2,624.7	2,627.9	2,631.2	2,634.5	2,637.8	2,641.1	2,644.4	2,647.6	2,650.9	2,654.2
810	2,657.5	2,660.8	2,664.0	2,667.3	2,670.6	2,673.9	2,677.2	2,680.4	2,683.7	2,687.0
820	2,690.3	2,693.6	2,696.8	2,700.1	2,703.4	2,706.7	2,710.0	2,713.2	2,716.5	2,719.8
830	2,723.1	2,726.4	2,729.7	2,732.9	2,736.2	2,739.5	2,742.8	2,746.1	2,749.3	2,752.6
840	2,755.9	2,759.2	2,762.5	2,765.7	2,769.0	2,772.3	2,775,6	2,778.9	2,782.1	2,785.4
850	2,788.7	2,792.0	2,795.3	2,798.6	2,801.8	2,805.1	2,808.4	2,811.7	2,815.0	2,818.2
860	2,821.5	2,824.8	2,828.1	2,831.4	2,834.6	2,827.9	2,841.2	2,844.5	2,847.8	2,851.0
870	2,854.3	2,857.6	2,860.9	2,864.2	2,867.4	2,870.7	2,874.0	2,877.3	2,880.6	2,883.9
880	2,887.1	2.890.4	2,893.7	2,897.0	2,900.3	2,903.5	2,906.8	2,910.1	2,913.4	2,916.7
890	2,919.9	2,923.2	2,926.5	2,929.8	2,933.1	2,936.3	2,939.6	2,942.9	2,946.2	2,949.5

LENGTHS — METERS TO FEET (Continued)

	0	1	2	3	4	5	6	7	8	9
900	2,952.8	2,956.0	2,959.3	2,962.6	2,965.9	2,969.2	2,972.4	2,975.7	2,979.0	2,982.3
910	2,985.6	2,988.8	2,992.1	2,995.4	2,998.7	3,002.0	3,005.2	3,008.5	3,011.8	3,015.1
920	3,018.4	3,021.6	3,024.9	3,028.2	3,031.5	3,034.8	3,038.1	3,041.3	3,044.6	3,047.9
930	3,051.2	3,054.5	3,057.7	3,061.0	3,064.3	3,067.6	3,070.9	3,074.1	3,077.4	3,080.7
940	3,084.0	3,087.3	3,090.5	3,093.8	3,097.1	3,100.4	3,103,7	3,106.9	3,110.2	3,113.5
950	3,116.8	3,120.1	3,123.4	3,126.6	3,129.9	3,133.2	3,136.5	3,139.8	3,143.0	3,146.3
960	3,149.6	3,152.9	3,156.2	3,159.4	3,162.7	3,166.0	3,169.3	3,172.6	3,175.8	3,179.1
970	3,182.4	3,185.7	3,189.0	3,192.3	3,195.5	3,198.8	3,202.1	3,205.4	3,208.7	3,211.9
980	3,215.2	3,218.5	3,221.8	3,225.1	3,228.3	3,231.6	3,234.9	3,238.2	3,241.5	3,244.7
990	3,248.0	3,251.3	3,254.6	3,257.9	3,261.1	3,264.4	3,267.7	3,271.0	3,274.3	3,277.6

LENGTHS — KILOMETERS TO MILES

From 1 *to* 1,000 *Units*

Reduction factor: 1 kilometer = 0.6213699495 mile

Values found in the body of the table give, in miles, the length indicated in kilometers at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	....	0.62137	1.2427	1.8641	2.4855	3.1069	3.7282	4.3496	4.9710	5.5923
10	6.2137	6.8351	7.4564	8.0778	8.6992	9.3206	9.9419	10.563	11.185	11.806
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.777	17.398	18.020
30	18.641	19.262	19.884	20.505	21.127	21.748	22.369	22.991	23.612	24.233
40	24.855	25.476	26.098	26.719	27.340	27.962	28.583	29.204	29.826	30.447
50	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.418	36.039	36.661
60	37.282	37.904	38.525	39.146	39.768	40.389	41.010	41.632	42.253	42.875
70	43.496	44.117	44.739	45.360	45.981	46.603	47.224	47.845	48.467	49.088
80	49.710	50.331	50.952	51.574	52.195	52.816	53.438	54.059	54.681	55.302
90	55.923	56.945	57.166	57.787	58.409	59.030	59.652	60.273	60.894	61.516

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
100	62.137	62.758	63.380	64.001	64.622	65.244	65.865	66.487	67.108	67.729
110	68.351	68.972	69.593	70.215	70.836	71.458	72.079	72.700	73.322	73.943
120	74.564	75.186	75.807	76.429	77.050	77.671	78.293	78.914	79.535	80.157
130	80.778	81.399	82.021	82.642	83.264	83.885	84.506	85.128	85.749	86.370
140	86.992	87.613	88.235	88.856	89.477	90.099	90.720	91.341	91.963	92.584
150	93.205	93.827	94.448	95.070	95.691	96.312	96.934	97.555	98.176	98.798
160	99.419	100.04	100.66	101.28	101.90	102.53	103.15	103.77	104.39	105.01
170	105.63	106.25	106.88	107.50	108.12	108.74	109.36	109.98	110.60	111.23
180	111.85	112 47	113.09	113.71	114.33	114.95	115.57	116.20	116.82	117.44
190	118.06	118.68	119.30	119.92	120.55	121.17	121.79	122.41	123.03	123.65
200	124.27	124.90	125.52	126.14	126.76	127.38	128.00	128.62	129.24	129.87
210	130.49	131.11	131.73	132.35	132.97	133.59	134.22	134.84	135.46	136.08
220	136.70	137.32	137.94	138.57	139.19	139.81	140.43	141.05	141.67	142.29
230	142.92	143.54	144.16	144.78	145.40	146.02	146.64	147.26	147.89	148.51
240	149.13	149.75	150.37	150.99	151.61	152.24	152.86	153.48	154.10	154.72
250	155.34	155.96	156.59	157.21	157.83	158.45	159.07	159.69	160.31	160.93
260	161.56	162.18	162.80	163.42	164.04	164.66	165.28	165.91	166.53	167.15
270	167.77	168.39	169.01	169.63	170.26	170.88	171.50	172.12	172.74	173.36
280	173.98	174.60	175.23	175.85	176.47	177.09	177.71	178.33	178.95	179.58
290	180.20	180.82	181.44	182.06	182.68	183.30	183.93	184.55	185.17	185.79

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
300	186.41	187.03	187.65	188.28	188.90	189.52	190.14	190.76	191.38	192.00
310	192.62	193.25	193.87	194.49	195.11	195.73	196.35	196.97	197.60	198.22
320	198.84	199.46	200.08	200.70	201.32	201.95	202.57	203.19	203.81	204.43
330	205.05	205.67	206.29	206.92	207.54	208.16	208.78	209.40	210.02	210.64
340	211.27	211.89	212.51	213.13	213.75	214.37	214.99	215.62	216.24	216.86
350	217.48	218.10	218.72	219.34	219.96	220.59	221.21	221.83	222.45	223.07
360	223.69	224.31	224.94	225.56	226.18	226.80	227.42	228.04	228.66	229.29
370	229.91	230.53	231.15	231.77	232.39	233.01	233.64	234.26	234.88	235.50
380	236.12	236.74	237.36	237.98	238.61	239.23	239.85	240.47	241.09	241.71
390	242.33	242.96	243.58	244.20	244.82	245.44	246.06	246.68	247.31	247.93
400	248.55	249.17	249.79	250.41	251.03	251.65	252.28	252.90	253.52	254.14
410	254.76	255.38	256.00	256.63	257.25	257.87	258.49	259.11	259.73	260.35
420	260.98	261.60	262.22	262.84	263.46	264.08	264.70	265.32	265.95	266.57
430	267.19	267.81	268.43	269.05	269.67	270.30	270.92	271.54	272.16	272.78
440	273.40	274.02	274.65	275.27	275.89	276.51	277.13	277.75	278.37	279.00
450	279.62	280.24	280.86	281.48	282.10	282.72	283.34	283.97	284.59	285.21
460	285.83	286.45	287.07	287.69	288.32	288.94	289.56	290.18	290.80	291.42
470	292.04	292.67	293.29	293.91	294.53	295.15	295.77	296.39	297.01	297.64
480	298.26	298.88	299.50	300.12	300.74	301.36	301.99	302.61	303.23	303.85
490	304.47	305.09	305.71	306.34	306.96	307.58	308.20	308.82	309.44	310.06

LENGTHS—KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
500	310.68	311.31	311.93	312.55	313.17	313.79	314.41	315.03	315.66	316.28
510	316.90	317.52	318.14	318.76	319.38	320.01	320.63	321.25	321.87	322.49
520	323.11	323.73	324.36	324.98	325.60	326.22	326.84	327.46	328.08	328.70
530	329.33	329.95	330.57	331.19	331.81	332.43	333.05	333.68	334.30	334.92
540	335.54	336.16	336.78	337.40	338.03	338.65	339.27	339.89	340.51	341.13
550	341.75	342.37	343.00	343.62	344.24	344.86	345.48	346.10	346.72	347.35
560	347.97	348.59	349.21	349.83	350.45	351.07	351.70	352.32	352.94	353.56
570	354.18	354.80	355.42	356.05	356.67	357.29	357.91	358.53	359.15	359.77
580	360.39	361.02	361.64	362.26	362.88	363.50	364.12	364.74	365.37	365.99
590	366.61	367.23	367.85	368.47	369.09	369.72	370.34	370.96	371.58	372.20
600	372.82	373.44	374.06	374.69	375.31	375.93	376.55	377.17	377.79	378.41
610	379.04	379.66	380.28	380.90	381.52	382.14	382.76	383.39	384.01	384.63
620	385.25	385.87	386.49	387.11	387.73	388.36	388.98	389.60	390.22	390.84
630	391.46	392.08	392.71	393.33	393.95	394.57	395.19	395.81	396.43	397.06
640	397.68	398.30	398.92	399.54	400.16	400.78	401.40	402.03	402.65	403.27
650	403.89	404.51	405.13	405.75	406.38	407.00	407.62	408.24	408.86	409.48
660	410.10	410.73	411.35	411.97	412.59	413.21	413.83	414.45	415.08	415.70
670	416.32	416.94	417.56	418.18	418.80	419.42	420.05	420.67	421.29	421.91
680	422.53	423.15	423.77	424.40	425.02	425.64	426.26	426.88	427.50	428.12
690	428.75	429.37	429.99	430.61	431.23	431.85	432.47	433.09	433.72	434.34

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
700	434.96	435.58	436.20	436.82	437.44	438.07	438.69	439.31	439.93	440.55
710	441.17	441.79	442.42	443.04	443.66	444.28	444.90	445.52	446.14	446.76
720	447.39	448.01	448.63	449.25	449.87	450.49	451.11	451.74	452.36	452.98
730	453.60	454.22	454.84	455.46	456.09	456.71	457.33	457.95	458.57	459.19
740	459.81	460.44	461.06	461.68	462.30	462.92	463.54	464.16	464.78	465.41
750	466.03	466.65	467.27	467.89	468.51	469.13	469.76	470.38	471.00	471.62
760	472.24	472.86	473.48	474.11	474.73	475.35	475.97	476.59	477.21	477.83
770	478.45	479.08	479.70	480.32	480.94	481.56	482.18	482.80	483.43	484.05
780	484.67	485.29	485.91	486.53	487.15	487.78	488.40	489.02	489.64	490.26
790	490.88	491.50	492.13	492.75	493.37	493.99	494.61	495.23	495.85	496.47
800	497.10	497.72	498.34	498.96	499.58	500.20	500.82	501.45	502.07	502.69
810	503.31	503.93	504.55	505.17	505.80	506.42	507.04	507.66	508.28	508.90
820	509.52	510.14	510.77	511.39	512.01	512.63	513.25	513.87	514.49	515.12
830	515.74	516.36	516.98	517.60	518.22	518.84	519.47	520.09	520.71	521.33
840	521.95	522.57	523.19	523.81	524.44	525.06	525.68	526.30	526.92	527.54
850	528.16	528.79	529.41	530.03	530.65	531.27	531.89	532.51	533.14	533.76
860	534.38	535.00	535.62	536.24	536.86	537.49	538.11	538.73	539.35	539.97
870	540.59	541.21	541.83	542.46	543.08	543.70	544.32	544.94	545.56	546.18
880	546.81	547.43	548.05	548.67	549.29	549.91	550.53	551.16	551.78	552.40
890	553.02	553.64	554.26	554.88	555.50	556.13	556.75	557.37	557.99	558.61

LENGTHS — KILOMETERS TO MILES (Continued)

	0	1	2	3	4	5	6	7	8	9
900	559.23	559.85	560.48	561.10	561.72	562.34	562.96	563.58	564.20	564.83
910	565.45	566.07	566.69	567.31	567.93	568.55	569.17	569.80	570.42	571.04
920	571.66	572.28	572.90	573.52	574.15	574.77	575.39	576.01	576.63	577.25
930	577.87	578.50	579.12	579.74	580.35	580.98	581.60	582.22	582.85	583.47
940	584.09	584.71	585.33	585.95	586.57	587.19	587.82	588.44	589.06	589.68
950	590.30	590.92	591.54	592.17	592.79	593.41	594.03	594.65	595.27	595.89
960	596.52	597.14	597.76	598.38	599.00	599.62	600.24	600.86	601.49	602.11
970	602.73	603.35	603.97	604.59	605.21	605.84	606.46	607.08	607.70	608.32
980	608.94	609.56	610.19	610.81	611.43	612.05	612.67	613.29	613.91	614.53
990	615.16	615.78	616.40	617.02	617.64	618.26	618.88	619.51	620.13	620.75

CAPACITIES—LITERS TO LIQUID QUARTS

From 1 *to* 1,000 *Units*

Reduction factor: 1 liter = 1.056710 liquid quarts (U. S.)

The values found in the body of the table give, in liquid quarts, the capacities indicated in liters at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	. . . . .	1.0567	2.1134	3.1701	4.2268	5.2836	6.3403	7.3970	8.4537	9.5104
10	10.567	11.624	12.681	13.737	14.794	15.851	16.907	17.964	19.021	20.077
20	21.134	22.191	23.248	24.304	25.361	26.418	27.474	28.531	29.588	30.645
30	31.701	32.758	33.815	34.871	35.928	36.985	38.042	39.098	40.155	41.212
40	42.268	43.325	44.382	45.439	46.495	47.552	48.609	49.665	50.722	51.779
50	52.836	53.892	54.949	56.006	57.062	58.119	59.176	60.232	61.289	62.346
60	63.403	64.459	65.516	66.573	67.629	68.686	69.743	70.800	71.856	72.913
70	73.970	75.026	76.083	77.140	78.197	79.253	80.310	81.367	82.423	83.480
80	84.537	85.594	86.650	87.707	88.764	89.820	90.877	91.934	92.990	94.047
90	95.104	96.161	97.217	98.274	99.331	100.39	101.44	102.50	103.56	104.61

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	105.67	106.73	107.78	108.84	109.90	110.95	112.01	113.07	114.12	115.18
110	116.24	117.29	118.35	119.41	120.46	121.52	122.58	123.64	124.69	125.75
120	126.81	127.86	128.92	129.98	131.03	132.09	133.15	134.20	135.26	136.32
130	137.37	138.43	139.49	140.54	141.60	142.66	143.71	144.77	145.83	146.88
140	147.94	149.00	150.05	151.11	152.17	153.22	154.28	155.34	156.39	157.45
150	158.51	159.56	160.62	161.68	162.73	163.79	164.85	165.90	166.96	168.02
160	169.07	170.13	171.19	172.24	173.30	174.36	175.41	176.47	177.53	178.58
170	179.64	180.70	181.75	182.81	183.87	184.92	185.98	187.04	188.09	189.15
180	190.21	191.26	192.32	193.38	194.43	195.49	196.55	197.60	198.66	199.72
190	200.77	201.83	202.89	203.95	205.00	206.06	207.12	208.17	209.23	210.29
200	211.34	212.40	213.46	214.51	215.57	216.63	217.68	218.74	219.80	220.85
210	221.91	222.97	224.02	225.08	226.14	227.19	228.25	229.31	230.36	231.42
220	232.48	233.53	234.59	235.65	236.70	237.76	238.82	239.87	240.93	241.99
230	243.04	244.10	245.16	246.21	247.27	248.33	249.38	250.44	251.50	252.55
240	253.61	254.67	255.72	256.78	257.84	258.89	259.95	261.01	262.06	263.12
250	264.18	265.23	266.29	267.35	268.40	269.46	270.52	271.57	272.63	273.69
260	274.74	275.80	276.86	277.91	278.97	280.03	281.08	282.14	283.20	284.25
270	285.31	286.37	287.43	288.48	289.54	290.60	291.65	292.71	293.77	294.82
280	295.88	296.94	297.99	299.05	300.11	301.16	302.22	303.28	304.33	305.39
290	306.45	307.50	308.56	309.62	310.67	311.73	312.79	313.84	314.90	315.96

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	317.01	318.07	319.13	320.18	321.24	322.30	323.35	324.41	325.47	326.52
310	327.58	328.64	329.69	330.75	331.81	332.86	333.92	334.98	336.03	337.09
320	338.15	339.20	340.26	341.32	342.37	343.43	344.49	345.54	346.60	347.66
330	348.71	349.77	350.83	351.88	352.94	354.00	355.05	356.11	357.17	358.22
340	359.28	360.34	361.39	362.45	363.51	364.56	365.62	366.68	367.74	368.79
350	369.85	370.91	371.96	373.02	374.08	375.13	376.19	377.25	378.30	379.36
360	380.42	381.47	382.53	383.59	384.64	385.70	386.76	387.81	388.87	389.93
370	390.98	392.04	393.10	394.15	395.21	396.27	397.32	398.38	399.44	400.49
380	401.55	402.61	403.66	404.72	405.78	406.83	407.89	408.95	410.00	411.06
390	412.12	413.17	414.23	415.29	416.34	417.40	418.46	419.51	420.57	421.63
400	422.68	423.74	424.80	425.85	426.91	427.97	429.02	430.08	431.14	432.19
410	433.25	434.31	435.36	436.42	437.48	438.53	439.59	440.65	441.70	442.76
420	443.82	444.87	445.93	446.99	448.05	449.10	450.16	451.22	452.27	453.33
430	454.39	455.44	456.50	457.56	458.61	459.67	460.73	461.78	462.84	463.90
440	464.95	466.01	467.07	468.12	469.18	470.24	471.29	472.35	473.41	474.46
450	475.52	476.58	477.63	478.69	479.75	480.80	481.86	482.92	483.97	485.03
460	486.09	487.14	488.20	489.26	490.31	491.37	492.43	493.48	494.54	495.60
470	496.65	497.71	498.77	499.82	500.88	501.94	502.99	504.05	505.11	506.16
480	507.22	508.28	509.33	510.39	511.45	512.50	513.56	514.62	515.67	516.73
490	517.79	518.84	519.90	520.96	522.01	523.07	524.13	525.18	526.24	527.30

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	528.36	529.41	530.47	531.53	532.58	533.64	534.70	535.75	536.81	537.87
510	538.92	539.98	541.04	542.09	543.15	544.21	545.26	546.32	547.38	548.43
520	549.49	550.55	551.60	552.66	553.72	554.77	555.83	556.89	557.94	559.00
530	560.06	561.11	562.17	563.23	564.28	565.34	566.40	567.45	568.51	569.57
540	570.62	571.68	572.74	573.79	574.85	575.91	576.96	578.02	579.08	580.13
550	581.19	582.25	583.30	584.36	585.42	586.47	587.53	588.59	589.64	590.70
560	591.76	592.81	593.87	594.93	595.98	597.04	598.10	599.15	600.21	601.27
570	602.32	603.38	604.44	605.49	606.55	607.61	608.66	609.72	610.78	611.84
580	612.89	613.95	615.01	616.06	617.12	618.18	619.23	620.29	621.35	622.40
590	623.46	624.52	625.57	626.63	627.69	628.74	629.80	630.86	631.91	632.97
600	634.03	635.08	636.14	637.20	638.25	639.31	640.37	641.42	642.48	643.54
610	644.59	645.65	646.71	647.76	648.82	649.88	650.93	651.99	653.05	654.10
620	655.16	656.22	657.27	658.33	659.39	660.44	661.50	662.56	663.61	664.67
630	665.73	666.78	667.84	668.90	669.95	671.01	672.07	673.12	674.18	675.24
640	676.29	677.35	678.41	679.46	680.52	681.58	682.63	683.69	684.75	685.80
650	686.86	687.92	688.97	690.03	691.09	692.15	693.20	694.26	695.32	696.37
660	697.43	698.49	699.54	700.60	701.66	702.71	703.77	704.83	705.88	706.94
670	708.00	709.05	710.11	711.17	712.22	713.28	714.34	715.39	716.45	717.51
680	718.56	719.62	720.68	721.73	722.79	723.85	724.90	725.96	727.02	728.07
690	729.13	730.19	731.24	732.30	733.36	734.41	735.47	736.53	737.58	738.64

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	739.70	740.75	741.81	742.87	743.92	744.98	746.04	747.09	748.15	749.21
710	750.26	751.32	752.38	753.43	754.49	755.55	756.60	757.66	758.72	759.77
720	760.83	761.89	762.94	764.00	765.06	766.11	767.17	768.23	769.28	770.34
730	771.40	772.46	773.51	774.57	775.63	776.68	777.74	778.80	779.85	780.91
740	781.97	783.02	784.08	785.14	786.19	787.25	788.31	789.36	790.42	791.48
750	792.53	793.59	794.65	795.70	796.76	797.82	798.87	799.93	800.99	802.04
760	803.10	804.16	805.21	806.27	807.33	808.38	809.44	810.50	811.55	812.61
770	813.67	814.72	815.78	816.84	817.89	818.95	820.01	821.06	822.12	823.18
780	824.23	825.29	826.35	827.40	828.46	829.52	830.57	831.63	832.69	833.74
790	834.80	835.86	836.91	837.97	839.03	840.08	841.14	842.20	843.25	844.31
800	845.37	846.42	847.48	848.54	849.59	850.65	851.71	852.76	853.82	854.88
810	855.94	856.99	858.05	859.11	860.16	861.22	862.28	863.33	864.39	865.45
820	866.50	867.56	868.62	869.67	870.73	871.79	872.84	873.90	874.96	876.01
830	877.07	878.13	879.18	880.24	881.30	882.35	883.41	884.47	885.52	886.58
840	887.64	888.69	889.75	890.81	891.86	892.92	893.98	895.03	896.09	897.15
850	898.20	899.26	900.32	901.37	902.43	903.49	904.54	905.60	906.66	907.71
860	908.77	909.83	910.88	911.94	913.00	914.05	915.11	916.17	917.22	918.28
870	919.34	920.39	921.45	922.51	923.56	924.62	925.68	926.73	927.79	928.85
880	929.90	930.96	932.02	933.07	934.13	935.19	936.25	937.30	938.36	939.42
890	940.47	941.53	942.59	943.64	944.70	945.76	946.81	947.87	948.93	949.98

CAPACITIES—LITERS TO LIQUID QUARTS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	951.04	952.10	953.15	954.21	955.27	956.32	957.38	958.44	959.49	960.55
910	961.61	962.66	963.72	964.78	965.83	966.89	967.95	969.00	970.06	971.12
920	972.17	973.23	974.29	975.34	976.40	977.46	978.51	979.57	980.63	981.68
930	982.74	983.80	984.85	985.91	986.97	988.02	989.08	990.14	991.19	992.25
940	993.31	994.36	995.42	996.48	997.53	998.59	999.65	1,000.7	1,001.8	1,002.8
950	1,003.9	1,004.9	1,006.0	1,007.0	1,008.1	1,009.2	1,010.2	1,011.3	1,012.3	1,013.4
960	1,014.4	1,015.5	1,016.6	1,017.6	1,018.7	1,019.7	1,020.8	1,021.8	1,022.9	1,024.0
970	1,025.0	1,026.1	1,027.1	1,028.2	1,029.2	1,030.3	1,031.3	1,032.4	1,033.5	1,034.5
980	1,035.6	1,036.6	1,037.7	1,038.7	1,039.8	1,040.9	1,041.9	1,043.0	1,044.0	1,045.1
990	1,046.1	1,047.2	1,048.3	1,049.3	1,050.4	1,051.4	1,052.5	1,053.5	1,054.6	1,055.7

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS

From 1 *to* 1,000 *Units*

Reduction factor: 1 kilogram = 2.204622341 avoirdupois pounds

The values found in the body of the table give, in avoirdupois pounds, the weights indicated in kilograms at the top and side.

	0	1	2	3	4	5	6	7	8	9
0	. . . . . .	2.2046	4.4092	6.6139	8.8185	11.023	13.228	15.432	17.637	19.842
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934
30	66.139	68.343	70.548	72.753	74.957	77.162	79.366	81.571	83.776	85.980
40	88.185	90.390	92.594	94.799	97.003	99.208	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.84	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.23	209.44	211.64	213.85	216.05	218.26

WEIGHTS—KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
100	220.46	222.67	224.87	227.08	229 28	231.49	233.69	235.89	238.10	240.30
110	242.51	244.71	246.92	249.12	251.33	253.53	255.74	257.94	260.15	262.35
120	264.55	266.76	268.96	271.17	273.37	275.58	277.78	279.99	282.19	284.40
130	286.60	288.81	291.01	293.21	295.42	297.62	299.83	302.03	304.24	306.44
140	308.65	310.85	313.06	315.26	317.47	319.67	321.87	324.08	326.28	328 49
150	330.69	332.90	335.10	337.31	339.51	341.72	343.92	346.13	348.33	350.54
160	352.74	354.94	357.15	359.35	361.56	363.76	365.97	368.17	370.38	372.58
170	374.79	376.99	379.20	381.40	383.60	385.81	388.01	390.22	392.42	394.63
180	396.83	399.04	401.24	403.45	405.65	407.86	410.06	412.26	414.47	416.67
190	418.88	421.08	423.29	425.49	427.70	429.90	432.11	434.31	436.52	438.72
200	440.92	443.13	445.33	447.54	449.74	451.95	454.15	456.36	458.56	460.77
210	462.97	465.18	467.38	469.58	471.79	473.99	476.20	478.40	480.61	482.81
220	485.02	487.22	489.43	491.63	493.84	496.04	498.24	500.45	502.65	504.86
230	507.06	509.27	511.47	513.68	515.88	518.09	520.29	522.50	524.70	526.90
240	529.11	531.31	533.52	535.72	537.93	540.13	542.34	544.54	546.75	548.95
250	551.16	553.36	555.56	557.77	559.97	562.18	564.38	566.59	568.79	571.00
260	573.20	575.41	577.61	579.82	582.02	584.22	586.43	588.63	590.84	593.04
270	595.25	597.45	599.66	601.86	604.07	606.27	608.48	610.68	612.89	615.09
280	617.29	619.50	621.70	623.91	626.11	628.32	630.52	632.73	634.93	637.14
290	639.34	641.55	643.75	645.95	648.16	650.36	652.57	654.77	656.98	659.18

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
300	661.39	663.59	665.80	668.00	670.21	672.41	674.61	676.82	679.02	681.23
310	683.43	685.64	687.84	690.05	692.25	694.46	696.66	698.87	701.07	703.27
320	705.48	707.68	709.89	712.09	714.30	716.50	718.71	720.91	723.12	725.32
330	727.53	729.73	731.93	734.14	736.34	738.55	740.75	742.96	745.16	747.37
340	749.57	751.78	753.98	756.19	758.39	760.59	762.80	765.00	767.21	769.41
350	771.62	773.82	776.03	778.23	780.44	782.64	784.85	787.05	789.25	791.46
360	793.66	795.87	798.07	800.28	802.48	804.69	806.89	809.10	811.30	813.51
370	815.71	817.91	820.12	822.32	824.53	826.73	828.94	831.14	833.35	835.55
380	837.76	839.96	842.17	844.37	846.58	848.78	850.98	853.19	855.39	857.60
390	859.80	862.01	864.21	866.42	868.62	870.83	873.03	875.24	877.44	879.64
400	881.85	884.05	886.26	888.46	890.67	892.87	895.08	897.28	899.49	901.69
410	903.90	906.10	908.30	910.51	912.71	914.92	917.12	919.33	921.53	923.74
420	925.94	928.15	930.35	932.56	934.76	936.96	939.17	941.37	943.58	945.78
430	947.99	950.19	952.40	954.60	956.81	959.01	961.22	963.42	965.62	967.83
440	970.03	972.24	974.44	976.65	978.85	981.06	983.26	985.47	987.67	989.88
450	992.08	994.28	996.49	998.69	1,000.9	1,003.1	1,005.3	1,007.5	1,009.7	1,011.9
460	1,014.1	1,016.3	1,018.5	1,020.7	1,022.9	1,025.1	1,027.4	1,029.6	1,031.8	1,034.0
470	1,036.2	1,038.4	1,040.6	1,042.8	1,045.0	1,047.2	1,049.4	1,051.6	1,053.8	1,056.0
480	1,058.2	1,060.4	1,062.6	1,064.8	1,067.0	1,069.2	1,071.4	1,073.7	1,075.9	1,078.1
490	1,080.3	1,082.5	1,084.7	1,086.9	1,089.1	1,091.3	1,093.5	1,095.7	1,097.9	1,100.1

WEIGHTS—KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
500	1,102.3	1,104.5	1,106.7	1,108.9	1,111.1	1,113.3	1,115.5	1,117.7	1,119.9	1,122.2
510	1,124.4	1,126.6	1,128.8	1,131.0	1,133.2	1,135.4	1,137.6	1,139.8	1,142.0	1,144.2
520	1,146.4	1,148.6	1,150.8	1,153.0	1,155.2	1,157.4	1,159.6	1,161.8	1,164.0	1,166.2
530	1,168.4	1,170.7	1,172.9	1,175.1	1,177.3	1,179.5	1,181.7	1,183.9	1,186.1	1,188.3
540	1,190.5	1,192.7	1,194.9	1,197.1	1,199.3	1,201.5	1,203.7	1,205.9	1,208.1	1,210.3
550	1,212.5	1,214.7	1,217.0	1,219.2	1,221.4	1,223.6	1,225.8	1,228.0	1,230.2	1,232.4
560	1,234.6	1,236.8	1,239.0	1,241.2	1,243.4	1,245.6	1,247.8	1,250.0	1,252.2	1,254.4
570	1,256.6	1,258.8	1,261.0	1,263.2	1,265.5	1,267.7	1,269.9	1,272.1	1,274.3	1,276.5
580	1,278.7	1,280.9	1,283.1	1,285.3	1,287.5	1,289.7	1,291.9	1,294.1	1,296.3	1,298.5
590	1,300.7	1,302.9	1,305.1	1,307.3	1,309.5	1,311.8	1,314.0	1,316.2	1,318.4	1,320.6
600	1,322.8	1,325.0	1,327.2	1,329.4	1,331.6	1,333.8	1,336.0	1,338.2	1,340.4	1,342.6
610	1,344.8	1,347.0	1,349.2	1,351.4	1,353.6	1,355.8	1,358.0	1,360.3	1,362.5	1,364.7
620	1,366.9	1,369.1	1,371.3	1,373.5	1,375.7	1,377.9	1,380.1	1,382.3	1,384.5	1,386.7
630	1,388.9	1,391.1	1,393.3	1,395.5	1,397.7	1,399.9	1,402.1	1,404.3	1,406.5	1,408.8
640	1,411.0	1,413.2	1,415.4	1,417.6	1,419.8	1,422.0	1,424.2	1,426.4	1,428.6	1,430.8
650	1,433.0	1,435.2	1,437.4	1,439.6	1,441.8	1,444.0	1,446.2	1,448.4	1,450.6	1,452.8
660	1,455.1	1,457.3	1,459.5	1,461.7	1,463.9	1,466.1	1,468.3	1,470.5	1,472.7	1,474.9
670	1,477.1	1,479.3	1,481.5	1,483.7	1,485.9	1,488.1	1,490.3	1,492.5	1,494.7	1,496.9
680	1,499.1	1,501.3	1,503.6	1,505.8	1,508.0	1,510.2	1,512.4	1,514.6	1,516.8	1,519.0
690	1,521.2	1,523.4	1,525.6	1,527.8	1,530.0	1,532.2	1,534.4	1,536.6	1,538.8	1,541.0

WEIGHTS — KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
700	1,543.2	1,545.4	1,547.6	1.549.8	1,552.1	1,554.3	1,556.5	1,558.7	1,560.9	1,563.1
710	1,565.3	1,567.5	1,569.7	1,571.9	1,574.1	1,576.3	1,578.5	1,580.7	1,582.9	1,585.1
720	1,587.3	1,589.5	1,591.7	1,593.9	1,596.1	1,598.4	1,600.6	1,602.8	1,605.0	1,607.2
730	1,609.4	1,611.6	1,613.8	1,616.0	1,618.2	1,620.4	1,622.6	1,624.8	1,627.0	1,629.2
740	1,631.4	1,633.6	1,635.8	1,638.0	1,640.2	1,642.4	1,644.6	1,646.9	1,649.1	1,651.3
750	1,653.5	1,655.7	1,657.9	1,660.1	1,662.3	1,664.5	1,666.7	1,668.9	1,671.1	1,673.3
760	1,675.5	1,677.7	1,679.9	1,682.1	1,684.3	1,686.5	1,688.7	1,690.9	1,693.2	1,695.4
770	1,697.6	1,699.8	1,702.0	1,704.2	1,706.4	1,708.6	1,710.8	1,713.0	1,715.2	1,717.4
780	1,719.6	1,721.8	1,724.0	1,726.2	1,728.4	1,730.6	1,732.8	1,735.0	1,737.2	1,739.4
790	1,741.7	1,743.9	1,746.1	1,748.3	1,750.5	1,752.7	1,754.9	1,757.1	1,759.3	1,761.5
800	1,763.7	1,765.9	1,768.1	1,770.3	1,772.5	1,774.7	1,776.9	1,779.1	1,781.3	1,783.5
810	1,785.7	1,787.9	1,790.2	1,792.4	1,794.6	1,796.8	1,799.0	1,801.2	1,803.4	1,805.6
820	1,807.8	1,810.0	1,812.2	1,814.4	1,816.6	1,818.8	1,821.0	1,823.2	1,825.4	1,827.6
830	1,829.8	1,832.0	1,834.2	1,836.5	1,838.7	1,840.9	1,843.1	1,845.3	1,847.5	1,849.7
840	1,851.9	1,854.1	1,856.3	1,858.5	1,860.7	1,862.9	1,865.1	1,867.3	1,869.5	1,871.7
850	1,873.9	1,876.1	1,878.3	1,880.5	1,882.7	1,885.0	1,887.2	1,889.4	1,891.6	1,893.8
860	1,896.0	1,898.2	1,900.4	1,902.6	1,904.8	1,907.0	1,909.2	1,911.4	1,913.6	1,915.8
870	1,918.0	1,920.2	1,922.4	1,924.6	1,926.8	1,929.0	1,931.2	1,933.5	1,935.7	1,937.9
880	1,940.1	1,942.3	1,944.5	1,946.7	1,948.9	1,951.1	1,953.3	1,955.5	1,957.7	1,959.9
890	1,962.1	1,964.3	1,966.5	1,968.7	1,970.9	1,973.1	1,975.3	1,977.5	1,979.8	1,982.0

WEIGHTS—KILOGRAMS TO AVOIRDUPOIS POUNDS (Continued)

	0	1	2	3	4	5	6	7	8	9
900	1,984.2	1,986.4	1,988.6	1,990.8	1,993.0	1,995.2	1,997.4	1,999.6	2,001.8	2,004.0
910	2,006.2	2,008.4	2,010.6	2,012.8	2,015.0	2,017.2	2,019.4	2,021.6	2,023.8	2,026.0
920	2,028.3	2,030.5	2,032.7	2,034.9	2,037.1	2,039.3	2,041.5	2,043.7	2,045.9	2,048.1
930	2,050.3	2,052.5	2,054.7	2,056.9	2,059.1	2,061.3	2,063.5	2,065.7	2,067.9	2,070.1
940	2,072.3	2,074.5	2,076.8	2,079.0	2,081.2	2,083.4	2,085.6	2,087.8	2,090.0	2,092.2
950	2,094.4	2,096.6	2,098.8	2,101.0	2,103.2	2,105.4	2,107.6	2,109.8	2,112.0	2,114.2
960	2,116.4	2,118.6	2,120.8	2,123.1	2,125.3	2,127.5	2,129.7	2,131.9	2,134.1	2,136.3
970	2,138.5	2,140.7	2,142.9	2,145.1	2,147.3	2,149.5	2,151.7	2,153.9	2,156.1	2,158.3
980	2,160.5	2,162.7	2,164.9	2,167.1	2,169.3	2,171.6	2,173.8	2,176.0	2,178.2	2,180.4
990	2,182.6	2,184.8	2,187.0	2,189.2	2,191.4	2,193.6	2,195.8	2,198.0	2,200.2	2,202.4

CONVERSION OF THERMOMETER SCALES

By I. Gottfried

1

Fahrenheit to Centigrade (with Constant, 32.F.) (From 1.F. to 9999.F.)

F.	C.	F.	C.	F.	C.	F.	C.
1	−17.22	10	−12.22	100	37.78	1000	537.78
2	−16.67	20	− 6.67	200	93.33	2000	1093.33
3	−16.11	30	− 1.11	300	148.89	3000	1648.89
4	−15.56	40	+ 4.44	400	204.44	4000	2204.44
5	−15	50	10	500	260	5000	2760
6	−14.44	60	15.56	600	315.56	6000	3315.56
7	−13.89	70	21.11	700	371.11	7000	3871.11
8	−13.33	80	26.67	800	426.67	8000	4426.67
9	−12.78	90	32.22	900	482.22	9000	4982.22

2

Fahrenheit to Centigrade (Without Constant)

F.	C.	F.	C.	F.	C.	F.	C.
1	.56	10	5.56	100	55.56	1000	555.56
2	1.11	20	11.11	200	111.11	2000	1111.11
3	1.67	30	16.67	300	166.67	3000	1666.67
4	2.22	40	22.22	400	222.22	4000	2222.22
5	2.78	50	27.78	500	277.78	5000	2777.78
6	3.33	60	33.33	600	333.33	6000	3333.33
7	3.89	70	38.89	700	388.89	7000	3888.89
8	4.44	80	44.44	800	444.44	8000	4444.44
9	5.00	90	50.00	900	500.00	9000	5000.00

To Convert Degrees Fahrenheit to Degrees Centigrade

Use the first table for one of the digits, and the second table for the others; then add.

Examples: To find the Centigrade equivalent for 35.F.

30 = 16.67(2)   30 = −1.11(1)
5 = −15 (1) or,   5 = 2.78(2)
35.F = 1.67.C   35.F = 1.67.C

To find the C. equivalent for 355.F. and 5445.F.

300   148.89(1)
50   27.78(2) or,
5   2.78(2)
355.F   179.45.C.

CONVERSION OF THERMOMETER SCALES (Continued)

300	166.67(2)	5000	2760 (1)
50	10 (1)	400	222.22(2)
5	2.78(2)	40	22.22(2)
355.F. =	179.45.C.	5	2.78(2)
		5445.F. =	3007.22.C.

1

Centigrade to Fahrenheit (With Constant 32.F.)

C.	F.	C.	F.	C.	F.	C.	F.
				000	32		
1	33.8	10	50	100	212	1000	1832
2	35.6	20	68	200	392	2000	3632
3	37.4	30	86	300	572	3000	5432
4	39.2	40	104	400	752	4000	7232
5	41	50	122	500	932	5000	9032
6	42.8	60	140	600	1112		
7	44.6	70	158	700	1292		
8	46.4	80	176	800	1472		
9	48.2	90	194	900	1652		

2

Centigrade to Fahrenheit (Without Constant)

C.	F.	C.	F.	C.	F.	C.	F.
1	1.8	10	18	100	180	1000	1800
2	3.6	20	36	200	360	2000	3600
3	5.4	30	54	300	540	3000	5400
4	7.2	40	72	400	720	4000	7200
5	9.0	50	90	500	900	5000	9000
6	10.8	60	108	600	1080		
7	12.6	70	126	700	1260		
8	14.4	80	144	800	1440		
9	16.2	90	162	900	1620		

CONVERSION OF THERMOMETER SCALES
(Continued)

To Convert Degrees Centigrade to Degrees Fahrenheit

Use the first table for one digit, and the second table for the others; then add.

Examples: To find the Fahrenheit equivalents for 15.C.; 155.C.; and 5432.C.

10	= 50(1)	18(2)	100	= 212(1)	=180(2)
5	= 9(2) or,	41(1)	50	= 90(2) or,	= 90(2)
15.C.	= 59.F.	59.F.	5	= 9(2)	41(1)
			155.C.	= 311.F	= 311.F.

5000	= 9000(2)		= 9000(2)
400	= 720(2)	or,	= 752(1)
30	= 54(2)		= 54(2)
2	= 35.6(1)		= 3.6(2)
5432.C.	= 9809.6.F.		= 9809.6.F.

THERMOMETER SCALES

Corrections to Reduce Gas Thermometer Temperature to Thermodynamic Scale.

The values below are corrections to be applied to temperatures determined by the gas thermometer indicated to give temperatures in the thermodynamic centigrade scale for an initial pressure of 100 cm.

Temp. °C	Corrections in °C					
	Constant Volume			Constant Pressure		
	Hydrogen	Nitrogen	Helium	Hydrogen	Nitrogen	Helium
+1200		+1.0			+2.3	
1000		+0.7			+1.8	
800		+ .5			+1.3	
600		+ .3			+0.9	
500		+ .2			+ .7	
450		+ .17	+0.05		+ .6	+0.008
400		+ .14	+ .04		+ .5	+ .006
350		+ .10	+ .03		+ .4	+ .005
300		+ .07	+ .02	+0.04	+ .3	+ .003
250		+ .04	+ .01	+ .03	+ .2	+ .002
200	+0.02	+ .02	+ .006	+ .02	+ .12	+ .001
150	+ .01	+ .01	+ .002	+ .01	+ .05	+ .001
100	.000	.000	.000	.000	.00	.000
75	− .001	− .005	− .001	− .003	− .02	.000
50	− .002	− .010	− .001	− .004	− .03	.000
+ 25	− .001	− .008	− .001	− .003	− .02	− .001
0	.000	.00	.000	.000	.00	.000
− 50	+ .005	+ .03	+ .002	+ .02	+ .12	+ .002
− 100	+ .015	+ .06	+ .005	+ .04	+ .4	+ .005
− 150	+ .03	+ .2	+ .01	+ .1	+1.3	+ .02
− 200	+ .06	+ .5	+ .02	+ .3		+ .04
− 250	+ .12		+ .04			

THERMOMETER SCALES (Continued)

Corrections to reduce Liquid in Glass to Standard Thermodynamic Scale.

Temp. °C	Corrections in °C					
	Mercury in			Pentane in Jena 16III	Alcohol in verre dur	Toluene in verre dur
	Jena 16III	Jena 59III	Jena 1565III			
—190				—23.4		
—180				—21.0		
—170				—18.6		
—160				—16.2		
—150				—13.9		
—140				—11.6		
—130				— 9.4		
—120				— 7.3		
—110				— 5.3		
—100				— 3.4		
— 90				— 1.7		
— 80				— 0.2		0.0
— 78.5				0.0	0.0	0.0
— 70				+ 1.0	+0.3	+ .4
— 60				+ 2.0	+ .6	+ .8
— 50				+ 2.6	+ .7	+1.1
— 40				+ 3.0	+ .9	+1.2
— 30	0.28	0.13		+ 2.9	+ .9	+1.2
— 20	.16	.07		+ 2.4	+ .8	+1.0
— 10	.07	.03		+ 1.5	+ .5	+0.6
0	.00	.00	0.00	0.0	.0	0.0
+ 10	— .06	— .02	— .03	— 2.0		
20	— .09	— .04	— .05	— 4.4		
30	— .11	— .04	— .06	— 7.6	—3.6	
40	— .12	— .03	— .06			
50	— .12	— .03	— .05			
60	— .10	— .02	— .04			
70	— .08	— .01	— .03			
80	— .06	.00	— .02			
90	— .03	+ .02	— .01			
100	.00	.00	.00			—24.4
120	+ .03	— .05	+ .06			
140	+ .02	— .16	+ .03			
160	— .02	— .31	— .13			
180	— .12	— .52	— .38			
200	— .29	— .84	— .90			
220	— .5	— 1.3	— 1.3			
240	— .9	— 1.9	— 1.8			
260	— 1.4	— 2.6	— 2.4			
280	— 2.0	— 3.4	— 3.1			
300	— 2.7	— 4.4	— 3.9			
320		— 5.8	— 4.8			
340		— 7.2	— 5.9			
360		— 8.8	— 7.3			
380		—10.6	— 8.9			
400		—12.6	—10.5			
420		—14.9	—12.4			
440		—17.4	—14.7			
460		—20.2	—17.2			
480		—23.3	—20.0			
500		—26.9	—23.1			
550			—32.			
600			—44.			
650			—58.			

TABULATION OF C° CENTIGRADE, T° KELVIN, AND 1000/T FROM −210 TO +210°C

(0°C TAKEN AS 273° KELVIN)

Francis J. Norton

0° to −210°C

C°	T°	1000/T	C°	T°	1000/T	C°	T°	1000/T
0	273	3.663	− 54	219	4.566	−108	165	6.061
− 1	272	3.676	− 55	218	4.587	−109	164	6.098
− 2	271	3.690	− 56	217	4.608	−110	163	6.135
− 3	270	3.704	− 57	216	4.630	−111	162	6.173
− 4	269	3.717	− 58	215	4.651	−112	161	6.211
− 5	268	3.731	− 59	214	4.673	−113	160	6.250
− 6	267	3.745	− 60	213	4.695	−114	159	6.289
− 7	266	3.759	− 61	212	4.717	−115	158	6.329
− 8	265	3.774	− 62	211	4.739	−116	157	6.369
− 9	264	3.788	− 63	210	4.762	−117	156	6.410
−10	263	3.802	− 64	209	4.785	−118	155	6.452
−11	262	3.817	− 65	208	4.808	−119	154	6.494
−12	261	3.831	− 66	207	4.831	−120	153	6.536
−13	260	3.846	− 67	206	4.854	−121	152	6.579
−14	259	3.861	− 68	205	4.878	−122	151	6.623
−15	258	3.876	− 69	204	4.902	−123	150	6.667
−16	257	3.891	− 70	203	4.926	−124	149	6.711
−17	256	3.906	− 71	202	4.950	−125	148	6.757
−18	255	3.922	− 72	201	4.975	−126	147	6.803
−19	254	3.937	− 73	200	5.000	−127	146	6.849
−20	253	3.953	− 74	199	5.025	−128	145	6.897
−21	252	3.968	− 75	198	5.050	−129	144	6.944
−22	251	3.984	− 76	197	5.076	−130	143	6.993
−23	250	4.000	− 77	196	5.102	−131	142	7.042
−24	249	4.016	− 78	195	5.128	−132	141	7.092
−25	248	4.032	− 79	194	5.155	−133	140	7.143
−26	247	4.049	− 80	193	5.181	−134	139	7.194
−27	246	4.065	− 81	192	5.208	−135	138	7.246
−28	245	4.082	− 82	191	5.236	−136	137	7.299
−29	244	4.098	− 83	190	5.263	−137	136	7.353
−30	243	4.115	− 84	189	5.291	−138	135	7.407
−31	242	4.132	− 85	188	5.319	−139	134	7.463
−32	241	4.149	− 86	187	5.348	−140	133	7.519
−33	240	4.167	− 87	186	5.376	−141	132	7.576
−34	239	4.184	− 88	185	5.405	−142	131	7.634
−35	238	4.202	− 89	184	5.435	−143	130	7.692
−36	237	4.219	− 90	183	5.464	−144	129	7.752
−37	236	4.237	− 91	182	5.495	−145	128	7.813
−38	235	4.255	− 92	181	5.525	−146	127	7.874
−39	234	4.273	− 93	180	5.556	−147	126	7.937
−40	233	4.292	− 94	179	5.587	−148	125	8.000
−41	232	4.310	− 95	178	5.618	−149	124	8.065
−42	231	4.329	− 96	177	5.650	−150	123	8.130
−43	230	4.348	− 97	176	5.682	−151	122	8.197
−44	229	4.367	− 98	175	5.714	−152	121	8.264
−45	228	4.386	− 99	174	5.747	−153	120	8.333
−46	227	4.405	−100	173	5.780	−154	119	8.403
−47	226	4.425	−101	172	5.814	−155	118	8.475
−48	225	4.444	−102	171	5.848	−156	117	8.547
−49	224	4.464	−103	170	5.882	−157	116	8.621
−50	223	4.484	−104	169	5.917	−158	115	8.696
−51	222	4.505	−105	168	5.952	−159	114	8.772
−52	221	4.525	−106	167	5.988	−160	113	8.850
−53	220	4.545	−107	166	3.024	−161	112	8.929
−54	219	4.566	−108	165	6.061	−162	111	9.009

C° CENTIGRADE—T° KELVIN (Continued)

C°	T°	1000/T	C°	T°	1000/T	C°	T°	1000/T
−162	111	9.009	−178	95	10.526	−194	79	12.658
−163	110	9.091	−179	94	10.638	−195	78	12.821
−164	109	9.174	−180	93	10.753	−196	77	12.987
−165	108	9.259	−181	92	10.870	−197	76	13.158
−166	107	9.346	−182	91	10.989	−198	75	13.333
−167	106	9.434	−183	90	11.111	−199	74	13.514
−168	105	9.524	−184	89	11.236	−200	73	13.699
−169	104	9.615	−185	88	11.364	−201	72	13.889
−170	103	9.709	−186	87	11.494	−202	71	14.085
−171	102	9.804	−187	86	11.628	−203	70	14.286
−172	101	9.901	−188	85	11.765	−204	69	14.493
−173	100	10.000	−189	84	11.905	−205	68	14.706
−174	99	10.101	−190	83	12.048	−206	67	14.925
−175	98	10.204	−191	82	12.195	−207	66	15.152
−176	97	10.309	−192	81	12.346	−208	65	15.385
−177	96	10.417	−193	80	12.500	−209	64	15.625
−178	95	10.526	−194	79	12.658	−210	63	15.873

0° to +210°C

0	273	3.663	39	312	3.205	78	351	2.849
1	274	3.650	40	313	3.195	79	352	2.841
2	275	3.636	41	314	3.185	80	353	2.833
3	276	3.623	42	315	3.175	81	354	2.825
4	277	3.610	43	316	3.165	82	355	2.817
5	278	3.597	44	317	3.155	83	356	2.809
6	279	3.584	45	318	3.145	84	357	2.801
7	280	3.571	46	319	3.135	85	358	2.793
8	281	3.559	47	320	3.125	86	359	2.786
9	282	3.546	48	321	3.115	87	360	2.778
10	283	3.534	49	322	3.106	88	361	2.770
11	284	3.521	50	323	3.096	89	362	2.762
12	285	3.509	51	324	3.086	90	363	2.755
13	286	3.497	52	325	3.077	91	364	2.747
14	287	3.484	53	326	3.067	92	365	2.740
15	288	3.472	54	327	3.058	93	366	2.732
16	289	3.460	55	328	3.049	94	367	2.725
17	290	3.448	56	329	3.040	95	368	2.717
18	291	3.436	57	330	3.030	96	369	2.710
19	292	3.425	58	331	3.021	97	370	2.703
20	293	3.413	59	332	3.012	98	371	2.695
21	294	3.401	60	333	3.003	99	372	2.688
22	295	3.390	61	334	2.994	100	373	2.681
23	296	3.378	62	335	2.985	101	374	2.674
24	297	3.367	63	336	2.976	102	375	2.667
25	298	3.356	64	337	2.967	103	376	2.660
26	299	3.344	65	338	2.959	104	377	2.653
27	300	3.333	66	339	2.950	105	378	2.646
28	301	3.322	67	340	2.941	106	379	2.639
29	302	3.311	68	341	2.933	107	380	2.632
30	303	3.300	69	342	2.924	108	381	2.625
31	304	3.289	70	343	2.915	109	382	2.618
32	305	3.279	71	344	2.907	110	383	2.611
33	306	3.268	72	345	2.899	111	384	2.604
34	307	3.257	73	346	2.890	112	385	2.597
35	308	3.247	74	347	2.882	113	386	2.591
36	309	3.236	75	348	2.874	114	387	2.584
37	310	3.226	76	349	2.865	115	388	2.577
38	311	3.215	77	350	2.857	116	389	2.571
39	312	3.205	78	351	2.849	117	390	2.564

C°	T°	$\frac{1000}{T}$	C°	T°	$\frac{1000}{T}$	C°	T°	$\frac{1000}{T}$
117	390	2.564	148	421	2.375	179	452	2.212
118	391	2.558	149	422	2.370	180	453	2.208
119	392	2.551	150	423	2.364	181	454	2.203
120	393	2.545	151	424	2.358	182	455	2.198
121	394	2.538	152	425	2.353	183	456	2.193
122	395	2.532	153	426	2.347	184	457	2.188
123	396	2.525	154	427	2.342	185	458	2.183
124	397	2.519	155	428	2.336	186	459	2.179
125	398	2.513	156	429	2.331	187	460	2.174
126	399	2.506	157	430	2.326	188	461	2.169
127	400	2.500	158	431	2.320	189	462	2.165
128	401	2.494	159	432	2.315	190	463	2.160
129	402	2.488	160	433	2.309	191	464	2.155
130	403	2.481	161	434	2.304	192	465	2.151
131	404	2.475	162	435	2.299	193	466	2.146
132	405	2.469	163	436	2.294	194	467	2.141
133	406	2.463	164	437	2.288	195	468	2.137
134	407	2.457	165	438	2.283	196	469	2.132
135	408	2.451	166	439	2.278	197	470	2.128
136	409	2.445	167	440	2.273	198	471	2.123
137	410	2.439	168	441	2.268	199	472	2.119
138	411	2.433	169	442	2.262	200	473	2.114
139	412	2.427	170	443	2.257	201	474	2.110
140	413	2.421	171	444	2.252	202	475	2.105
141	414	2.415	172	445	2.247	203	476	2.101
142	415	2.410	173	446	2.242	204	477	2.096
143	416	2.404	174	447	2.237	205	478	2.092
144	417	2.398	175	448	2.232	206	479	2.088
145	418	2.392	176	449	2.227	207	480	2.083
146	419	2.387	177	450	2.222	208	481	2.079
147	420	2.381	178	451	2.217	209	482	2.075
148	421	2.375	179	452	2.212	210	483	2.070

FIXED POINTS FOR LOW TEMPERATURES (0°C TAKEN AS 273.16° KELVIN)

Material	Change of state	C°	T° Kelvin	$\frac{1000}{T}$
Water	m	0	273.16	3.66086
Carbon tetrachloride	m	− 22.9	250.26	3.99584
Ammonia	b	− 33.4	239.76	4.17084
Mercury	m	− 38.9	234.26	4.26876
Chlorobenzene	m	− 45.6	227.56	4.39445
Chloroform	m	− 64.2	208.96	4.78560
Carbon dioxide	s	− 78.5	194.66	5.13716
Ethyl acetate	m	− 83.6	189.56	5.27537
Toluene	m	− 95.7	177.46	5.63507
Methyl cyclohexane	m	−126.3	146.86	6.80921
Methyl cyclopentane	m	−140.5	132.66	7.53807
Oxygen	b	−183.0	90.16	11.09139
Nitrogen	b	−195.8	77.36	12.92658

m = melting point: solid-liquid equilibrium.
b = boiling point: liquid-vapor equilibrium (760 mm).
s = sublimation point: solid-vapor equilibrium (760 mm).

TEMPERATURES — CENTIGRADE TO FAHRENHEIT

Conversion Table

The values in the body of the table give, in degrees Fahrenheit, the temperatures indicated in degrees Centigrade at the top and side.

1° C. = 1.8° F.

For temperatures below 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
0	+ 32.0	30.2	28.4	26.6	24.8	23.0	21.2	19.4	17.6	15.8
– 10	+ 14.0	12.2	10.4	8.6	6.8	5.0	3.2	+ 1.4	– 0.4	– 2.2
– 20	– 4.0	5.8	7.6	9.4	11.2	13.0	14.8	16.6	18.4	20.2
– 30	– 22.0	23.8	25.6	27.4	29.2	31.0	32.8	34.6	36.4	38.2
– 40	– 40.0	41.8	43.6	45.4	47.2	49.0	50.8	52.6	54.4	56.2
– 50	– 58.0	59.8	61.6	63.4	65.2	67.0	68.8	70.6	72.4	74.2
– 60	– 76.0	77.8	79.6	81.4	83.2	85.0	86.8	88.6	90.4	92.2
– 70	– 94.0	95.8	97.6	99.4	101.2	103.0	104.8	106.6	108.4	110.2
– 80	– 112.0	113.8	115.6	117.4	119.2	121.0	122.8	124.6	126.4	128.2
– 90	– 130.0	131.8	133.6	135.4	137.2	139.0	140.8	142.6	144.4	146.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
– 100	–148.0	149.8	151.6	153.4	155.2	157.0	158.8	160.6	162.4	164.2
– 110	–166.0	167.8	169.6	171.4	173.2	175.0	176.8	178.6	180.4	182.2
– 120	–184.0	185.8	187.6	189.4	191.2	193.0	194.8	196.6	198.4	200.2
– 130	–202.0	203.8	205.6	207.4	209.2	211.0	212.8	214.6	216.4	218.2
– 140	–220.0	221.8	223.6	225.4	227.2	229.0	230.8	232.6	234.4	236.2
– 150	–238.0	239.8	241.6	243.4	245.2	247.0	248.8	250.6	252.4	254.2
– 160	–256.0	257.8	259.6	261.4	263.2	265.0	266.8	268.6	270.4	272.2
– 170	–274.0	275.8	277.6	279.4	281.2	283.0	284.8	286.6	288.4	290.2
– 180	–292.0	293.8	295.6	297.4	299.2	301.0	302.8	304.6	306.4	308.2
– 190	–310.0	311.8	313.6	315.4	317.2	319.0	320.8	322.6	324.4	326.2
– 200	–328.0	329.8	331.6	333.4	335.2	337.0	338.8	340.6	342.4	344.2
– 210	–346.0	347.8	349.6	351.4	353.2	355.0	356.8	358.6	360.4	362.2
– 220	–364.0	365.8	367.6	369.4	371.2	373.0	374.8	376.6	378.4	380.2
– 230	–382.0	383.8	385.6	387.4	389.2	391.0	392.8	394.6	396.4	398.2
– 240	–400.0	401.8	403.6	405.4	407.2	409.0	410.8	412.6	414.4	416.2
– 250	–418.0	419.8	421.6	423.4	425.2	427.0	428.8	430.6	432.4	434.2
– 260	–436.0	437.8	439.6	441.4	443.2	445.0	446.8	448.6	450.4	452.2
– 270	–454.0	455.8	457.6	459.4	......	......	......	......	......	......

–273.16° C = –459.72° F. = absolute zero

For interpolation	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
0	32.0	33.8	35.6	37.4	39.2	41.0	42.8	44.6	46.4	48.2
10	50.0	51.8	53.6	55.4	57.2	59.0	60.8	62.6	64.4	66.2
20	68.0	69.8	71.6	73.4	75.2	77.0	78.8	80.6	82.4	84.2
30	86.0	87.8	89.6	91.4	93.2	95.0	96.8	98.6	100.4	102.2
40	104.0	105.8	107.6	109.4	111.2	113.0	114.8	116.6	118.4	120.2
50	122.0	123.8	125.6	127.4	129.2	131.0	132.8	134.6	136.4	138.2
60	140.0	141.8	143.6	145.4	147.2	149.0	150.8	152.6	154.4	156.2
70	158.0	159.8	161.6	163.4	165.2	167.0	168.8	170.6	172.4	174.2
80	176.0	177.8	179.6	181.4	183.2	185.0	186.8	188.6	190.4	192.2
90	194.0	195.8	197.6	199.4	201.2	203.0	204.8	206.6	208.4	210.2
100	212.0	213.8	215.6	217.4	219.2	221.0	222.8	224.6	226.4	228.2
110	230.0	231.8	233.6	235.4	237.2	239.0	240.8	242.6	244.4	246.2
120	248.0	249.8	251.6	253.4	255.2	257.0	258.8	260.6	262.4	264.2
130	266.0	267.8	269.6	271.4	273.2	275.0	276.8	278.6	280.4	282.2
140	284.0	285.8	287.6	289.4	291.2	293.0	294.8	296.6	298.4	300.2
150	302.0	303.8	305.6	307.4	309.2	311.0	312.8	314.6	316.4	318.2
160	320.0	321.8	323.6	325.4	327.2	329.0	330.8	332.6	334.4	336.2
170	338.0	339.8	341.6	343.4	345.2	347.0	348.8	350.6	352.4	354.2
180	356.0	357.8	359.6	361.4	363.2	365.0	366.8	368.6	370.4	372.2
190	374.0	375.8	377.6	379.4	381.2	383.0	384.8	386.6	388.4	390.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
200	392.0	393.8	395.6	397.4	399.2	401.0	402.8	404.6	406.4	408.2
210	410.0	411.8	413.6	415.4	417.2	419.0	420.8	422.6	424.4	426.2
220	428.0	429.8	431.6	433.4	435.2	437.0	438.8	440.6	442.4	444.2
230	446.0	447.8	449.6	451.4	453.2	455.0	456.8	458.6	460.4	462.2
240	464.0	465.8	467.6	469.4	471.2	473.0	474.8	476.6	478.4	480.2
250	482.0	483.8	485.6	487.4	489.2	491.0	492.8	494.6	496.4	498.2
260	500.0	501.8	503.6	505.4	507.2	509.0	510.8	512.6	514.4	516.2
270	518.0	519.8	521.6	523.4	525.2	527.0	528.8	530.6	532.4	534.2
280	536.0	537.8	539.6	541.4	543.2	545.0	546.8	548.6	550.4	552.2
290	554.0	555.8	557.6	559.4	561.2	563.0	564.8	566.6	568.4	570.2
300	572.0	573.8	575.6	577.4	579.2	581.0	582.8	584.6	586.4	588.2
310	590.0	591.8	593.6	595.4	597.2	599.0	600.8	602.6	604.4	606.2
320	608.0	609.8	611.6	613.4	615.2	617.0	618.8	620.6	622.4	624.2
330	626.0	627.8	629.6	631.4	633.2	635.0	636.8	638.6	640.4	642.2
340	644.0	645.8	647.6	649.4	651.2	653.0	654.8	656.6	658.4	660.2
350	662.0	663.8	665.6	667.4	669.2	671.0	672.8	674.6	676.4	678.2
360	680.0	681.8	683.6	685.4	687.2	689.0	690.8	692.6	694.4	696.2
370	698.0	699.8	701.6	703.4	705.2	707.0	708.8	710.6	712.4	714.2
380	716.0	717.8	719.6	721.4	723.2	725.0	726.8	728.6	730.4	732.2
390	734.0	735.8	737.6	739.4	741.2	743.0	744.8	746.6	748.4	750.2

For	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Interpolation	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
400	752.0	753.8	755.6	757.4	759.2	761.0	762.8	764.6	766.4	768.2
410	770.0	771.8	773.6	775.4	777.2	779.0	780.8	782.6	784.4	786.2
420	788.0	789.8	791.6	793.4	795.2	797.0	798.8	800.6	802.4	804.2
430	806.0	807.8	809.6	811.4	813.2	815.0	816.8	818.6	820.4	822.2
440	824.0	825.8	827.6	829.4	831.2	833.0	834.8	836.6	838.4	840.2
450	842.0	843.8	845.6	847.4	849.2	851.0	852.8	854.6	856.4	858.2
460	860.0	861.8	863.6	865.4	867.2	869.0	870.8	872.6	874.4	876.2
470	878.0	879.8	881.6	883.4	885.2	887.0	888.8	890.6	892.4	894.2
480	896.0	897.8	899.6	901.4	903.2	905.0	906.8	908.6	910.4	912.2
490	914.0	915.8	917.6	919.4	921.2	923.0	924.8	926.6	928.4	930.2
500	932.0	933.8	935.6	937.4	939.2	941.0	942.8	944.6	946.4	948.2
510	950.0	951.8	953.6	955.4	957.2	959.0	960.8	962.6	964.4	966.2
520	968.0	969.8	971.6	973.4	975.2	977.0	978.8	980.6	982.4	984.2
530	986.0	987.8	989.6	991.4	993.2	995.0	996.8	998.6	1000.4	1002.2
540	1004.0	1005.8	1007.6	1009.4	1011.2	1013.0	1014.8	1016.6	1018.4	1020.2
550	1022.0	1023.8	1025.6	1027.4	1029.2	1031.0	1032.8	1034.6	1036.4	1038.2
560	1040.0	1041.8	1043.6	1045.4	1047.2	1049.0	1050.8	1052.6	1054.4	1056.2
570	1058.0	1059.8	1061.6	1063.4	1065.2	1067.0	1068.8	1070.6	1072.4	1074.2
580	1076.0	1077.8	1079.6	1081.4	1083.2	1085.0	1086.8	1088.6	1090.4	1092.2
590	1094.0	1095.8	1097.6	1099.4	1101.2	1103.0	1104.8	1106.6	1108.4	1110.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
600	1112.0	1113.8	1115.6	1117.4	1119.2	1121.0	1122.8	1124.6	1126.4	1128.2
610	1130.0	1131.8	1133.6	1135.4	1137.2	1139.0	1140.8	1142.6	1144.4	1146.2
620	1148.0	1149.8	1151.6	1153.4	1155.2	1157.0	1158.8	1160.6	1162.4	1164.2
630	1166.0	1167.8	1169.6	1171.4	1173.2	1175.0	1176.8	1178.6	1180.4	1182.2
640	1184.0	1185.8	1187.6	1189.4	1191.2	1193.0	1194.8	1196.6	1198.4	1200.2
650	1202.0	1203.8	1205.6	1207.4	1209.2	1211.0	1212.8	1214.6	1216.4	1218.2
660	1220.0	1221.8	1223.6	1225.4	1227.2	1229.0	1230.8	1232.6	1234.4	1236.2
670	1238.0	1239.8	1241.6	1243.4	1245.2	1247.0	1248.8	1250.6	1252.4	1254.2
680	1256.0	1257.8	1259.6	1261.4	1263.2	1265.0	1266.8	1268.6	1270.4	1272.2
690	1274.0	1275.8	1277.6	1279.4	1281.2	1283.0	1284.8	1286.6	1288.4	1290.2
700	1292.0	1293.8	1295.6	1297.4	1299.2	1301.0	1302.8	1304.6	1306.4	1308.2
710	1310.0	1311.8	1313.6	1315.4	1317.2	1319.0	1320.8	1322.6	1324.4	1326.2
720	1328.0	1329.8	1331.6	1333.4	1335.2	1337.0	1338.8	1340.6	1342.4	1344.2
730	1346.0	1347.8	1349.6	1351.4	1353.2	1355.0	1356.8	1358.6	1360.4	1362.2
740	1364.0	1365.8	1367.6	1369.4	1371.2	1373.0	1374.8	1376.6	1378.4	1380.2
750	1382.0	1383.8	1385.6	1387.4	1389.2	1391.0	1392.8	1394.6	1396.4	1398.2
760	1400.0	1401.8	1403.6	1405.4	1407.2	1409.0	1410.8	1412.6	1414.4	1416.2
770	1418.0	1419.8	1421.6	1423.4	1425.2	1427.0	1428.8	1430.6	1432.4	1434.2
780	1436.0	1437.8	1439.6	1441.4	1443.2	1445.0	1446.8	1448.6	1450.4	1452.2
790	1454.0	1455.8	1457.6	1459.4	1461.2	1463.0	1464.8	1466.6	1468.4	1470.2

For	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
interpolation	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
800	1472.0	1473.8	1475.6	1477.4	1479.2	1481.0	1482.8	1484.6	1486.4	1488.2
810	1490.0	1491.8	1493.6	1495.4	1497.2	1499.0	1500.8	1502.6	1504.4	1506.2
820	1508.0	1509.8	1511.6	1513.4	1515.2	1517.0	1518.8	1520.6	1522.4	1524.2
830	1526.0	1527.8	1529.6	1531.4	1533.2	1535.0	1536.8	1538.6	1540.4	1542.2
840	1544.0	1545.8	1547.6	1549.4	1551.2	1553.0	1554.8	1556.6	1558.4	1560.2
850	1562.0	1563.8	1565.6	1567.4	1569.2	1571.0	1572.8	1574.6	1576.4	1578.2
860	1580.0	1581.8	1583.6	1585.4	1587.2	1589.0	1590.8	1592.6	1594.4	1596.2
870	1598.0	1599.8	1601.6	1603.4	1605.2	1607.0	1608.8	1610.6	1612.4	1614.2
880	1616.0	1617.8	1619.6	1621.4	1623.2	1625.0	1626.8	1628.6	1630.4	1632.2
890	1634.0	1635.8	1637.6	1639.4	1641.2	1643.0	1644.8	1646.6	1648.4	1650.2
900	1652.0	1653.8	1655.6	1657.4	1659.2	1661.0	1662.8	1664.6	1666.4	1668.2
910	1670.0	1671.8	1673.6	1675.4	1677.2	1679.0	1680.8	1682.6	1684.4	1686.2
920	1688.0	1689.8	1691.6	1693.4	1695.2	1697.0	1698.8	1700.6	1702.4	1704.2
930	1706.0	1707.8	1709.6	1711.4	1713.2	1715.0	1716.8	1718.6	1720.4	1722.2
940	1724.0	1725.8	1727.6	1729.4	1731.2	1733.0	1734.8	1736.6	1738.4	1740.2
950	1742.0	1743.8	1745.6	1747.4	1749.2	1751.0	1752.8	1754.6	1756.4	1758.2
960	1760.0	1761.8	1763.6	1765.4	1767.2	1769.0	1770.8	1772.6	1774.4	1776.2
970	1778.0	1779.8	1781.6	1783.4	1785.2	1787.0	1788.8	1790.6	1792.4	1794.2
980	1796.0	1797.8	1799.6	1801.4	1803.2	1805.0	1806.8	1808.6	1810.4	1812.2
990	1814.0	1815.8	1817.6	1819.4	1821.2	1823.0	1824.8	1826.6	1828.4	1830.2

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1000	1832.0	1833.8	1835.6	1837.4	1839.2	1841.0	1842.8	1844.6	1846.4	1848.2
1010	1850.0	1851.8	1853.6	1855.4	1857.2	1859.0	1860.8	1862.6	1864.4	1866.2
1020	1868.0	1869.8	1871.6	1873.4	1875.2	1877.0	1878.8	1880.6	1882.4	1884.2
1030	1886.0	1887.8	1889.6	1891.4	1893.2	1895.0	1896.8	1898.6	1900.4	1902.2
1040	1904.0	1905.8	1907.6	1909.4	1911.2	1913.0	1914.8	1916.6	1918.4	1920.2
1050	1922.0	1923.8	1925.6	1927.4	1929.2	1931.0	1932.8	1934.6	1936.4	1938.2
1060	1940.0	1941.8	1943.6	1945.4	1947.2	1949.0	1950.8	1952.6	1954.4	1956.2
1070	1958.0	1959.8	1961.6	1963.4	1965.2	1967.0	1968.8	1970.6	1972.4	1974.2
1080	1976.0	1977.8	1979.6	1981.4	1983.2	1985.0	1986.8	1988.6	1990.4	1992.2
1090	1994.0	1995.8	1997.6	1999.4	2001.2	2003.0	2004.8	2006.6	2008.4	2010.2
1100	2012.0	2013.8	2015.6	2017.4	2019.2	2021.0	2022.8	2024.6	2026.4	2028.2
1110	2030.0	2031.8	2033.6	2035.4	2037.2	2039.0	2040.8	2042.6	2044.4	2046.2
1120	2048.0	2049.8	2051.6	2053.4	2055.2	2057.0	2058.8	2060.6	2062.4	2064.2
1130	2066.0	2067.8	2069.6	2071.4	2073.2	2075.0	2076.8	2078.6	2080.4	2082.2
1140	2084.0	2085.8	2087.6	2089.4	2091.2	2093.0	2094.8	2096.6	2098.4	2100.2
1150	2102.0	2103.8	2105.6	2107.4	2109.2	2111.0	2112.8	2114.6	2116.4	2118.2
1160	2120.0	2121.8	2123.6	2125.4	2127.2	2129.0	2130.8	2132.6	2134.4	2136.2
1170	2138.0	2139.8	2141.6	2143.4	2145.2	2147.0	2148.8	2150.6	2152.4	2154.2
1180	2156.0	2157.8	2159.6	2161.4	2163.2	2165.0	2166.8	2168.6	2170.4	2172.2
1190	2174.0	2175.8	2177.6	2179.4	2181.2	2183.0	2184.8	2186.6	2188.4	2190.2

For Interpolation										
°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1200	2192.0	2193.8	2195.6	2197.4	2199.2	2201.0	2202.8	2204.6	2206.4	2208.2
1210	2210.0	2211.8	2213.6	2215.4	2217.2	2219.0	2220.8	2222.6	2224.4	2226.2
1220	2228.0	2229.8	2231.6	2233.4	2235.2	2237.0	2238.8	2240.6	2242.4	2244.2
1230	2246.0	2247.8	2249.6	2251.4	2253.2	2255.0	2256.8	2258.6	2260.4	2262.2
1240	2264.0	2265.8	2267.6	2269.4	2271.2	2273.0	2274.8	2276.6	2278.4	2280.2
1250	2282.0	2283.8	2285.6	2287.4	2289.2	2291.0	2292.8	2294.6	2296.4	2298.2
1260	2300.0	2301.8	2303.6	2305.4	2307.2	2309.0	2310.8	2312.6	2314.4	2316.2
1270	2318.0	2319.8	2321.6	2323.4	2325.2	2327.0	2328.8	2330.6	2332.4	2334.2
1280	2336.0	2337.8	2339.6	2341.4	2343.2	2345.0	2346.8	2348.6	2350.4	2352.2
1290	2354.0	2355.8	2357.6	2359.4	2361.2	2363.0	2364.8	2366.6	2368.4	2370.2
1300	2372.0	2373.8	2375.6	2377.4	2379.2	2381.0	2382.8	2384.6	2386.4	2388.2
1310	2390.0	2391.8	2393.6	2395.4	2397.2	2399.0	2400.8	2402.6	2404.4	2406.2
1320	2408.0	2409.8	2411.6	2413.4	2415.2	2417.0	2418.8	2420.6	2422.4	2424.2
1330	2426.0	2427.8	2429.6	2431.4	2433.2	2435.0	2436.8	2438.6	2440.4	2442.2
1340	2444.0	2445.8	2447.6	2449.4	2451.2	2453.0	2454.8	2456.6	2458.4	2460.2
1350	2462.0	2463.8	2465.6	2467.4	2469.2	2471.0	2472.8	2474.6	2476.4	2478.2
1360	2480.0	2481.8	2483.6	2485.4	2487.2	2489.0	2490.8	2492.6	2494.4	2496.2
1370	2498.0	2499.8	2501.6	2503.4	2505.2	2507.0	2508.8	2510.6	2512.4	2514.2
1380	2516.0	2517.8	2519.6	2521.4	2523.2	2525.0	2526.8	2528.6	2530.4	2532.2
1390	2534.0	2535.8	2537.6	2539.4	2541.2	2543.0	2544.8	2546.6	2548.4	2550.2

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1400	2552.0	2553.8	2555.6	2557.4	2559.2	2561.0	2562.8	2564.6	2566.4	2568.2
1410	2570.0	2571.8	2573.6	2575.4	2577.2	2579.0	2580.8	2582.6	2584.4	2586.2
1420	2588.0	2589.8	2591.6	2593.4	2595.2	2597.0	2598.8	2600.6	2602.4	2604.2
1430	2606.0	2607.8	2609.6	2611.4	2613.2	2615.0	2616.8	2618.6	2620.4	2622.2
1440	2624.0	2625.8	2627.6	2629.4	2631.2	2633.0	2634.8	2636.6	2638.4	2640.2
1450	2642.0	2643.8	2645.6	2647.4	2649.2	2651.0	2652.8	2654.6	2656.4	2658.2
1460	2660.0	2661.8	2663.6	2665.4	2667.2	2669.0	2670.8	2672.6	2674.4	2676.2
1470	2678.0	2679.8	2681.6	2683.4	2685.2	2687.0	2688.8	2690.6	2692.4	2694.2
1480	2696.0	2697.8	2699.6	2701.4	2703.2	2705.0	2706.8	2708.6	2710.4	2712.2
1490	2714.0	2715.8	2717.6	2719.4	2721.2	2723.0	2724.8	2726.6	2728.4	2730.2
1500	2732.0	2733.8	2735.6	2737.4	2739.2	2741.0	2742.8	2744.6	2746.4	2748.2
1510	2750.0	2751.8	2753.6	2755.4	2757.2	2759.0	2760.8	2762.6	2764.4	2766.2
1520	2768.0	2769.8	2771.6	2773.4	2775.2	2777.0	2778.8	2780.6	2782.4	2784.2
1530	2786.0	2787.8	2789.6	2791.4	2793.2	2795.0	2796.8	2798.6	2800.4	2802.2
1540	2804.0	2805.8	2807.6	2809.4	2811.2	2813.0	2814.8	2816.6	2818.4	2820.2
1550	2822.0	2823.8	2825.6	2827.4	2829.2	2831.0	2832.8	2834.6	2836.4	2838.2
1560	2840.0	2841.8	2843.6	2845.4	2847.2	2849.0	2850.8	2852.6	2854.4	2856.2
1570	2858.0	2859.8	2861.6	2863.4	2865.2	2867.0	2868.8	2870.6	2872.4	2874.2
1580	2876.0	2877.8	2879.6	2881.4	2883.2	2885.0	2886.8	2888.6	2890.4	2892.2
1590	2894.0	2895.8	2897.6	2899.4	2901.2	2903.0	2904.8	2906.6	2908.4	2910.2

For	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Interpolation	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1600	2912.0	2913.8	2915.6	2917.4	2919.2	2921.0	2922.8	2924.6	2926.4	2928.2
1610	2930.0	2931.8	2933.6	2935.4	2937.2	2939.0	2940.8	2942.6	2944.4	2946.2
1620	2948.0	2949.8	2951.6	2953.4	2955.2	2957.0	2958.8	2960.6	2962.4	2964.2
1630	2966.0	2967.8	2969.6	2971.4	2973.2	2975.0	2976.8	2978.6	2980.4	2982.2
1640	2984.0	2985.8	2987.6	2989.4	2991.2	2993.0	2994.8	2996.6	2998.4	3000.2
1650	3002.0	3003.8	3005.6	3007.4	3009.2	3011.0	3012.8	3014.6	3016.4	3018.2
1660	3020.0	3021.8	3023.6	3025.4	3027.2	3029.0	3030.8	3032.6	3034.4	3036.2
1670	3038.0	3039.8	3041.6	3043.4	3045.2	3047.0	3048.8	3050.6	3052.4	3054.2
1680	3056.0	3057.8	3059.6	3061.4	3063.2	3065.0	3066.8	3068.6	3070.4	3072.2
1690	3074.0	3075.8	3077.6	3079.4	3081.2	3083.0	3084.8	3086.6	3088.4	3090.2
1700	3092.0	3093.8	3095.6	3097.4	3099.2	3101.0	3102.8	3104.6	3106.4	3108.2
1710	3110.0	3111.8	3113.6	3115.4	3117.2	3119.0	3120.8	3122.6	3124.4	3126.2
1720	3128.0	3129.8	3131.6	3133.4	3135.2	3137.0	3138.8	3140.6	3142.4	3144.2
1730	3146.0	3147.8	3149.6	3151.4	3153.2	3155.0	3156.8	3158.6	3160.4	3162.2
1740	3164.0	3165.8	3167.6	3169.4	3171.2	3173.0	3174.8	3176.6	3178.4	3180.2
1750	3182.0	3183.8	3185.6	3187.4	3189.2	3191.0	3192.8	3194.6	3196.4	3198.2
1760	3200.0	3201.8	3203.6	3205.4	3207.2	3209.0	3210.8	3212.6	3214.4	3216.2
1770	3218.0	3219.8	3221.6	3223.4	3225.2	3227.0	3228.8	3230.6	3232.4	3234.2
1780	3236.0	3237.8	3239.6	3241.4	3243.2	3245.0	3246.8	3248.6	3250.4	3252.2
1790	3254.0	3255.8	3257.6	3259.4	3261.2	3263.0	3264.8	3266.6	3268.4	3270.2

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
1800	3272.0	3273.8	3275.6	3277.4	3279.2	3281.0	3282.8	3284.6	3286.4	3288.2
1810	3290.0	3291.8	3293.6	3295.4	3297.2	3299.0	3300.8	3302.6	3304.4	3306.2
1820	3308.0	3309.8	3311.6	3313.4	3315.2	3317.0	3318.8	3320.6	3322.4	3324.2
1830	3326.0	3327.8	3329.6	3331.4	3333.2	3335.0	3336.8	3338.6	3340.4	3342.2
1840	3344.0	3345.8	3347.6	3349.4	3351.2	3353.0	3354.8	3356.6	3358.4	3360.2
1850	3362.0	3363.8	3365.6	3367.4	3369.2	3371.0	3372.8	3374 6	3376.4	3378.2
1860	3380.0	3381.8	3383.6	3385.4	3387.2	3389.0	3390.8	3392.6	3394.4	3396.2
1870	3398.0	3399.8	3401.6	3403.4	3405.2	3407.0	3408.8	3410.6	3412.4	3414.2
1880	3416.0	3417.8	3419.6	3421.4	3423.2	3425.0	3426.8	3428.6	3430.4	3432.2
1890	3434.0	3435.8	3437.6	3439.4	3441.2	3443.0	3444.8	3446.6	3448.4	3450.2
1900	3452.0	3453.8	3455.6	3457.4	3459.2	3461.0	3462.8	3464.6	3466.4	3468.2
1910	3470.0	3471.8	3473.6	3475.4	3477.2	3479.0	3480.8	3482.6	3484.4	3486.2
1920	3488.0	3489.8	3491.6	3493.4	3495.2	3497.0	3498.8	3500.6	3502.4	3504.2
1930	3506.0	3507.8	3509.6	3511.4	3513.2	3515.0	3516.8	3518.6	3520.4	3522.2
1940	3524 0	3525.8	3527.6	3529.4	3531.2	3533.0	3534.8	3536.6	3538.4	3540.2
1950	3542.0	3543.8	3545.6	3547.4	3549.2	3551.0	3552.8	3554.6	3556.4	3558.2
1960	3560.0	3561.8	3563.6	3565.4	3567.2	3569.0	3570.8	3572.6	3574.4	3576.2
1970	3578.0	3579.8	3581.6	3583.4	3585.2	3587.0	3588.8	3590.6	3592.4	3594.2
1980	3596.0	3597.8	3599.6	3601.4	3603.2	3605.0	3606.8	3608.6	3610.4	3612.2
1990	3614.0	3615.8	3617.6	3619.4	3621 2	3623.0	3624.8	3626 6	3628.4	3630.2

For interpolation										
°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1 44	1.62	1.80

TEMPERATURES — CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2000	3632.0	3633.8	3635.6	3637.4	3639.2	3641.0	3642.8	3644.6	3646.4	3648.2
2010	3650.0	3651.8	3653.6	3655.4	3657.2	3659.0	3660.8	3662.6	3664.4	3666.2
2020	3668.0	3669.8	3671.6	3673.4	3675.2	3677.0	3678.8	3680.6	3682.4	3684.2
2030	3686.0	3687.8	3689.6	3691.4	3693.2	3695.0	3696.8	3698.6	3700.4	3702.2
2040	3704.0	3705.8	3707.6	3709.4	3711.2	3713.0	3714.8	3716.6	3718.4	3720.2
2050	3722.0	3723.8	3725.6	3727.4	3729.2	3731.0	3732.8	3734.6	3736.4	3738.2
2060	3740.0	3741.8	3743.6	3745.4	3747.2	3749.0	3750.8	3752.6	3754.4	3756.2
2070	3758.0	3759.8	3761.6	3763.4	3765.2	3767.0	3768.8	3770.6	3772.4	3774.2
2080	3776.0	3777.8	3779.6	3781.4	3783.2	3785.0	3786.8	3788.6	3790.4	3792.2
2090	3794.0	3795.8	3797.6	3799.4	3801.2	3803.0	3804.8	3806.6	3808.4	3810.2
2100	3812.0	3813.8	3815.6	3817.4	3819.2	3821.0	3822.8	3824.6	3826.4	3828.2
2110	3830.0	3831.8	3833.6	3835.4	3837.2	3839.0	3840.8	3842.6	3844.4	3846.2
2120	3848.0	3849.8	3851.6	3853.4	3855.2	3857.0	3858.8	3860.6	3862.4	3864.2
2130	3866.0	3867.8	3869.6	3871.4	3873.2	3875.0	3876.8	3878.6	3880.4	3882.2
2140	3884.0	3885.8	3887.6	3889.4	3891.2	3893.0	3894.8	3896.6	3898.4	3900.2
2150	3902.0	3903.8	3905.6	3907.4	3909.2	3911.0	3912.8	3914.6	3916.4	3918.2
2160	3920.0	3921.8	3923.6	3925.4	3927.2	3929.0	3930.8	3932.6	3934.4	3936.2
2170	3938.0	3939.8	3941.6	3943.4	3945.2	3947.0	3948.8	3950.6	3952.4	3954.2
2180	3956.0	3957.8	3959.6	3961.4	3963.2	3965.0	3966.8	3968.6	3970.4	3972.2
2190	3974.0	3975.8	3977.6	3979.4	3981.2	3983.0	3984.8	3986.6	3988.4	3990.2

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2200	3992.0	3993.8	3995.6	3997.4	3999.2	4001.0	4002.8	4004.6	4006.4	4008.2
2210	4010.0	4011.8	4013.6	4015.4	4017.2	4019.0	4020.8	4022.6	4024.4	4026.2
2220	4028.0	4029.8	4031.6	4033.4	4035.2	4037.0	4038.8	4040.6	4042.4	4044.2
2230	4046.0	4047.8	4049.6	4051.4	4053.2	4055.0	4056.8	4058.6	4060.4	4062.2
2240	4064.0	4065.8	4067.6	4069.4	4071.2	4073.0	4074.8	4076.6	4078.4	4080.2
2250	4082.0	4083.8	4085.6	4087.4	4089.2	4091.0	4092.8	4094.6	4096.4	4098.2
2260	4100.0	4101.8	4103.6	4105.4	4107.2	4109.0	4110.8	4112.6	4114.4	4116.2
2270	4118.0	4119.8	4121.6	4123.4	4125.2	4127.0	4128.8	4130.6	4132.4	4134.2
2280	4136.0	4137.8	4139.6	4141.4	4143.2	4145.0	4146.8	4148.6	4150.4	4152.2
2290	4154.0	4155.8	4157.6	4159.4	4161.2	4163.0	4164.8	4166.6	4168.4	4170.2
2300	4172.0	4173.8	4175.6	4177.4	4179.2	4181.0	4182.8	4184.6	4186.4	4188.2
2310	4190.0	4191.8	4193.6	4195.4	4197.2	4199.0	4200.8	4202.6	4204.4	4206.2
2320	4208.0	4209.8	4211.6	4213.4	4215.2	4217.0	4218.8	4220.6	4222.4	4224.2
2330	4226.0	4227.8	4229.6	4231.4	4233.2	4235.0	4236.8	4238.6	4240.4	4242.2
2340	4244.0	4245.8	4247.6	4249.4	4251.2	4253.0	4254.8	4256.6	4258.4	4260.2
2350	4262.0	4263.8	4265.6	4267.4	4269.2	4271.0	4272.8	4274.6	4276.4	4278.2
2360	4280.0	4281.8	4383.6	4285.4	4287.2	4289.0	4290.8	4292.6	4294.4	4296.2
2370	4298.0	4299.8	4301.6	4303.4	4305.2	4307.0	4308.8	4310.6	4312.4	4314.2
2380	4316.0	4317.8	4319.6	4321.4	4323.2	4325.0	4326.8	4328.6	4330.4	4332.2
2390	4334.0	4335.8	4337.6	4339.4	4341.2	4343.0	1344.8	4346.6	4348.4	4350.2

For	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Interpolation	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2400	4352.0	4353.8	4355.6	4357.4	4359.2	4361.0	4362.8	4364.6	4366.4	4368.2
2410	4370.0	4371.8	4373.6	4375.4	4377.2	4379.0	4380.8	4382.6	4384.4	4386.2
2420	4388.0	4389.8	4391.6	4393.4	4395.2	4397.0	4398.8	4400.6	4402.4	4404.2
2430	4406.0	4407.8	4409.6	4411.4	4413.2	4415.0	4416.8	4418.6	4420.4	4422.2
2440	4424.0	4425.8	4427.6	4429.4	4431.2	4433.0	4434.8	4436.6	4438.4	4440.2
2450	4442.0	4443.8	4445.6	4447.4	4449.2	4451.0	4452.8	4454.6	4456.4	4458.2
2460	4460.0	4461.8	4463.6	4465.4	4467.2	4469.0	4470.8	4472.6	4474.4	4476.2
2470	4478.0	4479.8	4481.6	4483.4	4485.2	4487.0	4488.8	4490.6	4492.4	4494.2
2480	4496.0	4497.8	4499.6	4501.4	4503.2	4505.0	4506.8	4508.6	4510.4	4512.2
2490	4514.0	4515.8	4517.6	4519.4	4521.2	4523.0	4524.8	4526.6	4528.4	4530.2
2500	4532.0	4533.8	4535.6	4537.4	4539.2	4541.0	4542.8	4544.6	4546.4	4548.2
2510	4550.0	4551.8	4553.6	4555.4	4557.2	4559.0	4560.8	4562.6	4564.4	4566.2
2520	4568.0	4569.8	4571.6	4573.4	4575.2	4577.0	4578.8	4580.6	4582.4	4584.2
2530	4586.0	4587.8	4589.6	4591.4	4593.2	4595.0	4596.8	4598.6	4600.4	4602.2
2540	4604.0	4605.8	4607.6	4609.4	4611.2	4613.0	4614.8	4616.6	4618.4	4620.2
2550	4622.0	4623.8	4625.6	4627.4	4629.2	4631.0	4632.8	4634.6	4636.4	4638.2
2560	4640.0	4641.8	4643.6	4645.4	4647.2	4649.0	4650.8	4652.6	4654.4	4656.2
2570	4658.0	4659.8	4661.6	4663.4	4665.2	4667.0	4668.8	4670.6	4672.4	4674.2
2580	4676.0	4677.8	4679.6	4681.4	4683.2	4685.0	4686.8	4688.6	4690.4	4692.2
2590	4694.0	4695.8	4697.6	4699.4	4701.2	4703.0	4704.8	4706.6	4708.4	4710.2

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2600	4712.0	4713.8	4715.6	4717.4	4719.2	4721.0	4722.8	4724.6	4726.4	4728.2
2610	4730.0	4731.8	4733.6	4735.4	4737.2	4739.0	4740.8	4742.6	4744.4	4746.2
2620	4748.0	4749.8	4751.6	4753.4	4755.2	4757.0	4758.8	4760.6	4762.4	4764.2
2630	4766.0	4767.8	4769.6	4771.4	4773.2	4775.0	4776.8	4778.6	4780.4	4782.2
2640	4784.0	4785.8	4787.6	4789.4	4791.2	4793.0	4794.8	4796.6	4798.4	4800.2
2650	4802.0	4803.8	4805.6	4807.4	4809.2	4811.0	4812.8	4814.6	4816.4	4818.2
2660	4820.0	4821.8	4823.6	4825.4	4827.2	4829.0	4830.8	4832.6	4834.4	4836.2
2670	4838.0	4839.8	4841.6	4843.4	4845.2	4847.0	4848.8	4850.6	4852.4	4854.2
2680	4856.0	4857.8	4859.6	4861.4	4863.2	4865.0	4866.8	4868.6	4870.4	4872.2
2690	4874.0	4875.8	4877.6	4879.4	4881.2	4883.0	4884.8	4886.6	4888.4	4890.2
2700	4892.0	4893.8	4895.6	4897.4	4899.2	4901.0	4902.8	4904.6	4906.4	4908.2
2710	4910.0	4911.8	4913.6	4915.4	4917.2	4919.0	4920.8	4922.6	4924.4	4926.2
2720	4928.0	4929.8	4931.6	4933.4	4935.2	4937.0	4938.8	4940.6	4942.4	4944.2
2730	4946.0	4947.8	4949.6	4951.4	4953.2	4955.0	4956.8	4958.6	4960.4	4962.2
2740	4964.0	4965.8	4967.6	4969.4	4971.2	4973.0	4974.8	4976.6	4978.4	4980.2
2750	4982.0	4983.8	4985.6	4987.4	4989.2	4991.0	4992.8	4994.6	4996.4	4998.2
2760	5000.0	5001.8	5003.6	5005.4	5007.2	5009.0	5010.8	5012.6	5014.4	5016.2
2770	5018.0	5019.8	5021.6	5023.4	5025.2	5027.0	5028.8	5030.6	5032.4	5034.2
2780	5036.0	5037.8	5039.6	5041.4	5043.2	5045.0	5046.8	5048.6	5050.4	5052.2
2790	5054.0	5055.8	5057.6	5059.4	5061.2	5063.0	5064.8	5066.6	5068.4	5070.2

For interpolation	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Continued)

Conversion Table

For temperatures above 0° C.

Temp. °C.	0	1	2	3	4	5	6	7	8	9
2800	5072.0	5073.8	5075.6	5077.4	5079.2	5081.0	5082.8	5084.6	5086.4	5088.2
2810	5090.0	5091.8	5093.6	5095.4	5097.2	5099.0	5100.8	5102.6	5104.4	5106.2
2820	5108.0	5109.8	5111.6	5113.4	5115.2	5117.0	5118.8	5120.6	5122.4	5124.2
2830	5126.0	5127.8	5129.6	5131.4	5133.2	5135.0	5136.8	5138.6	5140.4	5142.2
2840	5144.0	5145.8	5147.6	5149.4	5151.2	5153.0	5154.8	5156.6	5158.4	5160.2
2850	5162.0	5163.8	5165.6	5167.4	5169.2	5171.0	5172.8	5174.6	5176.4	5178.2
2860	5180.0	5181.8	5183.6	5185.4	5187.2	5189.0	5190.8	5192.6	5194.4	5196.2
2870	5198.0	5199.8	5201.6	5203.4	5205.2	5207.0	5208.8	5210.6	5212.4	5214.2
2880	5216.0	5217.8	5219.6	5221.4	5223.2	5225.0	5226.8	5228.6	5230.4	5232.2
2890	5234.0	5235.8	5237.6	5239.4	5241.2	5243.0	5244.8	5246.6	5248.4	5250.2
2900	5252.0	5253.8	5255.6	5257.4	5259.2	5261.0	5262.8	5264.6	5266.4	5268.2
2910	5270.0	5271.8	5273.6	5275.4	5277.2	5279.0	5280.8	5282.6	5284.4	5286.2
2920	5288.0	5289.8	5291.6	5293.4	5295.2	5297.0	5298.8	5300.6	5302.4	5304.2
2930	5306.0	5307.8	5309.6	5311.4	5313.2	5315.0	5316.8	5318.6	5320.4	5322.2
2940	5324.0	5325.8	5327.6	5329.4	5331.2	5333.0	5334.8	5336.6	5338.4	5340.2
2950	5342.0	5343.8	5345.6	5347.4	5349.2	5351.0	5352.8	5354.6	5356.4	5358.2
2960	5360.0	5361.8	5363.6	5365.4	5367.2	5369.0	5370.8	5372.6	5374.4	5376.2
2970	5378.0	5379.8	5381.6	5383.4	5385.2	5387.0	5388.8	5390.6	5392.4	5394.2
2980	5396.0	5397.8	5399.6	5401.4	5403.2	5405.0	5406.8	5408.6	5410.4	5412.2
2990	5414.0	5415.8	5417.6	5419.4	5421.2	5423.0	5424.8	5426.6	5428.4	5430.2

TEMPERATURES—CENTIGRADE TO FAHRENHEIT (Concluded)

Temp. °C.	0	1	2	3	4	5	6	7	8	9
3000	5432.0	5433.8	5435.6	5437.4	5439.2	5441.0	5442.8	5444.6	5446.4	5448.2
3010	5450.0	5451.8	5453.6	5455.4	5457.2	5459.0	5460.8	5462.6	5464.4	5466.2
3020	5468.0	5469.8	5471.6	5473.4	5475.2	5477.0	5478.8	5480.6	5482.4	5484.2
3030	5486.0	5487.8	5489.6	5491.4	5493.2	5495.0	5496.8	5498.6	5500.4	5502.2
3040	5504.0	5505.8	5507.6	5509.4	5511.2	5513.0	5514.8	5516.6	5518.4	5520.2
3050	5522.0	5523.8	5525.6	5527.4	5529.2	5531.0	5532.8	5534.6	5536.4	5538.2
3060	5540.0	5541.8	5543.6	5545.4	5547.2	5549.0	5550.8	5552.6	5554.4	5556.2
3070	5558.0	5559.8	5561.6	5563.4	5565.2	5567.0	5568.8	5570.6	5572.4	5574.2
3080	5576.0	5577.8	5579.6	5581.4	5583.2	5585.0	5586.8	5588.6	5590.4	5592.2
3090	5594.0	5595.8	5597.6	5599.4	5601.2	5603.0	5604.8	5606.6	5608.4	5610.2

For interpolation	°C	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
	°F	0.18	0.36	0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80

MOMENT OF INERTIA FOR VARIOUS BODIES

The mass of the body is indicated by m.

Body	Axis	Moment of inertia
Uniform thin rod	Normal to the length, at one end	$m\frac{l^2}{3}$
Uniform thin rod	Normal to the length, at the center	$m\frac{l^2}{12}$
Thin rectangular sheet, sides a and b	Through the center parallel to b	$m\frac{a^2}{12}$
Thin rectangular sheet, sides a and b	Through the center perpendicular to the sheet	$m\frac{a^2+b^2}{12}$
Thin circular sheet of radius r	Normal to the plate through the center	$m\frac{r^2}{2}$
Thin circular sheet of radius r	Along any diameter	$m\frac{r^2}{4}$
Thin circular ring. Plane figure formed by two concentric circles of radius r_1 and r_2	Through center normal to plane of ring	$m\frac{r_1^2+r_2^2}{2}$
Thin circular ring. Plane figure formed by two concentric circles of radius, r_1 and r_2	Any diameter	$m\frac{r_1^2+r_2^2}{4}$
Rectangular parallelopiped, edges a, b, and c	Through center perpendicular to face ab, (parallel to edge c)	$m\frac{a^2+b^2}{12}$
Sphere, radius r	Any diameter	$m\frac{2}{5}r^2$
Spherical shell, external radius, r_1 internal, radius r_2	Any diameter	$m\frac{2}{5}\frac{(r_1^5-r_2^5)}{(r_1^3-r_2^3)}$

MOMENT OF INERTIA FOR VARIOUS BODIES (Continued)

The mass of the body is indicated by m.

Body	Axis	Moment of inertia
Spherical shell, very thin, mean radius, r	Any diameter	$m\frac{2r^2}{3}$
Right circular cylinder (or disk) of radius r	The longitudinal axis of the solid (central axis perpendicular to circular section of disk)	$m\frac{r^2}{2}$
Right circular cylinder of radius r, length l	Through center perpendicular to the axis of the figure, (transverse diameter)	$m\left(\frac{r^2}{4}+\frac{l^2}{12}\right)$
Hollow circular cylinder, length l, external radius r_1 internal radius r_2	The longitudinal axis of the figure	$m\frac{(r_1^2+r_2^2)}{2}$
Thin cylindrical shell, length l, mean radius, r	The longitudinal axis of the figure	mr^2
Hollow circular cylinder, length l, external radius r_1, internal radius r_2	Transverse diameter	$m\left[\frac{r_1^2+r_2^2}{4}+\frac{l^2}{12}\right]$
Hollow circular cylinder, length l, very thin, mean radius r	Transverse diameter	$m\left(\frac{r^2}{2}+\frac{l^2}{12}\right)$
Elliptic cylinder, length l, transverse semiaxes a and b	Longitudinal axis	$m\left(\frac{a^2+b^2}{4}\right)$
Right cone, altitude h, radius of base r	Axis of the figure	$m\frac{3}{10}r^2$
Spheroid of revolution, equatorial radius r	Polar axis	$m\frac{2r^2}{5}$
Ellipsoid, axes $2a$, $2b$, $2c$	Axis $2a$	$m\frac{(b^2+c^2)}{5}$

RADIO FORMULÆ

A collection of formulae useful in the computation of inductance, capacitance, and other constants of oscillating circuits. From Radio Instruments and Measurements, Bureau of Standards.

CAPACITANCE

Units.—In the following formulæ all lengths are expressed in centimeters, areas in square centimeters; the dielectric constant K, is taken as unity for air. Capacitances will be given in micromicrofarads = 10^{-12} farads. The electrostatic unit of capacitance, sometimes called the centimeter = 1.1124 micromicrofarads.

Parallel plate condenser.—If s be the area of one plate: t, the thickness of the dielectric; K, the dielectric constant; and N, the number of plates,—the capacitance

$$C = 0.0885\, K \frac{(N-1)s}{t}.$$

Variable condenser, semicircular plates.—Where N is the total number of parallel plates; r_1 the outer, and r_2 the inner radius of the plates; t, the thickness of the dielectric, and K the dielectric constant,—the maximum capacitance is given by

$$C = 0.1390 K \frac{(N-1)(r_1^2 - r_2^2)}{t}.$$

Isolated thin circular disk. — If d is the diameter of the disk

$$C = 0.354d.$$

Isolated sphere. — If d is the diameter of the sphere

$$C = 0.556d.$$

Two concentric spheres. — If r_1 is the radius of the outer sphere; r_2, that of the inner sphere; K, the dielectric constant of the material between the spheres,

$$C = 1.112K \frac{r_1 r_2}{r_1 - r_2}.$$

Two coaxial cylinders. — If r_1 is the radius of the outer cylinder; r_2, that of the inner; l, the length of the cylinders; K, the dielectric constant,

$$C = K \frac{0.2416\, l}{\log_{10} \frac{r_1}{r_2}}.$$

Single long wire parallel to the ground. — For a wire of length l; diameter, d; suspended at a height h above the ground, where the diameter is small compared with the length, For $\frac{4h}{l} = \text{or} < 1$ $$C = \frac{0.2416\, l}{\log_{10} \frac{4h}{d} - k_1}$$

For $\frac{l}{4h} = \text{or} < 1$ $$C = \frac{0.2416\, l}{\log_{10} \frac{2\,l}{d} - k_2}$$

In which,

$$k_1 = \log_{10} \left[\frac{1 + \sqrt{1 + \left(\frac{4h}{l}\right)^2}}{2} \right] \qquad k_2 = \log_{10} \left[\frac{l}{4h} + \sqrt{1 + \left(\frac{l}{4h}\right)^2} \right]$$

the values of which may be found in a table at the end of this section.

Vertical wire. — For a wire of length l, relatively high above the ground; of diameter d, the approximate capacitance is as follows,

$$C = \frac{0.2416\, l}{\log_{10} \frac{2l}{d}}.$$

Two horizontal parallel wires at the same height. — If d is the diameter of each wire; l, the length of each; h, the height above the ground; D, the distance between wires, — where d and D are small compared to l,

$$C = \frac{0.1208\, l}{\log_{10} \frac{2D}{d} - \frac{D^2}{8h^2}}.$$

Two parallel horizontal wires, one above the other. — Use the preceding formula for parallel wires at the same height, substituting the mean height for h.

Two parallel wires joined together, both at the same height. — Let l be the length of each wire; D, the distance between centers; h, the height above the ground; d_2 the diameter of cross section of the wire. If d^2 and D^2 are small compared with l^2 and $4h^2$ respectively

For $\frac{4h}{l} = \text{or} < 1$ $$C = \frac{0.4831\, l}{\log_{10} \frac{4h}{d} + \log_{10} \frac{2h}{D} - 2k_1}.$$

For $\frac{l}{4h} = \text{or} < 1$ $$C = \frac{0.4831 l}{\log_{10} \frac{2l}{d} + \log_{10} \frac{l}{D} - 2k_2}.$$

k_1 and k_2 have the same significance as above and may be found from the tables at the end of the section.

Several wires in parallel.—If n parallel wires are joined together; D, the spacing between the wires; d, the diameter of the wire; h, the height above the ground; l, the length of the group,—the approximate capacitance is,

$$C = \frac{1.112\,l}{\dfrac{p_{11} + (n-1)p_{12}}{n} - k}.$$

p_{11} and p_{12} may be computed from the following:

For $\dfrac{4h}{l} = \text{or} < 1$

$$p_{11} = 4.605\left[\log_{10}\frac{4h}{d} - k_1\right]$$

$$p_{12} = 4.605\left[\log_{10}\frac{2h}{D} - k_1\right]$$

For $\dfrac{l}{4h} = \text{or} < 1$

$$p_{11} = 4.605\left[\log_{10}\frac{2l}{d} - k_2\right]$$

$$p_{12} = 4.605\left[\log_{10}\frac{l}{D} - k_2\right]$$

Values of k, k_1, k_2 may be found in the following table.

TABLE 1

$\frac{4h}{l}$	k_1	$\frac{l}{4h}$	k_2	n	k	n	k
0	0	0	0	2	0	11	2.22
0.1	0.001	0.1	0.043	3	0.308	12	2.37
.2	.004	.2	.086	4	.621	13	2.51
.3	.009	.3	.128	5	.906	14	2.63
.4	.016	.4	.169	6	1.18	15	2.74
.5	.025	.5	.209	7	1.43	16	2.85
.6	.035	.6	.247	8	1.66	17	2.95
.7	.045	.7	.283	9	1.86	18	3.04
.8	.057	.8	.318	10	2.05	19	3.14
.9	.069	.9	.351			20	3.24
1.0	.082	1.0	.383				

INDUCTANCE

Units. — In the following formulæ all lengths are expressed in centimeters. The inductance calculated will be in microhenries = 10^{-6} henry.

Long straight round wire. — If l is the length; d, the diameter of cross section; μ the permeability of the material, — the inductance at zero or low frequency is,

$$L = 0.002\,l\left[2.303\log_{10}\frac{4l}{d} - 1 + \frac{\mu}{4}\right]$$

For all except iron wire $\mu = 1$ and the last term becomes 0.25. For wires whose length is less than about 1000 times the diameter the term $+\frac{d}{2l}$ should be added inside the brackets.

For any frequency:

$$L = 0.002\,l\left[2.303 \log_{10} \frac{4l}{d} - 1 + \mu\delta\right]$$

where δ is a quantity given in Table 2 below as a function of x. x is to be computed from the relation

$$x = 0.1405 d\sqrt{\frac{\mu f}{\rho}}$$

where d and μ are as above; f, the frequency and ρ the resistivity of the material of the wire expressed in microhm-centimeters. (See Properties of Metallic Conductors.)

For copper at 20° C.

$$x = 0.1071\, d\sqrt{f}.$$

For wires other than iron, whose length is 100,000 times the diameter the inductance at infinite frequency is about 2% less than at zero frequency.

TABLE 2

Values of δ for computing inductance at any frequency.

x	δ	x	δ
0	0.250	12	0.059
0.5	.250	14	.050
1.0	.249	16	.044
1.5	.247	18	.039
2.0	.240	20	.035
2.5	.228	25	.028
3.0	.211	30	.024
3.5	.191	40	.0175
4.0	.1715	50	.014
4.5	.154	60	.012
5.0	.139	70	.010
6.0	.116	80	.009
7.0	.100	90	.008
8.0	.088	100	.007
9.0	.078	∞	.000
10.0	.070		

Two parallel round wires, return circuit.—If l is the length of each wire; d, the diameter; D, the distance between centers of wires; μ the permeability,—the inductance for any frequency is

$$L=0.004\,l\left[2.303\log_{10}\frac{2D}{d}-\frac{D}{l}+\mu\delta\right]$$

where δ is a quantity to be obtained from the table above as a function of x which is to be computed as explained for the previous formula.

For copper and at low frequency the term δ becomes 0.25.

Square of round wire.—If a is the length of the side of the square; d, the diameter of the wire; μ the permeability, the inductance for any frequency is,

$$L=0.008a\left[2.303\log_{10}\frac{2a}{d}+\frac{d}{2a}-0.774+\mu\delta\right]$$

where δ is obtained as above. For low frequency and for wires other than iron δ becomes 0.25; for infinite frequency the value is zero.

Grounded horizontal wire, the Earth acting as return circuit. If l is the length of wire; h, the height above the ground; l, the diameter of the wire; μ the permeability and δ the frequency constant (see table 2), the inductance,—where d is small compared with l,—is given as follows:

For $\frac{2h}{l}$ =or <1 $\qquad L=0.002\,l\left[2.3026\log_{10}\frac{4h}{d}-P+\mu\delta\right]$

For $\frac{l}{2h}$ =or <1 $\qquad L=0.002\,l\left[2.3026\log_{10}\frac{4\,l}{d}-Q+\mu\delta\right]$

P and Q may be found in the following table.

TABLE 3

$\frac{2h}{l}$	P	$\frac{l}{2h}$	Q	$\frac{2h}{l}$	P	$\frac{l}{2h}$	Q
0	0	0	1.0000	0.6	0.5136	0.6	1.2918
0.1	0.0975	0.1	1.0499	.7	.5840	.7	1.3373
.2	.1900	.2	1.0997	.8	.6507	.8	1.3819
.3	.2778	.3	1.1489	.9	.7139	.9	1.4251
.4	.3608	.4	1.1975	1.0	.7740	1.0	1.4672
.5	.4393	.5	1.2452	.....	....	.....	....

The mutual inductance of the case above may be expressed, For $\frac{2h}{l} = \text{or} < 1$ $\quad M = 0.002\,l\left[2.3026 \log_{10}\frac{2h}{D} - P + \frac{D}{l}\right]$

For $\frac{l}{2h} = \text{or} < 1$ $\quad M = 0.002\,l\left[2.3026 \log_{10}\frac{2l}{D} - Q + \frac{D}{l}\right]$

The values of P and Q are found in the table above.

Grounded wires in parallel. — Compute by the above formulae the inductance L_1 per unit length of a single wire and the mutual inductance M_1 per unit length of two adjacent wires, using the actual length in determining the ratios $\frac{2h}{l}$, $\frac{2l}{d}$ etc. Then the inductance of n parallel wires will be,

$$L = l\left[\frac{L_1 + (n-1)M_1}{n} - 0.001k\right]$$

where k is a function of n found in Table 1 under capacity formulae.

Circular ring of round wire. — If a is the mean radius of the ring; d, the diameter of the wire, the inductance at any frequency is

$$L = 0.01257a\left[2.303 \log_{10}\frac{16a}{d} - 2 + \mu\delta\right]$$

where δ is determined from the table above.

Circular coil of circular cross section. — For a coil of n fine wires wound with mean radius of the turns a, the cross section of whose winding is a circle of diameter d, the inductance at low frequency, for wire other than iron, neglecting insulation space is,

$$L = 0.01257an^2\left[2.303 \log_{10}\frac{16a}{d} - 1.75\right]$$

Torus with a single layer transverse winding, — a circular solenoid of circular cross section. If r is the distance from the center of the torus to the center of the transverse section; a, the radius of the turns of the winding; n, the number of turns, the inductance at low frequency is

$$L = 0.01257n^2\left[r - \sqrt{r^2 - a^2}\right]$$

Solenoid, single layer. If n is the number of turns; a the radius of the coil; b, the length, the approximate inductance at any frequency is,

$$L = \frac{0.03948a^2n^2}{b}K$$

where K is a function of $\frac{2a}{b}$ given in the table below.

TABLE 4

$\frac{2a}{b}$	K	$\frac{2a}{b}$	K	$\frac{2a}{b}$	K
0.00	1.0000	2.00	0.5255	7.00	0.2584
.05	.9791	2.10	.5137	7.20	.2537
.10	.9588	2.20	.5025	7.40	.2491
.15	.9391	2.30	.4918	7.60	.2448
.20	.9201	2.40	.4816	7.80	.2406
.25	.9016	2.50	.4719	8.00	.2366
.30	.8838	2.60	.4626	8.50	.2272
.35	.8665	2.70	.4537	9.00	.2185
.40	.8499	2.80	.4452	9.50	.2106
.45	.8337	2.90	.4370	10.00	.2033
50	.8181	3.00	.4292	......	......
.55	.8031	3.10	.4217	11.0	.1903
.60	.7885	3.20	.4145	12.0	.1790
.65	.7745	3.30	.4075	13.0	.1692
.70	.7609	3.40	.4008	14.0	.1605
.75	.7478	3.50	.3944	15.0	.1527
.80	.7351	3.60	.3882	16.0	.1457
.85	.7228	3.70	.3822	17.0	.1394
.90	.7110	3.80	.3764	18.0	.1336
.95	.6995	3.90	.3708	19.0	.1284
1.00	.6884	4.00	.3654	20.0	.1236
1.05	.6777	4.10	.3602	22.0	.1151
1.10	.6673	4.20	.3551	24.0	.1078
1.15	.6573	4.30	.3502	26.0	.1015
1.20	.6475	4.40	.3455	28.0	.0959
1.25	.6381	4.50	.3409	30.0	.0910
1.30	.6290	4.60	.3364	35.0	.0808
1.35	.6201	4.70	.3321	40.0	.0728
1.40	.6115	4.80	.3279	45.0	.0664
1.45	.6031	4.90	.3238	50.0	.0611
1.50	.5950	5.00	.3198	60.0	.0528
1.55	.5871	5.20	.3122	70.0	.0467
1.60	.5795	5.40	.3050	80.0	.0419
1.65	.5721	5.60	.2981	90.0	.0381
1.70	.5649	5.80	.2916	100.0	.0350
1.75	.5579	6.00	.2854	......	......
1.80	.5511	6.20	.2795	......	......
1.85	.5444	6.40	.2739	......	......
1.90	.5379	6.60	.2685	......	......
1.95	.5316	6.80	.2633	......	......

Long multiple layer solenoid. — The inductance is given approximately by,

$$L = L_1 - \frac{0.01257 n^2 ac}{b}(0.693 + B_s)$$

where L_1 is the inductance calculated from the formula for a single layer solenoid, n being the number of turns of the winding; a, the radius of the coil measured from the axis to the center of the cross section of the winding; b, the length of the coil; c, the radial depth of the winding; B_s a correction given in table below as a function of b/c.

TABLE 5

b/c	B_s	b/c	B_s
1	0.0000	16	0.3017
2	.1202	17	.3041
3	.1753	18	.3062
4	.2076	19	.3082
5	.2292	20	.3099
6	.2446	21	.3116
7	.2563	22	.3131
8	.2656	23	.3145
9	.2730	24	.3157
10	.2792	25	.3169
11	.2844	26	.3180
12	.2888	27	.3190
13	.2927	28	.3200
14	.2961	29	.3209
15	.2991	30	.3218

Square coil of rectangular cross section. — If a be the side of the square measured to the center of the rectangular section which has sides b and c and if n be the number of turns,

$$L = 0.008an^2\left[2.303 \log_{10} \frac{a}{b+c} + 0.2235 \frac{b+c}{a} + 0.726\right]$$

If the cross section is a square $b = c$ and the expression becomes

$$L = 0.008an^2\left[2.303 \log_{10} \frac{a}{b} + 0.447 \frac{b}{a} + 0.033\right]$$

MUTUAL INDUCTANCE

Two parallel wires. — If l be the length of each wire; D. the distance between, the inductance is

$$M = 0.002\, l\left[2.303 \log_{10} \frac{2l}{D} - 1 + \frac{D}{l}\right]$$

Coaxial solenoids, single layer coils, not concentric. If a is the radius of the smaller coil; A, the radius of the larger: n_1 and n_2 the number of turns on the smaller and larger coil respectively; $2l$ the length of the smaller coil; $2x$, the length of the larger; D, the distance between the centers of the coils measured along the common axis,

$$M = 0.009870\frac{a^2A^2n_1n_2}{2x.2\,l}\left[K_1k_1 + K_3k_3 + K_5k_5\right]$$

where

$$K_1 = \frac{2}{A^2}\left(\frac{x_2}{r_2} - \frac{x_1}{r_1}\right) \qquad k_1 = 2\,l$$

$$K_3 = \frac{1}{2}\left(\frac{x_1}{r_1^5} - \frac{x_2}{r_2^5}\right) \qquad k_3 = a^2\,l\left(3 - 4\frac{l^2}{a^2}\right)$$

$$K_5 = -\frac{A^2}{8}\left[\frac{x_1}{r_1^9}\left(3 - 4\frac{x_1^2}{A^2}\right) - \frac{x_2}{r_2^9}\left(3 - 4\frac{x_2^2}{A^2}\right)\right]$$

$$k_5 = a^4\,l\left(\frac{5}{2} - 10\frac{l^2}{a^2} + 4\frac{l^4}{a^4}\right)$$

where

$$x_1 = D - x \qquad r_1 = \sqrt{x_1^2 + A^2}$$

$$x_2 = D + x \qquad r_2 = \sqrt{x_2^2 + A^2}$$

The above is most accurate for short coils with relatively great distance between.

Coaxial, concentric solenoids, outer coil the longer. If a be the radius of the smaller coil; A, that of the larger; $2l$, the length of the inner coil; $2x$, the length of the outer; n_1 and n_2 the number of turns on the inner and outer coil respectively,

$$M = \frac{0.01974a^2n_1n_2}{g}\left[1 + \frac{A^2a^2}{8g^4}\left(3 - 4\frac{l^2}{a^2}\right)\right]$$

where $g = \sqrt{x^2 + A^2}.$

Coaxial, concentric solenoids, outer coil the shorter. Assuming the symbols as before except

$$g = \sqrt{l^2 + A^2}$$

$$M = 0.01974\frac{a^2n_1n_2}{g}\left[1 + \frac{A^2a^2}{8g^4}\left(3 - 4\frac{x^2}{a^2}\right)\right]$$

HIGH FREQUENCY RESISTANCE

Cylindrical straight wires.—The ratio R/R_0 of the high frequency resistance to the resistance at low frequency may be found from the table below, by calculating first the value of x from the relation,

$$x = \pi d\sqrt{\frac{2\mu f}{\rho}}\sqrt{\frac{1}{1000}}$$

where d is the diameter of the wire in centimeters; μ, the magnetic permeability; f, the frequency; ρ, the resistivity in microhm-centimeters.

RADIO FORMULAE (Continued)

For copper wire $x = 10da$ where a has a value given by $a = 0.01071\sqrt{f}$. The value of a for various frequencies may be found in the second of the two tables below. The above method gives the high-frequency resistance of simple circuits of any shape where the length is great compared with the diameter of the wire and the different portions of the circuit are not close to each other.

TABLE 6

Ratio of High-Frequency Resistance to the Direct-Current Resistance.

x	R/R_0	x	R/R_0	x	R/R_0
0	1.0000	5.2	2.114	14.0	5.209
0.5	1.0003	5.4	2.184	14.5	5.386
.6	1.0007	5.6	2.254	15.0	5.562
.7	1.0012	5.8	2.324	16.0	5.915
.8	1.0021	6.0	2.394	17.0	6.268
.9	1.0034	6.2	2.463	18.0	6.621
1.0	1.005	6.4	2.533	19.0	6.974
1.1	1.008	6.6	2.603	20.0	7.328
1.2	1.011	6.8	2.673	21.0	7.681
1.3	1.015	7.0	2.743	22.0	8.034
1.4	1.020	7.2	2.813	23.0	8.387
1.5	1.026	7.4	2.884	24.0	8.741
1.6	1.033	7.6	2.954	25.0	9.094
1.7	1.042	7.8	3.024	26.0	9.447
1.8	1.052	8.0	3.094	28.0	10.15
1.9	1.064	8.2	3.165	30.0	10.86
2.0	1.078	8.4	3.235	32.0	11.57
2.2	1.111	8.6	3.306	34.0	12.27
2.4	1.152	8.8	3.376	36.0	12.98
2.6	1.201	9.0	3.446	38.0	13.69
2.8	1.256	9.2	3.517	40.0	14.40
3.0	1.318	9.4	3.587	42.0	15.10
3.2	1.385	9.6	3.658	44.0	15.81
3.4	1.456	9.8	3.728	46.0	16.52
3.6	1.529	10.0	3.799	48.0	17.22
3.8	1.603	10.5	3.975	50.0	17.93
4.0	1.678	11.0	4.151	60.0	21.47
4.2	1.752	11.5	4.327	70.0	25.00
4.4	1.826	12.0	4.504	80.0	28.54
4.6	1.899	12.5	4.680	90.0	32.07
4.8	1.971	13.0	4.856	100.0	35.61
5.0	2.043	13.5	5.033	.....	......

As an extension of the above table the following relation may be used:

$$R/R_0 = x/2.828 + 0.25.$$

The equation is valid for values of x greater than 7 at which point the error is about 1 % and decreasing with increasing values of x.

TABLE 7

Values of a ($=0.01071\sqrt{f}$) for various frequencies.

f	a	Wave-length meters	f	a	Wave-length meters
100	0.1071	......	50,000	2.395	6,000
200	.1514	......	60,000	2.624	5,000
300	.1855	......	70,000	2.834	4,286
400	.2142	......	80,000	3.029	3,750
500	.2395	......	90,000	3.213	3,333
600	.2624	......	100,000	3.387	3,000
700	.2834	......	150,000	4.148	2,000
800	.3029	......	200,000	4.790	1,500
900	.3213	......	250,000	5.355	1,200
1,000	.3387	......	300,000	5.866	1,000
2,000	.4790	......	333,333	6.184	900
3,000	.5866	......	375,000	6.564	800
4,000	.6774	......	428,570	7.012	700
5,000	.7573	......	500,000	7.573	600
6,000	.8296	......	600,000	8.296	500
7,000	.8960	......	700,000	8.960	429
8,000	.9579	......	750,000	9.275	400
9,000	1.0160	......	800,000	9.579	375
10,000	1.071	30,000	900,000	10.16	333
15,000	1.312	20,000	1,000,000	10.71	300
20,000	1.514	15,000	1,500,000	13.12	200
30,000	1.855	10,000	3,000,000	18.55	100
40,000	2.142	7,500	....	......	.....

WAVE LENGTH

The wave length in meters is given by the following expression when L, the inductance, is in microhenries and C, the capacitance, is in microfarads. The resistance is assumed negligible.

$$\lambda = 1884\sqrt{LC}$$

VALUES OF "L C"

Compiled by Doctor P. L. Bayley

The following table gives values of the product of the inductance and capacitance (L C).

Key for Locating the Decimal Point for Expanded Ranges of "L C"

λ in meters	f in kilocycles per sec.	L C in microhenries × microfarads	
1	299,793	0.000,000,280,837	
6	49,965.5	0.000,010,146,1	
10	29,979.3	0.000,028,183,7	
60	4,996.55	0.001,014,61	Range of values in the main table
100	2,997.93	0.002,818,37	
600	499.655	0.101,461	
1,000	299.793	0.281,837	
6,000	49.9655	10.146,1	
10,000	29.9793	28.183,7	

λ	f	L C	λ	f	L C
59	5081.24	0.000981073	84	3568.96	0.00198864
60	4996.55	0.001014610	85	3526.98	0.00203627
61	4914.64	0.001048714	86	3485.97	0.00208446
62	4835.37	0.00108338	87	3445.90	0.00213322
63	4758.62	0.00111861	88	3406.74	0.00218254
64	4684.27	0.00115440	89	3368.46	0.00223243
65	4612.20	0.00119076	90	3331.03	0.00228288
66	4542.32	0.00122768	91	3294.43	0.00233389
67	4474.52	0.00126516	92	3258.62	0.00238546
68	4408.72	0.00130321	93	3223.58	0.00243760
69	4344.82	0.00134182	94	3189.29	0.00249031
70	4282.76	0.00138100	95	3155.72	0.00254358
71	4222.44	0.00142074	96	3122.84	0.00259741
72	4163.79	0.00146104	97	3090.65	0.00265180
73	4106.75	0.00150191	98	3059.11	0.00270676
74	4051.26	0.00154334	99	3028.21	0.00276228
75	3997.24	0.00158533	100	2997.93	0.00281837
76	3944.64	0.00162789	101	2968.25	0.00287502
77	3893.42	0.00167101	102	2939.15	0.00293223
78	3843.50	0.00171469	103	2910.61	0.00299000
79	3794.85	0.00175894	104	2882.63	0.00304834
80	3747.41	0.00180375	105	2855.17	0.00310725
81	3701.15	0.00184913	106	2828.24	0.00316675
82	3656.01	0.00189507	107	2801.80	0.00322674
83	3611.96	0.00194157	108	2775.86	0.00328734

VALUES OF "L C" (Continued)

λ	f	L C	λ	f	L C
109	2750.39	0.00334850	158	1897.42	0.00703577
110	2725.39	0.00341022	159	1885.49	0.00712511
111	2700.84	0.00347251	160	1873.71	0.00721502
112	2676.72	0.00353536	161	1862.07	0.00730548
113	2653.04	0.00359877	162	1850.57	0.00739652
114	2629.76	0.00366275	163	1839.22	0.00748811
115	2606.90	0.00372729	164	1828.01	0.00758028
116	2584.42	0.00379239	165	1816.93	0.00767300
117	2562.33	0.00385806	166	1805.98	0.00776629
118	2540.62	0.00392429	167	1795.17	0.00786014
119	2519.27	0.00399109	168	1784.48	0.00795455
120	2498.28	0.00405845	169	1773.92	0.00804953
121	2477.63	0.00412637	170	1763.49	0.00814508
122	2457.32	0.00419486	171	1753.18	0.00824118
123	2437.34	0.00426390	172	1742.98	0.00833785
124	2417.69	0.00433352	173	1732.91	0.00843509
125	2398.34	0.00440370	174	1722.95	0.00853288
126	2379.31	0.00447444	175	1713.10	0.00863124
127	2360.57	0.00454574	176	1703.37	0.00873017
128	2342.13	0.00461761	177	1693.75	0.00882966
129	2323.98	0.00469004	178	1684.23	0.00892971
130	2306.10	0.00476304	179	1674.82	0.00903032
131	2288.50	0.00483660	180	1665.52	0.00913150
132	2271.16	0.00491072	181	1656.31	0.00923325
133	2254.08	0.00498541	182	1647.21	0.00933555
134	2237.26	0.00506066	183	1638.21	0.00943842
135	2220.69	0.00513647	184	1629.31	0.00954186
136	2204.36	0.00521285	185	1620.50	0.00964586
137	2188.27	0.00528979	186	1611.7	0.00975042
138	2172.41	0.00536730	187	1603.17	0.00985542
139	2156.78	0.00544536	188	1594.64	0.00996123
140	2141.38	0.00552400	189	1586.21	0.01006764
141	2126.19	0.00560319	190	1577.86	0.01017430
142	2111.22	0.00568295	191	1569.60	0.01028168
143	2096.45	0.00576328	192	1561.42	0.0103896_2
144	2081.90	0.00584416	193	1553.33	0.0104981_3
145	2067.54	0.00592561	194	1545.32	0.0106072
146	2053.38	0.00600763	195	1537.40	0.0107168
147	2039.41	0.00609021	196	1529.56	0.0108270
148	2025.63	0.00617335	197	1521.79	0.0109378
149	2012.03	0.00625705	198	1514.11	0.0110491
150	1998.62	0.00634132	199	1506.50	0.0111610
151	1985.38	0.00642615	200	1498.97	0.0112735
152	1972.32	0.00651155	201	1491.51	0.0113865
153	1959.43	0.00659751	202	1484.12	0.0115001
154	1946.71	0.00668404	203	1476.81	0.0116142
155	1934.15	0.00677112	204	1469.57	0.0117289
156	1921.75	0.00685877	205	1462.40	0.0118442
157	1909.51	0.00694699	206	1455.31	0.0119600

VALUES OF "L C" (Continued)

λ	*f*	L C	λ	*f*	L C
207	1448.28	0.0120764	256	1171.07	0.0184704
208	1441.31	0.0121934	257	1166.51	0.0186150
209	1434.42	0.0123109	258	1161.99	0.0187602
210	1427.59	0.0124290	259	1157.50	0.0189059
211	1420.82	0.0125476	260	1153.05	0.0190522
212	1414.12	0.0126669	261	1148.63	0.0191990
213	1407.48	0.0127866	262	1144.25	0.0193464
214	1400.90	0.0129070	263	1139.90	0.0194944
215	1394.39	0.0130280	264	1135.58	0.0196429
216	1387.93	0.0131494	265	1131.29	0.0197920
217	1381.53	0.0132714	266	1127.04	0.0199416
218	1375.20	0.0133940	267	1122.82	0.0200918
219	1368.92	0.0135172	268	1118.63	0.0202426
220	1362.70	0.0136409	269	1114.47	0.0203940
221	1356.53	0.0137652	270	1110.34	0.0205459
222	1350.42	0.0138900	271	1106.25	0.0206981
223	1344.36	0.0140154	272	1102.18	0.0208514
224	1338.36	0.0141414	273	1098.14	0.0210050
225	1332.41	0.0142680	274	1094.14	0.0211592
226	1326.51	0.0143951	275	1090.16	0.0213139
227	1320.67	0.0145228	276	1086.21	0.0214692
228	1314.89	0.0146510	277	1082.29	0.0216250
229	1309.14	0.0147798	278	1078.39	0.0217815
230	1303.45	0.0149092	279	1074.53	0.0219384
231	1297.81	0.0150391	280	1070.69	0.0220960
232	1292.21	0.0151696	281	1066.88	0.0222541
233	1286.67	0.0153006	282	1063.10	0.0224128
234	1281.17	0.0154322	283	1059.34	0.0225720
235	1275.71	0.0155644	284	1055.61	0.0227318
236	1270.31	0.0156972	285	1051.91	0.0228922
237	1264.95	0.0158305	286	1048.23	0.0230531
238	1259.63	0.0159644	287	1044.57	0.0232146
239	1254.36	0.0160988	288	1040.95	0.0233767
240	1249.14	0.0162338	289	1037.35	0.0235393
241	1243.95	0.0163693	290	1033.77	0.0237025
242	1238.81	0.0165055	291	1030.22	0.0238662
243	1233.72	0.0166422	292	1026.69	0.0240305
244	1228.66	0.0167794	293	1023.18	0.0241954
245	1223.64	0.0169172	294	1019.70	0.0243608
246	1218.67	0.0170556	295	1016.25	0.0245268
247	1213.74	0.0171946	296	1012.81	0.0246934
248	1208.84	0.0173341	297	1009.40	0.0248605
249	1203.99	0.0174742	298	1006.02	0.0250281
250	1199.17	0.0176148	299	1002.66	0.0251965
251	1194.39	0.0177560	300	999.310	0.0253653
252	1189.65	0.0178978	301	995.990	0.0255347
253	1184.95	0.0180403	302	992.692	0.0257046
254	1180.29	0.0181830	303	989.416	0.0258751
255	1175.66	0.0183264	304	986.161	0.0260462

VALUES OF "L C" (Continued)

λ	f	L C	λ	f	L C
305	982.928	0.0262178	354	846.873	0.0353186
306	979.716	0.0263900	355	844.487	0.0355185
307	976.524	0.0265628	356	842.115	0.0357189
308	973.354	0.0267361	357	839.756	0.0359198
309	970.204	0.0269100	358	837.411	0.0361213
310	967.074	0.0270845	359	835.078	0.0363234
311	963.965	0.0272595	360	832.758	0.0365260
312	960.875	0.0274351	361	830.452	0.0367292
313	957.805	0.0276112	362	828.157	0.0369330
314	954.755	0.0277880	363	825.876	0.0371373
315	951.724	0.0279652	364	823.607	0.0373527
316	948.712	0.0281431	365	821.351	0.0375477
317	945.719	0.0283215	366	819.107	0.0377537
318	942.745	0.0285004	367	816.875	0.0379603
319	939.790	0.0286800	368	814.655	0.0381674
320	936.853	0.0288601	369	812.447	0.0383751
321	933.935	0.0290407	370	810.251	0.0385834
322	931.034	0.0292219	371	808.067	0.0387923
323	928.152	0.0294037	372	805.895	0.0390017
324	925.287	0.0295861	373	803.735	0.0392116
325	922.440	0.0297690	374	801.586	0.0394222
326	919.610	0.0299525	375	799.448	0.0396333
327	916.798	0.0301365	376	797.322	0.0398449
328	914.003	0.0303211	377	795.207	0.0400572
329	911.225	0.0305063	378	793.103	0.0402699
330	908.464	0.0306920	379	791.010	0.0404833
331	905.719	0.0308783	380	788.929	0.0406972
332	902.991	0.0310652	381	786.858	0.0409117
333	900.279	0.0312526	382	784.798	0.0411267
334	897.584	0.0314406	383	782.749	0.0413423
335	894.904	0.0316292	384	780.111	0.0415585
336	892.241	0.0318182	385	778.683	0.0417752
337	889.593	0.0320079	386	776.666	0.0419925
338	886.961	0.0321981	387	774.659	0.0422104
339	884.345	0.0323889	388	772.662	0.0424298
340	881.744	0.0325803	389	770.676	0.0426478
341	879.158	0.0327722	390	768.700	0.0428673
342	876.588	0.0329647	391	766.734	0.0430875
343	874.032	0.0331611	392	764.778	0.0433081
344	871.491	0.0333514	393	762.832	0.0435294
345	868.965	0.0335456	394	760.896	0.0437512
346	866.454	0.0337403	395	758.970	0.0439736
347	863.957	0.0339357	396	757.053	0.0441965
348	861.474	0.0341315	397	755.146	0.0444200
349	859.006	0.0343280	398	753.225	0.0446440
350	856.551	0.0345250	399	751.361	0.0448687
351	854.111	0.0347225	400	749.483	0.0450938
352	851.685	0.0349207	401	747.614	0.0453196
353	849.272	0.0351194	402	745.754	0.0455459

VALUES OF "L C" (Continued)

λ	f	L C	λ	f	L C
403	743.903	0.0457728	452	663.259	0.0575803
404	742.062	0.0460002	453	661.795	0.0578354
405	740.230	0.0462282	454	660.337	0.0580910
406	738.406	0.0464568	455	658.886	0.0583472
407	736.592	0.0466859	456	657.441	0.0586040
408	734.787	0.0469156	457	656.002	0.0588613
409	732.990	0.0471459	458	654.570	0.0591192
410	731.202	0.0473767	459	653.144	0.0593776
411	729.423	0.0476081	460	651.724	0.0596366
412	727.653	0.0478401	461	650.310	0.0598962
413	725.891	0.0480726	462	648.903	0.0601563
414	724.138	0.0483306	463	647.501	0.0604172
415	722.393	0.0485393	464	646.106	0.0606783
416	720.656	0.0487735	465	644.716	0.0609401
417	718.928	0.0490083	466	643.333	0.0612025
418	717.208	0.0492436	467	641.955	0.0614655
419	715.496	0.0494795	468	640.584	0.0617290
420	713.793	0.0497160	469	639.217	0.0619931
421	712.097	0.0499530	470	637.857	0.0622577
422	710.410	0.0501906	471	636.503	0.0625229
423	708.731	0.0504287	472	635.155	0.0627887
424	707.060	0.0506675	473	633.812	0.0630550
425	705.395	0.0509067	474	632.475	0.0633219
426	703.739	0.0511466	475	631.143	0.0635894
427	702.091	0.0513870	476	629.817	0.0638574
428	700.451	0.0516279	477	628.497	0.0641260
429	698.818	0.0518695	478	627.182	0.0643951
430	697.193	0.0521116	479	625.873	0.0646649
431	695.575	0.0523542	480	624.569	0.0649351
432	693.965	0.0525975	481	623.270	0.0652060
433	692.363	0.0528413	482	621.977	0.0654774
434	690.767	0.0530856	483	620.689	0.0657494
435	689.179	0.0533305	484	619.407	0.0660219
436	687.599	0.0535760	485	618.130	0.0662950
437	686.025	0.0538220	486	616.858	0.0665687
438	684.459	0.0540687	487	615.591	0.0668429
439	682.900	0.0543158	488	614.330	0.0671177
440	681.348	0.0545636	489	613.074	0.0673930
441	679.803	0.0548119	490	611.822	0.0676690
442	678.265	0.0550610	491	610.576	0.0679454
443	676.734	0.0553101	492	609.335	0.0682225
444	675.209	0.0555601	493	608.099	0.0685001
445	673.692	0.0558107	494	606.868	0.0687783
446	672.182	0.0560618	495	605.642	0.0690570
447	670.678	0.0563135	496	604.421	0.0693363
448	669.181	0.0565657	497	603.205	0.0696162
449	667.690	0.0568185	498	601.994	0.0698966
450	666.206	0.0570719	499	600.788	0.0701776
451	664.729	0.0573258	500	599.586	0.0704591

VALUES OF "L C" (Continued)

λ	*f*	L C	λ	*f*	L C
501	598.389	0.0707413	551	544.089	0.0855659
502	597.197	0.0710239	552	543.103	0.0858767
503	596.010	0.0713072	553	542.121	0.0861881
504	594.827	0.0715910	554	541.143	0.0865001
505	593.650	0.0718754	555	540.168	0.0868127
506	592.476	0.0721160	556	539.196	0.0871258
507	591.308	0.0724458	557	538.228	0.0874395
508	590.144	0.0727319	558	537.263	0.0877538
509	588.984	0.0730185	559	536.302	0.0880686
510	587.829	0.0733057	560	535.345	0.0883839
511	586.679	0.0735934	561	534.390	0.0886999
512	585.533	0.0738818	562	533.440	0.0890163
513	584.392	0.0741706	563	532.492	0.0893334
514	583.255	0.0744601	564	531.548	0.0896511
515	582.122	0.0747501	565	530.607	0.0899693
516	580.994	0.0750407	566	529.670	0.0902880
517	579.870	0.0753318	567	528.735	0.0906073
518	578.751	0.0756235	568	527.805	0.0909272
519	577.636	0.0759158	569	526.877	0.0912477
520	576.525	0.0762086	570	525.953	0.0915687
521	575.418	0.0765020	571	525.031	0.0918903
522	574.316	0.0767959	572	524.114	0.0922124
523	573.218	0.0770905	573	523.199	0.0925351
524	572.124	0.0773855	574	522.287	0.0928584
525	571.034	0.0776812	575	521.379	0.0931822
526	569.949	0.0779774	576	520.474	0.0935066
527	568.867	0.0782742	577	519.572	0.0938156
528	567.790	0.0785715	578	518.673	0.0941571
529	566.716	0.0788694	579	517.777	0.0944832
530	565.647	0.0791679	580	516.884	0.0948098
531	564.582	0.0794668	581	515.995	0.0951370
532	563.521	0.0797664	582	515.108	0.0954648
533	562.463	0.0800667	583	514.225	0.0957931
534	561.410	0.0803674	584	513.344	0.0961220
535	560.361	0.0806687	585	512.467	0.0964515
536	559.315	0.0809705	586	511.592	0.0967815
537	558.274	0.0812729	587	510.721	0.0971121
538	557.236	0.0815759	588	509.852	0.0974423
539	556.202	0.0818794	589	508.986	0.0977750
540	555.172	0.0821835	590	508.124	0.0981073
541	554.146	0.0824882	591	507.264	0.0984401
542	553.124	0.0827934	592	506.407	0.0987736
543	552.105	0.0830992	593	505.553	0.0991075
544	551.090	0.0834056	594	504.702	0.0994421
545	550.079	0.0837125	595	503.854	0.0997772
546	549.071	0.0840200	596	503.008	0.1001127
547	548.068	0.0843280	597	502.166	0.1004491
548	547.068	0.0846366	598	501.326	0.1007858
549	546.071	0.0849458	599	500.489	0.1011232
550	545.078	0.0852556	600	499.655	0.1014610

VALUES OF ω AND $1/\omega^2$

Computed by C. W. Winkler,
submitted by J. Johnsen

The values for ω were computed to 9 significant figures and rounded to 8. These values, in the range 100 to 1000 kc, were obtained by adding the common difference $2\pi \times 10^{-2}$ for intervals of 1 kc. Every fifth entry was checked by adding $\pi \times 10^{-1}$ to the previous key entry. Values from 1000 to 2000 kc were obtained in the same way except the common difference here is $2\pi \times 10^{-3}$. The values for $1/\omega^2$ were obtained by taking the reciprocal of the squared values of ω and were checked with some previously computed tables.

EXTENSION OF TABLES

Let the tabulated value for ω be M. The range of the tables may be extended as follows:

Frequency	ω	$1/\omega^2$
5 cycles	$M \times 10^{-5}$	$M \times 10^{10}$
50 cycles	$M \times 10^{-4}$	$M \times 10^{8}$
500 cycles	$M \times 10^{-3}$	$M \times 10^{6}$
5 kc	$M \times 10^{-2}$	$M \times 10^{4}$
50 kc	$M \times 10^{-1}$	$M \times 10^{2}$
500 kc	M	M
5 mc	$M \times 10$	$M \times 10^{-2}$
50 mc	$M \times 10^{2}$	$M \times 10^{-4}$
500 mc	$M \times 10^{3}$	$M \times 10^{-6}$
5000 mc	$M \times 10^{4}$	$M \times 10^{-8}$

VALUES OF ω

Freq. kc	$\omega \times 10^5$	Freq. kc	$\omega \times 10^6$	Freq. kc	$\omega \times 10^6$	Freq. kc	$\omega \times 10^6$
100	6.2831853						
105	6.5973446	205	1.2880530	305	1.9163715	405	2.5446900
110	6.9115038	210	1.3194689	310	1.9477874	410	2.5761060
115	7.2256631	215	1.3508848	315	1.9792034	415	2.6075219
120	7.5398224	220	1.3823008	320	2.0106192	420	2.6389378
125	7.8539816	225	1.4137167	325	2.0420352	425	2.6703538
130	8.1681409	230	1.4451326	330	2.0734511	430	2.7017697
135	8.4823001	235	1.4765485	335	2.1048671	435	2 7331856
140	8.7964594	240	1.5079645	340	2.1362830	440	2.7646015
145	9.1106187	245	1.5393804	345	2.1676989	445	2.7960175
150	9.4247779	250	1.5707963	350	2.1991148	450	2.8274334
155	9.7389372	255	1.6022122	355	2.2305308	455	2.8588493
160	10.0530965	260	1.6336282	360	2.2619467	460	2.8902652
	ω 10^6						
165	1.0367256	265	1.6650441	365	2 2933626	465	2.9216812
170	1.0681415	270	1.6964600	370	2.3247786	470	2.9530971
175	1.0995574	275	1.7278759	375	2.3561945	475	2.9845130
180	1.1309733	280	1.7592919	380	2.3876104	480	3.0159289
185	1.1623893	285	1.7907078	385	2.4190263	485	3.0473449
190	1.1938052	290	1.8221237	390	2.4504423	490	3.0787608
195	1.2252211	295	1.8535397	395	2.4818582	495	3.1101767
200	1.2566371	300	1.8849556	400	2.5132741	500	3.1415927

VALUES OF ω (Continued)

Freq. kc	$\omega \times 10^6$	Freq. kc	$\omega \times 10^6$	Freq. kc	$\omega \times 10^6$	Freq. kc	$\omega \times 10^6$
505	3.1730086	755	4.7438049	1005	6.3146012	1255	7.8853976
510	3.2044245	760	4.7752208	1010	6.3460172	1260	7.9168135
515	3.2358404	765	4.8066368	1015	6.3774331	1265	7.9482294
520	3.2672564	770	4.8380527	1020	6.4088490	1270	7.9796453
525	3.2986723	775	4.8694686	1025	6.4402649	1275	8.0110613
530	3.3300882	780	4.9008845	1030	6.4716809	1280	8.0424772
535	3.3615041	785	4.9323005	1035	6.5030968	1285	8.0738931
540	3.3929200	790	4.9637164	1040	6.5345127	1290	8.1053090
545	3.4243360	795	4.9951323	1045	6.5659286	1295	8.1367250
550	3.4557519	800	5.0265482	1050	6.5973446	1300	8.1681409
555	3.4871678	805	5.0579642	1055	6.6287605	1305	8.1995568
560	3.5185838	810	5.0893801	1060	6.6601764	1310	8.2309727
565	3.5499997	815	5.1207960	1065	6.6915923	1315	8.2623887
570	3.5814156	820	5.1522119	1070	6.7230083	1320	8.2938046
575	3.6128315	825	5.1836279	1075	6.7544242	1325	8.3252205
580	3.6442475	830	5.2150438	1080	6.7858401	1330	8.3566364
585	3.6756634	835	5.2464597	1085	6.8172561	1335	8.3880524
590	3.7070793	840	5.2778757	1090	6.8486720	1340	8.4194683
595	3.7384953	845	5.3092916	1095	6.8800879	1345	8.4508842
600	3.7699112	850	5.3407075	1100	6.9115038	1350	8.4823002
605	3.8013271	855	5.3721234	1105	6.9429198	1355	8.5137161
610	3.8327430	860	5.4035394	1110	6.9743357	1360	8.5451320
615	3.8641590	865	5.4349553	1115	7.0057516	1365	8.5765479
620	3.8955749	870	5.4663712	1120	7.0371675	1370	8.6079639
625	3.9269908	875	5.4977871	1125	7.0685835	1375	8.6393798
630	3.9584067	880	5.5292031	1130	7.0999994	1380	8.6707957
635	3.9896827	885	5.5606190	1135	7.1314153	1385	8.7022116
640	4.0212386	890	5.5920349	1140	7.1628312	1390	8.7336276
645	4.0526545	895	5.6234508	1145	7.1942472	1395	8.7650435
650	4.0840704	900	5.6548668	1150	7.2256631	1400	8.7964594
655	4.1154864	905	5.6862827	1155	7.2570790	1405	8.8278753
660	4.1469023	910	5.7176986	1160	7.2884949	1410	8.8592913
665	4.1783182	915	5.7491145	1165	7.3199109	1415	8.8907072
670	4.2097342	920	5.7805305	1170	7.3513268	1420	8.9221231
675	4.2411501	925	5.8119464	1175	7.3827427	1425	8.9535391
680	4.2725660	930	5.8433623	1180	7.4141587	1430	8.9849550
685	4.3039819	935	5.8747783	1185	7.4455746	1435	9.0163709
690	4.3353979	940	5.9061942	1190	7.4769905	1440	9.0477868
695	4.3668138	945	5.9376101	1195	7.5084064	1445	9.0792028
700	4.3982297	950	5.9690260	1200	7.5398224	1450	9.1106187
705	4.4296456	955	6.0004420	1205	7.5712383	1455	9.1420346
710	4.4610616	960	6.0318579	1210	7.6026542	1460	9.1734505
715	4.4924775	965	6.0632738	1215	7.6340701	1465	9.2048665
720	4.5238934	970	6.0946897	1220	7.6654861	1470	9.2362824
725	4.5553093	975	6.1261057	1225	7.6969020	1475	9.2676983
730	4.5867253	980	6.1575216	1230	7.7283180	1480	9.2991142
735	4.6181412	985	6.1889375	1235	7.7597338	1485	9.3305302
740	4.6495571	990	6.2203534	1240	7.7911498	1490	9.3619461
745	4.6809731	995	6.2517694	1245	7.8225657	1495	9.3933620
750	4.7123890	1000	6.2831853	1250	7.8539816	1500	9.4247779

VALUES OF ω (Continued)

Freq. kc	$\omega \times 10^6$	Freq. kc	$\omega \times 10^7$	Freq. kc	$\omega \times 10^7$	Freq. kc	$\omega \times 10^7$
1505	9.4561939	1630	1.0241592	1755	1.1026990	1880	1.1812388
1510	9.4876098	1635	1.0273008	1760	1.1058406	1885	1.1843804
1515	9.5190257	1640	1.0304424	1765	1.1089822	1890	1.1875220
1520	9.5504417	1645	1.0334840	1770	1.1121238	1895	1.1906636
1525	9.5818576	1650	1.0367256	1775	1.1152654	1900	1.1938052
1530	9.6132735	1655	1.0398672	1780	1.1184070	1905	1.1969468
1535	9.6446894	1660	1.0430088	1785	1.1215486	1910	1.2000884
1540	9.6761054	1665	1.0461504	1790	1.1246902	1915	1.2032300
1545	9.7075213	1670	1.0492919	1795	1.1278318	1920	1.2063716
1550	9.7389372	1675	1.0524335	1800	1.1309734	1925	1.2095132
1555	9.7703531	1680	1.0555751	1805	1.1341149	1930	1.2126548
1560	9.8017691	1685	1.0587167	1810	1.1372565	1935	1.2157964
1565	9.8331850	1690	1.0618583	1815	1.1403981	1940	1.2189379
1570	9.8646009	1695	1.0649999	1820	1.1435397	1945	1.2220795
1575	9.8960168	1700	1.0681415	1825	1.1466813	1950	1.2252211
1580	9.9274328	1705	1.0712831	1830	1.1498229	1955	1.2283627
1585	9.9588487	1710	1.0744247	1835	1.1529645	1960	1.2315043
1590	9.9902646	1715	1.0775663	1840	1.1561061	1965	1.2346459
1595	10.0216806	1720	1.0807079	1845	1.1592477	1970	1.2377875
1600	10.0530965	1725	1.0838495	1850	1.1623893	1975	1.2409291
	$\omega \times 10^7$						
1605	1.0084512	1730	1.0869911	1855	1.1655309	1980	1.2440707
1610	1.0115928	1735	1.0901326	1860	1.1686725	1985	1.2472123
1615	1.0147344	1740	1.0932742	1865	1.1718141	1990	1.2503539
1620	1.0178760	1745	1.0964158	1870	1.1749557	1995	1.2534955
1625	1.0210176	1750	1.0995574	1875	1.1780972	2000	1.2566371

VALUES OF $1/\omega^2$

Freq. kc	$1/\omega^2 \times 10^{-12}$	Freq. kc	$1/\omega^2 \times 10^{-13}$	Freq. kc	$1/\omega^2 \times 10^{-13}$	Freq. kc	$1/\omega^2 \times 10^{-13}$
100	2.533029						
105	2.297532	205	6.027435	305	2.722955	405	1.544294
110	2.093412	210	5.743831	310	2.635826	410	1.506858
115	1.915334	215	5.479783	315	2.552813	415	1.470767
120	1.759048	220	5.258299	320	2.473661	420	1.435957
125	1.621138	225	5.003515	325	2.398134	425	1.402369
130	1.498834	230	4.788335	330	2.326014	430	1.369945
135	1.389865	235	4.586744	335	2.257099	435	1.338633
140	1.292362	240	4.397620	340	2.191202	440	1.308383
145	1.204770	245	4.219957	345	2.128149	445	1.279146
150	1.125790	250	4.052847	350	2.067779	450	1.250878
155	1.054330	255	3.895470	355	2.009942	455	1.223538
	$1/\omega^2 \times 10^{-13}$	260	3.747085	360	1.954498	460	1.197083
160	9.894647	265	3.607019	365	1.901317	465	1.171478
165	9.304056	270	3.474663	370	1.850277	470	1.146686
170	8.764808	275	3.349460	375	1.801265	475	1.122672
175	8.271117	280	3.230905	380	1.754175	480	1.099405
180	7.817993	285	3.118534	385	1.708908	485	1.076853
185	7.401108	290	3.011925	390	1.665371	490	1.054989
190	7.016702	295	2.910691	395	1.623476	495	1.033784
195	6.661485	300	2.814477	400	1.583143	500	1.013211
200	6.332573						

VALUES OF $1/\omega^2$ (Continued)

Freq. kc	$1/\omega^2 \times 10^{-14}$	Freq. kc	$1/\omega^2 \times 10^{-14}$	Freq. kc	$1/\omega^2 \times 10^{-14}$	Freq. kc	$1/\omega^2 \times 10^{-14}$
505	9.932475	755	4.44372	1005	2.50789	1255	1.60825
510	9.738676	760	4.38542	1010	2.48312	1260	1.59550
515	9.55051	765	4.32831	1015	2.45871	1265	1.58292
520	9.36772	770	4.27227	1020	2.43467	1270	1.57048
525	9.19013	775	4.21732	1025	2.41097	1275	1.55819
530	9.01754	780	4.16342	1030	2.38763	1280	1.54604
535	8.84977	785	4.11055	1035	2.36461	1285	1.53403
540	8.68664	790	4.05869	1040	2.34193	1290	1.52216
545	8.52800	795	4.00780	1045	2.31957	1295	1.51043
550	8.37365	800	3.95785	1050	2.29753	1300	1.49883
555	8.22345	805	3.90884	1055	2.27581	1305	1.48737
560	8.07726	810	3.86074	1060	2.25438	1310	1.47604
565	7.93495	815	3.81550	1065	2.23327	1315	1.46484
570	7.79650	820	3.76714	1070	2.21239	1320	1.45376
575	7.66134	825	3.72162	1075	2.19191	1325	1.44281
580	7.52981	830	3.67692	1080	2.17166	1330	1.43198
585	7.40166	835	3.63302	1085	2.15170	1335	1.42127
590	7.27673	840	3.58990	1090	2.13200	1340	1.41069
595	7.15495	845	3.54753	1095	2.11257	1345	1.40022
600	7.03620	850	3.50592	1100	2.09341	1350	1.38986
605	6.92039	855	3.46504	1105	2.07451	1355	1.37963
610	6.80738	860	3.42487	1110	2.05586	1360	1.36950
615	6.69716	865	3.38539	1115	2.03747	1365	1.35949
620	6.58955	870	3.34660	1120	2.01931	1370	1.34957
625	6.48456	875	3.30844	1125	2.00416	1375	1.33978
630	6.38201	880	3.27095	1130	1.98373	1380	1.33009
635	6.28190	885	3.23410	1135	1.96629	1385	1.32051
640	6.18416	890	3.19786	1140	1.94908	1390	1.31102
645	6.08863	895	3.16110	1145	1.93210	1395	1.30164
650	5.99535	900	3.12719	1150	1.91533	1400	1.29236
655	5.90416	905	3.09274	1155	1.89879	1405	1.28318
660	5.81503	910	3.05885	1160	1.88245	1410	1.27410
665	5.72792	915	3.02551	1165	1.86633	1415	1.26511
670	5.64274	920	2.99270	1170	1.85041	1420	1.25621
675	5.55958	925	2.96044	1175	1.83469	1425	1.24741
680	5.47800	930	2.92869	1180	1.81918	1430	1.23870
685	5.39831	935	2.89745	1185	1.80386	1435	1.23009
690	5.32037	940	2.86671	1190	1.78873	1440	1.22185
695	5.24408	945	2.83646	1195	1.77380	1445	1.21312
700	5.16944	950	2.80667	1200	1.75905	1450	1.20477
705	5.09640	955	2.77737	1205	1.74448	1455	1.19650
710	5.02486	960	2.74851	1210	1.73010	1460	1.18832
715	4.95483	965	2.72011	1215	1.71588	1465	1.18023
720	4.88626	970	2.69213	1220	1.70185	1470	1.17221
725	4.81908	975	2.66459	1225	1.68798	1475	1.16428
730	4.75339	980	2.63747	1230	1.67429	1480	1.15642
735	4.68885	985	2.61077	1235	1.66076	1485	1.14865
740	4.62569	990	2.58446	1240	1.64739	1490	1.14096
745	4.56382	995	2.55855	1245	1.63419	1495	1.13333
750	4.50317	1000	2.53303	1250	1.62114	1500	1.12579

VALUES OF $1/\omega^2$ (Continued)

Freq. kc	$1/\omega^2 \times 10^{-14}$	Freq. kc	$1/\omega^2 \times 10^{-15}$	Freq. kc	$1/\omega^2 \times 10^{-15}$	Freq. kc	$1/\omega^2 \times 10^{-15}$
1505	1.11832	1630	9.53375	1755	8.22406	1880	7.16679
1510	1.11193	1635	9.47556	1760	8.17738	1885	7.12882
1515	1.10361	1640	9.41785	1765	8.13113	1890	7.09115
1520	1.09636	1645	9.36070	1770	8.08526	1895	7.05378
1525	1.08918	1650	9.30404	1775	8.03977	1900	7.01670
1530	1.08208	1655	9.24792	1780	7.99467	1905	6.97992
1535	1.07504	1660	9.19230	1785	7.94994	1910	6.94342
1540	1.06807	1665	9.13717	1790	7.90559	1915	6.90721
1545	1.06117	1670	9.08256	1795	7.86161	1920	6.87128
1550	1.05433	1675	9.02840	1800	7.81799	1925	6.83563
1555	1.04756	1680	8.97475	1805	7.77474	1930	6.80026
1560	1.04086	1685	8.92155	1810	7.73185	1935	6.76516
1565	1.03422	1690	8.86882	1815	7.68930	1940	6.73034
1570	1.02764	1695	8.81659	1820	7.64711	1945	6.69578
1575	1.02113	1700	8.76480	1825	7.60527	1950	6.66149
1580	1.01467	1705	8.71348	1830	7.56377	1955	6.62745
1585	1.00828	1710	8.66260	1835	7.52260	1960	6.59368
1590	1.00195	1715	8.61216	1840	7.48177	1965	6.56017
	$1/\omega^2 \times 10^{-15}$	1720	8.56218	1845	7.44128	1970	6.52691
		1725	8.51260	1850	7.40111	1975	6.49391
1595	9.95678	1730	8.46371	1855	7.36126	1980	6.46115
1600	9.89464	1735	8.41475	1860	7.32174	1985	6.42864
1605	9.83310	1740	8.36647	1865	7.28253	1990	6.39638
1610	9.77211	1745	8.31858	1870	7.24364	1995	6.36436
1615	9.71170	1750	8.27112	1875	7.20506	2000	6.33257
1620	9.65184						
1625	9.59254						

CONVERSION TABLE FOR TRANSMISSION UNITS

Decibels		Amplf'n ratio	Attenu'n ratio	Decibels		Amplf'n ratio	Attenu'n ratio
For current or voltage ratio	For power ratio			For current or voltage ratio	For power ratio		
				4.5	2.25	1.679	0.596
0.1	0.05	1.012	0.989	4.6	2.3	1.698	0.589
0.2	0.1	1.023	0.977	4.7	2.35	1.718	0.582
0.3	0.15	1.035	0.966	4.8	2.4	1.738	0.575
0.4	0.2	1.047	0.955	4.9	2.45	1.758	0.569
0.5	0.25	1.059	0.944	**5.0**	2.5	1.778	0.562
0.6	0.3	1.072	0.933	5.1	2.55	1.799	0.556
0.7	0.35	1.084	0.923	5.2	2.6	1.820	0.550
0.8	0.4	1.096	0.912	5.3	2.65	1.841	0.543
0.9	0.45	1.109	0.902	5.4	2.7	1.862	0.537
1.0	0.5	1.122	0.891	**5.5**	2.75	1.884	0.531
1.1	0.55	1.135	0.881	5.6	2.8	1.906	0.525
1.2	0.6	1.148	0.871	5.7	2.85	1.928	0.519
1.3	0.65	1.162	0.861	5.8	2.9	1.950	0.513
1.4	0.7	1.175	0.851	5.9	2.95	1.972	0.507
1.5	0.75	1.188	0.841	**6.0**	3.0	1.995	0.501
1.6	0.8	1.202	0.832	6.1	3.05	2.018	0.495
1.7	0.85	1.216	0.822	6.2	3.1	2.04	0.490
1.8	0.9	1.230	0.813	6.3	3.15	2.06	0.484
1.9	0.95	1.245	0.804	6.4	3.2	2.09	0.479
2.0	1.0	1.259	0.794	**6.5**	3.25	2.11	0.473
2.1	1.05	1.274	0.785	6.6	3.3	2.14	0.468
2.2	1.1	1.288	0.776	6.7	3.35	2.16	0.462
2.3	1.15	1.303	0.767	6.8	3.4	2.19	0.457
2.4	1.2	1.318	0.759	6.9	3.45	2.21	0.452
2.5	1.25	1.334	0.750	**7.0**	3.5	2.24	0.447
2.6	1.3	1.349	0.741	7.1	3.55	2.26	0.442
2.7	1.35	1.365	0.733	7.2	3.6	2.29	0.437
2.8	1.4	1.380	0.724	7.3	3.65	2.32	0.432
2.9	1.45	1.396	0.716	7.4	3.7	2.34	0.427
3.0	1.5	1.413	0.708	**7.5**	3.75	2.37	0.422
3.1	1.55	1.429	0.700	7.6	3.8	2.40	0.417
3.2	1.6	1.445	0.692	7.7	3.85	2.42	0.412
3.3	1.65	1.462	0.684	7.8	3.9	2.45	0.407
3.4	1.7	1.479	0.676	7.9	3.95	2.48	0.403
3.5	1.75	1.496	0.668	**8.0**	4.0	2.51	0.398
3.6	1.8	1.514	0.661	8.1	4.05	2.54	0.394
3.7	1.85	1.531	0.653	8.2	4.1	2.57	0.389
3.8	1.9	1.549	0.645	8.3	4.15	2.60	0.385
3.9	1.95	1.567	0.638	8.4	4.2	2.63	0.380
4.0	2.0	1.585	0.631	**8.5**	4.25	2.66	0.376
4.1	2.05	1.603	0.624	8.6	4.3	2.69	0.372
4.2	2.1	1.622	0.617	8.7	4.35	2.72	0.367
4.3	2.15	1.641	0.610	8.8	4.4	2.75	0.363
4.4	2.2	1.660	0.603	8.9	4.45	2.79	0.359
4.5	2.25	1.679	0.596	**9.0**	4.5	2.82	0.355

CONVERSION TABLE FOR TRANSMISSION UNITS

Decibels		Amplf'n ratio	Attenu'n ratio	Decibels		Amplf'n ratio	Attenu'n ratio
For current or voltage ratio	For power ratio			For current or voltage ratio	For power ratio		
9.0	4.5	2.82	0.355	**14.0**	7.0	5.01	0.200
9.1	4.55	2.85	0.351	14.1	7.05	5.07	0.197
9.2	4.6	2.88	0.347	14.2	7.1	5.13	0.195
9.3	4.65	2.91	0.343	14.3	7.15	5.19	0.193
9.4	4.7	2.95	0.339	14.4	7.2	5.25	0.191
9.5	4.75	2.98	0.335	**14.5**	7.25	5.31	0.188
9.6	4.8	3.02	0.331	14.6	7.3	5.37	0.186
9.7	4.85	3.05	0.327	14.7	7.35	5.43	0.184
9.8	4.9	3.09	0.324	14.8	7.4	5.50	0.182
9.9	4.95	3.13	0.320	14.9	7.45	5.56	0.180
10.0	5.0	3.16	0.316	**15.0**	7.5	5.62	0.178
10.1	5.05	3.20	0.313	15.1	7.55	5.69	0.176
10.2	5.1	3.24	0.309	15.2	7.6	5.75	0.174
10.3	5.15	3.27	0.305	15.3	7.65	5.82	0.172
10.4	5.2	3.31	0.302	15.4	7.7	5.89	0.170
10.5	5.25	3.35	0.298	**15.5**	7.75	5.96	0.168
10.6	5.3	3.39	0.295	15.6	7.8	6.03	0.166
10.7	5.35	3.43	0.291	15.7	7.85	6.10	0.164
10.8	5.4	3.47	0.288	15.8	7.9	6.17	0.162
10.9	5.45	3.51	0.285	15.9	7.95	6.24	0.160
11.0	5.5	3.55	0.282	**16.0**	8.0	6.31	0.158
11.1	5.55	3.59	0.279	16.1	8.05	6.38	0.157
11.2	5.6	3.63	0.275	16.2	8.1	6.45	0.155
11.3	5.65	3.67	0.272	16.3	8.15	6.53	0.153
11.4	5.7	3.72	0.269	16.4	8.2	6.61	0.151
11.5	5.75	3.76	0.266	**16.5**	8.25	6.68	0.150
11.6	5.8	3.80	0.263	16.6	8.3	6.76	0.148
11.7	5.85	3.85	0.260	16.7	8.35	6.84	0.146
11.8	5.9	3.89	0.257	16.8	8.4	6.92	0.144
11.9	5.95	3.94	0.254	16.9	8.45	7.00	0.143
12.0	6.0	3.98	0.251	**17.0**	8.5	7.08	0.141
12.1	6.05	4.03	0.248	17.1	8.55	7.16	0.140
12.2	6.1	4.07	0.245	17.2	8.6	7.24	0.138
12.3	6.15	4.12	0.242	17.3	8.65	7.33	0.136
12.4	6.2	4.17	0.240	17.4	8.7	7.41	0.135
12.5	6.25	4.22	0.237	**17.5**	8.75	7.50	0.133
12.6	6.3	4.27	0.234	17.6	8.8	7.59	0.132
12.7	6.35	4.32	0.232	17.7	8.85	7.67	0.130
12.8	6.4	4.37	0.229	17.8	8.9	7.76	0.129
12.9	6.45	4.42	0.226	17.9	8.95	7.85	0.127
13.0	6.5	4.47	0.224	**18.0**	9.0	7.94	0.126
13.1	6.55	4.52	0.221	18.1	9.05	8.04	0.124
13.2	6.6	4.57	0.219	18.2	9.1	8.13	0.123
13.3	6.65	4.62	0.216	18.3	9.15	8.22	0.122
13.4	6.7	4.68	0.214	18.4	9.2	8.32	0.120
13.5	6.75	4.73	0.211	**18.5**	9.25	8.41	0.119
13.6	6.8	4.79	0.209	18.6	9.3	8.51	0.118
13.7	6.85	4.84	0.206	18.7	9.35	8.61	0.116
13.8	6.9	4.90	0.204	18.8	9.4	8.71	0.115
13.9	6.95	4.95	0.202	18.9	9.45	8.81	0.114
14.0	7.0	5.01	0.200	**19.0**	9.5	8.91	0.112

CONVERSION TABLE FOR TRANSMISSION UNITS
(Continued)

Decibels		Amplf'n ratio	Attenu'n ratio	Decibels		Amplf'n ratio	Attenu'n ratio
For current or voltage ratio	For power ratio			For current or voltage ratio	For power ratio		
19.0	9.5	8.91	0.112	**55**	27.5	562.	0.00178
19.1	9.55	9.02	0.111	56	28.0	631.	0.00158
19.2	9.6	9.12	0.110	57	28.5	708.	0.00141
19.3	9.65	9.23	0.108	58	29.0	794.	0.00126
19.4	9.7	9.33	0.107	59	29.5	891.	0.00112
19.5	9.75	9.44	0.106	**60**	30.0	1000.	0.00100
19.6	9.8	9.55	0.105	61	30.5	1120.	0.000891
19.7	9.85	9.66	0.104	62	31.0	1260.	0.000794
19.8	9.9	9.77	0.102	63	31.5	1410.	0.000708
19.9	9.95	9.89	0.101	64	32.0	1580.	0.000631
20	10.0	10.00	0.100	**65**	32.5	1780.	0.000562
21	10.5	11.2	0.0891	66	33.0	2000.	0.000501
22	11.0	12.6	0.0794	67	33.5	2240.	0.000447
23	11.5	14.1	0.0708	68	34.0	2510.	0.000398
24	12.0	15.8	0.0631	69	34.5	2820.	0.000355
25	12.5	17.8	0.0562	**70**	35.0	3160.	0.000316
26	13.0	20.0	0.0501	71	35.5	3550.	0.000282
27	13.5	22.4	0.0447	72	36.0	3980.	0.000251
28	14.0	25.1	0.0398	73	36.5	4470.	0.000224
29	14.5	28.2	0.0355	74	37.0	5010.	0.000200
30	15.0	31.6	0.0316	**75**	37.5	5620.	0.000178
31	15.5	35.5	0.0282	76	38.0	6310.	0.000158
32	16.0	39.8	0.0251	77	38.5	7080.	0.000141
33	16.5	44.7	0.0224	78	39.0	7940.	0.000126
34	17.0	50.1	0.0200	79	39.5	8910.	0.000112
35	17.5	56.2	0.0178	**80**	40.0	10000.	0.000100
36	18.0	63.1	0.0158	81	40.5	11200.	0.0000891
37	18.5	70.8	0.0141	82	41.0	12600.	0.0000794
38	19.0	79.4	0.0126	83	41.5	14100.	0.0000708
39	19.5	89.1	0.0112	84	42.0	15800.	0.0000631
40	20.0	100.	0.0100	**85**	42.5	17800.	0.0000562
41	20.5	112.	0.00891	86	43.0	20000.	0.0000501
42	21.0	126.	0.00794	87	43.5	22400.	0.0000447
43	21.5	141.	0.00708	88	44.0	25100.	0.0000398
44	22.0	158.	0.00631	89	44.5	28200.	0.0000355
45	22.5	178.	0.00562	**90**	45.0	31600.	0.0000316
46	23.0	200.	0.00501	91	45.5	35500.	0.0000282
47	23.5	224.	0.00447	92	46.0	39800.	0.0000251
48	24.0	251.	0.00398	93	46.5	44700.	0.0000224
49	24.5	282.	0.00355	94	47.0	50100.	0.0000200
50	25.0	316.	0.00316	**95**	47.5	56200.	0.0000178
51	25.5	355.	0.00282	96	48.0	63100.	0.0000158
52	26.0	398.	0.00251	97	48.5	70800.	0.0000141
53	26.5	447.	0.00224	98	49.0	79400.	0.0000126
54	27.0	501.	0.00200	99	49.5	89100.	0.0000112
55	27.5	562.	0.00178	**100**	50.0	100000.	0.0000100

LABORATORY ARTS AND RECIPES

Many of the following recipes have been contributed by users of the Handbook. To those who have cooperated in this way we extend our grateful acknowledgment.

BLUING STEEL AND IRON

The metal is cleaned with a potassium bichromate-sulfuric acid mixture, then washed with ammonium hydroxide and rubbed dry. Apply ammonium polysulfide until the desired depth of color is obtained, allowing the object to dry after each application and rubbing briskly with soft clean cloth. The result is a deep blue which may be made very nearly black by repeated applications. Rubbing with boiled linseed oil will deepen this color more. The finish thus obtained is very resistant to oxidation.

CEMENTS AND ADHESIVES

Acid Proof Cement

1

A handy acid resisting cement can be made by mixing sodium silicate and asbestos powder to the consistency of a thin paste. If allowed to dry for a day, the resulting cement will resist the strongest acids.

2

Barium sulfate 4 parts, water glass 3 parts, asbestos 1 part. Sodium fluosilicate or sodium fluoborate is advised in addition when the cement is used on glass.

Aquarium Cement

1

Glazier's putty	10 lb.
Litharge	1 lb.
Red lead	1 lb.
Asphaltum	4 oz. fl.

Mix with boiled linseed oil to the proper consistency. Lamp black may be added to give a gray color.

2

Red lead	3 parts
Litharge	7 parts
Fine sand	10 parts
Powdered rosin	1 part

Add sufficient spar varnish to give the proper consistency.

Cement for Cellophane

The following is said to be a very satisfactory glue or cement for cellophane:

Gum acacia (gum arabic)	16.5 parts by weight
Glycerin	29.5 parts by weight
Water	49.5 parts by weight
Formaldehyde (40 %)	4.5 parts by weight

Cupric Oxide Cement

For a strong adhesive cement for attaching metal articles to each other or for cementing glass, a paste of cupric oxide and phosphoric acid is very satisfactory. The cement is adhesive, strong and sets quite rapidly.

De Khotinsky Cement

1

About 70 grams of light brown orange shellac is added in small amounts to 30 grams of heated pine tar. The mixture is stirred at frequent intervals for a period of two hours (or four hours) and maintained at a temperature of 130° C. or slightly lower. (The longer heating period gives a cement that is suitable for high vacuum work.) The product may be tested at intervals by dropping some of it into cold water and then subjecting it to bending pressure. Under such treatment, the product should not bend but break with a conchoidal fracture.

If a harder product is desired, 85 grams of light brown shellac may be mixed and heated with 30 grams of pine tar.

The finished product, while still warm, may be spread on a stone slab or a smooth surface and rolled into small sticks.

This sealing cement will be found useful whenever two pieces of apparatus are to be cemented together. The cementing is effected by warming the surfaces and applying melted cement. The removal of the cement may be facilitated by softening it with alcohol.

2

A handy water-proof laboratory cement of the type "Khotinsky Cement" is made from:

Dry yellow or orange shellac	3 parts by weight
Pine tar	1 part by weight

Place the shellac in a double boiler using water in the outer member. Add the pine tar and permit to digest with occasional stirring until the mass is homogeneous; this will take about five hours. Pull out like taffy and make into sticks. The cement can be made harder or softer by varying the amount of tar.

General Hints

Glues of all kinds are useful for wood, leather, paper and glass, where the joints are not required to be waterproof.

For waterproof joints of nearly all substances, including metals, shellac may be used. Flakes of solid shellac may be used with heat or it may be used as a solution in alcohol.

Khotinsky cement, Chatterton's compound and other resinous cements are used for similar purposes and in the some way as solid shellac. Glass cells made up with compounds of this nature may be made impervious to alcohol by painting over the joints with a rubber cement made by melting up small pieces of rubber tubing and adding carbon disulfide to make a thin syrup.

For celluloid a cement made by dissolving celluloid shavings in acetone is recommended.

Brass fittings are usually cemented on glass tubing with sealing wax. The glass tube should be wound with thread or twine to secure a close fit. The glass and the brass fitting should be warmed slightly above the melting point of wax. (Thick or pressed glass should be warmed slowly.) Wax may be applied to both parts and the thread well saturated with the melted wax. Enough should be used to insure filling the space completely. Join the parts while the wax is very soft and clamp in position until it is thoroughly cold.

For optical purposes, cementing glass, etc., Canada balsam is universally employed, and makes a permanent and nearly invisible joint.

Laboratory Adhesive

Nitrated cotton (5-6 sec.)	30 grams

Make up a solution of:

Di methyl ketone (acetone)	100 milliliters (c.c.)
Amyl acetate	45 milliliters (c.c.)
Butyl acetate	15 milliliters (c.c.)
Ethyl acetate	15 milliliters (c.c.)
*Ethyl abietate	1.5 milliliters (c.c.)

* ½ above of castor oil is a substitute.

Using the latter solution as solvent, add the nitrated cotton until the solution is of the consistency of syrup. Dissolving the cotton takes about two hours. If the mixture is too thick, a little more of the above solvent, which should be kept on hand, is added.

The above solution should not blush when applied to any surface. It should dry quickly into a tough film which is stable over a long period owing to the plasticizer, ethyl abietate.

The above is useful for cementing cross hairs, coating labels, sealing rubber to tubing, etc.

In case a more flexible film is desired the amount of the plasticizer may be doubled. In case of blushing increase amyl acetate.

Litharge Cement for Joining Metal to Glass

In the preparation of tanks with glass sides or bottom, it is desired to make these water tight by cementing the glass to the iron frame or to repair the leaks that may occur.

Litharge (PbO)	260 grams
Glycerin solution (glycerin 2 parts, water 1 part)	100 milliliters (c.c.)

Place the litharge in a mortar, add the diluted glycerin slowly while grinding. Mix thoroughly by grinding a short time. Heat will be evolved and the mixture will begin to set. While still soft, pour it into place and by means of a spatula work it into position as in the case of putty. Allow to stand for a day when it will be thoroughly hard.

If desired, it may be covered with a layer of white lead or aluminum paint.

Mucilage or Paste

Gum arabic (gum acacia)	1 part
Rice starch	1 part
Sugar	4 parts
Water	10 parts

Warm the gum arabic with some of the water until it has a jelly-like consistency. Mix the sugar and starch with enough water to make a smooth paste. Combine these two mixtures, and boil until the starch is clear.

Shellac Cement

De Khotinsky Type

(Benzene Resistant)

Note: Most recipes for de Khotinsky cement call for pine tar, to the amount of 40 to 50 %, as the material with which shellac is plasticized for the application in question. Recent investigation indicates that pine tar is inferior to the creosote plasticizer recommended below.

Prepare the plasticizer by mixing one volume of terpineol with three volumes of beechwood creosote (alkali-soluble). Coal-tar creosote, not completely alkali-soluble, will not do.

Heat from 12 to 25 grams of the plasticizer to about 130° C. With constant stirring add 85 grams of shellac as fast as it dissolves smoothly. When the mixture is homogeneous, allow to cool until it will barely flow from the vessel, and pour into molds which have been lightly but completely covered with petrolatum. The use of only 12 grams of plasticizer gives a very hard cement; 25 grams gives a very soft product.

Shellac-Wax Cement

(Benzene Soluble)

Rosin	35 grams
Shellac	20 grams
Beeswax	20 grams
Talc, fibrous (asbestine pulp)	0 to 30 grams

Melt the rosin in a large (6 or 8 in.) hemispherical iron pan, add the shellac and beeswax with stirring. Heat strongly with a large Bunsen flame so that the temperature reaches 360° C. in six minutes; then extinguish the burner. When the temperature has reached about 275° C., add the talc, if any is to be used. Finally when the mixture is so viscous that it will barely pour from the pan, pour into metal molds which have previously been very thoroughly scoured with washing powder and thickly coated with aqueous dextrine paste which is still wet. The talc gives a more viscous cement at temperatures just above the melting point.

Transparent Sealing Resin

A transparent resin which adheres well to glass, quartz and metals may be made by heating together equimolal quantities of phthalic anhydride and ethylene glycol for 24 hours at 200° C. The resin softens at 95°–110° C. It is unaffected by water but slowly dissolved by organic solvents and is particularly useful for high-vacuum seals.

Vacuum Wax

Wax for coating joints which may be used for ordinary vacuum distillations etc. where the temperature does not get too high:

Melt together equal parts (by weight) of beeswax and rosin. The product is pliable and easily removed from apparatus by simply using hot water.

CLEANING COMPOUNDS AND METHODS

Alcoholic Sodium Hydroxide Solution for Cleaning

Dissolve 120 grams sodium hydroxide in 120 c.c. water. Dilute to 1 liter with 95 % alcohol.

Burette Cleaning Assembly

A burette cleaning assembly may consist of a 300 c.c. beaker of cleaning solution mounted on a ring stand having a 7 × 9″ base. Higher on the stand is a clamp for engaging the burette to be cleaned and still higher a mounting of $\frac{3}{16}$″ rubber tubing connected with an aspirator. The cleaning solution is heated, the burette placed with its top dipping into the cleaning solution while the aspirator tubing is slipped on the delivery end of the burette. When hot cleaning liquid has been aspirated to near the glass stopcock or pinch-cock, the cock is closed and the aspirator tubing slipped off, leaving the cleaning solution in the burette. After a minute or so, the cock is opened and the cleaning solution is allowed to run out of the burette, which will leave a uniform film if the burette is clean. The burette is transferred to a sink and after cooling is rinsed with tap and distilled water. By this means 50 burettes per hour may be made ready for use.

Brown Stains on Burettes

Brown stains left on the inside of burettes used for $KMnO_4$ solutions may be removed by filling the burette with $FeSO_4$ solution after which the liquid is removed and completely washed out. A convenient, ready for use, solution of $FeSO_4$ may be made by placing small nails in a dilute H_2SO_4 solution, keeping the flask closed except for a hydrogen vent, thus preventing oxidation of the iron.

Cleaning Engler Flasks

To thoroughly remove all of the carbonaceous deposit baked in the bottom of an Engler flask from gasoline distillation, place 2 or 3 grams of commercial Na_2SO_4 in the flask to be cleaned; apply heat directly to the flask from a Bunsen burner. Heat until all the carbon residue has been loosened. Cool, rinse and drain.

Cleaning Fermentation Tubes and Other Glassware

Fermentation tubes (used in water testing) and other glassware difficult to clean in the ordinary way, may be cleaned as follows:

Moisten the inside of the tube with ethyl alcohol. Pour off the excess alcohol, leaving not to exceed two c.c. of the liquid in the tube. Add ten c.c. of concentrated nitric acid and let it stand. Soon a vigorous reaction takes place with the elimination of large quantities of nitrogen dioxide. When the reaction stops, wash with water. As some nitric acid may be blown out of the tube, it should be placed in a sink (preferably in a hood) until the reaction ceases. Do not close the tube.

Cleaning Fluid

An excellent solution for cleaning grease stains from cloth or leather consists of the following:

CCl_4	80 %
Ligroin	16 %
Amyl alcohol (ter.)	4 %

Cleaning Mercury

Mercury may be cleaned sufficiently for many laboratory purposes without distilling. Allow the mercury to fall in a fine spray into a quantity of dilute nitric acid, 25 parts of acid to 75 parts of distilled water. After being passed through the acid one or more times it should be passed through distilled water and dried. Most of the water may be removed with a clean filter, and the mercury heated in a porcelain dish to about 110° C. To produce the spray the stem of a glass funnel may be drawn down so as to leave only a small opening for the escape of mercury or a glass tube with a capillary point attached to a funnel with a tightly fitting rubber tube.

A three- to four-foot length of one-inch glass tube closed at one end and supported in a vertical position may be used to contain the acid solution. If a small glass tube be fused into the lower closed end of the large tube, and bent so as to stand up for a distance a little greater than 1/13.6 the column of acid solution in the large tube, a U-tube is formed in which a short column of mercury supports the long column of acid solution.

The end of the small tube should be bent over at the top so as to facilitate the delivery of the mercury and a short piece of clean rubber tubing with a pinch-cock put on at the start; as soon as mercury enough has collected in the bottom of the tube the pinch-cock may be opened. The mercury will rise nearly or quite to the top of the small tube, and as the quantity increases will be delivered from the small tube as fast as it falls in the spray.

The reversed end of the small tube should be short to avoid forming a siphon, which would completely empty the apparatus.

An efficient procedure, especially if the mercury is greasy, consists in spraying the mercury by means of the above apparatus, first, through a dilute solution (10 %) of potassium hydroxide, then through dilute nitric acid (10–15 %) and finally through distilled water.

Cleaning Optical Surfaces for Silvering

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

Probably the most important part of the silvering process is the proper cleaning of the surface to be silvered.

The surface is thoroughly cleaned of grease or other organic matter by the usual methods, using alcohol or chromic acid. Then it should be carefully cleansed with strong nitric acid, the whole surface being firmly rubbed with clean cotton tied to a rod of wood or glass. Care should be taken not to injure the surface. Rinse with water, and then wash the surface thoroughly with a strong solution of caustic potash, rubbing with a cotton brush as before. Finally, rinse with distilled water, and keep the surface wet until it is placed in the silvering solution. If the distilled water wets the whole surface uniformly the cleaning may be sufficient; if it does not wet uniformly, the operations must be repeated. The fingers should not touch the edges of the glass during the latter cleaning operations, as a layer of organic matter is apt to spread over the surface and render the silvering uneven.

Dr. Brashear recommends that the surface, after the washings described above, be rubbed with prepared chalk on a cotton wad until it is thoroughly dry and clean. It may then be put into the silvering solution at one's convenience.

Cleaning Solution for Glass

35 c.c. saturated sodium dichromate (technical)
1 liter conc. sulfuric acid poured into the dichromate solution

Avoid contact with the flesh or clothing.

Cleaning Solution

Trisodium phosphate	2 oz.
Sodium oleate	1 oz.
Distilled water	1 pint

Soak apparatus in the warm solution 10–15 minutes, then brush with a stiff brush.

Iodine Stains

Iodine stains can readily be removed from clothing by washing the stain with a 10 % solution of sodium thiosulfate ("hypo") in water.

Paint Brush Cleaner

(1)	Kerosene	2 pints
	Oleic acid	1 pint
(2)	Aqueous ammonia (conc.)	¼ pint
	Denatured alcohol	¼ pint

Stir (2) into (1) until uniform. To clean brushes, place in the mixture over night. Wash thoroughly with warm water.

Removal of Carbonaceous Matter

A 10–15 % solution of NaOH or KOH removes carbon etc. quickly. Rinse well with acid and H_2O.

Removing Carbon Deposits from Flasks

First rinse flask with acetone or carbon disulfide to remove traces of oil or tar. Add a few grams of magnesium nitrate. Heat gradually over a free Bunsen flame till water is all expelled and the magnesium nitrate melts. Rotate the flask to distribute the melt and continue the heating till the brown fumes of nitric oxide cease to evolve. Finally cool and dissolve the residual magnesium oxide in dilute acid by boiling.

Large deposits of carbon or tar will require a repetition of the above procedure.

Removing Carbon Residue from Glassware

Tri-sodium phosphate (Na_3PO_4)	2 tablespoonfuls
Sodium oleate	1 tablespoonful
Soft water	1 quart

Allow to stand in the solution for several minutes, brush off the incrustation and rinse with water.

COLORED LIQUIDS

For rendering columns of water easily visible, add a few drops of one per cent alcoholic solution of fluorescein to a liter of water. The dilute solution of fluorescein is bright green by reason of its fluorescence, although colorless by transmitted light.

A small quantity of an aqueous (1 %) solution of uranine (the sodium salt of fluorescein) may be used in place of the alcoholic solution mentioned above.

If liquids showing color by transmission are desired, dilute aqueous solutions may be made with any of the following dyes:

Dye	Color
Erythrosine	Pink
Eosine	Pink (green fluorescence)
Rhodamine B	Pink (red fluorescence)
Ponceau 2R	Scarlet
Naphthol green	Green
Methylene green	Bluish green
Methylene blue	Blue
Methyl violet	Purple

CROSS HAIRS

The spider lines which serve as an index in reading telescopes may be quickly replaced in an emergency by single silk fibers (from ordinary sewing silk) attached by soft wax. Single fibers may easily be removed from an untwisted strand.

Spider web should be used in permanent work. The fibers of the egg nest of certain species are employed and may be obtained of most dealers in scientific apparatus. In mounting them the following suggestions may be useful: The cross hair diaphragm of the telescope should be removed and clamped in a horizontal position. A bow of brass wire, about No. 28, should be employed to stretch the fiber. A background of black velvet makes the fibers more easily visible. With soft wax or other convenient adhesive ready on both tips of the bow, a fiber of the required length is to be disentangled with tweezers and wrapped several times about the ends of the bow under tension sufficient to straighten the fiber. The fiber, now conveniently handled by the wire bow, should be cautiously lowered onto the diaphragm in the proper position, the wire left hanging.

A small drop of shellac varnish applied at each side will hold the fiber in position as soon as it is thoroughly dry, after which the ends of the fiber should be cut away.

DIALYZERS

As a substitute for parchment and similar natural membranes, it has been found that those made from cellulose trinitrate are superior. "Parlodion" (DuPont)* may be used, dissolving one part of the nitrate in 2 each of ethanol and ethyl ether. The water adhering to the Parlodion should first be removed (the shreds are preserved by covering with water), otherwise a clear solution will not be obtained. Cut the round end off a ¾″ or 1″ test tube, and dip the flared end of the tube into the alcohol-ether solution of "Parlodion." Upon removing the tube from the solution a film will be found across the tube and after evaporation of the solvents the film will be found to be of sufficient strength to meet the purposes of a dialyzer. The liquid to be dialyzed is poured into the tube and contents are then set in a beaker of water. In a short time the working of the semi-permeable membrane will be shown by the rise of the level of the liquid inside the tube.

EXPANSION OF GLASSES, TEST FOR EQUALITY OF

In order to compare the coefficients of expansion of two pieces of glass, prior to sealing them together, melt the drawn out ends of each piece to beads; press these molten beads together with tweezers and draw into a thread. If the glasses can be sealed together, the thread will be straight; otherwise, it will curve because of the different coefficients of expansion.

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* Trade name.

FLUORESCENT SCREENS

For observations of the ultraviolet spectrum, moisten a small quantity of anthracene with water and brush a thin layer over a ground-glass surface. On drying most of the anthracene will adhere to the glass. The prepared surface should be placed so as to receive the radiation directly, glass being comparatively opaque to the shorter wave lengths.

GLASS GRINDING FLUID

Turpentine	45	c.c.
Ether (ethyl oxide)	22.5	c.c.
Camphor gum	31	g

To be used with powdered emery for grinding glass.

For smoothing edges a sheet of emery cloth moistened with the above solution may be used.

Plane surfaces should be ground on thick plate glass.

For grinding glass stoppers use coarse emery, turn in one direction, finish with fine emery.

GLASS GRINDING MEDIUM

Glycerin may be used instead of a camphor-turpentine mixture for a medium in which to suspend emery powder for grinding glass. Glycerin has body enough and is sufficiently viscous to carry the emery well, and besides this it is water-soluble, thus making it very easy to wash away the excess grinding agent when the job is done or when it is desirable to make a close inspection of the work done.

HEATING BATH

A bath fluid at temperatures above 150° C. and which does not appreciably affect glass is prepared by fusing 10 parts of potassium nitrate with 8.5 parts of sodium nitrite.

HEATING BATHS

For uniform heating of reactions the following materials have proven satisfactory:

For temperatures up to 100° C.	Steam
For temperatures from 100° – 250° C.	Crisco or Nujol
For temperatures from 200° – 300° C.	*o*-tolyl phosphate
For temperatures above 250° C.	Wood's metal.

HECTOGRAPH FILLER

Ingredients: ½ oz. of ground (dried) glue; 2 oz. of dried gelatine; 18 fluid oz. glycerin. These amounts should provide sufficient filler for a pan 12″ × 9″ × ½″.

Mix the glue with water and digest it on a water bath (a double boiler may be used) until it has the consistency of cream and is thoroughly melted. Soak the gelatine in cold water till soft free it from as much water as is possible by pressure in a cheesecloth and then melt it on a water bath or in a double boiler. Pour the three liquids together, and after they are thoroughly mixed, pour them into the pan. If any bubbles appear on the surface of the filler, scrape them off with the edge of a piece of cardboard while the filler is hot. Do not use the filler until at least six hours after it has been poured into the pan. The materials gel slowly. Keep the pan level and covered until its contents is no longer fluid.

HECTOGRAPH INK

Violet

Aniline violet	1 oz.
Hot water	7 oz. fl.

On cooling, add:

Alcohol	1 oz.
Glycerin	¼ oz.
Carbolic acid (phenol)	a few drops

Black

Nigrosine	1 part
Water	14 parts
Glycerin	4 parts

HYDROGEN SULFIDE

Pure hydrogen sulfide may be generated by allowing distilled water to drop on aluminum sulfide.

HYDROGEN SULFIDE SUPPLY

Mix and heat slightly 3 parts by weight of sulfur with 1 part by weight of paraffin. Then mix with sufficient shredded asbestos to make a porous mass. Partly fill an 8″ Pyrex test tube, connect with delivery tube and safety bottle. Heat. Furnishes good supply of H_2S. No leakage into the room as generation of H_2S ceases as soon as heat is removed. Mixture keeps. Test tube may be heated over again until reactants are used up.

INK FOR GLASS MARKING

Barium sulfate	15 parts by weight
Ammonium bifluoride	15 parts by weight
Ammonium sulfate	10 parts by weight
Oxalic acid	8 parts by weight
Glycerin	40 parts by weight
Water	12 parts by weight

If too thick, add more water. If the action is too slow, up to 5 % of sodium fluoride may be added. Use in a hood or well ventilated room.

LABEL PROTECTION

Collodion for Labels on Bottles

Dissolve 3–4 grams pyroxylin in 100 c.c. 1:3 mixture of alcohol and ether (25 c.c. absolute alcohol, 75 c.c. dry ether).

First soak the pyroxylin in the alcohol, then add the ether.

Labels for Bottles

Labels should be written in India Ink. They can be made waterproof and durable by coating with a saturated solution of paraffin in benzene.

Lacquer for Protecting Labels

An excellent lacquer for protecting labels may be made by dissolving 20 grams of vinyl acetate polymer (Vinylite A) in 100 c.c. of a mixture of 3 parts of toluene and 1 part of 95 % alcohol. This lacquer forms a colorless, transparent film which resists most reagents very well.

Protecting Varnish for Labels

Typed labels may be protected by several coats of a varnish made by dissolving ordinary tooth brush handles in acetone. The quantity of solvent should be adjusted to give a convenient viscosity. The varnish is water and acid resistant.

LOW MELTING ALLOY

The following alloy, Wood's metal, melts at about 65° C.:

Bismuth	50	parts by weight
Lead	25	parts by weight
Tin	12.5	parts by weight
Cadmium	12.5	parts by weight

LUBRICANT, DRY

Melt a quantity of paraffin and add as much fine flake or powdered graphite as is readily moistened by the melted wax. Cool and cut while soft into convenient sticks.

This lubricant when rubbed on the surfaces involved, adheres and greatly reduces friction. It is particularly useful when one or both of the surfaces are of wood or other non-metallic substance.

MILDEW PREVENTION ON LEATHER BOOK BINDINGS

Make a 2 % to 5 % solution—not more than 5 %—of copper sulfate. Immerse a soft towel or cloth in this solution. Remove the cloth and thoroughly wring out. Then hang out to dry. When thoroughly dried, it can be used to rub leather bound books. One treatment of the cloth will easily take care of scores or a hundred volumes, and the leather will not be marked by the chemical.

MIRRORS FOR SPECTROMETER ADJUSTMENT

A small square of thick plate glass with edges ground smooth and silvered on one surface affords a means of accurate adjustment.

To avoid the necessity of frequently resilvering, which arises where the mirrors are in constant use, the following course is suggested:

From selected German plate mirror 2 to 3 mm thick, cut two pieces of the same size, say 4 × 5 cm. Remove the protective layer of varnish or paint from both pieces by soaking in alcohol and rubbing with cotton, being careful not to injure the silver surface. From one piece remove every trace of varnish by repeated rinsing, dry and polish the silver surface thus exposed by stroking lightly with a chamois rouge pad. From the other piece remove the silver by nitric acid, wash thoroughly in distilled water and dry. Cement the clear piece on the silver face of the other with Canada balsam. This is accomplished by placing two or three drops of Canada balsam in xylol (obtained in collapsible tubes) on the center of the silver face, and evenly lowering upon it the clear glass. The balsam should spread rapidly to the edges of the plates. Minute bubbles of air in the balsam film are harmless; if large bubbles are present the plates should be slipped apart, cleaned with alcohol and the process repeated.

The balsam will be sufficiently hard in a few days to allow the excess to be scraped from the edges and the plates bound together with lantern slide binding strip. Gentle heat may be used to harden the balsam more rapidly.

PHENOL (CARBOLIC ACID) BURNS

To c. p. glycerin add bromine until slightly colored or saturated. Keep in glass stoppered bottle and apply quickly to phenol burns. The bromide reacts instantly with the phenol to form bromophenol.

POLARITY TEST PAPER

Dissolve one gram of phenolphthalein in a small quantity of alcohol. Add the solution of phenolphthalein to 100 c.c. of a 10 per cent solution of potassium chloride in distilled water. Filter paper should be soaked in the solution and dried. A strip of paper moistened with water and placed in contact with the two terminals will show a bright red stain at the negative terminal.

PURIFICATION OF ALCOHOL

To remove aldehydes from alcohol intended for use in the preparation of alcoholic solutions of sodium or potassium hydroxide, add to one liter of alcohol 5 to 10 grams of aluminum or zinc and 8 to 10 grams of potassium hydroxide; boil under reflux for 20 minutes, and distil. Best results are obtained if an all-glass apparatus is used. Alcoholic solutions, prepared with alcohol so treated, will not discolor if the purification of the alcohol has been carefully carried out.

RESISTANT PAINTS AND VARNISHES

Acid Proof Wood Stain

Solution No. 1	Solution No. 2
125 grams of copper sulfate	150 grams of good fresh anilin oil
125 grams of potassium chlorate	180 grams of concentrated hydrochloric acid
1000 grams of water	1000 grams of water

Wood must be free from paint, varnish, grease or chemicals. Apply two coats of solution No. 1 boiling hot with a paint brush, allowing each coat to dry thoroughly before the next coat is applied. Then apply two coats of solution No. 2 in the same way. When the wood is completely dried wash off excess chemicals with hot soapsuds. Finish with raw linseed oil. Polish comes from rubbing the oil down well with a cloth or sponge. Whenever the tables get dingy again go over them with a coat of linseed oil and rub smooth.

Resistant Coal Tar Varnish

A resistant varnish is made from coal tar pitch as follows:

Coal tar pitch	65 parts by weight
Phenol	5 parts by weight
Benzene	30 parts by weight

Resistant Paint

The following paint when used on galvanized iron has been found to hold up well, without cracking or peeling in a three year's test. It can also be used on black iron, tin, copper, or stone such as is used for laboratory desk tops. It withstands dilute acids.

Formula: Stir in 10 parts by weight of benzol into 30 parts by weight of ordinary thin coal tar. Then add with vigorous stirring 10 parts by weight of Silica Black (a new product patented under U. S. No. 1,940,352).

SCALE POLISH

To brighten up refractometer and polarimeter scales without injury to the metal rub with bone black or clarifying charcoal. A dry cloth with a little of the bone black is rubbed on the scale until a bright polish is produced. The divisions then stand out clearly and are easily read. The great advantage is that the fine lines are not worn away and no corrosive material is left to cause discolorations.

SILVERING GLASS

Brashear's Process

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

Two solutions are required, one, the reducing solution, should be prepared at least a week before it is used, and it may be made in large quantity and kept in stock with advantage; the other solution is to be prepared when used.

Reducing Solution

Distilled water	700 c.cm.
Pure sugar (loaf, granulated or rock candy)	80 g.

When dissolved add

Alcohol	175 c.cm.
Strong nitric acid (sp. gr. 1.42)	3 c.cm.
Add water to make	1000 c.cm.

For silvering, the mirror may rest face up on the bottom of a suitable dish; it may stand on edge, or be supported in any manner, face downward, dipping into the upper part of the solution. In the latter case, the mirror may be fastened with wax to a stick laid across the dish, or it may be supported on glass feet or on paraffined wood wedges. Dr. Brashear recommends that the mirror, if round, form the botton of the silvering dish, which is completed by wrapping a strip of paraffined paper around the edge of the mirror, this being held in place by rubber bands or fastened with several wrappings of cord.

Having selected a dish and support for the mirror, measure with water the quantity of solution that will be required to make a layer a centimeter or two thick over the surface to be silvered. For each 150 c.cm. of final solution, 1 g. of silver nitrate and 0.5 g. of caustic potash (purified by alcohol) will be required. Dissolve the silver and potash separately, using quantities of water of the proportion of 10 c.cm. to 1 g. of the solid. Ordinary graduates or flasks are the most convenient form of vessel in which to mix the solutions. Into the silver nitrate solution pour a few drops of dilute aqua ammonia. The solution will turn to a dark brown color; add ammonia little by little till the precipitate is nearly but not quite redissolved. Now add the potash solution, when a precipitate will again be formed. This is to be nearly, but not entirely, redissolved by the addition of more ammonia, a few drops being sufficient this time. After the ammonia has been added shake or stir the solution well and wait a minute or two to be certain that it does not entirely clear. If by chance too much ammonia has been used, a little silver nitrate is to be dissolved and added, a few drops at a time, till a permanent precipitate is formed. This excess of silver must be present, the solution showing a decided brown tint. The solution may be filtered, though usually this is not necessary.

A quantity of reducing solution equal to about one fourth part of the solution just prepared is measured out. The mirror, having been properly cleaned and rinsed with distilled water, is placed in position. The reducing solution is poured into the silver and potash solution, and mixed by a quick shaking of the graduate or stirring with a glass rod; the whole is then poured into the dish. If the mirror is immersed face down, care is necessary to remove air bubbles; the mirror may well be immersed after the solution is in, being dipped in at one side first. If the mirror is at the bottom of the dish, after cleaning it is covered with a thin layer of water, and the prepared solutions are poured into the dish without further trouble. In the latter case the dish must be rocked during the time of deposition.

The solution soon turns to a black color, which in a few minutes will turn to a brown; and when it becomes a light gray and the precipitate is flocculent, which may be in ten or fifteen minutes, the operation is at an end. If the mirror is allowed to remain in the solution too long, the surface will have a bleached appearance, which polishing will hardly remove. Remove the mirror, rinse with water, and carefully wipe off the sediment with a tuft of absorbent cotton. It is then set on edge to dry; a rinsing with alcohol will facilitate the drying, or all water may be safely taken up by pressing clean blotting paper over the surface.

When dry, the surface may be polished, if necessary, with a small pad of chamois leather stuffed with cotton, on which is spread a little rouge. Small, circular strokes of the pad, with light pressure, will soon bring out the deep luster of the silver.

A uniform temperature of the bath and the glass, of about 20° is essential to success.

Since fulminating silver is liable to be produced by the action of ammonia on silver oxide, especially in a warm room, all solutions should be thrown away as soon as the silvering operation is completed. The used solutions may be poured into a large jar, in which is thrown some common salt; this causes the silver to be precipitated as the chloride, and about 90 per cent of the original silver may be recovered.

ROCHELLE SALTS PROCESS

(From Miller's Laboratory Physics, Ginn & Co., publishers, by permission.)

For depositing the uniform thin film of silver required on the half-silvered glass of the interferometer, the following method is more suitable than the one described above, as the silver is deposited more slowly. If a thick film is desired, two or more successive deposits may be made, each of which may require an hour's time.

Dissolve 5 g. of silver nitrate in 300 c.cm. of distilled water, and add dilute aqua ammonia until the precipitate formed is nearly, *but not entirely*, redissolved in the manner explained in the preceding method. Filter the solution and add water to make 500 c.cm.

Dissolve one g. of silver nitrate in a small quantity of water and pour into about half a liter of boiling water; dissolve 0.83 g. of Rochelle salts in a small quantity of water, and add to the boiling solution. Continue the boiling for half an hour, till the gray precipitate collects as a powder in the bottom of the flask. Filter hot, and add water to make 500 c.cm.

These solutions may be kept in the dark for a month or two.

For silvering, equal volumes of the two solutions are mixed, and the glass is supported in the mixture in whatever fashion is convenient. Various methods are mentioned in the preceding article. The thickest possible deposit may require an hour's time. A second deposit may be made upon the first if necessary to secure the desired thickness. The drying and polishing may be carried out as described above.

A half-silvered film will be produced in about a minute; only experience can determine when the proper thickness has been secured. The glass appears as though it were very lightly smoked. A film that reflects a little more than half the light incident at 45° is desirable for interferometer use. A simple method of testing is to look at two similar gas flames, one seen through the film and the other seen reflected by it. It is well to silver at once all four surfaces of the two plane-parallel plates of the interferometer and to select for use that film which is of the proper and most uniform thickness.

SOAP SOLUTION FOR SOAP FILM EXPERIMENTS

Pure castile or palm-oil soap	1 oz.
Distilled water	8 oz.
Pure glycerin	4 oz.

Cut the soap in thin shavings and dissolve in the water. When the solution is complete, add the glycerin and mix very thoroughly. On standing the liquid becomes clear at the bottom. The clear portion may conveniently be removed by a siphon and preserved indefinitely.

SODIUM FLAME

An intense sodium flame is readily obtained by placing a small lump of rock salt in the center of the screen on a lighted Meker burner.

SODIUM LIGHT

Paper is to be soaked in a saturated solution of common salt, borax or other salt of sodium, and dried. When wrapped around a Bunsen burner, secured by a twist of wire and pushed up into the edge of the flame, a sodium flame of considerable intensity is obtained. As the ash of the paper breaks away it must be occasionally raised. Lithium chloride may be used in place of or with sodium salt to give the lithium line for spectrometric measurement. Sheet asbestos (thin) may replace the paper if desired. Since the asbestos is not consumed it is necessary to moisten the mantle with salt solution at intervals.

SOLDERING PYREX GLASS TO METAL

Dip the Pyrex glass tube to be soldered into a solution of chlorplatinic acid (or platinic chloride may be substituted) made by preparing a mixture consisting of 0.2 gram of the acid with 5 c.c. each of alcohol and ethyl ether to which 4 or 5 drops of turpentine have been added. After dipping the tube, carefully burn all the adhering liquid away leaving a film of platinum metal. That film will serve to hold the solder to the Pyrex glass and in doing so makes a very satisfactory gas-tight joint for a metal to glass connection.

SOLDERS

Composition by weight						Approximate temperature of fusion	Metals for which it is used	Flux commonly used
Lead	Tin	Copper	Zinc	Silver	Gold			
1	1	....	....	....	..	220° C.	Lead	Tallow
3	5	....	....	....	..	180	Zinc	Zinc chloride 25% HCl
2	5	....	....	....	..	195	Copper brass	Zinc chloride (neutral) or resin
							Iron	Zinc chloride or NH_4Cl
		2	1	....	..	....	Fe, Cu,	Borax
		55	45	....	..	880	Fe, Cu, brass	Borax
		4.5	0.5	15.0	..	1005	Fe, Cu, Au,	Borax
		6.5	2.0	11.0	..	983	Fe, Cu, Au,	Borax
		4	....	6	10	....	Gold	

STOPCOCK LUBRICANTS

Seal for Ground Glass Joints

Glycerin makes a very satisfactory seal for ground glass joints to prevent leakage of petroleum ether, ethyl ether or any other fluid in which glycerin is insoluble. Glycerin on the ground glass surface prevents sticking and so allows for the easy dismantling of the apparatus.

Stopcock Grease

Shepherd and Ledig (J. Ind. Eng. Chem. 19, 1059, 1927) prepare stopcock grease from the following ingredients by mixing with continuous stirring for 190 hours at 155° C., then placing the mixture in small 2 oz. containers, immediately chilling the contents on ice and allowing to age for 10 days before use. For high vacuum: 31 parts crepe rubber, 24 parts white "Vaseline" petroleum jelly, 5 parts paraffin (m. p. 36° C.); for general lubricant: 6 parts crepe rubber, 7 parts "Vaseline" petroleum jelly, 1 part paraffin; for light lubricant: 10 parts smoked sheet or pale crepe rubber, 18 parts "Vaseline" petroleum jelly and 1 part paraffin (m. p. 30° C.).

Stopcock Grease

Black rubber (red or pure gum)	1 part
Paraffin	2 parts
"Vaseline" petroleum jelly	4 parts

Melt the paraffin and "Vaseline" petroleum jelly together, add the rubber slowly and in small pieces taking care not to burn the rubber. A larger quantity of "Vaseline" petroleum jelly may be desirable.

Stopcock Lubricant

Petrolatum (500 grams) and raw crepe rubber (50 grams) are stirred together and kept in an oven at 125°–150° C. for several days, or until the mixture is homogeneous.

Stopcock Lubricant

Standard Viscous Oil No. 32 (Standard Oil Co. of California)	200 grams
Aluminum stearate	50 grams

Dissolve the stearate in the oil, heated to about 150° C., and cool. This makes an extremely sticky, ropy, tough adhesive for ground glass surfaces.

Stopcock Lubricant

In the laboratory it is often desirable to have a stopcock lubricant that will not dissolve away with the ordinary fat solvents such as the hydrocarbons or chlorinated hydrocarbons. In some set-ups the ordinary stopcock greases are quite useless, and syrupy phosphoric acid is very unsatisfactory.

A paste of Bentonite (colloidal clay) and glycerin may be used for such a purpose. One can adjust the viscosity of the paste to suit his needs. Such a lubricant is entirely unaffected by the non-aqueous solvents, and even in the presence of water holds remarkably long, probably due to the fact that the Bentonite makes a jelly with either glycerin or water. In addition it has the very decided advantage of permitting a stopcock lubricant to be used at temperatures up to or even well above 100° C. The viscosity does not diminish very much with rise in temperature.

UNIVERSAL WAX

(1) A soft wax useful in the laboratory may be made by melting together paraffin, "Vaseline" petroleum jelly and paraffin oil in various proportions according to the pliability desired.

(2) Another authority recommends equal quantities of beeswax and turpentine (by weight). It is customary to color the wax by adding finely-powdered Venetian red.

(3) Melt together 1 part of Venice turpentine and 5 parts of beeswax. Color with vermilion.

PHOTOGRAPHIC FORMULAS

Compiled by Haywood Parker, Jr.

In the processing of photographic materials, the best results will generally be obtained by following the manufacturer's recommendations. In certain special applications, however, as in technical or scientific work, special characteristics may be desired which indicate the use of other than the recommended solutions.

In selecting the formulas included here, the aim has been to provide a group of reliable, standard formulas covering all the needs normally encountered in the various applications of black-and-white photography.

Pure water, preferably distilled, should be used in all solutions. Desiccated or anhydrous sodium sulfite and the monohydrate of sodium carbonate are specified in most of the formulas. If other crystalline forms are used, the quantities should be adjusted according to the relative molecular weights.

Quantities are given in both metric and avoirdupois—U. S. liquid units. The values are not interchangeable between the different columns since the volumes of solution are not exactly the same. According to usage in the photographic field, volumes of liquid in the metric formulas are given in cubic centimeters (c.c.), rather than in milliliters (ml.). The milliliter is 1.000027 cubic centimeter, so that the units are, of course, interchangeable for photographic uses.

The following abbreviations are employed:

anh.	anhydrous
c.c.	cubic centimeter
dr.	dram
gm.	gram
gal.	gallon
gr.	grain
l.	liter
min.	minim
ml.	mililiter (equivalent to cubic centimeter, cm^3 or c.c.)
oz. (av.)	ounce (avoirdupois)
oz. fl.	fluid ounce
qt.	quart

The following conversion factors may be used:

1 oz. (av.) = 437.5 gr.
1 oz. (fl.) = 8 dr.
1 gal. (U. S.) = 3.7853 liters

DEVELOPERS

When a time of development is suggested, it is intended to serve as a guide only. Individual requirements as to density and contrast vary. Greater or less contrast may be obtained by developing for a longer or a shorter time respectively. The times given for tray development are for continuous agitation, those for tank for intermittent agitation.

GENERAL PURPOSE NEGATIVE DEVELOPERS

(See also the section on Universal Developers.)

Elon-Hydroquinone (Kodak DK-50)

Developer for professional films and plates.

Stock Solution

Water, about 125° F. (52° C.)	64 oz.	1¾ gal.	500 c.c.
Elon	145 gr.	1 oz. 75 gr.	2.5 gm.
Sodium sulfite, desiccated	4 oz.	14 oz. 75 gr.	30 gm.
Hydroquinone	145 gr.	1 oz.	2.5 gm.
Kodalk (sodium metaborate ($4H_2O$))	1 oz. 145 gr. (583 gr.)	4¾ oz.	10 gm.
Potassium bromide	30 gr.	100 gr.	.5 gm.
Water to make	1 gal.	3½ gal.	1000 c.c.

Dissolve chemicals in the order given.

Tray Development.—Use without dilution and develop about five minutes at 68° F. (20° C.).

Tank Development.—Use without dilution and develop about six minutes at 68° F. (20° C.). If a somewhat longer time is preferred, dilute with an equal volume of water and develop about nine minutes at 68° F. (20° C.).

Replenisher (Kodak DK-50R)

Water, about 125° F. (52° C.)	96 oz.	750 c.c.
Elon	290 gr.	5 gm.
Sodium sulfite, desiccated	4 oz.	30 gm.
Hydroquinone	1 oz. 145 gr. (583 gr.)	10 gm.
Kodalk (sodium metaborate $4H_2O$)	5¼ oz.	40 gm.
Water to make	1 gal.	1000 c.c.

Dissolve chemicals in the order given.

Instructions for DK-50R Replenisher

For Large Tanks (one gallon or more).—The replenisher should be added at a rate which will maintain constant development activity. Ordinarily this will be achieved by adding 6 gallons per 1000 rolls processed (approximately 80,000 square inches) or ¾ ounce per roll. In many cases this volume of replenisher will coincide with the quantity of developer lost through use. In other cases it may be necessary also to remove some exhausted developer or to add fresh developer in addition to the replenisher to maintain constant level in the tank.

The replenisher should be added and stirred in thoroughly after every batch of films or after not more than 4 rolls (320 square inches) have been processed per gallon of developer.

For Small Tanks (less than one gallon).—Ordinarily, constant developer activity will be maintained by adding 1 ounce of replenisher for each 80 square inches of film. This is equivalent to one 8 by 10 inch or four 4 by 5 inch sheet films, one 620 roll film, or one 36-exposure roll of 35 mm film. After processing 1 roll of film, pour 1 ounce of replenisher solution into the empty developer storage bottle. Then pour enough used developer into the bottle to fill it to the original volume, discarding any excess. If short of the original volume, add unused developer solution or replenisher diluted 2 parts with 1 part of water to make up for the loss. Repeat for each roll developed.

Metol-Hydroquinone Developer (Ansco 47)

This is a long-life, clean-working formula which will give excellent results as a standard film developer for either tray or tank development.

Kodak Developer D-61a, diluted one for one, is closely similar to this developer used full strength.

Hot water (125° F. or 52° C.)	3 qt.	2½ gal.	750 c.c.
Metol	88 gr.	½ oz. 90 gr.	1.5 gm.
Sodium sulfite, anh	6 oz.	1 lb. 5 oz. (21 oz.)	45 gm.
Sodium bisulfite	60 gr.	½ oz.	1 gm.
Hydroquinone	¼ oz. 65 gr.	1¼ oz. 65 gr. (612 gr.)	3 gm.
Sodium carbonate, monohydrated	¾ oz. 25 gr.	2¾ oz.	6 gm.
Potassium bromide	47 gr.	¼ oz. 55 gr.	.8 gm.
Water to make	1 gal.	3½ gal.	1000 c.c.

TANK DEVELOPMENT: Used without dilution. Normal development time 6 to 8 minutes at 68° F. (20° C.) with occasional agitation. For longer developing times, dilute one part developing solution with one part water and develop 12 to 16 minutes at 68° F. (20° C.).

TRAY DEVELOPMENT: Normal development time 5 to 7 minutes at 68° F. (20° C.).

Replenisher (Ansco 47A)

Add ¾ ounce of replenisher to Ansco 47 for each roll of 120 film (or equivalent) developed.

Hot water (125° F. or 52° C.)	24 oz.	3 qt.	750 c.c.
Metol	45 gr.	¼ oz. 65 gr.	3 gm.
Sodium sulfite, anh	1½ oz.	6 oz.	45 gm.
Sodium bisulfite	30 gr.	¼ oz. 8 gr.	2 gm.
Hydroquinone	88 gr.	¾ oz. 20 gr.	6 gm.
Sodium carbonate, monohydrated	¼ oz. 65 gr.	1½ oz. 45 gr.	12 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

This type of developer produces a brown stain image in addition to the silver image. Its use has been largely superseded by the general purpose M. Q. developers.

Pyro Tank Developer

Water	48 oz.	1360 c.c.
Sodium sulfite, anh	115 gr.	7.5 gm.
Sodium carbonate, anh	90 gr.	5.8 gm.
Pyro	45 gr.	2.9 gm.

Dissolve immediately before use. Use full strength.
Develop 15 minutes at 68° F. (20° C.).

PHOTOGRAPHIC FORMULAS (Continued)

Glycin Developer (Ansco 72)

This formula provides a highly concentrated stock solution which can be diluted to produce a clean working developer suitable for roll, pack, and sheet film when a long scale of gradation and low maximum density is desired.

Stock Solution

Hot water (125° F. or 52° C.)	24 oz.	3 qt.	750 c.c.
Sodium sulfite, anh	4¼ oz.	1 lb. 1 oz.	125 gm.
Potassium carbonate	8½ oz.	2 lb. 2 oz.	250 gm.
*Glycin	1½ oz. 75 gr.	6¾ oz.	50 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

* Parahydroxyphenylglycine.

TANK DEVELOPMENT: Take one part stock solution, fifteen parts water and develop 20 to 25 minutes at 68° F. (20° C.).

TRAY DEVELOPMENT: Take one part stock solution, four parts water and develop 5 to 10 minutes at 68° F. (20° C.).

M. Q.—BORAX, Semi-Fine Grain Developers

Elon-Hydroquinone Borax (Kodak D-76)

Developer for full emulsion speed and maximum shadow detail at normal contrast on films and plates.

Water, about 125° F. (52° C.)	24 oz.	96 oz.	750 c.c.
Elon	29 gr.	115 gr.	2 gm.
Sodium sulfite, desiccated	3 oz. 145 gr. (1458 gr.)	13¼ oz.	100 gm.
Hydroquinone	73 gr.	290 gr.	5 gm.
Borax, granular	29 gr.	115 gr.	2 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

Dissolve chemicals in the order given.

Average development time about 17 minutes at 68° F. (20° C.). See individual recommendations listed for each material.

Replenisher (Kodak D-76R)

Water, about 125° F. (52° C.)	24 oz.	96 oz.	750 c.c.
Elon	44 gr.	175 gr.	3 gm.
Sodium sulfite, desiccated	3 oz. 145 gr. (1458 gr.)	13¼ oz.	100 gm.
Hydroquinone	¼ oz.	1 oz.	7.5 gm.
Borax, granular	290 gr.	2 oz. 290 gr.	20 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

Dissolve chemicals in the order given.

Use the replenisher without dilution and add to the tank to maintain the acitivity of the developer, as described for Kodak Replenisher DK-50R.

Metol-Hydroquinone-Borax (Ansco 17)

In addition to its usefulness as a fine-grain developer, this formula is satisfactory for obtaining soft gradation. It is also recommended for motion picture negative development.

Hot water (125° F. or 52° C.)	24 oz.	3 qt.	750 c.c.
Metol	22 gr.	88 gr.	1.5 gm.
Sodium sulfite, anh.	2½ oz. 80 gr. (1174 gr.)	10¾ oz.	80 gm.
Hydroquinone	44 gr.	¼ oz. 65 gr.	3 gm.
Borax	44 gr.	¼ oz. 65 gr.	3 gm.
Potassium bromide	7½ gr.	30 gr.	.5 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

Do not dilute for use.

Tank or development time at 68° F. (20° C.), 10 to 15 minutes for fine-grain films, 12 to 20 minutes for direct copy, direct duplicating, and portrait cut films.

Replenisher (Ansco 17A)

Add ¾ ounce of replenisher to Ansco 17A for each roll of 120 film (or equivalent) developed.

Hot water (125° F. or 52° C.)	24 oz.	3 qt.	750 c.c.
Metol	32 gr.	129 gr.	2.2 gm.
Sodium sulfite, anh.	2½ oz. 80 gr. (1174 gr.)	10¾ oz.	80 gm.
Hydroquinone	65 gr.	269 gr.	4.5 gm.
Borax	263 gr.	2¼ oz. 75 gr. (1059 gr.)	18 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

Fine Grain Developer for Films and Plates (Kodak DK-20)

This is a true fine grain developer. It produces approximately the same reduction in image graininess as the straight paraphenylenediamine developers, with much less loss in effective film speed, shorter development times, and much lower toxicity.

Water, about 125° F. (52° C.)	96 oz.	750 c.c.
Elon	290 gr.	5 gm.
Sodium sulfite, desiccated	13¼ oz.	100 gm.
Kodalk (sodium metaborate, $4H_2O$)	115 gr.	2 gm.
Sodium thiocyanate (sulfocyanate)	60 gr.	1 gm.
Potassium bromide	30 gr.	.5 gm.
Cold water to make	1 gal.	1000 c.c.

Dissolve chemicals in the order given.

Average development time about 15 minutes in a tank at 68° F. (20° C.). See individual recommendations listed for each material.

The useful life of this developer can be increased 5 to 10 times by use of the following replenisher.

Replenisher (Kodak DK-20R)

Water, about 125° F. (52° C.)	96 oz.	750 c.c.
Elon	1 oz.	7.5 gm.
Sodium sulfite, desiccated	13¼ oz.	100 gm.
Kodalk (sodium metaborate $4H_2O$)	2 oz. 290 gr. (1165 gr.)	20 gm.
Sodium thiocyanate (sulfocyanate)	290 gr.	5 gm.
Potassium bromide	60 gr.	1 gm.
Cold water to make	1 gal.	1000 c.c.

Dissolve chemicals in the order given. The replenisher should be added at a rate which will maintain constant development activity, as described for Kodak Replenisher DK-50R.

Paraphenylenediamine Glycin (Dr. Sease formulas)

	No. 1	No. 2	No. 3	No. 4
Water	32 oz.	32 oz.	32 oz.	32 oz.
Sodium sulfite, dry	3 oz.	3 oz.	3 oz.	3 oz.
*Paraphenylenediamine (base)	146 gr.	146 gr.	146 gr.	146 gr.
**Glycin	......	15 gr.	88 gr.	175 gr.

* Paraphenylenediamine hydrochloride is not interchangeable with the paraphenylenediamine base called for in these formulas.

** Parahydroxyphenyl glycine.

No. 1 gives the finest grain, and requires three to four times normal exposure. The other formulas require about twice normal exposure, develop a film in a shorter time, and give more graininess as the glycin content increases. Formula No. 3 is standard, with a development time of about 20 minutes at 68° F. (20° C.)

CAUTION: Paraphenylenediamine, and solutions containing it, cause skin irritation for many people. Avoid contact with the powder or the developer solution.

Elon-Hydroquinone (Kodak D-11)

High Contrast Developers

Process tank or tray developer for high contrast on films and plates.

Water, about 125° F. (52° C.)	16 oz.	64 oz.	500 c.c.
Elon	15 gr.	60 gr.	1 gm.
Sodium sulfite, desiccated	2½ oz.	10 oz.	75 gm.
Hydroquinone	130 gr.	1 oz. 90 gr.	9 gm
Sodium carbonate, monohydrated	1 oz.	4 oz.	25 gm.
Potassium bromide	75 gr.	290 gr.	5 gm.
Cold water to make	32 oz.	1 gal.	1000 c.c.

Dissolve chemicals in the order given.

For process photography use without dilution. For development of copies of continuous-tone subjects, dilute with an equal volume of water. Develop about 5 minutes in a tank or 4 minutes in a tray at 68° F. (20° C.).

Elon-Hydroquinone (Kodak D-19)

This is a clean-working, long-life, contrast developer which is particularly recommended for use in photomicrography and for the development of films and plates for scientific and technical use.

	U. S. Liquid	**Metric**
Water, about 125° F. (50° C.)	64 oz.	500 c.c.
Elon	115 gr.	2.0 gm.
Sodium sulfite, desiccated	12 oz.	90.0 gm.
Hydroquinone	1 oz. 30 gr.	8.0 gm.
Sodium carbonate, monohydrated	7 oz.	52.5 gm.
Potassium bromide	290 gr.	5.0 gm.
Cold water to make	1 gal.	1.0 l.

Dissolve chemicals in order given.

Develop about 6 minutes in a tank or 5 minutes in a tray at 68° F. (20° C.) according to the contrast desired.

Metol-Hydroquinone (Ansco-30)

This developer is recommended for use with Ansco X-ray films and Ansco aerial films. It is clean-working, has long life and gives high contrast.

Hot water (125° F. or 52° C.)	24 oz.	3 qt.	750 c.c.
Metol	51 gr.	¼ oz. 95 gr.	3.5 gm.
Sodium sulfite, anh.	2 oz.	8 oz.	60 gm.
Hydroquinone	¼ oz. 20 gr.	1 oz. 90 gr. (527 gr.)	9 gm.
Sodium carbonate, monohydrated	1¼ oz. 40 gr. (587 gr.)	5¼ oz.	40 gm.
Potassium bromide	29 gr.	117 gr.	2 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

Do not dilute for use.

Normal development time at 68° F. (20° C.), for x-ray film, 6 minutes, for non-screen x-ray film, 8 minutes, for S. S. Pan-Aero film 10–15 minutes depending upon the type of developing machine.

Metol-Hydroquinone (Ansco 90)

This developer has been particularly designed for use with commercial and process films to produce negatives of brilliant contrast.

Hot water (125° F. or 52° C.)	24 oz.	3 qt.	750 c.c.
Metol	72 gr.	½ oz. 20 gr.	5 gm.
Sodium sulfite, anh	1¼ oz. 40 gr. (587 gr.)	5 oz.	40 gm.
Hydroquinone	88 gr.	¾ oz. 20 gr.	6 gm.
Sodium carbonate, monohydrated.	1¼ oz. 40 gr. (587 gr.)	5 oz.	40 gm.
Potassium bromide	44 gr.	¼ oz 65 gr.	3 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

Do not dilute for use.

Normal development time, 4 to 6 minutes at 68° F. (20° C.)

Hydroquinone Caustic Soda (Kodak D-8)

Developer for very high contrast on films and plates.

Stock Solution

Water, about 90° F. (32° C.)	24 oz.	96 oz.	750 c.c.
Sodium sulfite, desiccated	3 oz.	12 oz.	90 gm.
Hydroquinone	1½ oz.	6 oz.	45 gm.
Sodium hydroxide (caustic soda)	1¼ oz.	5 oz.	37.5 gm.
Potassium bromide	1 oz.	4 oz.	30 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

Dissolve chemicals in the order given. Stir the solution thoroughly before use.

For use, take 2 parts of stock solution and 1 part of water. Develop about 2 minutes in a tray at 68° F. (20° C.).

For general use, a developer which is slightly less alkaline and gives almost as much density can be obtained by using 410 gr. of sodium hydroxide per 32 oz. of stock solution (28 gm. per 1000 c.c.) instead of the quantity given in this formula.

Paraformaldehyde Developer (Kodak D-85)

This type of developer produces maximum contrast and density, by infectious development, on the fine-grain, high contrast materials used in photomechanical reproduction processes.

PHOTOGRAPHIC FORMULAS (Continued)

Ansco 79 developer is closely similar, except that it calls for potassium metabisulfite instead of sodium bisulfite.

	Avoirdupois	U. S. Liquid	Metric
Water, about 90° F. (30° C.)	64 oz.	2½ gal.	500 c.c.
Sodium sulfite, desiccated	4 oz.	1¼ lbs.	30.0 gm.
Paraformaldehyde	1 oz.	5 oz.	7.5 gm.
Sodium bisulfite	128 gr.	1 oz. 200 gr.	2.2 gm.
*Boric acid crystals	1 oz.	5 oz.	7.5 gm.
Hydroquinone	3 oz.	15 oz.	22.5 gm.
Potassium bromide	90 gr.	1 oz.	1.6 gm.
Water to make	1 gal.	5 gal.	1.0 l.

* Use crystalline boric acid as specified. Powdered boric acid dissolves with great difficulty and its use should be avoided.

Mixing Directions

Use a narrow-mouthed bottle for mixing the developer. First check the volume of the bottle and mark it to indicate the exact level of the quantity of solution to be mixed. Fill the bottle half full of water at about 90° F. (32° C.) and dissolve the chemicals in the order given. After adding each chemical, place the stopper in the bottle so that only a small quantity of air is present during agitation. When all the chemicals have been dissolved, add cold water until the solution comes up to the mark. Insert stopper tightly to exclude as much air as possible. Allow the developer to stand about two hours after mixing. Cool to 68° F. (20° C.) before use. If only a portion of the contents of the bottle is used at one time, it is suggested that the balance be saved by filling a bottle of smaller size which should then be stoppered tightly.

Time of Development: 1½ to 2 minutes at 68° F. (20° C.); see individual recommendations given for each material. With a correctly timed exposure, the image should appear in 30 to 45 seconds at the temperature specified.

This developer has the property of cutting development very sharply in the low densities thus insuring clear dot formation in the halftone negatives.

Elon-Hydroquinone (Kodak D-72)

(Ansco 125 is the same except for approximately 20% lower sodium carbonate content.)

Stock Solution

Water, about 125° F. (52° C.)	16 oz.	64 oz.	500 c.c.
Elon	45 gr.	175 gr.	3 gm.
Sodium sulfite, desiccated	1½ oz.	6 oz.	45 gm.
Hydroquinone	175 gr.	1 oz. 260 gr.	12 gm.
Sodium carbonate, monohydrated	2 oz. 290 gr.	10.5 oz.	80 gm.
Potassium bromide	30 gr.	115 gr.	2 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

Dissolve chemicals in the order given.

For paper: Take stock solution 1 part, water 2 parts, and develop about one minute at 68° F. (20° C.)

For films and plates: Take stock solution 1 part, water 1 part, and develop about 2½ minutes in a tray or 3 minutes in a tank at 68° F. (20° C.)

Universal Developers for Films, Plates, and Papers

Amidol for Films, Plates or Papers

The following developer will give excellent results for plates, films, lantern slides, bromide paper or gaslight paper. It should be dissolved immediately before using, since it keeps only a few hours in solution.

Amidol	25 gr.	1.6 gm.
Sodium sulfite	120 gr.	7.8 gm.
Water	10 oz.	300 c.c.
Potassium bromide	7 gr.	0.5 gm.

The concentration given is satisfactory for any of the purposes mentioned. Develop three to five minutes at a temperature of 68° F. or (20° C.)

Kodelon (Kodak DK-93)

Developer for films, plates, and papers.

Water, about 125° F. (52° C.)	16 oz.	64 oz.	500 c.c.
Kodelon (paraminophenol hydrochloride)	75 gr.	290 gr.	5 gm.
Sodium sulfite, desiccated	1 oz.	4 oz.	30 gm.
Hydroquinone	37 gr.	145 gr.	2.5 gm.
Kodalk (sodium metaborate $4H_2O$)	290 gr.	2 oz. 290 gr.	20 gm.
Potassium bromide	7 gr.	30 gr.	.5 gm.
Cold water to make	32 oz.	1 gal.	1000 c.c.

Dissolve the chemicals in the order given.

Use without dilution. Develop roll films about 9 minutes in a tank of fresh developer at 68° F. (20° C.). Develop professional films and plates about 6 minutes at 68° F. (20° C.). Greater or less contrast may be obtained by developing longer or shorter times than those specified.

For warm tones on papers, use without dilution and develop for 2 minutes at 68° F. (20° C.). For colder tones, double the quantity of Kodalk; use without dilution and develop 1 to 2 minutes at 68° F. (20° C.). In either case, the tones given with this developer are slightly warmer than the normal tones given with Kodak Developers D-52 and D-72.

The use of Kodak DK-93 is especially recommended for those persons subject to trouble from skin irritation.

Developers for Papers

(See also the section on Universal Developers)

Elon-Hydroquinone (Kodak D-52)

Developer for warm tone papers.

	Stock Solution		
Water, about 125° F. (52° C.)	16 oz.	64 oz.	500 c.c.
Elon	22 gr.	90 gr.	1.5 gm.
Sodium sulfite, desiccated	¾ oz.	3 oz.	22.5 gm.
Hydroquinone	90 gr.	350 gr.	6 gm.
Sodium carbonate, monohydrated	250 gr.	2¼ oz.	17 gm.
Potassium bromide	22 gr.	90 gr.	1.5 gm.
Cold water to make	32 oz.	1 gal.	1000 c.c.

Dissolve chemicals in the order given.

For use, take 1 part of stock solution to 1 part of water. Develop about 2 minutes at 68° F. (20° C.).

More bromide may be added if warmer tones are desired.

Metol-Hydroquinone-Glycin (Ansco 130)

This formula is a universal developer for all projection and contact papers. It gives rich black tones with excellent brilliance and detail. It provides unusual latitude in development and is clean-working even with long developing times.

Stock Solution

Hot water (125° F. or 52° C.)	24 oz.	3 qt.	750 c.c.
Metol	32 gr.	129 gr.	2.2 gm.
Sodium sulfite anh	1¾ oz.	6¾ oz.	50 gm.
Hydroquinone	159 gr.	1½ oz.	11 gm.
Sodium carbonate, monohydrated	2½ oz.	10½ oz.	78 gm.
Potassium bromide	80 gr.	¾ oz.	5.5 gm.
*Glycin	159 gr.	1½ oz.	11 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

* Parahydroxyphenyl glycine.

The prepared stock solution is clear but slightly colored. The coloration in this case does not indicate the developer has deteriorated or is unfit for use.

For use dilute 1 part stock solution with 1 part water.

Normal developing time 2 to 6 minutes, at 68° F. (20° C.).

Greater contrast can be obtained by using the developer stock solution full strength. Softer results can be obtained by diluting 1 part stock solution with 2 parts water.

High-Temperature Processing

Whenever possible, the temperature of the processing solutions should be held at 65° to 70° F. When this is not practical, special precautions must be taken to avoid excessive swelling and softening.

Most developers, except highly alkaline solutions, can be used up to 75° F. (24° C.), provided the development times are properly shortened and effective hardening rinse and fixing baths are used.

At higher temperatures, the use of Kodak Prehardener SH-5 before development will harden the emulsion sufficiently to allow use of normal solutions and processing procedure, even at temperatures as high as 110° F. (43° C.).

The use of the prehardener is the simplest and safest procedure for processing at high temperatures. When the prehardener is not available, however, the addition of sodium sulfate to the developer solution will permit operation at temperatures up to 90° or 95° F. (32° to 35° C.). Addition of the quantities of sodium sulfate shown in the table below will maintain approximately normal developing times at the higher temperatures. When using any of these developers, it is necessary to observe the following precautions:

1. Developer, stop bath, fixing bath, and wash water must be at the same temperature to within approximately 5° F. (2.5° C.).
2. After development, the film should be treated in a freshly prepared hardening rinse bath, such as Kodak Hardening Bath SB-4. The film should be agitated for several seconds when first immersed in the stop bath, and then left for 3 minutes.
3. The film should be fixed for about 10 minutes in a fresh acid hardening fixing bath, such as Kodak Fixing Bath F-5.
4. The film should be washed for 10 to 15 minutes in running water or in several changes of water. Longer washing may cause trouble.

Kodak Developers	Range of Temperatures	Sodium Sulfate (Desiccated)	
		Per Quart	Per Liter
D-11 D-19	75° to 80° F.	1 oz. 290 gr.	50 gm.
D-76	80° to 85° F.	2½ oz.	75 gm.
	85° to 90° F.*	3 oz. 145 gr.	100 gm.
DK-50	75° to 80° F.	3 oz. 145 gr.	100 gm.
D-72 (1:1)	80° to 85° F.	4 oz. 75 gr.	125 gm.
	85° to 90° F.*	5 oz.	150 gm.

* If necessary to develop at 90° to 90° F., decrease the time about one-third.

Prehardener (Kodak SH-5)

	Avoirdupois U. S. Liquid	**Metric**
Solution A		
Formaldehyde, about 37% solution by weight	1¼ dr.	5 c.c.
Solution B		
Water	28 oz.	900 c.c.
*0.5% solution of Kodak Anti-fog No. 2 (6-nitrobenzimidazoic nitrate)	1¼ oz.	40.0 c.c.
Sodium sulfate, desiccated	1 oz. 290 gr.	50.0 c.c.
Sodium carbonate, monohydrated	175 gr.	12.0 gm.
Water to make	32 oz.	1.0 l.

* To prepare a 0.5% solution, dissolve 18 grains of Kodak Anti-fog No. 2 in 8 ounces of distilled water (1 gram in 200 c.c. of water).

Directions for Mixing: The working solution should be prepared just before using by adding 1¼ drams (5 c.c.) of Solution A to 32 ounces (1 liter) of Solution B and mixing thoroughly.

Directions for Use: Bathe the exposed film in Kodak Prehardener SH-5 for 10 minutes with moderate agitation. Then remove the film from the solution, drain for a few seconds, immerse in water for 30 seconds, drain thoroughly-and immerse in the developer. The selection of the proper developer will depend upon the contrast and the time of development desired. In general up to 90° F. (32° C.), conventional developers such as Kodak D-76, Dk-50, D-19, etc., may be used without modification.

Times of development will be about as follows:

At 75° F. (24° C.)—use the normal development time recommended at 68° F. (20° C.) without prehardening.

At 80° F. (27° C.)—85% of normal time.

At 85° F. (29° C.)—70% of normal time.

At 90° F. (32° C.)—60% of normal time.

At 95° F. (35° C.)—50% of normal time.

Following development, rinse, fix in an acid hardening fixing bath, wash, and dry in the usual way.

At Temperatures Above 95° F. (35° C.) up to 110° F. (43° C.): Increase the concentration of Kodak Anti-Fog No. 2 in the prehardener up to double the normal formula concentration, if necessary, to control fog. Process as before, using a low-activity developer, such as Kodak D-76, to avoid excessively short development times. The average development time at 110° F. (43° C.) after prehardening is about one-quarter of the normal time at 68° F.

In case the development time at elevated temperatures is too short for practical use, sodium sulfate can be added to the developer to extend the time of development.

Keeping Properties: The keeping properties are adequate for ordinary tray and tank practice. Gradual deterioration does occur on standing, but the bath will keep satisfactorily (without use) in a closed bottle for 3 or 4 weeks at 95° F. (35° C.). For most applications, the useful life without replenishment is more than forty 8 × 10-inch films per gallon without serious change in properties.

Pinakryptol Green Desensitizer (Ansco 351)

This solution is not recommended for high speed panchromatic films.

Stock Solution

Pinakryptol green	15 gr.	1 gm.
*Water to make	16 oz.	500 c.c.

For use dilute one part stock desensitizing solution with ten parts water. Immerse films in total darkness for two minutes at 68° F. (20° C.), and then transfer to developing solution.

After one-half of the developing time, films may be inspected for 10 second periods at one-minute intervals; illumination being supplied by a yellow-green safelight placed 2 to 3 feet distant. Desensitized films should be developed approximately 50% longer than non-treated films to obtain comparable gradation and shadow detail.

The same stock solution may be used, if preferred, directly in the developer in the proportion: desensitizer: one part, developer: thirty parts. This procedure should not be followed with developers containing more than 1 gram per liter (15 grains per quart) of hydroquinone.

* Use of a 50-50 water-alcohol mixture for solution will improve the keeping qualities of the desensitizer.

Stock Solution

Hot water (125° F. or 52° C.)	24 oz.	3 qt.	750 c.c.
Metol	45 gr.	179 gr.	3 gm.
Sodium sulfite, anh.	1½ oz.	6 oz.	44 gm.
Hydroquinone	169 gr.	1½ oz. 20 gr. (676 gr.)	12 gm.
Sodium carbonate, monohydrated	2¼ oz.	9 oz.	65 gm.
Potassium bromide	30 gr.	119 gr.	2 gm.
Water to make	32 oz.	1 gal.	1000 c.c.

PAPER DEVELOPMENT: Dilute 1 part stock solution with 2 parts water. Develop 1 to 2 minutes at 70° F. (21° C.). For softer and slower development dilute 1 to 4, and develop 1½ to 3 minutes at 70° F. (21° C.). For greater brilliance, shorten the exposure slightly and lengthen the development time. For greater softness, lengthen the exposure slightly and shorten the development time.

Stop Bath (Kodak SB-1) (Ansco 210)

For papers.

Water	32 oz.	1000 c.c.
Acetic acid, 28%	1½ oz.	48 c.c.

To make approximately 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

Rinse prints for at least 5 seconds. Capacity: about twenty 8 × 10-inch prints per quart (1000 c.c.).

Stop Bath (Kodak SB-1a)

(Use after highly alkaline developers)

Water	32 oz.	1000 c.c.
Acetic acid, 28%	4 oz.	125 c.c.

To make approximately 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

The action of this bath checks development instantly, provided the acid has not been neutralized. It also tends to prevent uneven spots and streaks when the prints or negatives are immersed in the fixing bath.

Chrome Alum Hardening Bath (Kodak SB-3) (Ansco 216)

For use at 65° to 75° F. with films and plates.

Water	32 oz.	1000 c.c.
Potassium chrome alum	1 oz.	30 gm.

This bath can be used in place of the regular acetic acid stop bath to give additional hardening to the film. It is particularly desirable in hot weather, for tropical development, and for negatives which have to be enlarged while wet.

Agitate the negatives for a few seconds when first immersed in hardener. Leave them in the bath for 3 to 5 minutes to secure maximum hardening. This bath should be renewed frequently.

Hardening Bath (Kodak SB-4)

For use at 75° to 90° F. with films and plates.

This solution is recommended for use in conjunction with high temperature developers, such as those with sodium sulfate added, when working above 75° F. (24° C.).

Water	32 oz.	1000 c.c.
Potassium chrome alum	1 oz.	30 gm.
*Sodium sulfate, desiccated	2 oz.	60 gm.

* If crystalline sodium sulfate is preferred instead of the desiccated, use 4½ oz. (140 g) in the above formula.

Agitate the negatives for 30 to 45 seconds when they are first immersed in the hardener, or streakiness will result. Leave them in the bath for at least 3 minutes between development and fixation. If the temperature is below 85° F. (29° C.), rinse for 1 to 2 seconds in water before immersing in the hardener bath.

The hardening bath is a violet blue color by tungsten light when freshly mixed, but it ultimately turns a yellow-green with use; it then ceases to harden and should be replaced with a fresh bath. The hardening bath should never be overworked. An unused bath will keep indefinitely, but the hardening power of a partially used bath decreases rapidly on standing for a few days.

Formaldehyde Hardener (Kodak SH-1)

For use prior to aftertreatment (such as reduction or intensification) of films and plates.

Water	16 oz.	500 c.c.
Formaldehyde (about 37% solution by weight)	2½ dr.	10 c.c.
Sodium carbonate, monohydrated	90 gr.	6 gm.
Water to make	32 oz.	1000 c.c.

This formula is recommended for the treatment of negatives which normally would be softened by a chemical treatment as for the removal of stains or for intensification or reduction.

After hardening for three minutes, negatives should be rinsed and immersed for five minutes in a fresh acid fixing bath and then washed thoroughly before they are given any further chemical treatment.

Fixing Bath Non-Hardening; For Special Processes (Kodak F-24)

Water, about 125° F. (52° C.)	16 oz.	500 c.c.
Sodium thiosulfate (hypo)	8 oz.	240 gm.
Sodium sulfite, desiccated	145 gr.	10 gm.
Sodium bisulfite	365 gr.	25 gm.
Cold water to make	32 oz.	1000 c.c.

Dissolve chemicals in the order given.

This bath may be used for films, plates or paper when no hardening is desired.

For satisfactory use, the temperature of the developer, rinse bath, and wash water should not be higher than 68° F. (20° C.).

Acid Hardening Fixer (Ansco 201)

This hardening fixing bath for use with either film or paper may be stored indefinitely and used repeatedly until exhausted. If the fixing bath froths, turns cloudy, or takes longer than 10 minutes to fix out completely, it must be replaced by a fresh solution.

Solution 1			
Hot water (125° F. or 52° C.)	16 oz.	½ gal.	500 c.c.
Hypo	8 oz.	2 lb.	240 gm.
Solution 2			
Hot water (125° F. or 52° C.)	5 oz.	20 oz.	150 c.c.
Sodium sulfite, anh	½ oz.	2 oz.	15 gm.
Acetic acid (28%)	1½ oz.	6 oz.	45 c.c.
Potassium alum	½ oz.	2 oz.	15 gm.
Add solution 2 to 1 and add water to make	32 oz.	1 gal.	1000 c.c.

Dissolve chemicals thoroughly in order given and stir rapidly while adding solution 2 to solution 1. Glacial acetic acid may be diluted to 28% concentration by adding 3 parts of acid to 8 parts of water. Do not dilute for use. Normal fixing time 5 to 10 minutes at 65° to 70° F. (18° to 21° C.).

Acid Hardening Fixing Bath (Kodak F-5)

For films, plates, and papers.

This bath has the advantage over the older type of fixing baths, which do not contain boric acid, that it gives much better hardening and has less tendency to precipitate a sludge of aluminum sulfite.

Water about 125° F. (52° C.)	20 oz.	600 c.c.
Sodium thiosulfate (hypo)	8 oz.	240 gm.
Sodium sulfite, desiccated	½ oz.	15 gm.
*Acetic acid, 28%	1½ oz. fl.	48 c.c.
Boric acid, crystals	¼ oz.	7.5 gm.
Potassium alum	½ oz.	15 gm.
Cold water to make	32 oz.	1000 c.c.

* To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

Films or plates should be fixed properly in 10 to 20 minutes in a freshly prepared bath. The bath need not be discarded until the fixing time exceeds 20 minutes. Fix prints 5 to 10 minutes.

In warm weather and in inadequately ventilated darkrooms the odor of sulfur dioxide given off by the Kodak Fixing Bath F-5 may be objectionable. This can be eliminated almost entirely by omitting the boric acid and substituting twice its weight in Kodak Balanced Alkali. This modification is known as Kodak Fixing Bath F-6.

The hardener may also be mixed separately as a stock solution as follows:

Stock Solution for Preparing Kodak Fixing Bath F-5

	Avoirdupois	Metric
Water, about 125° F. (50° C.)	20 oz.	600 c.c.
Sodium sulfite, desiccated	2½ oz.	75.0 gm.
*Acetic acid, 28%	7½ oz.	235.0 c.c.
**Boric acid, crystals	1¼ oz.	37.5 gm.
Potassium alum	2½ oz.	75.0 gm.
Cold water to make	32 oz.	1.0 gm.

* To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts glacial acetic acid with 8 parts water.

** Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

Dissolve chemicals in the order given.

Add 1 part of cool stock hardener solution slowly to 4 parts of cool 30% hypo solution (2½ pounds per gallon of solution), while stirring the hypo rapidly.

Rapid Fixing Bath for General Photographic Use (Kodak F-7)

Water, about 125° F. (52° C.)	80 oz.	600 c.c.
Sodium thiosulfate (hypo)	3 lb.	360 gm.
Ammonium chloride	6¾ oz.	50 gm.
Sodium sulfite, desiccated	2 oz.	15 gm.
*Acetic acid, 28%	6 oz. fl.	48 c.c.
Boric acid, crystals	1 oz.	7.5 gm.
Potassium alum	2 oz.	15 gm.
Cold water to make	1 gal.	1000 c.c.

* To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

Dissolve chemicals in the order given.

This bath fixes much more rapidly than Kodak F-5 and its useful fixing capacity is considerably greater.

Caution: With rapid fixing baths, do not prolong the fixing time for fine-grain film or plate emulsions or for *any* paper prints; otherwise the image may have a tendency to bleach, especially at temperatures higher than 68° F. (20° C.). This caution is particularly important in the case of warm-tone papers.

Hypo Eliminator

Water	16 oz.	500 c.c.
Hydrogen peroxide (3 percent)	4 oz. fl.	125 c.c.
Ammonia (3 percent)	3¼ oz. fl.	100 c.c.
Water to make	32 oz.	1.0 l.

Directions for use: Wash prints for 30 minutes at 65° F. to 70° F. Immerse each print for 6 minutes in hypo eliminator solution, then wash for 10 minutes and dry. Capacity of bath is about fifty 8 × 10 prints or the equivalent per gallon.

Hypo Test Solution (Kodak HT-2)

For Testing the Degree of Washing of Films and Papers

	Avoirdupois U. S. Liquid	Metric
Water	24 oz.	750 c.c.
*Acetic acid, 28%	4 oz.	125.0 c.c.
Silver nitrate	¼ oz.	7.5 gm.
Water to make	32 oz.	1.0 l.

* To make approximately 28% acetic acid from glacial acetic acid, dilute 3 parts of glacial acetic acid with 8 parts of water.

Store in a screw-cap or glass-stoppered brown bottle away from strong light. Avoid contact of test solution with the hands, clothing, negatives, prints, or undeveloped photographic materials; otherwise black stains will ultimately result.

Test for Washing: After washing, cut off a small strip from the clear margin of the film or print and immerse a portion of it in a small volume of the test solution for about 3 minutes. Any discoloration of the treated strip indicates the presence of hypo, and the degree of stain shows the relative amount of hypo. Well washed films including those for record purposes usually show little or no coloration; with commercially washed films the tint may approach that of dark brown sugar. Well washed prints usually show a slight tint corresponding roughly to that of light brown sugar. A darker tint indicates insufficient washing. After testing, the treated strips should be discarded.

When the washing is known to be fairly thorough, a quick spot test can be made on the face of a print or of a blank piece of paper carried through the processing with the batch of prints. Remove excess water by wiping or blotting the face of the print, apply a drop of the test solution, allow 2 or 3 minutes for the solution to react, and judge immediately the depth of the stain as described above.

NOTE: The excess silver nitrate will darken on exposure to light. Therefore, even if the test shows adequate washing, return the print to the wash water for 2 or 3 minutes in order to remove as much as possible of the test solution.

Tray Cleaner (Kodak TC-1)

	Avoirdupois U. S. Liquid	Metric
Water	32 oz.	1.0 l.
Potassium bichromate	3 oz.	90.0 gm.
*Sulfuric acid (concentrated)	3 oz.	96.0 c.c.

* **Caution**: Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise the solution may boil and spatter the acid on the hands or face, causing serious burns.

For use, pour a small volume of the tray cleaner solution into the vessel to be cleaned. Rinse around so that the solution has access to all parts of the tray; then pour the solution out and wash the tray 6 or 8 times with water until all traces of the cleaning solution disappear. This solution will remove stains caused by oxidation products of developers and some silver and dye stains. It should *not* be used to clean the hands.

Tray Cleaner and Hand Stain Remover (Kodak TC-3)

Solution A*

	Avoirdupois U. S. Liquid	**Metric**
Water	1 gal.	1.0 l.
Potassium permanganate	¼ oz.	2.0 gm.
†Sulfuric acid (concentrated)	½ oz.	4.0 c.c.

* Store the solution in a stoppered glass bottle away from the light.

† **Caution:** Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise the solution may boil and spatter the acid on the hands or face, causing serious burns.

Solution B

	Avoirdupois U. S. Liquid	**Metric**
Water	1 gal.	1.0 l.
Sodium bisulfite	4 oz.	30.0 gm.
Sodium sulfite, desiccated	4 oz.	30.0 gm.

The solutions A and B can be used for cleaning several vessels but should be discarded after use.

An acid fixing bath may be used in place of Solution B but it is important to wash thoroughly to eliminate hypo from the tray or hands.

Cleaning Trays: To remove stains due to silver, silver sulfide, and many dyes, pour a small quantity of Solution A into the vessel and allow to remain for a few minutes; rinse well and then replace with a similar volume of Solution B. Agitate so as to clear the brown stain completely, then wash thoroughly.

Cleaning the Hands: To clean stains from the nails and skin, remove rings from the fingers and dip the hands in Solution A contained in a glass or other suitable vessel, gently rubbing the stained areas. Rinse briefly in running water and immerse in Solution B to remove the brown color; then wash throughly, preferably in warm water.

Stain Remover for Removal of Developer Stain on Negatives
(Kodak S-6)

Developer or oxidation stain may be removed by first hardening the film for 2 or 3 minutes in the formalin hardener then washing for 5 minutes and bleaching in:

Stock Solution A

Potassium permanganate	75 gr.	5 gm.
Water to make	32 oz.	1000 c.c.

Stock Solution B

Cold water	16 oz.	500 c.c.
Sodium chloride	2½ oz.	75 gm.
Sulfuric acid (concentrated)	½ oz.	16 c.c.
Water to make	32 oz.	1000 c.c.

Caution: Always add the sulfuric acid to the solution slowly, stirring constantly, and never the solution to the acid; otherwise the solution may boil and spatter the acid on the hands or face, causing serious burns.

Use equal parts of A and B. The solutions should not be mixed until ready for immediate use since they do not keep long after mixing. All particles of permanganate should be dissolved completely when preparing solution A, since undissolved particles are likely to produce spots on the negative. Bleaching should be complete in 3 or 4 minutes at 68° F. (20° C.). The brown stain of manganese dioxide formed in the bleach bath is best removed by immersing the negative in 1% sodium bisulfite solution. Then rinse well and develop in strong light, preferably sunlight, with any general purpose developer. Then wash thoroughly.

Warning: Slow-working developers, such as Kodak D-76, and Kodak DK-20, should not be used since they tend to dissolve the bleached image before the developing agents are able to act on it.

Iron Clearing Solution

To remove yellow stain caused by pyro or hydroquinone developer, wash well to free from hypo and place in

Water	20 oz.	568 c.c.
Ferrous sulfate, pure	3 oz.	85 gm.
Sulfuric acid, C. P.	1 oz.	28 gm.
Powdered alum	1 oz.	28 gm.

until stain is gone, then wash well.

INTENSIFIERS

Mercury Intensifier for Films and Plates (Kodak In-1)

BLEACH the negative in the following solution until it is white, *then wash thoroughly.*

Potassium bromide	¾ oz.	22.5 gm.
Mercuric chloride	¾ oz.	22.5 gm.
Water to make	32 oz.	1000 c.c.

The negative can be blackened with 10% sulfite solution, a developing solution, or dilute ammonia (1 part concentrated ammonia (28%) to 9 parts water), these giving progressively greater density in the order given.

Chromium Intensifier for Films and Plates (Kodak In-4)

Stock Solution

Potassium bichromate	3 oz.	90 gm.
Hydrochloric acid	2 oz. fl.	64 c.c.
Water to make	32 oz.	1000 c.c.

For use, take 1 part of stock solution to 10 parts of water.

Harden the negative first in a formaldehyde hardening solution. Bleach thoroughly at 65° to 70° F. (18° to 21° C.), then wash five minutes and redevelop fully in artificial light or daylight (not sunlight) in any quick-acting, non-staining developer which does not contain an excess of sulfite; for example, about 10 minutes at 68° F. (20° C.) in any general purpose developer. Developers containing a high proportion of sodium sulfite should be avoided. Then rinse, fix for five minutes, and wash thoroughly. Greater intensification can be secured by repeating the process. Negatives intensified with chromium are more permanent than those intensified with mercury.

PHOTOGRAPHIC FORMULAS (Continued)

Silver Intensifier for Films and Plates (Kodak In-5)

The following formula is the only intensifier known that will not change the color of the image on positive film on projection. It gives proportional intensification and is easily controlled by varying the time of treatment. The formula is equally suitable for positive and negative film.

Stock Solution No. 1
(Store in brown bottle)

Silver nitrate, crystals	2 oz.	60 gm.
Distilled water to make	32 oz.	1000 c.c.

Stock Solution No. 2

Sodium sulfite, desiccated	2 oz.	60 gm.
Water to make	32 oz.	1000 c.c.

Stock Solution No. 3

Sodium thiosulfate (hypo)	3½ oz.	105 gm.
Water to make	32 oz.	1000 c.c.

Stock Solution No. 4

Sodium sulfite, desiccated	½ oz.	15 gm.
Elon	365 gr.	25 gm.
Water to make	96 oz.	3000 c.c.

Prepare the intensifier solution for use as follows: Slowly add 1 part of solution No. 2 to 1 part of solution No. 1, shaking or stirring to obtain thorough mixing. The white precipitate which appears is then dissolved by the addition of 1 part of solution No. 3. Allow the resulting solution to stand a few minutes until clear. Then add, with stirring, 3 parts of solution No. 4. The intensifier is then ready for use and the film should be treated immediately. The mixed intensifier solution is stable for approximately 30 minutes at 68° F. (20° C.).

The degree of intensification obtained depends upon the time of treatment which should not exceed 25 minutes. After intensification, immerse the film for 2 minutes with agitation in a plain 30% hypo solution. Then wash thoroughly.

The stability of the mixed intensifier solution and the rate of intensification are very sensitive to changes in the thiosulfate concentration. A more active but less stable working solution may be obtained by using a stock solution No. 3 prepared with 3 oz. of hypo per 32 oz. (90 g per 1000 c.c.) instead of the quantity in the formula. The directions for preparing the working solution are the same as before but the mixed intensifier will not keep over 20 minutes at 68° F. (20° C.).

For best results, the intensifier should be used in artificial light; the solution tends to form a precipitate of silver quite rapidly when exposed directly to sunlight.

REDUCERS

Reducer formulas may be classified into three types, as follows:

1. Subtractive or cutting reducers which remove equal quantities of silver from the high, intermediate, and low densities, respectively. They have the effect of clearing up the shadow areas and therefore appear to increase the image contrast, but they do not change gamma. They are useful for treating fogged or overexposed images. Farmer's reducers and Kodak R-2 are in this group.

2. Proportional reducers which remove density in an amount which is proportional to the original density. They therefore lower

both gamma and visual contrast and correct for overdevelopment. Two solution, Farmer's and Kodak R-5 are in this group.

3. Super-proportional reducers which remove density increments which bear a greater proportion to the original density as the magnitude of the original density increases. They therefore reduce the highlight densities without destroying shadow detail and are useful for treating overdeveloped negatives of contrast subjects. Kodak R-15 is of this type.

Farmer's Reducer (Ansco 310)

This is a cutting reducer for lessening the density of heavy negatives. It is especially valuable for reproduction films to clear the whites.

Solution 1

Hypo	8 oz.	240 gm.
Water to make	32 oz.	1000 c.c.

Solution 2

Potassium ferricyanide	274 gr.	19 gm.
Water to make	8 oz.	250 c.c.

For use mix one part solution 2 and four parts solution 1 in 32 parts water. Solutions 1 and 2 should be stored separately and mixed immediately before use.

Reducer for Clearing Shadow Areas (Kodak R-2)

Stock Solution A

Water	32 oz.	1000 c.c.
Potassium permanganate	1¾ oz.	52.5 gm.

Stock Solution B

Water	32 oz.	1000 c.c.
Sulfuric acid (concentrated)	1 oz. fl.	32 c.c.

Caution: Always add the sulfuric acid to the water slowly, stirring constantly, and never the water to the acid; otherwise the solution may boil and spatter the acid on the hands or face causing serious burns.

The best method of dissolving the permanganate crystals in solution A is to use a small volume of hot water (about 180° F.) (82° C.) and shake or stir the solution vigorously until completely dissolved; then dilute to volume with cold water.

The negative must be thoroughly washed to remove all traces of hypo before it is reduced. For use, take 1 part A, 2 parts B and 64 parts of water. When the negative has been reduced sufficiently, place it in a fresh acid fixing bath for a few minutes, to remove yellow stains, then wash thoroughly.

If reduction is too rapid, use a larger volume of water when diluting the solution for use. This solution should *not be used* as a stain remover as it has a tendency to attack the image before it removes the stain.

The two solutions should not be combined until immediately before use. They will not keep long in combination.

Farmer's Reducer, Proportional, for Lowering Contrast (Kodak R-4b)

Farmer's Reducer also may be used as a two-bath formula by treating the negative in the ferricyanide solution first and subsequently in the hypo solution. This method gives almost proportional reduction and corrects for overdevelopment. The single solution Farmer's Reducer gives only cutting reduction and corrects for overexposure.

Solution A

Potassium ferricyanide	¼ oz.	7.5 gm.
Water to make	32 oz.	1000 c.c.

Solution B

Sodium thiosulfate (hypo)	6¾ oz.	200 gm.
Water to make	32 oz.	1000 c.c.

Treat the negatives in solution A with uniform agitation for 1 to 4 minutes at 65–70° F. (18–20° C.) depending on the degree of reduction desired. Then immerse them in solution B for 5 minutes and wash thoroughly. The process may be repeated if more reduction is desired. For the reduction of general fog, one part of solution A should be diluted with one part of water.

Proportional Reducer for Lowering Contrast (Kodak R-5)

Stock Solution A

Water	32 oz.	1000 c.c.
Potassium permanganate	4 gr.	.3 gm.
Sulfuric acid (10% solution)	½ oz. fl.	16 c.c.

Stock Solution B

Water	96 oz.	3000 c.c.
Potassium persulfate	3 oz.	90 gm.

To make a 10% solution of sulfuric acid, take 1 part of sulfuric acid and add it to 9 parts of water, slowly with stirring. *Never add the water to the acid* because the solution may boil and spatter the acid on the hands or face, cuasing serious burns.

For use, take one part of solution A to three parts of solution B. When sufficient reduction is secured, the negative should be cleared in a 1% solution of sodium bisulfite. Wash the negative thoroughly before drying.

Super-proportional Persulfate Reducer (Kodak R-15)

Stock Solution A

	Avoirdupois U. S. Liquid	**Metric**
Water	32 oz.	1.0 l.
Potassium persulfate	1 oz.	30.0 gm.

Stock Solution B

Water	8 oz.	250 c.c.
*Sulfuric acid (dilute solution)	½ oz.	15 c.c.
Water to make	16 oz.	500 c.c.

* To make: Take 1 part of concentrated sulfuric acid and with caution to avoid contact with the skin, add it slowly to 9 parts of water with stirring. *Never add the water to the acid* because the solution may boil and spatter the acid on the hands or face, causing serious burns.

For use: Take 2 parts of Solution A, and add 1 part of Solution B. Only glass, hard-rubber, or impervious and unchipped enamelware should be used to contain the reducer solution during mixing and use.

Treat the negative in the formaldehyde hardener (Kodak-SH-1 for 3 minutes and wash thoroughly before reduction. Immerse in the reducer with frequent agitation and inspection (accurate control by time is not possible) and treat until the required reduction is almost attained; then remove from the solution, immerse in an acid fixing bath for a few minutes, and wash thoroughly before drying. Used solutions do not keep well and should be promptly discarded.

For best keeping in storage, the persulfate Stock Solution A should be kept away from excessive heat and light. Keeping life of Stock Solution A—about 2 months at 75° F.

TONING FORMULAS

Minor variations in image color, from cold blue-black to warm brown-black, are best obtained by selection of paper type and control of development. Larger variations in color require chemical treatment of the image. The results produced by any one toner formula depend to a considerable extent on the type of paper used and the processing treatment previously given the silver image. In general, cold blue-black silver images tend to be resistant to toning and require the use of very active formulas, such as bleach-and-sulfide redevelop sepia toner. Similarly, warm brown-black silver images generally tone much more readily, and tend to give too yellowish tones with the bleach-and redevelop toner.

Bleach and Redeveloper Sepia Toner (Ansco 221)

This toner is recommended for warm-brown sepia tones.

Solution 1		
Hot water (125° F. or 52° C.)	24 oz.	750 c.c.
Potassium ferricyanide	1½ oz. 80 gr. (736) gr.)	50 gm.
Potassium bromide	144 gr.	10 gm.
Sodium carbonate, monohydrated	289 gr.	20 gm.
Water to make	32 oz.	1000 c.c.
Solution 2		
Sodium sulfide	1½ oz.	45 gm.
Water to make	16 oz.	500 c.c.

For use as described below, dilute one part solution 2 with eight parts water. IMPORTANT—Be sure to use sodium sulfide, not sodium sulfite, in compounding the re-developer. Also, use clean trays, free from exposed iron spots, especially with bleaching bath. Otherwise blue spots may form on prints.

Prints should be washed thoroughly and then bleached in solution 1 until the black image is converted to a very light brown color (about 1 minute). Prints should then be washed for 10 to 15 minutes and redeveloped in diluted solution 2.

Redevelopment should be complete in about 1 minute. After redevelopment the prints should be washed for about 30 minutes and then dried. If the toner should leave sediment which results in streaks or finger marks on the surface of the paper, the print should be immersed for a few seconds in a 3% solution of acetic acid, after which a 10-minute washing is necessary.

Polysulfide Toner (Kodak T-8)

The following single-solution toning bath is recommended for use on all papers except very warm-tone or very cold-tone. It produces slightly darker sepia tones than the redevelopment-sulfide toner, Kodak T-7a, and has the advantage, compared with hypo-alum toners, that it does not require heating, although raising the temperature to 100° F. reduces the time of toning from 15 to 3 minutes.

	Avoirdupoise U. S. Liquid	**Metric**
Water	96 oz.	750 c.c.
Polysulfide (liver of sulfur)	1 oz.	7.5 gm.
Sodium carbonate, monohydrated	145 gr.	2.5 gm.
Water to make	1 gal.	1.0 l.

Dissolve chemicals in the order given.

Immerse the well-washed black-and-white print for 15 to 20 minutes and agitate in the Kodak T-8 bath at 68° F. (20° C.) or for 3 or 4 minutes at 100° F. (38° C.).

After toning, rinse the print for a few seconds in running water and place for about 1 minute in a sodium bisulfite solution containing 1 ounce per quart (30 grams per liter) of water. Then immerse the print for about 2 minutes in a hardening bath prepared by adding 2 parts of Kodak Stock Hardener F-5a to 16 parts of water. If any sediment appears on the print, wipe the surface with a soft sponge. Wash the print for at least 30 minutes before drying.

Approximate capacity of the toning bath is about one hundred and fifty 8 × 10 inch prints (or equivalent) per gallon. When the bath begins to be cloudy, its life can be extended by the addition of the same quantity of carbonate as in the formula.

Hypo Alum Sepia Toner for Papers (Kodak T-1a)

Cold water	90 oz.	2800 c.c.
Sodium thiosulfate (hypo)	16 oz.	480 gm.

Dissolve thoroughly, and add the following solution:

Hot water, about 160° F. (70° C.)	20 oz.	640 c.c.
Potassium alum	4 oz.	120 gm.

Then add the following solution (including precipitate) *slowly to the hypo-alum solution while stirring the latter rapidly.*

Cold water	2 oz.	64 c.c.
Silver nitrate, crystals	60 gr.	4.0 gm.
Sodium chloride	60 gr.	4.0 gm.

After combining above solutions,

Add water to make	1 gal.	4000 c.c.

Note: The silver nitrate should be dissolved completely before adding the sodium chloride and immediately afterward the solution containing the milky white precipitate should be added to the hypo-alum solution as directed above. The formation of a black precipitate in no way impairs the toning action of the bath if proper manipulation technique is used.

For use, pour into a tray supported in a water bath and heat to 120° F. (49° C.). At this temperature prints will tone in 12 to 15 minutes depending on the type of paper. Never use the solution at a temperature above 120° F. (49° C.). Blisters and stains may result. Toning should not be continued longer than 20 minutes at 120° F. (49° C.).

In order to produce good sepia tones, the prints should be exposed so that the print is slightly darker than normal when developed normally (1½ to 2 minutes).

The prints to be toned should be fixed thoroughly and washed for a few minutes before being placed in the toning bath. Dry prints should be soaked thoroughly in water. To insure even toning, the prints should be immersed completely, and separated occasionally, especially during the first few minutes.

After prints are toned, they should be wiped with a soft sponge and warm water to remove any sediment, and washed for one hour in running water.

Nelson Gold Toner (Kodak T-21)

The Nelson Gold Toner has the advantage that a variety of excellent brown tones may be obtained by varying the time of toning; that is, the prints may be removed from the bath at any time when the desired color is reached. It is particularly recommended for use with warm-tone papers.

Stock Solution A

	Avoirdupois U. S. Liquid	**Metric**
Warm water, about 125° F. (50° C.)	1 gal.	4.0 l.
Sodium thiosulfate (hypo)	2 lb.	960.0 gm.
Potassium persulfate	4 oz.	120.0 gm.

Dissolve the hypo completely before adding the potassium perpersulfate. Stir the bath vigorously while adding the potassium persulfate. If the bath does not turn milky, increase the temperature until it does.

Prepare the following solution and add it (including precipitate) slowly to the hypo-persulfate solution while stirring the latter rapidly. *The bath must be cool when these solutions are added together.*

Cold water	2 oz.	64.0 c.c.
Silver nitrate, crystals	75 gr.	5.0 gm.
Sodium chloride	75 gr.	5.0 gm.

Note: The silver nitrate should be dissolved completely before adding the sodium chloride.

Stock Solution B

Water	8 oz.	250.0 c.c.
Gold chloride	15 gr.	1.0 gm.

For use, add 4 ounces (125 c.c.) of Solution B slowly to Solution A while stirring the latter rapidly.

The bath should not be used until after it has become cold and has formed a sediment. Then pour off the clear liquid for use.

Pour the clear solution into a tray supported in a water bath and heat to 110° F. (43° C.). During toning the temperature should be between 100° and 110° F. (38° and 43° C.).

Prints to be toned should be washed for a few minutes after fixing before they are placed in the toning solution. Dry prints should be soaked thoroughly in water before toning.

Keep at hand an untoned black-and-white print for comparison during toning. Prints should be separated at all times to insure even toning.

When the desired tone is obtained (5 to 20 minutes), remove and rinse the prints in cold water. After the prints have been toned, return them to the fixing bath for 5 minutes, then wash for 1 hour in running water.

The bath should be revived at intervals by the addition of Gold Solution B. The quantity to be added will depend upon the number of prints toned and the time of toning. For example, when toning to a warm brown, add 1 dram (4 c.c.) of gold solution after each fifty 8 × 10 inch prints or their equivalent have been toned. Fresh solution may be added from time to time to keep the bath up to the proper volume.

Prints toned in Nelson Gold Toner should be kept from excessive exposure to heat or intense light.

Gold Toner for Red or Blue Tones (Ansco 231)

This formula gives a range of red tones to sepia-toned prints, the brilliance of the tone depending on the paper used. If desired, deep blue tones may also be obtained with this formula by using black-and-white prints instead of prints that have first been sepia-toned. Unusual effects of mixed tones of blue-black shadows and soft reddish highlights can be produced by using prints which have been partially toned in a hypo alum speia-toner.

Hot water (125° F. or 52° C.)	24 oz.	750 c.c.
*Ammonium sulfocyanate	3½ oz.	105 gm.
Gold chloride, 1% solution	2 oz. fl.	60 c.c.
Water to make	32 oz.	1000 c.c.

* May be substituted by:

Sodium sulfocyanate	3¾ oz.	110 gm.
or		
Potassium sulfocyanate	4½ oz.	135 gm.

For Red Tones: Prints must first be bleached and toned by sulfide redevelopment method. After washing, place prints in above solution until toning is complete (requires 15–45 minutes). For redder tones one-half the specified amount of sulfocyanate may be used.

For Deep Blue Tones: Omit sepia toning operation and place well-washed black-and-white prints directly in above toning solution.

For Mixed Tones: Prints should be incompletely toned in a hypo alum toner and washed before treatment in above solution.

Iron Toner for Blue Tones on Papers (Kodak T-12)

Ferric ammonium citrate (green scales)	58 gr.	4 gm.
Oxalic acid, crystals	58 gr.	4 gm.
Potassium ferricyanide	58 gr.	4 gm.
Water to make	32 oz.	1000 c.c.

Dissolve each chemical separately in a small volume of water, about 8 oz. (250 c.c.) and filter before mixing together. This solution does not keep well except in brown bottles.

Immerse the well-washed print in the toning bath for 10 to 15 minutes until the desired tone is obtained. Then wash until the highlights are clear.

BLUE PRINT PAPER, FORMULAS FOR SENSITIZING

1

Solution A

Water	8.5 oz.	50 c.c.
Iron and ammonium citrate	1.7 oz.	10 gm.

Solution B

Water	8.5 oz.	50 c.c.
Potassium ferricyanide	1.4 oz.	8 gm.

Filter separately. The solutions, which may be preserved separately for some time, are best kept in the dark. For use, mix, in a dark room or by an artificial light of low intensity, equal quantities of the two solutions.

Any non-absorbent paper may be sensitized by brushing the solution over it rapidly with a soft, wide, flat brush, going over the surface twice, the second coat being applied in a direction at right angles to the first. An alternative method is to lower the paper, beginning at one edge, on to the surface of the solution in a tray and allow it to float for a few seconds. Care must be taken to exclude air bubbles. After sensitizing by either method, the paper should be hung by one edge in a dark room to dry.

2

Blue printing depends to a large extent upon surface of paper. The following formula is recommended as producing clear whites:

Solution 1	
Potassium ferricyanide, $K_3Fe(CN)_6$	10 gm.
Distilled water	100 c.c.

Solution 2	
Iron and ammonium citrate (ferric)	30 gm.
Water	100 c.c.
Gum arabic (gum acacia)	5 gm.

Equal parts of the above solutions are mixed just before use. The paper to be sensitized may be floated on the surface or the liquid may be applied with a tuft of absorbent cotton using cross strokes to insure an even coating. The sensitized paper must be dried in the dark and should be used within 36 hours.

ULTRAVIOLET SENSITIZATION

Silver Sensitizer for Cloth, etc.

Photographic plates can be made sensitive to short-wave ultraviolet light by immersion in a dilute solution of citric acid in 95% ethyl alcohol (1% citric acid). (Sodium salicylate may be substituted for the citric acid.) The plate is immersed in the citric acid solution and immediately withdrawn and dried in less than one minute by waving in the air before putting in the holder. After exposure the plate can be developed without previous washing and without special precautions. The coating of citric acid adheres to the plate so that a number of plates may be treated and stored away for future use. Citric acid has no detrimental action on the emulsion or the developer. The sharpness of the image is not diminished.

Sensitizer for Paper, Cloth, and Similar Fabrics

Many sensitizing formulas have appeared in the photographic literature, most of them being minor variations of a few basic types. Most of them will give acceptable results but the following formula has been found to be particularly dependable as well as easy to prepare and use. The ferric ammonium citrate and the silver nitrate which it calls for can be purchased through Kodak dealers. The tartaric acid can be obtained from a druggist.

Sensitizer Formula

	Avoirdupois U. S. Liquid	Metric
Ferric ammonium citrate	3 oz.	90 gm.
Tartaric acid	½ oz.	15 gm.
Silver nitrate	1¼ oz.	37.5 gm.
Water to make	32 oz.	1.0 l.

PHOTOGRAPHIC FORMULAS (Continued)

Mixing: Dissolve each of the chemicals separately in about 8 ounces of water. Mix the ferric ammonium citrate and the tartaric acid solutions and then add the silver nitrate solution slowly while stirring. Keep the solution in a brown glass bottle away from direct light. Under such conditions, the mixed solution will keep in good condition for several months.

Application: The sensitizing of the fabric or paper can be done in artificial light but it is best to work under a yellow light such as from a Wratten Safelight Series 00. The paper or fabric can be dipped in the solution and then hung up in a dark room to dry. If preferred, the sensitizing solution can be swabbed onto the surface with a tuft of absorbent cotten or a soft brush. In order to be certain of an even application, the sensitizing solution should first be spread with vertical strokes of the brush and then the surfaces reworked with horizontal strokes. The paper or fabric should then be pressed between two blotters to remove any excess of the sensitizer and then dried in a dark place which is free from dust.

Since the sensitizing formula contains silver nitrate, it is best to wear rubber gloves to prevent contact with the hands or fingers. Otherwise, black stains, which are very difficult to remove, will develop several hours afterwards.

A good brush or swab for applying the sensitizer can be made by folding several thicknesses of a soft, well-washed cotton cloth around the end of a piece of glass, about 2 inches wide by 6 inches long, and holding it in place with a rubber band.

Printing: After drying, the sensitized sheet is held in close contact under the desired negative and exposed to sunlight or very strong artificial light. It is preferable to use a spring printing frame to insure good contact with the negative. The exposure should be continued until details are visible in the highlight areas.

Development: After printing, wash the sensitized sheet for about 1 minute in running water. The resulting image will be a rather disagreeable yellow color but this will gradually intensify and change to a more pleasing brown when the print is allowed to dry in daylight. If preferred, after the preliminary water wash, the print can be immersed in a plain hypo solution containing 1 ounce of hypo to 20 ounces of water. This will change the image color to an excellent Van Dyke brown. Since the treatment in the hypo solution tends to reduce the density of the image, it is often useful for saving an overexposed print. If an almost black image is desired, the print can be washed as above and then ironed with a hot flatiron.

DIAPHRAGM OR STOP NUMBERS

F System	f/2	f/3	f/3.5	f/4	f/4.5	f/5.6	f/6.3
Rel. Exp.	1/16	1/7	1/5		1/3		5/8
U. S. No.				1		2	

F System	f/8	f/11.3	f/16	f/22.6	f/32	f/45	f/64
Rel. Exp.	1	2	4	8	16	32	
U. S. No.	4	8	16	32	64	128	256

PLATE AND FILM SPEEDS

Compiled with the collaboration of
Chas. H. Shipman

In 1900 two English amateurs, Messrs. Hurter and Driffield, proposed a system of plate speeds based on the assumption that, if a plate is given a series of graded exposures, and developed in a pyro developer free from bromide, a density-log exposure curve may be plotted from which a speed value may be determined which is supposed to be inversely proportional to the exposure required to produce average density. The Scheiner system is based upon the assumption that speeds are inversely proportional to the exposure necessary to produce a just visible image. It will be evident that these two systems cannot be compared exactly.

Kodak Film Speeds are determined by a system of testing in which the exposure on which the speed number is based is taken as the value of exposure for which the slope at the lower part of the characteristic curve is three-tenths the average slope over an exposure range of 30: 1 which is found to be the maximum contrast for the average scene.

The American Standards Association speeds are determined by a method essentially the same as that for measuring Kodak speeds.

There can be no simple relationship between speeds obtained in fundamentally different ways and the conversion table given below can be considered only a rough guide.

Comparison of Speed Systems

The following table shows values of exposure index in various systems corresponding to those of the American Standards Association.

American Standards Association	General Electric	Weston	H and D	American Scheiner	German Scheiner	Din	Relative Exposures
		.3	7.5	4	10		
		.35	8.75	5	11		
.6	.6	.5	12.5	6	12		
.8	......	.6	15	7	13		
1	1	.7	17.5	8	14	1/10	32
1.2	1.5	1	25	9	15	2/10	27
1.6	2	1.2	30	10	16	3/10	21
2	......	1.5	38	11	17	4/10	16
2.5	3	2	50	12	18	5/10	13
3	4	2.5	63	13	19	6/10	11
4	......	3	75	14	20	7/10	8
5	6	4	100	15	21	8/10	7
6	8	5	125	16	22	9/10	5
8	10	6	150	17	23	10/10	4
10	12	8	200	18	24	11/10	3.3
12	16	10	250	19	25	12/10	2.7
16	20	12	300	20	26	13/10	2
20	24	16	400	21	27	14/10	1.7
25	32	20	500	22	28	15/10	1.3
32	40	24	600	23	29	16/10	1
40	48	32	800	24	30	17/10	.8
50	64	40	1000	25	31	18/10	.67
64	80	50	1250	26	32	19/10	.5
80	100	64	1600	27	33	20/10	.4
100	125	80	2000	28	34	21/10	.33
125	150	100	2500	29	35	22/10	.25
160	200	125	3120	30	36	23/10	.2
200	250	160	4000	31	37	24/10	.17
250	300	200	5000	32	38	25/10	.125
320	400	250	6250	33	39	26/10	.1
400	500	320	8000	34	40	27/10	.08
500	600	400	10000	35	41	28/10	.0625
650	800	500	12500	36	42	29/10	.05
800	900	650	16250	37	43	30/10	.04
1000	1000	800	20000	38	44	31/10	.03125

PLATE AND FILM SPEEDS (Continued)

Shutter Speeds of Moving Picture Cameras

Ciné Ansco Model B	1/30 sec.
DeVry	1/30
Eastman (all models)	1/30
Filmo all 70's Reg. and 121	1/30
Filmo Golf 70, 71's, 75 and 141	1/40
Filmo 8 mm. (all)	1/30
Keystone Late Models A-3 and A-7	1/40
Keystone Model K-8 No 872650 and above	1/40
Keystone 16B	1/50
Keystone (other models)	1/50 sec.
Model B Agfa	1/30
Paillard Bolex	1/30
Paragon	1/30
Revere	1/30
Simplex	1/40
Stewart Warner 8	1/50
Stewart Warner Hollywood and 532A	1/40
Sept	1/90
Univex	1/30
Victor (all models)	1/30
Zeiss Kinamo S-10-16	1/30
Zeiss Movikon	1/30*

* When shutter is at 180°.

PLATE AND FILM SPEEDS

The following table presents the most recent figures available at the time of compilation for speed numbers in the American Standards Association, Weston, and General Electric systems. Values are given for daylight and for tungsten or photoflood illumination.

Speed values given can be considered only as a general guide. Figures given by different authorities differ somewhat according to the characteristics of negatives considered satisfactory. In general the speed numbers are given for full exposure.

In reading from a grey card of 18% reflectivity the result will be a meter reading approximate to a reading on the object if in mazda light. The reading from a white card of 90% reflectivity will be about five times as high, and, therefore, a value only one fifth as for a direct reading will be chosen.

In using the grey or white card it must be placed near the object and must fill the intake cone of the meter and must be free from shadow.

In copying line drawings the speed tables will not be accurate and will serve only as a guide for experiment. High contrast material must be used and, as it has small latitude, the exposure must be such as will keep the line clear and the rest as dark as possible.

In copy work account must be taken of the extended bellows. To get the actual f value of the stop being used divide the distance from the lens to film by the focal length of the lens and multiply the result by the f value of the indicated stop.

Manufacturer and type	American Standards Association		Weston		General Electric	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
ANSCO, U. S. A.						
Movie Film 8 and 16 mm Reversible						
Hypan	40	32	32	24	48	40
Triple S Pan	120	80	100	64	150	100
Color, Daylight	10	3*	8	2.5*	12	4*
Color, Tungsten	12†	16	10†	12	16†	20
Movie Film 8 and 16 Negative and Positive						
Supreme	64	40	50	32	80	48
Positive	10	2.5	8	2	12	3

PLATE AND FILM SPEEDS (Continued)

Manufacturer and type	American Standards Association		Weston		General Electric	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
ANSCO, U. S. A. (Continued)						
Rolls and Packs						
Plenachrome	64	40	50	32	80	48
Supreme	64	40	50	32	80	48
Superpan Press	125	80	100	64	150	100
35 and 70 mm						
Supreme	64	40	50	32	80	48
Ultra Speed Pan	125	80	100	64	150	100
Color, Daylight	12	4*	10	3*	16	5*
Color, Tungsten	10†	12	8†	10	12†	16
Sheet Film						
Commercial	32	10	24	8	40	12
Commercial Ortho	32	20	24	16	40	24
Isopan	64	40	50	32	80	48
Super Pan Portrait	64	40	50	32	80	48
Triple S Ortho	125	80	100	64	150	100
Superpan Press	125	80	100	64	150	100
Triple S Pan	250	160	200	125	300	200

* With Filter #10.
† With Filter #11.

DUPONT, U. S. A.						
Miniature 35 and 70 mm						
Microcopy	....	2.5*	....	2*	....	3*
Superior 2	64	40	50	32	80	48
Sheet Film						
Process Pan	16	10*	12	8*	20	12*
Commercial	32	10	24	8	40	12
Fine Grain Pan	32	20	24	16	40	24
X F Ortho	64	20	50	16	80	24
X F Pan	64	40	50	32	80	48
Arrow Pan	125	80	100	64	150	100
Arrow Pan Press	200	160	160	125	250	200
High Speed Pan, Type 428	250	160	200	125	300	200

* Reading on white card.

EASTMAN, U. S. A.						
8 and 16 mm Cine Film, Reversible						
Super X	40	32	32	24	48	40
Super XX	100	80	80	64	125	100
35 mm and 828						
Infrared	....	20*	....	16*	....	24*
Plus X	50	40	40	32	64	48
Super XX	100	80	80	64	125	100
35 mm Film, Reversible						
Direct Positive Pan	64	50	50	40	80	64
Rolls and Packs						
Plus X	50	40	40	32	64	48
Verichrome, Roll only	64	32	50	24	80	40
Super XX	100	80	80	64	125	100
Circuit XX	100	80	80	64	125	100

PLATE AND FILM SPEEDS (Continued)

Manufacturer and type	American Standards Association		Weston		General Electric	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
EASTMAN, U. S. A. (Continued)						
Sheet Film						
Infrared	....	20*	....	16*	....	24*
Contrast Process Ortho	....	10†	....	8†	....	12†
Contrast Process Pan	....	10†	....	8†	....	12†
Commercial	25	6	20	5	32	8
Commercial Ortho	32	16	24	12	40	20
Panatomic X	32	25	24	20	40	32
Portrait Pan	64	40	50	32	80	48
Super Ortho Press	100	50	80	40	125	64
Super XX	100	80	80	64	125	100
Ortho X	125	64	100	50	150	80
Super Panchro Press B	125	100	100	80	150	125
Royal Panchro	160	100	125	80	200	125
Tri X Pan	200	160	160	125	250	200
Plates						
Infrared	....	1.0*	....	4*	....	6*
Process	8	1.2†	6	1†	10	1.5†
Metallographic	....	20†	....	16†	....	24†
M	....	40†	....	32†	....	48†
#33 and Matte	20	5	16	4	24	6
#50	32	12	24	10	40	16
Panatomic X	32	20	24	16	40	24
Separation Negative, Type I and Matte	64	50	50	40	80	64
Super Ortho Press	64	32	50	24	80	40
Super Panchro Press	100	80	80	64	125	100
Tri X Panchromatic B and Matte	160	100	125	80	200	125
35 mm Film for Filing						
Microfile	....	2.5†	....	2†	....	3†
Color Film						
Ektachrome, Sheet and Roll, Daylight	8	.....	6	.....	10	
Ektachrome, Sheet and Roll, Type B	6‡	10	5‡	8	8‡	1
Ektacolor Sheet Film, Type B	5‡	8	4‡	6	6‡	1
Kodachrome, 8, 16, 35 mm and 828 Daylight Type	10	2.5§	8	2§	12	3§
Kodachrome, Type A	10‖	16	8‖	12	12‖	2
Kodacolor, Daylight Type, Roll Only	25					
Kodacolor, Type A, Roll Only	12‖	20	10‖	16	16‖	20

* With Wratten Filter 25.
† Reading on white card.
‡ With Wratten Filter 85B.
§ With Wratten Filter 80A.
‖ With Wratten Filter 85.

PLATE AND FILM SPEEDS (Continued)

Manufacturer and type	American Standards Association		Weston		General Electric	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
FERRANIA, ITALY						
16 mm Cine Film, Reversal						
Panchro 28	40	32	32	24	48	40
Panchro, CSS 32	100	64	80	50	125	80
16 mm Cine Film, Negative						
Super Panchro S2 32	100	64	80	50	125	80
Motion Picture Film 35 mm						
Cine Panchro C7	100	64	80	50	125	80
Type 51	10	.....	8	.....	12	
Type 82	20	.....	16	.....	24	
Roll Film						
Super Panchro 28	40	32	32	24	48	40
Ultrachromatic 30	64	40	50	32	80	48
Super Panchro 32	100	64	80	50	125	80
Miniature Film						
Super Panchro P3	40	32	32	24	48	40
Super Panchro S2	100	64	80	50	125	80
Sheet Film						
Super Panchro 28	40	32	32	24	48	40
Ultrachromatic 30	64	40	50	32	80	48
Super Panchro 32	100	64	80	50	125	80
Ferraniacolor Negative						
Roll Film 6 × 9	12	.....	10	.....	16	
Miniature Film	12	.....	10	.....	16	
Sheet Film	12	.....	10	.....	16	
Ferranicolor Reversal						
16 mm Cine 20	20	.....	16	.....	24	
Roll Film 6 × 9	20	.....	16	.....	24	
Miniature	20	.....	16	.....	24	
Sheet	20	.....	16	....	24	
GEVAERT, U. S. A. and BELGIUM						
8 and 16 mm Cine Film, Reversible						
Gevapan 27 Micro	12	8	10	6	16	10
Gevapan 26 Super	25	16	20	12	32	20
Gevapan 32 Ultra	100	64	80	50	125	80
Rolls and Packs						
Microgran 27	32	20	24	16	40	24
Gevachrome 30	64	32	50	24	80	40
Gevapan 30	64	40	50	32	80	48
Gevapan 33	125	80	100	64	150	100
Miniature Film 35 and 70 mm						
Microgran 27	32	20	24	16	40	24
Gevapan 30	64	40	50	32	80	48
Gevapan 33	125	100	100	64	150	100
Sheet Film						
Normal	25	6	20	5	32	8
Normal Ortho	32	10	24	8	40	12

PLATE AND FILM SPEEDS (Continued)

Manufacturer and type	American Standards Association		Weston		General Electric	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
GEVAERT, U. S. A. and BELGIUM (Continued)						
Sheet Film (Continued)						
Superchrome	64	32	50	24	80	40
Panchromosa	80	50	64	40	100	64
Gevachrome	100	50	80	40	125	64
Gevapan 30	64	40	50	32	80	48
Gevapan 33	125	80	100	64	150	100
Plates						
Superchrome	64	32	50	24	80	40
Panchromosa	80	50	64	40	100	64
ILFORD, ENGLAND						
8 and 16 mm Cine Film Reversal						
Pan F	20	12	16	10	24	16
H P 3	160	125	125	100	200	150
Rolls and Packs						
F P 3	80	64	64	50	100	80
H P 3	160	125	125	100	200	150
Selochrome	250	125	200	100	300	150
Miniature Film, 35 and 70 mm						
Pan F	20	12	16	10	24	16
F P 3	80	64	64	50	100	80
H P 3	160	125	125	100	200	150
Sheet Film						
Commercial Ortho	50	25	40	20	64	32
F P 3	80	64	64	50	100	80
Selochrome	100	50	80	40	125	64
H P 3	160	125	125	100	200	150
Hyperchromatic	250	125	200	100	300	150
Plates						
N 30 Ordinary	4	1.1	3	0.8	5	1.2
N 25 Soft Ordinary	4	1.1	3	0.8	5	1.2
G 30 Chromatic	6	3	5	2.5	8	4
Special Rapid	12	3	10	2.5	16	4
Zenith	32	8	25	6	40	10
R 20 Special Rapid	32	20	25	16	40	24
R 25 F P Special	50	40	40	32	64	48
R 10 Soft Gradation	64	40	50	32	80	48
Selochrome	100	50	80	40	125	64
Orthotone	100	50	80	40	125	64
F P 4	100	64	80	50	125	80
H P 3	250	200	200	160	300	250
H P S	500	400	400	320	600	500
Color Film						
Color Film D	10	2.5*	8	2*	12	3*
Color Film A	8†	10	6†	8	10†	12

* With Ilford Filter #351.
† With Ilford Filter #161.

PLATE AND FILM SPEEDS (Continued)

Manufacturer and type	American Standards Association		Weston		General Electric	
	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood	Daylight	Tungsten or Photoflood
KODAK, LIMITED, ENGLAND						
8 and 16 mm Cine Film, Reversible						
Panchromatic	10	8	8	6	12	10
Super X	40	32	32	24	48	40
Super XX	100	64	80	50	125	80
Negative Cine Film 16 mm						
Plus X	80	50	64	40	100	64
Rolls						
Panatomic X	32	20	24	16	40	24
Verichrome	50	25	40	20	64	32
Plus X	50	32	40	24	64	40
Super XX	100	64	80	50	125	80
Miniature Films, 35 mm						
Panatomic	32	20	24	16	40	24
Plus X	64	40	50	32	80	48
Super XX	100	64	80	50	125	80
Sheet Film						
Commercial Fine Grain	16	4	12	3	20	5
Commercial Ortho	25	8	20	6	24	10
Panatomic X	32	20	24	16	40	24
Super XX	100	64	80	50	125	80
Super Panchro Press B	100	64	80	50	125	80
Ortho X	125	64	100	50	150	80
Colour Film						
Kodachrome, Daylight	10	......	8	......	12	
Kodachrome Type A	10*	16†	8*	12†	12	20
Ektachrome, Daylight	8	......	6	......	10	
Ektachrome, Type B	6‡	10§	5‡	8§	8‡	12§
Plates						
O 250	8	3	6	2.5	10	4
P 300	25	20	20	16	32	24
O 800	64	32	50	24	80	40
P 1500	100	80	80	64	125	100
P 1200	200	160	160	125	250	200
E. N. MASON AND SONS, ENGLAND						
Criterian Plates						
Ordinary 80	3	0.8	2.5	0.6	4	1
Iso 700	25	10	20	8	32	12
Rapid Pan 750	25	16	20	12	32	20
Special Rapid Pan 1000	32	20	25	16	40	24
POLAROID, U. S. A.						
Type 41 Film, B and W	125	80	100	64	150	10

* With Wratten Filter #85.
† With photo flood lighting.
‡ With Wratten Filter 85B.
§ To 3200°K lighting.

WIRE TABLES

COMPARISON OF WIRE GAUGES

Diameter of Wire in Inches

Gauge No.	Brown & Sharpe	Birmingham or Stubs'.	Washburn & Moen	Imperial or Brit. Std.	Stubs' Steel	U. S. Std. plate
00000000	....	....	....	....	......	....
0000000	....	....	....	.500	......	....
000000	....	....	....	.464	......	.46875
00000	....	....	....	.432	......	.4375
0000	.4600	.454	.3938	.400	......	.40625
000	.4096	.425	.3625	.372	......	.375
00	.3648	.380	.3310	.348	......	.34375
0	.3249	.340	.3065	.324	......	.3125
1	.2893	.300	.2830	.300	.227	.28125
2	.2576	.284	.2625	.276	.219	.265625
3	.2294	.259	.2437	.252	.212	.25
4	.2043	.238	.2253	.232	.207	.234375
5	.1819	.220	.2070	.212	.204	.21875
6	.1620	.203	.1920	.192	.201	.203125
7	.1443	.180	.1770	.176	.199	.1875
8	.1285	.165	.1620	.160	.197	.171875
9	.1144	.148	.1483	.144	.194	.15625
10	.1019	.134	.1350	.128	.191	.140625
11	.09074	.120	.1205	.116	.188	.125
12	.08081	.109	.1055	.104	.185	.109375
13	.07196	.095	.0915	.092	.182	.09375
14	.06408	.083	.0800	.080	.180	.078125
15	.05707	.072	.0720	.072	.178	.0703125
16	.05082	.065	.0625	.064	.175	.0625
17	.04526	.058	.0540	.056	.172	.05625
18	.04030	.049	.0475	.048	.168	.05
19	.03589	.042	.0410	.040	.164	.04375
20	.03196	.035	.0348	.036	.161	.0375
21	.02846	.032	.0318	.032	.157	.034375
22	.02535	.028	.0286	.028	.155	.03125
23	.02257	.025	.0258	.024	.153	.028125
24	.02010	.022	.0230	.022	.151	.025

COMPARISON OF WIRE GAUGES (Continued)

Diameter of Wire in Inches

Gauge No.	Brown & Sharpe	Birmingham or Stubs'.	Washburn & Moen	Imperial or Brit. Std.	Stubs' steel	U. S. Std. plate
25	0.01790	0.020	0.0204	0.020	0.148	0.021875
26	0.01594	0.018	0.0181	0.018	0.146	0.01875
27	0.01419	0.016	0.0173	0.0164	0.143	0.0171875
28	0.01264	0.014	0.0162	0.0149	0.139	0.015625
29	0.01126	0.013	0.0150	0.0136	0.134	0.0140625
30	0.01003	0.012	0.0140	0.0124	0.127	0.0125
31	0.008928	0.010	0.0132	0.0116	0.120	0.0109375
32	0.007950	0.009	0.0128	0.0108	0.115	0.01015625
33	0.007080	0.008	0.0118	0.0100	0.112	0.009375
34	0.006304	0.007	0.0104	0.0092	0.110	0.00859375
35	0.005614	0.005	0.0095	0.0084	0.108	0.0078125
36	0.005000	0.004	0.0090	0.0076	0.106	0.00703125
37	0.004453	....	0.0085	0.0068	0.103	0.006640625
38	0.003965	....	0.0080	0.0060	0.101	0.00625
39	0.003531	....	0.0075	0.0052	0.099	....
40	0.003145	....	0.0070	0.0048	0.097	....
41	....	....	0.0066	0.0044	0.095	....
42	....	....	0.0062	0.0040	0.092	....
43	....	....	0.0060	0.0036	0.088	....
44	....	....	0.0058	0.0032	0.085	....
45	....	....	0.0055	0.0028	0.081	....
46	....	....	0.0052	0.0024	0.079	....
47	....	....	0.0050	0.0020	0.077	....
48	....	....	0.0048	0.0016	0.075	....
49	....	....	0.0046	0.0012	0.072	....
50	....	....	0.0044	0.0010	0.069	....

COMPARISON OF WIRE GAUGES (Continued)

DIAMETER OF WIRE IN CENTIMETERS

Gauge No.	Brown & Sharpe	Birmingham or Stubs.	Washburn & Moen	Imperial or Brit. Std.	Stubs' steel	U. S. Std. plate
00000000	....	....	....	....	....	....
0000000	....	....	1.245	1.27	....	1.27
000000	....	....	1.172	1.18	....	1.191
00000	....	....	1.093	1.10	....	1.111
0000	1.168	1.15	1.000	1.02	....	1.032
000	1.040	1.08	0.9208	0.945	....	0.9525
00	0.9266	0.965	0.8407	0.884	....	0.8731
0	0.8252	0.864	0.7785	0.823	....	0.7938
1	0.7348	0.762	0.7188	0.762	0.577	0.7144
2	0.6543	0.721	0.6668	0.701	0.556	0.6747
3	0.5827	0.658	0.6190	0.640	0.538	0.6350
4	0.5189	0.605	0.5723	0.589	0.526	0.5953
5	0.4620	0.559	0.5258	0.538	0.518	0.5556
6	0.4115	0.516	0.4877	0.488	0.511	0.5159
7	0.3665	0.457	0.4496	0.447	0.505	0.4763
8	0.3264	0.419	0.4115	0.406	0.500	0.4366
9	0.2906	0.376	0.3767	0.366	0.493	0.3969
10	0.2588	0.340	0.3429	0.325	0.485	0.3572
11	0.2305	0.305	0.3061	0.295	0.478	0.3175
12	0.2053	0.277	0.2680	0.264	0.470	0.2778
13	0.1828	0.241	0.232	0.234	0.462	0.2381
14	0.1628	0.211	0.203	0.203	0.457	0.1984
15	0.1450	0.183	0.183	0.183	0.452	0.1786
16	0.1291	0.165	0.159	0.163	0.445	0.1588
17	0.1150	0.147	0.137	0.142	0.437	0.1429
18	0.1024	0.124	0.121	0.122	0.427	0.1270
19	0.09116	0.107	0.104	0.102	0.417	0.1111
20	0.08118	0.089	0.0884	0.0914	0.409	0.09525
21	0.07229	0.081	0.0808	0.0813	0.399	0.08731
22	0.06439	0.071	0.0726	0.0711	0.394	0.07938
23	0.05733	0.064	0.0655	0.0610	0.389	0.07144
24	0.05105	0.056	0.0584	0.0559	0.384	0.06350

COMPARISON OF WIRE GAUGES (Continued)

Diameter of Wire in Centimeters

Gauge No.	Brown & Sharpe	Birmingham or Stubs'.	Washburn & Moen	Imperial or Brit. Std.	Stubs' steel	U. S. Std. plate
25	0.04547	0.051	0.0518	0.0508	0.376	0.05556
26	0.04049	0.046	0.0460	0.0457	0.371	0.04763
27	0.03604	0.041	0.0439	0.0417	0.363	0.04366
28	0.03211	0.036	0.0411	0.0378	0.353	0.03969
29	0.02860	0.033	0.0381	0.0345	0.340	0.03572
30	0.02548	0.030	0.0356	0.0315	0.323	0.03175
31	0.02268	0.025	0.0335	0.0295	0.305	0.02778
32	0.02019	0.023	0.0325	0.0274	0.292	0.02580
33	0.01798	0.020	0.0300	0.0254	0.284	0.02381
34	0.01601	0.018	0.0264	0.0234	0.279	0.02183
35	0.01426	0.013	0.024	0.0213	0.274	0.01984
36	0.01270	0.010	0.023	0.0193	0.269	0.01786
37	0.01131	....	0.022	0.0173	0.262	0.01687
38	0.01007	....	0.020	0.0152	0.257	0.01588
39	0.008969	....	0.019	0.0132	0.251	....
40	0.007988	....	0.018	0.0122	0.246	....
41	....	....	0.017	0.0112	0.241	....
42	....	....	0.016	0.0102	0.234	....
43	....	....	0.015	0.0091	0.224	....
44	....	....	0.015	0.0081	0.216	....
45	....	....	0.014	0.0071	0.206	....
46	....	....	0.013	0.0061	0.201	....
47	....	....	0.013	0.0051	0.196	....
48	....	....	0.012	0.0041	0.191	....
49	....	....	0.012	0.0030	0.183	....
50	....	....	0.011	0.0025	0.175	....

TWIST DRILL AND STEEL WIRE GAUGE

INCHES

No.	Size	No.	Size	No.	Size	No.	Size	No.	Size
1	0.2280	17	0.1730	33	0.1130	49	0.0730	65	0.0350
2	0.2210	18	0.1695	34	0.1110	50	0.0700	66	0.0330
3	0.2130	19	0.1660	35	0.1100	51	0.0670	67	0.0320
4	0.2090	20	0.1610	36	0.1065	52	0.0635	68	0.0310
5	0.2055	21	0.1590	37	0.1040	53	0.0595	69	0.02925
6	0.2040	22	0.1570	38	0.1015	54	0.0550	70	0.0280
7	0.2010	23	0.1540	39	0.0995	55	0.0520	71	0.0260
8	0.1990	24	0.1520	40	0.0980	56	0.0465	72	0.0250
9	0.1960	25	0.1495	41	0.0960	57	0.0430	73	0.0240
10	0.1935	26	0.1470	42	0.0935	58	0.0420	74	0.0225
11	0.1910	27	0.1440	43	0.0890	59	0.0410	75	0.0210
12	0.1890	28	0.1405	44	0.0860	60	0.0400	76	0.0200
13	0.1850	29	0.1360	45	0.0820	61	0.0390	77	0.0180
14	0.1820	30	0.1285	46	0.0810	62	0.0380	78	0.0160
15	0.1800	31	0.1200	47	0.0785	63	0.0370	79	0.0145
16	0.1770	32	0.1160	48	0.0760	64	0.0360	80	0.0135

CENTIMETERS

No.	Size	No.	Size	No.	Size	No.	Size	No.	Size
1	0.5791	17	0.4394	33	0.2870	49	0.1854	65	0.0889
2	0.5613	18	0.4305	34	0.2819	50	0.1778	66	0.0838
3	0.5410	19	0.4216	35	0.2794	51	0.1702	67	0.0813
4	0.5309	20	0.4089	36	0.2705	52	0.1613	68	0.0787
5	0.5220	21	0.4039	37	0.2642	53	0.1511	69	0.0743
6	0.5182	22	0.3988	38	0.2578	54	0.1397	70	0.0711
7	0.5105	23	0.3912	39	0.2527	55	0.1321	71	0.0660
8	0.5055	24	0.3861	40	0.2489	56	0.1181	72	0.0635
9	0.4978	25	0.3797	41	0.2438	57	0.1092	73	0.0610
10	0.4915	26	0.3734	42	0.2375	58	0.1067	74	0.0572
11	0.4851	27	0.3658	43	0.2261	59	0.1041	75	0.0533
12	0.4801	28	0.3569	44	0.2184	60	0.1016	76	0.0508
13	0.4699	29	0.3454	45	0.2083	61	0.0991	77	0.0457
14	0.4623	30	0.3264	46	0.2057	62	0.0965	78	0.0406
15	0.4572	31	0.3048	47	0.1994	63	0.0940	79	0.0368
16	0.4496	32	0.2946	48	0.1930	64	0.0914	80	0.0343

DIMENSIONS OF WIRE

STUBS' GAUGE

Giving the diameter and cross-section in English and metric system for the Birmingham or Stubs' gauge.

Gauge No.	Diameter in in.	Section in sq. in.	Diameter in cm	Section in sq. cm
0000	0.454	0.16188	1.1532	1.0444
000	.425	.14186	1.0795	0.9152
00	.380	.11341	0.9652	.7317
0	0.340	0.09079	0.8636	0.5858
1	.300	.07069	.7620	.4560
2	.284	.06335	.7214	.4087
3	.259	.05269	.6579	.3399
4	.238	.04449	.6045	.2870
5	0.220	0.03801	0.5588	0.2452
6	.203	.03237	.5156	.20881
7	.180	.02545	.4572	.16147
8	.165	.02138	.4191	.13795
9	.148	.01720	.3759	.11099
10	0.134	0.01410	0.3404	0.09098
11	.120	.011310	.3048	.07297
12	.109	.009331	.2769	.06160
13	.095	.007088	.2413	.04573
14	.083	.005411	.2108	.03491
15	0.072	0.004072	0.1829	0.02627
16	.065	.0033183	.16510	.021409
17	.058	.0026421	.14732	.017046
18	.049	.0018857	.12446	.012166
19	.042	.0013854	.10668	.008938
20	0.035	0.0009621	0.08890	0.006207
21	.032	.0008042	.08128	.005189
22	.028	.0006158	.07112	.003973
23	.025	.0004909	.06350	.003167
24	.022	.0003801	.05588	.002452
25	0.020	0.0003142	0.05080	0.002027
26	.018	.0002545	.04572	.0016417
27	.016	.0002011	.04064	.0012972
28	.014	.0001539	.03556	.0009932
29	.013	.0001327	.03302	.0008563
30	0.012	0.0001181	0.03048	0.0007297
31	.010	.00007854	.02540	.0005067
32	.009	.00006362	.02286	.0004104
33	.008	.00005027	.02032	.0003243
34	.007	.00003848	.01778	.0002483
35	0.005	0.00001963	0.01270	0.0001267
36	.004	.00001257	.01016	.0000811

DIMENSIONS OF WIRE (Continued)

British Standard Gauge

Giving the diameter and cross-section in English and metric system for the British Standard Gauge.

Gauge No.	Diameter in in.	Section in sq. in.	Diameter in cm	Section in sq. cm
0000000	0.500	0.1963	1.2700	1.267
000000	.464	.1691	1.1786	1.091
00000	0.432	0.1466	1.0973	0.9456
0000	.400	.1257	1.0160	.8107
000	.372	.1087	0.9449	.7012
00	.348	.0951	.8839	.6136
0	0.324	0.0825	0.8230	0.5319
1	.300	.07069	.7620	.4560
2	.276	.05983	.7010	.3858
3	.252	.04988	.6401	.3218
4	.232	.04227	.5893	.2727
5	0.212	0.03530	0.5385	0.2277
6	.192	.02895	.4877	.18679
7	.176	.02433	.4470	.15696
8	.160	.02010	.4064	.12973
9	.144	.01629	.3658	.10507
10	0.128	0.01287	0.3251	0.08302
11	.116	.010568	.2946	.06818
12	.104	.008495	.2642	.05480
13	.092	.006648	.2337	.04289
14	.080	.005027	.2032	.03243
15	0.072	0.004071	0.1829	0.02627
16	.064	.003217	.16256	.020755
17	.056	.002463	.14224	.015890
18	.048	.001810	.12192	.011675
19	.040	.001257	.10160	.008107
20	0.036	0.001018	0.09144	0.006567
21	.032	.0008042	.08128	.005189
22	.028	.0006158	.07112	.003973
23	.024	.0004524	.06096	.002922
24	.022	.0003801	.05588	.002452
25	0.020	0.0003142	0.05080	0.002027
26	.0180	.0002545	.04572	.0016417
27	.0164	.0002112	.04166	.0013628
28	.0148	.0001728	.03759	.0011099
29	.0136	0001453	.03454	.0009363
30	0.0124	0.0001208	0.03150	0.0007791
31	.0116	.00010568	.02946	.0006818
32	.0108	.00009161	.02743	.0005910
33	.0100	.00007854	.02540	.0005067
34	.0092	.00006648	.02337	.0004289
35	0.0084	0.00005542	0.02134	0.0003575
36	.0076	.00004536	.01930	.0002927
37	.0068	.00003632	.01727	.0002343
38	.0060	.00002827	.01524	.0001824
39	.0052	.00002124	.01321	.0001370
40	0.0048	0.00001810	0.01219	0.0001167
41	.0044	.00001521	.01118	.0000982
42	.0040	.00001257	.01016	.0000811
43	.0036	.00001018	.00914	.0000656
44	.0032	.00000804	.00813	.0000519
45	0.0028	0.00000616	0.00711	0.0000397
46	.0024	.00000452	.00610	.0000212
47	.0020	.00000314	.00508	.0000203
48	.0016	.00000201	.00406	.0000129
49	.0012	.00000113	.00305	.0000073
50	0.0010	0.00000079	0.00254	0.0000051

PLATINUM WIRE

Mass in Grams per Foot

B. &. S. Gauge	Diameter, inches	Mass, g per ft.	B. & S. Gauge	Diameter, inches	Mass, g per ft.
10	.1019	37.5	23	.02257	1.8
11	.09074	28.0	24	.02010	1.4
12	.08081	22.0	25	.01790	1.1
13	.07196	17.5	26	.01594	0.9
14	.06408	14.0	27	.01420	0.7
15	.05707	11.0	28	.01264	0.6
16	.05082	9.0	29	.01126	0.45
17	.04526	7.0	30	.01003	0.35
18	.04030	5.7	31	.008928	0.28
19	.03589	4.4	32	.007950	0.22
20	.03196	3.4	33	.007080	0.17
21	.02846	2.9	34	.006305	0.15
22	.02535	2.3	35	.005615	0.11

ALLOWABLE CARRYING CAPACITIES OF CONDUCTORS

(National Electrical Code)

The ratings in the following tabulation are those permitted by the National Electrical Code for flexible cords and for interior wiring of houses, hotels, office buildings, industrial plants, and other buildings.

The values are for copper wire. For aluminum wire the allowable carrying capacities shall be taken as 84 % of those given in the table for the respective sizes of copper wire with the same kind of covering.

Size A.W.G.	Area Circular Mils	Diameter of Solid Wires Mils	Rubber Insulation Amperes	Varnished Cambric Insulation Amperes	Other Insulations and Bare Conductors Amperes
18	1,624.	40.3	3*	...	6†
16	2,583.	50.8	6*	...	10†
14	4,107.	64.1	15	18	20
12	6,530.	80.8	20	25	30
10	10,380.	101.9	25	30	35
8	16,510.	128.5	35	40	50
6	26,250.	162.0	50	60	70
5	33,100.	181.9	55	65	80
4	41,740.	204.3	70	85	90
3	52,630.	229.4	80	95	100
2	66,370.	257.6	90	110	125
1	83,690.	289.3	100	120	150
0	105,500.	325.0	125	150	200
00	135,100.	364.8	150	180	225
000	167,800.	409.6	175	210	275
0000	211,600.	460	225	270	325

1 Mil = 0.001 inch.

* The allowable carrying capacities of No. 18 and 16 are 5 and 7 amperes respectively, when in flexible cords.

† The allowable carrying capacities of No. 18 and 16 are 10 and 15 amperes respectively, when in cords for portable heatsrs. Types AFS, AFSJ, HC, HPD, and HSJ.

WIRE TABLE, STANDARD ANNEALED COPPER

American Wire Gauge (B. & S.) English Units

Gauge No.	Diameter in mils at 20°C	Cross section at 20°C		Ohms per 1000 feet*			
		Circular mils	Sq. inches	0°C (32°F)	20°C (68°F)	50°C (122°F)	75°C (167°F)
0000	460.0	211600	0.1662	0.04516	0.04901	0.05479	0.05961
000	409.6	167800	.1318	.05695	.06180	.06909	.07516
00	364.8	133100	.1045	.07181	.07793	.08712	.09478
0	324.9	105500	.08289	.09055	.09827	.1099	.1195
1	289.3	83690	.06573	.1142	.1239	.1385	.1507
2	257.6	66370	.05213	.1440	.1563	.1747	.1900
3	229.4	52640	.04134	.1816	.1970	.2203	.2396
4	204.3	41740	.03278	.2289	.2485	.2778	.3022
5	181.9	33100	.02600	.2887	.3133	.3502	.3810
6	162.0	26250	.02062	.3640	.3951	.4416	.4805
7	144.3	20820	.01635	.4590	.4982	.5569	.6059
8	128.5	16510	.01297	.5788	.6282	.7023	.7640
9	114.4	13090	.01028	.7299	.7921	.8855	.9633
10	101.9	10380	.008155	.9203	.9989	1.117	1.215
11	90.74	8234	.006467	1.161	1.260	1.408	1.532
12	80.81	6530	.005129	1.463	1.588	1.775	1.931
13	71.96	5178	.004067	1.845	2.003	2.239	2.436
14	64.08	4107	.003225	2.327	2.525	2.823	3.071
15	57.07	3257	.002558	2.934	3.184	3.560	3.873
16	50.82	2583	.002028	3.700	4.016	4.489	4.884
17	45.26	2048	.001609	4.666	5.064	5.660	6.158
18	40.30	1624	.001276	5.883	6.385	7.138	7.765
19	35.89	1288	.001012	7.418	8.051	9.001	9.792
20	31.96	1022	.0008023	9.355	10.15	11.35	12.35
21	28.45	810.1	.0006363	11.80	12.80	14.31	15.57
22	25.35	642.4	.0005046	14.87	16.14	18.05	19.63
23	22.57	509.5	.0004002	18.76	20.36	22.76	24.76
24	20.10	404.0	.0003173	23.65	25.67	28.70	31.22
25	17.90	320.4	.0002517	29.82	32.37	36.18	39.36
26	15.94	254.1	.0001996	37.61	40.81	45.63	49.64
27	14.20	201.5	.0001583	47.42	51.47	57.53	62.59
28	12.64	159.8	.0001255	59.80	64.90	72.55	78.93
29	11.26	126.7	.00009953	75.40	81.83	91.48	99.52
30	10.03	100.5	.00007894	95.08	103.2	115.4	125.5
31	8.928	79.70	.00006260	119.9	130.1	145.5	158.2
32	7.950	63.21	.00004964	151.2	164.1	183.4	199.5
33	7.080	50.13	.00003937	190.6	206.9	231.3	251.6
34	6.305	39.75	.00003122	240.4	260.9	291.7	317.3
35	5.615	31.52	.00002476	303.1	329.0	367.8	400.1
36	5.000	25.00	.00001964	382.2	414.8	463.7	504.5
37	4.453	19.83	.00001557	482.0	523.1	584.8	636.2
38	3.965	15.72	.00001235	607.8	659.6	737.4	802.2
39	3.531	12.47	.000009793	766.4	831.8	929.8	1012
40	3.145	9.888	.000007766	966.5	1049	1173	1276

* Resistance at the stated temperatures of a wire whose length is 1000 feet at 20°C.

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) English Units (Continued)

Gauge No.	Pounds per 1000 feet	Feet per pound	Feet per ohm*			
			0°C (32°F)	20°C (68°F)	50°C (122°F)	75°C (167°F)
0000	640.5	1.561	22140	20400	18250	16780
000	507.9	1.968	17560	16180	14470	13300
00	402.8	2.482	13930	12830	11480	10550
0	319.5	3.130	11040	10180	9103	8367
1	253.3	3.947	8758	8070	7219	6636
2	200.9	4.977	6946	6400	5725	5262
3	159.3	6.276	5508	5075	4540	4173
4	126.4	7.914	4368	4025	3600	3309
5	100.2	9.980	3464	3192	2855	2625
6	79.46	12.58	2747	2531	2264	2081
7	63.02	15.87	2179	2007	1796	1651
8	49.98	20.01	1728	1592	1424	1309
9	39.63	25.23	1370	1262	1129	1038
10	31.43	31.82	1087	1001	895.6	823.2
11	24.92	40.12	861.7	794.0	710.2	652.8
12	19.77	50.59	683.3	629.6	563.2	517.7
13	15.68	63.80	541.9	499.3	446.7	410.6
14	12.43	80.44	429.8	396.0	354.2	325.6
15	9.858	101.4	340.8	314.0	280.9	258.2
16	7.818	127.9	270.3	249.0	222.8	204.8
17	6.200	161.3	214.3	197.5	176.7	162.4
18	4.917	203.4	170.0	156.6	140.1	128.8
19	3.899	256.5	134.8	124.2	111.1	102.1
20	3.092	323.4	106.9	98.50	88.11	80.99
21	2.452	407.8	84.78	78.11	69.87	64.23
22	1.945	514.2	67.23	61.95	55.41	50.94
23	1.542	648.4	53.32	49.13	43.94	40.39
24	1.223	817.7	42.28	38.96	34.85	32.03
25	0.9699	1031	33.53	30.90	27.64	25.40
26	.7692	1300	26.59	24.50	21.92	20.15
27	.6100	1639	21.09	19.43	17.38	15.98
28	.4837	2067	16.72	15.41	13.78	12.67
29	.3836	2607	13.26	12.22	10.93	10.05
30	.3042	3287	10.52	9.691	8.669	7.968
31	.2413	4145	8.341	7.685	6.875	6.319
32	.1913	5227	6.614	6.095	5.452	5.011
33	.1517	6591	5.245	4.833	4.323	3.974
34	.1203	8310	4.160	3.833	3.429	3.152
35	.09542	10480	3.299	3.040	2.719	2.499
36	.07568	13210	2.616	2.411	2.156	1.982
37	.06001	16660	2.075	1.912	1.710	1.572
38	.04759	21010	1.645	1.516	1.356	1.247
39	.03774	26500	1.305	1.202	1.075	0.9886
40	.02993	33410	1.035	0.9534	0.8529	.7840

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* Length at 20°C of a wire whose resistance is 1 ohm at the stated temperatures.

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) English Units (Continued)

Gauge No.	Diameter in mils at 20°C	Ohms per pound			Lbs. per ohm
		0°C (32°F)	20°C (68°F)	50°C (122°F)	20°C (68°F)
0000	460.0	0.00007051	0.00007652	0.00008554	13070
000	409.6	.0001121	.0001217	.0001360	8219
00	364.8	.0001783	.0001935	.0002163	5169
0	324.9	.0002835	.0003076	.0003439	3251
1	289.3	.0004507	.0004891	.0005468	2044
2	257.6	.0007166	.0007778	.0008695	1286
3	229.4	.001140	.001237	.001383	808.6
4	204.3	.001812	.001966	.002198	508.5
5	181.9	.002881	.003127	.003495	319.8
6	162.0	.004581	.004972	.005558	201.1
7	144.3	.007284	.007905	.008838	126.5
8	128.5	.01158	.01257	.01405	79.55
9	114.4	.01842	.01999	.02234	50.03
10	101.9	.02928	.03178	.03553	31.47
11	90.74	.04656	.05053	.05649	19.79
12	80.81	.07404	.08035	.08983	12.45
13	71.96	.1177	.1278	.1428	7.827
14	64.08	.1872	.2032	.2271	4.922
15	57.07	.2976	.3230	.3611	3.096
16	50.82	.4733	.5136	.5742	1.947
17	45.26	.7525	.8167	.9130	1.224
18	40.30	1.197	1.299	1.452	0.7700
19	35.89	1.903	2.065	2.308	.4843
20	31.96	3.025	3.283	3.670	.3046
21	28.46	4.810	5.221	5.836	.1915
22	25.35	7.649	8.301	9.280	.1205
23	22.57	12.16	13.20	14.76	.07576
24	20.10	19.34	20.99	23.46	.04765
25	17.90	30.75	33.37	37.31	.02997
26	15.94	48.89	53.06	59.32	.01885
27	14.20	77.74	84.37	94.32	.01185
28	12.64	123.6	134.2	150.0	.007454
29	11.26	196.6	213.3	238.5	.004688
30	10.03	312.5	339.2	379.2	.002948
31	8.928	497.0	539.3	602.9	.001854
32	7.950	790.2	857.6	958.7	.001166
33	7.080	1256	1364	1524	.0007333
34	6.305	1998	2168	2424	.0004612
35	5.615	3177	3448	3854	.0002901
36	5.000	5051	5482	6128	.0001824
37	4.453	8032	8717	9744	.0001147
38	3.965	12770	13860	15490	.00007215
39	3.531	20310	22040	24640	.00004538
40	3.145	32290	35040	39170	.00002854

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) Metric Units (Continued)

Gauge No.	Diameter in mm at 20°C	Cross section in mm^2 at 20°C	Ohms per kilometer*			
			0°C	20°C	50°C	75°C
0000	11.68	107.2	0.1482	0.1608	0.1798	0.1956
000	10.40	85.03	.1868	.2028	.2267	.2466
00	9.266	67.43	.2356	.2557	.2858	.3110
0	8.252	53.48	.2971	.3224	.3604	.3921
1	7.348	42.41	.3746	.4066	.4545	.4944
2	6.544	33.63	.4724	.5127	.5731	.6235
3	5.827	26.67	.5956	.6465	.7227	.7862
4	5.189	21.15	.7511	.8152	.9113	.9914
5	4.621	16.77	.9471	1.028	1.149	1.250
6	4.115	13.30	1.194	1.296	1.449	1.576
7	3.665	10.55	1.506	1.634	1.827	1.988
8	3.264	8.366	1.899	2.061	2.304	2.506
9	2.906	6.634	2.395	2.599	2.905	3.161
10	2.588	5.261	3.020	3.277	3.663	3.985
11	2.305	4.172	3.807	4.132	4.619	5.025
12	2.053	3.309	4.801	5.211	5.825	6.337
13	1.828	2.624	6.054	6.571	7.345	7.991
14	1.628	2.081	7.634	8.285	9.262	10.08
15	1.450	1.650	9.627	10.45	11.68	12.71
16	1.291	1.309	12.14	13.17	14.73	16.02
17	1.150	1.038	15.31	16.61	18.57	20.20
18	1.024	0.8231	19.30	20.95	23.42	25.48
19	0.9116	.6527	24.34	26.42	29.53	32.12
20	.8118	.5176	30.69	33.31	37.24	40.51
21	.7230	.4105	38.70	42.00	46.95	51.08
22	.6438	.3255	48.80	52.96	59.21	64.41
23	.5733	.2582	61.54	66.79	74.66	81.22
24	.5106	.2047	77.60	84.21	94.14	102.4
25	.4547	.1624	97.85	106.2	118.7	129.1
26	.4049	.1288	123.4	133.9	149.7	162.9
27	.3606	.1021	155.6	168.9	188.8	205.4
28	.3211	.08098	196.2	212.9	238.0	258.9
29	.2859	.06422	247.4	268.5	300.1	326.5
30	.2546	.05093	311.9	338.6	378.5	411.7
31	.2268	.04039	393.4	426.9	477.2	519.2
32	.2019	.03203	496.0	538.3	601.8	654.7
33	.1798	.02540	625.5	678.8	758.8	825.5
34	.1601	.02014	788.7	856.0	956.9	1041
35	.1426	.01597	994.5	1079	1207	1313
36	.1270	.01267	1254	1361	1522	1655
37	.1131	.01005	1581	1716	1919	2087
38	.1007	.007967	1994	2164	2419	2632
39	.08969	.006318	2514	2729	3051	3319
40	.07987	.005010	3171	3441	3847	4185

* Resistance at the stated temperatures of a wire whose length is 1 kilometer at 20°C.

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) Metric Units (Continued)

Gauge No.	Diameter in mm at 20°C	Kilograms per kilometer	Meters per gram	Meters per ohm* 0°C	20°C	50°C	75°C
0000	11.68	953.2	0.001049	6749	6219	5563	5113
000	10.40	755.9	.001323	5352	4932	4412	4055
00	9.266	599.5	.001668	4245	3911	3499	3216
0	8.252	475.4	.002103	3366	3102	2774	2550
1	7.348	377.0	.002652	2669	2460	2200	2022
2	6.544	299.0	.003345	2117	1951	1745	1604
3	5.827	237.1	.004217	1679	1547	1384	1272
4	5.189	188.0	.005318	1331	1227	1097	1009
5	4.621	149.1	.006706	1056	972.9	870.2	799.9
6	4.115	118.2	.008457	837.3	771.5	690.1	634.4
7	3.665	93.78	.01066	664.0	611.8	547.3	503.1
8	3.264	74.37	.01345	526.6	485.2	434.0	399.0
9	2.906	58.98	.01696	417.6	384.8	344.2	316.4
10	2.588	46.77	.02138	331.2	305.1	273.0	250.9
11	2.305	37.09	.02696	262.6	242.0	216.5	199.0
12	2.053	29.42	.03400	208.3	191.9	171.7	157.8
13	1.828	23.33	.04287	165.2	152.2	136.1	125.1
14	1.628	18.50	.05406	131.0	120.7	108.0	99.24
15	1.450	14.67	.06816	103.9	95.71	85.62	78.70
16	1.291	11.63	.08595	82.38	75.90	67.90	62.41
17	1.150	9.226	.1084	65.33	60.20	53.85	49.50
18	1.024	7.317	.1367	51.81	47.74	42.70	39.25
19	0.9116	5.803	.1723	41.09	37.86	33.86	31.13
20	.8118	4.602	.2173	32.58	30.02	26.86	24.69
21	.7230	3.649	.2740	25.84	23.81	21.30	19.58
22	.6438	2.894	.3455	20.49	18.88	16.89	15.53
23	.5733	2.295	.4357	16.25	14.97	13.39	12.31
24	.5106	1.820	.5494	12.89	11.87	10.62	9.764
25	.4547	1.443	.6928	10.22	9.417	8.424	7.743
26	.4049	1.145	.8736	8.105	7.468	6.680	6.141
27	.3606	0.9078	1.102	6.428	5.922	5.298	4.870
28	.3211	.7199	1.389	5.097	4.697	4.201	3.862
29	.2859	.5709	1.752	4.042	3.725	3.332	3.063
30	.2546	.4527	2.209	3.206	2.954	2.642	2.429
31	.2268	.3590	2.785	2.542	2.342	2.095	1.926
32	.2019	.2847	3.512	2.016	1.858	1.662	1.527
33	.1798	.2258	4.429	1.599	1.473	1.318	1.211
34	.1601	.1791	5.584	1.268	1.168	1.045	0.9606
35	.1426	.1420	7.042	1.006	0.9265	0.8288	.7618
36	.1270	.1126	8.879	0.7974	.7347	.6572	.6041
37	.1131	.08931	11.20	.6324	.5827	.5212	.4791
38	.1007	.07083	14.12	.5015	.4621	.4133	.3799
39	.08969	.05617	17.80	.3977	.3664	.3278	.3013
40	.07987	.04454	22.45	.3154	.2906	.2600	.2390

* Length at 20°C of a wire whose resistance is 1 ohm at the stated temperatures.

WIRE TABLE, STANDARD ANNEALED COPPER
(Continued)

American Wire Gauge (B. & S.) Metric Units (Continued)

Gauge No.	Ohms per kilogram			Grams per ohm
	0°C	20°C	50°C	20°C
0000	0.0001554	0.0001687	0.0001886	5928000
000	.0002472	.0002682	.0002999	3728000
00	.0003930	.0004265	.0004768	2344000
0	.0006249	.0006782	.0007582	1474000
1	.0009936	.001078	.001206	927300
2	.001580	.001715	.001917	583200
3	.002512	.002726	.003048	366800
4	.003995	.004335	.004846	230700
5	.006352	.006893	.007706	145100
6	.01010	.01096	.01225	91230
7	.01606	.01743	.01948	57380
8	.02553	.02771	.03098	36080
9	.04060	.04406	.04926	22690
10	.06456	.07007	.07833	14270
11	.1026	.1114	.1245	8976
12	.1632	.1771	.1980	5645
13	.2595	.2817	.3149	3550
14	.4127	.4479	.5007	2233
15	.6562	.7122	.7961	1404
16	1.043	1.132	1.266	883.1
17	1.659	1.801	2.013	555.4
18	2.638	2.863	3.201	349.3
19	4.194	4.552	5.089	219.7
20	6.670	7.238	8.092	138.2
21	10.60	11.51	12.87	86.88
22	16.86	18.30	20.46	54.64
23	26.81	29.10	32.53	34.36
24	42.63	46.27	51.73	21.61
25	67.79	73.57	82.25	13.59
26	107.8	117.0	130.8	8.548
27	171.4	186.0	207.9	5.376
28	272.5	295.8	330.6	3.381
29	433.3	470.3	525.7	2.126
30	689.0	747.8	836.0	1.337
31	1096	1189	1329	0.8410
32	1742	1891	2114	.5289
33	2770	3006	3361	.3326
34	4404	4780	5344	.2092
35	7003	7601	8497	.1316
36	11140	12090	13510	.08274
37	17710	19220	21480	.05204
38	28150	30560	34160	.03273
39	44770	48590	54310	.02058
40	71180	77260	86360	.01294

ALUMINUM WIRE TABLE

Hard-Drawn Aluminum Wire at 20°C (or, 68°F)

American Wire Gauge (B. & S.) English Units

Gauge No.	Diameter in mils	Cross section		Ohms per 1000 ft.	Pounds per 1000 ft.	Pounds per ohm	Feet per ohm
		Circular mils	Square inches				
0000	460	212000	0.166	0.0804	195	2420	12400
000	410	168000	.132	.101	154	1520	9860
00	365	133000	.105	.128	122	957	7820
0	325	106000	.0829	.161	97.0	602	6200
1	289	83700	.0657	.203	76.9	379	4920
2	258	66400	.0521	.256	61.0	238	3900
3	229	52600	.0413	.323	48.4	150	3090
4	204	41700	.0328	.408	38.4	94.2	2450
5	182	33100	.0260	.514	30.4	59.2	1950
6	162	26300	.0206	.648	24.1	37.2	1540
7	144	20800	.0164	.817	19.1	23.4	1220
8	128	16500	.0130	1.03	15.2	14.7	970
9	114	13100	.0103	1.30	12.0	9.26	770
10	102	10400	.00815	1.64	9.55	5.83	610
11	91	8230	.00647	2.07	7.57	3.66	484
12	81	6530	.00513	2.61	6.00	2.30	384
13	72	5180	.00407	3.29	4.76	1.45	304
14	64	4110.	.00323	4.14	3.78	0.911	241
15	57	3260	.00256	5.22	2.99	.573	191
16	51	2580	.00203	6.59	2.37	.360	152
17	45	2050	.00161	8.31	1.88	.227	120
18	40	1620	.00128	10.5	1.49	.143	95.5
19	36	1290	.00101	13.2	1.18	.0897	75.7
20	32	1020	.000802	16.7	0.939	.0564	60.0
21	28.5	810	.000636	21.0	.745	.0355	47.6
22	25.3	642	.000505	26.5	.591	.0223	37.8
23	22.6	509	.000400	33.4	.468	.0140	29.9
24	20.1	404	.000317	42.1	.371	.00882	23.7
25	17.9	320	.000252	53.1	.295	.00555	18.8
26	15.9	254	.000200	67.0	.234	.00349	14.9
27	14.2	202	.000158	84.4	.185	.00219	11.8
28	12.6	160	.000126	106.	.147	.00138	9.39
29	11.3	127	.0000995	134.	.117	.000868	7.45
30	10.0	101	.0000789	169.	.0924	.000546	5.91
31	8.9	79.7	.0000626	213.	.0733	.000343	4.68
32	8.0	63.2	.0000496	269.	.0581	.000216	3.72
33	7.1	50.1	.0000394	339.	.0461	.000136	2.95
34	6.3	39.8	.0000312	428.	.0365	.0000854	2.34
35	5.6	31.5	.0000248	540.	.0290	.0000537	1.85
36	5.0	25.0	.0000196	681.	.0230	.0000338	1.47
37	4.5	19.8	.0000156	858.	.0182	.0000212	1.17
38	4.0	15.7	.0000123	1080.	.0145	.0000134	0.924
39	3.5	12.5	.00000979	1360.	.0115	.00000840	.733
40	3.1	9.9	.00000777	1720.	.0091	.00000528	.581

ALUMINUM WIRE TABLE (Continued)
Hard-Drawn Aluminum Wire at 20°C (or, 68°F)
American Wire Gauge (B. & S.) Metric Units

Gauge No.	Diameter in mm	Cross section in mm²	Ohms per kilometer	Kilograms per kilometer	Grams per ohm	Meters per ohm
0000	11.7	107	0.264	289	1100000	3790
000	10.4	85.0	.333	230	690000	3010
00	9.3	67.4	.419	182	434000	2380
0	8.3	53.5	.529	144	273000	1890
1	7.3	42.4	.667	114	172000	1500
2	6.5	33.6	.841	90.8	108000	1190
3	5.8	26.7	1.06	72.0	67900	943
4	5.2	21.2	1.34	57.1	42700	748
5	4.6	16.8	1.69	45.3	26900	593
6	4.1	13.3	2.13	35.9	16900	470
7	3.7	10.5	2.68	28.5	10600	373
8	3.3	8.37	3.38	22.6	6680	296
9	2.91	6.63	4.26	17.9	4200	235
10	2.59	5.26	5.38	14.2	2640	186
11	2.30	4.17	6.78	11.3	1660	148
12	2.05	3.31	8.55	8.93	1050	117
13	1.83	2.62	10.8	7.08	657	92.8
14	1.63	2.08	13.6	5.62	413	73.6
15	1.45	1.65	17.1	4.46	260	58.4
16	1.29	1.31	21.6	3.53	164	46.3
17	1.15	1.04	27.3	2.80	103	36.7
18	1.02	0.823	34.4	2.22	64.7	29.1
19	0.91	.653	43.3	1.76	40.7	23.1
20	.81	.518	54.6	1.40	25.6	18.3
21	.72	.411	68.9	1.11	16.1	14.5
22	.64	.326	86.9	0.879	10.1	11.5
23	.57	.258	110	.697	6.36	9.13
24	.51	.205	138	.553	4.00	7.24
25	.45	.162	174	.438	2.52	5.74
26	.40	.129	220	.348	1.58	4.55
27	.36	.102	277	.276	0.995	3.61
28	.32	.0810	349	.219	.626	2.86
29	.29	.0642	440	.173	.394	2.27
30	.25	.0509	555	.138	.248	1.80
31	.227	.0404	700	.109	.156	1.43
32	.202	.0320	883	.0865	.0979	1.13
33	.180	.0254	1110	.0686	.0616	0.899
34	.160	.0201	1400	.0544	.0387	.712
35	.143	.0160	1770	.0431	.0244	.565
36	.127	.0127	2230	.0342	.0153	.448
37	.113	.0100	2820	.0271	.00963	.355
38	.101	.0080	3550	.0215	.00606	.282
39	.090	.0063	4480	.0171	.00381	.223
40	.080	.0050	5640	.0135	.00240	.177

CROSS-SECTION AND MASS OF WIRES

U. S. Measure

Diameters are given in mils (1 mil = .001 in.), and area in square mils (1 sq. mil = .000001 sq. in.). For sections and masses for one-tenth the diameters given, divide by 100 and for sections and masses for ten times the diameter multiply by 100.

Diam. in mils	Cross-sec. in sq. mils	Pounds per foot			
		Copper, density 8.90	Iron, density 7.80	Brass, density 8.56	Aluminum, density 2.67
10	78.54	0.000303	0.0002656	0.0002915	0.0000909
11	95.03	0367	03214	03527	01100
12	113.10	0436	03825	04197	01309
13	132.73	0512	04488	04926	01536
14	153.94	0594	05206	05713	01782
15	176.71	0.000682	0.0005976	0.0006558	0.0002045
16	201.06	0776	06799	07461	02327
17	226.98	0876	07675	08423	02627
18	254.47	0982	08605	09443	02946
19	283.53	1094	09588	10522	03282
20	314.16	0.001212	0.001062	0.001166	0.0003636
21	346.36	1336	1171	1285	04009
22	380.13	1467	1286	1411	04400
23	415.48	1603	1405	1542	04809
24	452.39	1746	1530	1679	05237
25	490.87	0.001894	0.001660	0.001822	0.0005682
26	530.93	2046	1795	1970	06147
27	572.56	2209	1936	2125	06628
28	615.75	2376	2082	2285	07127
29	660.52	2549	2234	2451	07646
30	706.86	0.002727	0.002390	0.002623	0.0008182
31	754.77	2912	2552	2801	08737
32	804.25	3103	2720	2985	09309
33	855.30	3300	2892	3174	09900
34	907.92	3503	3070	3369	10509
35	962.11	0.003712	0.003253	0.003570	0.001114
36	1017.88	3927	3442	3777	1178
37	1075.21	4149	3636	3990	1245
38	1134.11	4376	3844	4218	1316
39	1194.59	4609	4040	4433	1383
40	1256.64	0.004849	0.004249	0.004664	0.001455
41	1320.25	5094	4465	4900	1528
42	1385.44	5346	4685	5141	1604
43	1452.20	5603	4911	5389	1681
44	1520.53	5867	5142	5643	1760
45	1590.43	0.006137	0.005378	0.005902	0.001841
46	1661.90	6412	5620	6167	1924
47	1734.94	6694	5867	6438	2008
48	1809.56	6982	6119	6715	2095
49	1885.74	7276	6377	6998	2183
50	1963.50	0.007576	0.006640	0.007287	0.002273
51	2042.82	7882	6908	7581	2365
52	2123.72	8194	7181	7881	2458
53	2206.18	8512	7460	8187	2554
54	2290.22	8837	7744	8499	2651

CROSS-SECTION AND MASS OF WIRES (Continued)

U. S. Measure (Continued)

Diameters are given in mils (1 mil = .001 in.), and area in square mils (1 sq mil = .000001 sq. in.). For sections and masses for one-tenth the diameters given, divide by 100 and for sections and masses for ten times the diameter multiply by 100.

Diam. in mils	Cross-sec. in sq. mils	Pounds per foot			
		Copper, density 8.90	Iron, density 7.80	Brass, density 8.56	Aluminum, density 2.67
55	2375.83	0.009167	0.008034	0.008817	0.002750
56	2463.01	09504	08329	09140	2851
57	2551.76	09846	08629	09470	2954
58	2642.08	10195	08934	09805	3058
59	2733.97	10549	09245	10146	3165
60	2827.43	0.01091	0.00956	0.01049	0.003273
61	2922.47	1128	0988	1085	3383
62	3019.07	1165	1021	1120	3495
63	3117.25	1203	1054	1157	3608
64	3216.99	1241	1088	1194	3724
65	3318.31	0.01280	0.01122	0.01231	0.003841
66	3421.19	1320	1157	1270	3960
67	3525.65	1360	1192	1308	4081
68	3631.68	1401	1228	1348	4204
69	3739.28	1443	1264	1388	4328
70	3848.45	0.01485	0.01302	0.01429	0.004456
71	3959.19	1528	1339	1469	4583
72	4071.50	1571	1377	1511	4713
73	4185.39	1615	1415	1553	4845
74	4300.84	1660	1454	1596	4978
75	4417.86	0.01705	0.01494	0.01639	0.005114
76	4536.46	1751	1534	1684	5251
77	4656.63	1797	1575	1728	5390
78	4778.36	1844	1616	1773	5531
79	4901.67	1892	1658	1819	5674
80	5026.55	0.01939	0.01700	0.01865	0.005818
81	5153.00	1988	1743	1912	5965
82	5281.02	2038	1786	1960	6113
83	5410.61	2088	1830	2008	6263
84	5541.77	2138	1874	2057	6415
85	5674.50	0.02189	0.01919	0.02106	0.006568
86	5808.80	2241	1964	2156	6724
87	5944.68	2294	2010	2206	6881
88	6082.12	2347	2057	2257	7040
89	6221.14	2400	2104	2309	7201
90	6361.73	0.02455	0.02151	0.02360	0.007364
91	6503.88	2509	2199	2414	7528
92	6647.61	2565	2248	2467	7695
93	6792.91	2621	2297	2521	7863
94	6939.78	2678	2347	2575	8033
95	7088.22	0.02735	0.02397	0.02630	0.008205
96	7238.23	2793	2448	2686	8378
97	7389.81	2851	2499	2742	8554
98	7542.96	2910	2551	2799	8731
99	7697.69	2970	2603	2857	8910
100	7853.98	0.03030	0.02656	0.02915	0.009091

CROSS-SECTION AND MASS OF WIRES (Continued)

Metric Measure

Diameters are given in thousandths of a centimeter and area of section in square thousandths of a centimeter. 1 (cm/1000)² = .000001 sq. cm For sections and masses for diameters 1/10 or 10 times those of the table, divide or multiply by 100.

Diam. in thousandths of a cm	Cross-section in square thousandths of a cm	Grams per meter			
		Copper, density 8.90	Iron, density 7.80	Brass, density 8.56	Aluminum, density 2.67
10	78.54	0.06990	0.06126	0.06723	0.02097
11	95.03	.08458	.07412	.08135	.02537
12	113.10	.10065	.08822	.09681	.03020
13	132.73	.11813	.10353	.11362	.03544
14	153.94	.13701	.12008	.13177	.04110
15	176.71	0.1573	0.1378	0.1513	0.04718
16	201.06	.1789	.1568	.1721	.05368
17	226.98	.2020	.1770	.1943	.06060
18	254.47	.2265	.1985	.2178	.06794
19	283.53	.2523	.2212	.2427	.07570
20	314.16	0.2796	0.2450	0.2689	0.08388
21	346.36	.3083	.2702	.2965	.09248
22	380.13	.3383	.2965	.3254	.10149
23	415.48	.3698	.3241	.3557	.11093
24	452.39	.4026	.3529	.3872	.12079
25	490.87	0.4369	0.3829	0.4202	0.1311
26	530.93	.4725	.4141	.4545	.1418
27	572.56	.5096	.4466	.4901	.1529
28	615.75	.5480	.4803	.5271	.1644
29	660.52	.5879	.5152	.5654	.1764
30	706.86	0.6291	0.5514	0.6051	0.1887
31	754.77	.6717	.5887	.6461	.2015
32	804.25	.7158	.6273	.6884	.2147
33	855.30	.7612	.6671	.7321	.2284
34	907.92	.8081	.7082	.7772	.2424
35	962.11	0.856	0.7504	0.8236	0.2569
36	1017.88	.906	.7939	.8713	.2718
37	1075.21	.957	.8387	.9204	.2871
38	1134.11	1.012	.8866	.9730	.3035
39	1194.59	.063	.9318	1.0230	.3190
40	1256.64	1.118	0.980	1.076	0.3355
41	1320.25	.175	1.030	.130	.3525
42	1385.44	.233	.081	.186	.3699
43	1452.20	.292	.133	.243	.3877
44	1520.53	.353	.186	.302	.4060
45	1590.43	1.415	1.241	1.361	0.4246
46	1661.90	.479	.296	.423	.4437
47	1734.94	.544	.353	.485	.4632
48	1809.56	.611	.411	.549	.4832
49	1885.74	.678	.471	.614	.5035
50	1963.50	1.748	1.532	1.681	.5243
51	2042.82	.818	.593	.753	.5454
52	2123.72	.890	.657	.818	.5670
53	2206.18	.964	.721	.888	.5891
54	2290.22	2.038	.786	.960	.6115

CROSS-SECTION AND MASS OF WIRES (Continued)

Metric Measure (Continued)

Diameters are given in thousandths of a centimeter and area of section in square thousandths of a centimeter. 1 (cm/1000)^2 = .000001 sq. cm. For sections and masses for diameters 1/10 or 10 times those of the table, divide or multiply by 100.

Diam. in thousandths of a cm	Cross-section in square thousandths of a cm	Grams per meter			
		Copper, density 8.90	Iron, density 7.80	Brass, density 8.56	Aluminum, density 2.67
55	2375.83	2.114	1.853	2.034	0.6343
56	2463.01	.192	.921	.108	.6576
57	2551.76	.271	.990	.184	.6813
58	2642.08	.351	2.061	.262	.7054
59	2733.97	.433	.132	.340	.7300
60	2827.43	2.516	2.205	2.420	0.7549
61	2922.47	.601	.280	.502	.7803
62	3019.07	.687	.355	.584	.8061
63	3117.25	.774	.431	.668	.8323
64	3216.99	.863	.509	.760	.8589
65	3318.31	2.953	2.588	2.840	0.8860
66	3421.19	3.045	.669	.929	.9135
67	3525.65	.138	.750	3.018	.9413
68	3631.68	.232	.833	.109	.9697
69	3739.28	.328	.917	.201	.9984
70	3848.45	3.426	3.003	3.295	1.028
71	3959.19	.524	.088	.389	.057
72	4071.50	.624	.176	.485	.087
73	4185.39	.725	.265	.583	.117
74	4300.84	.828	.355	.682	.148
75	4417.86	3.932	3.446	3.782	1.180
76	4536.46	4.037	.538	.883	.211
77	4656.63	.144	.632	.986	.243
78	4778.36	.253	.727	4.090	.276
79	4901.67	.362	.823	.177	.309
80	5026.55	4.474	3.921	4.303	1.342
81	5153.00	.586	4.019	.411	.376
82	5281.02	.700	.119	.521	.410
83	5410.61	.815	.220	.631	.445
84	5541.77	.932	.323	.744	.480
85	5674.50	5.050	4.426	4.857	1.515
86	5808.80	.170	.531	.972	.551
87	5944.68	.291	.637	5.089	.587
88	6082.12	.413	.744	.206	.624
89	6221.14	.537	.852	.325	.661
90	6361.73	5.662	4.962	5.446	1.699
91	6503.88	.788	5.073	.567	.737
92	6647.61	.916	.185	.690	.775
93	6792.91	6.046	.298	.815	.814
94	6939.78	.176	.413	.940	.853
95	7088.22	6.309	5.529	6.068	1.893
96	7238.23	.442	.646	.196	.933
97	7389.81	.577	.764	.326	.973
98	7542.96	.713	.884	.457	2.014
99	7697.69	.851	6.004	.589	.055
100	7853.98	6.990	6.126	6.723	2.097

RESISTANCE OF WIRES

The following table gives the approximate resistance of various metallic conductors. The values have been computed from the resistivities at 20°C, except as otherwise stated, and for the dimensions of wire indicated. Owing to differences in purity in the case of elements and of composition in alloys, the values can be considered only as approximations.

The following dimensions have been adopted in the computations.

B. & S. gauge	Diameter mm	Diameter mils 1 mil = .001 in.	B. & S. gauge	Diameter mm	Diameter mils 1 mil = .001 in.
10	2.588	101.9	26	0.4049	15.94
12	2.053	80.81	27	0.3606	14.20
14	1.628	64.08	28	0.3211	12.64
16	1.291	50.82	30	0.2546	10.03
18	1.024	40.30	32	0.2019	7.950
20	0.8118	31.96	34	0.1601	6.305
22	0.6438	25.35	36	0.1270	5.000
24	0.5106	20.10	40	0.07987	3.145

B. & S. No.	Ohms per cm	Ohms per ft.	B. & S. No.	Ohms per cm	Ohms per ft.
*Advance (0°C) $\rho = 48. \times 10^{-6}$ ohm cm			Aluminum $\rho = 2.828 \times 10^{-6}$ ohm cm		
10	.000912	.0278	10	.0000538	.00164
12	.00145	.0442	12	.0000855	.00260
14	.00231	.0703	14	.000136	.00414
16	.00367	.112	16	.000216	.00658
18	.00583	.178	18	.000344	.0105
20	.00927	.283	20	.000546	.0167
22	.0147	.449	22	.000869	.0265
24	.0234	.715	24	.00138	.0421
26	.0373	1.14	26	.00220	.0669
27	.0470	1.43	27	.00277	.0844
28	.0593	1.81	28	.00349	.106
30	.0942	2.87	30	.00555	.169
32	.150	4.57	32	.00883	.269
34	.238	7.26	34	.0140	.428
36	.379	11.5	36	.0223	.680
40	.958	29.2	40	.0564	1.72

* Trade mark.

RESISTANCE OF WIRES (Continued)

B. & S. No.	Ohms per cm	Ohms per ft.	B. & S. No.	Ohms per cm	Ohms per ft.
Brass $\rho = 7.00 \times 10^{-6}$ ohm cm			Climax $\rho = 87. \times 10^{-6}$ ohm cm		
10	.000133	.00406	10	.00165	.0504
12	.000212	.00645	12	.00263	.0801
14	.000336	.0103	14	.00418	.127
16	.000535	.0163	16	.00665	.203
18	.000850	.0259	18	.0106	.322
20	.00135	.0412	20	.0168	.512
22	.00215	.0655	22	.0267	.815
24	.00342	.104	24	.0425	1.30
26	.00543	.166	26	.0675	2.06
27	.00686	.209	27	.0852	2.60
28	.00864	.263	28	.107	3.27
30	.0137	.419	30	.171	5.21
32	.0219	.666	32	.272	8.28
34	.0348	1.06	34	.432	13.2
36	.0552	1.68	36	.687	20.9
40	.140	4.26	40	1.74	52.9
Constantan (0°C) $\rho = 44.1 \times 10^{-6}$ ohm cm			Copper, annealed $\rho = 1.724 \times 10^{-6}$ ohm cm		
10	.000838	.0255	10	.0000328	.000999
12	.00133	.0406	12	.0000521	.00159
14	.00212	.0646	14	.0000828	.00253
16	.00337	.103	16	.000132	.00401
18	.00536	.163	18	.000209	.00638
20	.00852	.260	20	.000333	.0102
22	.0135	.413	22	.000530	.0161
24	.0215	.657	24	.000842	.0257
26	.0342	1.04	26	.00134	.0408
27	.0432	1.32	27	.00169	.0515
28	.0545	1.66	28	.00213	.0649
30	.0866	2.64	30	.00339	.103
32	.138	4.20	32	.00538	.164
34	.219	6.67	34	.00856	.261
36	.348	10.6	36	.0136	.415
40	.880	26.8	40	.0344	1.05
Eureka (0°C) $\rho = 47. \times 10^{-6}$ ohm cm			Excello $\rho = 92. \times 10^{-6}$ ohm cm		
10	.000893	.0272	10	.00175	.0533
12	.00142	.0433	12	.00278	.0847
14	.00226	.0688	14	.00442	.135
16	.00359	.109	16	.00703	.214
18	.00571	.174	18	.0112	.341
20	.00908	.277	20	.0178	.542
22	.0144	.440	22	.0283	.861
24	.0230	.700	24	.0449	1.37
26	.0365	1.11	26	.0714	2.18
27	.0460	1.40	27	.0901	2.75
28	.0580	1.77	28	.114	3.46
30	.0923	2.81	30	.181	5.51
32	.147	4.47	32	.287	8.75
34	.233	7.11	34	.457	13.9
36	.371	11.3	36	.726	22.1
40	.938	28.6	40	1.84	56.0

RESISTANCE OF WIRES (Continued)

B. & S. No	Ohms per cm	Ohms per ft.	B. & S. No.	Ohms per cm	Ohms per ft.
German silver $\rho = 33. \times 10^{-6}$ ohm cm			Gold $\rho = 2.44 \times 10^{-6}$ ohm cm		
10	.000627	.0191	10	.0000464	.00141
12	.000997	.0304	12	.0000737	.00225
14	.00159	.0483	14	.000117	.00357
16	.00252	.0768	16	.000186	.00568
18	.00401	.122	18	.000296	.00904
20	.00638	.194	20	.000471	.0144
22	.0101	.309	22	.000750	.0228
24	.0161	.491	24	.00119	.0363
26	.0256	.781	26	.00189	.0577
27	.0323	.985	27	.00239	.0728
28	.0408	1.24	28	.00301	.0918
30	.0648	1.97	30	.00479	.146
32	.103	3.14	32	.00762	.232
34	.164	4.99	34	.0121	.369
36	.260	7.94	36	.0193	.587
40	.659	20.1	40	.0487	1.48
Iron $\rho = 10. \times 10^{-6}$ ohm cm			Lead $\rho = 22. \times 10^{-6}$ ohm cm		
10	.000190	.00579	10	.000418	.0127
12	.000302	.00921	12	.000665	.0203
14	.000481	.0146	14	.00106	.0322
16	.000764	.0233	16	.00168	.0512
18	.00121	.0370	18	.00267	.0815
20	.00193	.0589	20	.00425	.130
22	.00307	.0936	22	.00676	.206
24	.00489	.149	24	.0107	.328
26	.00776	.237	26	.0171	.521
27	.00979	.299	27	.0215	.657
28	.0123	.376	28	.0272	.828
30	.0196	.598	30	.0432	1.32
32	.0312	.952	32	.0687	2.09
34	.0497	1.51	34	.109	3.33
36	.0789	2.41	36	.174	5.29
40	.200	6.08	40	.439	13.4
Magnesium $\rho = 4.6 \times 10^{-6}$ ohm cm			Manganin $\rho = 44. \times 10^{-6}$ ohm cm		
10	.0000874	.00267	10	.000836	.0255
12	.000139	.00424	12	.00133	.0405
14	.000221	.00674	14	.00211	.0644
16	.000351	.0107	16	.00336	.102
18	.000559	.0170	18	.00535	.163
20	.000889	.0271	20	.00850	.259
22	.00141	.0431	22	.0135	.412
24	.00225	.0685	24	.0215	.655
26	.00357	.109	26	.0342	1.04
27	.00451	.137	27	.0431	1.31
28	.00568	.173	28	.0543	1.66
30	.00903	.275	30	.0864	2.63
32	.0144	.438	32	.137	4.19
34	.0228	.696	34	.218	6.66
36	.0363	1.11	36	.347	10.6
40	.0918	2.80	40	.878	26.8

RESISTANCE OF WIRES (Continued)

B. & S. No.	Ohms per cm	Ohms per ft.
Molybdenum $\rho = 5.7 \times 10^{-6}$ ohm cm		
10	.000108	.00330
12	.000172	.00525
14	.000274	.00835
16	.000435	.0133
18	.000693	.0211
20	.00110	.0336
22	.00175	.0534
24	.00278	.0849
26	.00443	.135
27	.00558	.170
28	.00704	.215
30	.0112	.341
32	.0178	.542
34	.0283	.863
36	.0450	1.37
40	.114	3.47
*Nichrome $\rho = 150. \times 10^{-6}$ ohm cm		
10	.0021281	.06488
12	.0033751	.1029
14	.0054054	.1648
16	.0085116	.2595
18	.0138383	.4219
20	.0262176	.6592
22	.0346040	1.055
24	.0548088	1.671
26	.0875760	2.670
28	.1394328	4.251
30	.2214000	6.750
32	.346040	10.55
34	.557600	17.00
36	.885600	27.00
38	1.383832	42.19
40	2.303872	70.24
Platinum $\rho = 10. \times 10^{-6}$ ohm cm		
10	.000190	.00579
12	.000302	.00921
14	.000481	.0146
16	.000764	.0233
18	.00121	.0370
20	.00193	.0589
22	.00307	.0936
24	.00489	.149
26	.00776	.237
27	.00979	.299
28	.0123	.376
30	.0196	.598
32	.0312	.952
34	.0497	1.51
36	.0789	2.41
40	.200	6.08

B. & S. No.	Ohms per cm	Ohms per ft.
Monel Metal $\rho = 42. \times 10^{-6}$ ohm cm		
10	.000798	.0243
12	.00127	.0387
14	.00202	.0615
16	.00321	.0978
18	.00510	.156
20	.00811	.247
22	.0129	.393
24	.0205	.625
26	.0326	.994
27	.0411	1.25
28	.0519	1.58
30	.0825	2.51
32	.131	4.00
34	.209	6.36
36	.331	10.1
40	.838	25.6
Nickel $\rho = 7.8 \times 10^{-6}$ ohm cm		
10	.000148	.00452
12	.000236	.00718
14	.000375	.0114
16	.000596	.0182
18	.000948	.0289
20	.00151	.0459
22	.00240	.0730
24	.00381	.116
26	.00606	.185
27	.00764	.233
28	.00963	.294
30	.0153	.467
32	.0244	.742
34	.0387	1.18
36	.0616	1.88
40	.156	4.75
Silver (18°C) $\rho = 1.629 \times 10^{-6}$ ohm cm		
10	.0000310	.000944
12	.0000492	.00150
14	.0000783	.00239
16	.000124	.00379
18	.000198	.00603
20	.000315	.00959
22	.000500	.0153
24	.000796	.0243
26	.00126	.0386
27	.00160	.0486
28	.00201	.0613
30	.00320	.0975
32	.00509	.155
34	.00809	.247
36	.0129	.392
40	.0325	.991

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* Trade mark.

RESISTANCE OF WIRES (Continued)

B. & S. No.	Ohms per cm	Ohms per ft.	B. & S. No.	Ohms per cm	Ohms per ft.
Steel, piano wire (0°C) $\rho = 11.8 \times 10^{-6}$ ohm cm			Steel, invar (35 % Ni) $\rho = 81. \times 10^{-6}$ ohm cm		
10	.000224	.00684	10	.00154	.0469
12	.000357	.0109	12	.00245	.0746
14	.000567	.0173	14	.00389	.119
16	.000901	.0275	16	.00619	.189
18	.00143	.0437	18	.00984	.300
20	.00228	.0695	20	.0156	.477
22	.00363	.110	22	.0249	.758
24	.00576	.176	24	.0396	1.21
26	.00916	.279	26	.0629	1.92
27	.0116	.352	27	.0793	2.42
28	.0146	.444	28	.100	3.05
30	.0232	.706	30	.159	4.85
32	.0368	1.12	32	.253	7.71
34	.0586	1.79	34	.402	12.3
36	.0931	2.84	36	.639	19.5
40	.236	7.18	40	1.62	49.3
Tantalum $\rho = 15.5 \times 10^{-6}$ ohm cm			Tin $\rho = 11.5 \times 10^{-6}$ ohm cm		
10	.000295	.00898	10	.000219	.00666
12	.000468	.0143	12	.000348	.0106
14	.000745	.0227	14	.000553	.0168
16	.00118	.0361	16	.000879	.0268
18	.00188	.0574	18	.00140	.0426
20	.00299	.0913	20	.00222	.0677
22	.00476	.145	22	.00353	.108
24	.00757	.231	24	.00562	.171
26	.0120	.367	26	.00893	.272
27	.0152	.463	27	.0113	.343
28	.0191	.583	28	.0142	.433
30	.0304	.928	30	.0226	.688
32	.0484	1.47	32	.0359	1.09
34	.0770	2.35	34	.0571	1.74
36	.122	3.73	36	.0908	2.77
40	.309	9.43	40	.230	7.00
Tungsten $\rho = 5.51 \times 10^{-6}$ ohm cm			Zinc (0°C) $\rho = 5.75 \times 10^{-6}$ ohm cm		
10	.000105	.00319	10	.000109	.00333
12	.000167	.00508	12	.000174	.00530
14	.000265	.00807	14	.000276	.00842
16	.000421	.0128	16	.000439	.0134
18	.000669	.0204	18	.000699	.0213
20	.00106	.0324	20	.00111	.0339
22	.00169	.0516	22	.00177	.0538
24	.00269	.0820	24	.00281	.0856
26	.00428	.130	26	.00446	.136
27	.00540	.164	27	.00563	.172
28	.00680	.207	28	.00710	.216
30	.0108	.330	30	.0113	.344
32	.0172	.524	32	.0180	.547
34	.0274	.834	34	.0286	.870
36	.0435	1.33	36	.0454	1.38
40	.110	3.35	40	.115	3.50

FUSING CURRENTS FOR WIRES

Owing to the influence of various factors which control the rate of loss of heat energy the following values can be considered only as approximations.

Gauge No. A.W.G.	Diameter inches	Fusing current in amp.			
		Cu	Al	Fe	Fuse wire
43	0.0021	1	...	...	.....
41	.0026	...	1	...	.....
39	.0035	2	...	...	.....
38	.0040	...	2	...	.....
37	.0045	3	...	1	.....
35	.0056	4	3	...	.....
34	.0063	5	4	...	.....
33	.0071	...	...	2	.....
32	.0080	...	5	...	.....
30	.0100	10	...	3	1.7
28	.0126	15	10	...	.....
27	.0142	...	...	5	.....
26	.0159	20	15	...	.....
25	.0179	25	...	...	.....
24	.0201	30	20	10	4.9
23	.0226	35	25	...	.....
22	.0253	40	30	...	.....
21	.0285	45	35	15	.....
20	.032	60	40	...	9.0
19	.036	70	50	20	11.3
18	.040	80	60	25	13.3
17	.045	100	70	30	.....
16	.051	120	90	35	19.8
15	.057	140	100	45	.....
14	.064	160	120	50	25.4
13	.072	200	160	60	32
12	.081	225	180	70	39.1
11	.091	275	200	90	.....
10	.102	....	225	100	54.1
9	.114	....	275	120	63.1
8	.128	...	...	140	81.1
7	.144	...	...	160	90.6
6	.162	...	...	200	110.7
5	.182	...	...	225	132.1
4	.204	...	...	275	154.7

FUNDAMENTAL DATA RELATING TO SIEVES OF THE STANDARD SCREEN SCALE

From Catalogue No. 53 (1952 edition) of The W. S. Tyler Company, by permission

U. S. STANDARD SIEVE SERIES (1940)

NOMINAL DIMENSIONS, PERMISSIBLE VARIATIONS AND LIMITS FOR WOVEN WIRE CLOTH OF STANDARD SIEVES

(1)	(2) Sieve Openings	(3)	(4)	(5)	(6) Wire Diameter	(7)
Size in Inches Designation	Millimeters	Inches (Approximate Equivalent)	Permissible Variation in Average Opening, Per Cent	Permissible Variation in Maximum Opening,[a] Per Cent	Millimeters	Inches (Approximate Equivalent)
		COARSE SERIFS				
(4.24inch)**	107.6	4.24	±2	+3	5.6 to 9.7	0.220 to .380
4 -inch	101.6	4.00	±2	+3	5.6 to 9.7	.220 to .380
$3\frac{1}{2}$-inch	88.9	3.50	±2	+3	5.3 to 9.3	.210 to .365
3 -inch	76.2	3.00	±2	+3	4.8 to 8.1	.190 to .320
$2\frac{1}{2}$-inch	63.5	2.50	±2	+3	4.4 to 7.1	.175 to .280
(2.12inch)**	53.8	2.12	±2	+3	4.1 to 6.2	.160 to .245
2 -inch	50.8	2.00	±2	+3	4.1 to 6.2	.160 to .245
$1\frac{3}{4}$-inch	44.4	1.75	±2	+3	3.8 to 5.7	.150 to .225
$1\frac{1}{2}$-inch	38.1	1.50	±2	+3	3.7 to 5.3	.145 to .210
$1\frac{1}{4}$-inch	31.7	1.25	±2	+3	3.5 to 4.8	.140 to .190
(1.06inch)**	26.9	1.06	±3	+5	3.43 to 4.50	.135 to .177
1 -inch	25.4	1.00	±3	+5	3.43 to 4.50	.135 to .177
$\frac{7}{8}$-inch	22.2	.875	±3	+5	3.23 to 4.22	.127 to .166
$\frac{3}{4}$-inch	19.1	.750	±3	+5	3.10 to 3.91	.122 to .154
$\frac{5}{8}$-inch	15.9	.625	±3	+5	2.74 to 3.43	.108 to .135
(0.530inch)**	13.4	.530	±3	+5	2.39 to 3.10	.094 to .122
$\frac{1}{2}$-inch	12.7	.500	±3	+5	2.39 to 3.10	.094 to .122
$\frac{7}{16}$-inch	11.1	.438	±3	+5	2.23 to 2.84	.088 to .112
$\frac{3}{8}$-inch	9.52	.375	±3	+5	2.11 to 2.59	.083 to .102
$\frac{5}{16}$-inch	7.93	.312	±3	+5	1.85 to 2.36	.073 to .093
(0.265inch)**	6.73	.265	±3	+5	1.60 to 2.11	.063 to .083
$\frac{1}{4}$-inch (No. 3)	6.35	.250	±3	+5	1.60 to 2.11	.063 to .083

** The five sieves marked in the first column with a double asterisk (**) may be used instead of the 4-inch, 2-inch, 1-inch, $\frac{1}{2}$-inch, and $\frac{1}{4}$-inch sieves when it is desired to have a series of sieves nesting with the Fine Series and continuing that series with the $\sqrt{2}:1$ ratio. All of the other sieves listed above are in a $\sqrt[4]{2}:1$ ratio with the Fine Series within the limit of the specified permissible variations. Care should be taken in designating the five sieves marked with the double asterisk; they should not be designated as 4-inch, 2-inch, 1-inch, $\frac{1}{2}$-inch, and $\frac{1}{4}$-inch, but as 4.24-inch, 2.12-inch, 1.06-inch, 0.530-inch and 0.265-inch (or by the manufacturer's nominal values, e.g. for the last three, 1.050-inch, 0.525-inch, and 0.263-inch).

DATA FOR SIEVES (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
		FINE SERIES				
5660 micron (No. 3½)	5.66	0.223	±3	+10	1.28 to 1.90	0.050 to 0.075
4760 micron (No. 4)	4.76	.187	±3	+10	1.14 to 1.68	.045 to .066
4000 micron (No. 5)	4.00	.157	±3	+10	1.00 to 1.47	.039 to .058
3360 micron (No. 6)	3.36	.132	±3	+10	.87 to 1.32	.034 to .052
2830 micron (No. 7)	2.83	.111	±3	+10	.80 to 1.20	.031 to .047
2380 micron (No. 8)	2.38	.0937	±3	+10	.74 to 1.10	.0291 to .0433
2000 micron (No. 10)	2.00	.0787	±3	+10	.68 to 1.00	.0268 to .0394
1680 micron (No. 12)	1.68	.0661	±3	+10	.62 to .90	.0244 to .0354
1410 micron (No. 14)	1.41	.0555	±3	+10	.56 to .80	.0220 to .0315
1190 micron (No. 16)	1.19	.0469	±3	+10	.50 to .70	.0197 to .0276
1000 micron (No. 18)	1.00	.0394	±5	+15[a]	.43 to .62	.0169 to .0244
840 micron (No. 20)	.84	.0331	±5	+15[a]	.38 to .55	.0150 to .0217
710 micron (No. 25)	.71	.0280	±5	+15[a]	.33 to .48	.0130 to .0189
590 micron (No. 30)	.59	.0232	±5	+15[a]	.29 to .42	.0114 to .0165
500 micron (No. 35)	.50	.0197	±5	+15[a]	.26 to .37	.0102 to .0146
420 micron (No. 40)	.42	.0165	±5	+25[a]	.23 to .33	.0091 to .0130
350 micron (No. 45)	.35	.0138	±5	+25[a]	.20 to .29	.0079 to .0114
297 micron (No. 50)	.297	.0117	±5	+25[a]	.170 to .253	.0067 to .0100
250 micron (No. 60)	.250	.0098	±5	+25[a]	.149 to .220	.0059 to .0087
210 micron (No. 70)	.210	.0083	±5	+25[a]	.130 to .187	.0051 to .0074
177 micron (No. 80)	.177	.0070	±6	+40[a]	.114 to .154	.0045 to .0061
149 micron (No. 100)	.149	.0059	±6	+40[a]	.096 to .125	.0038 to .0049
125 micron (No. 120)	.125	.0049	±6	+40[a]	.079 to .103	.0031 to .0041
105 micron (No. 140)	.105	.0041	±6	+40[a]	.063 to .087	.0025 to .0034
88 micron (No. 170)	.088	.0035	±6	+40[a]	.054 to .073	.0021 to .0029
74 micron (No. 200)	.074	.0029	±7	+60[a]	.045 to .061	.0018 to .0024
62 micron (No. 230)	.062	.0024	±7	+90[a]	.039 to .052	.0015 to .0020
53 micron (No. 270)	.053	.0021	±7	+90[a]	.035 to .046	.0014 to .0018
44 micron (No. 325)	.044	.0017	±7	+90[a]	.031 to .040	.0012 to .0016
37 micron (No. 400)	.037	.0015	±7	+90[a]	.023 to .035	.0009 to .0014

[a] Note: For sieves from the 1000 micron (No. 18) to the 37 micron (No. 400) size, inclusive, not more than 5% of the opening shall exceed the nominal opening by more than one-half of the permissible variations in maximum opening.

These sieve series will meet the specifications of the National Bureau of Standards LC-584.

American Society for Testing Materials E11-39.

American Standards Association Z 23, 1-1939.

American Association of State Highway Officials T-27.

Federal Specification RR-S-366a 4-29-42.

TYLER STANDARD SCREEN SCALE SIEVES

In the following table the Tyler Standard Screen Scale Sieves Series has been expanded to include intermediate sieves for closer sizing which gives a ratio of the fourth root of two or 1.189 between openings in successive sieves.

Tyler Standard Screen Scale Sieves and U. S. Sieves can be used interchangeably.

Tyler Standard Screen Scale $\sqrt{2}$ Opening in Inches	For Closer Sizing Ratio $\sqrt[4]{2}$ Opening in Inches	Mesh	Diameter of Wire, Decimal of an Inch	U. S. Series Equivalents (Fine Series)	
				MICRON Designation	Number
3	....	....	.207	....	....
2	....	....	.192	....	....
1.5	....	....	.162	....	....
1.050	1.050	....	.148	....	....
....	.883	....	.135	....	....
.742	.742	....	.135	....	....
....	.624	....	.120	....	....
.525	.525	....	.105	....	....
....	.441	....	.105	....	....
.371	.371	....	.092	....	....
....	.312	2½	.088	....	....
.263	.263	3	.070	....	....
....	.221	3½	.065	5660	3½
.185	.185	4	.065	4760	4
....	.156	5	.044	4000	5
.131	.131	6	.036	3360	6
....	.110	7	.0328	2830	7
.093	.093	8	.032	2380	8
....	.078	9	.033	2000	10
.065	.065	10	.035	1680	12
....	.055	12	.028	1410	14
.046	.046	14	.025	1190	16
....	.0390	16	.0235	1000	18
.0328	.0328	20	.0172	840	20
....	.0276	24	.0141	710	25
.0232	.0232	28	.0125	590	30
....	.0195	32	.0118	500	35
.0164	.0164	35	.0122	420	40
....	.0138	42	.0100	350	45
.0116	.0116	48	.0092	297	50
....	.0097	60	.0070	250	60
.0082	.0082	65	.0072	210	70
....	.0069	80	.0056	177	80
.0058	.0058	100	.0042	149	100
....	.0049	115	.0038	125	120
.0041	.0041	150	.0026	105	140
....	.0035	170	.0024	88	170
.0029	.0029	200	.0021	74	200
....	.0024	250	.0016	62	230
.0021	.0021	270	.0016	53	270
....	.0017	325	.0014	44	325
.0015	.0015	400	.001	37	400

COMPARISON TABLE OF U. S., BRITISH, AND GERMAN SIEVE SERIES WITH TYLER EQUIVALENTS

TYLER (1)	U. S. (2)		BRITISH STANDARD (3)		I. M. M. (4)		GERMAN DIN (5)		
Equiv. Mesh	Mesh No.	Opg. Mm.	Mesh No.	Opg. Mm.	Mesh No.	Opg. Mm.	Din. No.	Mesh per Sq. cm.	Opg. Mm.
3½	3½	5.66	....	....	....	....	1	1	6.000
4	4	4.76	....	....	....	....	....	....	....
5	5	4.00	....	....	....	....	....	....	....
6	6	3.36	5	3.353	....	....	2	4	3.000
7	7	2.83	6	2.812	....	....	....	....	....
......	....	....	....	....	5	2.540	....	....	....
8	8	2.38	7	2.411	....	....	2½	6.25	2.400
9	10	2.00	8	2.057	....	....	3	9	2.000
10	12	1.68	10	1.676	....	....	4	16	1.500
......	....	....	....	....	8	1.600	....	....	....
12	14	1.41	12	1.405	....	....	....	....	....
......	....	....	....	....	10	1.270	....	....	....
14	16	1.19	14	1.204	....	....	5	25	1.200
......	....	....	....	....	12	1.059	....	....	....
16	18	1.00	16	1.003	....	....	6	36	1.020
20	20	.84	18	.853	....	....	....	....	....
......	....	....	....	....	16	.795	8	64	.750
24	25	.71	22	.699	....	....	....	....	....
......	....	....	....	....	20	.635	....	....	....
28	30	.59	25	.599	....	....	10	100	.600
......	....	....	....	....	....	....	11	121	.540
32	35	.50	30	.500	....	....	12	144	.490
35	40	.42	36	.422	30	.424	14	196	.430
42	45	.35	44	.353	....	....	16	256	.385
......	....	....	....	....	40	.317	....	....	....
48	50	.297	52	.295	....	....	20	400	.300
60	60	.250	60	.251	50	.254	24	576	.250
65	70	.210	72	.211	60	.211	30	900	.200
80	80	.177	85	.178	70	.180	....	....	....
100	100	.149	100	.152	80	.160	40	1600	.150
......	....	....	....	....	90	.139	....	....	....
115	120	.125	120	.124	100	.127	50	2500	.120
150	140	.105	150	.104	120	.104	60	3600	.102
170	170	.088	170	.089	....	....	70	4900	.088
......	....	....	....	....	150	.084	....	....	....
200	200	.074	200	.076	....	....	80	6400	.075
250	230	.062	240	.066	200	.063	100	10000	.060
270	270	.053	300	.053	....	....	....	....	....
325	325	.044	....	....	....	....	....	....	....
400	400	.037	....	....	....	....	....	....	....

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION

Station		Latitude °	Latitude ′	Longitude °	Longitude ′	Elevation, meters	g cm/sec²
UNITED STATES							
Alaska	Fort Egbert, Eagle City	64	47.4	141	12.4	269	982.183
	Percy Islands, S. E. Alaska	54	55.8	131	35.3	4	981.524
	Point Young, S. E. Alaska	58	11.5	134	33.4	7	981.757
	Quiet Harbor, S. E. Alaska	56	14.1	132	39.6	4	981.624
	St. Michael	63	28.5	162	2.4	1	982.192
	St. Paul Island	57	7.3	170	16.6	10	981.726
Arizona	Yavapai	36	3.9	112	7.1	2179	979.192
Arkansas	Little Rock	34	45.0	92	16.4	89	979.721
California	Mount Hamilton	37	20.4	121	38.6	1282	979.660
	San Francisco	37	47.5	122	25.7	114	979.965
Colorado	Colorado Springs	38	50.7	104	49.0	1841	979.490
	Denver	39	40.6	104	56.9	1638	979.609
Connecticut	Hartford	41	44.8	72	41.8	37	980.336
Delaware	Dover	39	9.7	75	32.0	12	980.099
District of Columbia	Washington B.S.	38	56.3	77	4.0	103	980.095
	Washington U.S.C. and G.S.	38	53.2	77	0.5	14	980.112
Florida	Apalachicola	29	43.5	84	58.8	4	979.322
	Key West	24	33.6	81	48.4	1	978.970
Georgia	Atlanta	33	45.0	84	23.3	324	979.524
Idaho	Boise	43	37.2	116	12.3	821	980.212
	Sandpoint	48	16.4	116	33.3	637	980.680
Illinois	Chicago	41	47.4	87	36.1	182	980.278
	Springfield	39	47.7	89	39.5	183	980.089
Indiana	Indianapolis	39	45.9	86	8.8	217	980.090
	Terre Haute	39	28.7	87	23.8	151	980.072
Louisiana	New Orleans	29	57.0	90	4.2	2	979.324
Maine	Calais	45	11.2	67	16.9	38	980.631
Maryland	Baltimore	39	17.8	76	37.3	30	980.097
Massachusetts	Cambridge	42	22.8	71	7.8	14	980.398
	Worcester	42	16.5	71	48.5	170	980.324
Minnesota	Minneapolis	44	58.7	93	13.9	256	980.597
Missouri	Kansas City	39	5.8	94	35.4	278	979.990
	St. Louis	38	38.0	90	12.2	154	980.001

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Cont.)

Station		Latitude		Longitude		Elevation, meters	g cm/sec²
		°	′	°	′		
UNITED STATES (Continued)							
Montana	Hinsdale	48	23.8	107	5.3	661	980.739
Nevada	Goldfield	37	42.2	117	14.5	1716	979.456
New Hampshire	Lancaster	44	29.5	71	34.3	261	980.486
New Jersey	Hoboken	40	44	74	2	11	980.269
	Princeton	40	21.0	74	39.5	64	980.178
New Mexico	Las Vegas	35	35.8	105	12.1	1960	979.204
New York	Albany	42	39.1	73	46.1	61	980.344
	Ithaca	42	27.1	76	29.0	247	980.300
	New York	40	48.5	73	57.7	38	980.267
	Potsdam	44	40.1	74	58.8	130	980.571
North Carolina	Asheville	35	35.9	82	33.3	670	979.603
	Wilmington	34	14.2	77	56.6	9	979.663
North Dakota	Bismarck	46	48.5	100	47.0	516	980.625
	Pembina	48	58.1	97	14.9	243	980.917
Ohio	Cincinnati	39	8.3	84	25.3	245	980.004
	Cleveland	41	30.4	81	36.6	210	980.241
Oregon	Portland	45	31.4	122	40.7	8	980.646
Pennsylvania	Philadelphia	39	57.1	75	11.7	16	980.196
	Pittsburgh	40	27.4	80	0.6	235	980.118
	State College	40	47.9	77	51.8	358	980.124
South Carolina	Charleston	32	47.2	79	56.0	6	979.546
South Dakota	Pierre	44	21.9	100	20.8	454	980.427
Texas	Austin	30	17.2	97	44.2	189	979.283
	El Paso	31	46.3	106	29.0	1146	979.124
	Galveston	29	18.2	94	47.5	3	979.272
	Georgetown	30	38.0	97	40.1	231	979.298
	Point Isabel	26	4.7	97	12.4	8	979.076
Utah	Salt Lake City	40	46.1	111	53.8	1322	979.803
Virginia	Charlottesville	38	2.0	78	30.3	166	979.938
	Richmond	37	32.2	77	26.1	30	979.960
Washington	Seattle	47	39.6	122	18.3	58	980.733
West Virginia	Charleston	38	20.9	81	37.7	184	979.936
Wisconsin	Madison	43	4.6	89	24.0	270	980.365
Wyoming	Norris Geyser Basin	44	44.2	110	42.0	2276	979.950

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Cont.)

Station		Latitude		Longitude		Elevation, meters	g cm/sec²
		°	′	°	′		
CANADA							
Alberta	Banff	51	10.9	115	34.5	1376	980.753
	Calgary	51	2.7	114	3.8	1044	980.823
	Chipewyan	58	42.7	111	8.8	229	981.723
	Peace River	56	14.1	117	17.2	324	981.482
British Columbia	Liard River	59	58.7	123	47.5	160	981.790
	Revelstoke	50	59.8	118	11.8	453	980.903
	Vancouver	49	16.8	123	6.8	6	980.949
Manitoba	Winnipeg	49	54.4	97	8.0	231	980.990
New Brunswick	St. John	45	16.0	66	5.0	33	980.663
	Woodstock	46	9.0	67	34.5	56	980.699
Northwest Territory	Arctic Red River	67	26.6	133	44.2	41	982.434
	Good Hope	66	15.3	128	38.2	59	982.340
	Norman	64	54.0	125	34.2	87	982.214
	Providence	61	21.2	117	39.2	156	981.955
	Resolution	61	10.1	113	40.5	152	981.942
	Simpson	61	51.6	121	20.8	132	982.004
Nova Scotia	Halifax	44	40.8	63	33.8	9	980.574
	Sydney	46	8.4	60	11.8	12	980.731
Ontario	Kenora	49	46.0	94	30.0	330	980.974
	Kingston	44	14.6	76	28.8	79	980.530
	Ottawa	45	23.6	75	43.0	83	980.618
	Port Arthur	48	26.0	89	13.0	189	980.820
	Sault Ste. Marie	46	30.4	84	19.2	186	980.680
	Woodstock	43	8.6	80	47.0	299	980.352
Prince Edward Island	Charlottetown	46	13.9	63	7.5	8	980.733
Quebec	St. Jérôme	45	46.6	74	0.0	107	980.681
Saskatchewan	Moose Jaw	50	23.4	105	31.8	541	980.943

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Cont.)

Station		Latitude		Longitude		Elevation, meters	g cm/sec²
		°	′	°	′		
CENTRAL AND SOUTH AMERICA							
Argentina	Bahía Blanca	38	47.1S.	62	15.9	2	980.061
	Buenos Aires	34	36.5S.	58	22.2	2	979.669
Brazil	Bahia	12	58.5S.	38	31.0	4	978.331
Canal Zone	Panama	8	54.9	79	31.9	6	978.243
Chile	Valdivia	39	53.4S.	73	28.3	10	979.920
	Valparaiso	33	1.8S.	71	38.5	60	979.609
Peru	Callao	12	4.1S.	77	15.8	1	978.375
Salvador	Acajutla	13	34.7	89	50.4	12	978.303
Uruguay	Montevideo	34	54.5S.	56	12.9	4	979.772
EUROPE							
Austria	Vienna	48	12.7	16	21.5E.	183	980.860
Belgium	Brussels	50	51.0	4	22 E.	102	981.112
Denmark	Copenhagen	55	41.2	12	34.7E.	14	981.559
England	Greenwich	51	28.6	0	0.0	48	981.188
Finland	Helsinki	60	9.7	24	57.3E.	29	981.912
France	Paris	48	50.2	2	20.3E.	61	980.943
Germany	Königsberg	54	42.8	20	29.8E.	22	981.477
	Leipzig	51	20.1	12	23.5E.	115	981.180
	Munich	48	8.7	11	36.6E.	525	980.733
Hungary	Budapest	47	29.5	19	3.6E.	108	980.852
Italy	Milan	45	28.0	9	11.5E.	141	980.569
	Rome	41	53.5	12	29.7E.	49	980.367
Netherlands	Amsterdam	52	21.9	4	54.7E.	0	981.288
Norway	Bergen	60	23.9	5	18.3E.	38	981.922
Portugal	Lisbon	38	42.5	9	11.3	75	980.088
Roumania	Bucharest	44	24.6	26	6.8E.	83	980.553
Russia and Siberia	Archangel	64	34	40	31.0E.	5	982.278
	Leningrad	59	56.5	30	17.7E.	3	981.929
	Odessa	46	26.4	30	46.4E.	43	980.769
Scotland	Glasgow	55	51.5	4	14.0	61	981.605
Spain	Barcelona	41	25.0	2	7.0E.	407	980.240

ACCELERATION DUE TO GRAVITY, LATITUDE, LONGITUDE AND ELEVATION (Cont.)

Station		Latitude		Longitude		Elevation, meters	g cm/sec^2
		°	′	°	′		
EUROPE (Continued)							
Sweden	Stockholm	59	20.6	18	3.5E.	45	981.843
Switzerland	Geneva	46	12.0	6	9.2E.	402	980.592
ASIA							
China	Hongkong	22	18.2	114	10.5E.	33	978.771
India	Madras	13	4.1	80	14.9E.	6	978.281
Japan	Tokyo	35	42.6	139	46.0E.	18	979.801
Siam	Bankok	13	43.9	100	29.4E.	7	978.278
AFRICA							
Algeria	Algiers	36	44.8	3	3 E.	213	979.905
Egypt and Anglo-Egyptian Sudan	Khartum	15	36.6	32	32.9E.	383	978.308
Liberia	Monrovia	6	19.0	10	48.8	41	978.165
Red Sea	Suez	29	56.0	32	33.4E.	3	979.307
Union of South Africa	Cape Town	33	56.1S.	18	28.7E.	11	979.657
AUSTRALIA	Melbourne	37	49.9S.	144	58.5E.	26	979.987
OCEANIC							
Atlantic Ocean and Mediterranean Sea							
Azores	Ponta Delgada	37	43.8	25	40.8	4	980.143
Bermuda	St. George	32	21	64	40	2	979.806
Canary Islands	Las Palmas	28	7.0	15	26.0	8	979.385
Greenland	Karajak Glacier	70	26.9	50	19.8	20	982.534
Iceland	Reykjavik	64	8.5	22	0.3	39	982.273
Jamaica	Kingston	17	57.7	76	47.3	2	978.591
Pacific and Indian Oceans							
Java	Batavia	6	11.0S.	106	49.8E.	7	978.178
New Zealand	Auckland	36	50.9S.	174	46.2E.	3	979.962
Philippines	Manila	14	34.7	120	38.6E.	3	978.360
Territory of Hawaii	Honolulu	21	18.1	157	51.8	6	978.946

ACCELERATION DUE TO GRAVITY AND LENGTH OF THE SECONDS PENDULUM

For Sea Level at Various Latitudes

Based on the formula of the U. S. Coast and Geodetic Survey. The length of the simple pendulum whose period is two seconds, that is which beats seconds, is computed in each case from the corresponding value of the acceleration.

Latitude	Acceleration due to gravity		Length of seconds pendulum	
°	cm/sec.^{2}	ft./sec.^{2}	cm	in.
0	978.039	32.0878	99.0961	39.0141
5	978.078	32.0891	99.1000	39.0157
10	978.195	32.0929	99.1119	39.0204
15	978.384	32.0991	99.1310	39.0279
20	978.641	32.1076	99.1571	39.0382
25	978.960	32.1180	99.1894	39.0509
30	979.329	32.1302	99.2268	39.0656
31	979.407	32.1327		
32	979.487	32.1353		
33	979.569	32.1380		
34	979.652	32.1407		
35	979.737	32.1435	99.2681	39.0819
36	979.822	32.1463		
37	979.908	32.1491		
38	979.995	32.1520		
39	980.083	32.1549		
40	980.171	32.1578	99.3121	39.0992
41	980.261	32.1607		
42	980.350	32.1636		
43	980.440	32.1666		
44	980.531	32.1696		
45	980.621	32.1725	99.3577	39.1171
46	980.711	32.1755		
47	980.802	32.1785		
48	980.892	32.1814		
49	980.981	32.1844		
50	981.071	32.1873	99.4033	39.1351
51	981.159	32.1902		
52	981.247	32.1931		
53	981.336	32.1960		
54	981.422	32.1988		
55	981.507	32.2016	99.4475	39.1525
56	981.592	32.2044		
57	981.675	32.2071		
58	981.757	32.2098		
59	981.839	32.2125		
60	981.918	32.2151	99.4891	39.1689
65	982.288	32.2272	99.5266	39.1836
70	982.608	32.2377	99.5590	39.1964
75	982.868	32.2463	99.5854	39.2068
80	983.059	32.2525	99.6047	39.2144
85	983.178	32.2564	99.6168	39.2191
90	983.217	32.2577	99.6207	39.2207

ACCELERATION DUE TO GRAVITY

FREE AIR CORRECTION FOR ALTITUDE

-0.0003086 cm/sec.^{2}/m for altitude in meters.
-0.000003086 ft./sec.^{2}/ft. for altitude in feet.

Altitude meters	Correction cm/sec.^{2}	Altitude feet	Correction ft./sec.^{2}
200	−0.0617	200	−0.000617
300	.0926	300	.000926
400	.1234	400	.001234
500	.1543	500	.001543
600	.1852	600	.001852
700	.2160	700	.002160
800	.2469	800	.002469
900	.2777	900	.002777

DATA IN REGARD TO THE EARTH

Equatorial radius, 6,378,388 meters, 3,963.34 miles.

Polar radius, 6,356,912 meters, 3,949.99 miles.

Radius of sphere having same volume, 6,371,221.3 meters, 3,958.89 miles.

Quadrant of the equator, 10,019,148.4 meters, 6,225.60 miles.

Quadrant of the meridian, 10,002,288.3 meters, 6,215.12 miles.

1° latitude at the equator = 68.70 miles.

1° latitude at the pole = 69.41 miles.

Mean density of the earth, 5.522 g/cm^3, 344.7 lb./ft.^{3}

Mass of the earth, 5.983×10^{24} kg, 6.595×10^{21} tons.

Mean surface density of the continents, 2.67 g/cm^3, 166.7 lb./ft.^{3}

Mean linear velocity of the earth in its orbit, 29.77 km/sec., 18.50 mi./sec.

Mean linear velocity of rotation of the surface at the equator, 0.465 km/sec., 0.289 mi./sec.

Land area, 148.847×10^6 km^2, 57.470×10^6 sq. mi.

Ocean area, 361.254×10^6 km^2, 139.480×10^6 sq. mi.

Highest mountain, Everest, 8840 meters, 29,003 ft.

Greatest sea depth, 10,430 meters, 34,219 ft.

Thermal gradient of the earth, higher at increasing depths, 30° C per km, 48° C per mi. (uncertain).

Mean distance to the sun, 149,500,000 km or 92,900,000 mi.

Mean distance to the moon, 384,393 km or 238,854 mi.

THE COMMONER CHEMICAL ELEMENTS IN THE EARTH'S CRUST

Reprinted from "Principles of Geochemistry" (1952) with the permission of Brian Mason, author, and John Wiley and Sons, publishers.

The "Earth's Crust" refers to the rocks only and does not include atmosphere or the oceans. The atom percent column is obtained by dividing the weight percent by the atomic weights and reducing to 100%. The radius is the ionic radius. The volume percent is the atomic percent multiplied by $\frac{4}{3}\pi r^3$ and reducing to 100%.

Element	Weight %	Atom %	Ion Radius (Å)	Volume %
O	46.60	62.55	1.32	91.97
Si	27.72	21.22	0.39	0.80
Al	8.13	6.47	0.57	0.77
Fe	5.00	1.92	0.82	0.68
Mg	2.09	1.84	0.78	0.56
Ca	3.63	1.94	1.06	1.48
Na	2.83	2.64	0.98	1.60
K	2.59	1.42	1.33	2.14

THE AVERAGE AMOUNTS OF THE ELEMENTS IN THE EARTH'S CRUST IN GRAMS PER METRIC TON OR PARTS PER MILLION

Reprinted from "Principles of Geochemistry" (1952) with the permission of Brian Mason, author, and John Wiley and Sons, publishers.

O	466,000	N	46	Br	1.6
Si	277,200	Ce	46	Ho	1.2
Al	81,300	Sn	40	Eu	1.1
Fe	50,000	Y	28	Sb	1?
Ca	36,300	Nd	24	Tb	0.9
Na	28,300	Nb	24	Lu	0.8
K	25,900	Co	23	Tl	0.6
Mg	20,900	La	18	Hg	0.5
Ti	4,400	Pb	16	I	0.3
H	1,400	Ga	15	Bi	0.2
P	1,180	Mo	15	Tm	0.2
Mn	1,000	Th	12	Cd	0.15
S	520	Cs	7	Ag	0.1
C	320	Ge	7	In	0.1
Cl	314	Sm	6.5	Se	0.09
Rb	310	Gd	6.4	A	0.04
F	300	Be	6	Pd	0.01
Sr	300	Pr	5.5	Pt	0.005
Ba	250	Sc	5	Au	0.005
Zr	220	As	5	He	0.003
Cr	200	Hf	4.5	Te	0.002?
V	150	Dy	4.5	Rh	0.001
Zn	132	U	4	Re	0.001
Ni	80	B	3	Ir	0.001
Cu	70	Yb	2.7	Os	0.001?
W	69	Er	2.5	Ru	0.001?
Li	65	Ta	2.1		

CHEMICAL COMPOSITION OF ROCKS

Reprinted from "Sedimentary Rocks" (1948) with the permission of F. J. Pettijohn, author, and Harper Brothers, publishers.

Element	Average igneous rock	Average shale	Average sandstone	Average limestone	Average sediment
SiO_2	59.14	58.10	78.33	5.19	57.95
TiO_2	1.05	0.65	0.25	0.06	0.57
Al_2O_3	15.34	15.40	4.77	0.81	13.39
Fe_2O_2	3.08	4.02	1.07	0.54	3.47
FeO	3.80	2.45	0.30		2.08
MgO	3.49	2.44	1.16	7.89	2.65
CaO	5.08	3.11	5.50	42.57	5.89
Na_2O	3.84	1.30	0.45	0.05	1.13
K_2O	3.13	3.24	1.31	0.33	2.86
H_2O	1.15	5.00	1.63	0.77	3.23
P_2O_5	0.30	0.17	0.08	0.04	0.13
CO_2	0.10	2.63	5.03	41.54	5.38
SO_3		0.64	0.07	0.05	0.54
BaO	0.06	0.05	0.05		
C		0.80			0.66
	99.56	100.00	100.00	99.84	99.93

ELEMENTS PRESENT IN SOLUTION IN SEA WATER, EXCLUDING DISSOLVED GASES

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Element	Concentration (grams/metric ton) or parts per million
Cl	18,980
Na	10,561
Mg	1,272
S	884
Ca	400
K	380
Br	65
C (inorganic)	28
Sr	13
(SiO_2)	0.01–7.0
B	4.6
Si	0.02–4.0
C (organic)	1.2–3.0
Al	0.16–1.9
F	1.4
N (as nitrate)	0.001–0.7
N (as organic nitrogen)	0.03–0.2
Rb	0.2
Li	0.1
P (as phosphate)	$>$0.001–0.10
Ba	0.05
I	0.05
N (as nitrite)	0.0001–0.05
N (as ammonia)	$>$0.005–0.05
As (as arsenite)	0.003–0.024
Fe	0.002–0.02
P (as organic phosphorus)	0–0.016
Zn	0.005–0.014
Cu	0.001–0.09
Mn	0.001–0.01
Pb	0.004–0.005
Se	0.004
Sn	0.003
Cs	0.002 (approximate)
U	0.00015–0.0016
Mo	0.0003–0.002
Ga	0.0005
Ni	0.0001–0.0005
Th	$<$0.0005
Ce	0.0004
V	0.0003
La	0.0003
Y	0.0003
Hg	0.0003
Ag	0.00015–0.0003
Bi	0.0002
Co	0.0001
Sc	0.00004
Au	0.000004–0.000008
Fe (in true solution)	$<10^{-9}$
Ra	2.10^{-11}–3.10^{-10}
Ge	Present
Ti	Present
W	Present
Cd	Present in marine organisms
Cr	Present in marine organisms
Tl	Present in marine organisms
Sb	Present in marine organisms
Zr	Present in marine organisms
Pt	Present in marine organisms

THE pH OF NATURAL MEDIA AND ITS RELATION TO THE PRECIPITATION OF HYDROXIDES

Reprinted from "Principles of Geochemistry" (1952) with the permission of Brian Mason, author, and John Wiley and Sons, publishers.

pH	Precipitation of hydroxides	Natural media	pH
11	Magnesium		11
10		Alkali soils	10
9	Bivalent manganese		9
8		Seawater	8
7	Bivalent iron	River water	7
6	Zinc copper	Rain water	6
5	Aluminum		5
4		Peat water	4
3	Trivalent iron	Mine waters	3
2		Acid thermal springs	2
1			1

PROPERTIES OF THE EARTH'S ATMOSPHERE AT ELEVATIONS UP TO 160 KILOMETERS

The average atmosphere up to 160 km based on pressure and density data obtained on rocket flights above White Sands, New Mexico.

Havens, Koll and LaGow, Journal of Geophysical Research, March, 1952

Altitude km above sea level	Pressure mm Hg	Density gm/meters³	Temperatures °K (N_2, O_2) M = 29	Temperatures °K (N_2, O) M = 24	Velocity of Sound m. sec	Mean Free Path cm (N_2)
0	760	1220	290		345	6.5×10^{-6}
10	210	425	230		310	1.9×10^{-5}
20	42	92	210		295	8.6×10^{-5}
30	9.5	19	235		315	4.2×10^{-4}
40	2.4	4.3	260		325	1.8×10^{-3}
50	7.5×10^{-1}	1.3	270		330	6.1×10^{-3}
60	2.1×10^{-1}	3.8×10^{-1}	260		325	2.1×10^{-2}
70	5.4×10^{-2}	1.2×10^{-1}	210		295	6.6×10^{-1}
80	1.0×10^{-2}	2.5×10^{-2}	190		280	3.2×10^{-1}
90	1.9×10^{-3}	4.0×10^{-3}	210		295	2.0
100	4.2×10^{-4}	$8. \times 10^{-4}$	240		315	10.0
110	1.2×10^{-4}	2.0×10^{-4}	270	220	330	40
120	3.5×10^{-5}	5.0×10^{-5}	330	270	370	1.5×10^{2}
130	1.5×10^{-5}	2.0×10^{-5}	390	320	400	4×10^{2}
140	7×10^{-6}	7×10^{-6}	450	370	430	1×10^{3}
150	3×10^{-6}	3.0×10^{-6}	510	420	460	2.5×10^{3}
160	2×10^{-6}	1.5×10^{-6}	570	470	480	5×10^{3}

Velocity of Seismic Waves

Depth km	Longitudinal or condensational km/sec.	Transverse or distortional km/sec.
0–20	5.4 –5.6	3.2
20–45	6.25–6.75	3.5
1300	12.5	6.9
2400	13.5	7.5

DATA CONCERNING THE SOLAR SYSTEM

Body	Mass Earth = 1	Distance from Sun		Sidereal period, days	Mean specific gravity
		km	miles		
Sun	329390.	....	....	....	1.42
Mercury	0.0549	58×10^6	36.0×10^6	87.97	5.61
Venus	0.8073	108×10^6	67.1×10^6	224.70	5.16
Earth	1.000	149×10^6	92.9×10^6	365.26	5.52
Mars	0.1065	228×10^6	141.7×10^6	686.98	3.95
Jupiter	314.5	778×10^6	483.4×10^6	4332.59	1.34
Saturn	94.07	1426×10^6	886.1×10^6	10759.20	0.69
Uranus	14.40	2869×10^6	1782.7×10^6	30685.93	1.36
Neptune	16.72	4495×10^6	2793.1×10^6	60187.64	1.30
Pluto	....	5900×10^6	3666.1×10^6	90885.	....
Moon	0.01228	$^*38 \times 10^4$	$^*23.9 \times 10^4$	27.32	3.36

Body	Diameter		Acceleration due to gravity at surface		Albedo visual
	km	miles	cm/sec.^{2}	ft./sec.^{2}	
Sun	1390600	864100	27440	900.3	.....
Mercury	5140	3194	392	12.9	0.069
Venus	12620	7842	882	28.9	.59
Earth	12756	7926	980	32.2	.....
Mars	6860	4263	392	12.9	.154
Jupiter	143600	89229	2646	86.8	.56
Saturn	120600	74937	1176	38.6	.63
Uranus	53400	33181	980	32.2	.63
Neptune	49700	30882	980	32.2	.73
Moon	3476	2159.9	167	5.47	.073

ATMOSPHERIC AND METEOROLOGICAL DATA

Total mass of the atmosphere, estimated by Ekholm 5.2×10^{21} g, 11.4×10^{18} pounds, 5.70×10^{16} tons.

Evidence of extent: twilight, 63 km, 39 mi.; meteors, 200 km, 124 mi.: aurora 44–360 km, 27–224 mi.

Height if homogeneous at normal atmospheric pressure, 7991 m, 4.965 mi.

Composition of the atmosphere, mean percentage by volume, at sea level, of the dry air components.

N_2	78.03	H_2	0.01
O_2	20.99	Ne	0.0012
A	0.94	He	0.0004
CO_2	0.03		

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* Distance to Earth.

STANDARD ATMOSPHERE

A standard atmosphere for heights up to 20 kilometers has been approved by the International Civil Aviation Organization and the National Advisory Committee on Aeronautics. The values correspond fairly well to average values observed at 40° N in North America. For basic assumptions regarding values in this table refer to Manual of the I C A O Standard Atmosphere, N A C A Technical Note, Washington 25, D. C., May 1954.

Altitude		Temperature °K	Pressure millibars	Density g/cm³	Viscosity poise	Speed of sound meters/sec
Km	Mi					
0	0	288.16	1013.25	.0012250	1.7932×10^{-4}	340.43
1	0.6	281.66	898.74	.0011117	1.7609	336.57
2	1.2	275.16	794.95	.0010065	1.7283	332.66
3	1.9	268.66	701.08	.0009091	1.6953	328.71
4	2.5	262.16	616.40	.0008191	1.6620	324.71
5	3.1	255.66	540.20	.0007361	1.6282	320.66
6	3.7	249.16	471.81	.0006597	1.5941	316.56
7	4.3	242.66	410.61	.0005895	1.5596	312.40
8	5.0	236.16	356.00	.0005252	1.5247	308.19
9	5.6	229.66	307.42	.0004664	1.4893	303.92
10	6.2	223.16	264.36	.0004127	1.4536	299.58
11	6.8	216.66	226.32	.0003639	1.4174	295.19
12	7.5	216.66	193.30	.0003108	1.4174	295.19
13	8.1	216.66	165.10	.0002655	1.4174	295.19
14	8.7	216.66	141.02	.0002268	1.4174	295.19
15	9.3	216.66	120.45	.0001937	1.4174	295.19
16	9.9	216.66	102.87	.0001654	1.4174	295.19
17	10.6	216.66	87.87	.0001413	1.4174	295.19
18	11.2	216.66	75.05	.0001207	1.4174	295.19
19	11.8	216.66	64.10	.0001031	1.4174	295.19
20	12.4	216.66	54.75	.0000880	1.4174	295.19

Atmospheric Electricity

Normal potential gradient:
  Over land, 67 to 317 volts/m.
  Over sea, 128 volts/m.
Potential gradient at Earth's surface beneath thunder cloud, 1×10^4 volts/m.
Quantity discharged by lightning flash, 10–50 coulombs.
Energy of flash, 1×10^{17} ergs.
Potential difference between discharge points, 1×10^9 volts.

Angular Radius of Halos and Rainbows

Coronae due to small water drops................	1° to 10°
Small halo, due to 60° angles of ice crystals........	22°
Large halo, due to 90° angles of ice crystals.......	46°
Rainbow, primary............................	41° 20′
Rainbow, secondary..........................	52° 15′

Solar Constant

The energy falling on one sq. cm. area at normal incidence, outside the earth's atmosphere, at the mean distance of the earth from the sun equals 2.00 small calories per minute. This value varies ±2%.

MOLECULAR CONSTANTS

The following gives the arithmetical average velocity, the mean free path, molecular diameter and collision frequency for the temperatures indicated and at standard pressure, 760 mm Hg. except as otherwise stated.

Gas	Average velocity in cm/sec.		Mean free path in cm at 75 cm Hg.		
	0° C	20° C	Boltzmann		Meyer
			0° C	20° C	20° C
Air	447×10^2	463×10^2	....	....	....
Ammonia	583	604	5.92×10^{-6}	6.60×10^{-6}	5.83×10^{-6}
Argon	381	395	8.98	9.88	8.73
Carbon monoxide	454	471	8.46	9.23	8.16
Carbon dioxide	362	376	5.56	6.15	5.44
Helium	1208	1252	25.25	27.45	33.10
Hydrogen	1696	1755	16.00	17.44	15.40
Krypton	263	272	9.5	....	....
Mercury	170	176	....	(14.70)	(13.0)
Neon	538	557	....	....	....
Nitrogen	454	471	8.50	9.29	8.21
Oxygen	425	440	9.05	9.93	8.78
Water vapor	566	587	....	....	....
Xenon	210	218	5.6	....	....

Gas	Collision frequency 20° C	Molecular diameter, cm		
		From viscosity	From van der Waal's equation	From heat conductivity
Ammonia	9150×10^6	2.97×10^{-8}	3.08×10^{-8}	....
Argon	4000	2.88	2.94	2.86×10^{-8}
Carbon monoxide	5100	3.19	3.12	....
Carbon dioxide	6120	3.34	3.23	3.40
Helium	4540	1.90	2.65	2.30
Hydrogen	10060	2.40	2.34	2.32
Krypton	....	....	(3.69)	3.14
Mercury	....	....	3.01	....
Nitrogen	5070	3.15	3.15	3.53
Oxygen	4430	2.98	2.92	....
Xenon	....	....	4.02	3.42

CRYSTAL IONIC RADII OF ELEMENTS

Values in this table have been computed by L. Pauling on the basis of wave mechanics. Values in parentheses are for univalent crystal radii.

By permission from L. Pauling, "Nature of the Chemical Bond," Cornell University Press.

Element	Radii in Å	Element	Radii in Å
A	(1.54)	Mg^{++}	0.65 (0.82)
Ag^{+}	1.26 (1.26)	$Mn^{+++++++}$	0.46 (0.75)
Al^{+++}	0.50 (0.72)	Mo^{++++++}	0.62 (0.93)
As^{+++++}	0.47 (0.71)	N^{+++++}	0.11 (0.25)
As^{---}	2.22 (2.85)	N^{---}	1.71 (2.47)
Au^{+}	1.37 (1.37)	Na^{+}	0.95 (0.95)
B^{+++}	0.20 (0.35)	Nb^{+++++}	0.70 (1.00)
Ba^{++}	1.35 (1.53)	Ne	(1.12)
Be^{++}	0.31 (0.44)	NH_4^{+}	(1.42)
Bi^{+++++}	0.74 (0.98)	O^{++++++}	0.09 (0.22)
$Br^{+++++++}$	0.39 (0.62)	O^{--}	1.40 (1.76)
Br^{-}	1.95 (1.95)	P^{+++++}	0.34 (0.59)
C^{++++}	0.15 (0.29)	P^{---}	2.12 (2.79)
C^{----}	2.60 (4.14)	Pb^{++++}	0.84 (1.06)
Ca^{++}	0.99 (1.18)	Rb^{+}	1.48 (1.48)
Cd^{++}	0.97 (1.14)	S^{++++++}	0.29 (0.53)
Ce^{++++}	1.01 (1.27)	S^{--}	1.84 (2.19)
$Cl^{+++++++}$	0.26 (0.49)	Sb^{+++++}	0.62 (0.89)
Cl^{-}	1.81 (1.81)	Sb^{---}	2.45 (2.95)
Cr^{++++++}	0.52 (0.81)	Sc^{+++}	0.81 (1.06)
Cs^{+}	1.69 (1.69)	Se^{++++++}	0.42 (0.66)
Cu^{+}	0.96 (0.96)	Se^{--}	1.98 (2.32)
$F^{+++++++}$	0.07 (0.19)	Si^{++++}	0.41 (0.65)
F^{-}	1.36 (1.36)	Si^{----}	2.71 (3.84)
Ga^{+++}	0.62 (0.81)	Sn^{++++}	0.71 (0.96)
Ge^{++++}	0.53 (0.76)	Sn^{----}	2.94 (3.70)
Ge^{----}	2.72 (3.71)	Sr^{++}	1.13 (1.32)
H^{-}	2.08 (2.08)	Te^{++++++}	0.56 (0.82)
He	(0.93)	Te^{--}	2.21 (2.50)
Hg^{++}	1.10 (1.25)	Ti^{++++}	0.68 (0.96)
$I^{+++++++}$	0.50 (0.77)	Tl^{+++}	0.95 (1.15)
I^{-}	2.16 (2.16)	V^{+++++}	0.59 (0.88)
In^{+++}	0.81 (1.04)	Xe	(1.90)
K^{+}	1.33 (1.33)	Y^{+++}	0.93 (1.20)
Kr	(1.69)	Zn^{++}	0.74 (0.88)
La^{+++}	1.15 (1.39)	Zr^{++++}	0.80 (1.09)
Li^{+}	0.60 (0.60)		

ENERGY, MASS, AND VELOCITY RELATIONS FOR THE ELECTRON

Energy mev	Electron mass		β	Velocity cm/sec
	g	m_0		
very small	9.1066×10^{-28}			
.018	9.42×10^{-28}	1.035	.25	$.75 \times 10^{10}$
.05	10.00×10^{-28}	1.10	.42	1.26×10^{10}
.1	10.90×10^{-28}	1.20	.548	1.65×10^{10}
.5	18.02×10^{-28}	1.98	.863	2.585×10^{10}
1	26.93×10^{-28}	2.96	.94	2.818×10^{10}
5	98.24×10^{-28}	10.8	.996	2.985×10^{10}
7	133.89×10^{-28}	14.7	.9976	2.990×10^{10}
10	187.38×10^{-28}	20.6	.9988	2.994×10^{10}
20	365.64×10^{-28}	40.1	.9992	near the velocity of light
100	1791.8×10^{-28}	196.6	.9998	near the velocity of light
1000	17839×10^{-28}	1960	.999999	near the velocity of light
10000	178160×10^{-28}	19580	.9999999	near the velocity of light

VALUES OF THE GENERAL PHYSICAL CONSTANTS*

Raymond T. Birge, Reviews of Modern Physics **13**, 233, 1941

Table A. Principal Constants and Ratios*

Section		
A	Velocity of light	$c = (2.99776 \pm 0.00004) \times 10^{10}$ cm · sec^{-1}
B	Gravitation constant	$G = (6.670 \pm 0.005) \times 10^{-8}$ dyne · cm^2 · g^{-2}
C	Liter (=1000 ml)	$l = 1000.028 \pm 0.002$ cm^3
D	Volume of ideal gas (0°C, A_0)	$V_0 = (22.4146 \pm 0.0006) \times 10^3$ cm^3 · atmos · mole^{-1} $V_0' = 22.4140 \pm 0.0006$ liter · atmos · mole^{-1}
D	Volume of ideal gas (0°C, A_{45})	$V_{45} = (22.4157 \pm 0.0006) \times 10^3$ cm^3 · atmos · mole^{-1} $V_{45}' = 22.4151 \pm 0.0006$ liter · atmos · mole^{-1}
E	International ohm (= p abs-ohm)	$p = 1.00048 \pm 0.00002$ (U. S. Int. ohm 1948, $p = 1.000495$)
E	International ampere (= q abs-amp)	$q = 0.99986 \pm 0.00002$ (U. S. Int. ampere 1948, $q = 0.999835$)
F	Atomic weights (see Table A′)	
G	Standard atmosphere	$A_0 = (1.013246 \pm 0.000004) \times 10^6$ dyne · cm^{-2} · atmos^{-1}
G	45° atmosphere	$A_{45} = (1.013195 \pm 0.000004) \times 10^6$ dyne · cm^{-2} · atmos^{-1}
H	Ice-point (absolute scale)	$T_0 = 273.16 \pm 0.01$°K
I	Joule equivalent	$J_{15} = 4.1855 \pm 0.0004$ abs-joule · cal$_{15}^{-1}$
I	Joule equivalent (electrical)	$J_{15}' = 4.1847 \pm 0.0003$ int-joule · cal$_{15}^{-1}$
J	Faraday constant	
K	Avogadro number (chemical scale)	$N_0 = (6.0228_3 \pm 0.0011) \times 10^{23}$ mole^{-1}
K	Electronic charge	$e = F/N_0 = (1.60203_3 \pm 0.00034) \times 10^{-20}$ abs. e.m.u. $e' = ec = (4.80251 \pm 0.0010) \times 10^{-10}$ abs. e.s.u.
L	Specific electronic charge	$e/m = (1.7592 \pm 0.0005) \times 10^7$ abs. e.m.u. · g^{-1} $e'/m = ec/m = (5.2736_6 \pm 0.0015) \times 10^{17}$ abs. e.s.u. · g^{-1}
M	Planck constant	h (see Table C).

Faraday constant (J):

(1) Chemical scale

$F = 96501._2 \pm 10$ int-coul · g-equiv^{-1}

$= 96487._7 \pm 10$ abs-coul · g-equiv^{-1}

$= 9648.7_7 \pm 1.0$ abs. e.m.u. · g-equiv^{-1}

$F' = Fc = (2.89247 \pm 0.00030) \times 10^{14}$ abs. e.s.u. · g-equiv^{-1}

(2) Physical scale

$F = 96514._0 \pm 10$ abs-coul · g-equiv^{-1}

$= 9651.4_0 \pm 1.0$ abs. e.m.u. · g-equiv^{-1}

$F' = Fc = (2.89326 \pm 0.00030) \times 10^{14}$ abs. e.s.u. · g-equiv^{-1}

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* Unless otherwise specified, all quantities in these tables that involve the mole or the gram equivalent are on the chemical scale of atomic weights.

VALUES OF THE GENERAL PHYSICAL CONSTANTS (Continued)

Table A′. Atomic Weights

(1) Physical scale ($O^{16} = 16.0000$)

$H^1 = 1.00813 \pm 0.00001_7$ $H^2 = 2.01473 \pm 0.00001_9$
$H = 1.00827_6 \pm 0.00001_7$ (from H^1/H^2 abundance $= 6900 \pm 100$)
$He^4 = 4.00389 \pm 0.00007$
$C^{12} = 12.00386 \pm 0.00004$ $C^{13} = 13.00761 \pm 0.00015$
$C = 12.01465 \pm 0.00023$ (from C^{12}/C^{13} abundance $= 92 \pm 2$)
$N^{14} = 14.00753 \pm 0.00005$ $N^{15} = 15.0049 \pm 0.0002$
$N = 14.01121 \pm 0.00009_5$ (from N^{14}/N^{15} abundance $= 270 \pm 6$)
$O^{16} = 16\ 0000$ $O^{17} = 17.0045$ $O^{18} = 18.0049$
$O = 16.00435_7 \pm 0\ 00008_6$ (from abundance $O^{16}:O^{18}:O^{17} = (506 \pm 10):1:(0.204 \pm 0.008)$)

(2) Chemical scale ($O = 16.0000$)

Ratio physical to chemical scale

$$r = (16.004357 \pm 0.000086)/16 = 1.000272 \pm 0.000005$$

$H^1 = 1.00785_6 \pm 0.00001_8$ (from physical scale)
$H^2 = 2.01418_2 \pm 0.00002_1$ (from physical scale)
$H = 1.00800_2 \pm 0.00001_8$ (from physical scale)
$He^4 = 4.00280 \pm 0.00007$ (from physical scale)
$C = 12.01139 \pm 0.00024$ (from physical scale)
$N = 14.00740 \pm 0.00012$ (from physical scale)
$N = 14.0086 \pm 0.0007$ (direct observation)
$Na = 22.994 \pm 0.003$ $Cl = 35.457 \pm 0.001$
$Ca = 40.080 \pm 0.005$ $Ag = 107.880 \pm 0.002$ $I = 126.915 \pm 0.004$

VALUES OF THE GENERAL PHYSICAL CONSTANTS (Continued)

Table B. Additional Quantities Evaluated or Used in Connection with Table A

Section			
A	Ratio of e.s.u. to e.m.u. (direct)	c'	$= (2.9971_2 \pm 0.0001) \times 10^{10}\ \mathrm{cm}^{1/2} \cdot \mathrm{sec}^{-1/2} \cdot \mathrm{int\text{-}ohm}^{1/2}$ $= (2.9978_4 \pm 0.0001_0) \times 10^{10}\ \mathrm{cm} \cdot \mathrm{sec}^{-1}$
A	Ratio of e.s.u. to e.m.u. (indirect)	$c' = c$	$= (2.99776 \pm 0.00004) \times 10^{10}\ \mathrm{cm} \cdot \mathrm{sec}^{-1}$
B	Average density of earth	δ	$= 5.517 \pm 0.004\ \mathrm{g} \cdot \mathrm{cm}^{-3}$
C	Maximum density of water	$\delta\, m(\mathrm{H_2O})$	$= 0.999972 \pm 0.000002\ \mathrm{g} \cdot \mathrm{cm}^{-3}$
D	Acceleration of gravity (standard)	g_0	$= 980.665\ \mathrm{cm} \cdot \mathrm{sec}^{-2}$
D	Acceleration of gravity (45°)	g_{45}	$= 980.616\ \mathrm{cm} \cdot \mathrm{sec}^{-2}$
D	Density of oxygen gas (0°C, A_{45})	L_1	$= 1.42897 \pm 0.00003\ \mathrm{g} \cdot \mathrm{liter}^{-1}$
D	Limiting density of oxygen gas (0°C, A_{45})	L_{lim}	$= 1.427609 \pm 0.000037\ \mathrm{g} \cdot \mathrm{liter}^{-1}$
D	Factor converting oxygen (0°C, A_{45}) to ideal gas	$1 - \alpha$	$= 1.000953_5 \pm 0.000009_4$
E	International coulomb ($= q$ abs-coul)	q	$= 0.99986 \pm 0.00002$ (U. S. Int. coulomb 1948, $q = 0.999835$)
E	International gauss ($= q$ abs-gauss)		
E	International henry ($= p$ abs-henry)	p	$= 1.00048 \pm 0.00002$ (U. S. Int. henry 1948, $q = 1.000495$)
E	International volt ($= pq$ abs-volt)	pq	$= 1.00034 \pm 0.00003$ (U. S. Int. volt 1948, $pq = 1.00033$)
E	International joule ($= pq^2$ abs-joule)	pq^2	$= 1.00020 \pm 0.00004_5$ (U. S. Int. joule 1948, $pq^2 = 1.000165$)
G	Specific gravity of Hg (0°C, A_0) referred to air-free water at maximum density	ρ_0	$= 13.59542 \pm 0.00005$
G	Density of Hg (0°C, A_0)	D_0	$= 13.59504_0 \pm 0.00005_7\ \mathrm{g} \cdot \mathrm{cm}^{-3}$
J	Electrochemical equivalents (chemical scale)		
	silver (apparent)	E_{Ag}	$= 1.11800 \times 10^{-3}\ \mathrm{g} \cdot \mathrm{int\text{-}coul}^{-1}$
	(corrected)	E_{Ag}	$= (1.11807 \pm 0.00012) \times 10^{-3}\ \mathrm{g} \cdot \mathrm{abs\text{-}coul}^{-1}$
	iodine (apparent)	E_{I}	$= (1.315026 \pm 0.000025) \times 10^{-3}\ \mathrm{g} \cdot \mathrm{int\text{-}coul}^{-1}$
	(corrected)	E_{I}	$= (1.31535 \pm 0.00014) \times 10^{-3}\ \mathrm{g} \cdot \mathrm{abs\text{-}coul}^{-1}$
K	Effective calcite grating space (18°C), Siegbahn system	d_{18}''	$= 3.02904 \times 10^{-8}\ \mathrm{cm}$
K	True calcite grating space (20°C), Siegbahn system	d_{20}'	$= 3.02951_2 \times 10^{-8}\ \mathrm{cm}$
K	True calcite grating space (20°C), c.g.s. system	d_{20}	$= (3.03567_4 \pm 0.00018) \times 10^{-8}\ \mathrm{cm}$
K	Ratio of grating and Siegbahn scales of wave-lengths	λ_g/λ_s	$= 1.002034 \pm 0.000060$
K	Density of calcite (20°C)	ρ	$= 2.71029 \pm 0.00003\ \mathrm{g} \cdot \mathrm{cm}^{-3}$
K	Structural constant of calcite (20°C)	ϕ	$= 1.09594 \pm 0.00001$
K	Molecular weight of calcite (chemical scale)	M	$= 100.091_4 \pm 0.005$
L	Rydberg constant for hydrogen ($\mathrm{H^1}$)	R_{H}	$= 109677.581_2 \pm 0.007_5\ \mathrm{cm}^{-1}$ (I.A. scale)
L	Rydberg constant for deuterium ($\mathrm{H^2}$)	R_{D}	$= 109707.419_3 \pm 0.007_5\ \mathrm{cm}^{-1}$ (I.A. scale)
L	Rydberg constant for helium	R_{He}	$= 109722.263 \pm 0.012\ \mathrm{cm}^{-1}$ (I.A. scale)
L	Rydberg constant for infinite mass	R_∞	$= 109737.303 \pm 0.017\ \mathrm{cm}^{-1}$ (I.A. scale) or $\pm\ 0.05\ \mathrm{cm}^{-1}$ (c.g.s. system)

VALUES OF THE GENERAL PHYSICAL CONSTANTS (Continued)

Table C. Partial List of Derived Quantities*

Planck constant

$$h = \left\{\frac{2\pi^2c^3F^5}{R_\infty N_0{}^5(e/m)}\right\}^{1/3} = (6.624_2 \pm 0.002_4) \times 10^{-27}\ \text{erg} \cdot \text{sec}$$

$$h/e = \left\{\frac{2\pi^2c^3F^2}{R_\infty N_0{}^2(e/m)}\right\}^{1/3} = (4.1349_0 \pm 0.0007_1) \times 10^{-7}\ \text{erg} \cdot \text{sec} \cdot \text{e.m.u.}^{-1}$$

$$h/e' = h/ec = \left\{\frac{2\pi^2F^2}{R_\infty N_0{}^2(e/m)}\right\}^{1/3} = (1.3793_3 \pm 0.0002_3) \times 10^{-17}\ \text{erg} \cdot \text{sec} \cdot \text{e.s.u.}^{-1}$$

Atomic weight of electron

$$E = F/(e/m)$$

$$\text{(physical scale)} = (5.4862_4 \pm 0.0017) \times 10^{-4}$$

$$\text{(chemical scale)} = (5.4847_5 \pm 0.0017) \times 10^{-4}$$

Band spectra constant connecting wave number and moment of inertia

$$h/8\pi^2c = \left\{\frac{F^5}{256\pi^4R_\infty N_0{}^5(e/m)}\right\}^{1/3} = (27.98_{65} \pm 0.01_0) \times 10^{-40}\ \text{g} \cdot \text{cm}$$

Boltzmann constant

$$k = R_0/N_0 = V_0A_0/T_0N_0 = (1.38047_4 \pm 0.00026) \times 10^{-16}\ \text{erg} \cdot \text{deg}^{-1}$$

Charge in electrolysis of one gram of H

$$F/H = 9572.1_{73} \pm 1.0\ \text{abs. e.m.u.} \cdot \text{g}^{-1}$$

Charge in electrolysis of one gram of H^1

$$e/M_{H^1} = F/H^1 = 9573.5_{60} \pm 1.0\ \text{abs e.m.u. g}^{-1}$$

Compton shift at 90°

$$h/mc = \left\{\frac{2\pi^2F^2(e/m)^2}{R_\infty N_0{}^2}\right\}^{1/3} = (0.024265_{14} \pm 0.000005_7) \times 10^{-8}\ \text{cm}$$

Energy in ergs of one abs-volt-electron

$$E_0 = 10^8e = 10^8F/N_0 = (1.60203_3 \pm 0.00034) \times 10^{-12}\ \text{erg}$$

Energy in calories per mole for one abs-volt-electron per molecule

$$\frac{F\ \text{(abs. coul. per gram equiv)}}{J_{15}\ \text{(abs. joules per cal)}} = 23052._{85} \pm 3._2\ \text{cal}_{15} \cdot \text{mole}^{-1}$$

VALUES OF THE GENERAL PHYSICAL CONSTANTS (Continued)

Fine structure constant.........$\alpha = 2\pi(e')^2/hc = \left\{\frac{4\pi R_\infty F(e/m)}{N_0}\right\}^{1/3} = (7.2976_6 \pm 0.0008_6) \times 10^{-3}$

$$1/\alpha = 137.030_2 \pm 0.016$$

$$\alpha^2 = (5.3256 \pm 0.0013) \times 10^{-5}$$

Gas constant per mole........$R_0 = V_0A_0/T_0 = (8.31436 \pm 0.00038) \times 10^7$ erg · deg^{-1} · mole^{-1}

$R_0' = R_0 \cdot 10^{-7}/J_{15} = 1.98646_7 \pm 0.00021$ cal$_{15}$ · deg^{-1} · mole^{-1}

$R_0'' = V_0'/T_0 = (8.20544_7 \pm 0.00037) \times 10^{-2}$ liter · atmos · deg^{-1} · mole^{-1}

$R_0''' = R_0/A_0 = V_0/T_0 = 82.0566_7 \pm 0.0037$ cm^3 · atmos · deg^{-1} · mole^{-1}

also $R_0T_0 = V_0A_0 = (2.27115_0 \pm 0.00006) \times 10^{10}$ erg · mole^{-1}

Loschmidt number (0°C, A_0).. $n_0 = N_0/V_0 = (2.6870_{12} \pm 0.0005_0) \times 10^{19}$ atmos^{-1} cm^{-3}

Magnetic moment of one Bohr magneton....$\mu_1 = (h/4\pi)(e/m) = \frac{1}{4\pi}\left\{\frac{2\pi^2c^3F^5(e/m)^2}{R_\infty N_0^5}\right\}^{1/3}$

$= (0.9273_{45} \pm 0.0003_7) \times 10^{-20}$ erg · gauss^{-1}

Magnetic moment per mole for one Bohr magneton per molecule

$$\mu_1N_0 = \frac{1}{4\pi}\left\{\frac{2\pi^2c^3F^5(e/m)^2}{R_\infty N_0^2}\right\}^{1/3} = 5585.2_4 \pm 1.6 \text{ erg} \cdot \text{gauss}^{-1} \cdot \text{mole}^{-1}$$

Mass of α-particle....................$M_\alpha = (\text{He} - 2E)/N_0 = (6.6442_2 \pm 0.0012) \times 10^{-24}$ g

Mass of atom of unit atomic weight.............$M_0 = 1/N_0 = (1.66035 \pm 0.00031) \times 10^{-24}$ g

Mass of electron.................$m = e/(e/m) = (F/N_0)/(e/m) = (9.1066_0 \pm 0.0032) \times 10^{-28}$ g

Mass of H¹ atom..............$M_{H^1} = H^1/N_0 = (1.67339_3 \pm 0.00031) \times 10^{-24}$ g

Mass of proton.................$M_p = (H^1 - E)/N_0 = (1.67248_2 \pm 0.00031) \times 10^{-24}$ g

Radiation density constant....................$a = 8\pi^5k^4/15c^3h^3 = \left(\frac{V_0A_0}{T_0}\right)^4 \frac{4\pi^3N_0R_\infty(e/m)}{15c^6F^5}$

$= (7.569_{42} \pm 0.0049) \times 10^{-15}$ erg · cm^{-3} · deg^{-4}

Ratio mass H¹ atom to mass electron......$M_{H^1}/m = (e/m)(H^1/F) = 1837.5_{61} \pm 0.5_6$

Ratio mass proton to mass electron.......$M_p/m = (e/m)\left(\frac{H^1 - E}{F}\right) = 1836.5_{61} \pm 0.5_6$

Second radiation constant......$c_2 = hc/k = \frac{c^2T_0}{V_0A_0}\left\{\frac{2\pi^2F^5}{R_\infty N_0^2(e/m)}\right\}^{1/3} = 1.4384_8 \pm 0.0003_4$ cm · deg

VALUES OF THE GENERAL PHYSICAL CONSTANTS (Continued)

Specific charge of α-particle. . . . . $2e/M_\alpha = \dfrac{2F}{\text{He} - 2E} = 4822.3_3 \pm 0.5_1$ abs. e.m.u. · g^{-1}

Specific charge of proton. . . . . $e/M_p = \dfrac{F}{H^1 - E} = 9578.7_7 \pm 1.0$ abs. e.m.u. · g^{-1}

Stefan-Boltzmann constant. . . . . $\sigma = ac/4 = 2\pi^5k^4/15c^2h^3 = \left(\dfrac{V_0A_0}{T_0}\right)^4 \dfrac{\pi^3 N_0 R_\infty (e/m)}{15(Fc)^5}$

$$= (5.672_{83} \pm 0.003_7) \times 10^{-5} \text{ erg} \cdot \text{cm}^{-2} \cdot \text{deg}^{-4} \cdot \text{sec}^{-1}$$

Wave-lengtn associated with one abs-volt†

$$\lambda_0 = 10^{-8}c^2(h/e') = \frac{c^2}{10^8}\left\{\frac{2\pi^2F^2}{R_\infty N_0{}^2(e/m)}\right\}^{1/3} = (12395._4 \pm 2._1) \times 10^{-8} \text{ cm} \cdot \text{abs-volt}$$

Wave number associated with one abs-volt

$$s_0 = 1/\lambda_0 = \frac{10^8}{c^2}\left\{\frac{R_\infty N_0{}^2(e/m)}{2\pi^2F^2}\right\}^{1/3} = 8067.4_9 \pm 1.4 \text{ cm}^{-1} \cdot \text{abs-volt}^{-1}$$

Wien's displacement law constant‡ . . . . . . $A = c_2/4.965114 = 0.28971_8 \pm 0.00007$ cm · deg

Zeeman displacement per gauss. . . . . . . $(e/m)/4\pi c = (4.6699_1 \pm 0.0013) \times 10^{-5}$ $\text{cm}^{-1} \cdot \text{gauss}^{-1}$

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* In order to be able to calculate, by propagation of errors, the probable error in a derived quantity, it is necessary to express the quantity explicitly in terms of the various fundamental quantities of Table A, or of Table B, and that has been done in each case. Since in this paper *e* and *h* are treated as derived quantities, they do not therefore appear in such explicit expressions. But in calculating *numerical* values of derived quantities, the work can often be greatly simplified by using the values of other previously calculated derived quantities—in particular *e* and *h*. In order to show how certain derived quantities depend on quantities like *e* and *h*, such alternative expressions are given in many cases.

† The factor 10^{-8} was accidentally omitted, in G.C. 1929, in the equation for λ_0.

‡ The factor 4.965114 is the root of $e^{-\beta} + (\beta/5) - 1 = 0$

ATOMIC CONSTANTS

From: A Survey of Atomic Constants (1955) by J. A. Bearden and John H. Thomsen, The John Hopkins University

N	Avogadro's number	$(6.0247 \pm .0002) \times 10^{23}$ mol^{-1} (physical scale)
c	Velocity of light	$(2.997928 \pm .000004) \times 10^{10}$ cm sec^{-1}
e	Electronic charge	$(4.80294 \pm .00008) \times 10^{-10}$ esu
m	Electron rest mass	$(9.1086 \pm .0003) \times 10^{-28}$ gm
h	Planck's constant	$(6.6254 \pm .0002) \times 10^{-27}$ erg sec
$F' = Ne/c$	Faraday's constant	$(9652.0 \pm .2)$ emu eq^{-1}
h/e		$(1.37944 \pm .00002) \times 10^{-17}$ erg sec esu^{-1}
$\alpha = 2\pi e^2/hc$	Fine structure constant	$(7.29729+ \pm .00003) \times 10^{-3}$
α^{-1}		$(137.0371 \pm .0005)$
e/mc	Specific charge of the electron	$(1.75888 \pm .00003) \times 10^{7}$ esu gm^{-1} sec cm^{-1}
h/m		$(7.27378 \pm .00005)$ cm^2 sec^{-1}
$\lambda_{ce} = h/mc$	Compton wavelength of the electron	$(2.42627 \pm .00002) \times 10^{-10}$ cm
Nm	Atomic weight of the electron	$(5.48760 \pm .00004) \times 10^{-4}$ amu
$a_0 = h^2/4\pi^2me^2$	First Bohr radius	$(5.29173 \pm .00002) \times 10^{-9}$ cm
$r_0 = e^2/mc^2$	Classical radius of the electron	$(2.81751 \pm .00006) \times 10^{-13}$ cm
H	Atomic weight of hydrogen	$(1.0081445 \pm .0000010)$ amu
$H^+ = H - Nm$	Atomic weight of proton	$(1.0075957 \pm .0000010)$ amu
H^+/Nm	Ratio proton mass to electron mass	$1836.13 \pm .02$
$\mu = mH^+/H$	Reduced mass of electron in the hydrogen atom	$(9.1036 \pm .0003) \times 10^{-28}$ gm
$\sigma = 2\pi^5R_0^4/15c^2h^3N^4$	Stefan Boltzmann constant	$(5.6696 \pm .0004) \times 10^{-5}$ erg cm^{-2} sec^{-1} (°K)$^{-4}$
$k = R_0N^{-1}$	Boltzmann constant	$(1.38049 \pm .00005) \times 10^{-16}$ erg (°K)$^{-1}$
$c_1 = 8\pi hc$	First radiation constant	$(4.9920 \pm .0002) \times 10^{-15}$ erg cm
$c_2 = hcNR_0^{-1}$	Second radiation constant	$(1.43879 \pm .00003)$ cm (°K)
$h/k = c_2/c$	Atomic specific heat constant	$(4.79894 \pm .00021) \times 10^{-11}$ sec deg
$(3k/N)^{\frac{1}{2}} = (3R_0/N^2)^{\frac{1}{2}}$	Multiplier of (Curie const.)$^{\frac{1}{2}}$	$(2.62148 \pm .00007) \times 10^{-20}$ (erg mol deg^{-1})$^{\frac{1}{2}}$ (physical scale)
λ_g/λ_s	Conversion factor from Siegbahn x-units to milliangstroms	$1.00203 \pm .00002$
R_∞	Rydberg for infinite mass	$109737.31 \pm .01$ cm^{-1}
$R_H = (1 - Nm/H)R_\infty$	Rydberg for hydrogen	$109677.57_6 \pm .01$ cm^{-1}
$\lambda_{\max} \mathrm{T} = chN/(4.965114R_0) = .2014052c_2$	Wien displacement constant	$(.289780 \pm .000005)$ cm (°K)
$\lambda_{cp} = \lambda_{ce}Nm/H^+$	Compton wavelength of the proton	$(1.32140 \pm .00002) \times 10^{-13}$ cm
$\lambda_0 = (hc^2/e)10^{-8}$	Wavelength associated with 1 ev.	$(1.23978 \pm .00002) \times 10^{-4}$ cm
$\nu_0 = 10^8(e/hc^2)$	Wave number associated with 1 ev.	$(8.0659 \pm .0001) \times 10^3$
$10^8e/c$	Energy associated with 1 ev.	$(1.60209 \pm .00001) \times 10^{-12}$ erg
$(F'/R_0)10^8$	"Temperature" associated with 1 ev.	$(1.16052 \pm .00001) \times 10^4$ °K

ATOMIC CONSTANTS (Continued)

$n_0 = N/V_0$	Loschmidt's number	$(2.68709 \pm .00009 \times 10^{19}$ cm^{-3}
$E_0 = (c^2/F')10^{-14}$	Conversion factor atomic mass units to Mev	$(9.3116 \pm .0001) \times 10^2$
$Eg = (c^2/e')10^{-14}$	Conversion factor from grams to Mev	$(5.6099 \pm .0001) \times 10^{26}$ mev gm^{-1}
$\mu_1 = he/4\pi m$	Bohr magneton	$(.92733_4 \pm .00002) \times 10^{-20}$ erg oer^{-1}
mc^2	Energy equivalent of *e* mass in mev	$(.510969 \pm .000010)$ mev (emass)$^{-1}$
$E_p = E_e H^+/Nm$	Energy equivalent of proton mass in mev.	$(938.210 \pm .008)$ mev (proton)$^{-1}$
S_0/R_0	Sakur Tetrode constant	$(-5.57305 \pm .00007)$
S_0		$(-4.634907 \pm .000036) \times 10^8$ erg mol^{-1} deg^{-1} (physical scale)
$\pi ce/4m$	Zeeman displacement per gauss	$(4.6703 \pm .0005) \times 10^{-5}$ cm^{-1} gauss^{-1}*
$a_0' = a_0(1 - \alpha^2)^{\frac{1}{2}}$	Separation of electron and proton in the ground state of H^1	$(.529196 \pm .000028) \times 10^{-8}$ cm*
$a_0'' = a_0' R_\infty / R_H$	Radius of the electron orbit, referred to center of mass for normal H^1	$(5.29484 \pm .000028) \times 10^{-8}$ cm*
$R_H \alpha^2/16$	Doublet separation in hydrogen	$(.365076 \pm .000038)$ cm^{-1}*
$\nu_0 = 10^8 e/hc$	Frequency associated with one ev	$(2.41856 \pm .00017) \times 10^{14}$ sec^{-1}*
$v_0 = [2 \cdot 10^8(e/m)]^{\frac{1}{2}}$	Speed of 1 ev electron	$(5.93188 \pm 0.00030) \times 10^7$ cm sec^{-1}*

* Cohen and DuMond, Review of Modern Physics, **21**: 651, 1949.

THE PARTICLES OF PHYSICS

Mass in units of 9.1085×10^{-28} g.	Generic name	Name	Sym-bol	Charge in units of 4.80×10^{-10} esu	Magnetic moment	Spin	Parity	Lifetime in free space (sec.)	Decay scheme	Energy release mev
0		Photon	γ	0	0	1	even	stable	—	—
0	Leptons	Neutrino	ν	0		$\frac{1}{2}$	even	stable?	—	—
0		Antineutrino	$\bar{\nu}$	0	$<10^{-7}$ Bohr magneton	$\frac{1}{2}$	even	stable?	—	—
1		Electron	e^-	−1	1.001146	$\frac{1}{2}$	even	stable	—	—
1		Positron	e^+	+1		$\frac{1}{2}$	even	stable	—	—
	L-Mesons									
206.9	μ-mesons	Negative muon	μ^-	−1		$\frac{1}{2}$	even	2.15×10^{-6}	$e^- + \nu + \nu$	105.2
"		Positive muon	μ^+	+1		$\frac{1}{2}$	even	"	$e^+ + \nu + \nu$	105.2
264.5	π-mesons	Neutral pion	π^0	0		0	odd	5×10^{-15}	$2\gamma, \gamma + e^+ + e^-$	135.1
273.3		Negative pion	π^-	−1		0	odd		$\mu^- + \nu$	33.9
"		Positive pion	π^+	+1		0	odd	2.53×10^{-3}	$\mu^+ + \nu$	33.9
966	K-Mesons	τ-meson	τ^-	−1		integer	odd	5×10^{-9}	$\pi^- + \pi^+ + \pi^-$	73.1
"		"	τ^+	+1		"	odd	"	$\pi^+ + \pi^+ + \pi^-$	"
"		θ-meson	θ^0	0		"		8×10^{-11}	$\pi^+ + \pi^-$	214
"		$K_{\pi3}$ or τ	$K_{\pi3}$	+1		"		5×10^{-9}	$\pi^+ + \pi^0 + \pi^0$	81.8
"		" " "	"	−1		"		"	$\pi^- + \pi^0 + \pi^0$	81.8
		$K_{\pi2}$ or χ	$K_{\pi2}$	+1		integer		$1\text{–}10 \times 10^{-9}$	$\pi^+ + \pi^0$	206–218
"		" " "	"	−1		"		"	$\pi^- + \pi^0$	206–218
"		$K_{\mu2}$	$K_{\mu2}$	+1		"		8.7×10^{-9}	$\mu^+ + \bar{\nu}$	
"		$K_{\mu3}$	$K_{\mu3}$	?		"		?	μ + 2 neutrals	
"		K_{e3}	K_{e3}	+1(−1?)		?	?		e + 2 neutrals	
1835	Nucleons	Proton	p	+1	2.7896	$\frac{1}{2}$	even	stable	—	—
1835		Antiproton	$\bar{p}$	−1		$\frac{1}{2}$*	even*		—	
1837		Neutron	n	0	−1.9130	$\frac{1}{2}$	even	1020	$p + e + \nu$	0.78
1837		Antineutron	$\bar{n}$	0		$\frac{1}{2}$*	even*		—	—
2181	Hyperons	Λ^0 (old V_1^0)	Λ^0	0		$\frac{1}{2}$		3.5×10^{-10}	$p + \pi^-$ or $n + \pi^0$	40
2327		Σ^+	Σ^+	+1		$\frac{1}{2}$		0.5×10^{-10}	$p + \pi^0$ or $n + \pi^+$	116 cr
										111
2327		Σ^-	Σ^-	−1		$\frac{1}{2}$			$n + \pi^-$	111
2583		Cascade particle	Ξ^-	−1		$\frac{1}{2}$		$\sim 1 \times 10^{-10}$	$\Lambda^0 + \pi^-$	67

* Presumed but not measured.

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SYMBOLS FOR FUNDAMENTAL PARTICLES

Symbols Proposed at Bagnères Congress

The following proposal for a new set of symbols for fundamental particles was agreed upon as a result of discussions held during the International Cosmic-Ray Congress at Bagnères de Bigorre in the French Pyrenees, July 6–12, 1953. The Congress was organized by the University of Toulouse with the support of Unesco and of the Commission for Cosmic Rays of IUPAP.

CLASSIFICATION OF PARTICLES

A. *Groups of Particles*

Light mesons (L-mesons):

π-mesons, μ-mesons, any other lighter meson which may be discovered.

Heavy mesons (K-mesons):

all particles heavier than π-mesons and lighter than protons.

Hyperons (Y-particles):

all particles with mass intermediate between that of the neutron and the deuteron (this definition might be revised if fundamental particles heavier than deuterons are discovered).

B. *"Christian Names"*

Use capital Greek letters for hyperons and small Greek letters for mesons.

(1) *Hyperons*

Λ^0: particle previously known as $V_1{}^0$ and characterized by the decay scheme $\Lambda^0 \to p + \pi^-$. If it turns out (as suggested by some results) that there are particles with this decay scheme and different Q-values, they could be designated by different subscripts.

Λ^+: the positive counterpart of Λ^0 with the possible decay schemes:

$$\Lambda^+ \to n + \pi^+$$
$$\Lambda^+ \to p + \pi^0$$

The existence of these particles is indicated by recent experiments.

(2) *Heavy Mesons*

$\tau \to 3\pi$ (considered certain).

$\kappa \to \mu + 2$ *neutral particles* (considered very probable; however, the nature of the neutral products is still unknown).

$\chi \to \pi + 1$ *neutral particle* (considered as probable; nature of neutral particle unknown).

SYMBOLS FOR FUNDAMENTAL PARTICLES (Continued)

θ^0: particle previously known as v^0, $V_2{}^0$, $V_4{}^0$, characterized by the decay scheme $\theta^0 \rightarrow \pi^\pm + (\pi^\pm \text{ or } \mu^\mp)$. If it turns out (as suggested by some results) that there are particles with this decay scheme and several Q-values, they could be designated by different subscripts.

V-event:

phenomenon which can be interpreted as the decay in flight of K-meson or Y-particle. Subdivisions: V^0-event; decay of a neutral particle; $V^\pm$-event, decay of a charged particle.

S-event:

phenomenon which can be interpreted as the decay at rest of a charged K-particle or Y-particle.

ABBREVIATIONS AND SYMBOLS

Abbreviations

The following list of abbreviations is intended to cover those in common use in chemistry and physics. Symbols are presented in a separate list following the abbreviations.

A.	Acre
Å	Ångström unit
a	Are
a.	Acid
abs.	Absolute
abt.	About
a.c.	Alternating current
acet.	Acetone
acet. a.	Acetic acid
al.	Alcohol
alk.	Alkali
alt.	Altitude
amal.	Amalgam; amalgamated
amor. *or* amorph.	Amorphous
amp.	Ampere
anh.	Anhydrous
antilog	Antilogarithm
ap.	Apothecaries'
appr.	Approximately
aq.	Aqua; aqueous; water
aq. reg.	Aqua regia
asym.	Asymmetrical
atm. *or* atmos.	Atmosphere (atmospheric)
At. No.	Atomic number
At. Wt.	Atomic weight
aux.	Auxiliary
Av.	Average
av. *or* avoir.	Avoirdupois
bar.	Barometer
bbl.	Barrel
bd.	Board
Bé	Beaumé (degrees)
B.G.	Birmingham gauge (hoop and sheet)
b.h.p.	Brake horse power
bl.	Blue
blk.	Black
B.M.	Board measure
b.p.	Boiling point
br.	Brown
BTU	British thermal unit
bu.	Bushel
B.W.G.	Birmingham wire gauge
bz.	Benzene
C	Centigrade
c	Carat; centi-
c.	Cold
ca	Candle
ca.	*Circa*, about; approximately
cal.	Calorie (gram)
cc. *or* c.c.	Cubic centimeter
cd.	Cord
c. cm	Cubic centimeter
Cent.	Centigrade
centi-	Prefix meaning 1/100
cf.	*Confer*, compare
c.f.m.	Cubic foot per minute
cgs	Centimeter-gram-second system of units
cgse	Cgs electrostatic system
cgsm	Cgs electromagnetic system
ch.	Chain
chl.	Chloroform
cir.	Circular
circum.	Cirumference
cl	Centiliter
cm	Centimeter
cm^2	Square centimeter
cm^3	Cubic centimeter
c.m.	Circular mil
coef.	Coefficient
colog	Cologarithm
colorl.	Colorless
comm'l	Commercial
conc.	Concentrated
cond.	Condensing
const.	Constant
cos	Cosine
$\cos^{-1}$	Arc or angle whose cosine is...; anticosine of; inverse cosine of
cosec	Cosecant
cosh	Hyperbolic cosine
$\cosh^{-1}$	Inverse hyperbolic cosine
cot	Cotangent
$\cot^{-1}$	Arc or angle whose cotangent is . . .
coth	Hyperbolic cotangent
$\coth^{-1}$	Inverse hyperbolic cotangent
covers	Coversed sine
c.p.	Candle power; circular pitch; center of pressure
cry. *or* cryst.	Crystalline; crystals
csc	Cosecant
$\csc^{-1}$	Arc or angle whose cosecant is...
csch	Hyperbolic cosecant
csch^{-1}	Inverse hyperbolic cosecant
CTU	Centigrade thermal unit
cu.	Cubic
cu. cm	Cubic centimeter
cu. ft.	Cubic foot
cu. in.	Cubic inch
cu. m	Cubic meter
cu. yd.	Cubic yard
cwt.	Hundredweight
cyl.	Cylinder
d	Derivative; deci-
d.	Decomposes; day
d.	Dextrorotary
d.c.	Direct current
dec.	Decomposes
deci-	Prefix meaning 1/10
def.	Definition (s)
deg	Thermometric degree; absolute C unless contrary is indicated
deka-	Prefix meaning 10
deliq.	Deliquescent
den. *or* dens.	Density
dg	Decigram
diam.	Diameter
dil.	Dilute
dissd.	Dissolved
dk	Deka-
dk.	Dark
dkg.	Dekagram
dkl	Dekaliter
dkm	Dekameter
dkm^2	Square dekameter
dkm^3	Cubic dekameter
dks	Dekastere
dl	Deciliter

ABBREVIATIONS AND SYMBOLS (Continued)

Abbreviations (Continued)

dm	Decimeter
dm^2	Square decimeter
dm^3	Cubic decimeter
d.p.	Diametral pitch; double pole
dr.	Dram
dr. ap. *or* ʒ ap.	Dram, apothecaries'
dr. av. *or* ʒ av.	Dram, avoirdupois
dr. fl. *or* ʒ fl.	Dram, fluid
dr. t. *or* ʒt.	Dram, troy
ds	Decistere
dwt.	Pennyweight
efflor.	Efflorescent
e.g.	*Exempli gratia*, for example
e.h.p.	Effective horse power
E.L.	Elastic limit
em	Cgsm unit of quantity of electricity
emf *or* e.m.f.	Electromotive force
es	Electrostatic or cgse unit of quantity of electricity
etc.	*Et. cetera*, and so forth
eth.	Ether
eth. acet.	Ethyl acetate
et. seq.	*Et sequentes*, and the following
evap.	Evaporation
ex.	Excess
exp	Exponential function
exp.	Explodes
exsec	Exterior secant
F	Fahrenheit
f.	From
fahr.	Fahrenheit
fath.	Fathom
feath.	Feathery
f.h.p.	Friction horse power
fir.	Firkin
fl.	Fluid
fl. dr.	Dram, fluid
fl. oz.	Ounce, fluid
fluores.	Fluorescent
fps	Foot-pound-second system of units
fpse	Foot-pound-second electrostatic system
fpsm	Foot-pound-second electromagnetic system
F.S.	Factor of safety
ft.	Foot
ft.^{2}	Square foot
ft.^{3}	Cubic foot
ft.-lb.	Foot-pound
fur.	Furlong
G	Gravitation constant
g	Gram
g-cal. *or* g.-cal.	Gram calorie
gal.	Gallon
gel.	Gelatinous
gi.	Gill
glac.	Glacial
glit.	Glittering
glyc.	Glycerine
gm.	Gram
gr.	Gray; grain
grn.	Green
gyr.	Gyration
h	Hecto-
h.	Hot; hour
ha	Hectare
hecto-	Prefix meaning 100
hex.	Hexagonal
hg	Hectogram
hhd.	Hogshead
hl	Hectoliter
hm	Hectometer
hm^2	Square hectometer
hm^3	Cubic hectometer
hor. *or* horiz.	Horizontal
h.-p.	High-Pressure
HP *or* h.p.	Horse power
h.p.-hr.	Horse power-hour
hr.	Hour
hyg.	Hygroscopic
i.	Insoluble
ibid.	*Ibidem*, in the same place
i.e.	*Id est*, that is
ign.	Ignites
i.h.p.	Indicated horse power
in.	Indigo; inch
in.^{2}	Square inch
in.^{3}	Cubic inch
inc.	Inclusive
in.-lb.	Inch-pound
insol.	Insoluble
Int.	International
iso.	Isotropic
isom.	Isometric
isoth.	Isothermal
k	Kilo-
kg	Kilogram
kg-cal.	Kilogram-calorie
kg-m	Kilogram-meter
kilo-	Prefix meaning 1,000
kl	Kiloliter
km	Kilometer
km^2	Square kilometer
km^3	Cubic kilometer
kva.	Kilovolt-ampere
kw.	Kilowatt
kw.-hr.	Kilowatt-hour
l	Liter
l.	Long
l	Laevorotary
lat.	Latitude
lb.	Pound
lb. ap.	Pound, apothecaries'
lb. av.	Pound, avoirdupois
lb. t.	Pound, troy
leaf.	Leaflets
lgr.	Ligroin
li.	Link
lin.	Linear
liq.	Liquid
lim.	Limit
ln	Natural hyperbolic or Napierian logarithm
log *or* log.	Logarithm
log$_e$	Logarithm to the base *e*; natural, hyperbolic or Napierian logarithm
log$_{10}$	Common logarithm; logarithm to the base 10
long.	Longitude
lng.	Long
l.-p.	Low-pressure
lt.	Light
lust.	Lustrous
♏	Minim or drop
m	Meter; milli-
m^2	Square meter
m^3	Cubic meter
m.	Minute
m.	Meta-
max.	Maximum
med.	Medium
meth.	Methyl
meth. al.	Methyl alcohol
m.e.p.	Mean effective pressure
met.	Metallic
mg	Milligram

ABBREVIATIONS AND SYMBOLS (Continued)

Abbreviations (Continued)

m.h.c.p.	Mean horizontal candle power
mi.	Mile
mic.	Microscopic
micro-	Prefix meaning 1/1,000,000 or 10^{-6}
micro-micro	Prefix meaning 10^{-12}
milli-	Prefix meaning 1/1,000
milli-micro-	Prefix meaning 10^{-9}
min *or* min.	Minute
min.	Minim; minimum; mineral
ml	Milliliter
m.l.h.c.p.	Mean lower hemispherical candle power
mm	Millimeter
mm^2	Square millimeter
mm^3	Cubic millimeter
mmf *or* m.m.f.	Magnetomotive force
mol.	Molecule
Mol. Wt.	Molecular weight
monocl.	Monoclinic
m.p.	Melting point
m.s.c.p.	Mean spherical candle power
myria-	Prefix meaning 10,000 or 10^4
mμ	Millimicron; millimicro-
N	Numeric; number (in mathematical tables)
n.	Normal
n	Refractive index
need.	Needles
o	Ortho-
Obs.	Observer
octahdr.	Octahedral
oil turp.	Oil of turpentine
or.	Orange
oz.	Ounce
oz. ap. *or* ℥ ap.	Ounce, apothecaries'
oz. av. *or* ℥ av.	Ounce, avoirdupois
oz. fl. *or* ℥ fl.	Ounce, fluid
oz. t. *or* ℥ t.	Ounce, troy
p	Para-
pa.	Pale
p. ct.	Per cent
perp.	Perpendicular
p.f.	Power factor
pk.	Peck
pl.	Plates
powd.	Powder
pr.	Prisms
precip. *or* p'p't'd	Precipitated
p. sol.	Partly soluble
pt.	Point; pint
purp.	Purple
pyr.	Pyridine
Q	Quantity
q	Quintal
qt.	Quart
q.v.	*Quod vide,* which see
R	Réaumur; radioactive mineral
rac	Racemic
rad	Radian, measure of angle
rad.	Radius
rd.	Rod
reg.	Regular
rev.	Revolution
rhbdr.	Rhombohedral
rhomb.	Rhombic or orthorhombic
R.M.S.	Square root of mean square
r.p.m.	Revolutions per minute
s	Stere
s.	Scruple; soluble; second
s. ap. *or* ℈	Scruple, apothecaries'
sat. *or* sat'd	Saturated
sc.	Scales
S.E.	Siemens unit
sec *or* sec.	Second (mean solar unless contrary is stated)
sec	Secant
sec^{-1}	Arc or angle whose secant is . . .
sech	Hyperbolic secant
sech^{-1}	Inverse hyperbolic secant
segm.	Segment
sh.	Short
sin	Sine
sin^{-1}	Arc or angle whose sine is . . .
sinh	Hyperbolic sine
sinh^{-1}	Inverse hyperbolic sine
sl.	Slightly
sm.	Small
sol.	Solution; soluble
soln.	Solution
sp.	Specific
specif.	Specification
sp. gr.	Specific gravity
sq.	Square
sq. ch.	Square chain
sq. ft.	Square foot
sq. in.	Square inch
sq. mi.	Square mile
sq. rd.	Square rod
sq. yd.	Square yard
std.	Standard
subl.	Sublimes
sym.	Symmetrical
t	Metric ton
t.	Troy
tab. *or* tabl.	Tablets
tan	Tangent
tan^{-1}	Arc or angle whose tangent is . . .
tanh	Hyperbolic tangent
tanh^{-1}	Inverse hyperbolic tangent
temp.	Temperature
tetr. *or* tetrag.	Tetragonal
tn.	Ton
tr.	Transition
tricl.	Triclinic
trig.	Trigonal
trim.	Trimetric
T.S.	Tensile strength
turp.	Turpentine
Tw.°	Degrees Twaddell, hydrometer scale
ult.	Ultimate
uns.	Unsymmetrical
U.S.	United States of America; universal system of lens apertures
v.	Very
v.	*Vide,* see
vel. *or* veloc.	Velocity
vers	Versed sine
vert	Vertical
visc.	Viscous
vol.	Volume
volt.	Volatilizes
w.	Water
wh.	White
wt.	Weight
yd.	Yard
yel.	Yellow
yr.	Year
μ	Micron; micro-
$\mu\mu$	Micromicron; micromicro-

Symbols

The following list of symbols is arranged from the Final Report of the Committee on Letter Symbols and Abbreviations of the American Association of Physics Teachers, H. K. Hughes, Chairman, published in the American Journal of Physics, Vol. 16, No. 3, 164–179, March, 1948.

Definitions in parentheses are those whose use is discouraged by the committee.

English Letter Symbols

$\mathbf{A}$	Magnetic vector potential.
A	Area; amplitude; atomic weight; refracting angle of prism; strength of simple acoustic source; power gain of amplifier; power amplification of amplifier; voltage gain of amplifier; voltage amplification of amplifier; Helmholtz function or maximum isothermal work function: per mole, per total value $[= U - TS]$; Richardson equation factors $[I_s = AT^2e^{-b/T}]$.
A_M	Helmholtz function or maximum isothermal work function per mole.
A_p	Power amplification of amplifier; power gain of amplifier.
A_v	Voltage amplification of amplifier; voltage gain of amplifier.
A, B, C	Cauchy constants $[n = A + B/\lambda^2 + C/\lambda^4]$.
$\mathbf{a}$	Linear acceleration.
a	Activity (chem.); aperture (optics); coefficient of accommodation; slit width (transparent portion); radius of tube, disk or membrane (acoust.); mean absorption coefficient for a room (acoust.); Helmholtz function or maximum isothermal work function: per atom or molecule, per mole, per unit mass; Van der Waals constants, $\left[\left(p + \frac{n^2a}{V^2}\right)(V - nb) = nRT\right]$.
a_m	Helmholtz function or maximum isothermal work function per atom or molecule.
a_1	Bohr radius $[= h^2/4\pi^2me^2]$.
$_a$ (subscript)	Adsorbed.
$_{av}$ (subscript)	Average value; or use bar over symbol (e.g., I_{av}, $\bar{I}$)
$\mathbf{B}$	Magnetic flux density or magnetic induction density.
B	Susceptance; brightness or luminance $[= dI/dA \cos\theta]$; volume modulus of elasticity (reciprocal of compressibility factor).

$\mathcal{B}$	Steradiancy [$= dJ/dA \cos\theta$].
b	Susceptance; breadth or width; closest possible distance of approach (in Rutherford scattering formula); radiation law constants (Wien); Wien displacement constant [$= \lambda_m T$]; Richardson equation factors [$I_s = AT^2 e^{-b/T}$]; Van der Waals constants $\left[\left(p + \frac{n^2a}{V^2}\right)(V - nb) = nRT\right]$
$_b$ (subscript)	Black body.
C	Compliance; normality; capacitance or permittance; heat capacity: per mole, total value (use subscripts p or V to indicate constancy of pressure or of volume); (speed or velocity rms.).
C_M	Heat capacity per mole.
$\mathbf{c}_0$	(Most probable velocity).
c	Speed of light in vacuum, speed of sound; velocity of light in vacuum; velocity of sound or other waves; induction coefficient, or partial capacitance coefficient; heat capacity: per atom or molecule, per mole, per unit mass (specific); concentration (*solutions*), or use bracket [ ] notation; distance from neutral axis to extreme fibre (*beams*); (acoustic conductivity of an opening).
c (with suitable subscript)	Partial capacitance.
c_m	Heat capacity per atom or molecule.
c_0	(Most probable speed).
c_1, or c_2	Planck radiation law constants $\left[\frac{J_\lambda}{A \cos\theta} = N_\lambda = \frac{c_1}{\lambda^5}\left(\exp\frac{c_2}{\lambda T} - 1\right)\right]$
$_c$ (subscript)	Cathode; critical properties.
$\mathbf{D}$	Electric displacement; displacement flux density; electric (dielectric) flux density [$\Psi = \int \mathbf{D} \cdot d\mathbf{A}$]; electric induction density.
$\dot{\mathbf{D}}$	Displacement current.
$\dot{\mathbf{D}}/4\pi$	Displacement current.
D	Diameter; optical density [$= \log_{10} P_0/P$]; optical attenuation; angle of minimum deviation; angular dispersion [$= d\theta/d\lambda$]; coefficient of diffusion (fluid); dioptric power [$= n/f$]; power of lens system, or refracting power [$= n/f$, diopters]; (density [$= m/V$]); (mass per unit volume (density)).

ABBREVIATIONS AND SYMBOLS (Continued)
English Letter Symbols (Continued)

d	Distance between corresponding points of grating (grating space); distance between lens units in an optical system; interplanar distance (Bragg law); spacing of Bragg planes in a crystal.
$\mathbf{E}$	Electric field strength.
E	Total energy; illuminance, or amount of illumination $[= \mathrm{d}F/\mathrm{d}A]$; Young modulus of elasticity; (electromotive force, or e.m.f.).
E_k	Kinetic energy.
E_p	Potential energy.
E_v	Energy of vibration.
$\mathcal{E}$	Irradiance or radiant flux density $[= \mathrm{d}\Phi/\mathrm{d}A$ or $\mathrm{d}P/\mathrm{d}A]$; electromotive force, or e.m.f.
e	Base of natural (Naperian) logarithms $[= 2.718 \ldots]$; coefficient of resiliance or coefficient of restitution.
$-e$	Electronic charge.
F	Formality; weight $[= mg]$; force; gravitational force; force in a string or membrane; force, stretching ("tension") in a string or membrane; luminous flux; distribution function; hyperfine quantum number $[= I + J]$; Faraday constant or equivalent.
F_g	Gravitational force.
$\mathfrak{F}$	Magnetomotive force, or magnetic scalar potential.
f	Fugacity; distribution function; relative humidity; frequency (elect. circuits, mechanics, acoust.); focal length of object space; degrees of freedom (kinetic theory; Gibb's phase rule); coefficient of friction (use if μ designates the Poisson ratio).
f_r	Natural or resonant frequency.
f_0	(Photoelectric threshold frequency).
f'	Focal length of image space.
$_f$ (subscript)	Filament.
G	Electric conductance; Gibbs function: per mole $[= G/n]$, total value $[= H - TS]$; gravitational constant, Newtonian; rigidity or shear modulus of elasticity.
G_M	Gibbs function per mole $[= G/n]$.
g	Electric conductance; gravitational acceleration; gyromagnetic ratio; statistical weight or degeneracy; Gibbs function: per atom or molecule, per mole $[= G/n]$, per unit mass; Landé factor.

ABBREVIATIONS AND SYMBOLS (Continued)
English Letter Symbols (Continued)

$-g$	Acceleration of free fall.
g_g	Grid or input conductance.
g_L	Gravitational acceleration, local value.
g_m	Gibbs function per atom or molecule; (grid-plate transconductance, real part of grid-plate transadmittance).
g_o	Gravitational acceleration, standard value [= 980.665 cm $\sec^{-2}$].
g_p	Plate or output conductance.
g_{pg}	Grid-plate transconductance, real part of grid-plate transadmittance.
$_G$ (subscript)	Gas or vapor.
$_g$ (subscript)	Control grid: (for several grids use subscripts $_{g_1, g_2, \ldots}$, beginning at cathode) Grid injector: Use subscript $_{g_4}$ numbered from cathode. Grid screen: Use subscript $_s$ or $_{g_2}$ etc. numbered from cathode. Grid, suppressor: Use subscript $_{su}$ or $_{g_3}$, etc. numbered from cathode.
$\mathbf{H}$	Magnetic field strength or magnetic field intensity.
H	Enthalpy (heat content): per mole, total value; irradiance or radiant flux density [= $d\Phi/dA$ or dP/dA]; Boltzmann function $\left[= \sum_i n_i \ln n_i\right]$; Hamiltonian function or operator; Henry law constant.
H_M	Enthalpy (heat content) per mole.
$\mathcal{H}$	Perturbing Hamiltonian function or operator.
h	Altitude; head; height, depth and thickness; radius of lens zone; degree of hydrolysis (*solution*); enthalpy (heat content): per atom or molecule, per mole, per unit mass; Planck constant.
$\hbar$	Dirac $h[= h/2\pi]$.
h_m	Enthalpy (heat content) per atom or molecule.
h, k, l	Miller indices.
$\left.\begin{matrix} h_1[= nh] \\ h_2[= nk] \\ h_3[= nl] \end{matrix}\right\}$	Bragg reflection indices.
$_h$ (subscript)	Heater.
I	Steady direct current; conduction current; convection current; effective (rms) current); (instantaneous current); nuclear spin; nuclear spin quantum number; moment of inertia; areal moment of

English Letter Symbols (Continued)

	inertia, rectangular [$= \int y^2 dA$]; activity at time t (radioactivity); acoustic intensity (e.g., erg $cm^{-2} sec^{-1}$); candlepower or luminous intensity [$= dF/d\omega$]; integration constant of Gibbs function equation; magnetic shell strength.
$\bar{I}$	Quiescent current; average current.
$\hat{I}$	Peak current.
I_{av}	Average current.
I_m	Maximum current; maximum peak current.
I_{max}	(Maximum current).
I_{mp}	Maximum peak current.
I_p	Peak current.
I_{pk}	(Peak current).
I_s	Saturation current; total electron emission or saturation.
I_{xx} etc.	Moment of inertia.
I_{xy} etc.	Product of inertia.
I_0	Initial activity (radioactivity).
$\mathbf{i}$	Unit vector in X-direction.
i	Instantaneous current; inertia of photographic plate; vapor pressure constant; mole factor, or van't Hoff coefficient; angle of incidence or angle between ray and normal in first medium; right-angle turning operator ($= \sqrt{-1}$; use j in electric circuits); square root of minus one [$= \sqrt{-1}$ (this is the special case, where $\varphi = \pi/2$, of the operator exp $j\varphi$ which turns a vector through the angle φ; use j in elect.); imaginary unit ($= \sqrt{-1}$, same as right-angle turning operator; use j in electric circuits); vector turning operator [$= \sqrt{-1}$] (this is the special case, where $\varphi = \pi/2$, of the operator exp $j\varphi$ which turns a vector through the angle φ; use j in elec. circuits).
$\mathbf{J}$	Electric current density.
J	Variable action; number of equivalents; radiant intensity [$= d\Phi/d\omega = dP/d\omega$]; total inner quantum number; total emissive power; (moment of inertia); polar areal moment of inertia [$= \int r^2 dA$]; electric or mechanical equivalent of heat (Joule constant).
J_λ	Monochromatic emissive power; spectral radiant intensity [$= dJ/d\lambda$].
J_ν	Monochromatic emissive power.

ABBREVIATIONS AND SYMBOLS (Continued)

English Letter Symbols (Continued)

$\mathbf{j}$	Unit vector in Y-direction.
j	Inner quantum number; right-angle turning operator ($= \sqrt{-1}$; use j in electric circuits); square root of minus one $= \sqrt{-1}$ (this is the special case, where $\varphi = \pi/2$, of the operator exp $j\varphi$ which turns a vector through the angle φ; use j in elect.); imaginary unit ($= \sqrt{-1}$, same as right-angle turning operator; use j in electric circuits); vector turning operator [$= \sqrt{-1}$] (this is the special case, where $\varphi = \pi/2$, of the operator $j\varphi$ which turns a vector through the angle φ; use j in electric circuits).
K	Curvature; Kerr constant; luminous efficiency [$= F/P$, $\lambda = 5550A$]; equilibrium constant (products/reactants).
K_λ	Visibility factor, or luminosity, or monochromatic luminous efficiency [$= F_\lambda/P_\lambda = F_\lambda/\Phi_\lambda$].
K_h	Hydrolysis constant.
$\mathbf{k}$	Unit vector in Z-direction.
k	Thermal conductivity; force constant [$= -F/s$]; spring constant [$= -F/s$]; specific reaction velocity, specific reaction rate or reaction velocity constant; wave length constant [$= 2\pi/\lambda$]; torque per unit twist or tortion constant; gas constant, molecular, or Boltzmann constant; radius of gyration; load per unit displacement; restoring force per unit displacement; magnetic susceptibility; volume magnetic susceptibility [$\mathbf{M} = k\mathbf{H}$]; compressibility factor (coefficient of compressibility; reciprocal of volume modulus of elasticity).
k_g	Grid conductance at zero frequency and constant plate potential [$= (\partial i_g/\partial v_g)_{vp}$].
k_p	Plate conductance at zero frequency and constant grid potential [$= (\partial i_p/\partial v_p)_{vg}$].
L	Inductance; relative heat content; total azimuthal or orbital quantum number; length of heat flow path; Lorentz unit [$= Be/4\pi mc^2$]; Lagrange function or Lagrangian or kinetic potential [$= E_k - E_p$].
L_{12} etc.	Mutual inductance.
l	Length; free path; length of heat flow path; azimuthal or orbital quantum number; length of vibrating string, rod or tube.

ABBREVIATIONS AND SYMBOLS (Continued)
English Letter Symbols (Continued)

$\bar{l}$	Mean free path.
l_T	Tait free path.
l_0	Length rest.
l, m, n	Direction cosines.
$_L$ (subscript)	Reference to liquid.
$\mathbf{M}$	Magnetization [$= \mathbf{m}/V$]; intensity of magnetization; magnetic polarization.
M	Atomic weight; molecular weight; mutual inductance; total magnetic quantum number.
$\mathbf{m}$	Magnetic moment.
m	Modulation factor; linear magnification; (magnetic pole strength); magnetic quantum number; number of phases (elect. circuits); order of spectrum, mass (general use); mass of atom or molecule; electronic mass (use m_e when m is magnetic quantum number).
m_e	Electronic mass. (Use when m is magnetic quantum number.)
m_m	Mass of atom or molecule.
m_0	Mass rest.
$_m$ or $_{max}$ (subscript)	Maximum
$_{min}$ (subscript)	Minimum
N	Safety factor; normalization factor (probability); steradiancy [$= \mathrm{d}j/\mathrm{d}A \cos\theta$]; number of turns or of conductors; number of molecules (total); total number of lines of a grating; number of atoms or nuclei at time t (radioactivity).
$N_{1,2\ldots}$	Number of atoms or nuclei (if more than one type is considered).
$N^{o}_{1,2\ldots}$	Initial number of atoms or nuclei (if more than one type is considered).
N_0	Initial number of atoms or nuclei (radioactivity); Avogadro number (number of molecules per mole.
n	Number; number of moles; number of components (Gibbs phase rule); number of molecules per unit volume (molecular concentration); number of revolutions or rotations per unit time; principal quantum number; refractive index; rotational frequency [rev/time]; (angular frequency without damping); rigidity or shear modulus of elasticity; molecular concentration or molecular density [$= N/V$]; (order of spectrum).
n'	(Angular frequency of free vibration with damping).

ABBREVIATIONS AND SYMBOLS (Continued)
English Letter Symbols (Continued)

n_g	Group refractive index.
n_o	Loschmidt number (number of molecules per unit volume at 0°C and 1 atm).
$_n$ (subscript)	normal (perpendicular).
$\mathbf{P}$	Electric polarization.
P	Probability; power (use same system of subscripts as for current except that P, unmodified, signifies average power); active power (elect); radiant power or radiant flux [$= dU/dt$]; pressure [$= F/A$] (use P for total pressure when p represents vapor pressure; amplitude of simple harmonic pressure (acoust.).
P_i	Input power.
P_p	Plate power.
P_s	Surface polarization or strength of double layer (electric).
P_0	Static pressure.
	Output power.
$\mathbf{p}$	Total electric moment.
p	Pressure [$= F/A$] (use P for total pressure when p represents vapor pressure); osmotic pressure; vapor pressure; varying pressure; partial pressure; generalized momentum; magnetic pole strength; (partial) potential coefficient; impact parameter (Rutherford scattering formula); distance between a principal plane of a lens system and the appropriate principal plane of a unit; (angular frequency of impressed force).
p_c	Critical pressure.
$_p$ (subscript)	Plate.
Q	Electric charge; quantity of electric charge; electric quadrupole moment; thermoelectric power; quantity of heat; quantity of light or luminous energy [$= \int F dt$]; storage factor energy; Q-factor or quality factor of reactor [$= X/R$]; moment of area [$= \int y dA$]; figure of merit of inductance [$= X/R$].
q	Electric charge; quantity of electric charge; generalized coordinate; heat entering system.
R	Range (radioactivity); acoustic resistance; electric resistance; radiation resistance; thermal resistance; Rydberg constant; rotational quantum number; universal gas constant [$pV = nRT = mRT/M$; $pv_M = RT$]; (radius of tube, disk or membrane)(acoustic).

ABBREVIATIONS AND SYMBOLS (Continued)
English Letter Symbols (Continued)

$\mathcal{R}_\infty$	Rydberg constant for infinite mass.
$\mathcal{R}$	Reluctance; radiant flux density [$= \mathrm{d}\Phi/\mathrm{d}A$ or $\mathrm{d}P/\mathrm{d}A$] (when referring to a source is called radiancy, symbol $\mathcal{R}$).
$\mathbf{r}$	Position vector; radius vector.
r	Relative humidity; radial distance; radius; nuclear radius; polar coordinates; angle of reflection; angle of refraction or angle between ray and normal in second medium; specific gas constant $pv = rT$ where $v = V/m$ and $r = R/M$; specific acoustic resistance; (electric resistance).
r_p	Plate resistance.
$_r$ (subscript)	Reduced properties.
S	Area; action; total spin; spin, total quantum number (strictly speaking spin is not a quantum number); static sensitivity of phototube; reciprocal capacitance or elastance; area of cross section, walls (acoust.); effective molecular cross section; entropy: per mole, total value.
S_M	Entropy per mole.
s	Slip (elect. mach.); spin; spin quantum number (strictly speaking spin is not a quantum number); turbidity (scattering coefficient); acoustic condensation; linear distance; arc length, or path; object distance (optics); distance between object and corresponding principal plane (object distance); linear displacement; displacement in general; dynamic sensitivity of phototube; entropy: per atom or molecule; per mole, per unit mass.
s'	Image distance (optics); distance between image and corresponding principal plane (image distance).
s_m	Entropy per atom or molecule.
s_p	Transconductance at zero frequency and constant plate potential [$(= \partial i_p/\partial v_g)v_p$].
$_s$ (subscript)	Adiabatic; source; Use $_s$ or $_{g_2}$ numbered from cathode for grid, screen.
$_{su}$ (subscript)	Or $_{g_3}$ numbered from cathode for grid, suppressor.
T	Absolute (Kelvin) temperature; reverberation time; oscillation period; period of a periodic motion; half life (radioactivity); (kinetic energy); (force in a string or membrane).
T_c	Critical temperature.
T_0	Ice point; absolute temperature of ice point.

t	Ordinary temperature; time (use τ when t is used for temperature); length of prism base.
t_c	Critical temperature.
t_0	Ice point; ordinary temperature of ice point.
$_t$ (subscript)	Transition between polymorphic forms.
U	Radiant energy; potential energy; total energy; internal or intrinsic energy (thermodyn.) per mole, total value.
U_λ	Spectral radiant energy or spectral monochromatic radiant energy [$= \mathrm{d}U/\mathrm{d}\lambda$].
U_M	Internal or intrinsic energy (thermodyn.) per mole.
$\mathbf{u}$	Velocity; group velocity; linear or particle velocity; velocity at time t; (velocity components of linear or particle).
$\hat{\mathbf{u}}$	Most probable velocity.
$\bar{\mathbf{u}}$	Average velocity.
$\mathbf{u}_{av}$	Average velocity.
$\mathbf{u}_g$	Group velocity.
$\mathbf{u}_t$	Velocity at time t.
$\left.\begin{matrix}\mathbf{u}_x\\ \mathbf{u}_y\\ \mathbf{u}_z\end{matrix}\right\}$	Linear or particle components of velocity; rectangular components of velocity.
$\mathbf{u}_0$	Initial velocity.
u	Speed; linear or particle speed; speed at time t; ionic velocity (with suitable subscript); reaction velocity [$= -\mathrm{d}c/\mathrm{d}t$]; density of radiant energy = [$\mathrm{d}U/\mathrm{d}V$]; time-independent wave function; angle of slope in object space; internal or intrinsic energy (thermodyn) per unit mass; per mole, per atom or molecule.
u'	Angle of slope in image space.
$\hat{u}$	Most probable speed.
$\bar{u}$	Velocity rms; speed rms.
u_φ	Phase or wave velocity.
u_{av}	Average speed.
u_m	Internal or intrinsic energy (thermodyn) per atom or molecule.
u_t	Speed at time t.
u_w	Phase or wave velocity.
u_0	Initial speed.
V	Atomic volume; total volume; volume of a cavity or room; volume of configuration-space; molecular volume; volume per mole; voltage (see potential difference); steady d-c potential difference; rms or effective potential difference; electric

	potential, or potential difference; inne potential (metals); specific magneti rotation or Verdet constant; shearin force in beam sector; (Hamilton-Jacob equation, time dependent variable (potential energy).
V_M	Volume per mole.
$\bar{V}$	Average potential difference; quiescen potential difference.
$\hat{V}$	Peak potential and peak potential difference.
$\hat{V}_m$	Maximum peak potential difference.
V_π	Peltier potential, and Peltier potenti difference.
V_{av}	Average potential difference.
V_c	Critical volume.
V_e	Excitation potential, and excitation potential difference.
V_i	Ionization potential; inner potentia (metals).
V_m	Maximum potential difference.
$V_{\max}$	(Maximum potential difference).
V_{mp}	Maximum peak potential difference.
V_p	Peak potential and peak potential difference.
V_{pk}	Peak potential; (peak potential difference).
V_s	Seebeck potential difference.
V_t	Thomson potential difference.
V_v	Volta potential or contact potential; Volta potential difference or contact potential difference.
$\mathbf{V}$	Velocity; group velocity; linear or particle velocity; velocity at time t; (linear or particle velocity components).
$\mathbf{V}_{av}$	Average velocity.
$\mathbf{V}_g$	Group velocity.
$\mathbf{V}_t$	Velocity at time t.
$\mathbf{V}_x$ $\mathbf{V}_y$ $\mathbf{V}_z$	Rectangular components of velocity.
$\mathbf{V}_0$	Initial velocity.
$\bar{\mathbf{V}}$	Average velocity.
$\hat{\mathbf{V}}$	Most probable velocity.
v	Speed; linear or particle speed; speed at time t; velocity of sound or other waves; vibrational quantum number; instantaneous potential difference; specific volume [$= V/m$]; specific volume per unit mass; volume per mole; volume per atom or molecule.

ABBREVIATIONS AND SYMBOLS (Continued)

English Letter Symbols (Continued)

$\hat{v}$	Most probable speed.
$\bar{v}$	Average speed.
$\tilde{v}$	Rms speed; rms velocity.
v_{av}	Average speed.
v_m	Volume per atom or molecule.
v_t	Speed at time t.
v_0	Initial speed.
W	Work; work energy; (weight [= mg]); radiant flux density or radiancy or radiance [= $\mathrm{d}\Phi/\mathrm{d}A$ or $\mathrm{d}P/\mathrm{d}A$] (when referring to a source is called radiancy symbol $\mathcal{R}$); Hamilton-Jacobi equation variable, time dependent.
$\mathbf{w}$	(Linear or particle velocity components).
w	Weight [= mg]; net work function; water vapor content, or mixing ratio; (work); (work energy); (transverse displacement, acoust.); (phase or wave velocity).
w_G	Work function, gross.
X	Volume displacement (acoust.); reactance, acoustic reactance.
X_C	Capacitive reactance.
X_L	Inductive reactance.
x	Specific acoustic reactance [= XA]; distance between object and principal focus of object space.
x'	Distance between image and principal focus of image space.
x, y, z	Variable; rectangular coordinates.
x (subscript)	Solid ($x$tal).
Y	Reciprocal impedance, or admittance; Young modulus of elasticity.
y	Altitude; height, depth and thickness; object length or height (optics); super compressibility factor; (transverse displacement, acoustic).
y'	Image length or height.
y_g	Grid or input admittance with plate load [= $g_g - jb_g$].
y_p	Output admittance (plate) [= $g_p - jb_p$].
y_{pg}	Grid plate transadmittance [= $g_{pg} - jb_{pg}$].
Z	Atomic number; impedance, acoustic impedance; molecular collision frequency [= no/time]; radius of circle of least confusion; radius of image of a point; modulus of section [= I/c, where c is distance of neutral axis from extreme fiber].
z	Valence; electrochemical equivalent; specific acoustic impedance [= ZA].

ABBREVIATIONS AND SYMBOLS (Continued)

Greek Letter Symbols

$\boldsymbol{\alpha}$	Angular acceleration.
α	Attenuation constant; specific rotation $[= \theta/lc]$; most probable speed; absorption coefficient of absorbing material (acoust.); thermal coefficient of resistance; linear coefficient of thermal expansion or linear expansivity; temperature coefficient of resistance; coefficient of recombination; Sommerfeld, or fine structure, constant $[= 2\pi e^2/ch]$; end correction for a tube (acoust.); half-angle subtended at point object by objective of microscope; angular resolving power of telescope; degree of dissociation (*solutions*); degree of ionization (*solutions*); (plane angle); (most probable velocity).
β	$1/kT$; u/c; phase constant $[\gamma = \alpha + j\beta]$; relativity ratio $[= v/c]$; ratio of speed to speed of light $[= v/c]$; volume coefficient of thermal expansion or volume expansivity $[= \alpha_1 + \alpha_2 + \alpha_3]$; (plane angle).
$\boldsymbol{\Gamma}$	Reciprocal inductance.
γ	Surface tension; propagation constant $[= \alpha + j\beta]$; angular magnification $[= \tan u'/\tan u]$; specific weight or weightivity $[w/V]$; ratio of specific heats $[= c_p/c_V]$; adiabatic exponent $[pV^\gamma = \text{const.}]$; contrast of photographic emulsion; (electric conductivity).
$\boldsymbol{\Delta}$	Optical length; optical tube length; optical path difference; distance between adjacent principal foci of two lens units; finite increment.
ΔH	Heat of reaction or phase change (evaporation, fusion, sublimation, etc.) per mole, total value.
ΔH_M	Heat of reaction or phase change (evaporation, fusion, sublimation, etc.) per mole.
Δh	Heat of reaction or phase change (evaporation, fusion, sublimation, etc.) per atom or molecule, per mole; per unit mass.
Δh_m	Heat of reaction or phase change (evaporation, fusion, sublimation, etc.) per atom or molecule.
δ	Deviation; angle of deviation; frequency deviation $[= \Delta f/f_r]$; difference in phase (e.g. cm.); total thermal expansion; total elongation (deflection); galvanometer deflection; deflection of beam of

	galvanometer, etc.; beam deflections or sag; piezoelectric strain constant or modulus; increment finite.
δ_m	Minimum deviation angle.
ϵ	Emittance; self energy $[= mc^2]$; epoch angle; extinction coefficient $[= (1/cl) \log_{10} P_0/P]$; piezoelectric stress constant; average molecular kinetic energy $[= \frac{1}{2}m\bar{v}^2]$; base of natural (Naperian) logarithms [= 2.718 . . .]; capacitivity, or dielectric coefficient (dielectric constant) in cgs units; permittivity (mks units); relative dielectric coefficient, or specific inductive capacity.
ϵ'	Emissivity; total value emissivity.
ϵ_r	Capacitivity, or dielectric coefficient (dielectric constant) in mks units; relative permittivity $[= \epsilon/\epsilon_0]$; relative dielectric coefficient, or specific inductive capacity.
ϵ_t'	Total value emissivity.
$\epsilon\lambda$	Monochromatic emissivity (color spectral).
ϵ_0	Permittivity of free space (mks units; see capacitivity).
ζ	Displacement of sound bearing particle; displacement components (of sound bearing particle).
η	Efficiency; coefficient of viscosity; displacement components of sound bearing particles; transverse displacement (acoust.); electric susceptibility $[\mathbf{P} = \eta\mathbf{E}]$.
ηV	Voltage efficiency $[= V_{\text{theor}}/V_{\text{actual}}]$ (*electrolysis.*)
Θ	Debye characteristic temperature; (Kelvin or absolute temperature).
θ	Angle of contact; angle of optical rotation; angle of diffraction; plane angle; glancing angle; angular displacement; angular distance; (ordinary temperature) polar coordinates.
κ	Absorption index $[= (\lambda/4\pi x) \ln P_0/P]$.
Λ	Permeance $= L/N^2$; Nuclear dissociation energy; equivalent conductivity (mho/equivalent).
λ	Decay constant $[N = N_0 \exp (-\lambda t)]$; disintegration constant $[N = N_0\epsilon - \lambda t]$ linear density (mass/length); charge density, linear; mass per unit length; wave length; free path.
$\bar{\lambda}$	Mean free path.
λ_e	Effective wave length.

Greek Letter Symbols (Continued)

λ_T	Tait free path.
λ (subscript)	Monochromatic; spectral.
μ	Inductivity, or absolute or magnetic permeability; gas amplification factor (photoelectric tubes); partial molal, or chemical potential Gibbs function [$= \partial G/\partial n$]; reduced mass $1/\mu = (1/m_1) + (1/m_2)$; coefficient of friction; sliding or kinetic coefficient of friction (use f when μ designates the Poisson ratio); grid control ratio (thyratrons); molecular conductivity (mho/mole); electric moment of atom, dipole molecule or dipole; magnetic moment of atom, molecule or dipole; amplification factor [$= -(\partial e_p/\partial e_g)i_p$]; Joule-Thomson (Kelvin) coefficient [$= \partial T/\partial p_H$]; Poisson ratio; (coefficient of diffusion (fluid)); (refractive index).
μ_I	Nuclear magneton [$= \mu_0/1838$].
μ_e	Electric moment of atom, dipole molecule, or dipole.
μ_g	(Refractive index group).
μ_k	(Sliding or kinetic coefficient of friction (use f when μ designates Poisson ratio)).
μ_m	Magnetic moment of atom, molecule or dipole.
μ_r	Relative magnetic permeability [$= \mu/\mu_0$ mks units]; coefficient of rolling friction (use f when μ designates Poisson ratio).
μ_s	Starting or static coefficient of friction (use f when μ designates the Poisson ratio).
μ_0	Bohr or orbital magneton [$= eh/4\pi mc$].
ν	Reluctivity [$= 1/\mu$]; permeability of free space reciprocal permeability; reciprocal of dispersive power; frequency (optics, quantum theory); coefficient of kinematic viscosity [$= \eta/\rho$]; Poisson ratio.
ν_0	Photoelectric threshold frequency.
Ξ	Propagation flux density.
ξ	Longitudinal displacement (acoust); displacement or displacement components of sound bearing particle; (transverse displacement (acoust.).
Π	Osmotic pressure; Peltier coefficient; Poynting vector; Hertzian vector.
π	(Osmotic pressure).
ρ	Density [$= m/V$]; vapor density; volume electric charge density; mass per unit volume (density); reflectance, or reflection factor [$= P/P_0$]; specific resistance

Greek Letter Symbols (Continued)

	or resistivity; absolute humidity; radius of curvature; (linear density, [mass/length]); (surface density [m/A); (mass per unit area); (mass per unit length).
ρv	Convection current.
ρ'	Reflectivity.
Σ	Exposure [$= Et$]; Summation Operator.
σ	Surface density m/A; dispersion [$= \mathrm{d}n/\mathrm{d}\lambda$]; area; mass per unit area; slip (elect. mach.); surface tension; electric conductivity; surface charge density; conductivity of an opening (acoust.); specific magnetization [$= \mathbf{m}/\sigma$]; magnetic leakage coefficient; wave number; effective molecular cross section; molecular diameter (collision); Stefan-Boltzmann constant [$= \mathrm{R}/\cdot \mathrm{T}_4$]; radiation law constants (see Stefan-Boltzmann); Thomson coefficient.
$\boldsymbol{\tau}$	Vector unit tangent to path.
τ	Transmittance or optical transmittance or transmission factor [$= P/P_0$]; time constant; mean life (radioactivity); decay modulus [$s = A \cos (\omega t + \varphi) \exp (-t/\tau)$; dew point temperature; (time, use when t is used for temperature); (total volume).
Φ	Magnetic flux or magnetic flux of induction [$= \int \mathbf{B} \cdot \mathrm{d}A$]; radiant power, or radiant flux [$= \mathrm{d}U/\mathrm{d}T$].
φ	Fluidity (reciprocal of viscosity); net work function per unit charge, or electron affinity [$\mathrm{d}\varphi = dw/de$ volts]; electromagnetic scalar potential; potential velocity (hydrodyn); electron affinity [$= w/e$, volts]; phase angle; angle of incidence or angle between ray and normal in first medium; (epoch angle).
φ_c	Critical angle.
φ_g	Work function per unit charge, gross, or gross electron affinity [$d\varphi_g = dw_g/de$, volts]; electron affinity, gross [$= w_g/e$, volts].
φ'	Angle of refraction or angle between ray and normal in second medium.
$\bar{\varphi}$	Polarizing angle or principal angle of incidence in dielectrics.
χ	Specific magnetic susceptibility [$= k/\sigma$].
Ψ	Total flux of electric displacement [$= \int \mathbf{D} \cdot \mathrm{d}\mathbf{A}$]; electric flux of induction [$= \int \mathbf{D} \cdot$

	d**A**]; electric or total electric (dielectric) flux [$= \int \mathbf{D} \cdot d\mathbf{A}$]; Planck function [$= -A/T$].
ψ	Time dependent wave function; Azimuth angle (optics).
$\bar{\psi}$	Principal azimuth angle.
Ω	Volume of phase space.
ω	Solid angle; pulsatance or periodicity [$= 2\pi f$]; angular speed; angular velocity; angular frequency [$= 2\pi f$, radians/time]; angular frequency of impressed force; angular frequency without damping; circular frequency [$= 2\pi f$]; dispersive power [$= (n_F - n_C)(n_D - 1)$]; specific magnetic rotation, or Verdet constant.
ω'	Angular frequency of free vibration with damping.
ω_r	Resonant periodicity.

Miscellaneous Symbols

$\cdots$ (superscripts)	Time derivatives, dots used over symbol.
$1/k$	Thermal resistivity.
M/z	Equivalent weight (chem).

AMERICAN STANDARD ABBREVIATIONS FOR SCIENTIFIC AND ENGINEERING TERMS

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Introductory Notes

Scope and Purpose

1. The Executive Committee of the Sectional Committee on Scientific and Engineering Symbols and Abbreviations has made the following distinction between symbols and abbreviations: Letter symbols are letters used to represent magnitudes of physical quantities in equations and mathematical formulas. Abbreviations are shortened forms of names or expressions employed in texts and tabulations, and should not be used in equations.

Fundamental Rules

2. Abbreviations should be used sparingly in text and with due regard to the context and to the training of the reader. Terms denoting units of measurement should be abbreviated in the text only when preceded by the amounts indicated in numerals; thus "several inches," "one inch," "12 in." In tabular matter, specifications, maps, drawings, and texts for special purposes, the use of abbreviations should be governed only by the desirability of conserving space.

3. Short words such as ton, day, and mile should be spelled out.

4. Abbreviations should not be used where the meaning will not be clear. In case of doubt, spell out.

5. The same abbreviation is used for both singular and plural, as "bbl" for barrel and barrels.

6. The use of conventional signs for abbreviations in text is not recommended; thus "per," not /; "lb," not #; "in," not ″. Such signs may be used sparingly in tables and similar places for conserving space.

7. The period should be omitted except in cases where the omission would result in confusion.

8. The letters of such abbreviations as ASA should not be spaced (not A S A).

9. The use in text of exponents for the abbreviations of square and cube and of the negative exponents for terms involving "per" is not recommended. The superior figures are usually not available on the keyboards of typesetting and linotype machines and conposition is therefore delayed. There is also the liklihood of confusion with footnote reference numbers. These shorter forms are permissible in tables and are sometimes difficult to avoid in text.

10. A sentence should not begin with a numeral followed by an abbreviation. Abbreviations for names of units are to be used only after numerical values, such as 25 ft or 110 v.

AMERICAN STANDARD ABBREVIATIONS (Continued)

Abbreviations*

absolute	abs
acre	spell out
acre-foot	acre-ft
air horsepower	air hp
alternating-current (as adjective)	a-c
ampere	amp
ampere-hour	amp-hr
amplitude, an elliptic function	am.
Angstrom unit	A
antilogarithm	antilog
atmosphere	atm
atomic weight	at. wt
average	avg
avoirdupois	avdp
azimuth	az or α

barometer	bar.
barrel	bbl
Baumé	Bé
board feet (feet board measure)	fbm
boiler pressure	spell out
boiling point	bp
brake horsepower	bhp
brake horsepower-hour	bhp-hr
Brinell hardness number	Bhn
British thermal unit[1]	Btu or B
bushel	bu

calorie	cal
candle	c
candle-hour	c-hr
candlepower	cp
cent	c or ¢
center to center	c to c
centigram	cg
centiliter	cl
centimeter	cm
centimeter-gram-second (system)	cgs
chemical	chem
chemically pure	cp
circular	cir
circular mils	cir mils
coefficient	coef
cologarithm	colog

---

* These forms are recommended for readers whose familiarity with the terms used makes possible a maximum of abbreviations. For other classes of readers editors may wish to use less contracted combinations made up from this list. For example, the list gives the abbreviation of the term "feet per second" as "fps." To some readers ft per sec will be more easily understood.

[1] Abbreviation recommended by the A.S.M.E. Power Test Codes Committee. B = 1 Btu, kB = 1000 Btu, mB = 1,000,000 Btu. The A.S.H.&V.E. recommends the use of Mb = 1000 Btu and Mbh = 1000 Btu per hr.

AMERICAN STANDARD ABBREVIATIONS (Continued)

concentrate	conc
conductivity	cond
constant	const
continental horsepower	cont hp
cord	cd
cosecant	csc
cosine	cos
cosine of the amplitude, an elliptic function	cn
cost, insurance, and freight	cif
cotangent	cot
coulomb	spell out
counter electromotive force	cemf
cubic	cu
cubic centimeter	cu cm, cm^3 (liquid, meaning milliliter, ml)
cubic foot	cu ft
cubic feet per minute	cfm
cubic feet per second	cfs
cubic inch	cu in.
cubic meter	cu m or m^3
cubic micron	cu μ or cu mu or μ^3
cubic millimeter	cu mm or mm^3
cubic yard	cu yd
current density	spell out
cycles per second	spell out or c
cylinder	cyl

day	spell out
decibel	db
degree[1]	deg or °
degree centigrade	C
degree Fahrenheit	F
degree Kelvin	K
degree Réaumur	R
delta amplitude, an elliptic function	dn
diameter	diam
direct-current (as adjective)	d-c
dollar	$
dozen	doz
dram	dr

efficiency	eff
electric	elec
electromotive force	emf
elevation	el
equation	eq
external	ext

---

[1] There are circumstances under which one or the other of these forms is preferred. In general the sign ° is used where space conditions make it necessary, as in tabular matter, and when abbreviations are cumbersome, as in some angular measurements, i.e., 59° 23′ 42″. In the interest of simplicity and clarity the Committee has recommended that the abbreviation for the temperature scale, F, C, K, etc., always be included in expressions for numerical temperatures, but, wherever feasible, the abbreviation for "degree" be omitted; as 69 F.

AMERICAN STANDARD ABBREVIATIONS (Continued)

farad	spell out or f
feet board measure (board feet)	fbm
feet per minute	fpm
feet per second	fps
fluid	fl
foot	ft
foot-candle	ft-c
foot-Lambert	ft-L
foot-pound	ft-lb
foot-pound-second (system)	fps
foot-second (see cubic feet per second)	
franc	fr
free aboard ship	spell out
free alongside ship	spell out
free on board	fob
freezing point	fp
frequency	spell out
fusion point	fnp
gallon	gal
gallons per minute	gpm
gallons per second	gps
grain	spell out
gram	g
gram-calorie	g-cal
greatest common divisor	gcd
haversine	hav
hectare	ha
henry	h
high-pressure (adjective)	h-p
hogshead	hhd
horsepower	hp
horsepower-hour	hp-hr
hour	hr
hour (in astronomical tables)	h
hundred	C
hundredweight (112 lb)	cwt
hyperbolic cosine	cosh
hyperbolic sine	sinh
hyperbolic tangent	tanh
inch	in.
inch-pound	in-lb
inches per second	ips
indicated horsepower	ihp
indicated horsepower-hour	ihp-hr
inside diameter	ID
intermediate-pressure (adjective)	i-p
internal	int
joule	j

AMERICAN STANDARD ABBREVIATIONS (Continued)

kilocalorie	kcal
kilocycles per second	kc
kilogram	kg
kilogram-calorie	kg-cal
kilogram-meter	kg-m
kilograms per cubic meter	kg per cu m or kg/m^3
kilograms per second	kgps
kiloliter	kl
kilometer	km
kilometers per second	kmps
kilovolt	kv
kilovolt-ampere	kva
kilowatt	kw
kilowatthour	kwhr

lambert	L
latitude	lat or ϕ
least common multiple	lcm
linear foot	lin ft
liquid	liq
lira	spell out
liter	l
logarithm (common)	log
logarithm (natural)	$\log_e$ or ln
longitude	long. or λ
low-pressure (as adjective)	l-p
lumen	l*
lumen-hour	l-hr*
lumens per watt	lpw

mass	spell out
mathematics (ical)	math
maximum	max
mean effective pressure	mep
mean horizontal candlepower	mhcp
megacycle	spell out
megohm	spell out
melting point	mp
meter	m
meter-kilogram	m-kg
mho	spell out
microampere	μa or mu a
microfarad	μf
microinch	μin.
micromicrofarad	μμf
micromicron	μμ or mu mu
micron	μ or mu

---

* The International Commission on Illumination has changed the symbol for lumen to lm, and the symbol for lumen-hour to lm-hr. This nomenclature is used in American Standard for Illuminating Engineering Nomenclature and Photometric Standards (ASA Z7.1–1942).

AMERICAN STANDARD ABBREVIATIONS (Continued)

microvolt	μv
microwatt	μw or mu w
mile	spell out
miles per hour	mph
miles per hour per second	mphps
milliampere	ma
milligram	mg
millihenry	mh
millilambert	mL
milliliter	ml
millimeter	mm
millimicron	mμ or m mu
million	spell out
million gallons per day	mgd
millivolt	mv
minimum	min
minute	min
minute (angular measure)	′
minute (time)(in astronomical tables)	m
mole	spell out
molecular weight	mol. wt
month	spell out

National Electrical Code	NEC

ohm	spell out or Ω
ohm-centimeter	ohm-cm
ounce	oz
ounce-foot	oz-ft
ounce-inch	oz-in.
outside diameter	OD

parts per million	ppm
peck	pk
penny (pence)	d
pennyweight	dwt
per	(See Fundamental Rules)
peso	spell out
pint	pt
potential	spell out
potential difference	spell out
pound	lb
pound-foot	lb-ft
pound-inch	lb-in.
pound sterling	£
pounds per brake horsepower-hour	lb per bhp-hr
pounds per cubic foot	lb per cu ft
pounds per square foot	psf
pounds per square inch	psi
pounds per square inch absolute	psia
power factor	spell out or pf

quart	qt

AMERICAN STANDARD ABBREVIATIONS (Continued)

radian	spell out
reactive kilovolt-ampere	kvar
reactive volt-ampere	var
revolutions per minute	rpm
revolutions per second	rps
rod	spell out
root mean square	rms
secant	sec
second	sec
second (angular measure)	″
second-foot (see cubic feet per second)	
second (time)(in astronomical tables)	s
shaft horsepower	shp
shilling	s
sine	sin
sine of the amplitude, an elliptic function	sn
specific gravity	sp gr
specific heat	sp ht
spherical candle power	scp
square	sq
square centimeter	sq cm or cm^2
square foot	sq ft
square inch	sq in.
square kilometer	sq km or km^2
square meter	sq m or m^2
square micron	sq μ or sq mu or μ^2
square millimeter	sq mm or mm^2
square root of mean square	rms
standard	std
stere	s
tangent	tan
temperature	temp
tensile strength	ts
thousand	M
thousand foot-pounds	kip-ft
thousand pound	kip
ton	spell out
ton-mile	spell out
versed sine	vers
volt	v
volt-ampere	va
volt-coulomb	spell out
watt	w
watthour	whr
watts per candle	wpc
week	spell out
weight	wt
yard	yd
year	yr

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